South Staffordshire Level 2 Strategic Flood Risk Assessment Detailed Site Summary Tables	

Site details

Site Code	**SA4**
Address	Land on either side of Stafford Road, North of Penkridge / 392583, 315215
Area	65.74ha
Current land use	Greenfield
Proposed land use	Residential

Sources of flood risk

Location of the site within the catchment	The River Penk flows along the eastern border of the site. The Staffordshire and Worcestershire Canal is located 0.3km to the east of the site, with the the Lodgerail Pool Reservoir based 0.89km to the east.
Existing drainage features	Two small ordinary watercourses are shown to drain from the west border of the site, joining near Strafford Road, before joining the River Penk. This watercourse is culverted under Stafford Road and appears to be incorporated into SuDS as part of the development at Goods Station Lane. There are also a number of small ponds across the site.
Fluvial	**The proportion of site at risk (EA Flood Zones):** **FZ3 –** 0.7% **FZ2 –** 1.3% **FZ1 –** 98.7% **The proportion of site at risk (modelled outlines):** **2% –** 0.6% **1% –** 0.7% **0.1% –** 0.8% *The % Flood Zones quoted show the % of the site at flood risk from that particular Flood Zone/event, including the percentage of the site at flood risk at a higher risk zone, e.g. FZ2 includes the FZ3 %. FZ1 is the remaining area outside FZ2 (FZ2 + FZ1 = 100%). As there are no Flood Risk Management features or defences the flood risk defined by the zones is also the actual flood risk.* **Available data:** The Environment Agency's (EA) Flood Maps for Planning have been used within this assessment. The Environment Agency's River Sow & Penk (2011) Model has been used to inform this assessment. The percentages quoted above relate to Environment Agency Flood Zones and the River Penk **Flood characteristics:** From the model results, flooding is shown to affect site in the 2%, 1% and 0.1% AEP events. The River Penk flows along the eastern border of the site. In the 2% AEP event, modelling suggests that only the area in the immediate vicinity of the River Penk (along the eastern border) will be flooded, with approximately 0.6% of the site affected. Predicted flood depths along the eastern border of the site are generally low (<0.2m – 0.4m) with the exception of areas in the southeast corner within the immediate vicinity of the river channel where depths reach up to >1.40m. Hazard across the flooded area is generally very low, with the only areas of greater hazard classification 'danger for most' being the land in the immediate vicinity of the river .

	The predicted extent of flooding obtained from the generalised modelling is not substantially greater in the 1% AEP event compared to the 2% AEP event. Predicted depths remain low (up to 0.4m) across the flooded area (except near the channel). In the 1% AEP event velocities up to 0.5m/s are predicted in the southeast corner of the site. Along the eastern border, the velocities remain as they were in the 2% event, <0.25m/s. Hazard classification in the 1% AEP event remains largely very low with a few areas of 'danger for most' in the channel and at the point where the ordinary watercourse meets the river. In the 0.1% AEP event, again the predicted results using the generalised modelling suggest there is only minor increase in flood extent compared to the 1% AEP event. Depths remain low across most of the flooded area but, as in the other AEP events, can reach >1.4m in the southeast corner. Velocities reach up to 0.8m/s in the southeast corner of the site. Hazard remains very low across most of the flooded area, however, reaches up to 'danger for most' in the areas of deeper pooling. Most of the site is at very low risk of fluvial flooding, and development should be avoided along the south-eastern border of the site directly adjacent the river.
Surface Water	**Proportion of site at risk (RoFfSW):** **3.3% AEP** – 2.2% Max depth: >1.2m Max velocity: 1.0 - 2.0m/s **1% AEP** – 3.4% Max depth: >1.2m Max velocity: 1.0-2.0m/s **0.1% AEP** – 4.7% Max depth: >1.2m Max velocity: >2.0m/s *The % SW extents quoted show the % of the site at surface water risk from that particular event, including the percentage of the site at flood risk at a higher risk zone (e.g. 100-year includes the 30-year %)* **Description of surface water flow paths:** The site is shown to be affected by surface water flooding in all modelled events. In the 3.3% AEP event, risk to the site is generally low, with surface water forming flow paths along the ordinary watercourse with a large area of pooling in the lower lying land surrounding the confluence of the ordinary watercourses, southwest of the roundabout. From online mapping, this area appears to be integrated into SuDS features which may not be accurately represented in the Environment Agency's Risk of Flooding from Surface Water dataset. There are also a number of significant areas of ponding (approximately 50-60m diameter) within the site. Maximum depths are >1.20m (solely at the large area of ponding southwest of the roundabout), maximum velocities between 1.0 -2.0m/s and maximum hazard 'danger for all'. In the 1% AEP event, surface water extent in all areas affected during the 3.3% and 1% AEP events increases. Depths and velocities are greatest along the ordinary watercourses at >1.2m, with velocities greatest in the flow path, up to 1.0-2.0m/s. Maximum hazard is 'danger for most' across the majority of the flooded area, with a small area of 'danger for all' at the large area of ponding. In the 0.1% AEP event, the predicted extent of flooding expands significantly, with flow paths widening and paths joining the largest areas of ponding forming. Depths across the flooded area are generally low, but exceed 1.2m at the large area of ponding southwest of the roundabout. Maximum hazard remains 'danger for most' across the majority of the flooded area with a singular area of 'danger for all' at the area of ponding southwest of the roundabout. Most of the site is shown to be at very low risk of surface water flooding. It is also noted that there appear to be SuDS features present that are not reflected in the modelling which may affect the true level of risk. This should be investigated as part of a site-specific Flood Risk Assessment and drainage strategy at the proposal stage.
Reservoir	The Environment Agency reservoir flood risk extent online dataset provides insight into the extent of water inundation originating from reservoirs. The site is shown to be at risk of flooding from reservoir sources in both the dry day and wet day scenario. The reservoir flood inundation on site is confined to the south eastern corner, which is closest to the River Penk.
Canals	The Staffordshire and Worcestershire Canal is located 0.3km to the east of the site. Due to topography, the canal is unlikely to pose a risk to the site in the event of a breach or overtopping event.
Groundwater	The Environment Agency's Areas at Risk form Groundwater Flooding dataset does not cover the site. It is recommended that the risk from groundwater flooding is investigated as part of a site-specific flood risk assessment at the proposal stage to confirm the risk to the site.
Flood history	The site is not situated within the boundaries or in the immediate vicinity of historical flooding events.

Flood risk management infrastructure	
Defences	The site is not protected by any formal flood defences.
Residual risk	There are no formal flood defences in the vicinity of the site that could pose a risk to the site in event of failure. There are three culverts: one underneath Teddesley Road, one under Stafford Road and one under Crown Bridge, which may pose a risk to the site if it were to become blocked. This should be investigated as part of a site-specific FRA.
Emergency planning	
Flood warning	The south eastern border of the site lies within an Environment Agency Flood Alert Area.
Access and egress	The site is split in half by Stafford Road, providing access to the entire site. Access and egress is unlikely to be affected in the 0.1% AEP fluvial event. Stafford Road is affected by surface water flooding in the 3.3%, 1% and 0.1% AEP surface water events, and access/egress may be impeded. During the 3.3% AEP and the 1% AEP events, flood depths on the road, near the roundabout reach up to 0.3-0.6m. However, in the 0.1% AEP event, depths could reach up to 0.6-0.9m. Safe access and egress will need to be demonstrated in the 1% AEP event plus climate change fluvial and rainfall events, using the depth, velocity and hazard outputs.
Climate change	
Implications for the site	• During the 1% AEP + 20% CC fluvial modelling outputs the site is not shown to be particularly sensitive to increased fluvial flows as a result of climate change, with flood extents and depths being only slightly larger than the equivalent 1% AEP present day event. • Surface water climate change uplifts have been modelled for the 3.3% AEP and 1% AEP surface water events in the Central and Higher climate change scenarios. Surface water risk is sensitive to climate change during the 3.3% and 1% climate change events. The area of surface water flooding increasing by approximately 38% in some areas of the site during the 3.3% Central event. Maximum depths on site reach up to >1.2m in the 1% AEP Higher Climate change scenario. • Developers should consider SuDS strategies to reduce the impacts of climate change from surface water in a detailed site-specific FRA. • The preservation of existing and predicted future surface water flow routes and storage volumes should be considered when preparing the layout and site scheme. • A site-specific FRA, with the most up-do-date climate change allowances, should be undertaken to investigate the implications of climate change on the site.
Requirements for drainage control and impact mitigation	

Broad-scale assessment of possible SuDS	**Geology & Soils**
	• Geology at the site consists of:
	  ○ Bedrock- Triassic Rocks (undifferentiated) Mudstone, Siltstone and Sandstone
	  ○ Superficial- the north west corner of the site is Till-Diamicton, the eastern edge of the site is Glaciofluvial Sheet Deposits, Devensian- Sand and Gravel
	• Soils at the site consist of:
	  ○ Freely draining slightly acid loamy soils (the eastern side of the site), slightly acid loamy and clayey soils with impeded drainage (the north western side of the site) and slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils (south western side of the site)
	
	SuDS
	• The site's susceptibility to groundwater flooding is unknow and this should be confirmed through additional site investigation work. Below ground development such as basements may be susceptible to groundwater flooding. Groundwater monitoring is recommended to determine the seasonal variability of groundwater levels, as this may affect the design of the surface water drainage system. Below ground development such as basements may not be appropriate at this site.
	• BGS data indicates that the underlying geology is a mixture of sandstone and mudstone which is likely to be of highly variable permeability; sandstone being permeable and mudstone is poorly draining. This should be confirmed through infiltration testing. Off-site discharge in accordance with the SuDS hierarchy may be required to discharge surface water runoff from the site.
	• The site is not located within a historic landfill site.

	• The site is not located within a Groundwater Source Protection Zone and there are no restrictions over the use of infiltration techniques with regard to groundwater quality. • Surface water discharge rates should not exceed the existing greenfield runoff rates for the site. Opportunities to further reduce discharge rates should be considered and agreed with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques. • The Risk of Flooding from Surface Water (RoFSW) mapping indicates the presence of surface water flow paths during the 3.3% AEP event. Existing flow paths should be retained and integrated with blue-green infrastructure and public open space. • If it is proposed to discharge runoff to a watercourse or sewer system, the condition and capacity of the receiving watercourse or asset should be confirmed through surveys and the discharge rate agreed with the asset owner.
Opportunities for wider sustainability benefits and integrated flood risk management	• Implementation of SuDS at the site could provide opportunities to deliver multiple benefits including volume control, water quality, amenity and biodiversity. This could provide wider sustainability benefits to the site and surrounding area. Proposals to use SuDS techniques should be discussed with relevant stakeholders (LPA, LLFA and EA) at an early stage to understand possible constraints. • Development at this site should not increase flood risk either on or off site. The design of the surface water management proposals should take into account the impacts of future climate change over the projected lifetime of the development. • Opportunities to incorporate filtration techniques such as filter strips, filter drains and bioretention areas must be considered. Consideration should be made to the existing condition of receiving waterbodies and their Water Framework Directive objectives for water quality. The use of multistage SuDS treatment will clean improve water quality of surface water runoff discharged from the site and reduce the impact on receiving water bodies. • Opportunities to incorporate source control techniques such as green roofs, permeable surfaces and rainwater harvesting must be considered in the design of the site. • The potential to utilise conveyance features such as swales to intercept and convey surface water runoff should be considered. Conveyance features should be located on common land or public open space to facilitate ease of access. Where slopes are >5%, features should follow contours or utilise check dams to slow flows. • Surface water discharge rates should not exceed the existing greenfield runoff rates for the site. Opportunities to further reduce discharge rates should be considered and agreed with the LLFA. It may be possible to reduce site runoff by maximising the permeable surfaces on site using a combination of permeable surfacing and soft landscaping techniques.
NPPF and planning implications	
Exception Test requirements	The Local Authority will need to confirm that the sequential test has been carried out in line with national guidelines. The Sequential Test will need to be passed before the Exception Test is applied. A small portion of the site lies inside Flood Zone 2 and 3. It is recommended a precautionary approach is taken and the Exception Test applied. This will inform the safe design of development and enable the flood hazards to be identified at the appropriate level of detail.
Requirements and guidance for site-specific Flood Risk Assessment	**Flood Risk Assessment:** • Due to the site lying partly within Flood Zone 2 and 3, a site-specific Flood Risk Assessment will be required. Detailed modelling of the ordinary watercourse, including channel survey, should be undertaken as part of the FRA. • The site-specific FRA should be carried out in line with the National Planning Policy Framework; Flood Risk and Coastal Change Planning Practice Guidance; the South Staffordshire Local Development Scheme; and the Staffordshire County Council Lead Local Flood Authority's Statutory Consultee for Planning Guidance Document. • Consultation with the Local Authority and the Lead Local Flood Authority should be undertaken at an early stage. **Guidance for site design and making development safe:** • The developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the development meets the objectives of the NPPF's policy on flood risk. For example, how the operation of any mitigation measures can be safeguarded and maintained

effectively through the lifetime of the development. (Para 048 Flood Risk and Coastal Change PPG).

- The development should be designed using a sequential approach. Development should be steered away from areas of flood risk along the southeast boundary of the site and near the roundabout on Stafford Road, preserving these spaces as green infrastructure. This is unlikely to significantly limit the area available for development. In particular, low-lying land in the south of the site should be left undeveloped and surface water flow routes should be preserved and integrated into blue-green infrastructure.
- Safe access and egress will need to be demonstrated in the 1% AEP event plus climate change fluvial and rainfall events, using the depth, velocity and hazard outputs. Ideally, the access route should be situated 300mm above the designed flood level and waterproofing techniques should be used where necessary. Raising of access routes must not impact on surface water flow routes or contribute to loss of floodplain storage. Consideration should be given to the siting of access points with respect to areas of surface water flood risk.
- Where buildings are situated in areas of flood risk, finished floor levels should be raised at least 300mm above the design flood level, including an allowance for freeboard.
- On site attenuation schemes would need to be tested to ensure flows are not exacerbated downstream within the catchment.
- Surface water should be discharged at the pre-development (greenfield) runoff rate which presents wider opportunities to improve biodiversity and amenity as well as climate change adaptation. An integrated flood risk management and sustainable drainage scheme for the site is advised.
- Developers should refer to Staffordshire County Council's SUDS Handbook and the Level 1 SFRA for information on SuDS for guidance on the information required by the LLFA from applicants to enable it to provide responses to planning applications.

Key messages

Despite the predicted generalised modelling flood extents on the site, flood depths are likely to be very low and the principle of development can be supported by implementing practical schemes based on an appropriate understanding of the flood hazards. This will involve:

- Detailed modelling of the watercourse on site which shows that the site is not at significant risk from fluvial flooding and users of the site will not be at risk in future as a result of climate change.
- Preparation of a site-specific Flood Risk Assessment demonstrates that the site is not at an increased risk of flooding in the future as a result of climate change, and that the development of the site does not increase the risk of flooding both on the site and downstream.
- Demonstration of safe access and egress in the 1% AEP fluvial and surface water events including allowance for climate change.
- Raising of finished floor levels at least 300mm above the design flood level, including an allowance for freeboard at locations where flood risk is predicted.

Mapping Information

The key datasets used to make planning recommendations regarding this site were the broadscale 2D modelling outputs from the Environment Agency's Flood Map for Planning and the Risk of Flooding from Surface Water map. More details regarding data used for this assessment can be found below.

Flood Zones	Flood Zones 2 and 3 have been taken from the Environment Agency's Flood Map for Planning mapping.
Climate change	Climate change uplifts have been applied to the Environment Agency's Risk of Flooding from Surface Water dataset for the 3.3% and 1% AEP scenarios.
Fluvial depth, velocity and hazard mapping	Depth, velocity and hazard outputs have been taken from the Environment Agency's River Sow & Penk 2011 model was used in this assessment. The model is TUFLOW and is 1d, with selected 2D domains.
Surface Water	The Risk of Flooding from Surface Water map has been used to define areas at risk from surface water flooding.
Surface water depth, velocity and hazard mapping	The surface water depth, hazard and velocity mapping are taken from the Environment Agency's Risk of Flooding from Surface Water mapping.