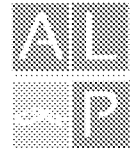


LAND SOUTH OF A259, ANGMERING
FLOOD RISK ASSESSMENT AND DRAINAGE STRATEGY

REDROW HOMES

21 FEBRUARY 2022



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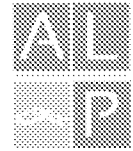
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Executive Summary

A site walkover was conducted in order to establish the location of existing drainage apparatus within and surrounding the development.

An established watercourse on the sites western boundary convey surface water runoff south, from the site, to the downstream established ditch and culvert network, discharging to the Ferring Rife.

The detailed flood map, for fluvial sources, provided by the Environment Agency show that the site area is located wholly within Flood Zone 1. There are no secondary flooding sources identified within the site.

In accordance with PPG ID: 7, the proposed development is classified as 'more vulnerable'. All development types are generally deemed acceptable in terms of flood risk in Flood Zone 1.

Based on the above, the site passes the Sequential Test with respect to NPPF and the Exception Test is not applicable.

The Assessment has considered the potential impact of the development on surface water runoff rates.

The surface water management strategy for the proposed development will manage and reduce the flood risk posed by the surface water runoff from the site.

Site investigation have confirmed infiltration type SuDS may be viable, but they also confirmed high groundwater.

The impermeable area of the proposed development has been calculated for the developed parcel and Urban Creep included, with all discharge rates provided at existing Greenfield discharge rates.

The attenuation requirement for the site could be met by attenuation basins situated in the lower portions of the development. Due to the topography of the site and the low discharge rate, attenuation requirements will be within various basins as opposed to one large one. This would avoid the need to artificially create a fall on site and reduce the quantity of fill material required to develop the site.

Additionally, further SuDS techniques, such as swales and permeable paving, could be introduced over the wider site. Flows will be restricted by use of a control device, such as a Hydrobrake, and the outfall from the attenuation facilities will route flows to the unnamed watercourse located to the west of the site, mimicking existing site conditions

Through the provision of a positive drainage network attributed to the Development, pluvial flooding to offsite receptors will be significantly reduced.

Exceedance flows can be safely accommodated within the Development.

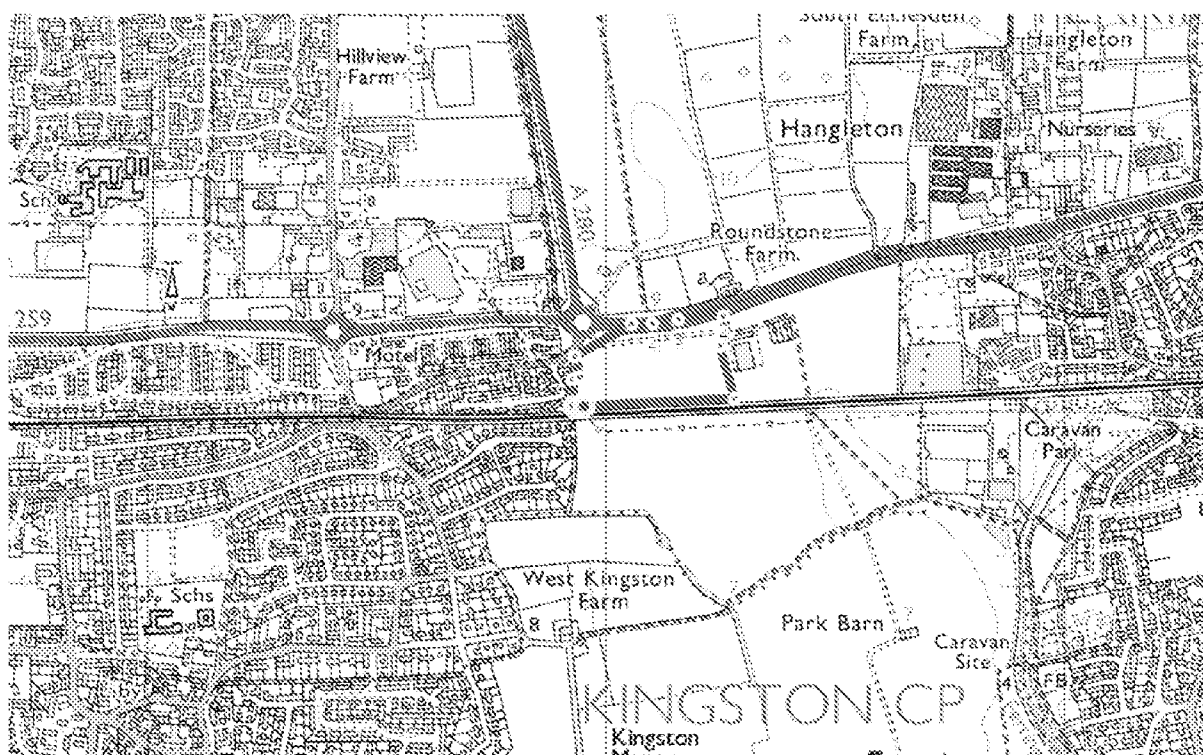
Overall, the Site should not be precluded on flood risk grounds as the Development will not be at risk from existing sources and will not result in an increase in flooding downstream.

1.0 Introduction

Site Context

- 1.1. This report has been prepared by Abley Letchford Partnership Ltd, on behalf of Redrow Homes, in relation to a planning application for the proposed residential development on land located to the south of the A259, Angmering. The location of the site in its local geographical context is shown below.

Site Location Plan

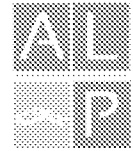


Development Proposals

- 1.2. The proposals will comprise a planning application, for the erection of 76 dwellings, with matters regarding the access, principle internal roads and development being considered in detail.

Requirement for a Flood Risk Assessment (FRA)

- 1.3. The requirement for a Flood Risk Assessment is set out in Section 14 of the revised National Planning Policy Framework (NPPF) as revised in July 2021.



- 1.4. The footnote accompanying Paragraph 167 states:

A site-specific flood risk assessment should be provided for all development in Flood Zones 2 and 3. In Flood Zone 1, an assessment should accompany all proposals involving: sites of 1 hectare or more; land which has been identified by the Environment Agency as having critical drainage problems; land identified in a strategic flood risk assessment as being at increased flood risk in future; or land that may be subject to other sources of flooding, where its development would introduce a more vulnerable use.

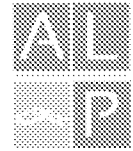
- 1.5. The site is a Greenfield site, extends greater than 1 hectare in total; therefore, a site-specific flood risk assessment is required. To comply with a Planning Application, matters related to flood risk and drainage are addressed within this report.

Report Aim and Formation

- 1.6. The principal aim of this report is to demonstrate the acceptability of the proposed development in respect to flood risk planning policy.
- 1.7. Consideration is given to the risks attributed to both the development itself and the users from all forms of flooding.
- 1.8. The report outlines the impacts the development could have on flood risk in the area by increasing flooding elsewhere resulting from increased surface water runoff, changes in flood routing or loss of flood plain storage and outlines the mitigation systems that will be implemented to minimise this risk.
- 1.9. The presented Drainage Strategy ensures that the guiding principles of Sustainable Drainage Systems (SuDS) are central to the disposal of surface water drainage from the proposed development ensuring a viable robust solution is implementable.
- 1.10. The report finishes by outlining provisions for wastewater disposal.

Report Structure

- 1.11. This report addresses the requirements of NPPF and considers the following aspects:
- Section 2: Policy and Sources of Information – a review of policy relevant to the assessment and sources of information.
 - Section 3: Baseline Environmental Conditions – a description of the site location, its topography, geology and hydrology.
 - Section 4: Flood Risk – the effect of flooding within the existing site layout from all sources.
 - Sections 5 and 6: Drainage Strategy – offer appropriate mitigation measures to protect the site in the post development scenarios for surface and foul water drainage strategies.
 - Section 7: Summary and Conclusions – a review of the suitability of the development proposals in the context of site vulnerability and the requirements of the NPPF.



2.0 Policy and Sources of Information

Introduction

- 2.1. This chapter provides a review of policy relevant to the assessment and sources of information

National Planning Policy

- 2.2. National Planning Policy in relation to Flood Risk is set out in Section 14 of the National Planning Policy Framework (NPPF) and Planning Practice Guidance ID:7 for Flood Risk and Coastal Change (PPG). Flood Risk is discussed in Paragraphs 159-169 of the NPPF.

- 2.3. Paragraphs 159-166 discuss the Sequential approach. Paragraph 162 refers to a Strategic Flood Risk Assessment (SFRA) that would form the basis of applying the Sequential Test for local authorities to allocate development, whilst Paragraphs 163-166 relates to the Exemption Tests.

- 2.4. Paragraph 167 discusses the determination of planning applications stating:

When determining any planning applications, local planning authorities should ensure that flood risk is not increased elsewhere. Where appropriate, applications should be supported by a site-specific flood risk assessment. Development should only be allowed in areas at risk of flooding where, in light of this assessment (and the sequential and exception tests, as applicable) it can be demonstrated that:

- a) within the site, the most vulnerable development is located in areas of lowest flood risk, unless there are overriding reasons to prefer a different location;*
- b) the development is appropriately flood resilient and resilient;*
- c) it incorporates sustainable drainage systems, unless there is clear evidence that this would be inappropriate;*
- d) any residual risk can be safely managed; and*
- e) safe access and escape routes are included where appropriate, as part of an agreed emergency plan.*

- 2.5. The development would be classed as Major Development providing more than 10 homes and the site is greater than 0.5 hectares. Paragraph 169 states:

Major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate. The systems used should:

- a) Take account of advice from the lead local flood authority (LLFA);*
- b) Have appropriate proposed minimum operational standards;*
- c) Have maintenance arrangements in place to ensure an acceptable standard of operation for the lifetime of the development; and*
- d) Where possible, provide multifunctional benefits.*



The Sequential Test, Exception Test and Sequential Approach

- 2.6. The sequential test is an approach used to enable new developments to be designed in areas at lower risk of flooding in preference to sites at higher risk. All opportunities to direct development to reasonably available areas with little or no flood risk should be explored prior to deciding to build in higher flood risk areas. For strategic sites, this is applied by the Local Planning Authority by means of a Strategic Flood Risk Assessment (SFRA).
- 2.7. Dependent upon the type of development under consideration, there may be a subsequent requirement to carry out the Exception Test as depicted within Figure 1 below. The Exception Test ensures that any new developments implemented within areas of flood risk will only occur where flood risk is clearly outweighed by other sustainability drivers and it will ensure that the development can be made safe from flooding and not increase the flood risk elsewhere. The test considers the vulnerability of the new development to flood risk and in order to 'pass', must demonstrate that:
- The development provides wider sustainability benefits to the community that outweigh the flood risk;
 - The development is sited on previously developed land, or if this is not the case, there are no other reasonable alternative sites; and
 - The development is safe, does not increase flood risk elsewhere and where possible will reduce flood risk overall.

Figure 1 – Flood Risk Vulnerability Classification Table 3 PPG ID 7

Flood Risk Vulnerability classification (see Table 1 PPG ID: 7)	Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
Zone 1 Low Probability	Yes	Yes	Yes	Yes	Yes
Zone 2 Medium Probability	Yes	Exception test required	Yes	Yes	Yes
Zone 3a High Probability	Exception test required	No	Exception test required	Yes	Yes
Zone 3b Functional Floodplain	Exception test required	No	No	No	Yes

Key: Yes: Development is appropriate, No: Development should not be permitted.

Climate Change

- 2.8. National Planning Policy (NPPF and PPG) make it a requirement to account for climate change within any proposed development proposal. Research has shown that expected climate change will increase the peak rainfall intensity and river flow, which could result in more frequent and severe flood events.
- 2.9. PPG ID:7 for Flood Risk and Coastal Change Table 2 sets out anticipated changes in peak rainfall intensity in small catchments (less than 5km²), or urbanised drainage catchment (as found within towns and cities. This is depicted below as Figure 2.



Figure 2 – Peak rainfall intensity allowance in small catchments or urban drainage

(Table 2 PPG ID 7)

Applies across all of England	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2115)
Upper End	10%	20%	40%
Central	5%	10%	20%

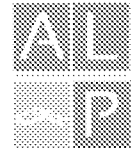
- 2.10. Underlying text supporting Table 2 states that Upper End climate change allowances should be used within the drainage design of all development types.

Environment Agency / GOV.UK

- 2.11. The Flood and Water Management Act 2010 provides the Environment Agency a strategic overview role for all forms of flooding and coastal erosion. They also have direct responsibility for the prevention, mitigation and remediation of flood damage for main rivers and coastal areas. The Environment Agency is a statutory consultee with regards to flood risk and planning dependent upon criteria.
- 2.12. Environment Agency Standing Advice has been consulted and reviewed within this assessment.
- 2.13. The GOV.UK Flood Map for Planning, Long Term Flood Risk and Catchment Data Explorer websites have been interrogated in respect to flood risk extents and sources.

Local Authorities

- 2.14. The Site lies within the administrative area of West Sussex County Council and Arun District Council.
- 2.15. West Sussex County Council (WSCC) became a Lead Local Flood Authority (LLFA) under the Flood and Water Management Act 2010 and provide guidance to assess, manage and inform flood risk.
- 2.16. Planning guidance published by WSCC regarding flood risk was consulted to assess the mitigation policies in place. This includes the "West Sussex LLFA Policy for the Management of Surface water (November 2018)" which sets out the drainage strategies and surface water management provisions by which applications for development will be assessed. Furthermore, the document provides links to wider special strategy and flood risk documents and these have been consulted in preparation of this assessment. These include, but are not restricted to:
- Water. People. Places. A guide for master planning sustainable drainage into developments.
 - West Sussex Local Flood Risk Management Strategy Report.
 - West Sussex Preliminary Flood Risk Assessment.
- 2.17. The Arun Local Plan was adopted on the 18th July 2018 and sets out a spatial vision, objectives and a sustainable strategy for delivering the needed growth of the District over the period 2011- 2031.
- 2.18. Chapter 18 of the Local Plan deals with Water within Arun. The strategic objectives set out are to:
- Plan for climate change and work in harmony with the environment.



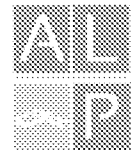
- Ensure water supply and quality are considered alongside wastewater.
 - Avoid increasing (and where possible reduce) risks of, or from, all forms of flooding.
 - Identify opportunities to include Sustainable Drainage Systems.
- 2.19. Having reviewed the key policies in the local plan the development site is considered to align with these primary objectives.
- 2.20. Aruns Supplementary Requirements for Surface Water Drainage Proposals set out local requirements for flooding and drainage including the Surface Water Proposals Checklist. These requirements have been included throughout the FRA and drainage proposals with the checklist provided as an appendix.

Southern Water

- 2.21. Southern Water is responsible for the disposal of waste water within the local area, and for the supply of clean water.
- 2.22. Information with regards to sewer and water main flooding contained within the SFRA has been consulted as part of this assessment. All Water Companies have a statutory obligation to maintain a register of properties/areas which are at risk of flooding from the public sewerage system, and this is shown on the DG5 Flood Register.

Other Sources of Information

- 2.23. A desktop study of the Site was carried out using the following websites to ascertain local features, hydrology and soil characteristics:
- DEFRA's MAGIC portal,
 - British Geological Survey (BGS) and
 - Cranfield University Soilscales portal.
- 2.24. A Site walkover conducted in 2021 allowed observation of existing topography, watercourses, and infrastructure.
- 2.25. Guidance with respect to Sustainable Drainage Systems (SuDS) is contained within DEFRA document Sustainable Drainage Systems, Non-statutory technical standards for sustainable drainage systems March 2015, as well as CIRIA C753 The SuDS Manual, BS8582:2013 – Code of Practice for Surface Water Management for Development Sites and Approved Document H of the Building Regulations.
- 2.26. Additional guidance on development and flood risk is contained within CIRIA C624 Development and Flood Risk – Guidance for the Construction Industry which identifies several key aims for a development to ensure it is sustainable in flood risk terms.



3.0 Baseline Environmental Conditions

Introduction

- 3.1. This chapter provides for a description of the site location, its topography, geology and hydrology.

Site Location and use

- 3.2. The site lies to the south east of Angmering centre on land to the of the A259. The site is bound along its northern side by the A259 and the railway line to the south. To the west is existing housing and to the east is additional land making up the rest of existing farm land.
- 3.3. Overall the site covers approximately 2.9 hectares (Ha) which comprises entirely arable field with no discernible landscape features
- 3.4. The site lies within the administrative area of Arun District Council.
- 3.5. The National Grid Reference of the site is TF 66341 27239.

Topography

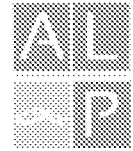
- 3.6. The topography of the site is predominantly flat in nature with levels fluctuating between 8.60m AOD to 7.70m AOD across the site. However, these changes in level are not uniform across the site and made up of small variations within the site with all boundaries predominantly at the same level.

Existing Drainage

- 3.7. The site currently drains by predominantly infiltration and evapotranspiration with some overland flow.
- 3.8. There are no surface water sewers, ditches or watercourses within the site itself. However, beyond the sites western boundary there is a watercourse, partly culverted, which takes overland flow south under the railway line and to a wider drainage network.
- 3.9. A site walkover was conducted with ADC to ascertain the condition of the watercourse beyond the sites boundaries. The result confirmed remedial works would be required to the watercourse due to siltation and poor maintenance.
- 3.10. Currently surface water flows unrestricted from the site, with the only barriers to flow being the capacity of the existing ditches and the culverts under the railway which are large in nature.
- 3.11. The nearest Southern Water foul sewers are in Old Worthing Road, north west of the site which takes flows west to the wider sewer network.

Geology and Hydrogeology

- 3.12. British Geological Survey mapping indicates the superficial geology beneath the site to comprise granular River Terrace Deposits. These are underlain by the bedrock geology of New Pit Chalk Formation. Site testing has confirmed the mapping to be predominantly correct although there are more clays in the superficial geology than envisaged.



- 3.13. The Cranfield University Soilscales maps indicates the soil to be freely draining slightly acidic loamy soil.
- 3.14. Aquifer designations reflect the importance of aquifers in terms of groundwater as a resource and in their role in supporting surface water flows and wetland ecosystems.
- 3.15. Aquifer maps are split into two different types of aquifer designations namely; Superficial (Drift), which are permeable unconsolidated deposits e.g. sands, gravels, etc, and Bedrock, which are solid permeable formations e.g. Sandstone, chalk, etc.
- 3.16. Environment Agency (EA) mapping indicates the site lies within Principal aquifer designation for Bedrock and Secondary A for Superficial Drift.
- 3.17. Mapping confirms that the Site lies outside of any Groundwater Source Protection Zone (SPZ).

Hydrology

- 3.18. The site lies in the catchment of the Ferring Rife located to the east of the site. The Ferring Rife is a tidal river located some 1km to the east of the site.
- 3.19. The Ferring Rife was rated 'Moderate' for Ecological Classification and 'Fail' for Chemical Classification in 2019.

Site Investigations

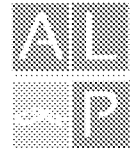
- 3.20. Intrusive ground investigations, groundwater monitoring and soakage testing to BRE DG365 has been undertaken to provide confirmation of the hydrogeology. These were undertaken in winter in accordance with Arun's Drainage Policy. They indicate infiltration type techniques are viable on the site and this tallies with the flood risk and the lack of existing surface water drainage features.

Groundwater Monitoring

- 3.21. Groundwater monitoring was commenced in October 2020 with nine further groundwater monitoring visits through to March 2021.
- 3.22. Groundwater levels ranged between 1.10m to 2m below ground level. Full results are contained within the Appendix.

Infiltration Testing

- 3.23. Infiltration testing was carried out between the 10 February 2021 to 02 March 2021. The scope of works comprised the mechanical excavation of eight trial pits and had a maximum of three soakage tests conducted in line with BRE365.
- 3.24. Tests were completed to depth of approximately 1.00m below ground level and no Groundwater was found.
- 3.25. The results indicated infiltration type techniques are viable across the site but not as good as expected giving the underlying Bedrock. This could be due to the high groundwater encountered above and also the clays in the Superficial deposits.



- 3.26. Winter testing resulted in infiltration rates of between 2.6×10^{-6} m/s and 8.8×10^{-6} m/s across the site. Full results are contained within the Appendix.

4.0 Flood Risk

Introduction

- 4.1. This chapter assesses flood risk at the site from all sources including appropriate allowance for climate change required by relevant National and Local planning policy.

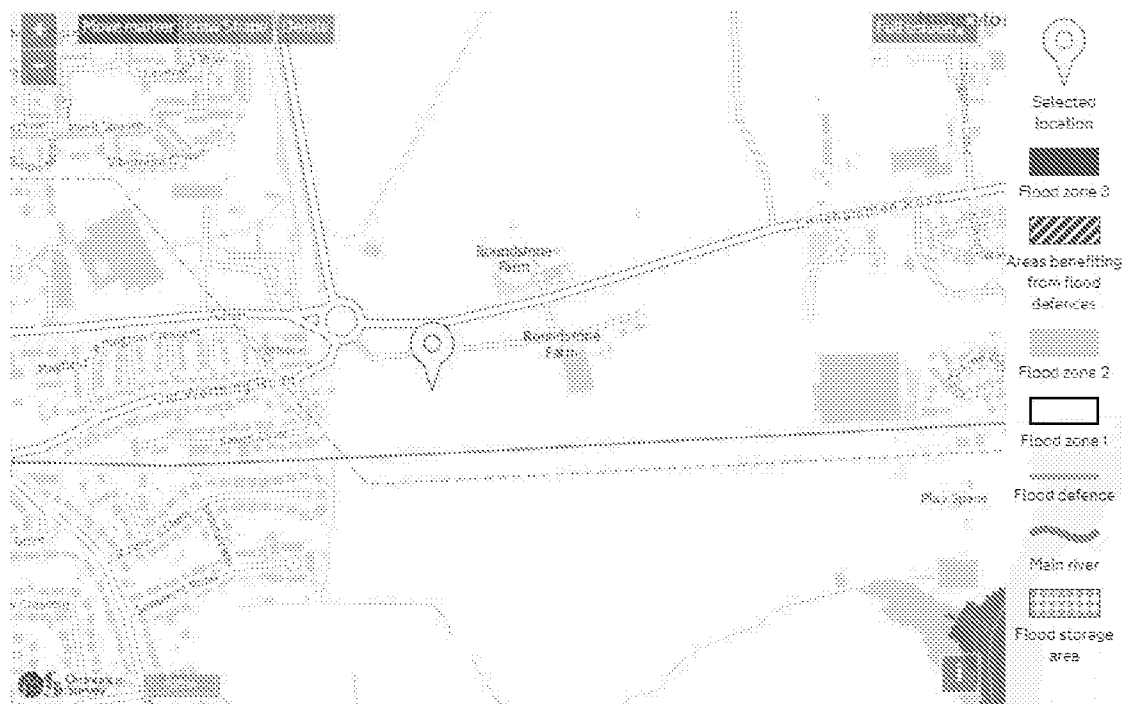
Flood Risk to the Site from Tidal Sources

- 4.2. The site is at a low risk from tidal flooding due to its inland elevated location.

Flood Risk to the Site from Fluvial Flooding Sources

- 4.3. A review of the EA's Flood Map for Planning maps show the site to be located entirely within Flood Zone 1. This zone comprises land where flooding from rivers and the sea (fluvial) is very unlikely. There is less than a 0.1% (1 in 1000) chance of flooding occurring each year. The site is at a low risk of flooding from fluvial sources.
- 4.4. Extracts from the EA Flood Maps are included below.

Environment Agency's Flood Zone Map

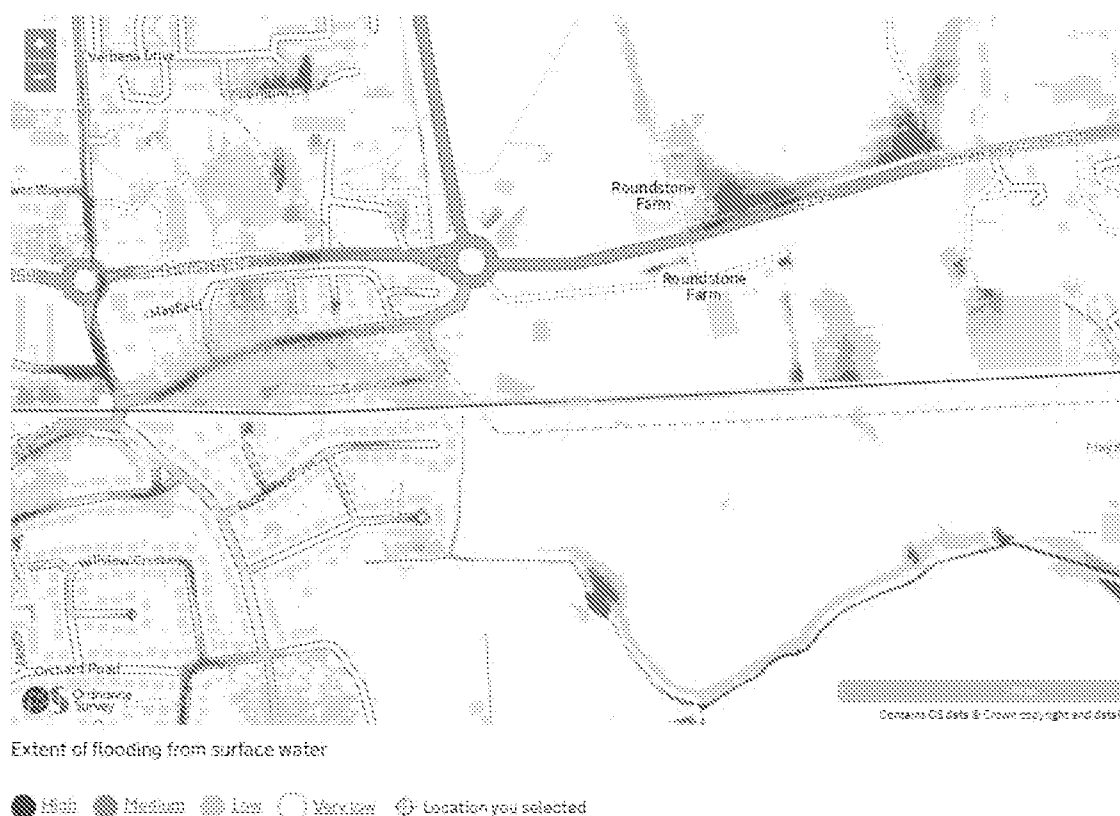


Flood Risk to the Site from Pluvial Flooding Sources

- 4.5. The SFRA, EA and GOV.uk websites and local available documents indicate there is no history of flooding at the site from heavy rainfall events or overland flood routes. The EA flood maps indicate a low to medium risk of surface water flooding on the site, this is confined to small locations.

- 4.6. Due to the flat nature of the site and no positive outfalls, it is assumed that any surface water flooding is generated by rainfall falling on-site and not be able to escape the site quickly enough.
- 4.7. The proposed development will provide positive improvements to overland flow with surface water being intercepted, stored in attenuation areas and discharged at controlled rates or into the ground.
- 4.8. The remaining Greenfield areas will be managed with grass and vegetation providing a surface treatment more conducive to reductions in overland flow.
- 4.9. Not only will these measures assist in management of surface water on site, but also contribute to a reduction in flood risk downstream, as the discharge rate off site is controlled, restricted and attenuated on site. However, cognisance will be taken to ensure downstream receptors are suitably recharged.
- 4.10. Therefore, overall, the site is at a very low risk of flooding from pluvial sources.

Environment Agency's Surface Water Map



Flood Risk to the Site from Groundwater

- 4.11. Groundwater flooding has the potential to occur after prolonged periods of unusually high rainfall. During such periods, more water than usual infiltrates through the ground, raising the water table above its normal depth below the surface. Where the water table is at shallow depth in any case, the water table can reach the surface. This can cause ground water to merge with rainfall and cause localised flooding.



- 4.12. On site ground water monitoring, during winter months provided a suite, of groundwater levels across the site with the groundwater predominantly 3.5m to 4.5m below ground level or non-existent. Only in one location was groundwater encountered during the onsite investigations and this was in the very low spot highlighted with the pluvial flood risk above. However, even this was some 1.8m below ground level and not in a location of development.
- 4.13. Groundwater flooding tends to occur sporadically in both location and time. Surface groundwater flooding has not been a risk on the site and there is no reason to believe it would present a problem and the test confirm this.

Flood Risk to the Site from Other Sources

- 4.14. The SFRA, EA and GOV.uk websites and local available documents indicate there is no existing flood risk from: reservoirs, sewers, canals or other artificial sources.
- 4.15. The site is deemed of low risk of flooding from these sources.

The Sequential Test

- 4.16. In the context of PPG Flood Risk and Coastal Change ID: 7 (Table 2) the proposed development has been identified as 'residential' development and therefore is classified as 'More Vulnerable'.
- 4.17. The proposed development is situated wholly within Flood Zone 1.
- 4.18. By applying the Flood Risk Vulnerability compatibility matrix under PPG Flood Risk Coastal Change ID:7 (Table 3), all development types are deemed to be accepted in Flood Zone 1 as depicted.

Flood Risk Vulnerability Classification Table 3 PPG ID 7

Flood Risk Vulnerability classification (see Table 1 PPG ID: 7)	Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Zone 1	Yes	Yes	Yes	Yes	Yes
Zone 2	Yes	Yes	Exception test required	Yes	Yes
Zone 3a	Exception test required	Yes	No	Exception test required	Yes
Zone 3b 'Functional Floodplain'	Exception test required	Yes	No	No	No

Key: Yes: Development is appropriate, No: Development should not be permitted.

- 4.19. It is therefore considered that, within the context of Flood Risk, the Site passes the Sequential Test with respect to NPPF and is suitable for the type of development proposed.



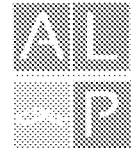
Flood Risk Summary

4.20. An overall summary of the risk of flooding from all sources is provided below.

Flood Risk Summary

Source of Flooding	High	Medium	Low	Comments
Tidal			✓	The Site is elevated and inland.
Fluvial			✓	The Site is located wholly within Flood Zone 1.
Pluvial			✓	There is minor pluvial flood risk associated with the low spot on the site and the inability to continue off site beyond the western boundary of the development. The proposed development and mitigation will reduce any perceived flood risk.
Groundwater			✓	EA/GOV.UK mapping and onsite groundwater monitoring does not indicate the Site to be at risk.
Sewers			✓	The Site has no exposure to existing sewer assets, except the aforementioned foul water rising main, with no evidence of flooding.
Reservoirs, canals and other artificial sources			✓	EA/GOV.UK mapping does not indicate the Site to be at risk.

4.21. Based upon the above information, the Site is deemed to be at **LOW RISK OF FLOODING**. The Proposed Site Plan is therefore in full accordance with National and Local planning policy concerning Flood Risk and as such is suitable for residential development.



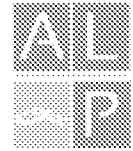
5.0 Surface Water Strategy

Introduction

- 5.1. This chapter provides details on an indicative surface water drainage strategy and measures to drain the Development.

Overall Strategy

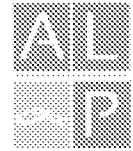
- 5.2. The proposed drainage strategy has been designed to exceed the requirements of the NPPF by providing a comprehensive drainage system which embraces the Sustainable Drainage Systems (SuDS) philosophy and key principles. The utilisation of SuDS not only provides the benefit of controlling waters at source and online treatment of collected surface water but also allows enhanced aesthetics through improved landscaping, biodiversity, and ecological opportunities.
- 5.3. These features offer a holistic treatment train and management system to the benefit of new residents, members of the wider community, downstream receptors and the environment.
- 5.4. The alteration of natural surface water flow patterns through developments can lead to problems elsewhere in the catchment, particularly flooding downstream. Changes to land uses can have significant downstream impacts where existing drainage systems may not have sufficient capacity for any additional surface water flow.
- 5.5. A surface water management strategy is therefore required to manage and reduce the flood risk posed by the surface water runoff from the site. The surface water drainage arrangements for any development site should be such that the volumes and peak flow rates of surface water leaving a developed site are no greater than the rates to the pre-development scenario, unless specific off-site arrangements are made and result in the same net effect.
- 5.6. Sustainable water management measures (SuDS) should be introduced to control the surface water runoff from the proposed development site therefore, managing the flood risk to the site and surrounding areas from the surface water runoff.
- 5.7. The Construction Industry Research and Information Association, CIRIA's C690 states the following:
- **Prevention** – the use of good site design and housekeeping measures on individual sites to prevent runoff and pollution (e.g. minimise areas of hard standing surfaces)
 - **Source Control** – control of runoff at or very near its source (such as the use of rainwater harvesting)
 - **Site Control** – management of water from several sub-catchments (including routing water from roofs and car parks to one or several soakaways for the entire site)
 - **Regional Control** – management of runoff from several sites, typically in a detention basin or wetland.



- 5.8. The SuDS Manual 2015 (C753) provides best practice guidance on the planning, design, construction, operation and maintenance of SuDS. This document provides guidance to ensure that SuDS are planned and designed to maximise the opportunities and benefits of surface water management.
- 5.9. The four main categories of benefits that can be achieved by SuDS, referred to as the four pillars of SuDS design, are:
- **Water quantity** – control the quantity of runoff to support the management of flood risk, and maintain and protect the natural water cycle;
 - **Water quality** – manage the quality of the runoff to prevent pollution
 - **Amenity** – create and sustain better places for people
 - **Biodiversity** – create and sustain better places for nature.
- 5.10. Supplemental to CIRIA guidance, Document H of the Building Regulations 2015 sets out three possible options to discharge surface water runoff. Rainwater shall discharge to one of the following, listed in order of priority:
- An adequate soakaway or some other adequate infiltration system; or where that is not reasonably practicable,
 - A watercourse; or where that is not reasonably practicable
 - A sewer.
- 5.11. Implementation of SuDS will ensure that flood risk downstream is not increased due to the proposed development. These features will also provide positive improvements to the quality of surface water runoff.
- 5.12. The following SuDS components are deemed applicable to the Site:
- Pervious surfacing systems – structural surfaces that allow water to penetrate into a granular layer thus providing storage and treatment, e.g. pervious paving.
 - Infiltration systems – components that facilitate the infiltration of water into the ground, e.g. soakaways.
 - Conveyance systems – components that convey flows to downstream storage systems, e.g. swales and filter drains.
 - Storage systems – components that control flow, and possibly volumes, by storing water and releasing it slowly, e.g. geocellular units, attenuation basins and wetlands.
 - Treatment systems – components that remove or facilitate the degradation of contaminants present in runoff, e.g. filter strips and proprietary treatment systems.

Infiltration Systems

- 5.13. Although infiltration appears to be a viable method of disposal, given the underlying soil conditions and low Greenfield run off rates, the high groundwater and restrictive infiltration rates found during winter testing precludes the use of some infiltration devices.



- 5.14. ADC have a stringent set of design parameters used within their schemes. Examples of these are: Adequate freeboard from base of infiltration features to groundwater; No incoming pipe into infiltration structures below the 1:10 plus climate change flood level; large factors of safety (FOS) for infiltration devices; catchpits prior to pipes entering infiltration devices; no ground raising.
- 5.15. The layout is being offered to adoption from both highways (S38) and drainage (S104). Highways do not allow infiltration within 5m of a highway or on a highway. NHBC (Building Regs) do not allow infiltration within 5m of a structure (foundation). Drainage adopted under S104 have the following cover requirements, namely; 1.2m cover in highways and 900mm cover in drives, with building regulations requesting 600mm cover in private areas.
- 5.16. Any surface water that ends up in the road and/or a carrier drain will be below the groundwater and therefore unable to drain by infiltration or to infiltration devices.
- 5.17. Notwithstanding the above, the ADC parameters of all incoming pipes above the 1:10 year plus climate change event and the large FOS required, coupled with a minimal infiltration rate, means all infiltration devices, served by a pipe and not from the surface, will require in excess of 500mm between any incoming pipe and the base of the infiltration structure, again pushing the base of the structure well below the groundwater level.
- 5.18. To achieve large scale infiltration on this site would require a large land raise which is against ADC policy. The site levels are designed to normal design parameters in that roads are set generally 300mm above existing ground level with dwellings set 400-500mm above. This ensures a cut and fill balance and minimises earthworks movements thus providing an environmental and sustainable development.

Pre and Post Development Rates / Areas

- 5.19. To quantify any potential increase in surface water runoff, the existing Greenfield/Pre-Development runoff rate from the Site must be determined. The rates of runoff have been determined using the current 'industry best practice' guidelines as outlined in the Interim Code of Practice for SuDS. The recommended methodology for sites up to 50 hectares in area is the ICP SuDS method.
- 5.20. An assessment of existing surface water runoff has been undertaken, to determine the potential surface water options and attenuation requirements for the site utilising the following parameters.
- Catchment Area: 1 ha (to determine a l/s/ha discharge rate)
 - Average Annual Rainfall (SAAR): 719mm/year
 - Soil: 0.300
 - Region No.: 7
- 5.21. Greenfield run off calculations for the existing site provided in the appendix show the following discharge rates:



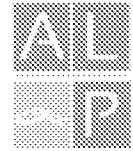
Pre-Development Runoff Rates/Volumes

Annual Probability	Greenfield/Pre-Development Runoff Rate per Hectare (l/s/ha)
1 in 1 year event	1.60
QBar	1.88
1 in 30 year event	4.33
1 in 100 year event	6.00

- 5.22. As QBar is < 2.0 l/s/ha the limiting discharge rate is set at 2.0 l/s/ha
- 5.23. The existing site is predominantly Greenfield. Therefore, any development will increase the impermeable area and surface water run off.
- 5.24. Based on the Illustrative Masterplan, it has been measured that the impermeable surfaces is approximately 1.5ha
- 5.25. Urban Creep is the conversion of permeable surfaces to impermeable over time through individual dwellings adding items such as extra parking spaces, extensions, conservatories, etc. In accordance with Arun Policy and The SuDS Manual (CIRIA 753) this can be up to 10% dependent on density applied to impermeable area within the property curtilage only. As a general rule by applying 5% to the total site impermeable area is far greater than just applying 10% to individual properties. Therefore, the inclusion of an additional 5% to the overall impermeable area in all calculations provides for all future Urban Creep. As the design develops this will be turned into a more accurate figure by applying Urban Creep to individual properties but, as this will be far less than the overall 5% provided, a robust assessment of rates and areas is provided at this time, in line with Arun DC Policy.
- 5.26. In order to comply with best practice as stipulated in EA Report SC030219 'Rainfall Runoff Management for Developments', proposed discharge rates should be restricted to one of two methods for all storms up to and including the 1 in a 100 year storm event plus a 40% upper end allowance for climate change.
- 5.27. This is either the Variable Greenfield discharge rates, with Long term Storage method or restricting all rates to the estimated mean greenfield runoff rate (QBar). This is the preferred method for Arun DC.

Surface Water Proposals

- 5.28. A surface water management strategy for the proposed development has been developed to manage and reduce the flood risk posed by the surface water runoff from the site. The drainage system for the proposed development will manage and reduce the flood risk posed by the surface water runoff.
- 5.29. The surface water management proposals have provided the framework for the site layout and are designed and located with the site constraints in mind, namely the high groundwater, low infiltration rates and the location of a suitable outfall.



- 5.30. It is proposed to provide a network of trapped gullies, pipes and Sustainable Drainage (SuDS) features to collect the surface water runoff from impermeable areas such as roads, roofs and driveways. The traditional system will work in combination with such features as permeable paving and attenuation features to provide attenuation storage and high-quality water benefits.
- 5.31. The layout of boundary ditches are unaffected and therefore existing outfall points will remain as is, with new headwalls being constructed within the site as required. In addition, the partly culverted watercourse to the sites western boundary will be opened up within the site. The watercourse south of the railway line, which takes flow from the site to the wider drainage network, will be remediated to clear silt and vegetation to reduce existing flood risk and provide a clear channel for discharge.
- 5.32. The banks of SuDS basins are designed in accordance with the SuDS Manual C753 in respect to having a maximum gradient of 1 in 4 and an appropriate freeboard above the maximum water level. This allows landscaping of both wetland and wildflower mixes to provide an appropriate landscape context in the vicinity of the features through the provision of an aquatic shelf.
- 5.33. The development will utilise Source Control techniques (such as permeable paving) which assist with the reduction of larger attenuation storage features and may provide the use of infiltration type features at source, bearing in mind the technical approval and adoption criteria previously stated.
- 5.34. Open SuDS features are designed so as not to compromise the safety of residents, visitors and their property. Generally open boundaries are provided, and perimeter planting could be utilised to define the extents of the features.
- 5.35. Proposed discharge rates will be restricted to QBAR, or minimum 2 l/s should rate be too low, for all storm events up to and including the 1 in 100 year storm event plus 40% allowance for climate change. This would negate the requirement for Long Term Storage and flows would be attenuated on site and discharged utilising an on-site flow control device such as a Hydrobrake.
- 5.36. All conveyance systems will be designed to cater for the 1:30 year storm event, in accordance with industry standard, with all attenuation features designed to allow for the 1 in 100 year storm event plus 40% climate change allowance.
- 5.37. The proposals draw reference to the DEFRA document Sustainable Drainage Systems, Non-statutory technical standards for sustainable drainage systems March 2015, as well as CIRIA C753 The SuDS Manual.
- 5.38. This proposal identifies the principal components of the surface water strategy and is subject to further detailed localised investigations as part of the subsequent Reserved Matters applications. These assumptions are subject to evolution as the design develops.

Exceedance Flood Routing

- 5.39. Flows in excess of the above design storms, which may flood from the network, will be kept within the internal road network, until such time as they can be directed into adjacent landscaping areas. This ensures that onsite or offsite residential units are afforded an increased level of protection from flood waters until such time as the rain events become significant.



Water Quality Improvements

- 5.40. CIRIA report C753 The SuDS Manual outlines the methodology for assessing water quality risks associated with new development. This is a simple index approach which provides a high level scoping analysis of the land usage and gives guidelines for appropriate treatment stages, identifying features necessary to provide adequate substance removal in line with Environment Agency requirements.
- 5.41. This is a three step process of Allocation, Mitigation and Review. Surfaces generating runoff are 'graded' on their potential to contribute to various harmful pollutants and gives each surface a risk of pollution from each element. An extract of Table 26.2 within the SuDS Manual is set out below.

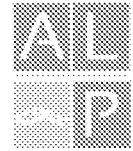
Extract from Table 26.2 SuDS Manual

Land Use	Pollution Hazard Level	Total Suspended Solids	Metals	Hydrocarbons
Residential Roofs	Very Low	0.2	0.2	0.05
Other Roofs	Low	0.3	0.2-0.8	0.05
Low traffic residential roads and non-residential parking with infrequent change.	Low	0.5	0.4	0.4
Commercial yard, parking with frequent change, other roads,	Medium	0.7	0.6	0.7
Sites with heavy pollution	High	0.8	0.8	0.9

- 5.42. The use of non-mechanical features decreases the requirements for maintenance and increase natural biodiversity. That said, the SuDS Manual does not remove the possibility of utilising separators, so long as they are considered in partnership with a comprehensive overall SuDS regime.
- 5.43. Without adequate treatment, the pollutants would cause damage if they were to enter the watercourse or water table in large volumes. The use of SuDS features to slow down and degrade these pollutants is critical to the provision of an acceptable discharge.
- 5.44. The respective cleansing abilities of common SuDS features are given by corresponding mitigation indices within the SuDS Manual. An extract of Table 26.3 is set out below.

Extract from Table 26.3 SuDS Manual

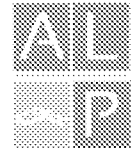
Type of SuDS component	Total Suspended Solids	Metals	Hydrocarbons
Filter strip	0.4	0.4	0.5
Filter Drain	0.4	0.4	0.4
Swale	0.5	0.6	0.6
Bioretention system	0.8	0.8	0.8
Permeable Paving	0.7	0.6	0.7
Detention Basin	0.5	0.5	0.6
Pond	0.7	0.7	0.5
Wetland	0.8	0.8	0.8



- 5.45. The individual pollution indices are totalled, with the first SuDS component utilising its full value and subsequent downstream SuDS features acting with 50% efficiency. This provides a realistic strategy which mimics the reduced cleansing effectiveness as the concentration of a pollutant decreases along the SuDS train.
- 5.46. In line with Environment Agency guidance, before the design phase is concluded, the proposals are reviewed and analysed in order to identify potential shortcomings and to ensure that adequate volume of SuDS features are provided to mitigate the risk of pollution from each source.
- 5.47. Surface water arising from highways or driveways should be provided with two trains of treatment prior to leaving the site in line with national guidance.
- 5.48. Rainwater falling on the permeable paving flows into the underlying granular layers. This effectively traps suspended solids and filters pollutants from the water. This will be directed to the swales and the basin. The drainage strategy provides a level of treatment in advance of discharging from the Site. This can be demonstrated using the Simple Index Approach outlined within CIRIA C753. The most significant pollutant load will arise from roadways and driveways and similar within the Site. These have an identified pollutant hazard level of 'Low' as set out in the tables above.
- 5.49. Under this designation, Table 26.3 of the SuDS Manual requires pollutant indices of 0.5 for Total Suspended Solids (TSS), 0.4 for Metals, and 0.4 for Liquid Hydrocarbons. By reference to the above tables, the provision of permeable paving, swales and basin within the drainage strategy exceeds the maximum anticipated pollutant hazard indices.

SuDS Maintenance Strategy

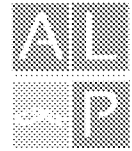
- 5.50. For the water treatment effects of SuDS features to remain effective, a comprehensive maintenance strategy should be implemented.
- 5.51. During construction, maintenance of SuDS features should be undertaken by the Contractor. Upon completion, the assets should be passed over to the Management Company, statutory authority, or community group commissioned to maintain the features in perpetuity.
- 5.52. As part of the strategy, a regular maintenance regime will be created, which consists of several primary measures required to ensure the longevity of the system. These should be undertaken on a regular basis to ensure consistent performance. Typical maintenance activities consist of:
- Inspecting and reporting; relatively regular review of the condition identifying issues and providing resolutions. Periodic review from the maintenance contractor;
 - Litter and debris removal;
 - Grass trimming, overall cutting and localised strimming preventing blockages;
 - Weed and evasive plant control;
 - Shrub management;
 - Aquatic and shoreline vegetation management;



- Sweeping pervious surfaces; and
 - Oil removal from proprietary systems.
- 5.53. A remedial maintenance schedule would be recommended as part of the handover of the SuDS features, remedial maintenance is required to provide repairs to the system and monitor long term damage ensuring the system remains consistently productive. the schedule could consist of;
- Structure rehabilitation and repair;
 - Infiltration surface rehabilitation;
 - Scarifying to remove “Thatch”;
 - Spiking or Tining the soil, which assists with aeration;
 - Air pressure treatment.
- 5.54. The maintenance schedule contents and timing will depend upon multiple factors including usage, contents of water utilising the system, location and biology. To this end, it is suggested that the schedule be finalised as part of detailed design; ensuring the most comprehensive maintenance schedule is incorporated for the phase in hand.
- 5.55. Community outreach can be undertaken as part of the development, which will raise awareness on the importance of SuDS to both flood risk and water quality in the local area. Imparting the new residents with knowledge on the risks associated with pollution to the surface water drainage system is key, as is the direct effect their actions may have on water quality and biodiversity in the area.

Adoption and Ownership

- 5.56. The drainage system is designed to the appropriate standards including the new Sewerage Sector Guidance (SSG), the Building Regulations and the requirement of the National Planning Policy Framework
- 5.57. The intention of adoption and ownership of drainage and SuDS is as follows:
- Surface water sewers within development parcels to be offered for adoption to Southern Water under the Section 104 process of the Water Industry Act.
 - Surface water highway drains, gullies and leads within adopted roads to be maintained by the Highway Authority.
 - Above ground attenuation (i.e. swales and basins) within development parcels to be offered for adoption to either the Local Authority or ownership under a management company.
 - SuDS features serving single properties, for example, permeable paved driveways to single dwellings, will be owned and maintained by the owner of that property.
- 5.58. Suitable adoption and maintenance regimes for SuDS should be submitted in support of the Reserved Matters application.



6.0 Foul Water Drainage

Introduction

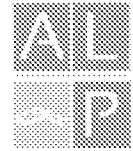
- 6.1. This chapter provides details on the proposed foul water drainage strategy and measures to convey effluent.

Overall Strategy

- 6.2. Due to the topography of the site and location of the existing foul sewer point of connection, wastewater from the site will require pumping to the receiving public sewer.
- 6.3. The nearest current point of connection is likely to be into the Southern Water existing manhole 8102, located in Old Worthing Road.
- 6.4. A gravity network on site will drain all flows to a pumping station before pumping flows into existing manhole 8102.
- 6.5. Discussions are ongoing with Southern Water regarding the extent of additional off-site sewers or improvements to existing sewers that will be required to provide sufficient capacity to service the development.
- 6.6. Notwithstanding this, the delivery of the proposed on-site foul water sewers will be designed in collaboration with Southern Water as approving body in accordance with the new Sewerage Sector Guidance (SSG) and will be offered to Southern Water for adoption under S104 Agreement of the Water Industry Act. The connection to the existing public sewer system will be made via a S106 Agreement of the Water Industry Act with Southern Water as part of the overall adoption process.

Adoption and Ownership

- 6.7. The drainage system is designed to the appropriate standards including the new Sewerage Sector Guidance (SSG), the Building Regulations and British Standards.
- 6.8. Foul water sewers within the development are to be offered for adoption to Southern Water under the Section 104 process of the Water Industry Act 1991.



7.0 Development Suitability

Introduction

- 7.1. This chapter assesses the suitability of the development proposals in the context of on and off-site vulnerability.

Assessment

- 7.2. This site-specific Flood Risk Assessment demonstrates that the Development satisfies the requirements of NPPF and can be justified in the proposed location by:

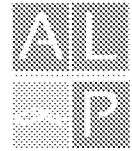
- meeting the criteria set out in NPPF;
- assessing the risk posed to the site from flood events;
- assessing the risk posed to the site from the site storm water generation and the site storm water runoff management; and
- assessing the risk the site poses to increase in flooding elsewhere.

- 7.3. Specifically, it has demonstrated:

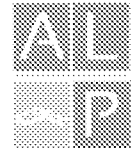
- The detailed Fluvial flood map, for fluvial sources, provided by the GOV.UK's Flood Map for Planning indicate that the site area is entirely located with Flood Zone 1; assessed as having a less than 1 in 1000 annual probability of river or sea flooding (<0.1%).
- Whilst the detailed flood map provided by GOV.UK indicates minimal pluvial flooding within the site, any future risk of pluvial flooding will be mitigated by the development and drainage regime.
- That a detailed review of available data indicates a low risk from secondary flooding sources, such as groundwater, sewers, reservoirs or canal.
- Through the provision of a positive drainage network attributed to the Development, pluvial flooding to offsite receptors will be significantly reduced.
- Exceedance flows can be safely accommodated within the Development.

Conclusion

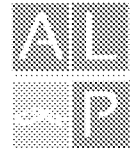
- 7.4. The proposed surface water drainage strategy will manage the flood risk posed by uncontrolled surface water runoff from the Site. Any increase in surface water run-off can be managed using SuDS source control techniques as well as attenuation features to provide storage in extreme storm events.
- 7.5. The above provides the minimum of two treatment stages which is in accordance with the recommendations of CIRIA C753.
- 7.6. All surface water drainage systems will be designed to restrict discharge rates to greenfield QBAR runoff rate and store the balance of water for all events up to and including the 1 in 100 year event including allowance for a 40% increase in rainfall intensities as a result of climate change and urban creep.



- 7.7. The proposed foul water drainage strategy presents a robust, viable method of conveyance of effluent to the public sewerage system.
- 7.8. Overall, the Site should not be precluded on flood risk grounds as the Development will not be at risk from existing sources and will not result in an increase in flooding downstream.

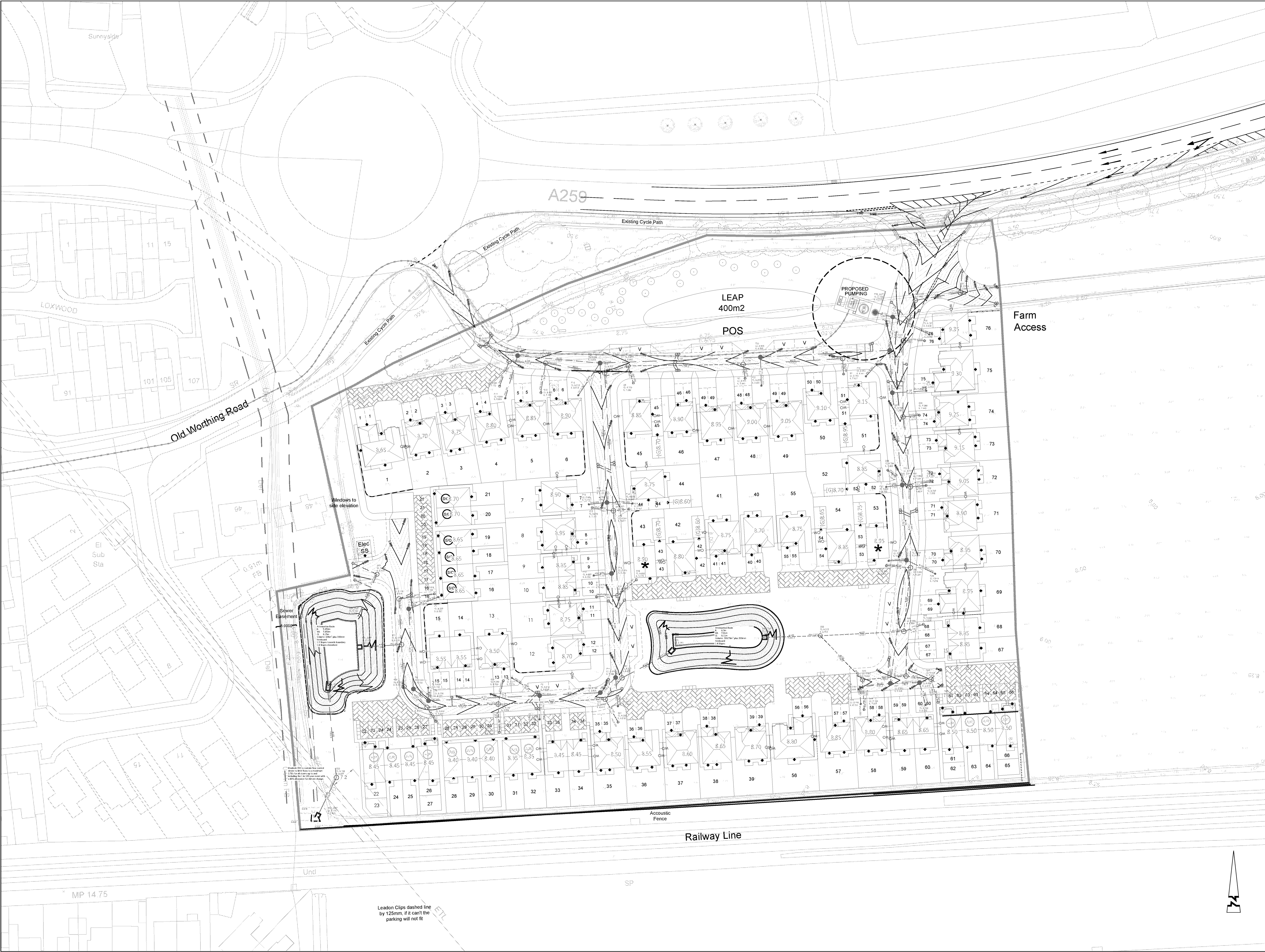


Appendices



Appendix 1 – Drawings

Preliminary Drainage Strategy



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GENERAL NOTES:

- Do not scale.
- Refer to all other Project Drawings.
- All sewers to comply with the requirements of the Design and Construction Guidance together with Southern Waters Addendum.
- All public sewers are to be the subject of a Section 104 agreement of the Water Industry Act 1991.
- Invert levels of existing manholes and sewers are to be checked on site before construction commences and results reported to engineers.
- All manhole ironworks to comply with BS EN124, and be stamped with BS Kitemark. Covers to suit loading as below:
 - Carriageways and Roads - D400
 - Driveways and Verges - C250
 - Footways and Pedestrian Areas - B125
 - Gardens/Landscaping - A15
- All sewer pipes, up to, and including 225mm are to be vitrified clay to BS EN295. All sewer pipes 300mm diameter and above to concrete pipes to BS EN1916.
- All drainage shall be installed and tested strictly in accordance with the Manufacturers' printed instructions, BS EN 752, BS EN 1601, Local Water Authority requirements and the Building Regulations.
- All bedding shall be Class 5 unless noted otherwise.
- All trenches under existing and proposed public highways are to be backfilled with thoroughly compacted Type 1 granular sub-base material.
- Drainage laid beneath roads and areas of vehicular access (car parking etc) with less than 1200mm of cover shall be encased in concrete bed and surround with associated movement joints. Drainage laid beneath paths, footways and pedestrian areas with less than 900mm of cover shall be similarly treated.
- Chambers with outgoing pipes greater than 600mm diameter shall be fitted with guard bars, safety chains or other approved safety devices.
- The use of precast concrete products made with sulphate resisting cement is mandatory, unless a laboratory report proves such precautions are not necessary.
- All gully connections to use a minimum diameter pipe of 150mm and to be surrounded by a minimum of 150mm of grade C8/C10 concrete over its full length (which should not exceed 15m) and its connection to the carrier system.
- All laterals to be 150mm laid at 1:80 (surface), 1:60 (foul) unless otherwise noted.

DRAINAGE NOTES:

- Do not scale.
- Refer to all other Project Drawings.
- All drainage to be in accordance with Document H of the Building Regulations, together with NHBC Standards Chapter 5.3 & BS8301.
- All private drains to be 100mm diameter unless stated otherwise.
- Where pipes pass through footings, retaining or screen walls, lintels to be provided over drains.
- Where inverts are less than 0.6m deep, inspection chambers (min dia 190mm) or access fittings (225x100mm) to be used, elsewhere proprietary plastic, brick or pcc i/cs to be used (sized in accordance with table 11 of Approved Document H).
- All gullies connected direct to drains to be roddable.
- Rainwater downpipes to be easily removable for rodding or to be provided with rodding access at ground level.
- Unless noted otherwise FW i/c's & RE's to be 0.6m below DPC level, SW i/c's & RE's to be 0.45m.
- Adequate precautions in accordance with Approved Document H and manufacturer's recommendations to be taken to protect drains (particularly plastic) at shallow depths.

KEY

FOUL	STORM

P1	02/22	First Issue	DS	SM
Rev	Date	Description	Drawn	Checked

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REDROW HOMES

Project
LAND SOUTH OF A259, ANGMERING

Title
FULL APPLICATION DRAINAGE LAYOUT

Status
PRELIMINARY

Scale	Date	Drawn	Checked
1:500 @ A1	FEB 2022	DS	SM
Drawing No	Revision		
A334-FA-50	P1		



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GENERAL NOTES:

1. Do not scale.
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4. All public sewers are to be the subject of a Section 104 agreement of the Water Industry Act 1991.
5. Invert levels of existing manholes and sewers are to be checked on site before construction commences and results reported to engineers.
6. All manhole ironworks to comply with BS EN124, and be stamped with BSI Kitemark. Covers to suit loading as below:
 - Carriageways and Roads - D400
 - Driveways and Verges - C250
 - Footways and Pedestrian Areas - B125
 - Gardens/Landscaping - A15
7. All sewer pipes, up to, and including 225mm are to be vitrified clay to BS EN255. All sewer pipes 300mm diameter and above to concrete pipes to BS EN1916.
8. All drainage shall be installed and tested strictly in accordance with the Manufacturers' printed instructions, BS EN 752, BS EN 1601, Local Water Authority requirements and the Building Regulations.
9. All bedding shall be Class S unless noted otherwise.
10. All trenches under existing and proposed public highways are to be backfilled with thoroughly compacted Type 1 granular sub-base material.
11. Drainage laid beneath roads and areas of vehicular access (car parking etc) with less than 1200mm of cover shall be encased in concrete bed and surround with associated movement joints. Drainage laid beneath paths, footways and pedestrian areas with less than 900mm of cover shall be similarly treated.
12. Chambers with outgoing pipes greater than 600mm diameter shall be fitted with guard bars, safety chains or other approved safety devices.
13. The use of precast concrete products made with sulphate resisting cement is mandatory, unless a laboratory report proves such precautions are not necessary.
14. All gully connections to use a minimum diameter pipe of 150mm and to be surrounded by a minimum of 150mm of grade C8/C10 concrete over its full length (which should not exceed 15m) and its connection to the carrier system.
15. All laterals to be 150mm laid at 1:80 (surface), 1:60 (foul) unless otherwise noted.

DRAINAGE NOTES:

1. Do not scale.
2. Refer to all other Project Drawings.
3. All drainage to be in accordance with Document H of the Building Regulations, together with NHBC Standards Chapter 5.3 & BS8301.
4. All private drains to be 100mm diameter unless stated otherwise.
5. Where pipes pass through footings, retaining or screen walls, lintels to be provided over drains.
6. Where inverts are less than 0.6m deep, inspection chambers (min dia 190mm) or access fittings (225x100mm) to be used, elsewhere proprietary plastic, brick or pcc's to be used (sized in accordance with table 11 of Approved Document H).
7. All gullies connected direct to drains to be roddable.
8. Rainwater downpipes to be easily removable for rodding or to be provided with rodding access at ground level.
9. Unless noted otherwise FW ICs & REs to be 0.6m below DPC level, SW ICs & REs to be 0.45m.
10. Adequate precautions in accordance with Approved Document H and manufacturer's recommendations to be taken to protect drains (particularly plastic) at shallow depths.

KEY

FOUL

STORM

Proposed adoptable sewer & MH

Highway gully and 150mmØ connection

Rising Main

Headwall

Proposed road contours (major at 100mm intervals, minor at 25mm intervals)

Proposed area of infiltrating permeable paving

Drainage Area

Areas susceptible to 10% Urban Creep

Areas of excess flows

Excess Flow 0.3855m³

P2	02/22	Drawing number updated	CB	SM
P1	02/22	First Issue	CB	SM
Rev	Date	Description	Drawn	Checked

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Client

REDROW HOMES

Project

LAND SOUTH OF A259, ANGMERING

Title

FULL APPLICATION DRAINAGE AREAS & EXCESS FLOWS PLAN

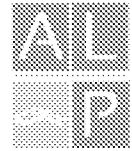
Status

PRELIMINARY

Scale	Date	Drawn	Checked
1:500 @ A1	FEB 2022	CB	SM
Drawing No		Revision	
A334-FA-51		P2	

Leadon Clips dashed line by 125mm, if it can't the parking will not fit





Appendix 2 – Documents

Arun District Council Surface Water Drainage Proposal Checklist

Ground Water Monitoring

Infiltration Testing



Surface Water Drainage Proposal Checklist

Ground Investigation Results				
Results Required		Results Provided?		
Winter groundwater monitoring results (Please refer to guidance note 1 below)		Yes	☐	☐
Period of winter groundwater monitoring Note 1		From	01/10/2020	
		To	30/03/2021	
Maximum recorded groundwater level		1.07 mBGL		
Winter infiltration test results Note 2		Yes	☐	☐
Date of winter infiltration testing		19/02/2021		
Details of the location and depth of the infiltration testing Note 3		Yes	☐	☐
Minimum infiltration rate Note 4		2.6 x 10-6 m/s		

Guidance Notes

1. A full winters groundwater monitoring should be undertaken, (October to March inclusive) to enable the peak annual groundwater levels to be established. The extent of winter monitoring for developments of less than 5 properties should be discussed with the council's Engineers.
2. Infiltration testing should be undertaken during the wet winter months (typically January) and in line with BRE365, or a similar approved method. Tests should be repeated 3x, to replicate saturated ground conditions. Please note that infiltration testing is to be carried out at a time and depth agreed with the Councils engineers.
3. Infiltration testing should be undertaken at the location and depth of any proposed infiltration structures. This must be above the maximum recorded groundwater level in that vicinity.
4. The minimum infiltration rate obtained at the location and depth of the proposed infiltration structures should be used to inform the design of the structures.

Proposed Method of Surface Water Disposal				
Infiltration On-site, via soak-away structures			No	☐
If on-site infiltration is not to be used, has justification for this been provided? Note 5	Yes	☐		☐
Attenuation (on-site) with a restricted discharge to a watercourse on, or adjacent to, the site	Yes	☐		☐
Attenuation (on-site) with a restricted discharge to a surface water sewer on, or adjacent to, the site			No	☐
Attenuation (on-site) with a restricted discharge to a foul water sewer on, or adjacent to, the site			No	☐

Guidance Notes

5. If on-site infiltration is not being used to drain the site you will need to provide evidence that demonstrates on-site infiltration is unviable.

Drainage Design: Supporting Calculations					
Calculations Required			Calculations Provided?		
Infiltration Structures	Half-drain time for 10 year event (plus climate change allowance)			No	
				Hours	
	Half-drain time for 100 year event (plus climate change allowance)			No	
				Hours	
	Calculations demonstrating that the 1 in 100 year event, plus climate change allowance can be accommodated on-site. Note 7			No	
Attenuation and Subsequent Restricted Discharge	Lowest base level of infiltration structure			mAOD mBGL	
	Has the design sought to provide treatment of potential contaminants? E.g. hydrocarbons.			No	
	Pre-development run-off rate calculations	Yes			
			2.9		l/s
	Proposed discharge rate Note 6		2.9		l/s
Attenuation and Subsequent Restricted Discharge	Calculations demonstrating that the 1 in 100 year event, plus climate change allowance can be accommodated on-site. Note 7	Yes			
	Has the design sought to provide treatment of potential contaminants? E.g. hydrocarbons.	Yes			
	If your proposed scheme incorporates any impermeable lined attenuation features we require calculations to demonstrate that appropriate resistance to floatation (due to groundwater levels) is catered for in the design	To Follow			
	If you propose discharging into or altering an ordinary watercourse; have you sought Ordinary Watercourse/Land Drainage Consent? Note 8	To Follow			
	If discharging to a watercourse, piped system or the sea, has the proposed drainage network been modelled against predicted top water levels for the 1 in 100 year storm event plus climate change allowance, within the existing system? Note 9	Yes			

Guidance Notes

- Any proposed discharge rate must be less than, or equal to, the pre-development rate. Greenfield sites must use the mean flow rate (Qbar) and be based upon the area occupied by the development, ignoring significant open spaces. Please note that the minimum acceptable discharge rate is 2l/s when using formal flow control devices, unless otherwise agreed. Additionally, if you are developing a brownfield site, we expect you to provide fully detailed plans of the existing surface water drainage arrangements on site, including impermeable areas, gullies, outfalls, pipes & diameters, manholes, etc. We generally seek 50% betterment in terms of run off from brownfield sites.
- The appropriate factor of safety from the table below must be applied to your calculations to ensure your design is fully in accordance with CIRIA R156/ CIRIA C753.



Factor of Safety Table						
Size of Area to be Drained	Consequences of failure					
	No damage or inconvenience		Minor inconvenience, e.g. surface water on car park		Damage to buildings or structures or roads.	
	Cv=1.0	Cv=0.75	Cv=1.0	Cv=0.75	Cv=1.0	Cv=0.75
<100 m ²	1.5	2	2	3	10	13
100m ² to 1000m ²	1.5	2	3	4	10	13
>1000m ²	1.5	2	5	6.5	10	13

8. Ordinary Watercourse/Land Drainage Consent will need to be sought, ideally in parallel with planning permission, if you propose discharging into, culverting or altering a watercourse.
9. Modelling is required to ensure that problems, such as surcharged outfalls, are addressed.

Plans/Drawings/Diagrams				
Required		Provided?		
Plan detailing the location of groundwater monitoring and infiltration testing		Yes		
Detailed drainage layout plan Note 10		Yes		
Construction detail plans Note 11		Yes		
Exceedance flow route plans Note 12		Yes		
Impermeable area plan		To Follow a		sign
If ground levels are being raised $\geq 300\text{mm}$ above existing levels and is unavoidable, have fully detailed plans been provided, together with drainage proposals, to address any potential drainage related issues.		Yes		

Guidance Notes

10. Drainage layout plans should include:
 - All surface water drainage pipes labelled with; diameters, pipe materials, falls and invert levels.
 - All infiltrating and attenuating structures (including permeable paving) labelled with; dimensions, invert and cover levels.
 - All manholes labelled with; cover levels, invert levels, cover types detailed.
 - All silt traps clearly labelled with sump depths.
 - Control structures with outflow rates and invert levels.
 - Proposed/existing levels of any areas subject to ground raising, together with suitable measures/detailed drawings for the associated management of surface water runoff. Please note that ground raising should be avoided unless there are exceptional circumstances.
11. Site specific construction detail plans should be supplied if your proposed drainage scheme includes any of the following elements: pipe bed and surround; infiltrating structures; attenuating structures; manholes; catch-pits/silt traps; control devices; permeable paving; headwalls.

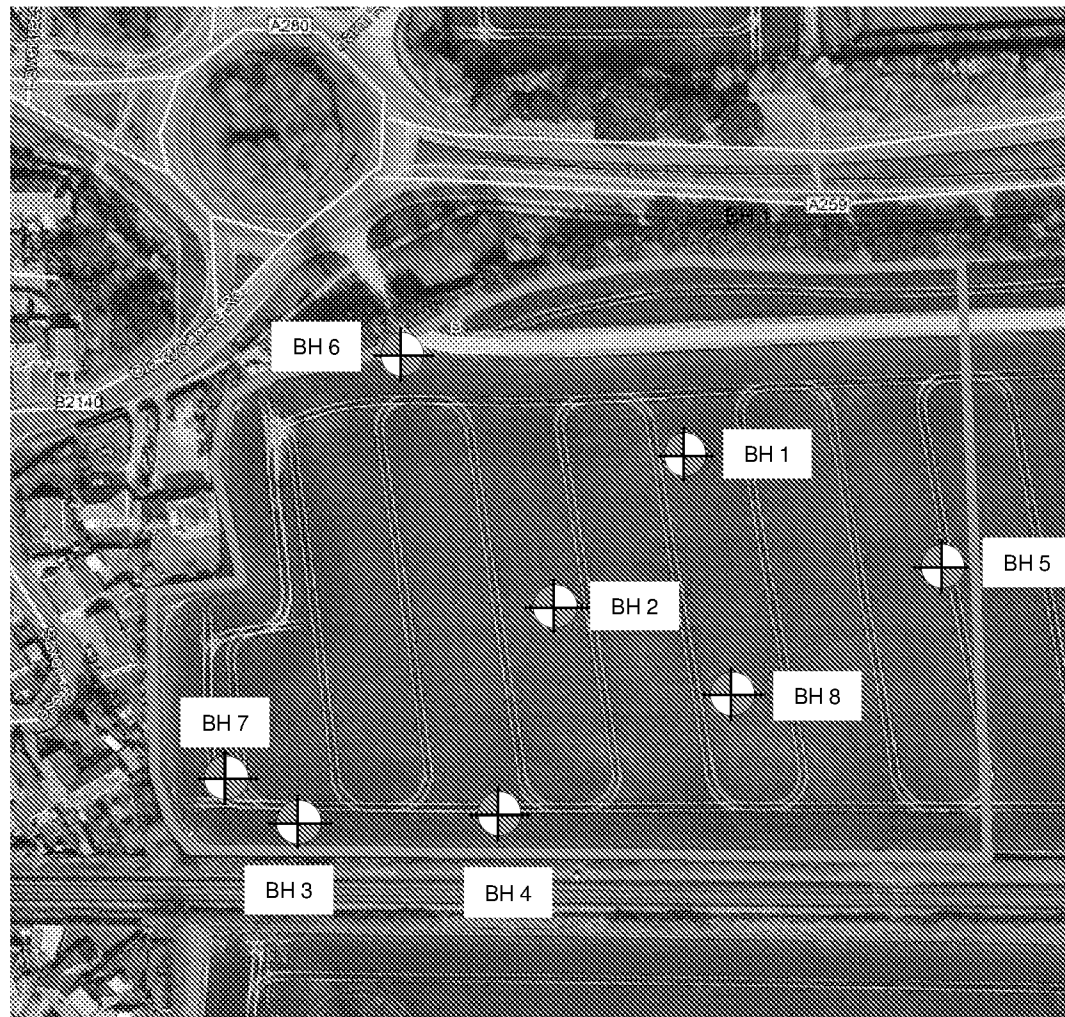


12. Unless specifically requested by the council's drainage engineers 'Exceedance Flow Route Plans' are only required for developments of more than 5 residential properties or more than 0.5ha of commercial development .

Site Angmering Land Parcel South of A259

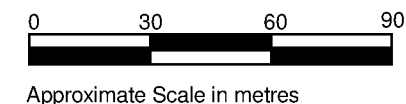
Client Redrow Homes Limited

**Winter Water Level
Monitoring
2020-2021**



Results of monitoring visits presented as depth below ground level (mBGL)

	01/10/20	18/11/20	07/12/20	18/12/20	04/01/21	18/01/21	16/02/21	11/03/21	30/03/21
BH 1	1.62	1.41	1.41	1.11	1.52	1.51	1.59	1.63	1.66
BH 2	1.14	1.23	1.25	1.20	1.39	1.37	1.45	1.49	1.53
BH 3	1.27	1.21	1.20	1.19	1.32	1.30	1.34	1.40	1.43
BH 4	1.17	1.07	1.07	1.08	1.19	1.16	1.21	1.26	1.31
BH 5	1.12	1.21	1.21	1.21	1.37	1.32	1.39	1.41	1.45
BH 6	1.95	1.81	1.80	1.78	1.88	1.85	1.90	1.94	1.97
BH 7	--	--	--	--	--	1.76	1.80	1.83	1.88
BH 8	--	--	--	--	--	1.69	1.73	1.76	1.80



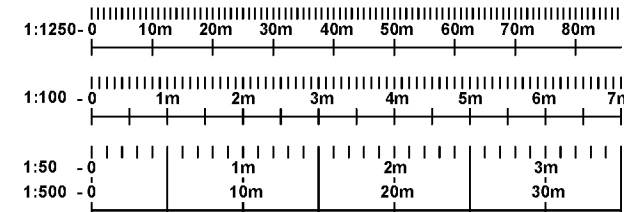


The Contractor is to check and verify all building and site dimensions, levels and sewer invert levels at connection points before work starts. The Contractor is to comply in all respects with current Building Legislation, British Standard Specifications, Building Regulations, Construction (Design & Management) Regulations, Party Wall Act, etc. whether or not specifically stated on this drawing. This drawing must be read with and checked against any structural, geotechnical or other specialist documentation provided. This drawing is not intended to show details of foundations, ground conditions or ground contaminants. Each area of ground relied upon to support any structure depicted (including drainage) must be investigated by the Contractor. A suitable method of foundation should be provided allowing for existing ground conditions. Any suspect or fluid ground, contaminants on or within the ground, should be further investigated by a suitable expert. Any earthwork constructions shown indicate typical slopes for guidance only & should be further investigated by a suitable expert. Where existing trees are to be retained they should be subject to a full Arboricultural Inspection for safety. All trees are to be planted so as to ensure they are a minimum of 5 metres from buildings and 3 metres from drainage and services. A suitable method of foundation is to be provided to accommodate the proposed tree planting. Geoff Perry Associates Limited do not accept any responsibility for any losses (financial or otherwise) to any Client or third party arising out of the Clients (be it Developer or Contractor but not limited thereto) non-compliance with afore mentioned provisos.

Revisions:

- Plot substitution. Pump station added in south west corner, visitor parking added. 19.10.20 BPC
- Central POS creates additional POS / suds in south west corner. 22.11.20 BPC
- Plots 16-29, 57-67 & 72-76 amended. 23.11.20 GVP
- All 76 plots reviewed and amended to version 23 of the crib sheet. New Access, relocation of affordable, increase size of Suds and introduction of the Windsor. (Full instruction on email from Craige Burden 01.12.20 @ 06.07). 03.12.20 GVP
- All units respaced to provide 1.35m minimum between units. Plots 16-21, 28-41, 56-60, 67-71 and 76 amended. 10.12.20 GVP
- H.A Symbols added to plots 28-32 and 61-66. Acoustic fence line thickened. 11.12.20 HS
- Plots 39 and 56 handed (meaning plots 28-39 & 56 needed re-spacing). Plots 36-39 and 56-58 pulled forward 3 metres. Basin centrally amended and basin the the West amended to sit under the overhead cables. Sewer Easement standoff located on drawing to the West and rear gardens of plots 22-27 amended. GVP 15.12.20

Scale Check:



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Client: REDROW HOMES SOUTHERN CONTIES

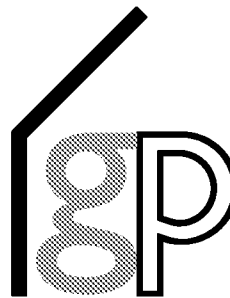
Project: LAND SOUTH OF THE A259 ANGMERING

Title: PLANNING LAYOUT

Date: 15 / 10 / 2020 Scale: 1:500 @ A1

Drawn by: BPC Checked by: ~

Job No. A 924 Drg No. 003 Rev. G

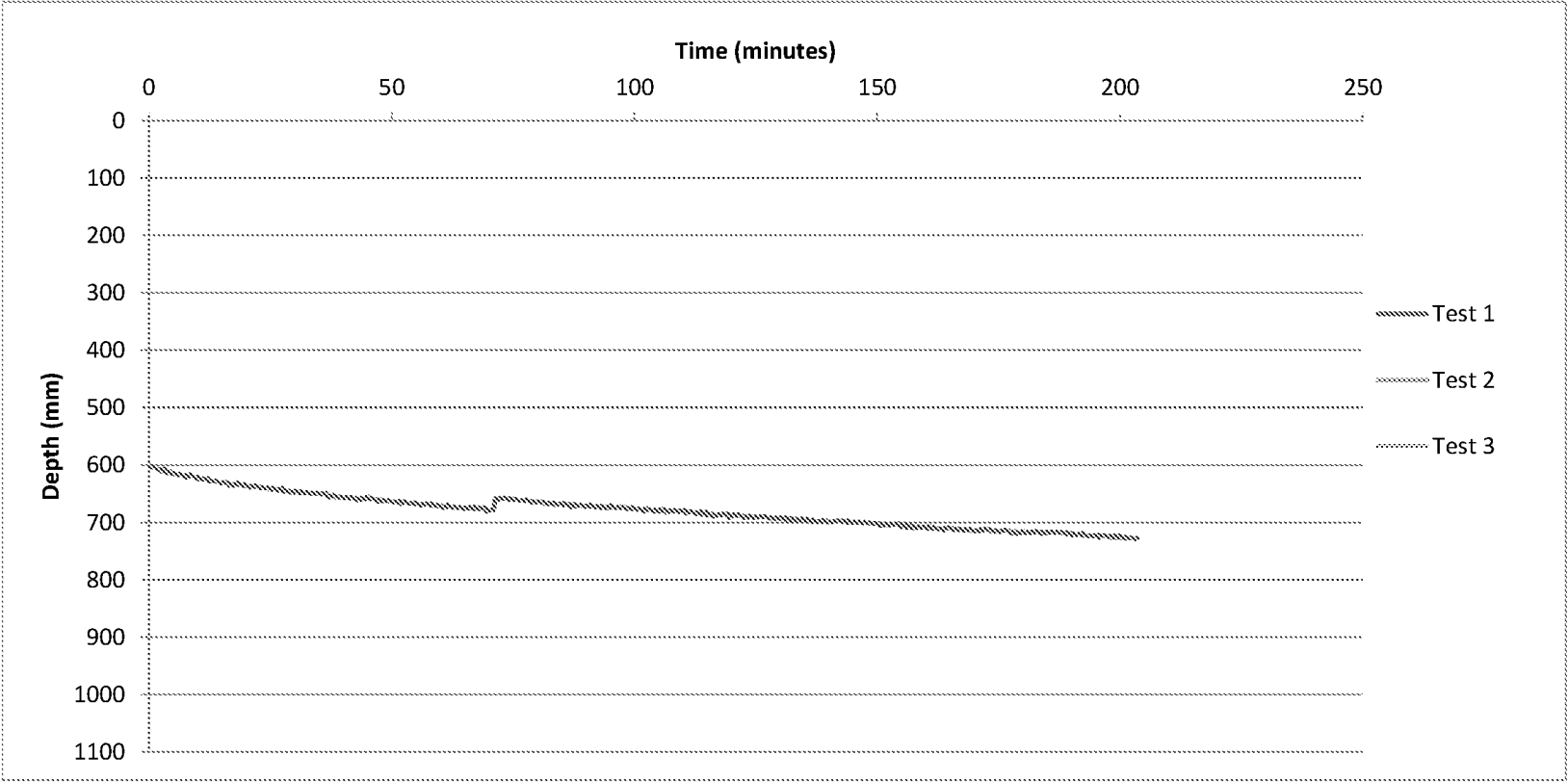


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Infiltration Test Results and Calculation of Infiltration Rates

Site: Land South of A529 - Angmering
Client: Redrow Homes
Test Reference: SA01

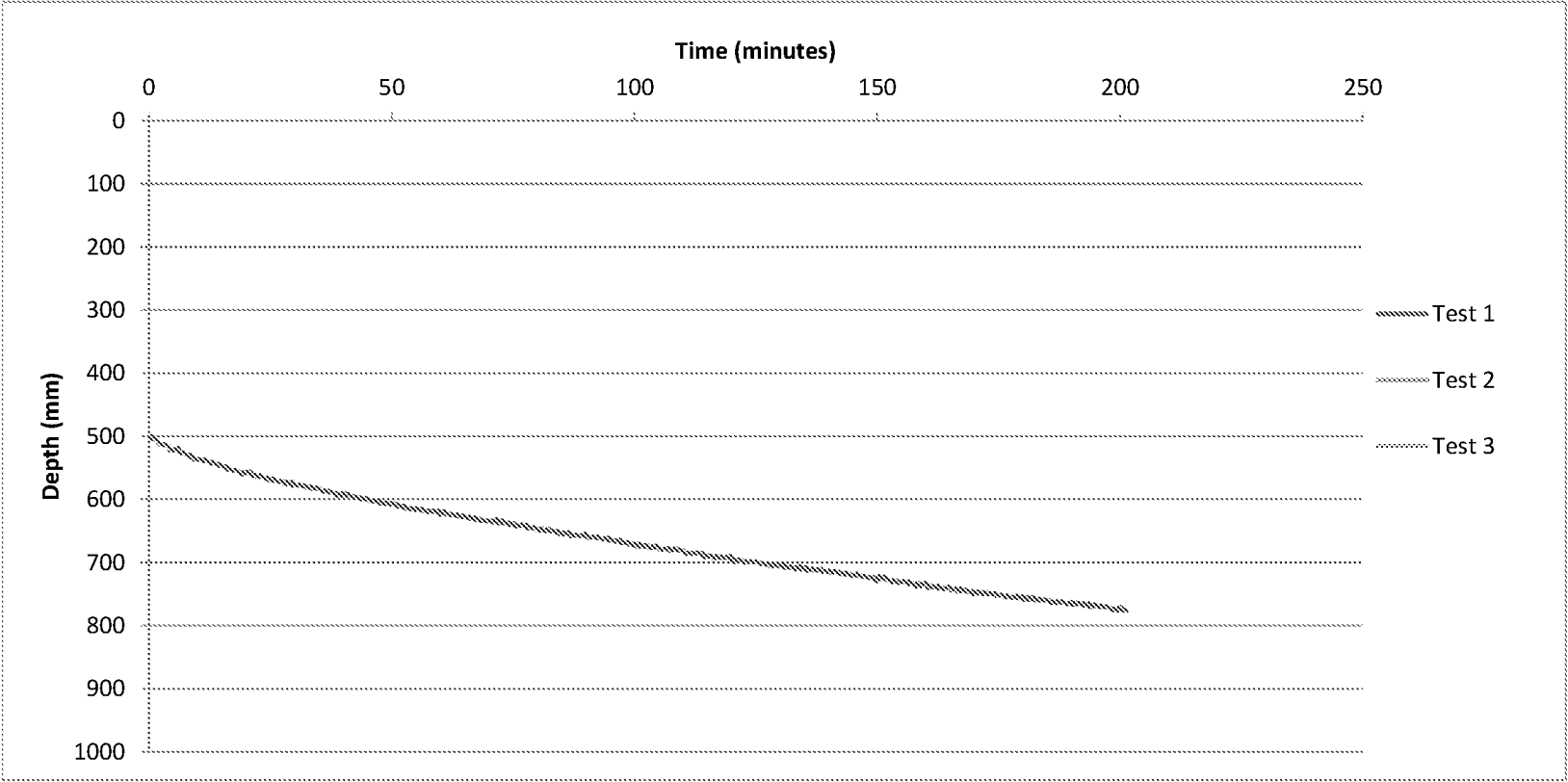
Test 1		Test 2		Test 3	
Pit Dimensions		Pit Dimensions		Pit Dimensions	
Trial pit length (mm)	1800	Trial pit length (mm)		Trial pit length (mm)	
Trial pit width (mm)	600	Trial pit width (mm)		Trial pit width (mm)	
Trial pit depth (mm)	1100	Trial pit depth (mm)		Trial pit depth (mm)	
Plan area (m ²)	1.08	Plan area (m ²)	0	Plan area (m ²)	0
Depth to water at start of test (mm)	600	Depth to water at start of test (mm)		Depth to water at start of test (mm)	
End time (sec)	12220	End time (sec)		End time (sec)	
Final depth (mm)	727	Final depth (mm)		Final depth (mm)	
75% Effective depth (mm)	725	75% Effective depth (mm)	0	75% Effective depth (mm)	0
25% Effective depth (mm)	975	25% Effective depth (mm)	0	25% Effective depth (mm)	0
Time at 75% effective depth - t _{p75} (sec)	11860	Time at 75% effective depth - t _{p75} (sec)		Time at 75% effective depth - t _{p75} (sec)	
Time at 25% effective depth - t _{p25} (sec)	NA	Time at 25% effective depth - t _{p25} (sec)		Time at 25% effective depth - t _{p25} (sec)	
Effective Storage volume of water (m ³)	0.54	Effective Storage volume of water (m ³)	0	Effective Storage volume of water (m ³)	0
V _{p75-25} (m ³)	0.27	V _{p75-25} (m ³)	0	V _{p75-25} (m ³)	0
Internal surface area - a _{p50} (m ²)	2.28	Internal surface area - a _{p50} (m ²)	0	Internal surface area - a _{p50} (m ²)	0
t _{p75-25} (sec)	#VALUE!	t _{p75-25} (sec)	0	t _{p75-25} (sec)	0
BR365 Soil Infiltration Rate	#VALUE!	BR365 Soil Infiltration Rate	#DIV/0!	BR365 Soil Infiltration Rate	#DIV/0!
Average Soil Infiltration Rate	3.5E-06	Average Soil Infiltration Rate	#DIV/0!	Average Soil Infiltration Rate	#DIV/0!
Testing completed by	GC	Calculation completed by	GC	Calculation checked by	
Date	10/02/2021	Date	02/03/2021	Date	



Infiltration Test Results and Calculation of Infiltration Rates

Site: Land South of A529 - Angmering
Client: Redrow Homes
Test Reference: SA02

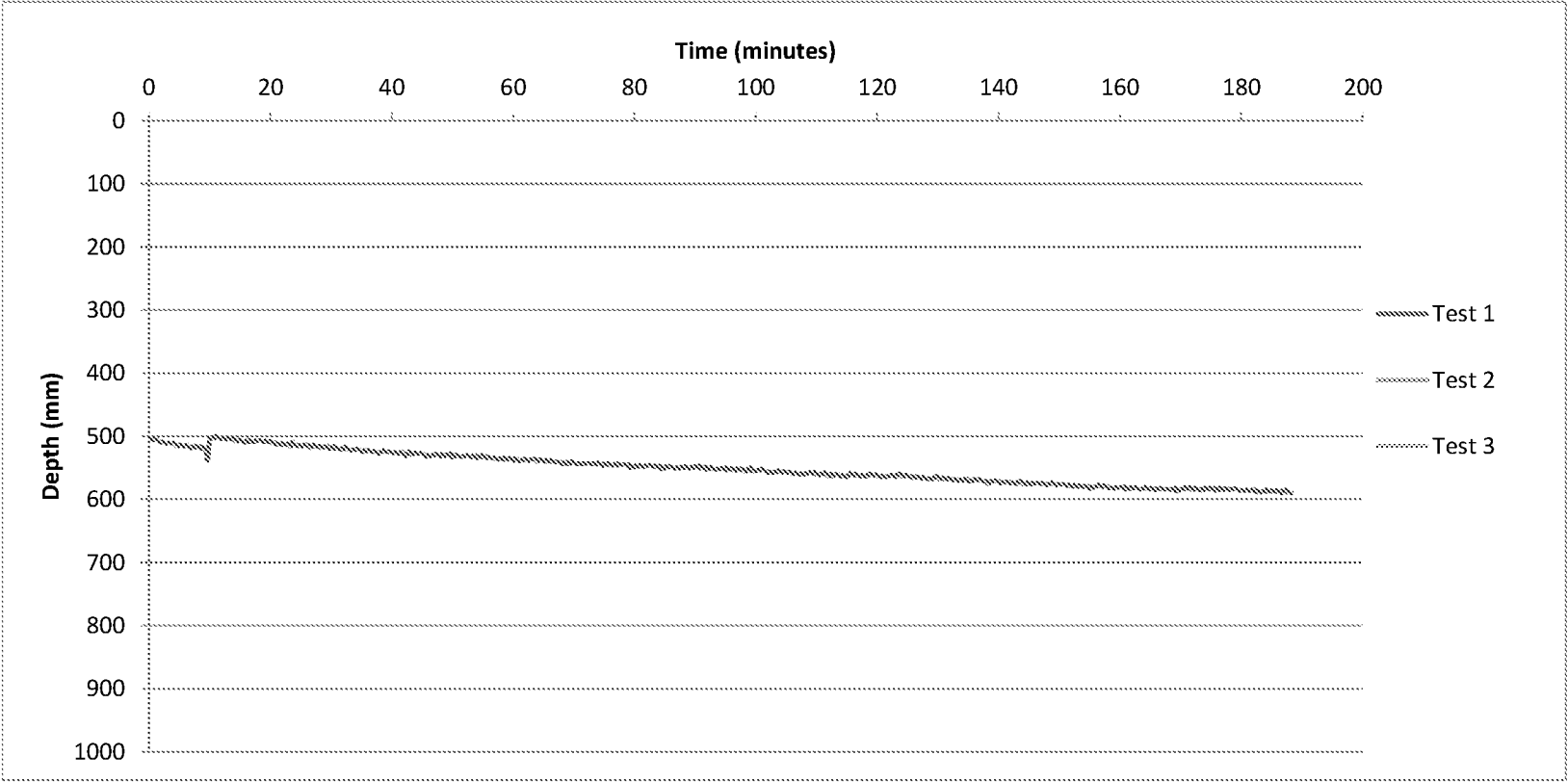
Test 1		Test 2		Test 3	
Pit Dimensions		Pit Dimensions		Pit Dimensions	
Trial pit length (mm)	1800	Trial pit length (mm)		Trial pit length (mm)	
Trial pit width (mm)	600	Trial pit width (mm)		Trial pit width (mm)	
Trial pit depth (mm)	1000	Trial pit depth (mm)		Trial pit depth (mm)	
Plan area (m ²)	1.08	Plan area (m ²)	0	Plan area (m ²)	0
Depth to water at start of test (mm)	500	Depth to water at start of test (mm)		Depth to water at start of test (mm)	
End time (sec)	12080	End time (sec)		End time (sec)	
Final depth (mm)	777	Final depth (mm)		Final depth (mm)	
75% Effective depth (mm)	625	75% Effective depth (mm)	0	75% Effective depth (mm)	0
25% Effective depth (mm)	875	25% Effective depth (mm)	0	25% Effective depth (mm)	0
Time at 75% effective depth - t _{p75} (sec)	3600	Time at 75% effective depth - t _{p75} (sec)		Time at 75% effective depth - t _{p75} (sec)	
Time at 25% effective depth - t _{p25} (sec)	NA	Time at 25% effective depth - t _{p25} (sec)		Time at 25% effective depth - t _{p25} (sec)	
Effective Storage volume of water (m ³)	0.54	Effective Storage volume of water (m ³)	0	Effective Storage volume of water (m ³)	0
V _{p75-25} (m ³)	0.27	V _{p75-25} (m ³)	0	V _{p75-25} (m ³)	0
Internal surface area - a _{p50} (m ²)	2.28	Internal surface area - a _{p50} (m ²)	0	Internal surface area - a _{p50} (m ²)	0
t _{p75-25} (sec)	#VALUE!	t _{p75-25} (sec)	0	t _{p75-25} (sec)	0
BR365 Soil Infiltration Rate	#VALUE!	BR365 Soil Infiltration Rate	#DIV/0!	BR365 Soil Infiltration Rate	#DIV/0!
Average Soil Infiltration Rate	8.8E-06	Average Soil Infiltration Rate	#DIV/0!	Average Soil Infiltration Rate	#DIV/0!
Testing completed by	GC	Calculation completed by	GC	Calculation checked by	
Date	10/02/2021	Date	02/03/2021	Date	



Infiltration Test Results and Calculation of Infiltration Rates

Site: Land South of A529 - Angmering
Client: Redrow Homes
Test Reference: SA03

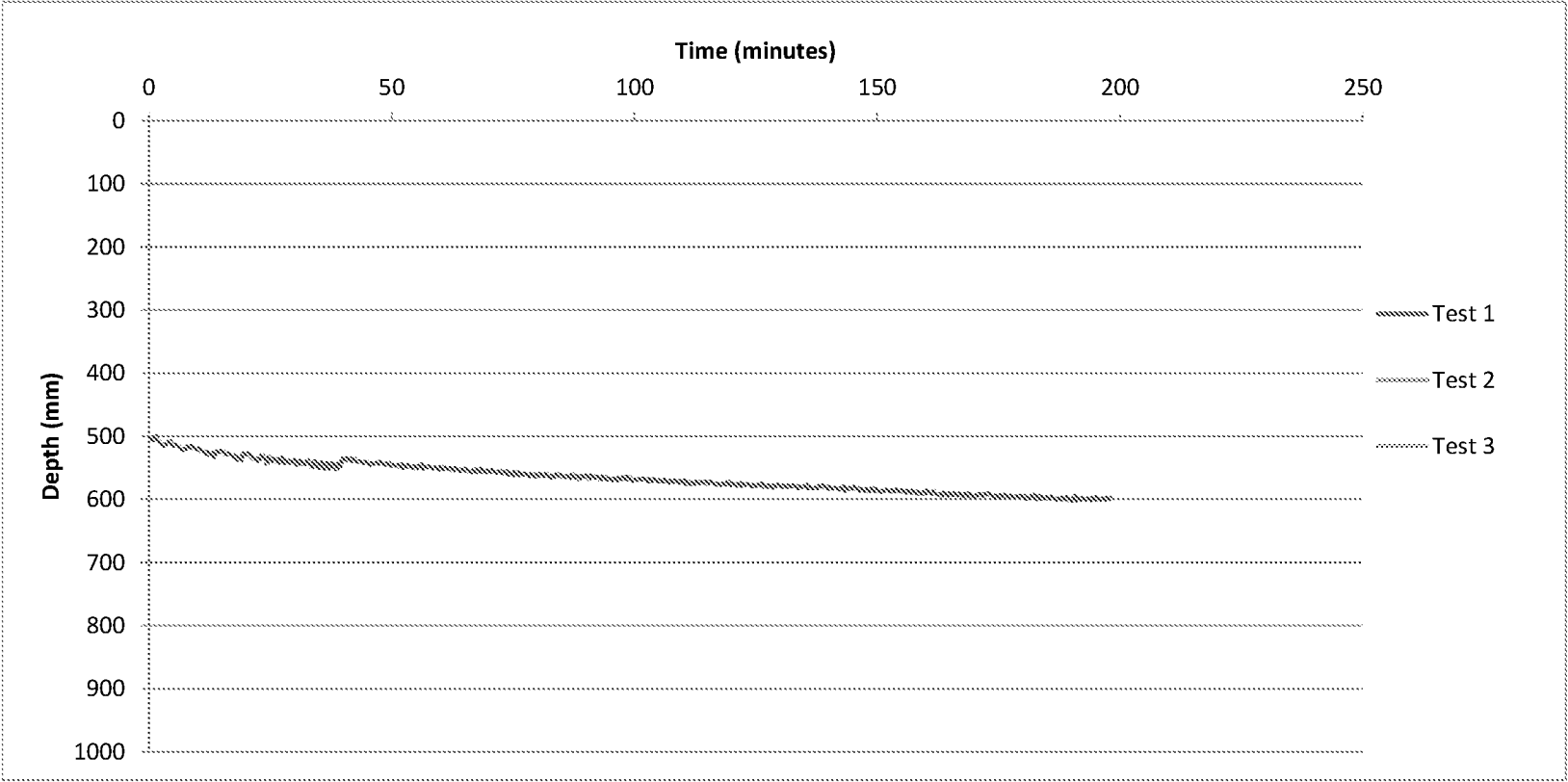
Test 1		Test 2		Test 3	
Pit Dimensions		Pit Dimensions		Pit Dimensions	
Trial pit length (mm)	1800	Trial pit length (mm)		Trial pit length (mm)	
Trial pit width (mm)	600	Trial pit width (mm)		Trial pit width (mm)	
Trial pit depth (mm)	1000	Trial pit depth (mm)		Trial pit depth (mm)	
Plan area (m ²)	1.08	Plan area (m ²)	0	Plan area (m ²)	0
Depth to water at start of test (mm)	500	Depth to water at start of test (mm)		Depth to water at start of test (mm)	
End time (sec)	11300	End time (sec)		End time (sec)	
Final depth (mm)	590	Final depth (mm)		Final depth (mm)	
75% Effective depth (mm)	625	75% Effective depth (mm)	0	75% Effective depth (mm)	0
25% Effective depth (mm)	875	25% Effective depth (mm)	0	25% Effective depth (mm)	0
Time at 75% effective depth - t _{p75} (sec)	NA	Time at 75% effective depth - t _{p75} (sec)		Time at 75% effective depth - t _{p75} (sec)	
Time at 25% effective depth - t _{p25} (sec)	NA	Time at 25% effective depth - t _{p25} (sec)		Time at 25% effective depth - t _{p25} (sec)	
Effective Storage volume of water (m ³)	0.54	Effective Storage volume of water (m ³)	0	Effective Storage volume of water (m ³)	0
V _{p75-25} (m ³)	0.27	V _{p75-25} (m ³)	0	V _{p75-25} (m ³)	0
Internal surface area - a _{p50} (m ²)	2.28	Internal surface area - a _{p50} (m ²)	0	Internal surface area - a _{p50} (m ²)	0
t _{p75-25} (sec)	#VALUE!	t _{p75-25} (sec)	0	t _{p75-25} (sec)	0
BR365 Soil Infiltration Rate	#VALUE!	BR365 Soil Infiltration Rate	#DIV/0!	BR365 Soil Infiltration Rate	#DIV/0!
Average Soil Infiltration Rate	2.6E-06	Average Soil Infiltration Rate	#DIV/0!	Average Soil Infiltration Rate	#DIV/0!
Testing completed by	GC	Calculation completed by	GC	Calculation checked by	
Date	10/02/2021	Date	02/03/2021	Date	



Infiltration Test Results and Calculation of Infiltration Rates

Site: Land South of A529 - Angmering
Client: Redrow Homes
Test Reference: SA04

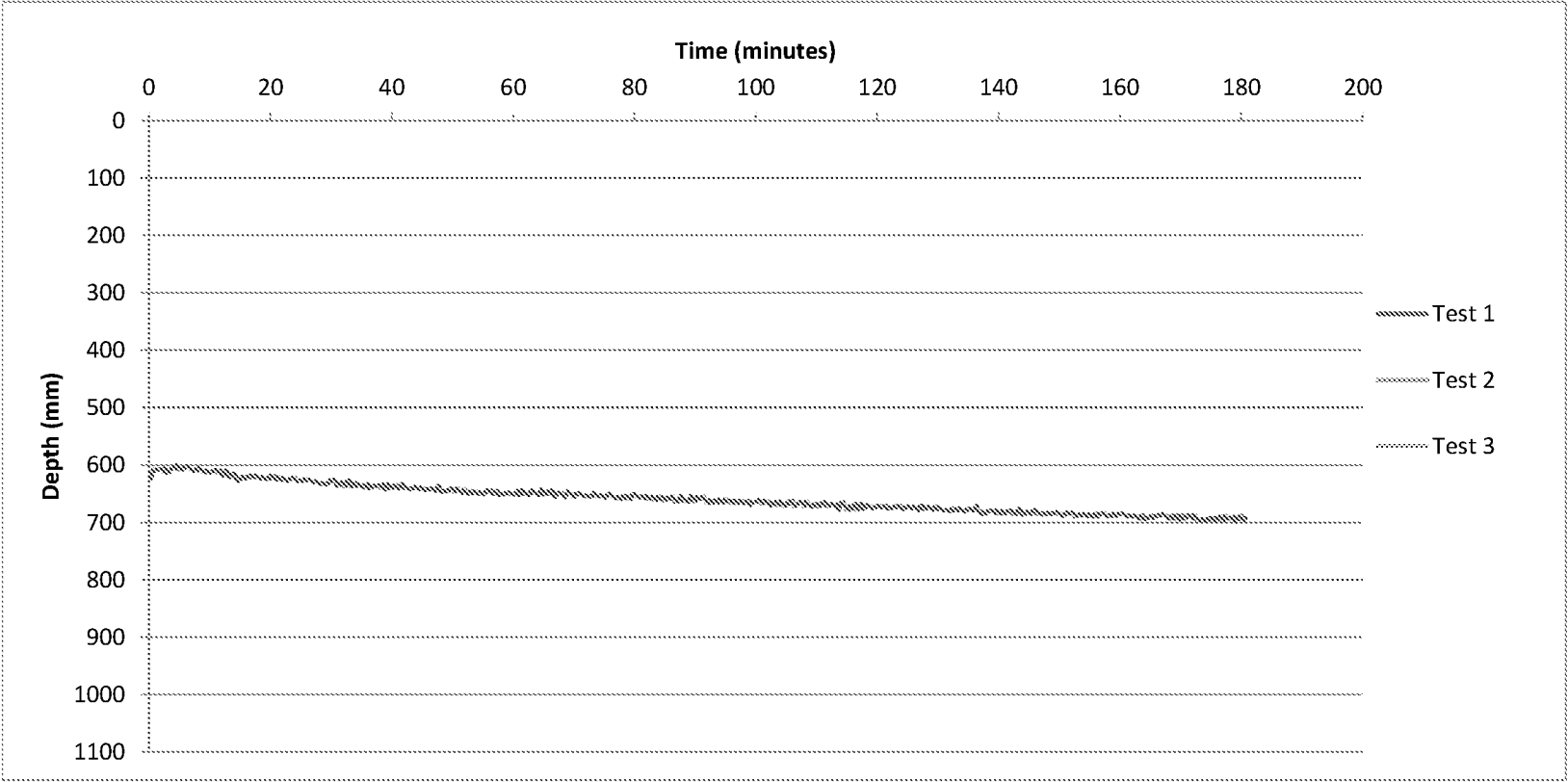
Test 1		Test 2		Test 3	
Pit Dimensions		Pit Dimensions		Pit Dimensions	
Trial pit length (mm)	1800	Trial pit length (mm)		Trial pit length (mm)	
Trial pit width (mm)	600	Trial pit width (mm)		Trial pit width (mm)	
Trial pit depth (mm)	1000	Trial pit depth (mm)		Trial pit depth (mm)	
Plan area (m ²)	1.08	Plan area (m ²)	0	Plan area (m ²)	0
Depth to water at start of test (mm)	500	Depth to water at start of test (mm)		Depth to water at start of test (mm)	
End time (sec)	11880	End time (sec)		End time (sec)	
Final depth (mm)	598	Final depth (mm)		Final depth (mm)	
75% Effective depth (mm)	625	75% Effective depth (mm)	0	75% Effective depth (mm)	0
25% Effective depth (mm)	875	25% Effective depth (mm)	0	25% Effective depth (mm)	0
Time at 75% effective depth - t _{p75} (sec)	NA	Time at 75% effective depth - t _{p75} (sec)		Time at 75% effective depth - t _{p75} (sec)	
Time at 25% effective depth - t _{p25} (sec)	NA	Time at 25% effective depth - t _{p25} (sec)		Time at 25% effective depth - t _{p25} (sec)	
Effective Storage volume of water (m ³)	0.54	Effective Storage volume of water (m ³)	0	Effective Storage volume of water (m ³)	0
V _{p75-25} (m ³)	0.27	V _{p75-25} (m ³)	0	V _{p75-25} (m ³)	0
Internal surface area - a _{p50} (m ²)	2.28	Internal surface area - a _{p50} (m ²)	0	Internal surface area - a _{p50} (m ²)	0
t _{p75-25} (sec)	#VALUE!	t _{p75-25} (sec)	0	t _{p75-25} (sec)	0
BR365 Soil Infiltration Rate	#VALUE!	BR365 Soil Infiltration Rate	#DIV/0!	BR365 Soil Infiltration Rate	#DIV/0!
Average Soil Infiltration Rate	2.7E-06	Average Soil Infiltration Rate	#DIV/0!	Average Soil Infiltration Rate	#DIV/0!
Testing completed by	GC	Calculation completed by	GC	Calculation checked by	
Date	10/02/2021	Date	02/03/2021	Date	



Infiltration Test Results and Calculation of Infiltration Rates

Site: Land South of A529 - Angmering
Client: Redrow Homes
Test Reference: SA05

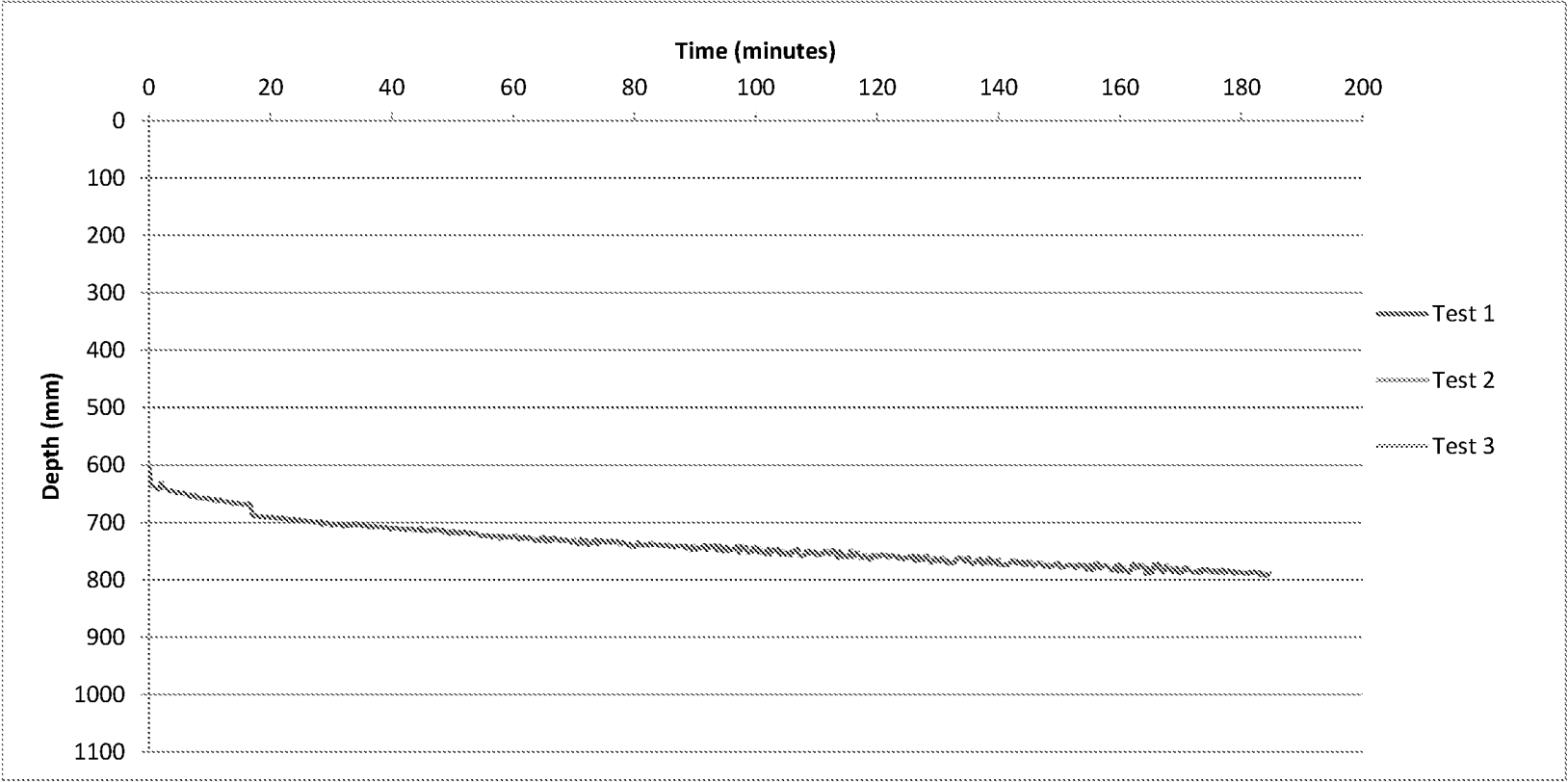
Test 1		Test 2		Test 3	
Pit Dimensions		Pit Dimensions		Pit Dimensions	
Trial pit length (mm)	1800	Trial pit length (mm)		Trial pit length (mm)	
Trial pit width (mm)	600	Trial pit width (mm)		Trial pit width (mm)	
Trial pit depth (mm)	1100	Trial pit depth (mm)		Trial pit depth (mm)	
Plan area (m ²)	1.08	Plan area (m ²)	0	Plan area (m ²)	0
Depth to water at start of test (mm)	600	Depth to water at start of test (mm)		Depth to water at start of test (mm)	
End time (sec)	10840	End time (sec)		End time (sec)	
Final depth (mm)	693	Final depth (mm)		Final depth (mm)	
75% Effective depth (mm)	725	75% Effective depth (mm)	0	75% Effective depth (mm)	0
25% Effective depth (mm)	975	25% Effective depth (mm)	0	25% Effective depth (mm)	0
Time at 75% effective depth - t _{p75} (sec)	NA	Time at 75% effective depth - t _{p75} (sec)		Time at 75% effective depth - t _{p75} (sec)	
Time at 25% effective depth - t _{p25} (sec)	NA	Time at 25% effective depth - t _{p25} (sec)		Time at 25% effective depth - t _{p25} (sec)	
Effective Storage volume of water (m ³)	0.54	Effective Storage volume of water (m ³)	0	Effective Storage volume of water (m ³)	0
V _{p75-25} (m ³)	0.27	V _{p75-25} (m ³)	0	V _{p75-25} (m ³)	0
Internal surface area - a _{p50} (m ²)	2.28	Internal surface area - a _{p50} (m ²)	0	Internal surface area - a _{p50} (m ²)	0
t _{p75-25} (sec)	#VALUE!	t _{p75-25} (sec)	0	t _{p75-25} (sec)	0
BR365 Soil Infiltration Rate	#VALUE!	BR365 Soil Infiltration Rate	#DIV/0!	BR365 Soil Infiltration Rate	#DIV/0!
Average Soil Infiltration Rate	2.8E-06	Average Soil Infiltration Rate	#DIV/0!	Average Soil Infiltration Rate	#DIV/0!
Testing completed by	GC	Calculation completed by	GC	Calculation checked by	
Date	10/02/2021	Date	02/03/2021	Date	



Infiltration Test Results and Calculation of Infiltration Rates

Site: Land South of A529 - Angmering
Client: Redrow Homes
Test Reference: SA06

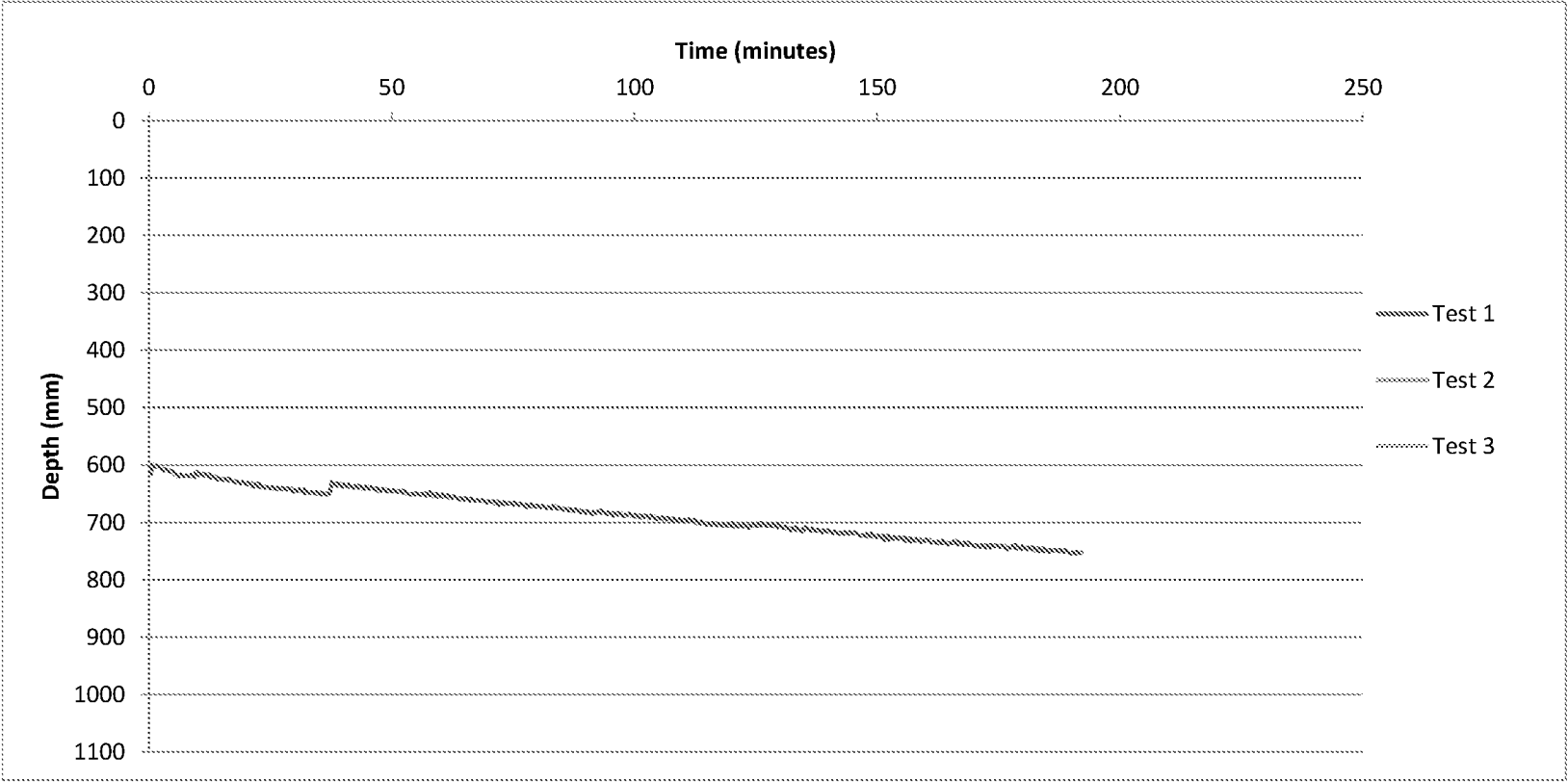
Test 1		Test 2		Test 3	
Pit Dimensions		Pit Dimensions		Pit Dimensions	
Trial pit length (mm)	1800	Trial pit length (mm)		Trial pit length (mm)	
Trial pit width (mm)	600	Trial pit width (mm)		Trial pit width (mm)	
Trial pit depth (mm)	1100	Trial pit depth (mm)		Trial pit depth (mm)	
Plan area (m ²)	1.08	Plan area (m ²)	0	Plan area (m ²)	0
Depth to water at start of test (mm)	600	Depth to water at start of test (mm)		Depth to water at start of test (mm)	
End time (sec)	11080	End time (sec)		End time (sec)	
Final depth (mm)	789	Final depth (mm)		Final depth (mm)	
75% Effective depth (mm)	725	75% Effective depth (mm)	0	75% Effective depth (mm)	0
25% Effective depth (mm)	975	25% Effective depth (mm)	0	25% Effective depth (mm)	0
Time at 75% effective depth - t _{p75} (sec)	3280	Time at 75% effective depth - t _{p75} (sec)		Time at 75% effective depth - t _{p75} (sec)	
Time at 25% effective depth - t _{p25} (sec)	NA	Time at 25% effective depth - t _{p25} (sec)		Time at 25% effective depth - t _{p25} (sec)	
Effective Storage volume of water (m ³)	0.54	Effective Storage volume of water (m ³)	0	Effective Storage volume of water (m ³)	0
V _{p75-25} (m ³)	0.27	V _{p75-25} (m ³)	0	V _{p75-25} (m ³)	0
Internal surface area - a _{p50} (m ²)	2.28	Internal surface area - a _{p50} (m ²)	0	Internal surface area - a _{p50} (m ²)	0
t _{p75-25} (sec)	#VALUE!	t _{p75-25} (sec)	0	t _{p75-25} (sec)	0
BR365 Soil Infiltration Rate	#VALUE!	BR365 Soil Infiltration Rate	#DIV/0!	BR365 Soil Infiltration Rate	#DIV/0!
Average Soil Infiltration Rate	6.1E-06	Average Soil Infiltration Rate	#DIV/0!	Average Soil Infiltration Rate	#DIV/0!
Testing completed by	GC	Calculation completed by	GC	Calculation checked by	
Date	10/02/2021	Date	02/03/2021	Date	



Infiltration Test Results and Calculation of Infiltration Rates

Site: Land South of A529 - Angmering
Client: Redrow Homes
Test Reference: SA07

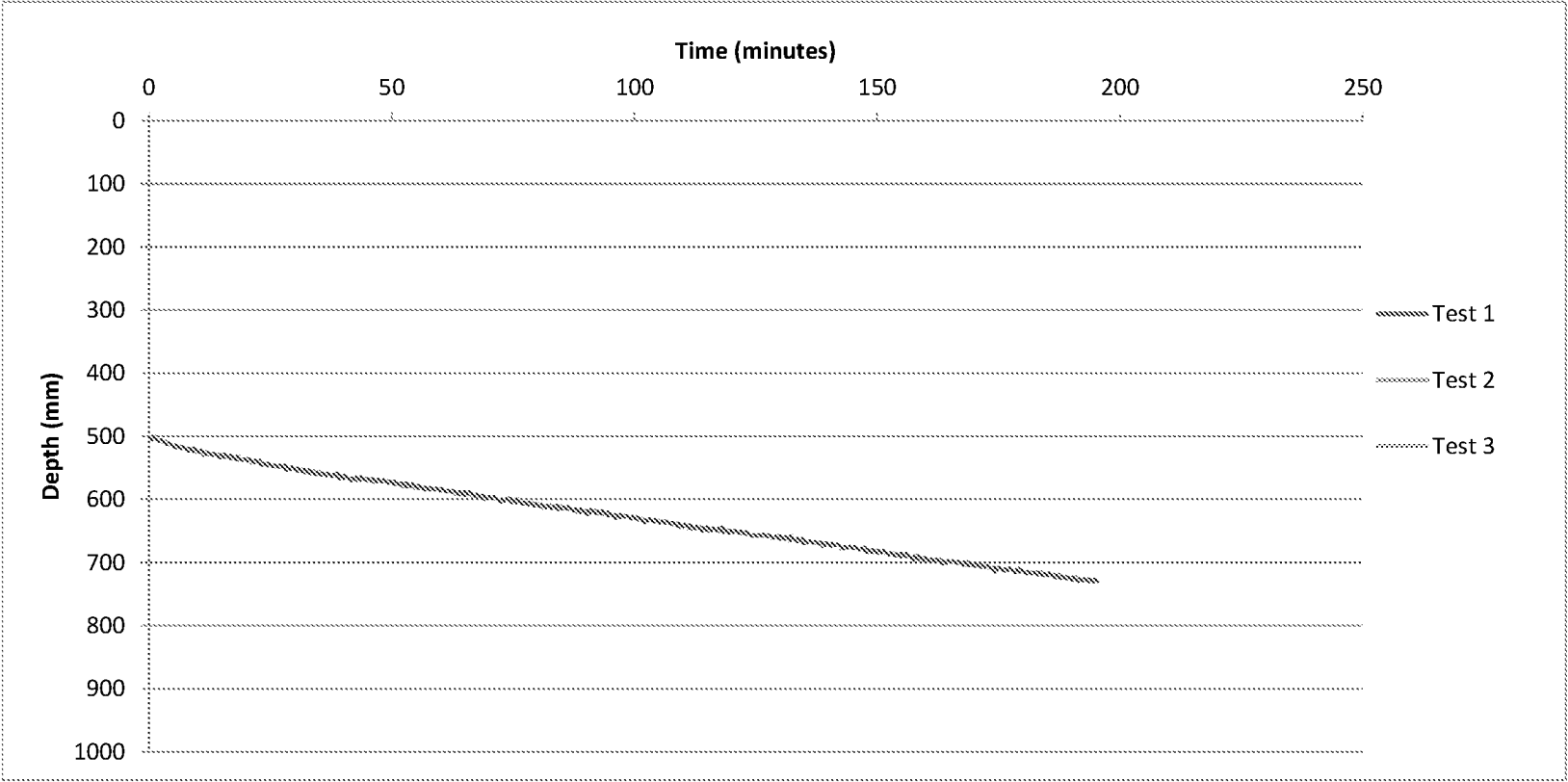
Test 1		Test 2		Test 3	
Pit Dimensions		Pit Dimensions		Pit Dimensions	
Trial pit length (mm)	1800	Trial pit length (mm)		Trial pit length (mm)	
Trial pit width (mm)	600	Trial pit width (mm)		Trial pit width (mm)	
Trial pit depth (mm)	1100	Trial pit depth (mm)		Trial pit depth (mm)	
Plan area (m ²)	1.08	Plan area (m ²)	0	Plan area (m ²)	0
Depth to water at start of test (mm)	600	Depth to water at start of test (mm)		Depth to water at start of test (mm)	
End time (sec)	11520	End time (sec)		End time (sec)	
Final depth (mm)	753	Final depth (mm)		Final depth (mm)	
75% Effective depth (mm)	725	75% Effective depth (mm)	0	75% Effective depth (mm)	0
25% Effective depth (mm)	975	25% Effective depth (mm)	0	25% Effective depth (mm)	0
Time at 75% effective depth - t _{p75} (sec)	8900	Time at 75% effective depth - t _{p75} (sec)		Time at 75% effective depth - t _{p75} (sec)	
Time at 25% effective depth - t _{p25} (sec)	NA	Time at 25% effective depth - t _{p25} (sec)		Time at 25% effective depth - t _{p25} (sec)	
Effective Storage volume of water (m ³)	0.54	Effective Storage volume of water (m ³)	0	Effective Storage volume of water (m ³)	0
V _{p75-25} (m ³)	0.27	V _{p75-25} (m ³)	0	V _{p75-25} (m ³)	0
Internal surface area - a _{p50} (m ²)	2.28	Internal surface area - a _{p50} (m ²)	0	Internal surface area - a _{p50} (m ²)	0
t _{p75-25} (sec)	#VALUE!	t _{p75-25} (sec)	0	t _{p75-25} (sec)	0
BR365 Soil Infiltration Rate	#VALUE!	BR365 Soil Infiltration Rate	#DIV/0!	BR365 Soil Infiltration Rate	#DIV/0!
Average Soil Infiltration Rate	4.6E-06	Average Soil Infiltration Rate	#DIV/0!	Average Soil Infiltration Rate	#DIV/0!
Testing completed by	GC	Calculation completed by	GC	Calculation checked by	
Date	10/02/2021	Date	02/03/2021	Date	



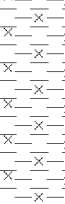
Infiltration Test Results and Calculation of Infiltration Rates

Site: Land South of A529 - Angmering
Client: Redrow Homes
Test Reference: SA08

Test 1		Test 2		Test 3	
Pit Dimensions		Pit Dimensions		Pit Dimensions	
Trial pit length (mm)	1800	Trial pit length (mm)		Trial pit length (mm)	
Trial pit width (mm)	600	Trial pit width (mm)		Trial pit width (mm)	
Trial pit depth (mm)	1000	Trial pit depth (mm)		Trial pit depth (mm)	
Plan area (m ²)	1.08	Plan area (m ²)	0	Plan area (m ²)	0
Depth to water at start of test (mm)	500	Depth to water at start of test (mm)		Depth to water at start of test (mm)	
End time (sec)	11720	End time (sec)		End time (sec)	
Final depth (mm)	729	Final depth (mm)		Final depth (mm)	
75% Effective depth (mm)	625	75% Effective depth (mm)	0	75% Effective depth (mm)	0
25% Effective depth (mm)	875	25% Effective depth (mm)	0	25% Effective depth (mm)	0
Time at 75% effective depth - t _{p75} (sec)	5680	Time at 75% effective depth - t _{p75} (sec)		Time at 75% effective depth - t _{p75} (sec)	
Time at 25% effective depth - t _{p25} (sec)	NA	Time at 25% effective depth - t _{p25} (sec)		Time at 25% effective depth - t _{p25} (sec)	
Effective Storage volume of water (m ³)	0.54	Effective Storage volume of water (m ³)	0	Effective Storage volume of water (m ³)	0
V _{p75-25} (m ³)	0.27	V _{p75-25} (m ³)	0	V _{p75-25} (m ³)	0
Internal surface area - a _{p50} (m ²)	2.28	Internal surface area - a _{p50} (m ²)	0	Internal surface area - a _{p50} (m ²)	0
t _{p75-25} (sec)	#VALUE!	t _{p75-25} (sec)	0	t _{p75-25} (sec)	0
BR365 Soil Infiltration Rate	#VALUE!	BR365 Soil Infiltration Rate	#DIV/0!	BR365 Soil Infiltration Rate	#DIV/0!
Average Soil Infiltration Rate	7.2E-06	Average Soil Infiltration Rate	#DIV/0!	Average Soil Infiltration Rate	#DIV/0!
Testing completed by	GC	Calculation completed by	GC	Calculation checked by	
Date	10/02/2021	Date	02/03/2021	Date	

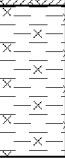


								TrialPit No SA01 Sheet 1 of 1	
Project Name Land South of A259				Project No. 45405		Co-ords: - Level:		Date 10/02/2021	
Location: Angmering, West Sussex						Dimensions: 1.80m		Scale 1:25	
Client: Redrow Homes						Depth: 1.10m		Logged GC	

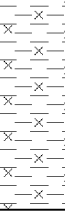
Samples & In Situ Testing			Depth (m)	Level (mAOD)	Legend	Stratum Description	
Depth (m)	Type	Results					
			0.40			TOPSOIL: Firm, brown, silty CLAY. Roots noted.	
			1.10			RIVER TERRACE DEPOSITS: Firm to stiff, orangish brown, silty CLAY.	1
						Trialpit Complete at 1.100m	2
							3
							4

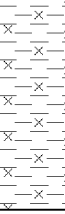
Remarks:							
Stability: 1. Trial pit remained dry and stable							

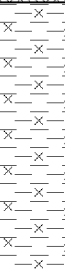
				TrialPit No SA02 Sheet 1 of 1			
Project Name Land South of A259			Project No. 45405		Co-ords: - Level:		Date 10/02/2021
Location: Angmering, West Sussex					Dimensions: 1.80m Depth: 1.00m 0.60m 		Scale 1:25
Client: Redrow Homes							Logged GC

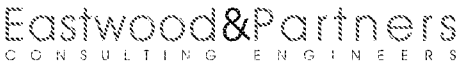
Samples & In Situ Testing			Depth (m)	Level (mAOD)	Legend	Stratum Description	
Depth (m)	Type	Results					
			0.50			TOPSOIL: Firm, brown, silty CLAY. Roots noted.	
			1.00			RIVER TERRACE DEPOSITS: Firm to stiff, orangish brown, silty CLAY.	
						Trialpit Complete at 1.000m	1
							2
							3
							4

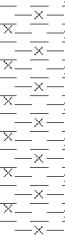
Remarks: Stability: 1. Trial pit remained dry and stable	
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Eastwood&Partners CONSULTING ENGINEERS						TrialPit No SA03 Sheet 1 of 1	
Project Name Land South of A259			Project No. 45405		Co-ords: - Level:		Date 10/02/2021
Location: Angmering, West Sussex					Dimensions: 1.80m		Scale 1:25
Client: Redrow Homes					Depth: 1.00m		Logged GC
Samples & In Situ Testing			Depth (m)	Level (mAOD)	Legend	Stratum Description	
Depth (m)	Type	Results					
			0.30			TOPSOIL: Firm, brown, silty CLAY. Roots noted.	
						RIVER TERRACE DEPOSITS: Firm to stiff, orangish brown, silty CLAY.	
			1.00			Trialpit Complete at 1.000m	
Remarks:							
Stability: 1. Trial pit remained dry and stable							

Eastwood&Partners CONSULTING ENGINEERS						TrialPit No SA04 Sheet 1 of 1	
Project Name Land South of A259			Project No. 45405		Co-ords: - Level:		Date 10/02/2021
Location: Angmering, West Sussex					Dimensions: 1.80m		Scale 1:25
Client: Redrow Homes					Depth: 1.00m		Logged GC
Samples & In Situ Testing			Depth (m)	Level (mAOD)	Legend	Stratum Description	
Depth (m)	Type	Results					
			0.30			TOPSOIL: Firm, brown, silty CLAY. Roots noted.	
						RIVER TERRACE DEPOSITS: Firm to stiff, orangish brown, silty CLAY.	
			1.00			Trialpit Complete at 1.000m	
Remarks: Stability: 1. Trial pit remained dry and stable							

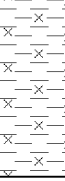
Eastwood&Partners CONSULTING ENGINEERS						TrialPit No SA05 Sheet 1 of 1	
Project Name Land South of A259			Project No. 45405		Co-ords: - Level:		Date 10/02/2021
Location: Angmering, West Sussex					Dimensions: 1.80m		Scale 1:25
Client: Redrow Homes					Depth: 1.10m		Logged GC
Samples & In Situ Testing			Depth (m)	Level (mAOD)	Legend	Stratum Description	
Depth (m)	Type	Results					
			0.20			TOPSOIL: Firm, brown, silty CLAY. Roots noted.	
			1.10			RIVER TERRACE DEPOSITS: Firm to stiff, orangish brown, silty CLAY.	
						Trialpit Complete at 1.100m	
Remarks:							
Stability: 1. Trial pit remained dry and stable							

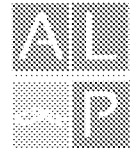
				TrialPit No SA06 Sheet 1 of 1			
Project Name Land South of A259			Project No. 45405		Co-ords: - Level:		Date 10/02/2021
Location: Angmering, West Sussex					Dimensions: 1.80m		Scale 1:25
Client: Redrow Homes					Depth: 1.10m		Logged GC

Samples & In Situ Testing			Depth (m)	Level (mAOD)	Legend	Stratum Description
Depth (m)	Type	Results				
			0.30			TOPSOIL: Firm, brown, silty CLAY. Roots noted.
			1.10			RIVER TERRACE DEPOSITS: Firm to stiff, orangish brown, silty CLAY.
						Trialpit Complete at 1.100m

Remarks:	
Stability: 1. Trial pit remained dry and stable	

Eastwood&Partners CONSULTING ENGINEERS						TrialPit No SA07 Sheet 1 of 1	
Project Name Land South of A259			Project No. 45405		Co-ords: - Level:		Date 10/02/2021
Location: Angmering, West Sussex					Dimensions: 1.80m		Scale 1:25
Client: Redrow Homes					Depth: 1.10m		Logged GC
Samples & In Situ Testing			Depth (m)	Level (mAOD)	Legend	Stratum Description	
Depth (m)	Type	Results					
			0.40			TOPSOIL: Firm, brown, silty CLAY. Roots noted.	
			1.10			RIVER TERRACE DEPOSITS: Firm to stiff, orangish brown, silty CLAY.	
						Trialpit Complete at 1.100m	
Remarks:							
Stability: 1. Trial pit remained dry and stable							

								TrialPit No SA08 Sheet 1 of 1	
Project Name Land South of A259				Project No. 45405		Co-ords: - Level:		Date 10/02/2021	
Location: Angmering, West Sussex						Dimensions: 1.80m		Scale 1:25	
Client: Redrow Homes						Depth: 1.00m		Logged GC	
Samples & In Situ Testing			Depth (m)	Level (mAOD)	Legend	Stratum Description			
Depth (m)	Type	Results							
			0.40			TOPSOIL: Firm, brown, silty CLAY. Roots noted.			
			1.00			RIVER TERRACE DEPOSITS: Firm to stiff, orangish brown, silty CLAY.			
						Trialpit Complete at 1.000m			
Remarks:									
Stability: 1. Trial pit remained dry and stable									



Appendix 3 – Calculations

Qbar Calculation

Drainage Calculation

Greenfield runoff rate estimation for sites

Greenfield runoff tool

Calculated by: Jonathan Shuttleworth

Site name: Land South of A259

Site location: Angmering

Site Details

Latitude: 50.81716° N

Longitude: 0.46647° W

Reference: 3108805516

Date: Jun 02 2021 15:32

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013), the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Runoff estimation approach

IH124

Site characteristics

Total site area (ha): 1.0

Methodology

Q_{BAR} estimation method: Calculate from SPR and SAAR

SPR estimation method: Calculate from SOIL type

Soil characteristics

	Default	Edited
SOIL type:	2	2
HOST class:	N/A	N/A
SPR/SPRHOST:	0.3	0.3

Hydrological characteristics

	Default	Edited
SAAR (mm):	719	719
Hydrological region:	7	7
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	2.3	2.3
Growth curve factor 100 years:	3.19	3.19
Growth curve factor 200 years:	3.74	3.74

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited
Q _{BAR} (l/s):	1.88	1.88
1 in 1 year (l/s):	1.6	1.6
1 in 30 years (l/s):	4.33	4.33
1 in 100 year (l/s):	6	6
1 in 200 years (l/s):	7.03	7.03

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement, which can both be found at www.uksuds.com/terms-and-conditions.htm. The outputs from this tool are estimates of greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
1	0.028	5.00	9.094	600	508090.404	103138.098	1.467
2	0.009	5.00	8.986	1350	508090.139	103142.596	1.479
3	0.027	5.00	8.856	600	508061.553	103136.848	1.473
4	0.061	5.00	8.740	1350	508060.926	103140.915	1.562
5	0.042	5.00	8.779	600	508028.760	103135.480	1.499
6			8.677	1200	508027.194	103140.471	1.712
7	0.045	5.00	8.587	1350	507985.789	103146.553	1.425
8	0.058	5.00	8.684	600	507989.508	103134.513	1.512
9			8.624	1350	507992.297	103141.797	1.510
10	0.026	5.00	8.805	600	508001.587	103132.604	1.450
11			8.683	1350	508003.027	103141.269	1.633
12	0.053	5.00	8.722	1350	508020.300	103138.409	1.926
13	0.028	5.00	8.670	600	508016.679	103098.821	1.489
14	0.015	5.00	8.661	600	508027.471	103098.480	1.474
15			8.561	1350	508022.897	103097.938	1.890
16	0.046	5.00	8.690	600	508029.612	103077.678	1.518
17	0.038	5.00	8.579	600	508017.920	103072.719	1.437
18	0.015	5.00	8.516	1350	508024.222	103073.126	1.922
19	0.067	5.00	8.383		508039.367	103056.227	1.785
20	0.023	5.00	8.277	1350	508025.418	103048.917	1.819
21	0.077	5.00	8.255	600	508024.258	103035.973	1.439
22	0.057	5.00	8.207	1350	508020.502	103042.650	1.774
23	0.018	5.00	8.228	600	507989.456	103032.927	1.434
24	0.032	5.00	8.286	600	507990.584	103048.076	1.493
25			8.142	1350	507989.079	103041.222	1.806
26	0.036	5.00	8.402	600	507970.747	103036.107	1.478
27			8.333	1350	507968.215	103040.274	2.062
28			8.295	1350	507961.489	103046.358	2.052
29	0.025	5.00	8.518	600	507970.400	103073.573	1.720
30			8.118	1350	507959.979	103072.079	1.500
31			8.177	1350	507960.765	103058.681	2.048
31_OUT	0.077		8.150		507949.209	103058.022	2.096
32	0.025	5.00	8.984	1350	508124.614	103161.991	1.425
33	0.003	5.00	9.142	1350	508111.431	103159.705	1.662
34	0.013	5.00	9.179	600	508114.171	103147.827	1.501
35	0.028	5.00	9.020	1350	508107.873	103147.838	1.613
36	0.043	5.00	8.985	600	508112.652	103126.012	1.545
37	0.018	5.00	8.794	1350	508107.833	103125.500	1.594
38	0.016	5.00	8.754	600	508103.393	103109.847	1.494
39	0.026	5.00	8.747	600	508114.611	103105.441	1.519
40	0.046	5.00	8.580	1350	508110.019	103104.954	1.552
41	0.043	5.00	8.762	600	508102.982	103081.850	1.456
42			8.683	1350	508110.014	103081.241	1.752
43	0.042	5.00	8.837	600	508113.808	103064.642	1.508
44			8.689	1350	508108.062	103062.555	1.835
45	0.024	5.00	8.570	600	508118.094	103041.760	1.371
46	0.034	5.00	8.428	1350	508116.058	103048.501	1.374
47	0.015	5.00	8.497	1350	508108.732	103049.463	1.487
48	0.058	5.00	8.726	600	508096.436	103039.638	1.419
49			8.637	1200	508095.954	103048.356	1.703
50			8.513	1200	508083.583	103061.290	1.760
50_OUT			8.300		508066.563	103060.783	1.617
51		5.00	8.150		507939.130	103045.118	2.150
52			8.150	1350	507941.638	103019.670	2.213
52_OUT			8.100		507936.465	103009.041	2.281
53	0.053	5.00	8.063	1200	507953.576	103079.305	1.458
53_OUT			8.150		507948.049	103067.099	2.096

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.012	31	31_OUT	11.373	0.600	6.129	6.100	0.029	399.1	450	8.01	50.0
1.011	28	31	12.344	0.600	6.242	6.204	0.038	316.5	375	8.82	50.0
16.001	30	31	13.421	0.600	6.618	6.554	0.264	30.8	225	5.30	50.0
16.000	29	30	10.528	0.600	6.798	6.693	0.105	190.3	150	5.17	50.0
1.010	27	28	9.069	0.600	6.371	6.343	0.028	323.9	375	8.62	50.0
1.009	25	27	20.686	0.600	6.338	6.271	0.065	321.3	375	8.47	50.0
13.000	26	27	4.876	0.600	6.924	6.496	0.428	11.4	150	5.05	50.0
1.008	22	25	31.455	0.600	6.433	6.306	0.097	324.5	375	8.12	50.0
13.000	23	25	8.304	0.600	6.794	6.561	0.233	35.6	150	5.08	50.0
14.000	24	25	7.017	0.600	6.793	6.561	0.232	36.2	150	5.06	50.0
1.007	20	22	7.965	0.600	6.438	6.433	0.025	318.6	375	7.60	50.0
12.000	21	22	7.461	0.600	6.816	6.658	0.158	48.5	150	5.09	50.0
1.006	18	20	24.239	0.600	6.594	6.458	0.136	178.2	375	7.47	50.0
11.000	19	20	15.748	0.600	6.598	6.533	0.065	242.3	300	8.29	50.0
1.005	15	18	24.847	0.600	6.471	6.594	0.077	322.7	375	7.17	50.0
9.000	16	18	7.045	0.600	7.172	6.919	0.253	29.9	150	5.05	50.0
10.000	17	18	6.313	0.600	7.142	6.919	0.223	19.6	150	5.05	50.0
1.004	12	15	40.554	0.600	6.786	6.671	0.125	204.4	375	6.76	50.0
8.000	14	15	4.406	0.600	7.187	6.896	0.291	15.8	150	5.03	50.0
7.000	13	15	6.280	0.600	7.181	6.896	0.285	22.0	150	5.05	50.0
1.003	6	12	7.186	0.600	6.965	6.796	0.169	42.5	375	6.06	50.0
4.002	11	12	17.908	0.600	7.050	6.946	0.104	168.3	225	5.60	50.0
6.000	10	11	8.784	0.600	7.355	7.125	0.230	38.2	150	5.09	50.0
4.001	9	11	10.743	0.600	7.114	7.050	0.064	167.9	225	5.31	50.0
4.000	7	9	8.061	0.600	7.162	7.114	0.048	167.9	225	5.13	50.0
5.000	8	9	7.800	0.600	7.172	7.114	0.058	135.6	225	5.12	50.0
1.002	4	6	33.735	0.600	7.178	7.040	0.138	244.5	300	6.04	50.0
3.000	5	6	5.231	0.600	7.280	7.190	0.090	58.2	150	5.07	50.0
1.001	2	4	29.261	0.600	7.307	7.253	0.054	115.3	225	5.46	50.0
2.000	3	4	4.115	0.600	7.383	7.328	0.055	75.1	150	5.06	50.0
1.000	1	2	4.506	0.600	7.627	7.582	0.045	100.1	150	5.07	50.0
17.007	50	50_OUT	17.028	0.600	6.753	6.683	0.070	242.3	300	7.44	50.0
17.006	44	50	24.512	0.600	6.934	6.753	0.181	242.7	300	7.15	50.0
24.003	49	50	17.898	0.600	6.934	6.828	0.106	148.8	225	5.75	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.012	1.011	160.8	112.7	1.598	1.600	0.831	0.0	278	1.091
1.011	1.013	111.9	107.9	1.677	1.598	0.796	0.0	298	1.147
16.001	1.838	73.1	4.8	1.275	1.598	0.035	0.0	39	1.052
16.000	1.003	17.7	4.8	1.570	1.275	0.035	0.0	53	0.852
1.010	1.001	110.6	107.9	1.687	1.677	0.796	0.0	301	1.134
1.009	1.005	111.0	103.0	1.431	1.687	0.760	0.0	287	1.135
13.000	3.401	53.0	4.9	1.328	1.687	0.036	0.0	31	1.885
1.008	1.000	110.5	96.3	1.399	1.431	0.710	0.0	272	1.122
13.000	1.691	29.9	2.4	1.284	1.431	0.018	0.0	29	1.023
14.000	1.837	32.5	4.3	1.343	1.431	0.032	0.0	37	1.276
1.007	1.009	111.5	78.1	1.444	1.399	0.576	0.0	232	1.089
12.000	1.448	25.6	10.5	1.289	1.399	0.077	0.0	67	1.380
1.006	1.354	149.5	65.9	1.547	1.444	0.487	0.0	174	1.312
11.000	1.005	71.1	9.0	1.485	1.444	0.067	0.0	72	0.694
1.005	1.003	110.8	52.6	1.515	1.547	0.388	0.0	182	0.991
9.000	2.263	40.0	6.2	1.368	1.547	0.046	0.0	40	1.656
10.000	2.288	40.4	5.1	1.287	1.547	0.038	0.0	36	1.575
1.004	1.000	110.5	47.0	1.551	1.515	0.347	0.0	170	0.960
8.000	2.544	45.0	2.0	1.324	1.515	0.015	0.0	22	1.300
7.000	2.154	38.1	3.5	1.339	1.515	0.026	0.0	31	1.352
1.003	2.785	307.6	22.6	1.337	1.551	0.167	0.0	68	1.647
4.002	1.005	39.9	17.3	1.408	1.551	0.127	0.0	103	0.969
6.000	1.633	28.9	3.5	1.300	1.408	0.026	0.0	35	1.113
4.001	1.006	40.0	13.7	1.285	1.408	0.101	0.0	91	0.915
4.000	1.006	40.0	6.2	1.200	1.285	0.045	0.0	59	0.732
3.000	1.121	44.6	7.6	1.287	1.285	0.056	0.0	63	0.842
1.002	1.001	70.7	16.9	1.262	1.337	0.125	0.0	99	0.825
3.000	1.320	23.3	5.7	1.349	1.337	0.042	0.0	50	1.089
1.001	1.217	48.4	5.0	1.254	1.262	0.037	0.0	49	0.792
2.000	1.161	20.5	3.7	1.323	1.262	0.027	0.0	43	0.882
1.000	1.004	17.7	3.8	1.317	1.254	0.028	0.0	47	0.801
17.007	1.003	70.9	60.1	1.460	1.317	0.443	0.0	212	1.121
17.006	1.005	71.0	42.4	1.535	1.460	0.313	0.0	167	1.048
24.003	1.003	39.9	17.7	1.478	1.460	0.130	0.0	105	0.974

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
23.000	48	49	8.731	0.600	7.307	7.009	0.298	29.8	150	3.08	50.0
24.002	47	49	12.826	0.600	7.010	6.934	0.076	169.8	225	3.45	50.0
24.001	46	47	7.350	0.600	7.034	7.010	0.024	167.9	225	3.24	50.0
24.000	45	46	7.042	0.600	7.199	7.129	0.070	100.6	150	3.12	50.0
17.005	42	44	18.788	0.600	6.931	6.854	0.077	244.0	300	6.75	50.0
23.000	43	44	6.113	0.600	7.329	7.004	0.325	18.8	150	3.04	50.0
17.004	40	42	25.713	0.600	7.028	6.931	0.097	244.1	300	6.44	50.0
22.000	41	42	7.058	0.600	7.306	7.081	0.225	31.4	150	3.07	50.0
17.003	37	40	20.662	0.600	7.200	7.028	0.172	120.1	300	5.04	50.0
20.000	38	40	8.217	0.600	7.260	7.178	0.082	100.4	150	3.14	50.0
21.000	39	40	1.018	0.600	7.228	7.178	0.050	92.4	150	3.07	50.0
17.002	35	37	22.308	0.600	7.407	7.275	0.132	149.2	225	3.40	50.0
19.000	36	37	4.846	0.600	7.440	7.350	0.090	53.8	150	3.06	50.0
17.001	33	35	12.389	0.600	7.480	7.407	0.073	169.7	225	3.43	50.0
18.000	34	35	6.298	0.600	7.678	7.482	0.196	32.1	150	3.06	50.0
17.000	32	33	18.380	0.600	7.559	7.480	0.079	169.8	225	3.22	50.0
26.001	52	52_OUT	11.821	0.600	5.937	5.919	0.018	100.2	150	3.62	50.0
26.000	51	52	25.371	0.600	6.000	5.937	0.063	405.9	450	3.43	50.0
27.000	53	53_OUT	13.395	0.600	6.605	6.150	0.455	29.4	225	3.69	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	E Area (ha)	E Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
23.000	1.867	33.0	7.9	1.269	1.478	0.058	0.0	50	1.531
24.002	1.003	39.9	9.8	1.262	1.478	0.072	0.0	76	0.834
24.001	1.006	40.0	7.8	1.339	1.262	0.058	0.0	67	0.784
24.000	1.002	17.7	3.3	1.221	1.339	0.024	0.0	44	0.766
17.005	1.002	70.8	36.6	1.452	1.535	0.270	0.0	153	1.010
23.000	2.333	41.2	5.7	1.358	1.535	0.042	0.0	38	1.650
17.004	1.001	70.7	30.8	1.252	1.452	0.227	0.0	139	0.968
22.000	1.804	31.9	5.8	1.306	1.452	0.043	0.0	43	1.372
17.003	1.433	101.3	18.9	1.294	1.252	0.139	0.0	88	1.106
20.000	1.002	17.7	2.2	1.344	1.252	0.016	0.0	35	0.681
21.000	1.046	18.5	3.5	1.369	1.252	0.026	0.0	44	0.806
17.002	1.002	39.8	10.6	1.388	1.294	0.078	0.0	79	0.848
19.000	1.374	24.3	5.8	1.395	1.294	0.043	0.0	50	1.133
17.001	1.001	39.8	3.8	1.437	1.388	0.028	0.0	46	0.630
18.000	1.782	31.5	1.8	1.351	1.388	0.013	0.0	24	0.968
17.000	1.002	39.8	3.4	1.200	1.437	0.025	0.0	44	0.616
26.001	1.004	17.7	0.0	2.063	2.131	0.000	0.0	0	0.000
26.000	1.003	159.5	0.0	1.700	1.763	0.000	0.0	0	0.000
27.000	2.420	96.2	7.2	1.233	1.775	0.053	0.0	42	1.441

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.012	11.575	399.1	450	PH1	8.177	6.129	1.598	8.150	6.130	1.600
1.011	12.344	316.5	375	PH1	8.295	6.243	1.677	8.177	6.203	1.598
16.001	19.421	50.6	225	PH1	8.118	6.818	1.275	8.177	6.838	1.598
16.000	10.528	100.3	150	PH1	8.518	6.798	1.570	8.118	6.800	1.275
1.010	9.089	323.9	375	PH1	8.333	6.271	1.687	8.295	6.233	1.677
1.009	20.886	321.3	375	PH1	8.142	6.336	1.431	8.333	6.371	1.687
13.000	4.876	11.4	150	PH1	8.402	6.924	1.328	8.333	6.496	1.687
1.008	31.455	324.3	375	PH1	8.207	6.433	1.399	8.142	6.336	1.431
13.000	3.304	35.6	150	PH1	8.228	6.794	1.284	8.142	6.561	1.431
14.000	7.017	36.2	150	PH1	8.286	6.793	1.343	8.142	6.561	1.431
1.007	7.965	318.6	375	PH1	8.277	6.433	1.444	8.207	6.433	1.399

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.012	31	1350	Manhole	Adoptable	31_OUT		Junction	
1.011	28	1350	Manhole	Adoptable	31	1350	Manhole	Adoptable
16.001	30	1350	Manhole	Adoptable	31	1350	Manhole	Adoptable
16.000	29	600	Manhole	Adoptable	30	1350	Manhole	Adoptable
1.010	27	1350	Manhole	Adoptable	28	1350	Manhole	Adoptable
1.009	25	1350	Manhole	Adoptable	27	1350	Manhole	Adoptable
13.000	26	600	Manhole	Adoptable	27	1350	Manhole	Adoptable
1.008	22	1350	Manhole	Adoptable	25	1350	Manhole	Adoptable
13.000	23	600	Manhole	Adoptable	25	1350	Manhole	Adoptable
14.000	24	600	Manhole	Adoptable	25	1350	Manhole	Adoptable
1.007	20	1350	Manhole	Adoptable	22	1350	Manhole	Adoptable

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
12.000	7.861	48.5	150	PH1	8.255	6.816	1.289	8.207	6.638	1.399
1.000	24.239	178.2	375	PH1	8.516	6.894	1.547	8.277	6.458	1.444
11.000	15.748	242.3	300	PH1	8.383	6.598	1.485	8.277	6.583	1.444
1.005	24.847	322.7	375	PH1	8.561	6.671	1.515	8.516	6.594	1.547
9.000	7.055	20.0	150	PH1	8.690	7.172	1.368	8.516	6.819	1.547
10.000	6.315	19.6	150	PH1	8.579	7.142	1.287	8.516	6.819	1.547
1.004	40.354	324.4	375	PH1	8.722	6.796	1.551	8.561	6.671	1.515
8.000	4.606	15.6	150	PH1	8.661	7.187	1.324	8.561	6.894	1.515
7.000	6.280	32.6	150	PH1	8.670	7.181	1.339	8.561	6.896	1.515
1.003	7.196	42.5	375	PH1	8.677	6.965	1.337	8.722	6.796	1.551
4.002	17.508	168.3	225	PH1	8.683	7.050	1.408	8.722	6.846	1.551
6.000	8.784	38.2	150	PH1	8.805	7.355	1.300	8.683	7.125	1.408
4.001	10.743	167.9	225	PH1	8.624	7.114	1.285	8.683	7.050	1.408
4.000	8.061	167.9	225	PH1	8.587	7.162	1.200	8.624	7.114	1.285
3.000	7.809	135.6	225	PH1	8.684	7.172	1.287	8.624	7.114	1.285
1.002	33.735	244.5	300	PH1	8.740	7.178	1.262	8.677	7.046	1.337
3.000	5.231	58.2	150	PH1	8.779	7.280	1.349	8.677	7.130	1.337
1.001	25.281	115.3	225	PH1	8.986	7.597	1.254	8.740	7.253	1.262
2.000	4.115	75.1	150	PH1	8.856	7.383	1.323	8.740	7.038	1.262
1.000	4.506	100.1	150	PH1	9.094	7.627	1.317	8.986	7.582	1.254
17.007	17.028	243.3	300	PH1	8.513	6.755	1.460	8.300	6.683	1.317
17.006	24.512	242.7	300	PH1	8.689	6.854	1.535	8.513	6.755	1.460
24.001	17.898	168.6	225	PH1	8.637	6.934	1.478	8.513	6.824	1.460
25.000	8.731	39.5	150	PH1	8.726	7.307	1.269	8.637	7.009	1.478
24.002	12.826	168.6	225	PH1	8.497	7.010	1.262	8.637	6.934	1.478
24.001	7.389	167.9	225	PH1	8.428	7.054	1.119	8.497	7.010	1.262
24.000	7.842	100.6	150	PH1	8.570	7.199	1.221	8.428	7.129	1.149
17.004	18.788	344.0	300	PH1	8.683	6.843	1.452	8.689	6.854	1.535
23.000	6.113	18.6	150	PH1	8.837	7.329	1.358	8.689	7.004	1.535
17.004	23.715	244.5	300	PH1	8.580	7.028	1.252	8.683	6.931	1.452
22.000	7.058	31.4	150	PH1	8.762	7.306	1.306	8.683	7.081	1.452
17.003	26.682	126.1	300	PH1	8.794	7.290	1.294	8.580	7.028	1.252
20.000	6.237	100.6	150	PH1	8.754	7.260	1.344	8.580	7.178	1.252
21.000	4.618	92.4	150	PH1	8.747	7.228	1.369	8.580	7.178	1.252
17.002	22.338	169.2	225	PH1	9.020	7.457	1.388	8.794	7.275	1.294

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
12.000	21	600	Manhole	Adoptable	22	1350	Manhole	Adoptable
1.000	18	1350	Manhole	Adoptable	20	1350	Manhole	Adoptable
11.000	19		Junction		20	1350	Manhole	Adoptable
1.005	15	1350	Manhole	Adoptable	18	1350	Manhole	Adoptable
9.000	16	600	Manhole	Adoptable	18	1350	Manhole	Adoptable
10.000	17	600	Manhole	Adoptable	18	1350	Manhole	Adoptable
1.004	12	1350	Manhole	Adoptable	15	1350	Manhole	Adoptable
8.000	14	600	Manhole	Adoptable	15	1350	Manhole	Adoptable
7.000	13	600	Manhole	Adoptable	15	1350	Manhole	Adoptable
1.003	6	1350	Manhole	Adoptable	12	1350	Manhole	Adoptable
4.002	11	1350	Manhole	Adoptable	12	1350	Manhole	Adoptable
6.000	10	600	Manhole	Adoptable	11	1350	Manhole	Adoptable
4.001	9	1350	Manhole	Adoptable	11	1350	Manhole	Adoptable
4.000	7	1350	Manhole	Adoptable	9	1350	Manhole	Adoptable
5.000	8	600	Manhole	Adoptable	9	1350	Manhole	Adoptable
1.002	4	1350	Manhole	Adoptable	6	1200	Manhole	Adoptable
3.000	5	600	Manhole	Adoptable	6	1200	Manhole	Adoptable
1.001	2	1350	Manhole	Adoptable	4	1350	Manhole	Adoptable
2.000	3	600	Manhole	Adoptable	4	1350	Manhole	Adoptable
1.000	1	600	Manhole	Adoptable	2	1350	Manhole	Adoptable
17.007	50	1200	Manhole	Adoptable	50_OUT		Junction	
17.006	44	1350	Manhole	Adoptable	50	1200	Manhole	Adoptable
24.003	49	1200	Manhole	Adoptable	50	1200	Manhole	Adoptable
25.000	48	600	Manhole	Adoptable	49	1200	Manhole	Adoptable
24.002	47	1350	Manhole	Adoptable	49	1200	Manhole	Adoptable
24.001	46	1350	Manhole	Adoptable	47	1350	Manhole	Adoptable
24.000	45	600	Manhole	Adoptable	46	1350	Manhole	Adoptable
17.005	42	1350	Manhole	Adoptable	44	1350	Manhole	Adoptable
23.000	43	600	Manhole	Adoptable	44	1350	Manhole	Adoptable
17.004	40	1350	Manhole	Adoptable	42	1350	Manhole	Adoptable
22.000	41	600	Manhole	Adoptable	42	1350	Manhole	Adoptable
17.003	37	1350	Manhole	Adoptable	40	1350	Manhole	Adoptable
20.000	38	600	Manhole	Adoptable	40	1350	Manhole	Adoptable
21.000	39	600	Manhole	Adoptable	40	1350	Manhole	Adoptable
17.002	35	1350	Manhole	Adoptable	37	1350	Manhole	Adoptable



Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
19.000	4.846	58.8	150	PH1	8.985	7.440	1.395	8.794	7.350	1.294
17.001	12.389	169.7	225	PH1	9.142	7.480	1.437	9.020	7.487	1.388
18.000	6.298	32.1	150	PH1	9.179	7.678	1.351	9.020	7.482	1.388
17.000	13.380	169.4	225	PH1	8.984	7.559	1.200	9.142	7.480	1.437
26.001	11.821	100.2	150	PH1	8.150	5.987	2.063	8.100	5.818	2.131
26.000	25.571	405.9	450	PH1	8.150	6.000	1.700	8.150	5.987	1.763
27.000	13.389	29.4	225	PH1	8.063	6.605	1.233	8.150	6.150	1.775

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
19.000	36	600	Manhole	Adoptable	37	1350	Manhole	Adoptable
17.001	33	1350	Manhole	Adoptable	35	1350	Manhole	Adoptable
18.000	34	600	Manhole	Adoptable	35	1350	Manhole	Adoptable
17.000	32	1350	Manhole	Adoptable	33	1350	Manhole	Adoptable
26.001	52	1350	Manhole	Adoptable	52_OUT		Junction	
26.000	51		Junction		52	1350	Manhole	Adoptable
27.000	53	1200	Manhole	Adoptable	53_OUT		Junction	

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)	
1	508090.404	103138.098	9.094	1.467	600		0	1.000	7.427	150
2	508090.139	103142.596	8.986	1.479	1350		1	1.000	7.582	150
							0	1.001	7.567	225
3	508061.553	103136.848	8.856	1.473	600		0	2.000	7.383	150
4	508060.926	103140.915	8.740	1.562	1350		1	2.000	7.320	150
							2	1.001	7.253	225
							0	1.002	7.173	300
5	508028.760	103135.480	8.779	1.499	600		0	3.000	7.080	150
6	508027.194	103140.471	8.677	1.712	1200		1	3.000	7.190	150
							2	1.002	7.040	300
							0	1.003	6.985	375
7	507985.789	103146.553	8.587	1.425	1350		0	4.000	7.162	225
8	507989.508	103134.513	8.684	1.512	600		0	5.000	7.172	225
9	507992.297	103141.797	8.624	1.510	1350		1	5.000	7.114	225
							2	4.000	7.114	225
							0	4.001	7.114	225
10	508001.587	103132.604	8.805	1.450	600		0	6.000	7.055	150
11	508003.027	103141.269	8.683	1.633	1350		1	6.000	7.125	150
							2	4.001	7.050	225
							0	4.002	7.050	225
12	508020.300	103138.409	8.722	1.926	1350		1	4.002	6.948	225
							2	1.003	6.796	375
							0	1.004	6.796	375



ABLEY LETCHFORD
PARTNERSHIP
Civil Engineering

Abley Letchford Partnership
3 Tealgate, Charnham Park
Hungerford
RG17 0YT

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Network: STORM
Jonathan Shuttleworth
21/02/2022

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Angmering

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)	
13	508016.679	103098.821	8.670	1.489	600					
						0	7.000	7.181	150	
14	508027.471	103098.480	8.661	1.474	600					
						0	8.000	7.187	150	
15	508022.897	103097.938	8.561	1.890	1350		1	8.000	6.898	150
						2	7.000	6.898	150	
						3	1.004	6.671	375	
						0	1.005	6.671	375	
16	508029.612	103077.678	8.690	1.518	600					
						0	9.000	7.172	150	
17	508017.920	103072.719	8.579	1.437	600					
						0	10.000	7.142	150	
18	508024.222	103073.126	8.516	1.922	1350		1	10.000	6.919	150
						2	9.000	6.919	150	
						3	1.005	6.594	375	
						0	1.006	6.594	375	
19	508039.367	103056.227	8.383	1.785						
						0	11.000	6.588	300	
20	508025.418	103048.917	8.277	1.819	1350		1	11.000	6.532	300
						2	1.004	6.458	375	
						0	1.007	6.458	375	
21	508024.258	103035.973	8.255	1.439	600					
						0	12.000	6.916	150	
22	508020.502	103042.650	8.207	1.774	1350		1	12.000	6.838	150
						2	1.007	6.433	375	
						0	1.009	6.433	375	
23	507989.456	103032.927	8.228	1.434	600					
						0	13.000	6.786	150	
24	507990.584	103048.076	8.286	1.493	600					
						0	14.000	6.793	150	
25	507989.079	103041.222	8.142	1.806	1350		1	14.000	6.581	150
						2	13.000	6.581	150	
						3	1.008	6.936	375	
						0	1.009	6.936	375	
26	507970.747	103036.107	8.402	1.478	600					
						0	15.000	6.924	150	
27	507968.215	103040.274	8.333	2.062	1350		1	15.000	6.498	150
						2	1.009	6.271	375	
						0	1.010	6.271	375	
28	507961.489	103046.358	8.295	2.052	1350		1	1.010	6.243	375
						0	1.011	6.243	375	
29	507970.400	103073.573	8.518	1.720	600					
						0	16.000	6.798	150	
30	507959.979	103072.079	8.118	1.500	1350		1	16.000	6.693	150
						0	16.001	6.618	225	



ABLEY LETCHFORD
PARTNERSHIP
(Incorporated in England)

Abley Letchford Partnership
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Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
31	507960.765	103058.681	8.177	2.048	1350		1	16.001	225
							2	1.011	375
							0	1.012	450
31_GUP	507949.209	103058.022	8.150	2.096			1	1.012	450
32	508124.614	103161.991	8.984	1.425	1350		0	17.000	225
							1	17.000	225
33	508111.431	103159.705	9.142	1.662	1350		0	17.001	225
							1	17.000	225
34	508114.171	103147.827	9.179	1.501	600		0	18.000	150
							1	18.000	150
35	508107.873	103147.838	9.020	1.613	1350		1	18.000	150
							2	17.001	225
							0	19.001	225
36	508112.652	103126.012	8.985	1.545	600		0	19.000	150
							1	19.000	150
37	508107.833	103125.500	8.794	1.594	1350		1	19.000	150
							2	17.001	225
							0	17.001	300
38	508103.393	103109.847	8.754	1.494	600		0	20.000	150
							1	21.000	150
39	508114.611	103105.441	8.747	1.519	600		0	21.000	150
							1	21.000	150
							2	20.000	150
							3	17.003	300
40	508102.982	103081.850	8.762	1.456	600		0	22.000	150
							1	22.000	150
41	508110.014	103081.241	8.683	1.752	1350		1	17.004	300
							2	17.005	300
							0	17.005	300
42	508113.808	103064.642	8.837	1.508	600		0	23.000	150
							1	23.000	150
43	508108.062	103062.555	8.689	1.835	1350		1	17.005	300
							2	17.005	300
							0	17.006	300
44	508118.094	103041.760	8.570	1.371	600		0	24.000	150
							1	24.000	150
45	508116.058	103048.501	8.428	1.374	1350		0	24.001	225
							1	24.001	225
47	508108.732	103049.463	8.497	1.487	1350		0	24.002	225
							1	24.002	225



Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
48	508096.436	103039.638	8.726	1.419	600				
49	508095.954	103048.356	8.637	1.703	1200		0	25.000	7.387
							1	25.000	7.089
							2	24.000	6.834
50	508083.583	103061.290	8.513	1.760	1200		0	24.000	6.834
							1	24.000	6.834
							2	17.000	6.753
50_OUT	508066.563	103060.783	8.300	1.617			0	17.000	6.753
							1	17.000	6.683
51	507939.130	103045.118	8.150	2.150					
52	507941.638	103019.670	8.150	2.213	1350		0	26.000	6.000
							1	26.000	5.927
52_OUT	507936.465	103009.041	8.100	2.281			0	26.000	5.937
							1	26.000	5.819
53	507953.576	103079.305	8.063	1.458	1200				
53_OUT	507948.049	103067.099	8.150	2.096			0	27.000	6.605
							1	27.000	6.150

Simulation Settings

Rainfall Methodology	FEH-13	Drain Down Time (mins)	240
Summer CV	0.750	Additional Storage (m³/ha)	20.0
Winter CV	0.840	Check Discharge Rate(s)	x
Analysis Speed	Detailed	Check Discharge Volume	x
Skip Steady State	✓		

Storm Durations

30 : 60 : 120 : 180 : 240 : 360 : 480 : 600 : 720 : 960 : 1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
100	40	0	0

Node 52 Online Hydro-Brake® Control

Flap Valve	x
Replaces Downstream Link	✓
Invert Level (m)	5.937
Design Depth (m)	1.913
Design Flow (l/s)	2.7
Objective	(HE) Minimise upstream storage
Sump Available	✓
Product Number	CTL-SHE-0067-2700-1913-2700
Min Outlet Diameter (m)	0.100
Min Node Diameter (mm)	1200

Node 53_OUT Online Orifice Control

Flap Valve	x	Invert Level (m)	6.054	Discharge Coefficient	0.600
Replaces Downstream Link	x	Diameter (m)	0.225		



ABLEY LETCHFORD
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Infrastructure Solutions

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Node 51 Flow through Pond Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	
Side Inf Coefficient (m/hr)	0.00000	Main Channel Length (m)	17.637
Safety Factor	2.0	Main Channel Slope (1:X)	325.7
Porosity	1.00	Main Channel n	0.035
Invert Level (m)	6.000		

Inlets

53_OUT : 31_OUT

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	150.3	0.0	2.150	764.3	0.0

Node 19 Flow through Pond Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	
Side Inf Coefficient (m/hr)	0.00000	Main Channel Length (m)	25.503
Safety Factor	2.0	Main Channel Slope (1:X)	300.0
Porosity	1.00	Main Channel n	0.035
Invert Level (m)	6.598		

Inlets

50_OUT

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	121.0	0.0	1.650	666.8	0.0

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.05%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute summer	1	20	8.579	0.952	16.9	0.6340	0.0000	SURCHARGED
30 minute summer	2	20	8.544	1.037	19.9	1.6130	0.0000	SURCHARGED
30 minute summer	3	20	8.538	1.155	16.3	0.7498	0.0000	SURCHARGED
30 minute summer	4	20	8.506	1.328	60.6	2.9301	0.0000	FLOOD RISE
30 minute summer	5	20	8.495	1.215	25.3	1.0245	0.0000	FLOOD RISE
30 minute summer	6	20	8.403	1.438	73.6	1.6264	0.0000	FLOOD RISE
30 minute winter	7	20	8.587	1.425	24.8	2.9483	1.4298	FLOOD
30 minute winter	8	20	8.614	1.443	30.5	1.4760	0.0000	FLOOD RISE
30 minute winter	9	20	8.585	1.471	43.2	2.1051	0.0000	FLOOD RISE
30 minute winter	10	20	8.584	1.229	14.2	0.7877	0.0000	FLOOD RISE
30 minute summer	11	20	8.531	1.481	50.2	2.1192	0.0000	FLOOD RISE
30 minute summer	12	20	8.381	1.585	141.9	3.1342	0.0000	SURCHARGED
30 minute summer	13	20	8.179	0.998	15.7	0.6309	0.0000	SURCHARGED
30 minute summer	14	20	8.150	0.963	9.0	0.4682	0.0000	SURCHARGED
30 minute summer	15	20	8.139	1.468	157.8	2.1013	0.0000	SURCHARGED
30 minute winter	16	20	8.075	0.903	25.1	0.8029	0.0000	SURCHARGED
30 minute winter	17	20	8.021	0.879	20.7	0.7137	0.0000	SURCHARGED
30 minute winter	18	21	7.936	1.342	199.3	2.1283	0.0000	SURCHARGED
1440 minute winter	19	1410	7.844	1.246	7.5	0.9310	0.0000	SURCHARGED
1440 minute winter	20	1410	7.844	1.386	14.0	2.3357	0.0000	SURCHARGED
30 minute summer	21	19	8.135	1.319	46.6	1.7906	0.0000	FLOOD RISE
1440 minute winter	22	1410	7.844	1.411	17.2	2.9200	0.0000	SURCHARGED
1440 minute winter	23	1410	7.845	1.051	0.5	0.5610	0.0000	SURCHARGED
1440 minute winter	24	1440	7.845	1.052	1.0	0.7468	0.0000	SURCHARGED
1440 minute winter	25	1440	7.845	1.509	18.5	2.1596	0.0000	FLOOD RISE
1440 minute winter	26	1440	7.845	0.921	1.1	0.7089	0.0000	SURCHARGED
1440 minute winter	27	1440	7.846	1.575	19.5	2.2543	0.0000	SURCHARGED
1440 minute winter	28	1440	7.845	1.602	19.5	2.2930	0.0000	SURCHARGED
1440 minute winter	29	1440	7.847	1.049	1.1	0.7256	0.0000	SURCHARGED
1440 minute winter	30	1440	7.846	1.228	1.1	1.7571	0.0000	FLOOD RISE
1440 minute winter	31	1410	7.844	1.715	20.4	2.4547	0.0000	SURCHARGED
1440 minute winter	31_OUT	1440	7.847	1.793	22.7	1.3109	0.0000	OK
30 minute winter	32	21	8.760	1.201	13.6	2.1387	0.0000	FLOOD RISE
30 minute winter	33	21	8.753	1.273	20.7	1.8659	0.0000	SURCHARGED
30 minute winter	34	21	8.751	1.073	12.4	0.4893	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
30 minute summer	1	1.000	2	14.9	1.044	0.838	0.0793	
30 minute summer	2	1.001	4	19.0	0.921	0.394	1.1637	
30 minute summer	3	2.000	4	12.0	1.094	0.585	0.0724	
30 minute summer	4	1.002	6	54.6	1.004	0.772	2.3756	
30 minute summer	5	3.000	6	20.6	1.324	0.885	0.0921	
30 minute summer	6	1.003	12	73.7	0.844	0.240	0.7937	
30 minute winter	7	4.000	9	17.3	0.498	0.433	0.3206	
30 minute winter	8	5.000	9	26.4	0.663	0.591	0.3102	
30 minute winter	9	4.001	11	39.1	0.982	0.976	0.4273	
30 minute winter	10	6.000	11	12.2	1.127	0.423	0.1546	
30 minute summer	11	4.002	12	50.0	1.258	1.253	0.6963	
30 minute summer	12	1.004	15	139.4	1.264	1.262	4.4730	
30 minute summer	13	7.000	15	11.9	1.502	0.312	0.1106	
30 minute summer	14	8.000	15	6.7	1.439	0.150	0.0811	
30 minute summer	15	1.005	18	158.0	1.433	1.426	2.7406	
30 minute winter	16	9.000	18	22.5	1.852	0.562	0.1242	
30 minute winter	17	10.000	18	18.1	1.775	0.448	0.1112	
30 minute winter	18	1.006	20	198.4	1.799	1.327	2.6735	
1440 minute winter	19	11.000	20	5.4	0.568	0.077	1.1090	
1440 minute winter	20	1.007	22	13.3	0.537	0.119	0.8785	
30 minute summer	21	12.000	22	42.6	2.418	1.663	0.1349	
1440 minute winter	22	1.008	25	17.1	0.559	0.155	3.4694	
1440 minute winter	23	13.000	25	0.5	0.475	0.017	0.1462	
1440 minute winter	24	14.000	25	1.2	0.570	0.037	0.1235	
1440 minute winter	25	1.009	27	18.5	0.512	0.166	2.3037	
1440 minute winter	26	15.000	27	1.1	0.798	0.020	0.0858	
1440 minute winter	27	1.010	28	19.5	0.517	0.176	1.0003	
1440 minute winter	28	1.011	31	19.4	0.570	0.174	1.3615	
1440 minute winter	29	16.000	30	1.1	0.438	0.060	0.1853	
1440 minute winter	30	16.001	31	1.0	0.403	0.014	0.5338	
1440 minute winter	31	1.012	31_OUT	20.4	0.550	0.127	1.8340	
1440 minute winter	31_OUT	Flow through pond	51_OUT	13.3	0.025	0.000	744.3367	
30 minute winter	32	17.000	33	12.1	0.762	0.303	0.5321	
30 minute winter	33	17.001	35	13.4	0.489	0.336	0.4927	
30 minute winter	34	18.000	35	5.9	1.092	0.188	0.1109	

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.05%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute winter	35	21	8.744	1.337	30.2	2.5343	0.0000	FLOOD RISK
30 minute winter	36	21	8.721	1.281	23.4	1.0746	0.0000	FLOOD RISK
30 minute winter	37	21	8.648	1.448	54.5	2.4033	0.0000	FLOOD RISK
30 minute winter	38	21	8.593	1.333	8.7	0.6626	0.0000	FLOOD RISK
30 minute winter	39	21	8.605	1.377	14.2	0.8605	0.0000	FLOOD RISK
30 minute winter	40	21	8.580	1.552	89.4	3.1397	0.3855	FLOOD
30 minute winter	41	21	8.503	1.197	23.4	1.0451	0.0000	FLOOD RISK
30 minute winter	42	21	8.407	1.476	103.5	2.1115	0.0000	FLOOD RISK
30 minute winter	43	21	8.278	0.949	23.1	0.8021	0.0000	SURCHARGED
30 minute winter	44	21	8.195	1.341	120.4	1.9188	0.0000	SURCHARGED
30 minute winter	45	21	8.190	0.991	13.1	0.6274	0.0000	SURCHARGED
30 minute winter	46	21	8.161	1.107	28.8	2.1272	0.0000	FLOOD RISK
30 minute winter	47	21	8.137	1.127	32.1	1.8367	0.0000	SURCHARGED
30 minute summer	48	19	8.328	1.021	34.9	1.1230	0.0000	SURCHARGED
30 minute winter	49	21	8.081	1.147	57.5	1.2967	0.0000	SURCHARGED
30 minute winter	50	22	7.851	1.098	174.0	1.2419	0.0000	SURCHARGED
1440 minute winter	50_OUT	1410	7.844	1.161	12.1	0.0000	0.0000	OK
1440 minute winter	51	1410	7.843	1.843	13.3	0.0000	0.0000	SURCHARGED
1440 minute winter	52	1410	7.843	1.906	2.7	2.7281	0.0000	SURCHARGED
30 minute summer	52_OUT	1	5.819	0.000	2.2	0.0000	0.0000	OK
1440 minute winter	53	1410	7.843	1.238	1.6	2.3021	0.0000	FLOOD RISK
1440 minute winter	53_OUT	1410	7.844	1.790	1.5	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
30 minute winter	35	17.002	37	30.5	0.992	0.766	0.8884	
30 minute winter	36	19.000	37	19.8	1.320	0.814	0.0853	
30 minute winter	37	17.003	40	54.7	0.834	0.540	1.4550	
30 minute winter	38	20.000	40	6.3	0.731	0.354	0.1450	
30 minute winter	39	21.000	40	10.9	0.892	0.587	0.0813	
30 minute winter	40	17.004	42	84.7	1.203	1.198	1.6699	
30 minute winter	41	22.000	42	20.3	1.451	0.636	0.1243	
30 minute winter	42	17.005	44	101.7	1.444	1.436	1.3230	
30 minute winter	43	23.000	44	20.4	1.649	0.494	0.1076	
30 minute winter	44	17.006	50	118.7	1.685	1.671	1.7261	
30 minute winter	45	24.000	46	10.6	0.910	0.598	0.1240	
30 minute winter	46	24.001	47	24.5	0.735	0.612	0.2939	
30 minute winter	47	24.002	49	29.7	0.746	0.744	0.5101	
30 minute summer	48	25.000	49	31.1	1.767	0.943	0.1537	
30 minute winter	49	24.003	50	55.5	1.396	1.392	0.7118	
30 minute winter	50	17.007	50_OUT	172.7	2.453	2.435	1.1991	
1440 minute winter	50_OUT	Flow through pond	19	5.7	0.029	0.000	385.8333	
1440 minute winter	51	26.000	52	2.7	0.193	0.017	4.0516	
1440 minute winter	52	Hydro-Brake®	52_OUT	2.7				225.3
1440 minute winter	53	27.000	53_OUT	1.5	0.551	0.016	0.5329	
1440 minute winter	53_OUT	Flow through pond	51	13.3	0.025	0.000	744.3367	

Nodes

Name	Area (ha)	Cover Level (m)	Depth (m)
Plots 1-4	0.025	8.400	0.650
Plots 17-21	0.013	8.250	0.650
Plots 22-27	0.020	8.150	0.650
Plots 28-30	0.008	8.350	0.650
Plots 31-32	0.005	8.200	0.650
Plots 33 & 34	0.002	8.250	0.650
Plots 36-39	0.027	8.350	0.650
Plots 56-57	0.012	8.350	0.650
Plots 40-42	0.021	8.350	0.650
Plots 53-55	0.015	8.350	0.650

Simulation Settings

Rainfall Methodology	FEH-13	Drain Down Time (mins)	240
Summer CV	0.750	Additional Storage (m³/ha)	20.0
Winter CV	0.840	Check Discharge Rate(s)	x
Analysis Speed	Detailed	Check Discharge Volume	x
Skip Steady State	✓		

Storm Durations

15 : 30 : 60 : 120 : 180 : 240 : 360 : 480 : 600 : 720 : 960 : 1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
100	40	0	0

Node Plots 1-4 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.01260	Porosity	0.30
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	7.750
Safety Factor	4.0	Time to half empty (mins)	1000

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	251.0	251.0	0.400	251.0	251.0	0.401	0.0	251.0

Node Plots 17-21 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00900	Porosity	0.30
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	7.600
Safety Factor	4.0	Time to half empty (mins)	1400

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	130.0	130.0	0.400	130.0	130.0	0.401	0.0	130.0

Node Plots 22-27 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.01008	Porosity	0.30
Side Inf Coefficient (m/hr)	0.01008	Invert Level (m)	7.500
Safety Factor	4.0	Time to half empty (mins)	1250

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	200.0	200.0	0.400	200.0	200.0	0.401	0.0	200.0

Node Plots 28-30 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.01008	Porosity	0.30
Side Inf Coefficient (m/hr)	0.01008	Invert Level (m)	7.700
Safety Factor	4.0	Time to half empty (mins)	1250

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	75.0	75.0	0.400	75.0	75.0	0.401	0.0	75.0

Node Plots 31-32 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.01008	Porosity	0.30
Side Inf Coefficient (m/hr)	0.01008	Invert Level (m)	7.550
Safety Factor	4.0	Time to half empty (mins)	1250

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	50.0	50.0	0.400	50.0	50.0	0.401	0.0	50.0

Node Plots 33 & 34 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.01008	Porosity	0.30
Side Inf Coefficient (m/hr)	0.01008	Invert Level (m)	7.600
Safety Factor	4.0	Time to half empty (mins)	1250

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	24.0	24.0	0.400	24.0	24.0	0.401	0.0	24.0

Node Plots 36-39 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00936	Porosity	0.30
Side Inf Coefficient (m/hr)	0.00936	Invert Level (m)	7.700
Safety Factor	4.0	Time to half empty (mins)	1346

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	272.0	272.0	0.400	272.0	272.0	0.401	0.0	272.0

Node Plots 40-42 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00936	Porosity	0.30
Side Inf Coefficient (m/hr)	0.00936	Invert Level (m)	7.700
Safety Factor	4.0	Time to half empty (mins)	1346

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	216.0	216.0	0.400	216.0	216.0	0.401	0.0	216.0

Node Plots 53-55 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00972	Porosity	0.30
Side Inf Coefficient (m/hr)	0.00972	Invert Level (m)	7.700
Safety Factor	4.0	Time to half empty (mins)	1296

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	150.0	150.0	0.400	150.0	150.0	0.401	0.0	150.0

Node Plots 56-57 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00972	Porosity	0.30
Side Inf Coefficient (m/hr)	0.00972	Invert Level (m)	7.700
Safety Factor	4.0	Time to half empty (mins)	1296

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	120.0	120.0	0.400	120.0	120.0	0.401	0.0	120.0



Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.91%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
360 minute winter	Plots 1-4	352	7.962	0.212	2.3	16.1521	0.0000	OK
480 minute winter	Plots 17-21	472	7.835	0.235	0.9	9.2448	0.0000	OK
480 minute winter	Plots 22-27	472	7.727	0.227	1.5	13.7491	0.0000	OK
960 minute winter	Plots 28-30	870	7.951	0.251	0.3	5.6980	0.0000	OK
480 minute winter	Plots 31-32	464	7.797	0.247	0.4	3.7454	0.0000	OK
180 minute winter	Plots 33 & 34	172	7.788	0.188	0.3	1.3618	0.0000	OK
480 minute winter	Plots 36-39	472	7.926	0.226	2.0	18.6405	0.0000	OK
480 minute winter	Plots 56-57	472	7.930	0.230	0.9	8.3808	0.0000	OK
480 minute winter	Plots 40-42	472	7.925	0.225	1.5	14.7300	0.0000	OK
600 minute winter	Plots 53-55	570	7.929	0.229	0.9	10.4000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)
360 minute winter	Plots 1-4	Infiltration	0.2
480 minute winter	Plots 17-21	Infiltration	0.1
480 minute winter	Plots 22-27	Infiltration	0.1
960 minute winter	Plots 28-30	Infiltration	0.1
480 minute winter	Plots 31-32	Infiltration	0.0
180 minute winter	Plots 33 & 34	Infiltration	0.0
480 minute winter	Plots 36-39	Infiltration	0.2
480 minute winter	Plots 56-57	Infiltration	0.1
480 minute winter	Plots 40-42	Infiltration	0.1
600 minute winter	Plots 53-55	Infiltration	0.1

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