



Russell Homes

# Stansty Chain Road, Wrexham

Flood Consequence Assessment and Drainage Strategy

881197 R1 (09)



INVESTORS  
IN PEOPLE



NOVEMBER 2019

## RSK GENERAL NOTES

**Project No.:** 881197 R1 (09)-FCA  
**Site:** Land off Stansty Chain Road  
**Title:** Flood Consequence Assessment and Drainage Strategy  
**Client:** Russell Homes  
**Date:** November 2019  
**Office:** Wigan  
**Status:** Final

|               |                                                                                   |                           |                                                                                     |
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| Date:         | November 2019                                                                     | Date:                     | November 2019                                                                       |

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| Date:                  | November 2019                                                                       | Date:                   | November 2019                                                                         |

| Issue No | Version/Details                        | Date issued | Author | Reviewed by | Approved by |
|----------|----------------------------------------|-------------|--------|-------------|-------------|
| 03       | Updated with new infiltration results  | 03.07.2017  | RB     | KJ          | IC          |
| 04       | Updated to incorporate basin locations | 15.11.2017  | RB     | KJ          | IC          |
| 05       | Updated to incorporate levels on plan  | 22.11.2017  | RB     | CW          | IC          |
| 06       | Updated drainage strategy              | 01.12.2017  | RB     | KJ          | CW          |
| 07       | Updated drainage strategy              | 14.10.2019  | RW     | KJ          | CW          |
| 08       | Final Issue                            | 17.10.2019  | RW     | KJ          | CW          |
| 09       | Updated infiltration results           | 27.11.2019  | RW     | KJ          | CW          |

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Where field investigations have been carried out, these have been restricted to a level of detail required to achieve the stated objectives of the work.

This work has been undertaken in accordance with the quality management system of RSK LDE Ltd.  
 Russell Homes

Land off Stansty Chain Road  
 Flood Consequence Assessment  
 881197 R1 (09)

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# 1 INTRODUCTION

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RSK Land and Development Engineering Ltd (RSK) was commissioned to carry out a Flood Consequence Assessment (FCA) by Russell Homes. The assessment is in support of the development of the masterplan for the proposed development of land off Stansty Chain Road, Wrexham.

The assessment has been prepared in accordance with the Planning Policy Wales (NPPF) <sup>(Ref. 1)</sup> and its accompanying Technical Advice Note (TAN) 15 <sup>(Ref. 2)</sup>, the Interim Code of Practice for Sustainable Drainage <sup>(Ref. 3)</sup>, BS 8533-2011 Assessing and Managing Flood Risk in Development Code of Practice <sup>(Ref. 4)</sup> the Statutory Standards for Sustainable Drainage (SuDS) in Wales <sup>(Ref. 5)</sup> and the Sustainable Drainage (SuDS) Statutory Guidance <sup>(Ref. 6)</sup>, with site-specific advice from Natural Resources Wales (NRW), the Lead Local Flood Authority (LLFA), the Local Planning Authority (LPA), the architect and the client.

The PPW / TAN 15 sets out the criteria for development and flood risk by stating that inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk, but where development is necessary, making it safe without increasing flood risk elsewhere. The key definitions are:

- “areas at risk of flooding” means land within Flood Zones B and C; or land within Flood Zone A which has critical drainage problems and which has been notified to the local planning authority by the Natural Resources Wales; and
- “flood risk” means risk from all sources of flooding - including from rivers and the sea, directly from rainfall on the ground surface and rising groundwater, overwhelmed sewers and drainage systems, and from reservoirs, canals and lakes and other artificial sources.

For this site, the key aspects that require the assessment are:

- the site is approximately 21.75Ha in size, split into two land parcels on either side of Stansty Chain Road;
- the Natural Resources Wales Flood Map (**Figure 1.1**) shows the site to lie outside areas considered to be Flood Zone 2 and 3; and
- the Welsh Assembly Government’s Development Advice Map (**Figure 1.2**) shows that the site is located entirely within Zone A.

Therefore a Flood Consequence Assessment is required in accordance with the requirements of TAN 15 as a result of its size.

The comments given in this report and opinions expressed are subject to RSK Group Service Constraints provided in **Appendix A**.



**Figure 1.1: NRW Flood Zone Map (accessed October 2019)**



**Figure 1.2: Development Advice Maps (accessed October 2019)**

## 2 CONTEXT AND SCOPE OF WORK

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A key element of project development is to prepare a FCA to establish the flood risk associated with the proposed development and to propose suitable mitigation, if required, to reduce the risk to a more acceptable level.

The scope of work relating to a FCA is based on the guidance provided in PPW and its accompanying Technical Advice Notice 15.

A site-specific FCA must demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall. The scope of this assessment therefore comprises the following elements:

- To review architect plans, planning information and other studies to determine existing site conditions;
- To obtain information on the hydrology and hydrological regime in and around the site;
- To obtain the views of the NRW / LLFA including scope, location and impacts;
- To determine the extent of new flooding provision and the influence on the site based on updated hydraulic modelling of the watercourse and associated floodplain;
- To assess the impact on the site from climate change effects and anticipated increases in rainfall over a 100 year period for the proposed residential development; and
- To review site surface water drainage based on the proposed layout and SuDS proving layout and, if necessary, to determine the extent of infrastructure required;

## 3 SITE DESCRIPTION

### 3.1 Location

Site Name: Land off Stansty Chain Road

Site Address: Stansty Chain Road, Wrexham, LL11 4YG

Site National Grid Reference: Easting: 332335; Northing: 351809

The site is situated, approximately 1.35km northwest of the town centre near to the Plas Coch Retail Park. The site is bounded by the A483, Mold Road and the Shrewsbury to the Wirral railway line. The site is split into two land parcels, northeast and southwest of Stansty Chain Road which provides access to the proposed development. There are two residential properties located southwest of Stansty Chain Road which are excluded from the proposed development boundary. For the purposes of this report this site will be described as one land parcel.

**Table 3.1: Site setting**

| Direction | Characteristic                                                                                                                                                                                                                                            |
|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Northeast | A tree lined boundary separates the site from railway track. Beyond the railway is the Rhosddu Industrial Estate.                                                                                                                                         |
| Southeast | The A483 forms the boundary. This highway is elevated to the centre and east of the site as it rises over Stansty Chain Road and the railway line. Beyond the highway, are residential properties to the east and the Plas Coch Retail Park to the south. |
| Northwest | There is agricultural land surrounding private residential properties, farm complexes and a farm shop to the northwest of the site.                                                                                                                       |
| Southwest | Mold Road forms the boundary and beyond the highway is agricultural land surrounding private properties off Summerhill Road.                                                                                                                              |

**Figure 3.1** shows a Site Location Map.



**Figure 3.1: Site location plan**

## 3.2 Land use and topography

The site is currently used for agricultural purposes, due to the grass coverage; it is assumed that livestock grazing is the main current land use. There were no observed impermeable surfaces on-site and therefore the site can be considered as hydraulically Greenfield.

A site specific topographical survey has been carried out on the site. The land undulates and has falls in multiple directions. In general the land falls towards the watercourse in the southern section of the site as well as Stansty Chain Road and the site boundaries. The highest point on site is located to the north at the top of a slope which rises west of Stansty Chain Road to an elevation of 93.55 meters above ordnance datum (mAOD).

The lowest point on-site is located to the east of the site near to where Stansty Chain Road continues under the A483 at this point there is a localised low point which falls down to an elevation of 83.40mAOD. These two elevations are not related to each other as the site undulates.

The topographic survey and existing site layout is included in **Appendix B**.

The approximate land use of the site is as follows:

**Table 3.2: Existing site land uses**

| Land use                         | Area (m <sup>2</sup> ) | Percentage of total |
|----------------------------------|------------------------|---------------------|
| <b>South-western land parcel</b> |                        |                     |
| Impermeable                      | 0                      | 0%                  |
| Permeable                        | 158,067                | 73%                 |
| <b>North-eastern land parcel</b> |                        |                     |
| Impermeable                      | 0                      | 0%                  |
| Permeable                        | 59,400                 | 27%                 |
| <b>Total</b>                     | <b>217,467</b>         | <b>100%</b>         |

### 3.3 Hydrology

The closest Main River to the site is the River Gwenfro which is located approximately 1km to the southwest of the site. The River flows from west to east towards the centre of Wrexham.

There is an on-site watercourse, a ditch (**Image 3.1**), which flows from the west at Mold Road towards the east at the A483. The ditch is approximately 0.75m deep; however **Image 3.1** and the topography shows that the surrounding area falls towards the ditch.

The watercourse flows towards an area of reeds which covers the headwall of a culvert which conveys flows from the watercourse under the highway as shown within **Image 3.2**



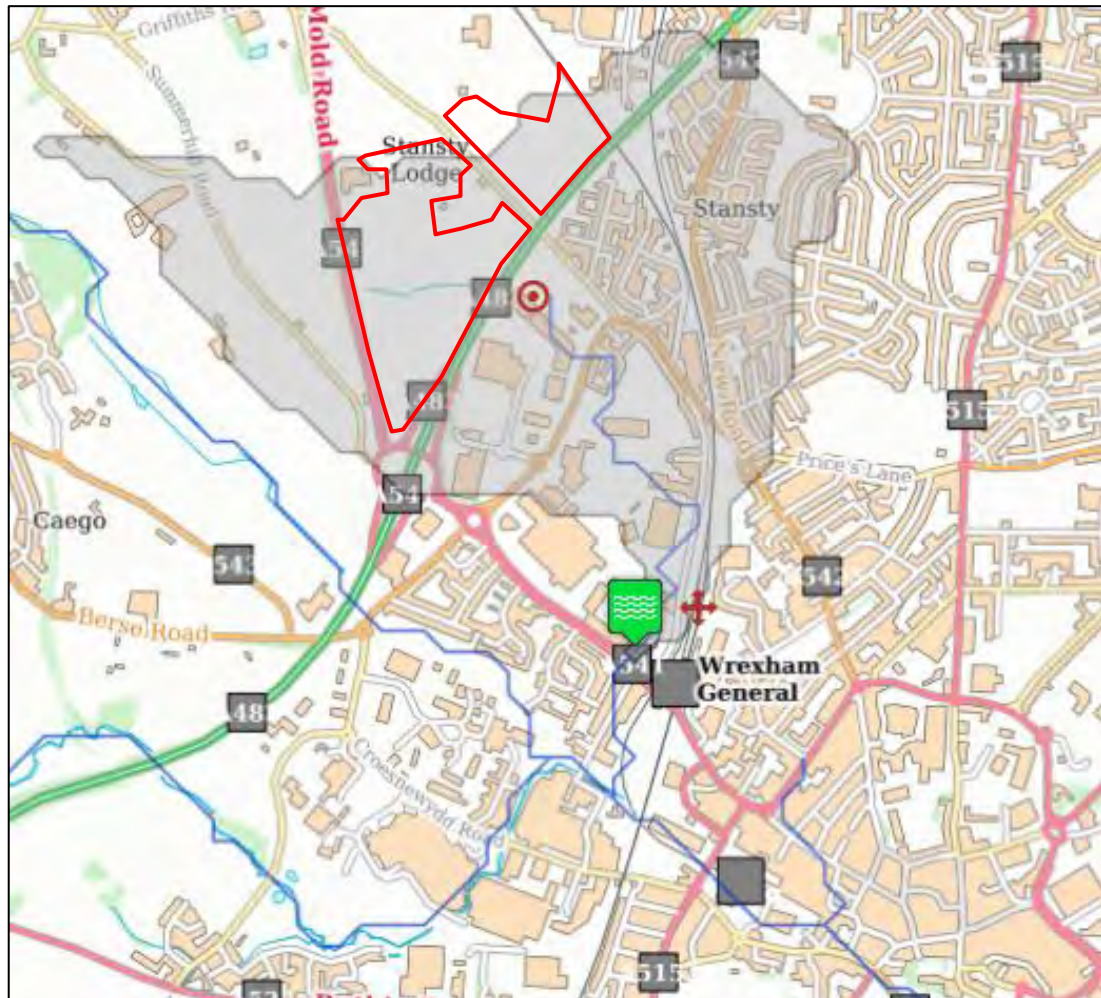
**Images 3.1: Facing west: On-site watercourse**



**Images 3.2: Facing east: Shows overgrown headwall as water is culverted under elevated A483**

The upstream catchment of this watercourse is unknown; however, it is thought that when Mold Road was constructed to the west of the site, it severed the supply of the watercourse from the upstream catchment. The surface water risk map from Natural Resources Wales (**Figure 8.1**) shows that surface water ponds west of the highway. As a result the current watercourse is thought to only drain the site.

The onwards route of the watercourse from the culvert under the A483 is thought to naturally flow towards the centre of Wrexham ultimately discharging into a tributary of the River Gwenfro based on **Figure 3.2**. However, further evidence has concluded the watercourse is severed by man-made barriers and cannot flow beyond the boundary of Plas Coch Retail Park. There is no evidence of a downstream flow route, instead the runoff is thought to pond at the retail park, as suggested by the stagnant water and frequent flooding.



**Figure 3.2: Flood Estimate Handbook online screenshot of the onwards route the watercourse was thought to take. Available from: <https://fehweb.ceh.ac.uk/GB/map>**

### 3.4 Geology

Based on published geological records for the area (British Geological Survey online mapping), the site exhibits the following geology:

- Split Superficial Geology:
  - Majority of the land to the southwest of Stansty Chain Road, other than surrounding the watercourse and the A483: Glaciofluvial Sheet Deposits, Devensian - Sand and Gravel. Superficial Deposits formed up to 2 million

years ago in the Quaternary Period. Local environment previously dominated by ice age conditions.

- Remainder of the site is underlain with: Till, Devensian - Diamicton. Superficial Deposits formed up to 2 million years ago in the Quaternary Period. Local environment previously dominated by ice age conditions.
- Base rock Geology: Pennine Lower Coal Measures Formation and Pennine Middle Coal Measures Formation (undifferentiated). Sedimentary Bedrock formed approximately 309 to 313 million years ago in the Carboniferous Period. Local environment previously dominated by swamps, estuaries and deltas.

Environmental Engineering Partnerships Ltd. (e3p) have undertaken a number of ground investigations to assess the underlying ground conditions of the site. These pits are undertaken to a depth of 2.9m below ground level (mbgl). Typically the site consists of a layer of topsoil with a mixture of silt, clay, sand and gravel forming various strata up to the recorded depths on-site. This follows the BGS mapping and the logs appear to show a greater portion of sand and gravel than clay based superficial soils. These trial pit logs are shown within **Appendix C**.

## 3.5 Climate Change

Within the context of the existing flood risk at the site, and the requirements of the PPW and TAN15, climate change impacts from different flood sources have been considered alongside the present day scenario as described in Section 7.

As an overview; climate change can affect local flood risk in several ways. Impacts will depend on local conditions and vulnerability.

In the Dee River Basin District, wetter winters and more rain falling in wet spells may increase river flooding for rivers and tributaries. In turn, this may increase pressure on drains, sewers and water quality. Storm intensity in summer could increase even in drier summers. Rising sea or river levels may increase local flood risk inland or away from major rivers because of interactions with drains, sewers and smaller watercourses.

In accordance with the requirements of the PPW the latest climate change predictions will be considered within this assessment. Wrexham County Borough Council has stated that the climate change factor which they would expect to see in terms of rainfall for the lifetime of the development would be 30%, (**Appendix D**).

### 3.5.1 Implications for Flood Risk

Climate changes can affect local flood risk in several ways. Impacts will depend on local conditions and vulnerability.

More intense rainfall causes more surface runoff, increasing localised flooding and erosion. In turn, this may increase pressure on drains, sewers and water quality. Storm intensity in summer could increase even in drier summers, so we need to be prepared for the unexpected.

Rising sea or river levels may increase local flood risk inland or away from major rivers because of interactions with drains, sewers and smaller watercourses. Where



appropriate, we need local studies to understand climate impacts in detail, including effects from other factors like land use. Sustainable development and drainage will help us adapt to climate change and manage the risk of damaging floods in future.

## 4 DEVELOPMENT PROPOSALS

The proposed development is for a residential development. This report has been prepared to inform a planning application for the residential development of the site in Wrexham.

The application is made for outline permission with all matters other than access reserved. Accordingly, the layout and design of the development are reserved for determination at a later date, and the Masterplan submitted is purely illustrative at this stage.

The illustrative Masterplan shows that the proposed site will contain multiple parcels of residential development as well as play areas, public open spaces, highways and drainage features, as shown within **Appendix E**. This is likely to be refined through the planning process.

Approximately 75% of each land parcel will be developed with an impermeable area of 55% covering the developed land. Therefore the approximate land uses of the proposed north-eastern land parcel are summarised in **Table 4.1** and of the south-western land parcel within **Table 4.2**.

**Table 4.1: North-eastern proposed land uses**

| Land use                  | Area (m <sup>2</sup> ) | Percentage of Developable Area (%) | Percentage of Total Land Parcel (%) |
|---------------------------|------------------------|------------------------------------|-------------------------------------|
| Impermeable               | 24,475                 | 55                                 | 41                                  |
| Permeable                 | 20,025                 | 45                                 | 34                                  |
| Total Developable Area    | 44,500                 | 100                                | 75                                  |
| Remaining Greenfield Area | 14,900                 | N/A                                | 25                                  |
| Total Land Parcel Area    | 59,400                 | N/A                                | 100                                 |

**Table 4.2: South-western proposed land uses**

| Land use                  | Area (m <sup>2</sup> ) | Percentage of Developable Area (%) | Percentage of Total Land Parcel (%) |
|---------------------------|------------------------|------------------------------------|-------------------------------------|
| Impermeable               | 65,203                 | 55                                 | 41                                  |
| Permeable                 | 53,347                 | 45                                 | 34                                  |
| Total Developable Area    | 118,550                | 100                                | 75                                  |
| Remaining Greenfield Area | 39,517                 | N/A                                | 25                                  |
| Total Land Parcel Area    | 158,067                | N/A                                | 100                                 |

## 5 LEGISLATION AND POLICY CONTEXT

### 5.1 National policy

**Table 5.1: National legislation and policy context**

| Legislation                                  | Key provisions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Planning Policy Wales Edition 9 (Nov 2016)   | <p>The aims of planning policy on development and flood risk are to ensure that flood risk is taken into account at all stages in the planning process to avoid inappropriate development in areas at risk of flooding, and to direct development away from areas at highest risk.</p> <p>Development proposals should seek to reduce, and certainly not increase, flood risk arising either from river and/or coastal flooding or from additional run-off from development in any location.</p> <p><u>13.4.2</u> ...Surface water run-off is to be controlled as near to the source as possible by the use of sustainable urban drainage systems...should also ensure that development does not:</p> <ul style="list-style-type: none"> <li>• increase the risk of flooding elsewhere by loss of flood storage or flood flow route; or</li> <li>• increase the problem of surface water run-off.</li> </ul> |
| Technical Advice Note 15 (2004)              | PPW is supported by the Technical Advice Note 15, which provide additional guidance on flood risk.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Flood and Water Management Act 2010 (Ref. 7) | <p>This legislation was formally ratified in April 2010 with the aim is to implementing the findings of the 2007 Pitt Review and co-ordinating control of drainage and flood issues. There are a number of increased responsibilities within the act that affect adoption of Sustainable Drainage Systems (SuDS) features and the role of the NRW to expand on the mapping data they provide. The implementation of SuDS features has many beneficial impacts on the treatment of surface water during remediation works.</p>                                                                                                                                                                                                                                                                                                                                                                                |
| Water Resources Act 1991 (Ref. 8)            | <p>Section 24 –NRW is empowered under this Act to maintain and improve the quality of ‘controlled’ waters</p> <p>Section 85 – It is an offence to cause or knowingly permit pollution of controlled waters</p> <p>Section 88 – Discharge consents are required for discharges to controlled waters</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Water Framework Directive (2000) (Ref. 9)    | <p>The Water Framework Directive (WFD) requires all inland and coastal waters to reach ‘good’ chemical and biological status by 2015. Flood risk management is unlikely to have a significant impact on chemical water quality except where maintenance works disturb sediment (such as de-silting) or where pollutants are mobilised from contaminated land by floodwaters.</p> <p>The main impact of the WFD on flood risk management, both now and in the future, relates to the ecological quality of water bodies. Channel works, such as straightening and deepening, or flood risk</p>                                                                                                                                                                                                                                                                                                                |

| Legislation | Key provisions                                                                                                                                                                                                                                                            |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|             | management schemes that modify geomorphological processes can change river morphology. The WFD aims to protect conservation sites identified by the EC Habitats Directive and Birds Directive that have water-related features, by designating them as 'protected sites'. |

## 5.2 Local policy

Local policies ensure that flood risk is taken into account at all stages in the planning process to avoid inappropriate development in areas at risk of flooding and making development safe without increasing flood risk elsewhere and where possible, reducing flood risk. The current adopted Development Plan for the Wrexham Local Planning Authority Area is the Wrexham's Unitary Development Plan (UDP).

Wrexham County Borough Council formally adopted the UDP in February 2005. The main objective of the UDP is to ensure sustainable development. It seeks to integrate economic, social and environmental goals and accords with the Council's Local Agenda. Future land development land needs are satisfied in a controlled and incremental manner and new development is balanced against the interests of conservation and rehabilitation.

Relevant policies to flood risk, drainage and hydrology are outlined in **Table 5.2** below.

**Table 5.2: Local policy context**

| UDP document                             | Key provisions and policies                                                                                                                                                                                                                                                                                                                                                                             |
|------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Policy GDP1                              | i) Ensure that development does not result in, or is subject to, flooding, soil erosion, landslides or contamination, either on or off the site.                                                                                                                                                                                                                                                        |
| Policy EC12 – Development and Flood Risk | Development (including the raising of land) within defined flood plains will only be permitted if it:-<br>a) would not be subject to an unacceptable risk of flooding on-site; and/or<br>b) does not result in an unacceptable risk of flooding on or off-site; and/or<br>c) does not adversely affect flood management or maintenance schemes                                                          |
| Policy EC13 – Surface Water Run-off      | Development which would result in an unacceptable adverse impact on the water environment due to additional surface water run-off will not be permitted.<br><br>5.18 Development on green field sites usually results in an increase in the amount of impermeable land. This can alter the natural water cycle as rates and volumes of surface water reaching a surface watercourse generally increase. |

| UDP document        | Key provisions and policies                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                     | <p>5.19 Wherever practicable surface water should be disposed of as close to the source as possible. Where potential risks are identified appropriate flow attenuation facilities or mitigation measures may be a pre-requisite for development. Consideration should be given to the use of softer engineering structures referred to as Sustainable Urban Drainage Systems (SUDS). SUDS is a concept that focuses decisions about drainage design, construction and maintenance on the quality of the receiving environment and people. SUDS are physical structures built to receive surface water runoff. They typically include swales, ponds, infiltration basins and porous surfaces and should be considered as alternatives to conventional drainage where appropriate.</p> <hr/> <p>The Council will require the developer to demonstrate, both financially and practically, how the long term maintenance of any attenuation facilities or mitigation measures will be achieved.</p> |
| Emerging Local Plan | <p>The Council are currently producing the Wrexham Local Development Plan 2013 – 2028, which will eventually supersede the adopted UDP. The Local Development Plan is at an advanced stage and therefore should be afforded due weight.</p> <p>Emerging Policy DM1 seeks to ensure development does not increase the risk of flooding but make adequate provision for sustainability dealing with foul and surface water drainage and not result in an unacceptable impact upon the water environment.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

## 6 TECHNICAL ADVICE NOTE 15

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TAN15 provides technical guidance on flood risk and development which supplements the policy set out in Planning Policy Wales.

In line with Figure 2 of TAN15, the development category for the works is Highly Vulnerable Development, which includes all residential premises. In line with Figure 1 of TAN15, Highly Vulnerable Development is acceptable in Flood Zone A. As a result no justification test will be required and there is no need to consider flood risk further.

### 6.1 Assessing Flood Consequences

To satisfy the criteria of the assessment of flood consequences, the following conditions should be satisfied;

1. Flood defences must be shown by the developer to be structurally adequate;
2. The cost of future maintenance for all new / approved flood mitigation measures, including defences must be accepted by the developer and agreed with NRW;
3. The developer must ensure that future occupiers of the development area are aware of the flooding risk and consequences;
4. Effective flood warnings are provided at the site;
5. Escape / evacuation routes are shown by the developer to be operational under all conditions;
6. Flood emergency plans and procedures produced by the developer must be in place;
7. The development is designed by the developer to allow the occupier the facility for rapid movement of goods to areas away from the floodwaters;
8. Development is designed to minimise structural damage during a flooding event and is flood proofed to enable it to be returned to its prime use quickly in the aftermath of the flood;
9. No flooding elsewhere.

## 7 SOURCES OF INFORMATION

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### 7.1 Natural Resources Wales consultation

#### 7.1.1 Flood zone maps

The NRW Flood Zone mapping study for Wales is available on their website at <https://naturalresources.wales/our-evidence-and-reports/maps/flood-risk-map/?lang=en>

The current displayed map is reproduced as **Figure 1.1** and shows the site to lie within Flood Zone 1, at very low risk of flooding from fluvial or tidal sources.

The Welsh Assembly Development Advice Map has also been reproduced as **Figure 1.2** and shows the Welsh Assembly's TAN15 data.

#### 7.1.2 Site specific consultation

Natural Resources Wales was formally consulted as part of this assessment, with request for flood related information. In their response they noted that they do not hold any information regarding the site. Their full response to the flood data request can be found in **Appendix F**.

Wrexham County Borough Council has also been consulted. Their full response to the flood data request can be found in **Appendix D**. In summary the Council have provided a map which incorporates their understood knowledge of the area. This mapping is similar to that shown within the surface water flood maps provided by Natural Resources Wales. However, it also incorporates historic flood events. There is an event located to the northeast of the site on the railway; however, the cause of this flooding has not been stated. Downstream of the site, within Plas Coch Retail Park there are multiple historic events which the Council have confirmed as being associated with the drainage ditch which crosses the site. The Council have undertaken some investigation and this ditch passes through a culvert beneath the A483 and stops at the boundary to the retail park, the ditch which it opens out into does not currently have an onwards route and has likely been severed as part of the urbanisation of the area. As this ditch fills up it causes flooding both to the site and to the retail park.

As a result, the Council has stated that the on-site watercourse does not have an onwards route and thus is simply a ditch into which surface water should not be discharged.

## 7.2 Relevant studies

Table 7.1: Relevant studies

| Study                                                                                            | Comments                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|--------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Wrexham County Borough Council Local Flood Risk Management Strategy<br>April 2013 (Ref. 10)      | <p>The Local Strategy must specify:</p> <ul style="list-style-type: none"> <li>the risk management authorities in the authority's area;</li> <li>the flood and coastal erosion risk management functions that may be exercised by those authorities in relation to the area;</li> <li>the objectives for managing local flood risk (including any objectives included in the authority's flood risk management plan prepared in accordance with the Flood Risk Regulations 2009);</li> <li>the measures proposed to achieve those objectives;</li> <li>how and when the measures are expected to be implemented;</li> <li>the costs and benefits of those measures, and how they are to be paid for;</li> <li>the assessment of local flood risk for the purpose of the strategy;</li> <li>how and when the strategy is to be reviewed; and</li> <li>how the strategy contributes to the achievement of wider environmental objectives.</li> </ul> <p>The Local Strategy must be consistent with the National Strategy for Flood and Coastal Erosion Risk Management in Wales.</p>                                                                                                                                                                                       |
| Local Planning Guidance: Management of Surface Water Generated from New Development<br>(Ref. 11) | <p>Early consultation with all relevant authorities is recommended. The key authorities are as follows:</p> <ul style="list-style-type: none"> <li>The Council's Flood and Water management</li> <li>Dŵr Cymru / Welsh Water</li> <li>Cyfoeth Naturiol Cymru / Natural Resources Wales (NRW)</li> <li>The Council's Highways Development Control Team.</li> </ul> <hr/> <p>Wrexham County Borough Council advocates that surface water run-off should be controlled as near to its source as possible. Preferably sustainable drainage systems (SuDS) should be utilised. The variety of SuDS techniques available means that virtually any development should be able to include a scheme based around these principles. Surface water should be disposed of to the receptors listed in order of priority below:</p> <ol style="list-style-type: none"> <li>Infiltrated to ground;</li> <li>To a watercourse</li> <li>To a surface water sewer</li> <li>Other</li> </ol> <hr/> <p>For undeveloped Greenfield sites discharge rates and volumes are normally required to be limited to the equivalent Greenfield runoff rate (with on-site attenuation for all events up to the 1% (1 in 100 year) rainfall event with an appropriate allowance for climate change).</p> |

| Study                                                                                           | Comments                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                 | <p>Storage of Water on Site: The drainage system should be designed so that flooding does not occur on any part of the development for the 3.33% (1 in 30 year) rainfall event other than in those areas/systems designated to store or convey water. It may be acceptable to allow some on-site flooding of roads etc. for rainfall events beyond this. However flooding within the development site should not occur in any part of a building or utility plant susceptible to water during a 1% (1 in 100 year) + climate change rainfall event.</p> <p>A practicable minimum limit on the discharge rate from a flow attenuation device is often a compromise between attenuating to a satisfactorily low flow rate while keeping the risk of blockage to an acceptable level. It is suggested that this is 5 litres per second, using an appropriate vortex flow control device or other technically acceptable flow control device. The minimum size of pipe discharging from a flow attenuation device should be 150mm laid at a gradient not flatter than 1 in 150, which meets the requirements of Sewers for Adoption 7th Edition.</p>                                                                                                                                                                                                                                                                           |
| <p>River Dee<br/>Catchment Flood<br/>Management Plan,<br/>January 2010<br/>(CFMP) (Ref. 12)</p> | <p>The CFMP considers all types of inland flooding, from rivers, groundwater, surface water and tidal flooding, but not flooding directly from the sea (coastal flooding), which is covered by Shoreline Management Plans (SMPs). Coverage of surface and groundwater is however limited due to a lack of available information.</p> <p>The role of CFMPs is to establish flood risk management policies which will deliver sustainable flood risk management for the long term. CFMPs helps to understand the scale and extent of flooding now and in the future, and should be used to inform spatial planning and decision making by local authorities.</p> <p>CFMPs assess how flood risk is likely to change in the next 100 years. They do this at a strategic level and not at a detailed, local level. It is estimated that a 1% AEP (Annual Exceedance Probability) river flood event, could place approximately 290 properties at flood risk if the event occurred across the whole CFMP area in the future. The CFMP has identified a number of key locations currently at risk in a 1% AEP flood.</p> <p>The site falls within the 'Wrexham' sub-catchment and the policy applicable to this site is Policy Option 4 - Areas of low, moderate or high flood risk where NRW are already managing the flood risk effectively but where we may need to take further actions to keep pace with climate change.</p> |

## **7.3 Drainage**

### **7.3.1 Public sewer**

Sewer details have been referenced from sewer record plans obtained from Dwr Cymru Welsh Water (**Appendix G**). The plans indicate the following network of sewers around the site:

- The nearest public foul sewer is located approximately 80m east of the site in the private gardens of Finney Close. Welsh Water have confirmed that this is a 100mm diameter pipe. Downstream of this network, the network becomes a 150mm diameter pipe and at manhole reference SJ32517701 it becomes a 225mm diameter system;
- A public surface water sewer is located within Windsor Drive approximately 0.43km south of the site, and;
- A public combined sewer is located within Crispin Lane approximately 0.58km east of the site.

### **7.3.2 Private drainage**

No details of the existing site drainage network have been provided; however, it is reasonable to assume that there are private surface water and foul networks within the area which are not recorded.

## 8 SOURCES OF FLOOD RISK

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### 8.1 Criteria

In accordance with the PPW and advice from NRW, a prediction of the flood sources and levels is required along with the effects of climate change from the present for the design life of the development (in this case assumed to be 100 years). To consider these effects of climate change over the lifetime of the development.

The flood risk elements that need to be considered for any site are defined in BS 8533 as the “Forms of Flooding” and are listed as:

- Flooding from Rivers (fluvial flood risk);
- Flooding from the Sea (tidal flood risk);
- Flooding from the Land;
- Flooding from Groundwater;
- Flooding from Sewers (sewer and drain exceedance, pumping station failure etc); and
- Flooding from Reservoirs, Canals and other Artificial Structures.

The following section reviews each of these in respect of the subject site.

### 8.2 Flooding from rivers (fluvial flood risk)

#### 8.2.1 Main River

The latest Welsh Government Development Advice Maps (**Figure 1.1**) shows that the site lies within Flood Zone A, representing a site that is considered to be at little or no risk of fluvial or coastal/tidal flooding.

The latest Natural Resources Wales ‘Risk of Flooding from Rivers and Sea’ flood map (**Figure 1.2**) indicates that the site is located within an area of Flood Zone 1 and is defined as having a less than 1 in 1000 annual probability of river flooding (0.1%). As stated by NRW.

As the nearest Main River is located approximately 1km to the south of the site, it is determined that the site is at very low risk from this source.

### 8.3 Flooding from the sea (tidal flood risk)

The site is not considered to be at risk from tidal flooding due to its inland location.

### 8.4 Flooding from the land (overland pluvial flood risk)

If intense rain is unable to soak into the ground or be carried through manmade drainage systems, for a variety of reasons, it can run off over the surface causing localised floods before reaching a river or other watercourse.

Generally, where there is impermeable surfacing or where the ground infiltration capacity is exceeded, surface water runoff will occur. Excess surface water flows from the site are believed to drain naturally to the local water features, either by overland flow or through infiltration.

Natural Resources Wales's surface water flood map (**Figure 8.1**) shows that there are sections of the site which are at low to medium risk of flooding from pluvial sources. However, these occupy localised topographic lows as shown within the topographic survey in **Appendix B**. There is a low point to the south of the site which is recorded in the mapping in **Figure 8.1** and was observed on-site within **Image 8.1**, thus confirming the accuracy of this mapping.



**Figure 8.1: Natural Resources Wales surface water flood risk map**



**Image 8.1: Facing northeast: Ponding to the south of the site**

The small flow path which crosses the site follows the watercourse from west to east. There is a medium risk of ponding to the west of Mold Road which is likely the source of the watercourse upstream of the site boundary prior to the highway construction. Downstream of the site there is shown to be areas at medium risk of flooding within Plas Coch Retail Park which is likely as a result of the ditches in this location (continuation of the watercourse) becoming exceed as the onwards routes have been severed. This follows the information received from the Council as well as the mapping shown within **Appendix D**. There is therefore an opportunity for this development site to improve this situation to the betterment of the localised area.

In line with the Natural Resources Wales data, the risk of pluvial flooding to the site can be considered as mostly **very low** with localised areas of low to medium risk which will be taken into account within the design and layout of the site.

Areas of steep ground have the potential to generate runoff, which can present a flood source to immediately lower areas. This source of flooding is often exacerbated when steep ground is combined with impermeable soils and geology and / or significant areas of development with associated hard standing areas. Where roads are laid perpendicular to the contours of the land, preferential surface water flow pathways may be created.

## 8.5 Flooding from groundwater

Groundwater flooding tends to occur after much longer periods of sustained high rainfall. Higher rainfall means more water will infiltrate into the ground and cause the water table to rise above normal levels. Groundwater tends to flow from areas where the ground level is high, to areas where the ground level is low. In low-lying areas the water table is usually at shallower depths anyway, but during very wet periods, with all the additional groundwater flowing towards these areas, the water table can rise up to the surface causing groundwater flooding.

Based on Trial pits undertaken by e3p (Ref: TP109-TP112), (see **Appendix C**), water was struck at; the surface, 1.05mbgl, 1.60mbgl, 1.93mbgl and 2.4mbgl. However, this was not believed to be the resting groundwater level but minor water ingress from perched water within the superficial strata.

According to the Wrexham County Borough Council's Preliminary Flood Risk Assessment:

*"There were no records of past groundwater flooding within WCBC; this is due to the topography and geology of the area."*

As a result, the flood risk from this source can be considered to be **low**.

#### **8.5.1 Climate change**

Climate change could increase the risk of groundwater flooding as a result of increased precipitation filtering into the groundwater body. If winter rainfall becomes more frequent and heavier, groundwater levels may increase. Higher winter recharge may however be balanced by lower recharge during the predicted hotter and drier summers. This is less likely to cause a significant change to flood risk than from other sources, since groundwater flow is not as confined. It is probable that any locally perched aquifers may be more affected, but these are likely to be isolated. The change in flood risk is likely to be low.

### **8.6 Flooding from sewers**

Flooding from artificial drainage systems occurs when flow entering a system, such as an urban storm water drainage system, exceeds its conveyance capacity, the system becomes blocked or it cannot discharge due to a high water level in the receiving watercourse. A sewer flood is often caused by surface water drains discharging into the combined sewer systems; sewer capacity is exceeded in large rainfall events causing the backing up of floodwaters within properties or discharging through manholes.

Most adopted surface water drainage networks are designed to the criteria set out in Sewers for Adoption <sup>(Ref. 14)</sup>. One of the design parameters is that sewer systems be designed such that no flooding of any part of the site occurs in a 1 in 30 year rainfall event. By definition a 1 in 100 year event would exceed the capacity of the surrounding sewer network as well as any proposed drainage.

However, due to the lack of sewers within the vicinity of the site, the flood risk from this source can be considered to be **low**.

#### **8.6.1 Climate change**

The impact of climate change is likely to be negative regarding flooding from sewers. Increased rainfall and more frequent flooding put existing sewer and drainage systems under additional pressure resulting in the potential for more frequent surcharging and potential flooding. This would increase the frequency of local sewer flooding but would not be significant in terms of the proposed development.

## **8.7 Reservoirs**

Flood events can occur from a sudden release of large volumes of water from reservoirs, canals and artificial structures.

Reservoir flooding is also extremely unlikely. There has been no loss of life in the UK from reservoir flooding since 1925. Since then reservoir safety legislation has been introduced to ensure reservoirs are maintained.

The Natural Resources Wales reservoir flood map shows that the site is not at risk of flooding from this source.

### **8.7.1 Climate change**

Reservoirs can be managed over time, controlling inflow/outflow of water and therefore there is the capacity to control the effects of climate change. Increased rainfall has the potential to increase base flow, but this should be minimal. It is unlikely that there will be a substantial change to the risk of flooding for this site.

## **8.8 Canals**

There are no Canal & River Trust owned canals within the vicinity of the site, therefore no risk is attributed to this source.

## **8.9 Flood risk resulting from the development**

The proposed development will use the latest best practice guidance to ensure that flood risk is not increased as a result of the development. This will require the provision of a suitable surface water management plan to ensure that the surface water generated from the development is managed on-site.

The existing onsite watercourse currently drains part of the site and causes flooding to the retail park due to the severed onwards flow route at the retail park. By removing or at least severing the ditch and its outfall on site this will reduce surface water runoff from the site contributing to flooding at the retail park. This strategy is considered will improve the existing situation by reducing the risk of flooding off site. The method of management is investigated further in Section 9 of this report.

## 9 DRAINAGE STRATEGY

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### 9.1 Surface Water

#### 9.1.1 Overview

The PPW and TAN 15 states that SuDS should be considered wherever practical. The use of SuDS is also encouraged by local policy (see Section 5).

In addition, Building Regulations Part H <sup>(Ref 15)</sup> requires that the first choice of surface water disposal should be to discharge to an adequate soakaway or infiltration system, where practicable. If this is not reasonably practicable then discharge should be to a watercourse, the least favourable option being to a sewer (surface water before combined). Infiltration techniques should therefore be applied wherever they are appropriate.

The Recommended non-statutory standards for sustainable drainage (SuDS) in Wales states; *“This Standard addresses the use of surface water by the development and where it should be discharged. The aim is to ensure that runoff is treated as a resource and managed in a way that minimises the impact of the development on flood risk, the morphology and pollution of receiving waters and the associated ecology. This will ensure that early consideration is given to the use of rainwater harvesting systems to both manage runoff and deliver a source of non-potable water for the site where practical. Where it is not, prioritisation should be given to infiltration. Discharges to sewerage systems should be limited where possible.”*

This section discusses the potential quantitative effects of the development on both the risk of surface water flooding on-site and elsewhere within the catchment, as well as the type of potential SuDS features that could be incorporated as part of the masterplan.

#### 9.1.2 Pre-development situation

The site is currently a Greenfield Space and is approximately 21.75Ha. The existing site is considered to drain via infiltration and overland flows from the site. Soakaway testing has been undertaken across the site to determine the rate at which runoff infiltrates into the ground. Greenfield Runoff calculations have been undertaken to estimate the rate at which surface water runoff leaves the site.

The pro-rata IoH 124 method <sup>(Ref. 16)</sup> has been used to estimate the Greenfield surface water runoff for the site. Calculations are contained in **Appendix H**.

**Table 9.1: IOH 124 surface water runoff (Greenfield)**

| Return period | Peak flow (l/s)      |                   |
|---------------|----------------------|-------------------|
|               | Total Site (21.75Ha) | Pro-rata (per Ha) |
| QBar          | 53.2                 | 2.45              |
| 1 in 1 year   | 46.8                 | 2.15              |
| 1 in 30 year  | 93.8                 | 4.31              |
| 1 in 100 year | 115.9                | 5.33              |

As discussed within **Section 3.4** the superficial geology within the area is split between Glacial Till and Sand and Gravel. Infiltration testing was undertaken to BRE Digest 365 standards across the site; The results of these tests are summarised in **Table 9.2**, the full results and trial pit locations are shown in **Appendix I**. All rates achieved have shown that infiltration based SuDS will be achievable across the site.

**Table 9.2: Infiltration Results (October 2019)**

| Trial Pit | Infiltration rate (m/s) |
|-----------|-------------------------|
| SA201     | $3.43 \times 10^{-5}$   |
| SA202     | $2.11 \times 10^{-4}$   |
| SA203     | $1.92 \times 10^{-4}$   |
| SA204     | $1.15 \times 10^{-5}$   |
| SA205     | $1.92 \times 10^{-4}$   |
| SA206     | $2.53 \times 10^{-5}$   |
| SA207     | $1.94 \times 10^{-5}$   |
| SA208     | $1.27 \times 10^{-5}$   |
| SA209     | $6.80 \times 10^{-4}$   |
| SA210     | $6.68 \times 10^{-4}$   |

### 9.1.3 Post-development situation

The proposed development is for a residential use, as explained within **Section 4**. It is assumed that 75% of each land parcel will be developed and of this proposed development area approximately 55% will be impermeable, as shown within Section 4. This will result in an increase in surface water across the site and therefore it will be necessary to manage surface water on-site.

As soakaway testing has proven the viability of infiltration based SuDS then a drainage strategy which utilises infiltration features has been outlined in **Appendix J**.

It will be considered necessary to provide improvements to water quality through appropriate source treatment. It is anticipated that sufficient levels of treatment can be achieved through trapped gullies within the highways, filter strips, utilise vegetation lined conveyance swales, and a pollutant absorbent media lining infiltration basins.

#### 9.1.3.1 Off site discharge options

##### *Infiltration*

Infiltration should be considered as the primary option to discharge surface water from the developed site based on the observed infiltration rates which are considered to be positive and could be provided within swales and ponds.

From the observed rates on-site, infiltration is considered to be feasible based on the data supplied.

##### *Discharge to watercourse*

If the downstream route of the on-site watercourse which flows under the A483 can be identified and uncovered, it is feasible that a connection could be re-instated from the existing drainage ditch on-site, enabling the discharge of surface water directly to a local watercourse. This would provide additional drainage strategy options to that identified.

##### *Discharge to surface water sewer*

Should this option be considered, a new surface water sewer would be required to connect to a public surface water sewer. This is dependent on sufficient falls and an agreed connection location with Welsh Water.

### 9.1.4 Proposed drainage strategy

The proposed drainage strategy for the site is included in **Appendix J**. The strategy shows a combination of swales, permeable paving, house soakaways, tree pits and infiltration basins all being utilised to provide sufficient surface water attenuation and drainage across the site.

The SuDS should be designed to convey surface water conveniently from impermeable areas to areas of infiltration. For the proposed development, sufficient storage should be provided to retain up to the 1 in 30 year event below ground and the 1 in 100 plus climate change event on-site prior to discharge.

In principle, the strategy contains the following features and criteria:

- It is considered that infiltration rates observed across the site in the most recent testing are appropriate for infiltration based SuDS;
- Tree pits are shown to be placed along roadsides to provide surface water attenuation. Tree pits can improve the performance of infiltration SuDS as the root growth increases soil infiltration and capacity;
- Swales can be placed along side the highways to provide attenuation and areas of infiltration. Highway runoff will require levels of treatment to ensure that Groundwater in the area is not at risk of contamination from pollutants. Treatment could be provided in the form of filter strips, trapped gullies, catchpit manholes or petrol interceptors dependent on the pollutant risk from the impermeable area;
- House soakaways can be placed in the rear gardens of the private dwellings as shown on the SuDS plan in **Appendix J**. The number of house soakaways will be dependant on the infiltration rates. House soakaways will drain predominantly rooftop runoff which is considered at low risk from pollutants;
- Permeable paving is shown in areas of shared car parking. Permeable paving can provide attenuation in the sub base and allow infiltration to the underlying soil. The paving can be designed to provide an adequate level of water quality treatment. The jointing material between blocks can remove the majority of silt and attached pollutants. The underlying aggregates can provide biodegradation of organic pollutants and the absorption of pollution.

The dimensions, volumes and location of the SuDS features will need to be determined as the development framework plan develops and during the detailed planning stage. Detailed design of individual features is not part of the scope of this report. Preliminary design criteria have been based upon guidance given in The SUDS Manual<sup>1</sup>.

## 9.2 Foul Water

### 9.2.1 Existing network

The 225mm diameter public sewer to east of the site at the junction of Stansty Road and Colliery Road is considered the most feasible and suitable connection point for the site.

As the invert level of the receiving network is currently unknown, it is difficult to determine whether a gravitational connection from the proposed site can be made or whether a foul pumping station will be required. However, if a foul pumping station is required, the developer can provide this, having delivered similar facilities on other sites. The connection is proposed via Stansty Road, off-site, within the highway.

A pre-development enquiry has been submitted to Welsh Water with the intention of identifying whether this connection location is feasible and has capacity to receive flows from the development. At the time of writing this report the application is under review by Welsh Water.

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<sup>1</sup> CIRIA, 'The SUDS Manual - C697', 2007

A report (Indicative Programme for Hydraulic modelling Assessment) confirming the connection location and potential associated works is currently in preparation by Dwr Cymru (Welsh Water). As a statutory consultee, they will set out the connection requirements which Russell Homes will follow.

## **10 PLANNING CONSIDERATIONS AND MITIGATION OPTIONS**

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### **10.1 Site layout and design**

Flood risk should be considered at an early stage in deciding the layout and design of a site to provide an opportunity to reduce flood risk within the development, and a site specific Flood Risk Assessment is recommended.

TAN 15 uses a sequential, risk-based approach should be applied to try to locate more vulnerable land use to higher ground, while more flood-compatible development (e.g. vehicular parking, recreational space) can be located in higher risk areas.

Waterside areas, or areas along known flow routes, can be used for recreation, amenity and environmental purposes, allowing the preservation of flow routes and flood storage, and at the same time providing valuable social and environmental benefits contributing to other sustainability objectives. Landscaping should ensure safe access to higher ground from these areas, and avoid the creation of isolated islands as water levels rise.

### **10.2 Modification of ground levels**

Due to the very low risk nature of the site, there is no requirement to raise finished floor levels as a result of fluvial flood risk. However, by raising properties 150mm above the surrounding ground levels reduces the risk of runoff towards individual dwellings.

Due to the undulating topography of the site it is likely that material will be moved around the site in order to provide developable levels and create gravitational falls for the conveyance of surface water towards the south-western most site boundary where the infiltration based SuDS will likely be positioned.

### **10.3 Safe access and egress**

As the NRW flood map and indicates that the site is located in Flood Zone 1 safe access and egress can be achieved at all times by pedestrians and vehicles.

### **10.4 Watercourse easements**

Provided that it can be confirmed that there is no inflow into the ditch other than runoff from the site and that the downstream extent has been severed, the ditch could be filled in, subject to consent from the Council. This will be required if the proposed drainage strategy of an infiltration basin in the south is confirmed due to the difference between the existing and proposed levels in order to provide a gravitational connection to the south. If the ditch is to be filled in, no easement will be required. However, if the ditch remains as the outfall is established it will require on-going maintenance which the developer agrees to through a management company. This then adds opportunities to enhance the landscape and ecological value around the ditch.

## 11 CONCLUSIONS

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This FCA complies with the TAN 15 and PPW and demonstrates that flood risk from all sources has been considered in the proposed development. It is also consistent with the Local Planning Authority requirements with regard to flood risk. This FCA has been prepared to consider the amendments to the parameters for the site following the positive consultation undertaken with Wrexham County Borough Council.

The site is located entirely within Flood Zone 1 according to the updated flood modelling exercise.

TAN 15 sets out a Justification Test, which states that preference should be given to development located within Flood Zone 1 (DAM Zone A). This flood consequence assessment **demonstrates that the requirements of the justification test have been met**, with the location of the proposed housing being located outside of the 1 in 100 year (inducing climate change) flood extent. No housing is proposed in Flood Zones 2 or 3.

The proposed development will alter the impermeable area on site and as a result a surface water drainage strategy will be required as the outline masterplan progresses.

This flood consequence assessment has concluded that:

- As the site is located within Flood Zone 1, the and as such are at a very low risk of flooding from fluvial sources;
- No development is proposed in Flood Zones 2 or 3;
- The site is far enough inland not to be at risk of any tidal flooding event;
- Flood risk from surface water across the site is predominantly considered to be very low with isolated areas of low to medium flood risk which are present on site and these will be considered in the layout of the site;
- Flood risk from groundwater is considered low;
- Flood risk from other sources including sewers, reservoirs and artificial sources – is demonstrated to be low;
- The development will have no impact on other forms of flooding;

Overall, taking into account the above points, the development of the site should not be precluded on flood risk grounds, as all on-site flood risk and potential off site flooding risk can be safely and properly mitigated in line with current guidance and regulations.

## 12 REFERENCES

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1. Welsh Assembly Government, *Planning Policy Wales Edition 9*, Jan 2016.
2. Welsh Assembly Government, *Planning Policy Wales, Technical Advice Note 15: Development and Flood Risk*, July 2004
3. DEFRA (2004), 'Interim Code of Practice for Sustainable Drainage Systems' National SUDS Working Group, July 2004.
4. BSI (2011), 'BS 8533-2011 Assessing and managing flood risk in development Code of practice'.
5. Welsh Assembly Government (2018) 'Statutory standards for sustainable drainage (SuDS) in Wales – designing, constructing, operating and maintaining surface water drainage systems'.
6. Welsh Assembly Government (2019) 'Sustainable Drainage (SuDS) Statutory Guidance
7. Flood and Water Management Act, 2010.
8. Water Resources Act, 1991.
9. European Commission (2000) , 'Directive 2000/60/EC - Water Framework Directive
10. Wrexham County Borough Council: Local Flood Risk Management Strategy April 2013
11. Wrexham County Borough Council: Local Planning Guidance: Management of Surface Water Generated from New Development
12. River Dee Catchment Flood Management Plan, January 2010 (CFMP)
13. Communities and Local Government, 'Improving the flood performance of new buildings – flood resilient construction', 2007.
14. WRC, 'Sewers for Adoption' 7th Edition, 2012.
15. Building Regulations Part H
16. Institute of Hydrology (IoH), 'Flood Estimation for small catchments - Report 124', 1994.

# APPENDIX A

## SERVICE CONSTRAINTS

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### RSK Group service constraints

1. This report and the Drainage design carried out in connection with the report (together the "Services") were compiled and carried out by RSK LDE Ltd (RSK) for Russell Homes (the "client") in accordance with the terms of a contract between RSK and the "client". The Services were performed by RSK with the skill and care ordinarily exercised by a reasonable Civil Engineer at the time the Services were performed. Further, and in particular, the Services were performed by RSK taking into account the limits of the scope of works required by the client, the time scale involved and the resources, including financial and manpower resources, agreed between RSK and the client.
2. Other than that expressly contained in paragraph 1 above, RSK provides no other representation or warranty whether express or implied, in relation to the Services.
3. Unless otherwise agreed the Services were performed by RSK exclusively for the purposes of the client. RSK is not aware of any interest of or reliance by any party other than the client in or on the Services. Unless expressly provided in writing, RSK does not authorise, consent or condone any party other than the client relying upon the Services. Should this report or any part of this report, or otherwise details of the Services or any part of the Services be made known to any such party, and such party relies thereon that party does so wholly at its own and sole risk and RSK disclaims any liability to such parties. Any such party would be well advised to seek independent advice from a competent environmental consultant and/or lawyer.
4. It is RSK's understanding that this report is to be used for the purpose described in the introduction to the report. That purpose was a significant factor in determining the scope and level of the Services. Should the purpose for which the report is used, or the proposed use of the site change, this report may no longer be valid and any further use of or reliance upon the report in those circumstances by the client without RSK's review and advice shall be at the client's sole and own risk. Should RSK be requested to review the report after the date hereof, RSK shall be entitled to additional payment at the then existing rates or such other terms as agreed between RSK and the client.
5. The passage of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the report inaccurate or unreliable. The information and conclusions contained in this report should not be relied upon in the future without the written advice of RSK. In the absence of such written advice of RSK, reliance on the report in the future shall be at the client's own and sole risk. Should RSK be requested to review the report in the future, RSK shall be entitled to additional payment at the then existing rate or such other terms as may be agreed between RSK and the client.
6. The observations and conclusions described in this report are based solely upon the Services, which were provided pursuant to the agreement between the client and RSK. RSK has not performed any observations, investigations, studies or testing not specifically set out or required by the contract between the client and RSK. RSK is not liable for the existence of any condition, the discovery of which would require performance of services not otherwise contained in the



Services. For the avoidance of doubt, unless otherwise expressly referred to in the introduction to this report, RSK did not seek to evaluate the presence on or off the site of asbestos, electromagnetic fields, lead paint, heavy metals, radon gas or other radioactive or hazardous materials.

7. The Services are based upon RSK's observations of existing physical conditions at the site gained from a walk-over survey of the site together with RSK's interpretation of information including documentation, obtained from third parties and from the client on the history and usage of the site. The Services are also based on information and/or analysis provided by independent testing and information services or laboratories upon which RSK was reasonably entitled to rely. The Services clearly are limited by the accuracy of the information, including documentation, reviewed by RSK and the observations possible at the time of the walk-over survey. Further RSK was not authorised and did not attempt to independently verify the accuracy or completeness of information, documentation or materials received from the client or third parties, including laboratories and information services, during the performance of the Services. RSK is not liable for any inaccurate information or conclusions, the discovery of which inaccuracies required the doing of any act including the gathering of any information which was not reasonably available to RSK and including the doing of any independent investigation of the information provided to RSK save as otherwise provided in the terms of the contract between the client and RSK.

8. The phase II or intrusive environmental site investigation aspects of the Services is a limited sampling of the site at pre-determined borehole and soil vapour locations based on the operational configuration of the site. The conclusions given in this report are based on information gathered at the specific test locations and can only be extrapolated to an undefined limited area around those locations. The extent of the limited area depends on the soil and groundwater conditions, together with the position of any current structures and underground facilities and natural and other activities on site. In addition chemical analysis was carried out for a limited number of parameters [as stipulated in the contract between the client and RSK] [based on an understanding of the available operational and historical information,] and it should not be inferred that other chemical species are not present.

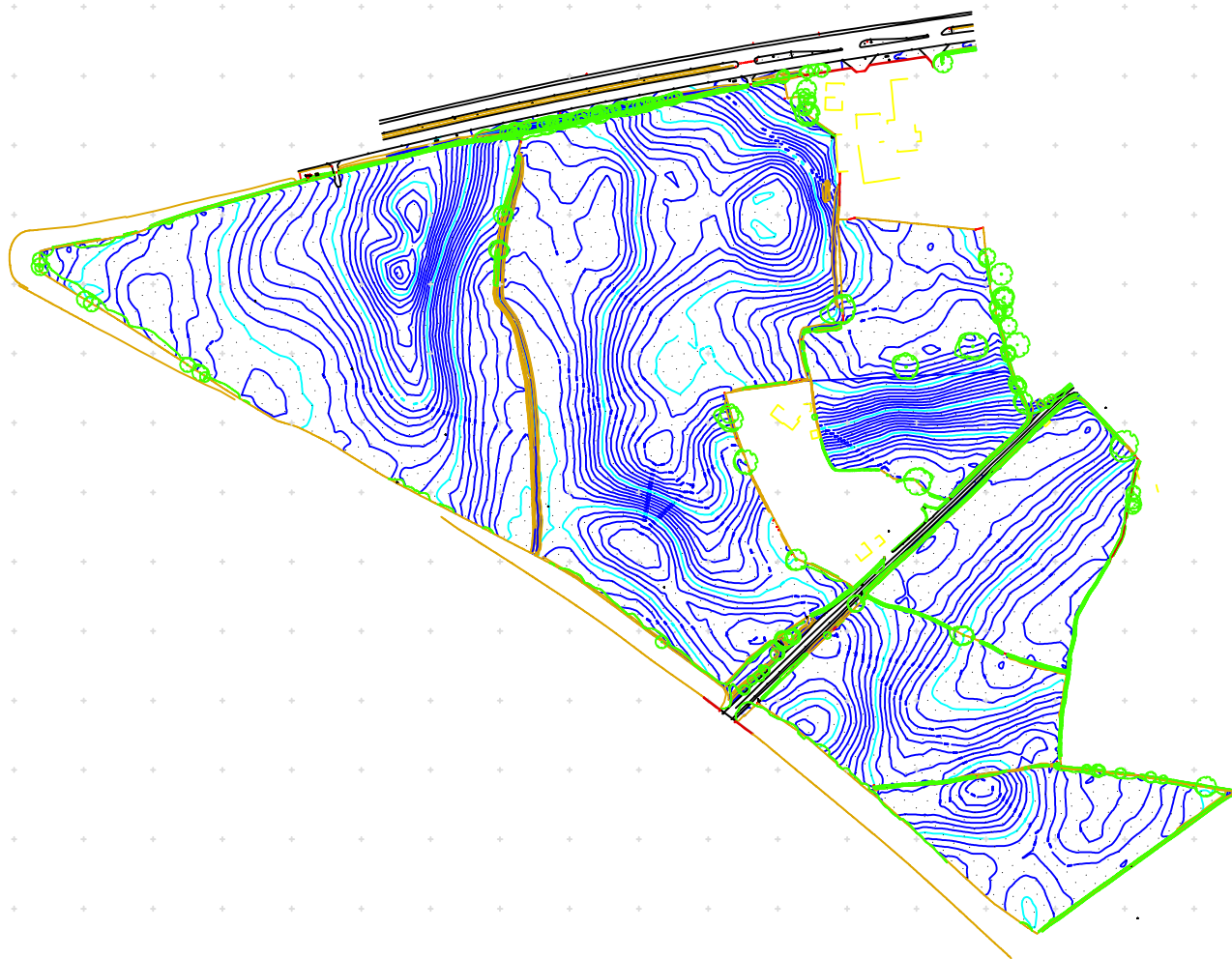
9. Any site drawing(s) provided in this report is (are) not meant to be an accurate base plan, but is (are) used to present the general relative locations of features on, and surrounding, the site.



## **APPENDIX B**

# **TOPOGRAPHIC SURVEY**

---





## **APPENDIX C**

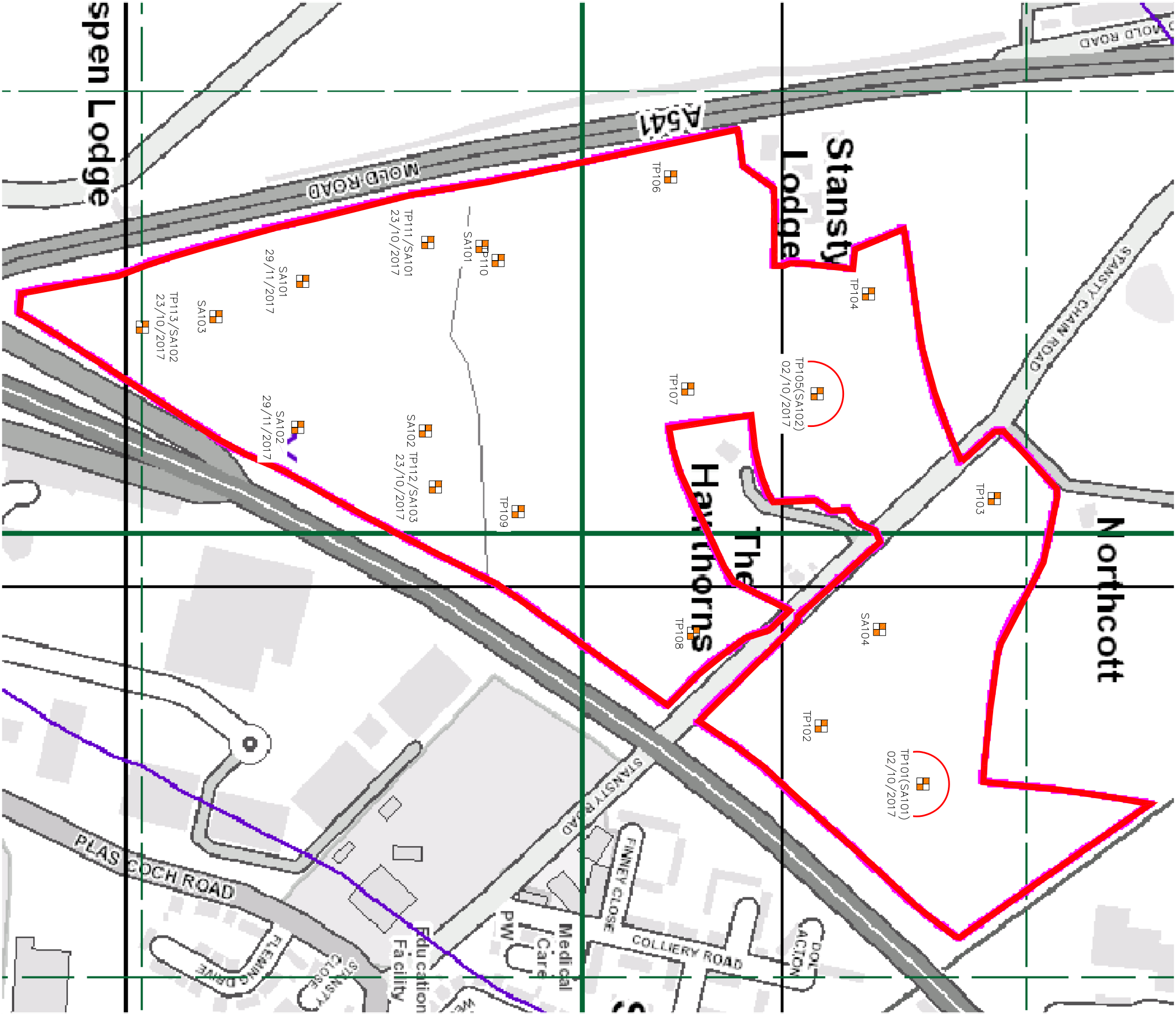
# **GROUND INVESTIGATION**

---



## TRIAL HOLE LOCATIONS

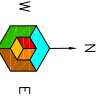
---



- Location Symbols**
- TP101 Approximate Trial Pit Location
  - SA101 Approximate Soakaway Location

|        |  |  |  |  |  |
|--------|--|--|--|--|--|
| Notes: |  |  |  |  |  |
|        |  |  |  |  |  |
|        |  |  |  |  |  |

|            |  |                             |            |                                |        |                  |
|------------|--|-----------------------------|------------|--------------------------------|--------|------------------|
| P1         |  | -                           | 30-11-2017 | DRAFT                          | CB     | MD               |
| Phase      |  | Revision                    | Date       | Issue                          | Drawn  | Authorised       |
| Client:    |  | Russell Homes               |            | Job No:                        | 11-130 | Date: 30-11-2017 |
| Job Title: |  | Stansty Chain Road, Wrexham |            | Drawing No:                    | 004    | Scale: NTS @ A3  |
|            |  |                             |            | Exploratory Hole Location Plan |        |                  |



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## TRIAL HOLE LOGS

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# Trial Pit Log

Trialpit No

**TP101**

Sheet 1 of 1

Project Name: Stansty Chain Road

Project No.  
11130

Co-ords: 332390.00 - 351620.00

Level:

Date

02/10/2017

Location: Wrexham

Dimensions  
(m):

2.5

Depth  
2.00

0.6

Scale

1:25

Logged  
H. Costigan

Client: Russells Construction

| Water<br>Strike | Samples and In Situ Testing |      |         | Depth<br>(m) | Level<br>(m) | Legend | Stratum Description                                                                                                                                                              |   |
|-----------------|-----------------------------|------|---------|--------------|--------------|--------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
|                 | Depth                       | Type | Results |              |              |        |                                                                                                                                                                                  |   |
|                 |                             |      |         | 0.53         |              |        | Dark brown slightly gravelly very clayey SAND (Topsoil). Gravel is fine to medium sub-rounded to rounded of sandstone and quartz.                                                |   |
|                 |                             |      |         | 2.00         |              |        | Red brown very clayey GRAVEL with cobbles and boulders. Gravel is fine to coarse sub-rounded of mudstone, sandstone and coal. Cobbles and boulders are sub-rounded of sandstone. | 1 |
|                 |                             |      |         |              |              |        | End of pit at 2.00 m                                                                                                                                                             | 2 |
|                 |                             |      |         |              |              |        |                                                                                                                                                                                  | 3 |
|                 |                             |      |         |              |              |        |                                                                                                                                                                                  | 4 |
|                 |                             |      |         |              |              |        |                                                                                                                                                                                  | 5 |

Remarks: Complete.

Stability: Partially stable.





# Trial Pit Log

Trialpit No

**TP102**

Sheet 1 of 1

Project Name: Stansty Chain Road

Project No.  
11130

Co-ords: 332390.00 - 351620.00

Level:

Date

02/10/2017

Location: Wrexham

Dimensions  
(m):

2.5

Depth  
2.10

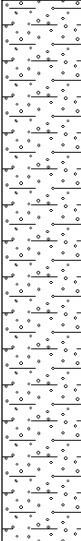
0.6

Scale

1:25

Client: Russells Construction

Logged  
H. Costigan

| Water<br>Strike | Samples and In Situ Testing |      |         | Depth<br>(m) | Level<br>(m) | Legend                                                                             | Stratum Description                                                                                                                                                              |
|-----------------|-----------------------------|------|---------|--------------|--------------|------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                 | Depth                       | Type | Results |              |              |                                                                                    |                                                                                                                                                                                  |
|                 |                             |      |         | 0.30         |              |   | Dark brown slightly gravelly very clayey SAND (Topsoil). Gravel is fine to medium sub-rounded to rounded of sandstone and quartz.                                                |
|                 |                             |      |         | 2.10         |              |  | Red brown very clayey GRAVEL with cobbles and boulders. Gravel is fine to coarse sub-rounded of mudstone, sandstone and coal. Cobbles and boulders are sub-rounded of sandstone. |
|                 |                             |      |         |              |              |                                                                                    | End of pit at 2.10 m                                                                                                                                                             |

1

2

3

4

5

Remarks: Complete.

Stability: Partially stable.





# Trial Pit Log

Trialpit No

**TP103**

Sheet 1 of 1

Project Name: Stansty Chain Road

Project No.  
11130

Co-ords: 332390.00 - 351620.00

Level:

Date

02/10/2017

Location: Wrexham

Dimensions  
(m):

2.5

Depth  
2.10

0.6

Scale

1:25

Client: Russells Construction

Logged  
H. Costigan

| Water<br>Strike | Samples and In Situ Testing |      |         | Depth<br>(m) | Level<br>(m) | Legend | Stratum Description                                                                                                               |   |
|-----------------|-----------------------------|------|---------|--------------|--------------|--------|-----------------------------------------------------------------------------------------------------------------------------------|---|
|                 | Depth                       | Type | Results |              |              |        |                                                                                                                                   |   |
|                 |                             |      |         | 0.45         |              |        | Dark brown slightly gravelly very clayey SAND (Topsoil). Gravel is fine to medium sub-rounded to rounded of sandstone and quartz. |   |
|                 |                             |      |         | 1.10         |              |        | Brown clayey gravelly fine SAND. Gravel is fine to medium sub-rounded to rounded of sandstone and mudstone.                       | 1 |
|                 |                             |      |         | 2.10         |              |        | Brown gravelly clayey fine to medium SAND. Gravel is fine to medium sub-angular to sub-rounded of sandstone and mudstone.         | 2 |
|                 |                             |      |         |              |              |        | End of pit at 2.10 m                                                                                                              | 3 |
|                 |                             |      |         |              |              |        |                                                                                                                                   | 4 |
|                 |                             |      |         |              |              |        |                                                                                                                                   | 5 |

Remarks: Complete.

Stability: Stable.





# Trial Pit Log

Trialpit No

**TP104**

Sheet 1 of 1

Project Name: Stansty Chain Road

Project No.  
11130

Co-ords: 332390.00 - 351620.00

Level:

Date

02/10/2017

Location: Wrexham

Dimensions  
(m):

2.5

Depth  
2.10

0.6

Scale

1:25

Logged  
H. Costigan

Client: Russells Construction

| Water<br>Strike | Samples and In Situ Testing |      |         | Depth<br>(m) | Level<br>(m) | Legend | Stratum Description                                                                                                                                                    |   |
|-----------------|-----------------------------|------|---------|--------------|--------------|--------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
|                 | Depth                       | Type | Results |              |              |        |                                                                                                                                                                        |   |
|                 |                             |      |         |              |              |        | MADE GROUND: Dark brown clayey gravelly sand with cobbles of brick and plastic. Gravel is fine to coarse angular to sub-angular of timber, plastic, metal and asphalt. | 1 |
|                 |                             |      |         | 1.30         |              |        |                                                                                                                                                                        |   |
|                 |                             |      |         |              |              |        | Orange gravelly medium SAND. Gravel is fine to coarse sub-angular to sub-rounded of sandstone.                                                                         |   |
|                 |                             |      |         | 1.60         |              |        |                                                                                                                                                                        |   |
|                 |                             |      |         |              |              |        | Brown very sandy gravelly CLAY. Gravel is fine to coarse sub-angular to sub-rounded of sandstone.                                                                      | 2 |
|                 |                             |      |         |              |              |        |                                                                                                                                                                        |   |
|                 |                             |      |         | 2.10         |              |        | End of pit at 2.10 m                                                                                                                                                   |   |
|                 |                             |      |         |              |              |        |                                                                                                                                                                        | 3 |
|                 |                             |      |         |              |              |        |                                                                                                                                                                        | 4 |
|                 |                             |      |         |              |              |        |                                                                                                                                                                        | 5 |

Remarks: Complete.

Stability: Stable.





# Trial Pit Log

Trialpit No

**TP105**

Sheet 1 of 1

Project Name: Stansty Chain Road

Project No.  
11130Co-ords: 332390.00 - 351620.00  
Level:Date  
02/10/2017

Location: Wrexham

Dimensions  
(m):

2.5

Client: Russells Construction

Depth  
2.20

0.6

Scale  
1:25Logged  
H. Costigan

| Water<br>Strike | Samples and In Situ Testing |      |         | Depth<br>(m) | Level<br>(m) | Legend | Stratum Description                                                                                                               |   |
|-----------------|-----------------------------|------|---------|--------------|--------------|--------|-----------------------------------------------------------------------------------------------------------------------------------|---|
|                 | Depth                       | Type | Results |              |              |        |                                                                                                                                   |   |
|                 |                             |      |         | 0.44         |              |        | Dark brown slightly gravelly very clayey SAND (Topsoil). Gravel is fine to medium sub-rounded to rounded of sandstone and quartz. | 1 |
|                 |                             |      |         | 1.50         |              |        | Stiff red brown very sandy gravelly CLAY. Gravel is fine to medium sub-angular to sub-rounded of sandstone, mudstone and quartz.  | 2 |
|                 |                             |      |         | 2.20         |              |        | Brown sandy clayey GRAVEL. Gravel is fine to coarse sub-angular to sub-rounded of sandstone, coal and mudstone.                   | 3 |
|                 |                             |      |         |              |              |        | End of pit at 2.20 m                                                                                                              | 4 |
|                 |                             |      |         |              |              |        |                                                                                                                                   | 5 |

Remarks: Complete.

Stability: Partially unstable.





# Trial Pit Log

Trialpit No

**TP106**

Sheet 1 of 1

Project Name: Stansty Chain Road

Project No.  
11130

Co-ords: 332390.00 - 351620.00

Level:

Date

02/10/2017

Location: Wrexham

Dimensions  
(m):

2.5

Client: Russells Construction

Depth  
2.10

0.6

Scale

1:25

Logged  
H. Costigan

| Water<br>Strike | Samples and In Situ Testing |      |         | Depth<br>(m) | Level<br>(m) | Legend | Stratum Description                                                                                                               |   |
|-----------------|-----------------------------|------|---------|--------------|--------------|--------|-----------------------------------------------------------------------------------------------------------------------------------|---|
|                 | Depth                       | Type | Results |              |              |        |                                                                                                                                   |   |
|                 |                             |      |         | 0.40         |              |        | Dark brown slightly gravelly very clayey SAND (Topsoil). Gravel is fine to medium sub-rounded to rounded of sandstone and quartz. |   |
|                 |                             |      |         | 1.16         |              |        | Red brown clayey gravelly SAND. Gravel is fine to coarse sub-angular to sub-rounded of sandstone and mudstone.                    | 1 |
|                 |                             |      |         | 2.20         |              |        | Brown sandy clayey GRAVEL. Gravel is fine to coarse sub-angular to sub-rounded of sandstone, coal and mudstone.                   | 2 |
|                 |                             |      |         |              |              |        | End of pit at 2.10 m                                                                                                              | 3 |
|                 |                             |      |         |              |              |        |                                                                                                                                   | 4 |
|                 |                             |      |         |              |              |        |                                                                                                                                   | 5 |

Remarks: Complete.

Stability: Partially unstable.





# Trial Pit Log

Trialpit No

**TP107**

Sheet 1 of 1

Project Name: Stansty Chain Road

Project No.  
11130

Co-ords: 332390.00 - 351620.00

Level:

Date

02/10/2017

Location: Wrexham

Dimensions  
(m):

2.5

Depth  
2.90

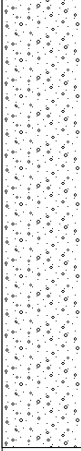
0.6

Scale

1:25

Logged  
H. Costigan

Client: Russells Construction

| Water<br>Strike | Samples and In Situ Testing |      |         | Depth<br>(m) | Level<br>(m) | Legend                                                                             | Stratum Description                                                                                                                    |   |
|-----------------|-----------------------------|------|---------|--------------|--------------|------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|---|
|                 | Depth                       | Type | Results |              |              |                                                                                    |                                                                                                                                        |   |
|                 |                             |      |         | 0.33         |              |   | Dark brown slightly gravelly very clayey SAND (Topsoil). Gravel is fine to medium sub-rounded to rounded of sandstone and quartz.      |   |
|                 |                             |      |         | 1.40         |              |   | Brown red slightly clayey gravelly fine to medium SAND. Gravel is fine to medium sub-angular to sub-rounded of mudstone and sandstone. | 1 |
|                 |                             |      |         | 2.90         |              |  | Brown sandy clayey GRAVEL. Gravel is fine to coarse sub-angular to sub-rounded of sandstone, coal and mudstone.                        | 2 |
|                 |                             |      |         |              |              |                                                                                    | End of pit at 2.90 m                                                                                                                   | 3 |
|                 |                             |      |         |              |              |                                                                                    |                                                                                                                                        | 4 |
|                 |                             |      |         |              |              |                                                                                    |                                                                                                                                        | 5 |

Remarks: Complete.

Stability: Partially unstable.





# Trial Pit Log

Trialpit No

**TP108**

Sheet 1 of 1

Project Name: Stansty Chain Road

Project No.  
11130

Co-ords: 332390.00 - 351620.00

Level:

Date

02/10/2017

Location: Wrexham

Dimensions  
(m):

2.5

Depth  
2.05

0.6

Scale

1:25

Client: Russells Construction

Logged  
H. Costigan

| Water<br>Strike | Samples and In Situ Testing |      |         | Depth<br>(m) | Level<br>(m) | Legend | Stratum Description                                                                                                               |   |
|-----------------|-----------------------------|------|---------|--------------|--------------|--------|-----------------------------------------------------------------------------------------------------------------------------------|---|
|                 | Depth                       | Type | Results |              |              |        |                                                                                                                                   |   |
|                 |                             |      |         | 0.37         |              |        | Dark brown slightly gravelly very clayey SAND (Topsoil). Gravel is fine to medium sub-rounded to rounded of sandstone and quartz. |   |
|                 |                             |      |         | 1.04         |              |        | Brown very sandy GRAVEL. Gravel is fine to coarse sub-angular to sub-rounded of sandstone and mudstone.                           | 1 |
|                 |                             |      |         | 2.05         |              |        | Brown very gravelly medium to coarse SAND. Gravel is fine to coarse sub-angular to sub-rounded of mudstone, sandstone and coal.   | 2 |
|                 |                             |      |         |              |              |        | End of pit at 2.05 m                                                                                                              | 3 |
|                 |                             |      |         |              |              |        |                                                                                                                                   | 4 |
|                 |                             |      |         |              |              |        |                                                                                                                                   | 5 |

Remarks: Complete.

Stability: Stable.





# Trial Pit Log

Trialpit No

**TP109**

Sheet 1 of 1

Project Name: Stansty Chain Road

Project No.  
11130Co-ords: 332390.00 - 351620.00  
Level:Date  
02/10/2017

Location: Wrexham

Dimensions  
(m):

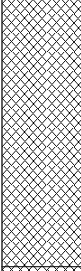
2.5

Client: Russells Construction

Depth  
2.10

0.6

Scale  
1:25Logged  
H. Costigan

|  Water<br>Strike | Samples and In Situ Testing |      |         | Depth<br>(m) | Level<br>(m) | Legend                                                                              | Stratum Description                                                                                                                              |   |
|---------------------------------------------------------------------------------------------------|-----------------------------|------|---------|--------------|--------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|---|
|                                                                                                   | Depth                       | Type | Results |              |              |                                                                                     |                                                                                                                                                  |   |
|                                                                                                   |                             |      |         | 0.90         |              |    | MADE GROUND: Dark brown slightly gravelly very clayey sand (Topsoil). Gravel is fine to medium sub-rounded to rounded of sandstone and quartz.   |   |
|                                                                                                   |                             |      |         |              |              |                                                                                     | MADE GROUND: Brown very gravelly clay (reworked). Gravel is fine to coarse angular to sub-rounded of sandstone and brick (Strong organic odour). | 1 |
|                                                                                                   |                             |      |         | 2.10         |              |  | End of pit at 2.10 m                                                                                                                             | 2 |
|                                                                                                   |                             |      |         |              |              |                                                                                     |                                                                                                                                                  | 3 |
|                                                                                                   |                             |      |         |              |              |                                                                                     |                                                                                                                                                  | 4 |
|                                                                                                   |                             |      |         |              |              |                                                                                     |                                                                                                                                                  | 5 |

Remarks: 1. Complete. 2. Water strike encountered on the surface of trial pit.

Stability: Partially unstable.





# Trial Pit Log

Trialpit No

**TP110**

Sheet 1 of 1

Project Name: Stansty Chain Road

Project No.  
11130

Co-ords: 332390.00 - 351620.00

Level:

Date

02/10/2017

Location: Wrexham

Dimensions  
(m):

2.5

Depth  
2.25

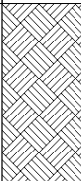
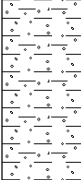
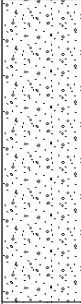
0.6

Scale

1:25

Client: Russells Construction

Logged  
H. Costigan

| Water<br>Strike | Samples and In Situ Testing |      |         | Depth<br>(m) | Level<br>(m) | Legend                                                                             | Stratum Description                                                                                                                                                  |   |
|-----------------|-----------------------------|------|---------|--------------|--------------|------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
|                 | Depth                       | Type | Results |              |              |                                                                                    |                                                                                                                                                                      |   |
| ▼               |                             |      |         | 0.61         |              |   | Dark brown slightly gravelly very clayey SAND (Topsoil). Gravel is fine to medium sub-rounded to rounded of sandstone and quartz.                                    |   |
|                 |                             |      |         | 1.25         |              |   | Soft red brown very gravelly sandy CLAY. Gravel is fine to coarse sub-angular to sub-rounded of sandstone.                                                           | 1 |
|                 |                             |      |         | 2.25         |              |  | Grey very gravelly clayey medium to coarse SAND with occasional cobbles of sandstone. Gravel is fine to coarse sub-angular to sub-rounded of mudstone and sandstone. | 2 |
|                 |                             |      |         |              |              |                                                                                    | End of pit at 2.25 m                                                                                                                                                 | 3 |
|                 |                             |      |         |              |              |                                                                                    |                                                                                                                                                                      | 4 |
|                 |                             |      |         |              |              |                                                                                    |                                                                                                                                                                      | 5 |

Remarks: 1. Complete. 2. Water strike encountered at 1.93m bgl.

Stability: Unstable within grey sand.





# Trial Pit Log

Trialpit No

**TP111**

Sheet 1 of 1

Project Name: Stansty Chain Road

Project No.  
11130

Co-ords: 332390.00 - 351620.00

Level:

Date

02/10/2017

Location: Wrexham

Dimensions  
(m):

2.5

Depth  
2.60

0.6

Scale

1:25

Logged  
H. Costigan

Client: Russells Construction

| Water<br>Strike | Samples and In Situ Testing |      |         | Depth<br>(m) | Level<br>(m) | Legend | Stratum Description                                                                                                               |   |
|-----------------|-----------------------------|------|---------|--------------|--------------|--------|-----------------------------------------------------------------------------------------------------------------------------------|---|
|                 | Depth                       | Type | Results |              |              |        |                                                                                                                                   |   |
|                 |                             |      |         | 0.70         |              |        | Dark brown slightly gravelly very clayey SAND (Topsoil). Gravel is fine to medium sub-rounded to rounded of sandstone and quartz. |   |
|                 |                             |      |         |              |              |        | Firm brown orange sandy gravelly CLAY. Gravel is fine to coarse sub-angular to sub-rounded of sandstone.                          | 1 |
| ▼               |                             |      |         |              |              |        | Brown silty sandy GRAVEL. Gravel is fine to coarse sub-angular to sub-rounded of mudstone and sandstone.                          | 2 |
| ▼               |                             |      |         | 2.40         |              |        |                                                                                                                                   |   |
|                 |                             |      |         | 2.60         |              |        | End of pit at 2.60 m                                                                                                              | 3 |
|                 |                             |      |         |              |              |        |                                                                                                                                   | 4 |
|                 |                             |      |         |              |              |        |                                                                                                                                   | 5 |

Remarks: 1. Complete. 2. Water strikes encountered a 1.60m and 2.40m bgl.

Stability: Stable.





# Trial Pit Log

Trialpit No

**TP112**

Sheet 1 of 1

Project Name: Stansty Chain Road

Project No.  
11130

Co-ords: 332390.00 - 351620.00

Level:

Date

02/10/2017

Location: Wrexham

Dimensions  
(m):

2.5

Depth  
2.35

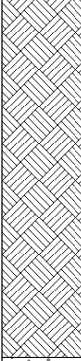
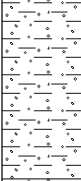
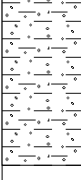
0.6

Scale

1:25

Logged

Client: Russells Construction

| Water<br>Strike                                                                   | Samples and In Situ Testing |      |         | Depth<br>(m) | Level<br>(m) | Legend                                                                              | Stratum Description                                                                                                               |   |
|-----------------------------------------------------------------------------------|-----------------------------|------|---------|--------------|--------------|-------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|---|
|                                                                                   | Depth                       | Type | Results |              |              |                                                                                     |                                                                                                                                   |   |
|  |                             |      |         | 1.20         |              |    | Dark brown slightly gravelly very clayey SAND (Topsoil). Gravel is fine to medium sub-rounded to rounded of sandstone and quartz. | 1 |
|                                                                                   |                             |      |         | 1.80         |              |   | Firm dark grey gravelly CLAY. Gravel is fine to medium sub-angular to sub-rounded of mudstone and sandstone.                      | 2 |
|                                                                                   |                             |      |         | 2.35         |              |  | Stiff brown mottled grey gravelly CLAY. Gravel is fine to coarse sub-angular to sub-rounded of sandstone and mudstone.            | 3 |
|                                                                                   |                             |      |         |              |              |                                                                                     | End of pit at 2.35 m                                                                                                              | 4 |
|                                                                                   |                             |      |         |              |              |                                                                                     |                                                                                                                                   | 5 |

Remarks: 1. Complete. 2. Water strike encountered at 1.05m bgl.

Stability: Stable.





# Trial Pit Log

Trialpit No

**TP113**

Sheet 1 of 1

Project Name: Stansty Chain Road

Project No.  
11130

Co-ords: 332390.00 - 351620.00

Level:

Date

02/10/2017

Location: Wrexham

Dimensions  
(m):

2.5

Client: Russells Construction

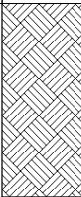
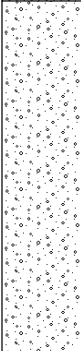
Depth  
1.80

0.6

Scale

1:25

Logged

| Water<br>Strike | Samples and In Situ Testing |      |         | Depth<br>(m) | Level<br>(m) | Legend                                                                             | Stratum Description                                                                                                               |   |
|-----------------|-----------------------------|------|---------|--------------|--------------|------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|---|
|                 | Depth                       | Type | Results |              |              |                                                                                    |                                                                                                                                   |   |
|                 |                             |      |         | 0.64         |              |   | Dark brown slightly gravelly very clayey SAND (Topsoil). Gravel is fine to medium sub-rounded to rounded of sandstone and quartz. |   |
|                 |                             |      |         | 1.80         |              |  | Brown clayey very sandy GRAVEL. Gravel is fine to coarse sub-angular to sub-rounded of mudstone, coal and sandstone.              | 1 |
|                 |                             |      |         |              |              |                                                                                    | End of pit at 1.80 m                                                                                                              | 2 |
|                 |                             |      |         |              |              |                                                                                    |                                                                                                                                   | 3 |
|                 |                             |      |         |              |              |                                                                                    |                                                                                                                                   | 4 |
|                 |                             |      |         |              |              |                                                                                    |                                                                                                                                   | 5 |

Remarks: Complete.

Stability: Stable.





## **APPENDIX D**

# **WREXHAM COUNCIL CORRESPONDENCE**

---

## Robert Brenton

---

**From:** Neil Taunt [Neil.Taunt@wrexham.gov.uk]  
**Sent:** 22 June 2017 11:48  
**To:** Kathryn Olive  
**Subject:** RE: Land off Stansty Chain Road, Wrexham - Flood Information Request  
**Attachments:** Stansty Chain Road LL11 4YG.PDF

Hi Kathryn,

In response to your recent request for information I can provide the following:

Information on the recently published climate change guidance for this area: Please view WG advice note or confirm with NRW.

Information on surface water flood risk including flow pathways and depths: The attached map summarises information held by WCBC and includes NRW surface water flood map data.

Information on historic flooding from all sources: The attached map shows the location of reported incidents of surface water flooding. In addition multiple incidents have occurred at the Plas Coch Retail Park associated with the drainage ditch that crosses the enquiry site, passes through culvert beneath the A483 and stops at the boundary to the retail park. This has anecdotally contributed to localised flooding in the vicinity of "sinks" on the attached map (south east site extent).

Any data on existing surface water discharges to the surrounding watercourse or sewers: WCBC hold no data on this

Any data on groundwater flooding: WCBC hold no data on this.

Any information on reservoir flooding: WCBC hold not data on this.

Any information on culverted watercourses or privates sewers which you know of which do not show up on the public sewer records: We hold no information in addition to that displayed on the attached map.

Finally, please could you provide any recommendation on how the surface water is to be managed; for example, restrictions in discharge rates the requirements for SuDS, possible discharge locations and attenuation requirements?

Guidance on surface water management within Wrexham CBC can be found at

[http://www.wrexham.gov.uk/english/planning\\_portal/publications/surface\\_water.htm](http://www.wrexham.gov.uk/english/planning_portal/publications/surface_water.htm).

With regards to the comments above in relation to the ditch course that crosses the southern portion of the enquiry site, historic and ongoing flooding issues both to this site, the neighbouring A483 and adjacent retail park would preclude the use of this feature to discharge surface water generated by new impermeable surfaces on this the enquiry site.

If you have any further questions please do not hesitate to contact me.

Regards

Neil

**Neil Taunt MCIWEM C.WEM CEnv CSci**

Senior Flood Management Officer / Uwch Swyddog Rheoli Llifogydd



☎ 01978 729734

✉ Housing, Public Protection and Environment Department, Wrexham County Borough Council, Abbey Road South, Wrexham Industrial Estate, Wrexham LL13 9PW

✉ Adran Tai, Gwarchod y Cyhoedd a'r Amgylchedd, Cyngor Bwrdeistref Sirol Wreccsam, De Ffordd yr Abaty, Ystad Ddiwydiannol Wreccsam, Wreccsam LL13 9PW

🌐 [wrexham.gov.uk](http://wrexham.gov.uk) | [wreccsam.gov.uk](http://wreccsam.gov.uk)

---

**From:** [KOlive@rsk.co.uk](mailto:KOlive@rsk.co.uk) [<mailto:KOlive@rsk.co.uk>]  
**Sent:** 15 June 2017 13:26  
**To:** contact-us  
**Subject:** Land off Stansty Chain Road, Wrexham - Flood Information Request

Dear Sir/Madam,

Please could I order information on flooding and drainage for the following site in order to inform a Flood Risk Assessment:

Land off Stansty Chain Road  
Wrexham  
LL11 4YG

Grid reference – 332335 E, 351809 N

**Location Plan is attached.**

I would like all the flooding information and advice you have including the following, if available:

Information on the recently published climate change guidance for this area,  
Information on surface water flood risk including flow pathways and depths,  
Information on historic flooding from all sources,  
Any data on existing surface water discharges to the surrounding watercourse or sewers,  
Any data on groundwater flooding,  
Any information on reservoir flooding; and,  
Any information on culverted watercourses or private sewers which you know of which do not show up on the public sewer records.

Finally, please could you provide any recommendation on how the surface water is to be managed; for example, restrictions in discharge rates the requirements for SuDS, possible discharge locations and attenuation requirements?

We have a relatively quick turn around on this project and would therefore appreciate a quick response.

If you have any queries please don't hesitate to contact me.

Kind regards,

Kathryn

**Kathryn Olive**  
Administrator  
Land & Development Engineering

**RSK**  
14 Beecham Court, Pemberton Business Park, Wigan, WN3 6PR, UK

Switchboard: +44 (0) 1942 493255  
<http://www.rsk.co.uk>

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Rydym yn croesawu gohebiaeth yn Gymraeg. Byddwn yn ymateb i unrhyw ohebiaeth yn Gymraeg ac ni fydd hyn yn arwain at unrhyw oedi.

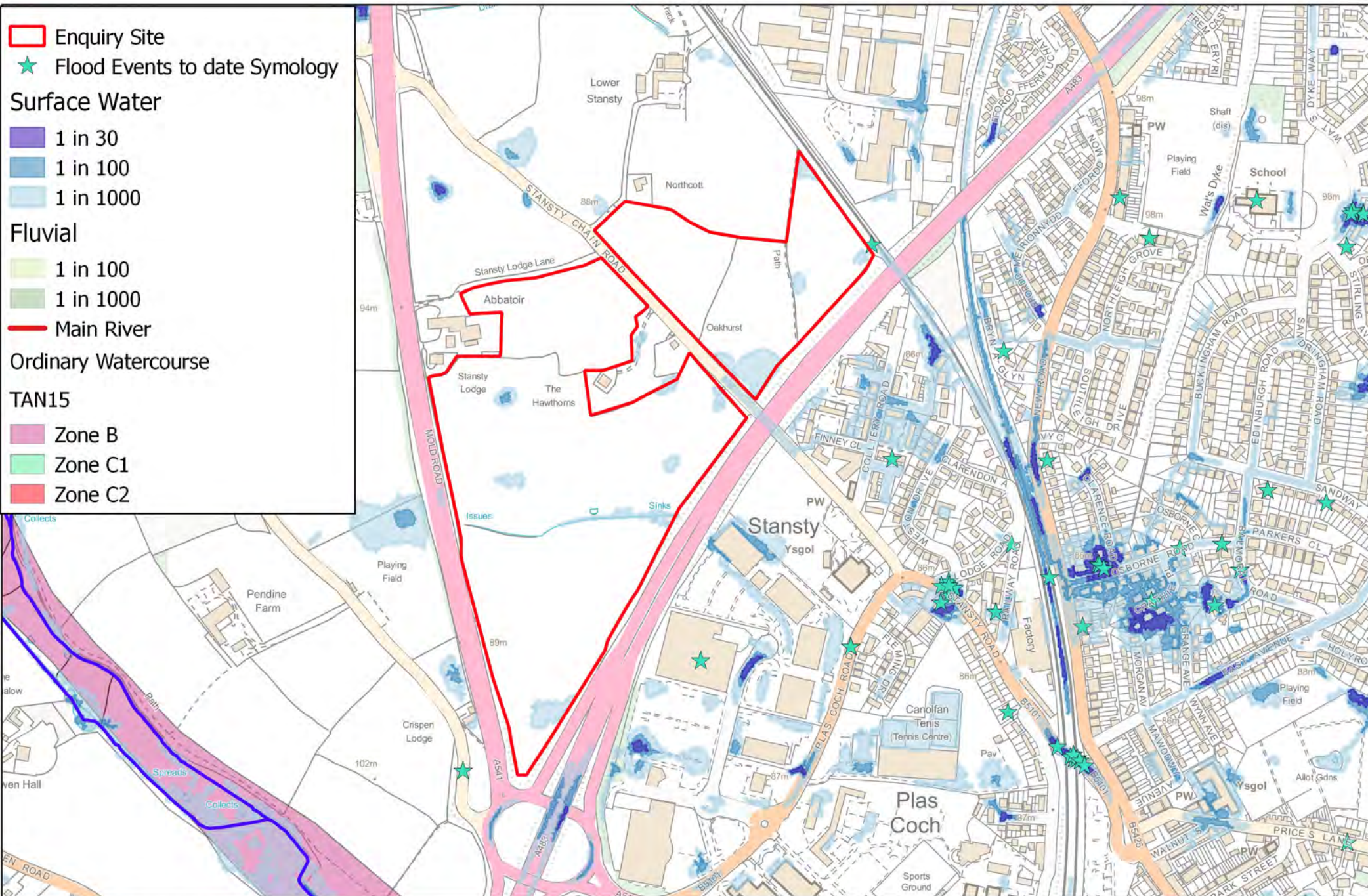
Ewch i weld - mi fedrwch chi dalu, rhoi gwybod, gwneud cais, dweud eich dweud, a dod o hyd i wybodaeth ar-lein yn [www.wreccsam.gov.uk](http://www.wreccsam.gov.uk). Arbedwch bapur - meddyliwch cyn argraffu!

Mae'r neges e-bost hon ac unrhyw atodiadau wedi eu bwriadu ar gyfer yr unigolyn neu'r sefydliad y?i cyfeirir atynt yn unig. Am yr amodau llawn yngl?n ? chynnwys a defnyddio'r neges e-bost hon, ac unrhyw atodiadau, cyfeiriwch at [www.wreccsam.gov.uk/top\\_navigation/disclaimersw.htm](http://www.wreccsam.gov.uk/top_navigation/disclaimersw.htm)

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Land off Stansty Chain Road - LL11 4YG

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 © Hawlfraint a hawliau cronfa ddata'r Goron 2014. Arolwg Ordnans 100023429

## Robert Brenton

---

**From:** Neil Taunt [Neil.Taunt@wrexham.gov.uk]  
**Sent:** 26 June 2017 08:31  
**To:** Robert Brenton  
**Subject:** RE: Welsh Climate Change factors

Hi Robert,

I would normally expect to see a 30% increase to account for cc.

Many thanks

Neil

---

**From:** [RBrenton@rsk.co.uk](mailto:RBrenton@rsk.co.uk) [<mailto:RBrenton@rsk.co.uk>]  
**Sent:** 23 June 2017 15:43  
**To:** Neil Taunt  
**Subject:** Welsh Climate Change factors

Hi Neil,

Regarding the Stansty Chain Road site, I am doing some attenuation figures for it and although you sent through the document on surface water. It states that the site should attenuated up to the 1 in 100 +CC event. However, I cannot find what this climate change factor should be for a residential site. Could you offer some advice on what you would expect to see?

Kind regards,

**Robert Brenton**  
Hydrologist BSc (Hons) FdSc

**RSK**  
Land & Development Engineering  
14, Beecham Court, Pemberton Business Park, Wigan, UK, WN3 6PR

Switchboard: +44 (0) 1942 493255  
Fax: +44 (0) 1942 493171

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fydd hyn yn arwain at unrhyw oedi.

Ewch i weld - mi fedrwch chi dalu, rhoi gwybod, gwneud cais, dweud eich dweud, a dod o hyd i wybodaeth ar-lein yn [www.wreccsam.gov.uk](http://www.wreccsam.gov.uk). Arbedwch bapur - meddyliwch cyn argraffu!

Mae'r neges e-bost hon ac unrhyw atodiadau wedi eu bwriadu ar gyfer yr unigolyn neu'r sefydliad y'i cyfeirir atynt yn unig. Am yr amodau llawn ynglŷn ? chynnwys a defnyddio'r neges e-bost hon, ac unrhyw atodiadau, cyfeiriwch at [www.wreccsam.gov.uk/top\\_navigation/disclaimersw.htm](http://www.wreccsam.gov.uk/top_navigation/disclaimersw.htm)

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## **APPENDIX E**

# **PROPOSED CONCEPT FRAMEWORK**

---



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Based upon Ordnance Survey data with the permission of Ordnance Survey on behalf of the controller of Her Majesty's Stationary Office. © Crown Copyright. Licence No. 100017603. Contractors, Sub-contractors and suppliers are to check all relevant dimensions and levels of the site and building before commencing any site drawings or building work. Any discrepancies should be recorded in the Addendum. Where applicable this drawing is to be read in conjunction with the Consultant's drawings.

| REV | DESCRIPTION | DATE | AUTHOR | CHKD |
|-----|-------------|------|--------|------|
|     |             |      |        |      |

| KEY                |  |
|--------------------|--|
| Residential        |  |
| Private Garden     |  |
| Road               |  |
| Private Drive      |  |
| Path               |  |
| Public Open Space  |  |
| Play Space         |  |
| Ecology Pond/Swale |  |
| Vegetation         |  |

- 1 Noise Bund with planted vegetation.
- 2 Retained Mature Trees.
- 3 Central Green Pocket within Development.
- 4 Tree Lined Avenue into Development.
- 5 Swale Features along Roads.
- 6 Locally Equipped Area of Children's Play Space.
- 7 Green Ecological Corridor with SUDS Features.
- 8 Frontage onto Open Space.
- 9 Large Areas of Public Open Space.
- 10 Proposed New Bus Stop
- 11 Site Access

**Urban & Landscape Design**

Manchester Office  
Quay West at MediaCityUK, Trafford Wharf Road, Trafford Park, Manchester, M17 2JH  
t: 0161 698 7215 w: www.wyg.com

PROJECT  
**Stansty Green**  
Wrexham  
Russell Homes

DRAWING  
**Illustrative Masterplan**

| SCALE       | DATE        | AUTHOR | CHKD |
|-------------|-------------|--------|------|
| 1:1000 @ A0 | 09/12/19    | EF     | AC   |
| JOB NO.     | DRAWING NO. | REV    |      |
| A106224     | 002         | J      |      |



# **APPENDIX F**

## **NATURAL RESOURCES WALES**

### **CORRESPONDENCE**

---

## Kristian Jackson

---

**From:** Data Distribution [datadistribution@cyfoethnaturiolcymru.gov.uk]  
**Sent:** 28 June 2017 13:46  
**To:** Kathryn Olive  
**Subject:** RE: ATI13124A Flood Product Enquiry Wrexham Land off Stansty Chain Road, LL11 4YG 150617  
**Attachments:** nrw-flood-risk-map-public-user-guide-mar-2017.pdf

Dear Ms Olive

Thank you for your recent enquiry concerning the site above. Unfortunately, we do not hold any detailed data for this site. However, did you know that we have some Self Service Open Data available to you? You can do this by making the most of the open data provided free online:

- NRW Flood Risk Map Viewer: create and export an A4 or A3 PDF map at a scale of 1:5000. You will find many spatial risk layers, including the Development Advice Map, flood zones, surface water and reservoir hazard data. Guidance is attached.
- "Lle" the Welsh Government Portal for Open Spatial data: Spatial data is free to download, view and use within your own GIS system. The flood datasets includes Flood Zones, Flood Defences, Historic Flood Outlines, Areas Benefiting Defences, Surface Water, Development Advice Map, and LiDAR data. You can also download the 'Coastal Design – Extreme Sea Levels' report and data covering still water levels for the Welsh Coastline (wave overtopping is not calculated). You can also try contacting your relevant Local Authority as they may hold additional information on historical or surface water flooding in this area.

Please Note The Following:

- All information supplied will need to be verified by the recipient PRIOR to using in a Flood Consequences Assessment (FCA). We would expect to see a review of hydrology, in-channel survey, floodplain topography etc. to demonstrate the data is suitable for the purposes of producing an FCA.
- As of 1<sup>st</sup> of December, 2016 you will need to apply climate change allowances carefully to ensure compliance with Welsh Government climate change clarification letter.
- For Coastal and Estuarine sites NRW will require assessment of wave overtopping. It is up to the developer to justify why an assessment *isn't* required.
- Please contact your local Flood Risk Analysis Team to discuss the suitability and appropriateness of using the Tidal Dee Breach outputs in supporting and informing any site specific Flood Consequences Assessment. You can reach your local team by phoning 03000 65 35 00 and asking for the FRA Team that covers Wrexham.
- Pre-application Advice: NRW are changing the way in which we provide advice to developers. We will continue to meet our duties as an adviser. In addition we will offer a free initial opinion on your proposal. However, in cases where you would like to access any extra advice that falls outside of our statutory duties, we can only offer this as part of our Discretionary Planning Advice Service (DPA Service). For more information regarding free service and our discretionary planning can be found in the following links: Welsh Version / English version.

Your request for our free or charged discretionary advice service needs to be accompanied by the relevant 'Request Form' which is available to download from our website. You will then need to send the form to northplanning@cyfoethnaturiolcymru.gov.uk who will coordinate our response.

I trust this information is useful to you.

Yours sincerely,

Michelle

Eich Enw/Your name: Michelle Lewis

Teitl Swydd/Job Title: Swyddog Cysylltiadau Allanol/ External Relations Officer

Teitl eich tim/Title of your team: Cysylltiadau Allanol/External Relations

Cyfoeth Naturiol Cymru/Natural Resources Wales

Ffon/Tel: **VOIP: 03000653577** or Ganolfan Gwasanaethau Cwsmeriad/Customer Services Centre - 03000 65 3000

E-bost/E-mail: [datadistribution@naturalresourceswales.gov.uk](mailto:datadistribution@naturalresourceswales.gov.uk)

Evch i / Browse our [Data Services webpage](#)

Gwefan/Website: [www.cyfoethnaturiolcymru.gov.uk/www.naturalresourceswales.gov.uk](http://www.cyfoethnaturiolcymru.gov.uk/www.naturalresourceswales.gov.uk)

Os hoffech i'n hymateb fod yn Gymraeg neu'n ddwyieithog, rhwch wybod i mi drwy roi clych o amgylch yr opsiwn priodol isod: If you would like our response to be in the Welsh language or bilingual, please let me know by circling the appropriate option below: [Cymraeg/Welsh](#) - [Dwyieithog/Bilingual](#)

Ein diben yw sicrhau bod adnoddau naturiol Cymru yn cael eu cynnal, eu gwella a'u defnyddio yn gynaliadwy, yn awr ac yn y dyfodol. Our purpose is to ensure that the natural resources of Wales are sustainably maintained, enhanced and used, now and in the future.

----- Original Message -----

**From:** [KOlive@rsk.co.uk](mailto:KOlive@rsk.co.uk)

**Received:** Thu Jun 15 2017 13:22:55 GMT+0100 (GMT Daylight Time)

**To:** Enquiries Queue; HZW-005344; HZW-006866

**Subject:** Land off Stansty Chain Road, Wrexham - Flood Information Request

Dear Sir/Madam,

Please could I order information on flooding and drainage for the following site in order to inform a Flood Consequences Assessment:

Land off Stansty Chain Road  
Wrexham  
LL11 4YG

Grid reference – 332335 E, 351809 N

**Location Plan is attached.**

I would like all the flooding information you have including the following, if available:

- Confirmation of the site's Flood Zone 1 designation, alternatively could you provide the flood flows and levels for a range of return periods including the 1 in 2, 10, 30, 100, 100+CC, 200, 1000,
- Information on the recently published climate change guidance for this area and how this may impact on the data available for the area,
- Information on surface water flood risk including flow pathways and depths,
- Information on historic flooding,
- Information on flood defences in the area, if any,
- Any data on existing surface water discharges to the surrounding watercourses,
- Any data on groundwater flooding,
- Any information on reservoir flooding; and,
- Any information on culverted watercourses or private sewers which you know of which do not show up on the public sewer records.

Finally, please could you provide any recommendation on how the surface water is to be managed; for example, restrictions in discharge rates the requirements for SuDS, possible discharge locations and attenuation requirements?

We have a relatively quick turn around on this project and would therefore appreciate a quick response.

If you have any queries please don't hesitate to contact me.

Kind regards,

Kathryn

**Kathryn Olive**  
Administrator  
Land & Development Engineering

**RSK**

14 Beecham Court, Pemberton Business Park, Wigan, WN3 6PR, UK

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# **APPENDIX G**

## **DWY CYMRU WELSH WATER SEWER**

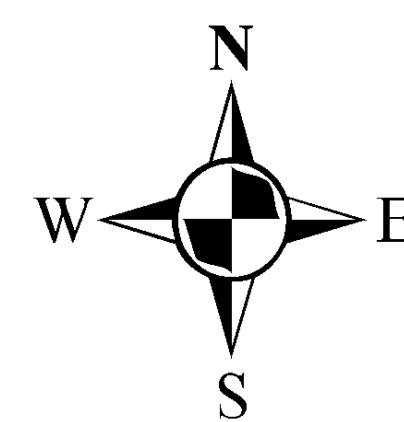
### **RECORDS**

---



Dŵr Cymru  
Welsh Water

prifathrodd ym 2014



LEGEND (Representative of most common features)

- Waste network:
- |  |                         |  |                                                         |
|--|-------------------------|--|---------------------------------------------------------|
|  | Foul chamber            |  | Outfall                                                 |
|  | Surface water chamber   |  | Lamp hole                                               |
|  | Combined chamber        |  | Storm overflow                                          |
|  | Combined sewer overflow |  | Rising main                                             |
|  | Special purpose chamber |  | Gravity sewer                                           |
|  | Treatment works         |  | Private sewer                                           |
|  | Pumping station         |  | Private sewer subject to Sect. 104 adaptation agreement |
- NB: Sewer symbol colour indicates the type.
- |        |                                                  |  |                        |
|--------|--------------------------------------------------|--|------------------------|
| RED    | Combined                                         |  | Private Sewer Transfer |
| GREEN  | Surface water                                    |  | Lateral Drain          |
| BROWN  | Foul                                             |  | Inspection Chamber     |
| Purple | Former S24 sewers (for indicative purposes only) |  |                        |

Notes:

1. The information contained in this document is for informational purposes only and does not constitute a contract. The information is provided as a guide only and is not intended to be used as a basis for any legal action. The information is provided as a guide only and is not intended to be used as a basis for any legal action.

EXACT LOCATIONS OF ALL APPARATUS TO BE DETERMINED ON SITE.

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j - eod Eŵ  
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mab ied aow  
mab ied aow

PPOTQIPRONSS  
NMICRM  
a q  
COMSLQMT



## **APPENDIX H**

# **GREENFIELD RUNOFF CALCULATIONS**

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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                    |                                                                                     |                       |   |      |       |           |        |       |       |           |     |               |          |            |      |            |      |         |      |         |      |           |      |            |       |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|-------------------------------------------------------------------------------------|-----------------------|---|------|-------|-----------|--------|-------|-------|-----------|-----|---------------|----------|------------|------|------------|------|---------|------|---------|------|-----------|------|------------|-------|
| RSK LDE Ltd                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                    | Page 1                                                                              |                       |   |      |       |           |        |       |       |           |     |               |          |            |      |            |      |         |      |         |      |           |      |            |       |
| 18 Frogmore Road<br>Hemel Hempstead<br>Herts, HP3 9RT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                    |  |                       |   |      |       |           |        |       |       |           |     |               |          |            |      |            |      |         |      |         |      |           |      |            |       |
| Date 02/11/2017 09:48<br>File                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Designed By RBrenton<br>Checked By |                                                                                     |                       |   |      |       |           |        |       |       |           |     |               |          |            |      |            |      |         |      |         |      |           |      |            |       |
| Elstree Computing Ltd                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Source Control W.12.5              |                                                                                     |                       |   |      |       |           |        |       |       |           |     |               |          |            |      |            |      |         |      |         |      |           |      |            |       |
| <p align="center"><u>ICP SUDS Mean Annual Flood</u></p> <p align="center">Input</p> <table> <tr> <td>Return Period (years)</td> <td>1</td> <td>Soil</td> <td>0.300</td> </tr> <tr> <td>Area (ha)</td> <td>21.750</td> <td>Urban</td> <td>0.000</td> </tr> <tr> <td>SAAR (mm)</td> <td>900</td> <td>Region Number</td> <td>Region 9</td> </tr> </table> <p align="center"><b>Results      l/s</b></p> <table> <tr> <td>QBAR Rural</td> <td>53.2</td> </tr> <tr> <td>QBAR Urban</td> <td>53.2</td> </tr> <tr> <td>Q1 year</td> <td>46.8</td> </tr> <tr> <td>Q1 year</td> <td>46.8</td> </tr> <tr> <td>Q30 years</td> <td>93.8</td> </tr> <tr> <td>Q100 years</td> <td>115.9</td> </tr> </table> |                                    |                                                                                     | Return Period (years) | 1 | Soil | 0.300 | Area (ha) | 21.750 | Urban | 0.000 | SAAR (mm) | 900 | Region Number | Region 9 | QBAR Rural | 53.2 | QBAR Urban | 53.2 | Q1 year | 46.8 | Q1 year | 46.8 | Q30 years | 93.8 | Q100 years | 115.9 |
| Return Period (years)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1                                  | Soil                                                                                | 0.300                 |   |      |       |           |        |       |       |           |     |               |          |            |      |            |      |         |      |         |      |           |      |            |       |
| Area (ha)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 21.750                             | Urban                                                                               | 0.000                 |   |      |       |           |        |       |       |           |     |               |          |            |      |            |      |         |      |         |      |           |      |            |       |
| SAAR (mm)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 900                                | Region Number                                                                       | Region 9              |   |      |       |           |        |       |       |           |     |               |          |            |      |            |      |         |      |         |      |           |      |            |       |
| QBAR Rural                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 53.2                               |                                                                                     |                       |   |      |       |           |        |       |       |           |     |               |          |            |      |            |      |         |      |         |      |           |      |            |       |
| QBAR Urban                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 53.2                               |                                                                                     |                       |   |      |       |           |        |       |       |           |     |               |          |            |      |            |      |         |      |         |      |           |      |            |       |
| Q1 year                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 46.8                               |                                                                                     |                       |   |      |       |           |        |       |       |           |     |               |          |            |      |            |      |         |      |         |      |           |      |            |       |
| Q1 year                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 46.8                               |                                                                                     |                       |   |      |       |           |        |       |       |           |     |               |          |            |      |            |      |         |      |         |      |           |      |            |       |
| Q30 years                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 93.8                               |                                                                                     |                       |   |      |       |           |        |       |       |           |     |               |          |            |      |            |      |         |      |         |      |           |      |            |       |
| Q100 years                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 115.9                              |                                                                                     |                       |   |      |       |           |        |       |       |           |     |               |          |            |      |            |      |         |      |         |      |           |      |            |       |
| ©1982-2010 Micro Drainage Ltd                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                    |                                                                                     |                       |   |      |       |           |        |       |       |           |     |               |          |            |      |            |      |         |      |         |      |           |      |            |       |



# APPENDIX I

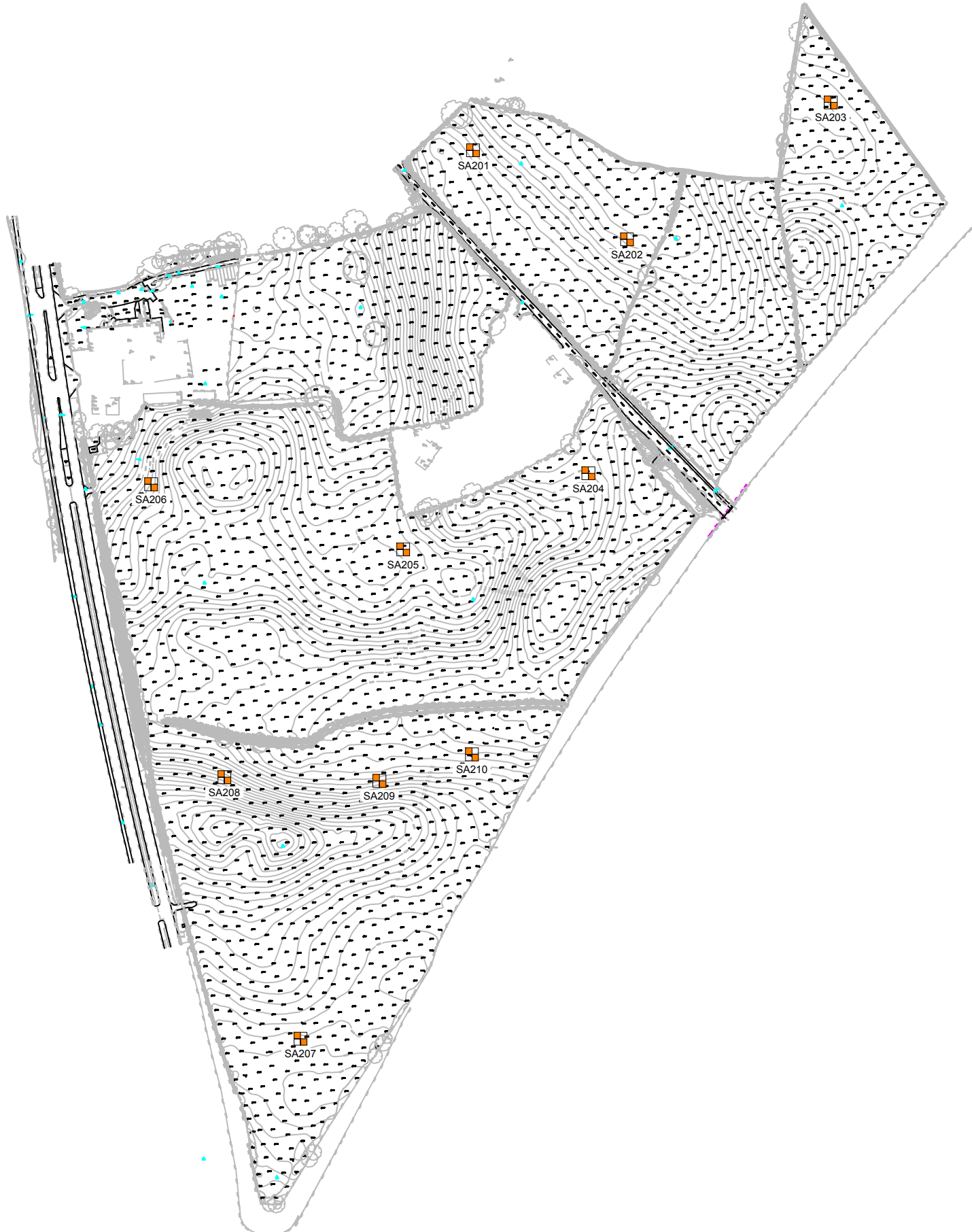
## INFILTRATION TESTING

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## TRIAL HOLE LOCATIONS

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Location Symbols

 Approximate Soakaway Test Location

|        |          |            |       |       |         |
|--------|----------|------------|-------|-------|---------|
| Notes: |          |            |       |       |         |
| P1     | -        | 04.11.2019 | DRAFT | CB    | NS      |
| Phase  | Revision | Date       | Issue | Drawn | Checked |

|            |                                |
|------------|--------------------------------|
| Client:    | Russell Homes                  |
| Job Title: | Stansty Chain Road,<br>Wrexham |

|                |                        |        |            |
|----------------|------------------------|--------|------------|
| Job No:        | 11-130                 | Date:  | 04.11.2019 |
| Drawing No:    | 005                    | Scale: | NTS @ A3   |
| Drawing Title: | Soakaway Location Plan |        |            |



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## TRIAL HOLE LOGS

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e3p

## Trial Pit Log

TrialPit No  
SA201  
Sheet 1 of 1

Project Name: Stansty Chain Road

Project No.  
11130Co-ords: 332435.54 - 352183.61  
Level: 87.06Date  
15/10/2019

Location: Wrexham

Dimensions  
(m):

2.00

Scale  
1:24

Client: Russell Homes

Depth  
2.00

0.30

Logged  
M. Whittaker

| Water<br>Strike | Samples & In Situ Testing |      |         | Depth<br>(m) | Level<br>(m) | Legend | Stratum Description                                                                                                 |   |
|-----------------|---------------------------|------|---------|--------------|--------------|--------|---------------------------------------------------------------------------------------------------------------------|---|
|                 | Depth                     | Type | Results |              |              |        |                                                                                                                     |   |
|                 |                           |      |         | 0.30         | 86.76        |        | Dark brown clayey fine to medium SAND (TOPSOIL) with rootlets.                                                      |   |
|                 |                           |      |         |              |              |        | Firm brown slightly silty gravelly CLAY. Gravel is fine to coarse angular to sub-rounded of mudstone and sandstone. | 1 |
|                 |                           |      |         | 1.80         | 85.26        |        | Brown GRAVEL. Gravel is fine to coarse sub angular to sub rounded of mudstone and sandstone.                        |   |
|                 |                           |      |         | 2.00         | 85.06        |        | End of Pit at 2.00m                                                                                                 | 2 |
|                 |                           |      |         |              |              |        |                                                                                                                     | 3 |
|                 |                           |      |         |              |              |        |                                                                                                                     | 4 |
|                 |                           |      |         |              |              |        |                                                                                                                     | 5 |

Remarks: Complete

Stability: Stable



|                                  |                                 |                                                |                        |
|----------------------------------|---------------------------------|------------------------------------------------|------------------------|
| Project Name: Stansty Chain Road | Project No. 11130               | Co-ords: 332538.64 - 352110.36<br>Level: 88.74 | Date<br>15/10/2019     |
| Location: Wrexham                | Dimensions (m):<br>2.00<br>0.30 |                                                | Scale<br>1:30          |
| Client: Russell Homes            | Depth<br>2.00                   |                                                | Logged<br>M. Whittaker |

| Water Strike | Samples & In Situ Testing |      |         | Depth (m) | Level (m) | Legend                                                                            | Stratum Description                                                                                                                                                          |   |
|--------------|---------------------------|------|---------|-----------|-----------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
|              | Depth                     | Type | Results |           |           |                                                                                   |                                                                                                                                                                              |   |
|              |                           |      |         | 0.35      | 88.39     |  | Dark brown clayey fine to medium SAND (TOPSOIL) with rootlets.                                                                                                               |   |
|              |                           |      |         |           |           |  | Firm brown slightly silty gravelly CLAY with lenses of brown clayey gravelly fine to coarse sand. Gravel is fine to coarse angular to sub angular of mudstone and sandstone. | 1 |
|              |                           |      |         | 2.00      | 86.74     |                                                                                   | End of Pit at 2.00m                                                                                                                                                          | 2 |
|              |                           |      |         |           |           |                                                                                   |                                                                                                                                                                              | 3 |
|              |                           |      |         |           |           |                                                                                   |                                                                                                                                                                              | 4 |

## Trial Pit Photographs



Soakaway 202

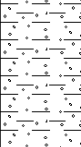
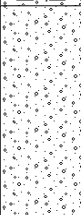


Soakaway 202 Spoil

Remarks: Complete

Stability: Stable

|                                  |                                                                                                               |                                                |                        |
|----------------------------------|---------------------------------------------------------------------------------------------------------------|------------------------------------------------|------------------------|
| Project Name: Stansty Chain Road | Project No. 11130                                                                                             | Co-ords: 332684.33 - 352209.01<br>Level: 86.93 | Date<br>15/10/2019     |
| Location: Wrexham                | Dimensions (m): <span style="float: right;">2.00</span><br>Depth 1.80 <span style="float: right;">0.30</span> |                                                | Scale<br>1:30          |
| Client: Russell Homes            |                                                                                                               |                                                | Logged<br>M. Whittaker |

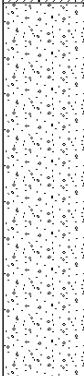
| Water Strike | Samples & In Situ Testing |      |         | Depth (m) | Level (m) | Legend                                                                            | Stratum Description                                                                                                          |   |
|--------------|---------------------------|------|---------|-----------|-----------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|---|
|              | Depth                     | Type | Results |           |           |                                                                                   |                                                                                                                              |   |
|              |                           |      |         | 0.30      | 86.63     |  | Dark brown clayey fine to medium SAND (TOPSOIL) with rootlets.                                                               |   |
|              |                           |      |         | 0.95      | 85.98     |  | Firm brown slightly silty gravelly CLAY. Gravel is fine to coarse angular to sub rounded of mudstone and sandstone.          |   |
|              |                           |      |         | 1.80      | 85.13     |  | Brown slightly sandy GRAVEL. Gravel is fine to coarse angular to sub rounded of mudstone, sandstone and rare coal fragments. | 1 |
|              |                           |      |         |           |           |                                                                                   | End of Pit at 1.80m                                                                                                          | 2 |
|              |                           |      |         |           |           |                                                                                   |                                                                                                                              | 3 |
|              |                           |      |         |           |           |                                                                                   |                                                                                                                              | 4 |

## Trial Pit Photographs



|                                     |                                                                                       |
|-------------------------------------|---------------------------------------------------------------------------------------|
| Remarks: Complete                   |                                                                                       |
| Stability: Unstable from 0.85m bgl. |  |

|                                  |                                 |                                                |                        |
|----------------------------------|---------------------------------|------------------------------------------------|------------------------|
| Project Name: Stansty Chain Road | Project No. 11130               | Co-ords: 332511.49 - 351942.93<br>Level: 86.04 | Date<br>15/10/2019     |
| Location: Wrexham                | Dimensions (m):<br>2.00<br>0.30 |                                                | Scale<br>1:30          |
| Client: Russell Homes            | Depth<br>1.80                   |                                                | Logged<br>M. Whittaker |

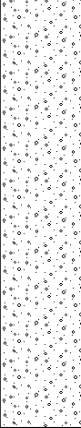
| Water Strike                                                                              | Samples & In Situ Testing |      |         | Depth (m) | Level (m) | Legend                                                                            | Stratum Description                                                                                                                                         |   |
|-------------------------------------------------------------------------------------------|---------------------------|------|---------|-----------|-----------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
|                                                                                           | Depth                     | Type | Results |           |           |                                                                                   |                                                                                                                                                             |   |
|                                                                                           |                           |      |         | 0.30      | 85.74     |  | Dark brown clayey fine to medium SAND (TOPSOIL) with rootlets.                                                                                              |   |
|                                                                                           |                           |      |         |           |           |  | Brown slightly clayey gravelly fine to medium SAND. Gravel is fine to coarse angular to sub rounded of mudstone and sandstone. (Becoming saturated at base) | 1 |
| <br>1.80 |                           |      |         | 1.80      | 84.24     |                                                                                   | End of Pit at 1.80m                                                                                                                                         | 2 |
|                                                                                           |                           |      |         |           |           |                                                                                   |                                                                                                                                                             | 3 |
|                                                                                           |                           |      |         |           |           |                                                                                   |                                                                                                                                                             | 4 |

## Trial Pit Photographs



|                                                                                                  |                                                                                       |
|--------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Remarks: Complete                                                                                |                                                                                       |
| Stability: 1. Unstable from 0.70m bgl. 2. Water strike at 1.80m bgl, becoming saturated at base. |  |

|                                  |                   |                                                |                        |
|----------------------------------|-------------------|------------------------------------------------|------------------------|
| Project Name: Stansty Chain Road | Project No. 11130 | Co-ords: 332379.10 - 351890.30<br>Level: 90.03 | Date<br>15/10/2019     |
| Location: Wrexham                |                   | Dimensions (m): 2.00<br>Depth 2.00             | Scale<br>1:30          |
| Client: Russell Homes            |                   |                                                | Logged<br>M. Whittaker |

| Water Strike | Samples & In Situ Testing |      |         | Depth (m) | Level (m) | Legend                                                                            | Stratum Description                                                                                                                                                                                           |   |
|--------------|---------------------------|------|---------|-----------|-----------|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
|              | Depth                     | Type | Results |           |           |                                                                                   |                                                                                                                                                                                                               |   |
|              |                           |      |         | 0.30      | 89.73     |  | Dark brown clayey fine to medium SAND (TOPSOIL) with rootlets.                                                                                                                                                |   |
|              |                           |      |         | 2.00      | 88.03     |  | Brown slightly silty sandy GRAVEL with cobbles. Gravel is fine to coarse angular to sub angular of mudstone sandstone mixed lithology and coal. Cobbles are angular to sub angular of mudstone and sandstone. | 1 |
|              |                           |      |         |           |           |                                                                                   | End of Pit at 2.00m                                                                                                                                                                                           | 2 |
|              |                           |      |         |           |           |                                                                                   |                                                                                                                                                                                                               | 3 |
|              |                           |      |         |           |           |                                                                                   |                                                                                                                                                                                                               | 4 |

## Trial Pit Photographs



Soakaway 205

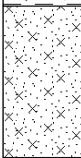


Soakaway 205 Spoil

Remarks: Complete

Stability: Unstable

|                                  |                                                                                          |                                                |                        |
|----------------------------------|------------------------------------------------------------------------------------------|------------------------------------------------|------------------------|
| Project Name: Stansty Chain Road | Project No. 11130                                                                        | Co-ords: 332197.46 - 351934.46<br>Level: 91.27 | Date<br>15/10/2019     |
| Location: Wrexham                | Dimensions (m):<br>Depth 2.00                                                            |                                                | Scale<br>1:30          |
| Client: Russell Homes            | 0.30  |                                                | Logged<br>M. Whittaker |

| Water Strike | Samples & In Situ Testing |      |         | Depth (m) | Level (m) | Legend                                                                            | Stratum Description                                                                                                            |   |
|--------------|---------------------------|------|---------|-----------|-----------|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|---|
|              | Depth                     | Type | Results |           |           |                                                                                   |                                                                                                                                |   |
|              |                           |      |         | 0.25      | 91.02     |  | Dark brown clayey fine to medium SAND (TOPSOIL) with rootlets.                                                                 |   |
|              |                           |      |         | 1.40      | 89.87     |  | Firm brown slightly silty sandy gravelly CLAY. Gravel is fine to coarse angular to sub rounded of mudstone sandstone and coal. | 1 |
|              |                           |      |         | 2.00      | 89.27     |  | Red/Brown slightly silty fine to medium SAND.                                                                                  | 2 |
|              |                           |      |         |           |           |                                                                                   | End of Pit at 2.00m                                                                                                            | 3 |
|              |                           |      |         |           |           |                                                                                   |                                                                                                                                | 4 |

## Trial Pit Photographs



Soakaway 206



Soakaway 206 Spoil

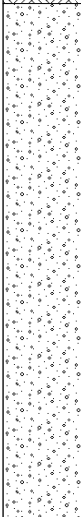
Remarks: Complete

Stability:

# Trial Pit Log

Trial Pit No  
SA207  
Sheet 1 of 1

|                                  |                   |                                                   |                        |
|----------------------------------|-------------------|---------------------------------------------------|------------------------|
| Project Name: Stansty Chain Road | Project No. 11130 | Co-ords: 332308.75 - 351536.52<br>Level: 87.73    | Date<br>15/10/2019     |
| Location: Wrexham                |                   | Dimensions (m):<br>0.30 <input type="text"/> 2.00 | Scale<br>1:24          |
| Client: Russell Homes            |                   | Depth<br>1.80                                     | Logged<br>M. Whittaker |

| Water Strike | Samples & In Situ Testing |      |         | Depth (m) | Level (m) | Legend                                                                             | Stratum Description                                                                                                                      |   |
|--------------|---------------------------|------|---------|-----------|-----------|------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|---|
|              | Depth                     | Type | Results |           |           |                                                                                    |                                                                                                                                          |   |
|              |                           |      |         | 0.15      | 87.58     |   | Dark brown clayey fine to medium SAND (TOPSOIL) with rootlets.                                                                           |   |
|              |                           |      |         |           |           |  | Brown slightly silty clayey sandy GRAVEL. Gravel is fine to coarse angular to sub angular to sub rounded of mudstone sandstone and coal. | 1 |
|              |                           |      |         | 1.80      | 85.93     |                                                                                    | End of Pit at 1.80m                                                                                                                      | 2 |
|              |                           |      |         |           |           |                                                                                    |                                                                                                                                          | 3 |
|              |                           |      |         |           |           |                                                                                    |                                                                                                                                          | 4 |
|              |                           |      |         |           |           |                                                                                    |                                                                                                                                          | 5 |

|                   |                                                                                       |
|-------------------|---------------------------------------------------------------------------------------|
| Remarks: Complete |  |
| Stability: Stable |                                                                                       |

Project Name: Stansty Chain Road

Project No.  
11130

Co-ords: 332249.70 - 351724.86  
Level: 89.01

Date  
15/10/2019

Location: Wrexham

Dimensions (m): 2.00

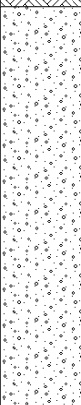
Scale  
1:30

Client: Russell Homes

Depth  
2.00

0.30

Logged  
M. Whittaker

| Water Strike | Samples & In Situ Testing |      |         | Depth (m) | Level (m) | Legend                                                                            | Stratum Description                                                                                                                                          |   |
|--------------|---------------------------|------|---------|-----------|-----------|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
|              | Depth                     | Type | Results |           |           |                                                                                   |                                                                                                                                                              |   |
|              |                           |      |         | 0.20      | 88.81     |  | Dark brown clayey fine to medium SAND (TOPSOIL) with rootlets.                                                                                               |   |
|              |                           |      |         |           |           |  | Brown slightly clayey silty gravelly fine to medium SAND. Gravel is fine to coarse angular to sub rounded of mudstone, sandstone and rare coal fragments.    | 1 |
|              |                           |      |         | 1.80      | 87.21     |                                                                                   |                                                                                                                                                              |   |
|              |                           |      |         | 2.00      | 87.01     |                                                                                   | Brown silty slightly clayey gravelly fine to medium SAND. Gravel is fine to coarse sub angular to sub rounded of Mudstone sandstone and rare coal fragments. | 2 |
|              |                           |      |         |           |           |                                                                                   | End of Pit at 2.00m                                                                                                                                          |   |
|              |                           |      |         |           |           |                                                                                   |                                                                                                                                                              | 3 |
|              |                           |      |         |           |           |                                                                                   |                                                                                                                                                              | 4 |

## Trial Pit Photographs



Soakaway 208

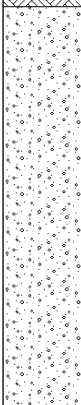


Soakaway 208 Spoil

Remarks: Complete

Stability: Stable

|                                  |                   |                                                   |                        |
|----------------------------------|-------------------|---------------------------------------------------|------------------------|
| Project Name: Stansty Chain Road | Project No. 11130 | Co-ords: 332360.73 - 351722.40<br>Level: 87.30    | Date<br>15/10/2019     |
| Location: Wrexham                |                   | Dimensions (m):<br>0.30 <input type="text"/> 2.00 | Scale<br>1:30          |
| Client: Russell Homes            |                   | Depth<br>1.80                                     | Logged<br>M. Whittaker |

| Water Strike | Samples & In Situ Testing |      |         | Depth (m) | Level (m) | Legend                                                                            | Stratum Description                                                                                                                                                                                                  |   |
|--------------|---------------------------|------|---------|-----------|-----------|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
|              | Depth                     | Type | Results |           |           |                                                                                   |                                                                                                                                                                                                                      |   |
|              |                           |      |         | 0.20      | 87.10     |  | Dark brown clayey fine to medium SAND (TOPSOIL) with rootlets.                                                                                                                                                       |   |
|              |                           |      |         | 1.80      | 85.50     |  | Brown slightly clayey gravelly fine to medium SAND with cobbles. Gravel is fine to coarse angular to sub rounded of mudstone sandstone and rare coal fragments. Cobbles are sub-angular to sub-rounded of sandstone. | 1 |
|              |                           |      |         |           |           |                                                                                   | End of Pit at 1.80m                                                                                                                                                                                                  | 2 |
|              |                           |      |         |           |           |                                                                                   |                                                                                                                                                                                                                      | 3 |
|              |                           |      |         |           |           |                                                                                   |                                                                                                                                                                                                                      | 4 |

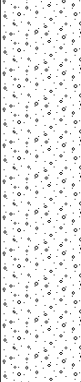
## Trial Pit Photographs



Remarks: Complete

Stability: Stable

|                                  |                                                                                          |                                                |                        |
|----------------------------------|------------------------------------------------------------------------------------------|------------------------------------------------|------------------------|
| Project Name: Stansty Chain Road | Project No. 11130                                                                        | Co-ords: 332427.45 - 351740.82<br>Level: 86.82 | Date<br>15/10/2019     |
| Location: Wrexham                | Dimensions (m):<br>Depth 1.70                                                            |                                                | Scale<br>1:30          |
| Client: Russell Homes            | 0.30  |                                                | Logged<br>M. Whittaker |

| Water Strike | Samples & In Situ Testing |      |         | Depth (m) | Level (m) | Legend                                                                            | Stratum Description                                                                                                                                                                                             |   |
|--------------|---------------------------|------|---------|-----------|-----------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
|              | Depth                     | Type | Results |           |           |                                                                                   |                                                                                                                                                                                                                 |   |
|              |                           |      |         | 0.15      | 86.67     |  | Dark brown clayey fine to medium SAND (TOPSOIL) with rootlets.                                                                                                                                                  |   |
|              |                           |      |         | 1.70      | 85.12     |  | Brown slightly clayey gravelly fine to medium SAND with cobbles. Gravel is fine to coarse angular to sub angular to sub rounded of mudstone and sandstone. Cobbles are sub-angular to sub-rounded of sandstone. | 1 |
|              |                           |      |         |           |           |                                                                                   | End of Pit at 1.70m                                                                                                                                                                                             | 2 |
|              |                           |      |         |           |           |                                                                                   |                                                                                                                                                                                                                 | 3 |
|              |                           |      |         |           |           |                                                                                   |                                                                                                                                                                                                                 | 4 |

## Trial Pit Photographs



Soakaway 210

Remarks: Complete

Stability: Unstable from 1.00m bgl.



## **INFILTRATION TESTING – 15.10.2019**

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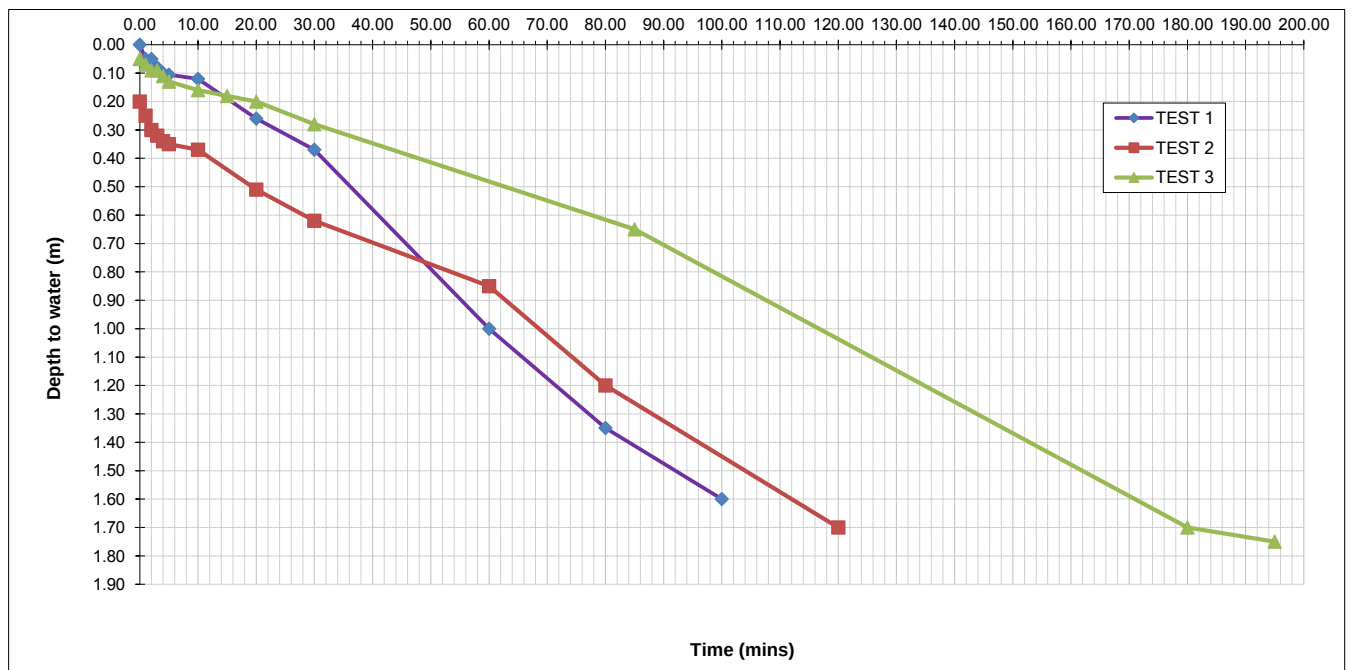


**Site:** Stansty Chain Road, Wrexham  
**Job Number:** 11-130  
**Date of Test:** 15/10/2019

**Trial Pit Number:** SA201  
**Length:** 2.00 m  
**Width:** 0.30 m  
**Depth:** 2.00 m  
**Groundwater Level:** N/A m

|                                     |      | TEST 1    |                    | TEST 2    |                    | TEST 3    |                    |
|-------------------------------------|------|-----------|--------------------|-----------|--------------------|-----------|--------------------|
|                                     |      | Time(min) | Depth to Water (m) | Time(min) | Depth to Water (m) | Time(min) | Depth to Water (m) |
|                                     |      | 0.00      | 0.00               | 0.00      | 0.20               | 0.00      | 0.05               |
|                                     |      | 1.00      | 0.05               | 1.00      | 0.25               | 1.00      | 0.07               |
|                                     |      | 2.00      | 0.05               | 2.00      | 0.30               | 2.00      | 0.09               |
|                                     |      | 3.00      | 0.08               | 3.00      | 0.32               | 3.00      | 0.09               |
|                                     |      | 4.00      | 0.1                | 4.00      | 0.34               | 4.00      | 0.11               |
|                                     |      | 5.00      | 0.105              | 5.00      | 0.35               | 5.00      | 0.13               |
|                                     |      | 10.00     | 0.12               | 10.00     | 0.37               | 10.00     | 0.16               |
|                                     |      | 20.00     | 0.26               | 20.00     | 0.51               | 15.00     | 0.18               |
|                                     |      | 30.00     | 0.37               | 30.00     | 0.62               | 20.00     | 0.2                |
|                                     |      | 60.00     | 1                  | 60.00     | 0.85               | 30.00     | 0.28               |
|                                     |      | 80.00     | 1.35               | 80.00     | 1.2                | 85.00     | 0.65               |
|                                     |      | 100.00    | 1.60               | 120.00    | 1.7                | 180.00    | 1.7                |
|                                     |      |           |                    |           |                    | 195.00    | 1.75               |
|                                     |      |           |                    |           |                    |           |                    |
| Effective Storage Depth             | m    | 2.00      |                    | 1.80      |                    | 1.95      |                    |
| 75% Effective Storage Depth         | m    | 1.50      |                    | 1.35      |                    | 1.46      |                    |
| (i.e. depth below GL)               | m    | 0.50      |                    | 0.65      |                    | 0.54      |                    |
| 25% Effective Storage Depth         | m    | 0.50      |                    | 0.45      |                    | 0.49      |                    |
| (i.e. depth below GL)               | m    | 1.50      |                    | 1.55      |                    | 1.51      |                    |
| Effective Storage Depth 75%-25%     | m    | 1.00      |                    | 0.90      |                    | 0.98      |                    |
|                                     |      |           |                    |           |                    |           |                    |
| Time to fall to 75% effective depth | mins | 36.00     |                    | 45.00     |                    | 60.00     |                    |
| Time to fall to 25% effective depth | mins | 92.00     |                    | 108.00    |                    | 163.00    |                    |
|                                     |      |           |                    |           |                    |           |                    |
| V (75%-25%)                         | m3   | 0.60      |                    | 0.54      |                    | 0.59      |                    |
| a (50%)                             | m2   | 5.20      |                    | 4.74      |                    | 5.09      |                    |
| t (75%-25%)                         | mins | 56.00     |                    | 63.00     |                    | 103.00    |                    |
|                                     |      |           |                    |           |                    |           |                    |
| SOIL INFILTRATION RATE              | m/s  | 3.43E-05  |                    | 3.01E-05  |                    | 1.86E-05  |                    |

**DESIGN SOIL INFILTRATION RATE, f**
3.43E-05





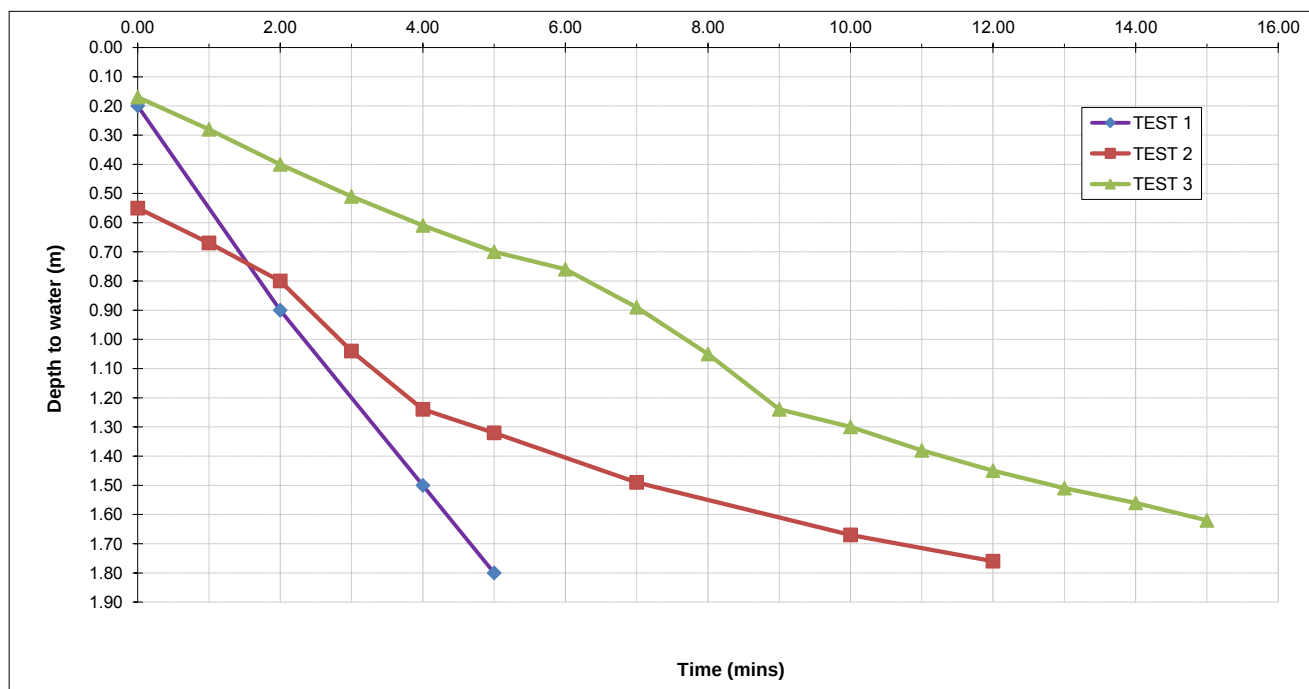
**Site:** Stansty Chain Road, Wrexham  
**Job Number:** 11-130  
**Date of Test:** 15/10/2019

**Trial Pit Number:** SA202  
**Length:** 2.00 m  
**Width:** 0.30 m  
**Depth:** 2.00 m  
**Groundwater Level:** m

|                                     |      | TEST 1    |                    | TEST 2    |                    | TEST 3    |                    |
|-------------------------------------|------|-----------|--------------------|-----------|--------------------|-----------|--------------------|
|                                     |      | Time(min) | Depth to Water (m) | Time(min) | Depth to Water (m) | Time(min) | Depth to Water (m) |
|                                     |      | 0.00      | 0.20               | 0.00      | 0.55               | 0.00      | 0.17               |
|                                     |      | 2.00      | 0.90               | 1.00      | 0.67               | 1.00      | 0.28               |
|                                     |      | 4.00      | 1.5                | 2.00      | 0.8                | 2.00      | 0.4                |
|                                     |      | 5.00      | 1.8                | 3.00      | 1.04               | 3.00      | 0.51               |
|                                     |      |           |                    | 4.00      | 1.24               | 4.00      | 0.61               |
|                                     |      |           |                    | 5.00      | 1.32               | 5.00      | 0.7                |
|                                     |      |           |                    | 7.00      | 1.49               | 6.00      | 0.76               |
|                                     |      |           |                    | 10.00     | 1.67               | 7.00      | 0.89               |
|                                     |      |           |                    | 12.00     | 1.76               | 8.00      | 1.05               |
|                                     |      |           |                    |           |                    | 9.00      | 1.24               |
|                                     |      |           |                    |           |                    | 10.00     | 1.3                |
|                                     |      |           |                    |           |                    | 11.00     | 1.38               |
|                                     |      |           |                    |           |                    | 12.00     | 1.45               |
|                                     |      |           |                    |           |                    | 13.00     | 1.51               |
|                                     |      |           |                    |           |                    | 14.00     | 1.56               |
|                                     |      |           |                    |           |                    | 15.00     | 1.62               |
| Effective Storage Depth             | m    |           | 1.80               |           | 1.45               |           | 1.83               |
| 75% Effective Storage Depth         | m    |           | 1.35               |           | 1.09               |           | 1.37               |
| (i.e. depth below GL)               | m    |           | 0.65               |           | 0.91               |           | 0.63               |
| 25% Effective Storage Depth         | m    |           | 0.45               |           | 0.36               |           | 0.46               |
| (i.e. depth below GL)               | m    |           | 1.55               |           | 1.64               |           | 1.54               |
| Effective Storage Depth 75%-25%     | m    |           | 0.90               |           | 0.73               |           | 0.92               |
| Time to fall to 75% effective depth | mins |           | 1.20               |           | 2.20               |           | 4.50               |
| Time to fall to 25% effective depth | mins |           | 4.20               |           | 9.50               |           | 13.50              |
| V (75%-25%)                         | m3   |           | 0.54               |           | 0.44               |           | 0.55               |
| a (50%)                             | m2   |           | 4.74               |           | 3.94               |           | 4.81               |
| t (75%-25%)                         | mins |           | 3.00               |           | 7.30               |           | 9.00               |
| SOIL INFILTRATION RATE              | m/s  |           | 6.33E-04           |           | 2.52E-04           |           | 2.11E-04           |

DESIGN SOIL INFILTRATION RATE, f

2.11E-04





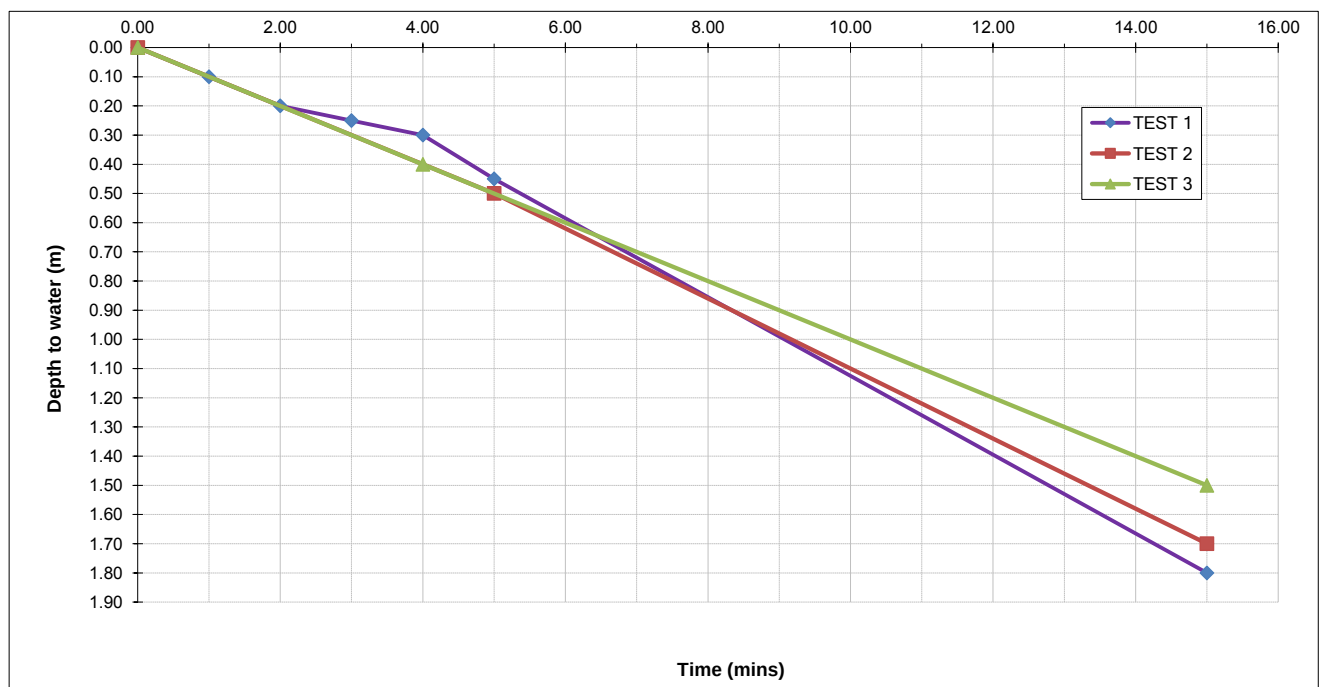
**Site:** Stansty Chain Road, Wrexham  
**Job Number:** 11-130  
**Date of Test:** 15/10/2019

**Trial Pit Number:** SA203  
**Length:** 2.00 m  
**Width:** 0.30 m  
**Depth:** 2.00 m  
**Groundwater Level:** m

|                                     |      | TEST 1    |                    | TEST 2    |                    | TEST 3    |                    |
|-------------------------------------|------|-----------|--------------------|-----------|--------------------|-----------|--------------------|
|                                     |      | Time(min) | Depth to Water (m) | Time(min) | Depth to Water (m) | Time(min) | Depth to Water (m) |
|                                     |      | 0.00      | 0.00               | 0.00      | 0.00               | 0.00      | 0.00               |
|                                     |      | 1.00      | 0.10               | 5.00      | 0.5                | 4.00      | 0.40               |
|                                     |      | 2.00      | 0.2                | 15.00     | 1.7                | 15.00     | 1.50               |
|                                     |      | 3.00      | 0.25               |           |                    |           |                    |
|                                     |      | 4.00      | 0.3                |           |                    |           |                    |
|                                     |      | 5.00      | 0.45               |           |                    |           |                    |
|                                     |      | 15.00     | 1.8                |           |                    |           |                    |
| Effective Storage Depth             | m    |           | 2.00               |           | 2.00               |           | 2.00               |
| 75% Effective Storage Depth         | m    |           | 1.50               |           | 1.50               |           | 1.50               |
| (i.e. depth below GL)               | m    |           | 0.50               |           | 0.50               |           | 0.50               |
| 25% Effective Storage Depth         | m    |           | 0.50               |           | 0.50               |           | 0.50               |
| (i.e. depth below GL)               | m    |           | 1.50               |           | 1.50               |           | 1.50               |
| Effective Storage Depth 75%-25%     | m    |           | 1.00               |           | 1.00               |           | 1.00               |
| Time to fall to 75% effective depth | mins |           | 5.60               |           | 5.00               |           | 5.00               |
| Time to fall to 25% effective depth | mins |           | 12.70              |           | 13.30              |           | 15.00              |
| V (75%-25%)                         | m3   |           | 0.60               |           | 0.60               |           | 0.60               |
| a (50%)                             | m2   |           | 5.20               |           | 5.20               |           | 5.20               |
| t (75%-25%)                         | mins |           | 7.10               |           | 8.30               |           | 10.00              |
| SOIL INFILTRATION RATE              | m/s  |           | 2.71E-04           |           | 2.32E-04           |           | 1.92E-04           |

**DESIGN SOIL INFILTRATION RATE, f**

**1.92E-04**





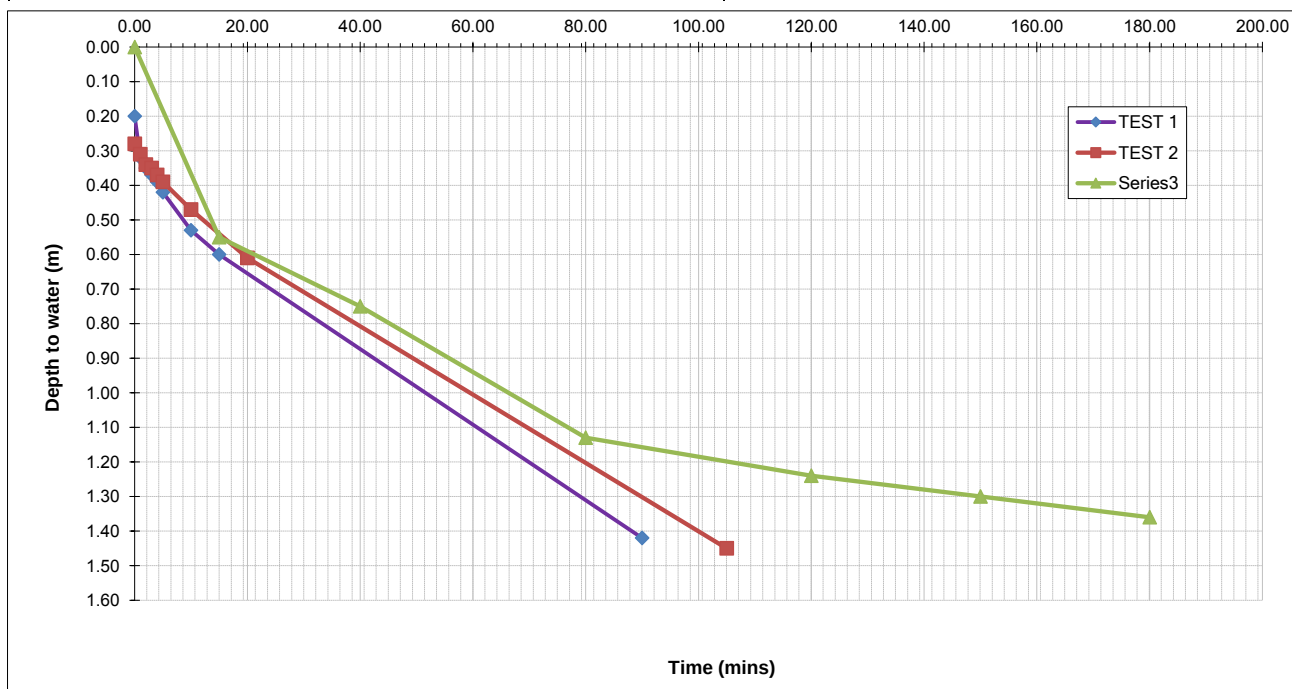
**Site:** Stansty Chain Road, Wrexham  
**Job Number:** 11-130  
**Date of Test:** 15/10/2019

**Trial Pit Number:** SA204  
**Length:** 2.00 m  
**Width:** 0.30 m  
**Depth:** 1.80 m  
**Groundwater Level:** m

|                                     |      | TEST 1    |                    | TEST 2    |                    | TEST 3    |                    |
|-------------------------------------|------|-----------|--------------------|-----------|--------------------|-----------|--------------------|
|                                     |      | Time(min) | Depth to Water (m) | Time(min) | Depth to Water (m) | Time(min) | Depth to Water (m) |
|                                     |      | 0.00      | 0.20               | 0.00      | 0.28               | 0.00      | 0.00               |
|                                     |      | 1.00      | 0.32               | 1.00      | 0.31               | 15.00     | 0.55               |
|                                     |      | 2.00      | 0.35               | 2.00      | 0.34               | 40.00     | 0.75               |
|                                     |      | 3.00      | 0.37               | 3.00      | 0.35               | 80.00     | 1.13               |
|                                     |      | 4.00      | 0.39               | 4.00      | 0.37               | 120.00    | 1.24               |
|                                     |      | 5.00      | 0.42               | 5.00      | 0.39               | 150.00    | 1.30               |
|                                     |      | 10.00     | 0.53               | 10.00     | 0.47               | 180.00    | 1.36               |
|                                     |      | 15.00     | 0.6                | 20.00     | 0.61               |           |                    |
|                                     |      | 90.00     | 1.42               | 105.00    | 1.45               |           |                    |
| Effective Storage Depth             | m    |           | 1.60               |           | 1.52               |           | 1.80               |
| 75% Effective Storage Depth         | m    |           | 1.20               |           | 1.14               |           | 1.35               |
| (i.e. depth below GL)               | m    |           | 0.60               |           | 0.66               |           | 0.45               |
| 25% Effective Storage Depth         | m    |           | 0.40               |           | 0.38               |           | 0.45               |
| (i.e. depth below GL)               | m    |           | 1.40               |           | 1.42               |           | 1.35               |
| Effective Storage Depth 75%-25%     | m    |           | 0.80               |           | 0.76               |           | 0.90               |
| Time to fall to 75% effective depth | mins |           | 15.00              |           | 26.00              |           | 12.00              |
| Time to fall to 25% effective depth | mins |           | 88.00              |           | 101.00             |           | 178.00             |
| V (75%-25%)                         | m3   |           | 0.48               |           | 0.46               |           | 0.54               |
| a (50%)                             | m2   |           | 4.28               |           | 4.10               |           | 4.74               |
| t (75%-25%)                         | mins |           | 73.00              |           | 75.00              |           | 166.00             |
| SOIL INFILTRATION RATE              | m/s  |           | 2.56E-05           |           | 2.47E-05           |           | 1.14E-05           |

DESIGN SOIL INFILTRATION RATE,  $f$

1.14E-05



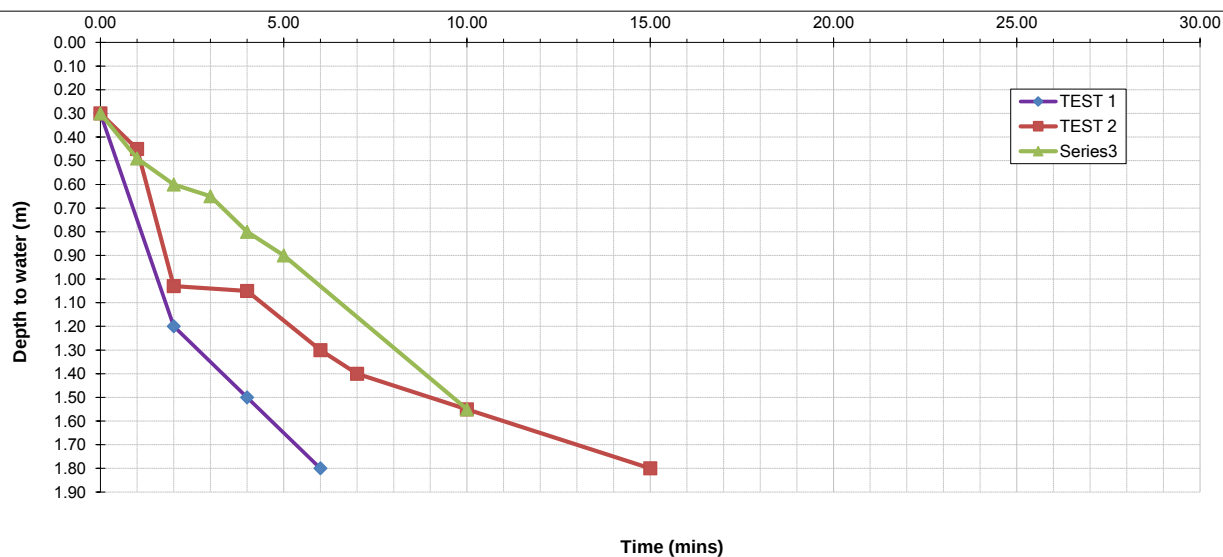


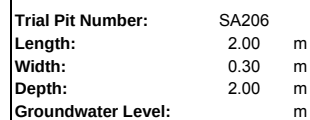
**Site:** Stansty Chain Road, Wrexham  
**Job Number:** 11-130  
**Date of Test:** 15/10/2019

**Trial Pit Number:** SA205  
**Length:** 2.00 m  
**Width:** 0.30 m  
**Depth:** 2.00 m  
**Groundwater Level:** m

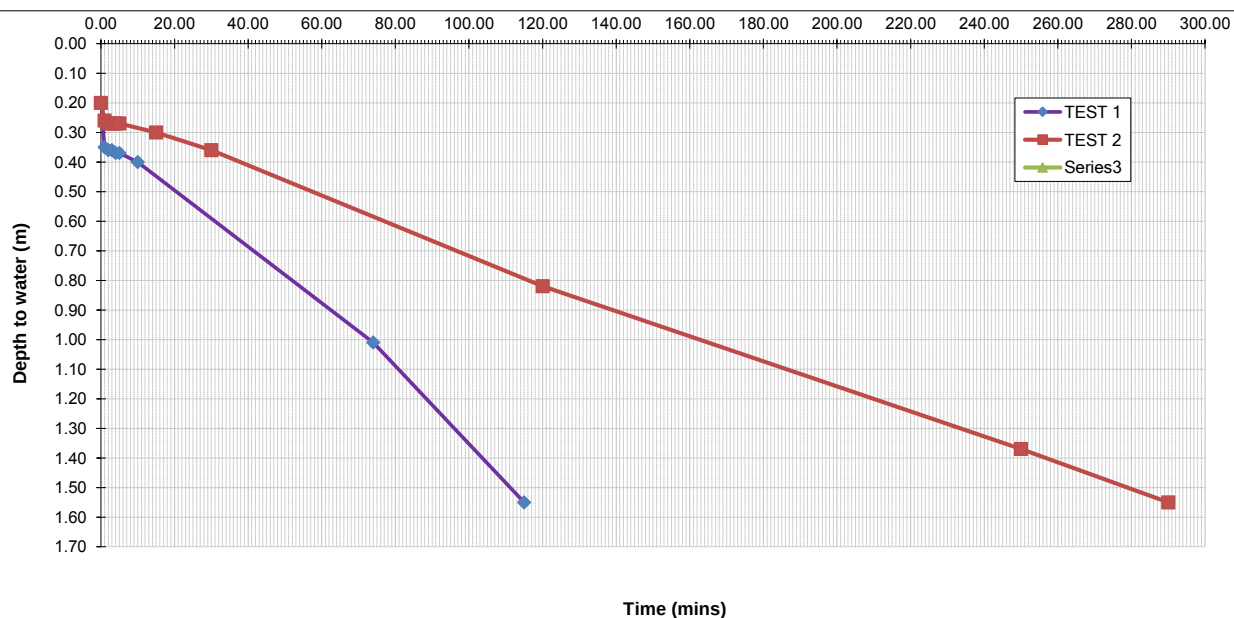
|                                     |      | TEST 1    |                    | TEST 2    |                    | TEST 3    |                    |
|-------------------------------------|------|-----------|--------------------|-----------|--------------------|-----------|--------------------|
|                                     |      | Time(min) | Depth to Water (m) | Time(min) | Depth to Water (m) | Time(min) | Depth to Water (m) |
|                                     |      | 0.00      | 0.30               | 0.00      | 0.30               | 0.00      | 0.30               |
|                                     |      | 2.00      | 1.20               | 1.00      | 0.45               | 1.00      | 0.49               |
|                                     |      | 4.00      | 1.5                | 2.00      | 1.03               | 2.00      | 0.6                |
|                                     |      | 6.00      | 1.8                | 4.00      | 1.05               | 3.00      | 0.65               |
|                                     |      |           |                    | 6.00      | 1.3                | 4.00      | 0.8                |
|                                     |      |           |                    | 7.00      | 1.4                | 5.00      | 0.9                |
|                                     |      |           |                    | 10.00     | 1.55               | 10.00     | 1.55               |
|                                     |      |           |                    | 15.00     | 1.8                | 15.00     | 1.7                |
|                                     |      |           |                    |           |                    | 20.00     | 1.8                |
| Effective Storage Depth             | m    |           | 1.70               |           | 1.70               |           | 1.70               |
| 75% Effective Storage Depth         | m    |           | 1.28               |           | 1.28               |           | 1.28               |
| (i.e. depth below GL)               | m    |           | 0.73               |           | 0.73               |           | 0.73               |
| 25% Effective Storage Depth         | m    |           | 0.43               |           | 0.43               |           | 0.43               |
| (i.e. depth below GL)               | m    |           | 1.58               |           | 1.58               |           | 1.58               |
| Effective Storage Depth 75%-25%     | m    |           | 0.85               |           | 0.85               |           | 0.85               |
| Time to fall to 75% effective depth | mins |           | 1.00               |           | 1.20               |           | 3.50               |
| Time to fall to 25% effective depth | mins |           | 4.60               |           | 11.00              |           | 12.00              |
| V (75%-25%)                         | m3   |           | 0.51               |           | 0.51               |           | 0.51               |
| a (50%)                             | m2   |           | 4.51               |           | 4.51               |           | 4.51               |
| t (75%-25%)                         | mins |           | 3.60               |           | 9.80               |           | 8.50               |
| SOIL INFILTRATION RATE              | m/s  |           | 5.24E-04           |           | 1.92E-04           |           | 2.22E-04           |

**DESIGN SOIL INFILTRATION RATE, f** 1.92E-04





|                                  |           |
|----------------------------------|-----------|
| DESIGN SOIL INFILTRATION RATE, f | -2.53E-05 |
|----------------------------------|-----------|





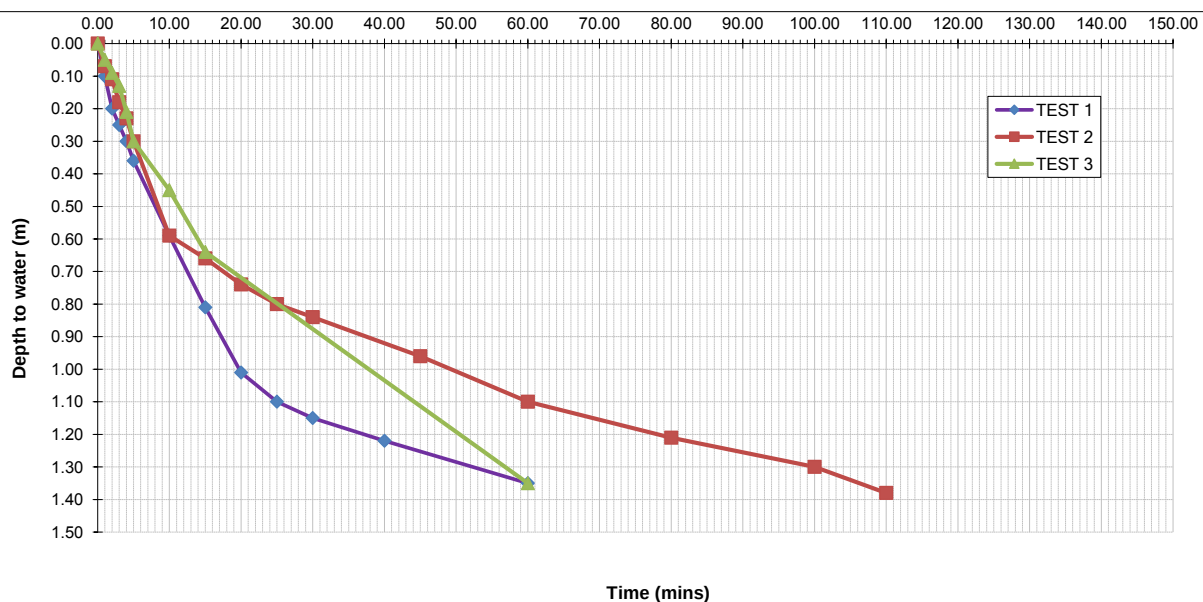
**Site:** Stansty Chain Road, Wrexham  
**Job Number:** 11-130  
**Date of Test:** 15/10/2019

**Trial Pit Number:** SA207  
**Length:** 2.00 m  
**Width:** 0.30 m  
**Depth:** 1.80 m  
**Groundwater Level:** m

|                                     |  | TEST 1    |                    | TEST 2    |                    | TEST 3    |                    |
|-------------------------------------|--|-----------|--------------------|-----------|--------------------|-----------|--------------------|
|                                     |  | Time(min) | Depth to Water (m) | Time(min) | Depth to Water (m) | Time(min) | Depth to Water (m) |
|                                     |  | 0.00      | 0.00               | 0.00      | 0.00               | 0.00      | 0.00               |
|                                     |  | 1.00      | 0.10               | 1.00      | 0.07               | 1.00      | 0.05               |
|                                     |  | 2.00      | 0.2                | 2.00      | 0.11               | 2.00      | 0.09               |
|                                     |  | 3.00      | 0.25               | 3.00      | 0.18               | 3.00      | 0.13               |
|                                     |  | 4.00      | 0.3                | 4.00      | 0.23               | 4.00      | 0.21               |
|                                     |  | 5.00      | 0.36               | 5.00      | 0.3                | 5.00      | 0.30               |
|                                     |  | 10.00     | 0.59               | 10.00     | 0.59               | 10.00     | 0.45               |
|                                     |  | 15.00     | 0.81               | 15.00     | 0.66               | 15.00     | 0.64               |
|                                     |  | 20.00     | 1.01               | 20.00     | 0.74               | 60.00     | 1.35               |
|                                     |  | 25.00     | 1.1                | 25.00     | 0.8                |           |                    |
|                                     |  | 30.00     | 1.15               | 30.00     | 0.84               |           |                    |
|                                     |  | 40.00     | 1.22               | 45.00     | 0.96               |           |                    |
|                                     |  | 60.00     | 1.35               | 60.00     | 1.1                |           |                    |
|                                     |  |           |                    | 80.00     | 1.21               |           |                    |
|                                     |  |           |                    | 100.00    | 1.3                |           |                    |
|                                     |  |           |                    | 110.00    | 1.38               |           |                    |
| Effective Storage Depth             |  | m         | 1.80               |           | 1.80               |           | 1.80               |
| 75% Effective Storage Depth         |  | m         | 1.35               |           | 1.35               |           | 1.35               |
| (i.e. depth below GL)               |  | m         | 0.45               |           | 0.45               |           | 0.45               |
| 25% Effective Storage Depth         |  | m         | 0.45               |           | 0.45               |           | 0.45               |
| (i.e. depth below GL)               |  | m         | 1.35               |           | 1.35               |           | 1.35               |
| Effective Storage Depth 75%-25%     |  | m         | 0.90               |           | 0.90               |           | 0.90               |
| Time to fall to 75% effective depth |  | mins      | 6.00               |           | 7.00               |           | 10.00              |
| Time to fall to 25% effective depth |  | mins      | 60.00              |           | 105.00             |           | 60.00              |
| V (75%-25%)                         |  | m3        | 0.54               |           | 0.54               |           | 0.54               |
| a (50%)                             |  | m2        | 4.74               |           | 4.74               |           | 4.74               |
| t (75%-25%)                         |  | mins      | 54.00              |           | 98.00              |           | 50.00              |
| SOIL INFILTRATION RATE              |  | m/s       | 3.52E-05           |           | 1.94E-05           |           | 3.80E-05           |

**DESIGN SOIL INFILTRATION RATE, f**

1.94E-05





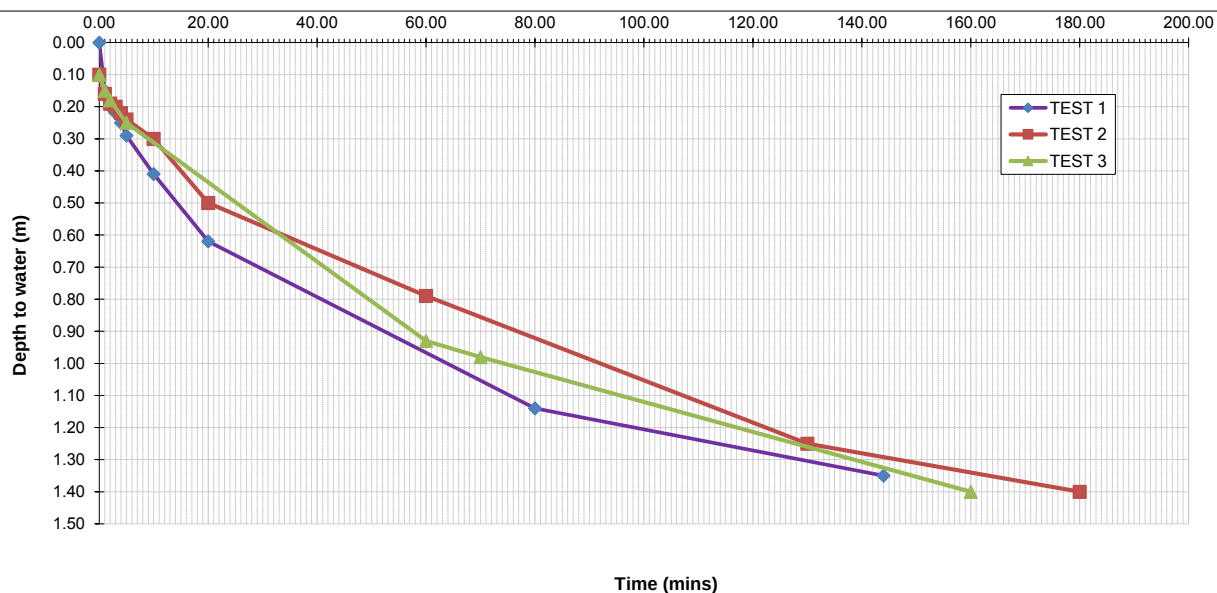
**Site:** Stansty Chain Road, Wrexham  
**Job Number:** 11-130  
**Date of Test:** 15/10/2019

**Trial Pit Number:** SA208  
**Length:** 2.00 m  
**Width:** 0.30 m  
**Depth:** 1.80 m  
**Groundwater Level:** m

|                                     |      | TEST 1    |                    | TEST 2    |                    | TEST 3    |                    |
|-------------------------------------|------|-----------|--------------------|-----------|--------------------|-----------|--------------------|
|                                     |      | Time(min) | Depth to Water (m) | Time(min) | Depth to Water (m) | Time(min) | Depth to Water (m) |
|                                     |      | 0.00      | 0.00               | 0.00      | 0.10               | 0.00      | 0.10               |
|                                     |      | 1.00      | 0.15               | 1.00      | 0.16               | 1.00      | 0.15               |
|                                     |      | 2.00      | 0.2                | 2.00      | 0.19               | 2.00      | 0.18               |
|                                     |      | 3.00      | 0.22               | 3.00      | 0.2                | 5.00      | 0.25               |
|                                     |      | 4.00      | 0.25               | 4.00      | 0.22               | 60.00     | 0.93               |
|                                     |      | 5.00      | 0.29               | 5.00      | 0.24               | 70.00     | 0.98               |
|                                     |      | 10.00     | 0.41               | 10.00     | 0.3                | 160.00    | 1.40               |
|                                     |      | 20.00     | 0.62               | 20.00     | 0.5                |           |                    |
|                                     |      | 80.00     | 1.14               | 60.00     | 0.79               |           |                    |
|                                     |      | 144.00    | 1.35               | 130.00    | 1.25               |           |                    |
|                                     |      |           |                    | 180.00    | 1.4                |           |                    |
| Effective Storage Depth             | m    |           | 1.80               |           | 1.70               |           | 1.70               |
| 75% Effective Storage Depth         | m    |           | 1.35               |           | 1.28               |           | 1.28               |
| (i.e. depth below GL)               | m    |           | 0.45               |           | 0.53               |           | 0.53               |
| 25% Effective Storage Depth         | m    |           | 0.45               |           | 0.43               |           | 0.43               |
| (i.e. depth below GL)               | m    |           | 1.35               |           | 1.38               |           | 1.38               |
| Effective Storage Depth 75%-25%     | m    |           | 0.90               |           | 0.85               |           | 0.85               |
| Time to fall to 75% effective depth | mins |           | 13.00              |           | 27.00              |           | 28.00              |
| Time to fall to 25% effective depth | mins |           | 144.00             |           | 175.00             |           | 157.00             |
| V (75%-25%)                         | m3   |           | 0.54               |           | 0.51               |           | 0.51               |
| a (50%)                             | m2   |           | 4.74               |           | 4.51               |           | 4.51               |
| t (75%-25%)                         | mins |           | 131.00             |           | 148.00             |           | 129.00             |
| SOIL INFILTRATION RATE              | m/s  |           | 1.45E-05           |           | 1.27E-05           |           | 1.46E-05           |

**DESIGN SOIL INFILTRATION RATE, f**

1.27E-05





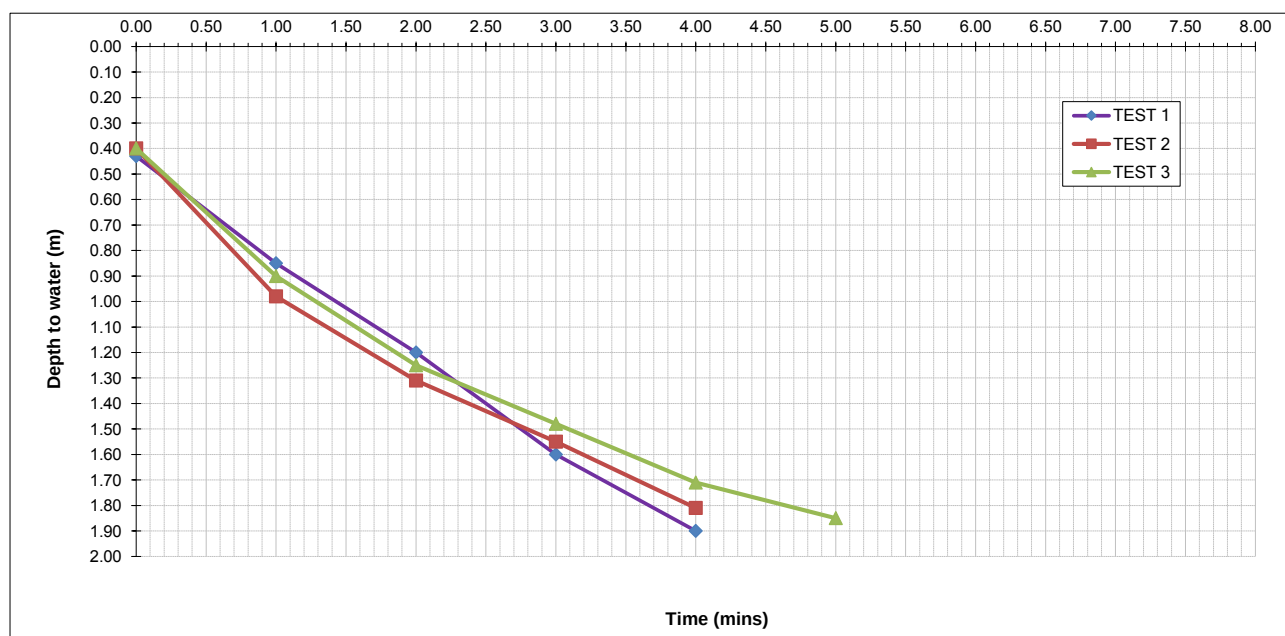
**Site:** Stansty Chain Road, Wrexham  
**Job Number:** 11-130  
**Date of Test:** 15/10/2019

**Trial Pit Number:** SA209  
**Length:** 2.00 m  
**Width:** 0.30 m  
**Depth:** 2.00 m  
**Groundwater Level:** m

|                                     |      | TEST 1    |                    | TEST 2    |                    | TEST 3    |                    |
|-------------------------------------|------|-----------|--------------------|-----------|--------------------|-----------|--------------------|
|                                     |      | Time(min) | Depth to Water (m) | Time(min) | Depth to Water (m) | Time(min) | Depth to Water (m) |
|                                     |      | 0.00      | 0.43               | 0.00      | 0.40               | 0.00      | 0.40               |
|                                     |      | 1.00      | 0.85               | 1.00      | 0.98               | 1.00      | 0.90               |
|                                     |      | 2.00      | 1.2                | 2.00      | 1.31               | 2.00      | 1.25               |
|                                     |      | 3.00      | 1.6                | 3.00      | 1.55               | 3.00      | 1.48               |
|                                     |      | 4.00      | 1.9                | 4.00      | 1.81               | 4.00      | 1.71               |
|                                     |      |           |                    |           |                    | 5.00      | 1.85               |
| Effective Storage Depth             | m    |           | 1.57               |           | 1.60               |           | 1.60               |
| 75% Effective Storage Depth         | m    |           | 1.18               |           | 1.20               |           | 1.20               |
| (i.e. depth below GL)               | m    |           | 0.82               |           | 0.80               |           | 0.80               |
| 25% Effective Storage Depth         | m    |           | 0.39               |           | 0.40               |           | 0.40               |
| (i.e. depth below GL)               | m    |           | 1.61               |           | 1.60               |           | 1.60               |
| Effective Storage Depth 75%-25%     | m    |           | 0.79               |           | 0.80               |           | 0.80               |
| Time to fall to 75% effective depth | mins |           | 0.95               |           | 0.70               |           | 0.80               |
| Time to fall to 25% effective depth | mins |           | 3.10               |           | 3.20               |           | 3.55               |
| V (75%-25%)                         | m3   |           | 0.47               |           | 0.48               |           | 0.48               |
| a (50%)                             | m2   |           | 4.21               |           | 4.28               |           | 4.28               |
| t (75%-25%)                         | mins |           | 2.15               |           | 2.50               |           | 2.75               |
| SOIL INFILTRATION RATE              | m/s  |           | 8.67E-04           |           | 7.48E-04           |           | 6.80E-04           |

**DESIGN SOIL INFILTRATION RATE, f**

6.80E-04





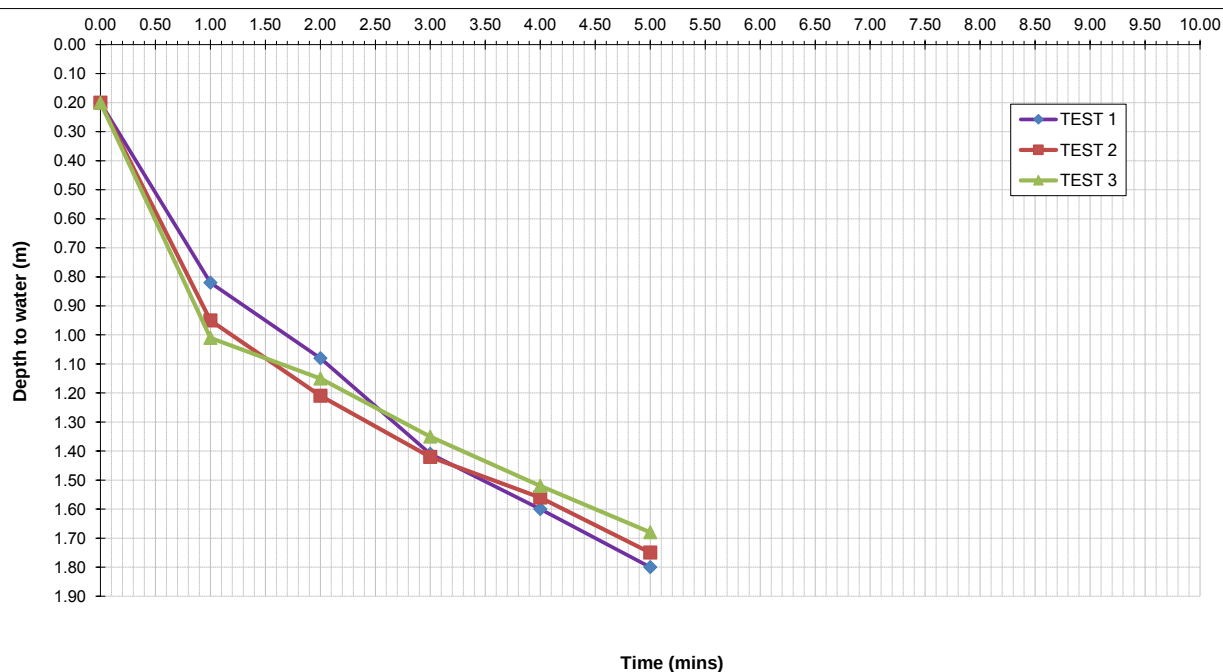
**Site:** Stansty Chain Road, Wrexham  
**Job Number:** 11-130  
**Date of Test:** 15/10/2019

**Trial Pit Number:** SA210  
**Length:** 2.00 m  
**Width:** 0.30 m  
**Depth:** 1.80 m  
**Groundwater Level:** m

|                                     |      | TEST 1    |                    | TEST 2    |                    | TEST 3    |                    |
|-------------------------------------|------|-----------|--------------------|-----------|--------------------|-----------|--------------------|
|                                     |      | Time(min) | Depth to Water (m) | Time(min) | Depth to Water (m) | Time(min) | Depth to Water (m) |
|                                     |      | 0.00      | 0.20               | 0.00      | 0.20               | 0.00      | 0.20               |
|                                     |      | 1.00      | 0.82               | 1.00      | 0.95               | 1.00      | 1.01               |
|                                     |      | 2.00      | 1.08               | 2.00      | 1.21               | 2.00      | 1.15               |
|                                     |      | 3.00      | 1.41               | 3.00      | 1.42               | 3.00      | 1.35               |
|                                     |      | 4.00      | 1.6                | 4.00      | 1.56               | 4.00      | 1.52               |
|                                     |      | 5.00      | 1.8                | 5.00      | 1.75               | 5.00      | 1.68               |
| Effective Storage Depth             | m    |           | 1.60               |           | 1.60               |           | 1.60               |
| 75% Effective Storage Depth         | m    |           | 1.20               |           | 1.20               |           | 1.20               |
| (i.e. depth below GL)               | m    |           | 0.60               |           | 0.60               |           | 0.60               |
| 25% Effective Storage Depth         | m    |           | 0.40               |           | 0.40               |           | 0.40               |
| (i.e. depth below GL)               | m    |           | 1.40               |           | 1.40               |           | 1.40               |
| Effective Storage Depth 75%-25%     | m    |           | 0.80               |           | 0.80               |           | 0.80               |
| Time to fall to 75% effective depth | mins |           | 0.65               |           | 0.55               |           | 0.50               |
| Time to fall to 25% effective depth | mins |           | 2.90               |           | 2.90               |           | 3.30               |
| V (75%-25%)                         | m3   |           | 0.48               |           | 0.48               |           | 0.48               |
| a (50%)                             | m2   |           | 4.28               |           | 4.28               |           | 4.28               |
| t (75%-25%)                         | mins |           | 2.25               |           | 2.35               |           | 2.80               |
| SOIL INFILTRATION RATE              | m/s  |           | 8.31E-04           |           | 7.95E-04           |           | 6.68E-04           |

**DESIGN SOIL INFILTRATION RATE, f**

6.68E-04





## **APPENDIX J**

# **INDICATIVE DRAINAGE STRATEGY**

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Prior to any construction, the contractor must confirm the precise invert level and pipe diameter of the receiving drainage system and must immediately advise RSK of any variation to that upon which the design has been based.

The details provided on this drawing are subject to comments by all the relevant approving authorities. Until such time as all comments have been received and incorporated onto the drawings, all the information provided and costings, are used at Clients risk and no liability will be accepted by RSK.

LEGEND:

- Infiltration Basin
- Swale
- Tree Pit soakaway
- Carrier Pipe
- Fall
- Garden Soakaway
- Permeable Paving
- Steep Gradients
- Extra Survey Required.

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |          |              |       |            |      |  |  |  |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|--------------|-------|------------|------|--|--|--|--|
| P1                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 14/10/19 | FIRST ISSUE  |       | FJP        |      |  |  |  |  |
| Rev.                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Date     | Amendment    | Drawn | Chkd       | Appd |  |  |  |  |
| <div><div></div><div>LAND &amp; DEVELOPMENT ENGINEERING LTD</div><div><div>Spring Lodge<br/>112 Chester Road<br/>Hesley<br/>Cheshire, WA6 0AR<br/>United Kingdom</div><div>Tel: +44 (0) 1928 726006<br/>Fax: +44 (0) 1928 726553<br/>Email: <a href="mailto:info@rsk.co.uk">info@rsk.co.uk</a><br/>Web: <a href="http://www.rsk.co.uk">www.rsk.co.uk</a></div></div></div> |          |              |       |            |      |  |  |  |  |
| Client                                                                                                                                                                                                                                                                                                                                                                                                                                                          |          |              |       |            |      |  |  |  |  |
| RUSSELL HOMES                                                                                                                                                                                                                                                                                                                                                                                                                                                   |          |              |       |            |      |  |  |  |  |
| Project Title                                                                                                                                                                                                                                                                                                                                                                                                                                                   |          |              |       |            |      |  |  |  |  |
| Land at Stansky Chain Road<br>Wrexham                                                                                                                                                                                                                                                                                                                                                                                                                           |          |              |       |            |      |  |  |  |  |
| Status                                                                                                                                                                                                                                                                                                                                                                                                                                                          |          |              |       |            |      |  |  |  |  |
| INFORMATION                                                                                                                                                                                                                                                                                                                                                                                                                                                     |          |              |       |            |      |  |  |  |  |
| Drawing Title                                                                                                                                                                                                                                                                                                                                                                                                                                                   |          |              |       |            |      |  |  |  |  |
| Indicative SuDS layout                                                                                                                                                                                                                                                                                                                                                                                                                                          |          |              |       |            |      |  |  |  |  |
| Drawn                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Date     | Checked      | Date  | Approved   | Date |  |  |  |  |
| FJP                                                                                                                                                                                                                                                                                                                                                                                                                                                             | OCT 19   |              |       |            |      |  |  |  |  |
| Scale                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 1:1250   | Orig Size    | A0    | Dimensions |      |  |  |  |  |
| Project No.                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 881197   | Drawing File |       | Rev.       |      |  |  |  |  |
| Drawing No.                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 40-01    |              |       | P1         |      |  |  |  |  |
| Scale 1:1250                                                                                                                                                                                                                                                                                                                                                                                                                                                    |          |              |       |            |      |  |  |  |  |
| <div><div>0</div><div>25</div><div>50</div><div>75</div><div>100m</div></div>                                                                                                                                                                                                                                                                                                                                                                                   |          |              |       |            |      |  |  |  |  |