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Revision History

<table>
<thead>
<tr>
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<th>Amendments</th>
<th>Issued to</th>
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<tr>
<td>Rev 1.0 / 4 April 2017</td>
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Contract
This report describes work commissioned by Warwickshire County Council in January 2017. Warwickshire County Council's representative for the contract was Neil Spencer.

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Purpose
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JBA is aiming to reduce its per capita carbon emissions.
# Contents

1 Introduction .......................................................................................................................... 1
2 Site Details .......................................................................................................................... 1
   2.1 Site description .................................................................................................................. 1
   2.2 Site topography ................................................................................................................ 2
   2.3 Site geology ...................................................................................................................... 2
   2.4 Existing hydrology .......................................................................................................... 2
   2.5 Existing drainage conditions ............................................................................................ 2
   2.6 Proposed development .................................................................................................... 3
3 Proposed Drainage Arrangements ....................................................................................... 3
   3.1 Design guidance .............................................................................................................. 3
   3.2 Proposed drainage regime ............................................................................................... 5
4 Construction (Design and Management) Regulations 2015 ................................................. 8
Appendices ..............................................................................................................................
   A Topographic Survey ......................................................................................................... I
   B Source Protection Zones Map .......................................................................................... II
   C Soakaway Test Results ..................................................................................................... III
   D Drawings .......................................................................................................................... IV
   E Scheme Layout ................................................................................................................. V
   F Correspondence ................................................................................................................ VI
   G Calculations ...................................................................................................................... VII
List of Tables
Table 2-1: Summary of site details ........................................................................................................... 1
Table 3-1: Peak rainfall intensity allowance in small and urban catchments .................. 5
Table 3-2: Existing runoff rates .................................................................................................................. 6
Table 3-3: Attenuation storage requirements .............................................................................................. 7

Abbreviations
EA ........................................ Environment Agency
GI ........................................ Ground Investigation
Ha .......................................... Hectares
JBA ....................................... Jeremy Benn Associates
LLFA ..................................... Lead Local Flood Authority
LTSV ...................................... Long Term Storage Volume
mm ....................................... millimetres
m ........................................... metres
m AOD ............................... metres Above Ordnance Datum
OS NGR .............................. Ordnance Survey National Grid Reference
NPPF .................................... National Planning Policy Framework
SuDS ................................. Sustainable Drainage Systems
1 Introduction

JBA Consulting was commissioned by Warwickshire County Council in January 2017 to undertake fluvial flood risk modelling and prepare an outline Surface Water Drainage Strategy for the proposed improvement works to the existing highway alignment east of Westley Bridge near Stoneleigh.

This report contains the surface water drainage strategy only. The results of the fluvial flood risk modelling study are contained in a separate Technical Note entitled ‘Finham Brook flood risk modelling study’, by JBA Consulting, October 2017.

2 Site Details

2.1 Site description

The development site is located between Kenilworth and Coventry, some 900m north-west of the village of Stoneleigh.

The existing site comprises approximately 840m of Stoneleigh Road, 140m of Dalehouse Lane and 990m of slip roads of A46. The site location and key details are shown in Table 2-1.

Table 2-1: Summary of site details

<table>
<thead>
<tr>
<th>Site name</th>
<th>Westley Bridge Improvements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approximate site area</td>
<td>2.8ha</td>
</tr>
<tr>
<td>Existing land-use</td>
<td>Existing highway</td>
</tr>
<tr>
<td>Purpose of development</td>
<td>Existing highway improvement works</td>
</tr>
<tr>
<td>OS NGR</td>
<td>E431975 N273577</td>
</tr>
<tr>
<td>Local Planning Authority</td>
<td>Warwick District Council</td>
</tr>
<tr>
<td>Lead Local Flood Authority</td>
<td>Warwickshire County Council</td>
</tr>
</tbody>
</table>

Contains Ordnance Survey data © Crown copyright 2017. All rights reserved.
2.2 Site topography
A topographical survey was carried out for the site by On Centre Surveys Ltd in January 2017. The topography of the site under consideration is as follows:

- Dalehouse Lane - the road levels vary from approximately 70.35mAOD at the western extent to 67.60mAOD, some 45m from the existing roundabout,
- Stoneleigh Road north-west of Westley Bridge - the road levels vary from approximately 72.00mAOD at the northern extent to 65.50mAOD near the bridge,
- Stoneleigh Road south-east of Westley Bridge to existing roundabout - the road levels fall from approximately 65.50mAOD at the bridge and 68.00mAOD at the roundabout to a midway low point of 65.25mAOD.
- Existing roundabout - ground levels vary between 68.60mAOD along the northern part and 70.60mAOD along the southern part.
- Stoneleigh Road between south east of existing roundabout and the eastern road extent - the levels rise from approximately 70.60mAOD at the existing roundabout to approximately 80.70mAOD some 33m south east of the A46 bridge. The levels then fall from this high point to approximately 77.30mAOD at the eastern extent.
- Slip roads to A46 - the ground levels fall towards the A46. The levels along the A46 at the connection points vary between 76.30mAOD and 69.90mAOD.

A copy of the topographical survey is included in Appendix A.

2.3 Site geology
The British Geological Survey (BGS) mapping shows the site to be underlain by Kenilworth Sandstone Formation. No superficial deposits are recorded.

BGS records of historic boreholes along the A46 and near the Westley Bridge have been reviewed as party of this study.

The typical borehole contained layers of sandy clay, silty clay and sandy silt with gravel and silty sand. Sandstone was encountered at varying levels between 3.0m and 6.0m bgl. Groundwater was encountered in some of the boreholes at some 1.85m bgl near the Westley Bridge and 3.0m bgl along the A46 route.

In line with the EA mapping, the site is shown to be located above a Principal Bedrock Aquifer within high vulnerability zone. A plan provided by the Environment Agency (EA) as part of the consultation undertaken for this study suggests the site to be located in Zone 2 - Outer Protection Zone. The said plan is included in Appendix B.

It is understood that an intrusive ground investigation is currently ongoing on site. Soakaway tests were carried out on site by Geotechnics in September 2017 (Project No PC176864) and draft results provided for review. Tests were taken at four different locations along the Stoneleigh Road. Results from three trial pits show varying infiltration rates between 1.1 - 2.2 x 10^{-5} m/s. In one trial pit located next to the northern A46 slip road a higher value of 1.43x10^{-4} m/s was derived. It's understood that further tests are planned to be undertaken in order to assess the infiltration potential across the whole site.

The draft soakaway test results are included in Appendix C.

2.4 Existing hydrology
Based on the FEH CD-ROM, v.3.0 the majority of the scheme lies within the natural catchment of the Finham Brook. Only the most south-eastern part of the Stoneleigh Road is located within the natural catchment of the River Sowe. The indicative natural catchment boundaries are shown on drawing 2017s5573-001 included in Appendix D.

Both, the Finham Brook and the River Sowe are classified by the Environment Agency as having overall Moderate status (as per 2015 cycle).

2.5 Existing drainage conditions
Existing utility survey was carried out in parallel with the topographic survey by On Centre Surveys Ltd in January 2017. A copy of the survey is included in Appendix A. It should be noted that the
The survey suggests the following:

- Dalehouse Lane and the Stoneleigh Road between the Westley Bridge and the A46 bridge are served by gully based drainage system. Some gullies were found to be silted up and flooded. Although not clearly identified on the survey it is assumed that the drainage discharges to Finham Brook.
- The full extent of the catchment drained by this system is currently uncertain.
- Stoneleigh Road between the A46 bridge and the eastern scheme extent is served by gully based system. A short section of a ditch with headwall is also noted along the most eastern part of the site. The full extent of this drainage system and its discharge environment are currently uncertain. Based on the local topography it is possible that the drainage system discharges to the River Sowe in the village of Stoneleigh, some 1.4km from the A46 bridge.
- A46 slip roads are drained via a combination of gullies and filter trenches. These drainage systems are believed to connect to the A46 drainage system.
- The A46 is mainly drained via filter trenches. It is unknown if the filter trenches are lined and perforated interceptor pipes are present at the bottom of the trenches or the trenches drain to the ground. The discharge environment of the A46 drainage is therefore currently uncertain. Based on the topography of the road however it is assumed that the drainage discharges to the Finham Brook, some 660m north east of the A46 bridge.

2.6 Proposed development

The proposal is for an improvement to the existing road alignment comprising the following:

- Removal of existing Stoneleigh Road roundabout and existing roads,
- Construction of new roundabout on Stoneleigh Road and realignment of Dalehouse Lane approach,
- Construction of a new bridge over Finham Brook,
- Construction of new bridge/ roundabout over A46,
- Modifications to existing northbound and southbound slip roads.

The proposed site layout is included in Appendix E.

3 Proposed Drainage Arrangements

The outline drainage strategy has been prepared on an assumption that the existing sections of road made redundant due to construction of the offline road sections will be reinstated to greenfield conditions. If this is not the case the runoff rates and attenuation volumes presented in this report will need to be amended.

3.1 Design guidance

A drainage strategy outlining the means of surface water disposal from the proposed development has been produced in line with the following guidance documents:

- CIRIA 753 'The SuDS Manual', November 2015;

A preliminary consultation with the Flood Risk and Drainage department of the Warwickshire County Council and the Environment Agency has been undertaken as part of the study. The comments made by the authorities have been accounted for during production of this drainage strategy. Copies of the correspondence files are included in Appendix F.
3.1.1 Water quantity

Peak rate of runoff can be readily managed and reduced using flow control and attenuation techniques. The reduction of runoff volume can however be more difficult to achieve as it relies upon infiltration, evapo-transpiration or re-use. Where these SuDS techniques are not viable then the alternative is to provide an appropriate attenuation in underground (e.g. oversized pipes, tanks) and/or over ground (e.g. detention basins, retention ponds, swales) storage facilities by restricting the runoff rates to the greenfield equivalent.

To mitigate against increasing downstream flooding due to the additional volume of runoff alternative approaches should be considered as follows:

- Segregation of the Long-Term Storage Volume (LTS), the difference between the pre- and post-development runoff volumes from the main peak flow attenuation. The LTS is then discharged at very low rates (less than 2l/s/ha) and the remaining peak flow attenuation can be discharged at equivalent greenfield runoff rates with suitable deductions made for the discharge from the LTS. In practice, this arrangement is quite complex and depends on catchment size, site layout, topography and number of outfalls and adoption of SuDS;
- Restricting discharges for all return period storms up to the 100-year plus climate change to the pre-development \( Q_{\text{BAR}} \) or \( Q_{\text{MED}} \) or \( Q_{\text{1year}} \) flow rate. Effectively, surface water is managed collectively and discharged at low rates to extend the runoff hydrograph from the site.

The latter approach has been adopted for this drainage strategy. The site is considered as brownfield.

The Warwickshire County Council requires 50% betterment to be applied to the existing discharge rates from brownfield sites.

3.1.2 Water quality

To mitigate against adverse impacts on the water quality in the receiving water environment CIRIA 753 The SuDS Manual recommends the following steps to determine the required water quality management for discharges to surface waters and groundwaters:

- Plan land use to prevent runoff and associated pollutants for most rainfall events up to 5mm in depth,
- Identify the pollution hazard level associated with the given type of development,
- Select risk assessment approach based on receiving water environment and the pollution hazard level,
- Carry out the risk assessment for each outfall considering the pollution hazard level, the status of the receiving water environment and effectiveness of the proposed SuDS techniques.

Trunk roads are noted as having high pollution hazard level and the water quality assessment should be carried out in line with Highway Agency's requirements.

However, as the proposed works are improvements to the existing road rather than a new road scheme and the relatively small scale of the scheme it is considered that the drainage should aim to provide some improvement to the existing scenario but it should not be treated as a greenfield site development.

A detailed water quality assessment has therefore not been undertaken at this stage. This may however be required at a later stage using Highways' Agency Water Risk Assessment tool (HAWRAT) when the scheme details and the drainage discharge environments are confirmed.

3.1.3 Climate change impact

In line with the climate change allowances recommended by the EA in their updated February 2017 guidance the peak rainfall intensities should take into account increases for future climate change impacts in the urban drainage designs. The recommended climate change allowances are shown in Table 3-1.
Table 3-1: Peak rainfall intensity allowance in small and urban catchments

<table>
<thead>
<tr>
<th></th>
<th>Applies across all of England</th>
<th>Total potential change anticipated for the ‘2020s’ (2015 to 2039)</th>
<th>Total potential change anticipated for the ‘2050s’ (2040 to 2069)</th>
<th>Total potential change anticipated for the ‘2080s’ (2070 to 2115)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper end</td>
<td>10%</td>
<td>20%</td>
<td>40%</td>
<td></td>
</tr>
<tr>
<td>Central</td>
<td>5%</td>
<td>10%</td>
<td>20%</td>
<td></td>
</tr>
</tbody>
</table>

Considering the potential design lifespan of the development, the ‘2080s’ scenario has been adopted for this drainage strategy. 40% increase has been accounted for in the design.

3.2 Proposed drainage regime

The existing catchment areas and potential discharge points have been identified based on the topographic and utility survey carried out by On Centre Surveys Ltd in January 2017.

The existing catchment areas have then been compared against the proposed catchment areas, assumed to drain to the same discharge points as the existing drainage systems. The comparison concluded that the proposed scheme will increase the total impermeable area by approximately 1.13ha.

The existing and proposed drained areas are shown on drawing 2017s5573-001 included in Appendix D.

As the post-development hardstanding area will increase when compared against the existing scenario the existing runoff rates and volumes will also increase. To mitigate against increased flood risk elsewhere the proposed flows will need to be attenuated.

3.2.1 Discharge hierarchy

The following discharge hierarchy has been considered (in order of preference) during the preliminary design process:

- Discharge to ground

Based on the soakaway test results carried out on site there is a potential for some of the surface water runoff to be disposed of via infiltration to ground. Considering the infiltration rates, it is concluded however that the scheme could not purely rely on infiltration and additional methods of surface water disposal will be required.

Furthermore, considering the proximity of the scheme to Finham Brook local high groundwater levels may be present in the scheme extents closest to the watercourse, which would preclude infiltration. No long-term groundwater monitoring results are currently available to assess this.

Furthermore, the site is located within Zone 2 - Outer Protection Zone, used locally for public water supply by Severn Trent Water Ltd, in line with the EA data.

The published EA's guidance states:

"Where infiltration SuDS are to be used for surface run-off from roads, car parking and public or amenity areas, they should: ...use a SuDS management treatment train – that is, use drainage components in series to achieve a robust surface water management system that does not pose an unacceptable risk of pollution to groundwater."

Considering the above partial infiltration is only proposed within the areas located on higher elevations further away from the brook. For the purpose of this drainage strategy a partial infiltration up to the 10-year storm event has been assessed, where practicable (unless stated otherwise). Due to heightened risk of groundwater pollution during accidental spillages, the runoff will have to be routed via lined filter trenches/infiltration basins with penstocks or similar facilities prior to discharge to the soakaways. The penstocks will enable isolation of the contaminated flows preventing them from reaching groundwater.
Discharge to watercourses

As the site lies within the natural catchments of the Finham Brook and the River Sowe and assuming the existing road drainage currently discharges to these watercourses, it is proposed to maintain the existing drainage regime and discharge any runoff from the improved scheme not infiltrating to the ground into the watercourses in a form of overflow. The discharges will be indirect via existing road drainage systems.

3.2.2 Runoff rate and volume control

A conservative approach has been taken in calculation of the existing discharge rates and the current hardstanding areas only have been used.

In addition to the scheme catchment areas, the areas upstream of the scheme, believed to contribute to the existing drainage systems (based on the local road topography) have also been accounted for in the calculations.

Existing runoff rates have been estimated using two alternative approaches in line with the Warwickshire County Council's guidance as follows:

- Capacity of the existing outfalls - assessed using hydraulic tables;
- Modified Rational Method formula, as follows:

\[ Q = 3.61 \times A \times Cv \times i \]

Where:

- \( Q \) - flow rate (l/s)
- \( A \) - total hardstanding area (ha)
- \( Cv \) - calculated as 0.76 and 0.80 using Wallingford Procedure (summer and winter accordingly)
- \( i \) - rainfall intensity of 35 mm/hr

The lowest value from the two methods has then been used. The calculated runoff rates for each catchment area, including 50% betterment, are summarised in Table 3-2. The locations of the proposed discharge points are shown on drawing 2017s5573-002, included in Appendix D.

Table 3-2: Existing runoff rates

<table>
<thead>
<tr>
<th>Discharge point</th>
<th>Drainage catchment</th>
<th>Existing area (ha)</th>
<th>Upstream catchment (ha)</th>
<th>Runoff based on existing pipe capacity (l/s)</th>
<th>Runoff based on Modified Rational Method (l/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DP1</td>
<td>Stoneleigh Road - West</td>
<td>0.115</td>
<td>0.155</td>
<td>6.8 (100mm dia pipe)</td>
<td>21.5</td>
</tr>
<tr>
<td>DP2</td>
<td>Roundabout</td>
<td>0.554</td>
<td>0.412</td>
<td>89.2 (300mm dia pipe)</td>
<td>69.6</td>
</tr>
<tr>
<td>DP3</td>
<td>North-western sliproad</td>
<td>0.289</td>
<td>0.004</td>
<td>17.9 (225mm dia pipe)</td>
<td>15.0</td>
</tr>
<tr>
<td>DP4</td>
<td>North-eastern sliproad</td>
<td>0.299</td>
<td>0.214</td>
<td>17.9 (assumed 225mm dia pipe)</td>
<td>36.7</td>
</tr>
<tr>
<td>DP5</td>
<td>South-western sliproad</td>
<td>0.119</td>
<td>-</td>
<td>17.9 (assumed 225mm dia pipe)</td>
<td>6.0</td>
</tr>
</tbody>
</table>
3.2.3 Attenuation sizing

A ‘quick storage estimate’ module within Micro Drainage software has been used to estimate the required 100-year plus 40% climate change attenuation volume for each of the drained catchment.

The attenuation volume has been estimated based on the following design parameters:

- Design rainfall based on FEH CD-ROM, v3.0 catchment descriptors,
- Cv calculated as 0.76 and 0.80 using Wallingford Procedure (summer and winter accordingly),
- Impermeable areas and allowable discharge rates as per Table 3-3.

Table 3-3: Attenuation storage requirements

<table>
<thead>
<tr>
<th>Discharge point</th>
<th>Drainage catchment</th>
<th>Proposed area (ha)</th>
<th>Allowable discharge rate (l/s)</th>
<th>Attenuation storage (m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DP1</td>
<td>Stoneleigh Road - West</td>
<td>0.687</td>
<td>9.2 (assumed 150mm dia pipe)</td>
<td>11.8</td>
</tr>
<tr>
<td>DP2</td>
<td>Roundabout</td>
<td>0</td>
<td>-</td>
<td>0</td>
</tr>
<tr>
<td>DP3</td>
<td>North-western sliproad</td>
<td>0.154</td>
<td>11.8</td>
<td>11.8</td>
</tr>
<tr>
<td>DP4</td>
<td>North-eastern sliproad</td>
<td>0.253</td>
<td>17.9</td>
<td>431-696</td>
</tr>
<tr>
<td>DP5</td>
<td>South-western sliproad</td>
<td>0.112</td>
<td>17.9</td>
<td>360-547</td>
</tr>
<tr>
<td>DP6</td>
<td>Stoneleigh Road - East</td>
<td>0.687</td>
<td>15.0</td>
<td>8.7-24</td>
</tr>
<tr>
<td>DP7</td>
<td>North-eastern sliproad (downstream section)</td>
<td>0.027</td>
<td>0.4 (infiltration to ground)</td>
<td>2.12-12</td>
</tr>
</tbody>
</table>

The calculation sheets are included in Appendix G. It should be noted that the above attenuation storage estimates are based on the ‘reduced’ existing discharge rates and do not take into account the potential reduction due to infiltration to ground. The values are therefore considered as conservative.

For the purpose of this outline strategy the lowest infiltration value from the four soakaway tests has been used to derive the potential area required to accommodate the 10-year storage based on infiltration. Any runoff beyond the 10-year and up to the 100-year+40%CC will be discharged to the watercourses via existing drainage systems.

It is envisaged at this stage that the attenuation storage will be provided within a combination of overground SuDS features (swales, detention basins, etc.), filter trenches and underground storage.
tanks. The soakaways will take form of trenches comprising underground crates and stone aggregate.

Any treatment and conveyance SuDS facilities upstream of the soakaways should be lined and equipped with penstock valves or similar to facilitate management of accidental spillages.

The exact volume and size of the attenuation storage will be confirmed at the detailed stage of the design, when the new road layout is finalised, further information on soil infiltration potential and groundwater levels within the planned soakaway locations become available and will depend on the type of storage facilities and outlet control devices employed. The land availability and potential impact of the soakaways on the road construction will also need to be confirmed.

The surface water drainage strategy is shown on drawing 2017s5573-002 included in Appendix D.

It should be noted that the outline drainage design has been based on currently available information and design parameters and assumptions described in this report. If any of the design parameters, including the proposed site layout change, the design will require to be re-visited to confirm its suitability.

3.2.4 Runoff treatment
Filter trenches and the overground SuDS features will provide a degree of runoff treatment, and therefore betterment to the existing scenario, prior to discharge to ground and existing watercourses. Where gullies are used they should be trapped to remove the coarse sediments prior to discharge to the SuDS facilities.

3.2.5 Design for exceedance
In the event of a blockage or exceedance of the drainage system capacity overland flow will naturally follow the new road topography. Considering the rural character of the area no properties will be directly affected by the overland flow routes.

3.2.6 Long term management
Maintenance responsibilities for the local road network and associated drainage facilities post-construction will lie with Warwickshire County Council. Maintenance of the strategic road network and associated drainage facilities will be the responsibility of Highways England.

3.2.7 Consents
For works on or near ordinary watercourses/ditches an application for ordinary watercourse consent under Land Drainage Act 1991 to the Warwickshire County Council, the LLFA, will be required.

Construction of any drainage facilities (including outfalls to watercourses) outside the land in the Client’s ownership will require agreement with relevant land owners.

4 Construction (Design and Management) Regulations 2015

Under the Construction (Design and Management) Regulations 2015 (CDM 2015) it is the designer’s duty to:

- eliminate foreseeable health and safety risks to anyone affected by the project
- take steps to reduce or control any risks that cannot be eliminated
- communicate, cooperate and coordinate with the client, other designers and contractors involved in the project so that designs are compatible and health and safety risks accounted for during the project and beyond

The following hazards associated with the construction, operation and maintenance of the proposed surface water drainage system, have been identified during the preliminary site assessment:

1 The drainage strategy is based on scheme layout drawing no. 9.2-A46-083-014 rev A dated October 2017. Minor revisions are still being undertaken to the scheme layout drawing, but the changes are of minor nature and will not have a significant impact on the findings of this drainage strategy.
• Overground services: overhead cables crossing Stoneleigh Road at the bridge over Finham Brook,
• Underground services: water mains, gas mains, drainage pipes and electric and telecom cables crossing the existing road,
• Ground / groundwater conditions: limited information at present. BGS information suggests the site to be underlain by Kenilworth Sandstone Formation. Superficial deposits contain sandy clay and sandy silt layers with gravelly and silty sand. Potential for groundwater levels between 1.85m bgl near Westley Bridge and 3.0m bgl along the A46 route,
• Inundation: fluvial flooding from Finham Brook,
• Working near water: construction of outfalls to Finham Brook and existing road drainage; maintenance of drainage facilities,
• Existing trees along the roads,
• Site access: off A46, Stoneleigh Road and Dalehouse Lane,
• Live traffic,
• Risk of pollution to the water environment due to excavations and use of construction machines.

It should be noted that the above indicate potential significant hazards on and in the vicinity of the site based on a desk study of available information. This list therefore should not be considered as exhaustive and a detailed site/services survey should be undertaken prior to commencing construction activities on site.
Appendices

A  Topographic Survey