Flood Risk Assessment and SuDS Report
November 2024

EAS

Eco-Living Cottages, Colne Spring Villa, Coursers Road, Colney Heath, AL4 0PB

Manor Coliving Ltd

EAS

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The content of this report is based on information available as of November 2024, the validity of the statements made may therefore vary over time as planning guidance / policies and the evidence base change.

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1 Introduction

1.1 This Flood Risk Assessment (FRA) and SuDS Statement has been prepared by EAS on behalf of Manor Coliving Ltd regarding the proposed development at Colne Spring Villa, Coursers Road, Colney Heath (hereinafter, the 'Site'). A site location plan is located in **Appendix A**.

1.2 The proposals consist of 9 eco-living residential units with associated parking and cycle parking. Proposed development plans are in **Appendix B**.

1.3 The red line boundary of the site remains entirely within Flood Zone 1. Flood Zone 1 is defined as having less than a 0.1% annual probability of river flooding. The site remains outside all modelled surface water flood extents, excluding a negligible area in the centre of the site which is shown to experience depth below 150mm in the 0.1% AEP modelled event. This FRA will assess all sources of flooding and detail mitigation measures where necessary.

1.4 This report also details a SuDS strategy to demonstrate compliance with national and local policy requirements.

1.5 The contents of this FRA and SuDS report are based on the advice set out in the National Planning Policy Framework (NPPF) last updated December 2023, Annex 3: Flood risk vulnerability classification, also from the NPPF and PPG 'Guidance for Flood Risk and Coastal Change', updated in August 2022.

1.6 This report is based on the Environment Agency flood maps, geology mapping, OS mapping, topographic survey, Strategic Flood Risk Assessment and local policy.

1.7 This document includes the following sections:

Section 2 – describes any relevant local and national planning policy;

Section 3 – provides a site description and background information;

Section 4 – review any potential sources of flooding;

Section 5 – details the proposed drainage strategy;

Section 6 – details the maintenance for the proposed drainage strategy; and

Section 7 – summarises and concludes the report.

2 Policy Context

Introduction

2.1 This section sets out the policy context. This report is based on the advice set out in the National Planning Policy Framework (NPPF) last updated December 2023 and the Planning Practical Guidance (PPG) updated in August 2022.

2.2 Paragraph 167 footnote 59 of the NPPF states:

"A site-specific flood risk assessment should be provided for all developments in Flood Zones 2 and 3. In Flood Zone 1, an assessment should accompany all proposals involving: sites of 1 hectare or more; land which has been identified by the Environment Agency as having critical drainage problems; land identified in a strategic flood risk assessment as being at increased flood risk in future; or land that may be subject to other sources of flooding, where its development would introduce a more vulnerable use."

2.3 The flood zones are defined as:

- Flood Zone 1 - less than a 0.1% (1 in 1000) annual probability of river or tidal flooding.
- Flood Zone 2 - between a 0.1% and 1% (1 in 1000 and 1 in 100) annual probability of river flooding; or between a 0.1% and 0.5% (1 in 1000 and 1 in 200) annual probability of flooding from tidal sources.
- Flood Zone 3a- This zone comprises land assessed as having a 1% (1 in 100) or greater annual probability of river flooding; and for tidal flooding at least a 0.5% (1 in 200) annual probability of flooding from tidal sources.
- Flood Zone 3b - This zone comprises land where water has to flow or be stored in times of flood. This classification is usually classified as land which had a 3.33% (1 in 30) annual probability of flooding.

2.4 Paragraph 165 discusses the suitability of development location, particularly with regards to future risks induced by climate change:

"Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk (whether existing or future). Where development is necessary in such areas, the development should be made safe for its lifetime without increasing flood risk elsewhere".

2.5 Paragraph 166 of the National Planning Policy Framework (NPPF) sets out how:

"Strategic policies should be informed by a strategic flood risk assessment, and should manage flood risk from all sources. They should consider cumulative impacts in, or affecting, local areas susceptible to flooding, and take account of advice from the Environment Agency and other relevant flood risk management authorities, such as lead local flood authorities and internal drainage boards".

2.6 Paragraphs 175 NPPF discusses the application of sustainable drainage systems:

"Major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate. The systems used should:

a) Take account of advice from the lead local flood authority;

b) Have appropriate proposed minimum operational standards;

c) Have maintenance arrangements in place to ensure an acceptable standard of operation of the lifetime of the development; and

d) Where possible, provide multifunctional benefits."

2.7 The red line of the site falls entirely within Flood Zone 1. Flood Zone 1 is defined as having less than a 0.1% annual probability of river flooding. The EA Flood Map has been enclosed in **Appendix C**. On the periphery of the eastern boundary of the site is an area located in Flood Zones 2 and 3, sourced from the River Colne, an EA Main River.

St Albans District Current Local Plan Review 1994 (Last Updated: July 2020)

2.8 The current adopted Local Plan is The District Local Plan Review 1994, which will be replaced by a new plan. In 2007, Local Plans 'expired' after 27th September 2007 unless 'saved', therefore the current 1994 review contains saved policies which are still part of the development plans for St Albans.

2.9 Policy 84 (Saved) – Flooding and River Catchment Management states:

"The Council will consult with the National Rivers Authority on all matters likely to affect the water environment in order to reduce the risk of flooding and to ensure proper management of the river catchment. The following principles will apply:

(i) in areas liable to flood, development or the intensification of existing development, will not normally be permitted. Appropriate flood protection will generally be required where the redevelopment of existing developed areas is permitted in areas at risk from flooding;

(ii) where appropriate, a condition will be attached to planning permissions to ensure that strips are provided alongside 'main river'(1) watercourses and kept free of development in order to allow access for dredging and discretionary maintenance;

(iii) all works in, under, over and adjacent to watercourses shall be appropriately designed and implemented and alternatives to culverting should be explored where possible;

(iv) proposals shall not increase flood risk in areas downstream due to additional surface water runoff. If development is permitted, it must include appropriate surface water runoff control measures."

2.10 Policy 84A (Saved) – Drainage Infrastructure states:

"The Council will consult Thames Water Utilities Ltd. and the National Rivers Authority on all planning applications that might cause sewerage flooding. The following principles will apply:

(i) planning permission will not normally be granted for new development in areas which are considered presently at risk of sewerage flooding; or where development would result in an unacceptable increase in sewerage flood risk there or elsewhere;

(ii) a detailed drainage impact study may be required at the planning application stage;

(iii) where planning permission is granted, it may be subject to a condition or agreement relating to the approval of a drainage strategy, which may include phasing of the development."

St Albans District New Draft Local Plan 2041 (Last Updated: September 2024)

2.11 A new local plan began public consultation in July 2023, is set for submission in March 2025 and set to be adopted in March 2026. The New Local Plan establishes St Albans District Council's long term spatial planning strategy for delivering and managing development and infrastructure, and for environmental protection and enhancement, to 2041. All policies in this plan are considered to be in draft until adopted.

2.12 Policy NEB 8 – Managing Flood Risk includes:

"Proposals located within flood zones (i.e. Flood Zones 2 or 3, or sites within Flood Zone 1 where there is an identified flood risk) need to meet the requirements of the sequential and exception tests, in accordance with national policy. Any Flood Risk Assessment must be undertaken in accordance with advice from the Environment Agency (if applicable) or Lead Local Flood Authority.

Where the sequential and exception tests have been applied, proposals located within areas identified as being at risk of flooding will not be permitted unless the following is demonstrated:

a) That the most vulnerable development within the site is located in areas of lowest risk;

b) That all sources of flood risk are considered, including fluvial and surface water flood risk;

c) That the development is appropriately flood resistant and resilient and incorporates appropriate infrastructure to address the increasing potential for flood events due to Climate Change;

d) That flood risk will not be increased elsewhere and, where possible, reduce flood risk offsite;

e) How the proposal incorporates sustainable drainage systems;

f) How any residual risk can be safely managed; and

g) That safe access and egress routes are included where appropriate and have an agreed emergency plan.

Where appropriate, proposals should include a comprehensive green infrastructure strategy with infrastructure that will provide a number of different functions relating to amenity, ecology and flood risk.

Where a development may affect a watercourse or waterbody, the proposal must demonstrate:

h) A comprehensive approach to watercourse management;

i) The full use of Sustainable Drainage Systems (SuDS); and

j) Flood and drainage storage areas as necessary.

Surface Water Management

k) All major development should incorporate sustainable drainage systems (SuDS) into proposals, and manage surface water run-off to achieve greenfield run-off rates where feasible;

l) Proposals for minor and householder development should incorporate SuDS where applicable;

m) SuDS should be green, provide multiple benefits, such as biodiversity and integrate into the green infrastructure network; and

n) Development proposals incorporating SuDS will need to include management and maintenance plans for the proposed SuDS, with appropriate contributions sought where necessary.

Southwest Hertfordshire Level 1 Strategic Flood Risk Assessment (SFRA) Level 1 Addendum for St Albans (July 2024)

2.13 The revised SFRA forms part of the evidence based used to inform the Local Plan update.

2.14 Appendix D and Appendix G of the SFRA show that the site is located outside the EA historic flood map extents.

2.15 Appendix F of the SFRA notes the extents of Flood Zones 2 and 3 when climate change is accounted for. The site appears to remain in Flood Zone 1.

2.16 Appendix H of the SFRA displays the risk of surface water flooding across the district. The site appears to be outside all modelled surface water flood extents.

2.17 Appendix J of the SFRA displays the risk of surface water flooding across the District when a 40% climate change allowance is accounted for. The surface water flood extent appears not to encroach within the site however does extend further into land to the south of the site in the location of the pond.

2.18 Appendix K of the SFRA notes groundwater emergence depths to a 5m resolution across the District. The site is located in an area where groundwater could be present within 0.025m from the surface. Paragraph 5.5 of the SFRA states:

"The JBA groundwater flood map provides an indication of where groundwater is most likely

to emerge and flow. The mapping cannot be used to predict the likelihood of groundwater emerging or to quantify the volumes of groundwater that might be expected to emerge in a given area. In high-risk areas, a site-specific risk assessment for groundwater flooding may be required to fully inform the likelihood of flooding."

2.19 Appendix L of the SFRA details the location of defences, assets and structures associated with watercourses with District. There are no defences, assets and structures located within the site. On the right bank of the River Colne on the other side of the channel from the site, natural high ground defences are located.

2.20 Appendix N displays the reservoir flood extents across the District. The site is not located within a reservoir flood extent.

2.21 Appendix O shows the site is located on the periphery of the '062FWF28CHeath' Flood Warning Area.

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3 Existing Site Assessment

Site Description

3.1 This Flood Risk Assessment (FRA) and SuDS Statement has been prepared by EAS on behalf of Manor Coliving Ltd regarding the proposed development at Colne Spring Villa, Coursers Road, Colney Heath. The location plan is included in **Appendix A**.

3.2 The part of the site under consideration is not currently developed and forms part of the existing Colne Spring Villa gardens.

3.3 The proposals consist of 9 eco-living residential units with associated parking and cycle parking. Proposed development plans are in **Appendix B.**

Local Watercourses

3.4 An EA Main River, the River Colne is located approximately 60m east of the redline boundary of the site.

Site Levels

3.5 A topographical survey has been undertaken and is included in **Appendix D**.

3.6 The site has a general fall south-eastward, with levels ranging from 75.85mAOD in the northwestern corner, falling to 71.58mAOD in the southeastern corner.

3.7 The site also sees an easterly fall along the southern boundary, with levels of 75.58mAOD in the west, falling the levels of 72.17mAOD in the east.

Geology

3.8 With reference to the British Geological Survey (BGS) online mapping, the site is located within an area with a bedrock of Lewes Nodular Chalk Formation and Seaford Chalk Formation (undifferentiated) and variable superficial deposits of both the Kesgrave Catchment Subgroup – Sand and Gravel, and Alluvium – clay, silt, sand and gravel.

3.9 With reference to the BGS Borehole Viewer, a borehole record located 140m west of the site (BGS reference: TL20NW14) encountered groundwater seepage at 6m bgl. Boulder clay was recorded to a depth of 5.9m bgl, with glacial gravel, described as ‘Clayey sand’, recorded below to a depth of 11m.

3.10 The DEFRA Magic Map shows the site is located on an ‘Principal’ bedrock aquifer and a ‘Secondary A’ aquifer based on superficial drift.

3.11 The DEFRA Magic Map shows the site is located in the source protection Zone I – Inner Catchment.

3.12 The DEFRA Magic Map shows the site is located in a medium to high groundwater vulnerability area.

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Sewer Records

3.13 The Thames Water Asset Location Map is enclosed in **Appendix E**.

3.14 Two foul water sewers run north-westerly along the eastern boundary of the site, in line with the western boundary of the River Colne. These sewers run parallel to each other.

Existing Drainage

3.15 A site visit undertaken by EAS has identified an existing drainage system into the River Colne, with Figure 2 showing relevant photographs for each feature described.

3.16 An existing pond has been identified within the site boundary (Figure 2.A), which is an uncompleted project by the site owner. This pond has an existing piped connection into the eastern boundary ditch, created by the site owner (Figure 2.B).

3.17 This ditch flows in a northerly direction, and discharges into another man-made pond located in a clearing in the woodland, approximately 50m east of the existing houses (Figure 2.C). The pond located within the woodland, is assumed to outfall to the river Colne (figure 2.D), to the east.

A

B

C

D

Figure 2: Images from site visit to Eco-living Cottages, Colney Heath, St Albans, AL4 0PB (Source EAS)

A. Existing Pond within site boundary, **B**. Pipe connecting pond to a ditch to the east, **C.** Pond located in the woodland, 50m east of existing houses, **D.** River Colne, to the East

4 Potential Source of Flooding

Fluvial

4.1 A copy of the Environment Agency's Flood Map for Planning is enclosed in **Appendix C**.

4.2 The site is located entirely in Flood Zone 1. Land in Flood Zone 1 is considered to have an annual risk of flooding from a fluvial source of less than 0.1% annual probability. Flood Zones 2 and 3 associated with the River Colne are located just outside the eastern site boundary.

4.3 Due to the proximity of the site boundary to flood zone 2, DEFRA fluvial flood data was analysed in QGIS and subsequently overlain with the site boundary to ensure absolute accuracy. This map confirmed that the site is entirely outside of Flood Zones 2 and 3. This flood map is included in **Appendix C**.

Surface Water

4.4 Surface water flooding refers to flooding caused when the intensity of rainfall, particularly in urban areas, can create runoff which temporarily overwhelms the capacity of the local drainage systems or does not infiltrate into the ground. The water ponds on the ground and flows towards low-lying land. This source of flood risk is also known as 'pluvial'.

4.5 The EA long term risk maps (available of the GOV.UK website) shows the majority of the site is at a very low risk of surface water flooding, with only a small amount of flooding noted under the low risk (between 0.1% and 1% chance each year). The EA long term risk maps are included in **Appendix F**.

4.6 A high-risk scenario indicates a greater than 3.3% annual probability of surface water flooding, i.e., the most frequently occurring scenario. The medium risk scenario indicates an annual probability of surface water flooding between 3.3% and 1%. In both scenarios, the site was shown to not be affected by surface water fooding.

4.7 The low-risk scenario indicates an annual probability of surface water flooding between 1% and 0.1%, (i.e. the least frequent but worst-case scenario). Under this scenario, a small area of surface flooding was noted on the access road, with levels of flooding up to 30cm.

4.8 Defra surface water flood data was obtained and overlayed with the site to further analyse surface water flood risks.

DEFRA Surface Water Flood Mapping

4.9 The available Defra surface water flooding data for a 0.1% annual probability, analysed in QGIS, is also included in **Appendix G**, showing the flooding depth on both the existing site and proposed development. The Defra surface water mapping shows the predicted depths of flooding at 150mm intervals, which is more precise than the EA long term flood risk maps.

4.10 For the 0.1% AEP event (1 in 1000yr.), surface water flooding is shown to the centre of the site along the existing access road, with maximum depths of <150mm. No surface water flooding is located on any of the proposed buildings; therefore, no displacement is likely to occur. This small area of pooling water is likely to be drained by the proposed permeable paving and therefore, it is unlikely that any surface water flooding would occur post development.

Artificial

4.11 The EA long term risk maps also display the risk from reservoirs. The site is shown not to be in a reservoir flood risk area. An extract of the EA long term risk maps is included in **Appendix F**.

4.12 The risk of flooding from artificial source is considered low.

Groundwater

4.13 The South West Hertfordshire SFRA's interactive Flood Risk Map shows the groundwater to be >5m deep below the site.

4.14 Usually in the absence of a ground investigation BGS borehole information provides the most helpful indication of whether groundwater flooding is an issue, but perched groundwater (rather than the aquifer) may still be found in certain conditions.

4.15 Borehole records show that groundwater seepage was encountered at 6m bgl (BGS reference: TL20NW14), with boulder clay located above this.

4.16 The MAGIC Map website (https://magic.defra.gov.uk/MagicMap.aspx) shows the site lying within Zone I, Inner source protection zone.

4.17 The MAGIC Map website shows the site is located within a medium vulnerability area. Medium groundwater vulnerability is defined as "areas that offer some groundwater protection. Intermediate between high and low vulnerability."

4.18 The risk of groundwater emergence is likely to be low due to the geology of clay, however on-site investigation prior to construction will determine if any perched groundwater is present.

5 Floods Warnings

5.1 Due to the site proximity to Flood zones 2 and 3, it is recommended that residents sign up to receive EA Flood Warnings.

5.2 The EA operate a flood forecasting and warning service in areas at risk of flooding from rivers or the sea, which relies on direct measurements of rainfall, river levels, tide levels, in-house predictive models, rainfall radar data and information from the Met Office. This service operates 24 hours a day, 365 days a year.

5.3 The site is located within the 'The River Colne at Colney Heath including North Mymms' Flood Warning Area.

5.4 It is recommended that the site manager and residents subscribe to the EA flood warning service by using the link: https://www.fws.environment-agency.gov.uk/app/olr/home. Alternatively, registration can be completed by telephone via the EA Floodline on 0345 988 1188 or Typetalk 0345 602 6340.

5.5 Upon receipt of a Flood Alert, residents should remain vigilant of potential flooding along the eastern boundary of the site; however, as the site itself and the access onto Coursers Road are within Flood Zone 1, evacuation should not be necessary.

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6 Proposed Drainage Stategy

Relevant SuDS Policy

6.1 SuDS mimic natural drainage patterns and provide a method of surface water drainage which can decrease the quantity of water discharged, and hence reduce the risk of flooding. SuDS design should meet the "four pillars" of SuDS of: water quantity, water quality, amenity and biodiversity, wherever possible.

6.2 In decreasing order of preference, the preferred means of disposal of surface water runoff is:

- Discharge to ground.
- Discharge to a surface water body.
- Discharge to a surface water sewer.
- Discharge to a combined sewer.

Site-Specific SuDS

6.3 The various SuDS methods need to be considered in relation to site-specific constraints. Several SuDS options are available to reduce or temporarily hold back the discharge of surface water runoff. Table 6.1 outlines the constraints and opportunities to each of the SUDS devices in accordance with the hierarchical approach outlined in The SuDS Manual CIRIA C753. It also indicates what could and could not be incorporated within the development, based upon site-specific criteria.

Device	Description	Constraints / Comments	Appropriate
Living roofs (source control)	Provide soft landscaping at roof level which reduces surface water runoff.	Green roofs proposed on bin stores	Yes
Infiltration devices & Soakaways (source control)	Store runoff and allow water to percolate into the ground via natural infiltration.	Infiltration not viable	No
Pervious surfaces (source control)	Storm water is allowed to infiltrate through the surface into a storage layer, from which it can either infiltrate and/or slowly release to sewers.	Permeable paving has been proposed for part of access road	Yes
Rainwater harvesting (source control)	Reduces the annual average rate of runoff from the Site by reusing water for non-potable uses e.g. toilet flushing, recycling processes.	Rainwater harvesting tanks have been proposed	Yes

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Swales (permeable conveyance)	Broad shallow channels that convey / store runoff and allow infiltration (ground conditions permitting).	No suitable location onsite	No
Filter drains & perforated pipes (permeable conveyance)	Trenches filled with granular materials (to take flows from adjacent impermeable areas) that convey runoff while allowing infiltration.	Not proposed due to scope of works	No
Filter Strips (permeable conveyance)	Wide gently sloping areas of grass or dense vegetation that remove pollutants from run-off from adjacent areas.	Not proposed due to scope of works	No
Infiltration basins (end of pipe treatment)	Depressions in the surface designed to store runoff and allow infiltration.	Not appropriate due to scope of works	No
Wet ponds & constructed wetlands (end of pipe treatment)	Provide water quality treatment & temporary storage above the permanent water level.	Existing pond to be utilised	Yes
Attenuation Underground (end of pipe treatment)	Oversized pipes or geo-cellular tanks designed to store water below ground level.	Pond achieves adequate attenuation, therefore not required	No
Raingardens	Rain gardens are relatively small depressions in the ground that can act as infiltration points for roof water and other 'clean' surface water.	Raingarden planters have been proposed for each property	Yes

Table 6.1 Site Specific SuDS

Consideration of SuDS Hierarchy

6.4 The site is shown to have bedrock geology of chalk but given the variable superficial deposits and a nearby borehole showing boulder clay, it is likely infiltration on the site is variable, and therefore has not been proposed. However, a site visit has noted an existing pond to the south of the site, which will be utilised within this drainage strategy. The existing basin is an uncompleted project by the site owner, who has proposed that it be completed to form the main balancing pond for the development.

6.5 The existing pond has an existing piped connection into the eastern boundary ditch, which the owner created to flow in a northern direction into the man-made pond located to the east of Colne Spring Villa and subsequently outfalls into the river Colne to the east. This existing drainage system has been noted in Section 3.

Surface Water Drainage Design Parameters

6.6 The following best practice design parameters have been considered:

- The local 2070s 'Upper End' Climate Change allowance is 40% and has been applied to the hydraulic drainage network design.

- The Hydraulic Model has been for a 1:2yr Storm Event, 1:30yr Storm Event, 1:30yr + 40% Climate Change Event, 1:100yr Storm Event and 1:100yr + 40% Climate Change Storm Event.
- FEH22 rainfall data has been used.
- The CV Value for Winter and Summer storms has been set to 1.0.
- A 5min time of entry has been used.
- In line with Hertfordshire's LLFA Guidelines, the proposed attenuation has a half-drain time within 48hrs (2880mins).
- The drainage calculations include a surcharged outfall.

6.7 Pre and Post Discharge Volumes and Long Term Storage – Non-Statutory Technical Guidance Policy S5 States:

"Where reasonably practicable, for developments which have been previously developed, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event must be constrained to a value as close as is reasonably practicable to the greenfield runoff volume for the same event but should never exceed the runoff volume from the development site prior to redevelopment for that event. "

6.8 Policy S6 States:

"Where it is not reasonably practicable to constrain the volume of runoff to any drain, sewer or surface water body in accordance with S4 or S5 above, the runoff volume must be discharged at a rate that does not adversely affect flood risk."

6.9 CIRIA's Susdrain Fact Sheet and SC030219 (Rainfall Runoff Management for Developments) sets out how post-development volumes that exceed pre-development volumes should be managed. If the post development discharge volume for a 1 in 100yr 360min Storm exceeds that of the Greenfield 1 in 100yr 360min Storm, either:

"Limit discharge from the site for all storms up to and including the 1 in 100yr + Climate Change Event to the QBAR/1:2yr Greenfield Runoff Rate;

Or

"For the greenfield volume, provide variable discharge rates to meet the equivalent greenfield QBAR, 1 in 30 and 1 in 100 rates, and either infiltrate or provide Long Term Storage for the additional volume of runoff produced by the development, to discharge at QBAR or 2l/s/ha, whichever is the greater."

Post Development Runoff Rate

6.10 Greenfield runoff rates were estimated using the ReFH2 method on the Causeway Flow software. The results of which are included in **Appendix H**. The proposed impermeable area of the site is 0.33ha, the following greenfield runoff rates for a range of storm events have been scaled accordingly:

- 1 in 1 year – 2.5 l/s/ha – 0.8 l/s
- 1 in 2 year – 3.0 l/s/ha – 0.9l/s
- 1 in 30 year – 8.1 l/s/ha – 2.5l/s
- 1 in 100 year – 10.6 l/s/ha – 3.2l/s

6.11 Causeway Flow Greenfield ReFH2 Method was used to calculate the 1:100yr 360min Storm Event Discharge Volume for 0.33ha. The results are included in **Appendix H** and show the existing discharge volume is 39.93m³.

6.12 The proposals seek to match the 1 in 1 year Greenfield Runoff Rate for all storms up to and including the 1:100yr + 40% Climate Change Event. It is therefore proposed for the runoff rate to be restricted to 0.8 l/s for all storms up to and including a 1 in 100 year +40% climate change event.

Proposed SuDS Strategy

6.13 As outlined in Table 6.1 above, a number of SuDS Features shall be utilised to form the Surface Water Drainage Strategy in order to meet the 4 Pillars of SuDS.

- Water Quantity – Permeable Paving, Pond
- Water Quality – Raingarden Planters, Permeable Paving
- Biodiversity – Raingarden Planters, Pond
- Amenity – Raingarden Planters, Pond, Rainwater Re-Use Tanks

6.14 The proposed SuDS Layout is included in **Appendix J** and Causeway Flow Hydraulic Model Outputs is contained in **Appendix I**.

Pipe Network

6.15 The proposed drainage strategy employs a pipe network running through the site and draining to the existing pond to the south of the site, via a gravity connection.

6.16 Rainwater downpipes are to be located at each of the corners of each property (two at the front and two at the rear) and will direct surface water run-off from roof area into the proposed pipe network. Raingarden planters have been proposed for each of the properties, with location varying per property. Surface water will discharge into raingarden planters via rainwater downpipes, then subsequently draining into the proposed pipe network.

6.17 The pipe network is proposed to run in a southerly direction, and discharge into the existing pond (Figure 2.A).

Permeable Paving

6.18 The road along the south of the site is proposed to utilise lined permeable paving. Causeway Flow was used to determine the required sub-base depth of permeable paving for all rainfall events up to and including the 1 in 100yr +40%CC event. The permeable paving (786m^2), will have a minimum sub-base depth of 500mm, resulting in a maximum attenuation of 80.58m^3.

6.19 Road area to the north (546m^2), and some road area to the south (136m^2) of the site is proposed to be hardstanding, due to root protection zones in these areas. These two areas of hardstanding are proposed to drain into the area of permeable paving.

6.20 Surface water from the permeable paving will connect into the main pipe network in the southeast of the site, restricted by a 50mm orifice plate.

Green Roofs

6.21 Green Roofs have been proposed on each of the bin stores within this development. Green roofs will be piped into the proposed pipe network.

Attenuation Basin

6.22 The proposed pipe network will drain into an existing unfinished pond, in the southeast corner of the site, which is to re-purposed as an attenuation basin. This basin will be modified to allow for sufficient storage of surface water, and act as a treatment stage.

Pond – Depth: 1m, Top of Pond: 809m^2, Base of Pond: 453m^2, Maximum volume held 314.60m^3

6.23 Discharge from this pond will be restricted by a hydrobrake and outfall to the existing ditch located to the east of the site. This hydrobrake will restrict the run-off to a maximum rate of 0.8 l/s for all storms up to and including a 1 in 100-year event +40% climate change.

6.24 This existing ditch was observed to drain to a nearby pond, which drains into a nearby river, as identified in Section 3.18.

6.25 The Causeway Flow hydraulic calculations have been included in **Appendix I** with the proposed drainage layout for the attenuation-based strategy included at **Appendix J.** A standard details drawing is included in **Appendix K.**

Rainwater Re-use Storage Tanks

6.26 Rainwater harvesting tanks have been proposed within this site. To account for the most extreme storm events when these tanks will be unable to store excess surface water, these tanks have not been modelled within this drainage strategy. Tanks sizes and exact locations are to be determined at a later date.

Long Term Storage

6.27 The proposals seek to match the existing 1:1yr Pre-Development Runoff Rate for all storms up to and including the 1:100yr + 40% Climate Change Event, as such Long Term Storage is not required.

Half Drain Times

6.28 The half drain times have been met in accordance with Hertfordshire's Guidelines, which require half drain times of below 48 hours (2880 minutes).

6.29 The permeable paving has a half drain time of 208 minutes, and the pond has a half drain time of 2880, both meeting the required times of less than 48 hours (2880 mins).

Exceedance Event

6.30 The proposed surface water drainage strategy is designed to accommodate a 1:100yr + 40% Climate Change Storm Event. In the unlikely event that an exceedance event occurs, any flood waters would flow in a southeast direction, away from the proposed development. An Exceedance Route Plan is included in **Appendix L**.

Water Quality

6.31 The proposed drainage strategies are to meet the water quality requirements set out by Table 26.2 of the CIRIA SuDS Manual C753 which sets out the specific pollution hazard indices for residential roofs and low traffic roads in Table 6.2 below.

Land Use	Hazard Level	Pollution Hazard Indices		
		Suspended Solids	Metals	Hydrocarbons
Residential roofs	Very low	0.2	0.2	0.05
Individual property driveways and low traffic roads	Low	0.5	0.4	0.4
Pollution Mitigation Required		0.5	0.4	0.4

Table 6.2 Land Use Pollution Hazard Ratings. Extracted from the CIRIA SuDS Manual C753 Simple Index Approach Tool.

6.32 There are two pathways in which drainage moves through this system. The first utilises permeable paving, followed by a pond

6.33 Table 6.3 below, shows how the permeable paving and pond proposed for this development will adequately mitigate the associated risks to water pollution and maintain water quality.

SuDS Component	Pollution Mitigation Indices		
	Suspended Solids	Metals	Hydrocarbons
Permeable Paving	0.7	0.6	0.7
Pond	0.7(x0.5) = 0.35	0.7(x0.5) = 0.35	0.5(x0.5) = 0.25
Total Pollution Mitigation	>0.95	0.95	0.95

Table 6.3 SuDS Component Pollution Mitigation for Permeable Paving and a Pond Extracted and adapted from the CIRIA SuDS Manual C753 Simple Index Approach Tool

6.34 The second pathway utilises a pipe network, flowing into the pond.

6.35 Table 6.4 below, shows how the pond proposed for this development will adequately mitigate the associated risks to water pollution and maintain water quality.

SuDS Component	Pollution Mitigation Indices		
	Suspended Solids	Metals	Hydrocarbons
Pond	0.7	0.7	0.5
Total Pollution Mitigation	0.7	0.7	0.5

Table 6.4 SuDS Component Pollution Mitigation for Permeable Paving and a Pond Extracted and adapted from the CIRIA SuDS Manual C753 Simple Index Approach Tool

7 Maintenance of Devlopement Drainage

7.1 The maintenance of the SuDS features will remain the responsibility of the site owner or an appointed maintenance company. The site owner/appointed management company will be responsible for maintaining an attenuation storage tank/soakaway and raingarden planter.

7.2 Regular inspections and maintenance should be carried out for each of these elements, particularly after periods of heavy rainfall. Maintenance tasks and frequencies for the aforementioned SuDS features are detailed in the CIRIA SUDS Manual (C753) and have been summarised below in Table 7.1 - 7.4 below.

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

Table 7.1: Maintenance tasks for an Permeable Paving (Source: CIRIA C753, The SUDS Manual)

Maintenance Schedule	Required Action	Frequency
Regular Inspections	Inspect infiltration surfaces for silting and ponding, record de-watering time of the facility and assess standing water levels in underdrain (if appropriate) to determine if maintenance is necessary.	Quarterly.
	Check operation of underdrains by inspection of flows after rain.	Annually.
	Inspect inlets and outlets for blockage.	Quarterly.
Regular maintenance	Remove litter and surface debris and weeds.	Quarterly (or more frequently for tidiness or aesthetic reasons).
	Replace any plants, to maintain planting density.	As required.
	Remove sediment, litter and debris build-up from around inlets or from forebays.	Quarterly or biannually.
Occasional Maintenance	Infill any holes or scour in the filter medium, improve erosion protection if required.	As required.
	Repair minor accumulations of silt by raking away surface mulch, scarifying surface of medium and replacing mulch.	As required.
Remedial Actions	Remove and replace filter medium and vegetation above	As required but likely to be > 20 years.

Table 7.2: Maintenance tasks for Bioretention Systems (Raingarden planters) (Source: CIRIA C753, The SUDS Manual)

Maintenance Schedule	Required Action	Frequency
Regular Inspections	Inspect all components including soil substrate, vegetation, drains, irrigation systems (if applicable), membranes and roof structure for proper operation, integrity of waterproofing and structural stability.	Annually and after severe storms.
	Inspect soil substrate for evidence of erosion channels and identify any sediment sources.	Annually and after severe storms.

	Inspect drain inlets to ensure unrestricted runoff from the drainage layer to the conveyance or roof drain system.	Annually and after severe storms.
	Inspect underside of roof for evidence of leakage.	Annually and after severe storms.
Regular maintenance	Remove debris and litter to prevent clogging of inlet drains and interference with plant growth.	Six monthly and annually or as required.
	During establishment (i.e. one year), replace dead plants as required.	Monthly (but usually responsibility of manufacturer).
	Post establishment, replace dead plants as required (where >5% of coverage).	Annually (in autumn).
	Remove fallen leaves and debris from deciduous plant foliage.	Six monthly or as required.
	Remove nuisance and invasive vegetation, including weeds.	Six monthly or as required.
	Mow grasses, prune shrubs and manage other planting (if appropriate) as required – clippings should be removed and not allowed to accumulate.	Six monthly or as required.
Remedial Actions	If erosion channels are evident, these should be stabilised with extra soil substrate similar to the original material, and sources of erosion damage should be identified and controlled.	As required.
	If drain inlet has settled, cracked or moved, investigate and repair as appropriate.	As required.

Table 7.3: Maintenance tasks for Green Roofs (Source: CIRIA C753, The SUDS Manual).

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).

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

Table 7.4: Maintenance tasks for Ponds (Source: CIRIA C753, The SUDS Manual).

7.3 A maintenance schedule for the rainwater re-use storage tanks will be provided by the manufacturer.

7.4 It is recommended that during the first 12 months of operation all SuDS and drainage features are visually inspected on a monthly basis to determine any seasonal patterns this includes all SuDS features, inspection chambers, inlets and outlets. This will determine whether or not the recommended service intervals set out by CIRIA in the figures above will be sufficient for maintenance beyond the first year.

7.5 After the first 12 months, the maintenance schedule should be designed to at least meet the requirements set out by CIRIA based on the outcome of the monitoring.

Manholes, Sewers and Inspection Chambers

7.6 All inspection chambers and manholes, including the orifice plate chambers, should be inspected on a bi-annual basis with further visual checks carried out throughout the year, such as in November after the heaviest leaf-fall has occurred.

7.7 Should a blockage occur at any time, it is advised to seek professional help to jet the drainage system to clean and clear the system.

Gutters and Downpipes

7.8 It is good practice to ensure that these are occasionally inspected to ensure they are in good order and free of leaves & debris. Once every 6 months should be sufficient.

8 Conclusions

8.1 This Flood Risk Assessment (FRA) and SuDS Statement has been prepared by EAS on behalf of Manor Coliving Ltd regarding the proposed development at Colne Spring Villa, Coursers Road, Colney Heath.

8.2 The proposals consist of 9 eco-living residential units with associated parking and cycle parking.

Flood Risk Summary

8.3 The red line boundary of the site remains entirely within Flood Zone 1. Flood Zone 1 is defined as having less than a 0.1% annual probability of river flooding.

8.4 In the 0.1% AEP surface water flood event, a small area of surface water flooding with a depth of below 150mm, is noted within the southern access road. This small area of pooling water is likely to be drained by the proposed permeable paving and therefore, it is unlikely that any surface water flooding would occur post development.

SuDS Summary

8.5 The proposed drainage strategy employs a pipe network running through the site and draining to the existing pond to the south of the site, via a gravity connection. Raingarden planters have been proposed for each of the properties, and green roofs will manage run-off from the proposed bin stores.

8.6 An area of permeable paving will be located along the southern road of the site, which will manage surrounding hardstanding, and connect into the pipe network.

8.7 Surface water within this network will be discharged into the existing pond, which is to be modified to allow for sufficient storage.

8.8 Discharge from this pond will be restricted by a hydrobrake which will restrict run-off to a maximum rate of 0.8 l/s for all storms up to and including a 1 in 100-year event +40% climate change, and outfall into an existing ditch to the east of the site.

Conclusion

8.9 The proposals will not increase flood risk onsite or elsewhere as detailed in this report and are therefore deemed policy compliant on flood risk and SuDS grounds.

Appendices

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Appendix: A - Location Plan

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK
1st Floor Millers House, Roydon Road, Stanstead Abbotts, SG12 8HN. Tel 01920 871 777 e: contact@eastp.co.uk www.eastp.co.uk

End User Licence for data products supplied through FIND Mapping Ltd, OS Partner licence no: 100047514

SCALE 1:1250 0 30 60 90

SITE Application Boundary

OWNERSHIP Boundary

Revision	Description	Drawn	Checked	Date
05	FOR PLANNING	BH	BH	06/11/2024
04	FOR PLANNING	BH	BH	25/10/2024
03	FOR PLANNING	BH	BH	22/10/2024
02	FOR PLANNING	BH	BH	25/09/2024
01	FOR PLANNING	BH	BH	24/09/2024

CREATE
DESIGN + ARCHITECTURE

Wigglesworth House 69 Southwark Bridge Road London SE1 9HH
+44 207 021 0267 info@createdesign.org www.createdesign.org

Colne Spring Eco-Living Cottages

AL4 0PB

Client

MANOR COLIVING LTD

<PRJ_STATUS>

SITE LOCATION PLAN

SITE LOCATION PLAN

CDA Ref	Scale(s)	Original Paper Size
#Project Ref	1:1250	A1

Drawing Number

Project	Originator	Volume	Level	Type	Role	Class	Number
775	CDA	ZZ	00	DR	A	00	0100

Revision: 05

Revision Description: FOR PLANNING

Appendix: B – Proposed Development Plans

SCALE 1:500 0 15 30 45m

SITE Application Boundary

Rev	Description	Drawn	Checked	Date
11	FOR PLANNING	BH	BH	18/11/2024
10	FOR PLANNING	BH	BH	13/11/2024
09	FOR PLANNING	BH	BH	06/11/2024
08	FOR PLANNING	BH	BH	25/10/2024
07	FOR PLANNING	BH	BH	10/10/2024
06	FOR PLANNING	BH	MW	12/08/2024
05	FOR PLANNING	BH	MW	06/08/2024
04	FOR COMMENT	BH	MW	26/07/2024
03	FOR COMMENT	BH	MW	25/07/2024
02	FOR COMMENT	BH	MW	17/07/2024
01	WIP	BH	MW	28/06/2024

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DESIGN + ARCHITECTURE
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Colne Spring Eco-Living Cottages

AL4 0PB

Client

MANOR COLIVING LTD

<PRJ_STATUS>

PROPOSED PLANNING

PROPOSED LEVEL 00 PLAN

CDA Ref	Scale(s)	Original Paper Size
#Project Ref	1:500	A3

Drawing Number

Project	Originator	Volume	Level	Type	Role	Class	Number
775	CDA	ZZ	00	DR	A	05	0100

Revision: 11

Revision Description: FOR PLANNING

Appendix: C – EA Flood Map for Planning

Environment Agency

Flood map for planning

Your reference	Location (easting/northing)	Created
<Unspecified>	**520648/205339**	**26 Nov 2024 8:23**

Your selected location is in flood zone 1, an area with a low probability of flooding.

You will need to do a flood risk assessment if your site is **any of the following:**

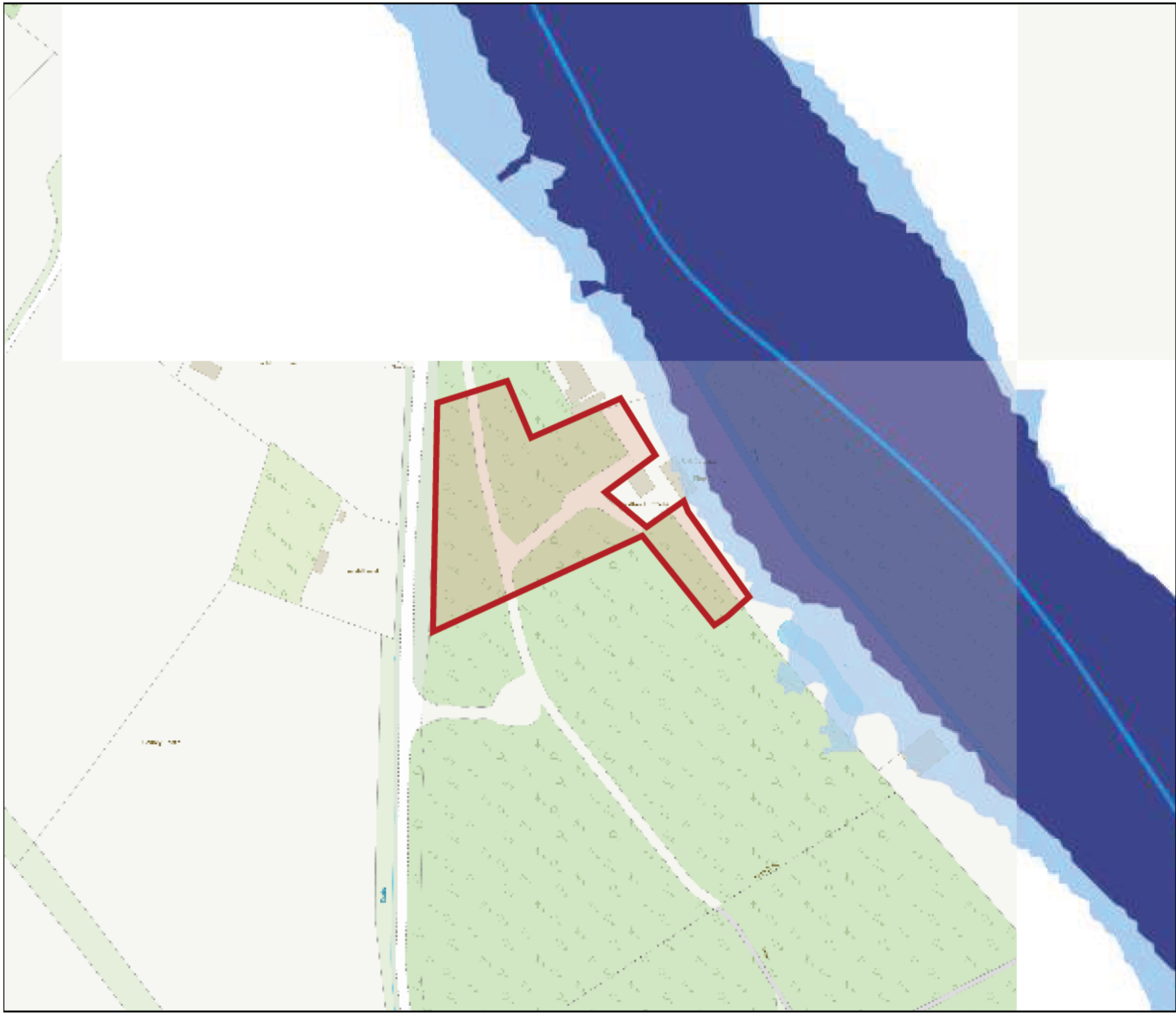
- bigger that 1 hectare (ha)
- In an area with critical drainage problems as notified by the Environment Agency
- identified as being at increased flood risk in future by the local authority's strategic flood risk assessment
- at risk from other sources of flooding (such as surface water or reservoirs) and its development would increase the vulnerability of its use (such as constructing an office on an undeveloped site or converting a shop to a dwelling)

Notes

The flood map for planning shows river and sea flooding data only. It doesn't include other sources of flooding. It is for use in development planning and flood risk assessments.

This information relates to the selected location and is not specific to any property within it. The map is updated regularly and is correct at the time of printing.

Environment Agency



Flood map for planning

Your reference
<Unspecified>

Location (easting/northing)
520648/205339

Scale
1:2500

Created
26 Nov 2024 8:23

- Selected area
- Flood zone 3
- Flood zone 2
- Flood zone 1
- Flood defence
- Main river
- Water storage area

0 20 40 60m

KEY

FLOOD ZONE 2

FLOOD ZONE 3

REV	DATE	BY	DESCRIPTION	CHK	APD
-	-	-	-	-	-

DRAWING STATUS:
PRELIMINARY

1st Floor Millers House, Roydon Road,
Stanstead Abbotts, Hertfordshire, SG12 8HN
Tel: 01920 871777

www.eastp.co.uk

CLIENT:
MANOR COLIVING LTD

ARCHITECT:
ARCHITECT

PROJECT:
ECO-VILLAGE COTTAGES
COLNEY HEATH

TITLE:
FLOOD MAP FOR PLANNING
FLUVIAL FLOOD EXTENTS

SCALE @ A2:	DESIGN-DRAWN:	DATE:
1:500	CA	06.11.2024
PROJECT No:	DRAWING No:	
5295	SK04	

Appendix: D – Topographical Survey

TRANSPORT PLANNING HIGHWAYS AND DRAINAGE FLOOD RISK
1st Floor Millers House, Roydon Road, Stanstead Abbotts, SG12 8HN. Tel 01920 871 777 e: contact@eastp.co.uk www.eastp.co.uk

SURVEY ORIENTATION & LEVEL DATUM

Survey position and orientation is to Ordnance Survey National Grid, computed using GNSS observations and Leica SmartNet RTK Network corrections.

Levels are related to Ordnance Survey Datum, computed using GNSS observations and Leica SmartNet RTK Network corrections.

LEGEND

Abbreviations

A/C	Air Conditioning Unit	IC	Inspection Chamber
B	Bollard	LP	Lamp Post
BB	Belisha Beacon	MH	Manhole
BP	Block Paving	MK	Marker Post
BT	British Telecom Cover	PB	Post Box
CATV	Cable Television Cover	PL	Pavement Light
CB	Control Box	PM	Parking Meter
CF	Soffit/Ceiling Fall	O/H	Overhead
CCTV	CCTV Cover	Rad	Radiator
CONC	Concrete	RE	Rodding Eye
CPS	Concrete Paving Slab	RS	Road Sign
DK	Drop Kerb	RWP	Rain Water Pipe
DP	Down Pipe	SB	Steel Beam
EB	Electrical Box/Panel	SP	Sign Post
ER	Earth Rod	SVP	Soil Vent Pipe
FB	Flower Bed	TMAC	Tarmac Surface
FH	Fire Hydrant	TP	Telegraph Pole
G	Gully	TPS	Tactile Paving Slab
GV	Gas Valve	VP	Vent Pipe
Ht	Height	WV	Water Valve

Levels

AHL	Arch Head Level	SL	Soffit/Ceiling Level
ASL	Arch Spring Level	TFL	Top of Fence Level
CL	Cover Level	TWL	Top of Wall Level
DHL	Door Head Level	UBL	Underside of Beam Level
FL	Floor Level	WHL	Window Head Level
IL	Invert Level	WSL	Window Sill Level

Arrows

Fall or Slope Down

Step, Ramp or Slope Up

Arched

N

0m 5m 10m 15m 20m

Scale Bar (1:200)

REVISION HISTORY

REV	DATE	NOTES

CLIENT

Cyril Ogunmakin

PROJECT

Colney Spring Villa,
Colney Heath, AL4 0PB

DRAWING

Topgraphic Survey

Ridgeway Surveys
LAND & ENGINEERING SURVEYORS
Address Unit 10 Chiltern Court
Asheridge Road
Chesham
Bucks
HP5 2PX
Telephone 020 8204 1087
Email info@ridgewaysurveys.com
Website www.ridgewaysurveys.com

SURVEYED	DRAWN	CHECKED	DATE	SCALE
RL	HE	RB	May 2024	1:200@A0

JOB NO	DRAWING NO	REVISION
08224	08224-001	

EAS

Appendix: E – Thames Water Sewer Mapping

DWS/DWS Standard/2014_2812453

0 15 30 60 90 120
Meters

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 before any works are undertaken.

Scale:	1:2524
Width:	500m
Printed By:	sradhak
Print Date:	10/07/2014
Map Centre:	520617,205431
Grid Reference:	TL2005SE

Comments:

Appendix: F – Long Term Flood Mapping

Surface Water Flood Extent

Surface water

Extent

High

More than 3.3% chance each year

Medium

Between 1% and 3.3% chance each year

Low

Between 0.1% and 1% chance each year

Site Boundary

High Risk: Surface Water Depth

Depth

Above 90cm

30cm to 90cm

Below 30cm

High

3.3% chance each year

Site Boundary

Medium Risk: Surface Water Depth

Depth

- Above 90cm
- 30cm to 90cm
- Below 30cm

Medium
1% chance each year

Site Boundary

Low Risk: Surface Water Depth

Depth

Above 90cm

30cm to 90cm

Below 30cm

Low
0.1% chance each year

Site Boundary

Risk of Reservoir Flooding

Reservoirs

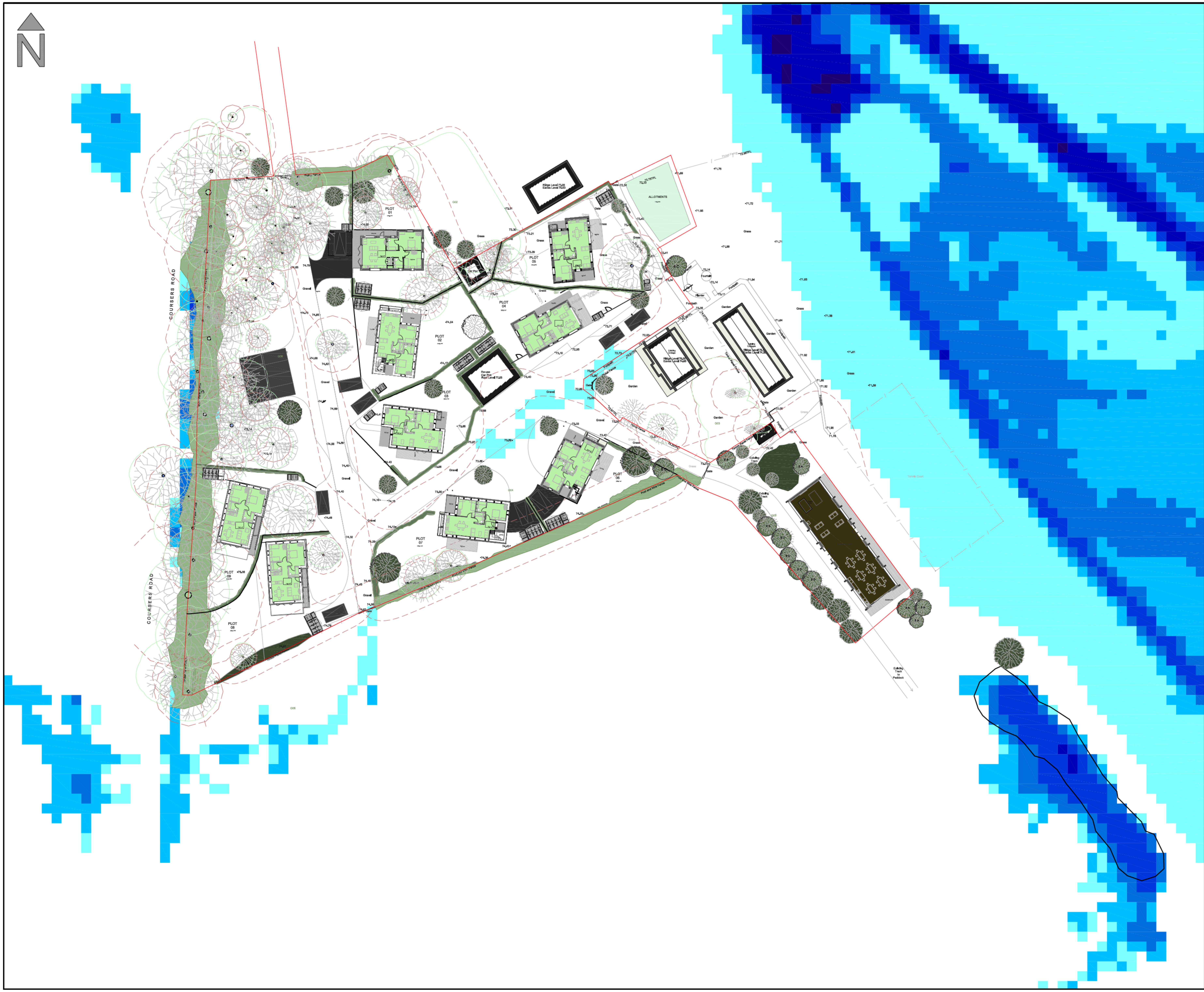
Extent

When river levels are normal

When there is also flooding from rivers

Selected address

Appendix: G – DEFRA Surface Water Flood Mapping



KEY

Key	
	<0.15m FLOOD DEPTH
	0.15m–0.3m FLOOD DEPTH
	0.3m–0.6m FLOOD DEPTH
	0.6m–0.9m FLOOD DEPTH
	0.9m–1.2m FLOOD DEPTH

REV	DATE	BY	DESCRIPTION	CHK	APD
–	–	–	–	–	–

DRAWING STATUS:

PRELIMINARY

1st Floor Millers House, Roydon Road,
Stanstead Abbotts, Hertfordshire, SG12 8HN
Tel: 01920 871777
www.eastp.co.uk

CLIENT:

MANOR COLIVING LTD

ARCHITECT:

ARCHITECT

PROJECT:

ECO–LIVING COTTAGES
COLNEY HEATH

TITLE:

SURFACE WATER FLOOD DEPTH
0.1% AEP EVENT
(1 IN 1000YR.)

SCALE @ A2:	DESIGN–DRAWN:	DATE:
1:500	CA	06/11/2024

PROJECT No:	DRAWING No:
5295	SK03

Appendix: H – Causeway Flow Outputs – Greenfield Run-Off Rates

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK
1st Floor Millers House, Roydon Road, Stanstead Abbotts, SG12 8HN. Tel 01920 871 777 e: contact@eastp.co.uk www.eastp.co.uk

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	100	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	1.000	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	50.0		

Simulation Settings

Rainfall Methodology	FEH-22	Drain Down Time (mins)	1440	30 year (l/s)	8.1
Rainfall Events	Singular	Additional Storage (m³/ha)	0.0	100 year (l/s)	10.6
Summer CV	1.000	Starting Level (m)		Check Discharge Volume	✓
Winter CV	1.000	Check Discharge Rate(s)	✓	100 year 360 minute (m³)	121
Analysis Speed	Normal	1 year (l/s)	2.5		
Skip Steady State	x	2 year (l/s)	3.0		

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0
10	0	0	0
30	0	0	0
30	40	0	0
100	0	0	0
100	40	0	0

Pre-development Discharge Rate

Site Makeup	Greenfield	Betterment (%)	0
Greenfield Method	ReFH2	Q 1 year (l/s)	2.5
Region	England, Wales, NI	Q 2 year (l/s)	3.0
Include Baseflow	x	Q 30 year (l/s)	8.1
Positively Drained Area (ha)	1.000	Q 100 year (l/s)	10.6

Pre-development Discharge Volume

Site Makeup	Greenfield	Return Period (years)	100
Greenfield Method	ReFH2	Storm Duration (mins)	360
Region	England, Wales, NI	Betterment (%)	0
Include Baseflow	x	Runoff Volume (m³)	121
Positively Drained Area (ha)	1.000		

Appendix: I – Causeway Flow Outputs – SuDS Strategy

Design Settings

Rainfall Methodology	FEH-22	Maximum Time of Concentration (mins)	30.00	Preferred Cover Depth (m)	0.900
Return Period (years)	100	Maximum Rainfall (mm/hr)	50.0	Include Intermediate Ground	✓
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00	Enforce best practice design rules	x
CV	1.000	Connection Type	Level Soffits		
Time of Entry (mins)	5.00	Minimum Backdrop Height (m)	0.600		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
1	0.004	5.00	75.350	600	520621.907	205376.363	1.050
2	0.004	5.00	75.350	600	520621.934	205367.786	1.116
3	0.004	5.00	75.350	600	520608.095	205375.214	1.050
4	0.004	5.00	75.350	600	520608.093	205367.800	1.257
5	0.000	5.00	75.150	600	520597.523	205366.899	1.161
6	0.004	5.00	74.460	600	520620.742	205355.283	1.050
7	0.004	5.00	74.460	600	520621.940	205346.351	1.189
8	0.004	5.00	74.460	600	520614.479	205354.630	1.050
9	0.004	5.00	74.460	600	520615.350	205346.460	1.286
10	0.000	5.00	74.750	600	520602.536	205343.674	1.657
11	0.003	5.00	75.140	600	520567.645	205320.618	1.050
12	0.003	5.00	75.140	600	520582.944	205320.146	1.138
13	0.003	5.00	75.140	600	520568.099	205337.406	1.050
14	0.003	5.00	75.140	600	520582.775	205336.983	1.267
15			74.000	600	520603.702	205332.730	1.096
16		5.00	74.900	600	520589.264	205298.887	1.050
17	0.007	5.00	74.780	600	520599.277	205299.413	1.050
18		5.00	75.100	600	520589.431	205312.149	1.050
19	0.007	5.00	74.600	600	520598.317	205312.811	1.050
20			74.000	600	520597.078	205323.301	1.185
21	0.004	5.00	74.590	600	520608.650	205330.256	1.050
22	0.004	5.00	74.590	600	520612.346	205329.332	1.178
23	0.004	5.00	74.590	600	520608.066	205326.741	1.050
24	0.004	5.00	74.590	600	520611.287	205325.902	1.279
25	0.004	5.00	74.390	600	520603.024	205306.626	1.050
26	0.004	5.00	74.390	600	520603.199	205309.873	1.101
27			74.000	600	520606.473	205323.301	1.364
28	0.004	5.00	74.390	600	520606.859	205306.324	1.050
29	0.004	5.00	74.390	600	520606.910	205309.777	1.139
30	0.004	5.00	74.150	600	520612.138	205306.454	1.050
31	0.004	5.00	74.150	600	520612.206	205309.682	1.137
32			74.000	600	520612.144	205319.842	1.574
33		5.00	74.250	600	520646.566	205378.386	1.050
34	0.008	5.00	74.250	600	520655.655	205379.675	1.141
35	0.008	5.00	74.250	600	520647.629	205364.986	1.050
36			74.250	600	520656.569	205365.854	1.279
37	0.007	5.00	74.250	600	520650.434	205364.175	1.050
38			74.250	600	520654.547	205356.568	1.136
39			74.000	600	520656.192	205351.565	1.172
40	0.007	5.00	74.000	600	520637.298	205365.741	1.050
41			74.000	600	520638.224	205357.398	1.136
42	0.156	5.00	74.000		520639.514	205330.483	1.125
43	0.007	5.00	74.000	600	520644.357	205340.276	1.735
44	0.004	5.00	74.150	600	520679.651	205312.911	1.050
45	0.004	5.00	74.150	600	520677.011	205318.315	1.133
46	0.007	5.00	73.600	600	520690.949	205321.899	1.392
48	0.008	5.00	72.570	600	520714.424	205347.877	0.750
49	0.008	5.00	72.570	600	520702.076	205335.202	0.829
50	0.008	5.00	72.570	600	520742.672	205333.295	1.017
51	0.008	5.00	72.570	600	520729.191	205317.977	1.109
52			72.420	600	520712.310	205302.897	1.139
53			72.000		520730.964	205283.403	1.000
53_OUT			71.000	1200	520760.498	205282.479	0.295
47			72.420	1200	520706.181	205317.402	1.001

Links (Results)

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	1.004	17.7	0.7	0.900	0.966	0.004	0.0	21	0.492
1.001	1.003	17.7	1.4	0.966	1.107	0.008	0.0	29	0.605
2.000	1.687	29.8	0.7	0.900	1.107	0.004	0.0	16	0.705
1.002	1.003	17.7	2.9	1.107	1.011	0.016	0.0	41	0.739
1.003	1.174	20.7	2.9	1.011	0.900	0.016	0.0	38	0.829
3.000	1.003	17.7	0.7	0.900	1.039	0.004	0.0	21	0.492
3.001	1.005	17.8	1.4	1.039	1.136	0.008	0.0	29	0.606
4.000	1.332	23.5	0.7	0.900	1.136	0.004	0.0	18	0.594
3.002	1.005	17.8	2.9	1.136	1.507	0.016	0.0	41	0.740
1.004	1.002	17.7	5.8	1.507	0.946	0.032	0.0	59	0.897
5.000	1.003	17.7	0.5	0.900	0.988	0.003	0.0	18	0.446
5.001	1.002	17.7	1.1	0.988	1.117	0.006	0.0	25	0.550

Links (Results)

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
6.000	1.563	27.6	0.5	0.900	1.117	0.003	0.0	14	0.604
5.002	2.797	49.4	2.2	1.117	0.946	0.012	0.0	21	1.406
1.005	1.000	17.7	8.0	0.946	1.035	0.044	0.0	71	0.975
7.000	1.100	19.4	0.0	0.900	0.900	0.000	0.0	0	0.000
7.001	1.165	20.6	1.3	0.900	0.900	0.007	0.0	25	0.650
8.000	2.397	42.4	0.0	0.900	0.900	0.000	0.0	0	0.000
7.002	2.312	40.9	2.5	0.900	1.035	0.014	0.0	25	1.295
1.006	1.003	17.7	10.5	1.035	1.214	0.058	0.0	83	1.043
9.000	1.001	17.7	0.7	0.900	1.028	0.004	0.0	21	0.490
9.001	1.005	17.8	1.4	1.028	1.129	0.008	0.0	29	0.606
10.000	1.462	25.8	0.7	0.900	1.129	0.004	0.0	17	0.638
9.002	2.262	40.0	2.9	1.129	0.664	0.016	0.0	27	1.320
11.000	1.007	17.8	0.7	0.900	0.951	0.004	0.0	21	0.494
11.001	2.262	40.0	1.4	0.951	1.023	0.008	0.0	20	1.076
1.007	1.002	17.7	14.8	1.214	1.349	0.082	0.0	105	1.119
12.000	1.005	17.8	0.7	0.900	0.989	0.004	0.0	21	0.492
12.001	2.337	41.3	1.4	0.989	1.349	0.008	0.0	19	1.090
13.000	1.005	17.8	0.7	0.900	0.987	0.004	0.0	21	0.492
13.001	2.006	35.5	1.4	0.987	1.349	0.008	0.0	21	0.989
1.008	1.005	40.0	17.7	1.349	1.435	0.098	0.0	105	0.977
14.000	1.000	17.7	0.0	0.900	0.991	0.000	0.0	0	0.000
14.001	1.003	17.7	1.4	0.991	1.129	0.008	0.0	29	0.605
15.000	1.541	27.2	1.4	0.900	1.129	0.008	0.0	24	0.824
14.002	1.000	17.7	2.9	1.129	1.022	0.016	0.0	41	0.736
16.000	1.003	17.7	1.3	0.900	0.986	0.007	0.0	27	0.582
16.001	2.348	41.5	1.3	0.986	1.022	0.007	0.0	18	1.052
14.003	1.950	34.5	4.2	1.022	1.435	0.023	0.0	35	1.317
17.000	1.004	17.8	1.3	0.900	0.986	0.007	0.0	27	0.583
17.001	2.006	35.5	1.3	0.986	1.435	0.007	0.0	20	0.954
18.000	1.307	52.0	28.2	0.900	0.915	0.156	0.0	118	1.333
1.009	1.008	71.3	52.6	1.435	1.092	0.291	0.0	192	1.099
19.000	1.005	17.8	0.7	0.900	0.983	0.004	0.0	21	0.492
19.001	2.262	40.0	1.4	0.983	0.601	0.008	0.0	20	1.076
1.010	2.511	177.5	55.3	1.087	0.701	0.306	0.0	115	2.226
20.000	1.005	17.8	1.4	0.600	0.665	0.008	0.0	29	0.606
20.001	1.005	17.8	2.9	0.679	0.959	0.016	0.0	41	0.740
21.000	1.005	17.8	1.4	0.867	0.959	0.008	0.0	29	0.606
20.002	1.005	17.8	5.8	0.959	0.839	0.032	0.0	59	0.899
1.012	1.010	71.4	61.1	0.839	0.532	0.338	0.0	214	1.130
1.013	1.004	17.7	61.1	0.850	0.145	0.338	0.0	150	1.022
1.011	1.010	71.4	55.3	0.701	0.839	0.306	0.0	199	1.112

Simulation Settings

Rainfall Methodology	FEH-22	Winter CV	1.000	Drain Down Time (mins)	4320	Check Discharge Rate(s)	x
Rainfall Events	Singular	Analysis Speed	Normal	Additional Storage (m³/ha)	0.0	Check Discharge Volume	x
Summer CV	1.000	Skip Steady State	x	Starting Level (m)			

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)	Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0	100	0	0	0
30	0	0	0	100	40	0	0
30	40	0	0				

Node 42 Online Orifice Control

Flap Valve	x	Replaces Downstream Link	✓	Diameter (m)	0.050
Downstream Link	18.000	Invert Level (m)	72.875	Discharge Coefficient	0.600

Node 53 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Downstream Link	1.013	Sump Available	✓
Replaces Downstream Link	✓	Product Number	CTL-SHE-0045-8000-0700-8000
Invert Level (m)	71.000	Min Outlet Diameter (m)	0.075
Design Depth (m)	0.700	Min Node Diameter (mm)	1200
Design Flow (l/s)	0.8		

Node 42 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	0.30	Width (m)	28.000	Depth (m)	0.500
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	73.370	Length (m)	28.000	Inf Depth (m)	
Safety Factor	2.0	Time to half empty (mins)	208	Slope (1:X)	100.0		

Node 53 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	71.000
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	2880

Depth (m)	Area (m^2)	Inf Area (m^2)	Depth (m)	Area (m^2)	Inf Area (m^2)
0.000	453.0	0.0	1.000	809.0	0.0

Results for 2 year Critical Storm Duration. Lowest mass balance: 99.90%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	1	11	74.320	0.020	0.7	0.0058	0.0000	OK
15 minute summer	2	11	74.262	0.028	1.4	0.0081	0.0000	OK
15 minute summer	3	11	74.316	0.016	0.7	0.0045	0.0000	OK
15 minute summer	4	11	74.135	0.042	2.8	0.0119	0.0000	OK
15 minute summer	5	11	74.026	0.037	2.8	0.0106	0.0000	OK
15 minute summer	6	11	73.430	0.020	0.7	0.0058	0.0000	OK
15 minute summer	7	11	73.299	0.028	1.4	0.0080	0.0000	OK
15 minute summer	8	11	73.428	0.018	0.7	0.0050	0.0000	OK
15 minute summer	9	11	73.215	0.041	2.8	0.0116	0.0000	OK
15 minute summer	10	11	73.151	0.058	5.5	0.0163	0.0000	OK
15 minute summer	11	11	74.107	0.017	0.5	0.0049	0.0000	OK
15 minute summer	12	11	74.027	0.025	1.0	0.0071	0.0000	OK
15 minute summer	13	11	74.104	0.014	0.5	0.0040	0.0000	OK
15 minute summer	14	11	73.894	0.021	2.0	0.0058	0.0000	OK
15 minute summer	15	12	72.977	0.073	7.5	0.0207	0.0000	OK
15 minute summer	16	1	73.850	0.000	0.0	0.0000	0.0000	OK
15 minute summer	17	11	73.755	0.025	1.2	0.0071	0.0000	OK
15 minute summer	18	1	74.050	0.000	0.0	0.0000	0.0000	OK
15 minute summer	19	11	73.575	0.025	2.4	0.0070	0.0000	OK
15 minute summer	20	12	72.896	0.081	9.6	0.0229	0.0000	OK
15 minute summer	21	11	73.560	0.020	0.7	0.0058	0.0000	OK
15 minute summer	22	11	73.441	0.029	1.4	0.0082	0.0000	OK
15 minute summer	23	11	73.557	0.017	0.7	0.0048	0.0000	OK
15 minute summer	24	11	73.340	0.029	2.8	0.0083	0.0000	OK
15 minute summer	25	11	73.361	0.021	0.7	0.0059	0.0000	OK
15 minute summer	26	11	73.309	0.020	1.4	0.0056	0.0000	OK
15 minute summer	27	12	72.741	0.105	13.4	0.0298	0.0000	OK
15 minute summer	28	11	73.361	0.021	0.7	0.0059	0.0000	OK
15 minute summer	29	10	73.270	0.019	1.4	0.0054	0.0000	OK
15 minute summer	30	11	73.121	0.021	0.7	0.0059	0.0000	OK
15 minute summer	31	10	73.034	0.021	1.4	0.0058	0.0000	OK
15 minute summer	32	12	72.531	0.105	15.9	0.0296	0.0000	OK
15 minute summer	33	1	73.200	0.000	0.0	0.0000	0.0000	OK
15 minute summer	34	10	73.137	0.028	1.4	0.0079	0.0000	OK
15 minute summer	35	10	73.223	0.023	1.4	0.0065	0.0000	OK
15 minute summer	36	11	73.012	0.041	2.7	0.0117	0.0000	OK
15 minute summer	37	10	73.228	0.028	1.2	0.0080	0.0000	OK
15 minute summer	38	11	73.132	0.018	1.2	0.0050	0.0000	OK
15 minute summer	39	11	72.863	0.035	3.9	0.0100	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	1	1.000	2	0.7	0.378	0.039	0.0124	
15 minute summer	2	1.001	4	1.4	0.445	0.079	0.0449	
15 minute summer	3	2.000	4	0.7	0.312	0.023	0.0186	
15 minute summer	4	1.002	5	2.8	0.761	0.158	0.0389	
15 minute summer	5	1.003	10	2.7	0.808	0.132	0.0720	
15 minute summer	6	3.000	7	0.7	0.378	0.039	0.0261	
15 minute summer	7	3.001	9	1.4	0.455	0.079	0.0300	
15 minute summer	8	4.000	9	0.7	0.300	0.030	0.0341	
15 minute summer	9	3.002	10	2.8	0.565	0.158	0.0409	
15 minute summer	10	1.004	15	5.5	0.750	0.309	0.1388	
15 minute summer	11	5.000	12	0.5	0.330	0.028	0.0135	
15 minute summer	12	5.001	14	1.0	0.590	0.056	0.0220	
15 minute summer	13	6.000	14	0.5	0.450	0.018	0.0103	
15 minute summer	14	5.002	15	2.0	0.844	0.040	0.0626	
15 minute summer	15	1.005	20	7.4	0.815	0.420	0.0817	
15 minute summer	16	7.000	17	0.0	0.000	0.000	0.0096	
15 minute summer	17	7.001	19	1.2	0.629	0.058	0.0256	
15 minute summer	18	8.000	19	0.0	0.000	0.000	0.0084	
15 minute summer	19	7.002	20	2.4	0.729	0.059	0.0805	
15 minute summer	20	1.006	27	9.7	0.845	0.547	0.2055	
15 minute summer	21	9.000	22	0.7	0.371	0.040	0.0246	
15 minute summer	22	9.001	24	1.4	0.579	0.079	0.0244	
15 minute summer	23	10.000	24	0.7	0.415	0.027	0.0193	
15 minute summer	24	9.002	27	2.8	1.220	0.070	0.0057	
15 minute summer	25	11.000	26	0.7	0.492	0.039	0.0072	
15 minute summer	26	11.001	27	1.4	1.049	0.035	0.0123	
15 minute summer	27	1.007	32	13.5	1.067	0.765	0.1721	
15 minute summer	28	12.000	29	0.7	0.505	0.039	0.0124	
15 minute summer	29	12.001	32	1.4	1.073	0.034	0.0251	
15 minute summer	30	13.000	31	0.7	0.483	0.039	0.0127	
15 minute summer	31	13.001	32	1.4	0.964	0.040	0.0241	
15 minute summer	32	1.008	43	16.1	0.926	0.402	0.2507	
15 minute summer	33	14.000	34	0.0	0.000	0.000	0.0104	
15 minute summer	34	14.001	36	1.4	0.447	0.077	0.0427	
15 minute summer	35	15.000	36	1.4	0.538	0.051	0.0274	
15 minute summer	36	14.002	39	2.7	0.767	0.153	0.0510	
15 minute summer	37	16.000	38	1.2	0.704	0.068	0.0150	
15 minute summer	38	16.001	39	1.2	0.607	0.029	0.0114	
15 minute summer	39	14.003	43	3.9	1.271	0.113	0.0341	

Results for 2 year Critical Storm Duration. Lowest mass balance: 99.90%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	40	10	72.978	0.028	1.2	0.0080	0.0000	OK
15 minute summer	41	11	72.883	0.019	1.2	0.0054	0.0000	OK
120 minute summer	42	80	73.516	0.641	13.3	9.0244	0.0000	SURCHARGED
15 minute summer	43	12	72.391	0.126	25.9	0.0356	0.0000	OK
15 minute summer	44	11	73.121	0.021	0.7	0.0059	0.0000	OK
15 minute summer	45	11	73.037	0.020	1.4	0.0057	0.0000	OK
15 minute summer	46	12	72.293	0.085	28.2	0.0242	0.0000	OK
15 minute summer	48	10	71.849	0.029	1.4	0.0083	0.0000	OK
15 minute summer	49	10	71.780	0.039	2.8	0.0111	0.0000	OK
15 minute summer	50	10	71.581	0.028	1.4	0.0080	0.0000	OK
15 minute summer	51	11	71.524	0.063	5.5	0.0180	0.0000	OK
15 minute summer	52	13	71.424	0.143	32.9	0.0405	0.0000	OK
480 minute winter	53	384	71.145	0.145	8.4	69.5077	0.0000	OK
15 minute summer	53_OUT	1	70.855	0.150	0.5	0.0000	0.0000	OK
15 minute summer	47	12	71.554	0.135	28.3	0.1527	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	40	17.000	41	1.2	0.677	0.068	0.0155	
15 minute summer	41	17.001	43	1.2	0.923	0.034	0.0148	
120 minute summer	42	Orifice	43	4.1				
15 minute summer	43	1.009	46	26.0	1.177	0.365	0.3054	
15 minute summer	44	19.000	45	0.7	0.486	0.039	0.0120	
15 minute summer	45	19.001	46	1.4	1.027	0.035	0.0046	
15 minute summer	46	1.010	47	28.3	1.253	0.159	0.7181	
15 minute summer	48	20.000	49	1.4	0.584	0.077	0.0151	
15 minute summer	49	20.001	51	2.7	0.511	0.151	0.1507	
15 minute summer	50	21.000	51	1.4	0.314	0.077	0.0429	
15 minute summer	51	20.002	52	5.4	0.819	0.303	0.0197	
15 minute summer	52	1.012	53	32.5	1.001	0.455	0.8801	
480 minute winter	53	Hydro-Brake®	53_OUT	0.7				78.8
15 minute summer	47	1.011	52	28.0	0.876	0.392	1.0584	

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.90%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	1	10	74.333	0.033	1.9	0.0095	0.0000	OK
15 minute summer	2	10	74.281	0.047	3.8	0.0132	0.0000	OK
15 minute summer	3	10	74.326	0.026	1.9	0.0073	0.0000	OK
15 minute summer	4	10	74.165	0.072	7.5	0.0203	0.0000	OK
15 minute summer	5	11	74.053	0.064	7.4	0.0181	0.0000	OK
15 minute summer	6	10	73.443	0.033	1.9	0.0093	0.0000	OK
15 minute summer	7	13	73.414	0.143	3.8	0.0405	0.0000	OK
15 minute summer	8	10	73.439	0.029	1.9	0.0081	0.0000	OK
15 minute summer	9	13	73.414	0.240	7.5	0.0678	0.0000	SURCHARGED
15 minute summer	10	13	73.408	0.315	14.8	0.0892	0.0000	SURCHARGED
15 minute summer	11	11	74.118	0.028	1.4	0.0081	0.0000	OK
15 minute summer	12	11	74.044	0.042	2.8	0.0120	0.0000	OK
15 minute summer	13	11	74.113	0.023	1.4	0.0065	0.0000	OK
15 minute summer	14	11	73.907	0.034	5.6	0.0097	0.0000	OK
15 minute summer	15	13	73.332	0.428	16.2	0.1211	0.0000	SURCHARGED
15 minute summer	16	1	73.850	0.000	0.0	0.0000	0.0000	OK
15 minute summer	17	10	73.772	0.042	3.4	0.0119	0.0000	OK
15 minute summer	18	1	74.050	0.000	0.0	0.0000	0.0000	OK
15 minute summer	19	10	73.591	0.041	6.7	0.0116	0.0000	OK
15 minute summer	20	12	73.260	0.445	19.8	0.1259	0.0000	SURCHARGED
15 minute summer	21	10	73.573	0.033	1.9	0.0093	0.0000	OK
15 minute summer	22	10	73.460	0.048	3.8	0.0137	0.0000	OK
15 minute summer	23	10	73.567	0.027	1.9	0.0078	0.0000	OK
15 minute summer	24	10	73.362	0.051	7.5	0.0145	0.0000	OK
15 minute summer	25	10	73.375	0.035	1.9	0.0098	0.0000	OK
15 minute summer	26	10	73.320	0.031	3.8	0.0088	0.0000	OK
15 minute summer	27	12	73.040	0.404	27.6	0.1143	0.0000	SURCHARGED
15 minute summer	28	10	73.374	0.034	1.9	0.0097	0.0000	OK
15 minute summer	29	10	73.282	0.031	3.8	0.0087	0.0000	OK
15 minute summer	30	10	73.134	0.034	1.9	0.0096	0.0000	OK
15 minute summer	31	10	73.046	0.033	3.8	0.0093	0.0000	OK
15 minute summer	32	12	72.600	0.174	34.1	0.0493	0.0000	OK
15 minute summer	33	1	73.200	0.000	0.0	0.0000	0.0000	OK
15 minute summer	34	10	73.156	0.047	3.8	0.0133	0.0000	OK
15 minute summer	35	10	73.238	0.038	3.8	0.0107	0.0000	OK
15 minute summer	36	11	73.043	0.072	7.6	0.0203	0.0000	OK
15 minute summer	37	10	73.248	0.048	3.4	0.0136	0.0000	OK
15 minute summer	38	10	73.143	0.029	3.4	0.0082	0.0000	OK
15 minute summer	39	11	72.889	0.061	10.8	0.0173	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	1	1.000	2	1.9	0.500	0.106	0.0250	
15 minute summer	2	1.001	4	3.7	0.577	0.210	0.0916	
15 minute summer	3	2.000	4	1.9	0.384	0.063	0.0382	
15 minute summer	4	1.002	5	7.4	0.966	0.417	0.0805	
15 minute summer	5	1.003	10	7.4	1.061	0.359	0.1490	
15 minute summer	6	3.000	7	1.9	0.504	0.106	0.1344	
15 minute summer	7	3.001	9	3.9	0.583	0.221	0.1694	
15 minute summer	8	4.000	9	1.9	0.369	0.080	0.1340	
15 minute summer	9	3.002	10	7.7	0.686	0.436	0.1426	
15 minute summer	10	1.004	15	11.5	0.866	0.650	0.3345	
15 minute summer	11	5.000	12	1.4	0.443	0.079	0.0282	
15 minute summer	12	5.001	14	2.8	0.794	0.158	0.0459	
15 minute summer	13	6.000	14	1.4	0.608	0.051	0.0213	
15 minute summer	14	5.002	15	5.6	0.977	0.113	0.1309	
15 minute summer	15	1.005	20	14.6	0.853	0.827	0.1581	
15 minute summer	16	7.000	17	0.0	0.000	0.000	0.0203	
15 minute summer	17	7.001	19	3.3	0.841	0.162	0.0534	
15 minute summer	18	8.000	19	0.0	0.000	0.000	0.0174	
15 minute summer	19	7.002	20	6.7	0.927	0.163	0.1514	
15 minute summer	20	1.006	27	18.8	1.068	1.061	0.3162	
15 minute summer	21	9.000	22	1.9	0.487	0.106	0.0500	
15 minute summer	22	9.001	24	3.7	0.729	0.209	0.0514	
15 minute summer	23	10.000	24	1.9	0.513	0.073	0.0408	
15 minute summer	24	9.002	27	7.4	1.550	0.185	0.0119	
15 minute summer	25	11.000	26	1.9	0.658	0.106	0.0145	
15 minute summer	26	11.001	27	3.8	1.248	0.094	0.0932	
15 minute summer	27	1.007	32	27.5	1.564	1.556	0.2363	
15 minute summer	28	12.000	29	1.9	0.671	0.106	0.0249	
15 minute summer	29	12.001	32	3.7	1.098	0.091	0.1029	
15 minute summer	30	13.000	31	1.9	0.641	0.106	0.0255	
15 minute summer	31	13.001	32	3.7	0.983	0.105	0.0969	
15 minute summer	32	1.008	43	34.1	1.097	0.854	0.4489	
15 minute summer	33	14.000	34	0.0	0.000	0.000	0.0216	
15 minute summer	34	14.001	36	3.8	0.582	0.213	0.0901	
15 minute summer	35	15.000	36	3.8	0.664	0.139	0.0578	
15 minute summer	36	14.002	39	7.5	0.997	0.424	0.1085	
15 minute summer	37	16.000	38	3.4	0.947	0.190	0.0311	
15 minute summer	38	16.001	39	3.3	0.759	0.080	0.0241	
15 minute summer	39	14.003	43	10.8	1.668	0.314	0.0720	

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.90%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	40	10	72.997	0.047	3.4	0.0134	0.0000	OK
15 minute summer	41	10	72.896	0.032	3.4	0.0090	0.0000	OK
60 minute winter	42	59	73.663	0.788	34.8	36.0960	0.0000	SURCHARGED
15 minute summer	43	11	72.456	0.191	54.9	0.0539	0.0000	OK
15 minute summer	44	10	73.134	0.034	1.9	0.0096	0.0000	OK
15 minute summer	45	10	73.051	0.034	3.8	0.0096	0.0000	OK
15 minute summer	46	11	72.333	0.125	61.5	0.0355	0.0000	OK
15 minute summer	48	10	71.870	0.050	3.8	0.0142	0.0000	OK
15 minute summer	49	10	71.809	0.068	7.6	0.0192	0.0000	OK
15 minute summer	50	10	71.600	0.047	3.8	0.0133	0.0000	OK
15 minute summer	51	11	71.585	0.124	15.1	0.0351	0.0000	OK
15 minute summer	52	12	71.533	0.252	74.2	0.0712	0.0000	OK
600 minute winter	53	585	71.327	0.327	12.1	166.9434	0.0000	SURCHARGED
15 minute summer	53_OUT	1	70.855	0.150	0.7	0.0000	0.0000	OK
15 minute summer	47	12	71.652	0.233	61.2	0.2636	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	40	17.000	41	3.4	0.906	0.189	0.0322	
15 minute summer	41	17.001	43	3.4	1.193	0.095	0.0367	
60 minute winter	42	Orifice	43	4.6				
15 minute summer	43	1.009	46	54.7	1.459	0.767	0.5158	
15 minute summer	44	19.000	45	1.9	0.630	0.106	0.0247	
15 minute summer	45	19.001	46	3.7	1.340	0.094	0.0094	
15 minute summer	46	1.010	47	61.2	1.476	0.345	1.3290	
15 minute summer	48	20.000	49	3.8	0.703	0.213	0.0350	
15 minute summer	49	20.001	51	7.5	0.643	0.423	0.3257	
15 minute summer	50	21.000	51	3.8	0.389	0.213	0.0929	
15 minute summer	51	20.002	52	15.0	1.038	0.843	0.0431	
15 minute summer	52	1.012	53	74.6	1.274	1.045	1.5812	
600 minute winter	53	Hydro-Brake®	53_OUT	0.8				178.6
15 minute summer	47	1.011	52	60.9	0.999	0.853	2.0194	

Results for 30 year +40% CC Critical Storm Duration. Lowest mass balance: 99.90%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	1	10	74.341	0.041	2.7	0.0115	0.0000	OK
15 minute summer	2	10	74.290	0.056	5.4	0.0159	0.0000	OK
15 minute summer	3	10	74.330	0.030	2.7	0.0086	0.0000	OK
15 minute summer	4	10	74.183	0.090	10.7	0.0253	0.0000	OK
15 minute summer	5	11	74.068	0.079	10.6	0.0224	0.0000	OK
15 minute summer	6	13	73.756	0.346	3.6	0.0978	0.0000	SURCHARGED
15 minute summer	7	13	73.755	0.484	10.0	0.1369	0.0000	SURCHARGED
15 minute summer	8	13	73.753	0.343	3.4	0.0970	0.0000	SURCHARGED
15 minute summer	9	13	73.752	0.578	9.9	0.1634	0.0000	SURCHARGED
15 minute summer	10	13	73.747	0.654	17.8	0.1851	0.0000	SURCHARGED
15 minute summer	11	10	74.124	0.034	2.0	0.0096	0.0000	OK
15 minute summer	12	10	74.053	0.051	4.0	0.0143	0.0000	OK
15 minute summer	13	10	74.117	0.027	2.0	0.0077	0.0000	OK
15 minute summer	14	10	73.913	0.040	7.9	0.0114	0.0000	OK
15 minute summer	15	13	73.658	0.754	16.7	0.2133	0.0000	SURCHARGED
15 minute summer	16	1	73.850	0.000	0.0	0.0000	0.0000	OK
15 minute summer	17	10	73.780	0.050	4.7	0.0142	0.0000	OK
15 minute summer	18	1	74.050	0.000	0.0	0.0000	0.0000	OK
15 minute summer	19	10	73.599	0.049	9.3	0.0138	0.0000	OK
15 minute summer	20	13	73.558	0.743	21.7	0.2103	0.0000	SURCHARGED
15 minute summer	21	10	73.579	0.039	2.7	0.0111	0.0000	OK
15 minute summer	22	10	73.471	0.059	5.4	0.0167	0.0000	OK
15 minute summer	23	10	73.573	0.033	2.7	0.0092	0.0000	OK
15 minute summer	24	10	73.375	0.064	10.7	0.0180	0.0000	OK
15 minute summer	25	10	73.382	0.042	2.7	0.0118	0.0000	OK
15 minute summer	26	10	73.326	0.037	5.4	0.0105	0.0000	OK
15 minute summer	27	12	73.250	0.614	34.5	0.1738	0.0000	SURCHARGED
15 minute summer	28	10	73.381	0.041	2.7	0.0117	0.0000	OK
15 minute summer	29	10	73.288	0.037	5.4	0.0103	0.0000	OK
15 minute summer	30	10	73.141	0.041	2.7	0.0116	0.0000	OK
15 minute summer	31	10	73.052	0.039	5.4	0.0112	0.0000	OK
15 minute summer	32	12	72.651	0.225	43.4	0.0636	0.0000	OK
15 minute summer	33	1	73.200	0.000	0.0	0.0000	0.0000	OK
15 minute summer	34	10	73.165	0.056	5.4	0.0159	0.0000	OK
15 minute summer	35	10	73.245	0.045	5.4	0.0128	0.0000	OK
15 minute summer	36	10	73.059	0.088	10.7	0.0250	0.0000	OK
15 minute summer	37	10	73.257	0.057	4.7	0.0161	0.0000	OK
15 minute summer	38	10	73.148	0.034	4.7	0.0096	0.0000	OK
15 minute summer	39	11	72.902	0.074	15.1	0.0210	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	1	1.000	2	2.7	0.546	0.151	0.0326	
15 minute summer	2	1.001	4	5.3	0.628	0.301	0.1202	
15 minute summer	3	2.000	4	2.7	0.417	0.090	0.0501	
15 minute summer	4	1.002	5	10.6	1.048	0.597	0.1062	
15 minute summer	5	1.003	10	10.6	1.159	0.513	0.1951	
15 minute summer	6	3.000	7	2.7	0.549	0.151	0.2456	
15 minute summer	7	3.001	9	5.6	0.616	0.317	0.1708	
15 minute summer	8	4.000	9	2.9	0.396	0.124	0.2377	
15 minute summer	9	3.002	10	9.9	0.701	0.558	0.1426	
15 minute summer	10	1.004	15	13.3	0.846	0.749	0.3345	
15 minute summer	11	5.000	12	2.0	0.488	0.112	0.0361	
15 minute summer	12	5.001	14	3.9	0.870	0.221	0.0586	
15 minute summer	13	6.000	14	2.0	0.667	0.072	0.0271	
15 minute summer	14	5.002	15	7.8	0.942	0.158	0.1361	
15 minute summer	15	1.005	20	17.6	1.002	0.998	0.1581	
15 minute summer	16	7.000	17	0.0	0.000	0.000	0.0259	
15 minute summer	17	7.001	19	4.7	0.919	0.226	0.0679	
15 minute summer	18	8.000	19	0.0	0.000	0.000	0.0221	
15 minute summer	19	7.002	20	9.3	0.945	0.227	0.1587	
15 minute summer	20	1.006	27	22.8	1.296	1.287	0.3162	
15 minute summer	21	9.000	22	2.7	0.533	0.151	0.0653	
15 minute summer	22	9.001	24	5.3	0.785	0.299	0.0684	
15 minute summer	23	10.000	24	2.7	0.556	0.104	0.0541	
15 minute summer	24	9.002	27	10.6	1.680	0.265	0.0166	
15 minute summer	25	11.000	26	2.7	0.725	0.151	0.0188	
15 minute summer	26	11.001	27	5.4	1.383	0.134	0.0969	
15 minute summer	27	1.007	32	33.7	1.915	1.904	0.2389	
15 minute summer	28	12.000	29	2.7	0.741	0.151	0.0322	
15 minute summer	29	12.001	32	5.3	1.074	0.130	0.1449	
15 minute summer	30	13.000	31	2.7	0.707	0.151	0.0330	
15 minute summer	31	13.001	32	5.3	1.006	0.151	0.1364	
15 minute summer	32	1.008	43	43.0	1.158	1.075	0.5247	
15 minute summer	33	14.000	34	0.0	0.000	0.000	0.0277	
15 minute summer	34	14.001	36	5.3	0.634	0.300	0.1164	
15 minute summer	35	15.000	36	5.4	0.714	0.197	0.0748	
15 minute summer	36	14.002	39	10.5	1.081	0.593	0.1402	
15 minute summer	37	16.000	38	4.7	1.038	0.263	0.0393	
15 minute summer	38	16.001	39	4.6	0.825	0.112	0.0309	
15 minute summer	39	14.003	43	15.2	1.798	0.441	0.0958	

Results for 30 year +40% CC Critical Storm Duration. Lowest mass balance: 99.90%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	40	10	73.007	0.057	4.7	0.0160	0.0000	OK
15 minute summer	41	10	72.901	0.037	4.7	0.0104	0.0000	OK
120 minute winter	42	114	73.758	0.883	30.6	58.3861	0.0000	FLOOD RISK
15 minute summer	43	11	72.489	0.224	71.0	0.0633	0.0000	OK
15 minute summer	44	10	73.141	0.041	2.7	0.0116	0.0000	OK
15 minute summer	45	10	73.058	0.041	5.4	0.0116	0.0000	OK
15 minute summer	46	11	72.353	0.145	80.6	0.0411	0.0000	OK
15 minute summer	48	10	71.882	0.062	5.4	0.0175	0.0000	OK
15 minute summer	49	10	71.824	0.083	10.7	0.0235	0.0000	OK
15 minute summer	50	12	71.702	0.149	5.4	0.0422	0.0000	OK
15 minute summer	51	12	71.695	0.234	20.7	0.0662	0.0000	SURCHARGED
15 minute summer	52	12	71.637	0.356	96.8	0.1007	0.0000	SURCHARGED
720 minute winter	53	705	71.458	0.458	12.9	245.1083	0.0000	SURCHARGED
15 minute summer	53_OUT	1	70.855	0.150	0.8	0.0000	0.0000	OK
15 minute summer	47	12	71.843	0.424	80.4	0.4793	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	40	17.000	41	4.7	1.002	0.263	0.0404	
15 minute summer	41	17.001	43	4.6	1.204	0.131	0.0678	
120 minute winter	42	Orifice	43	4.8				
15 minute summer	43	1.009	46	70.8	1.561	0.994	0.6190	
15 minute summer	44	19.000	45	2.7	0.687	0.151	0.0324	
15 minute summer	45	19.001	46	5.4	1.467	0.134	0.0123	
15 minute summer	46	1.010	47	80.4	1.539	0.453	1.6076	
15 minute summer	48	20.000	49	5.3	0.726	0.301	0.0476	
15 minute summer	49	20.001	51	10.6	0.679	0.595	0.3866	
15 minute summer	50	21.000	51	4.7	0.416	0.265	0.1619	
15 minute summer	51	20.002	52	20.1	1.147	1.133	0.0528	
15 minute summer	52	1.012	53	96.9	1.400	1.358	1.7790	
720 minute winter	53	Hydro-Brake®	53_OUT	0.8				207.4
15 minute summer	47	1.011	52	79.0	1.122	1.107	2.3344	

Results for 100 year Critical Storm Duration. Lowest mass balance: 99.90%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	1	10	74.338	0.038	2.4	0.0108	0.0000	OK
15 minute summer	2	10	74.287	0.053	4.8	0.0149	0.0000	OK
15 minute summer	3	10	74.329	0.029	2.4	0.0081	0.0000	OK
15 minute summer	4	10	74.176	0.083	9.5	0.0235	0.0000	OK
15 minute summer	5	11	74.063	0.074	9.4	0.0208	0.0000	OK
15 minute summer	6	13	73.620	0.210	3.0	0.0595	0.0000	SURCHARGED
15 minute summer	7	13	73.619	0.348	4.8	0.0985	0.0000	SURCHARGED
15 minute summer	8	13	73.616	0.206	3.7	0.0582	0.0000	SURCHARGED
15 minute summer	9	13	73.613	0.439	8.8	0.1242	0.0000	SURCHARGED
15 minute summer	10	13	73.606	0.513	15.7	0.1453	0.0000	SURCHARGED
15 minute summer	11	10	74.122	0.032	1.8	0.0091	0.0000	OK
15 minute summer	12	10	74.050	0.048	3.6	0.0135	0.0000	OK
15 minute summer	13	10	74.116	0.026	1.8	0.0073	0.0000	OK
15 minute summer	14	10	73.911	0.038	7.1	0.0108	0.0000	OK
15 minute summer	15	13	73.529	0.625	18.6	0.1769	0.0000	SURCHARGED
15 minute summer	16	1	73.850	0.000	0.0	0.0000	0.0000	OK
15 minute summer	17	10	73.778	0.048	4.3	0.0135	0.0000	OK
15 minute summer	18	1	74.050	0.000	0.0	0.0000	0.0000	OK
15 minute summer	19	10	73.596	0.046	8.5	0.0131	0.0000	OK
15 minute summer	20	13	73.438	0.623	20.4	0.1764	0.0000	SURCHARGED
15 minute summer	21	10	73.577	0.037	2.4	0.0105	0.0000	OK
15 minute summer	22	10	73.467	0.055	4.8	0.0156	0.0000	OK
15 minute summer	23	10	73.571	0.031	2.4	0.0087	0.0000	OK
15 minute summer	24	10	73.370	0.059	9.5	0.0167	0.0000	OK
15 minute summer	25	10	73.379	0.039	2.4	0.0111	0.0000	OK
15 minute summer	26	10	73.324	0.035	4.8	0.0099	0.0000	OK
15 minute summer	27	12	73.170	0.534	31.9	0.1513	0.0000	SURCHARGED
15 minute summer	28	10	73.379	0.039	2.4	0.0110	0.0000	OK
15 minute summer	29	10	73.285	0.034	4.8	0.0097	0.0000	OK
15 minute summer	30	10	73.139	0.039	2.4	0.0109	0.0000	OK
15 minute summer	31	10	73.050	0.037	4.8	0.0105	0.0000	OK
15 minute summer	32	12	72.629	0.203	40.1	0.0573	0.0000	OK
15 minute summer	33	1	73.200	0.000	0.0	0.0000	0.0000	OK
15 minute summer	34	10	73.162	0.053	4.9	0.0151	0.0000	OK
15 minute summer	35	10	73.243	0.043	4.9	0.0122	0.0000	OK
15 minute summer	36	10	73.054	0.083	9.7	0.0236	0.0000	OK
15 minute summer	37	10	73.254	0.054	4.3	0.0154	0.0000	OK
15 minute summer	38	10	73.146	0.032	4.3	0.0092	0.0000	OK
15 minute summer	39	11	72.899	0.071	13.8	0.0200	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	1	1.000	2	2.4	0.530	0.134	0.0298	
15 minute summer	2	1.001	4	4.7	0.611	0.267	0.1097	
15 minute summer	3	2.000	4	2.4	0.406	0.080	0.0457	
15 minute summer	4	1.002	5	9.4	1.020	0.530	0.0967	
15 minute summer	5	1.003	10	9.4	1.126	0.455	0.1781	
15 minute summer	6	3.000	7	2.6	0.531	0.148	0.2456	
15 minute summer	7	3.001	9	5.3	0.594	0.297	0.1708	
15 minute summer	8	4.000	9	2.6	0.382	0.111	0.2377	
15 minute summer	9	3.002	10	9.3	0.711	0.522	0.1426	
15 minute summer	10	1.004	15	12.9	0.829	0.726	0.3345	
15 minute summer	11	5.000	12	1.8	0.474	0.100	0.0334	
15 minute summer	12	5.001	14	3.5	0.845	0.198	0.0541	
15 minute summer	13	6.000	14	1.8	0.647	0.065	0.0251	
15 minute summer	14	5.002	15	7.0	0.943	0.142	0.1343	
15 minute summer	15	1.005	20	16.5	0.935	0.931	0.1581	
15 minute summer	16	7.000	17	0.0	0.000	0.000	0.0242	
15 minute summer	17	7.001	19	4.2	0.897	0.206	0.0636	
15 minute summer	18	8.000	19	0.0	0.000	0.000	0.0207	
15 minute summer	19	7.002	20	8.5	0.975	0.208	0.1565	
15 minute summer	20	1.006	27	21.3	1.211	1.203	0.3162	
15 minute summer	21	9.000	22	2.4	0.517	0.134	0.0597	
15 minute summer	22	9.001	24	4.7	0.766	0.265	0.0622	
15 minute summer	23	10.000	24	2.4	0.541	0.092	0.0492	
15 minute summer	24	9.002	27	9.4	1.636	0.235	0.0144	
15 minute summer	25	11.000	26	2.4	0.702	0.134	0.0172	
15 minute summer	26	11.001	27	4.8	1.345	0.119	0.0956	
15 minute summer	27	1.007	32	31.7	1.803	1.793	0.2366	
15 minute summer	28	12.000	29	2.4	0.717	0.134	0.0295	
15 minute summer	29	12.001	32	4.7	1.146	0.115	0.1311	
15 minute summer	30	13.000	31	2.4	0.684	0.134	0.0303	
15 minute summer	31	13.001	32	4.7	1.052	0.134	0.1233	
15 minute summer	32	1.008	43	40.1	1.147	1.004	0.5021	
15 minute summer	33	14.000	34	0.0	0.000	0.000	0.0258	
15 minute summer	34	14.001	36	4.8	0.620	0.273	0.1086	
15 minute summer	35	15.000	36	4.9	0.703	0.179	0.0697	
15 minute summer	36	14.002	39	9.6	1.056	0.543	0.1311	
15 minute summer	37	16.000	38	4.3	1.012	0.241	0.0368	
15 minute summer	38	16.001	39	4.2	0.806	0.102	0.0290	
15 minute summer	39	14.003	43	13.9	1.772	0.402	0.0867	

Results for 100 year Critical Storm Duration. Lowest mass balance: 99.90%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	40	10	73.004	0.054	4.3	0.0152	0.0000	OK
15 minute summer	41	10	72.899	0.035	4.3	0.0099	0.0000	OK
120 minute winter	42	112	73.725	0.850	27.7	50.6401	0.0000	FLOOD RISK
15 minute summer	43	11	72.478	0.213	65.8	0.0603	0.0000	OK
15 minute summer	44	10	73.138	0.038	2.4	0.0109	0.0000	OK
15 minute summer	45	10	73.056	0.038	4.8	0.0109	0.0000	OK
15 minute summer	46	11	72.347	0.139	74.4	0.0393	0.0000	OK
15 minute summer	48	10	71.878	0.058	4.9	0.0165	0.0000	OK
15 minute summer	49	10	71.820	0.079	9.8	0.0222	0.0000	OK
15 minute summer	50	12	71.641	0.088	4.9	0.0250	0.0000	OK
15 minute summer	51	12	71.640	0.179	18.9	0.0506	0.0000	SURCHARGED
15 minute summer	52	12	71.594	0.313	88.3	0.0886	0.0000	SURCHARGED
720 minute winter	53	705	71.414	0.414	12.2	218.3077	0.0000	SURCHARGED
15 minute summer	53_OUT	1	70.855	0.150	0.8	0.0000	0.0000	OK
15 minute summer	47	12	71.765	0.346	74.1	0.3916	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	40	17.000	41	4.3	0.977	0.240	0.0379	
15 minute summer	41	17.001	43	4.2	1.205	0.119	0.0576	
120 minute winter	42	Orifice	43	4.7				
15 minute summer	43	1.009	46	65.6	1.532	0.921	0.5866	
15 minute summer	44	19.000	45	2.4	0.667	0.134	0.0296	
15 minute summer	45	19.001	46	4.7	1.424	0.119	0.0112	
15 minute summer	46	1.010	47	74.1	1.522	0.418	1.5703	
15 minute summer	48	20.000	49	4.9	0.720	0.274	0.0437	
15 minute summer	49	20.001	51	9.6	0.669	0.543	0.3771	
15 minute summer	50	21.000	51	4.6	0.407	0.256	0.1307	
15 minute summer	51	20.002	52	18.2	1.042	1.024	0.0528	
15 minute summer	52	1.012	53	87.8	1.309	1.230	1.7434	
720 minute winter	53	Hydro-Brake®	53_OUT	0.8				209.2
15 minute summer	47	1.011	52	72.4	1.028	1.014	2.3344	

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.90%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	1	10	74.346	0.046	3.4	0.0131	0.0000	OK
15 minute summer	2	10	74.298	0.064	6.8	0.0181	0.0000	OK
15 minute summer	3	10	74.334	0.034	3.4	0.0097	0.0000	OK
15 minute summer	4	10	74.198	0.105	13.5	0.0298	0.0000	OK
15 minute summer	5	11	74.081	0.092	13.4	0.0260	0.0000	OK
15 minute summer	6	14	74.047	0.637	4.9	0.1803	0.0000	SURCHARGED
15 minute summer	7	14	74.047	0.776	7.3	0.2197	0.0000	SURCHARGED
15 minute summer	8	14	74.046	0.636	7.9	0.1799	0.0000	SURCHARGED
15 minute summer	9	14	74.044	0.870	10.5	0.2462	0.0000	SURCHARGED
15 minute summer	10	13	74.033	0.940	15.5	0.2659	0.0000	SURCHARGED
15 minute summer	11	10	74.128	0.038	2.6	0.0109	0.0000	OK
15 minute summer	12	10	74.060	0.058	5.2	0.0164	0.0000	OK
15 minute summer	13	10	74.121	0.031	2.6	0.0088	0.0000	OK
15 minute summer	14	10	73.919	0.046	10.2	0.0130	0.0000	OK
15 minute summer	15	13	73.912	1.008	20.7	0.2854	0.0000	FLOOD RISK
15 minute summer	16	1	73.850	0.000	0.0	0.0000	0.0000	OK
15 minute summer	17	13	73.805	0.075	6.0	0.0213	0.0000	OK
15 minute summer	18	1	74.050	0.000	0.0	0.0000	0.0000	OK
15 minute summer	19	13	73.800	0.250	12.0	0.0708	0.0000	SURCHARGED
15 minute summer	20	13	73.783	0.968	24.5	0.2741	0.0000	FLOOD RISK
15 minute summer	21	10	73.584	0.044	3.4	0.0125	0.0000	OK
15 minute summer	22	10	73.480	0.068	6.8	0.0192	0.0000	OK
15 minute summer	23	10	73.577	0.037	3.4	0.0104	0.0000	OK
15 minute summer	24	13	73.415	0.104	13.5	0.0294	0.0000	OK
15 minute summer	25	13	73.416	0.076	3.4	0.0214	0.0000	OK
15 minute summer	26	13	73.417	0.128	6.8	0.0362	0.0000	OK
15 minute summer	27	13	73.410	0.774	37.1	0.2190	0.0000	SURCHARGED
15 minute summer	28	10	73.387	0.047	3.4	0.0132	0.0000	OK
15 minute summer	29	10	73.292	0.041	6.8	0.0116	0.0000	OK
15 minute summer	30	10	73.146	0.046	3.4	0.0131	0.0000	OK
15 minute summer	31	10	73.057	0.044	6.8	0.0126	0.0000	OK
15 minute summer	32	11	72.691	0.265	48.7	0.0750	0.0000	SURCHARGED
15 minute summer	33	1	73.200	0.000	0.0	0.0000	0.0000	OK
15 minute summer	34	10	73.173	0.064	6.8	0.0181	0.0000	OK
15 minute summer	35	10	73.251	0.051	6.8	0.0144	0.0000	OK
15 minute summer	36	10	73.075	0.104	13.5	0.0293	0.0000	OK
15 minute summer	37	10	73.265	0.065	6.0	0.0184	0.0000	OK
15 minute summer	38	10	73.152	0.038	6.0	0.0109	0.0000	OK
15 minute summer	39	10	72.913	0.085	19.2	0.0239	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	1	1.000	2	3.4	0.577	0.191	0.0389	
15 minute summer	2	1.001	4	6.7	0.658	0.380	0.1440	
15 minute summer	3	2.000	4	3.4	0.435	0.114	0.0601	
15 minute summer	4	1.002	5	13.4	1.098	0.755	0.1278	
15 minute summer	5	1.003	10	13.5	1.208	0.649	0.2939	
15 minute summer	6	3.000	7	3.2	0.553	0.178	0.2456	
15 minute summer	7	3.001	9	6.4	0.609	0.362	0.1708	
15 minute summer	8	4.000	9	-4.5	0.405	-0.190	0.2377	
15 minute summer	9	3.002	10	11.3	0.744	0.638	0.1426	
15 minute summer	10	1.004	15	14.1	0.847	0.798	0.3345	
15 minute summer	11	5.000	12	2.6	0.524	0.144	0.0435	
15 minute summer	12	5.001	14	5.0	0.931	0.285	0.0705	
15 minute summer	13	6.000	14	2.6	0.720	0.093	0.0326	
15 minute summer	14	5.002	15	10.1	1.071	0.204	0.1409	
15 minute summer	15	1.005	20	19.0	1.082	1.077	0.1581	
15 minute summer	16	7.000	17	0.0	0.000	0.000	0.0443	
15 minute summer	17	7.001	19	6.0	0.957	0.290	0.1776	
15 minute summer	18	8.000	19	0.0	0.000	0.000	0.0784	
15 minute summer	19	7.002	20	10.9	0.963	0.266	0.2478	
15 minute summer	20	1.006	27	26.1	1.485	1.475	0.3162	
15 minute summer	21	9.000	22	3.4	0.562	0.191	0.0780	
15 minute summer	22	9.001	24	6.7	0.818	0.378	0.0977	
15 minute summer	23	10.000	24	3.4	0.581	0.131	0.0860	
15 minute summer	24	9.002	27	12.9	1.727	0.324	0.0383	
15 minute summer	25	11.000	26	3.4	0.772	0.190	0.0633	
15 minute summer	26	11.001	27	6.8	1.295	0.169	0.1551	
15 minute summer	27	1.007	32	37.1	2.109	2.097	0.2390	
15 minute summer	28	12.000	29	3.4	0.790	0.190	0.0381	
15 minute summer	29	12.001	32	6.8	1.157	0.164	0.1512	
15 minute summer	30	13.000	31	3.4	0.752	0.190	0.0391	
15 minute summer	31	13.001	32	6.8	1.040	0.190	0.1427	
15 minute summer	32	1.008	43	48.4	1.236	1.211	0.5378	
15 minute summer	33	14.000	34	0.0	0.000	0.000	0.0328	
15 minute summer	34	14.001	36	6.7	0.665	0.380	0.1395	
15 minute summer	35	15.000	36	6.8	0.752	0.248	0.0896	
15 minute summer	36	14.002	39	13.3	1.153	0.752	0.1674	
15 minute summer	37	16.000	38	6.0	1.108	0.336	0.0468	
15 minute summer	38	16.001	39	5.9	0.872	0.143	0.0366	
15 minute summer	39	14.003	43	19.2	1.835	0.558	0.1297	

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.90%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	40	10	73.015	0.065	6.0	0.0183	0.0000	OK
15 minute summer	41	10	72.905	0.041	6.0	0.0117	0.0000	OK
120 minute winter	42	118	73.853	0.978	38.8	80.5853	0.0000	FLOOD RISK
15 minute summer	43	11	72.521	0.256	83.6	0.0725	0.0000	OK
15 minute summer	44	10	73.146	0.046	3.4	0.0131	0.0000	OK
15 minute summer	45	10	73.064	0.047	6.8	0.0133	0.0000	OK
15 minute summer	46	11	72.386	0.178	95.8	0.0503	0.0000	OK
15 minute summer	48	12	71.947	0.127	6.8	0.0360	0.0000	OK
15 minute summer	49	12	71.943	0.202	13.6	0.0571	0.0000	SURCHARGED
15 minute summer	50	12	71.836	0.283	6.8	0.0800	0.0000	SURCHARGED
15 minute summer	51	12	71.825	0.364	24.2	0.1029	0.0000	SURCHARGED
15 minute summer	52	12	71.739	0.458	115.0	0.1297	0.0000	SURCHARGED
960 minute winter	53	945	71.568	0.568	13.0	314.6036	0.0000	SURCHARGED
15 minute summer	53_OUT	1	70.855	0.150	0.8	0.0000	0.0000	OK
15 minute summer	47	12	72.029	0.610	94.5	0.6894	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	40	17.000	41	6.0	1.070	0.335	0.0482	
15 minute summer	41	17.001	43	5.9	1.242	0.167	0.0981	
120 minute winter	42	Orifice	43	5.1				
15 minute summer	43	1.009	46	83.5	1.591	1.171	0.7385	
15 minute summer	44	19.000	45	3.4	0.725	0.190	0.0387	
15 minute summer	45	19.001	46	6.8	1.553	0.169	0.0146	
15 minute summer	46	1.010	47	94.5	1.566	0.533	1.7595	
15 minute summer	48	20.000	49	6.8	0.742	0.382	0.1081	
15 minute summer	49	20.001	51	12.2	0.762	0.687	0.4929	
15 minute summer	50	21.000	51	5.8	0.428	0.328	0.1620	
15 minute summer	51	20.002	52	21.9	1.246	1.234	0.0528	
15 minute summer	52	1.012	53	115.1	1.640	1.611	1.8338	
960 minute winter	53	Hydro-Brake®	53_OUT	0.8				211.6
15 minute summer	47	1.011	52	93.5	1.329	1.311	2.3344	

EAS

Appendix: J – Proposed SuDS Layout

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK
1st Floor Millers House, Roydon Road, Stanstead Abbotts, SG12 8HN. Tel 01920 871 777 e: contact@eastp.co.uk www.eastp.co.uk

KEY

- SITE BOUNDARY
- EXISTING BUILDING
- PROPOSED BUILDING AN INTE
- PROPOSED HARDSTANDIN
- PERMEABLE PAVING WITH MIN. 500mm SUB-BASE
- PROPOSED RAINWATER EU E STORAGE TANK (VOLUME T E CONFIRMED BY MANUFACTU E
- GREEN ROOF
- STORAGE POND (DEPTH: 1. m; TOP OF POND: 809m²; A E F POND: 453m² – VOLUME: 1m³
- RAISED PLANTER WITH RE T TE OUTFALL
- SURFACE WATER PIPE NETW K
- SURFACE WATER MANHOLE
- PERMAVOID DIFFUSER UNIT
- RAINWATER DOWNPIPE
- 50mm ORIFICE PLATE WITH SUITABLE FILTER
- HYDROBRAKE WITH SUITA LE FILTER TO RESTRICT RUN FF AT 0.8l/s
- HEADWALL

N.B. CL OF EXISTING DITCH BASED ON LI A. IL LEVEL OF EXISTING DITCH BASED ON SITE OBSERVATIONS. IL LEVEL TO BE CONFIRME AT A LATER STAGE BY AN EXTENDED TOPOGRAPHI AL SURVEY.

EXISTING POND TO BE RECONFIGURED TO VI E REQUIRED ATTENUATION.

REV	DATE	BY	DESCRIPTION	HK	A
–	–	–	–	–	–

DRAWING STATUS: FOR PLANNING

EAS
1st Floor Millers House, Roydon Road,
Stanstead Abbotts, Hertfordshire, SG12 8HN
Tel: 01920 871777
www.eastp.co.uk

CLIENT: MANOR COLIVING LTD

ARCHITECT: –

PROJECT: ECO–VILLAGE COTTAGES COLNEY HEATH

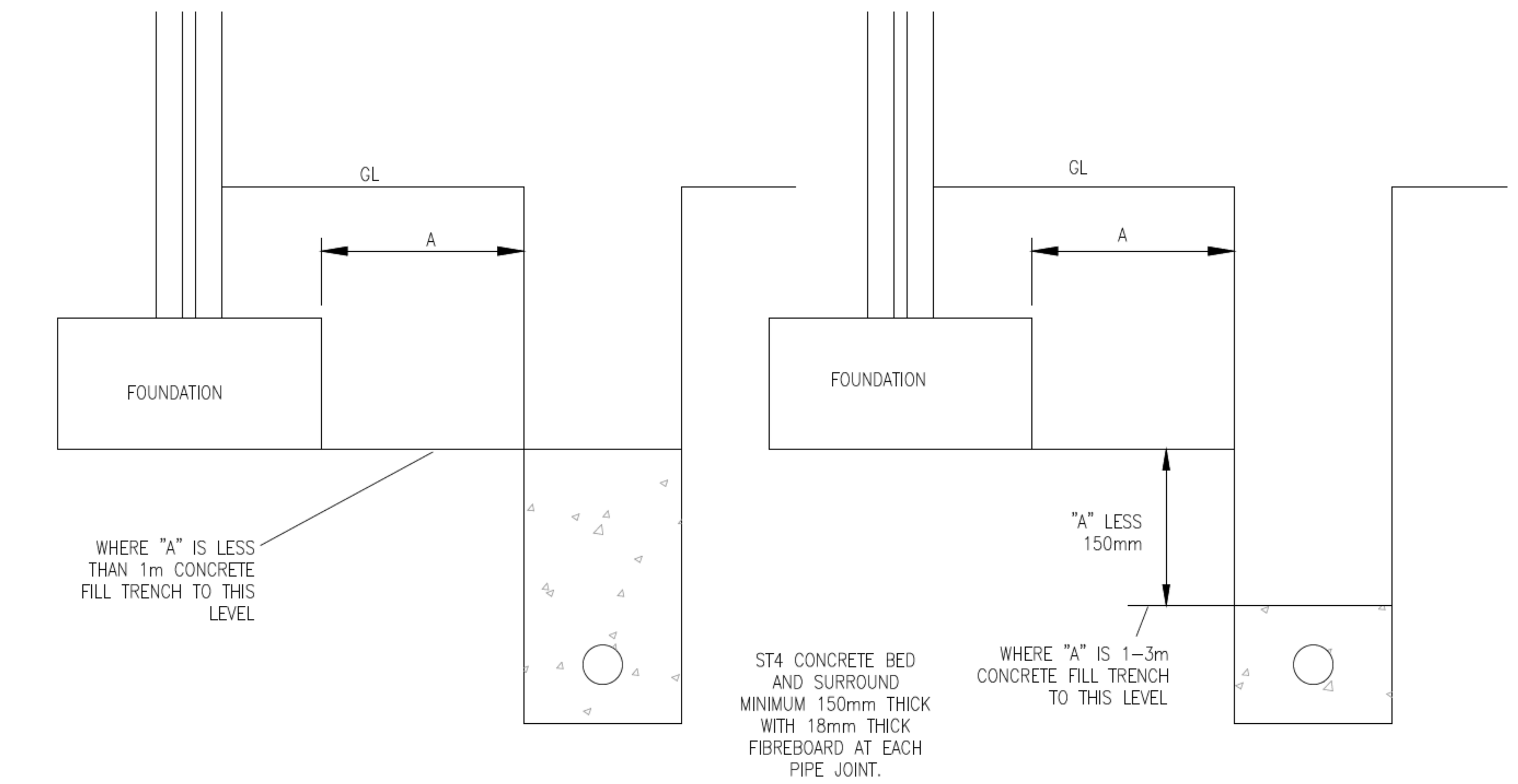
TITLE: SuDS DRAINAGE LAYOUT

SCALE @ A0:	DESIGN–DRAWN:	DATE:
1:250	CA	03.1 . 4

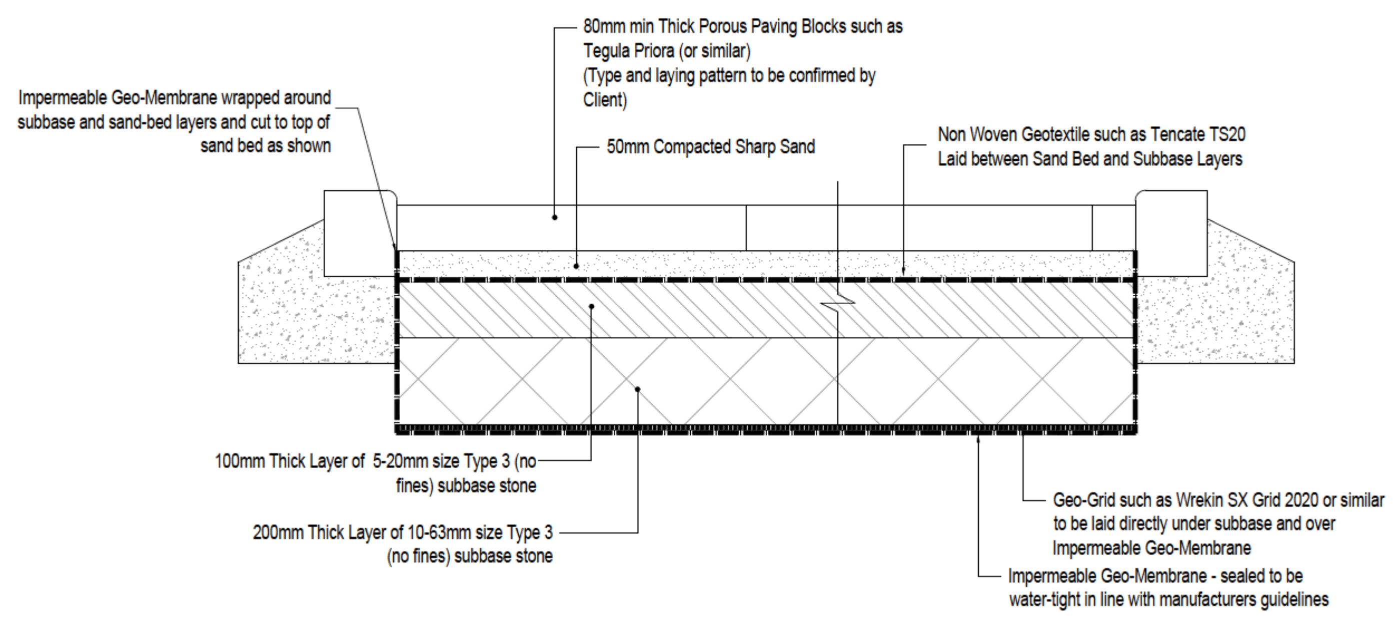
PROJECT No:	DRAWING No:
5295	SK06

Appendix: K – Standard Details

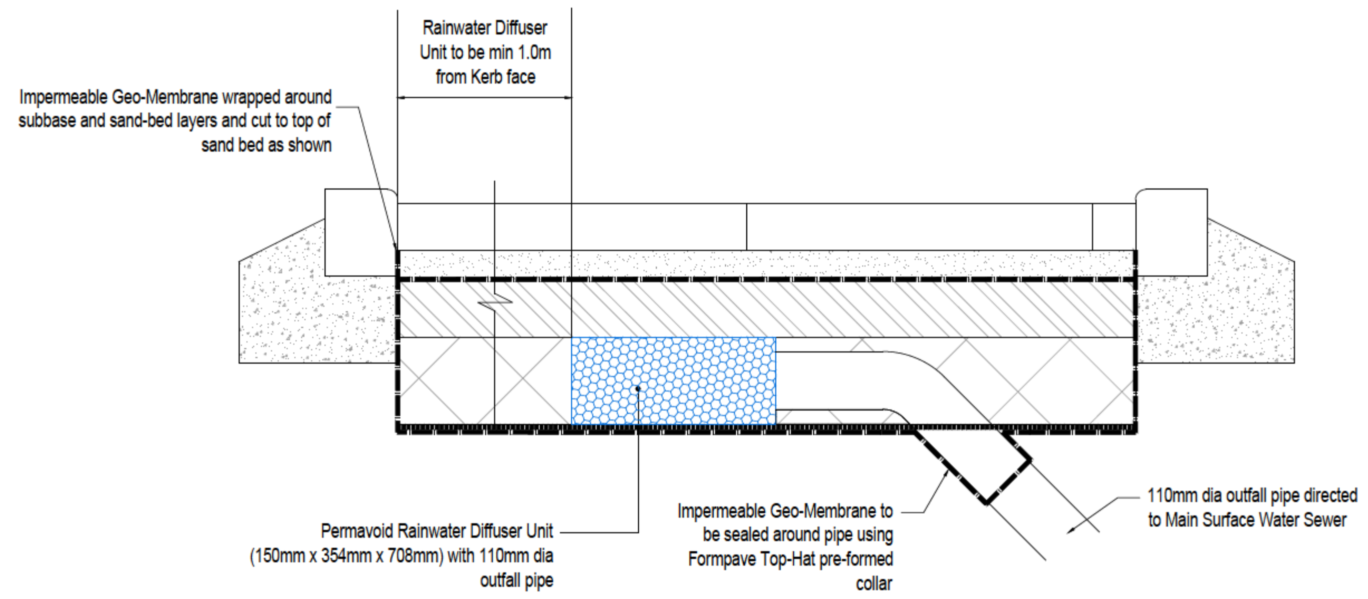
TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK
1st Floor Millers House, Roydon Road, Stanstead Abbotts, SG12 8HN. Tel 01920 871 777 e: contact@eastp.co.uk www.eastp.co.uk



PIPES ADJACENT TO BUILDINGS
TYPICAL DETAIL
NTS



Porous (Permeable) Block Paved
Carriageway Construction
Rainwater Diffuser Outfall Arrangement Required
NTS



Porous Block Paved Carriageway
Surface Water Outfall Arrangement
(no Gullies)
NTS

SUB-BASE SPECIFICATION FOR PERMEABLE PAVING SUB-BASE

THE GRANULAR SUB-BASE MATERIAL SHALL COMPRISE CRUSHED ROCK OR CONCRETE POSSESSING WELL DEFINED EDGES. IT MUSH BE SOUND, CLEAN, NON FRIABLE AND FREE FROM CLAY OR OTHER DELETRIOUS MATTER.

THE MATERIAL MUST NOT BE PLASTIC WHEN TESTED IN ACCORDANCE WITH BS1377 TEST No 4.

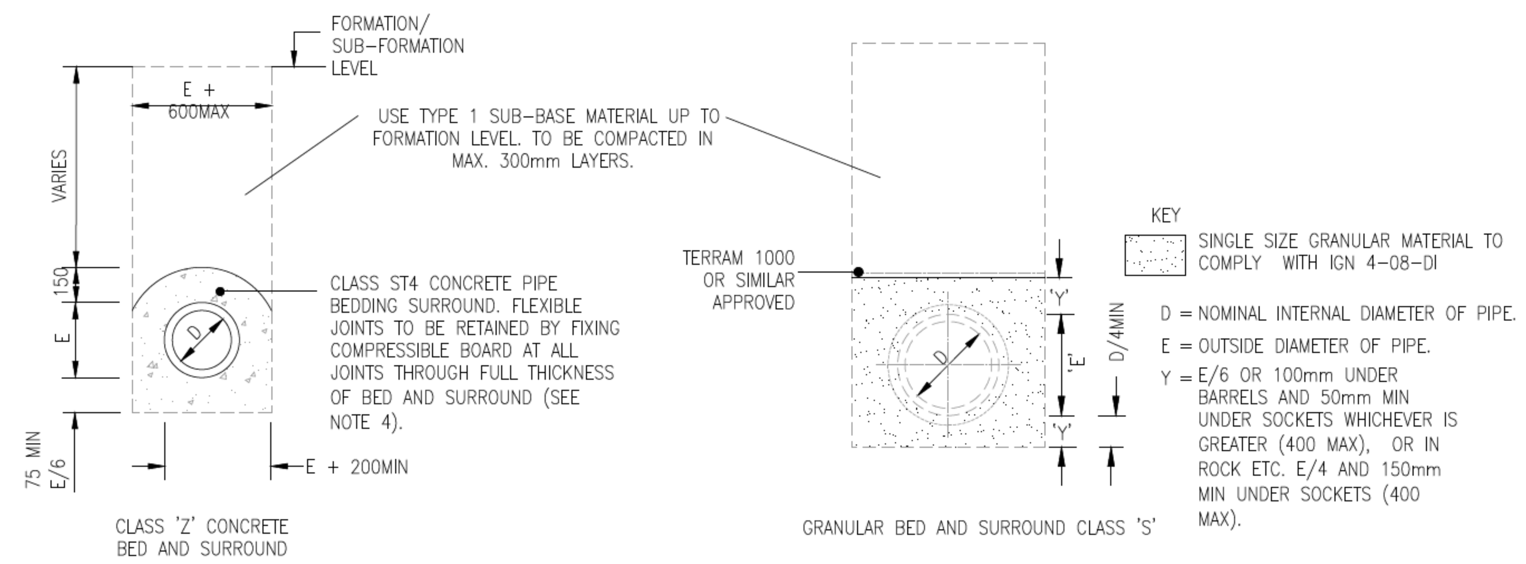
THE CRUSHED STONE USED FOR THE LAYING COURSE AND SUB-BASE MUST HAVE A MINIMUM 10% FINES VALUE OF 150kN WHEN TESTED IN ACCORDANCE WITH BS812 PART 111.

THE SELECTED TEST SAMPLES MUST NOT BE OVER DRIED AND SHOULD BE SOAKED IN WATER AT ROOM TEMPERATURE FOR 48 HOURS BEFORE THE TEST. THE 100mm DEEP UPPER LAYER OF SUB-BASE MATERIAL SHOULD BE GRADED 20mm–5mm TO BS882.

THE 63–10mm MATERIAL SHOULD BE GRADED AS FOLLOWS:

BS Sieve size	%passing
100mm	100
63mm	90–100
37.5mm	60–80
20mm	15–30
10mm	0–5

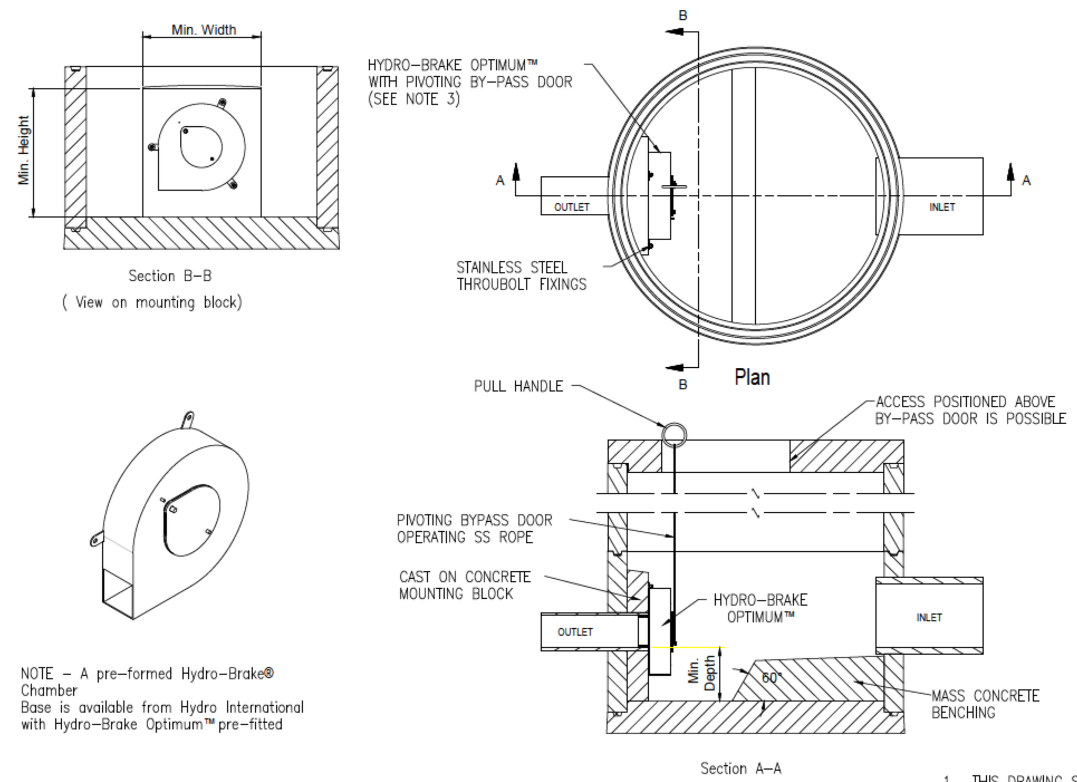
THE BLOCKS SHOULD BE VIBRATED USING A VIBRATING PLATE TYPEDVP75/22" OR SIMILAR. FOLLOWING THE FIRST PASS WITH A VIBRATING PLATE A LIGHT DRESSING OF 3mm SINGLE SIZE CLEAN STONE SHOULD BE APPLIED TO THE SURFACE AND BRUSHED IN, APPROX 2kg PER m^2 (AVAILABLE FROM BRETT). BLOCKS SHOULD AGAIN BE VIBRATED AND ANY DEBRIS BRUSHED OFF.



TO PIPES WITH COVER OF LESS THAN 900mm IN TRAFFICKED AREAS AND LESS THAN 600mm COVER IN LANDSCAPED AREAS.

TO PIPES WITH COVER OF GREATER THAN 900mm IN TRAFFICKED AREAS AND GREATER THAN 600mm COVER IN LANDSCAPED AREAS.

DRAINAGE TRENCH DETAIL
STANDARD CONSTRUCTION DETAIL
NTS



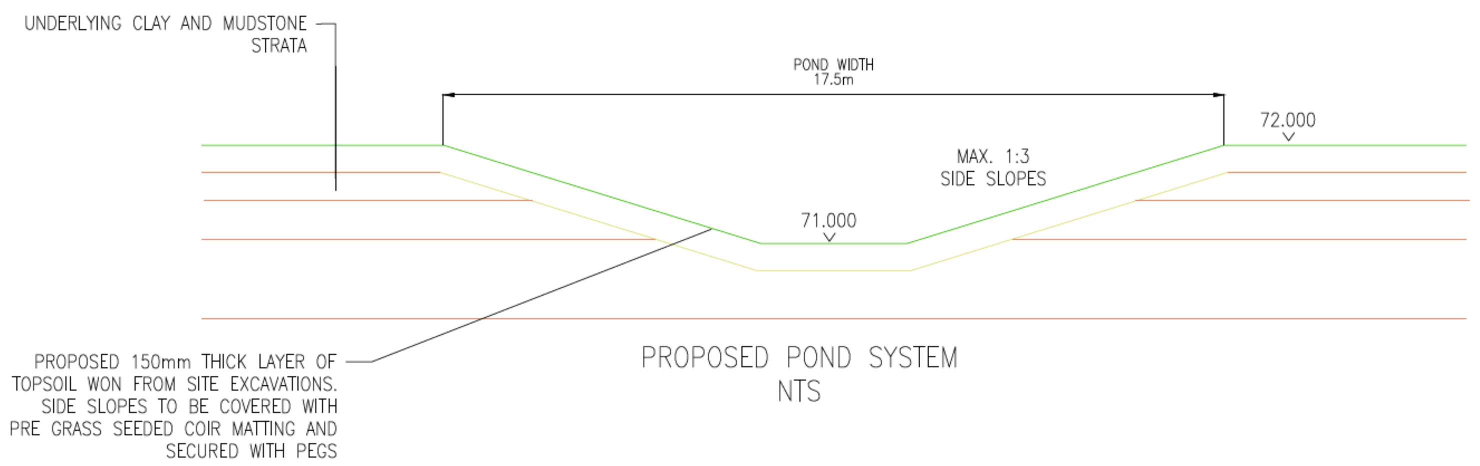
1. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH ALL RELEVANT GENERAL ARRANGEMENT & DETAIL DRAWINGS.

2. ALL COMPONENTS SHALL BE MANUFACTURED IN ACCORDANCE WITH THE PRODUCTION SPECIFICATION HRD–FM09/15.

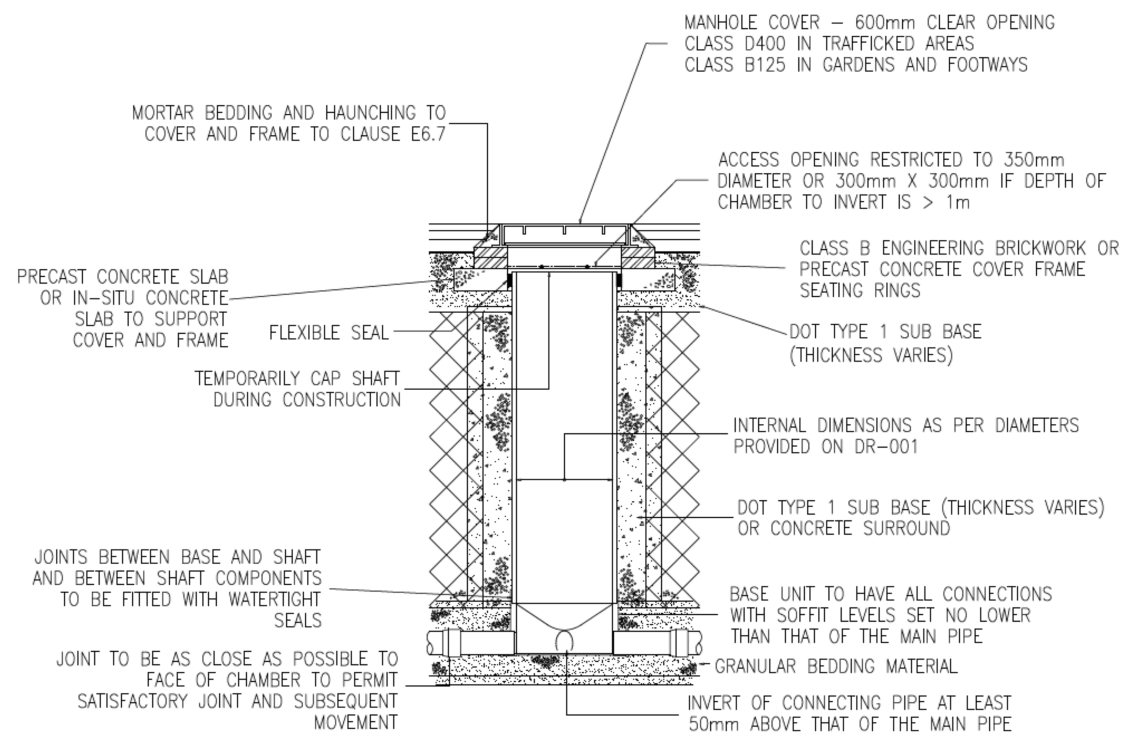
3. HYDRO–BRAKE OPTIMUM™ IS ALSO AVAILABLE WITH ALTERNATIVE FIXING MOUNTS (E.G. CURVED BACK PLATE, PUSH FIT)

HYDROBRAKE TYPE MD14 TO BE USED

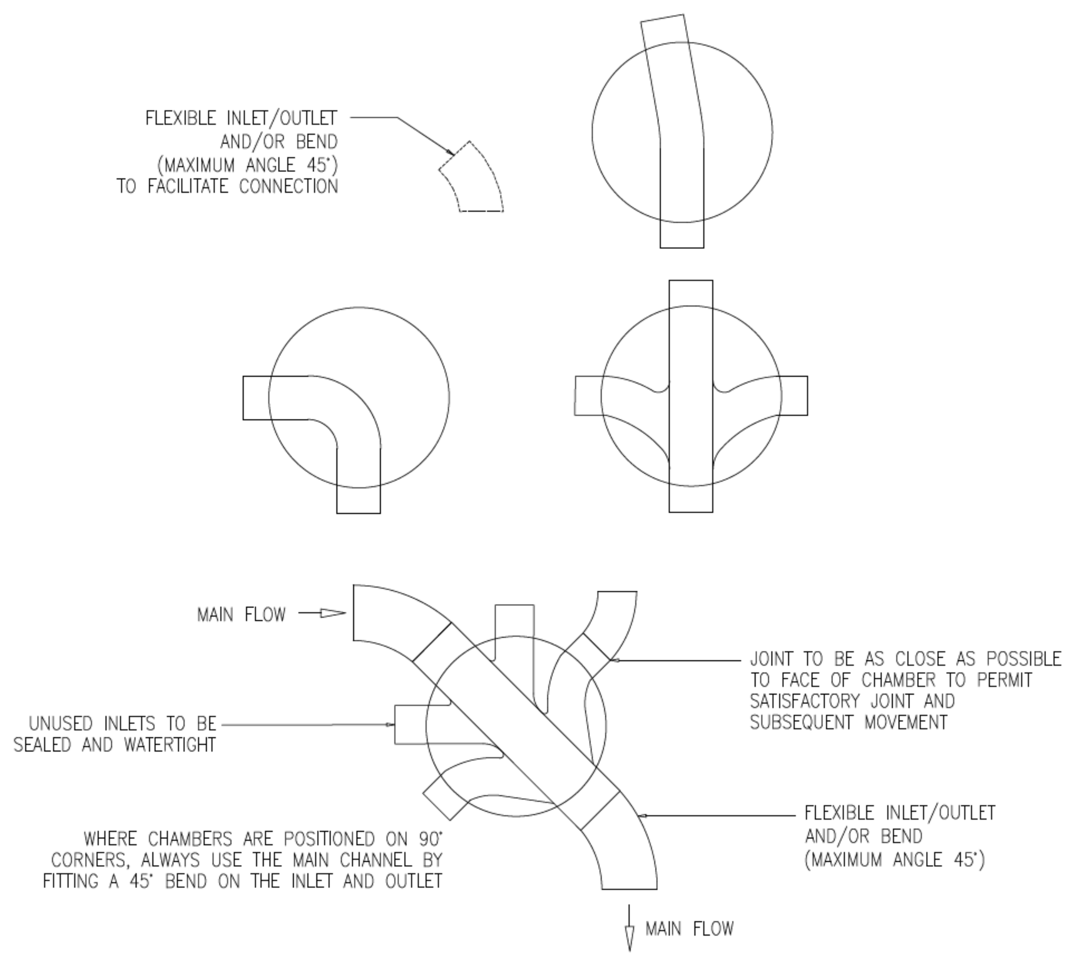
PLEASE NOTE THAT THIS IS A TYPICAL STANDARD DETAIL AND IS NOT SITE SPECIFIC. WHEN HYDRO–BRAKE IS ORDERED, HYDRO–INTERNATIONAL WILL PROVIDE A SPECIFIC INSTALLATION DETAIL



PROPOSED POND SYSTEM
NTS



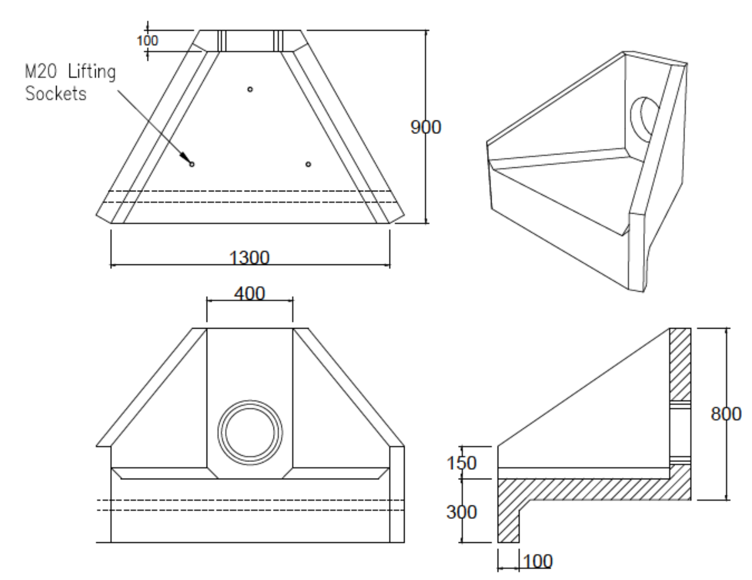
TYPICAL INSPECTION CHAMBER DETAIL
NTS



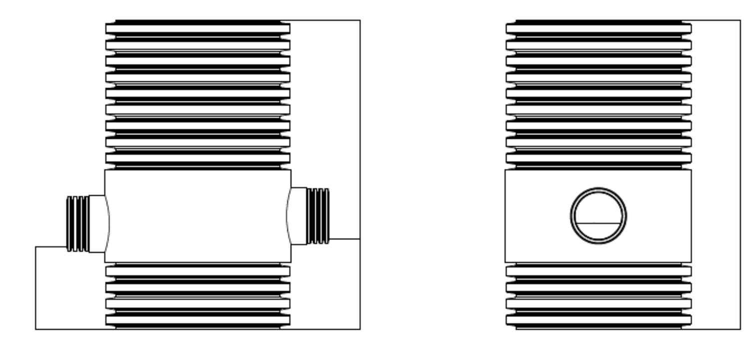
NOTE: WHERE A BEND IS USED IMMEDIATELY OUTSIDE THE MANHOLE, THIS MAY BE USED AS THE ROCKER PIPE

BASE LAYOUTS FOR INSPECTION CHAMBERS
NTS

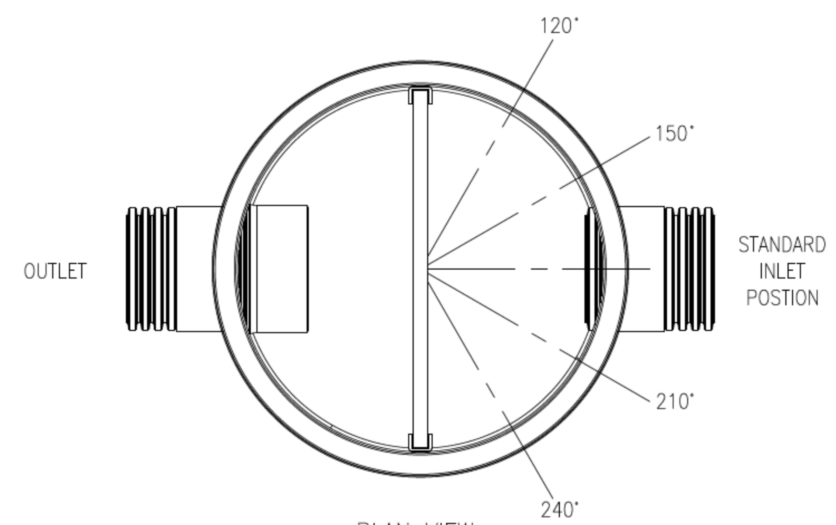
Note: Isometric drawing is for reference only, details may not accurately represent actual design - please see detailed views for technical information



PRECAST CONCRETE HEADWALL DETAIL



TYPICAL ORIFLO FLOW CONTROL CHAMBER DETAIL WITH CATCHPIT



PLAN VIEW

REV	DATE	BY	DESCRIPTION	CHK	APD
–	–	–	–	–	–

DRAWING STATUS: FOR PLANNING

1st Floor Millers House, Roydon Road,
Stanstead Abbotts, Hertfordshire, SG12 8HN
Tel: 01920 871777

www.eastp.co.uk

CLIENT: MANOR COLIVING LTD

ARCHITECT: –

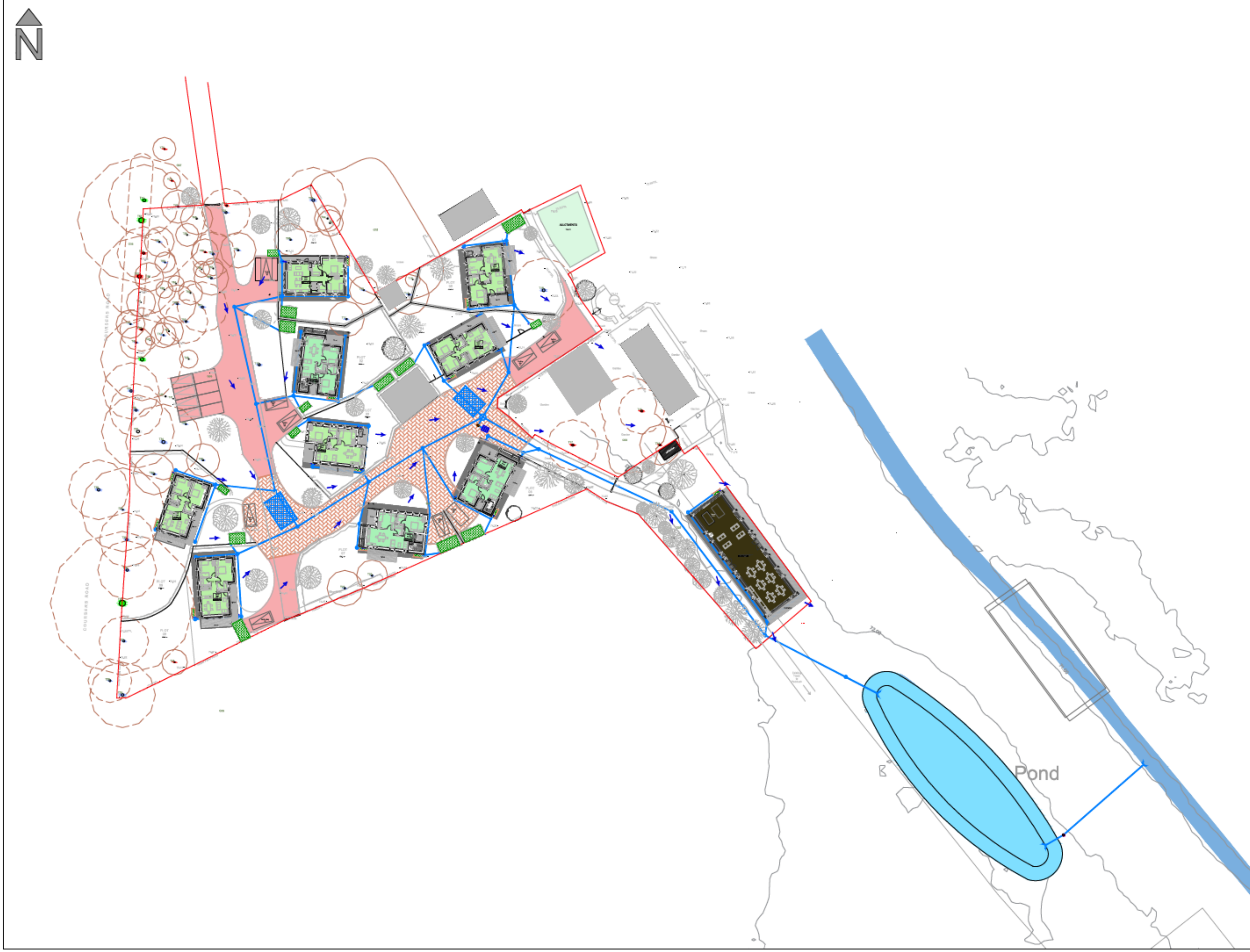
PROJECT: ECO–VILLAGE COTTAGES COLNEY HEATH

TITLE: DRAINAGE CONSTRUCTION DETAILS

SCALE @ A1:	DESIGN–DRAWN:	DATE:
NTS	CA	04.12.2024
PROJECT No: 5295	DRAWING No: SK07	

Appendix: L – Exceedance Flow Plan

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK
1st Floor Millers House, Roydon Road, Stanstead Abbotts, SG12 8HN. Tel 01920 871 777 e: contact@eastp.co.uk www.eastp.co.uk



KEY

FLOW ARROW

FOR PLANNING

MANOR COLIVING LTD

–

ECO-VILLAGE COTTAGES
OGLNEY HEATH

EXCEEDANCE FLOW ROUTE

1:250

04.12.2024

5285

SK06