FLOOD RISK ASSESSMENT

NATIONAL PLANNING POLICY FRAMEWORK (NPPF)

Proposed Residential Development, former Werrington School, Stoke-on-Trent

Commissioned by:	Lovell Partnerships Ltd c/o Unit E Pinewood Bell Heath Way Woodgate Business Park Birmingham B32 3BZ
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Reference:	B14215
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STEWART & HARRIS

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APPENDIX

1 Introduction

1.1 Stewart and Harris, part of the Patrick Parsons Group were commissioned by Lovell Partnerships Limited to prepare a Level 1 Flood Risk Assessment to accompany a full planning application at the former Werrington School, Stoke-on-Trent, which will be made to Stoke-on-Trent City Council.

1.2 The development proposes the demolition of the former school and construction of 31 open market residential dwellings with associated highway infrastructure.

1.3 The development lies entirely within Flood Zone 1 where there is a low probability of fluvial flooding occurring.

1.4 This Flood Risk Assessment follows government and local guidance on development and flood risk (National Planning Policy Framework NPPF) and is undertaken in consultation with the relevant bodies.

It is a requirement for development applications to consider the potential risk of flooding to the proposed development over its expected lifetime and any possible impacts on flood risk elsewhere in terms of its effects on flood flows and run off.

The following aspects of flood risk should be addressed in all planning applications in flood risk areas:

- The area liable to flooding.
- The probability of flooding occurring now and over time.
- The extent and standard of existing flood defences and their effectiveness over time.
- The rates of flow likely to be involved.
- The likelihood of impacts to other areas, properties and habitats.
- The effects of climate change which currently requires designs to include 1 in 100 year rainfall events + 30% climate change allowance.
- The nature and current expected lifetime of the development proposed and the extent to which it is designed to deal with flood risk.

2 Site Location and Description

2.1 The site is located on land occupied by the former Werrington Primary School, located in the residential estate between Armshead Road and Ash Bank Road, accessed off Russell Grove, Werrington. The village of Werrington lies approximately 8km north-east of Stoke-on-Trent city centre. The Ordnance survey National Grid reference to the centre of the site is E393980, N347570 (see site location plan in Appendix A1).

2.2 The site is rectangular in shape and occupies a total area of 0.83 ha.

2.3 The Werrington Primary School was constructed in the early 1980s and was closed in the last few years, possibly 2012. At the time of writing, the building had not been demolished but remains vacant and securely boarded up.

2.4 The neighbouring land use is as follows:

To the west - Rear gardens to residential units, mainly bungalows, accessed off Russell Grove/Stonehouse Road
To the north - Rear gardens to residential units accessed off Russell Grove
To the east - Rear gardens to residential units accessed off Oak Mount Road
To the south - Rear gardens to residential units accessed off Oak Mount Road and Stonehouse Road, in between there is a strip of Public Open Space giving pedestrian access from the school to Oak Mount Road near the junction of Ash Bank Road

2.5 Vehicular access to the site will be via Russell Grove in the north-west corner of the site.

2.6 The site itself is relatively flat, with levels ranging from 259.6m AOD around the entrance off Russell Grove, 260.7m AOD in the northern most corner and down the eastern boundary and along the southern boundary of 258.4m AOD. The highest point is along the eastern corner where the site rises locally to 262.5m AOD. The existing building finished floor level is approximately 259.2m AOD.

2.7 The existing buildings and hardstandings are still in existence pending ecological works and planning permission, therefore this site is classified as Brownfield land.

2.8 The primary school building occupies the centre of the site, with the access road to the west and hardstanding playground/parking in the north of the site. There is a small grass playing field near the site entrance in the north-west and a small grassed area in the south east corner. The majority of the site is covered with hardstanding with only a few soft overgrown landscaped areas towards the northeast and southwest of the site. Dense hedges bound the site in addition to a 1.9m high fence.

2.9 A Topographical Survey can be found in Appendix A2.

3 Site Development Proposals

3.1 At the time of writing the report the proposals are as follows:

- Demolish the existing primary school building and all associated outbuildings, remove hardstandings, access roads and car parking areas.
- Redevelop the site for residential use, suitable for 21 open market and 10 affordable rental dwellings and associated adopted infrastructure.

3.2 A copy of the development proposals can be found in Appendix A8.

4 Existing Drainage

4.1 Severn Trent Water Limited have been contacted for information regarding existing public foul and surface water sewers and permission to connect into the sewer network. A copy of the sewer records can be found in Appendix A4.

4.2 PRIVATE DRAINAGE

4.2.1 The existing school buildings and hardstanding areas appear to be positively drained, however, no record drawings are available. A connectivity survey to locate and trace existing foul and storm water connections has been undertaken on part of the site on behalf of Lovell Partnerships and is included in Appendix A3.

4.2.2 Using these records we have allowed for utilising existing connections for both foul and storm sewers, in order to minimise disruption to local residents. A further connectivity survey will be required for the remainder of the site and this will be undertaken in due course and will therefore be reviewed on an ongoing basis. Any redundant drains will be abandoned or removed.

4.3 PUBLIC FOUL WATER DRAINAGE

4.3.1 There is an existing public foul water sewer 150mm dia, going south-east along the rear of the properties in Russell Grove from head of run manhole 9502, in the vicinity of the site entrance, via manhole 9508 in adjacent rear gardens, manhole 9507 (also in rear gardens) in between house numbers 66 and 67 before crossing Stonehouse Road between manholes 9505 and 9510. The sewer records indicate that the depths of these drains are approximately 1.6 to 1.8 metres deep, therefore connections are feasible. Copy of sewer records are included in Appendix A.4.

4.3.2 At the time of writing, the most feasible point of connection for the foul drainage is to manhole 9507, which is thought to be where the current school drainage discharges to the sewer via a private manhole in the school property. This manhole is located in third party land in the rear garden of a neighbouring property (either 66 or 67 Stonehouse Road).

4.3.3 A drainage connectivity survey was undertaken in October 2014 by Lovell Partnerships in conjunction with DNUK who undertook a CCTV survey of the private drainage network within the site. This survey confirmed that the school drainage connects in to manhole 9507, as shown on the hand-annotated plan in Appendix A.3. It may be possible to re-use the existing connection and/or manholes, once the condition has been verified by the CCTV survey.

4.3.4 Should connections be required to manhole 9502, the finished floor levels of the proposed units in the south of the site will need to be raised by approximately 1.5 to 2 metres to facilitate a gravity connection.

4.3.5 There is an additional public foul water sewer 225mm dia, running through the public open space to the south of the site, which could offer a less intrusive point of connection in the vicinity of 0401. Sewer records indicate that this manhole is approximately 5m deep and involves crossing third party land. Permission is currently being sought to determine whether this is feasible.

4.3.6 An application has been made for a Developer Enquiry and this is awaited from Severn Trent Water. Once received it will be included in Appendix A.4.

4.4 PUBLIC SURFACE WATER DRAINAGE

4.4.1 There is an existing public surface water sewer 225mm dia going south along Russell Grove from the head of the run at Manhole 9501 to 9504 into Stonehouse Road with an incoming 150mm spur from manhole 9505 into 9506, before it turns to the west and continues along Stonehouse Road. Copy of sewer records are included in Appendix A.4.

4.4.2 The proposed point of connection for the storm drainage is likely to be to either manhole 9503 or manhole 9504. The current school drainage discharges to manhole 9503 via a private network within the school grounds. Dependent on levels it may be possible to re-use the existing connection and/or manholes, once the condition has been verified by the CCTV survey.

4.4.3 Sewer records indicate that the public surface water sewer is approximately 2m deep therefore no problems are anticipated for connections from the development.

4.4.4 Additional note from Severn Trent Water Limited:

Since 1st October 2011 many private sewers have been transferred into the ownership of Severn Trent Water Limited as public sewers, where two or more properties in separate ownership are served by those sewers. Most of these former private sewers will not be shown on the public sewer records, therefore a full site survey should be carried out prior to any layout design or construction works to identify where these sewers may be and to avoid later delays and possible added costs.

4.4.5 The development layout will be designed to have a minimum impact on the existing sewers, with easements provided of 5 metres o/a for the 225mm dia pipes and 10 metres o/a for pipes 300mm dia and above. Where this is not possible, a sewer diversion will be required with the proposed route agreed with Severn Trent Water Limited, subject to a Section 185 Agreement.

4.4.6 There is an additional public storm water sewer 1350mm dia, running along Oak Mount Road, adjacent to the public open space to the south of the site, which could offer an alternative point of connection in the vicinity of manhole 0403, although levels rise in this location and this could only be achieved if finished floor levels were raised across the site. Sewer records indicate that this manhole is approximately 5m deep and involves crossing third party land and connections to a sewer of this size could be costly. Permission is currently being sought to determine whether this is feasible.

4.4.7 An application has been made for a Developer Enquiry and this is awaited from Severn Trent Water. Once received it will be included in Appendix A.4.

4.5 HYDROLOGY

4.5.1 The nearest surface water courses are over 200 metres outside the perimeters of the residential estate in Werrington village, therefore connections to watercourses are unviable.

5 The Environment Agency and Local Guidance

5.1 The Environment Agency and Local Authority Flood Map shows the site to be within Flood Risk Zone 1 – with less than 1 in 1000 chance of flooding from rivers in any one year.

5.2 Applicable Planning Policy

5.2.1 Technical Guidance to the National Planning Policy Framework. It deals specifically with development planning zones. The main study requirement is to identify the flood zones and vulnerability classification relevant to the proposed residential development, based on an assessment of current and future conditions.

5.3 Planning Zones

5.3.1 The overall aim should be to steer new developments to Flood Zone 1. Where there are no reasonably available sites in Flood Zone 1, local planning and authorities allowing land in local plans or determining planning applications for development at any particular location should take into account the flood risk vulnerability of land uses and consider reasonably available sites in Flood Zone 2. Only where there are no reasonably available sites in Flood Zones 1 or 2 should the suitability of sites in Flood Zone 3 be considered, taking into account the flood risk vulnerability of land uses and applying the exception test if required.

Table 5.1 – Flood Zones

Zone 1: Low Probability	
Definition This zone comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding (<0.1%).	**Appropriate Uses** All uses of land are appropriate in this zone. **FRA requirements** For development proposals on sites comprising one hectare or above the vulnerability to flooding from other sources as well as from river and sea flooding and the potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the new development on surface water run-off, should be incorporated in a flood risk assessment. This need only be brief unless the factors above or other local considerations require particular attention. **Policy Aims** In this zone, developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area and beyond through the layout and form of the development and the appropriate application of sustainable drainage systems.
Zone 2: Medium Probability	
Definition This zone comprises land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1%-0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5%-0.1%) in any year.	**Appropriate Uses** Essential infrastructure and the water compatible, less vulnerable and more vulnerable uses as set out in table 2 are appropriate in this zone. The highly vulnerable uses are only appropriate in this zone if the Exception Test is passed. **FRA Requirements** All development proposals in this zone should be accompanied by a flood risk assessment. **Policy Aims** In this zone, developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area through the layout and form of the development and the appropriate application of sustainable drainage systems.

Zone 3a: High Probability	
Definition This zone comprises land assessed as having between a 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.	**Appropriate Uses** The water compatible and less vulnerable uses of land (table 2) are appropriate in this zone. The highly vulnerable uses should not be permitted in this zone. The more vulnerable uses and essential infrastructure should only be permitted in this zone if the Exception Test is passed. Essential infrastructure permitted in this zone should be designed and constructed to remain operational and safe for users in times of flood. **FRA requirements** All development proposals in this zone should be accompanied by a flood risk assessment. **Policy Aims** In this zone, developers and local authorities should seek opportunities to: • Reduce the overall level of flood risk in the area through the layout and form of the development and the appropriate application of sustainable drainage systems. • Relocate existing development to land in zones with a lower probability of flooding and • Create space for flooding to occur by restoring functional floodplain and flood flow pathways and by identifying, allocating and safeguarding open space for flood storage.

Zone 3b: Functional Floodplain	
Definition This zone comprises land where water has to flow or be stored in times of flood. Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. The identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. But land which would flood with an annual probability of 1 in 20 (5%) or greater in any year, or is designed to flood in an extreme (0.1%) flood, should provide a starting point for consideration and discussions to identify the functional floodplain.	**Appropriate Uses** Only the water-compatible uses and the essential infrastructure listed in table 2 that has to be there should be permitted in this zone. It should be designed and constructed to: ▪ Remain operational and safe for users in times of flood ▪ Result in no net loss of floodplain storage ▪ Not impede water flows ▪ Not increase flood risk elsewhere **FRA Requirements** All development proposals in this zone should be accompanied by a flood risk assessment. **Policy Aims** In this zone, developers and local authorities should seek opportunities to: ▪ Reduce the overall level of flood risk in the area through the layout and form of the development and the appropriate application of sustainable drainage systems. ▪ Relocate existing development to land with a lower probability of flooding.

Table 5.2 – Flood Risk Vulnerability Classification

Essential Infrastructure	▪ Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk. ▪ Essential utility infrastructure which has to be located in a flood risk area for operational reasons, including electricity generating power stations and grid and primary substations and water treatment works that need to remain operational in times of flood. ▪ Wind turbines.
Highly Vulnerable	▪ Police stations, ambulance stations and fire stations and command centres and telecommunications installations required to be operational during flooding. ▪ Emergency dispersal points. ▪ Basement dwellings. ▪ Caravans, mobile homes and park homes intended for permanent residential use. ▪ Installations requiring hazardous substances consent (where there is a demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water-side locations or need to be located in other high flood risk areas, in these instances the facilities should be classified as “essential infrastructure”).
More Vulnerable	▪ Hospitals. ▪ Residential institutions such as residential care homes, children’s homes, social services homes, prisons and hostels. ▪ Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels. ▪ Non-residential uses for health services, nurseries and educational establishments. ▪ Landfill and sites used for waste management facilities and hazardous waste. ▪ Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.

Less Vulnerable	▪ Police, ambulance and fire stations which are not required to be operational during flooding. ▪ Buildings used for shops, financial, professional and other services, restaurants and cafes, hot food takeaways, offices, general industry, storage and distribution, non-residential institutions not included in “more vulnerable” and assembly and leisure. ▪ Land and buildings used for agriculture and forestry. ▪ Waste treatment (expect landfill and hazardous waste facilities). ▪ Minerals working and processing (except for sand and gravel working). ▪ Water treatment works which do not need to remain operational during times of flood. ▪ Sewerage treatment works (if adequate measures to control pollution and manage sewage during flooding events are in place).
Water Compatible Development	▪ Flood control infrastructure. ▪ Water transmission infrastructure and pumping stations. ▪ Sewerage transmission infrastructure and pumping stations. ▪ Sand and gravel working. ▪ Docks, marinas and wharves. ▪ Navigations facilities. ▪ Ministry of Defence installations. ▪ Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location. ▪ Water-based recreation (excluding sleeping accommodation). ▪ Lifeguard and coastguard stations. ▪ Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms. ▪ Essential ancillary sleeping or residential accommodation for staff required by uses in this category, subject to a specific warning and evacuation plan.

Flood Risk Vulnerability and Flood Zone Compatibility

Flood risk vulnerability classification (see table 2)		Essential infrastructure	Water compatible	Highly vulnerable	More vulnerable	Less vulnerable
Flood zone (see table 1	Zone1	✓	✓	✓	✓	✓
	Zone 2	✓	✓	Exception Test required	✓	✓
	Zone 3a	Exception Test required	✓	×	Exception Test required	✓
	Zone 3b functional floodplain	Exception Test required	✓	×	×	×

Key: ✓ Development is appropriate
× Development should not be permitted

Notes to table:

This table does not show:
a) The application of the Sequential Test which guides development to Flood Zone 1 first, then Zone 2 and then Zone 3.
b) Flood Risk Assessment requirements, or
c) The Policy aims for each flood zone.

5.4 Stoke-on-Trent City Council

Stoke-on-Trent City Council has been consulted via the Staffordshire Moorlands District Council Strategic Flood Risk Assessment, Level 1 – Report dated August 2008 produced by Halcrow Group Ltd, to assess the potential risk to the site.

There are three watercourses at a distance of more than 200m from the site, all located within private or third party land.

5.5 Strategic Flood Risk Assessment Summary

Existing Water Features	Three separate watercourses – minimum 200m away
Historical Flooding	None
Fluvial Flood Risk	None
River and Coastal Flooding	None
Flooding from Artificial sources	There are five sites within the ST9 0 postcode, although more information is not available
Flooding from impounded water bodies	None
Groundwater Flooding	No known problems
Flood Warning Zone	Stoke on Trent and Ashbourne Area including Newcastle Under Lyme, Leek and Stone. Areas away from watercourses running through towns are considered as low/negligible risk
Groundwater Source Protection Zone (GSPZ)	Werrington has two of 18 No Groundwater Source Protection Zones - Inner Zones identified by the EA.

The strategic Flood Risk Assessment maps suggest that the site is not affected by fluvial flooding, therefore the site is located in Flood Zone 1.

A copy of the Flood Zone Maps can be found in Appendix A5.

The surface water pluvial flooding map shows no areas of flooding within the site boundary or within the local area to a distance of several hundred metres. The site is not located adjacent to an unmapped watercourse which would not have been considered as part of the SFRA.

Groundwater flooding map shows the site to be moderate to high susceptibility, care must be taken when constructing foundations.

Werrington is located in a GSPZ, which requires storage of runoff to be attenuated to prevent infiltration.

5.6 Environment Agency

The Environment Agency website was checked to assess the potential risk to the site from flooding.

The site is located in Flood Zone 1.

A copy of the Flood Map can be found in Appendix A5.

5.7 Potential Flood Risk to the Site

5.7.1 An appraisal was made of the site and surrounding areas to assess the potential risk of flooding at the site.

5.7.2 The proposed development is bound by residential properties served off adopted public roads to all four sides.

5.7.3 The site in general falls north west towards the site entrance in Russell Grove

5.7.4 Both Russell Grove and Stonehouse Road fall away from the site.

5.7.5 It is unlikely any flooding from third party land will flow towards the site.

5.7.6 Flooding during heavy storms needs to be diverted away from the buildings and routed towards the roads.

5.8 Flood Risk Assessment Summary

Possible Flood Mechanisms

JBA were consulted to produce an overview of the risk to flooding from the Centremaps live data source, which is included as Appendix A.6:

Source/Pathway	Significant	Comment/Reason
Rivers/Coastal	No	No Risk
NaFRA Flooding Map	No	Very Low (lowest category)
Historic Flooding Events	No	No Risk
Pluvial	Yes	rhas been assessed to be high risk by rainfall-generated overland flow before runoff enters the sewer
Fluvial	No	No Risk
Infrastructure Failure	Yes	There are Severn Trent Water Limited sewers in close proximity to the site.

Flood Risk Assessment Summary

Aspects of Flood Risk	Assessment/Comment
Area liable to flooding	The development site lies within Flood Zone 1 of the Environment Agency Flood Zone Map.
Probability of flooding occurring	There are no records of flooding from surface water or groundwater at the site.
Standard of existing flood defences and their effectiveness	N/A
Likely depth of flooding	0.1 to 0.3 metres by a 1 in 75 year event
Rates of flow likely to be involved	N/A
Surface Water Features	There are no features within 250m of the site

6 Existing Ground Conditions

6.1 Georisk Management Geo-environmental technical Consultants undertook a ground investigation and subsequent report in July 2014. A summary of its findings is below.

6.2 Site History

The history of the site has been established by reviewing the historical Ordnance Survey Maps.

6.2.1 1880

The site is an open field with occasional mature trees around the boundaries. The surrounding area comprises fields and smallholdings. The village of Werrington is situated towards the south east of the site.

6.2.2 1925

The site shows no sign of change. The village of Werrington has been further developed, several ponds and surface water features are now located around the site.

6.2.3 1937

The site shows no sign of change. An area of Armshead Road has started to develop.

6.2.4 1964

The site shows no sign of change. The residential expansion around Werrington starts in the early 1950's.

6.2.5 1970

The site shows no change but the surrounding areas are undergoing significant residential development.

6.2.6 1983

The development of Werrington School has taken place.

6.2.7 1994

The school remains but the immediate area surrounding the site is now residential.

6.3 Hydrology

6.3.1 The nearest surface water feature is over 250m from the boundary of the site. There are no significant surface water features that could influence the hydrology of the site.

6.3.2 There is one current surface water abstraction license located within 1000m of the site.

6.4 Hydrogeology

6.4.1 Information obtained from Envirocheck by Georisk Management indicates that the site is located over a Secondary A Aquifer, where permeable layers could support water supplies at a local level, generally these were formerly classified as minor aquifers.

6.4.2 The aquifer designation data is based on geological mapping provided by the British Geological Survey. The maps are divided into two different types of aquifer designation.

- Superficial (drift) permeable unconsolidated (loose) deposits. For example, sands and gravels.
- Bedrock – solid permeable formations, e.g., sandstones, chalk and limestone.

6.5 Radon Gas

6.5.1 The information provided for Georisk Management by the BGS and in the Envirocheck report indicates that radon protection measures are not necessary in the construction of new dwellings or extensions.

6.6 BGS Recorded Mineral Sites

6.6.1 There are nine BGS Recorded Mineral sites within 250m of the site including one on the site itself. The BGS Recorded Mineral site located on the site itself was an opencast quarry for sand from the Glaciolacustrine Deposits, which has now ceased operations.

6.7 Ground Conditions

6.7.1 Made Ground

Encountered at each test location from ground level down to depths of between 0.10m and 1.10m. A variable mixture of pale grey and orangish brown sandy angular gravel of limestone and brick or firm grey and brown gravelly clay, with gravel from limestone with occasional brick cobbles and clay pipe. This was not mapped from the geological records but is anticipated to originate from construction of the school.

6.7.2 Superficial Deposits - Glacial Tills

Encountered in all trial pits and windowless boreholes from beneath the top soil or Made Ground down to the end of pits at between 2.0 and 4.45 metres. Represented by gravelly clay and sand and gravel deposits.

6.7.3 Millstone Grit Group

Not encountered in the investigation, but would typically be found at depth according to BGS records. Represented by a fine to very coarse grained feldspathic sandstone with interbedded siltstones and mudstone.

6.7.4 Groundwater

Groundwater was only recorded in one borehole at a depth of 0.7 metres and was not expected to be encountered during the intrusive investigations. It is believed this is perched water and not indicative of groundwater depths.

6.7.5 Asbestos

No asbestos was encountered in samples of the Made Ground taken across the site.

6.7.6 Soakaway Design

Soakaway tests were undertaken in four trial pits in accordance with BRE Digest 365 Soakaway Design.

Insufficient percolation prevented an infiltration rate to be calculated, therefore soakaways are unsuitable for use on this site.

7 Drainage Proposals

7.1 Storm Water Management

7.1.1 Flood risk in any area is controlled by a number of contributing factors. At the local scale, when developing or re-developing a site, it is usual to acknowledge that part of the site itself would play in contributing to, or potentially alleviating flood risk.

Any failure to implement a carefully considered storm water management plan is likely to result in excessive peak flows to a local watercourse and in turn exacerbate flood risk downstream.

Allowable rates of site storm water discharge from the site to the public sewer system are being discussed with Severn Trent Water Limited as part of the Developer Enquiry.

7.2 Sustainable Urban Drainage Systems (SUDS)

7.2.1 Sustainable urban drainage systems (SUDS) involve the management of storm water from developments effectively in order to reduce the impact of run-off both to the site in question, and properties downstream and not to exacerbate existing problems. This is achieved by not increasing peak flows that will otherwise result from the development. The philosophy of SUDS is to mimic, as closely as possible, the natural drainage from a site before development, and to ensure that storm water runoff is treated so there is no detriment to water quality of the receiving watercourse.

Using a SUDS system may provide water quantity and quality control, as well as increased amenity value. Appropriately designed and maintained schemes may improve the sustainable water management at the site by:

- Reducing peak flows to watercourses or sewers and potentially reducing the risk of flooding downstream.
- Reducing the volume, rate of discharge, and the frequency of water flowing directly to watercourses or sewers from the developed sites.
- Improving water quality compared with conventional surface water sewers by removing pollutants.

7.3 Potential SUDS Options on Site

7.3.1 The following represents our considered views on suitable SUDS options appropriate to this site. CIRIA C697 The SUDS manual was consulted to examine the use of SUDS on this site. Our conclusions are based on the assessment of the site and the evaluation of the relevant design requirements and regulatory consultation.

7.4 Potential SUDS Techniques Considered for this Site.

7.4.1 Green Roofs

Green roofs comprise a multi-layered system that covers the roof of a building or podium structure with vegetation cover, over a drainage layer. They are designed to intercept and retain precipitation, reducing the volume of run-off and attenuating peak flows.

Cost to the structure can be considerable and poor maintenance will leave it looking unsightly.

Not recommended.

7.4.2 Soakaways

Soakaways are square or circular excavations, either filled with rubble or lined with brickwork, precast concrete or polyethylene rings/perforated storage structures surrounded by granular backfill. They can be grouped and linked together to drain large areas including highways. The supporting structure and backfill can be substituted by modular geocellular units. Soakaways provide storm water attenuation, storm water treatment and groundwater recharge.

The site is a medium to high permeability classification, however, the vast majority of the site is underlain by several metres of Glacial Tills, which did not yield a sufficient infiltration rate to make soakaways feasible.

Not recommended.

7.4.3 Swales

Swales are linear vegetated drainage features in which surface water can be stored or conveyed. They can be designed to allow infiltration, where appropriate. They should promote low flow velocities to allow much of the suspended particulate load in the storm water runoff to settle out, thus providing effective pollutant removal. Roadside swales can replace conventional gullies and drainage pipes.

On larger sites, swales are relatively easy to incorporate into the landscape design it can reduce the run-off rates and volumes.

They are however, inefficient on densely populated sites and at this time there is a lack of clarity and direction as to how these facilities are to be adopted and maintained in the future in conjunction with the emerging legislation. The shallow storm drainage and lack of adjacent watercourses does not support the inclusion of swales

Not recommended.

7.4.4 Pervious Pavements

Pervious pavements provide a pavement suitable for pedestrian and/or vehicular traffic, while allowing rainwater to infiltrate through the surface and into the underlying layers. The water is temporarily stored between infiltration to the ground, reuse or discharge to a watercourse or other drainage system. Pavements with aggregate sub-bases can provide good water quality treatment.

The use of permeable paving for parking bays can be used as a stone sub-base not only stores and slows down the rate of discharge, but also raises the water quality.

Recommended.

7.4.5 Geo-cellular/Modular Systems

Modular plastic geo-cellular systems with a high void ratio that can be used to create a below ground storage structure.

Modular tanks can be used for run off attenuation but requires silt trap protection and a suitable means of access for cleaning and inspection.

Recommended.

7.4.6 Ponds

Ponds can provide both storm water attenuation and treatment. They are designed to support emergent and submerged aquatic vegetation along their shoreline. Run off from each rain event is detained and treated in the pool. The retention time promotes removal through sedimentation and the opportunity for biological uptake mechanisms to reduce nutrient concentrations.

They are however, inefficient on small and densely populated sites and at this time there is a lack of clarity and direction as to how these facilities are to be adopted and maintained in the future in conjunction with the emerging legislation.

Not Recommended.

7.4.7 Water butts

Water butts can be an effective way of utilising roof run-off for re-use in private gardens, particularly in Code for Sustainable Homes compliance is part of the design brief. Run off from each rain event is detained however, no water quality improvements can be gained from this technique. No attenuation benefit can be obtained from water butts as for design purposes it is generally accepted they would be full prior to a heavy storm.

They are however, inefficient on small and densely populated sites and at this time there is a lack of clarity and direction as to how these facilities are to be adopted and maintained in the future in conjunction with the emerging legislation.

Not Recommended.

7.5 Surface Water Discharge

7.5.1 Severn Trent Water Limited and the Environment Agency guidelines on Greenfield and Brownfield developments must be adhered to for this site.

7.5.2 The prevailing ground conditions of between 0.7m and 4.45m are Glacial Tills, comprise sandy gravelly clays, overlying Millstone Grits which are fine sandstones at depth.

With regard to soakaway design due to several metres of Glacial Tills, these soils are unsuitable for soakaways to be used.

7.5.3 Severn Trent Water Limited and a subsequent connectivity survey have confirmed that the former Werrington School discharged surface water to a public sewer.

7.6 Calculated Existing Brownfield Discharge Rate

The existing topographical survey plan can be found in Appendix A2.

Discharge is towards the exiting public surface water sewer at the site entrance in Russell Grove.

Discharge Area = 0.251ha

Based upon a 50mm/hr rainfall using the brownfield formula stated in Developer enquiry

Maximum brownfield discharge = 34.9 l/s

7.7 Allowable Discharge

Severn Trent Water Limited will require a 20% reduction in the discharge rate.

Allowable discharge = 27.9 l/s

7.8 Proposed Development Discharge

The calculated maximum allowable discharge = 28l/s.

At this stage until the Developer Enquiry is received, we have conservatively assumed that 5 l/s can be discharged, reflecting a greenfield run-off rate. As such the attenuation requirements have been calculated to adhere to this rate. Once the Developer Enquiry is received we will review this and adjust the discharge rate and attenuation as required.

The total proposed contributing area is calculated at 0.83 Ha

Based upon the maximum allowable discharge, the table below shows the amount of attenuation required for any given return period.

Return Period	Max Flow l/s	Attenuated Volumes m^3
2	3.6 l/s	63 m^3
30	3.6 l/s	132 m^3
60	4.0 l/s	158 m^3
100	4.2 l/s	180 m^3
100 + 30%	5.0 l/s	240 m^3

7.8.1 The development layout shall be designed to have a minimum impact on the existing sewers, with easements provided of 6m o/a for the 225mm dia pipes and 10m o/a for pipes over 225mm dia. Where this is not possible, a sewer diversion will be required with the route agreed with Severn Trent Water.

7.8.2 Stewart and Harris Limited have prepared a surface water strategy drawing which can be found in Appendix A.7.

7.8.3 Stewart and Harris Limited have prepared micro-drainage calculations which can be found in Appendix A.8.

7.9 Foul Water Discharge

7.9.1 Severn Trent Water Limited has confirmed that their records indicate that the foul water from the existing properties does drain to a public sewer.

7.9.2 It is our proposals to discharge foul water from the development of 31 houses into the existing public foul sewer at a rate of approximately 2 l/sec.

7.9.4 We are waiting for Severn Trent Water Limited to confirm that we have unrestricted foul water discharge.

7.9.5 A separate adopted foul water drainage system is to be provided within the site.

7.9.7 The development layout shall be designed to have a minimum impact on the existing sewers, with easements provided of 5m for the 225mm dia pipes and 10m for pipes over 225mm dia. Where this is not possible, a sewer diversion will be required with the route agreed with Severn Trent Water Limited.

7.9.8 Stewart and Harris Limited have prepared a foul water strategy which can be found in Appendix A7.

8 Conclusions

8.1 Severn Trent Water Limited have been contacted and documents have been reviewed to determine the foul and surface water strategy for this development.

8.2 Foul water will discharge into the existing public foul sewer.

8.3 Surface water will discharge into the existing public sewer and is restricted to 5 l/sec into the existing public surface water sewer. Once the Developer Enquiry is received and the connectivity survey completed this will be reviewed and the attenuation adjusted accordingly.

8.4 Attenuation will be provided through storage tanks located in private areas and in oversized pipes under adopted roads.

8.5 Porous paving has been considered and included in private drives and private shared spaces.

8.6 The use of sustainable urban drainage (SUDS) has been considered and only attenuation tanks and porous paving could be incorporated within the design, dependent on viability.

8.7 The site lies within the Environment Agency Flood Zone 1. The location of the proposals is therefore appropriate.

8.8 This report has been prepared to meet the requirements of National Planning Policy Framework for a site not at risk of flooding.