

# Land at Daventry Road, Southam

## Technical Note: Highways, Transportation and Drainage

30<sup>th</sup> September 2014

### 1 Introduction

#### Background

Brookbanks Consulting Limited is appointed by Hallam Land Management Ltd to provide highways, transportation and drainage advice to support the promotion of a potential development site at Southam, Warwickshire.

The Stratford-on-Avon District Council Local Plan was adopted on 14th July 2006 and forms part of the statutory development plan for the District. Following this, the Planning and Compulsory Purchase Act 2004 introduced Local Development Documents (LDDs). The LDDs will comprise a Local Development Framework (LDF) for the District Authority area, one of the key documents underpinning this is the Core Strategy.

The Core Strategy is the principal document within the Local Development Framework (LDF). It will set out the vision and key objectives for the future development of the District to 2031 and how these can be achieved. The Council are currently undertaking a 'call for sites' exercise to inform its proposed Site Allocations Plan that will sit alongside the Core Strategy.

This document has been prepared to support representations made on behalf of Hallam Land Management Ltd, and demonstrate the suitability of the land for development. The opportunities that are present to bring forward proposals to deliver a sustainable development at Southam.

#### Site Setting

The site is located in Warwickshire, south of the A425 Daventry Road. To the south, the site is bound by Welsh Road East and to the west by residential properties. To the east, the site is bound by a new employment development accessed off Welsh Road East (10/02780/FUL) and agricultural land. The site is indicated in Figure 1a, below.

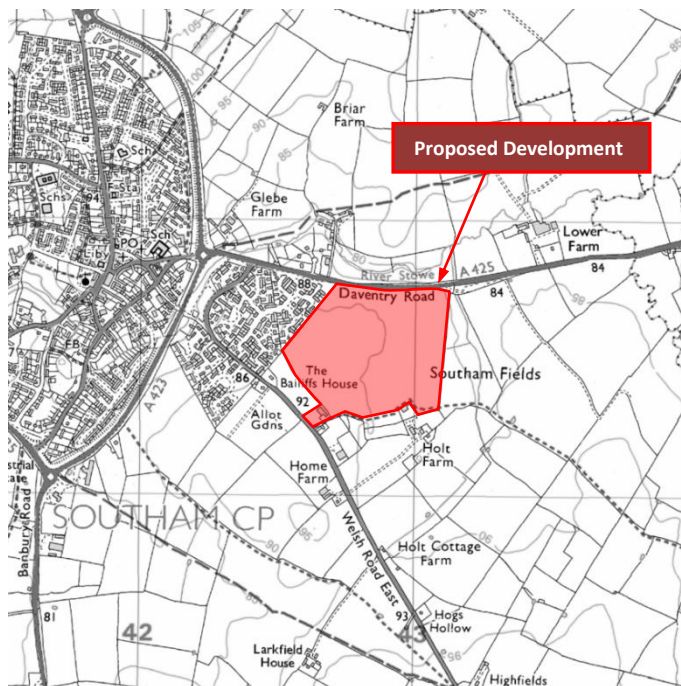


Figure 1a: Site location

## 2 Transportation Review

The National Planning Policy Framework requires plans to be prepared with the objective of contributing to the achievement of sustainable development. In transportation terms, the Framework requires plans to ensure development is located where the need to travel will be minimised and the use of sustainable transport modes can be maximised.

The following paragraphs identify the opportunities to provide a sustainable development on this site in highways and transport terms.

### Walking and Cycling Networks

There are intermittent footways within the local road network with cycle trips predominantly being catered for within the highway. There is an existing footpath running along the southern boundary of the site connecting to Welsh Road East.

The Public Rights of Way's (PROW's) surrounding the site are indicated on Figure 2a below. This indicates there are several PROW's in the vicinity to site, connecting into a wider network of PROW.

In addition to the PROW network, there is an existing underpass of the A423, with the location shown below. This delivers a safe, direct and convenient pedestrian and cycle route from Welsh Road East to Southam town centre and avoids the need to cross the A423.



Figure 2a: PROW network

-  Bridleway
-  Footpath
-  Underpass

To ensure that the development improves walking and cycling links and encourages the use of more sustainable modes of transport, it is important that the development delivers both on-site and off-site enhancements.

The development of the site should include a comprehensive network of walking and cycling routes that will connect the residential development with any local facilities proposed within the development. The network would be inclusive to all potential users on site.

The on-site walking and cycling network should also include convenient connections into the existing off-site networks such that walking and cycling is an attractive alternative to the motorcar to access the off-site facilities. The off site networks should provide high quality links into Southam town centre to improve integration. This will ensure that cohesive links between the development and the existing areas of Southam is achieved.

The key desire line for pedestrian and cycle activity will be along Welsh Road East towards Southam town centre as it offers a wide range of leisure / education / employment / retail opportunities. The entirety of the site lies within acceptable walking and cycling distance of these facilities and is located where it will encourage residents to travel by sustainable modes.

The route towards Southam will be along the Daventry Road and Welsh Road East. As identified earlier, there is an existing underpass off the A423 that can be accessed via Welsh Road East. The underpass provides a safe, direct route into the existing amenities of the town. This offers an excellent sustainable link with the facilities along Daventry Road and Welsh Road East can be improved to ensure a continuous route. Furthermore, the existing crossing point at the Daventry Road / A423 junction will be enhanced to provide an alternative safe crossing point.

Key local pedestrians and cycling links are shown below, together with the underpass, in Figure 2b.

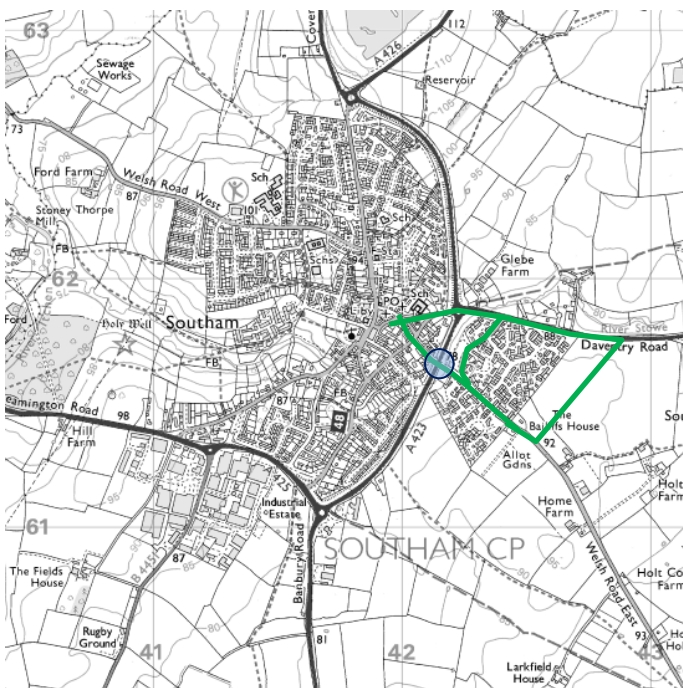


Figure 2b: Key routes for walking and cycling routes/ footpaths

#### OPPORTUNITY 1 – IMPACT ON WALKING AND CYCLING NETWORKS

Provide a comprehensive on site pedestrian and cycle network.

Provides multiple safe pedestrian links into Southam

Connect with the existing good links to Southam town centre, using the underpass of the A423 and A423/ Daventry road junction

#### Public Transport

Southam is served by several public transport services, as indicated below.

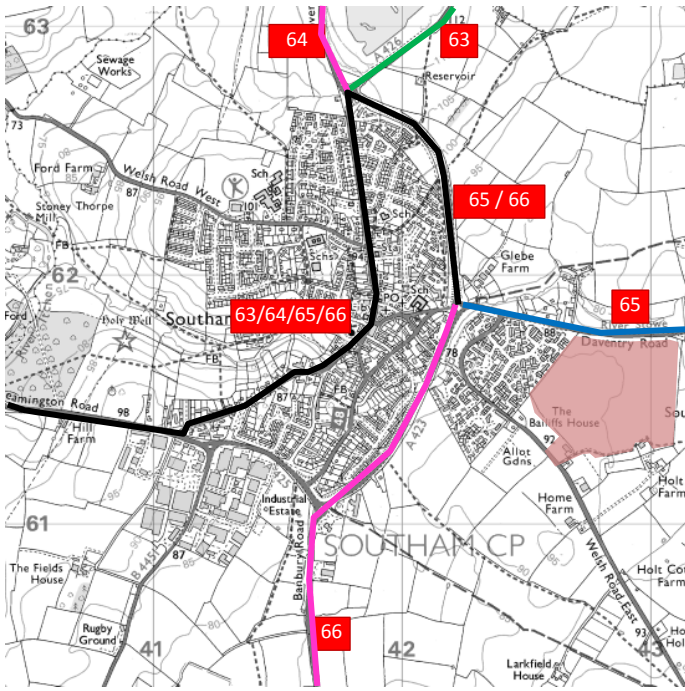


Figure 2c: Southam public transport network

Route Number	Operator	Destinations
63	Stagecoach	Rugby – Southam - Leamington
64	Stagecoach	Rugby – Long Itchington - Southam - Leamington
65	Stagecoach	Leamington – Southam - Daventry
66	Stagecoach	Leamington – Southam - Banbury

Figure 2d: Southam public transport network

Together with walking and cycling, a fast reliable road based public transport system is able to provide a viable alternative to the motorcar. The proposed development has sufficient quantum to be able to deliver improvements to the public transport coverage that will have the frequency and reliability to attract patronage to secure long term viability.

To consider the potential routes it is important to understand both the inbound and outbound trips that are likely. The key destinations will be:

- Rugby
- Leamington Spa
- Daventry
- Banbury

It is important to identify a strategy to maximise connectivity to the most strategically important areas. These should include interchange locations to allow for onward movements by existing public transport routes. It is considered that the above key destinations are served from Southam.

The Route 65 operates across the site frontage along Daventry Road, currently operating with a frequency of 120 minutes. The frequency of this route can be improved and could be brought into the site to maximise the attractiveness. When brought into the site, the 65 Service would continue along Welsh Road East and therefore enhance the public transport coverage for the existing dwellings / employees within this corridor.



## OPPORTUNITY 2 – IMPACT ON PUBLIC TRANSPORT NETWORKS

Provide bus services to serve strategically important conurbations.

Improve the bus service to operate at improved frequency during the peak, supported by high quality infrastructure.

### Accessibility

The accessibility of the development is achieved through successfully forming transport links from the development to the external transport routes, so a permeable layout is delivered. This allows future site occupiers to access local facilities and amenities by different modes of travel. A qualitative review of the accessibility implications of the proposed development has been conducted.

There is a wide range of local amenities provided within Southam, with the town centre being 1km to west of the site. Present day local amenities are indicated in Figure 2d. Journeys of less than 2km should be targeted for the promotion of walking as a suitable and sustainable mode of travel. The equivalent distance quoted for cycling is 5km. This demonstrates that all the identified local amenities are within walking / cycling range, as indicated by the distance contours in Figure 2e.

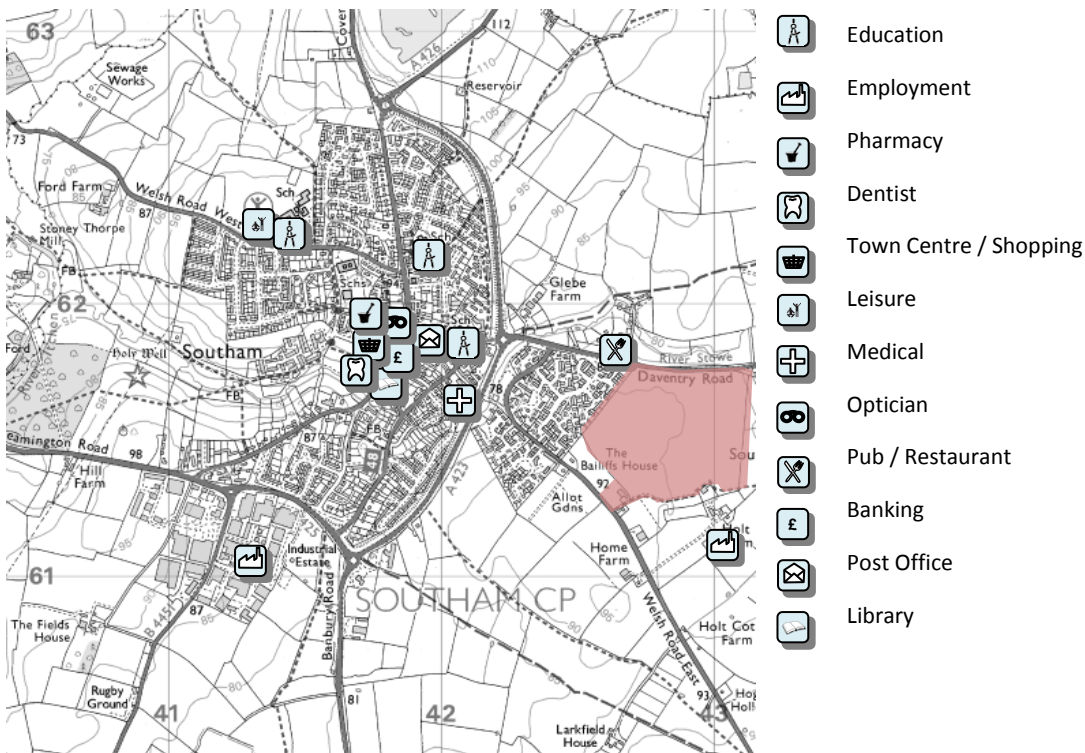
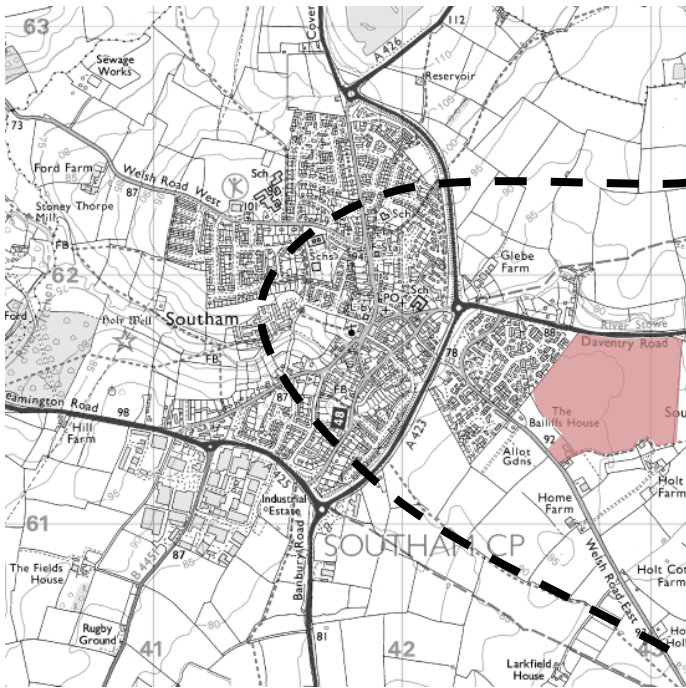



Figure 2d: Location of local facilities



1km Isochrone 

**Figure 2e:** Distance isochrones

Presently, a number of local facilities exist in Southam. However, as part of the residential development, the opportunity exists to provide other supporting land uses to respond to the everyday needs of the resident population and provide facilities for the existing residents within the Welsh Road East area.

Multi-purpose or linked trips will promote more sustainable patterns of travel. There are a range of non-employment trips that need to be considered, these include education, shopping and leisure. The development of this site could include:

- Convenience store
- Primary School
- Health care provision
- Open space and play area
- Restaurant / public house

By delivering a mix of uses and amenities this will reduce the need to travel outside the site boundary, increasing trip internalisation which will reduce the impact on the wider road network.

The development should also aim to deliver a self-sufficient community supported by a range of housing types and tenures.

### OPPORTUNITY 3 – ACCESSIBILITY

Provide a development that provides a mix of uses where a need can be demonstrated, such as: Convenience store, Primary School Health care provision, Open space/play areas, Restaurant / public house

To promote the use of modes other than the private motor car, a comprehensive travel plan should be implemented.

The purpose of a Travel Plan for a new development is to minimise the adverse environmental effects of development related travel from the outset. A holistic approach to the development proposals will result in a successful travel plan, where the need to travel is reduced inherently by design.

Any targets set within a Travel Plan should encourage the use of alternative and sustainable modes of travel, and in so doing, reduce the number of vehicle journeys to, from and within the development.

This can be achieved by:

- Reducing the need to travel
- Providing realistic alternatives to the car
- Making alternatives to driving alone more attractive
- Managing car parking provision

Benefits of Travel Plans include:

- Improving health, fitness and wellbeing
- Improving access
- Reducing congestion in the local area

Travel plans can be prepared to inform the master plan process and to assist with the development of a new development that makes the best use of sustainable modes.

The Travel Plan endeavors to promote environmentally sustainable travel choices for residents and visitors to the area. This will seek to encourage visitors and employees to use alternative modes to the single occupancy car and to emphasise the health benefits of more sustainable modes of travel.

The travel plan will include specific measures to maximise sustainable forms of travel, including car share databases, car clubs and offer discounted vouchers for public transport trips.

#### OPPORTUNITY 4 – SUSTAINABLE MODES OF TRAVEL

Provide a travel plan to identify the strategy to discourage the reliance on the private motorcar and to build upon the sustainable infrastructure improvements.

#### Road Network

The local road network is indicated in Figure 2f, below.

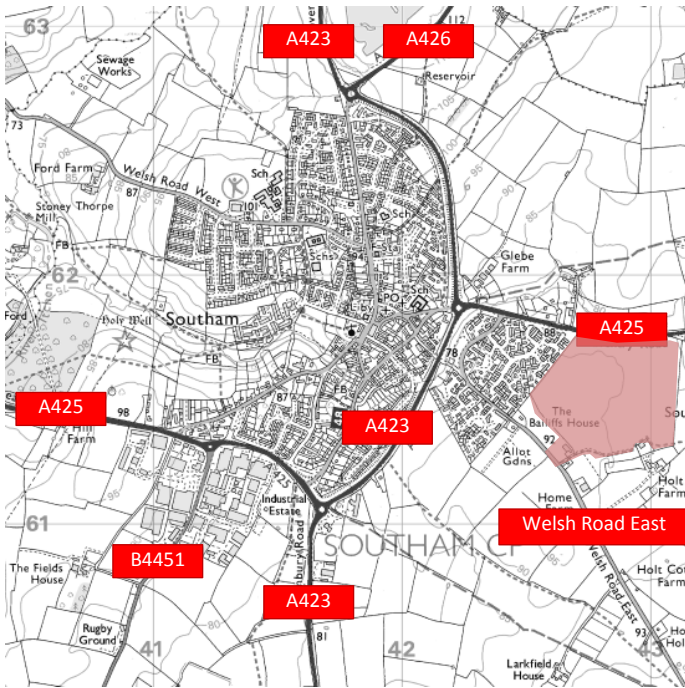


Figure 2f: Southam road network

The A425 borders the site to the north, this is a single carriageway road catering for east – west trips from Southam to Daventry to the east of the site, which in turn provides access to the M1 at junctions 16 and 18. To the west of the site, the A425 continues and forms an access into Welsh Road East before continuing towards Southam. Welsh Road East provide access to a significant housing area. Welsh Road East provides access to the site to the south.

The A425 connects with the A423 forming a four arm roundabout. The western arm provides access into the town centre and the facilities and amenities found therein. The roads within the town are single carriageway roads, the majority having footways. The A423 forms a bypass for the town centre. To the south of Southam, the A423 connects with the A425, which heads to Leamington Spa, before continuing towards Banbury and the M40.

The A425 south of Southam connects with Kineton Road, B4451, which heads in a southerly direction through Bishop’s Itchington towards Gaydon and junction 12 of the M40 motorway.

The A423 to the north, continues in a northerly direction towards Coventry. The A425 connects with the A426 which in turn connects with Rugby.

An initial review indicates that the local road network generally operates within capacity.

The masterplan for the site should be based on a clear hierarchy that encourages the safe movement of all the future residents, irrespective of the manner in which they travel. A broad hierarchy is described below:

**Primary route:** A spine road through the site connecting to the possible external access points designed to cater for public transport vehicles and includes a segregated walking and cycling path.

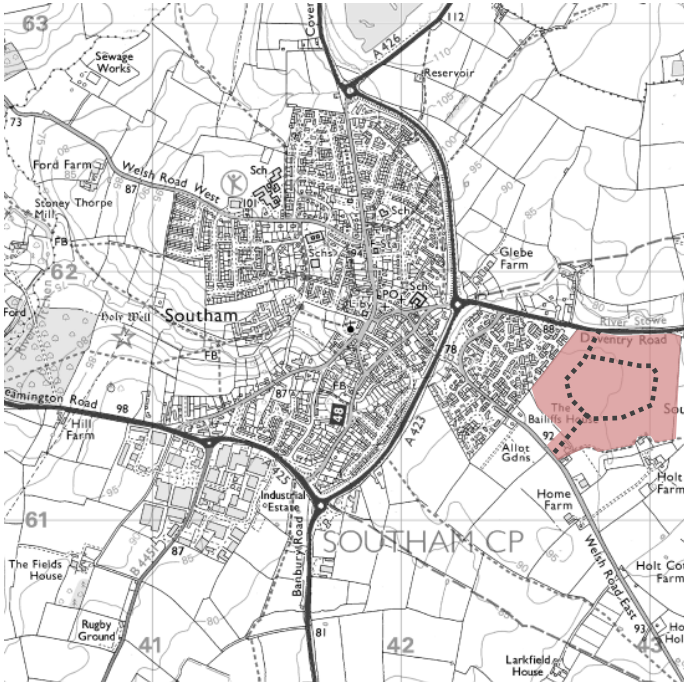
The primary and secondary route can be designed to cater for public transport vehicles and will include bus stop facilities, such that the majority of the site will be within 400m of a bus stop. These routes will form a public transport route through the development to link the development into the Warwickshire hinterland.

**Secondary Route:** Secondary routes are designed to penetrate the individual development blocks and cater for vehicles at reduced speeds, which will be reflected in the design and appearance of these roads.



**Tertiary Route:** These will be designed to penetrate individual housing clusters and will be designed to encourage lower vehicle speeds and could incorporate shared spaces between motor vehicles, pedestrians and cyclists.

In relation to the off site road network, it is envisaged through careful masterplanning and supporting sustainable modes of travel, as discussed above, the development will not have a significant impact on the operation of the local road network.



**Figure 2g:** Development access strategy

Access to the development could be taken from the A425 via a T junction, reflecting the Welsh Road East junction. Developments that deliver more than 150 – 200 dwellings often require a second point of access. The potential access points have been reviewed to ensure that access can be delivered. Potential access points have been developed, in accordance with the design guidance contained within the Design Manual for Road Bridges. These are contained in this report, demonstrating safe points of access can be delivered.

Through the initial investigations, no locations have been identified as a traffic constraint. It is considered unlikely that a development of this quantum will trigger the need for any substantial highway interventions.

In the previous sections of the report, it is explained that the transport network should include:

- Strong walking and cycling links
- Significantly enhanced public transport

The development of the site should consider the phased delivery of local facilities and amenities that provides a range of day to day key facilities to further reduce the need to travel.

#### OPPORTUNITY FIVE – ROAD NETWORK

Provide a comprehensive road hierarchy on site, supported by walking/cycling/public transport enhancements.

Provide where appropriate, improved specific off site junctions.

## Key Site Opportunities

To deliver a sustainable development and to improve this area of Southam, the development should consider the need to:

- Deliver a comprehensive walking and cycling access strategy that will improve connectivity with the hinterland of the site
- Deliver improvements to public transport routes that will enhance connectivity with the site, surrounding residential and commercial areas and neighbouring towns
- Reduce the need to travel
- Deliver an access strategy that will effectively and efficiently penetrate the whole of the site

With the above in mind, there are numerous interventions that can be delivered that will greatly benefit the wider transport networks and assist in the delivery of a sustainable development. The identified opportunities are indicated below.

Opportunity	Description
<b>OPPORTUNITY ONE</b> Walking and Cycling Networks	Masterplan to include walking and cycling network on site Well designed connections into the existing off site networks Improved routes into the hinterland to include links
<b>OPPORTUNITY TWO</b> Public Transport Networks	Enhanced public transport network connecting the site High quality facilities Operating at improved frequency during peak times
<b>OPPORTUNITY THREE</b> Accessibility	Provide a range of local amenities and facilities Improve quality of life for future and existing residents
<b>OPPORTUNITY FOUR</b> Sustainable travel	Reduce the need travel outside the development for everyday conveniences through the delivery of complementary land uses Comprehensive travel planning to further reduce traffic generation
<b>OPPORTUNITY FIVE</b> Road network	Improvements to off site junctions where appropriate

Figure 2h: Key Site Opportunities

## Transport Summary

The site has been reviewed to determine the opportunities presented to deliver a sustainable residential development.

With the introduction of appropriate measures as part of the development, a sustainable development can be delivered in accordance with the National Planning Policy Framework. Recommended measures are:

- Provide a comprehensive on site pedestrian and cycle network
- Provide continuous footways along the Daventry Road and Welsh Road East connecting the site with the surrounding residential and commercial areas
- Provide a high quality connection to the A423 underpass
- Provide good links beyond to the existing town centre of Southam
- Provide a bus service with improved frequency to serve the site and surrounding residential and commercial areas, supported by high quality infrastructure
- Provide a mix of uses that carefully considers the local needs of the development and surrounding residential area
- Provide a travel plan to identify the strategy to discourage the reliance on the private motorcar and to build upon the sustainable infrastructure improvements
- Provide a comprehensive road hierarchy on site, supported by walking/cycling/public transport enhancements
- Provide where appropriate, improved specific off site junctions

### 3 Flood Risk & Drainage

#### National Planning Context

The National Planning Policy Framework (NPPF) was introduced in March 2012, with the aim at rationalising and simplifying planning guidance. The Policy is supported by a PPG, which provides advice in relation to Flood Risk and Drainage matters. This element of the guidance largely follows the principles set out in the earlier adopted planning guidance on flood risk and drainage, being PP25.

Allocation and planning of development must be considered against a risk based search sequence, as provided by the NPPF guidance. In terms of fluvial flooding, the guidance categorises flood zones in three principal levels of risk, as follows:

Flood Zone	Annual Probability of Flooding
Zone 1: Low probability	< 0.1 %
Zone 2: Medium probability	0.1 – 1.0 %
Zone 3a / 3b: High probability	> 1.0 %

Figure 3a: NPPF Flood Risk Parameters

The Guidance states that Planning Authorities should “*apply a sequential, risk-based approach to the location of development to avoid where possible flood risk to people and property and manage any residual risk, taking account of the impacts of climate change.*”

According to the NPPF guidance, residential development at the proposed site, being designated as “More Vulnerable” classifications, should lie outside the envelope of the predicted 1 in 100 year (1%) flood, with preference given to sites lying outside the 1 in 1,000 (0.1%) year event and within Flood Zone 1

Sites with the potential to flood during a 1 in 100 (1%) year flood event (Flood Zone 3a) are not normally considered appropriate for proposed residential development unless on application of the “Sequential Test”, the site is demonstrated to be the most appropriate for development and satisfactory flood mitigation can be provided. Additionally, proposed residential developments within Flood Zone 3a are required to pass the “Exception Test”, the test being that:

- The development is to provide wider sustainability benefits
- The development will be safe, not increase flood risk and where possible reduce flood risk

#### Regional & Local Policy

**Regional Flood Risk Assessment:** In accordance with the now superseded PPS25 guidance, the West Midlands Regional Assembly published their Regional Flood Risk Assessment (RFRA) in October 2007. The document is a high level review of flood risk and strategy, with limited if any policy background to current national guidance. .

The RFRA assesses the housing growth allocation for all of the sub-regions under its control and identifies the broad flooding risk associated with each. Stratford upon Avon has been identified within this document as within the medium growth category suggesting that between a 21% and 25% increase in housing has already been allocated within the sub-region. These figures were set against inherent flood risk values and the Stratford upon Avon area was subsequently deemed to have a relatively low probability of flooding.

The document further sets out that these figures are broad indicators of flood risk based on land percentage and probability with no specific flooding data included. The document advises that all LPA’s produce a Strategic Flood Risk Assessment to provide specific details that support or disprove these indicative values.

**Strategic Flood Risk Assessment:** To support local planning policy, NPPF guidance recommends that local planning authorities produce a Strategic Flood Risk Assessment (SFRA). The SFRA should be used to help define the Local Development Framework and associated policies; considering potential development zones in the context of the sequential test defined in the guidance.

A Level 1 SFRA was produced for the sub-regional group in January 2008. The group comprised Coventry City Council, Solihull Metropolitan Borough Council and the County, Boroughs and District Councils of Warwickshire including Stratford-on-Avon District Council as the authority relevant to the proposed site.

Since the publication of this document, there have been a number of significant to the planning policy within the UK including the revocation of Regional Spatial Strategies, the introduction of the National Planning Policy Framework (NPPF) and the Flood and Water Management Act (FWMA).

To this end, the sub-regional group commissioned a new SFRA which was subsequently published in September 2013. The SFRA document makes no specific reference to the proposed development site however, it assessed the risk of flooding in the wider Warwickshire area from the following sources:

- Fluvial Flooding
- Surface Water Flooding
- Sewer Flooding
- Groundwater Flooding

In addition, the SFRA provides the following recommendations for dealing with flood risk and drainage:

#### **Flood Risk Recommendations**

1. Ensure the Sequential Test is undertaken for all land allocations to reduce the flood risk to the allocation and ensure that the vulnerability classification of the proposed development is appropriate to the Flood Zone classification;
2. FRAs should be undertaken for all developments within Flood Zones 2 and 3 to assess the risk of flooding to the development and identify options to mitigate the flood risk to the development, site users and surrounding area;
3. FRAs are required for developments identified as at risk from other sources of flooding, proportionate to the nature and scale of the flood risk source and the type of development proposed;
4. To manage future flood risk, FRAs should look at opportunities to accommodate additional water as a result of climate change;
5. An 8m buffer strip must be maintained along fluvial river corridors respectively, to ensure that maintenance of the channel can be undertaken;
6. Promote flood resilience at the individual property level; and,
7. Continue to maintain those assets that are effective in managing current and future flood risk, and look to improve defences where they fall below the required standard of protection.

Finished floor levels of all residential and commercial development within Flood Zone 3 should be raised above the 1% AEP (1 in 100 year) plus climate change flood level (including a freeboard allowance of at least 600mm).

Potential access & egress routes should be identified and recommendations made for appropriate actions of future occupants in the event of flooding.

The groundwater, surface water and historic flood mapping should be reviewed to determine the risk of flooding from sources other than fluvial. When a proposed development is located within an area with an identified flood risk, then a flood risk assessment should determine the actual risk to the development and recommend appropriate mitigation measures. The flood risk assessment must demonstrate to the satisfaction of the Environment Agency that the development will not exacerbate the existing flooding situation, and improve existing conditions where possible.

#### **SuDS Recommendations**

1. Sustainable Drainage Systems must be included in new developments as a way to manage surface water;
2. For Greenfield development sites, the rate of surface water runoff generated as a result of the development must be equivalent to the rate of surface water runoff generated from the undeveloped site.;
3. For Brownfield development sites, developers are expected to deliver a substantial reduction in the existing rate of surface water runoff generated from the development and, where possible, limit the rate of surface water runoff to the equivalent Greenfield rate;
4. Where practicable, runoff rates should be restricted to greenfield runoff rates in areas known to have a history of sewer flooding;
5. Where practicable, the separation of surface water from sewers should be undertaken, through consultation with Severn Trent Water or Thames Water Utilities;
6. Sustainable Drainage Systems should be considered in line with the Management Train hierarchy set out in The SuDS Manual, C697, whereby 'Prevention' techniques are considered initially. Adopted techniques should also be located in accordance with the restrictions set out in Policy and Practice for the Protection of Groundwater.

**Water Cycle Study:** The Stratford-on-Avon District Council Water Cycle Strategy was completed in March 2010 and is based on previous drafts of the Stratford-on-Avon Core Strategy. The objective of the study is to encourage an integrated and sustainable approach to the Water Cycle in the District and provide supporting evidence to inform the selection of preferred options for growth.

It covers issues with water supply, water treatment and surface water in relation to the regional development strategy. The strategy gives recommendations for surface water management and flood risk including:

- Separation of surface water and foul water sewers for new developments
- Aspiration to achieve 100% above ground drainage for new developments where feasible
- Developers are to ensure linkage of SuDS to green infrastructure to provide environmental enhancement, amenity and biodiversity
- Water efficiency systems such as rainwater harvesting are to be used where feasible
- SuDS designs are to support the findings of the Warwickshire Surface Water Management Plan, the SuDS manual and Stratford-on-Avon District Council's SFRA
- Surface water discharges are designed to deliver water quality improvements in the watercourse or aquifer where possible to meet objectives set in the Water Framework Directive

**River Severn Catchment Flood Management Plan:** This document was produced by the Environment Agency in December 2009 with the aim to *"help us to understand the scale and extent of flooding now and in the future, and set policies for managing flood risk within the catchment. CFMPs should be used to inform planning and decision making by key stakeholders."*

The proposed development site lies within the Upper Avon area within the Flood Management Plan which is identified to have a relatively low level of fluvial flood risk with fewer than 190 properties at risk from the 1% flood event.



The Upper Avon sub-area is covered by Policy Option 6: *'Areas of low to moderate flood risk where we will take action with others to store water or manage run-off in locations that provide overall flood risk reduction or environmental benefits'*.

It is confirmed that this policy will be applied either locally to a flooding problem, or some distance away where flooding is not a problem. The principle behind this policy is that flooding can be transferred to places where it can bring benefits which in turn reduces the risk in areas where flooding is a problem.

The proposed actions to implement the preferred policy are:

- Maintain flood warning systems and explore opportunities to improve their effectiveness and coverage
- Review how effective and sustainable each flood defence is. Review maintenance operations to ensure they are proportionate to flood risk.
- Carry out a strategic study to investigate the following aspects of storage of floodwater on the floodplain: making the best use of existing storage areas; the potential for extra storage areas within the undeveloped floodplain.
- Encourage rural best practices in land-use and in land-management to restore more sustainable natural floodplains and to reduce run-off.

#### OPPORTUNITY SIX – PLANNING POLICY

Development at Southam is to have regard to the Stratford-upon-Avon Strategic Flood Risk Assessment with proposals providing specific compliance with the SFRA policies.

**Development Flood Risk Assessment:** At a local, site by site, level the NPPF guidance and supporting documents advocate the preparation of a Flood Risk Assessment (FRA). NPPF guidance requires that developments covering an area of greater than one hectare prepare an FRA in accordance with Annex E of the guidance. A FRA is required to be proportionate to the risk and appropriate to the scale, nature and location of the development.

#### Flooding History & Known Mechanisms

The Environment Agency currently holds a detailed SFRM model for the River Stowe downstream of the site to the north. The mapping is therefore based detailed modelling techniques for the 1 in 100 year (1%AEP) and 1 in 1000 year (0.1%AEP) event storms.

The Flood Zone plan for the area shows a corridor of flooding along the River Stowe to the north of the site with flows on the watercourse seen to come out of bank during the 1 in 100 (1% AEP) and 1 in 1,000 year (0.1% AEP) events. The current EA Flood Zone Map is shown below in Figure 3b.

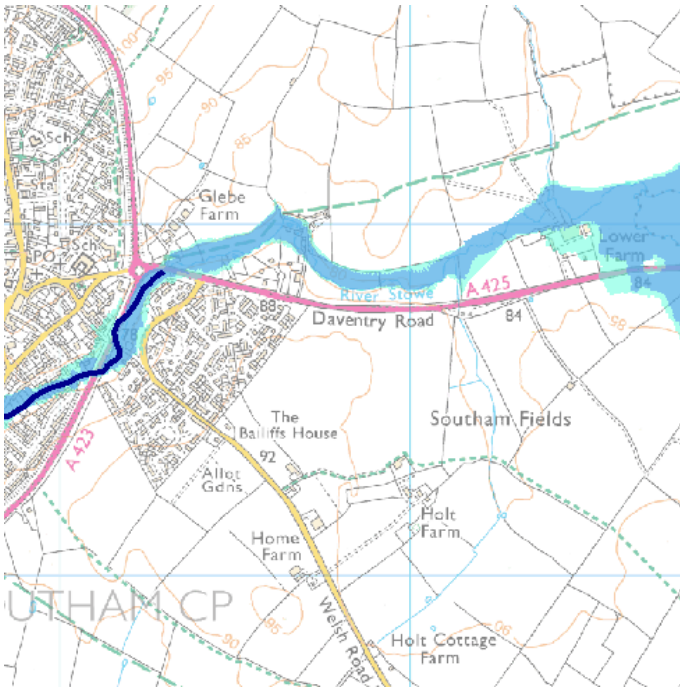


Figure 3b: EA Flood Zone Plan

- Flooding from rivers without defences – 1 in 100 year (1%) event (Zone 3)
- Extent of extreme flood – 1 in 1,000 year (0.1%) event (Zone 2)
- Flood defences
- Areas benefiting from flood defences

The proposed development is shown to lie within Flood Zone 1 being an area of low probability of flood risk and as such, in a preferable location for development when appraised in terms of the NPPF guidance

### Storm Drainage

The site is currently undeveloped in nature, as such, there is potential for the site to implement a site storm water drainage system that provide Sustainable Drainage (SuDS) measures that are consistent with the recommendations of NPPF, the Stratford-upon-Avon SFRA documents, Sewers for Adoption and published guidance in the form of CIRIA C522, C609, C697 et al.

The existing site wide drainage mechanisms will be appraised to ensure the system post development proposals do not materially alter the baseline regime. To ensure development does not increase flood risk, water discharged from the site will be at a rate no greater than the baseline conditions for the range of storm events.

Reference to the published geology confirms that much of the site is underlain by limestone and as such, there is potential that the site could be served by an infiltration type drainage system, implementing measures close to source to deal with stormwater runoff

Coupled with the storm water control benefits, the use of SuDS can also provide a betterment on water quality. National guidance in the form of CIRIA 609 outlines that by implementing SuDS, storm water from the site can be polished to an improved standard thus ensuring the development proposals have no adverse effects on the wider hydrology.

The following paragraphs outline the potential SuDS features appropriate for use on site and their place within a multi tiered system.

### Primary Drainage Systems (source control)

At the head of the drainage network, across the site, source control measures will be implemented to reduce the amount of run-off being conveyed directly to piped drainage systems.

Through work on other similar strategically sized projects, BCL has shown that peak discharges of circa 15% in residential areas can readily be achieved using source control measures without unacceptable impacts on net developable land or prohibitive financial implications.

### Permeable Paving

Permeable Paving is approved by many Local Authorities for implementation on the development road network and can act as a receptor for surface water run-off from nearby house roofs. However, the system is perhaps best suited to managed parking areas and shared surfaces where block paving is typically used as the surface treatment and ongoing maintenance can be ensured by way of a management company or the like.

There is little need for underground pipes or gullies, and the attenuation afforded within the sub-base layer helps to reduce the volume of storage required elsewhere.



Figure 4a: Permeable paving

### Filter Strips

Filter strips have been used in the drainage of highways for many years. The absence of traditional pipe work in such a system frees the drainage design to employ shallow gradients on both channels and drains, which in turn also act as a means of passive treatment to improve water quality.

Highways within the development could potentially incorporate filter drains. Alternatively, filter strips can be used to collect flows from areas such as a group of houses. Figure 4b below shows an example of a filter strip in a road corridor.

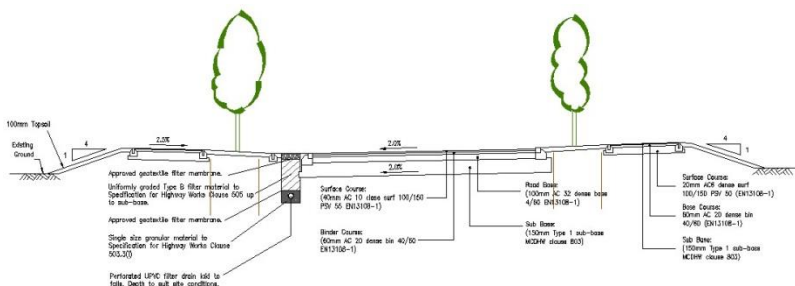


Figure 4b: Filter Strip along highway

### Ditches

Ditches may be used along highways and in common areas to infiltrate, attenuate and convey flows from hard surfaces across the development before being discharged in to the secondary system. Linear features, such as ditches and filter strips provide an efficient means of improving water quality.

### Swales

While swales implemented at development parcel level can be very land hungry, costly to maintain and provide difficulties with frontage access, the opportunity potentially exists to implement a swale on the western boundary of the site, through the development. Green space being incorporated along the highways could be designed to allow 'over the edge' flows to be directed into the swale for infiltration, attenuation and conveyance. A typical highway swale is show in Figure 4c below:



Figure 4c: Swale along road corridor

### Attenuation Drainage Systems

Attenuation drainage systems collect partially treated excess water from the primary source control systems at a local level, thereafter providing both flow and water quality attenuation and flow conveyance through the site towards the main outfall.

It is anticipated that a basin will be utilised and designed to primarily be dry with permanently wet low flow channels to convey run-off in periods of low rainfall, which will in turn provide the passive treatment benefits offered within the remainder of the surface water management network.

The primary aims of the basin will therefore be:

- Final flow and water quality conditioning
- Provide landscaping, amenity and ecological benefits

At this stage, without the benefit of masterplanning proposals for the site, the nature of the SuDS measures to be implemented will need to remain flexible with the above information acting as a guide for the strategy to be employed.

### OPPORTUNITY SEVEN – SUSTAINABLE DRAINAGE

The storm drainage system at the site is to be designed in accordance with NPPF, SFRA, Sewers for Adoption and published CIRIA guidance et al.