

Land East of Drove Lane, Yapton

Drainage Strategy and Maintenance Statement

Planning application reference: Y/92/17/OUT

For



Project Number:

13024

October 2018

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Document History and Status

Revision	Date	Purpose/Status	File Ref	Author	Check	Review
D1	18.10.18	For Review	AHah13024-181018-YaptonDrainageStatement-D1.docx	AH	BS	DS
F1	18.10.18	For Planning	See below	AH	BS	DS

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Document Details

Last saved	18/10/2018 17:49
Path	AHah13024-181018-YaptonDrainageStatement-F1.docx
Author	A.Hoy
Project Partner	D.Smith
Project Number	13024
Project Name	Land east of Drove Lane, Yapton

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1.0 INTRODUCTION

1.1 Brief

- 1.1.1. CampbellReith has been appointed by Landlink Estates (the Applicant) to prepare a Drainage Strategy and Maintenance Statement for the land east of Drove Lane, Yapton, BN18 0EB, herein referred to as the 'site'. The national grid reference for the site is 497396E and 103244N. The site boundary is shown in Figure 1.1 below.
- 1.1.2. The outline planning application (Ref: Y/92/17/OUT) is seeking permission with all matters reserved, for up to 300 dwellings, link road, surface drainage, open space and landscaping. The proposed masterplan is contained in Appendix A.
- 1.1.3. This report should be read alongside the submitted Flood Risk Assessment (FRA) and initial drainage strategy prepared by Odyssey (Ref: 14-111-Land South of B2233 Main Road, Yapton November 2017).
- 1.1.4. The site lies adjacent to the 'Gleeson site' (Ref: Y/91/17/OUT) located to the east where a FRA and drainage strategy for residential development was prepared to support the planning application. The supporting ground and groundwater investigation submitted as part of that application has been reviewed to inform this report.

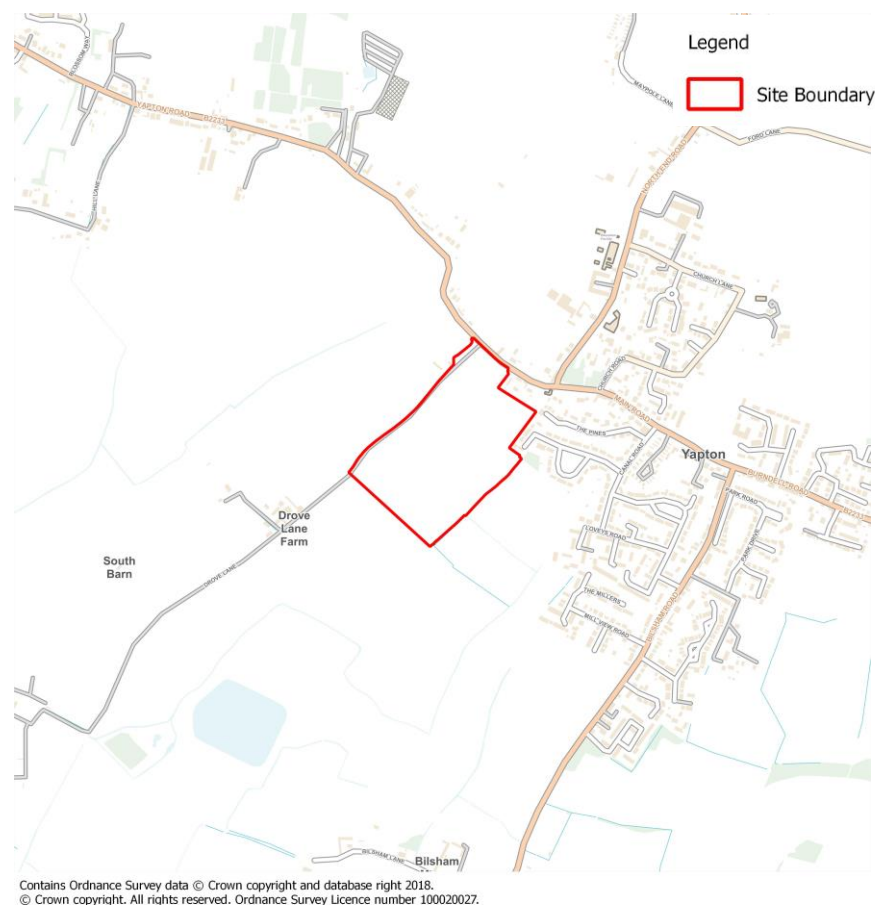


Figure 1.1: Site Boundary

2.0 DESIGN CRITERIA

2.1. Surface Water Drainage

2.1.1. The surface water drainage system has been designed in accordance with the National Planning Policy Framework (NPPF, 2018) and the accompanying Guidance and Technical Standards for SuDS (DEFRA, 2015). It also complies with the requirements under Building Regulations Part H.

2.1.2. In accordance with CIRIA SuDS Manual 2015 (Report C753), NPPF and Building Regulations Part H the surface water drainage design follows a discharge destination hierarchy, with infiltration drainage considered as a first priority before consideration for discharge to a watercourse and as a last resort discharging to a public sewer.

2.2. Consultation

2.2.1. West Sussex County Council (WSCC) acts as the Lead Local Flood Authority (LLFA) for the area. As the LLFA, WSCC is responsible for overseeing flood risk including the management of groundwater flooding, surface water runoff and ordinary watercourses.

2.2.2. On the 11th January 2018 WSCC in its capacity as LLFA was consulted on the initial drainage strategy designed by Odyssey. The LLFA noted in its comments that the surface water drainage strategy should consider the following:

- Maintain the existing surface water flow paths
- Risk of high groundwater and possible groundwater flooding
- Winter groundwater monitoring to determine the feasibility of infiltration drainage

2.2.3. CampbellReith engaged with Arun District Council (ADC) who are acting as agent to the LLFA (in addition to its role as Local Planning Authority) and a meeting was held on 15th August 2018.

2.2.4. The meeting was to review the initial drainage strategy, taking account of comments received as part of the planning application consultation and establish the requirements for both the LLFA and engineer at ADC.

2.2.5. Following correspondence with ADC, the Council confirmed the joint position of the LLFA and ADC, which relaxed a previously stated requirement for a 1m buffer between the top groundwater level and the base of any infiltration systems. This was confirmed by email on 17th September 2018.

2.2.6. CampbellReith submitted an updated drainage strategy for the site on [9 October]. On 10 October 2018, ADC confirmed in principle the proposed surface water drainage strategy and approach for future groundwater monitoring and testing. Correspondence between CampbellReith and ADC is contained in Appendix B.

3.0 GROUND CONDITIONS

3.1. Overview

3.1.1. Baseline information for the site has been discussed in the Odyssey FRA. Following comments from ADC, this section discusses the geology and hydrogeology of the site in detail in order to determine the feasibility of infiltration drainage and groundwater flood risk to the site.

3.1.2. The following reports have been reviewed to inform this section:

- *Odyssey (June 2018) Land West of B2132 Bilsham Road, Yapton – Flood risk and Drainage Strategy Addendum (Ref: 14-111).*
- *Odyssey (November 2017) Land South of B2233 Main Road, Yapton. Flood Risk Assessment and Drainage Strategy (Ref: 14-111).*
- *BRD Environmental Limited (September 2017) Ground Investigation Report. (Ref: BRD2934-0D1)*
- *BRD Environmental Limited (October 2017) Land at Bilsham Road, Yapton Groundwater Monitoring Records. (Ref: BRD2693).*

3.2. Geology

3.2.1. The BGS Online Geology Viewer notes that the underlain bedrock for the site as Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation, Culver Chalk Formation and Portadown Chalk Formation. Superficial deposits for the site have been mapped comprising river terrace deposits – sand, silt and clay.

3.2.2. The BRD soil report notes that there was a historical canal along the northern boundary which is evident by the ground level difference between WS01 and WS06.

3.2.3. Ground investigations undertaken by BRD in September/October 2017 confirm the expected geology of the site. Made ground was recorded to the north east of the site associated with the alignment of the former canal.

3.3. Surface Water Flow Paths

3.3.1. A review of the topographical data for the site suggests that the surface water overland flow routes head towards the south western corner of the site boundary, as shown in Figure 3.1. The drainage strategy seeks to maintain these existing flow paths and discharge at restricted greenfield runoff rates. The proposed development plans do not seek to significantly alter the existing levels of the site.

3.3.2. A detailed surface water flow path figure (ref: 13024-CRH-Z1-SK-00-C-5050-P1) is contained in Appendix C.



Figure 3.1: Existing surface water flow paths

3.4. Groundwater Monitoring

- 3.4.1. Groundwater monitoring was undertaken for the site by BRD Environmental in September and October 2017. Although the results provided an indication of the existing groundwater levels (Ref: 13024-CRH-Z1-SK-00-5051 in Appendix D) the monitoring did not give an accurate representation of the critical groundwater levels as the monitoring did not take place during the representative winter period.
- 3.4.2. Borehole investigations were undertaken on either side of the embankment along the former canal alignment. Test results demonstrated groundwater within the boreholes on the northern side of the embankment, with boreholes on the southern section remaining dry. The results demonstrated no hydraulic connectivity between the former canal side and the southern part of the site. Consequently boreholes WS01 and WS02 have been discounted from the review.
- 3.4.3. In the absence of winter groundwater monitoring for the site, the results from the adjacent Gleeson site have been referred to owing to the expected hydraulic connectivity between the two sites. The correlation between the groundwater levels across the two sites is shown on drawing 13024-CRH-Z1-SK-00-5051-P1 included in Appendix D.
- 3.4.4. Review of the data indicates that on average groundwater levels rose by approximately 2.1m over the winter months compared to the October 2017 monitoring data.
- 3.4.5. Extrapolating the anticipated rise in groundwater levels indicated that at their highest, winter groundwater levels on the site would be within 0.5m below ground level in the south western corner.
- 3.4.6. It is anticipated that although groundwater will rise during the winter months, the water level is unlikely to reach the surface. No historical groundwater flood events have been recorded for the site or the surrounding area.

- 3.4.7. Further groundwater monitoring is programmed for the 2018/2019 winter period in order to inform the detailed design. Proposed borehole locations as agreed with ADC are illustrated on Proposed Groundwater Monitoring BH Locations drawing (ref: 13024-CRH-Z1-SK-00-5055-P1) presented in Appendix D.

3.5. **Infiltration Testing**

- 3.5.1. Infiltration testing was carried out for the site by BRD Environmental during September 2017 and October 2017. The infiltration rates for the site are illustrated in the figure (ref: 13024-CRH-Z1-SK-00-C-5052-P1) contained within Appendix D. The results concluded that the northern area of the site had favourable critical infiltration rates of 9.4×10^{-6} m/s whilst the southern area had a critical infiltration rate of 2.9×10^{-6} m/s.
- 3.5.2. Whilst the infiltration testing was undertaken at average depths of 2.2m, the borehole logs indicate variance in the geology strata. From discussions held with ADC, it was agreed that the recorded infiltration rates could be used for preliminary calculations albeit further testing would be required at the relevant depth to support the detailed design.
- 3.5.3. For the purpose of the preliminary design the worst-case infiltration rate for the northern and southern parts of the site has been considered.

4.0 SURFACE WATER DRAINAGE STRATEGY

4.1. Existing Runoff Rates

- 4.1.1. The greenfield runoff rates are outlined in Table 4.1, the calculations are contained in Appendix E.

Table 4.1: Greenfield runoff rates for all storm events

Storm Event	Greenfield Runoff Rate (litres/second/hectare)
Qbar	3.1
1 in 1 year	2.6
1 in 30 year	7.1
1 in 100 year	9.8

4.2. Drainage Constraints

- 4.2.1. The following site constraints have been considered during the design of the surface water drainage strategy:

- Existing surface water flow paths should be maintained;
- High likelihood of shallow groundwater in the south western corner of site;
- Further winter groundwater monitoring required;
- 5m buffer required between the discharge infiltration systems and any structure. A soakaway viability figure is contained in Appendix E (ref: 13024-CRH-Z1-SK-00-C-5053-P1);
- Risk of groundwater contamination;
- Permeable paving is not suitable for Adopted Highways following correspondence with WSCC Highways (see Appendix B);
- Highways adoption criteria requires a separate surface water sewer system to drain private residential (non-highway) runoff; and
- Southern Water will not adopt any sewer which is within 5m of any surface water retaining or conveying component including soakaways, swales, ponds and watercourses.

4.3. Surface Water Management

- 4.3.1. The surface water drainage strategy aims to control runoff from impermeable areas at source and attenuate through SuDS features. Infiltration drainage has been considered as a primary method for surface water management following discussions with the ADC, acting on behalf of the LLFA.
- 4.3.2. The following SuDS features have been considered within the strategy:
- Permeable paving for all driveway, parking spaces and secondary access roads
 - Soakaways for housing blocks have been specified where appropriate

- Detention basins provided along the southern and western boundaries of the site for runoff which cannot be stored by the permeable paving and soakaways. .
- 4.3.3. The following assumptions have been made when calculating the required attenuation and size of infiltration drainage features:
- The greenfield runoff rate for the site has been calculated at 3.1 l/s/ha based on the geology of the site;
 - The masterplan indicates a proposed developable area of 8.3ha which with an assumed 60% impermeable area would yield 4.98ha generating runoff;
 - Preliminary calculations have been used for the worst case infiltration rates of 9.4×10^{-6} m/s for the northern part of the site and 2.9×10^{-6} m/s for the southern part of the site;
 - The SuDS features have been designed for both the critical 1 in 10 and 1 in 100 (including 40% climate change) storm event;
 - Permeable paving for the roads and parking storage was estimated using a 0.45m deep base with a void ratio of 30%;
 - The widths of the roads for storage were assumed to be 3.5m, allowing for a minimum 1.2m service corridor;
 - The width of the proposed soakaways were assumed as 0.6m;
 - The detention basins were assumed to provide a maximum 0.4m depth of storage volume, taking account of potential groundwater levels.
- 4.3.4. Assuming no infiltration for the site, with a maximum discharge rate set at Q_{bar} , the required storage volume would be approximately 5,700m³ allowing for 40% climate change and 10% urban creep element for future extensions.
- 4.3.5. The proposed drainage components adopt infiltration based systems with no impermeable lining. The permeable drainage systems can cater for the 1 in 10 year storm and will require storage within the detention basins for the higher intensity/duration rainfall events. Based on the worst-case infiltration rates the northern part of the site can accommodate and provide storage for most of the 1 in 100 year storm event including climate change. The southern part of the site requires additional storage to cater for higher storms. It is anticipated that the northern basins will primarily be dry and only be triggered for extreme events. The drainage strategy seeks to provide a high level overflow set at greenfield runoff rate to maximise retention and infiltration on site.
- 4.3.6. The infiltration systems have been designed using the BRE 365 method up to the 1 in 100 year storm event including climate change allowance. An allowance has been made for 10% urban creep and a factor safety of 2 has been applied to the infiltration rate to reflect the potential variation over winter testing.
- 4.3.7. The proposed shallow systems may require additional protection within the traffic areas in the form of concrete surround for the pipes and/or use of high strength plastic pipes to compensate for the lack of depth of cover and the use of proprietary cellular systems which require minimum cover and capability to withstand vehicular loading. There is no proposal to raise the levels of the site to provide cover.

- 4.3.8. Taking account of potential high groundwater towards the south western corner of the site, the detention basins are intended to be shallow systems up to 0.4m deep and unlined. To provide additional freeboard, there may be requirement on the downstream end of the basins to introduce earth berms (approximately 600mm high subject to detail design). Allowance has been made within the proposed permeable paving areas for a service strip for routing of the different utility services including the foul sewer network.
- 4.3.9. If infiltration is not possible the proposed detention basins are able to accommodate the runoff up to the 1 in 100 year storm + climate change allowance.
- 4.3.10. The surface water drainage strategy (ref: CRH13024-CRH-Z1-SK-00-5054-P1) and accompanying calculations are contained in Appendix E.

4.4. **Surface Water Quality**

- 4.4.1. The SuDS components within the surface water drainage strategy have been designed in accordance with the guidance set-out in the SuDS Manual.
- 4.4.2. 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.
- 4.4.3. 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 4.2: CIRIA Pollution hazard indices for different land use classifications

Land Use	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydro-carbons
Residential Roofs	Very Low	0.2	0.2	0.05
Commercial/Industrial Roofs	Low	0.3	0.2	0.05
Individual property driveways, residential car parks, low traffic roads, car parks with infrequent change	Low	0.5	0.4	0.4

- 4.4.4. As previously mentioned ADC has confirmed relaxation of the previously required 1-metre buffer between the base of the proposed infiltration systems and top of groundwater level.
- 4.4.5. Table 26.4 of the SuDS manual highlights the indicative SuDS mitigation indices for discharges to groundwater. Permeable paving, soakaways and detention basins provide adequate treatment to the low to very low pollution end use to surface water runoff before being discharged to the ground.
- 4.4.6. Table 4.3 provides the indicative SuDS mitigation indices for discharges to surface waters (taken from Table 26.3 of the SuDS manual).

Table 4.3: CIRIA Indicative SuDS Mitigation Indices for Discharge to Surface Waters

Type of SuDS Component	Total Suspended Solids (TSS)	Mitigation Indices	
		Metals	Hydro-carbons
Filter Strip	0.4	0.4	0.5
Filter Drain	0.4	0.4	0.4
Swale	0.5	0.6	0.6
Bio-retention System	0.8	0.8	0.8
Permeable Pavement	0.7	0.6	0.7
Detention Basin	0.5	0.5	0.6

- 4.4.7. The provision of any of the proposed individual drainage components, either the permeable paving or the detention basins would provide sufficient mitigation potential prior to discharge into any body of water.
- 4.4.8. The inclusion of SuDS within the drainage strategy effectively addresses the requirements under the Water Framework Directive.

5.0 SCHEDULE OF MAINTENANCE

5.1. Introduction

5.1.1. 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; and
- Remedial maintenance – tasks required when a fault needs rectifying and often includes unforeseen events.

5.1.2. The proposed drainage system is to remain private and maintained by a third party management company to be set up post-construction.

5.1.3. Maintenance requirements for each SuDS feature has been outlined below.

5.2. Permeable Paving

Construction

5.2.1. Construction vehicles and equipment not directly involved in the construction of the pervious pavements 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. Landscaping activities will be carefully designed and carried out to prevent deposition of topsoil, turf and other materials on the surface of the pavement. Infiltration surfaces will not be compacted and will be protected at all times. Excavations for the pervious pavement installation should aim to be undertaken in times of dry weather, when possible, to prevent mobilisation of sediments from exposed surfaces during rainfall events. Surfaces exposed as part of the pervious paving installation works should be stabilised as soon as possible. Perimeter controls should be installed prior to construction to protect watercourses.

Maintenance Schedule

5.2.2. Table 5.1 shows the operation and maintenance requirements for the pervious pavements which are in accordance with the CIRIA C753 SuDS Manual.

Table 5.1: Operation and maintenance requirements for pervious pavements (CIRIA C753, 2015)

Maintenance Schedule	Required Action	Typical Frequency
Regular maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations - pay particular attention to areas where water runs onto pervious surfaces from adjacent impervious areas as these areas are most likely to collect the most sediment

Occasional maintenance	Stabilise and mow contributing and adjacent areas	As required
	Removal of weeds or management using Glyphosate applied directly onto the weeds by an applicator rather than spraying	As required - once per year on less frequently used pavements
Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50 mm of the level of the paving	As required
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material	As required
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
Monitoring	Initial inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth - if required, take remedial action	Three-monthly, 48 hrs after large storms in first six months
	Assess silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

5.3. Soakaways

Construction

- 5.3.1. Construction vehicles and equipment not directly involved in the construction of the soakaways will be kept away from these areas. The construction activities should not clog the infiltration system or compact the underlying soils. 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 from discharging into the soakaway.
- 5.3.2. Excavations for the pervious pavement installation should aim to be undertaken in times of dry weather, when possible, to prevent mobilisation of sediments from exposed surfaces during rainfall events.

Maintenance Schedule

- 5.3.3. Table 5.2 shows the operation and maintenance requirements for the detention basins, taken from the CIRIA C753 SuDS Manual.

Table 5.2: Operation and maintenance requirements for soakaways

Maintenance Schedule	Required Action	Typical frequency
Regular maintenance	Inspect for sediment and debris in pre-treatment components and floor of inspection tube or chamber and inside of concrete manhole rings	Annually
	Cleaning of gutters and filters on downpipes	Annually (or as required based on inspections)
	Trimming any roots that may be causing blockages	Annually (or as required)
Occasional Maintenance	Remove sediment and debris from pre-treatment components and floor of inspection tube or chamber and inside of concrete manhole rings	As required, based on inspections
Remedial Action	Reconstruct soakaway and/ or replace or clean void fill, if performance deteriorates or failure occurs	As required
	Replacement of clogged geotextile (will require reconstruction of soakaway)	As required
Monitoring	Inspect silt traps and note rate of sediment accumulation	Monthly in the first year and then annually
	Check soakaway to ensure emptying is occurring	Annually

5.4. Detention Basins

Construction

- 5.5. 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

- 5.5.1. Table 5.3 shows the operation and maintenance requirements for the detention basins, taken from the CIRIA C753 SuDS Manual.

Table 5.3: Operation and maintenance requirements for detention basins (CIRIA C753, 2015)

Maintenance Schedule	Required Action	Typical frequency
Regular maintenance	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
Occasional maintenance	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
Remedial actions	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

5.6. Proprietary Treatment Systems

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

Construction

- 5.6.2. 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

- 5.6.3. The maintenance schedule for the aforementioned SuDS has been adopted from the SuDS Manual C753 and are summarised in Table 5.4.

Table 5.4: Maintenance and Operation of Proprietary Treatment Systems (CIRIA C753, 2015)

Maintenance Schedule	Required Action	Typical Frequency
Regular maintenance	Remove litter and debris	Monthly (or as required)
	Monitoring	Inspect monthly
Occasional maintenance	Sediment management	Annually or as required
Remedial maintenance	Structure rehabilitation/repair	As required

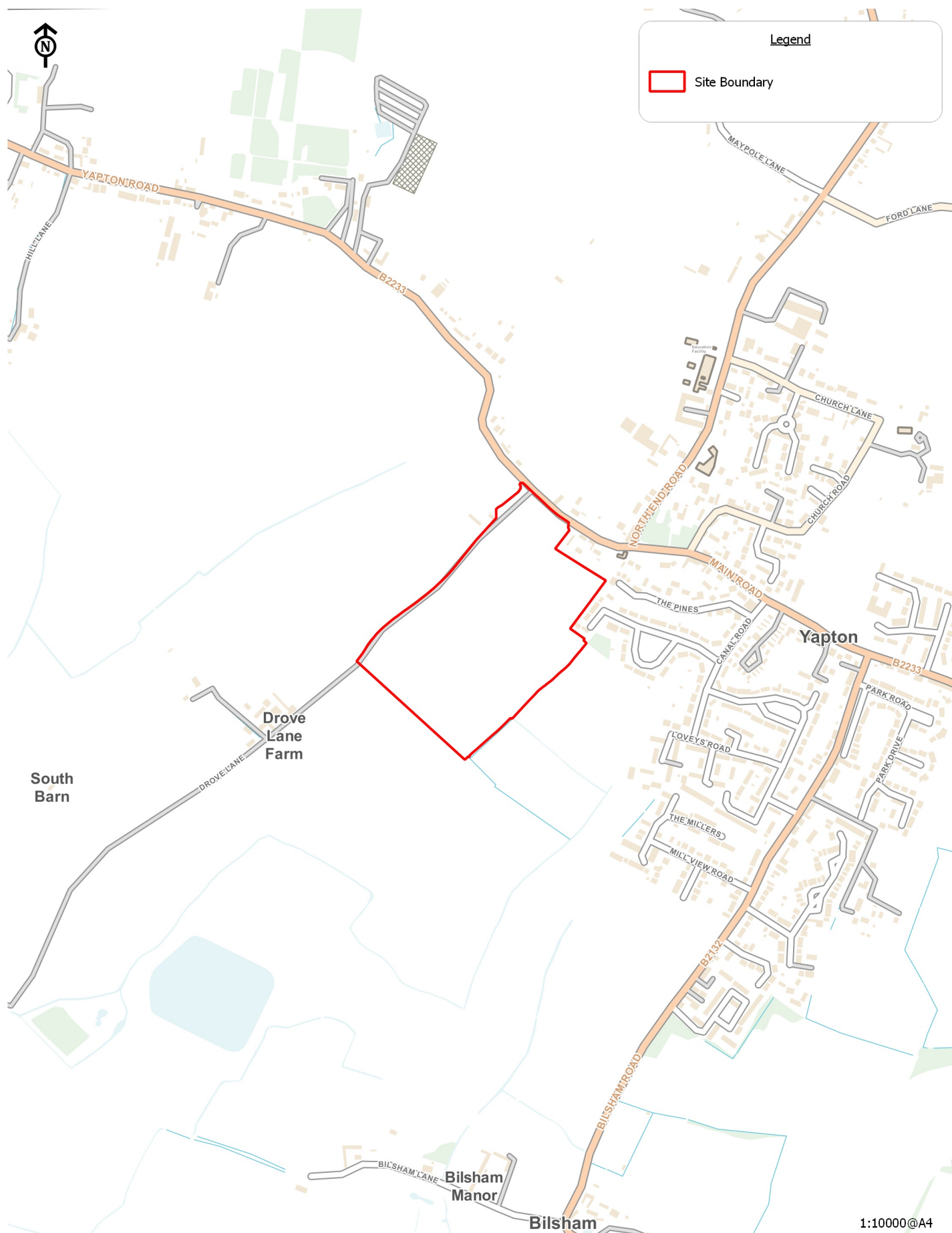
6.0 NEXT STEPS

- 6.1. The locations of the proposed boreholes for winter and groundwater monitoring have been agreed with ADC.
- 6.2. At the time of preparing this report the winter groundwater monitoring was being programmed.
- 6.3. Subject to groundwater levels over the winter period, infiltration testing will be undertaken at depths to be agreed with ADC.
- 6.4. The results of the winter monitoring and testing will be used to further develop and finalise the drainage strategy post-planning.

7.0 CONCLUSIONS

- 7.1. CampbellReith has prepared this Drainage Strategy and Maintenance Statement to support the outline planning permission with all matters reserved, for up to 300 dwellings, link road, surface drainage, open spacing and landscaping (Ref: Y/92/17/OUT). This report should be read alongside the approved Flood Risk Assessment and initial drainage strategy prepared by Odyssey (Ref: 14-111-Land South of B2233 Main Road, Yapton).
- 7.2. CampbellReith has consulted with Arun District Council (ADC) to discuss and confirm the feasibility of shallow infiltration drainage across the site. The proposed drainage strategy is subject to future winter groundwater monitoring and testing.
- 7.3. In the absence of previous winter monitoring, winter groundwater monitoring results from the adjacent Gleeson site have been interpolated to estimate the critical groundwater levels for the site. The data suggests a difference in summer and winter groundwater levels as being 2.1m with potential shallow groundwater water level of 0.5m bgl in the south western corner of the site.
- 7.4. Infiltration testing across the site recorded critical infiltration rates of 9.4×10^{-6} m/s in the northern area and 2.9×10^{-6} m/s in the southern area. The split in rates is delineated by the proposed landscape buffer across the site.
- 7.5. The surface water drainage system has been designed in accordance with the National Planning Policy Framework (NPPF) and the accompanying Guidance and Technical Standards for SuDS. It also complies with the requirements under Building Regulations Part H.
- 7.6. The surface water drainage strategy aims to control runoff from impermeable areas at source and attenuate through SuDS features. Infiltration drainage has been considered as a primary method for surface water management following discussions with the ADC, acting on behalf of the LLFA.
- 7.7. Permeable paving is proposed for all driveways, parking spaces and secondary access roads across the site. Soakaways have been specified for housing blocks where appropriate, taking into consideration a 5m buffer from each building edge. Detention basins have been proposed along the southern and western boundaries, providing storage when runoff cannot be stored in the paving and soakaways during exceedance events.
- 7.8. The maintenance of SuDS features is vital ensuring that they work as efficiently as they set out to do. The primary access road is proposed to be offered for adoption. The management of the remaining SuDS will be the responsibility of an appointed management team and a strategy has been included within this report.
- 7.9. This report has established that the use of infiltration based drainage system is viable for the site and complies with all current guidance.

Appendix A: Site Location and Proposed Masterplan



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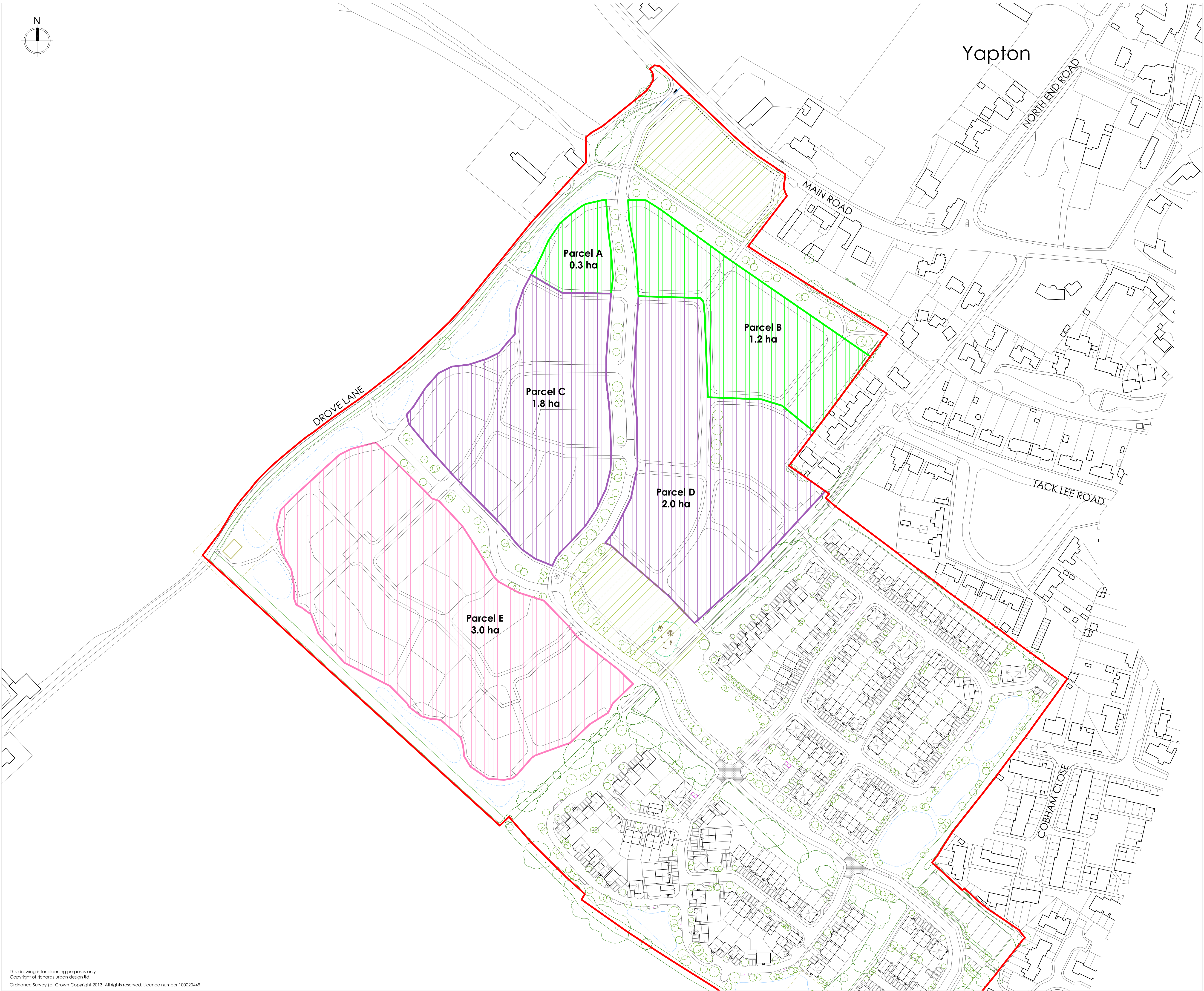
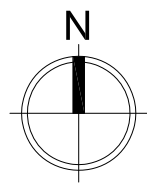
Land East of Drove Lane, Yapton
Client: Llandink Estates

Figure 1:
Site Location Plan

Scale: 1:10000@A4
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Job Number: 13024
Drawn by - Checked by: RP - AH
Drg No - Status/Revision: GIS001 - A
File location: N:/13000 - 13249/13024 R - Land East of Drove Lane Yapton/Project_Workspaces (pdf in
Date (Revision History): Outputs
ARUN DISTRICT COUNCIL Y/92/17/OUT
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Site
**LAND AT DROVE LANE,
YAPTON**

Drawing
Illustrative masterplan

Date
12.09.18

Scale
1:1250@A1

Drawing ref:
1244.03



KEY

- Site boundary
- Existing trees retained
- Existing hedgerows retained
- Proposed planting
- Potential SuDS feature (as shown in Odyssey drainage strategy)
- Potential location for pumping station + 15m offset
- Residential development (Canal Green Character Area - 30 dph)
- Residential development (Drove Park Character Area - 20 to 30 dph)
- Residential development (Drove Fields Character Area - 30 to 40 dph)
- Public open space (amenity space)

Appendix B: Consultation



RE: Y/92/17/OUT - Land east of Drove Lane Yapton BN18 0EB (Landlink Site)Laura Gibbons to:
 'BavaSathan@campbellreith.com' 10/10/2018 11:13
 Cc: "davidsmith@campbellreith.com", "Lisa Jackson"
 From: "Laura Gibbons" <Laura.Gibbons@arun.gov.uk>
 To: "'BavaSathan@campbellreith.com'" <BavaSathan@campbellreith.com>
 Cc: "davidsmith@campbellreith.com" <DavidSmith@campbellreith.com>, "Lisa Jackson" <lisa@jacksonplanning.com>
 History:

This message has been replied to and forwarded.

1 Attachment



Proposed GW and infiltration testing locations.pdf

Hi Bava,

Thank you for sending over the further information. I have had a look at the calculations and I am happy with these. The parameters you have used are acceptable, and I am therefore happy with the design concept. As stated everything will need to be looked at in more detail following the completion of the winter groundwater monitoring and infiltration testing.

Additional proposed locations for winter groundwater monitoring and infiltration testing are shown on the attached plan. As stated on the phone the depths of the infiltration tests will be dependent on the groundwater monitoring results at the respective locations. The groundwater monitoring needs to be completed October- March inclusive.

Thanks,

Laura Gibbons, MEng, GMICE
 Engineer (Drainage & Coastal)

Laura Gibbons Engineer (Drainage & Coastal), Engineering Services, Arun District Council Location: First Floor, Arun Civic Centre, Maltravers Road, Littlehampton, BN17 5LF Internal: 37818 External: +44 (0) 1903 737818 Fax: +44 (0) 1903 716018 E-mail: laura.gibbons@arun.gov.uk Arun is Working in Partnership with Chichester District Council Visit Arun's web site at http://www.arun.gov.uk/ and www.chichester.gov.uk  Save the environment - think before you print.

Sent: 09 October 2018 10:08

To: Laura Gibbons

Cc: davidsmith@campbellreith.com; Lisa Jackson

Subject: Re: Y/92/17/OUT - Land east of Drove Lane Yapton BN18 0EB (Landlink Site)

Good morning Laura,

Further to our earlier conversation, please find attached some sample calculation sheets together with the summary sheet detailing the different proposed infiltration systems.

As discussed those are based on worst case infiltration rates for the site which will be confirmed subject to the winter monitoring and testing. You will note that as well as using the BRE 365 method of calculating the infiltration systems up to the 1 in 100 years including climate change allowance, we have made allowance for urban creep for 10% and added a factor of safety of 2 to the infiltration rate to reflect potential variation over winter testing. The proposed drainage system is very robust and in any event should infiltration fail or not been suitable following additional testing, the detention basin will provide full storage and restricted at greenfield runoff overflow.

We also discussed the proposed test locations and monitoring boreholes and understand that in comparison Gleeson are proposing 17 test locations across their sites. I will review your mark up with the additional test locations and follow up on that.

I trust that the information provided enables you to confirm your agreement in principle for the drainage strategy, however do not hesitate to contact me if you have any additional queries.

Kind regards,

Bava

Bava Sathan
 Associate

Raven House,
 29 Linkfield Lane,
 Redhill, Surrey
 RH1 1SS

Tel +44 (0)1737 784500
www.campbellreith.com

From: "Lisa Jackson" <lisa@jacksonplanning.com>
 To: BavaSathan@campbellreith.com
 Cc: "Laura Gibbons" <Laura.Gibbons@arun.gov.uk>, "davidsmith@campbellreith.com" <DavidSmith@campbellreith.com>

Date: 08/10/2018 09:27
 Subject: Re: Y/92/17/OUT - Land east of Drove Lane Yapton BN18 0EB (Landlink Site)

Dear Bava
 A point of clarification please.

You suggest the northern basins are different from southern basins and you describe the northern basins as primarily dry. Does this suggest that the southern basins are not dry in the winter months? Or is simply different design solutions like the berms we discussed?

The capacity/ necessity to hold water will have a bearing on the biodiversity strategy and the open space calculations. It would be helpful to understand the differences for the meeting tomorrow.

Kind regards,
 Lisa

Lisa Jackson
 Jackson Planning Ltd
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 Andover, Hants, SP11 9DU
lisa@jacksonplanning.com
 01264 730286
 0755 400 6494

On 5 Oct 2018, at 18:20, BavaSathan@campbellreith.com wrote:

Good evening Laura,

Further to our conversation earlier in the week and exchange of correspondence between yourself and Gleeson confirming your acceptance in principle for the surface water drainage strategy for their site, as discussed please find attached the alternative drainage strategy for the site together with supporting documents.

We have undertaken a review of the existing levels and slopes across the site to identify the existing flow paths and do not propose to alter levels across the site to change those natural flow routes. Any surface water runoff from the site will find its way naturally towards the south west corner of the site as shown on Drawing 13024/5050.

We have also reviewed the groundwater level information across both the Landlink and Gleeson sites. Winter ground water monitoring was undertaken across the Gleeson site. There is a correlation between groundwater levels across the two sites as you will note from Drawing 13024/5051. The soil report for Landlink site notes that there was a historical canal along the northern boundary which is evident by the ground level difference between WS01 and WS06. Groundwater was encountered in WS01 and WS02 in October 2017 whilst WS05 and WS06 were dry. This would indicate no hydraulic conductivity between the two parcels of land and as such WS01 and WS02 have been discounted from the review (they are also located outside the proposed developable area on the masterplan).

Over the winter months there was an average of 2.1m rise in groundwater levels across the Gleeson site and it is reasonable to anticipate similar rise across the Landlink site. The estimated groundwater levels are shown for our site on Drawing 13024/5051. At its shallowest groundwater is anticipated to be approximately 500mm below ground level at the south west corner of the site

I have attached extract of the Greenfield runoff calculation sheet for the site.

We propose to introduce permeable paving for the secondary road, access driveways and parking areas and retain the proposed detention basins albeit all unlined to allow infiltration into the ground. We have indicated linear soakaways in the rear gardens with a 5m offset from the buildings. The proposed drainage strategy is shown on drawing 13024/5052.

Reviewing the ground investigation report and infiltration tests previously undertaken there is a distinctive split between the northern part of the site to the south. The demarcation appears to be the ecological strip crossing west to east of the site on the proposed masterplan. We have undertaken preliminary calculations using the worst case infiltration rates of 9.4×10^{-6} m/s for the northern part of the site and 2.9×10^{-6} m/s for the southern part of the site.

Based upon those infiltration rates the northern part of the site can accommodate and provide storage for most of the 1 in 100 yr storm event including climate change. The southern part of the site requires additional storage to cater for the higher storms. This is reflected by the annotation of NB for north basins and SB for south basins. It is anticipated that the northern basins will be primarily dry and only be triggered for the extreme events. The proposal is for a high level overflow set at Greenfield runoff rate to maximise retention and infiltration within the site. We have noted your confirmation for a reduce freeboard level of 150mm on the Gleeson site and would propose to reflect the same arrangement across this site.

I also attach a mark up of the layout showing proposed locations for groundwater level monitoring over the winter together with winter infiltration testing. Once you confirm your acceptance of those proposed locations we can arrange for that to be undertaken.

I will contact you on Monday morning to go through the email and address any questions you may have ahead of your meeting on Tuesday afternoon. I hope that the revised proposal together with the winter groundwater monitoring/testing meets your requirements and that you can confirm your approval in principle for the surface water drainage strategy.

Kind regards,

Bava

Bava Sathan
 Associate

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From: "Laura Gibbons" <Laura.Gibbons@arun.gov.uk>
To: "BavaSathan@campbellreith.com" <BavaSathan@campbellreith.com>
Cc: "DavidSmith@campbellreith.com" <DavidSmith@campbellreith.com>
Date: 20/09/2018 08:15
Subject: RE: Y/92/17/OUT - Land east of Drove Lane Yapton BN18 0EB (Landlink Site)

Hi Bava,
I have just got your phone message, please can you ensure you send across the information before our meeting later. I would really like to be able to at least read through this before we meet.
Thanks,

Laura Gibbons, MEng, GMICE
Engineer (Drainage & Coastal)

Laura Gibbons Engineer (Drainage & Coastal), Engineering Services, Arun District Council Location: First Floor, Arun Civic Centre, Maltravers Road, Littlehampton, BN17 5LF Internal: 37818 External: +44 (0) 1903 737818 Fax: +44 (0) 1903 716018 E-mail: laura.gibbons@arun.gov.uk Arun is Working in Partnership with Chichester District Council Visit Arun's web site at http://www.arun.gov.uk/ and www.chichester.gov.uk  Save the environment - think before you print.

Sent: 18 September 2018 10:41
To: Laura Gibbons
Cc: DavidSmith@campbellreith.com
Subject: RE: Y/92/17/OUT - Land east of Drove Lane Yapton BN18 0EB (Landlink Site)

Good morning Laura,

Thank you for your email confirmation.

I will send you later this afternoon the mark ups of our progress reviewing the drainage strategy and proposals for this site to inform our discussions on Thursday.

Kind regards,

Bava

Bava Sathan
Associate

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From: "Laura Gibbons" <Laura.Gibbons@arun.gov.uk>
To: "BavaSathan@campbellreith.com" <BavaSathan@campbellreith.com>
Cc: "DavidSmith@campbellreith.com" <DavidSmith@campbellreith.com>
Date: 17/09/2018 14:21
Subject: RE: Y/92/17/OUT - Land east of Drove Lane Yapton BN18 0EB (Landlink Site)

Hi Bava,

I realise I hadn't confirmed the results of my conversations with WSCC. They fully support my position regarding this development and infiltration.

See you on Thursday.

Laura Gibbons, MEng, GMICE
Engineer (Drainage & Coastal)

[Laura Gibbons](#) | Engineer (Drainage & Coastal), Engineering Services, [Arun District Council](#) | Location: First Floor, Arun Civic Centre, Maltravers Road, Littlehampton, BN17 5LF
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Sent: 06 September 2018 15:33
To: Laura Gibbons
Cc: DavidSmith@campbellreith.com
Subject: Y/92/17/OUT - Land east of Drove Lane Yapton BN18 0EB (Landlink Site)

Good afternoon Laura,

Thank you for your time earlier to discuss the drainage strategy for the above site and Planning Application. For ease of reference please find below a summary of our conversation:

- Groundwater level across the site (subject to confirmation following winter monitoring) - we've agreed that we will use available groundwater level from the Gleeson site and stepping it relative to the ground level across the site starting from the highest ground level at the northern boundary and following the natural terrain towards the south west corner of the site.
- As part of the drainage strategy for the site we will look at potential to maximise the use of infiltration systems in particular for the northern part of the site where infiltration rates are more favourable.
- The ground investigation borehole logs indicate the geology of the terrain to be consistent across the site. Whilst the infiltration tests have been undertaken at depths of approximately 2.2m, it is reasonable to assume that the infiltration rate would be similar across the same geology. We propose to use the worst case infiltration rate for our drainage review.
- The infiltration systems will be designed to disperse half of its storage volume within 24hrs for the 1 in 10yrs storm and if possible achieve the same criteria for the 1 in 100yr storm. If not possible we will look at providing overflow systems to cascade into detention and storage basins.
- With regard to the 'adequate' buffer from top of groundwater level and base of infiltration system, Arun District Council's approach is that provided adequate treatment stages are incorporated in the design, then the base of any infiltration system can be just above the highest recorded winter groundwater level, i.e. no requirement for any buffer zone. This is on the understanding that there is sufficient storage for all storm return period and appropriate overflow discharge to allow the excess water to drain away during periods of high groundwater levels reaching the surface.

You mentioned that you are meeting with your counterpart at West Sussex County Council (LLFA) tomorrow and will be discussing their requirement on the buffer zone and clarify their position on the matter. You will provide an update confirming the mutual position of Arun DC and West Sussex County Council on the matter following your meeting.

We also discussed the potential conflicting requirements between West Sussex County Council as Highway Authority, Southern Water and Arun DC and agreed that in some areas there may be a need for a compromise in the surface water drainage system to allow the road to be adopted.

I understand that you are away on leave over the last week of September, we have tentatively pencilled in a meeting to review the proposed drainage strategy for our site and agree the principles prior to submitting the scheme for Planning Consideration. Once you have consulted your diary, please let me know what date and time best suits you on either of 20 or 21 September. If you can kindly arrange for a meeting room at your offices and send us a meeting invite we will ensure you receive the draft strategy ahead of the meeting.

Thank you and kind regards,

Bava
Bava Sathan
Associate

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Appendix C: Existing Surface Water Flow Path