



Drainage Provision for Land South of Burndell Road BN18 oHR

Yapton , West Sussex



Drainage Provision for Land South of Burndell Road BN18 oHR

Yapton, West Sussex

Prepared By

.....
A P Traves
Associate

Opus International Consultants (UK) Ltd
Fareham Office
Modulus House, Salterns Lane
Fareham, PO16 0QS
United Kingdom

Reviewed By

.....
J Simmonds
Engineer

Telephone: +44 1329 822021
Facsimile: +44 1329 825274

Date: 3 May 2018
Reference: EF2300DP/APT
Status: Issue 2

Contents

1	Introduction.....	2
2	Foul Water Drainage Provision	3
3	Surface Water Drainage Provision	5

Appendices

Appendix A	Foul Water Drainage
Appendix B	Surface Water Drainage

Issue 2:
Two surface water systems amalgamated into a single system to remove the discharge into the watercourse to the SE corner of the site

1 Introduction

- 1.1 This application furthers the proposal and Decision notice F/7/15/OUT for the site dated 10 March 2016.
- 1.2 The current proposal is consistent with the outline proposal ie:
- It is to serve 45 residential dwellings.
 - Foul drainage site network to drain by gravity to on site Waste Water Pumping Station connection to the public sewer affronting the site.
 - Off site foul sewer improvements to support the proposed development.
 - Two gravity surface water systems, including permeable pavement elements and attenuation storage, outfall to the existing ditch network in the site.
- 1.3 A Flood Risk Assessment (FRA) was undertaken in support of the outline application (F/7/15/OUT). This key aspects of the FRA area:
- Inclusion of water butts (FRA paragraph 4.4)
 - Use of permeable pavement on driveways (FRA paragraph 4.4)
 - Consideration of discharge by infiltration depending upon test results and if not feasible then attenuated discharge to site ditches (FRA paragraph 4.9)
 - A design surface water discharge rate of 10.4 l/sec (FRA paragraph 3.11)
 - The site is in FZ1 (FRA paragraph 5.2) and inherently meets the Sequential Test
 - There is minimal flood risk from any other source at the site (FRA paragraph 9.6)

2 Foul Water Drainage Provision

Capacity of the Public Foul Water Sewer Network and Connection of the site to this Network

- 2.1 At outline application stage (Ref F/7/15/OUT) the statutory undertaker, Southern Water, advised in their consultation response of 11/6/15 that:
- There was at that time inadequate capacity in the local network to provide foul sewage disposal to service the proposed development; and
 - Section 98 (S98) of the Water industry Act 1991 provides the legal mechanism through which the appropriate infrastructure can be requested (by the developer) and provided to drain a specific location.
- 2.2 Since the granting of outline planning permission (F/7/15/OUT) on 10/3/16, Southern Water updated their assessment of the off site foul water drainage infrastructure required to support the development.
- 2.3 A S98 application, to requisition the works identified by Southern Water to service the proposed development, was made to Southern Water. Southern water have advised existing MHs SU9703350 and SU97033502 will need to be replaced and a 45m length of new offline storage sewer constructed as indicated on Southern Water drawing JN.670007-201.0Z0801 rev A a copy of which is contained in the Appendix.
- 2.4 The proposed connection is ID:SU98025902.
- 2.5 By the time any detailed planning permission may be granted for this development and a S106 connection application is made, the new sewer connection procedure will be in place which came into force on 1 April 2018. Under this new procedure the developer will pay a fixed sum per plot (Infrastructure Charge) towards any off site sewer works and Southern Water will deliver these as part of their statutory duties.

Foul Water Sewer and Drain Network within the Site and Connection to Public Sewer

- 2.5 The foul sewer infrastructure on site will comprise a private gravity network discharging to a manhole outside the proposed Waste Water Pumping Station (WWPS) in the northeast corner of the site. The gravity connection into the pumping station, the pumping station and rising main connection out to the public sewer in Burndell Road will be offered for S104 by Southern Water. The proposed arrangement is shown on drawing FAEF2300-C300-P3, a copy of which is contained in Appendix A.
- 2.6 The WWPS retains the location set out on drawing TSP/BRO/P2551/07A considered at outline application stage, and referenced in decision Notice F/7/15/OUT condition (3).
- 2.7 The WWPS, rising main and gravity network elements proposed for S104 adoption (paragraph 2.5 refers) will be designed and constructed in accordance with Sewers for Adoption 7. The developer(s) will enter into S104 (Water Industry Act) agreement with the statutory undertaker (Southern Water) for the adoption of this foul sewer infrastructure.

These adopted assets will thereafter be operated and maintained by the statutory undertaker (Southern Water).

- 2.8 The private gravity network will be designed and constructed in accordance with Building Regulations. Plot specific infrastructure will thereafter be maintained by the respective householders and shared infrastructure will thereafter be maintained by the estate management company.

3 Surface Water Drainage Provision

Surface Water Drainage Network

- 3.1 As discussed in paragraph 1.3 the FRA sought to first consider an infiltration strategy, subject to the findings of a site investigation. A soils investigation was undertaken by Messrs Soils Ltd and reported upon in their report of April 2016. The key aspects of the report in relation to surface water drainage were:

- Three window sample bores were sunk to 5.0mbgl encountering chalk at 2.7-4.0mbgl. WS3 encountered groundwater at 4.0mbgl on 6/11/15 when sunk. The 3 WS bores were then used to monitor GWLs over Winter. Readings were initially low (3.04- 3.58mbgl on 13/11/15) rising to a high on 8/1/16 (0.8-1.38mbgl, 0.6mbgl for WS3 8/3/16) and have since subsided back to @2-2.5mbgl (27/4/16).
- Soakage tests were undertaken in 6 trial pits. The trial pits generally terminate in the overlying River Terrace Deposits which is primarily clay by does contain sand and gravel components. The permeability measured is very variable and the higher permeabilities seem to be associated with proximity to the underlying Chalk bedrock.

As GWL seems to vary from 1-3mbgl seasonally it becomes too shallow at times to be reliant on soakaways for storage. Also the depth of overlying clay is too great for permeable pavement to communicate with the underlying Chalk. An infiltration strategy is not feasible and a strategy of attenuated discharge to the ditches has been provided in accordance with the FRA and SUDs hierarchy.

- 3.2 Water butts will be installed to the properties.
- 3.3 The proposed surface water drainage arrangement is shown on drawing FAEF2300-C300-P3, a copy of which is contained in Appendix A. The surface water system will be a private network.
- 3.4 The surface water drainage scheme proposed at outline planning stage comprised two surface water networks; a western network outfalling to the southern ditch from a storage pond in the south west corner of the site; and an eastern system outfalling to the ditch near the south eastern corner of the site from linear storage. The amended detailed proposals have now removed the eastern outfall to avoid any neighbour sensitivity.
- The amalgamated system comprises network storage within areas of permeable pavement and a storage tank. The previous eastern system is now a secondary arm to the amalgamated system and serves the highway along the eastern side of the site and comprises linear filter trench storage. This outfalls to the ditch on the southern boundary.

The amalgamated sytem is designed to accommodate 1% AEP + 40% climate change rainfall events and regulate discharge to a combined rate of 10.4 l/sec (FRA paragraph 3.11 refers).

- 3.5 Private road gullies will be provided to ensure no surface run off out to the public highway.

Surface Water Drainage Pollution and Water Quality

- 3.6 The development comprises low (driveways and low traffic roads) and very low (residential roof) pollution hazard levels (Table 4.3 CIRIA C753 SUDS Manual) The proposals comprise the following treatment train:

West: permeable pavement → Downstream defender unit → existing ditch (swale)

These treatment train provides the necessary mitigation (CIRIA C753 SUDS Manual-Table 26.3)

Surface Water Drainage Operation and Maintenance

- 3.7 Surface water O&M is contained in the schedule in Appendix B.

Flood Flow Paths

- 3.8 For rainfall events in excess of the design requirements (refer to paragraph 3.4) the site highways will provide flood flow paths as shown on drawing EF2300-C380-P1, a copy of which is contained in Appendix B. During such an exceedance event surface water ponding would be expected to locally occur around the road gulley positions as indicated on the drawing. In places this would locally produce 0-50mm of standing water on the edge of the footway. This depth accords with FD2320/TR2 Table 13.1 extended version to give a flood hazard rating of 0.53 which classifies this as a very low hazard rating, and is thus demonstrated to be safe.

APPENDIX A:

Foul Water Drainage

LEGEND

- EXISTING ADOPTED SOUTHERN WATER FOU. SEWER
- TYPE 1 1200R RIGID MANHOLE WITH INVERT LEVEL ON ADOPTABLE FOU. SEWER
- TYPE 1A 1200R RIGID MANHOLE WITH INVERT LEVEL ON PRIVATE FOU. SEWER
- TYPE 2 1500R RIGID MANHOLE WITH INVERT LEVEL ON PRIVATE FOU. SEWER
- TYPE 3 600/450D FLEXIBLE IC WITH INVERT LEVEL ON PRIVATE FOU. SEWER
- TYPE 4 400/150R FLEXIBLE IC WITH INVERT LEVEL ON PRIVATE FOU. SEWER
- TYPE 5 1200R RIGID MANHOLE WITH INVERT LEVEL ON PRIVATE STORM DRAIN
- TYPE 6 600/450D FLEXIBLE IC WITH INVERT LEVEL ON PRIVATE STORM DRAIN
- TYPE 7 400/150R FLEXIBLE IC WITH INVERT LEVEL ON PRIVATE STORM DRAIN
- CATCHMENT MANHOLE WITH INVERT LEVEL ON PRIVATE STORM DRAIN
- CATCHMENT CHAMBER WITH INVERT LEVEL ON PRIVATE STORM DRAIN
- RODDING EYE WITH INVERT LEVEL ON PRIVATE STORM DRAIN
- ROAD GULLY WITH LATERAL STORM DRAIN
- YARD GULLY
- LINEAR CHANNEL DRAIN
- RAINWATER DIFFUSER UNIT
- WAVY AQUACELL MODULAR ATTENUATION TANK
- PERFORATED PIPE WITHIN PERMISSIBLE PAVING
- PROPOSED PERMEABLE PAVING

Tank 3. Aquacell Modular Attenuation Tank. 7 x 29 x 1.0m (d) 1624 N° Blocks. Storage volume: 308.56m³. Soffit level: 6.24

Manhole with HydroBrake limiting discharge flow to 10.4%

Outfall headwall

French drain

Piped section of trench drain

Ground level +300mm to allow for no dig construction to the rear of pumping station

Scale: 1:100

Scale: 1:1000

Scale: 1:10000

SAFETY HEALTH AND ENVIRONMENTAL INFORMATION BOX

1:1 0 10 20 30 40 50 60 70 80 90 100 mm

BACKGROUND IS BASED ON THE ARCHITECT'S GA DRAWING

ANY DISCREPANCIES OR UNCERTAINTY WITH THE CONTENT OF THIS DRAWING ARE TO BE REPORTED TO THE ENGINEER PRIOR TO CONSTRUCTION.

Revision	Amendment	Approved	Revision Date
P1	FIRST ISSUE	APT	06.03.2018
P2	PRIVATE FW DRAINAGE UPDATED	APT	29.03.2018
P3	SW & FW DRAINAGE UPDATED	APT	25.04.2018



OPUS
Fareham Office
441 1322 82321

Designed: JPS
Drawn: JPS

Approved: APT
Approved Date: 25.04.2018

Scale: 1:250 AT A0

Project: BURNDELL ROAD YAPTON

Sheet: DRAINAGE LAYOUT

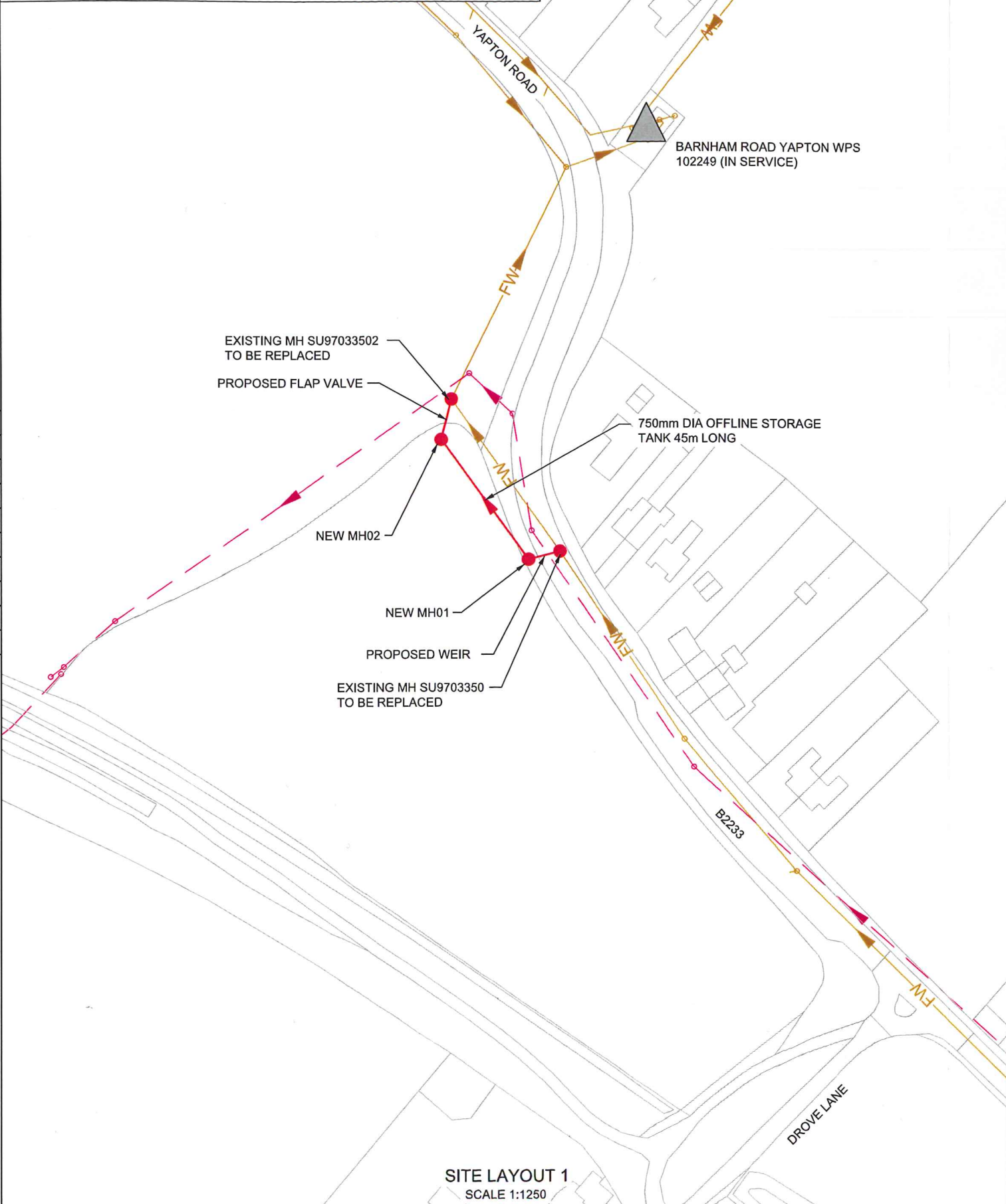
Project No: FA-E-F2300.00

Sheet No: C300
Revision: P3

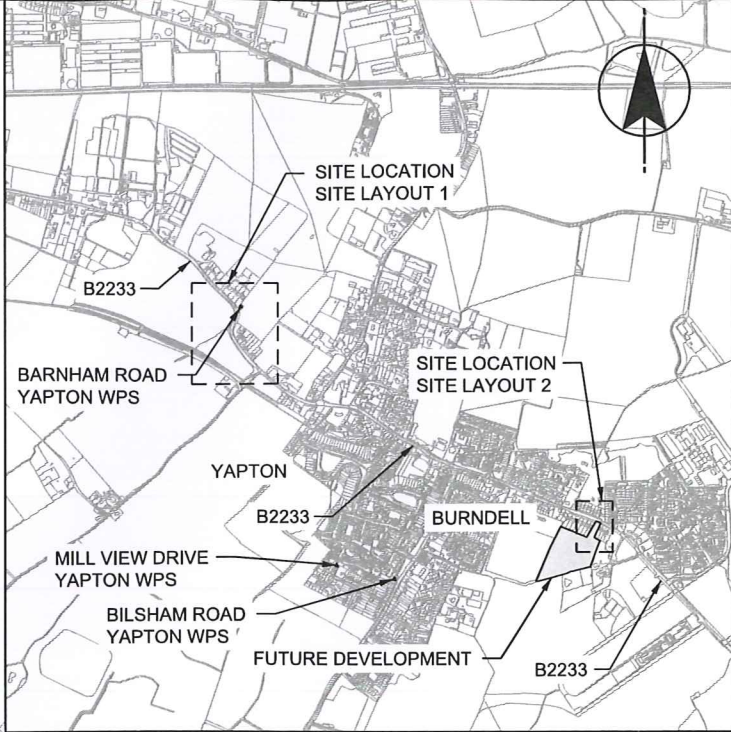
- STANDARD NOTES
- This drawing is to be read in conjunction with all other OPUS drawings, and with relevant Architect and Engineer's drawings and specifications.
 - No dimensions are to be scaled from the drawing. Unless stated otherwise all dimensions are in millimetres and all levels are in metres from the sea datum. All dimensions to be checked on site. All details and dimensions relating to sub-Contractors work must be checked and agreed between the sub-Contractor or supplier and the general Contractor.
 - The electronic information from this drawing cannot be guaranteed as dimensionally drawn exact. Signed dimensions must be used for setting out and checking. CPD signs and company information must be removed from copies if information is re-used.
 - The main Contractor is responsible for the design of all temporary works, and is also responsible for the safe maintenance and stability of existing buildings at all times.
 - The main Contractor is responsible for the mitigation of all occurrences of ground water during the construction period.
 - Any information given regarding existing underground services is given in good faith after consultation with the relevant authority, however accuracy is not guaranteed. The main Contractor is responsible for checking all information on site prior to work commencing and taking due care and attention while undertaking the works.
 - The contractor must comply with all current legislation relating to Health & Safety.
- DRAINAGE NOTES
- All works to be constructed in strict accordance with specification of the Local Authority, BS8301:1985 & BS8301:2011.
 - All pipe runs near buildings to comply with the Building Regulations 2000 Part H1. Where a pipe is within 1m of a foundation the trench shall be filled with class GEN3 concrete to the lowest level of the foundation. Where the trench is further than 1m from the foundation, the trench shall be filled with class GEN3 concrete to a level below the lowest level for the foundation equal to the distance from the foundation less 150mm. In both cases the pipe shall be bedded and surrounded in 150mm thick class GEN3 concrete.
 - Where pipes, external to the structure, have a depth to soffit from ground level of less than 450mm they shall have a class GEN2 concrete enclosure (150mm thick).
 - Where a pipe, under a carriageway, has a depth of cover of less than 1.2m the pipe shall be laid in a class 2 bedding.
 - Where pipes are bedded and surrounded in concrete, flexible joints should be provided. Compressible boards (fibreglass or polypropylene) shall be provided at a maximum of 8m centres (excluding joint pipes). The boards shall be placed on pipe diameter and to a height and width equal to the concrete cross section. A board thickness of 18mm for pipes up to 450mm nominal diameter and 18mm for pipes over 450mm nominal diameter.
 - All private building drainage shall be constructed in strict accordance with BS8301:2011.
 - Unless otherwise specified, building drainage to be 100mm internal diameter.
 - Minimum gradient for Ø100mm surface drainage pipes is 1:80, and Ø150mm is 1:100.
 - Minimum gradient for foul drainage pipes:
Ø100mm: 1:40 where flow is less than 15L/s, or where no WCs are connected.
Ø100mm: 1:75 where flow is 15L/s or greater, or where 2 or more WCs are connected.
Ø150mm: 1:100 where flow is less than 35L/s, or where 2 or more WCs are connected.
Ø150mm: 1:150 where flow is 35L/s or greater, or where 5WCs or more WCs are connected.
 - All gullies not connected to inspection chambers are to be roddable.
 - All gully connections other than those at manholes to be made via "Y" junctions.
 - Gullies connected with pedestrian/drive crossings to have pedestrian type gully covers.
 - All road gully connections to be 150mm diameter.
 - All sub stacks to be fitted with an admission valve where branch drain exceeds 12m, except at the head of the run. Sub stack pipes located at the head of a run to be installed with roof tile vent.
 - All connections to be made from soffit to soffit.
 - Trench temporary formwork is required to all excavations exceeding 1.2m depth to provide adequate support and stability of all times.
 - Sewers are to be constructed in single sections between manholes only. Trenches to be bedded prior to excavating the succeeding power run.
 - All concrete and concrete products to be in accordance with BS8301 for subsoils.
 - Where sewer or drains are to be abandoned they shall be removed or infilled by grouting in accordance with the Civil Engineer Specification for the Water Industry 7th Edition, clause 523.

BULLET POINT NOTES:

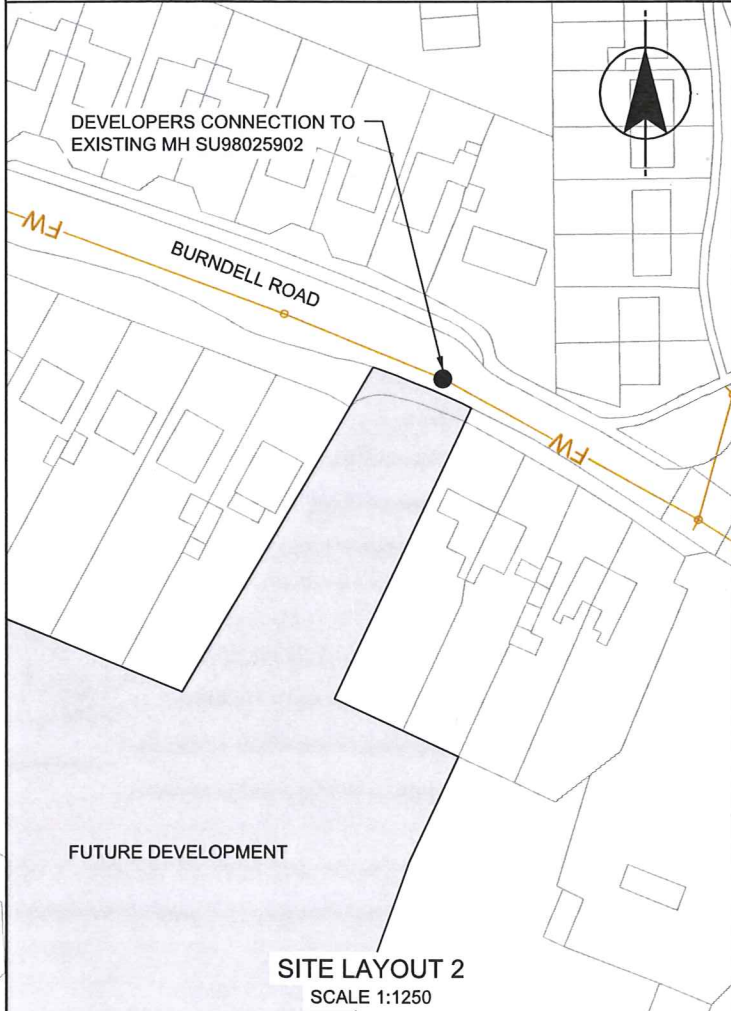
- THIS DRAWING IS BASED ON HISTORICAL AND O.S. DATA. INCONSISTENCY IN DATA SHOULD BE CHECKED AND VERIFIED BEFORE COMMENCING DETAIL DESIGN
- EXISTING AND INDICATIVE PIPE ROUTES BASED ON GIS DATA. SOUTHERN WATER SERVICES LTD. ACCEPT NO RESPONSIBILITY IN THE EVENT OF INACCURACY. THE ROUTES ARE TO BE CHECKED AND VERIFIED BEFORE DETAIL DESIGN AND ARE SHOWN PURELY FOR OUTLINE DESIGN.



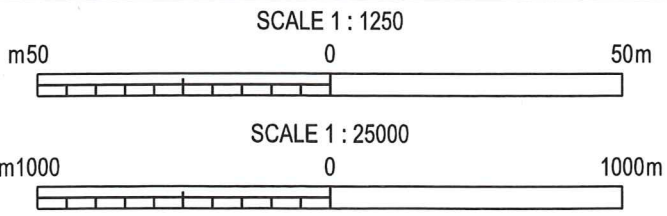
SITE LAYOUT 1
SCALE 1:1250



SITE LOCATION
SCALE 1:25000



SITE LAYOUT 2
SCALE 1:1250



S.W. DRAWING NO.
JN.670007-201.0Z0801

REVISION
A

NOTES

1. ALL DIMENSIONS IN MILLIMETRES AND ALL LEVELS IN METRES UNLESS SHOWN OTHERWISE.

LEGEND

- FW — EXISTING FOUL SEWER
- FW — EXISTING FOUL SEWER
- FW — EXISTING PRIVATE SEWER
- FW — PROPOSED SEWER
- PROPOSED MANHOLE
- DEVELOPERS CONNECTION
- FUTURE DEVELOPMENT

CURRENT VERSION INFORMATION

DATE	DRWN	CHD	REV	REV	REASON FOR ISSUE
03.03.2017	BN	NW	RM	A	FOR INFORMATION

THIS DRAWING IS ISSUED BY SOUTHERN WATER SUBJECT TO THE CONDITIONS THAT IT IS NOT COPIED EITHER IN WHOLE OR IN PART OR DISCLOSED TO THIRD PARTIES UNLESS PRIOR WRITTEN AUTHORIZATION IS GIVEN BY SOUTHERN WATER. PREVIOUS VERSIONS OF THIS DRAWING SHOULD BE STAMPED SUPERSEDED OR DESTROYED. DO NOT SCALE THIS DRAWING - IF IN DOUBT ASK.

Southern Water

In Partnership with

MWH

Southern House
Yeoman Road
Worthing
West Sussex
BN13 3NX
telephone (01903) 264444
fax (01903) 691435

PROJECT TITLE

S98 NORTHWOOD FIELD
BURNDOLL ROAD
YAPTON

DRAWING TITLE

PROPOSED SITE LAYOUT PLAN

SITE UNIT MEMORIC	SITE UNIT NO.
PRN 670007-201	SCALE AS SHOWN
S.W. DRAWING NO. JN.670007-201.0Z0801	MASTER SIZE A3
	REVISION A

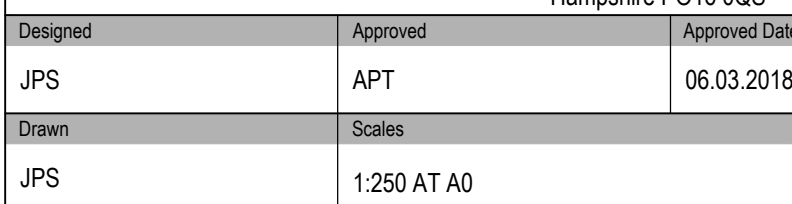
APPENDIX B:

Surface Water Drainage



- LEGEND:**
- | | |
|---|---|
| HP | High point |
| LP | Low point |
|  | Existing ditch |
|  | Flood flow direction |
|  | Exceedance ponding
<150mm on channels and
<50mm on footways |

ANY DISCREPANCIES OR
UNCERTAINTY WITH THE
CONTENT OF THIS DRAWING ARE
TO BE REPORTED TO THE
ENGINEER PRIOR TO
CONSTRUCTION.

[illegible]

Project No.	FA E-F2300.00
-------------	---------------

Sheet No.	Revision
C380	P1

SUDS operation and maintenance - general

There are three categories on maintenance activities:

Regular maintenance consists of basic tasks done on a frequent and predictable schedule, including vegetation management, litter and debris removal, and inspections.

Occasional maintenance comprises tasks that are likely to be required periodically, but on a much less frequent and predictable basis than the routine tasks (sediment removal is an example). The table below summarises the likely maintenance activities required for each SUDS component and specific maintenance activities is given in the following sections.

Remedial maintenance comprises intermittent tasks that may be required to rectify faults associated with the system. Where remedial work is found to be necessary, it is likely to be due to site-specific characteristics or unforeseen events, and as such timings are difficult to predict. Remedial maintenance items can comprise items such as:

- inlet/outlet repairs
- erosion repairs
- reinstatement or realignment of edgings, barriers, rip-rap or other erosion control
- infiltration surface rehabilitation
- replacement of blocked filter fabrics
- construction stage sediment removal (although this activity should have been undertaken before the maintenance contract)
- system rehabilitation immediately following a pollution event.

O&M activity	SUDS component												
	Pond	Wetland	Detention basin	Infiltration basin	Soakaway	Infiltration trench	Filter trench	Modular storage	Pervious pavements	Swale/bioretention/greenroofs	Filter strip	Sand filter	Pre-treatment systems
Regular maintenance													
Inspection	■	■	■	■	■	■	■	■	■	■	■	■	■
Litter/debris removal	■	■	■	■	□	■	■	□	■	■	■	■	■
Grass cutting	■	■	■	■	□	■	■	□	□	■	■	□	□
Wee/invasive plant control	□	□	□	□		□	□		□	□	□	□	□
Shrub management	□	□	□	□					□	□	□		□
Shoreline vegetation management	■	■	□										□
Aquatic vegetation management	■	■	□										□
Occasional maintenance													
Sediment management *	■	■	■	■	■	■	■	■	■	■	■	■	■
Vegetation/plant replacement	□	□	□	□						□	□		□
Vacuum sweeping and brushing									■				
Remedial maintenance													
Structure rehabilitation/repair	□	□	□	□	□	□	□	□	□	□	□	□	□
Infiltration surface reconditioning				□	□	□	□		□	□	□	□	

■ will be required

□ may be required

* sediment to be collected upstream of the main device

GENERAL MAINTENANCE

Litter/debris removal

This is an integral part of SUDS maintenance and reduces the risks of inlet and outlet blockages, retains amenity value and minimises pollution risks. High litter removal frequencies may be required at high profile commercial/retail parks where aesthetics are a major driver.

Grass cutting

It is recommended that grass cutting be minimised around SUDS facilities, apart from swales and filter strips and structural embankments where a height of 100–150 mm is recommended to prevent the plants falling over, or “lodging”, when water flows across the surface. In general, allowing grass to grow tends to enhance water quality performance. Short grass around a wet system such as pond or wetland provides an ideal habitat for nuisance species such as geese; allowing the grass to grow is an effective means of discouraging them. Grass around wet pond or wetland systems should not be cut to the edge of the permanent water. Grass cutting is an activity undertaken primarily to enhance the perceived aesthetics of the facility. The frequency of cutting will tend to depend on surrounding land uses, and public requirements. Therefore, grass cutting should be done as infrequently as possible, recognising the aesthetic concerns of local residents. However, grass around inlet and outlet infrastructure should be trimmed closely to reduce risks to system performance. If a manicured, parkland effect is required, then cutting will need to be undertaken more regularly than for meadow type grass areas, which aim to maximise habitat and biodiversity potential.

Weed/invasive plant control

Weeds are generally defined as vegetation types that are unwanted in a particular area. For SUDS, weeds are often alien or invasive species, which do not enhance the technical performance or aesthetic value of the system, or non-native species and the spread of which is undesirable. In some places, weeding has to be done by hand to prevent the destruction of surrounding vegetation (hand weeding should generally be required only during the first year, ie during plant establishment). However, over grassed surfaces, mowing can be an effective management measure. The use of herbicides and pesticides should be prohibited since they cause water quality deterioration. The use of fertilisers should also be limited or prohibited to minimise nutrient loadings which are damaging to water bodies.

Shrub management

Shrubs tend to be densely planted and are likely to require weeding at the base, especially during the first year to ensure that they get enough water. Shrubs should be selected so they can grow to their maximum natural height without pruning.

Aquatic/shoreline vegetation management

Aquatic plant aftercare in the first 1–3 years may be required to ensure establishment of planted vegetation and control nuisance weeds/invasive plants. Once established, the build-up of dead vegetation from previous seasons should be removed at convenient intervals to reduce organic silt accumulation (eg every three years and at the end of landscape contract periods).

Emergent vegetation may need to be harvested every 5–10 years to maintain flood attenuation volumes, optimise water quality treatment potential and ensure fresh growth, although this is often not required. Care should be taken to avoid nesting birds during the breeding season and to avoid great crested newt and water vole habitats. The typical window for this activity is towards the end of the growing season (September and October). As vegetation matures, plant height may also become a safety issue in residential areas.

Where emergent vegetation is managed, up to 25 per cent can be removed by cutting at 100 mm above soil level using shearing action machinery. Up to 25 per cent of submerged vegetation can be cut and raked out at any one time, using approved rakes, grabs or other techniques, depending on whether clay or waterproof membranes are present. Aquatic vegetation arisings should be stacked close to the water's edge for 48 hours to de-water and allow wildlife to return to the SUDS feature. They should then be removed to wildlife piles, compost heaps or off site before decomposition, rotting or damage to existing vegetation can occur.

Algae removal may be undertaken for aesthetic purposes during the first 3–5 years of a pond/wetland's life. The growth of algae, which is considered by some to be visually intrusive, is encouraged by nutrients introduced into the water body. This situation should settle down once upstream construction activities are complete.

Management of green waste

Appropriate methods should be implemented to dispose of green waste, including

- The development of wildlife piles
- On- or off-site composting
- Disposal to landfill

REMEDIAL MAINTENANCE

Structure rehabilitation/repair

There will come a time with most SUDS techniques when a major overhaul of the system is required to remove clogged filters, geotextiles, gravel etc. This will typically be between 10 and 25 years, depending on the technique and factors such as the type of catchment and sediment load. For example the use of geotextiles close to the surface in pervious surfaces traps the majority of sediment in a relatively easily accessible location. Reconstruction of the surface layer and bedding layer is all that is required, rather than reconstruction of the whole pavement depth.

Major overhaul is most likely to be required on techniques that rely on filtration through soils or aggregates, such as sand filters and infiltration devices. Other SUDS techniques are unlikely to need major overhaul if routine maintenance is undertaken as required (for example ponds and wetlands).

Rehabilitation activities for each SUDS component are described on the following tables.

Infiltration surface rehabilitation

In the event that grassed surface permeability has reduced, there are a number of landscape techniques that can be used to open the surface to encourage infiltration. Such activities are not commonplace and are likely to be required only in circumstances where silt has not been effectively managed upstream.

1. Scarifying to remove “thatch”. Thatch is a tightly intermingled organic layer of dead and living shoots, stems and roots, developing between the zone of green vegetation and the soil surface. Scarifying with tractor-drawn or self-propelled equipment to a depth of at least 50 mm breaks up silt deposits, removes dead grass and other organic matter and relieves compaction of the soil surface.
2. Spiking or tining the soil, using aerating equipment to encourage water percolation. This is particularly effective if followed by top dressing with a medium to fine sand, and is best undertaken when the soil is moist. Spiking or tining with tractor drawn or self-propelled equipment penetrates and perforates soil layers to a depth of at least 100 mm (at 100 mm centres) and allows the entry of air, water, nutrients and top dressing materials.
3. As a last resort, it may be necessary to remove and replace the grass and topsoil by:
 - removing accumulated silt and (subject to a toxicity test) applying to land or dispose of to landfill
 - removing damaged turf which should be composted
 - cultivating remaining topsoil to required levels
 - re turfing (using turf of a quality and appearance to match existing) or reseeded (to BS 7370: Part 3, Clause 12.6 (BSI, 1991) using seed to match existing turf) area to required levels. It may be necessary to supply and fix fully biodegradable coir blanket to protect seeded soil. Turf and seeded areas should be top dressed with fine sieved topsoil to BS 3882 (BSI, 1994) to achieve final design levels. Watering will be required to promote successful germination and/or establishment.

Water butts operation and maintenance

Maintenance schedule	Required action	Frequency
Regular maintenance	Cleaning of tank, inlets, outlets, gutters, withdrawal devices and roof drain filters of silts and other debris..	Annually (or following poor performance).
Occasional maintenance	Replacement of any filters.	As required
Remedial actions	Repair of erosion damage, or damage to tank.	As required
Monitoring	Inspection of the tank for debris and sediment build up.	Annually (or following poor performance).
	Inspection of inlets, outlets and withdrawal devices.	Annually (or following poor performance).
	Inspection of areas receiving overflow, for evidence of erosion.	After extreme storms.
	Inspection of roof drain filters	Annually (or following poor performance).

Trenches operation and maintenance

Maintenance schedule	Required action	Frequency
Regular maintenance	Litter and debris removal from trench surface, access chambers and pre-treatment devices.	Monthly (or as required).
	Removal and washing of exposed stones on the trench surface.	Annual (bi-annual the first year) or when silt is evident on the surface.
	Trimming any roots that may be causing blockages	Annual (semi-annual the first year).
	Remove weeds on the trench surface.	Monthly (at start, then as required)
Occasional maintenance	Removal of sediment from pre-treatment devices.	Six monthly.
	Remove tree roots or trees that grow close to the trench.	As required.
	At locations with high pollution loads, remove surface geotextile and replace, and wash or replace filter media.	Five yearly.
Remedial actions	Clear perforated pipework of blockages.	As required
	Rehabilitate infiltration or filtration surfaces.	As required
	Replace geotextiles and clean and replace filter media, if clogging occurs.	As required
	Excavate trench walls to expose clean soils if infiltration performance reduces to unacceptable levels.	As required
	Inspect inlets, outlets and inspection points for blockages, clogging, standing water and structural damage.	Monthly in the first year and then annually.
Monitoring	Inspect pre-treatment systems, inlets, trench surfaces and perforated pipework for silt accumulation. Establish appropriate silt removal frequencies.	Half yearly.

Sediment testing may be required before sediment excavation to determine its classification and appropriate disposal methods. For industrial site runoff sediment testing will be essential. In the majority of cases, it will be acceptable to distribute the sediment on-site if there is an appropriate safe and acceptable location to do so.

Swales operation and maintenance

Maintenance schedule	Required action	Frequency
Regular maintenance	Litter and debris removal.	Monthly (or as required).
	Grass cutting – 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).
Occasional maintenance	Check for poor vegetation growth due to lack of sunlight or dropping of leaf litter, and cut back adjacent vegetation where possible.	Annually.
	Re-seed areas of poor vegetation growth. Alter plant types to better suit conditions, if required.	Annually, or if bare soil is exposed over 10% or more of the swale treatment area.
Remedial actions	Repair erosion or other damage by re-turfing or reseeded.	As required
	Re-level uneven surfaces and reinstate design levels.	As required
	Scarify and spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of the soil surface.	As required
	Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip.	As required
	Remove and dispose of oils or petrol residues using safe standard practices.	As required
Monitoring	Inspect inlets, outlets and overflows for blockages, and clear if required.	Monthly.
	Inspect infiltration surfaces for ponding, compaction, silt accumulation. Record areas where water is ponding for > 48 hours.	Monthly, or when required.
	Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies.	Half yearly.

Sediment testing may be required before sediment excavation to determine its classification and appropriate disposal methods. For industrial site runoff sediment testing will be essential. In the majority of cases, it will be acceptable to distribute the sediment on-site if there is an appropriate safe and acceptable location to do so.

Pervious pavement operation and maintenance

Maintenance schedule	Required action	Frequency
Regular maintenance	Brushing and vacuuming.	Three times/year at end of winter, mid-summer, after autumn leaf fall, or as required based on site-specific observations of clogging or manufacturers' recommendations.
Occasional maintenance	Stabilise and mow contributing and adjacent areas.	As required
	Removal of weed.	As required
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.	As required
	Rehabilitation of surface and upper sub-structure.	As required (if infiltration performance is reduced as a result of significant clogging).
Monitoring	Initial inspection.	Monthly for 3 months after installation.
	Inspect for evidence of poor operation and/or weed growth. If required take remedial action.	3-monthly, 48 h after large storms.
	Inspect silt accumulation rates and establish appropriate brushing frequencies.	Annually
	Monitor inspection chambers.	Annually

Modular systems operation and maintenance

Maintenance schedule	Required action	Frequency
Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action.	Monthly for 3 months, then six monthly
	Debris removal from catchment surface (where may cause risks to performance)	Monthly
	Where rainfall infiltrates into blocks from above, check surface of filter for blockage by silt, algae or other matter. Remove and replace surface infiltration medium as necessary.	Monthly (and after large storms)
	Remove sediment from pre-treatment structures	Annually, or as required
Occasional maintenance	-	-
Remedial actions	Repair/rehabilitation of inlets, outlet , overflows and vents	As required
Monitoring	Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed	Annually and after large storms



**Opus International Consultants
(UK) Ltd**

Modulus House, Salterns Lane
Fareham, PO16 0QS
United Kingdom

t: +44 1329 822021
f: +44 1329 825274
w: www.opusinternational.co.uk

Registered in England & Wales,
Company Reg. No: 2847568
Reg Office: Willow House, Brotherswood Court
Great Park Road, Bristol, BS32 4QW