

Central Arun Crematorium

Flood Risk Assessment

For



Project Number: 13062

January 2019

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Document History and Status

Revision	Date	Purpose/Status	File Ref	Author	Check	Review
D3	20.12.18	For Client Review	AHah13062-201218-CentralArunCrematoriumFRA-D3.doc	AH	BS	DS
D4	21.12.18	Planning	AHah13062-211218-CentralArunCrematoriumFRA-D4.doc	AH	BS	DS
F1	08.01.19	Planning	See Below	AH	BS	DS

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Document Details

Last saved	07/01/2019 16:43
Path	13062-CRH-ZZ-XX-RP-C-0001_FRA P01.doc
Author	A.Hoy
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Project Number	13062
Project Name	Central Arun Crematorium

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EXECUTIVE SUMMARY

CampbellReith has been commissioned by Landlink Estates Limited to prepare a Flood Risk Assessment in accordance with the National Planning Policy Framework, to inform the proposed development for a crematorium at Bilsham, West Sussex.

The site is located in Flood Zone 1, where all types of development are considered acceptable by the Environment Agency.

Risk of flooding from fluvial, tidal, surface water, sewer flooding and artificial sources have been assessed and are all considered low for the site.

Future fluvial flood risk, as a result of climate change, has been assessed indicating potential increase in flood risk to the development. Subject to further information from the Lead Local Flood Authority on climate change predictions, consideration should be given to mitigation measures within the detailed design of the buildings.

Assessment of groundwater flood risk will be subject to further testing which will inform detailed design. In the absence of site-specific records nearby borehole logs suggest groundwater levels are approximately 0.4m bgl.

The Greenfield runoff rate (Q_{bar}) for the site has been calculated at 2.96 litres/second/hectare. Assuming no infiltration due to envisaged groundwater levels, approximately 600 m³ of storage would be required to cater for all storm events up to and including the 1 in 100 year + climate change, with discharge restricted at Q_{bar} into the ditch alongside the south eastern corner of the site.

The surface water drainage strategy proposed within this Flood Risk Assessment incorporates multiple drainage features to provide water quality, quantity, amenity and biodiversity benefits in accordance with current guidance and standards.

The proposed surface water drainage system will effectively control all runoff generated within the site and maintain pre-development Greenfield runoff off-site without increasing flood risk elsewhere.

The foul water from the proposed development will discharge via gravity to a cesspit located in the service yard of the development for off-site discharge.

Based upon the information available at the time of preparing this report, the proposed development is considered suitable at the proposed location.

1.0 INTRODUCTION

1.1. Brief

1.1.1. CampbellReith has been commissioned by Landlink Estates Limited (LEL) to prepare a Flood Risk Assessment (FRA) in accordance with the National Planning Policy Framework (NPPF)¹, to inform the proposed development at Grevatt's Lane West, Bilsham, West Sussex, herein referred to as 'the site'. The site location is contained in Appendix A.

1.1.2. This assessment has been based on readily available information.

1.2. Project Overview

1.2.1. LEL is seeking full planning permission for a new crematorium on agricultural land to the north east of Bilsham in West Sussex.

1.2.2. The planning application includes the crematorium building, surface car parking, means of access, a service yard and landscaped grounds.

1.3. Aims and Objectives

1.3.1. This report has been prepared in accordance with the NPPF and the accompanying Planning Practice Guidance (PPG)².

1.3.1. This FRA aims to identify the sources of flooding related to the site and whether the development poses any increase in flood risk.

1.3.2. The objectives of this FRA are to establish:

- Whether the site is likely to be affected by current or future flooding from any source;
- Whether proposed future development will increase flood risk elsewhere;
- Whether the measures proposed to deal with these effects and risks are appropriate;
- The evidence to satisfy the Local Planning Authority's (LPA) Sequential Test if required, and;
- A surface water drainage design and concept foul water design for the site.

¹ Ministry of Housing, Communities & Local Government (2018) National Planning Policy Framework. Ref: ISBN 978-1-5286-0745-2.

² Department for Environment, Food & Rural Affairs and Environment Agency (2014) Planning Practice Guidance: Flooding and Coastal Change

2.0 PLANNING POLICY

2.1. National Planning Policy Framework (NPPF)

- 2.1.1. The NPPF was recently updated in July 2018. It includes the government's national planning policies to protect people and property from flooding; either now or in the future and provide guidance which all LPAs are expected to follow. There are three main steps which should be followed to ensure that the risk of flooding from development is minimised; assess the flood risk, avoid flood risk and manage and mitigate the flood risk.
- 2.1.2. The NPPF recommends new development adopts a sequential, flood risk-based approach to the location of development, taking into account climate change and its impact now and for the future to avoid any possible flood risk. The aim of the sequential test is to steer development to areas considered to be at the lowest risk from sources of flooding. If this is not possible then the exception test would be required demonstrating that the development would provide wider sustainability benefits to the community that would outweigh the flood risk. This should demonstrate that the development would be safe for its lifetime, taking into account the vulnerability of the users, without increasing flood risk elsewhere and where possible reducing the current risk of flooding.
- 2.1.3. The NPPF also states that major developments should incorporate sustainable drainage systems (SuDS) unless there is clear evidence that this would be inappropriate.

2.2. Planning Practice Guidance (PPG)

- 2.2.1. A FRA is required when developments are:
- Located within Flood Zone 2 or 3 including minor development and change of use;
 - More than 1 hectare (ha) in Flood Zone 1;
 - Less than 1 ha in Flood Zone 1, including a change of use in development type to a more vulnerable class (for example from commercial to residential), where they could be affected by sources of flooding other than rivers and sea (for example surface water drains, reservoirs); or
 - In an area within Flood Zone 1 which has critical drainage problems as notified by the Environment Agency (EA).
- 2.2.2. Table 2.1 on the following page summarises the compatibility of flood risk vulnerability classification as extracted from Paragraph 67 of the PPG in relation to the above flood zones.

Table 2.1. Flood Vulnerability and Flood Zone Compatibility Table

Flood Zones	Flood Risk Vulnerability Classification				
	Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	Exception Test Required	✓	✓	✓
Zone 3a	Exception Test required	✗	Exception Test Required	✓	✓
Zone 3b	Exception Test required*	✗	✗	✗	✓*

Key: ✓ Development is appropriate.

✗ Development should not be permitted.

2.3. Roles and Responsibilities

- 2.3.1. The Environment Agency (EA) is a statutory consultee for planning applications and is responsible for managing the risk of flooding from main rivers, reservoirs, estuaries and the sea.
- 2.3.2. The roles of the Lead Local Flood Authorities (LLFA) were established following the Flood Risk Regulations (2009) and Flood and Water Management Act (2010). They are responsible for developing, maintaining and applying a strategy for local flood risk management in their areas and maintaining a register of flood risk assets. They also have lead responsibility for managing the risk of flooding from surface water, groundwater and ordinary watercourses. West Sussex County Council (WSOC) is the relevant LLFA and Arun District Council (ADC) acts as agent to the LLFA.

2.4. Climate Change

- 2.4.1. The NPPF sets out how the planning system should help minimise vulnerability and provide resilience to the impacts of climate change. The EA provides guidance on the climate change allowances which should be considered when assessing the future risk of flooding.
- 2.4.2. Climate change allowances should be applied to the peak rainfall intensities. Table 2.2 below shows the anticipated change in extreme rainfall intensity in small and urban catchments. The central and upper allowances should be applied to assess the range of impact.

Table 2.2. EA Peak Rainfall Intensities

Applies Across All Of England	Total Potential Change Anticipated For The '2020s' (2015 to 2039)	Total Potential Change Anticipated For The '2050s' (2040 to 2060)	Total Potential Change Anticipated For The '2080s' (2070 to 2115)
Upper End	10%	20%	40%
Central	5%	10%	20%

3.0 LOCAL POLICIES AND GUIDANCE

3.1. Local Policy References

3.1.1. The following documents have been reviewed to inform this assessment:

- Arun District Council (July 2018) Arun Local Plan 2011-2031
- Arun District Council (2016) Level 1 and Level 2 Strategic Flood Risk Assessment (SFRA)
- Arun District Council Supplementary Requirements for Surface Water Drainage Proposals
- Arun District Council Land Drainage Byelaws
- West Sussex County Council (November, 2012) Report on June 2012 Flood Event
- West Sussex LLFA Policy for the Management of Surface Water
- West Sussex Local Flood Risk Management Strategy (2014)
- Water. People. Places a guide for master planning sustainable drainage into developments.

3.2. Arun District Council Adopted Local Plan

3.2.1. ADC adopted the Local Plan for 2011-2031 in July 2018. The plan sets out the council's vision, objectives and sustainable strategy for delivering growth of the district over the period 2011-2031. The Local Plan is used as a guide to inform the council on planning decisions.

3.2.2. The following policies should be considered when assessing flood risk and surface water management of a site:

- Policy W DM2 - Flood Risk
- Policy W DM3 - Sustainable Urban Drainage

3.3. Strategic Flood Risk Assessment

3.3.1. A Level 1 and Level 2 SFRA was prepared by JBA Consulting for ADC in November 2016. Surface water and groundwater flooding were identified as the main sources of flooding within the district. Tidal and fluvial flood risk were still present with the River Arun and Aldingbourne Rife providing the main source of fluvial flood risk. The site is located approximately 4.5 km east of the Aldingbourne Rife.

3.3.2. Contained in Appendix B are flood risk maps and information extracted from the SFRA and applicable to the site. The appended information has been used to inform the assessment in Section 5 of this report.

4.0 SITE CONTEXT

4.1. Site Location

- 4.1.1. The site is located off Grevatt's Lane West, Bilsham, West Sussex as illustrated in Figure 4.1 below. The nearest postcode for the site is BN18 0LA and the National Grid Reference for the approximate centre of the site is 497927E and 101736N.

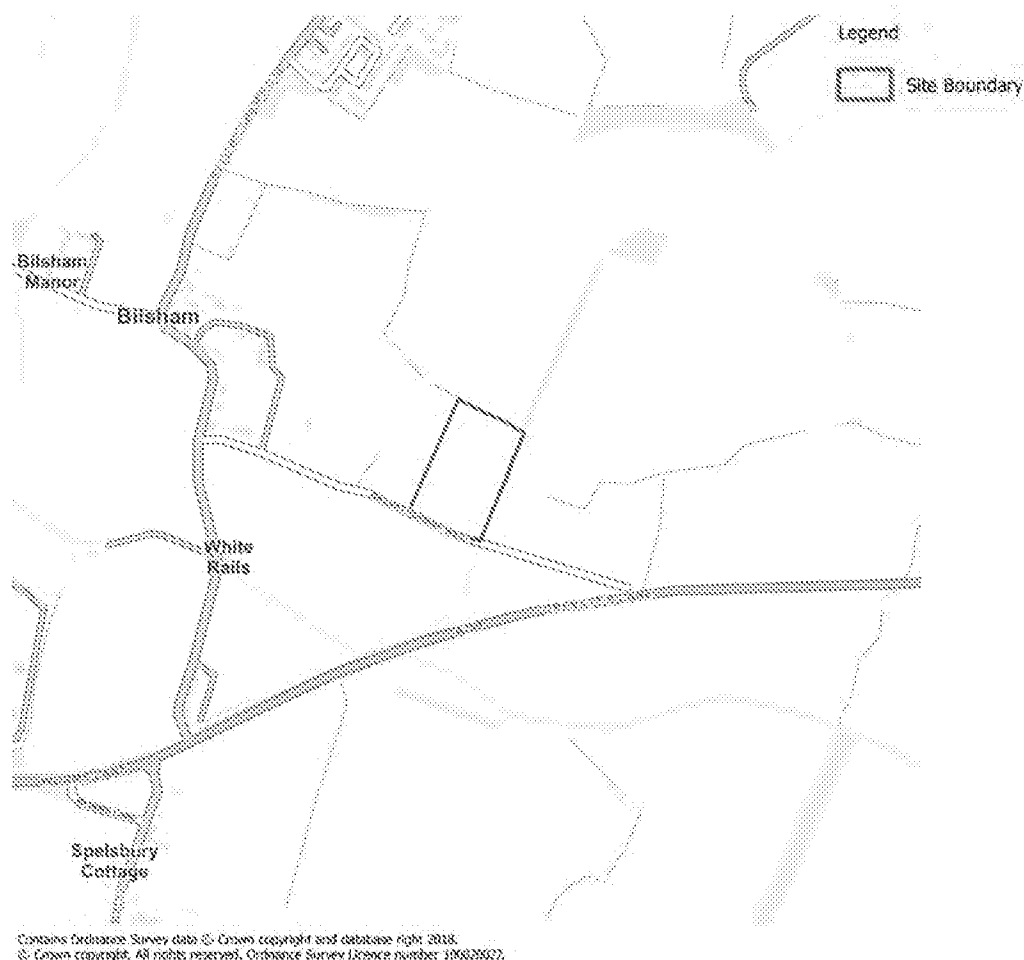


Figure 4.1: Site Boundary

- 4.1.2. ADC is the LPA for the site and WSCC acts as the LLFA for the area.
- 4.1.3. The site is predominantly laid to field and is used for agriculture. No buildings or structures are present on site. The site boundary includes Grevatt's Lane West, a single tarmac track with grass verges, linking with Bilsham Road (B2132) to the west and to Grevatt's Lane (A259) to the east. The site is bound by agricultural fields to the north, east, south and west.
- 4.1.4. The site is situated within a rural setting located approximately 1.2km to the southeast of Yapton and 1.2km to the north of Middleton-on-Sea. The land use in the wider area is predominantly agricultural.

4.2. Site History

- 4.2.1. There is no planning history to the site which has remained predominantly in agricultural use.

4.3. Topography

- 4.3.1. Lidar data has been obtained as part of this assessment showing levels gently sloping from northwest to southeast, as shown in Figure 4.2. Available data indicates levels vary between 5m AOD and 3m AOD.
- 4.3.2. A topographical survey was undertaken by Survey Solutions in October 2018 and a copy of the survey data is contained in Appendix C. The survey confirms the Lidar information, with levels ranging from approximately 4.85m AOD to the northwest down to 3.82m AOD in the southeast.



Figure 4.2: Lidar Data

4.4. Geology

- 4.4.1. The British Geological Survey (BGS) Online Geology Viewer³ notes that the underlying bedrock for the site is Lewes Nodular Chalk Formation and notes the superficial deposits as River Terrace Deposits (undifferentiated).

³ British Geological Survey Online Geology of Britain Viewer. <http://mapapps.bgs.ac.uk/geologyofbritain/home.html>

- 4.4.2. At the time of preparing this report the soil investigation, including winter groundwater monitoring and winter infiltration testing to BRE Digest 365 were in progress. The findings will be used to validate the drainage strategy as part of the detail design prior to construction.

4.5. Hydrology

- 4.5.1. A desk-study review of ordnance survey mapping notes that the site is flanked to the north, east and west by field ditches. The field ditch to the east flows south beneath Grevatt's Lane West before discharging to the Ryebank Rife, which is classified as a Main River by the EA. The levels of the eastern field ditch are presented in the topographical survey contained in Appendix C.
- 4.5.2. The ditches bordering the north, east and west of the site have been identified as ordinary watercourses within the SFRA.
- 4.5.3. No other water bodies are present across the site or within its immediate vicinity.

4.6. Hydrogeology

- 4.6.1. The site is situated above a Principal Aquifer. The superficial deposits are classified as a Secondary A aquifer.
- 4.6.2. The site is not located within a Source Protection Zone (SPZ). The groundwater vulnerability of the site is classified as Major Aquifer High.
- 4.6.3. The groundwater levels beneath the site are currently unknown and are subject to confirmation from ongoing winter groundwater monitoring.

4.7. Existing Site Drainage

- 4.7.1. Southern Water is the incumbent sewer provider for the area and the asset plans are contained in Appendix D.
- 4.7.2. Review of the available records confirms no Southern Water sewers across the site. A 600mm diameter foul rising main abuts the south eastern boundary of the site and runs approximately northeast to southwest.
- 4.7.3. The natural surface water flow paths have been devised based on the available Lidar data and are shown on Figure 4.3 overleaf.
- 4.7.4. Table 4.1 below summarises the Greenfield runoff rates for the total site. Details of the Greenfield runoff calculations are attached in Appendix D.

Table 4.1: Greenfield runoff rates

Storm Event	Greenfield Runoff Rate (litres/sec/ha)
Qbar	= 2.96
1 in 1 Year	= 2.52
1 in 30 Year	= 6.82
1 in 100 Year	= 9.45



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Figure 4.3: Existing Surface Water Flow Paths

5.0 EXISTING FLOOD RISK TO THE SITE

5.1. Fluvial Flood Risk

- 5.1.1. The EA Flood Zone Map shows the site is wholly located within Flood Zone 1 as shown in Figure 5.1. The EA defines⁴ Flood Zones from rivers or the sea for Flood Zone 1 as land having less than 1 in 1,000 annual probability of river or sea flooding (shown as 'clear' on the Flood Map – all land outside Zones 2 and 3). The risk of fluvial flooding is deemed low.

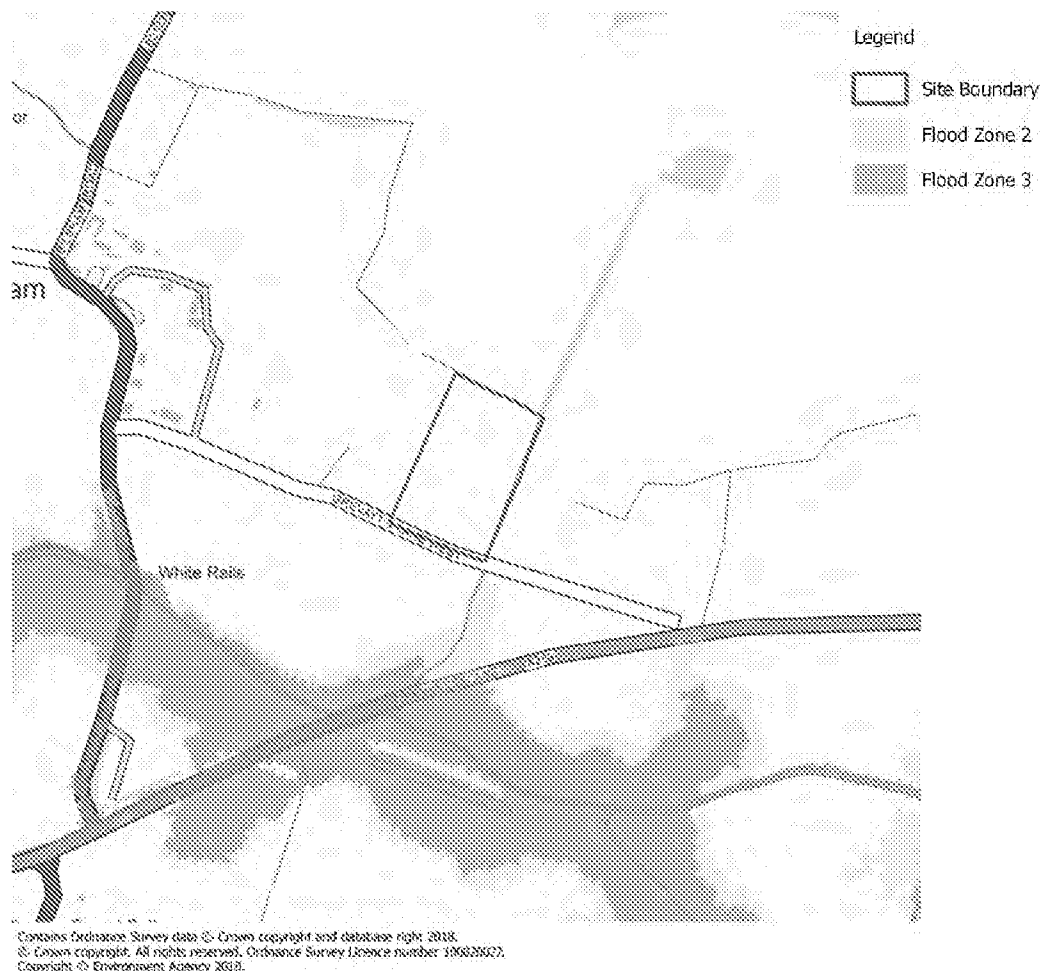


Figure 5.1: Environment Agency Flood Zones

5.2. Tidal Flood Risk

- 5.2.1. The site is located within Flood Zone 1 and is not located close to any tidal sources. The risk of tidal flooding is therefore considered low.

5.3. Flood Alert Area

- 5.3.1. The site does not fall within a flood alert or flood warning area.

⁴ Environment Agency & DEFRA (2014) Flood Zone Definition: <https://www.gov.uk/guidance/flood-risk-and-coastal-change#flood-zone-and-flood-risk-tables>

5.4. Surface Water Flood Risk

5.4.1. The EA classifies surface water flood risk⁵ as follows:

- VERY LOW – the area has a chance of surface water flooding of less than 0.1%
- LOW – the area has a chance of surface water flooding of between 0.1% and 1%
- MEDIUM – the area has a chance of surface water flooding of between 1% and 3.3%
- HIGH - the area has a chance of surface water flooding of greater than 3.3%

5.4.2. The EA's Updated Flood Map for Surface Water is presented in Figure 5.2.



Figure 5.2. EA Updated Flood Map for Surface Water

5.4.3. Figure 5.2 shows the majority of the site is considered to be at very low risk from surface water flooding. Part of the existing drainage ditches along the north, east and western boundaries of the site present low to high risk of surface water flooding. The risk associated with the ditches is to be expected, as they form existing low lying land and are designed to act as storage areas for surface water.

5.4.4. Review of the SFRA suggests no surface water flood records are associated with the site. Surface water flood records have been recorded 500m northwest of the site along Bilsham Road and 1.5km east on Grevatt's Lane. No further information was available for these events. On

⁵ Environment Agency. Long Term Flood Risk Information <https://flood-warning-information.service.gov.uk/long-term-flood-risk/map>

account of the distance of these past events and the site boundary, the risk of surface water flooding to the site remains low.

5.5. Groundwater Flood Risk

- 5.5.1. A review of the SFRA suggests the site is situated in an area which has a high potential for groundwater to reach the surface although no historical groundwater flood events had been recorded for the site. In the absence of site-specific records to inform on this element, reference has been made to a nearby site promoted by LEL under Planning Reference: Y/92/17/OUT. That site is approximately 1.4 km to the north west of the proposed development site and groundwater is anticipated at depths of 0.4m below ground in that area.
- 5.5.2. The bedrock geology of the site is likely to be permeable in nature and it is possible for a shallow groundwater table to be present beneath the site.
- 5.5.3. As mentioned in Section 4.4 ground investigation and monitoring was being undertaken at the time of preparing this report.

5.6. Sewer Flood Risk

- 5.6.1. A review of available information indicates no records of sewer flooding on-site.
- 5.6.2. The risk of sewer flooding is expected to be low.

5.7. Artificial Flood Risk

- 5.7.1. Information available from the EA for risk of inundation from reservoirs indicates that the site is at low risk of flooding from that source.

5.8. Historical Flood Risk

- 5.8.1. Review of the SFRA suggests no historical flood events have been recorded on the site.

5.9. Flood Risk Summary

Table 5.1: Summary of existing flood risk

Flood Risk	Level of Risk
Fluvial	LOW
Tidal	LOW
Surface Water	MEDIUM – majority VERY LOW with small areas of HIGH risk
Groundwater	HIGH – assumed chance of groundwater occurring at surface
Sewer	LOW
Artificial	LOW

5.10. Climate Change Impact

- 5.10.1. Climate change must be considered as an integral part of any site specific FRA in order to minimise the impact of future flooding and allow adequate consideration for resilience to alleviate the burden on potential future users of the proposed development.

- 5.10.2. As part of ADC's SFRA, JBA Consulting prepared a map showing climate change for map on the fluvial flood zones for the years 2031, 2061 and 2111. The SFRA maps indicate that the south eastern and eastern part of the site may become part of Flood Zone 3a by 2111.
- 5.10.3. ADC was contacted to provide future climate change flood level information and confirmed that the council does not hold the details. The future flood maps do not provide flood level information and are indicative only.
- 5.10.4. The EA has been approached for detailed flood level information, but the information was not available at the time of preparing this report. Subject information on the projected future flood levels being available from the EA, additional consideration can be given at detailed design stage to any other requirements for future proofing the proposed development.

6.0 DEVELOPMENT PROPOSALS

6.1. Development Description

- 6.1.1. The proposed development is for a single 'chapel' crematorium with single cremator. The facility is designed as a secular building to cater for those of any faith or those with no faith. The crematorium will be set within generous grounds with a garden of remembrance and garden of reflection, a car park with overspill area in addition to a servicing area associated with cremation functions.
- 6.1.2. The circulation and car parking are commensurate with the capacity of the ceremony hall with parking for 119 cars. Car parking for the staff and visitors to the site are catered for in the service area. The layout also envisages a garden of remembrance in a formal style and a garden of reflection with more naturalistic planting.
- 6.1.3. The proposed layout is presented in Appendix E.

6.2. Vulnerability of Development

- 6.2.1. Paragraph 66 of the PPG defines the different categories of development in terms of flood risk vulnerability. The proposed development is for a crematorium; a bespoke use which would fall under the 'less vulnerable' category. It will have an office facility with a limited number of staff during operational hours. There is no residential element associated with the development.
- 6.2.2. In accordance with Section 2.2.2 and Table 2.1 of this report the proposed development is suitable for both current and future flood risk classifications including future climate change allowances.

6.3. Existing and Proposed Impermeable and Permeable Areas

- 6.3.1. The existing and proposed impermeable and permeable areas are presented in Table 6.1.

Table 6.1: Existing and Proposed Permeable and Impermeable Areas

	Permeable (ha)	Impermeable (ha)
Existing	2.50	0.00
Proposed	1.78	0.72

7.0 SURFACE WATER MANAGEMENT

7.1. Design Criteria

7.1.1. The surface water drainage system has been designed in accordance with the NPPF Framework, the accompanying PPG and Technical Standards for SuDS. It also complies with the requirements under Building Regulations Part H and ADC's Supplementary Requirements for Surface Water Drainage Proposals.

7.1.2. In line with the SuDS hierarchy under Paragraph 80 of the PPG, surface water should be managed by:

- 1.) Infiltration to the maximum extent that is practical – where it is safe and acceptable to do so
- 2.) Discharge to watercourses
- 3.) Discharge to surface water sewer, highway drain or another drainage system
- 4.) Discharge to combined sewers (last resort)

7.2. Proposed Surface Water Runoff Rates and Attenuation

7.2.1. As previously mentioned in Section 4.7 an assessment of the Greenfield runoff rates (Qbar) for the site has been made. Proposed discharge rates for the development should be restricted to Qbar at 2.96 litres/second/hectare for the developable area (2.13 l/s).

7.2.2. A conservative assessment has been undertaken to calculate the required surface water attenuation for the site. The total storage required for all storm events up to the 1 in 100 year plus climate change allowance is 600 m³, the calculations are contained in Appendix F.

7.3. Site Constraints

7.3.1. A review of the site characteristics and local policy has informed the following site constraints which have influenced the surface water drainage strategy:

- The groundwater levels beneath the site and infiltration rates of the geology are unknown. Site investigations were underway at the time of writing this report
- The site is situated on a Principal and Secondary A Aquifer
- Discharging to ordinary watercourses is subject to confirmation from the LLFA

7.4. SuDS Strategy

7.4.1. The proposed drainage strategy layout presented in Appendix F, illustrates the typical SuDS features proposed to manage the surface water runoff from the site.

7.4.2. Surface water runoff from impermeable areas will be controlled at source. The following SuDS features have been considered within the proposed drainage strategy:

- Filter Drain;
- Swale; and,
- Detention Basin

- 7.4.3. The proposed drainage system includes features which provide water quality, quantity, amenity and biodiversity benefits, meeting the four pillars of sustainable drainage as outlined in the CIRIA SuDS Manual (CIRIA Report C753).
- 7.4.4. The topography of the site is fairly flat, and the groundwater levels beneath the site are envisaged to be high. To compensate for these elements it is proposed that the drainage is kept at shallow depths and uses a combination of elements to convey the overland flow towards the south east of the site, mimicking the natural discharge paths. Runoff from the impermeable areas can be collected via filter drains or beanie blocks where possible which will then convey the runoff to the swales and then flow into the detention basins as illustrated on the drainage layout.
- 7.4.5. The proposed swales act more as a conveyance feature rather than an attenuation feature providing a further level of treatment to the runoff from the impermeable areas.
- 7.4.6. Similarly, runoff from the roofs of the proposed buildings can be discharged into filter trench drains or a piped network linked to the detention basins.
- 7.4.7. The SuDS features across the site eventually discharge to the detention basin on the eastern boundary of the site with an overflow to the existing drainage ditch located south east of the site restricted to Qbar.
- 7.4.8. Taking account of envisaged high groundwater levels across the site, the detention basins and swales are intended to be shallow systems up to 0.4m deep and unlined. Subject to the soil investigations and infiltration testing, the contribution of surface water discharge through infiltration may be reassessed and the size of the detention basins adjusted at detail design stage.
- 7.4.9. Subject to the winter groundwater monitoring exercise, should groundwater levels prove to be high, consideration will be given at detail design stage for lining of the detention basins.
- 7.4.10. The proposed surface water drainage system can effectively control all runoff generated within the site and maintain pre-development Greenfield runoff off-site without increasing flood risk elsewhere.
- 7.4.11. Furthermore, the incorporation of SuDS measures provides amenity and ecological benefits as well as managing flood risks from the site.
- 7.4.12. The maintenance of SuDS features is vital ensuring that they work as efficiently as they set out to do. A schedule of maintenance for the proposed SuDS features is contained in Appendix G.

7.5. Water Quality

- 7.5.1. The CIRIA SuDS Manual defines the 'SuDS Management Train' as the sequence of drainage components that collectively provide the necessary processes to control the frequency of runoff, the flow rates and the volumes of runoff, and to reduce concentrations of contaminants to acceptable levels.
- 7.5.2. Treatment within SuDS components is essential for frequent rainfall events such as the 1:1 return period event, where urban contaminants are being mobilised and washed off urban surfaces, and the aggregated contribution to the total pollutant load to the receiving surface water body is potentially high. For rainfall events greater than the 1:1 return period, the pollutants become diluted and the environmental risks will be reduced which means that the

SuDS treatment process becomes less crucial. Treatment effectiveness is strongly linked to the hydraulic control of runoff, in particular velocity control and retention time.

- 7.5.3. Table 26.2 of the CIRIA SuDS Manual provides the pollution hazard indices for different land use classifications as shown in the table below.

Table 7.1: CIRIA Pollution hazard indices for different land use classifications

Land Use	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydro-carbons
Commercial/Industrial Roofs	Low	0.3	0.2	0.05
Individual property driveways, residential car parks, low traffic roads (e.g. cul de sacs, home zones and general access roads) and non-residential car parking with infrequent change (e.g. schools, offices) i.e. <300 traffic movements/day	Low	0.5	0.4	0.4

- 7.5.4. Table 7.2 below summarises the treatment efficiency of different SuDS components discharging to surface waters as detailed in Chapter 26 of the SuDS Manual.

Table 7.2: CIRIA Indicative SuDS Mitigation Indices for Discharges to Surface Waters

Type of SuDS Component	Total Suspended Solids (TSS)	Mitigation Indices	
		Metals	Hydro-carbons
Filter Drain	0.4	0.4	0.4
Swale	0.5	0.6	0.6
Detention Basin	0.5	0.5	0.6

- 7.5.5. Where multiple drainage features are used, the efficiency of the secondary system to treat water is reduced. By using a swale discharging into a detention basin the combined mitigation indices is as follows:

Table 7.3: Mitigation Indices for Proposed Combined Drainage System

	Mitigation Indices	Total Mitigation
TSS	0.5 + 0.5(0.5)	0.75
Metals	0.6 + 0.5(0.5)	0.85
Hydrocarbons	0.6 + 0.5(0.6)	0.90

- 7.5.6. The mitigation indices of the proposed drainage system exceeds the anticipated pollutant loadings from the proposed use and is considered adequate to provide water quality discharge.

7.6. Foul Water Strategy

- 7.6.1. The foul water from the proposed development will discharge via gravity to a cesspit located in the service yard. A minimum cesspit size of 18,000 litres (subject to detailed design), should be considered. Final foul requirements from the crematorium would need to be confirmed by the crematorium operators at detail design stage.
- 7.6.2. The use of a septic tank was considered and assessed as not being viable for disposal of foul water sewerage. The existing ditch to the south east of the site, to which the treated effluent would discharge, runs dry during the summer and would pose potential contamination and possible water quality issues.
- 7.6.3. The drainage strategy together with supporting information and calculation are contained in Appendix F.

8.0 FLOOD RISK FROM THE PROPOSED DEVELOPMENT

8.1. Fluvial Flood Risk

- 8.1.1. The proposed development will incorporate SuDS features in accordance with NPPF and as such there will be no increased discharge off-site.

8.2. Tidal Flood Risk

- 8.2.1. The site is not in an area at risk from tidal flooding and will have no impact on tidal flooding.

8.3. Surface Water Flood Risk

- 8.3.1. The existing ditches to the north, east and west of the site exhibit flood risk. The development will avoid developing within 3m of these ditches to conform to local byelaws and minimise any impact from surface water flood risk.
- 8.3.2. As discussed in Section 7.0 the surface water runoff generated by the proposed development will be managed within the site boundary without any increase in either discharge rate or volume. The resultant risk is considered low.

8.4. Groundwater Flood Risk

- 8.4.1. The site lies above a Principal Aquifer and the presence of possible groundwater beneath the site is high, although no records of groundwater flooding have been recorded for the site.
- 8.4.2. Subject to the ground investigation and winter groundwater monitoring which is currently being undertaken, the presence of groundwater will be confirmed. This will inform the detailed design and the potential for discharging surface water by infiltration.

8.5. Sewer Flood Risk

- 8.5.1. As mentioned previously the only public sewer in proximity to the site is the rising main and there are no proposals to connect into it. The flood risk associated with that element is considered low.
- 8.5.2. The proposed development will create a new source of foul water flow from the site. The management of the foul water has been addressed in Section 7.0 of this report and with appropriate measures is not considered a risk to the site.

8.6. Artificial Flood Risk

- 8.6.1. The proposed development is unlikely to increase the artificial flood risk to the site.

8.7. Climate Change Impacts

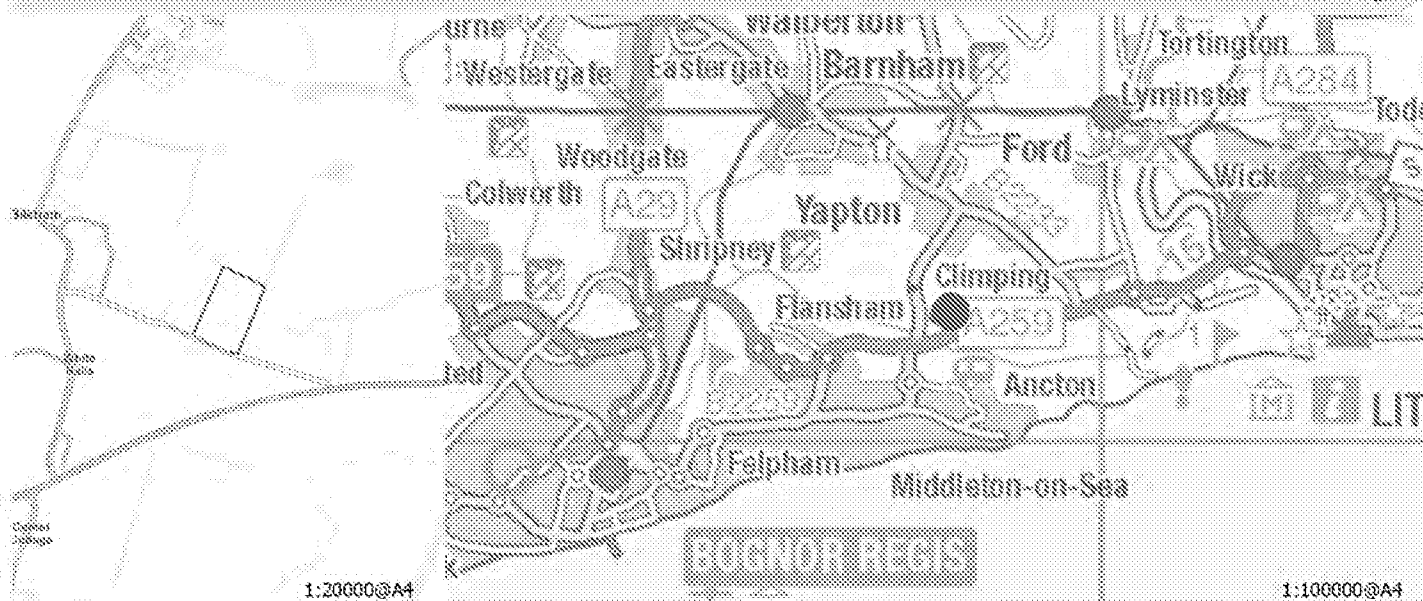
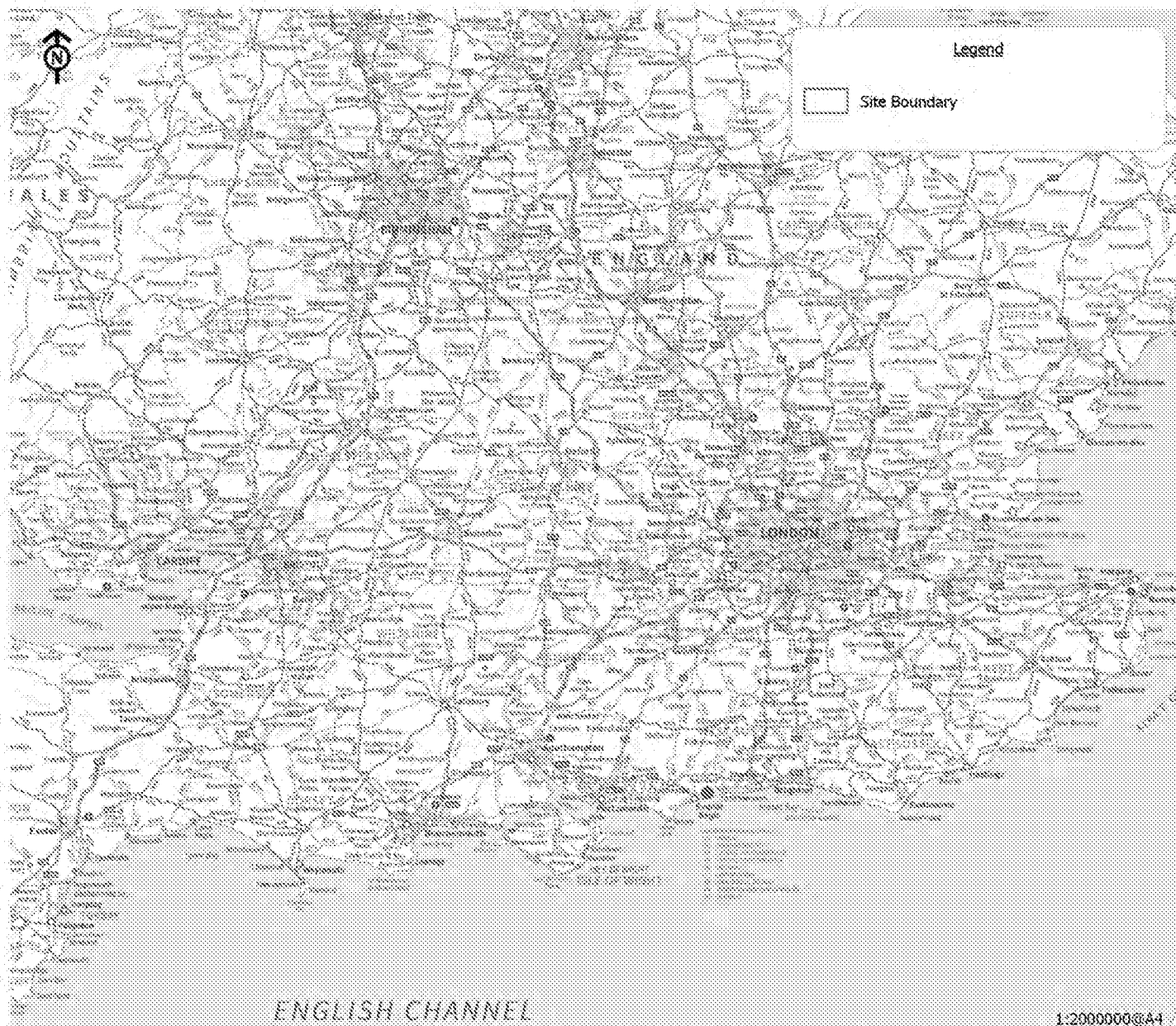
- 8.7.1. As discussed in Section 5.10, climate change may increase the future risk of fluvial flooding to the site for the projected year of 2111. The areas mapped in the SFRA are indicative only and actual flood levels may vary compared to existing topographical data. The SFRA does not provide flood levels for the 2111 flood event. A Product 4 data report has been requested from the EA however was unavailable at the time of preparing this report.

- 8.7.2. Although future climate change may affect the site, the development is classified under NPPF as less vulnerable. In accordance with Table 3 of the PPG, less vulnerable development is considered acceptable in terms of flood risk at the proposed location.
- 8.7.3. The proposed development will have set hours of opening and controlled access to the grounds, meaning if an unlikely flood event was to happen in approximately 100 years' time, access to the site could be controlled to ensure safe operation.
- 8.7.4. Upon receipt of the Product 4 data flood resilience measures can be considered for incorporation into the design of the building to future proof against the impact of climate change flood events and facilitate recovery should an event occur. The future risk is considered low.

9.0 CONCLUSION

- 9.1.1. CampbellReith has prepared this Flood Risk Assessment to support the planning application for the proposed crematorium development at Bilsham, West Sussex.
- 9.1.2. The site is located in Flood Zone 1 where all types of development are considered acceptable in accordance with the NPPF.
- 9.1.3. The SFRA identifies surface water and groundwater as the primary risks within the study area. Tidal and fluvial flood present a secondary risk. Flooding from surface water, groundwater, sewer networks and reservoirs have been assessed and following further investigation are expected to be low for the site.
- 9.1.4. Future fluvial flood risk as a result of climate change has been assessed indicating potential increase in flood risk to the development site in 2111. Subject to the provision of further information from the EA on projected flood levels, consideration can be given during detailed design of the buildings to mitigation measures.
- 9.1.5. An assessment of the surface water catchment has been made and the Greenfield runoff rate (Qbar) for the site has been calculated at 2.96 litres/second/hectare and restricted to the developable area of the site. Qbar should be applied to the developable area of 0.72 Ha.
- 9.1.6. A conservative assessment has been undertaken to calculate the required surface water attenuation storage for the site. The total required storage is 600 m³ to cater for all storms up to and including the 1 in 100 year rainfall event including allowance for climate change.
- 9.1.7. The proposed drainage system includes features which provide water quality, quantity, amenity and biodiversity benefits, meeting the four pillars of SuDS requirements.
- 9.1.8. The proposed surface water drainage system will effectively control all runoff generated within the site and maintain pre-development Greenfield runoff offsite without increasing flood risk elsewhere.
- 9.1.9. Regular maintenance of the SuDS features will be required to maintain the operational efficiency of the drainage systems.
- 9.1.10. The foul water will be contained in a cesspit for off-site disposal.
- 9.1.11. Providing the guidance presented within this FRA is followed, CampbellReith considers that the site is suitable for the proposed development.

Appendix A: Site Location



Central Arun Crematorium

Site Location

Client: Landlink Estates Limited

Scale: 1:20,000; 1:100,000; 1:2,000,000 @A4
 Copyright: © Crown copyright. All rights reserved. Licence number 100026027
 Contains Ordnance Survey data © Crown copyright and database right 2018.
 Job Number: 13062
 Drawn by - Checked by: RP - AH
 Date/Revision: 02/05/17 - B
 File Location: N:\13062 - 13249\13062 R Central Arun Crematorium\Project Workspace (pdf in Outputs)
 Date (Revision History): 26/12/2016 (A, First Issue, 12/11/18, RP, B, Boundary Update, 20/12/18, RP)

CampbellReith
 Consulting Engineers

LONDON 020 7340 1700 □ MANCHESTER 0161 819 3090
 REDHILL 01797 784 500 □ BIRMINGHAM 0121 75 467 484
 BRISTOL 0117 916 1066 □ DUBLIN 00 971 4453 4735
 www.campbellreith.com

Appendix B: SFRA Extracts

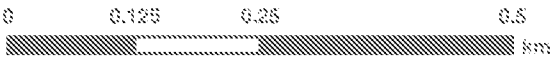


Key Plan



Legend

-  Arun District SFRA boundary
- Main Rivers**
-  Aidingbourne Rile
 -  Ash Grove
 -  Barnham Lane Ditch
 -  Barnham Rile
 -  Black Ditch
 -  Decoy Ponds Ditch
 -  East Poling Drain
 -  El Springs Ditch
 -  Ferring Rile
 -  Forebridge Rile
 -  Lidsey Rile
 -  Little Turlington Stream
 -  North Bersford Ditch
 -  Pegham Harbour Channels
 -  Pegham Rile
 -  River Arun
 -  Rope Walk Ditch
 -  Ryebank Rile
 -  Shropney Manor Ditch
 -  West Poling Drain
 -  Ylpton Rile
 -  Ordinary watercourse



REF	Date	Comments
A	June 2016	-
B		
C		

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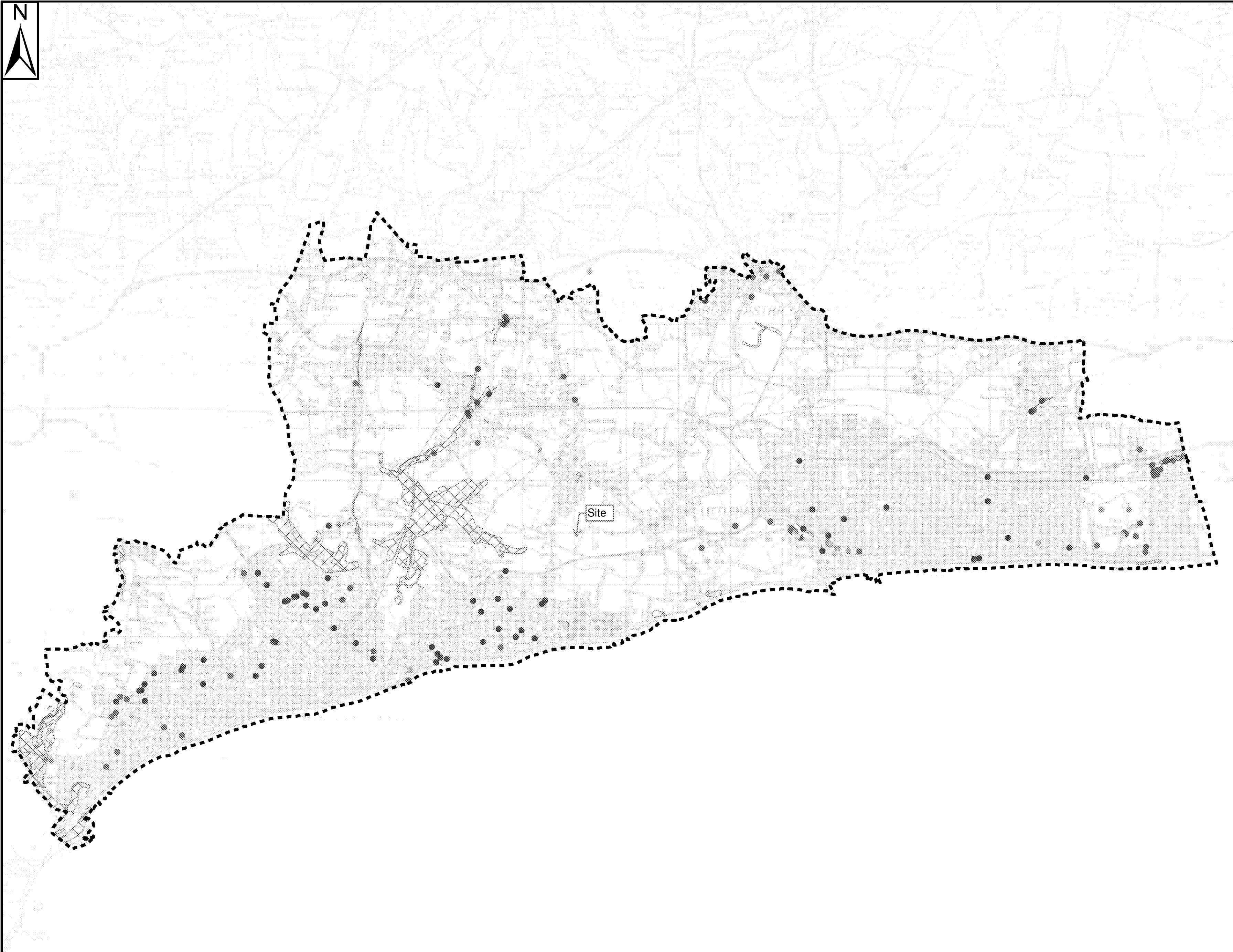
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LEVEL 1 SFRA: APPENDIX B WATERCOURSES

Sheet No: 13 of 48 Index Number: AGC_13

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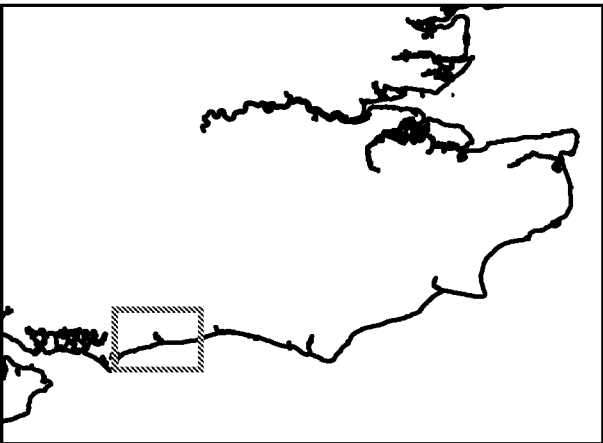
Notes

The Historic Flooding Map shows the recorded incidents and flood outlines provided by Arun District Council, West Sussex County Council, Southern Water and Environment Agency. Historical flood extent was obtained from the Environment Agency.

Flooding incidents provided have been categorised based upon the details provided in the records. Unknown flood points could not be determined from the information provided, and therefore could be from a number of sources.

Please note that not all historical records may be shown on this map, and that it is therefore advised you contact Arun District Council for updated information post 2015.

Key Plan



Legend

- Arun District SFRA boundary
- Historic flood outline

Source of flooding

- Fluvial
- Coastal
- Tidal
- Surface Water
- Failure
- Unknown

REF	Date	Comments
A	June 2016	-

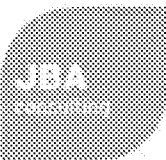


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**SFRA: APPENDIX H
HISTORIC FLOOD RECORDS**

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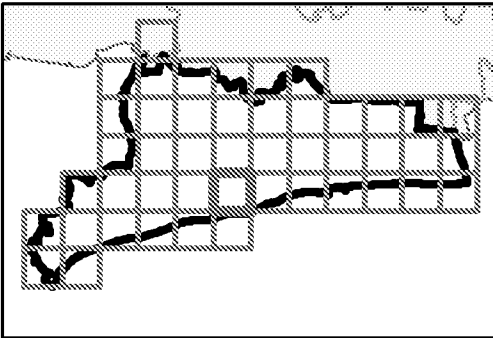
Notes

The Areas Susceptible to Groundwater Flooding (ASiGWF) is a strategic scale map showing groundwater flood areas on a 1km square grid. The data was produced to annotate indicative Flood Risk Areas for Preliminary Flood Risk Assessment (PFRA) studies and allow the Lead Local Flood Authorities (LLFAs) to determine whether there may be a risk of flooding from groundwater.

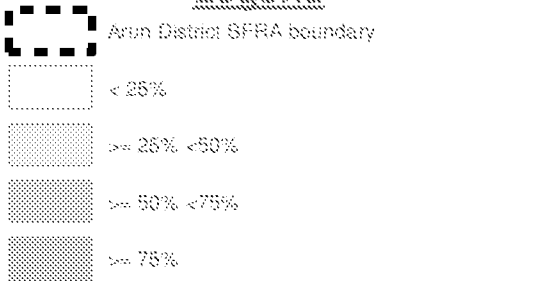
This data shows the proportion of each 1km grid square where geological and hydrogeological condition show that groundwater might emerge. It does not show the likelihood of groundwater flooding occurring. It does not take account of the chance of flooding from groundwater rebound. This dataset covers a large area of land, and only isolated locations within the overall susceptible area are actually likely to suffer the consequences of groundwater flooding.

The ASiGWF data should be used only in combination with other information, for example local data or historic data. It should not be used as sole evidence for any specific flood risk management, land use planning or other decisions at any scale. However, the data can help to identify areas for assessment at a local scale where finer resolution datasets exist.

Key Plan



Legend



REF	Date	Comments
A	June 2016	-
B		
C		

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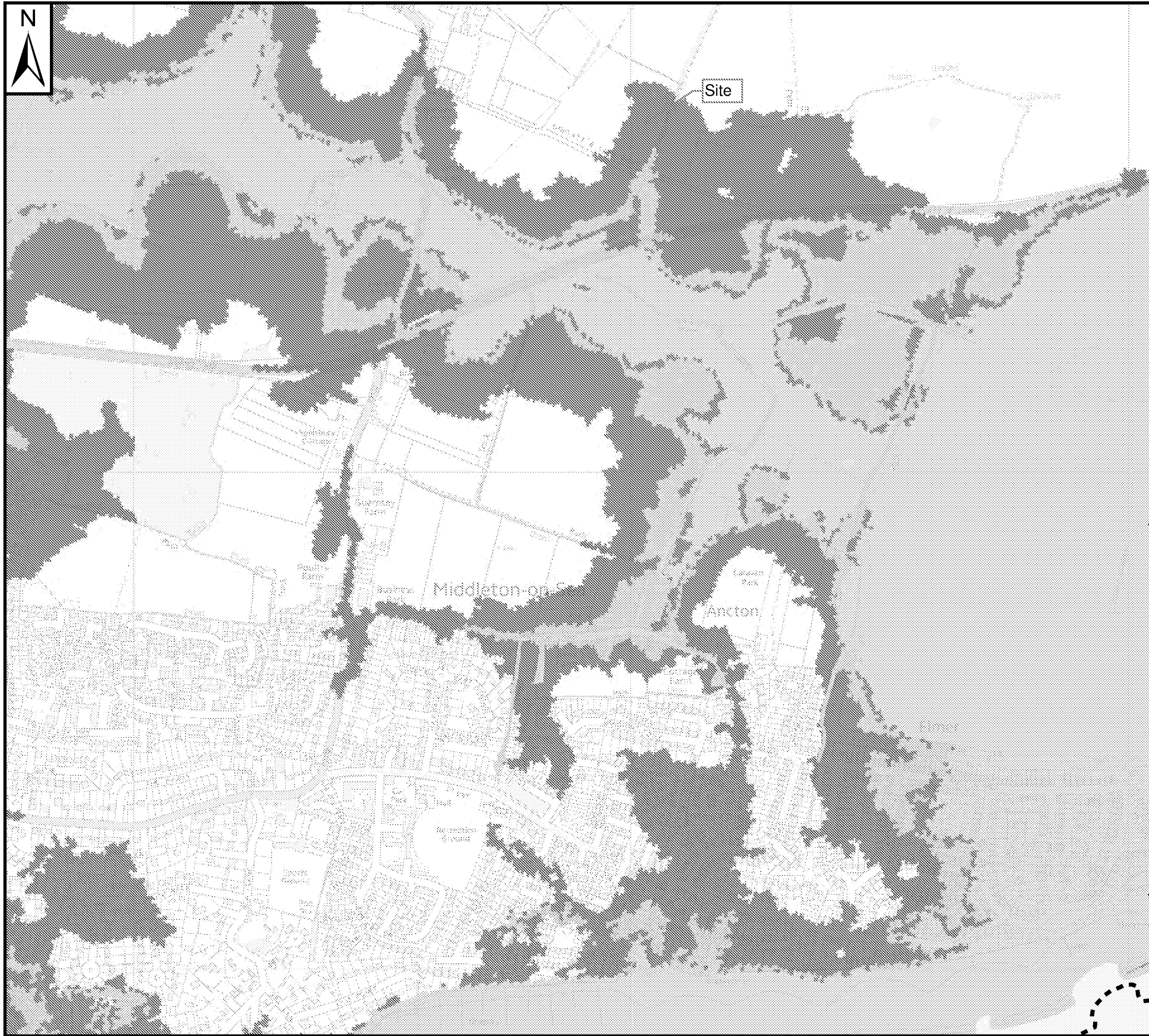
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**LEVEL 1 SFRA: APPENDIX F
AREAS SUSCEPTIBLE TO GROUNDWATER**

Sheet No: 13 of 48 Index Number: AGC_13

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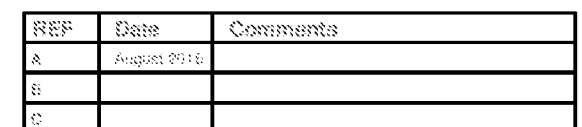




Hydraulic modelling has been undertaken as part of this SFRA to provide updated climate change flood mapping in the Arun District for Flood Zone 3a. This modelling followed the latest guidance for climate change in FRAs/SFRAs released by the Environment Agency in February 2015 (and updated in April 2016). Climate change for fluvial events has been based on the Higher Central estimates for the years 2021, 2061 and 2111. Present day flood risk information is available for comparison. Arun District is within the South East River Basin District and therefore allowance are:

For tidal/coastal models, undefended case still water level and defended case still water level with wave overtopping simulations have been completed to inform future flood risk within the Arun District. Again, climate change allowance predictions are for the years 2031, 2061 and 2111, with present day outputs for comparison.

	Arm District SFRA boundary		Future Flood Zone 3a (2051)
	Present Flood Zone 3a		Future Flood Zone 3a (2111)
	Future Flood Zone 3a (2031)		



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LEVEL 1 SFRA: APPENDIX D CLIMATE CHANGE MAPPING

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Appendix C: Topographical Survey

AF	Auto Headlight	FD	Fire Hydrant	RS	Rebound Seat
AM	Amuse Ride	FE	Feed	SD	Sign Drive
AN	Animal	FF	Feed	SE	Seat
AO	Animal Ocean	FL	Foot	SW	Stop Wave
AP	Animal	FM	Feed	SY	Stop
B	Bed	FN	Foot	SY	Stop
BB	Bed Bed	FO	Foot	SY	Stop
BC	Bed	FP	Foot	SY	Stop
BD	Bed	FR	Foot	SY	Stop
BE	Bed	FS	Foot	SY	Stop
BF	Bed	FT	Foot	SY	Stop
BG	Bed	FU	Foot	SY	Stop
BH	Bed	FV	Foot	SY	Stop
BI	Bed	FW	Foot	SY	Stop
BJ	Bed	FX	Foot	SY	Stop
BK	Bed	FY	Foot	SY	Stop
BL	Bed	FZ	Foot	SY	Stop
BM	Bed	GA	Foot	SY	Stop
BN	Bed	GB	Foot	SY	Stop
BO	Bed	GC	Foot	SY	Stop
BP	Bed	GD	Foot	SY	Stop
BQ	Bed	GE	Foot	SY	Stop
BR	Bed	GF	Foot	SY	Stop
BS	Bed	GG	Foot	SY	Stop
BT	Bed	GH	Foot	SY	Stop
BU	Bed	GI	Foot	SY	Stop
BV	Bed	GJ	Foot	SY	Stop
BW	Bed	GK	Foot	SY	Stop
BX	Bed	GL	Foot	SY	Stop
BY	Bed	GM	Foot	SY	Stop
BZ	Bed	GN	Foot	SY	Stop
CA	Car	GO	Foot	SY	Stop
CB	Car	GP	Foot	SY	Stop
CC	Car	GQ	Foot	SY	Stop
CD	Car	GR	Foot	SY	Stop
CE	Car	GS	Foot	SY	Stop
CF	Car	GT	Foot	SY	Stop
CG	Car	GU	Foot	SY	Stop
CH	Car	GV	Foot	SY	Stop
CI	Car	GW	Foot	SY	Stop
CJ	Car	GX	Foot	SY	Stop
CK	Car	GY	Foot	SY	Stop
CL	Car	GA	Foot	SY	Stop
CM	Car	GB	Foot	SY	Stop
CN	Car	GC	Foot	SY	Stop
CO	Car	GD	Foot	SY	Stop
CP	Car	GE	Foot	SY	Stop
CQ	Car	GF	Foot	SY	Stop
CR	Car	GG	Foot	SY	Stop
CS	Car	GH	Foot	SY	Stop
CT	Car	GI	Foot	SY	Stop
CU	Car	GJ	Foot	SY	Stop
CV	Car	GK	Foot	SY	Stop
CW	Car	GL	Foot	SY	Stop
CX	Car	GM	Foot	SY	Stop
CY	Car	GN	Foot	SY	Stop
CZ	Car	GO	Foot	SY	Stop
DA	Car	GP	Foot	SY	Stop
DB	Car	GQ	Foot	SY	Stop
DC	Car	GR	Foot	SY	Stop
DD	Car	GS	Foot	SY	Stop
DE	Car	GT	Foot	SY	Stop
DF	Car	GU	Foot	SY	Stop
DG	Car	GV	Foot	SY	Stop
DH	Car	GW	Foot	SY	Stop
DI	Car	GX	Foot	SY	Stop
DJ	Car	GY	Foot	SY	Stop
DK	Car	GA	Foot	SY	Stop
DL	Car	GB	Foot	SY	Stop
DM	Car	GC	Foot	SY	Stop
DN	Car	GD	Foot	SY	Stop
DO	Car	GE	Foot	SY	Stop
DP	Car	GF	Foot	SY	Stop
DQ	Car	GG	Foot	SY	Stop
DR	Car	GH	Foot	SY	Stop
DS	Car	GI	Foot	SY	Stop
DT	Car	GJ	Foot	SY	Stop
DU	Car	GK	Foot	SY	Stop
DV	Car	GL	Foot	SY	Stop
DW	Car	GM	Foot	SY	Stop
DX	Car	GN	Foot	SY	Stop
DY	Car	GO	Foot	SY	Stop
DZ	Car	GP	Foot	SY	Stop
EA					

Topographical Surveys

All building names, descriptions, number of storeys, construction type and roof line details are indicative only and taken externally from ground level.

All below ground details including drainage, voids and services have been identified from above ground and therefore all details relating to these features including: sizes, depth, description etc will be approximate only. All critical dimensions and connections should be checked and verified prior to start work.

Detail, services and features may not have been surveyed if obstructed or not reasonably visible at the time of the survey.

Measurements to internal walls are taken to the wall finishes at approx 1

Cill heights are measured as floor to the cill and head heights are measured from cill to the top of window.

General

utilites and drainage details and connections prior to commencing work. errors or discrepancies must be notified to Survey Solutions immediately.

The accuracy of the digital data is the same as the plotting scale implies. dimensions are in metres unless otherwise stated.

The survey control listed is only to be used for topographical surveys at the stated scale. All control must be checked and verified prior to use.

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The co-ordinate system established for this survey is related to Ordnance

Survey (OS) national grid at a single point using GPS Smartnet, then orient to Grid North with a scale factor of 1.000.

The level datum established for this survey is related to Ordnance Survey using GPS Smartnet.

To avoid discrepancies, any co-ordinated data used in conjunction with this survey must be derived directly from this control data.

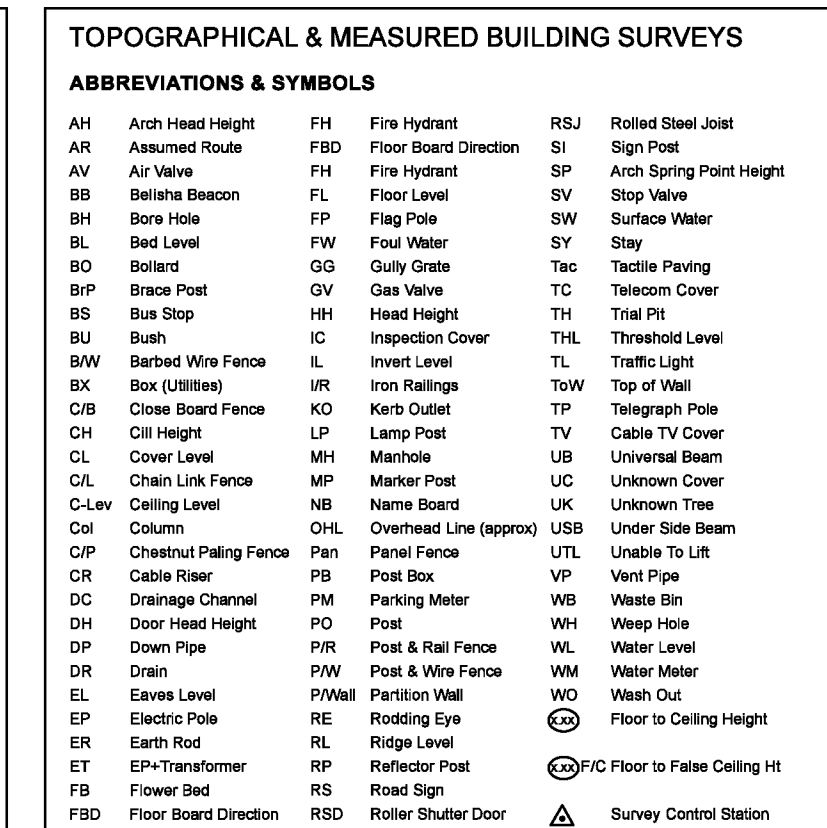
The major contour interval is 1 metre, the minor contour interval is 0.500 m

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PROJECT TITLE GREVATT'S LANE WEST, YAPTON, ARUNDEL, BN18 0LA.			
DRAWING DETAIL TOPOGRAPHICAL SURVEY Sheet 3 of 3			
CLIENT DAVID LANGMEAD			SCALE 1:200
SURVEYOR 3B/AD	SURVEY DATE 29/10/218	CHECKED BY AK	APPROVED BY JM
DRAWING NUMBER 23061se-03			DWG STATUS FINAL
		REVISION	ISSUE DATE 09/11/18

Appendix D: Southern Water Asset Records and Existing Greenfield Runoff Rates

Calculated by: Jacques Calitz
Site name: Crematorium
Site location: Crematorium

Site coordinates
Latitude: 50.80713° N
Longitude: 0.61367° W

This is an estimation of the greenfield runoff rate limits that are needed to meet normal best practice criteria in line with Environment Agency guidance "Preliminary rainfall runoff management for developments", WS-074/A/TR1/1 rev. E (2012) and the SuDS Manual, C753 (Ciria, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Reference: 6505541
Date: 2018-12-20T15:56:57

Methodology	IH124
-------------	-------

Site characteristics

Total site area (ha)	2.5
----------------------	-----

Methodology

Qbar estimation method	Calculate from SPR and SAAR	
SPR estimation method	Calculate from SOIL type	
	Default	Edited
SOIL type	3	3
HOST class	---	---
SPR/SPRHOST	0.37	0.37

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 year	2.3	2.3
Growth curve factor: 100 year	3.19	3.19

Notes:

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

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

(3) Is $SPR/SPRHOST \leq 0.3$?

Greenfield runoff rates

	Default	Edited
Qbar (l/s)	7.41	7.41
1 in 1 year (l/s)	6.3	6.3
1 in 30 years (l/s)	17.04	17.04
1 in 100 years (l/s)	23.64	23.64

Appendix E: Proposed Layout



GENERAL NOTES:
1. DO NOT SCALE FROM THIS DRAWING. DIMENSIONS GOVERN.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
3. ALL DIMENSIONS SHALL BE VERIFIED ON SITE BEFORE PROCEEDING WITH THE WORK.
4. PLINCKE SHALL BE NOTIFIED IN WRITING OF ANY DISCREPANCIES.
5. PLINCKE ACCEPTS NO LIABILITY FOR ANY EXPENSE LOSS OR DAMAGE OF WHATSOEVER NATURE AND HOWSOEVER ARISING FROM ANY OMISSION MADE TO THIS DRAWING OR IN THE EXECUTION OF THE WORK TO WHICH IT RELATES WHICH HAS NOT BEEN REFERRED TO THEM AND PRIOR APPROVAL OBTAINED.

A1

Original Sheet Size

0mm

50mm

KEY PLAN

N

CDM:	
IN ADDITION TO THE HAZARDS / RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING:	
ITEM NO.	RISK REGISTER DETAILS

KEY:

0

10

20

50m

Application boundary

Strategic views to wider landscape & existing trees

01

Porte Cochere

02

Cortage waiting area

03

Protected view

04

Floral Tribute

05

Remembrance Court

06

Main car park
= 32no spaces (incl. of 12no Blue Badge bays)

07

Overflow car park
= 56 no spaces

08

Overflow car park
= 19 no spaces (reinforced grass)

09

Staff / Visitor parking
= 12 no spaces

Total parking = 119 spaces

10

Service yard

11

Congregation pedestrian route from car park

12

Native planting belts between parking areas

13

Native tree belt

14

Wildflower meadows

15

Swale

16

Drainage attenuation basin

17

Cortage pick up parking

18

New tree avenue on approach road

FOR PLANNING

PL01	ISSUED FOR PLANNING	15.12.18	CJ	AC
REV	REVISION	DATE	OWN	APP'D

plincke.

landscape urbanism design

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Manchester
+44 (0)161 237 9225

Project:
ARUN CREMATORIUM

Drawing:
PROPOSED SITE PLAN

Date:
15.11.18

Scale:
1:500 @A1

Status:
FOR PLANNING

Dm:
CJ

App'd:
AC

Drawing No:
0524-DR-100

Rev:
PL01

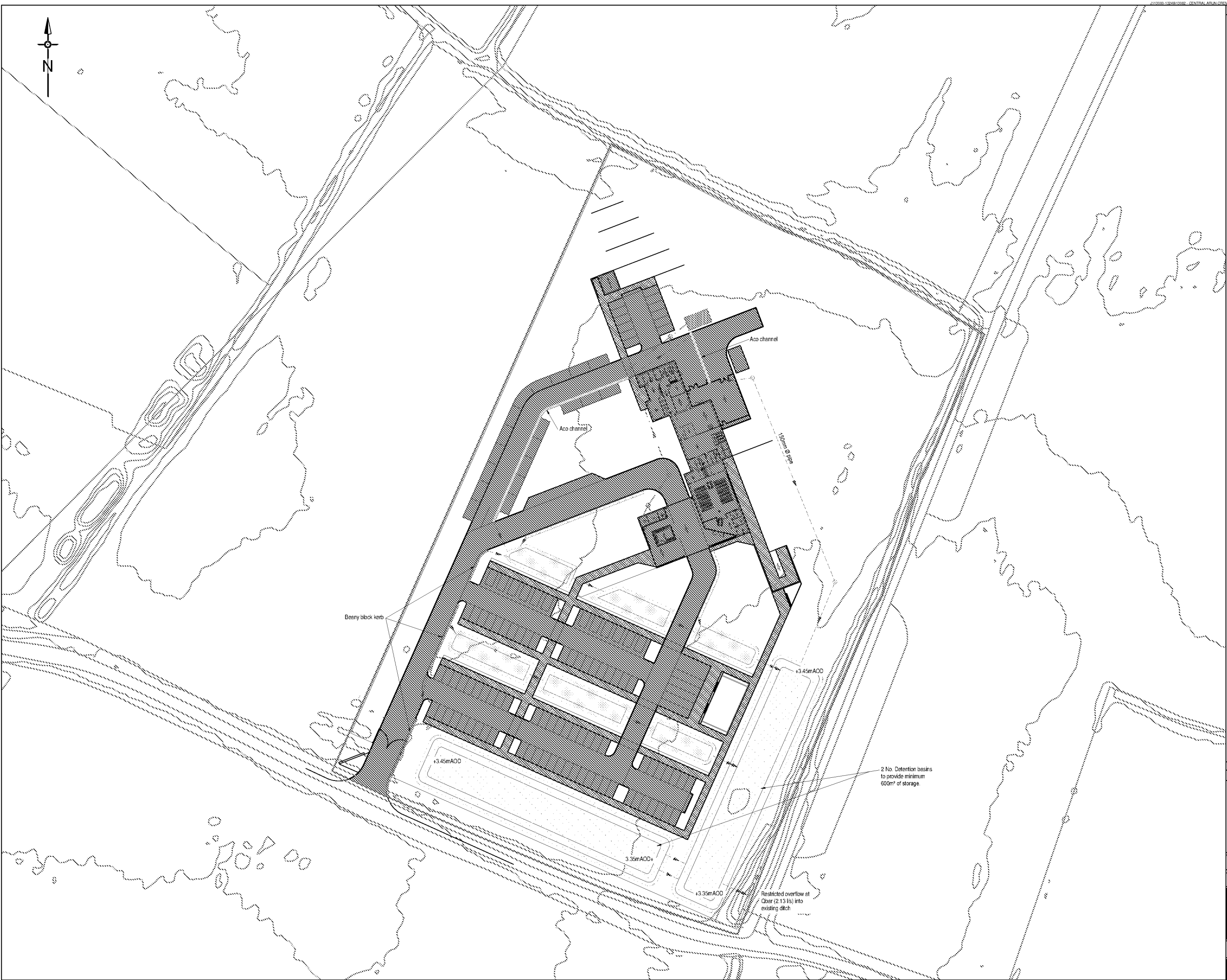
Appendix F: Proposed Drainage Strategy and Supporting Calculations

NOTES

1. DO NOT SCALE FROM THIS DRAWING ON PRINT OR ELECTRONICALLY. WORK FROM FIGURED DIMENSIONS ONLY.
2. No deviation from the details on this drawing is allowed without CampbellReith's prior permission in writing.
3. Read this drawing with all Architects, Service Engineers and CampbellReith's relevant details, specifications and drawings.
4. All work is to be done in accordance with the relevant specifications issued by CampbellReith, British Standard Codes of Practice, Statutory Requirements and the Contract Documents.
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P: PRELIMINARY Evolving drawings for approvals, tenders, billings etc.
C: CONSTRUCTION Fully developed drawings issued under instructions for construction.
6. ONLY STATUS C DRAWINGS TO BE USED FOR CONSTRUCTION.
7. Suitability Code:
Work in Progress
S0 - Work in Progress
Shared (Non-Contractual)
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Legend

- Proposed main road (non permeable)
- Development parcels - draining to swale
- Detention basins
- Indicative swales
- Gravel strip/french drain
- Proposed surface water pipes
- Proposed foul water pipes
- Indicative position of proposed cesspit
- Beany block kerb
- Aco drain



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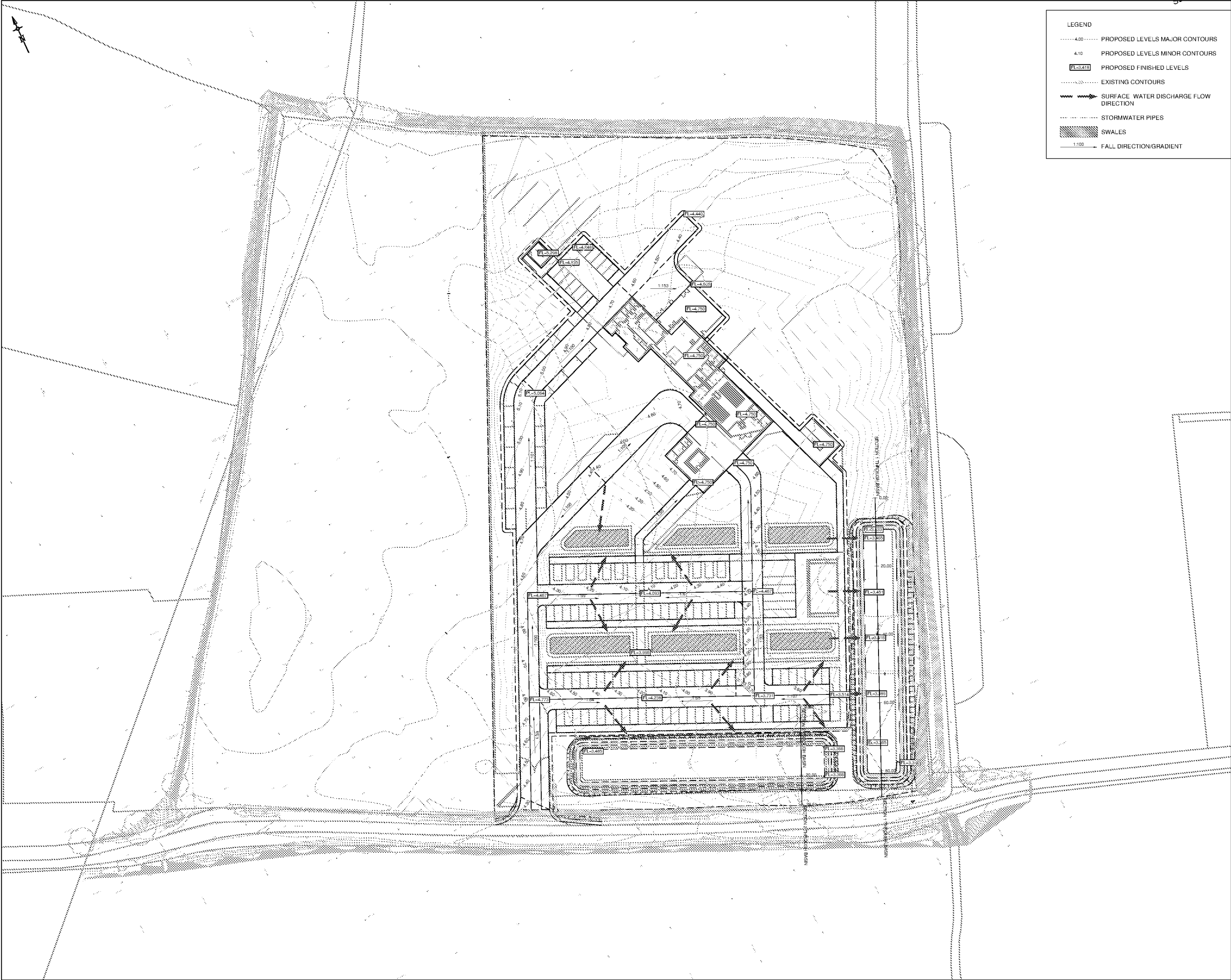
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Drainage Strategy Layout

DRAWN BY	DATE MADE	SCALE @ A1	CHECKED	SUITABILITY	OR PROJECT
RN	01/19	NTS	CRH	S2	13062
PROJECT No.	ISSUER	AREA	LEVEL	TYPE	ROLE
13062	CRH	ZZ	XX	DR	C
					5200
					P1



LEGEND

-----4.00----- PROPOSED LEVELS MAJOR CONTOURS

4.10 PROPOSED LEVELS MINOR CONTOURS

FL-3.418 PROPOSED FINISHED LEVELS

-----4.20----- EXISTING CONTOURS

~~~~~ SURFACE WATER DISCHARGE FLOW DIRECTION

----- STORMWATER PIPES

SWALES

1:100 FALL DIRECTION/GRADIENT

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**Proposed Levels and  
Drainage Strategy**

|             |           |       |       |         |             |            |
|-------------|-----------|-------|-------|---------|-------------|------------|
| DRAWN BY    | DATE MADE | SCALE | @ AT  | CHECKED | SUITABILITY | OR PROJECT |
| MW          | 01/19     | 1:500 | CRH   | S2      | 13062       |            |
| PROJECT No. | ISSUER    | AREA  | LEVEL | TYPE    | ROLE        | NUMBER     |
| 13062       | CRH       | ZZ    | XX    | DR      | C           | 5201       |



**LEGEND**

-----4.00----- PROPOSED LEVELS MAJOR CONTOURS

-----4.10----- PROPOSED LEVELS MINOR CONTOURS

**FL-3.410** PROPOSED FINISHED LEVELS

-----4.20----- EXISTING CONTOURS

----->----- SURFACE WATER FLOW PATH

 SWALES

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|                                                                                                                              |  |
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| <i>Construction</i>                                                                                                          |  |
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|     |                     |          |    |
|-----|---------------------|----------|----|
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Proposed Surface Water  
Flow Paths

|             |           |            |            |             |            |        |     |
|-------------|-----------|------------|------------|-------------|------------|--------|-----|
| DRAWN BY    | DATE MADE | SCALE @ A1 | C1 CHECKED | SUITABILITY | CR PROJECT |        |     |
| MW          | 01/19     | 1:500      | CRH        | S2          | 13062      |        |     |
| PROJECT No. | ISSUER    | AREA       | LEVEL      | TYPE        | ROLE       | NUMBER | REV |
| 13062       | CRH       | ZZ         | XX         | DR          | C          | 5202   | P1  |

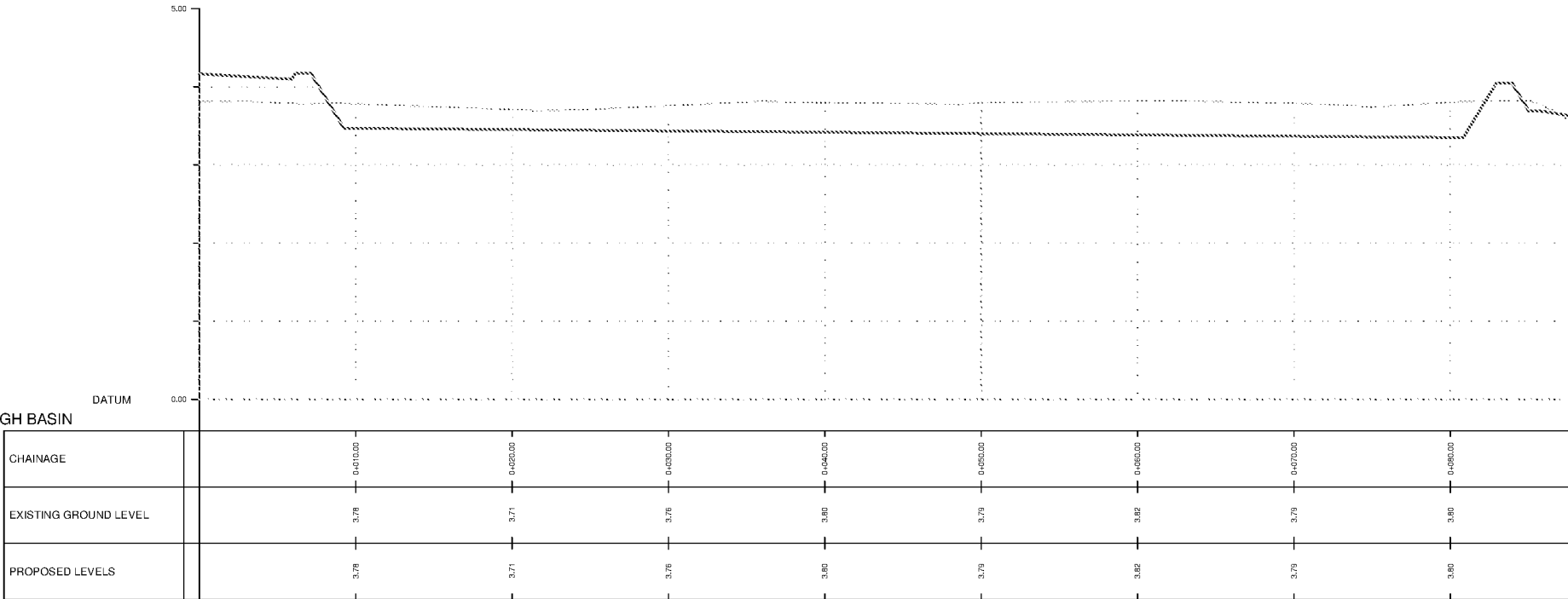
LEGEND

----- PROPOSED VERTICAL PROFILE  
..... EXISTING GROUND LEVEL

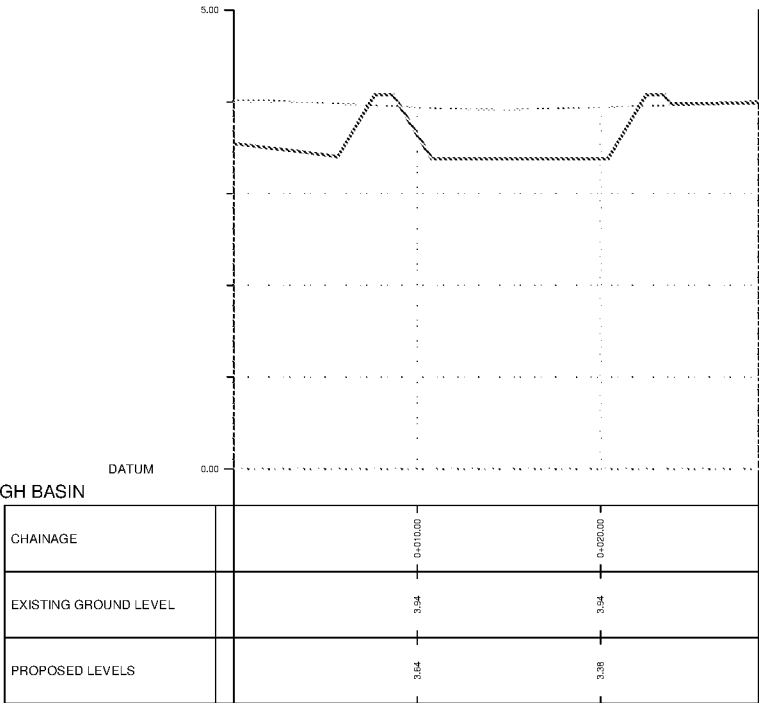
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SECTION 1 THROUGH BASIN



SECTION 2 THROUGH BASIN



Scale: Horiz 1:200  
Vert 1:40

|     |                     |          |    |
|-----|---------------------|----------|----|
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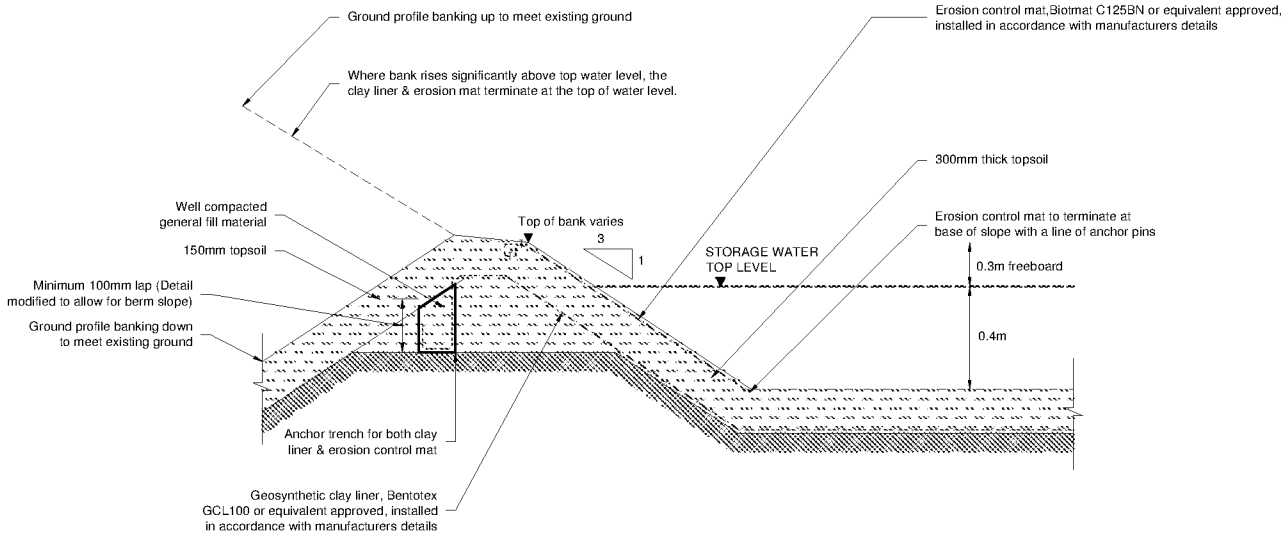
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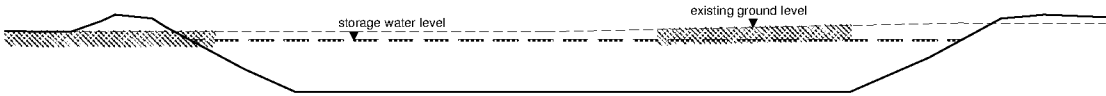
**Proposed Pond Sections**

|             |           |            |         |             |            |
|-------------|-----------|------------|---------|-------------|------------|
| DRAWN BY    | DATE MADE | SCALE @ AT | CHECKED | SUITABILITY | OR PROJECT |
| MW          | 01/19     | As shown   | CRH     | S2          | 13062      |
| PROJECT No. | ISSUER    | AREA       | LEVEL   | TYPE        | ROLE       |
| 13062       | CRH       | ZZ         | XX      | DR          | C          |
| 5203        | P1        |            |         |             |            |

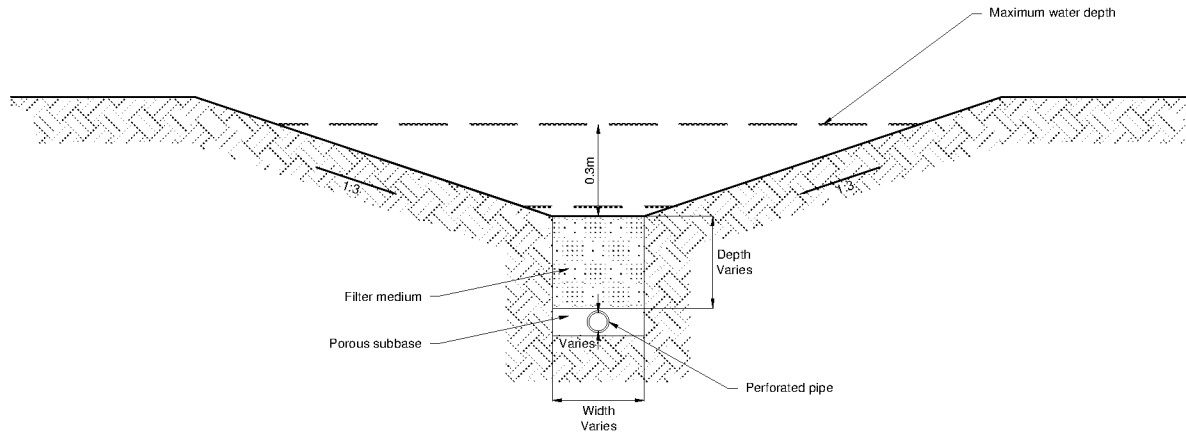


Clay liner & erosion mat  
detail - basin  
Scale Horiz. 1:50  
Vert. 1:25

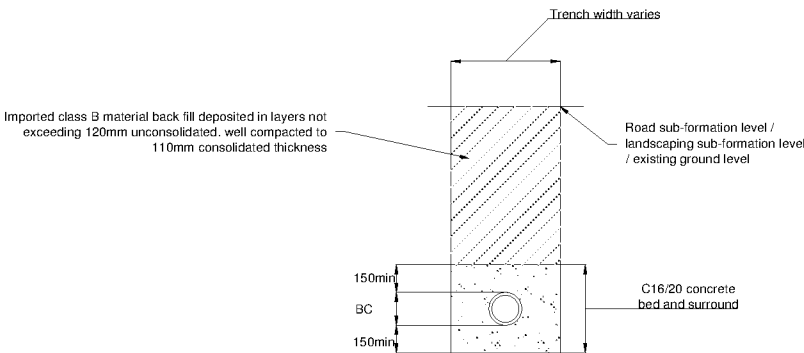
Typical basin detail



Typical Section - Basin  
Scale Horiz. 1:100  
Vert. 1:50



Typical enhanced swale detail



NOTE:  
To all pipes with cover from finished surface to crown less than or equal to 900mm in trafficked areas or less than 600mm cover in landscaped areas or under buildings.

Typical pipe surround detail

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**Drainage Details**  
**Sheet 2 of 2**

|             |           |            |       |         |             |            |
|-------------|-----------|------------|-------|---------|-------------|------------|
| DRAWN BY    | DATE MADE | SCALE @ A1 | C1    | CHECKED | SUITABILITY | OR PROJECT |
| GK          | 01/19     | NTS        | CRH   | S2      | 13062       |            |
| PROJECT No. | ISSUER    | AREA       | LEVEL | TYPE    | ROLE        | NUMBER     |
| 13062       | CRH       | ZZ         | XX    | DR      | C           | 5211       |



Calculated by: Jacques Calitz  
Site name: Crematorium  
Site location: Yapton

Site coordinates  
Latitude: 50.80631° N  
Longitude: 0.60901° W

This is an estimation of the storage volume requirements that are needed to meet normal best practice criteria in line with Environment Agency guidance "Preliminary rainfall runoff management for developments", W5-074/A/TR1/1 rev. E (2012) and the SuDS Manual, C753 (Ciria, 2015). It is not to be used for detailed design of drainage systems. It is recommended that hydraulic modelling software is used to calculate volume requirements and design details before finalising the drainage scheme.

Reference: 6495859  
Date: 2018-12-20T16:03:38

|             |       |
|-------------|-------|
| Methodology | IH124 |
|-------------|-------|

## Site characteristics

|                                                              |      |
|--------------------------------------------------------------|------|
| Total site area (ha)                                         | 2.5  |
| Significant public open space (ha)                           | 1.78 |
| Area positively drained (ha)                                 | 0.72 |
| Pervious area contribution (%)                               | 0    |
| Impermeable area (ha)                                        | 0.72 |
| Percentage of drained area that is impermeable (%)           | 100  |
| Impervious area drained via infiltration (ha)                | 0    |
| Return period for infiltration system design (year)          | 10   |
| Impervious area drained to rainwater harvesting systems (ha) | 0    |
| Return period for rainwater harvesting system design (year)  | 10   |
| Compliance factor for rainwater harvesting system design (%) | 66   |
| Net site area for storage volume design (ha)                 | 0.72 |
| Net impermeable area for storage volume design (ha)          | 0.72 |

\* Where rainwater harvesting or infiltration has been used for managing surface water runoff such that the effective impermeable area is less than 50 % of the 'area positively drained', the 'net site area' and the estimates of Qbar and other flow rates will have been reduced accordingly.

## Design criteria

| Volume control approach          | Flow control to max of 2 l/s/ha or |        |
|----------------------------------|------------------------------------|--------|
|                                  | Default                            | Edited |
| Climate change allowance factor  | 1.4                                | 1.4    |
| Urban creep allowance factor     | 1                                  | 1      |
| Interception rainfall depth (mm) | 5                                  | 5      |
| Minimum flow rate (l/s)          | 2                                  | 2      |
| Qbar estimation method           | Specify Qbar manually              |        |
| SPR estimation method            | Calculate from SOIL type           |        |
|                                  | Default                            | Edited |
| Qbar total site area (l/s)       | 7.4                                | 2      |
| SOIL type                        | 3                                  | 3      |
| HOST class                       | N/A                                | N/A    |
| SPR                              | 0.37                               | 0.37   |

## Hydrology

|                               | Default | Edited |
|-------------------------------|---------|--------|
| SAAR (mm)                     | 718     | 718    |
| M5-60 Rainfall Depth (mm)     | 17      | 17     |
| 'r' Ratio M5-60/M5-2 day      | 0.4     | 0.4    |
| Rainfall 100 yrs 6 hrs        | 55      |        |
| Rainfall 100 yrs 12 hrs       | 74.97   |        |
| FEH/FSR conversion factor     | 1.19    | 1.19   |
| Hydrological region           | 7       |        |
| Growth curve factor: 1 year   | 0.85    | 0.85   |
| Growth curve factor: 10 year  | 1.62    | 1.62   |
| Growth curve factor: 30 year  | 2.3     | 2.3    |
| Growth curve factor: 100 year | 3.19    | 3.19   |

## Site discharge rates

|                            | Default | Edited |
|----------------------------|---------|--------|
| Qbar total site area (l/s) | 7.4     | 2      |
| Qbar net site area (l/s)   | 2.13    | 0.58   |
| 1 in 1 year (l/s)          | 2       | 2      |
| 1 in 30 years (l/s)        | 2.1     | 2      |
| 1 in 100 years (l/s)       | 2.1     | 2      |

## Estimated storage volumes

|                                          | Default | Edited |
|------------------------------------------|---------|--------|
| Interception storage (m³)                | 29      | 29     |
| Attenuation storage (m³)                 | 570     | 571    |
| Long term storage (m³)                   | 0       | 0      |
| Treatment storage (m³)                   | 86      | 86     |
| Total storage (excluding treatment) (m³) | 598     | 600    |

## **Appendix G: Schedule of Maintenance**

## 1.0 SCHEDULE OF MAINTENANCE

### 1.1. Brief

- 1.1.1. This schedule of maintenance has been prepared to support the surface water drainage strategy for the proposed crematorium development at Central Arun.
- 1.1.2. This document should be read alongside the Flood Risk Assessment and Drainage Strategy (Ref: AHah13062-191218-CentralArunCrematoriumFRA-D1).

### 1.2. Introduction

- 1.2.1. The maintenance of SuDS features is vital ensuring that they work as efficiently as they set out to do. Maintenance activities can be broadly defined as:
- Regular maintenance – basic tasks carried out regularly
  - Occasional maintenance – tasks that are required periodically but on a much less frequent basis
  - Remedial maintenance – tasks required when a fault needs rectifying and often includes unforeseen events
- 1.2.2. This section highlights indicative maintenance requirements of the proposed SuDS features that should be considered in the masterplan. This section will be subject to review following detailed design.

### 1.3. Filter Drains

#### *Construction*

- 1.3.1. During construction it is important to prevent muddy water from flowing into the system. Where possible, construction should be undertaken during dry periods. The filter drains should be constructed with adequate fall to ensure the area drains efficiently. During construction the contractor must ensure the designed width and depth are correct and the geotextile has the specified porosity.

#### *Maintenance Schedule*

- 1.3.2. Table 1 below shows the operation and maintenance requirements for filter drains, taken from the CIRIA C753 SuDS Manual.

*Table 1: Operation and maintenance requirements for filter drains (CIRIA C753, 2015)*

| Maintenance Schedule       | Required Action                                                                                                                        | Typical Frequency        |
|----------------------------|----------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| <b>Regular maintenance</b> | Remove litter (including leaf litter) and debris from filter drain surface, access chambers and pre-treatment devices                  | Monthly (or as required) |
|                            | Inspect filter drain surface, inlet/outlet pipework and control systems for blockages, clogging, standing water and structural damage. | Monthly                  |

|                               |                                                                                                                                                 |                             |
|-------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|
|                               | Inspect pre-treatment systems, inlets and perforated pipework for silt accumulation, and establish appropriate silt removal frequencies         | Six monthly                 |
|                               | Remove sediment from pre-treatment devices                                                                                                      | Six monthly, or as required |
| <b>Occasional maintenance</b> | Remove or control tree roots when they are encroaching the sides of the filter drain, using recommended methods (eg NJUG, 2007 or BS 3998:2010) | As required                 |
|                               | Clear perforate pipework or blockages                                                                                                           | As required                 |

#### 1.4. Swales

##### *Construction*

- 1.4.1. Construction vehicles and equipment not directly involved in the construction of the rills and swales should be kept away from these areas. Excavations for the swales should aim to be undertaken in times of dry weather, when possible, to prevent mobilisation of sediments from exposed surfaces. Exposed surfaces after rill or swale excavations should be stabilised as soon as possible with grass seed and straw mulch. Perimeter controls should be installed prior to construction to protect watercourses.

##### *Maintenance Schedule*

- 1.4.2. Table 2 below shows the operation and maintenance requirements for the swale, taken from the CIRIA C753 SuDS Manual.

*Table 2: Operation and maintenance requirements for swales (CIRIA C753, 2015)*

| Maintenance Schedule       | Required Action                                                                      | Typical Frequency                                             |
|----------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------|
| <b>Regular maintenance</b> | Remove litter and debris                                                             | Monthly, or as required                                       |
|                            | Cut grass - to retain grass height within specified design range                     | Monthly (during growing season), or as required               |
|                            | Manage other vegetation and remove nuisance plants                                   | Monthly at start, then as required                            |
|                            | Inspect inlets, outlets and overflows for blockages, and clear if required           | Monthly                                                       |
|                            | Inspect vegetation coverage                                                          | Monthly for 6 months, quarterly for 2 years, then half yearly |
|                            | Inspect inlets for silt accumulation, establish appropriate silt removal frequencies | Half yearly                                                   |
|                            | Inspect check dams for blockages and failure.                                        | Half yearly                                                   |

|                               |                                                                                                  |                                                                                     |
|-------------------------------|--------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| <b>Occasional maintenance</b> | Reseed areas of poor vegetation growth, alter plant types to better suit conditions, if required | As required or if bare soil is exposed over 10% or more of the swale treatment area |
| <b>Remedial actions</b>       | Repair erosion or other damage by re-turfing or reseed                                           | As required                                                                         |
|                               | Relevel uneven surfaces and reinstate design levels                                              | As required                                                                         |
|                               | Remove and dispose of oils or petrol residues using safe standard practices                      | As required                                                                         |

## 1.5. Detention Basins

### *Construction*

- 1.5.1. Construction vehicles and equipment not directly involved in the construction of the detention basin will be kept away from these areas. Silt fences, staged excavation works and temporary drainage swales/bunds to divert runoff away from exposed areas will be utilised, as appropriate, to manage the risks associated with, and to intercept the discharge of, sediment laden runoff prior to its discharge to nearby watercourses. Excavations for the detention basin should aim to be undertaken in times of dry weather when possible, to prevent mobilisation of sediments, during rainfall events. Surfaces exposed as part of the detention basin construction should be stabilised as soon as possible, by the use of hydroseeding or an alternative approved approach. Perimeter controls should be installed prior to construction to protect watercourses. Perimeter controls should be installed prior to construction to protect watercourses.

### *Maintenance Schedule*

- 1.5.2. Table 3 shows the operation and maintenance requirements for the detention basins, taken from the CIRIA C753 SuDS Manual.

*Table 3: Operation and maintenance requirements for detention basins (CIRIA C753, 2015)*

| Maintenance Schedule       | Required Action                                                                                               | Typical frequency                                       |
|----------------------------|---------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|
| <b>Regular maintenance</b> | Remove litter and debris                                                                                      | Monthly (or as required)                                |
|                            | Cut the grass - public areas                                                                                  | Monthly (during growing season)                         |
|                            | Cut the meadow grass                                                                                          | Half yearly (spring, before nesting season, and autumn) |
|                            | Inspect marginal and bankside vegetation and remove nuisance plants (for first 3 years)                       | Monthly (at start, then as required)                    |
|                            | Inspect inlets, outlets, banksides, structures, pipework etc. for evidence of blockage and/or physical damage | Monthly                                                 |

|                               |                                                                                                                                                                                                                  |                                                                                         |
|-------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
|                               | Inspect silt accumulation rates in the detention basin and establish appropriate removal frequencies; undertake contamination testing once some build-up has occurred, to inform management and disposal options | Half yearly                                                                             |
|                               | Check any mechanical devices, e.g. penstocks                                                                                                                                                                     | Half yearly                                                                             |
|                               | Tidy all dead growth (scrub clearance) before start of growing season (Note: tree maintenance is usually part of overall landscape management contract)                                                          | Annually                                                                                |
|                               | Remove sediment from any forebay.                                                                                                                                                                                | Every 1-5 years, or as required                                                         |
|                               | Remove sediment and planting from one quadrant of the main body of detention basins without sediment forebays.                                                                                                   | Every 5 years, or as required                                                           |
| <b>Occasional maintenance</b> | Remove sediment from the main body of big detention basins when pool volume is reduced by 20%                                                                                                                    | With effective pre-treatment, this will only be required rarely, e.g. every 25-50 years |
| <b>Remedial actions</b>       | Repair erosion or other damage                                                                                                                                                                                   | As required                                                                             |
|                               | Replant, where necessary                                                                                                                                                                                         | As required                                                                             |
|                               | Aerate detention basin when signs of eutrophication are detected                                                                                                                                                 | As required                                                                             |
|                               | Realign rip-rap or repair other damage                                                                                                                                                                           | As required                                                                             |
|                               | Repair/rehabilitate inlets, outlets and overflows.                                                                                                                                                               | As required                                                                             |

## 1.6. Proprietary Treatment Systems

- 1.6.1. The proprietary treatment systems include conventional pipework, gullies, catchpits, manholes, channels and headwalls.

### *Construction*

- 1.6.2. During construction the principal contractor must ensure that preventative measures have been put in place as to not allow the construction runoff drain into the system. Measures must be taken to ensure debris from the construction site does not block the components. Routine inspections should be undertaken ensuring that the drainage is functioning properly. Outfalls must be constructed to the correct level and all joints must be correctly sealed. During construction backfill should be correctly installed as specified as per the manufactures' recommendations.

### *Maintenance Schedule*

- 1.6.3. The maintenance schedule for the aforementioned SuDS has been adopted from the SuDS Manual C753 and are summarised in Table 4.

*Table 4: Maintenance and Operation of Proprietary Treatment Systems (QRIA C753, 2015)*

| Maintenance Schedule       | Required Action          | Typical Frequency        |
|----------------------------|--------------------------|--------------------------|
| <b>Regular maintenance</b> | Remove litter and debris | Monthly (or as required) |

|                               |                                 |                         |
|-------------------------------|---------------------------------|-------------------------|
|                               | Monitoring                      | Inspect monthly         |
| <b>Occasional maintenance</b> | Sediment management             | Annually or as required |
| <b>Remedial maintenance</b>   | Structure rehabilitation/repair | As required             |

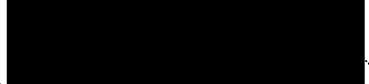
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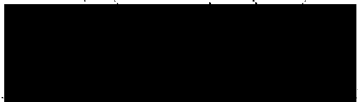
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