



FLOOD RISK ASSESSMENT & DRAINAGE STRATEGY
FOR
PROPOSED RESIDENTIAL DEVELOPMENT
LAND TO THE SOUTH OF WARREN LANE, LONG ASHTON
ON BEHALF OF
LONG ASHTON LAND COMPANY LIMITED

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1.0 INTRODUCTION

1.1 This *Flood Risk Assessment & Drainage Strategy (FRA & DS)* has been prepared by Cole Easdon Consultants Limited (CEC) on behalf of Long Ashton Land Company Limited in support of a planning application for a residential development at Land south of Warren Lane, Long Ashton, Somerset, BS41 9AG. Refer to CEC Figure 3454/500 Figure 1 [*Site Location Plan*] in Appendix 1.

Development Proposals

1.2 The development proposals include up to 35 dwellings, allotments and associated access, parking, drainage infrastructure and landscaping.

1.3 This study is based on the Illustrative Site Layout by Nash Partnership provided to Cole Easdon Consultants in May 2020. Refer to Appendix 5.

Need for Study

1.4 The purpose of this assessment is to demonstrate that the development proposal outlined above can be satisfactorily accommodated without worsening flood risk for the area and without placing the development itself at risk of flooding, as per National guidance provided within the National Planning Policy Framework document (NPPF).

1.5 Accordingly, this study has been prepared to:

- i. assess flood risk to the development from fluvial sources;
- ii. assess flood risk to the development from other potential sources, including ditches, sewers, groundwater and overland flows;
- iii. ensure that the proposed development will fully comply with the requirements of the Environment Agency's (EA's) policy on the safeguarding of floodplains; and
- iv. assess a surface and foul water drainage strategy for the proposed development.

Local Policy

1.6 This assessment also demonstrates that the proposals meet the requirements of North Somerset Council Core Strategy CS3 (Environmental impacts and flood risk assessment) which states that new development will need to be mindful of the increased risks of flooding as a result of climate change and to manage flood risk by avoiding development within areas of flood risk.

Scope of Study

- 1.7 In Section 2.0, we describe the characteristics of the proposed development site and surrounding area. In Section 3.0, we assess flood risk issues and outline the proposed surface water drainage strategy. In Section 4.0, we outline the proposed foul water drainage strategy and finally, conclusions are presented in Section 5.0.
- 1.8 The following resources have been used for this study:
- *Flood Map for Surface Water - Environment Agency (EA, accessed September 2019);*
 - *Flood Zone Map - Environment Agency (EA, accessed September 2019);*
 - *Geological Map - British Geological Survey (BGS, Accessed September 2019);*
 - *Groundwater Source Protection Zones Map - Environment Agency (Magic Map, accessed February 2020);*
 - *Revised Climate Change Allowances (EA, March 2016);* and
 - *Wessex Water Sewer Records (March 2019).*
- 1.9 The following publicly available documents have also been reviewed as part of this assessment:
- *Building Regulations 2010 - Approved Document H (Drainage and Waste Disposal);*
 - *C753 The SuDS Manual (CIRIA, November 2015);*
 - *National Planning Policy Framework (NPPF) (2019);*
 - *Non-Statutory Technical Standards for Sustainable Drainage Systems (Defra, March 2015);*
 - *Planning Practice Guidance (PPG) (March 2014);*
 - *Rainfall Runoff Management for Developments (R&D Technical Report W5-074/A/TR/1 Revision E, Defra, June 2012);*
 - *Sewers for Adoption, 6th Edition - A Design and Construction Guide for Developers (SFA 6) (March 2006);*
 - *North Somerset Council Adopted Core Strategy (January 2017);*
 - *North Somerset District Council SFRA Level 1 (October 2008);* and
 - *West of England sustainable drainage developer guide, Section 1 (March 2015).*
- 1.10 The following abbreviations are used in this Report:
- AOD - Above Ordnance Datum;
 - BGS - British Geological Survey;
 - EA - Environment Agency;
 - FZM - Flood Zone Map prepared by the EA;



- NPPF - National Planning Policy Framework;
- QBAR - Annual flood flow (return period of approximately 1:2.3 years);
- SFRA - Strategic Flood Risk Assessment;
- NSC - North Somerset Council;
- SuDS - Sustainable Urban Drainage Systems; and
- WW - Wessex Water.

2.0 THE EXISTING SITE

Refer to CEC Plan 3454/500(A) [*Existing Site Layout*] in Appendix 6.

- 2.1 The proposed development site comprises a 2.22 ha parcel of greenfield land located on the north side of Weston Road, Long Ashton. The site is bound by agricultural land to the north and west of the site. The eastern boundary is formed by Warren Lane and the southern boundary is formed by Weston Road.
- 2.2 Land use within the vicinity of the site is predominantly agricultural to the west and residential to the east.

Existing Topography

- 2.3 A topographical survey shows the site to slope in a southerly direction with levels varying from 63.00mAOD on the northern boundary, to 49.50mAOD on the southern boundary of the site. Refer to Drawing No. 3022-11NOV14-04 [*Topographical Survey*] by AD Horner Limited, located within Appendix 5.

Nearby Watercourses/Drainage Features

- 2.4 There are no watercourses or ditches within the vicinity of the site. The Land Yeo river is located 590m to the west of the site; it flows in a westerly direction before discharging into the Bristol Channel at Clevedon. Multiple unnamed drainage channels are located to the south of the site, each drain the locality and feed into Land Yeo river. The River Avon is located 4km to the north east of the site. It flows in a westerly direction and discharges into the Bristol Channel at Avonmouth.

Existing Drainage

- 2.5 Asset records provided by Wessex Water shows there to be a 100mm diameter public foul water sewer to the north of the site. The sewer flows in an easterly direction before joining the 150mm diameter foul sewer within Warren Lane. A 100mm diameter public surface water sewer is also located to the north of the site and flows in an easterly direction and joins the network within Warren Lane. The records also show a 150mm diameter public foul sewer located within Weston Road to the east of the site. It flows in a southerly direction and joins the network within Bramley Copse to the south east of the site. A public 225mm diameter public surface water sewer is located within Pear Tree Avenue to the south of the site. Refer to Appendix 2.

- 2.6 The site is greenfield. It is assumed that surface water currently follows the natural site topography and flows to the south, as overland flow, or infiltrates to ground. Greenfield runoff rates for the proposed hard areas on the site (0.802ha including 10% urban creep) have been calculated as 4.7l/s for the mean annual runoff event (QBAR), 9.0l/s for the 1:30-year event and 11.4l/s for the 1:100-year event. Refer to Appendix 4 for greenfield runoff calculations.

Existing Ground Conditions

- 2.7 Records acquired from the British Geological Survey (BGS) indicate the site is underlain by Mercia Mudstone Group - Mudstone and Halite-stone. No superficial deposits are recorded. Refer to CEC Figure 3454/500 Figure 4 [*BGS Geology Map*] in Appendix 1.
- 2.8 An intrusive site investigation has been completed on site. Refer to Appendix 3. 3 No. trial pits were dug to a depth of 1.20m below ground level (bgl) (TP1 and TP3) and 1.8mbgl (TP2). In TP1 topsoil was found to a depth of 0.30m bgl and underlain by Mercia mudstone group-Clay to the base of the pit at 1.20mbgl. TP2 contained topsoil to a depth of 0.30mbgl with head deposits of sandy gravelly clay between 0.30mbgl - 0.8mbgl and underlain by Mercia mudstone group- Clay to the base of the pit at 1.80mbgl. In TP3 topsoil was found to 0.30mbgl with head deposits of sandy gravelly clay between 0.30mbgl - 1.0mbgl and underlain by Mercia mudstone group- Clay to the base of the pit at 1.20mbgl. Groundwater seepages were encountered between 0.0m - 0.3m depth within each of the trial pits.
- 2.9 Infiltration testing was attempted within TP1 and TP3. However, this was unsuccessful due to the presence of groundwater.
- 2.10 The EA's aquifer destination map shows that the bedrock geology is classed as a Secondary 'B' Aquifer and the superficial deposits are classed as unproductive. The EA groundwater vulnerability map designates the site high vulnerability to groundwater with a soluble rock risk.
- 2.11 EA mapping shows the site is not in a groundwater source protection zone.

3.0 FLOOD RISK ISSUES & SURFACE WATER DRAINAGE STRATEGY

Refer to CEC Plans 3454/500(A) [*Existing Site Layout*] and 3454/501(A) [*Proposed Drainage Layout*], both located in Appendix 6.

3.1 This Section presents an assessment of flood risk to the development from:

- a) external sources; and
- b) surface water discharge from the proposed development.

3.2 Recommended flood risk mitigation measures appropriate to the level of perceived risk are included in the assessment. The mitigation measures are summarised in Table 3.1 below.

A) Assessment of Flood Risk to the Development Site from External Sources

Ai) Assessment of Flood Risk from Fluvial Sources

3.3 The Flood Zone Map (FZM) for the locality as produced by the EA is shown on CEC Figure 3454/500/Figure 2 [*EA Flood Zone Map*] within Appendix 1. According to the FZM it can be seen that the site lies within Flood Zone 1 (Low risk).

3.4 *NPPF Practice Guidance (Table 2: Flood Risk Vulnerability Classification)* classifies the proposed site usage 'residential' as 'More vulnerable' development. In accordance with the *NPPF Practice Guidance (Table 3: Flood Risk Vulnerability and Flood Zone Compatibility)*, More Vulnerable Development is appropriate within Flood Zone 1.

3.5 The Level 1 Strategic Flood Risk Assessment (SFRA) for North Somerset Council (NSC) states that 65 properties within the ward of Long Ashton and Wraxall are within 50m of a known area of flooding. It does not indicate that the development site is at risk from fluvial flooding. Therefore, flood risk from fluvial sources can be considered low.

Fluvial/Tidal Flood Risk Mitigation Measures

3.6 No mitigation required.

Aii) Assessment of Flood Risk from Existing Ditches

3.7 There are no ditches within the vicinity of the site. Flood risk from this source is therefore low.

Ditch Flood Risk Mitigation Measures

- 3.8 No mitigation required.

Aiii) Assessment of Flood Risk from Sewers/Drains

- 3.9 Wessex Water sewer records indicate that the closest sewer to the site is a 150mm diameter foul sewer located 60m to the east of the site within Weston Road. No incidents of sewer flooding have been recorded within the NSC Level 1 SFRA for Long Ashton. Flooding from sewers can therefore be considered low.

Sewer/ Drain Flood Risk Mitigation Measures

- 3.10 No mitigation required.

Aiv) Assessment of Flood Risk from Overland Flow (Pluvial)

- 3.11 The Surface Water Flood Zone Map for the locality as produced by the EA is shown on CEC Figure 3454/500/Figure 3 [*EA Surface Water Flood Zone Map*] within Appendix 1. The mapping shows the site to be at very low risk from surface water flooding.
- 3.12 There are surface water flow paths located to the south of the site, classed as low-high. If overland flooding were to occur the flooding would be contained within the Weston Road highway and land to the south of the site which is at a lower level.

Overland Flow Flood Risk Mitigation Measures

- 3.13 No mitigation required.

Av) Assessment of Flood Risk from Groundwater

- 3.14 BGS records indicate the site to be underlain by Mercia Mudstone Group - Mudstone and Halite-stone. The ground investigation found the site to be underlain by head deposits of sandy gravelly clay underlain by Mercia Mudstone Group - Clay. Groundwater seepages were encountered between 0.0m - 0.3m depth within each of the trial pits. The site investigation was completed after a period of heavy rainfall and it is likely the groundwater was perched above the impermeable clay layer. Should groundwater emergence occur within the site, floodwaters would follow the natural topography of the site and flow in a southerly direction towards Weston Road.
- 3.15 The NSC Level 1 SFRA does not record any historic incidents of flooding within the vicinity of the development site.

3.16 The risk of groundwater flooding can therefore be considered moderate.

Groundwater Flood Risk Mitigation Measures

3.17 Finished floor levels should be raised 150mm above finished ground levels.

Avi) Assessment of Flood Risk from Artificial sources

3.18 The EA Risk of Flooding from Reservoirs Map shows the site not to be at risk from flooding as a result of artificial sources. Flooding from artificial sources can therefore be considered low.

Reservoir Flood Risk Mitigation Measures

3.19 No mitigation required.

Table 3.1: Assessment of Flood Risk to the Development Site Arising from External Sources

Source of Potential Flooding to the Development Site	Flood Risk	Mitigation/Comments
Groundwater	Moderate	Finished floor levels to be raised 150mm above finished ground levels
Fluvial	Low	No mitigation measures required
Overland Flow		
Public Sewer / Drains		
Ditches		
Tidal		
Artificial Sources		

B) Assessment of Flood Risk Arising from Surface Water Discharge from the Proposed Development

Refer to CEC Plan 3454/501(A) [*Proposed Drainage Layout*] in Appendix 6.

3.20 In order to mitigate flood risk posed by post development runoff, adequate control measures will be provided within the site, including Sustainable Urban Drainage Systems (SuDS).

Bi) Surface Water Runoff Control

3.21 The proposed development comprises some 7702m² of impermeable surfacing (roofs, parking and driveways).

- 3.22 An additional allowance of 10% has been added to the proposed residential dwellings impermeable area to take into account future urban creep, in accordance with the West of England Sustainable Drainage Developer Guide, Section 1. Therefore, all post development calculations have been made on the basis of 8,020m² of impermeable area. Refer to calculations in Appendix 4.

Bii) Infiltration Potential

- 3.23 The site is underlain Mercia Mudstone Group - Mudstone and Halite-stone. An intrusive site investigation confirmed the site to be underlain by clay. Clays are impermeable and would prevent the effective operation of infiltration-based SuDS. Testing was attempted within two trial pits on site and both failed. An attenuation strategy is therefore proposed. Refer to the Geotechnical Report located within Appendix 3.

Drainage Hierarchy

- 3.24 The drainage strategy for the site has been prepared according to the drainage discharge hierarchy from *CIRIA C753 The SuDS Manual*, as follows:
1. Infiltration to the maximum extent that is practical.
 2. Discharge to surface waters.
 3. Discharge to surface water sewer.

Biii) Proposed Surface Water Drainage Strategy

Discharge location

- 3.25 It is proposed that surface water from the proposed development will be directed into a cellular storage located in the south east corner of the site. The cellular storage will drain into the existing public surface water sewer located within Pear Tree Avenue.

Discharge Rate

- 3.26 Proposed surface water discharge will be restricted to the QBAR greenfield runoff rate (4.7l/s).

Proposed Sustainable Drainage Systems

- 3.27 In order to utilise upstream storage of surface water, some of the parking areas on the site are to be split up into areas of tanked permeable paving. Tanked permeable pavements comprise block paving laid over a clean stone storage medium which is enclosed within an impermeable membrane. Water percolates through the block work and into the storage layer below, which acts as a tank. Roof water is piped directly into the storage layer.

3.28 The surface water from the permeable paving will be piped and discharge into a cellular storage tank located within the south eastern corner of the site. Surface water from the proposed paths will be conveyed within a swale before discharging into the cellular storage.

3.29 The proposed SuDS areas are divided into 5 catchments as detailed below.

Permeable Paving Area 1

3.30 Permeable paving area 1 comprises four residential units and parking area within the north western corner of the site. Discharge from area 1 will be restricted to 1.1l/s and will require an effective storage depth of 0.70m.

Permeable Paving Area 2

3.31 This area comprises the singular residential unit and parking area within the north eastern corner of the site. The discharge from this area will be restricted to 0.5l/s and an effective storage depth of 0.35m is required.

Permeable Paving Area 3

3.32 This area comprises the three residential units and parking area within the western area of the site. The discharge from this area will be restricted to 0.9l/s and an effective storage depth of 0.65m is required.

Permeable Paving Area 4

3.33 Permeable paving area 4 comprises the parking areas and garages within the western area of the site. The discharge from this area will be restricted to 0.5l/s. An effective storage depth of 0.35m is required.

Permeable Paving Area 5

3.34 This area comprises the four residential units and parking area within the eastern side of the site. The discharge from this area will be restricted to 0.5l/s and will require an effective storage depth of 0.65m.

3.35 Each of the proposed areas of permeable paving will discharge into the cellular storage located within the south eastern corner of the site.

Conveyance Swales

- 3.36 Swales will be used to convey surface water from the proposed footpaths to the north and west of the site. Surface water from the swales will be piped into the cellular storage.

Cellular Storage

- 3.37 The remaining surface water from the residential units, parking and paths will be collected and piped directly into the cellular storage tank. Preliminary calculations indicate that some 404.0m³ of storage will be required to attenuate surface water discharge for all events up to and including the 1:100 year + 40% climate change to 4.7l/s. This volume can be provided within a cellular storage tank with dimensions 10m x 44m x 1.0m deep with a 95% void ratio.
- 3.38 All attenuation facilities have been designed to accommodate and dispose of runoff from storms up to the 1:100 year + 40% climate change event, without flooding, in accordance with NPPF guidance.

Table 3.2: Summary of Existing & Proposed Surface Water Discharge Rates

Developable Area (ha)		Discharge Point	Calculation Method	Discharge Rate (l/s)				Total Attenuation Volume Required (m ³)
				1:2 yr (QBAR)	1:30 yr	1:100 yr	1:100 yr +40%	
Greenfield (existing)	0.802	To ground	ICP SuDS	4.7	9.0	11.4	-	-
Proposed*	0.802	Attenuated to sewer	Micro Drainage	4.7	4.7	4.7	4.7	602.6

*Post development calculations include a 10% allowance for future urban creep in privately owned areas

Design Exceedance

- 3.39 Should the onsite drainage system fail under extreme rainfall events or blockage; flooding may occur within the site. Any resultant floodwater will be routed along highway corridors or via landscaped areas in a southerly direction following the natural topography, away from the proposed dwellings. The proposed cellular storage is located in the south eastern corner of the site, downslope of the proposed development area, therefore design exceedance flows from the cellular storage will not impact on the proposed dwellings.

Water Quality

- 3.40 Water quality has been assessed in line with the Simple Index approach from Chapter 26 of CIRIA C753 *The SuDS Manual*:
1. Step 1 - Allocate suitable pollution hazard indices for the proposed land use.
 2. Step 2 - Select SuDS with a total pollution mitigation index that equals or exceeds the pollution hazard index.

3.41 The highest pollution hazard level for the proposed land use is Low (residential car parks and low trafficked roads). The pollution hazard indices for this land use are shown in Table 3.3 below.

Table 3.3: Pollution Hazard Indices for the Proposed Site (from Table 26.2 of CIRIA C753 The SuDS Manual)

Total suspended solids (TSS)	Metals	Hydrocarbons
0.5	0.4	0.4

3.42 All SuDS components to be used in the development have been assessed for their effectiveness in pollutant removal prior to discharge to surface waters in Table 26.3 in CIRIA C753 *The SuDS Manual*. The pollution mitigation indices are show in Table 3.4 below.

Table 3.4: Pollution Mitigation Indices for Permeable Pavement (from Table 26.3 of CIRIA C753 The SuDS Manual)

Attenuation Device	Total suspended solids (TSS)	Metals	Hydrocarbons
Permeable Pavement	0.7	0.6	0.7

3.43 The Pollution Mitigation Indices for permeable pavement are greater than the Pollution Hazard Indices for car parks and low trafficked roads. The proposed facilities will therefore provide sufficient water quality treatment prior to discharge.

Adoption & Maintenance

3.44 The proposed SuDS will be managed privately by a management company as part of the site's overall maintenance programme. A Maintenance Schedule is discussed below and outlined in Table 3.5.

Permeable Paving

3.45 Permeable surfaces need to be regularly cleaned of silt and other sediments to preserve their infiltration capability. A brush and suction cleaner, which can be a lorry-mounted device or a smaller precinct sweeper, should be used and the sweeping regime should be as follows:

1. End of winter (April) - to collect winter debris.
2. Mid-summer (July/August) - to collect dust, flower and grass-type deposits.
3. After autumn leaf fall (November).

3.46 If reconstruction is necessary, the following procedure should be followed:

1. Lift surface layer and laying course.

2. Remove any geotextile filter layer.
3. Inspect sub-base and remove, wash and replace if required.
4. Renew any geotextile layer.
5. Renew laying course, jointing material and concrete block paving.

3.47 Materials removed from the voids or the layers below the surface of the paving may contain hazardous substances such as heavy metals and hydrocarbons which may need to be disposed of as controlled waste.

Cellular Storage

- 3.48 It is not envisaged that silt build up within the cellular crate systems will require a rigorous maintenance regime so long as silt is removed from upstream catch pits and inspection chambers on a regular basis. Notwithstanding this, a suitable maintenance regime for the systems will comprise of routine inspection and silt removal (as necessary). Inspection should be undertaken using CCTV equipment offered up the inspection tunnels located within the crate system. Camera access can be gained via inspection chambers and inlet pipework located at each end of the tunnels.
- 3.49 Silt removal can be achieved by jetting the inspection tunnels. Jetting should be undertaken in accordance with current jetting guidelines, in particular the Code of Practice for Sewer Jetting published by The Water Research Centre. Jetting at 150bar at 300l/min should be more than adequate in removing any build-up of material within the tunnel. The crate system will take higher pressures. However, unlike regular jetting which relies heavily on high pressure to remove hardened deposits on the inner bore of pipes, effective cleansing of a crate system relies more on the delivery flow rate to flush solids back through the system.
- 3.50 A standard jet head with rear facing nozzles should be used. The head should be fed to the far end of the crate tunnel via the nearest inspection chamber, activated and retracted. As the nozzle is removed, debris will be swept back into the inspection chamber where it can then be removed with the use of a standard gully sucker. This method will ensure the effective removal of gross solids (carrier bags, cans, leaf litter etc.) from the system. Whilst 100% removal cannot be guaranteed, it has been shown that this jetting method will also remove an element of finer material which would otherwise be 'lost' within the system.

Swales

- 3.51 Ongoing maintenance can be included in the wider landscape management strategy for the site.
- 3.52 Regular inspection and maintenance are important for the continued effective operation of swales. Adequate access should be provided to all swale areas for inspection/maintenance. The major maintenance requirement is mowing to retain grass lengths of 75-150mm across the treatment surface to assist in pollutant filtering and sediment retention.

Pipework and Catchpits

- 3.53 It is not envisaged that silt build up within the pipework systems will require a rigorous maintenance regime so long as silt is removed from upstream catch pits on a regular basis. Notwithstanding this, a suitable maintenance regime for the systems will comprise of routine inspection (every six months) and silt removal (as necessary).

Flow Controls

- 3.54 Flow controls should be inspected regularly for blockages and silt/ debris removed as necessary.

Table 3.5: Suggested Maintenance Regime for Elements of the Drainage Infrastructure

Drainage Element	Schedule	Maintenance Requirement	Frequency
Permeable Paving	Regular	Brushing and vacuuming over whole surface	Once a year, after autumn leaf fall
	Occasional	Removal of weeds	As required
	Remedial	Remedial work to any depressions or cracked or broken blocks considered a hazard to end users or detrimental to performance	As required
		Rehabilitation of surface and upper sub-structure by remedial sweeping	Every 10 - 15 years, or as required
	Monitoring	Initial inspection	Monthly for 3 months after installation
		Inspect for evidence of weed growth or poor operation	Three monthly, 48 hours after large storms in first six months
		<ul style="list-style-type: none"> ▪ Inspect silt accumulation rates ▪ Monitor inspection chambers 	Annually



Drainage Element	Schedule	Maintenance Requirement	Frequency
Swale	Regular	<ul style="list-style-type: none"> Mow grass Inspect inlets, outlets and overflows for blockages 	Monthly
		<ul style="list-style-type: none"> Remove litter and debris Inspect inlets and facility surface for silt accumulation, ponding or compaction 	Monthly, or as required
		Manage nuisance vegetation and other plans	Monthly, then as required
		Inspect vegetation coverage	Monthly for 6 months, quarterly for 2 years, then half yearly
	Occasional	<ul style="list-style-type: none"> Reseed areas of poor growth 	As required or if bare soil exposed over 10%+ of swale treatment area
	Remedial	<ul style="list-style-type: none"> Repair and damage or erosion Relevel uneven surfaces and reinstate design levels Remove build-up of sediment and oils/petrol residues 	As required
Cellular Attenuation Storage	Regular	Remove debris from the catchment surface	Monthly
		Inspect and identify any areas that are not operating correctly	Monthly for 3 months, then annually
		Remove sediment from pre-treatment structures and internal forebays	Annually, or as required
	Remedial	Repair and rehabilitate inlets, outlets, overflows and vents	As required
	Monitoring	Inspect inlets, outlets, overflows and vents to ensure they are operating as designed	Annually
		Survey inside of tank for sediment build-up and remove as necessary	Every 5 years, or as required
Pipework, Catchpits & Flow Controls	Regular	<ul style="list-style-type: none"> Inspect for accumulation of silt Inspect inlets, outlets and overflows for blockages Inspect for debris and litter 	Every six months
	Occasional	<ul style="list-style-type: none"> Remove debris and litter Remove silt 	As required

Note: In addition to the above maintenance requirements, it is recommended that all drainage elements are inspected:

- Following the first storm event
- Monthly for the first 3 months following commissioning

4.0 FOUL WATER DRAINAGE STRATEGY

Refer to CEC Plan 3454/501(A) [*Proposed Drainage Layout*] in Appendix 6.

- 4.1 Wessex Water sewer records indicate that a 150mm diameter public foul water sewer is located 86m to the south east of the site within Pear Tree Avenue.
- 4.2 It is not possible to achieve a gravity connection from the site to the public foul sewer. Foul flows from the site will therefore be pumped via a pumping station located in the east of the site. A rising main will connect the pumping station to MH3805 in Pear Tree Avenue.
- 4.3 A foul sewer capacity check has been submitted to Wessex Water. The Water Authority has confirmed that a connection to the network within Pear Tree Avenue is acceptable in principle but will require confirmation of proposed flow rates and pipe sizes before connection. Refer to correspondence located with Appendix 2.
- 4.4 All proposed foul drainage infrastructure will be offered for adoption by Wessex Water.

5.0 DISCUSSION AND CONCLUSIONS

Assessment of Flood Risk from External Sources

- 5.1 Flood risk to the proposed development from various sources, including rivers, sewers, groundwater, ditches and overland flow has been considered in this study.
- 5.2 Flood risk from groundwater is considered moderate.
- 5.3 Flood risk from all other sources is low.
- 5.4 Finished floor levels to be raised 150mm above finished ground levels to mitigate groundwater flood risk.

Assessment of Flood Risk Arising from Surface Water Discharge from the Proposed Development

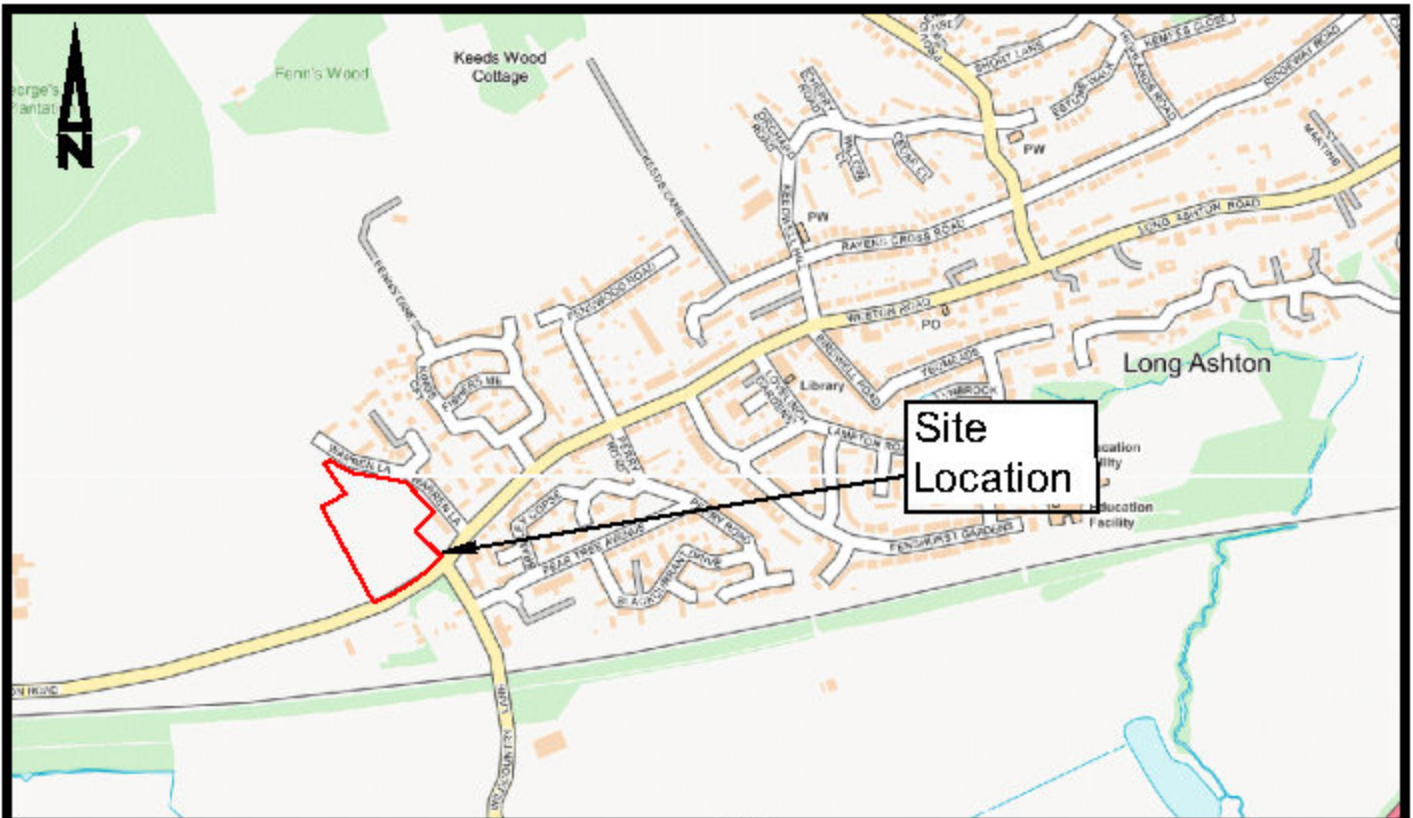
- 5.5 The proposed development will introduce impermeable surfaces in the form of roads, car parking areas and roof areas. Surface water runoff from the development site will be managed on site for storms up to the 1:100 year + 40% climate change event, without flooding.
- 5.6 Post development runoff will be discharged the existing public surface water sewer within Pear Tree Avenue located to the south east of the site, at the existing QBAR runoff rate (4.7l/s).
- 5.7 On site storage will be provided in permeable paving and cellular storage Sustainable Urban Drainage System (SuDS). Preliminary calculations indicate that some 602.6m³ of storage is required for the proposed development.
- 5.8 Should the on-site drainage system fail under extreme rainfall events or due to blockage, flooding may occur within the site. Any resultant floodwater will be routed in a south easterly direction following the natural topography, along highway corridors and landscaped areas and away from the proposed dwellings.
- 5.9 Water quality has been assessed in line with the Simple Index approach from Chapter 26 of CIRIA C753 *The SuDS Manual*. The proposed SuDS devices provide adequate mitigation for the pollution generated by the development.



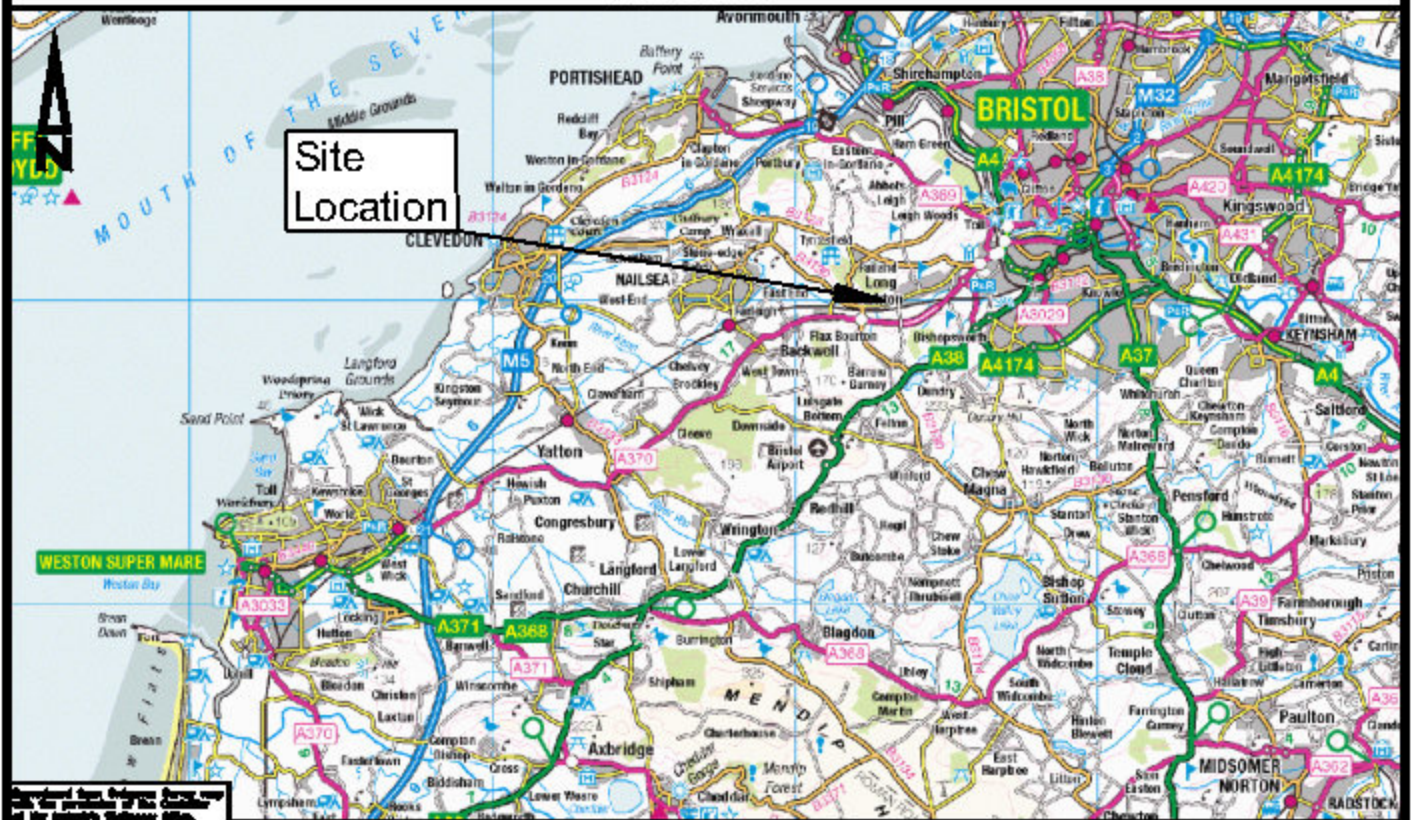
- 5.10 Post development foul flows will be discharged into the existing public foul water sewer located within Pear Tree Avenue, via an offsite rising main connection.
- 5.11 The proposed SuDS features will be maintained by a management company. Proposed surface water sewers and all foul drainage infrastructure will be offered for adoption by Wessex Water.
- 5.12 This study has been undertaken in accordance with the principles set out in NPPF. We can conclude that providing the development adheres to the conditions advised in Paragraphs 5.1 to 5.11 above, the said development proposals can be accommodated without increasing flood risk within the locality in accordance with objectives set by Central Government and the EA.

Cole Easdon Consultants Limited
June 2020

Appendix 1



Scale: 1:10,000



Scale: 1:250,000

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Job Title
Land South of Warren Lane
Long Ashton
Somerset

Client
Long Ashton
Land Company Ltd

Drawing Status	
FOR APPROVAL	<input type="checkbox"/>
FOR ISSUE	<input checked="" type="checkbox"/>
FOR APPROVAL	<input type="checkbox"/>
FOR APPROVAL	<input type="checkbox"/>
FOR APPROVAL	<input type="checkbox"/>
FOR APPROVAL	<input type="checkbox"/>

Drawing Title
Site Location Plan

Drawn By
ZB

Date Drawn
February 2020

Scale
As Shown (A4)

Checked By
DF

Drawing No
1454/500 Figure 1

Revision



Flood Zone 1
- Low Risk



Flood Zone 2
- Medium Risk



Flood Zone 3
- High Risk



Main Rivers

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Job Title:

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Long Ashton
Somerset

Client:

Long Ashton
Land Company Ltd

Drawing Status:

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	FOR TENDER	
	FOR APPROVAL	
	FOR CONSTRUCTION	
AS BUILT		

Drawing Title:

EA Flood Zone Map

Drawn By

ZB

Date Drawn

February 2020

Scale

1:10,000 @ A4

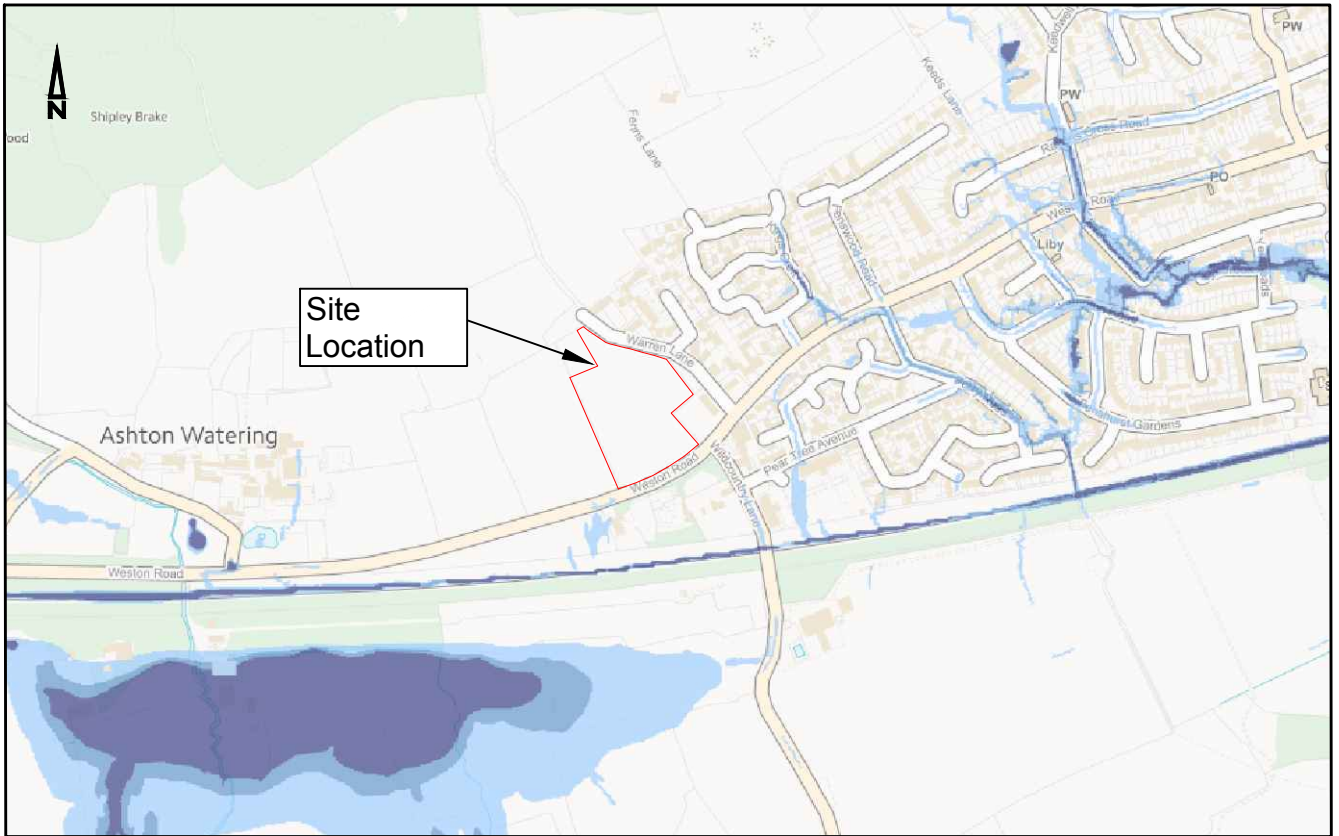
Checked By

DF

Drawing No.

3454/500 Figure 2

Revision



Surface Water Flooding - Very Low Risk



Surface Water Flooding - Low Risk



Surface Water Flooding - Medium Risk



Surface Water Flooding - High Risk

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Job Title:

Land South of Warren Lane
Long Ashton
Somerset

Client:

Long Ashton
Land Company Ltd

Drawing Status:

CONSTRUCTION AT CLIENT AND/OR CONTRACTOR RISK	FOR COMMENT	
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	FOR TENDER	
	FOR APPROVAL	
	FOR CONSTRUCTION	
	AS BUILT	

Drawing Title:

EA Surface Water Flood Zone Map

Drawn By

ZB

Date Drawn

February 2020

Scale

1:10,000 @ A4

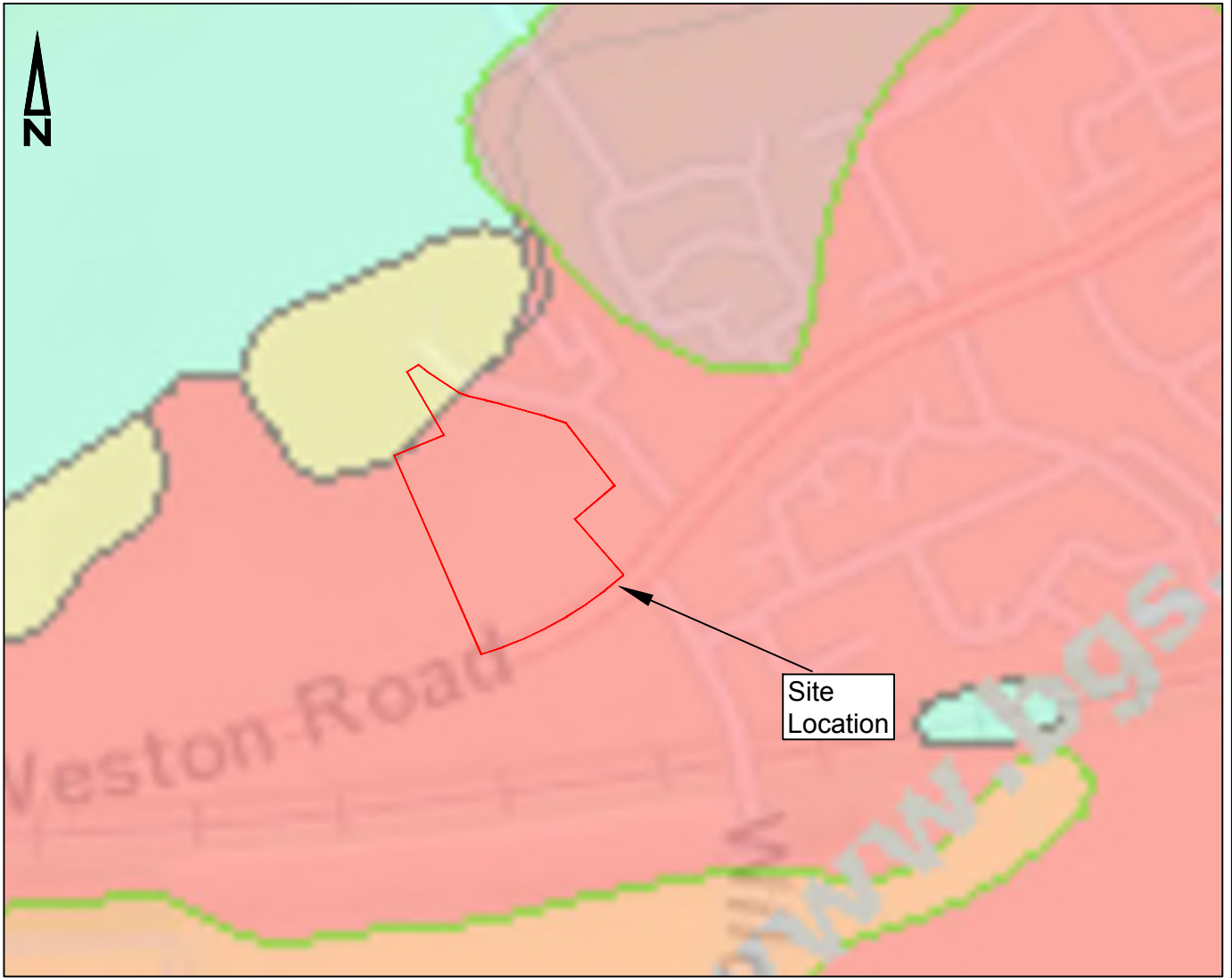
Checked By

DF

Drawing No.

3454/500 Figure 3

Revision



Key:

- Mercia Mudstone Group - Mudstone and Halite-stone
- Quartzitic Sandstone Formation - Sandstone
- Oxwich Head Limestone Formation - Limestone, Ooidal
- River Terrace Deposits, 1 - Silt

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CLIENT AND/OR CONTRACTOR	FOR PLANNING	<input checked="" type="checkbox"/>																				
	FOR TENDER	<input type="checkbox"/>																				
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	FOR CONSTRUCTION	<input type="checkbox"/>																				
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Drawn By ZB	Date Drawn February 2020	Scale 1:5,000 @ A4																				
Checked By DF	Drawing No. 3454/500 Figure 4																					
	Revision																					

Appendix 2



Gatcombe Farm North FM

Printed on : 05/03/2019 11:16

WATER MAINS		Public	Private
Public	Raw Water	—	---
Abandoned	Valve	X
	Hydrant	●	●
	PRV	▲	▲
	Meter	M	M
SEWERS		Public - Section 104 - Private	
Foul	Combined	—	---
Surface	Abandoned sewers	X
OTHER WESSEX PIPES			
Rising Mains	Effluent Disposal Main	—	---
Overflow	NON-WESSEX PIPES	X
Private Rising Mains	Culverted Water Course	—	---
Highway Drain		X

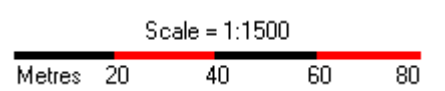
Information in this plan is provided for identification purposes only. No warranty as to accuracy is given or implied. The precise route of pipe work may not exactly match that shown. Wessex Water does not accept liability for inaccuracies.

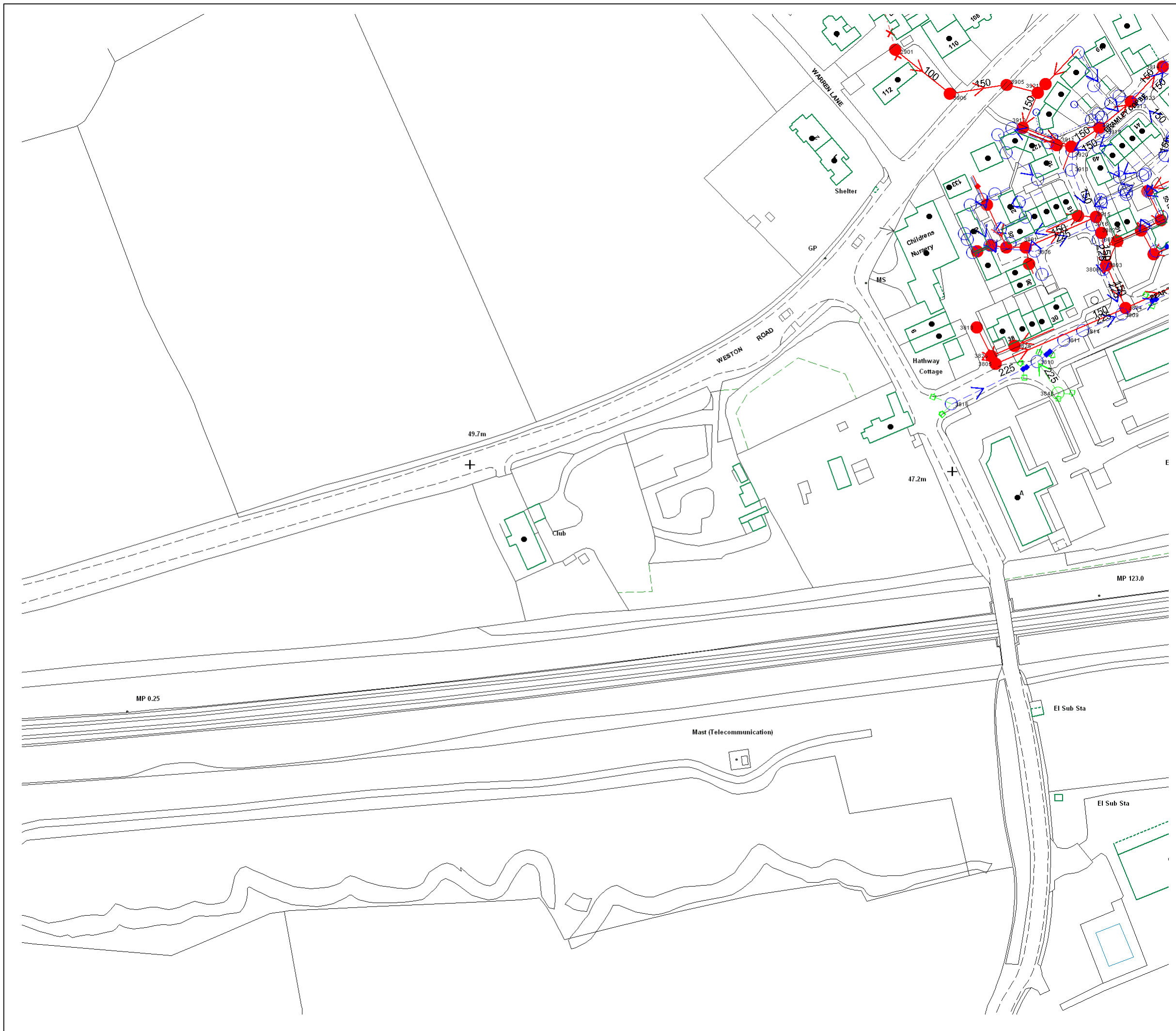
Sewers and lateral drains adopted by Wessex Water under the Water Industry (Schemes for Adoption of Private Sewers) Regulations 2011 are to be plotted over time and may not yet be shown.

In carrying out any works, you accept liability for the cost of any repairs to Wessex Water apparatus damaged as a result of your works. You are advised to commence excavations using hand tools only. Mechanical digging equipment should not be used until pipe work has been precisely located.

If you are considering any form of building works and pipe work is shown within the boundary of your property or a property to be purchased (or very close by) a surveyor should plot its exact position prior to commencing works or purchase. Building over or near Wessex Water's apparatus is not normally permitted.

Centre: 353066.58 , 170071.76





Gatcombe Farm South FM

Printed on : 05/03/2019 11:17

WATER MAINS		Public	Private
Public Raw Water			
Abandoned			
Valve		Hydrant	PRV
		Meter	
SEWERS		Public - Section 104 - Private	
Foul			
Combined			
Surface			
Abandoned sewers			
OTHER WESSEX PIPES			
Rising Mains			
Effluent Disposal Main			
Overflow			
NON-WESSEX PIPES			
Private Rising Mains			
Culverted Water Course			
Highway Drain			

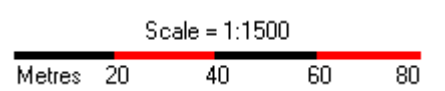
Information in this plan is provided for identification purposes only. No warranty as to accuracy is given or implied. The precise route of pipe work may not exactly match that shown. Wessex Water does not accept liability for inaccuracies.

Sewers and lateral drains adopted by Wessex Water under the Water Industry (Schemes for Adoption of Private Sewers) Regulations 2011 are to be plotted over time and may not yet be shown.

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Centre:353164.21 , 169782.04



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ST53695913	Manhole - Single	50.02	47.03	3
ST53694920	Manhole - Single	51.19	47.39	3.8
ST53695916	Manhole - Single	50.3	46.97	3.33
ST53695917	Manhole - Single	49.86	46.87	2.99
ST53704021	Manhole - Single	52.49	49.4	3.09
ST53704022	Manhole - Single	49.16	46.54	2.62
ST53704023	Manhole - Single	50.55	49.14	1.41
ST53705105	Manhole - Single	52.13		0
ST53705106	Manhole - Single	50.19		0
ST53695918	Manhole - Single	49.86	46.54	3.32
ST53695919	Manhole - Single	51.53	48.98	2.55
ST53702025	Manhole - Single	57.03	56	1.03

ST53703139	Manhole - Single	56.94	56.3	0.64
ST53703050	Manhole - Single	55.61	55.42	0
ST53703052	Manhole - Single	55.48		0
ST53703053	Manhole - Single	55.2		0
ST53703054	Manhole - Single	55.29		0
ST53703055	Manhole - Single	55.34		0
ST53703056	Manhole - Single	53.06	52.2	0.86
ST53693928	Manhole - Single	51.9		0
ST53693929	Manhole - Single	51.17		0
ST53693818	Manhole - Single	51.19		0
ST53693930	Manhole - Single	51.42		0
ST53693820	Manhole - Single	51.15		0
ST53693821	Manhole - Single	51.42		0
ST53693822	Manhole - Single	51.34		0
ST53694807	Manhole - Single	50.82		0
ST53693826	Manhole - Single	50.6		0
ST53693827	Manhole - Single	50.81		0
ST53693828	Manhole - Single	50.6		0
ST53694924	Manhole - Single	51.32		0
ST53694925	Manhole - Single	51.29		0
ST53693931	Manhole - Single	50.86		0
ST53693932	Manhole - Single	50.97		0
ST53694927	Manhole - Single	51.81		0
ST53694928	Manhole - Single	51.71		0
ST53694929	Manhole - Single	51.53		0
ST53694930	Manhole - Single	51.57		0
ST53694933	Manhole - Single	51.71		0
ST53694934	Manhole - Single	51.82		0
ST53694935	Manhole - Single	51.71		0
ST53694936	Manhole - Single	51.44		0
ST53694937	Manhole - Single	51.82		0
ST53694940	Manhole - Single	52.34		0
ST53694941	Manhole - Single	52.4		0
ST53694942	Manhole - Single	52.52		0
ST53694949	Manhole - Single	52.14		0
ST53704025	Manhole - Single	52.56		0
ST53694951	Manhole - Single	52.37		0
ST53694954	Manhole - Single	52.15		0
ST53694955	Manhole - Single	52.12		0
ST53694956	Manhole - Single	52		0
ST53704027	Manhole - Single	52.15		0
ST53702020	Manhole - Single	57.11	52.85	4.26
ST53702021	Manhole - Single	57.74	55.44	2.3
ST53702022	Manhole - Single	57.74	55.74	2
ST53703046	Manhole - Single	55.26	52.07	3.19
ST53703047	Manhole - Single	55.19	51.94	3.25
ST53702136	Manhole - Single	64.4	63.05	1.35
ST53703201	Manhole - Single	59.33	57.9	1.43
ST53693922	Manhole - Single	51.78	49.65	2.13
ST53694921	Manhole - Single	51.72	49.6	2.12

ST53693923	Manhole - Single	52.34	49.45	2.89
ST53693924	Manhole - Single	52.31	49.37	2.94
ST53694922	Manhole - Single	52.53	49.25	3.28
ST53704028	Manhole - Single	51.98		0
ST53704029	Manhole - Single	50.99		0
ST53704030	Manhole - Single	50.95		0
ST53693829	Manhole - Single	51.47		0
ST53693830	Manhole - Single	51.4		0
ST53693831	Manhole - Single	51.41		0
ST53693833	Manhole - Single	51.47		0
ST53693939	Manhole - Single	51.53		0
ST53693940	Manhole - Single	51.48		0
ST53693941	Manhole - Single	51.76		0
ST53693944	Manhole - Single	51.41		0
ST53693945	Manhole - Single	51.14		0
ST53693834	Manhole - Single	51.24		0
ST53693835	Manhole - Single	51.14		0
ST53693948	Manhole - Single	51.99		0
ST53693949	Manhole - Single	52.53		0
ST53693950	Manhole - Single	52.44		0
ST53693951	Manhole - Single	52.45		0
ST53693952	Manhole - Single	51.69		0
ST53693955	Manhole - Single	52.39		0
ST53693956	Manhole - Single	52.17		0
ST53693957	Manhole - Single	52.05		0
ST53693958	Manhole - Single	52.33		0
ST53693959	Manhole - Single	52.38		0
ST53693960	Manhole - Single	52.38		0
ST53693961	Manhole - Single	52.69		0
ST53693962	Manhole - Single	52.54		0
ST53693963	Manhole - Single	52.48		0
ST53693964	Manhole - Single	52.41		0
ST53693965	Manhole - Single	52.39		0
ST53693969	Manhole - Single	51.96		0
ST53693970	Manhole - Single	51.64		0
ST53693971	Manhole - Single	51.14		0
ST53693972	Manhole - Single	51.12		0
ST53693973	Manhole - Single	50.96		0
ST53693974	Manhole - Single	50.98		0
ST53693976	Manhole - Single	50.93		0
ST53694958	Manhole - Single	50.96		0
ST53694959	Manhole - Single	50.92		0
ST53693977	Manhole - Single	50.83		0
ST53693978	Manhole - Single	50.9		0
ST53693979	Manhole - Single	50.81		0
ST53693836	Manhole - Single	50.64		0
ST53694808	Manhole - Single	50.85		0
ST53694963	Manhole - Single	51.73		0
ST53693980	Manhole - Single	51.02		0
ST53693981	Manhole - Single	51.03		0

ST53694964	Manhole - Single	51.77		0
ST53694965	Manhole - Single	51.73		0
ST53694967	Manhole - Single	50.79		0
ST53694968	Manhole - Single	50.77		0
ST53695920	Manhole - Single	50.59		0
ST53705009	Manhole - Single	51.06		0
ST53704035	Manhole - Single	52.19		0
ST53704036	Manhole - Single	52.18		0
ST53704037	Manhole - Single	52.34		0
ST53704038	Manhole - Single	52.29		0
ST53704039	Manhole - Single	52.39		0
ST53704041	Manhole - Single	52.08		0
ST53704042	Manhole - Single	52.2		0
ST53704043	Manhole - Single	50.93		0
ST53704044	Manhole - Single	51.01		0
ST53694969	Manhole - Single	51.03		0
ST53694970	Manhole - Single	50.87		0
ST53694971	Manhole - Single	50.71		0
ST53694972	Manhole - Single	50.58	48.44	2.14
ST53694973	Manhole - Single	50.55		0
ST53695922	Manhole - Single	50.9		0
ST53695923	Manhole - Single	50.7		0
ST53695924	Manhole - Single	50.44		0
ST53695925	Manhole - Single	50.43		0
ST53694974	Manhole - Single	50.59		0
ST53695927	Manhole - Single	50.42		0
ST53694979	Manhole - Single	51.59		0
ST53694980	Manhole - Single	51.51		0
ST53694981	Manhole - Single	51.52		0
ST53694982	Manhole - Single	51.54		0
ST53694983	Manhole - Single	51.71		0
ST53694984	Manhole - Single	51.78	49.53	2.25
ST53694985	Manhole - Single	51.8		
ST53705012	Manhole - Single	49.01		0
ST53704046	Manhole - Single	52.59	51.74	0.85
ST53702027	Manhole - Single	57.83	55.64	2.19
ST53702028	Manhole - Single	57.75	55.94	1.81
ST53702029	Manhole - Single	58.5	57.45	1.05
ST53701005	Manhole - Single	60.15	59.68	0.48
ST53701006	Manhole - Single	60.4	59.75	0.65
ST53701105	Manhole - Single	63.7		0
ST53701106	Manhole - Single	62.5	61.49	1.01
ST53701107	Manhole - Single	62.15	61.15	1
ST53701007	Manhole - Single	61.67	60.67	1
ST53701008	Manhole - Single	60.95	59.59	1.36
ST53702030	Manhole - Single	58.14	55.71	2.44
ST53701108	Manhole - Single	64.45		0
ST53701009	Manhole - Single	59.4	58.05	1.35
ST53701010	Manhole - Single	59.2	58.22	0.98
ST53701011	Manhole - Single	60	58.8	1.2

ST53701012	Manhole - Single	61.7		0
ST53701013	Manhole - Single	63.42		0
ST53701014	Manhole - Single	63.1	62.35	0.75
ST53701015	Manhole - Single	63.5	62.2	1.3
ST53701016	Manhole - Single	62.74	61.99	0.75
ST53701109	Manhole - Single	62.7	61.8	0.9
ST53701110	Manhole - Single	62.6	61.53	1.07
ST53701018	Manhole - Single	62.1	61.5	0.6
ST53701019	Manhole - Single	61.32	60.32	1
ST53701020	Manhole - Single	60.15	59.15	1
ST53701021	Manhole - Single	59.65	58.65	1
ST53701022	Manhole - Single	59.94		0
ST53701023	Manhole - Single	58.61		0
ST53701024	Manhole - Single	57.93	56.58	1.35
ST53701025	Manhole - Single	58.15	57.37	0.78
ST53701030	Manhole - Single	63.07	61.01	2.06
ST53701031	Manhole - Single	63.5	62.5	1
ST53701032	Manhole - Single	63.06	62	1.06
ST53701033	Manhole - Single	63	62.11	0.89
ST53701114	Manhole - Single	62.6	61.86	0.74
ST53701034	Manhole - Single	60.61	59.19	1.43
ST53701035	Manhole - Single	59.04	57.25	1.79
ST53701036	Manhole - Single	63		0
ST53701042	Manhole - Single	58.24		0
ST53702032	Manhole - Single	58.19	56.05	2.14
ST53702033	Manhole - Single	58.17	56.03	2.14
ST53702035	Manhole - Single	57.85		0
ST53702038	Manhole - Single	58.06		0
ST53701043	Manhole - Single	57.97	56.67	1.3
ST53701003	Manhole - Single	63.19		0
ST53701028	Manhole - Single	62.51	61.4	1.11
ST53701029	Manhole - Single	62.16	60.74	1.43
ST53705108	Manhole - Single	51.77		0
ST53703142	Manhole - Single	57.05		0
ST53703143	Manhole - Single	57.06		0
ST53695929	Manhole - Single	50.5		0
ST53694992	Manhole - Single	52.44		0
ST53694993	Manhole - Single	52.45		0
ST53701048	Manhole - Single	63.8		0.2
ST53701049	Manhole - Single	63.7		0
ST53701050	Manhole - Single	63.42		0
ST53701051	Manhole - Single	63.71		0.15
ST53701052	Manhole - Single	63.24		0
ST53695934	Manhole - Single	50.09		0
ST53695935	Manhole - Single	50.11		0
ST53702039	Manhole - Single	57.95	55.48	2.47
ST53702040	Manhole - Single	57.84	55.76	2.09
ST53701057	Manhole - Single	58.55		0
ST53701058	Manhole - Single	60.51		0
ST53701059	Manhole - Single	61.48		0

ST53701065	Manhole - Single	61.85		0
ST53701066	Manhole - Single	60.91		0
ST53701067	Manhole - Single	61.71		0
ST53701068	Manhole - Single	62.11		0
ST53701070	Manhole - Single	58.31		0
ST53701072	Manhole - Single	58.53		0
ST53702046	Manhole - Single	57.94		0
ST53701074	Manhole - Single	58.27		0
ST53702048	Manhole - Single	57.98		0
ST53702049	Manhole - Single	57.97		0
ST53702050	Manhole - Single	58.03		0
ST53702051	Manhole - Single	58.04		0
ST53701075	Manhole - Single	60.27		0
ST53701076	Manhole - Single	59.66		0
ST53704204	Manhole - Single	53.53		0
ST53705211	Manhole - Single	53.44		0
ST53704213	Manhole - Single	56.39		0
ST53704214	Manhole - Single	55.85		0
ST53703205	Manhole - Single	56.98		0
ST53704221	Manhole - Single	56.58		0
ST53704223	Manhole - Single	56.35		0
ST53704227	Manhole - Single	55.91		0
ST53695812	Manhole - Single	49.41	46.04	3.37
ST53695813	Manhole - Single	49.42	48.14	1.28
ST53695956	Manhole - Single	49.41	48.31	1.1
ST53695957	Manhole - Single	49.24	48.24	1
ST53695826	Manhole - Single	49.45	46.1	3.35
ST53695827	Manhole - Single	49.45	48.29	1.16
ST53695828	Manhole - Single	49.4	43.97	5.43
ST53695829	Manhole - Single	49.23	48.03	1.2
ST53695830	Manhole - Single	49.4	48.09	1.31
ST53695966	Manhole - Single	49.81	48.28	1.53
ST53695968	Manhole - Single	49.65	48.59	1.06
ST53695969	Manhole - Single	49.87	48.83	1.04
ST53695970	Manhole - Single	49.79	48.94	0.85
ST53695971	Manhole - Single	49.79	49.09	0.7
ST53695972	Manhole - Single	49.83	48.63	1.2
ST53695973	Manhole - Single	49.85	49.25	0.6
ST53695981	Manhole - Single	49.87		0
ST53694891	Manhole - Single	50.6	49.87	0.73
ST536958H6	Manhole - Single	49.79	48.78	1.01
ST536958H7	Manhole - Single	49.8	48.55	1.25
ST536958H8	Manhole - Single	49.8	48.44	1.36
ST536958H9	Manhole - Single	49.79	48.69	1.1
ST536958I0	Manhole - Single	49.75	49.05	0.7
ST536958K3	Manhole - Single	49.87	49.24	0.63
ST536958K4	Manhole - Single	49.87	48.95	0.92
ST536958K5	Manhole - Single	49.87	48.95	0.92
ST536958K6	Manhole - Single	49.98	49.38	0.6
ST536958M1	Manhole - Single	49.53	48.24	1.29

ST536958M2	Manhole - Single	49.44	48.3	1.14
ST536958M3	Manhole - Single	49.25	48.54	0.71
ST536958M4	Manhole - Single	49.45	48.04	1.41
ST536958M5	Manhole - Single	49.53	47.95	1.58
ST53695983	Manhole - Single	49.33	48.22	1.11
ST536958M8	Manhole - Single	49.25	48.5	0.75
ST536958M9	Manhole - Single	49.25	48.65	0.6
ST53695984	Manhole - Single	49.48	48.22	1.26
ST536958N0	Manhole - Single	49.25	48.74	0.51
ST53695985	Manhole - Single	49.48	48.6	0.88
ST53695986	Manhole - Single	49.5	48.32	1.18
ST53695987	Manhole - Single	49.55	48.37	1.18
ST53695988	Manhole - Single	49.55	48.5	1.05
ST53695989	Manhole - Single	49.58	48.63	0.95
ST536958N1	Manhole - Single	49.37	48.77	0.6
ST53695991	Manhole - Single	50.02	48.58	1.44
ST53695992	Manhole - Single	50.19	48.5	1.69
ST53695993	Manhole - Single	50.27	49.1	1.17
ST53695994	Manhole - Single	50.09	49.4	0.69
ST53695995	Manhole - Single	51	49.4	1.6
ST536948C5	Manhole - Single	50.64	50.1	0.54
ST536948C6	Manhole - Single	50.82	49.91	0.91
ST53695999	Manhole - Single	50.72	49.95	0.77
ST536948C8	Manhole - Single	50.89	49.95	0.94
ST536959A1	Manhole - Single	50.67	49.83	0.84
ST536959A7	Manhole - Single	50.64	49.75	0.89
ST536959A8	Manhole - Single	50.68	49.51	1.17
ST536959A9	Manhole - Single	50.96	49.09	1.87
ST536948D4	Manhole - Single	50.76	49.7	1.06
ST536948D5	Manhole - Single	50.74	49.9	0.84
ST536948D6	Manhole - Single	50.65	50.05	0.6
ST536948D7	Manhole - Single	50.89	49.75	1.14
ST53704049	Manhole - Single	51.6		0
ST53694999	Manhole - Single	52		0
ST536949A0	Manhole - Single	51.86		0
ST536949A1	Manhole - Single	52.11		0
ST536949A2	Manhole - Single	51.99		0
ST536949A3	Manhole - Single	51.96		0
ST536959D1	Manhole - Single	51.1		0
ST536959D2	Manhole - Single	50.66		0
ST536959D5	Manhole - Single	50.65		0
ST536959D6	Manhole - Single	50.59		0
ST536949A6	Manhole - Single	51.29		0
ST536959D7	Manhole - Single	51.62		0
ST536949B5	Manhole - Single	50.76		0
ST536949B6	Manhole - Single	50.66		0
ST536949B7	Manhole - Single	52.21		0
ST536949B8	Manhole - Single	52.47		0
ST536949B9	Manhole - Single	52.36		0
ST536949C0	Manhole - Single	52.47		0

ST536949C1	Manhole - Single	52.52		0
ST536949C3	Manhole - Single	51.71		0
ST536959D8	Manhole - Single	50.42		0
ST536959D9	Manhole - Single	50.7		0
ST53705014	Manhole - Single	50.83		0
ST53705019	Manhole - Single	49.23		0
ST53702167	Manhole - Single	61.02	60.7	0.32
ST53702168	Manhole - Single	60.74	60.55	0
ST53703194	Manhole - Single	60.24	59.6	0.64
ST53703195	Manhole - Single	59.82	59.1	0.72
ST53703197	Manhole - Single	57.55	57.1	0.45
ST53702170	Manhole - Single	60.95	61.4	0
ST53702171	Manhole - Single	62.17	61.85	0.32
ST53703198	Manhole - Single	55.84	55.4	0.44
ST53703199	Manhole - Single	57.57	57.1	0.47
ST53702172	Manhole - Single	58.78	58.05	0.73
ST53702173	Manhole - Single	58.45	57.9	0.55
ST53702176	Manhole - Single	58.48	57.41	1.07
ST537030B4	Manhole - Single	56.57	56	0.57
ST537031A1	Manhole - Single	56.88	56	0.88
ST537030B5	Manhole - Single	54.16	52.08	2.08
ST537030B6	Manhole - Single	55.44	54.7	0.74
ST537030B7	Manhole - Single	53.23	52.4	0.83
ST537030B8	Manhole - Single	53.79	52.5	1.29
ST53693983	Manhole - Single	53.18	52.64	0.54
ST537030C1	Manhole - Single	54.76	54.14	0.62
ST537030C2	Manhole - Single	56.56	55.8	0.76
ST537030C3	Manhole - Single	54.98		0
ST537030C4	Manhole - Single	55.96	55.2	0.76
ST537030C6	Manhole - Single	55.96	54.07	1.89
ST537030C7	Manhole - Single	55.75	54.11	1.64
ST537030C8	Manhole - Single	56	54.3	1.7
ST537030C9	Manhole - Single	55.96	54.4	1.56
ST537030D0	Manhole - Single	56.18	54.68	1.5
ST537030D1	Manhole - Single	56.16	54.65	1.51
ST537030D2	Manhole - Single	56.09	55.6	0.49
ST53702064	Manhole - Single	57.03	56.01	1.02
ST53702065	Manhole - Single	57.06	55.6	1.46
ST53702066	Manhole - Single	57.67	56.93	0.74
ST53702067	Manhole - Single	57.48	57.1	0.38
ST53702071	Manhole - Single	57.9	56.58	1.32
ST53702072	Manhole - Single	57.9	56.55	1.35
ST53702073	Manhole - Single	57.82	57.1	0.72
ST53702074	Manhole - Single	57.81	57.2	0.61
ST53702075	Manhole - Single	58.07	57.35	0.72
ST53702076	Manhole - Single	58.74	58.15	0.59
ST53702178	Manhole - Single	60.01	56.62	3.39
ST53702179	Manhole - Single	60.01		0
ST53702181	Manhole - Single	60.08	59.01	1.07
ST53702182	Manhole - Single	61.59	60.43	1.16

ST53702183	Manhole - Single	61.6	60.4	1.2
ST53702185	Manhole - Single	62.03	60.34	1.69
ST53702186	Manhole - Single	61.99	60.9	1.09
ST53701124	Manhole - Single	62.31	60.75	1.56
ST53702187	Manhole - Single	62.02	60.32	1.7
ST53702189	Manhole - Single	61.8	61.08	0.72
ST53702194	Manhole - Single	62.83	61.83	1
ST53702195	Manhole - Single	63.47	62.38	1.09
ST53702196	Manhole - Single	64.2	63.18	1.02
ST537021A0	Manhole - Single	62.75	61.83	0.92
ST537021A1	Manhole - Single	63.1	61.97	1.13
ST537021A2	Manhole - Single	63.41	62.04	1.37
ST537021A3	Manhole - Single	64.07	62.18	1.89
ST53701125	Manhole - Single	64.59	63.74	0.85
ST537021A4	Manhole - Single	64.12	63.1	1.02
ST537021B2	Manhole - Single	62.62	62.52	0
ST537021B3	Manhole - Single	62.16	61.6	0.56
ST537021B4	Manhole - Single	61.73	60.51	1.22
ST537021B5	Manhole - Single	61.75	60.54	1.21
ST537021B8	Manhole - Single	61.02	59.38	1.64
ST537021B9	Manhole - Single	60.95	59.4	1.55
ST53703099	Manhole - Single	53.14	52.25	0.89
ST53693982	Manhole - Single	53.43		0
ST537030A0	Manhole - Single	53.12	53.1	0
ST537030A1	Manhole - Single	55.03	54.37	0.66
ST537030A3	Manhole - Single	54.63	53.9	0.73
ST537030A4	Manhole - Single	52.87	52.6	0.27
ST53704050	Manhole - Single	54.24	53.7	0.54
ST53704051	Manhole - Single	53.83	53.5	0.33
ST53703185	Manhole - Single	55.74	55.2	0.54
ST53703186	Manhole - Single	55.77	55.31	0.46
ST53703187	Manhole - Single	56.41	56	0.41
ST53703188	Manhole - Single	56.62	56.6	0
ST53703191	Manhole - Single	59.49		0
ST53703192	Manhole - Single	59.53	59.2	0.33
ST53702161	Manhole - Single	62.95	63	0
ST53701122	Manhole - Single	65.54		0
ST53701123	Manhole - Single	65.04		0
ST53702162	Manhole - Single	62.82	62.3	0.52
ST53702163	Manhole - Single	61.52	60.95	0.57
ST53702164	Manhole - Single	61.79	61.3	0.49
ST53702165	Manhole - Single	61.63	61.15	0.48
ST53702166	Manhole - Single	59.54	58.5	1.04
ST53702054	Manhole - Single	58.23	57.25	0.98
ST53702055	Manhole - Single	57.82	56.7	1.12
ST53702056	Manhole - Single	57.67		0
ST53702057	Manhole - Single	56.96	56.25	0.71
ST537030A5	Manhole - Single	56.19	55.8	0.39
ST537030A7	Manhole - Single	54.83	54.2	0.63
ST537030A9	Manhole - Single	54.98	54.5	0.48

ST537030B0	Manhole - Single	55.71	55.54	0
ST537030B1	Manhole - Single	55.5		0
ST537030B2	Manhole - Single	56.62	56	0.62
ST537031A2	Manhole - Single	59.62	58.52	1.1
ST537031A3	Manhole - Single	59.53	58.75	0.78
ST537031A4	Manhole - Single	59.17	57.9	1.27
ST537031A5	Manhole - Single	59.15	57.87	1.28
ST537031A8	Manhole - Single	58.88	57.74	1.14
ST537031A9	Manhole - Single	58.07	57.5	0.57
ST537031B0	Manhole - Single	58.56	57.55	1.01
ST537031B1	Manhole - Single	57.89	57.32	0.57
ST537031B2	Manhole - Single	58.14	57.45	0.69
ST537031B3	Manhole - Single	57.62	56.95	0.67
ST537031B4	Manhole - Single	57.24	57.14	0
ST537031B5	Manhole - Single	57.24	56.45	0.79
ST537031B6	Manhole - Single	56.14	55.2	0.94
ST537031B7	Manhole - Single	56.13	55.17	0.96
ST537031B8	Manhole - Single	56.53	55.87	0.66
ST537031B9	Manhole - Single	56.5	55.79	0.71
ST537031C0	Manhole - Single	56.33	55.72	0.61
ST537031C1	Manhole - Single	55.92	54.94	0.98
ST537031C5	Manhole - Single	55.69	54.7	0.99
ST537031C6	Manhole - Single	55.71	54.65	1.06
ST537030D8	Manhole - Single	55.25	54.4	0.85
ST53704053	Manhole - Single	54.65	53.3	1.35
ST537030E0	Manhole - Single	54.69	53.27	1.42
ST53704055	Manhole - Single	54.34	54.25	0
ST537030E2	Manhole - Single	54.45	53.6	0.85
ST537030E3	Manhole - Single	55.23	54.53	0.7
ST53704056	Manhole - Single	53.3	52.12	1.18
ST53704057	Manhole - Single	53.4	52.43	0.97
ST53704058	Manhole - Single	52.86	51.6	1.26
ST537030E7	Manhole - Single	52.92	52.1	0.82
ST53704060	Manhole - Single	52.85	51.55	1.3
ST537030F0	Manhole - Single	53.49	52.27	1.22
ST537030F1	Manhole - Single	53.31	51.79	1.52
ST537030F2	Manhole - Single	53.31	52.68	0.63
ST537030F3	Manhole - Single	54.43	52.02	2.41
ST537030F4	Manhole - Single	54.5	52.81	1.69
ST537030F5	Manhole - Single	54.05	52.2	1.85
ST537030F6	Manhole - Single	54.01	52.36	1.65
ST537030G2	Manhole - Single	54.54	53.48	1.06
ST537030H1	Manhole - Single	55.76	55.79	0
ST537030H2	Manhole - Single	55.61	54.1	1.51
ST537030H3	Manhole - Single	55.41	54.23	1.18
ST537030H4	Manhole - Single	55.36	54.25	1.11
ST537030H5	Manhole - Single	55.2	54.3	0.9
ST537030H8	Manhole - Single	55.51	54.8	0.71
ST537030I3	Manhole - Single	55.43	54.75	0.68
ST537030I4	Manhole - Single	55.52	54.53	0.99

ST537030I5	Manhole - Single	55.66	54.22	1.44
ST537030I7	Manhole - Single	55.64	54.25	1.39
ST537031D0	Manhole - Single	55.77	54.14	1.63
ST537031D4	Manhole - Single	56.05	54.47	1.58
ST537031D5	Manhole - Single	56.58	54.7	1.88
ST537031D6	Manhole - Single	56.49	54.64	1.85
ST537031D7	Manhole - Single	56.71	55.02	1.69
ST537031E5	Manhole - Single	56.94	55.85	1.09
ST537031E6	Manhole - Single	56.9	55.83	1.07
ST537031F1	Manhole - Single	57.14	56.2	0.94
ST537031F2	Manhole - Single	57.22	56.22	1
ST537031F3	Manhole - Single	56.87	56.07	0.8
ST537030J0	Manhole - Single	56.6	55.71	0.89
ST537030J1	Manhole - Single	56.35	55.56	0.79
ST537030J5	Manhole - Single	56.53	54.98	1.55
ST537030J6	Manhole - Single	56.5	55.1	1.4
ST537030J8	Manhole - Single	56.57		0
ST537030J9	Manhole - Single	56.81		0
ST537030K0	Manhole - Single	56.58	54.72	1.86
ST537030K2	Manhole - Single	56.16		0
ST537030K5	Manhole - Single	56.55	55.4	1.15
ST537030K6	Manhole - Single	56.6	54.66	1.94
ST537031F7	Manhole - Single	57.12	56.02	1.1
ST537031F8	Manhole - Single	57.18	56.05	1.13
ST537031G0	Manhole - Single	57.8	56.46	1.34
ST537031G1	Manhole - Single	57.92	56.65	1.27
ST537031G4	Manhole - Single	57.91	56.87	1.04
ST537031G5	Manhole - Single	57.92	56.9	1.02
ST537031G7	Manhole - Single	59.71	58.06	1.65
ST537031G8	Manhole - Single	59.96	58.35	1.61
ST537031G9	Manhole - Single	59.96	58.38	1.58
ST537031H0	Manhole - Single	59.65	58.74	0.91
ST537031H1	Manhole - Single	59.39	58.95	0.44
ST537031H2	Manhole - Single	59.42	58.54	0.88
ST537031H3	Manhole - Single	59.53	58.65	0.88
ST537031H4	Manhole - Single	59.59	58.1	1.49
ST537031H5	Manhole - Single	59.51	58.1	1.41
ST537031H6	Manhole - Single	59.32	58.43	0.89
ST537021C1	Manhole - Single	60.67	59.7	0.97
ST537021C2	Manhole - Single	60.63	59.67	0.96
ST537021C4	Manhole - Single	62.02	60.64	1.38
ST537021C5	Manhole - Single	61.46	60.12	1.34
ST537021C6	Manhole - Single	61.5	60.1	1.4
ST537021C7	Manhole - Single	62.04	60.69	1.35
ST537021C9	Manhole - Single	60.12	58.82	1.3
ST537021D0	Manhole - Single	60.66	58.94	1.72
ST537021D6	Manhole - Single	59.46	58.5	0.96
ST537021D7	Manhole - Single	58.6	58.07	0.53
ST537021D8	Manhole - Single	59.35	58.25	1.1
ST537021D9	Manhole - Single	58.45	57.75	0.7

ST537021E0	Manhole - Single	58.59	57.57	1.02
ST537021E1	Manhole - Single	58.47	57.66	0.81
ST537021E2	Manhole - Single	59.42	57.95	1.47
ST537021E3	Manhole - Single	59.08	57.41	1.67
ST537021E4	Manhole - Single	58.81	57.3	1.51
ST537021E5	Manhole - Single	58.59	57.22	1.37
ST537021E6	Manhole - Single	58.55	57.15	1.4
ST537021F1	Manhole - Single	58.62	58.05	0.57
ST537021F6	Manhole - Single	58.98	58.25	0.73
ST537021F7	Manhole - Single	58.42	57.9	0.52
ST537031I6	Manhole - Single	57.89	57	0.89
ST537031I7	Manhole - Single	57.74	56.88	0.86
ST537031J0	Manhole - Single	57.71	57.13	0.58
ST537031J1	Manhole - Single	57.26	56.32	0.94
ST537031J2	Manhole - Single	57.33	56.35	0.98
ST537031J3	Manhole - Single	57.83	57.01	0.82
ST537031J6	Manhole - Single	56.38		0
ST53704105	Manhole - Single	55.97		0
ST53704106	Manhole - Single	55.39		0
ST53705220	Manhole - Single	49.85		0
ST53705221	Manhole - Single	49.98		0
ST53693984	Manhole - Single	52.36		0
ST536949C4	Manhole - Single	52.94		0
ST53704107	Manhole - Single	55.68		0

MAN_REFNO	MAN_TYPE_CD	MAN_COVER_LEVEL	MAN_LOWEST_INVERT	MAN_DEPTH
ST53693801	Manhole - Single	51.07	49.35	1.72
ST53693915	Manhole - Single	50.89	48.46	2.43
ST53693802	Manhole - Single	50.56	48.19	2.37
ST53693803	Manhole - Single	50.04	47.71	2.33
ST53693804	Manhole - Single	49.93	46.87	3.06
ST53693805	Manhole - Single	49.43	48.43	1
ST53693806	Manhole - Single	50.87	49.34	1.53
ST53693916	Manhole - Single	50.73	48.83	1.9
ST53693807	Manhole - Single	50.44	48.53	1.91
ST53693808	Manhole - Single	49.97	48	1.97
ST53693809	Manhole - Single	49.94	46.5	3.44
ST53693810	Manhole - Single	49.16	47.81	1.35
ST53693811	Manhole - Single	49.57	47.71	1.86
ST53693918	Manhole - Single	51.63	50.07	1.56
ST53693813	Manhole - Single	50.28		0
ST53694914	Manhole - Single	50.93	46.08	4.85
ST53694802	Manhole - Single	48.95	45.3	3.65
ST53694803	Manhole - Single	48.78	45.24	3.54
ST53695801	Manhole - Single	48.66	45.19	3.47
ST53695802	Manhole - Single	49.38	44.78	4.6
ST53695803	Manhole - Single	49.66	44.83	4.83
ST53694804	Manhole - Single	50.98	46.41	4.57
ST53694805	Manhole - Single	48.9	46	2.9
ST53695805	Manhole - Single	48.7	44.18	4.52
ST53695806	Manhole - Single	49.55	44.8	4.75
ST53695807	Manhole - Single	49.46	44.75	4.71
ST53695810	Manhole - Single	49.39	44.1	5.29
ST53694806	Manhole - Single	50.16	46.31	3.85
ST53694920	Manhole - Single	51.19	47.39	3.8
ST53693814	Manhole - Single	49.75	47.64	2.11
ST53695919	Manhole - Single	51.53	48.98	2.55
ST53693929	Manhole - Single	51.17		0
ST53693818	Manhole - Single	51.19		0
ST53693930	Manhole - Single	51.42		0
ST53693820	Manhole - Single	51.15		0
ST53693821	Manhole - Single	51.42		0
ST53693822	Manhole - Single	51.34		0
ST53693823	Manhole - Single	49.63		0
ST53693825	Manhole - Single	49.91		0
ST53694807	Manhole - Single	50.82		0
ST53693826	Manhole - Single	50.6		0
ST53693827	Manhole - Single	50.81		0
ST53693828	Manhole - Single	50.6		0
ST53694924	Manhole - Single	51.32		0
ST53694925	Manhole - Single	51.29		0
ST53693931	Manhole - Single	50.86		0
ST53693932	Manhole - Single	50.97		0
ST53694929	Manhole - Single	51.53		0
ST53694930	Manhole - Single	51.57		0

ST53693815	Manhole - Single	50.67	49.55	1.12
ST53693816	Manhole - Single	49.04	48.05	0.99
ST53693922	Manhole - Single	51.78	49.65	2.13
ST53693829	Manhole - Single	51.47		0
ST53693830	Manhole - Single	51.4		0
ST53693831	Manhole - Single	51.41		0
ST53693833	Manhole - Single	51.47		0
ST53693939	Manhole - Single	51.53		0
ST53693940	Manhole - Single	51.48		0
ST53693941	Manhole - Single	51.76		0
ST53693944	Manhole - Single	51.41		0
ST53693945	Manhole - Single	51.14		0
ST53693834	Manhole - Single	51.24		0
ST53693835	Manhole - Single	51.14		0
ST53693952	Manhole - Single	51.69		0
ST53693970	Manhole - Single	51.64		0
ST53693971	Manhole - Single	51.14		0
ST53693972	Manhole - Single	51.12		0
ST53693973	Manhole - Single	50.96		0
ST53693974	Manhole - Single	50.98		0
ST53693976	Manhole - Single	50.93		0
ST53694958	Manhole - Single	50.96		0
ST53694959	Manhole - Single	50.92		0
ST53693977	Manhole - Single	50.83		0
ST53693978	Manhole - Single	50.9		0
ST53693979	Manhole - Single	50.81		0
ST53693836	Manhole - Single	50.64		0
ST53694808	Manhole - Single	50.85		0
ST53693980	Manhole - Single	51.02		0
ST53693981	Manhole - Single	51.03		0
ST53694979	Manhole - Single	51.59		0
ST53694980	Manhole - Single	51.51		0
ST53694981	Manhole - Single	51.52		0
ST53694982	Manhole - Single	51.54		0
ST53695929	Manhole - Single	50.5		0
ST53695934	Manhole - Single	50.09		0
ST53695935	Manhole - Single	50.11		0
ST53695831	Manhole - Single	49.35	48.57	0.78
ST53695973	Manhole - Single	49.85	49.25	0.6
ST53695981	Manhole - Single	49.87		0
ST53695872	Manhole - Single	49.63	48.83	0.8
ST53695875	Manhole - Single	50.51	49.91	0.6
ST53695876	Manhole - Single	50.05	48.74	1.31
ST53695877	Manhole - Single	50.02	48.56	1.46
ST53695878	Manhole - Single	50.03	48.83	1.2
ST53695879	Manhole - Single	49.9	48.43	1.47
ST53695880	Manhole - Single	50	48.36	1.64
ST53695881	Manhole - Single	50.05	48.54	1.51
ST53695885	Manhole - Single	49.88	49.02	0.86
ST53695896	Manhole - Single	49.73	48.2	1.53

ST53695897	Manhole - Single	49.88	48.76	1.12
ST53695898	Manhole - Single	49.58	48.9	0.68
ST536958A1	Manhole - Single	49.8	44.86	4.94
ST536958A2	Manhole - Single	49.79	48.59	1.2
ST53694810	Manhole - Single	47	45.24	1.76
ST53694811	Manhole - Single	48.8	46.19	2.61
ST536958A6	Manhole - Single	48.79	47.6	1.19
ST536958A7	Manhole - Single	48.9	47.69	1.21
ST536958A8	Manhole - Single	48.89	47.46	1.43
ST536958A9	Manhole - Single	49.34	48.34	1
ST536958B0	Manhole - Single	49.36	48.16	1.2
ST536958B1	Manhole - Single	49.3	48.32	0.98
ST536958B2	Manhole - Single	49.39	48	1.39
ST536958B3	Manhole - Single	49.3	47.71	1.59
ST536958B4	Manhole - Single	49.36	48.1	1.26
ST536958B5	Manhole - Single	49.35	48.55	0.8
ST536958B6	Manhole - Single	49.32	48.72	0.6
ST53694813	Manhole - Single	48.79	47.15	1.64
ST53694814	Manhole - Single	48.52	47.27	1.25
ST53694815	Manhole - Single	48.86	47.39	1.47
ST53694816	Manhole - Single	48.55	47.47	1.08
ST53694702	Manhole - Single	48.58	47.9	0.68
ST53694817	Manhole - Single	48.57	47.77	0.8
ST53694818	Manhole - Single	48.58	47.81	0.77
ST53694819	Manhole - Single	48.65	47.75	0.9
ST53694828	Manhole - Single	48.88	46.22	2.66
ST53694829	Manhole - Single	49.07	47.78	1.29
ST53694830	Manhole - Single	49	47.99	1.01
ST53694831	Manhole - Single	49	47.62	1.38
ST53694832	Manhole - Single	49.03	45.92	3.11
ST53694833	Manhole - Single	49.21	48.1	1.11
ST53694834	Manhole - Single	49.05	48.33	0.72
ST53694850	Manhole - Single	49.24	47.96	1.28
ST53694851	Manhole - Single	49.22	48.16	1.06
ST53694852	Manhole - Single	49.5	48.46	1.04
ST53694853	Manhole - Single	49.22	48.56	0.66
ST53694856	Manhole - Single	49.33	48.73	0.6
ST53694857	Manhole - Single	49.34	48.54	0.8
ST53694858	Manhole - Single	49.96	49.03	0.93
ST53694859	Manhole - Single	49.94	49.22	0.72
ST53694860	Manhole - Single	49.96	49.23	0.73
ST53694862	Manhole - Single	49.6	48.82	0.78
ST53694863	Manhole - Single	49.62	49.02	0.6
ST53694864	Manhole - Single	49.46	48.42	1.04
ST53694869	Manhole - Single	50.27	49.68	0.59
ST53694870	Manhole - Single	50.32	49.57	0.75
ST53694871	Manhole - Single	50.24	49.48	0.76
ST53694872	Manhole - Single	50	48.8	1.2
ST53694873	Manhole - Single	49.95	49	0.95
ST53694890	Manhole - Single	50.56	49.87	0.69

ST53694891	Manhole - Single	50.6	49.87	0.73
ST53694892	Manhole - Single	50.6	49.87	0.73
ST53694893	Manhole - Single	50.53	49.87	0.66
ST53694894	Manhole - Single	50.47	49.52	0.95
ST53694895	Manhole - Single	50.47	49.72	0.75
ST536948B6	Manhole - Single	49	47.63	1.37
ST536948C0	Manhole - Single	49.5	48.75	0.75
ST536948C1	Manhole - Single	49.85	49.25	0.6
ST536958H6	Manhole - Single	49.79	48.78	1.01
ST536958H7	Manhole - Single	49.8	48.55	1.25
ST536958H8	Manhole - Single	49.8	48.44	1.36
ST536958H9	Manhole - Single	49.79	48.69	1.1
ST536958I0	Manhole - Single	49.75	49.05	0.7
ST536958I1	Manhole - Single	49.7	48.34	1.36
ST536958I2	Manhole - Single	49.69	48.54	1.15
ST536958I3	Manhole - Single	49.66	48.42	1.24
ST536958I4	Manhole - Single	49.68	48.17	1.51
ST536958I5	Manhole - Single	49.35	48.75	0.6
ST536958I6	Manhole - Single	49.35	48.9	0.45
ST536958I7	Manhole - Single	49.57	48.28	1.29
ST536958I8	Manhole - Single	49.35	48.2	1.15
ST536958I9	Manhole - Single	49.3	48.12	1.18
ST536958J0	Manhole - Single	49.52	48.78	0.74
ST536958J1	Manhole - Single	49.3	47.8	1.5
ST536958J2	Manhole - Single	49.35	47.92	1.43
ST536958J3	Manhole - Single	49.59	48.04	1.55
ST536958J4	Manhole - Single	49.95	49.35	0.6
ST536958J5	Manhole - Single	49.34	47.68	1.66
ST536958J6	Manhole - Single	49.3	48.05	1.25
ST536958J7	Manhole - Single	49.57	46.05	3.52
ST536958J8	Manhole - Single	49.43	44.31	5.12
ST536958J9	Manhole - Single	49.37	47.66	1.71
ST536958K0	Manhole - Single	49.37	48.04	1.33
ST536958K3	Manhole - Single	49.87	49.24	0.63
ST536958K4	Manhole - Single	49.87	48.95	0.92
ST536958K5	Manhole - Single	49.87	48.95	0.92
ST536958K6	Manhole - Single	49.98	49.38	0.6
ST536958L9	Manhole - Single	49.09	48.09	1
ST536958M0	Manhole - Single	49.49	48.18	1.31
ST536958M1	Manhole - Single	49.53	48.24	1.29
ST536958M2	Manhole - Single	49.44	48.3	1.14
ST536958M3	Manhole - Single	49.25	48.54	0.71
ST536958M4	Manhole - Single	49.45	48.04	1.41
ST536958M5	Manhole - Single	49.53	47.95	1.58
ST536958M6	Manhole - Single	49.46	47.88	1.58
ST536958M7	Manhole - Single	49.29	47.74	1.55
ST53695983	Manhole - Single	49.33	48.22	1.11
ST536958M8	Manhole - Single	49.25	48.5	0.75
ST536958M9	Manhole - Single	49.25	48.65	0.6
ST53695984	Manhole - Single	49.48	48.22	1.26

ST536958N0	Manhole - Single	49.25	48.74	0.51
ST53695985	Manhole - Single	49.48	48.6	0.88
ST53695986	Manhole - Single	49.5	48.32	1.18
ST53695987	Manhole - Single	49.55	48.37	1.18
ST53695988	Manhole - Single	49.55	48.5	1.05
ST53695989	Manhole - Single	49.58	48.63	0.95
ST536958N1	Manhole - Single	49.37	48.77	0.6
ST53695991	Manhole - Single	50.02	48.58	1.44
ST53695992	Manhole - Single	50.19	48.5	1.69
ST53695993	Manhole - Single	50.27	49.1	1.17
ST53695994	Manhole - Single	50.09	49.4	0.69
ST536958G1	Manhole - Single	48.93	47.79	1.14
ST536958G2	Manhole - Single	49.08	47.7	1.38
ST536958G3	Manhole - Single	48.97	48.37	0.6
ST536958G4	Manhole - Single	49	48.4	0.6
ST536958G5	Manhole - Single	48.92	47.76	1.16
ST536958G6	Manhole - Single	49	48.4	0.6
ST536958G7	Manhole - Single	48.85	47.57	1.28
ST536948A2	Manhole - Single	48.72	46.28	2.44
ST536948A3	Manhole - Single	48.98	47.84	1.14
ST536948A4	Manhole - Single	49	48.28	0.72
ST536948A5	Manhole - Single	48.97	48.17	0.8
ST536948A6	Manhole - Single	49.15	47.98	1.17
ST536948A7	Manhole - Single	49	48.15	0.85
ST536948A8	Manhole - Single	48.98	47.98	1
ST536948A9	Manhole - Single	49.15	47.75	1.4
ST536948B0	Manhole - Single	48.96	46.41	2.55
ST536958G8	Manhole - Single	49.08	48.38	0.7
ST536958G9	Manhole - Single	49.04	48.53	0.51
ST536948B1	Manhole - Single	49.29	48.06	1.23
ST536948B2	Manhole - Single	49.26	47.85	1.41
ST536948B3	Manhole - Single	49.95	48.98	0.97
ST536948B4	Manhole - Single	50	49.16	0.84
ST536948B5	Manhole - Single	48.98	47.6	1.38
ST53695995	Manhole - Single	51	49.4	1.6
ST536948C5	Manhole - Single	50.64	50.1	0.54
ST536948C6	Manhole - Single	50.82	49.91	0.91
ST53695999	Manhole - Single	50.72	49.95	0.77
ST536948C8	Manhole - Single	50.89	49.95	0.94
ST536959A1	Manhole - Single	50.67	49.83	0.84
ST536959A7	Manhole - Single	50.64	49.75	0.89
ST536959A8	Manhole - Single	50.68	49.51	1.17
ST536959A9	Manhole - Single	50.96	49.09	1.87
ST536948D4	Manhole - Single	50.76	49.7	1.06
ST536948D5	Manhole - Single	50.74	49.9	0.84
ST536948D6	Manhole - Single	50.65	50.05	0.6
ST536948D7	Manhole - Single	50.89	49.75	1.14
ST53693848	Manhole - Single	48.97	47.89	1.08
ST536948G4	Manhole - Single	49		0
ST536948G5	Manhole - Single	49.4		0

Zoe Bell

Subject: FW: 3454 Land south of Warren Lane, Long Ashton Capacity Enquiry

From: Teddy Takyi-Amuah <Teddy.Takyi-Amuah@wessexwater.co.uk>

Sent: 02 June 2020 10:03

To: Zoe Bell

Subject: RE: 3454 Land south of Warren Lane, Long Ashton Capacity Enquiry

Good morning Zoe,

[RE : ST56NW/ 50 Land south of Warren Lane, Long Ashton Capacity Enquiry](#)

Many thanks for your email. I called your number below to discuss the drainage strategy and conclude on a pump rate but was informed to send an email through to you to request a call-back or number. I apologise, however, as I failed to do so. Please consider the updated comments below regarding the site. I understand the comments below are a lot to consider so please feel free to provide a contact telephone number to go through your strategy and my response.

Foul Drainage

Under our interpretation of the OFWAT charging arrangements, Wessex water will need to consider capacity improvements in correspondence with the LPA, developers and the phasing of all allocated sites coming forward within the catchment. Under these arrangements; we also believe the charging point of the site-specific connection to be equal to the cost of connecting to the nearest size for size sewer based upon the outline permission of the site. The connecting private foul sewers size from the site will also need to correspond with the same size or above of the proposed receiving public sewer.

Based on the above and our earlier revisions; A point of connection can be considered to an adequate point within the 150 mm dia foul sewers within Pear Tree Avenue. This option also negates the need to consider upsizing through back gardens as earlier envisioned. We will expect further details on the conclusion of the actual peak pump rates and times. Manhole 3805 and 3823 are the closest and are recorded with the following levels. A connection to either manholes or downstream of this network will be subject to the confirmation of the final peak flows and pump times.

Manhole 3805

Cover: 49.43

Invert:48.43

Manhole:3823

Cover: 49.63

Invert: none recorded

Surface water

My earlier paragraph also highlighted below still applies to the surface water (SW) strategy.

“Given the site’s previous use and your infiltration tests to date. We would expect that this evidence has been reviewed by the LLFA as the statutory consultee before any acceptance by Wessex Water. Capacity within the receiving SW network within Peartree Avenue is limited, and we would expect robust investigations and evidence to come forward to discount other methods above connecting into the public surface water sewers”.

Wessex water will need to plan and execute capacity improvements to support this development as per the new charging arrangements. The site must be in phases with the drainage strategy and the deliverance of initial phases focused on obtaining confirmation from Wessex water. This information will be discussed and reviewed in line with any planned improvements for the catchment and to support subsequent planning applications and applications to connect. Our capacity revisions will focus on crucial catchment pressures and impacts to prioritise and outline design measures for rehabilitation, mitigation and enhancements required to facilitate the approved sites.

Where it is reasonable to do so, we may propose that assets provided by developers are upsized to provide capacity for later growth. Where assets are upsized as a result of our request, we will contribute towards the reasonable cost. The infrastructure charges will ensure that the cost of providing network reinforcement is met by developers, providing the development does not progress at a rate which exceeds the time we need to plan and deliver the required network capacity.

I hope the above is enough to proceed with the design. A review of the contents of this email will be required where 18 months or more have elapsed. In the light of significant changes, any changes that are likely to impact upon the response (e.g. changes drainage strategy, development numbers or phasing) will need to be discussed with Wessex Water.

Kind regards

Teddy Takyi-Amuah

Planning Liaison Assistant Engineer
Wessex Water
Claverton Down Bath BA2 7WW
wessexwater.co.uk

Appendix 3

PADDOCK

GEO ENGINEERING



**Gatcombe Farm, Warren Lane, Long Ashton,
Bristol, BS41 9DA**

GROUND INVESTIGATION – BRE365 INFILTRATION TESTING



Long Ashton Land Company Ltd

October 2019

P19-177inf

Milton Keynes: The Log Cabin, Manor Farm, Whaddon Road, Newton Longville, Milton Keynes, MK17 0AU

Swindon/Oxford: 21 Tyrell Close, Stanford in the Vale, Oxon, SN7 8EY

T: 44 (0) 1908 764032

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E: matt@paddockgeoengineering.co.uk

W: www.paddockgeoengineering.co.uk

Company Number: 8613165
VAT Number: GB 166 808772

Issue:	Date	Written By:	Comment
1	23/10/19	Max Campbell BSc FGS	-
		Checked By:	
		Matt Paddock MSc FGS	
For and on Behalf of Paddock Geo Engineering Limited			

CONTENTS Ground Investigation – Infiltration Testing

APPENDICES

- A Site Location / Proposed Development Plan**
- B Trial Pit Location Plan**
- C Trial Pit Logs**
- D Laboratory Analysis Results – Not Used**
- E Infiltration Testing Results**
- F Site Photographs**

GROUND INVESTIGATION – BRE365 INFILTRATION TESTING

GATCOMBE FARM, WARREN LANE, LONG ASHTON, BRISTOL, BS41 9DA.

Further to instructions received from Long Ashton Land Company Ltd; the Client, infiltration testing have been carried out within trial pits at the above site in relation to assessing the infiltration properties of the underlying ground.

Objectives

This assessment has been carried out to a scope of works as detailed by the project Engineers; Cole Easdon Consultants. The assessment has been designed to assess the infiltration properties of the near surface strata.

Scope of Works

The works comprised the forming of 3no. trial pits with infiltration testing within two of the pits to the BRE365 methodology.

Terms of Reference

The assessment has been carried out generally in accordance with the following guidance.

- Code of Practice for Site Investigations, British Standards Institution BS5930: 2015
- BRE Digest 365 – Soakaway Design 2016

Sitework

The sitework comprised the forming of three machine excavated trial pits to a maximum depth of 1.80m below ground level (bgl) on 15th October 2019.

The trial pit positions are indicated on the enclosed Trial Pit Plan presented in Appendix B.

The trial pit arisings were logged by a Geotechnical Engineer generally in accordance with BS5930:2015. No samples were recovered from the trial pits.

All Trial Pits had an infiltration test carried out to the BRE365 methodology to the full depth.

The trial pits were reinstated upon completion of testing with compacted arisings.

Encountered Strata

A log of the Trial Pit and a Trial Pit Location Plan showing the positions investigated are presented in Appendix C and B respectively.

The strata encountered within the boreholes is summarised in the table below. These details are also included on the Trial Pit Logs presented in Appendix C.

Encountered Strata

Encountered Strata – Window Sample Boreholes Strata	Exploratory Hole and Basal Depth (m bgl)		
	TP1	TP2	TP3
TOPSOIL Dark orange brown slightly sandy slightly gravelly CLAY.	0.30	0.30	0.30
HEAD DEPOSITS Firm to stiff orange brown slightly sandy slightly gravelly CLAY.	N/A	0.8	1.0
MERCIA MUDSTONE GROUP Stiff red brown silty CLAY.	1.20	1.80	1.20
Total Depth (m bgl)	1.20	1.80	1.20

Groundwater Details

Groundwater was encountered in all trial pits to varying depths, groundwater depth are summarised in the table below.

Exploratory position	Depth (m bgl)
	Struck depth – 15/10/19
TP1	Groundwater seepage from surface
TP2	Groundwater seepage from surface
TP3	Groundwater seepage from surface

Laboratory Analysis

No lab analysis was carried out.

Surface Water Soakaways

Infiltration testing was carried out within two the trial pits to the BRE365 methodology to allow an estimate of Infiltration Factor for the site. The test was carried out only once within TP1 and TP3 due to the lack of movement while undertaking the infiltration testing.

The two trial pits that were tested, were formed to a depth of 1.20m depth bgl and filled with 0.50m to 0.90m of water at the base to limit the water used and trial pit instability. Therefore, for the infiltration calculations an invert incoming pipe level slightly above the filled water level was employed.

The results are presented in Appendix E and are summarised in the table below.

Infiltration Factors

Trial Pit	Soil Tested	Test Depth	Infiltration Factor (ms ⁻¹)		
			Cycle 1	Cycle 2	Cycle3
TP1	MMG	0.30m-1.20m	<<<10 ⁻⁷		
TP2			N/A		
TP3	MMG	0.70m-1.20m	<<<10 ⁻⁷		

Note:

MMG Mercia Mudstone Group

Testing in both trail pits indicated little to no movement. During our site visit, the ground conditions were very boggy and in the lower area of the site flooded. The infiltration testing along with the visible ground conditions indicated that water on site is not able to soakaway effectively.

Give the infiltration testing results the tested soils are considered unsuitable for the construction of effective conventional soakaways and another method for surface water disposal should be sought along the hierarchy of disposal methods.

General Notes

This report is produced for the sole use of the Client, and no responsibility of any kind, whether for negligence or otherwise, can be accepted for any Third Party who may rely upon it.

The conclusions and recommendations given in this report are based on our understanding of the future plans for the site and based on a scope of works agreed by the Client and afforded by the agreed budget. No responsibility is accepted for conditions not encountered, which are outside of the agreed scope of work.

The report has been prepared following the guidelines and principles established in the British Standards, BS 5930, CIRIA Guidance and NHBC Standards. It necessarily relies on the co-operation of other organisations and the free availability of information and total access. No responsibility can, therefore, be accepted for conditions arising from information that was inaccurate or not available to the investigating team as a result of information being withheld or access being denied.

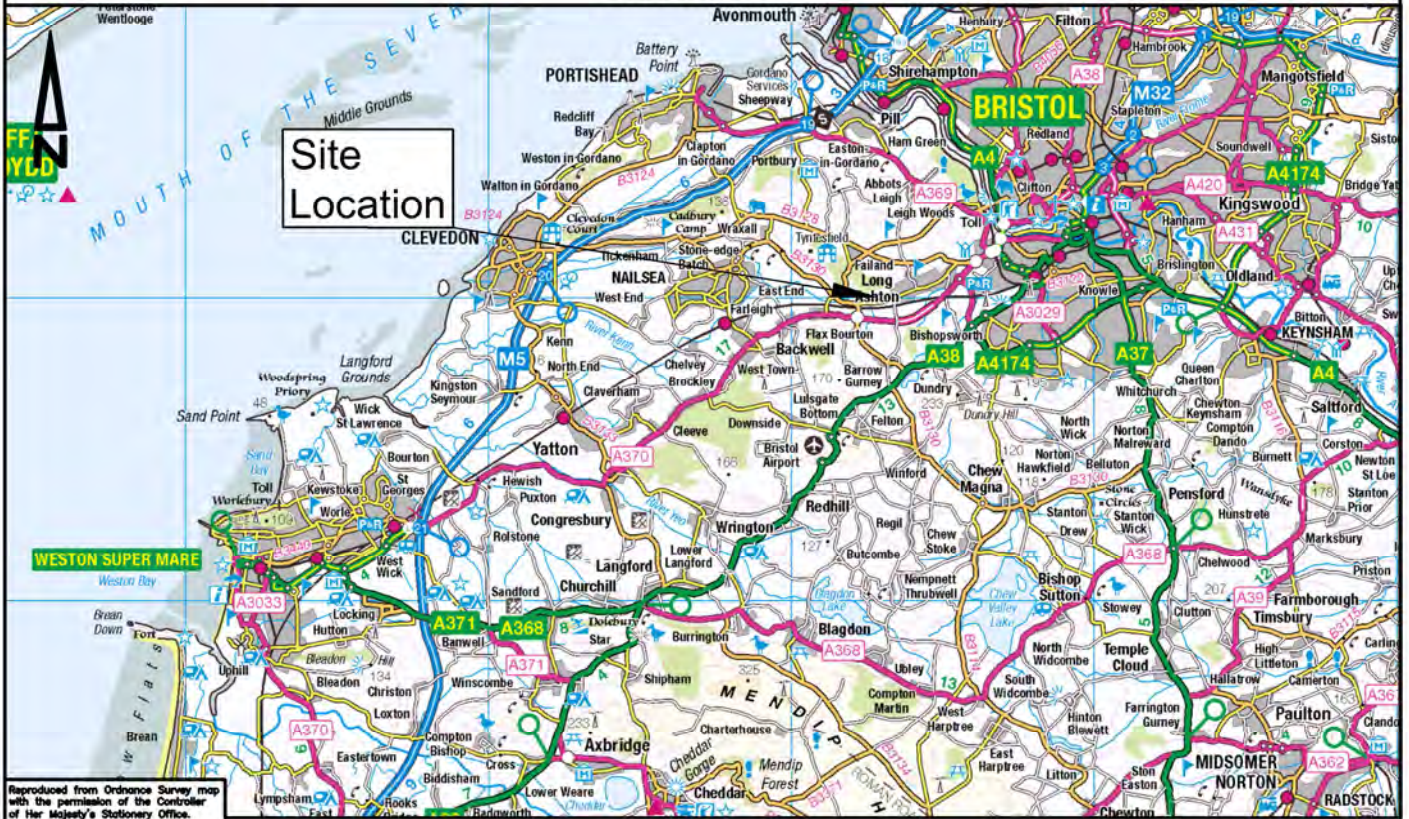
This report may suggest an opinion on a possible configuration of strata or conditions between exploratory points and below the maximum depth of investigation. However, this is for guidance only and no liability can be accepted for its accuracy.

APPENDIX A

Site Location / Proposed Development Plan



Scale: 1:10,000



Scale: 1:250,000

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E-mail cec@ColeEasdon.com

Job Title:

Proposed Residential Development
Land at Gatcombe Farm
Warren Lane, Long Ashton
Somerset

Drawing Title:

Site Location Plan

Client:

Long Ashton
Land Company Ltd

Drawn By:

HP

Date Drawn:

February 2019

Checked By:

Drawing No.

3454/500 Figure 1

Drawing Status:

FOR COMMENT	
FOR PLANNING	
FOR TENDER	
FOR APPROVAL	
FOR CONSTRUCTION	
AS BUILT	

Scale:

As Shown (A4)

Revision

APPENDIX B

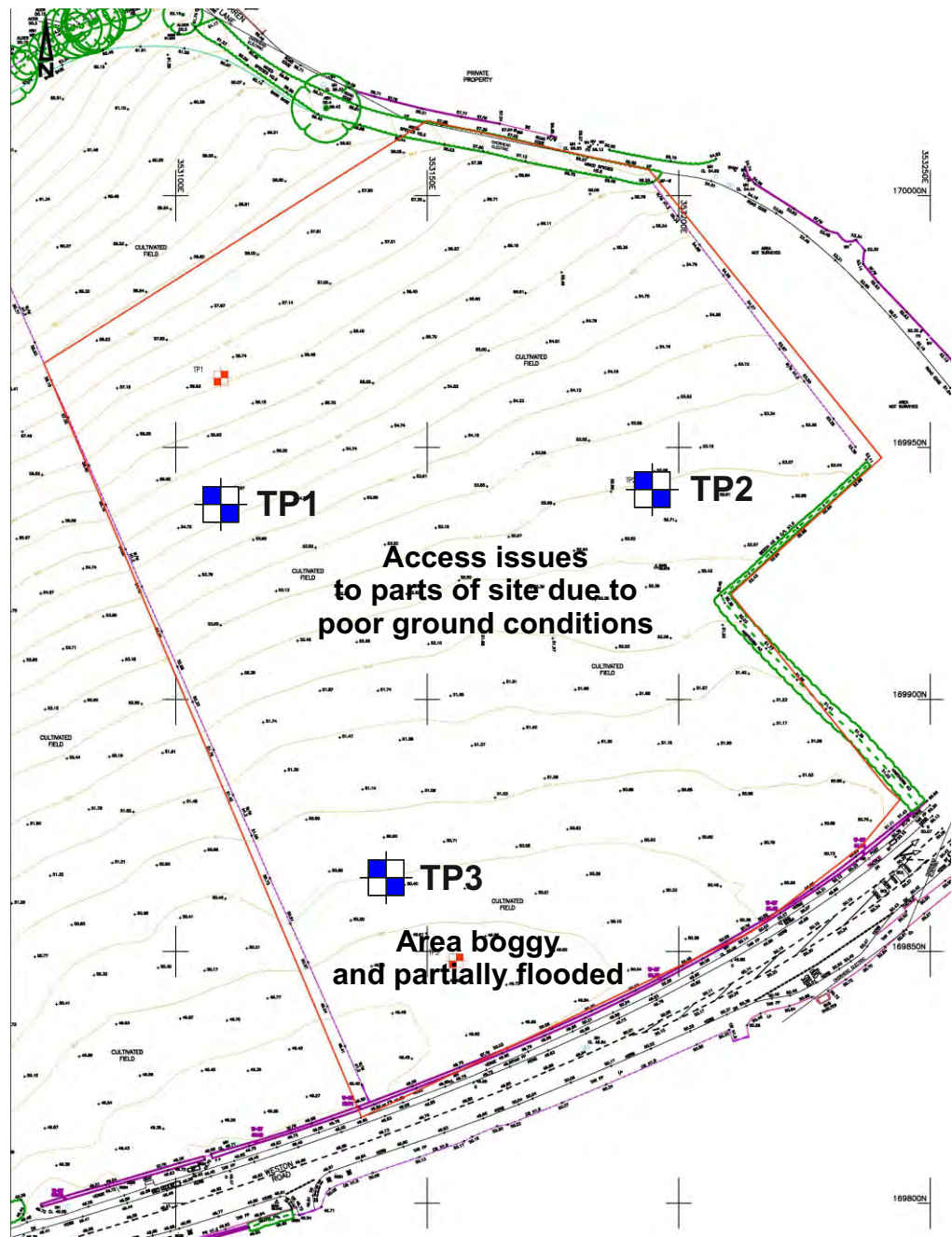
Trial Pit Location Plan

Exploratory Location Plan

**Gatcombe Farm,
Long Ashton,
Bristol,
BS41 9DA**

**Long Ashton Land
Company Ltd**

October 2019




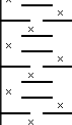
 **Trial Pit Location**

**Not to scale.
All positions are approximate.
Based on plan provided by
Cole Easdon Consultants**

APPENDIX C

Trial Pit Logs

Excavation Method Machine excavated trial pits	Dimensions 1.50m x 0.45m	Ground Level (mOD)	Client Long Ashton Land Company Ltd	Job Number P19-173
	Location (Observed measurements)		Dates 15/10/2019	Engineer MIP

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
			Water strike(1) at 0.30m.		(0.30) 0.30	Dark orange brown slightly sandy slightly gravelly loamy CLAY. (TOPSOIL)		∇1
					(0.90)	Stiff red brown silty CLAY. (MERCIA MUDSTONE GROUP)		
					1.20	Complete at 1.20m		



Remarks

Infiltration testing undertaken.
Groundwater seepage encountered between 0.30m and 1.0m depth.
Trial pit remained upright and stable upon completion.

Scale (approx) 1:50	Logged By MIP	Figure No. P19-173.TP1
-------------------------------	-------------------------	----------------------------------

Excavation Method Machine excavated trial pits	Dimensions 1.50m x 0.45m	Ground Level (mOD)	Client Long Ashton Land Company Ltd	Job Number P19-173
	Location (Observed measurements)	Dates 15/10/2019	Engineer MIP	Sheet 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
			Water strike(1) at 0.00m.					
					0.30	Dark orange brown slightly sandy slightly gravelly loamy CLAY. (TOPSOIL)		∇1
					0.50	Firm to stiff orange brown slightly sandy slightly gravelly CLAY. (HEAD DEPOSITS)		
					0.80	Stiff red brown silty CLAY. (MERCIA MUDSTONE GROUP)		
					1.00			
					1.80	Complete at 1.80m		






Remarks

Infiltration testing undertaken.
Trial pit remained upright and stable upon completion.
Groundwater seepage encountered between 0.30m and 1.0m depth.

Scale (approx) 1:50	Logged By MIP	Figure No. P19-173.TP2
-------------------------------	-------------------------	----------------------------------

Excavation Method Machine excavated trial pits	Dimensions 1.50m x 0.45m	Ground Level (mOD)	Client Long Ashton Land Company Ltd	Job Number P19-173
	Location (Observed measurements)	Dates 15/10/2019	Engineer MIP	Sheet 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
			Water strike(1) at 0.30m.		(0.30) 0.30	Dark orange brown slightly sandy slightly gravelly loamy CLAY. (TOPSOIL)		▽1
					(0.70)	Firm to stiff orange brown slightly sandy slightly gravelly CLAY. (HEAD DEPOSITS)		
					1.00 (0.20) 1.20	Stiff red brown silty CLAY. (MERCIA MUDSTONE GROUP)		
						Complete at 1.20m		



Remarks

Infiltration testing undertaken.
Trial pit remained upright and stable upon completion.
Groundwater seepage encountered between 0.30m and 1.0m depth.

Scale (approx) 1:50	Logged By MIP	Figure No. P19-173.TP3
-------------------------------	-------------------------	----------------------------------

APPENDIX D

Laboratory Analysis Results – Not Used

APPENDIX E

Infiltration Testing Results

Infiltration Test to BRE365 - TP1 Test 1

Field Data

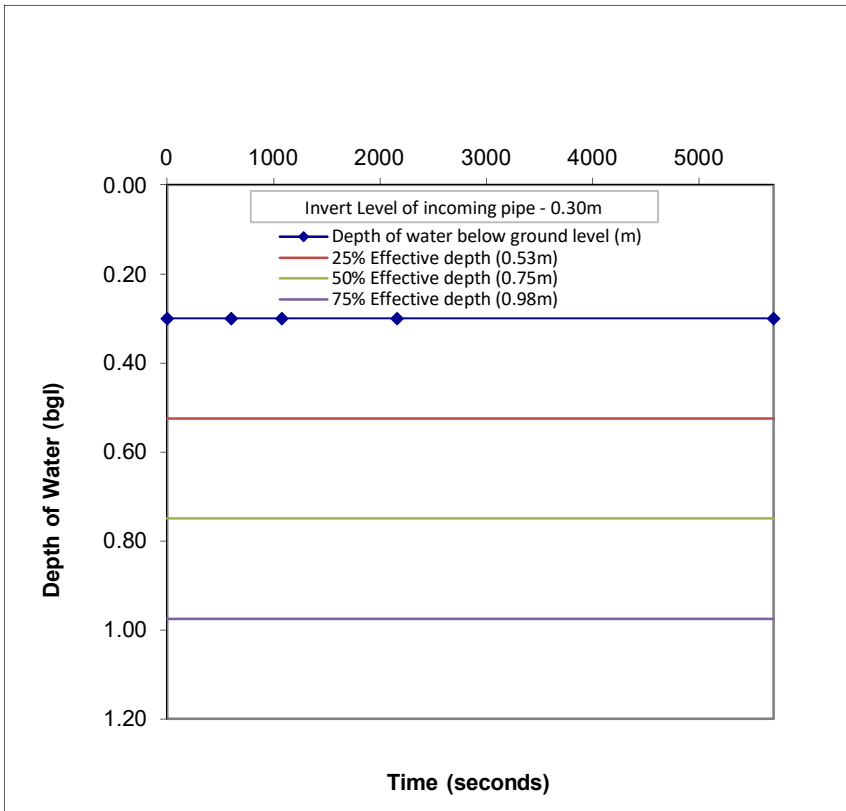
Location: TP1 **TEST 1**
Weather: Sunny
Engineer: MIP
Date: 15/10/2019

Time	Time Elapsed (min)	Time Elapsed (sec)	Depth of Water below GL (m)
	0.0	0	0.30
	10.0	600	0.30
	18.0	1080	0.30
	36.0	2160	0.30
	95.0	5700	0.30

Strata Tested Mercia Mudstone Group

1.5m	Pit Depths (m bgl)
	Length
	1.5
	Width
	0.45
	Depth
	1.2
TP1 - 1.2 m depth Assume invert level of incoming drain is 0.3m bgl. Effective depth = 0.9m	25% Effective Depth
	0.53
	75% Effective Depth
	0.98
	Inlet Depth
	0.3
	0.45m

Linear extrapolated values for calculation



CALCULATION:

$$\text{Soil Infiltration Rate}(f) = \frac{V_{p75-25}}{a_{p50} \times t_{p75-25}}$$

Where:

$$V_{p75-25} = \text{effective storage volume between 75\% and 25\% effective depth}$$

$$1.5 \times 0.45 \times (0.975 - 0.525) = \mathbf{0.30375}$$

$$a_{p50} = \text{internal area of TP upto 50\% effective depth + base of TP}$$

$$2(1.5 \times 0.45) + 2(0.45 \times 0.45) + (1.5 \times 0.45) = \mathbf{2.43}$$

$$t_{p75-25} = \text{the time for water level to fall from 75\% - 25\% effective depth} = \mathbf{N/A} \text{ secs}$$

$$f = \mathbf{N/A} \text{ m/s}$$

Comment

Trial pit terminated due to lack of infiltration over 95 minutes.



Client: Long Ashton Land Company Ltd
Project No: P19-173
Project: Gatcombe Farm, Warren Lane,
 Long Ashton, Somerset,
 BS41 9DA

Infiltration Test to BRE365 - TP3 Test 1

Field Data

Location: TP3

TEST 1

Weather: Sunny

Engineer: MIP

Date: 15/10/2019

Time	Time Elapsed (min)	Time Elapsed (sec)	Depth of Water below GL (m)
	0.0	0	0.70
	15.0	900	0.70
	32.0	1920	0.70
	68.0	4080	0.70
	125.0	7500	0.70

Strata Tested Mercia Mudstone Group

1.5m	TP3 - 1.2 m depth Assume invert level of incoming drain is 0.7m bgl. Effective depth = 0.5m	Pit Depths (m bgl)
		Length 1.5 Width 0.45 Depth 1.2 25% Effective Depth 0.83 75% Effective Depth 1.08 Inlet Depth 0.7
	0.45m	

Linear extrapolated values for calculation

CALCULATION:

Soil Infiltration Rate(f) =
 $V_{p75-25} / (ap_{50} \times tp_{75-25})$

Where:

V_{p75-25} = effective storage
 volume between 75% and 25%
 effective depth
 $1.5 \times 0.45 \times (1.075 - 0.825)$
 = **0.16875**

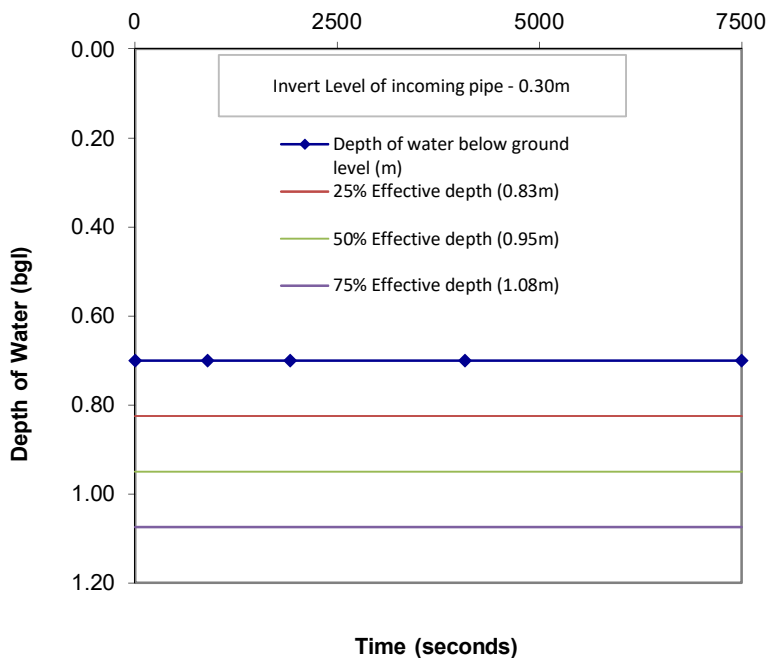
ap_{50} = internal area of TP upto
 50% effective depth + base of TP
 $2(1.5 \times) + 2(0.45 \times) + (1.5 \times 0.45)$
 = **1.65**

tp_{75-25} = the time for water level
 to fall from 75% - 25% effective
 depth
 = **N/A** secs

f = **N/A** m/s

Comment

Trial pit terminated due to lack of infiltration
 over 125 minutes.



APPENDIX F

Site Photographs



Photo of the site



Photo of the site



TP1



TP1 arisings



TP2



TP2 arisings



TP3



TP3 arisings