

Prepared for:
Mr Ankit Madan

December 2018

Our reference:
87427-Madan-ParkfieldRd v1 111218

Location:
54 Parkfield Road
Ickenham
UB10 8LW



Document Issue Record

Location:	54 Parkfield Road, Ickenham, UB10 8LW				
Application:	Construction of two x 2-storey dwellings with habitable roofspace, outbuildings to rear, installation of vehicular crossover to front and associated landscaping works involving demolition of existing bungalow				
Prepared for:	Mr Ankit Madan				
Title:	Technical Note - Surface Water Drainage Condition Discharge				
Project No.:	87427	Date:	December 2018	Issue No.:	1
Written By:	T. Smith, BSc (Hons), E. Bouet, BSc (Hons)	Checked By:	E. Bouet, BSc (Hons)	Authorised By:	E. Jeffery, MSci (Hons)

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Unda Consulting Limited, Southpoint, Old Brighton Road, Gatwick, RH11 0PR. +44 (0) 1293 214 444. info@unda.co.uk

1. Introduction

- 1.1. This Surface Water Drainage Technical Note has been prepared by Unda Consulting Limited on behalf of Mr Ankit Madan, to address Condition 8 of planning application reference APP/R5510/W/17/3192388.
- 1.2. This relates to the construction of two x 2-storey dwellings with habitable roofspace, outbuildings to rear, installation of vehicular crossover to front and associated landscaping works involving demolition of existing bungalow, at the site of 54 Parkfield Road, Ickenham, UB10 8LW.
- 1.3. This report assesses the surface water drainage strategy for the proposed development.
- 1.4. Planning Condition 8 of Decision Notice APP/R5510/W/17/3192388 states the following:

"Within two months of the date of this permission development drainage detail proposals incorporating Sustainable Drainage Systems SUDS shall be submitted for approval in writing to the Local Planning Authority. The proposals shall include:

- a. the measures employed to delay and control the surface water discharged from the site and to prevent pollution of the receiving ground and surface waters;*
- b. a timetable for implementation; and,*
- c. a management and maintenance plan for the lifetime of the development to include the arrangements required to secure the operation of the scheme throughout its lifetime.*

The scheme shall also demonstrate methods to minimise the use of potable water through water collection, reuse and recycling and will:

- d. provide details of water collection facilities to capture rainwater; and,*
- e. provides details of how rain and grey water will be recycled and reused in the development. Thereafter the development shall be implemented and retained/maintained in accordance with these details for as long as the development remains in existence."*

- 1.5. This Technical Note provides the information required to address planning Conditions 8 relating to disposal of surface water.

2. Existing Site:

- 2.1. The site is an existing residential property (bungalow). A map showing the site location is presented below in Figure 1.



Figure 1: Aerial photograph of site and surrounding area (Source: Google Earth)

Site Topography:

- 2.2. A measured topographic survey undertaken in May 2016 by KND Surveys suggests that the ground topography on site ranges from approximately 19.88mAOD to the south west by Parkfield Road, to 20.85mAOD in the north east (rear of the existing garden).

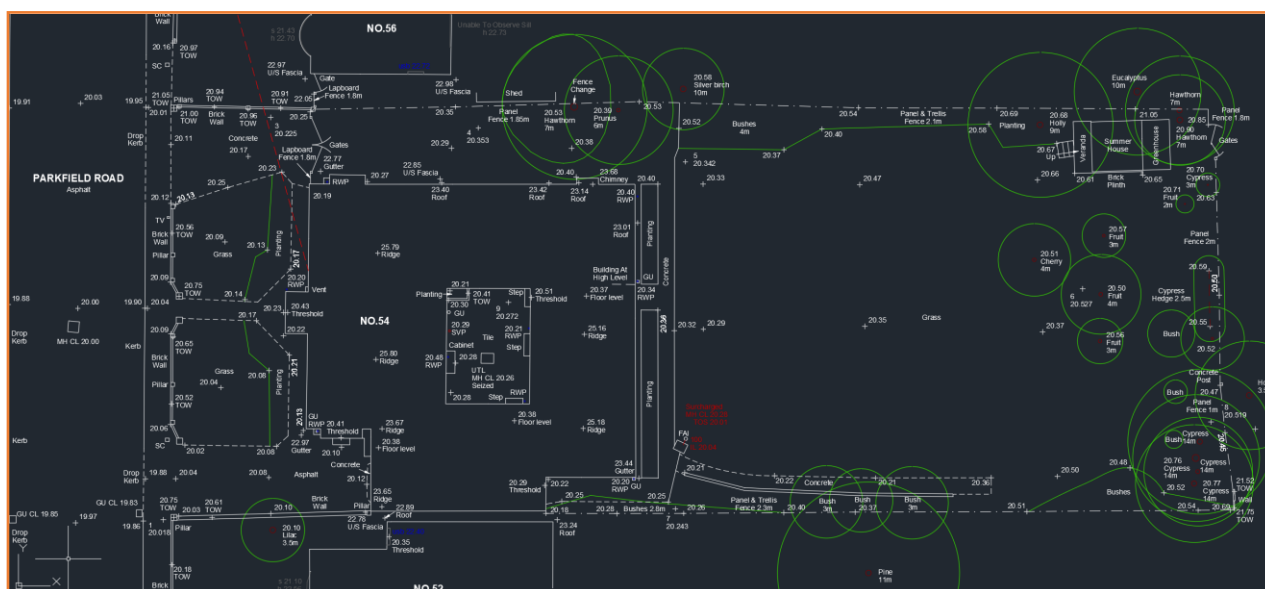


Figure 2: Extract from measured topographic survey (Source: KND Surveys)

Existing Ground Conditions:

- 2.3. The British Geological Survey (BGS) Map indicates that the bedrock underlying the site is London Clay Formation, Clay, Silt and Sand. Sedimentary Bedrock formed approximately 48 to 56 million years ago in the Palaeogene Period.
- 2.4. The soil type in the area taken from the UKSO Website is Deep Prequaternary Marine/Estuarine - Sand and Silt.

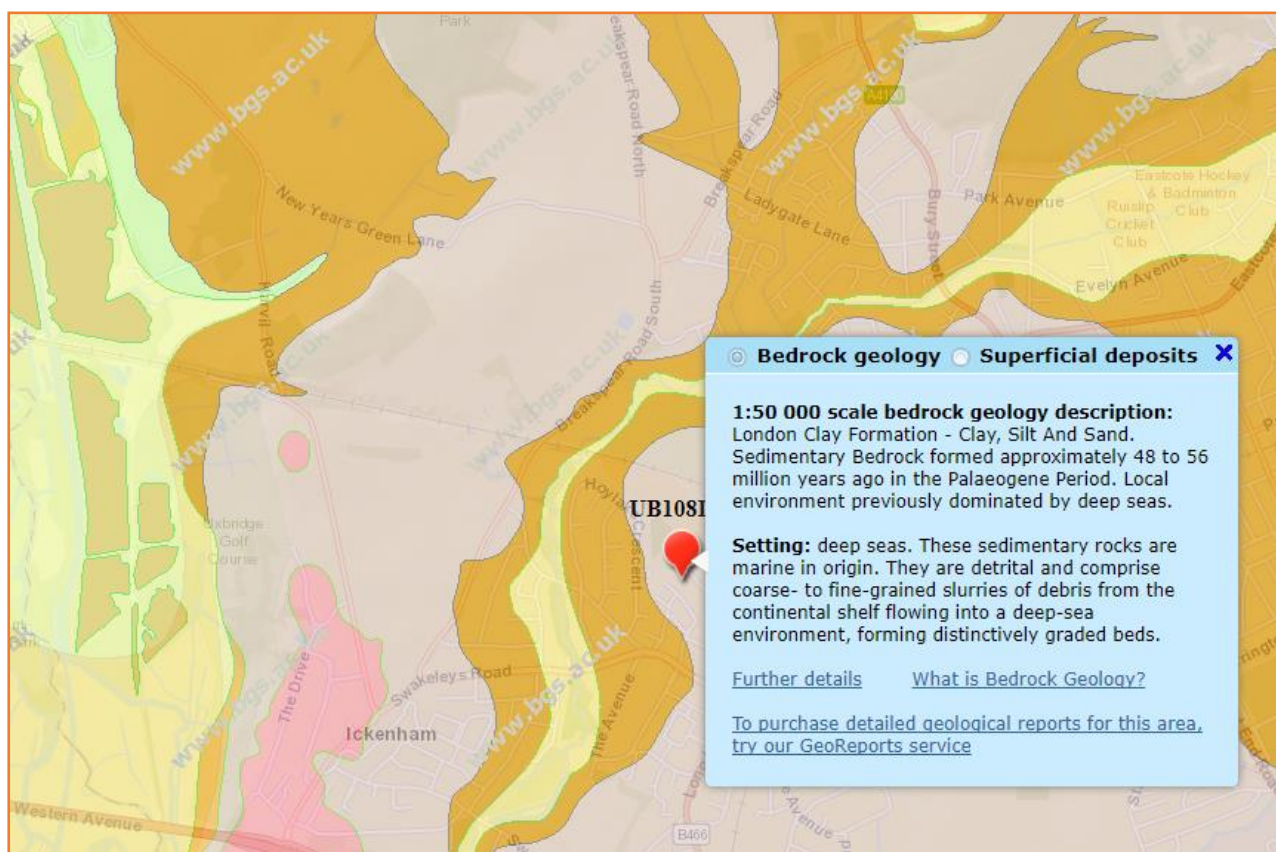


Figure 3: Geology (Source: BGS)

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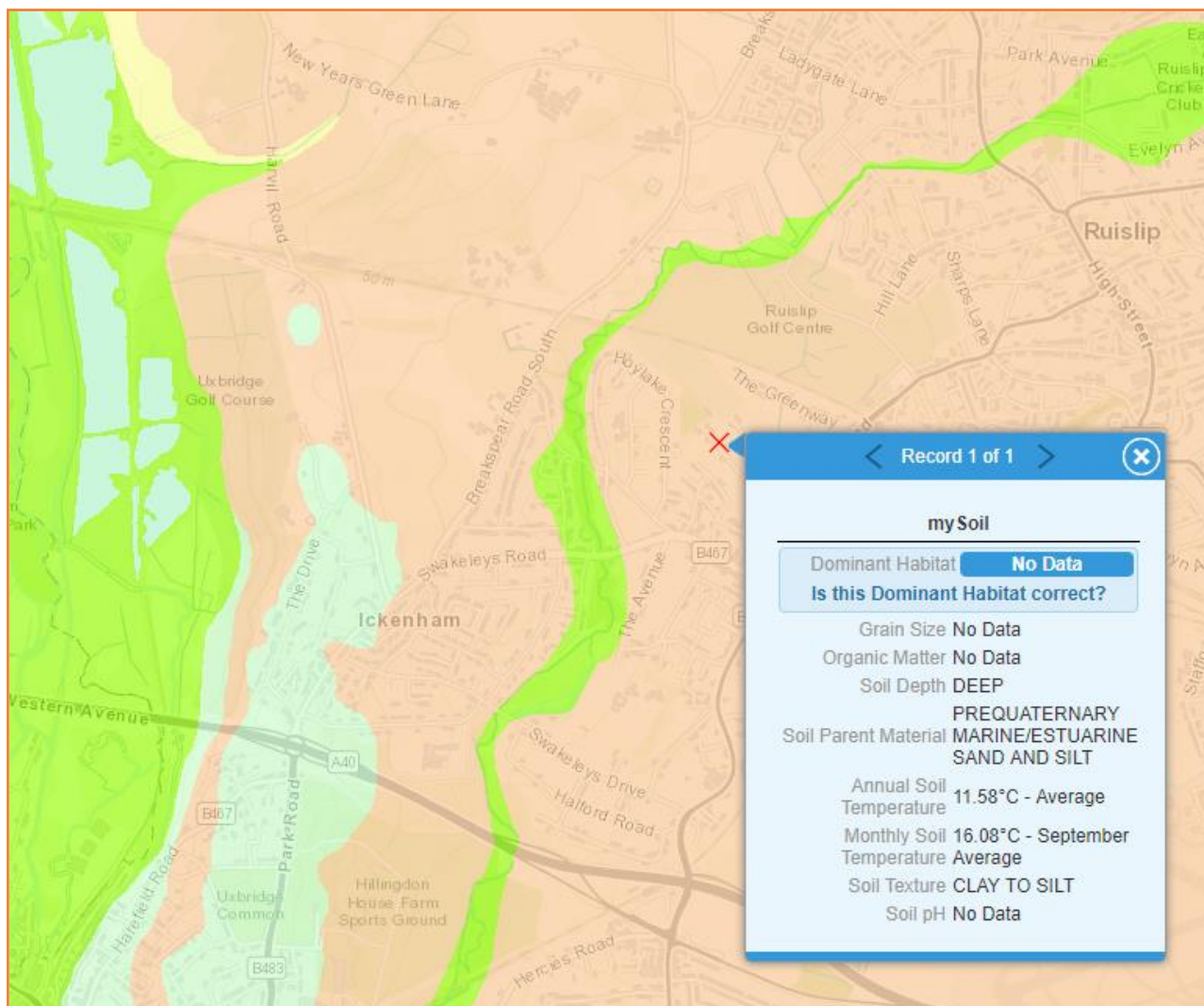


Figure 4: Soil type (Source: UK Soils)

Existing Drainage:

- 2.5. Records provided by both Thames Water and the applicant indicate that the site is currently drained by separate public surface and foul water sewers.
- 2.6. Surface water from the front of the existing property is understood to flow at an unrestricted rate into the main public surface water sewer beneath Parkfield Road via connection to the front of the property (Source: Applicant).
- 2.7. Thames Water records indicate that the surface water sewer to the front of the property beneath Parkfield Road has a diameter of between 150mm and 225mm.
- 2.8. The invert levels of these sewers are currently unknown, and are not recorded on Thames Water records.

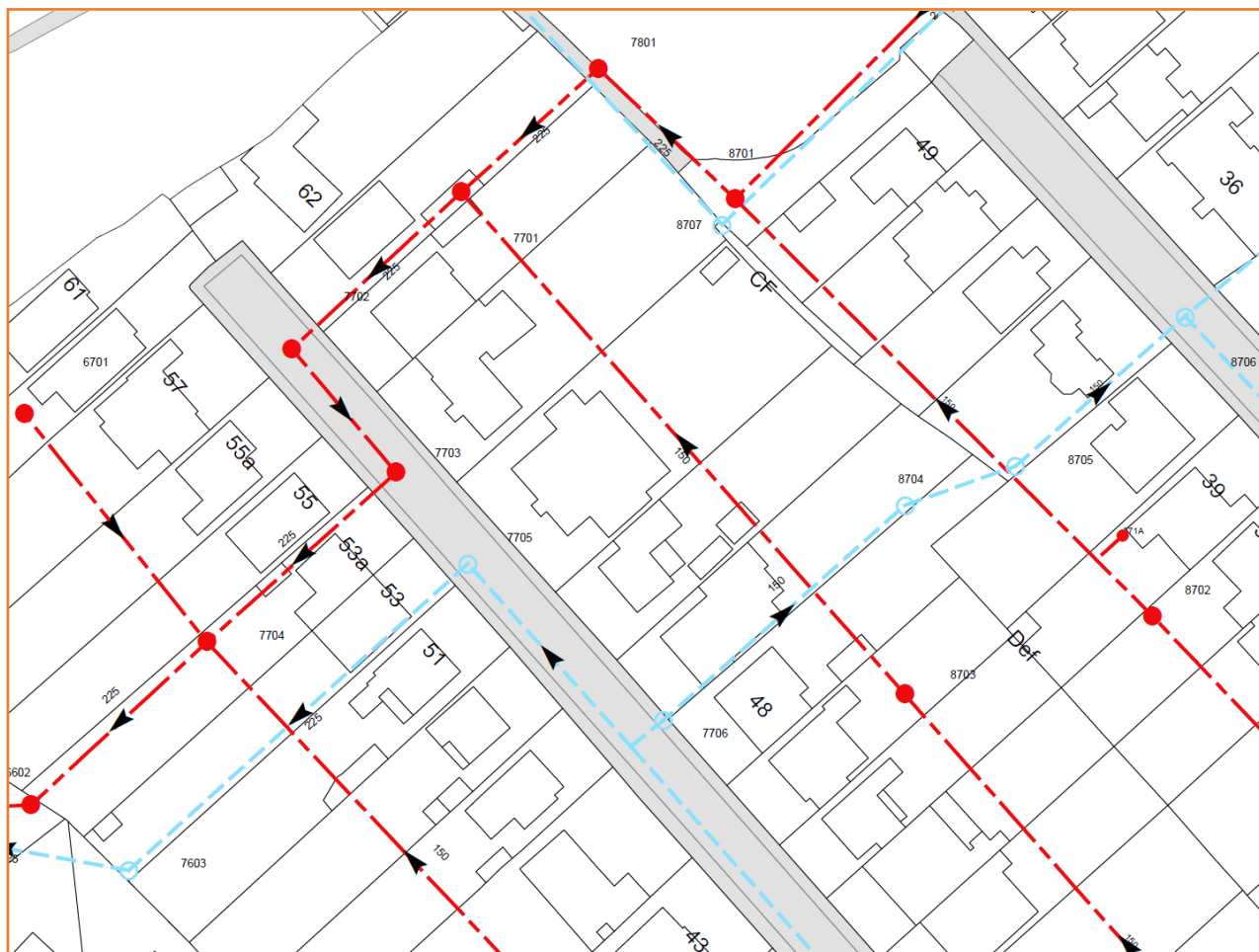


Figure 5: Sewer records (Source: Thames Water)

3. Permitted Development Proposals:

- 3.1. The permitted planning application is for the construction of two x 2-storey dwellings with habitable roofspace, outbuildings to rear, installation of vehicular crossover to front and associated landscaping works involving demolition of existing bungalow, at the site of 54 Parkfield Road, Ickenham, UB10 8LW.
- 3.2. Post development, the two properties will be known as 54a Parkfield Road, and 54b Parkfield Road.

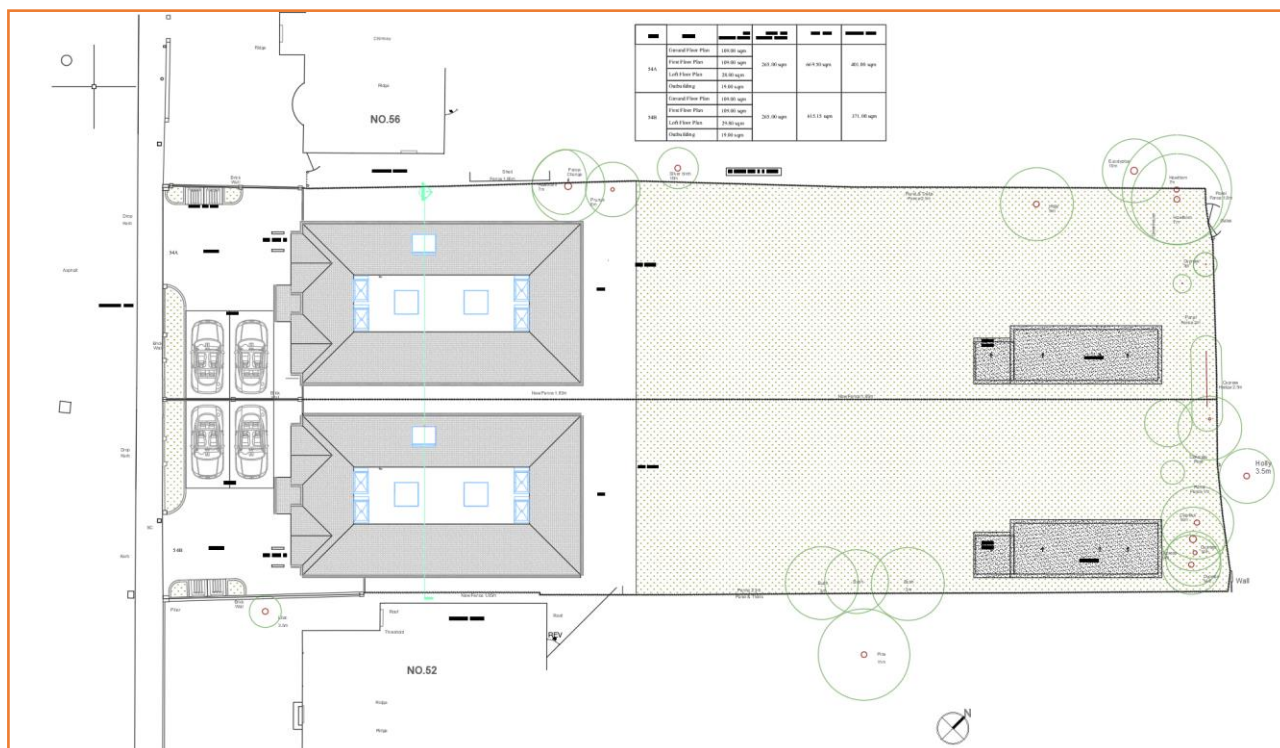


Figure 6: Permitted development plans (Source: FAR-Architecture)

4. Proposed Surface Water Drainage:

- 4.1. Refer to Plan 87427/001 [Proposed Drainage Layout] enclosed with this Report.

Infiltration Potential:

- 4.2. BGS records indicate that the site is underlain largely by clay strata.

Clays are typically impermeable and prevent the effective operation of soakaways. Furthermore, the approved site layout is such that the required 5m buffer between a soakaway and existing/proposed building foundations cannot be provided. In view of these constraints drainage by infiltration is not feasible.

Discharge Location:

- 4.3. Records provided by both Thames Water and the applicant indicate that the site is currently drained by separate public surface and foul water sewers.
- 4.4. Surface water from the front of the existing property is understood to flow at an unrestricted rate into the main public surface water sewer beneath Parkfield Road via connection to the front of the property.
- 4.5. Thames Water records indicate that the surface water sewer to the front of the property beneath Parkfield Road has a diameter of between 150mm and 225mm.
- 4.6. The invert levels of these sewers are currently unknown, and are not recorded on Thames Water records.
- 4.7. It is proposed to attenuate surface water from roof areas on site (approx. 169m² per property) and discharge as a controlled rate of 0.6l/s via the existing surface water main sewer connection.
- 4.8. Runoff from the proposed parking areas and driveways will be collected and stored in tanked permeable pavement / porous tarmac located beneath these areas. From the tanked permeable paving, runoff will be discharged at a controlled rate of 0.6l/s via the existing surface water main sewer connection.

Rainwater Harvesting Strategy:

- 4.9. The London Plan Policy 5.15 highlights the need to *‘...protect and conserve water supplies and resources in order to secure London’s needs in a sustainable manner by...minimising use of mains water’*. Therefore, rainwater harvesting is considered to be a sustainable solution for the proposed development.
- 4.10. The collection area available for rainwater harvesting at the new proposed properties is 169m² per property, and there will be 4 bedrooms in each house post development. It is assumed that there will be 5 people living in each house post development, and that the houses will be fitted with ultra-low flush toilets, which use 6l per flush. Therefore, the assumed toilet use per person is 35 l/person/d. 35 l/d x 5 people = 175 l/d usage for toilet flushing. There will be 3 toilets in each dwelling. It is anticipated that the ground floor toilet will be used some 66% of the time, equating to a water usage of 115 l/d. Garden use may account for an additional 10 l/d.
- 4.11. An example of a suitable rainwater harvesting (RWH) tank for 54a and 54b Parkfield Road is the Shallow Dig F-Line Tank. Refer to the enclosed specification from Rainwater Harvesting Limited. This tank has a 10000 litre storage capacity. 54a Parkfield Road, and 54b Parkfield Road will have their own individual tanks.
- 4.12. Microdrainage calculations show that 7100l per house is required for attenuation for the critical duration 1:100 year + 40% climate change event. Refer to the enclosures. Therefore 2900 litres storage volume would be available for reuse. Rainwater Harvesting Limited have advised that the capacity of this tank is sufficient to supply non-potable water for the ground floor toilet (115 l/d) and for garden use (10 l/d), effectively providing up to 5+ days usage during prolonged dry periods.
- 4.13. Runoff from the proposed properties at 54a Parkfield Road, and 54b Parkfield Road will be collected, filtered and stored in the individual RWH tanks, which will be buried in the gardens. From the tanks, water will be piped to the ground floor toilet within

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the dwellings, and to an outlet where it can be drawn off for garden use. The toilet and outlet will have a back-up connection to a mains water supply, to provide water when the RWH tank is empty.

- 4.14. If the RWH tanks contains more water than the 2900l required for toilet and garden usage, the additional water will be discharged via the existing surface water sewer at a runoff rate of 0.6l/s per property, via an orifice plate.
- 4.15. All preliminary surface water drainage calculations have been undertaken using MicroDrainage software. Refer to the Appendix.

Tanked Permeable Paving:

- 4.16. The proposed development comprises some 155m² of potentially impermeable hardstanding per property.
- 4.17. Runoff from the proposed parking areas and driveways will be collected and stored in tanked permeable pavement / porous tarmac located beneath these areas. Check dams will be utilised within the subbase where the topography is on a gradient, so as to maximise storage potential.
- 4.18. From the tanked permeable paving, runoff will be discharged at a controlled rate of 0.6l/s via the existing surface water main sewer connection.
- 4.19. Preliminary calculations indicate that sufficient storage required to attenuate runoff from the proposed impermeable areas arising from the critical 1:100 year + 40% climate change event can be provided within a tanked permeable paving area of dimensions 14m x 11m x 0.15m deep.
- 4.20. Preliminary calculations indicated that some 6.1m³ of storage is required to attenuate the runoff for all storms up to and including the 1:100 year + 40% climate change event.
- 4.21. All preliminary surface water drainage calculations have been undertaken using MicroDrainage software. Refer to the Appendix.

Water Quality:

- 4.22. Water quality has been assessed in line with the Simple Index approach from Chapter 26 of CIRIA C753 The SuDS Manual:
- Step 1 – Allocate suitable pollution hazard indices for the proposed land use.
Step 2 – Select SuDS with a total pollution mitigation index that equals or exceeds the pollution hazard index.
- 4.23. 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 1 below.

Total suspended solids (TSS)	Metals	Hydrocarbons
0.5	0.4	0.4

Table 1: Pollution Hazard Indices for the proposed site (from Table 26.2 of CIRIA C753 The SuDS Manual)

- 4.24. All SuDS components are assessed for their effectiveness in pollutant removal prior to discharge to sewer in Table 26.3 in CIRIA C753 The SuDS Manual. The pollution mitigation indices for permeable pavements are show in Table 2 below.

Total suspended solids (TSS)	Metals	Hydrocarbons
0.7	0.6	0.7

Table 2: Pollution Mitigation Indices for permeable pavements (from Table 26.3 of CIRIA C753 The SuDS Manual)

- 4.25. The Pollution Mitigation Indices for permeable pavement are greater than the Pollution Hazard Indices for car parks and low trafficked roads. Therefore, permeable pavements will provide sufficient water quality treatment prior to discharge to ground sewer.

- 4.26. Runoff from roof areas is considered to be uncontaminated and does not warrant any form of treatment process to improve water quality. Nevertheless, it is suggested to include debris / sediment traps on any new drainage.

Design Exceedance:

- 4.27. Should the onsite drainage system fail under extreme rainfall events or blockage, flooding may occur within the site. Any resultant floodwater will be routed away from the proposed property. Runoff flow can be managed through detailing the new external levels to direct water north, away from structures and into Parkfield Road. If this is to occur exceedance flows will dissipate via highways drainage, infiltration and evaporation.

Adoption and Maintenance:

- 4.28. It is proposed that all SuDS facilities will be maintained privately by the end user. 54a Parkfield Road, and 54b Parkfield Road will be responsible for their own individual rainwater harvesting systems and SuDS facilities.

Rainwater Harvesting System

- 4.29. Maintenance tasks are based upon guidance from CIRIA's C753 The SuDS Manual. Refer to the enclosures for a product specific maintenance schedule for the specified rainwater harvesting tank systems.
- 4.30. Routine inspection of the filter system at quarterly intervals is advised, even if they do not appear to need specific intervention. Pumps need very little attention, but their design life is generally regarded as only being 10 years. Where automatic provision of potable water occurs (if and when rainwater is either not available or the system has failed), sensor warnings should be relayed in such a manner as to inform the user of the current status of the system.
- 4.31. Rainwater harvesting systems should be designed so that when there is an absence of rain, or a need to disconnect the system for maintenance or repair, that potable water is safely available for all appliances to avoid inconvenience. Tanks should be available for internal inspection, and the cover should be lockable. The proposed outlets for garden usage will require a sign to inform users that the water is not suitable for drinking.

Tanked Permeable Paving

- 4.32. 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).
- 4.33. 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.
- 4.34. 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.
- 4.35. A draft Maintenance Schedule is outlined in the Table below.

Drainage Element	Maintenance Requirement	Frequency
Rainwater Harvesting Tanks	▪ Cleaning and/or replacement of filters	Three times a year or as necessary
	▪ Inspection of tank for debris and sediment build-up ▪ Inspection of inlets, outlets, withdrawal devices, overflow areas, pumps and filters ▪ Cleaning of tank, inlets, outlets, gutters, withdrawal devices and roof drain filters to remove silt and other debris	Annually or as necessary
	▪ Repair of overflow erosion damage or damage to tank ▪ Pump repairs	As required
Tanked Permeable Paving	▪ Sweeping/vacuuming to remove build-up of silt or other sediments	Three times a year or as necessary
	▪ Removal of weeds ▪ Replacement of cracked paving blocks ▪ Remedial work to cracks and depressions	As required

Table 3: Maintenance Regime for Elements of the Drainage Infrastructure**Water Authority:**

- 4.36. No new connection or increase in discharge is proposed to the public surface water sewer. As such, the proposal is acceptable to the Water Authority (Thames Water).

5. Discussion and Conclusions:

- 5.1. This Surface Water Drainage Strategy has been prepared by Unda Consulting Limited on behalf of Mr Ankit Madan, to address Condition 8 of planning application reference APP/R5510/W/17/3192388.
- 5.2. This relates to the construction of two x 2-storey dwellings with habitable roofspace, outbuildings to rear, installation of vehicular crossover to front and associated landscaping works involving demolition of existing bungalow, at the site of 54 Parkfield Road, Ickenham, UB10 8LW.
- 5.3. Planning Condition 8 of Decision Notice APP/R5510/W/17/3192388 states the following:

"Within two months of the date of this permission development drainage detail proposals incorporating Sustainable Drainage Systems SUDS shall be submitted for approval in writing to the Local Planning Authority. The proposals shall include:

- a. the measures employed to delay and control the surface water discharged from the site and to prevent pollution of the receiving ground and surface waters;*
- b. a timetable for implementation; and,*
- c. a management and maintenance plan for the lifetime of the development to include the arrangements required to secure the operation of the scheme throughout its lifetime.*

The scheme shall also demonstrate methods to minimise the use of potable water through water collection, reuse and recycling and will:

- d. provide details of water collection facilities to capture rainwater; and,*
- e. provides details of how rain and grey water will be recycled and reused in the development. Thereafter the development shall be implemented and retained/maintained in accordance with these details for as long as the development remains in existence."*

- 5.4. Records provided by both Thames Water and the applicant indicate that the site is currently drained by separate public surface and foul water sewers.
- 5.5. Surface water from the front of the existing property is understood to flow at an unrestricted rate into the main public surface water sewer beneath Parkfield Road via connection to the front of the property (Source: Applicant).
- 5.6. Thames Water records indicate that the surface water sewer to the front of the property beneath Parkfield Road has a diameter of between 150mm and 225mm. The invert levels of these sewers are currently unknown, and are not recorded on Thames Water records.
- 5.7. The London Plan Policy 5.15 highlights the need to '*...protect and conserve water supplies and resources in order to secure London's needs in a sustainable manner by...minimising use of mains water*'. Therefore, rainwater harvesting is considered to be a sustainable solution for the proposed development.
- 5.8. Microdrainage calculations show that 7100l per house is required for attenuation for the critical duration 1:100 year + 40% climate change event. Refer to the enclosures. Therefore 2900 litres storage volume would be available for reuse. Rainwater Harvesting Limited have advised that the capacity of this tank is sufficient to supply non-potable water for the ground floor toilet (115 l/d) and for garden use (10 l/d), effectively providing up to 5+ days usage during prolonged dry periods.

Runoff from the proposed properties at 54a Parkfield Road, and 54b Parkfield Road will be collected, filtered and stored in the individual RWH tanks, which will be buried in the gardens. From the tanks, water will be piped to the ground floor toilet within the dwellings, and to an outlet where it can be drawn off for garden use. The toilet and outlet will have a back-up connection to a mains water supply, to provide water when the RWH tank is empty.

- 5.9. If the RWH tanks contains more water than the 2900l required for toilet and garden usage, the additional water will be discharged via the existing surface water sewer at a runoff rate of 0.6l/s per property, via an orifice plate.

- 5.10. Runoff from the proposed parking areas and driveways will be collected and stored in tanked permeable pavement / porous tarmac located beneath these areas. Check dams will be utilised within the subbase where the topography is on a gradient, so as to maximise storage potential.
- 5.11. From the tanked permeable paving, runoff will be discharged at a controlled rate of 0.6l/s via the existing surface water main sewer connection.
- 5.12. Proposed surface water connections utilise existing public sewer connections and will not increase discharge. They are acceptable to Thames Water in principal.
- 5.13. It is proposed that all SuDS facilities will be maintained privately by the end user. 54a Parkfield Road, and 54b Parkfield Road will be responsible for their own individual rainwater harvesting systems and SuDS facilities.

Unda Consulting Limited

December 2018

6. Appendix

- Plan 87427/001 – Proposed Rainwater Harvesting and Surface Water Drainage Layout;
- Topographic Survey (KND Surveys Ltd);
- Rainwater Harvesting MicroDrainage Calculations, Specification, and Maintenance Schedule;
- Tanked Permeable Paving MicroDrainage Calculations;
- Thames Water Sewer Records;
- APP/R5510/W/17/3192388 Decision Notice.

Key

- Proposed Buildings
- Proposed Downpipes
- Proposed Surface Water Pipework
- Proposed Rainwater Harvesting Tanks
- Proposed Tanked Permeable Paving
- Existing Surface Water Manhole Cover
- Existing Surface Water Pipework

- Notes:**
- Discharge of roof runoff via two rainwater harvesting tanks. Preliminary calculations indicate that sufficient storage required to attenuate runoff arising from the proposed increase in roof areas, during the critical 1 in 100 year + 40% Climate Change event, can be provided within two rainwater harvesting tanks (one per property) of dimensions 4.5m x 3.0m.
 - Proposed discharge at controlled rate via Rain-Activ.
 - Discharge of surface water from proposed driveways and parking areas can be achieved, during the critical 1 in 100 year + 40% Climate Change event, via Tanked Permeable Paving of dimensions 14m x 11m x 0.15m deep.

Client:
Ankit Madan

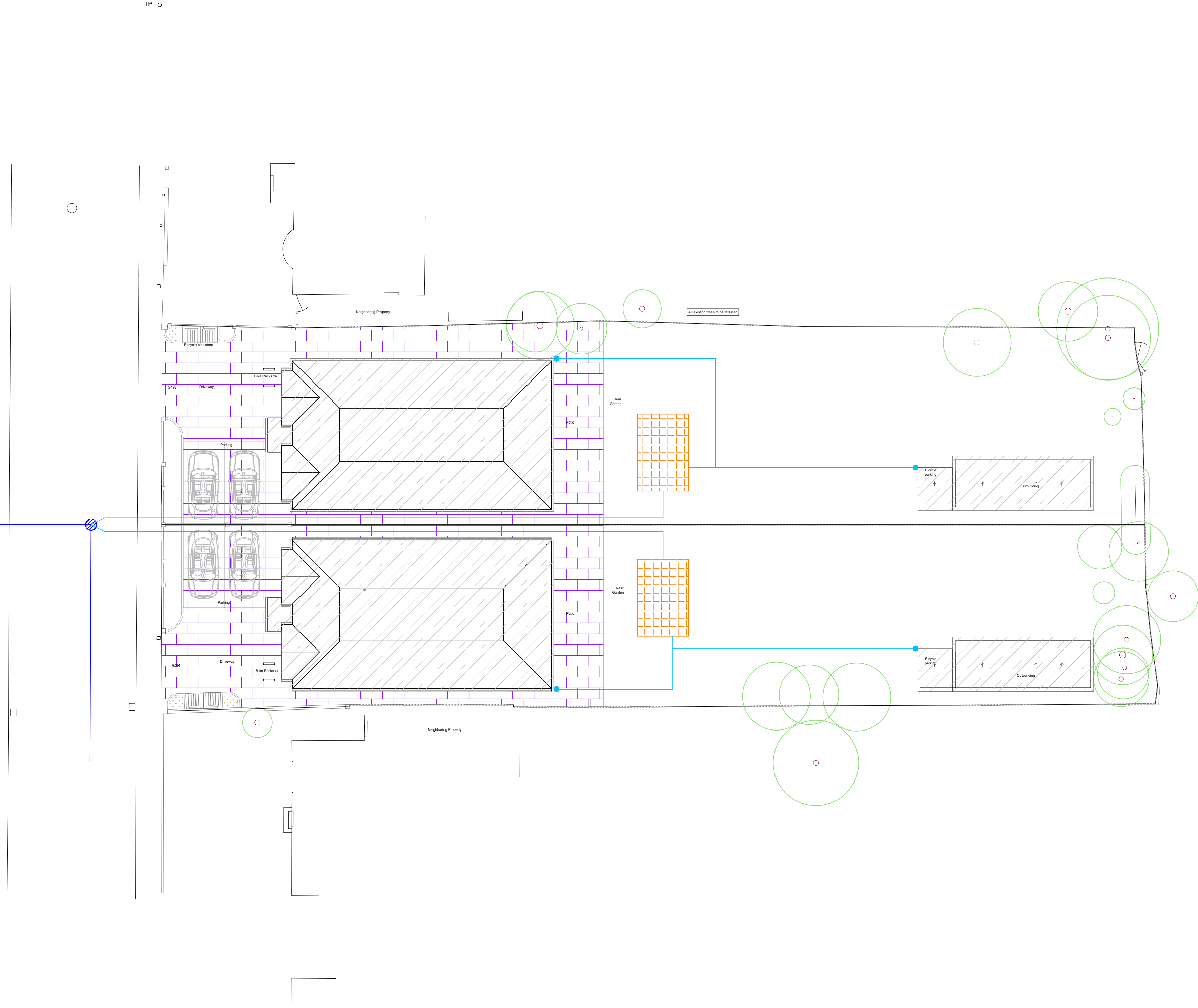
Site Address:
54 Parkfield Road,
Ickenham,
UB10 8LW

Job Reference: 87427-Madan-ParkfieldRd	Date: 11-Dec-18
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Drawing Number: 87427-01	Revision: v1.0
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Designed by: EB	Drawn by: TS	Checked by: EB
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Scale: 1:150@A2	Unda Consulting Ltd Southpoint Old Brighton Road Gatwick RH11 0PR
Disclaimer: The drawings provided are for planning purposes only.	





Unda Consulting Ltd		Page 1
Southpoint Old Brighton Road Gatwick RH11 0PR	87427-Madan-ParkfieldRd 54 Parkfield Rd, UB10 8LW Construction 2 houses	
Date 01/12/2018 File	Designed by EJ Checked by EB	
XP Solutions		
Source Control 2018.1.1		
<u>ICP SUDS Mean Annual Flood</u> Input Return Period (years) 100 Soil 0.450 Area (ha) 0.130 Urban 0.000 SAAR (mm) 688 Region Number Region 6 Results 1/s QBAR Rural 0.6 QBAR Urban 0.6 Q100 years 1.8 Q1 year 0.5 Q30 years 1.3 Q100 years 1.8		
©1982-2018 Innovyze		



SHALLOW DIG F-LINE TANK

	5000
Weight Kg	250
Length	2960
Width	2220
Overall Height	1350 - 1750
Ground to Invert VS60 (Pedestrian 635mm Shaft)	345 - 745
Minimum Attenuation Capacity	7100 litres
Invert to Outlet	809

EXCAVATION

10000 (2 x 5000 side by side)

Length	3360
Width	5340
Overall height VS60	1450 - 1850

Overall height allows for 100mm compacted aggregate

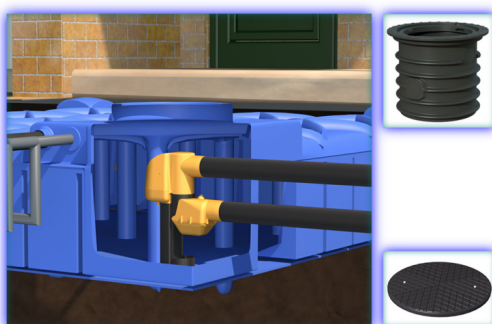
The overall height difference above is because up to 400 mm can be cut off of the 635 mm shaft on site so as to achieve your exact invert level.

Please see Drainage Calculation Summary on page 7



Product Code : **RWH-10000FL-RA**

10,000 Litre Rain Activ Attenuation System



Components

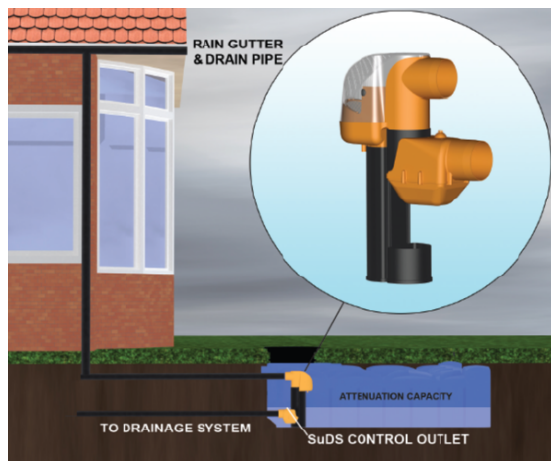
Product Code	Description	Qty
RWFT5000	F-LINE 5000L TANK	2
RWDS0062	F-LINE TANK 635mm EXTENSION SHAFT - VS60	2
RWDS0066	F-LINE TANK WALK ON LID	2
GF-332033	DN100 SEALS FOR TANK CONNECTION	2
RWH-RV01	RAINVANTAGE FILTER KIT INC SIPHON & OVERFLOW	1
RWH-RA02	RAIN ACTIV SUDS COMPONENT PRE FITTED ALLOWING FOR A MINIMUM OF 7100 LITRES WORTH OF ATTENUATION AND A CONTROLLED DISCHARGE RATE OF 0.6 LITRES PER SECOND	1
RWH-RA01	MICRO DRAINAGE CALCULATIONS	1



Rain Activ SuDS Solution

Rain Activ is a totally new concept within the storm attenuation market. Utilising shallow dig underground water tanks as well as a filtration and controlled discharge module.

Rain Activ collects water from the roof and removes debris via a self-cleaning filter. Once inside the tank, the clean water is attenuated and discharged slowly at a calculated rate through an orifice.



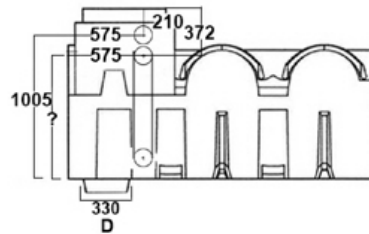
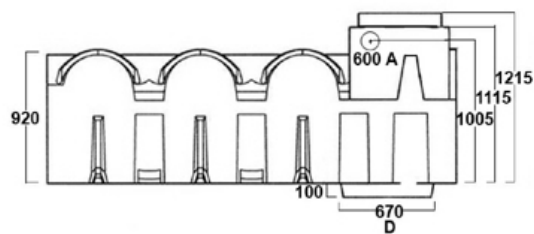
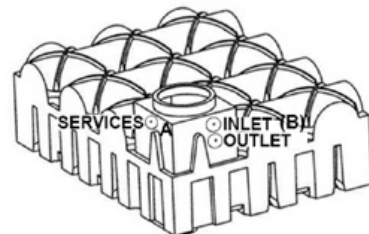
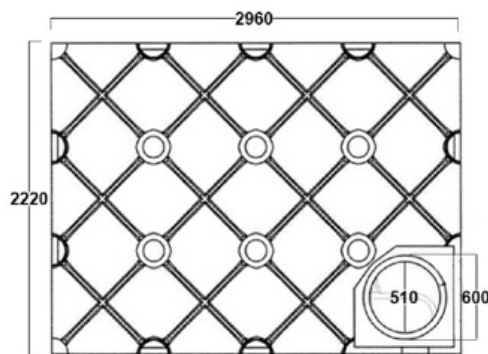
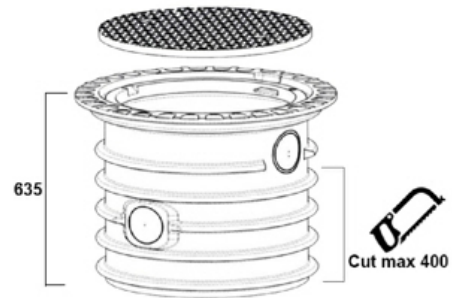
- Ultra-low discharge SuDS system.
- Peak discharge rates as low as 0.05 L/sec per property.
- Primary solution reduces secondary SuDS infrastructure and costs.
- Each system individually calibrated to site requirement.
- Can be used in combination with Rainwater Harvesting.

Rain Activ is ideal for sites where low rates of storm water discharge are required. With peak discharge rates as low as 0.05 L/sec, the system provides a solution for applications where flow is typically not sufficient for vortex flow control systems.

By collecting and slowing the water at source, the scale and cost of secondary SuDS infrastructure such as balancing ponds and geocellular storage can be heavily reduced. For many developments this can increase the available land for development.

Where applicable, Rain Activ can be used in conjunction with Rainwater Harvesting by simply adding a pump and management system.

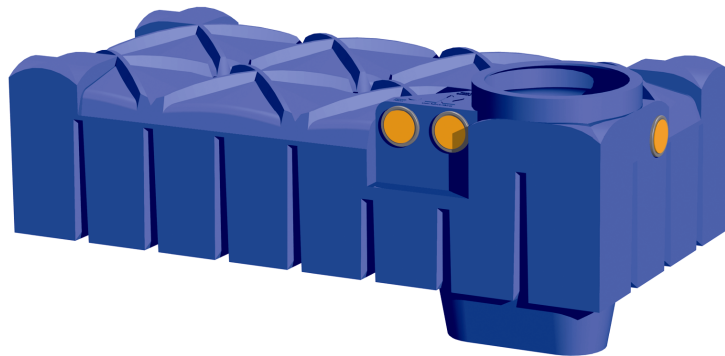
5000L F-Line



10,000 is achieved by linking 2 x 5000L tanks together using the DN100 seals supplied.



F-Line Flat Tank shallow dig underground tank



- The F-Line is a high quality, rotationally moulded, one piece rainwater tank that can be installed without the need for concrete, thereby minimising installation costs and supported by our long term 25 year tank guarantee.
- Minimal installation depth
- Easy and quick to install
- Small excavation pit and little earth excavation preserves your garden
- Ideal for installation in new or existing properties
- Can be installed in ground water up to tank shoulder
- Easy to install

The F-line flat tank can be installed into much higher water tables than a standard round tank. If you don't know what your water table will be like in the winter, you're safer to install a flat tank. The F-Line tanks are flat and the installation depth is up to 60% less than other rainwater tanks. The excavation can be up to 70% less, meaning little earth excavation, easy handling and less cost for you! The small excavation pit is easily filled in and your garden will look just like it did before.



Drainage Calculation Summary

The calculations below have been based on the following criteria:

1:100 Year Storm Event

40% Climate Change

Geographical Location; 54 Parkfield Road, Ickenham. UB10 8LW

Total impermeable area = 169.87 sqm

We have run the Micro Drainage Calculations (see pages below) and designed a system as follows;

- 10000L tank with a 15 mm orifice, providing 7100 litres of attenuation and a peak discharge of 0.6l/s
- The highest stress put on the system was during the 1:100 year (+40%), 120 minute winter storm.
- Various other events were trailed; (38 in total) all at or below a peak discharge of 0.6 l/s

The reason we can use a very small orifice (between 5-50mm) without risk of blockage is because;

- High quality pre filtration, removing any particles larger than 1000 micron. (*So nothing larger than 1mm can enter the tank.*)
- The filter is self cleaning but does require an annual check for any major debris. As detailed in the maintenance guide.

The orifice and filter have been developed for simple auditing. (Remove the manhole and look directly below to check for blockage.)

Rainwater Harvesting Ltd							Page 1
Unit A Harrier Park Orton Southgate Peterborough PE2 6YQ							
Date 11/12/2018 11:49 File IMW 54 Parkfield Rd UB1...							
XP Solutions				Designed by RainWater Harves... Checked by			
				Source Control 2016.1			
<u>Summary of Results for 100 year Return Period (+40%)</u>							
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	0.399	0.399	0.5	0.0	0.5	4.2	O K
30 min Summer	0.501	0.501	0.5	0.0	0.5	5.2	O K
60 min Summer	0.574	0.574	0.6	0.0	0.6	6.0	O K
120 min Summer	0.599	0.599	0.6	0.0	0.6	6.2	O K
180 min Summer	0.595	0.595	0.6	0.0	0.6	6.2	O K
240 min Summer	0.580	0.580	0.6	0.0	0.6	6.0	O K
360 min Summer	0.544	0.544	0.5	0.0	0.5	5.7	O K
480 min Summer	0.507	0.507	0.5	0.0	0.5	5.3	O K
600 min Summer	0.473	0.473	0.5	0.0	0.5	4.9	O K
720 min Summer	0.441	0.441	0.5	0.0	0.5	4.6	O K
960 min Summer	0.387	0.387	0.5	0.0	0.5	4.0	O K
1440 min Summer	0.305	0.305	0.4	0.0	0.4	3.2	O K
2160 min Summer	0.225	0.225	0.3	0.0	0.3	2.3	O K
2880 min Summer	0.173	0.173	0.3	0.0	0.3	1.8	O K
4320 min Summer	0.113	0.113	0.2	0.0	0.2	1.2	O K
5760 min Summer	0.081	0.081	0.2	0.0	0.2	0.8	O K
7200 min Summer	0.062	0.062	0.2	0.0	0.2	0.6	O K
8640 min Summer	0.049	0.049	0.2	0.0	0.2	0.5	O K
10080 min Summer	0.040	0.040	0.1	0.0	0.1	0.4	O K
15 min Winter	0.449	0.449	0.5	0.0	0.5	4.7	O K
30 min Winter	0.565	0.565	0.6	0.0	0.6	5.9	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)		
15 min Summer	139.755	0.0	4.4	0.0	18		
30 min Summer	91.475	0.0	5.8	0.0	32		
60 min Summer	57.005	0.0	7.3	0.0	60		
120 min Summer	34.310	0.0	8.7	0.0	96		
180 min Summer	25.153	0.0	9.6	0.0	130		
240 min Summer	20.060	0.0	10.2	0.0	164		
360 min Summer	14.548	0.0	11.1	0.0	232		
480 min Summer	11.581	0.0	11.8	0.0	300		
600 min Summer	9.696	0.0	12.4	0.0	368		
720 min Summer	8.382	0.0	12.8	0.0	434		
960 min Summer	6.656	0.0	13.6	0.0	560		
1440 min Summer	4.803	0.0	14.7	0.0	808		
2160 min Summer	3.460	0.0	15.9	0.0	1168		
2880 min Summer	2.739	0.0	16.8	0.0	1528		
4320 min Summer	1.968	0.0	18.1	0.0	2248		
5760 min Summer	1.555	0.0	19.0	0.0	2944		
7200 min Summer	1.294	0.0	19.8	0.0	3672		
8640 min Summer	1.114	0.0	20.4	0.0	4408		
10080 min Summer	0.981	0.0	21.0	0.0	5136		
15 min Winter	139.755	0.0	5.0	0.0	18		
30 min Winter	91.475	0.0	6.5	0.0	32		
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Rainwater Harvesting Ltd							Page 2
Unit A Harrier Park Orton Southgate Peterborough PE2 6YQ							
Date 11/12/2018 11:49 File IMW 54 Parkfield Rd UB1...			Designed by RainWater Harves... Checked by				
XP Solutions			Source Control 2016.1				
<u>Summary of Results for 100 year Return Period (+40%)</u>							
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
60 min Winter	0.653	0.653	0.6	0.0	0.6	6.8	O K
120 min Winter	0.681	0.681	0.6	0.0	0.6	7.1	O K
180 min Winter	0.673	0.673	0.6	0.0	0.6	7.0	O K
240 min Winter	0.650	0.650	0.6	0.0	0.6	6.8	O K
360 min Winter	0.596	0.596	0.6	0.0	0.6	6.2	O K
480 min Winter	0.542	0.542	0.5	0.0	0.5	5.6	O K
600 min Winter	0.493	0.493	0.5	0.0	0.5	5.1	O K
720 min Winter	0.449	0.449	0.5	0.0	0.5	4.7	O K
960 min Winter	0.375	0.375	0.5	0.0	0.5	3.9	O K
1440 min Winter	0.271	0.271	0.4	0.0	0.4	2.8	O K
2160 min Winter	0.178	0.178	0.3	0.0	0.3	1.9	O K
2880 min Winter	0.126	0.126	0.3	0.0	0.3	1.3	O K
4320 min Winter	0.074	0.074	0.2	0.0	0.2	0.8	O K
5760 min Winter	0.050	0.050	0.2	0.0	0.2	0.5	O K
7200 min Winter	0.038	0.038	0.1	0.0	0.1	0.4	O K
8640 min Winter	0.030	0.030	0.1	0.0	0.1	0.3	O K
10080 min Winter	0.025	0.025	0.1	0.0	0.1	0.3	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)		
60 min Winter	57.005	0.0	8.1	0.0	60		
120 min Winter	34.310	0.0	9.8	0.0	102		
180 min Winter	25.153	0.0	10.8	0.0	138		
240 min Winter	20.060	0.0	11.5	0.0	176		
360 min Winter	14.548	0.0	12.5	0.0	250		
480 min Winter	11.581	0.0	13.2	0.0	322		
600 min Winter	9.696	0.0	13.8	0.0	392		
720 min Winter	8.382	0.0	14.4	0.0	458		
960 min Winter	6.656	0.0	15.2	0.0	588		
1440 min Winter	4.803	0.0	16.5	0.0	838		
2160 min Winter	3.460	0.0	17.8	0.0	1208		
2880 min Winter	2.739	0.0	18.8	0.0	1556		
4320 min Winter	1.968	0.0	20.2	0.0	2248		
5760 min Winter	1.555	0.0	21.3	0.0	2992		
7200 min Winter	1.294	0.0	22.2	0.0	3672		
8640 min Winter	1.114	0.0	22.9	0.0	4384		
10080 min Winter	0.981	0.0	23.5	0.0	5136		
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Rainwater Harvesting Ltd		Page 3																																	
Unit A Harrier Park Orton Southgate Peterborough PE2 6YQ																																			
Date 11/12/2018 11:49 File IMW 54 Parkfield Rd UB1...	Designed by RainWater Harves... Checked by																																		
XP Solutions		Source Control 2016.1																																	
<u>Rainfall Details</u> <table> <tr> <td>Rainfall Model</td> <td>FSR</td> <td>Winter Storms</td> <td>Yes</td> </tr> <tr> <td>Return Period (years)</td> <td>100</td> <td>Cv (Summer)</td> <td>0.750</td> </tr> <tr> <td>Region</td> <td>England and Wales</td> <td>Cv (Winter)</td> <td>0.840</td> </tr> <tr> <td>M5-60 (mm)</td> <td>20.100</td> <td>Shortest Storm (mins)</td> <td>15</td> </tr> <tr> <td>Ratio R</td> <td>0.407</td> <td>Longest Storm (mins)</td> <td>10080</td> </tr> <tr> <td>Summer Storms</td> <td>Yes</td> <td>Climate Change %</td> <td>+40</td> </tr> </table> <u>Time Area Diagram</u> Total Area (ha) 0.017 <table> <tr> <th colspan="2">Time (mins)</th> <th>Area</th> </tr> <tr> <th>From:</th> <th>To:</th> <th>(ha)</th> </tr> <tr> <td>0</td> <td>4</td> <td>0.017</td> </tr> </table>			Rainfall Model	FSR	Winter Storms	Yes	Return Period (years)	100	Cv (Summer)	0.750	Region	England and Wales	Cv (Winter)	0.840	M5-60 (mm)	20.100	Shortest Storm (mins)	15	Ratio R	0.407	Longest Storm (mins)	10080	Summer Storms	Yes	Climate Change %	+40	Time (mins)		Area	From:	To:	(ha)	0	4	0.017
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Date 11/12/2018 11:49 File IMW 54 Parkfield Rd UB1...	Designed by RainWater Harves... Checked by	
XP Solutions Source Control 2016.1		

Model Details

Storage is Online Cover Level (m) 1.000

Tank or Pond Structure

Invert Level (m) 0.000

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	10.4	0.755	10.4	0.756	0.0

Orifice Outflow Control

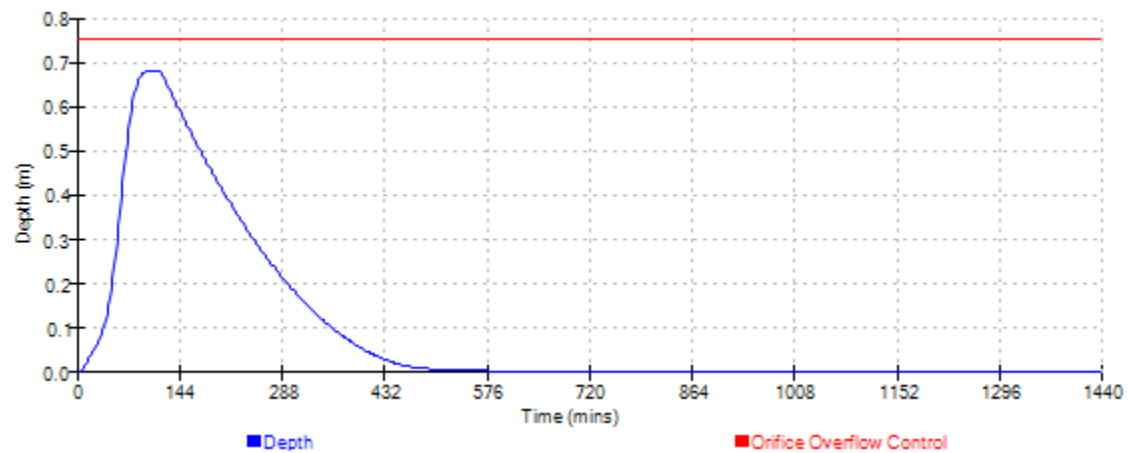
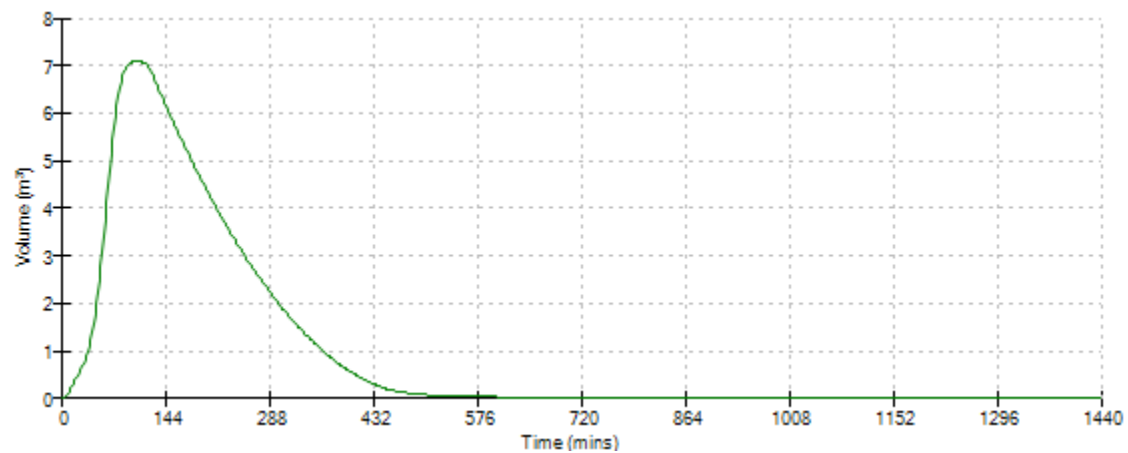
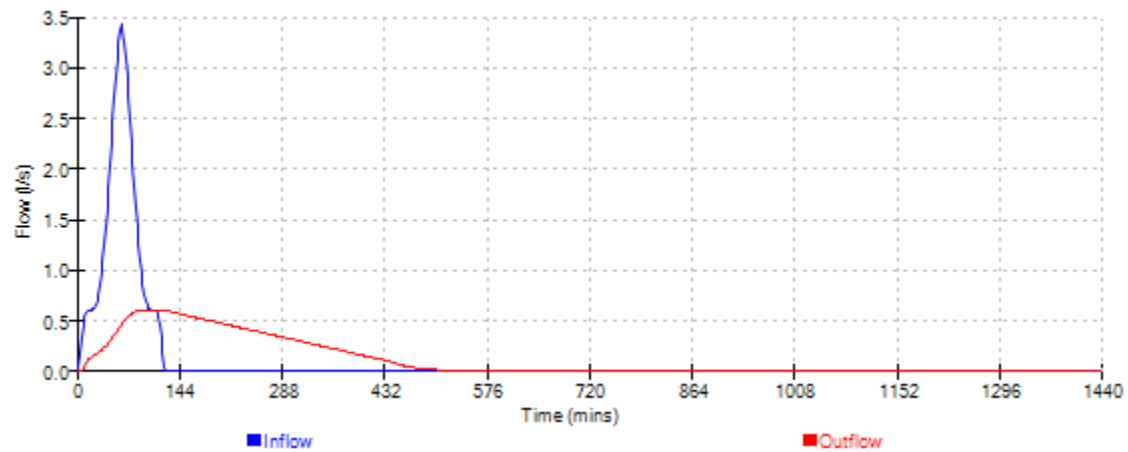
Diameter (m) 0.015 Discharge Coefficient 0.950 Invert Level (m) 0.000

Orifice Overflow Control

Diameter (m) 0.100 Discharge Coefficient 0.600 Invert Level (m) 0.754

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Event: 120 min Winter



Rain Activ maintenance schedule.

Filter: *Warranty 2 years. Expected service life 100 years.*

Self cleaning filter with 1000 micron screen.

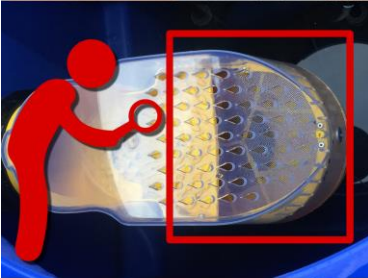
Every 6 months. Visually check the filter for larger blockages.

1. Release child locks on the lid. (13mm bolt).



2. Inspect filter for visible large blockage.

If large or non moving debris is found refer to stage 3. If none is found refer to stage 6.



NB: Small debris will be periodically self cleaned during storms. Leaves, moss and other smaller debris will self clean and do not require removing unless obvious they are causing a blockage.

3. (If a blockage has been found) Remove filter lid.



4. Remove debris, wash filter head under a tap.



5. Replace filter head.



6. Replace lid, ensure 13mm child safe locks are tight.



Risk if neglected: Very low, possible reduction of filter efficiency. Reduction in quality of water for rainwater harvesting.

NB: the filter is fully self cleaning under normal conditions. Only abnormal or large debris from gutters can cause a blockage.

Maintenance frequency can be reduced by adding additional leaf and debris guards to gutters. Dependant on the quality of guarding and location, maintenance intervals can be reduced to 12, 18, or 24 months.

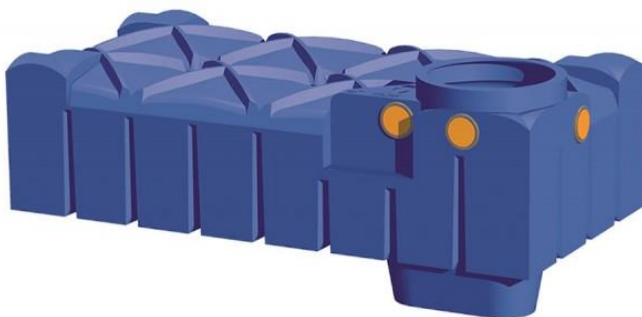
Examples of gutter guarding systems.



F-Line Tank. *Warranty 25 years. Expected service life 100 years.*

Every 10 years. Pump out completely and clean sidewalls with pressure washer, pump out using dirty water pump. (Around 0.5cm of very fine silt builds per year.)

Risk if missed: Low, potential reduction in water quality for rainwater harvesting. If missed multiple times (circa 50 years), potential blockage of outlet orifice.



Gutters: N/A

Clean every 10 years to reduce strain on self cleaning filter. Remove all leaf matter, moss, debris. Wash through.

Risk if missed: Very low, increased fine sediment entering the tank.

Unda Consulting Ltd						Page 1																																																																																																																																																																																																																																																																																		
Southpoint Old Brighton Road Gatwick RH11 0PR																																																																																																																																																																																																																																																																																								
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XP Solutions			Source Control 2018.1.1																																																																																																																																																																																																																																																																																					
<u>Summary of Results for 100 year Return Period (+40%)</u> Half Drain Time : 86 minutes. <table><thead><tr><th>Storm Event</th><th>Max Level (m)</th><th>Max Depth (m)</th><th>Max Infiltration (l/s)</th><th>Max Control (l/s)</th><th>Max E Outflow (l/s)</th><th>Max Volume (m³)</th><th>Status</th></tr></thead><tbody><tr><td>15 min Summer</td><td>19.890</td><td>0.070</td><td>0.0</td><td>0.6</td><td>0.6</td><td>3.2</td><td>Flood Risk</td></tr><tr><td>30 min Summer</td><td>19.912</td><td>0.092</td><td>0.0</td><td>0.6</td><td>0.6</td><td>4.2</td><td>Flood Risk</td></tr><tr><td>60 min Summer</td><td>19.929</td><td>0.109</td><td>0.0</td><td>0.6</td><td>0.6</td><td>5.0</td><td>Flood Risk</td></tr><tr><td>120 min Summer</td><td>19.936</td><td>0.116</td><td>0.0</td><td>0.6</td><td>0.6</td><td>5.4</td><td>Flood Risk</td></tr><tr><td>180 min Summer</td><td>19.936</td><td>0.116</td><td>0.0</td><td>0.6</td><td>0.6</td><td>5.4</td><td>Flood Risk</td></tr><tr><td>240 min Summer</td><td>19.934</td><td>0.114</td><td>0.0</td><td>0.6</td><td>0.6</td><td>5.3</td><td>Flood Risk</td></tr><tr><td>360 min Summer</td><td>19.925</td><td>0.105</td><td>0.0</td><td>0.6</td><td>0.6</td><td>4.9</td><td>Flood Risk</td></tr><tr><td>480 min Summer</td><td>19.916</td><td>0.096</td><td>0.0</td><td>0.6</td><td>0.6</td><td>4.4</td><td>Flood Risk</td></tr><tr><td>600 min Summer</td><td>19.906</td><td>0.086</td><td>0.0</td><td>0.6</td><td>0.6</td><td>4.0</td><td>Flood Risk</td></tr><tr><td>720 min Summer</td><td>19.897</td><td>0.077</td><td>0.0</td><td>0.6</td><td>0.6</td><td>3.6</td><td>Flood Risk</td></tr><tr><td>960 min Summer</td><td>19.884</td><td>0.064</td><td>0.0</td><td>0.6</td><td>0.6</td><td>2.9</td><td>Flood Risk</td></tr><tr><td>1440 min Summer</td><td>19.871</td><td>0.051</td><td>0.0</td><td>0.5</td><td>0.5</td><td>2.3</td><td>Flood Risk</td></tr><tr><td>2160 min Summer</td><td>19.860</td><td>0.040</td><td>0.0</td><td>0.4</td><td>0.4</td><td>1.8</td><td>Flood Risk</td></tr><tr><td>2880 min Summer</td><td>19.854</td><td>0.034</td><td>0.0</td><td>0.3</td><td>0.3</td><td>1.6</td><td>Flood Risk</td></tr><tr><td>4320 min Summer</td><td>19.848</td><td>0.028</td><td>0.0</td><td>0.2</td><td>0.2</td><td>1.3</td><td>Flood Risk</td></tr><tr><td>5760 min Summer</td><td>19.844</td><td>0.024</td><td>0.0</td><td>0.2</td><td>0.2</td><td>1.1</td><td>Flood Risk</td></tr><tr><td>7200 min Summer</td><td>19.842</td><td>0.022</td><td>0.0</td><td>0.2</td><td>0.2</td><td>1.0</td><td>Flood Risk</td></tr><tr><td>8640 min Summer</td><td>19.840</td><td>0.020</td><td>0.0</td><td>0.1</td><td>0.1</td><td>0.9</td><td>Flood Risk</td></tr><tr><td>10080 min Summer</td><td>19.839</td><td>0.019</td><td>0.0</td><td>0.1</td><td>0.1</td><td>0.9</td><td>Flood Risk</td></tr><tr><td>15 min Winter</td><td>19.901</td><td>0.081</td><td>0.0</td><td>0.6</td><td>0.6</td><td>3.7</td><td>Flood Risk</td></tr></tbody></table> <table><thead><tr><th>Storm Event</th><th>Rain (mm/hr)</th><th>Flooded Volume (m³)</th><th>Discharge Volume (m³)</th><th>Time-Peak (mins)</th></tr></thead><tbody><tr><td>15 min Summer</td><td>143.129</td><td>0.0</td><td>3.5</td><td>18</td></tr><tr><td>30 min Summer</td><td>93.302</td><td>0.0</td><td>4.8</td><td>32</td></tr><tr><td>60 min Summer</td><td>57.877</td><td>0.0</td><td>6.1</td><td>60</td></tr><tr><td>120 min Summer</td><td>34.670</td><td>0.0</td><td>7.5</td><td>96</td></tr><tr><td>180 min Summer</td><td>25.347</td><td>0.0</td><td>8.3</td><td>128</td></tr><tr><td>240 min Summer</td><td>20.178</td><td>0.0</td><td>8.8</td><td>164</td></tr><tr><td>360 min Summer</td><td>14.609</td><td>0.0</td><td>9.6</td><td>230</td></tr><tr><td>480 min Summer</td><td>11.612</td><td>0.0</td><td>10.2</td><td>294</td></tr><tr><td>600 min Summer</td><td>9.711</td><td>0.0</td><td>10.7</td><td>356</td></tr><tr><td>720 min Summer</td><td>8.388</td><td>0.0</td><td>11.0</td><td>414</td></tr><tr><td>960 min Summer</td><td>6.652</td><td>0.0</td><td>11.6</td><td>528</td></tr><tr><td>1440 min Summer</td><td>4.791</td><td>0.0</td><td>12.5</td><td>766</td></tr><tr><td>2160 min Summer</td><td>3.445</td><td>0.0</td><td>13.4</td><td>1124</td></tr><tr><td>2880 min Summer</td><td>2.724</td><td>0.0</td><td>14.0</td><td>1472</td></tr><tr><td>4320 min Summer</td><td>1.953</td><td>0.0</td><td>14.7</td><td>2204</td></tr><tr><td>5760 min Summer</td><td>1.542</td><td>0.0</td><td>15.1</td><td>2936</td></tr><tr><td>7200 min Summer</td><td>1.282</td><td>0.0</td><td>15.4</td><td>3672</td></tr><tr><td>8640 min Summer</td><td>1.103</td><td>0.0</td><td>15.5</td><td>4400</td></tr><tr><td>10080 min Summer</td><td>0.971</td><td>0.0</td><td>15.5</td><td>5104</td></tr><tr><td>15 min Winter</td><td>143.129</td><td>0.0</td><td>4.0</td><td>18</td></tr></tbody></table>								Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status	15 min Summer	19.890	0.070	0.0	0.6	0.6	3.2	Flood Risk	30 min Summer	19.912	0.092	0.0	0.6	0.6	4.2	Flood Risk	60 min Summer	19.929	0.109	0.0	0.6	0.6	5.0	Flood Risk	120 min Summer	19.936	0.116	0.0	0.6	0.6	5.4	Flood Risk	180 min Summer	19.936	0.116	0.0	0.6	0.6	5.4	Flood Risk	240 min Summer	19.934	0.114	0.0	0.6	0.6	5.3	Flood Risk	360 min Summer	19.925	0.105	0.0	0.6	0.6	4.9	Flood Risk	480 min Summer	19.916	0.096	0.0	0.6	0.6	4.4	Flood Risk	600 min Summer	19.906	0.086	0.0	0.6	0.6	4.0	Flood Risk	720 min Summer	19.897	0.077	0.0	0.6	0.6	3.6	Flood Risk	960 min Summer	19.884	0.064	0.0	0.6	0.6	2.9	Flood Risk	1440 min Summer	19.871	0.051	0.0	0.5	0.5	2.3	Flood Risk	2160 min Summer	19.860	0.040	0.0	0.4	0.4	1.8	Flood Risk	2880 min Summer	19.854	0.034	0.0	0.3	0.3	1.6	Flood Risk	4320 min Summer	19.848	0.028	0.0	0.2	0.2	1.3	Flood Risk	5760 min Summer	19.844	0.024	0.0	0.2	0.2	1.1	Flood Risk	7200 min Summer	19.842	0.022	0.0	0.2	0.2	1.0	Flood Risk	8640 min Summer	19.840	0.020	0.0	0.1	0.1	0.9	Flood Risk	10080 min Summer	19.839	0.019	0.0	0.1	0.1	0.9	Flood Risk	15 min Winter	19.901	0.081	0.0	0.6	0.6	3.7	Flood Risk	Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	15 min Summer	143.129	0.0	3.5	18	30 min Summer	93.302	0.0	4.8	32	60 min Summer	57.877	0.0	6.1	60	120 min Summer	34.670	0.0	7.5	96	180 min Summer	25.347	0.0	8.3	128	240 min Summer	20.178	0.0	8.8	164	360 min Summer	14.609	0.0	9.6	230	480 min Summer	11.612	0.0	10.2	294	600 min Summer	9.711	0.0	10.7	356	720 min Summer	8.388	0.0	11.0	414	960 min Summer	6.652	0.0	11.6	528	1440 min Summer	4.791	0.0	12.5	766	2160 min Summer	3.445	0.0	13.4	1124	2880 min Summer	2.724	0.0	14.0	1472	4320 min Summer	1.953	0.0	14.7	2204	5760 min Summer	1.542	0.0	15.1	2936	7200 min Summer	1.282	0.0	15.4	3672	8640 min Summer	1.103	0.0	15.5	4400	10080 min Summer	0.971	0.0	15.5	5104	15 min Winter	143.129	0.0	4.0	18
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status																																																																																																																																																																																																																																																																																	
15 min Summer	19.890	0.070	0.0	0.6	0.6	3.2	Flood Risk																																																																																																																																																																																																																																																																																	
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120 min Summer	19.936	0.116	0.0	0.6	0.6	5.4	Flood Risk																																																																																																																																																																																																																																																																																	
180 min Summer	19.936	0.116	0.0	0.6	0.6	5.4	Flood Risk																																																																																																																																																																																																																																																																																	
240 min Summer	19.934	0.114	0.0	0.6	0.6	5.3	Flood Risk																																																																																																																																																																																																																																																																																	
360 min Summer	19.925	0.105	0.0	0.6	0.6	4.9	Flood Risk																																																																																																																																																																																																																																																																																	
480 min Summer	19.916	0.096	0.0	0.6	0.6	4.4	Flood Risk																																																																																																																																																																																																																																																																																	
600 min Summer	19.906	0.086	0.0	0.6	0.6	4.0	Flood Risk																																																																																																																																																																																																																																																																																	
720 min Summer	19.897	0.077	0.0	0.6	0.6	3.6	Flood Risk																																																																																																																																																																																																																																																																																	
960 min Summer	19.884	0.064	0.0	0.6	0.6	2.9	Flood Risk																																																																																																																																																																																																																																																																																	
1440 min Summer	19.871	0.051	0.0	0.5	0.5	2.3	Flood Risk																																																																																																																																																																																																																																																																																	
2160 min Summer	19.860	0.040	0.0	0.4	0.4	1.8	Flood Risk																																																																																																																																																																																																																																																																																	
2880 min Summer	19.854	0.034	0.0	0.3	0.3	1.6	Flood Risk																																																																																																																																																																																																																																																																																	
4320 min Summer	19.848	0.028	0.0	0.2	0.2	1.3	Flood Risk																																																																																																																																																																																																																																																																																	
5760 min Summer	19.844	0.024	0.0	0.2	0.2	1.1	Flood Risk																																																																																																																																																																																																																																																																																	
7200 min Summer	19.842	0.022	0.0	0.2	0.2	1.0	Flood Risk																																																																																																																																																																																																																																																																																	
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15 min Summer	143.129	0.0	3.5	18																																																																																																																																																																																																																																																																																				
30 min Summer	93.302	0.0	4.8	32																																																																																																																																																																																																																																																																																				
60 min Summer	57.877	0.0	6.1	60																																																																																																																																																																																																																																																																																				
120 min Summer	34.670	0.0	7.5	96																																																																																																																																																																																																																																																																																				
180 min Summer	25.347	0.0	8.3	128																																																																																																																																																																																																																																																																																				
240 min Summer	20.178	0.0	8.8	164																																																																																																																																																																																																																																																																																				
360 min Summer	14.609	0.0	9.6	230																																																																																																																																																																																																																																																																																				
480 min Summer	11.612	0.0	10.2	294																																																																																																																																																																																																																																																																																				
600 min Summer	9.711	0.0	10.7	356																																																																																																																																																																																																																																																																																				
720 min Summer	8.388	0.0	11.0	414																																																																																																																																																																																																																																																																																				
960 min Summer	6.652	0.0	11.6	528																																																																																																																																																																																																																																																																																				
1440 min Summer	4.791	0.0	12.5	766																																																																																																																																																																																																																																																																																				
2160 min Summer	3.445	0.0	13.4	1124																																																																																																																																																																																																																																																																																				
2880 min Summer	2.724	0.0	14.0	1472																																																																																																																																																																																																																																																																																				
4320 min Summer	1.953	0.0	14.7	2204																																																																																																																																																																																																																																																																																				
5760 min Summer	1.542	0.0	15.1	2936																																																																																																																																																																																																																																																																																				
7200 min Summer	1.282	0.0	15.4	3672																																																																																																																																																																																																																																																																																				
8640 min Summer	1.103	0.0	15.5	4400																																																																																																																																																																																																																																																																																				
10080 min Summer	0.971	0.0	15.5	5104																																																																																																																																																																																																																																																																																				
15 min Winter	143.129	0.0	4.0	18																																																																																																																																																																																																																																																																																				
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Southpoint Old Brighton Road Gatwick RH11 0PR							
Date 04/12/2018 12:04 File 87427-PP.SRCX			Designed by Emma-Jeffery Checked by				
XP Solutions			Source Control 2018.1.1				
<u>Summary of Results for 100 year Return Period (+40%)</u>							
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	19.926	0.106	0.0	0.6	0.6	4.9	Flood Risk
60 min Winter	19.946	0.126	0.0	0.6	0.6	5.8	Flood Risk
120 min Winter	19.953	0.133	0.0	0.6	0.6	6.1	Flood Risk
180 min Winter	19.951	0.131	0.0	0.6	0.6	6.1	Flood Risk
240 min Winter	19.946	0.126	0.0	0.6	0.6	5.8	Flood Risk
360 min Winter	19.932	0.112	0.0	0.6	0.6	5.2	Flood Risk
480 min Winter	19.916	0.096	0.0	0.6	0.6	4.4	Flood Risk
600 min Winter	19.901	0.081	0.0	0.6	0.6	3.7	Flood Risk
720 min Winter	19.889	0.069	0.0	0.6	0.6	3.2	Flood Risk
960 min Winter	19.876	0.056	0.0	0.5	0.5	2.6	Flood Risk
1440 min Winter	19.862	0.042	0.0	0.4	0.4	2.0	Flood Risk
2160 min Winter	19.853	0.033	0.0	0.3	0.3	1.5	Flood Risk
2880 min Winter	19.848	0.028	0.0	0.2	0.2	1.3	Flood Risk
4320 min Winter	19.843	0.023	0.0	0.2	0.2	1.1	Flood Risk
5760 min Winter	19.840	0.020	0.0	0.1	0.1	0.9	Flood Risk
7200 min Winter	19.838	0.018	0.0	0.1	0.1	0.8	Flood Risk
8640 min Winter	19.837	0.017	0.0	0.1	0.1	0.8	Flood Risk
10080 min Winter	19.836	0.016	0.0	0.1	0.1	0.7	Flood Risk
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)			
30 min Winter	93.302	0.0	5.4	32			
60 min Winter	57.877	0.0	7.0	60			
120 min Winter	34.670	0.0	8.5	108			
180 min Winter	25.347	0.0	9.4	138			
240 min Winter	20.178	0.0	10.0	176			
360 min Winter	14.609	0.0	10.9	250			
480 min Winter	11.612	0.0	11.5	316			
600 min Winter	9.711	0.0	12.0	376			
720 min Winter	8.388	0.0	12.5	428			
960 min Winter	6.652	0.0	13.2	540			
1440 min Winter	4.791	0.0	14.2	778			
2160 min Winter	3.445	0.0	15.2	1124			
2880 min Winter	2.724	0.0	15.9	1500			
4320 min Winter	1.953	0.0	16.7	2160			
5760 min Winter	1.542	0.0	17.3	2904			
7200 min Winter	1.282	0.0	17.6	3664			
8640 min Winter	1.103	0.0	17.8	4408			
10080 min Winter	0.971	0.0	17.9	5176			
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XP Solutions	Source Control 2018.1.1	

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.400	Shortest Storm (mins)	15
Ratio R	0.416	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

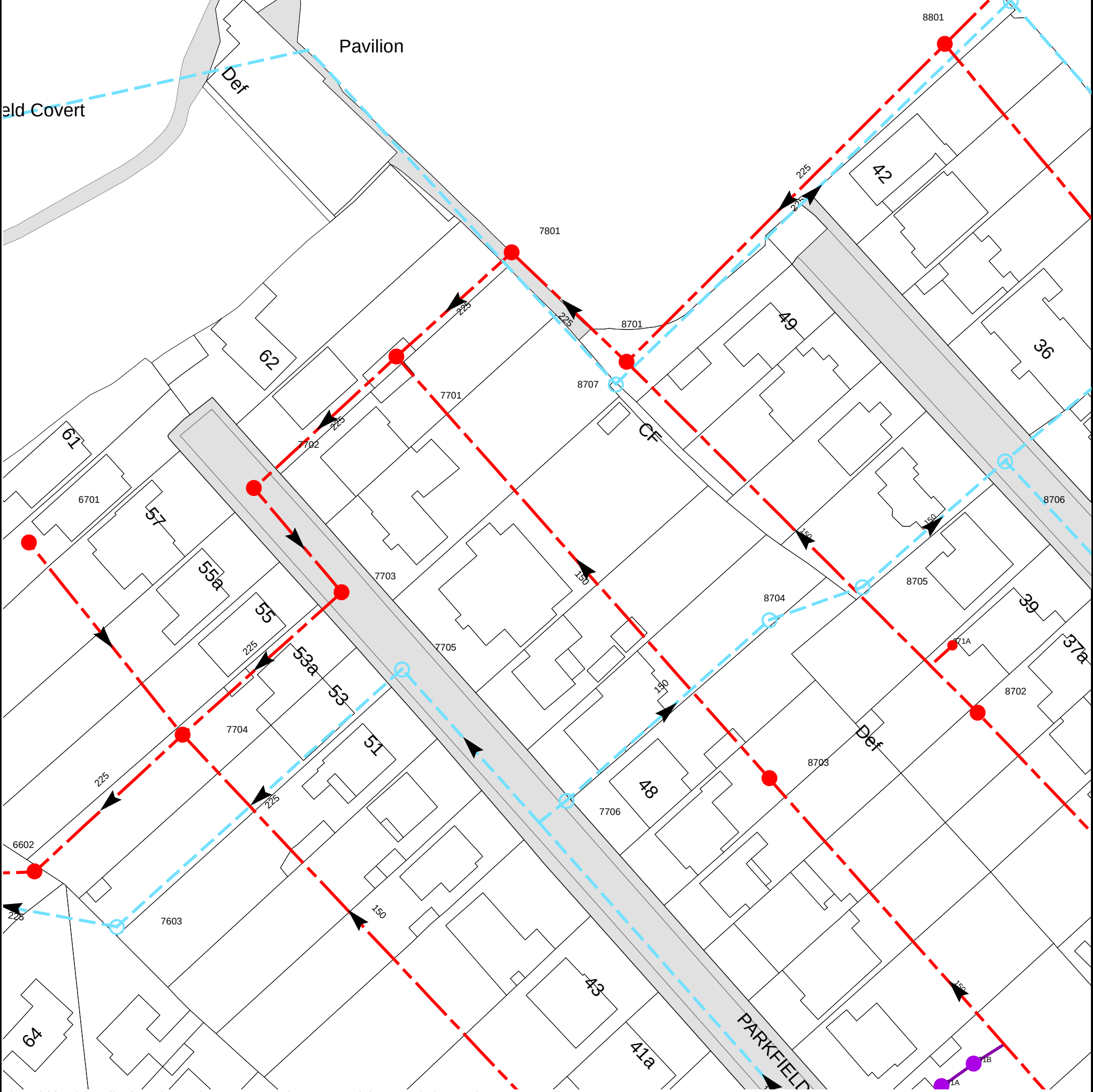
Time Area Diagram

Total Area (ha) 0.016

Time (mins)	Area
From:	To: (ha)

0	4 0.016
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Southpoint Old Brighton Road Gatwick RH11 0PR																																																																																																																																							
Date 04/12/2018 12:04 File 87427-PP.SRCX	Designed by Emma-Jeffery Checked by																																																																																																																																						
XP Solutions	Source Control 2018.1.1																																																																																																																																						
<u>Model Details</u> Storage is Online Cover Level (m) 20.100 <u>Porous Car Park Structure</u> <table><tr><td>Infiltration Coefficient Base (m/hr)</td><td>0.00000</td><td>Width (m)</td><td>14.0</td></tr><tr><td>Membrane Percolation (mm/hr)</td><td>1000</td><td>Length (m)</td><td>11.0</td></tr><tr><td>Max Percolation (l/s)</td><td>42.8</td><td>Slope (1:X)</td><td>0.0</td></tr><tr><td>Safety Factor</td><td>2.0</td><td>Depression Storage (mm)</td><td>5</td></tr><tr><td>Porosity</td><td>0.30</td><td>Evaporation (mm/day)</td><td>3</td></tr><tr><td>Invert Level (m)</td><td>19.820</td><td>Cap Volume Depth (m)</td><td>0.150</td></tr></table> <u>Hydro-Brake® Optimum Outflow Control</u> <table><tr><td>Unit Reference</td><td>MD-SCL-0042-6000-0150-6000</td></tr><tr><td>Design Head (m)</td><td>0.150</td></tr><tr><td>Design Flow (l/s)</td><td>0.6</td></tr><tr><td>Flush-Flo™</td><td>Calculated</td></tr><tr><td>Objective</td><td>Minimise blockage risk</td></tr><tr><td>Application</td><td>Surface</td></tr><tr><td>Sump Available</td><td>Yes</td></tr><tr><td>Diameter (mm)</td><td>42</td></tr><tr><td>Invert Level (m)</td><td>19.820</td></tr><tr><td>Minimum Outlet Pipe Diameter (mm)</td><td>75</td></tr><tr><td>Suggested Manhole Diameter (mm)</td><td>1200</td></tr></table> <table><tr><th>Control Points</th><th>Head (m)</th><th>Flow (l/s)</th></tr><tr><td>Design Point (Calculated)</td><td>0.150</td><td>0.6</td></tr><tr><td>Flush-Flo™</td><td>0.064</td><td>0.6</td></tr><tr><td>Kick-Flo®</td><td>0.112</td><td>0.5</td></tr><tr><td>Mean Flow over Head Range</td><td>-</td><td>0.4</td></tr></table> The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated <table><tr><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th></tr><tr><td>0.100</td><td>0.6</td><td>1.200</td><td>1.5</td><td>3.000</td><td>2.3</td><td>7.000</td><td>3.6</td></tr><tr><td>0.200</td><td>0.7</td><td>1.400</td><td>1.6</td><td>3.500</td><td>2.5</td><td>7.500</td><td>3.7</td></tr><tr><td>0.300</td><td>0.8</td><td>1.600</td><td>1.7</td><td>4.000</td><td>2.7</td><td>8.000</td><td>3.8</td></tr><tr><td>0.400</td><td>0.9</td><td>1.800</td><td>1.8</td><td>4.500</td><td>2.9</td><td>8.500</td><td>3.9</td></tr><tr><td>0.500</td><td>1.0</td><td>2.000</td><td>1.9</td><td>5.000</td><td>3.0</td><td>9.000</td><td>4.0</td></tr><tr><td>0.600</td><td>1.1</td><td>2.200</td><td>2.0</td><td>5.500</td><td>3.2</td><td>9.500</td><td>4.2</td></tr><tr><td>0.800</td><td>1.2</td><td>2.400</td><td>2.1</td><td>6.000</td><td>3.3</td><td></td><td></td></tr><tr><td>1.000</td><td>1.4</td><td>2.600</td><td>2.2</td><td>6.500</td><td>3.4</td><td></td><td></td></tr></table>			Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	14.0	Membrane Percolation (mm/hr)	1000	Length (m)	11.0	Max Percolation (l/s)	42.8	Slope (1:X)	0.0	Safety Factor	2.0	Depression Storage (mm)	5	Porosity	0.30	Evaporation (mm/day)	3	Invert Level (m)	19.820	Cap Volume Depth (m)	0.150	Unit Reference	MD-SCL-0042-6000-0150-6000	Design Head (m)	0.150	Design Flow (l/s)	0.6	Flush-Flo™	Calculated	Objective	Minimise blockage risk	Application	Surface	Sump Available	Yes	Diameter (mm)	42	Invert Level (m)	19.820	Minimum Outlet Pipe Diameter (mm)	75	Suggested Manhole Diameter (mm)	1200	Control Points	Head (m)	Flow (l/s)	Design Point (Calculated)	0.150	0.6	Flush-Flo™	0.064	0.6	Kick-Flo®	0.112	0.5	Mean Flow over Head Range	-	0.4	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	0.100	0.6	1.200	1.5	3.000	2.3	7.000	3.6	0.200	0.7	1.400	1.6	3.500	2.5	7.500	3.7	0.300	0.8	1.600	1.7	4.000	2.7	8.000	3.8	0.400	0.9	1.800	1.8	4.500	2.9	8.500	3.9	0.500	1.0	2.000	1.9	5.000	3.0	9.000	4.0	0.600	1.1	2.200	2.0	5.500	3.2	9.500	4.2	0.800	1.2	2.400	2.1	6.000	3.3			1.000	1.4	2.600	2.2	6.500	3.4		
Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	14.0																																																																																																																																				
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Design Head (m)	0.150																																																																																																																																						
Design Flow (l/s)	0.6																																																																																																																																						
Flush-Flo™	Calculated																																																																																																																																						
Objective	Minimise blockage risk																																																																																																																																						
Application	Surface																																																																																																																																						
Sump Available	Yes																																																																																																																																						
Diameter (mm)	42																																																																																																																																						
Invert Level (m)	19.820																																																																																																																																						
Minimum Outlet Pipe Diameter (mm)	75																																																																																																																																						
Suggested Manhole Diameter (mm)	1200																																																																																																																																						
Control Points	Head (m)	Flow (l/s)																																																																																																																																					
Design Point (Calculated)	0.150	0.6																																																																																																																																					
Flush-Flo™	0.064	0.6																																																																																																																																					
Kick-Flo®	0.112	0.5																																																																																																																																					
Mean Flow over Head Range	-	0.4																																																																																																																																					
Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)																																																																																																																																
0.100	0.6	1.200	1.5	3.000	2.3	7.000	3.6																																																																																																																																
0.200	0.7	1.400	1.6	3.500	2.5	7.500	3.7																																																																																																																																
0.300	0.8	1.600	1.7	4.000	2.7	8.000	3.8																																																																																																																																
0.400	0.9	1.800	1.8	4.500	2.9	8.500	3.9																																																																																																																																
0.500	1.0	2.000	1.9	5.000	3.0	9.000	4.0																																																																																																																																
0.600	1.1	2.200	2.0	5.500	3.2	9.500	4.2																																																																																																																																
0.800	1.2	2.400	2.1	6.000	3.3																																																																																																																																		
1.000	1.4	2.600	2.2	6.500	3.4																																																																																																																																		
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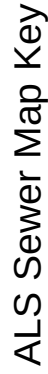


The width of the displayed area is 200 m and the centre of the map is located at OS coordinates 507789,186756
The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

Based on the Ordnance Survey Map with the Sanction of the controller of H.M. Stationery Office, License no. 100019345 Crown Copyright Reserved.

NB. Levels quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates that no survey information is available

Manhole Reference	Manhole Cover Level	Manhole Invert Level
861A	n/a	n/a
861B	n/a	n/a
8703	42.49	41.35
8702	42.64	41.5
871A	n/a	n/a
8704	n/a	n/a
8705	n/a	n/a
8706	n/a	n/a
8707	n/a	n/a
8701	42.71	39.46
8801	43.03	39.72
8802	n/a	n/a
6701	42.09	41.33
6602	40.69	38.13
7603	n/a	n/a
7704	n/a	n/a
7702	42.33	39.16
7703	42.12	39.08
7701	42.69	39.27
7705	n/a	n/a
7706	n/a	n/a
7801	42.74	39.36
The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.		



Sewer Fittings

Sewer Fittings

A feature in a sewer that does not affect the flow in the pipe. Example: a vent is a fitting as the function of a vent is to release excess gas.

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Surface Water: A sewer designed to convey surface water (e.g. rain water from roofs, yards and car parks) to rivers or watercourses.

Trunk Surface Water

Trunk Foul

 Vent Pipe

Gallery

Sludge Rising Main

Proposed Thames Water Rising Main

----- Vacuum

- 1) All levels associated with the plans are to Ordnance Datum Newlyn.
- 2) All measurements on the plans are metric.
- 3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate direction of flow.
- 4) Most private pipes are not shown on our plans, as in the past, this information has not been recorded.
- 5) 'na' or '0' on a manhole level indicates that data is unavailable.

Sewer Fittings

A feature in a sewer that does not affect the flow in the pipe. Example: a vent is a fitting as the function of a vent is to release excess gas.

Dam Chase

Motor
W

0

Operational Controls

A feature in a sewer that changes or diverts the flow in the sewer. Example: A hydrobrake limits the flow passing downstream.

t: Drop Pipe

1. *Introduction*

End Items

End symbols appear at the start or end of a sewer pipe. Examples: an Undefined End at the start of a sewer indicates that Thames Water has no knowledge of the position of the sewer upstream of that symbol, Outfall on a surface water sewer indicates that the pipe discharges into a stream or river.

Undefined End

 Inlet

Other Symbols

Symbols used on maps which do not fall under other general categories

* Change of characteristic indicator (C.O.C.I.)

Summit 

Lines denoting areas of underground surveys, etc.

144

 Operational Site Tunnel Conduit Braid

Other Sewer Types (Not Operated or Maintained by Thames Water)

—●— Surface Water Sewer

Droped



Abandoned Sewer

Appeal Decision

Site visit made on 18 June 2018

by Rachel Walmsley BSc MSc MA MRTPI

an Inspector appointed by the Secretary of State

Decision date: 29 October 2018

Appeal Ref: APP/R5510/W/17/3192388
54 Parkfield Road, Ickenham UB10 8LW

- The appeal is made under section 78 of the Town and Country Planning Act 1990 against a refusal to grant planning permission.
 - The appeal is made by Mr Ankit Madan against the decision of the Council of the London Borough of Hillingdon.
 - The application Ref 20899/APP/2016/2376, dated 18 June 2016, was refused by notice dated 27 June 2017.
 - The development proposed is two x 2-storey dwellings with habitable roofspace, outbuildings to rear, installation of vehicular crossover to front and associated landscaping works involving demolition of existing bungalow.
-

Decision

1. The appeal is allowed and planning permission is granted for two x 2-storey dwellings with habitable roofspace, outbuildings to rear, installation of vehicular crossover to front and associated landscaping works involving demolition of existing bungalow at 54 Parkfield Road, Ickenham UB10 8LW in accordance with the terms of the application, Ref 20899/APP/2016/2376 dated 18 June 2016, subject to the conditions set out in the attached conditions schedule.

Procedural matters

2. During the course of the appeal, the Environment Agency revised its flood zone map. As a result the appeal site is now within flood zone 1. Accordingly the Council no longer pursues its reason for refusal and I have had regard to this in my decision.
3. A revised version of the National Planning Policy Framework (the Framework)¹ has been published since the appeal was lodged. Both main parties were given the opportunity to comment on any relevant implications for the appeal. I have had regard to the Framework and any comments received in reaching my decision.

Main Issue

4. This is whether the development would be consistent with policies relating to flood risk.

¹ National Planning Policy Framework, Ministry of Housing, Communities and Local Government (July 2018)

Reasons

5. Saved policy EM6 of the Local Plan², together with the Framework and the Planning Practice Guidance (PPG) directs development away from flood zones 2 and 3. The development would be in flood zone 1 and therefore would not present a risk of flooding.
6. Nonetheless, for development within flood zone 1 the Framework requires that the risk of flooding is still assessed. Footnote 50 of the Framework sets out when a Flood Risk Assessment (FRA) is required for development within flood zone 1. The appeal site is less than 1 hectare. The Environment Agency have not indicated that the site is subject to critical drainage problems and there is nothing within the evidence before me to indicate that the land has been identified in a strategic flood risk assessment and at an increased risk of flooding in the future. The development comprises the redevelopment of the site for housing, replacing an existing bungalow with two dwellings which I do not consider to be a more vulnerable use. In all, therefore, the development would meet the requirements of footnote 50 and as such does not require a FRA.
7. The Framework and the PPG also provides advice on when a Sequential Test does not need to be applied³. In the case of a development being in flood zone 1, a sequential test is not required unless a Strategic Flood Risk Assessment indicates otherwise. With no Strategic Flood Risk Assessment before me, and in the absence of any evidence to suggest otherwise, I am satisfied that a sequential test is not required.
8. I do however have before me a site specific Flood Risk Assessment. It identifies that flood risk from surface water and groundwater is low and negligible respectively, but from fluvial flows moderate. To attenuate run-off a sustainable urban drainage system (SUDS) is proposed with the development. In addition it is proposed that minimum floor levels should be set no lower than 43.27m AOD and water saving measures installed to prevent any increase in flood risk. These measures could be reasonably secured by condition. In the absence of any specific or substantive evidence to suggest that these measures are not required, I consider it reasonable to secure them by condition as part of any planning approval.
9. With nothing before me to indicate that the SUDS would not be viable, securing them by condition would meet the requirement in saved policy EM6 to use sustainable urban drainage systems (SUDS).
10. In all, therefore, for the reasons given above, the development would be consistent with policies relating to flood risk and as such would not be contrary to saved policy EM6 of the Local Plan nor the Framework in terms of its approach to managing flood risk.

Conditions

11. I have found that the development would not give rise to unacceptable harm and it would comply with the development plan. I therefore propose to allow the appeal and grant planning permission. However, it is necessary to attach

² A Vision for 2026, Local Plan: Part 1, Strategic Policies (adopted November 2012)

³ Sites allocated in development plans, minor development or change of use, proposal in flood zone 1 (unless the Strategic Flood Risk Assessment indicates otherwise)

planning conditions to the permission to ensure that the development is carried out appropriately. I set out below the reasons for the conditions stated.

12. The Council has suggested a number of planning conditions which I have considered against the advice in the PPG. In addition to the standard time limitation for commencement, I have imposed a condition specifying the relevant drawings as this provides certainty.
13. Conditions regarding materials and landscaping are necessary to ensure that the character and appearance of the area is safeguarded.
14. Conditions regarding vehicle and cycle parking and access visibility are required to avoid harm to highway safety.
15. For the reasons given in my decision, conditions requiring the implementation of a sustainable urban drainage scheme and water recycling measures have been applied to help reduce runoff across the site and a condition included regarding minimum floor levels to prevent any increase in flood risk. The development would need to comply with the relevant water saving measures within Building Regulations and therefore a condition to this effect has not been included.

Conclusion

16. For the reasons given and having regard to all other matters raised, I conclude that the development would not be contrary to the development plan nor the Framework when taken as a whole. There are no material considerations to suggest a decision other than in accordance with the development plan and therefore the appeal is allowed.

R Walmsley

INSPECTOR

CONDITIONS SCHEDULE

- 1) The development hereby permitted shall begin not later than 3 years from the date of this decision.
- 2) The development hereby permitted shall be carried out in accordance with the following approved plans: PP09-AM-11-16 Rev 1; PP05-AM-11-16 Rev 1; PP08b-AM-11-16 Rev 1; PP04-AM-11-16 Rev 1; PP08A-AM-11-16 Rev 1; PP06-AM-11-16 Rev 1; PP02-AM-11-16 Rev 1; PP07-AM-11-16 Rev 1; and PP03-AM-11-16 Rev 1.
- 3) No development shall take place until details and samples of the external materials have been submitted to and approved by the local planning authority in writing. The relevant works shall be carried out in accordance with the approved sample details.
- 4) No site clearance, preparatory work or development shall take place until details of both hard and soft landscape works have been submitted to and approved in writing by the local planning authority. These details shall include:

- a. a plan and specification for new planting (showing species, size (at time of planting and at maturity) and spacing and location;
- b. means of enclosure and retaining structures to include refuse storage;
- c. details of earthworks including detailed plans and sections of the finished site levels and ground floor levels of the proposed building, above ordnance datum and in relation to existing ground levels;
- d. existing and proposed functional services above and below ground (e.g. drainage, power, communications cables, pipelines etc. indicating alignments, levels, access points, supports as relevant);
- e. areas for hard surfacing and the materials to be used,
- f. details of external lighting and;
- g. a method and programme for the implementation of the works.

All planting, seeding or turfing comprised in the approved details of landscaping referred to under condition 4 shall be carried out in the first planting and seeding seasons following the occupation of the development or its completion, whichever is the sooner; and any trees or plants which within a period of 5 years from the completion of the development die, are removed or become seriously damaged or diseased shall be replaced in the next planting season with others of similar size and species.

- 5) No part of the development hereby permitted shall be occupied until details of secure cycle storage, to include size, position and means of access and enclosure, have been submitted to and approved in writing by the local planning authority. The approved details shall be provided at the site before the development is occupied and thereafter retained.
- 6) No part of the development hereby permitted shall be occupied until the approved parking layout has been provided on site. The parking area shall be retained for its designated use for as long as the development hereby permitted remains in existence.
- 7) No development shall take place until a visibility splay to the vehicular access to the site, with an 'x' distance of 2.4 metres and a 'y' distance of 90 metres to the near edge of the public highway carriageway, has been completed on site. The visibility splay and clear visibility over a height of 600mm above the carriageway level and within the visibility shall exist at all times.
- 8) Within two months of the date of this permission development drainage detail proposals incorporating Sustainable Drainage Systems SUDS shall be submitted for approval in writing to the Local Planning Authority. The proposals shall include:
 - a. the measures employed to delay and control the surface water discharged from the site and to prevent pollution of the receiving ground and surface waters;
 - b. a timetable for implementation; and,
 - c. a management and maintenance plan for the lifetime of the development to include the arrangements required to secure the operation of the scheme throughout its lifetime.

The scheme shall also demonstrate methods to minimise the use of potable water through water collection, reuse and recycling and will:

- d. provide details of water collection facilities to capture rainwater; and,
- e. provides details of how rain and grey water will be recycled and reused in the development.

Thereafter the development shall be implemented and retained/maintained in accordance with these details for as long as the development remains in existence.

- 9) Minimum floor levels for the proposed houses shall be set no lower than 43.27 metres AOD.