

Land South of Church Street, Church Gresley Drainage Strategy Report: Foul & Surface Water

St. Modwen Developments Limited
October 2013

ATKINS

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Executive Summary

Site Name and Address:	Land off Silkstone Close Church Gresley Swadlincote South Derbyshire																																		
Grid Reference:	SK 297 181	Size (hectares):	12 hectares																																
Current Use:	<table border="1"> <tr><td>Greenfield</td><td></td></tr> <tr><td>Brownfield (disused)</td><td>X</td></tr> <tr><td>Industrial</td><td></td></tr> <tr><td>Commercial</td><td></td></tr> <tr><td>Landfill</td><td></td></tr> <tr><td>Rail</td><td></td></tr> <tr><td>Residential</td><td></td></tr> <tr><td>Other</td><td></td></tr> </table>	Greenfield		Brownfield (disused)	X	Industrial		Commercial		Landfill		Rail		Residential		Other		Proposed Use:	<table border="1"> <tr><td>Residential</td><td>X</td></tr> <tr><td>Commercial</td><td></td></tr> <tr><td>Industrial</td><td></td></tr> <tr><td>Hospital</td><td></td></tr> <tr><td>Educational</td><td></td></tr> <tr><td>Rail</td><td></td></tr> <tr><td>Landfill</td><td></td></tr> <tr><td>Other</td><td></td></tr> </table>	Residential	X	Commercial		Industrial		Hospital		Educational		Rail		Landfill		Other	
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Hospital																																			
Educational																																			
Rail																																			
Landfill																																			
Other																																			
Comment:	Former clay and colliery site (restored)	Comment:	Residential development																																
Flood Zone:	1	Vulnerability:	More Vulnerable																																
Sequential Test:	Passed	Exception Test:	N/A																																

Description:

A 12ha site formerly used for the excavation of clay and coal materials is proposed for a residential development. The proposed development will comprise up to 306 residential dwellings with the provision of access, parking, public open space, landscaping and associated infrastructure. In line with the National Planning Policy Framework and Environment Agency Standing Advice, the site has been reviewed for potential flood risks at an early stage.

The initial screening for flood risks has identified that the site is not at risk from the following sources: coastal/tidal/estuarine flooding; overland flows from adjacent areas; infrastructure flooding from canals, reservoirs or flood defences.

1. Introduction

1.1. General

The proposed drainage network developed from the drainage strategy must be capable of operating correctly following climate-change over the anticipated lifespan of the development. Residential developments are considered likely to remain for at least 100-years. According to NPPF and PPS25, Table B.2, the peak rainfall intensity that is used to test the system performance must be increased by 30%. The drainage network, therefore, must be effective at managing surface water on the site for rainfall up to and including the 1 in 100-year +30% storm event.

1.2. Existing Site Features

The site comprises an area of open space / grassland with several well trodden paths transecting the site. A drain and hedgerow (or line of trees) bisects the site from northeast to southwest roughly through its centre. The western boundary of the site is densely covered with vegetation and trees. The northern tip of the site (south of Rockcliffe Close) is densely covered in trees and vegetation.

The site is bounded by trees and areas of densely planted woodlands.

Adjacent land predominantly comprises residential development with some light industrial / commercial properties to the north and west and a mix of open grassland / woodlands to the east and south.

1.2.1. Topography

A site-specific topographical survey has been undertaken for the site. The ground within the site boundary slopes down in a south-easterly direction, from 125m AOD along the north-western boundary to 105m AOD at the south-eastern corner of the site. The fall of the site is approximately uniform at 1 in 20 (5%) taken as a perpendicular route running northwest to southeast across the site.

The surrounding land reaches a high-point of around 130m to the north-west of the site boundary along Queen Street.

1.2.2. Geology & Groundwater

Reference to the 1:50,000 BGS Geological Map for Loughborough Sheet 141 (Ref. 2) indicates that drift deposits are absent below the site. The solid geology comprises Pennine Middle Coal Measures Formation typically comprising mudstone, siltstone and sandstone. A geological fault is shown running through the eastern section of the site trending north-west to south-east with a down-throw to the south-east.

A review of information on the BGS website provides an indication of the type of ground on the site by comparison with available BGS boreholes that are located to within a 100m of the site boundary. Borehole SK21NE177 lies just off Church Street (opposite Woodside Doctor's Surgery). This borehole indicates stiff grey shaley clay to approximately 4m deep and then grey clay/mudstone below that. Borehole SK21NE75 lies approximately 50m due south from the southern tip of the site. Although there is no data for the first two metres of the borehole, it describes the lower strata as dark grey silty and fine, suggesting a clayey material.

These two records (refer to Appendix C3) coupled with the site history described in the Flood Risk Assessment report, suggest that the site will be unsuitable for the disposal of surface water by infiltration methods.

Site-specific ground investigation information is not yet available for the site and the existing or potential drainage pathways across the site are therefore unknown.

1.2.3. Hydrological Features

A watercourse/drain is present along the southern boundary flowing from west to east and another drain flows south along the eastern boundary from a pond located to the north-east of the site (at SK 30163 18379) in the former clay pit site. From the topographical survey, it appears that these watercourses are located wholly outside of the site boundary.

Just inside the site's southern boundary and running parallel to the watercourse is shown another ditch course. However, this is disjointed and, although connectivity may exist with the watercourse, the site survey does not show any obvious connection. This connection would need to be proved and the "gaps" in its connectivity would need to be recreated in order to utilise this ditch as a prospective outfall.

A drainage ditch is also identifiable on detailed mapping running from north-east to south-west through the central area of the site and flowing into the watercourse along the south-western boundary.

Another ditch is shown on the survey, within the site boundary along the northern edge of the development. The ditch appears as a land drainage outfall from St. George's Primary School playing field, runs along the northern boundary for approximately 60m and outfalls via a pipe from the site. The master plan proposals and the location of this ditch, preclude it from being any part of the proposed development.

Management of watercourses varies. Ordinary watercourses are under the management of the Lead Local Flood Authority (LLFA) whereas main rivers are under Environment Agency management.

Other features nearby include:

- A large lake located approximately 420m to the east, near Donnington Pastures, with opencast workings just to the south and east of the lake at Spring Cottage and Boothorpe.
- A surface water balancing pond, immediately to the east of the site, presumably attenuating the flows from the new Thorpe Downs Road residential development.
- Various smaller lagoons and pools associated with the mine workings are also present.

1.2.4. Current Site Drainage

The site appears to be greenfield, although historic land-use maps show the industrial heritage of the site. In terms of its current surface water drainage, overland flows discharge to the formalised ditches described above as follow:

Rain falling onto the site will drain overland in an easterly direction; the western part of the site is intercepted by the existing north-south ditch. This water is discharge to a ditch immediately south of the site's southern boundary. Rainfall to the east of the north-south ditch will drain overland, across the eastern boundary of the site and into the ordinary watercourse approximately 50m to the east of the site.

Due to the size of the existing ditch course in and/or around the site, there is no current information to suggest whether these features have the capacity to cause flooding to the existing site. The design development will need to provide sufficient calculations to be assured that if such flooding occurs, the proposed development will be unaffected. Potentially, this will require a Level 3 Detailed Assessment.

Existing agricultural land drainage may be present but this has not been proved.

Borehole records suggest that infiltration is unlikely below the first few layers of topsoil.

2. Site Drainage Proposals

2.1. Details of Proposed Development

An outline plan of the 12 ha proposed site layout is provided in Appendix A. The site is only at outline design stage at the time of writing this report. If the site layout and development plans should change from that presented in this report, further assessment will be required to confirm the mitigation measures proposed herein when they become available. The proposed development will comprise up to 306 residential dwellings with the provision of access, parking, public open space, landscaping and associated infrastructure.

The drainage strategy has therefore focussed upon the residential option to calculate the flow rates and attenuation volumes.

2.2. Surface Water Strategy

2.2.1. General

The means of draining the surface water from site are required to mirror the behaviour of the existing site run-off, so far as is practicable, in order to offset the off-site flood risk that might otherwise be created, or to bypass it entirely.

The proposed drainage strategy has been based on the masterplan drawing STMOD-DYS-CG-002/5, produced by Node Urban Design in October 2013. Subsequent amendments to this version still hold with the general principles of the original masterplan.

The site has been divided into 2 sub-catchments based on topography and existing drainage patterns within the site and the existing (north-south) ditch course that the Environment Agency (EA) wished to be retained. Existing catchment boundaries are shown on the masterplan in Appendix A. Where appropriate, these existing catchments have been approximately combined to form the proposed development catchments.

The underlying strata have poor permeability characteristics: the possibility of widespread infiltration has not been considered as an alternative due to this and the current understanding of groundwater behaviour on site. This also indicated that local area infiltration features would not drain down fast enough to create follow-on storage for subsequent storm events. The storage requirements may be reduced when the permeability of the existing ground is included but the infiltration potential is not considered sufficient to be relied upon as a major part of the new site drainage mechanism.

2.2.2. Requirements of the Regulators

The site lies wholly within the Flood Zone 1 as defined on the Environment Agency's website. During the assessment of flood risk, the EA made the following comments that they would expect to be incorporated into the surface water strategy. These are discussed more fully in the Flood Risk Assessment report, but the key points that affect the drainage strategy are listed below:

- *Retain any existing ditch or watercourse features across the site and incorporate them into the drainage strategy for the site to conserve wildlife habitat ...*
- *Retain a minimum of 4m standoff from any ordinary watercourse....*
- *Review utilities sewer maps...[and] check for privately owned culverts or sewers*
- *... maintain Greenfield runoff rates from the site.*
- *Drainage systems should be designed to manage the first 5mm of rainfall on-site and only rainfall in excess of that should leave the site.*
- *Any SuDS systems used on site should conform to the forthcoming National Standards and appropriate arrangements devised for adoption by relevant authorities.*
- *Sufficient allowance for climate change implications for rainfall and runoff volumes should be included in any drainage design or watercourse assessments.*

The SDDC SFRA does not detail any specific requirements to be considered for drainage design above and beyond those laid down by the other regulatory bodies.

Severn Trent Water are the adopting authority for public sewerage on this area. A copy of the STW sewer records are contained in Appendix C2.

2.2.3. Drainage Catchments

For the purposes of the site-wide surface water strategy the site has been split into 2 sub-catchments, divided by the existing ditch course that runs across the site in a north-south direction.

Each of these sub-catchments will be drained using a combination of traditional piped methods and ditches and/or swales. The existing central ditch will be maintained, in accordance with the Environment Agency's direction (letter reference LT/2012/114910/01-L01 dated 8th August 2012 in Appendix C - Correspondence).

The ditches, swales and to a certain degree the proposed pipes, will provide some attenuation for the developed site. The primary attenuation for the site will be provided by the proposed balancing pond located in the southern area of the site.

2.2.4. Drainage Discharge & Outfalls

The surface water discharge from the site will be maintained to the agreed greenfield run-off rate, in accordance with the National Planning Policy Framework (NPPF) and its associated technical guidance document.

There will be one outfall from the site, located at the south-eastern corner of the site. The site flows will discharge from the balancing pond, probably utilising a vortex flow control, (Hydrobrake[®] or similar) into the existing ditch course.

Note: The red line planning boundary does not include the ditch course to which the site surface water is ultimately discharged. Land access, ownership and legal issues will be resolved to ensure that a legitimate connection exists for the development.

2.2.5. Use of SuDS

The Level 2 Flood Risk Assessment derived a number of SuDS techniques that will be considered for the site. The selection of the most appropriate SuDS needs to consider existing constraints, requirements imposed by the Regulator, proposed development outcomes as well as ownership and maintenance issues. To that end, the more likely SuDS features to be incorporated will be:

- Source control, such as rainwater harvesting and re-use;
- Retention pond(s);
- Existing natural ditches and watercourses;
- Proposed ditches and/or swales;
- Sub surface storage (point source storage).

At this stage of the scheme design's development, it cannot be guaranteed that specific areas or buildings will utilise permeable pavements or green roofs though such measures can contribute significantly to run-off reduction and control. Rainwater harvesting, whilst appropriate to the scheme's aims, would not be considered as part of the drainage solution since it cannot be relied upon in the design storm event. Such applications have not therefore been considered at this stage as part of the outline surface-water strategy but their use within the development should be encouraged where layouts, ownership and/or building forms are amenable.

2.2.6. Network Performance

The surface water drainage strategy developed uses a conventional piped sewerage system to drain the residential blocks. The system is designed for a 2-year rainfall event and has been simulated to accommodate no flooding in a 30-year rainfall simulation, in accordance with Sewers for Adoption 7th Edition.

In detail, the piped network is made up of 6 sub-catchments. The contributing areas associated with the plots have been set at 70% impermeable to represent the residential development density. These piped systems are connected to the balancing pond utilising a combination of existing ditch courses and proposed swales, depicted on the strategy plan as 'Channels A, B, C & D'. The storage will be catered for using a combination of the residual volume within the pipes, swales and ditch courses and, primarily, the detention basin located at the south-eastern corner of the site.

There is opportunity to utilise public open space (POS) and green space as overland flow and/or storage areas for higher return period rainfall events. Rainfall from such events and the associated pluvial flows are not designed to be catered for within a piped network. However, the proposed falls of the site should be designed such that the risk of such extreme flows is mitigated from causing damage to property.

The predicted poor permeability of the ground means that conduits such as sewers and service trenches, with granular backfill, may act as land-drains. There is a possibility that water will accumulate in the backfill and flow with the fall of the drain to affect lower-lying parts of the site. In order to prevent this, the detailed design of the drainage networks will need to incorporate regular 'stanks' or similar barriers at intervals in the backfill, so that no continuous flow-path can be established.

Similarly, any existing field-drain or land drainage network will need to be de-commissioned or disrupted sufficiently during construction of the new development so that it ceases to act coherently and no localised catchment remains that could cause discharges of groundwater within the development. It is not intended that these types of network remain in the future.

2.2.7. Storage

Preliminary storage calculations determined in the Flood Risk Assessment report, describe the storage requirements as follows:

As an outline indication, the results of the UK SuDS website assessment for the development for two scenarios, the first where long terms storage can be provided on site and the second assuming no storage is provided and discharged flows are restricted to 2 litres / second / hectare. The volume of water that would require interception storage to ensure no runoff passes directly into a river (or receiving sewer) based on rainfall events up to 5mm would be 346m³. For a design that has long term storage as an option, attenuation storage volumes were estimated at 5,282m³, long term storage volumes at 2,387m³ and treatment storage of 1,128m³ (total 8,044m³). Where long term storage is not an option and the site relies upon throttled discharge, flows across the site will require more stringent controls and would need to accommodate 8,527m³ of attenuation storage and 1,128m³ of treatment

2.2.8. Ownership & Maintenance

The adoption issues associated with the surface water system relate to the requirements of Severn Trent Water, the local Highway Authority (Derbyshire County Council, DCC) and the Local Authority (South Derbyshire District Council, SSDC). These three bodies will need to be consulted over the intended form of the main drainage components and provisional future ownership/maintenance arrangements.

It is proposed that Severn Trent Water would adopt the piped sewer networks under a Section 104 (Water Industry Act) agreement, whilst DCC and/or SSDC (as a SAB) would adopt the open-channel systems, flow control elements and attenuation-storage areas, the latter being within areas of public-open-space that SSDC are likely to be managing.

2.3. Foul Water Strategy

2.3.1. Existing Situation

There are two foul water pump stations (FWPS) in proximity to the site; refer to the Severn Trent Water public sewer records in Appendix C2.

The first is located on Occupation Road, approximately 300m east of the site. Severn Trent Water sewer records indicate that the foul water rising main laid from this FWPS runs along and within the entire southern boundary of the development site. The exact location will need to be located on site. The nearest location of the foul water gravity sewerage that drains to this pumping station is the public manhole 0802, which is located approximately 180m to the east of the site.

The second FWPS is indicated on the public sewer records as being in a compound at the end of the recently constructed Thorpe Downs Road. The sewer records state that this FWPS and its associated infrastructure, including the rising main, are still subject to a Section 104 agreement being finalised. The possibility of outfalling to this FWPS would involve negotiation with Severn Trent Water and, potentially, the developer of Thorpe Downs Road.

The presence of an adoptable sewerage system just outside the site boundary with Manhole 0802, may present a potential gravity outfall solution for the development, depending upon capacity and land ownership issues.

2.3.2. Development Impact

The proposed development is predicted to generate up to 0.4Ml/day of foul sewage from a potential 624 dwellings.

It is anticipated that the figure provided for the 'residential-only' proposal will be sufficient to address flow rates for either of the alternative proposals.

Correspondence from STW has requested that the developer undertakes a Sewerage Capacity Assessment (SCA) in order to determine the acceptability of the outfall.

2.3.3. Adoption

The foul water system for the proposed development will be 'conventional', designed to comply with Sewers for Adoption 7th Edition and it is therefore intended that the general foul sewer and, if required, pumping-station system be adopted by Severn Trent Water.

The phasing of the development may initially lead to only partial utilisation of the foul sewerage with a consequential increase in maintenance against risk of siltation or septicity. Discussions with Severn Trent Water will be required at detailed design stage to address this issue and to identify any engineering features that will mitigate these effects.

If the FWPS is required, the risk of flooding from power failure halting pumping operations will be addressed through provision of emergency storage against the risk and provision of connections for temporary generators or mobile pumps to replace the fixed plant in such an emergency or during maintenance.

2.4. Residual Risks

The main residual risk considered to apply to the proposed surface water scheme is that arising from exceedance of the new drainage system's capacity in weather conditions above the design standard. In such circumstances there is a high risk of excess run-off being unable to get into the drainage network and instead flowing overland. In addition, due to the poor permeability of the natural ground, even unpaved areas are likely to generate excess run-off in prolonged wet weather as the ground reaches saturation.

The development layout and detailed design of individual buildings will account for likely flow-paths of such water and ensure that appropriate corridors are provided to give a continuous but controlled route through the development for overland flow. This will be investigated further at detailed-design stage and the development design will need to demonstrate that it can control such flooding above the drainage design-standards.

Any residual risk of flooding from the foul water gravity sewerage to convey domestic sewage to a suitable outfall is considered negligible. The current arrangement proposed for this comprises a dedicated foul water system, designed to adoptable standards. As such, the flows through this asset are known and controlled and the risk of flood is minimised by design.

A foul water "suitable outfall" could be to a new foul water pumping station, subject to the results of the STW Sewer Capacity Assessment. The reliance of the domestic drainage systems on pumping to convey flows away from the site puts these systems at risk of failure from power supply (as well as potential mechanical failure, though that can be managed and controlled through regular maintenance). Facilities will be provided for temporary sewage storage and connection points for mobile generators, if standby generators are considered unnecessary.

3. Conclusions & Recommendations

3.1. Drainage Summary – Surface Water

Infiltration is not a viable means for the disposal of the surface run-off from the proposed development, due to the nature of the soil beneath the site and the previous site use. Although site investigation information (October 2012) is not yet available, it is highly unlikely that it would alter this conclusion.

Surface water runoff will discharge via various attenuation, treatment and SuDS techniques to an existing ditch course located just beyond the southern site boundary. The legal ownership and access issues to this ditch course should be resolved to ensure a legitimate outfall for the surface water is available for the proposed site.

It is anticipated that the 'open' sections (ditch course, swales and balancing pond) will be adopted by the lead Local Flood Authority as a SAB and that the 'conventional' piped drainage will be adopted by Severn Trent Water.

3.2. Drainage Summary – Foul Water

A conventional piped foul water system will adequately drain the proposed development. Discharge from the site will be via a new pumping station, located on the eastern boundary of the site, and rising main which will have one of two options as an outfall.

The outfall for its rising main will be dictated by Severn Trent Water and could be either via a new rising main to connect to the existing rising main within the site; or through the site to the public manhole 3107. STW will advise following their consideration, but the preferred option from STW is the point of connection at MH3107.

A potential third option exists to take the foul water via an off-site gravity connection to public manhole 0802, subject to land ownership issues and any technical capacity being agreed with Severn Trent Water.

Whichever option chosen, the developer will be assured of a site-wide foul water drainage solution that is within the developer's gift to undertake and will be prospectively adoptable by Severn Trent Water.

Appendix A. Drawings

A.1. Proposed Masterplan STMOD-DYS-CG-002/5

Appendix B. Calculations

B.1. WinDES calculations

Surface Water Drainage Strategy

Appendix C. Correspondence

C.1. Environment Agency

Letter reference LT/2012/114910/01-L01, dated 8th August 2012

C.2. Severn Trent Water

Letter reference WT26941/8095267, dated 22nd August 2012

C.3. BGS Borehole Record

Borehole record SK21NE177

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