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SuDS MAINTENANCE GUIDE

OWNERS MANUAL

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1.0 INTRODUCTION

This guidance provides best practice guidance on the maintenance of Sustainable Drainage Systems (SuDS) to facilitate their effective implementation within the Athlone House development.

Unlike conventional drainage systems, SuDS features are often visible and their function should be easily understood by those responsible for maintenance. When problems occur, they are generally obvious and can be remedied simply, using standard landscaping practice. If systems are properly monitored and maintained, any deterioration in performance can often be managed out.

Like any drainage system maintenance is a necessary and important consideration of SuDS design and sufficient thought should be given to long-term maintenance and its funding during feasibility and planning stages. In particular, the following requirements should be given full consideration:

1.1 WHO IS RESPONSIBLE FOR MAINTENACE OF THE SUDS FEATURES USED FOR THIS SCHEME

Construction period - Following construction but prior to the completion the responsibility for all the SuDS maintenance shall lie with the contractor.
After which, the owner (Mr Fridman) will be responsible for the maintenance of the communal access roads and associated drainage.

1.2 OWNER'S MANUAL

SuDS are different from conventional drainage and require different maintenance regimes. This manual details the following:

- location of all SuDS techniques in a site
- brief summary of how the techniques work, their purpose and how they can be damaged
- maintenance requirements (a maintenance plan) and a maintenance record
- explanation of the consequences of not carrying out the maintenance that is specified
- identification of areas where certain activities are prohibited (for example stockpiling materials on pervious surfaces)
- an action plan for dealing with accidental spillages
- advice on what to do if alterations are to be made to a development, if service companies undertake excavations or other similar works carried out that could affect the SuDS.

1.3 LOCATION OF SuDS TECHNIQUES USED ON THE SCHEME

The location of the SuDS features are shown on drawing 1480-DR -50, 51, 52, 53, 54 & 55 attached at the back of this document.

1.4 SUDS TECHNIQUES USED ON THIS SCHEME:

- Rainwater Harvesting
- Trenches
- Pervious Pavements
- Geocellular/Modular Systems
- Ponds
- Silt traps and catchpits
- Flow control devices

1.5 SUMMARY OF HOW THE TECHNIQUES WORK FOR THE SCHEME

The roof runoff from discharges via a piped system into a tanked cellular storage system with an attenuated discharge into the pond/lake.
Rain water harvesting has also been added to the system to address discharge volume and minimize water usage.

Discharge from the tanked cellular storage is controlled by a Hydrobrake or similar flow control device with the discharge limited to the agreed rate. The storage is sized to accommodate a 1 in 100 year storm with an allowance of 40% for climate change and is robustly designed to assume that there is free discharge into the system for all impermeable areas associated with the development including the access roads.
This outfall will have a formalized outfall with a trash screen so that it can maintained and kept clear of debris.

The access road drains into linear filter trenches either side of the road. These trenches will provide both bio-retention in the surface layer and also retention of suspended solids and heavy metals/ pollutants in the flier material. In addition oil interceptors have been provide to provide an additional level of treatment by providing retention of suspended solids and hydro-carbons. The trenches will also provide a degree of infiltration although the ground conditions are poor and infiltration rates cannot meet design criteria that would allow purely infiltration features to be used for surface water disposal.

The filter trenches have connection to the piped surface water system so any runoff reaching this system is attenuated in the tanked cellular storage.

Water quality is improved by the implementation of various treatment features/devices.

1.6 MAINTENANCE REQUIREMENTS

These are detailed in the appropriate section of this document.

1.7 AREAS WHERE ACTIVITIES ARE PROHIBITED

Heavy loads should not be allowed in areas where cellular soakaways are located. Failure to do so may cause structural damage and collapse of the cellular limits.

Permeable paving – No stock piling of materials should take place on areas of permeable paving as this will cause the surface to block and prevent the through flow of rainwater.

1.8 ACCIDENTAL SPILLAGES

Health and safety consideration are a priority and addressing accidental spillages should only be attempted if the nature of the spillage is known and it potential hazardous properties understood. The source of the spillage should be stopped and excess surface spillage removed by suction tank or absorption matts. Silt traps and sumps should be emptied by suction tanker. Areas of affected permeable paving should have the surface and laying course removed. The surfacing blocks should be cleaned and re-laid on new bedding material. Heavy pollution of the sub-base will require removal and replacement of the sub-base.

1.9 ALTERATIONS

If any alterations are proposed to the development, the design Engineer must be notified so that the impact/implications of the work can be assessed. Utilities should be restricted in the designated service zone areas.

1.10 HEALTH AND SAFETY

To comply with the Construction (Design and Management) Regulations (CDM) 2015, designers must assess all foreseeable risks during construction and maintenance and the design must minimise them by the following (in order of preference):

1. **Avoid.**
2. **Reduce.**
3. **Identify and mitigate residual risks.**

CDM 2015 requires designers to ensure that all maintenance risks have been identified, eliminated, reduced and/or controlled where appropriate. This information will be required as part of the health and safety file.

2.0 OPERATION AND MAINTENANCE ACTIVITY CATEGORIES

There are likely to be three categories of maintenance activities:

1. **Regular maintenance** (including inspections and monitoring).
2. **Occasional maintenance.**
3. **Remedial maintenance.**

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

Occasional maintenance comprises tasks that are likely to be required periodically, but on a much less frequent and predictable basis than the regular tasks (eg sediment removal or filter replacement). Table 2 summarises the likely maintenance activities required for each SuDS component and guidance on specific maintenance activities is given in the following sections.

Remedial maintenance describes the intermittent tasks that may be required to rectify faults associated with the system, although the likelihood of faults can be minimised by good design, construction and regular maintenance activities. Where remedial work is found to be necessary, it is likely to be due to site-specific characteristics or unforeseen events, and so timings are difficult to predict. Remedial maintenance can comprise activities such as:

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

It is important to note that these remedial activities will not be required for all systems, but for the purpose of estimating whole life maintenance costs, a contingency sum of 15-20% should be added to the annual regular and occasional maintenance costs to cover the risk of these activities being required.

Table 2 - *Typical key SuDS components operation and maintenance activities*
For full specifications, see individual chapters.

O & M Activity	Pond/wetland	Detention basin	Infiltration basin	Silt traps and catchpits	Soakaway	Infiltration/Filter trench	Filter trench	Modular storage	Pervious pavement	Swale/bioretention/green roofs	Filter strip	Sand filter	Pre-treatment systems	Perforated ring soakaways	Bio retention areas	Rain gardens	Oil interceptors	Flow Control Devices
Regular Maintenance																		
Inspection	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Litter/debris removal	■	■	■	□	□	■	■	□	■	■	■	■	■	■	■	■	□	□
Grass cutting	■	■	■	□	□	■	■	□	□	■	■	□	□		■		□	□
Weed/invasive plant control	□	□	□			□	□		□	□	□	□	□		□	■		
Shrub management	□	□	□						□	□	□		□		□	■		
Shoreline vegetation management	■	□											□					
Aquatic vegetation managment	■	□											□					
Occasional Maintenance																		
Sediment management (*)	■	■	■	■	■	■	■	■	■	■	■	■	■		■	■	■	■
Vegetation/plant replacement	□	□	□							□	□		□		□	□		
Vacumn sweeping and brushing									■									
Remdial Maintenance																		
Structure rehabilitation/repair	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Infiltration surface reconditioning			□		□	□	□		□	□	□	□		□	□	□		

■ Will be required
□ May be required

* Sediment should be collected and managed in pre-treatment systems, upstream of the main device.
The maintenance regime of a site also needs to consider the response to extreme pollution events. A response action plan should be developed and communicated to all those involved in the operation of a site, so that if a spillage occurs it can be prevented from causing pollution to receiving waters.

2.1 REGULAR MAINTENANCE ACTIVITIES

Inspections and reporting
Regular SuDS scheme inspections will:

- help determine optimum future maintenance activities
- confirm hydraulic, water quality, amenity and ecological performance
- allow identification of potential system failures, eg blockage, poor infiltration, poor water quality etc.

Inspections can generally be required at monthly site visits (eg for grass cutting) for little additional cost, and should, therefore, be subsumed into regular maintenance requirements. During the first year of operation, inspections should ideally be carried out after every significant storm event to ensure proper functioning, but in practice this may be difficult or impractical to arrange.
Typical routine inspection questions that will indicate when occasional or remedial maintenance activities are required, and/or when water quality requires investigation include:

- are inlets or outlets blocked?
- does any part of the system appear to be leaking (especially ponds and wetlands)?
- is the vegetation healthy?
- is there evidence of poor water quality (eg algae, oils, milky froth, odour, unusual colourings)?
- is there evidence of sediment build-up?
- is there evidence of ponding above an infiltration surface?
- is there any evidence of structural damage that requires repair?
- are there areas of erosion or channelling over vegetated surfaces?

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

Grass cutting

It is recommended that grass cutting be minimised around SuDS facilities, apart from swales and filter strips and structural embankments where a height of 100–150 mm is recommended to prevent the plants falling over, or "lodging", when water flows across the surface. In general, allowing grass to grow tends to enhance water quality performance. Short grass around a wet system such as pond or wetland provides an ideal habitat for nuisance species such as geese; allowing the grass to grow is an effective means of discouraging them. Grass around wet pond or wetland systems should not be cut to the edge of the permanent water.

Grass cutting is an activity undertaken primarily to enhance the perceived aesthetics of the facility. The frequency of cutting will tend to depend on surrounding land uses, and public requirements. Therefore, grass cutting should be done as infrequently as possible, recognising the aesthetic concerns of local residents. However, grass around inlet and outlet infrastructure should be strimmed closely to reduce risks to system performance. If a manicured, parkland effect is required, then cutting will need to be undertaken more regularly than for meadow type grass areas, which aim to maximise habitat and biodiversity potential.

Weed/invasive plant control

Weeds are generally defined as vegetation types that are unwanted in a particular area.
For SuDS, weeds are often alien or invasive species, which do not enhance the technical performance or aesthetic value of the system, or non-native species and the spread of which is undesirable.

In some places, weeding has to be done by hand to prevent the destruction of surrounding vegetation (hand weeding should generally be required only during the first year, ie during plant establishment). However, over grassed surfaces, mowing can be an effective management measure. The use of herbicides and pesticides should be prohibited since they cause water quality deterioration. The use of fertilisers should also be limited or prohibited to minimise nutrient loadings which are damaging to water bodies.

Shrub management

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

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

Emergent vegetation may need to be harvested every 5–10 years to maintain flood attenuation volumes, optimise water quality treatment potential and ensure fresh growth, although this is often not required. Care should be taken to avoid nesting birds during the breeding season and to avoid great crested newt and water vole habitats.

The typical window for this activity is towards the end of the growing season (September and October). As vegetation matures, plant height may also become a safety issue in residential areas. Where emergent vegetation is managed, up to 25 per cent can be removed by cutting at 100 mm above soil level using shearing action machinery. Up to 25 per cent of submerged vegetation can be cut and raked out at any one time, using approved rakes, grabs or other techniques, depending on whether clay or waterproof membranes are present. Aquatic vegetation arisings should be stacked close to the water's edge for 48 hours to de-water and allow wildlife to return to the SuDS feature. They should then be removed to wildlife piles, compost heaps or off site before decomposition, rotting or damage to existing vegetation can occur.

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

Management of green waste

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

1 The development of wildlife piles
These provide refuges, hibernation shelter, food and egg laying sites for a large number of animals. When rotted down at the end of 3–5 years they provide compost that can be used as fertiliser for planting areas outside of the SuDS system.

In general:

- wildlife piles should be located in sunny or semi-shaded areas away from direct access by people
- their bases should be constructed using substantial prunings or other branch material laid in a criss-cross pattern
- seasonal shrub and other woody prunings should be added through the winter
- non-woody and grass cuttings should be added through the summer
- wildlife piles should comprise tidy piles up to 1.2 m high
- new wildlife piles should be constructed each year and old wildlife piles should be used as compost to plant beds after 3–5 years
- wildlife piles should be located above normal flood level of watercourses and be protected by hedges or similar features.

A schematic of a typical wildlife pile structure is shown in Figure 1.1.

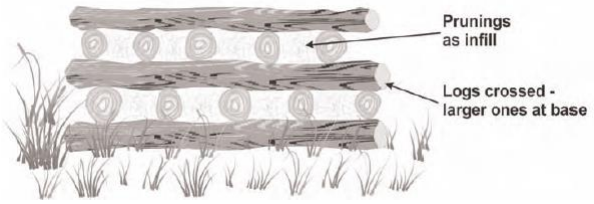

Figure 1.1 *Schematic of a wildlife pile (courtesy of Steve Wilson and Robert Bray of Sustainable Drainage Associates)*

2 On- or off-site composting

A compost facility allows all green waste, particularly grass cuttings and prunings to be recycled and provide compost for mulching ornamental plant beds. The following process should be followed for composting:

- shred all arisings from site
- combine all arisings in active compost bin with grass cuttings not exceeding 70%
- turn and mix active compost when bin is >50% full, at weekly intervals for at least four weeks
- turn and mix full bin every 28 days until used
- combine adjacent compost bins/bays when contents are settled to 50% volume reduction
- Use compost after 3–4 months.

A schematic/photo of a typical composting structure is given in Figure 1.2.

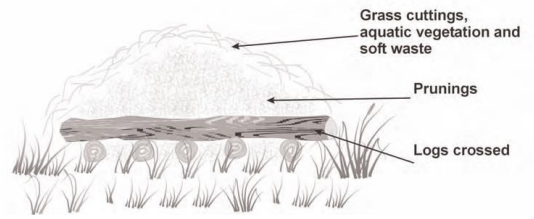

Figure 1.2 *Schematic of a composting structure (courtesy Steve Wilson and Robert Bray of Sustainable Drainage Associates)*

3 Disposal to landfill
As a last resort, green waste can be disposed of to some approved tips or landfill sites, although it is only accepted at certain locations.

Vacuum sweeping and brushing
Pervious surfaces need to be regularly cleaned of silt and other sediments to preserve their infiltration capacity. Advice issued with permeable pre-cast concrete paving suggests a minimum of three sweepings per year. Chapter 12 should be referred to for details of this process.

2.2 IRREGULAR MAINTENANCE ACTIVITIES

Sediment removal
To ensure long-term effectiveness, the sediment that accumulates in SuDS should be removed periodically. The required frequency of sediment removal is dependent on many factors including:

- design of upstream drainage system
- type of system
- design storage volume
- characteristics of upstream catchment area (eg land use, level of imperviousness, upstream construction activities, erosion control management and effectiveness of upstream pre-treatment).

Sediment accumulation will typically be rapid for the entire construction period (including time required for the building, turfing and landscaping of all upstream development plots). Once a catchment is completely developed and all vegetation is well-established, sediment mobility and accumulation is likely to drop significantly.

Vegetation/plant replacement
Some replacement of plants may be required in the first 12 months after installation, especially after storm events. Dead or damaged plants should be removed and replaced to restore the prescribed number of living plants per hectare.

Inspection programmes should identify areas of filtration, or infiltration surfaces where vegetation growth is poor and likely to cause a reduced level of system performance.
Such areas can then be rehabilitated, and plant growth repaired.

2.3 REMEDIAL MAINTENANCE

Structure rehabilitation/repair

There will come a time with most SuDS techniques when a major overhaul of the system is required to remove clogged filters, geotextiles, gravel etc. This will typically be between 10 and 25 years, depending on the technique and factors such as the type of catchment and sediment load. The SuDS design allows for vehicle access to undertake this work and consider the need for the overhaul without causing major disruption. For example, the use of geotextiles close to the surface in pervious surfaces traps the majority of sediment in a relatively easily accessible location. Reconstruction of the surface layer and bedding layer is all that is required, rather than reconstruction of the whole pavement depth.

Major overhaul is most likely to be required on techniques that rely on filtration through soils or aggregates, such as sand filters and infiltration devices. Other SuDS techniques are unlikely to need major overhaul if routine maintenance is undertaken as required (for example ponds and wetlands). Rehabilitation activities for each SuDS component are described in the individual component chapters. The requirements should be identified in the owner's manual.

Infiltration surface rehabilitation

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

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

3.0 APPLICATIONS OF THE PRINCIPLES OF LANDSCAPE MAINTENANCE

In contrast to conventional drainage, which comprises mainly sub-surface pipework and associated infrastructure, SuDS are predominantly surface systems. A key feature of SuDS is their integration within the local landscape and their amenity contribution, and it is appropriate therefore that landscape maintenance practice is applied to their management.

Landscape maintenance documentation
Typical landscape maintenance documentation and its potential relevance to SuDS systems is summarised below:

(A) Management plan – describing the management objectives for a site over time, and the management strategies that should be employed to realise these objectives and reconcile any potential conflicts that may arise.

Management plans are most appropriate for application in major parks and open spaces, wherever there are alternative choices for future action, and potential conflicts of purpose and priorities that need to be resolved. The following extract from *A guide to management plans for parks and open spaces* (Barber, 1991) sets out the types of management plans that can be prepared:

(i) Management plan

This predicts a degree of physical change, and therefore should present design proposals in its recommendations. It puts the emphasis on the presentation of anticipated physical change with much of the documentation being in support.

(ii) Outline plan

This is generally accepted as a more appropriate title for a management plan that wishes to establish the guiding principles, without providing detailed proposals which might constrain future options for achieving the outline objectives.

(iii) Maintenance plan

This is appropriate if the principal interest is in establishing the best way of maintaining an area, or where there is a need to match maintenance aspirations to a secure financial base. Planned maintenance programmes over longer timescales can be made more secure by the more public exposure of the need and the commitment that the Maintenance Plan should be able to guarantee. A Maintenance Plan can also establish changes in maintenance regimes that may be required to match a change in objectives e.g. the need to adapt operation and maintenance practices to accommodate specific wildlife habitats that may develop.

For a SuDS scheme, the maintenance plan will generally be the most appropriate type of management plan to use. The document should include an explanation of the function of the SuDS scheme and why it is being used on the site.

Where the drainage system has an impact on the wildlife value or public use of a site, it would be prudent to develop this simple explanation further to explain habitat enhancement goals, health and safety issues and long-term management implications.

Sites with special wildlife or amenity interest may require detailed management plans, which monitor habitat development, infrastructure changes or damage to sites and ensure rapid responses to such changes, should they occur.

It is common for smaller commercial, industrial and housing sites to have a simple maintenance statement. In this case, a single page explaining the site management (including the sustainable drainage system) would be useful for all parties involved in the care of the development.

(B) Conditions of contract – appropriate conditions will be required. Advice can be sought from the Landscape Institute. Guidance is also provided in CIRIA publication C625 (Shaffer *et al*, 2004).

(C) Specification – detailing the materials to be used and the standard of work required.
A specification, usually preceded by preliminaries, details how work shall be carried out and contains clauses that give general instructions to the contractor. Specific SuDS maintenance clauses

may be included in a general specification or as a separate "Sustainable drainage maintenance specification" section.

(D) Schedule of work – itemising the tasks to be undertaken and the frequency at which they will be performed.

The tasks required to maintain the site and the frequency necessary to achieve an acceptable standard should be set out in the schedule of work.

Smaller sites will usually have simple specification notes given to a contractor as a basis for maintenance on a performance basis. Examples of performance criteria are items such as:

- length of grass
- tidiness
- extent of weed growth, etc.

This document will often form the basis of a pricing mechanism and can also act as a checklist to ensure the work has been carried out satisfactorily.

For additional information on the development of appropriate schedules, reference should be made to *the operation and maintenance of sustainable drainage systems* (HR Wallingford, 2004).

4.0 FREQUENCY OF MAINTENANCE TASKS

Landscape maintenance contract periods are usually of one to three years' duration.
The three-year period is increasingly common to ensure continuity and commitment to long-term landscape care. The frequency of regular landscape maintenance tasks in a contract period can range from daily to once in the contract period. In practice most site tasks are based on monthly or fortnightly site visits, except where grass or weed growth requires a higher frequency of work. In many cases a performance specification is used with terms such as "beds shall be maintained weed-free" or "grass shall be cut to a height of 50 mm with a minimum height of 25 mm and a maximum height of 100 mm" to obtain the required standards.

Frequency can be specified within the schedule to include irregular items such as "'meadow grass' cut two times annually in July and September to a height of 50 mm, all arisings raked off and removed to wildlife features, compost facility or to tip", which provides flexibility for work that is not critical to the management of the site.

Maintenance tasks which suit a performance approach commonly include plant growth, grass cutting, pruning and tree maintenance. However, work tasks such as sweeping paths, regular litter collection and cleaning road surfaces will require work at an agreed frequency with more specific timings such as weekly, monthly or annually.

Where the frequency and timing of tasks is critical, a mixture of performance and frequency specification is necessary to provide effective maintenance.

SuDS maintenance generally tends towards a frequency requirement to ensure a predicable standard of care which can be recorded on site and which provides a reasonable basis for pricing work. A convenient frequency for many tasks is at a monthly inspection as this is the usual minimum site attendance required in a landscape specification. The monthly frequency should provide for an inspection of all SuDS features and checking all inlets and outlets.

Certain SuDS maintenance tasks however fall outside this monthly cycle and need to be accommodated in the contract.

There are other tasks associated with ensuring the long-term performance of the systems that may be more difficult to predict and could even fall outside any contract period. It may therefore be more appropriate to review requirements for system rehabilitation at interim periods, when contracts are falling due for renewal.

5.0 REFERENCES

- Ciria C753 (2015) – The SuDS Manual
- Wildfowl & Wetlands Trust guidance (2012) – Maximising the potential for people and wildlife
- HR WALLINGFORD (2004). Whole Life Costing for Sustainable Drainage. Report SR 627.
- DEFRA (2010). Surface Water Management Plan Technical Guidance.

6.0 RAINWATER HARVESTING

DESCRIPTION

Rainwater harvesting (RWH) is the collection of rainwater runoff for use. Runoff can be collected from roofs and other impermeable areas, stored, treated (where required) and then used as a supply of water for domestic, commercial, industrial and for institutional properties.

OPERATION AND MAINTENANCE REQUIREMENTS

Any property with an RWH system installed should be provided with appropriate information as to what equipment has been installed, its purpose, its operation and maintenance requirements, the actions needed to address any potential failure and the expected performance of the system. Information on the options for external maintenance support should also be provided.

Most systems require periodic checking and maintenance to ensure trouble-free and reliable operation. There are wide differences in the extent of maintenance required for different systems, and manufacturers' guidelines should always be followed. The table below provides guidance on the type of operational and maintenance requirements that may be appropriate. The list of actions is not exhaustive and some actions may not always be required.

Maintenance requirements are largely dependent on the runoff source and the runoff use (and thus treatment processes provided). This will range from weekly input through to rare intervention. Routine inspection of the fitter system at quarterly annual 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), it is useful to have sensor warnings relayed in such a manner as to inform the user of the current status of the system.

RWH 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 accessible for internal inspection, and the cover should preferably be lockable. For more guidance on operation and maintenance of RWH systems, see SS 8515:2009+A1:2013.

The maintenance responsibility for an RWH system is usually with the owner of the property, but any communal systems require the participating community to be informed of the system, as detailed, but also be provided with information of who the organisation is that is maintaining the system and any financial commitments and any legally binding maintenance agreement.

Rainwater Harvesting operation and maintenance requirements

Maintenance schedule	Required action	Frequency
Regular maintenance	Inspection of the tank for debris and sediment buildup, inlets/outlets/withdrawal devices, overflow areas, pumps, filters	Annually (and following poor performance)
	Cleaning of tank., inlets, outlets, gutters, withdrawal dev ices and roof drain filters of silts and other debris	Annually (and following poor performance)
Occasional maintenance	Cleaning and/or replacement of any filters	Three monthly (or as required)
Remedial Actions	Repair of overflow erosion damage or damage to tank.	As required
	Pump repairs	As required

7.0 FILTER STRIPS

DESCRIPTION
Filter strips are vegetated strips of land designed to accept runoff as overland sheet flow from upstream development. They lie between a hard-surfaced area and a receiving stream, surface water collection, treatment or disposal system.
They treat runoff by vegetative filtering and promote settlement of particulate pollutants and infiltration.

OPERATION AND MAINTENANCE REQUIREMENTS
Regular inspection and maintenance is important for the effective operation of filter strips as designed. Maintenance responsibility for a filter strip should always be placed with an appropriate organisation. Access for maintenance vehicles must be available, but this is not usually a constraint due to the likely location of the filter strip adjacent to impermeable areas.
Operation and maintenance requirements for filter strips are described in the table below.

Filter strips operation and maintenance requirements

Maintenance schedule	Required action	Frequency
Regular maintenance	Litter and debris removal.	Monthly (or as required).
	Grass cutting – to retain grass height within specified design range	Monthly (during growing season), or as required
	Manage other vegetation and remove nuisance plants.	Monthly (at start, then as required).
Occasional maintenance	Check for poor vegetation growth due to lack of sunlight or dropping of leaf litter, and cut back adjacent vegetation where possible.	Annually.
	Re-seed areas of poor vegetation growth. Alter plant types to better suit conditions, if required.	filter strip area.
	Repair erosion or other damage by re-turfing or reseeding.	as required.
	Re-level uneven surfaces and reinstate design levels.	as required.
	Scarify and spike topsoil layer to improve infiltration performance,	as required.
	break up silt deposits and prevent compaction of the soil surface.	
	Remove build up of sediment on upstream gravel trench, flow spreader, or at top of the filter strip	as required.
	Remove and dispose of oils or petrol residues using safe standard practices.	as required.
Monitoring	Inspect filter strip surface to identify evidence of erosion, compaction, ponding, sedimentation and contamination (e.g. oils).	Half yearly.
	Check flow spreader and filter strip surface for even gradients.	Half yearly.
	Inspect gravel diaphragm trench upstream of filter strip for clogging	Half yearly.
	Inspect silt accumulation rates and establish appropriate removal frequencies.	Half yearly.

8.0 TRENCHES

DESCRIPTION
Trenches are shallow excavations filled with rubble or stone that create temporary subsurface storage for either infiltration or filtration of storm water runoff. Ideally, they should receive lateral inflow from an adjacent impermeable surface but point source inflows may be acceptable. Infiltration trenches allow water to exfiltrate into the surrounding soils from the bottom and sides of the trench. Filtration or filter trenches can be used to filter and convey storm water to downstream SuDS components.

OPERATION AND MAINTENANCE REQUIREMENTS
Regular inspection and maintenance is important for the effective operation of trenches as designed. Maintenance responsibility for a trench should always be placed with an appropriate organisation.

Adequate access should be provided to the trench surface and maintenance points for inspection and maintenance, including for appropriate equipment and vehicles.
Operation and maintenance requirements for trenches are described in the table below.
Trenches operation and maintenance requirements

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

Sediments excavated from upstream pre-treatment devices that receive runoff from residential or standard road and roof areas are generally not toxic or hazardous material and can be safely disposed of by either land application or landfilling.

However, consultation should take place with the environmental regulator to confirm appropriate protocols. Sediment testing may be required before sediment excavation to determine its classification and appropriate disposal methods. For industrial site runoff, sediment testing will be essential. In the majority of cases, it will be acceptable to distribute the sediment on-site if there is an appropriate safe and acceptable location to do so. Additional detail on waste management is provided in Chapter 33 of CIRIA C753.

Implementation of the CDM 2015 and generic health and safety criteria are presented in Sections 36 of CIRIA C753. Maintenance activities should be detailed in the Health and Safety Plan and a risk assessment should be undertaken.

9.0 PERVIOUS PAVEMENTS

DESCRIPTION
Pervious pavements provide a pavement suitable for pedestrian and/or vehicular traffic, while allowing rainwater to infiltrate through the surface and into the underlying layers. The water is temporarily stored before infiltration to the ground, reuse, or discharge to a watercourse or other drainage system. Pavements with aggregate sub-bases can provide good water quality treatment.

OPERATION AND MAINTENANCE REQUIREMENTS
Regular inspection and maintenance is important for the effective operation of pervious pavements. Maintenance responsibility for a pervious pavement and its surrounding area should be placed with an appropriate responsible organisation. Before handing over the facility to the client, it should be inspected for clogging, litter, weeds and water ponding and all failures should be rectified. After handover, the facility should be inspected regularly, preferably during and after heavy rainfall to check effective operation and to identify any areas of ponding.

Pervious surfaces need to be regularly cleaned of silt and other sediments to preserve their infiltration capability. Experience in the UK is limited, but advice issued with permeable precast concrete paving has suggested a minimum of three surface sweepings per year. Manufacturers' recommendations should always be followed.

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).

Care should be taken in adjusting vacuuming equipment to avoid removal of jointing material. Any lost material should be replaced.

The likely design life (or period before pavement rehabilitation is required) has yet to be established for the UK. However, it should be no different from standard paving assuming that an effective maintenance regime is in place to minimise risks of infiltration clogging.

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.

The reconstruction of failed areas of concrete block pavement should be less costly and disruptive than the rehabilitation of continuous concrete or asphalt porous surfaces due to the reduced area that is likely to be affected. Materials removed from the voids or the layers below the surface may contain heavy metals and hydrocarbons and may need to be disposed of as controlled waste. Sediment testing should be carried out before disposal to confirm its classification and appropriate disposal methods. Guidance on waste management is provided in Chapter 33 of CIRIA C753.

Pervious pavement operation and maintenance requirements

Maintenance schedule	Required action	Frequency
Regular maintenance	Brushing and vacuuming.	Three times/year at end of winter, mid-summer, after autumn leaf fall, or as required based on site-specific observations of clogging or manufacturers' recommendations.
Occasional maintenance	Stabilise and mow contributing and adjacent areas.	As required.
	Removal of weed.	As required.
	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50 mm of the level of the paving.	As required.
Remedial actions	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users.	As required.
	Rehabilitation of surface and upper sub-structure.	As required (if infiltration performance is reduced as a result of significant clogging).
	Initial inspection.	Monthly for 3 months after installation
Monitoring	Inspect for evidence of poor operation and/or weed growth. If required, take remedial action.	3-monthly, 48 h after large storms.
	Inspect silt accumulation rates and establish appropriate brushing frequencies.	Annually.
	Monitor inspection chambers.	Annually.

Implementation of the CDM Regulations (DETR, 1994) and generic health and safety criteria are presented in Sections 2.5.10 and 3.4.2 of CIRIA C697 respectively. Maintenance activities should be detailed in the Health and Safety Plan and a risk assessment should be undertaken.

10.0 GEOCELLULAR/MODULAR SYSTEMS

DESCRIPTION

Modular plastic geocellular systems with a high void ratio, that can be used to create a below ground infiltration (soakaway) or storage structure.

OPERATION AND MAINTENANCE REQUIREMENTS

Regular inspection and maintenance is required to ensure the effective long-term operation of below ground modular storage systems. Maintenance responsibility for systems should be placed with a responsible organization. Maintenance requirements for modular systems are described in the table below. Maintenance plans and schedules should be developed during the design phase. Specific maintenance needs of the system should be monitored, and maintenance schedules adjusted to suit requirements.

Modular systems – operation and maintenance requirements

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

11.0 PONDS

DESCRIPTION
Ponds can provide both stormwater attenuation and treatment. They are designed to support emergent and submerged aquatic vegetation along their shoreline. Runoff from each rain event is detained and treated in the pool. The retention time promotes pollutant removal through sedimentation and the opportunity for biological uptake mechanisms to reduce nutrient concentrations.

OPERATION AND MAINTENANCE REQUIREMENTS
Regular inspection and maintenance is important for the effective operation of ponds as designed. Maintenance responsibility for a pond and its surrounding area should always be placed with a responsible organisation.

A maintenance access way (or "easement") should be provided to the pond from a public or private road. An assessment should be made at the planning stage regarding the maintenance and associated access requirements. Ideally, access should be at least 3.5 metres wide, have a maximum cross fall of 1 in 15, and be sufficiently robust to withstand maintenance equipment and vehicles. However temporary access routes for infrequent operations could be considered where permanent routes are not appropriate. The access should extend to the forebay, safety and aquatic benches, inlet and outlet infrastructure. Consideration should be given as to whether maintenance vehicles will need to turn around.

Operation and maintenance requirements for ponds are described in the table below.

Ponds operation and maintenance requirements

Regular maintenance	Litter removal.	As required
	Grass cutting – public areas.	Monthly (during growing season)
	Grass cutting – meadow grass.	Half yearly (spring, before nesting season, and autumn)
	Inspect vegetation to pond edge and remove nuisance plants (for first 3 years).	Monthly (at star required)
	Hand cut submerged and emergent aquatic plants (at minimum of 0.1 m above pond base; include max 25% of pond surface).	Annually
	Remove 25% of bank vegetation from waters edge to a minimum of 1 m above water level.	Annually.
	Tidy all dead growth before start of growing season.	Annually.
	Remove sediment from forebay.	1–5 years, or as required.
	Remove sediment from one quadrant of the main body of ponds without sediment forebays.	2–10 years.
Occasional maintenance	Re-seed areas of poor vegetation growth.	Annually, or as required.
	Prune and trim trees and remove cuttings.	2 years, or as required.
	Remove sediment from forebay, when 50% full and from micropools if volume reduced by > 25%.	3 – 10 years (or as required).
Remedial actions	Repair of erosion or other damage by re-seeding or re-turfing.	As required.
	Realignment of rip-rap.	As required.
	Repair/rehabilitation of inlets, outlets and overflows.	As required.
	Re-level uneven surfaces and reinstate design levels.	As required.
Monitoring	Inspect inlets, outlets and overflows for blockages, and clear if required.	Monthly/after large storms.
	Inspect banksides, structures, pipework, etc for evidence of physical damage.	Monthly/after large storms.
	Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies.	Half yearly.
	Check penstocks and other mechanical devices.	Half yearly.

Sediments excavated from ponds or forebays that receive runoff from residential or standard road and roof areas are generally not toxic or hazardous material and can therefore be safely disposed of by either land application or landfilling. However, consultation should take place with the environmental regulator to confirm appropriate protocols. Sediment testing may be required before sediment excavation to determine its classification and appropriate disposal methods. For industrial site runoff, sediment testing will be essential. In the majority of cases, it will be acceptable to distribute the sediment on site if there is an appropriate safe and acceptable location to do so.
Additional detail on waste management is provided in Chapter 33 of CIRIA C753. If ponds are to be drawn down, care should be taken to prevent downstream discharge of sediments and anoxic water. The environmental regular should be notified prior to such activities.

New ponds may become rapidly dominated by invasive native plants, particularly Common Bulrush *(Typha latifolia)*. As it is not desirable for all new ponds to be bulrush dominated, it should be ensured that in the first five years, while vegetation is establishing, certain plant growth is controlled. After this period, ponds can usually be allowed to develop naturally, recognising that, unless the margins are occasionally managed, they are likely to become dominated by trees and shrubs.

Eutrophication of SuDS ponds can occur during the summer months. Eutrophication is best alleviated by controlling the nutrient source or providing a continuous baseflow to the pond. Unless eutrophication is severe, aeration can be used as a stop-gap measure to save aquatic animal species and reduce risks to receiving waters. However, the addition of barley straw bales, dredging or rendering the nutrients inactive by chemical means can also be successful.
Maintenance plans and schedules should be developed during the design phase.

12.0 OIL INTERCEPTORS

DESCRIPTION
Oil interceptors are tank systems with internal baffles to intercept oil and other hydro carbon dissolved and suspended spillages in surface water runoff. There are two types full retention and bypass interceptors. Both are similar in terms of maintenance required.

OPERATION AND MAINTENANCE REQUIREMENTS
Any owner of an oil interceptor tank should be provided with appropriate information as to what equipment has been installed, its purpose, its operation and maintenance requirements, the actions needed to address any potential failure and the expected performance of the system. Information on the options for external maintenance support should also be provided.

Most systems require periodic checking and maintenance to ensure trouble-free and reliable operation. There are wide differences in the extent of maintenance required for different systems, and manufacturers' guidelines should always be followed. Table below provides guidance on the type of operational and maintenance requirements that may be appropriate. The list of actions is not exhaustive, and some actions may not always be required.

Compared to other SuDS, these facilities rely heavily on frequent routine maintenance to prevent pollution. If this does not occur, experience shows that they quickly start to convey pollution downstream. They are usually hidden beneath the ground, and pollution that is trapped in the system is not obvious and can contribute to the deterioration of downstream water quality if allowed to accumulate. This can be mitigated to some extent by the incorporation of automatic monitors, as required by the British Standard. However, the monitors do need to be linked to a location that is clearly visible by the site management team when it alarms. The polluted runoff may also become visible in the outfall to any surface features, which will give warning that maintenance is required.

Maintenance requirements are largely dependent on the runoff source and the runoff use (and thus treatment processes provided). This will range from weekly input through to rare intervention. Routine inspection of the fitter system at quarterly annual intervals is advised, even if they do not appear to need specific intervention. The system should be provided with a sensor warning relayed in such a manner as to inform the user of the current status of the system.

Tanks should be accessible for internal inspection, and the cover should preferably be lockable.
The maintenance responsibility for an oil interceptor system is usually with the owner of the property, but any communal systems require the participating community to be informed of the system, as detailed, but also be provided with information of who the organisation is that is maintaining the system and any financial commitments and any legally binding maintenance agreement. Proper disposal of oil, solids and floating debris removed from components must be ensured, and the environmental regulator should be approached for advice where there are any doubts concerning disposal options. A small portion of water will be removed along with the pollutants during the clean-out process, which should be considered when costing sediment disposal processes.

Oil Interceptor operation and maintenance requirements

Maintenance schedule	Required action	Frequency
Regular maintenance	Remove litter and debris, and inspect for sediment, oil and grease accumulation	Six monthly
	Change the filter media	As recommended by manufacturer
Occasional maintenance	Replace malfunctioning parts or structures	As required
Monitoring	Inspect for evidence of poor operation	Six monthly
	Inspect filter media and establish appropriate replacement frequencies	Six monthly
	Inspect sediment accumulation rates and establish appropriate removal frequencies	Monthly during first half year of operation, then every six months

13.0 SILT TRAPS AND CATCHPITS

DESCRIPTION
Silt traps and catchpits are circular or rectangular manholes and /or chambers with a sump in them to collect suspended solids. Some chambers have removeable silt buckets to assist with the removal of accumulated silt deposits. Catchpits are usually concrete ring or segment structures and silt traps preformed plastic chambers.

OPERATION AND MAINTENANCE REQUIREMENTS
Regular inspection and maintenance is required to ensure the effective long-term operation of below ground silt traps and catchpits systems. Maintenance responsibility for systems should be placed with a responsible organization. Maintenance requirements are described in the table below. Maintenance plans and schedules should be developed during the design phase. Specific maintenance needs of the system should be monitored, and maintenance schedules adjusted to suit requirements.

Silt traps and catchpits – *operation and maintenance requirements*

Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action.	Monthly for 3 months, then six monthly
	Debris removal from catchment surface (where may cause risks to performance)	Monthly
	Inspection of silt traps and catchpits to assess silt accumulation	Monthly (and after large storms)
	Removal of accumulated silt from silt trap and catchpit sumps	Annually, or as required
Remedial actions	Repair/rehabilitation of inlets, outlet, overflows and vents	As required
Monitoring	Inspect/check all inlets, outlets, and overflows to ensure that they are in good condition and operating as designed	Annually and after large storms

14.0 ATTENUATION STORAGE TANKS

DESCRIPTION
Attenuation storage tanks are used to create a below-ground void space for the temporary storage of surface water before infiltration, controlled release or use. The storage structure is usually formed using one of the following methods:

1. geo-cellular storage systems
2. plastic corrugated arch structures (constructed over and backfilled with an open-graded
3. aggregate base)
4. oversize concrete pipes
5. oversize plastic pipes
6. corrugated steel pipes
7. precast or/ *in situ* concrete box culvert sections and tanks (including flat-packed
8. concrete panels)
9. glass-reinforced plastic (GRP) tanks
10. hybrid structures using reinforced earth walls and concrete roof panels

OPERATION AND MAINTENANCE REQUIREMENTS
Regular inspect ion and maintenance is required to ensure the effective long-term operation of belowground storage systems. Maintenance responsibility for systems should be placed with a responsible organisation. The table below provides guidance on the type of operational and maintenance requirements that may be appropriate. The list of act ions is not exhaustive, and some actions may not always be required.

Maintenance Plans and schedules should be developed during the design phase and will be specific to the type of tank that is adopted. Specific maintenance needs of the system should be monitored, and maintenance schedules adjusted to suit requirements. Further detail on the preparation of maintenance specifications and schedules of work is given in Chapter 32 of CIRIA C753.

CDM 2015 requires designers to ensure that all maintenance risks have been identified, eliminated, reduced and/or controlled where appropriate. This information will be required as part of the health and safety file.

Attenuation Storage Tanks – *operation and maintenance requirements*

Maintenance schedule	Required action	Frequency
Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action	Monthly for 3 months, then annually
	Remove debris from the catchment surface (where it may cause risks to performance)	Monthly
	For systems where rainfall infiltrates into the tank from above, check surface of filter for blockage by sediment, algae or other matter; remove and replace surface infiltration medium as necessary.	Annually
	Remove sediment from pre-treatment structures and/or internal forebays	Annually, or as required
Remedial Actions	Repair/rehabilitate inlets, outlet, overflows and vents	As required
Monitoring	Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed	Annually
	Survey inside of tank for sediment build-up and remove if necessary	Every 5 years or as required

15.0 FLOW CONTROL CHAMBERS AND DEVICES

Description
Flow control devices are usually installed in circular or rectangular manholes and are small orifice or vortex devices designed to hold back surface water and discharge at a low pre-specified rate. They are usually associated with up-stream storage tanks or modular storage that accommodates the peak flow volume until drain down at the attenuated discharge rate controlled by the flow control device.

OPERATION AND MAINTENANCE REQUIREMENTS
Regular inspection and maintenance is required to ensure the effective long-term operation of flow control devices. Maintenance responsibility for systems should be placed with a responsible organization. Maintenance requirements are described in the table below. Maintenance plans and schedules should be developed during the design phase. Specific maintenance needs of the system should be monitored, and maintenance schedules adjusted to suit requirements.

Silt traps and catchpits – *operation and maintenance requirements*

Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action.	Monthly for 3 months, then six monthly
	Debris removal from catchment surface (where may cause risks to performance)	Monthly
	Inspection of flow control chamber to assess if system is draining down correctly and that the orifice or flow control device is not blocked. Assess if there are any silt accumulations in the chamber sump.	Monthly (and after large storms)
	Removal of accumulated silt from silt trap and catchpit sumps	Annually, or as required
Remedial actions	Repair/rehabilitation of inlets, outlet, overflows and vents	As required
Monitoring	Inspect/check all inlets, outlets, and overflows to ensure that they are in good condition and operating as designed	Annually and after large storms

APPENDIX A - MONITORING AND MAINTENANCE RECORD

You need to keep a record of the checks you have completed that are set out in the checklist below along with any additional checks you have made.
If you have a maintenance contract with a contractor, keep a record of any work carried out on your pond system by them. If invoices state the work carried out, these will be sufficient.
If you do the checks you should enter:

- The check or maintenance job
- Who did it;
- The result (for example when abnormal noise heard, called in specialist to investigate).

Action	Date and Time	Carried out by	Result
For example, inlet and outlet pipes checked	06/04/2012 09.30	Mr A N Other	Obstruction cleared.

APPENDIX B - ACCIDENT AND INCIDENT RECORD

You should record any accidents, other incidents or near misses relating to the operation of the SUDS system for example untreated sewage being released into the ponds. The form could also be used to record health and safety incidents.

"Other incidents" covers impacts on the environment that are not accidents, such as failing to maintain the system, or vandals causing damage to the detention pond.

Date and time of the incident	
What happened, what was it about?	
Was anyone else aware of this – other witnesses? If so who?	
What caused it?	
What action did you take to fix the problem?	
What have you done to make sure that it does not happen again?	
Was there any significant pollution – for example: untreated sewage being discharged into a drain, river or stream? Yes / No If yes, what pollution occurred?	
If there was significant pollution then you must notify the Environment Agency on 0800 807060 as soon as possible. Have you done so?	Yes/No/not applicable At what time did you phone? EA Incident reference no.
You must also write or send an email to confirm this to the local office (see your accident management plan for the address). Have you done so?	Yes/No/not applicable
Please print your name, sign and date.	

APPENDIX C - KEY SITE AND EMERGENCY CONTACTS

This table contains information and contacts you may need in an emergency

SITE DETAILS			
Address:			
Postcode:			
Site access grid reference:			
SITE CONTACTS		Office Hours (specify)	Out of hours
Owner:			
General manager:			
Site manager:			
Site supervisor:			
Security contact:			
Landowner / agent:			
EMERGENCY SERVICES		Office Hours	Out of hours
Emergency			
Medical:			
Police:			
Fire:			
REGULATORS		Office Hours	Out of hours
Health and Safety Executive (HSE):			
Local Authority:			
Environment Agency	General number:	08708 506 506	
	24 hour emergency hotline:	0800 80 70 60	0800 80 70 60
Natural England/Countryside Council for Wales			
OTHER KEY CONTACTS		Office Hours	Out of hours
Adjacent landowners:			
Neighbours:			
Specialist advisors:			

APPENDIX D – LOCATIONS OF SUDS/DRAINAGE FEATURES

Drainage Strategy

Foul Drainage

Private gravity system discharging into Thames Water foul sewer.

Surface Water Drainage

Gravity system discharging into tanked cellular storage sized to accommodate 1 in 100 year storm with 30% allowance for climate change. Attenuated green field runoff rate discharge into existing pond controlled by Hydrobrake or similar device.

NOTE:

1. DO NOT SCALE, IF IN DOUBT ASK.
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT STRUCTURAL ENGINEER'S DRAWINGS AND DETAILS, THE SPECIFICATION FOR THE WORKS, THE RELEVANT ARCHITECT'S DRAWINGS AND ANY OTHER SPECIALIST'S DRAWINGS.

Drainage Key

Sewers

	Foul water drain (private/non adoptable)
	Surface water drain (private/non adoptable)
	Foul water sewer (Adoptable)
	Surface water sewer (Adoptable)
	Highway drain (Adoptable)
	Foul rising main
	Existing highway drain
	Existing foul water drain (private/non adopted)
	Existing surface water drain (private/non adopted)
	Existing foul water sewer (Adopted)
	Existing surface water sewer (Adopted)
	Existing combined water sewer (Adopted)
	Redundant sewer

Chamber Key

FW	SW	
		Mini access chamber (mac) - 300mmØ *
		PPIC - 475mmØ *
		P.C.C. units/brick *
		Adoptable demarcation manhole within 1m of boundary *
		Manhole Depth 1.25 to 1.5m * Depth 1.55 to 3.0m *

* General note
(Refer to standard details & long sections for chamber sizes. Size may need to increase dependant on number of incoming pipes/size of incoming pipes)

	Surface water rodding eye
F1	Manhole reference number
	Rain water down pipe (roddable access)
	Soil vent pipe/soil stack
	Yard gully (150m - 200mmØ trapped)
	Road gully (trapped) C250
	Floor gully (trapped)
	Linear drainage channel
	Cellular storage (refer to drawing for sizes)
	Headwall
	Retaining wall
FFL XX.XX	Finished Floor Level (FFL)
	No Dig construction (see drg 1480-DR-56).

Rev.	Date	Amendments	By	Chk'd
C06	24/08/18	Condenser area drainage amended as clouded	NJ	DJ
C05	13/08/18	Cover and invert levels updated	NJ	DJ
C04	26/03/18	Amended to RFI 095	NJ	DJ
C03	19/03/18	Pavilion drainage amended	NJ	DJ
C02	26/02/18	Gate house drainage amended	NJ	DJ
C01	19/02/18	Construction issue	NJ	DJ
P01	19/07/16	Initial issue	ATD	DJ

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Project:
Athlone House
Hampstead Lane
London

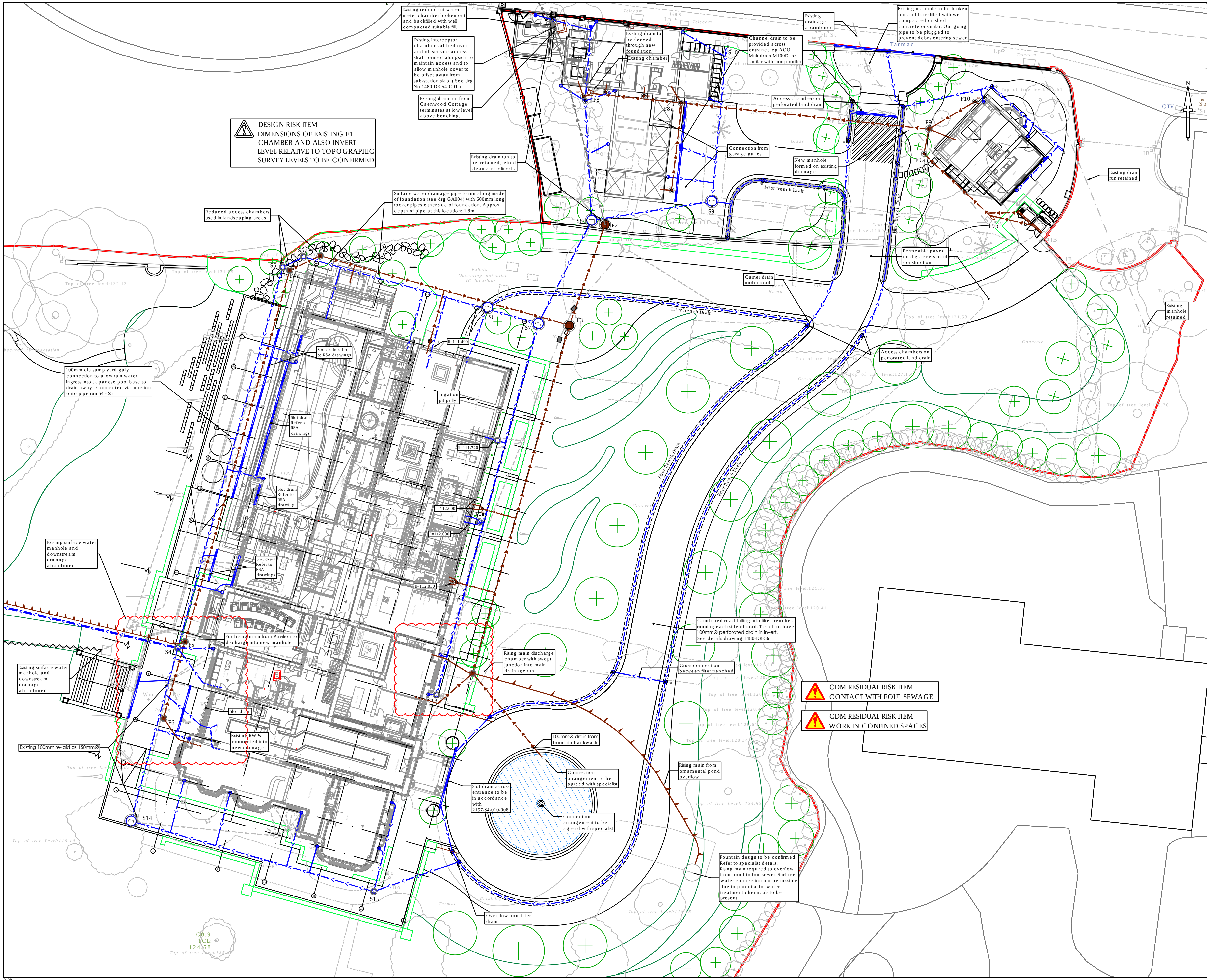
Drawing title:
Site-wide Drainage Strategy Plan

Scale at A1:	Drawn by:	Date:	Chk'd by:
1:500	ATD	19/07/2016	DJ

CONSTRUCTION

Project Number:	Drawing Type:	Drawing No:	Revision:
1480	DR	50	C06

2129



NOTE:

1. DO NOT SCALE, IF IN DOUBT ASK.

2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT STRUCTURAL ENGINEER'S DRAWINGS AND DETAILS, THE SPECIFICATION FOR THE WORKS, THE RELEVANT ARCHITECT'S DRAWINGS AND ANY OTHER SPECIALIST'S DRAWINGS.

Drainage Key

Sewers

- Foul water drain (private/non adoptable)
- Surface water drain (private/non adoptable)
- Foul rising main
- Existing foul water drain (private/non adopted)
- Existing surface water drain (private/non adopted)
- Existing foul water sewer (Adopted)
- Existing surface water sewer (Adopted)
- Existing combined water sewer (Adopted)
- Redundant sewer

Chamber Key

FW	SW	
mac	mac	Mini access chamber (mac) - 300mmØ *
		PPIC - 475mmØ *
R	R	PPIC - 475mmØ with Recessed cover
		P.C.C. units/brick *
DM	DM	Adoptable demarcation manhole within 1m of boundary *
		Manhole Depth 1.25 to 1.5m * Depth 1.55 to 3.0m *
EXMHAB		Existing manhole abandoned

* General note (Refer to standard details & long sections for chamber sizes. Size may need to increase dependant on number of incoming pipes/size of incoming pipes)

RE	Surface water rodding eye
F1	Manhole reference number
	Rain water down pipe (roddable access)
	Soil vent pipe/soil stack
yg	Yard gully (150m - 200mmØ trapped)
RG	Road gully (trapped) C250
fg	Floor gully (trapped)
	Linear drainage channel
	Cellular storage (refer to drawing for sizes)
	Headwall
	Retaining wall
	No Dig construction - See 1480-DR-56
	Tree root protection zone (RPZ)
	Tree root membrane

Rev.	Date	Amendments	By	Chk'd
C10	02/11/18	Drainage amended as clouded	NJ	DJ
C09	24/08/18	Condenser area drainage amended as clouded	NJ	DJ
C08	12/07/18	Layout updated and gatehouse bin store amended	NJ	DJ
C07	13/06/18	Manholes F8 to F9b detailed. F2 to F3 amended.	NJ	DJ
C06	18/05/18	As clouded, Japanese pool connection added, ancillary buildings drainage updated	NJ	DJ
C05	10/04/18	Amended as clouded, landscaping updated	NJ	DJ
C04	26/03/18	Amended to RFI 095, landscaping amended and Gatehouse Cottage drainage amended	NJ	DJ
C03	19/03/18	Drainage direction arrows added	NJ	DJ
C02	26/02/18	Gate house drainage amended	NJ	DJ
C01	19/02/18	Construction issue	NJ	DJ
P01	29/06/17	Initial issue	NJ	DJ

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Project:
Athlone House
Hampstead Lane
London

Drawing title:
Drainage Layout
Athlone House

Scale at A1:	Drawn by:	Date:	Chk'd by:
1:200	NJ	29/06/2017	DJ

CONSTRUCTION

Project Number:	Drawing Type:	Drawing No:	Revision:
1480	DR	51	C10

Drainage Strategy

Foul Drainage

Private gravity system discharging into Thames Water foul sewer.

Surface Water Drainage

Gravity system discharging into tanked cellular storage sized to accommodate 1 in 100 year storm with 30% allowance for climate change. Attenuated green field runoff rate discharge into existing pond controlled by Hydrobrake or similar device.

NOTE:

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DESIGN RISK ITEM
WORKS TO ORNAMENTAL POND SUBJECT TO LANDSCAPE ARCHITECTS INFORMATION

Irrigation tank to make allowance for 1.1m deep SW chmaber in close proximity.

100mmØ cavity drain connection into manhole Drain to pass over irrigation tank.

100mm dia connection from BBQ station

Hydrobrake flow control chamber with discharge limited to 10.6 l/s Head=1200mm

Surface water outfall to discharge into back of cascade feature

100mmØ rwp junction cavity drainage to connect into main runmain run.

100mmØ rwp junction connection into drainage main run.

New 80mm (IBC) rising main from pumping station

Existing surface water outfall under pavilion to be broken out and abandoned. Surface water to be diverted around building.

Existing manholes abandoned. Broken out and backfilled with suitable material

Existing ornamental lake overflow into Hampstead Heath Watercourse. Pipe to be cleared of debris and grill fixed over outlet from pond. Position to be confirmed.

Offline Tanked Cellular Storage located beneath tennis court
19mL x 5mW x 1.2m Deep to provide with 114 cum storage
with an additional 19mL x 5m x 0.4m beneath attenuation tank outlet to provide lake topping up supply storage volume of 38m³ (3800 litres)
To contain a 1in100 year storm with an allowance of 30% for climate change. Storage tank to have inspection tunnel to allow for future maintenance and CCTV inspection

Incoming invert levels = 98.750

100mmØ connection

Yard gully to connect into internal downpipe

Existing 225mm drain run to be abandoned

150mm Ø outflow from lower lake top up' storage volume of cellular attenuation storage tank.

150mm Ø outfall from lake top up storage controlled by valve provided by others

100mm dia sump yard gully connection to allow rain water ingress into Japanese pool base to drain away . Connected via junction onto pipe run S17 - S18

Trapped gully to provide rodding access to drain run

Yard gully to connect into internal downpipe

100mmØ connection

Surface water drainage approx 2.0m below

Manhole to provide access to cellular storage inspection tunnel

100mmØ washout connection from ornamental pond

Shower gully connection to foul drainage

100mmØ cavity drain connection into mini access chamber
CL=99.84
IL=99.24
Chamber dia 300mm

100mm perforated land drain with granular surround and filtration geotextile wrap to drain back of retaining wall.
Drain to connect into manhole S18

Existing 225mm drain run to be abandoned

Drainage Key

Sewers

	Foul water drain (private/non adoptable)
	Surface water drain (private/non adoptable)
	Foul rising main
	Existing foul water drain (private/non adopted)
	Existing surface water drain (private/non adopted)
	Existing foul water sewer (Adopted)
	Existing surface water sewer (Adopted)
	Existing combined water sewer (Adopted)
	Redundant sewer

Chamber Key

FW	SW	
		Mini access chamber (mac) - 300mmØ *
		PPIC - 475mmØ *
		P.C.C. units/brick *
		Adoptable demarcation manhole within 1m of boundary *
		Manhole Depth 1.25 to 1.5m * Depth 1.55 to 3.0m *

* General note
(Refer to standard details & long sections for chamber sizes. Size may need to increase dependant on number of incoming pipes/size of incoming pipes)

	Surface water rodding eye
F1	Manhole reference number
	Rain water down pipe (roddable access)
	Soil vent pipe/soil stack
	Yard gully (150m - 200mmØ trapped)
	Road gully (trapped) C250
	Floor gully (trapped)
	Linear drainage channel
	Cellular storage (refer to drawing for sizes)
	Headwall
	Retaining wall

Rev.	Date	Amendments	By	Chk'd
C06	18/05/18	SW connection to hot tub noted	NJ	DJ
C05	16/05/18	Amended as clouded	NJ	DJ
C04	10/04/18	Amended as clouded	NJ	DJ
C03	19/03/18	Pavilion drainage updated	NJ	DJ
C02	26/02/18	Pavilion drainage updated	NJ	DJ
C01	19/02/18	Construction issue	NJ	DJ
P01	12/09/16	Initial issue	ATD	DJ

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Project:
Athlone House
Hampstead Lane
London

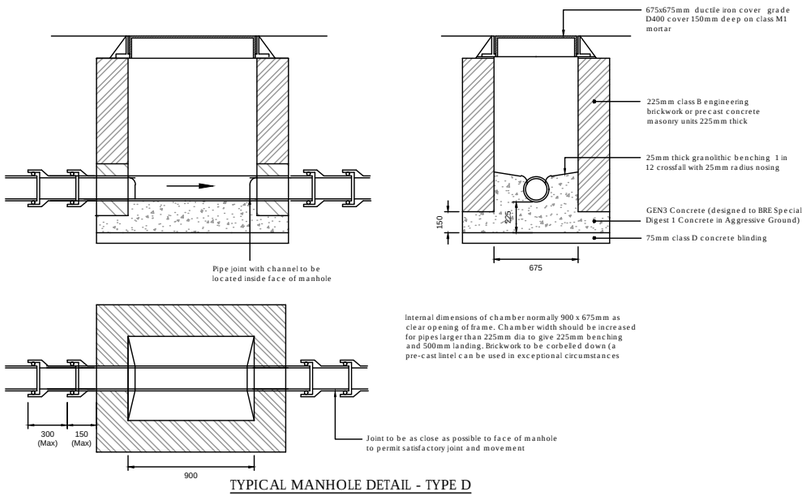
Drawing title:
Summer Pavilion Drainage Layout

Scale at A1:	Drawn by:	Date:	Chk'd by:
1:200	ATD	12/09/2016	DJ

CONSTRUCTION

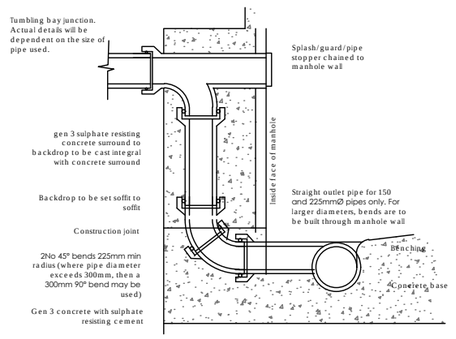
Project Number:	Drawing Type:	Drawing No:	Revision:
1480	DR	52	C06

2129



TYPICAL MANHOLE DETAIL - TYPE D

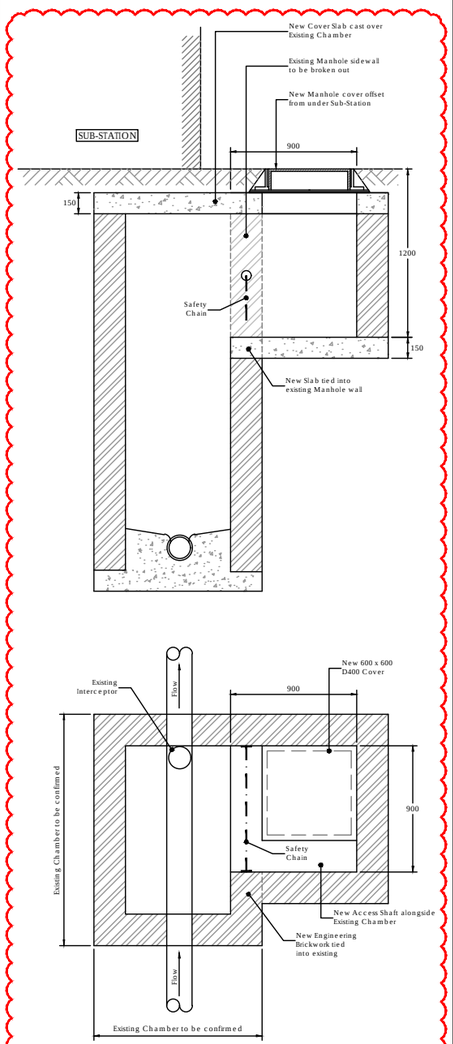
(Depth from ground level to soffit of pipe less than 1.0m)



EXTERNAL VERTICAL BACKDROP DETAIL

Nominal Bore of Pipe (mm)	Alternative Aggregate Sizes (mm)		CF Value Max
	Single-Sized	Graded	
100-150	10	-	0.2
225-300	10 or 14	14 to 5	0.2
375-525	10,14 or 20 14 or 20	14 to 5 or 20 to 5	0.2
Exceeding	14,20 or 40	14 to 5 or 20 to 5	0.15
		14 to 5, 20 to 5 or 40 to 5	0.5

PIPE BEDDING DETAILS



MANHOLE F1 (UNDER SUB-STATION)

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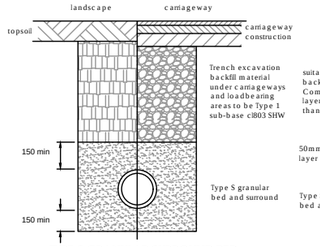
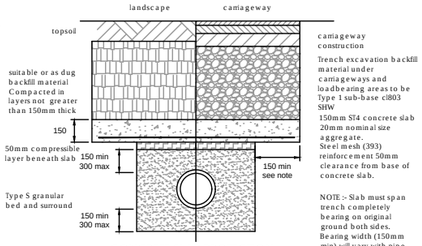


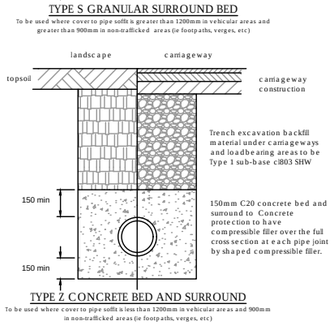
TYPE S GRANULAR SURROUND BED

To be used where cover to pipe soffit is greater than 1200mm in vehicular areas and greater than 900mm in non-trafficked areas (ie footpaths, verges, etc)



CONCRETE SLAB PROTECTION

To be used where cover to pipe soffit is less than 1200mm in vehicular areas and 900mm in non-trafficked areas (ie footpaths, verges, etc)

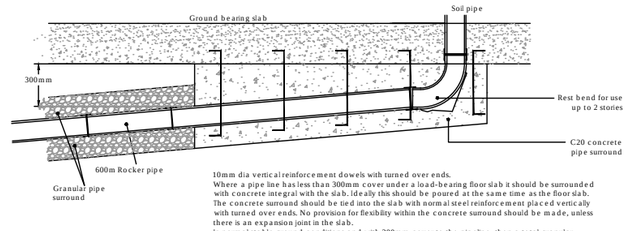


TYPE Z CONCRETE BED AND SURROUND

To be used where cover to pipe soffit is less than 1200mm in vehicular areas and 900mm in non-trafficked areas (ie footpaths, verges, etc)

Pipe nominal size (DN)	Pipe Bedding Requirement (mm)
100	10 nominal single size
over100 150	10 or 14mm nominal single size or 14mm to 5mm graded
over150-300	10, 14 or 20mm nominal single-size or 14mm to 5mm graded or 20mm to 5mm graded 20mm to 5mm graded
over 300 to 550	14, 20 or 40mm nominal single-size crushed rock or 14mm to 5mm graded or 20mm to 5mm graded
over 550	14, 20 or 40mm nominal single-size crushed rock or 14mm to 5mm graded or 20mm to 5mm graded or 40mm to 5mm graded

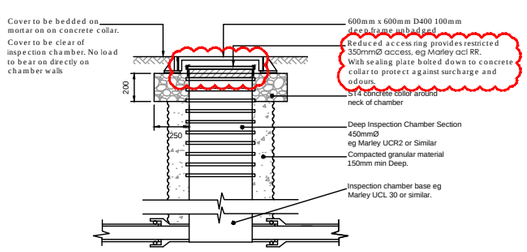
GRANULAR BEDDING AND SIDEFILL MATERIAL GRADINGS



10mm dia vertical reinforcement dowels with turned over ends.
Where a pipe line has less than 300mm cover under a load-bearing floor slab it should be surrounded with concrete integral with the slab. Ideally this should be poured at the same time as the floor slab.
The concrete surround should be tied into the slab with normal steel reinforcement placed vertically with turned over ends. No provision for flexibility within the concrete surround should be made, unless there is an expansion joint in the slab.
In normal stable ground conditions and with 300mm cover to the pipeline then a total granular surround can be used.

In buildings up to 3 storeys the rest bend at the base of the soil stack should be 450mm below the invert of the lowest incoming drain. In buildings over 3 storeys this should be increased to 750mm. In buildings over 5 storeys the ground floor drainage connections should have their own connections to the external drain.

PIPE SURROUND BENEATH GROUND BEARING SLAB



REDUCED ACCESS CHAMBER WITH SEALING PLATE, FOR TERRACE LOCATIONS

Max Depth 3.0m

Rev.	Date	Amendments	By	Chk'd
C01	19/02/18	Construction issue	NJ	DJ
P2	19/02/18	Manhole F1 detail added. Access chamber detail amended	SNN	DJ
P1	19/06/17	Initial issue	NJ	DJ

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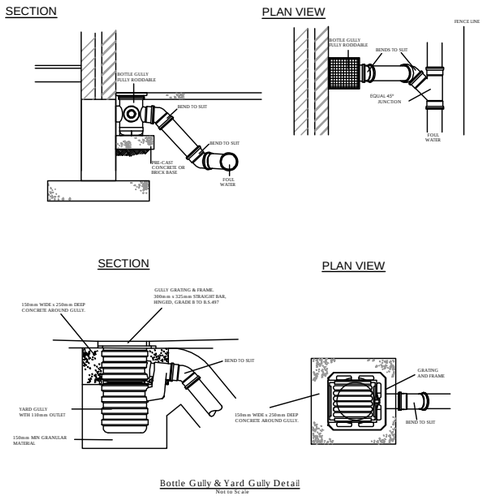
Project:
Athlone House
Hampstead Lane
London

Drawing title:
Drainage Construction Details
Sheet 2 of 3

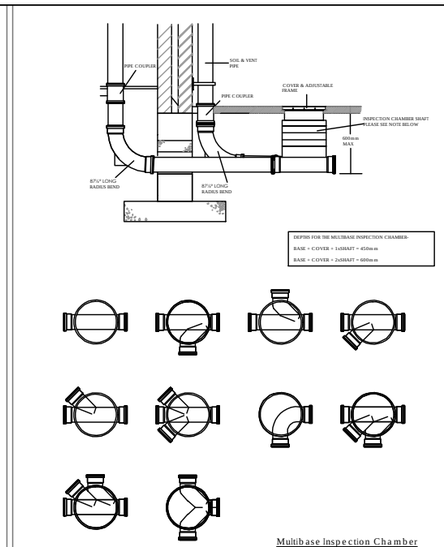
Scale at A1:	Drawn by:	Date:	Chk'd by:
1:20	NJ	13/06/2017	DJ

CONSTRUCTION

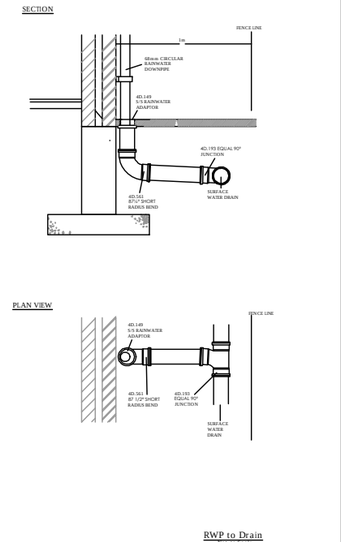
Project Number:	Drawing Type:	Drawing No:	Revision:
1480	DR	54	C01



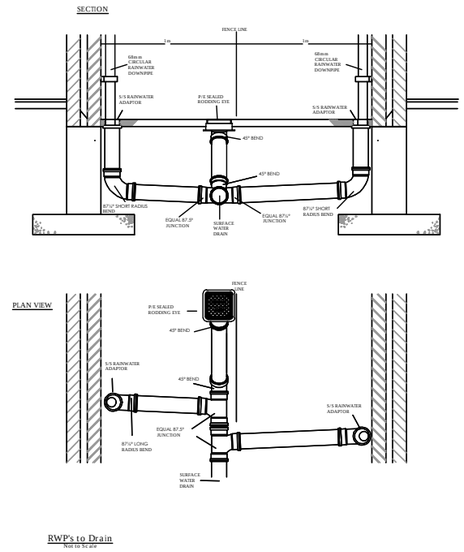
Bottle Gully & Yard Gully Detail
Not to Scale



Multibase Inspection Chamber
Not to Scale



RWP to Drain
Not to Scale



RWP's to Drain
Not to Scale

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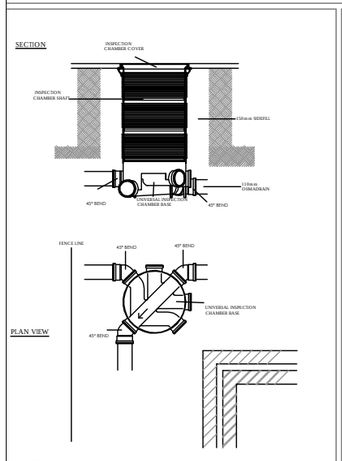
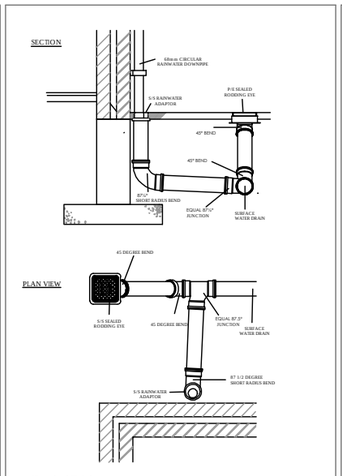
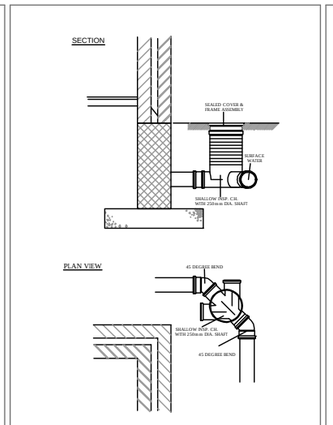


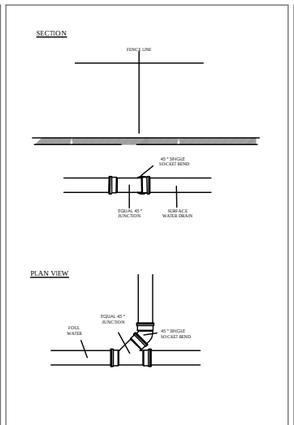
UIC - 90° Change of Direction with a Side Branch Connection
Not to Scale



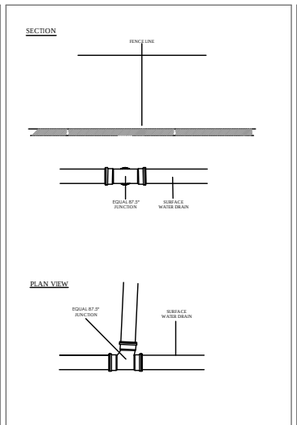
Head of SW drain
Not to Scale



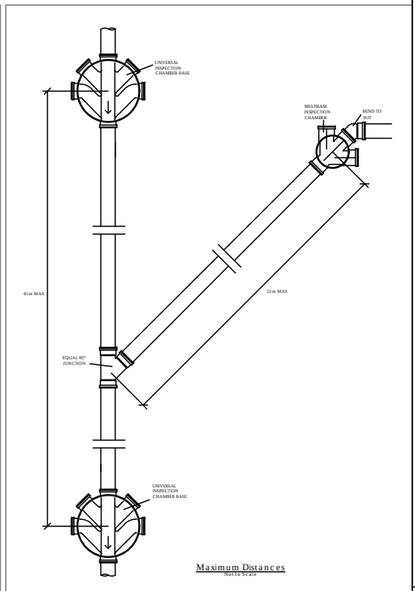
Shallow inspection Chamber - 90° Change of Direction
Not to Scale



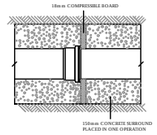
Foul Water Junction to Run
Not to Scale



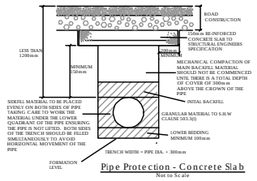
Surface Water Junction to Run
Not to Scale



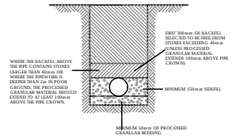
Maximum Distances
Not to Scale



Pipe protection - Concrete Surround
Not to Scale



Pipe Protection - Concrete Slab
Not to Scale



PLEASE NOTE:-

IN THE CASE OF 110mm~160mm OSMADRAIN AND 150mm OSMA ULTRARIB PIPES, WHERE THE GRANULAR MATERIAL IS NOT PROCESSED AND HAVE AND IS NOT PUNISHED WHEN WASHED UPON, A 50mm DEPTH OF BEDDING MATERIAL MAY BE USED. IN THIS CASE THE MATERIAL MUST BE NOMINAL 10mm SINGLE-SIZED AGGREGATE.

OsmaDrain Pipe laid on 50mm minimum Processed Granular Material
Not to Scale

Rev.	Date	Amendments	By	Chk'd
C01	19/02/18	Construction issue	NJ	DJ
P1	19/06/17	Initial issue	NJ	DJ

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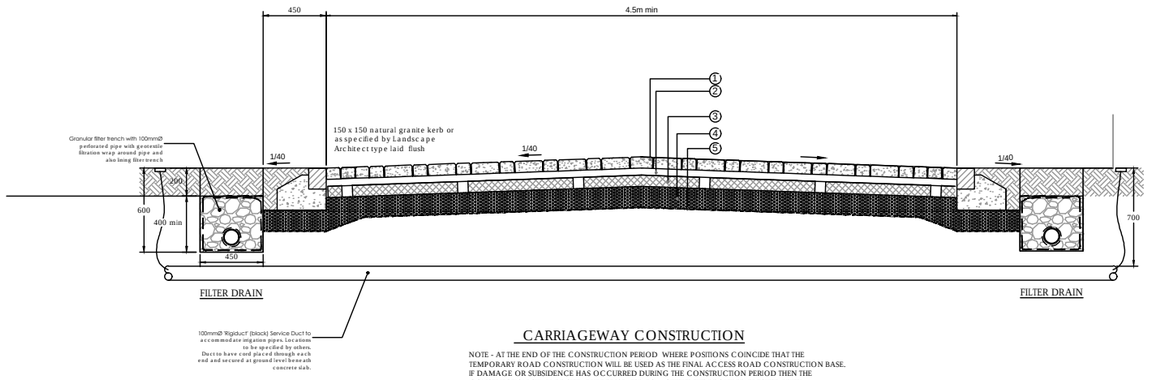
Project:
Athlone House
Hampstead Lane
London

Drawing title:
General Drainage
Construction Details
Sheet 3 of 3

Scale at A1:	Drawn by:	Date:	Chk'd by:
1:20	NJ	13/06/2017	DJ

CONSTRUCTION

Project Number:	Drawing Type:	Drawing No:	Revision:
1480	DR	55	C01



CARRIAGEWAY CONSTRUCTION

NOTE - AT THE END OF THE CONSTRUCTION PERIOD WHERE POSITIONS COINCIDE THAT THE TEMPORARY ROAD CONSTRUCTION WILL BE USED AS THE FINAL ACCESS ROAD CONSTRUCTION BASE. IF DAMAGE OR SUBSIDENCE HAS OCCURRED DURING THE CONSTRUCTION PERIOD THEN THE CONSTRUCTION SHALL BE SUITABLY REINSTATED TO ACHIEVE THE REQUIRED FINISHED LEVEL TOLERANCES.

1	Block/flag paving - Type, colour and bond to be advised by Landscape Architect
2	50mm depth of compacted sand bedding course (Category II sand).
3	80mm AC 20mm dense bin 40/60 to BSEN 13108 - 1:2006
4	200mm Type 1 Sub-base to Cl 803 SHW
5	Geo grid eg Tensar TriAx P-0-10849 Type 1 Geogrid or similar approved

NOTE - WHERE LOWER CBR VALUES ARE ENCOUNTERED IT WILL BE NECESSARY TO UNDERTAKE FORMATION IMPROVEMENT BY REMOVAL OF SOFT MATERIAL, PROOF ROLLING, AND ROLLING IN CAPPING LAYER MATERIAL.

Reference to be made to Tensar feasibility report 0-10849 dated 17th October 2017. tel: 07824 370249

Construction based on CBR value of 3.0%

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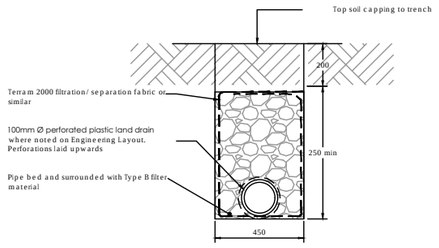
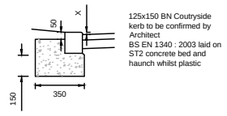
Grading	
Sieve Size	Passing
63	100
37.5	85 - 100
20	0 - 25
10	0 - 5



FILTER DRAIN



125x150 BN Coutryside kerb to be confirmed by Architect BS EN 1340 : 2003 laid on ST2 concrete bed and haunch whilst plastic

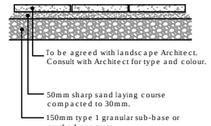
X = Refer to engineers finishes drawing

BN KERB CONSTRUCTION

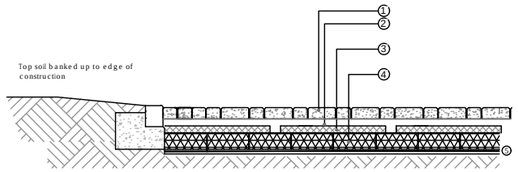
50x150 EF Countryside concrete or as specified by Architect edging to BS EN 1340 : 2003 laid flush unless otherwise specified

ST4 concrete bed & haunch

50x150 EF PATH EDGING



SLABBED FOOTWAY DETAIL (NOT TERRACE AREAS)



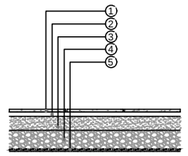
NO DIG ACCESS CONSTRUCTION

1	Block/flag paving - Type, colour and bond to be advised by Landscape Architect
2	50mm depth of compacted sand bedding course (Category II sand).
3	80mm AC 20mm dense bin 40/60 to BSEN 13108 - 1:2006
4	150mm' Cellweb' cellular sub-base confinement system filled with Opend graded crushed rock aggregate infill (CellWeb 01455 617139)
5	Permafilter Geotextile (Polypipe code PV23002) or similar approved. Note geotextile to be wrapped up side of SuDS agg and surfacing material where no side restraint is specified.

NOTE - WHERE LOWER CBR VALUES ARE ENCOUNTERED IT WILL BE NECESSARY TO UNDERTAKE FORMATION IMPROVEMENT BY REMOVAL OF SOFT MATERIAL, PROOF ROLLING, AND ROLLING IN CAPPING LAYER MATERIAL.

NOTES:

1. All earthworks within the root protection area of retained trees to be hand excavated in accordance with BS 5837:2005
2. Unless otherwise stated in appendix 30/10 ground preparation within the root protection area of retained trees to be restricted to the removal of the loose topsoil/humus layer only. Any major Hollows to be filled with inert no-fines aggregate to provide a level surface.
3. Exact location of all excavation to be agreed on site.
4. Care must be taken when working around roots greater than 25 mm in diameter and clusters of small roots avoiding damage to the bark. In the event that roots greater than 25 mm are encountered under no circumstances should they be cut. Where roots less than 25mm require removal they should be cut back cleanly using secateurs or a sharp pruning saw. All excavation work within the RPA of the trees shall be by hand only.
5. Retained roots within the construction to be encased in split ducting of an appropriate diameter to give 5 to 20mm clearance around the root. Ducting to extend a minimum of 100mm beyond the footing on either side. Ducting to be taped together after placement.
6. Concrete to be compacted using internal vibration.
7. Where services must be placed within the root protection area, they should be positioned to avoid footings with reference to NJUG guidance and ducting to avoid future disturbances.
8. Back filling should be carried out using the excavated soil which should be worked in and around any retained roots and lightly tamped not compacted and respecting the original soil profile.



1	20mm thick limestone tiles to architects specifications.
2	30mm Class 1 mortar bedding
3	150mm Pav 2 concrete with expansion joints
4	150mm type 1 sub-base to clause 803
5	Separation geotextile Terram 1000 or similar

Terrace Paving Detail

Rev.	Date	Amendments	By	Chk'd
C4	13/08/18	Terrace concrete depth updated to previously agreed	SNN	DJ
C3	12/01/18	Service Duct crossing added	SNN	DJ
C2	11/12/17	Terrace paving detail added.	ATD	DJ
C1	23/11/17	Issued for Construction - Refer to notation	NJ	DJ
P5	15/11/17	Carriageway construction detail amended	NJ	DJ
P4	03/10/17	Lower access road overlay removed	ATD	DJ
P3	12/09/17	Carriageway construction amended and No dig detail updated	ATD	DJ
P2	25/08/17	Permeable paved road detail updated	NJ	DJ

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Project:
Athlone House
Hampstead Lane
London

Drawing title:
Private Road
Construction Details

Scale at A1:	Drawn by:	Date:	Chk'd by:
1:20	NJ	13/06/2017	DJ

CONSTRUCTION

Project Number:	Drawing Type:	Drawing No:	Revision:
1480	DR	56	C4