Flood Risk Assessment & SuDS Drainage Strategy

March 2025

EAS

Land at Status Park, Nobel Drive, Hillingdon

MBH Heathrow Ltd

Document History

JOB NUMBER: 4401/2023
DOCUMENT REF: FRA&SuDS Status Park
REVISIONS: D – Response to LLFA

Revision	Comments	By	Checked	Authorised	Date
A	Client Draft	JC	MD	SA	18/04/2023
B	For Submission	JC	MD	SA	20/04/2023
C	Update	MD	MD	MD	21/06/2024
D	Response to LLFA	AW	JC	MD	13/03/2025
E					
F					

The content of this report is based on information available as of March 2025, the validity of the statements made may therefore vary over time as planning guidance / policies and the evidence base change.

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK ■ TOPOGRAPHICAL SURVEYS
Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG **Tel 01920 871 777 e: contact@eastp.co.uk www.eastp.co.uk**

EAS

Contents

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK ■ TOPOGRAPHICAL SURVEYS
Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG **Tel 01920 871 777 e: contact@eastp.co.uk www.eastp.co.uk**

1 Introduction

1.1 EAS have prepared this Flood Risk Assessment (FRA) and SuDS Drainage Strategy to accompany a planning application for the erection of a residential building together with associated landscaping and car parking, and including the reconfiguration of the Vista Court, Atlantico House and Peninsula House residential car parks on Nobel Drive. The proposed development is on Land at Status Park, Nobel Drive, Hillingdon, UB3 5EY.

1.2 The site location plan is included in **Appendix A** and the proposed development plans are in **Appendix B**. The site covers an area of 1.626ha and comprises Vista Court, Atlantico House and Peninsula House with associated landscaping and parking areas. The proposals are to erect a residential building in the existing carpark to the west of Vista Court. As described above, the proposals also include the reconfiguration of the landscape and parking areas serving the existing residential buildings.

1.3 This Flood Risk Assessment and SuDS Drainage Strategy Report shall concentrate on the area within the application boundary relating to the new residential building and its associated landscape and parking only. The wider proposed amendments to the landscaping and parking serving the existing residential buildings will have a positive impact on surface water runoff overall due to the significant reduction of impermeable area. This is measured to be 955m² and will reduce surface water runoff rates and volumes overall from this area – and will continue to drain via the existing private surface water drainage system serving the site.

1.4 The area which this report shall concentrate on 0.44ha of the application site which relates to the new build and associated hard and soft landscaping. When referring to 'the site' for the remainder of this report, this will be in relation to the 0.44ha area. A plan showing the application site boundary and the flood risk assessment boundary is included in **Appendix B**.

1.5 The site is shown to be in Flood Zone 1 on the EA Flood Map for Planning. Due to the presence of 'high' surface flood risk, a Flood Risk Assessment is required to accompany a planning application to meet the requirements of the National Planning Policy Framework (NPPF). All sources of flooding have been evaluated in this report.

1.6 The contents of this FRA and drainage report are based on the advice set out in the National Planning Policy Framework (NPPF) updated in December 2024 and Annex 3: Flood risk vulnerability classification, also obtained from the NPPF.

1.7 This report is based on the Environment Agency Flood Maps and detailed modelled data, geology mapping, OS mapping, topographical survey, Strategic Flood Risk Assessment and local policy.

1.8 This document includes the following sections:

- Section 2 – outlines response to LLFA comments;
- Section 3 - describes the relevant policy;
- Section 4 - site description, including site levels, proximity to watercourses etc.;
- Section 5 - outlines potential sources of flooding;

- Section 6 – details the proposed drainage strategy;
- Section 7 – details the maintenance schedule for the proposed drainage strategy;
- Section 8 - concludes the report.

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK ■ TOPOGRAPHICAL SURVEYS
Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG **Tel 01920 871 777 e: contact@eastp.co.uk www.eastp.co.uk**

2 LLFA Response

2.1 This section summarises the response to the LLFA comments as outlined in the comments letter for application Ref. 74423/APP/2024/1908, dated 24th December 2024. The comments are presented below in grey, with EAS responses in blue.

Demonstrates that rainwater harvesting measures have been considered as part of the drainage design, or sufficient justification needs to provided if the features are not proposed. If features are proposed, these should be included in the updated drainage layout.

2.2 Rainwater Butts are not feasible within the proposed SuDS strategy as it is already proposed that rainwater downpipes are served by Raingarden Planters, which are arguably a more effective SuDS feature, meeting all 4 pillars of SuDS. Other methods of rainwater harvesting are not suitable for this site due to economic constraints, including initial high costs alongside ongoing maintenance. In addition, due to the close proximity to the airport, there are concerns of water contamination prior to the runoff passing through the proposed SuDS.

Explains how the proposals will not impact the local groundwater flood risk outside the development.

2.3 It should be noted that the proposals do not direct surface water runoff to ground as such the existing groundwater levels are no expected to be altered as a result of the proposed development. Furthermore, the proposal creates a notable reduction in discharge rate compared to existing, from 56.4 l/s to 2.5 l/s for the 1 in 100yr + 40% CC event. Therefore, it is anticipated this will reduce the surface water flood risk outside the site. As the site is proposing to discharge to a surface water sewer, surface water from the proposed hardstanding areas will not be draining into the ground. This will ensure that the site does not increase the risk of groundwater flooding.

Provides the greenfield and proposed runoff rates, with updated supporting calculations, including the whole site area of 4400m2, demonstrating that no flooding is predicted on site.

2.4 The greenfield runoff rates and volumes are provided in para. 7.3 and 7.4 of this report relating to the proposed impermeable area only – it is not standard practice to include grassed and landscaped areas. It should be noted that these landscapes areas fall away from the proposed drainage network and should not be accounted for in any rate.

2.5 The proposed calculations enclosed in **Appendix J** show that the proposed drainage network effectively manages surface water from the site for all events up to and including the 1 in 100yr +40% climate change event without flooding.

Provides the greenfield, existing, and proposed runoff volumes using the whole site area for the 1 in 1-year, 1 in 30- year, 1 in 100-year, and 1 in 100-year + 40% CC, along with supporting calculations, and demonstrates that the proposed runoff volume does not exceed the existing runoff volume.

2.6 The greenfield runoff rates and volumes are provided in para. 7.3 and 7.4 of this report. It is not practicable or proportionate to provide long term storage based on a comparison of greenfield volumes with this Brownfield site. The pre-development brownfield discharge volume has therefore been used to calculate an appropriate Long Term Storage Volume which is rational. In line with Non-Statutory Technical Guidance Policy S4, runoff volumes are based on the 1 in 100 year 360 minute (6hr) storm event and are discussed on paragraph 7.2 of this report. As the proposed drainage strategy has resulted in a 46.4m^3 increase in runoff volume for this event, long term storage has been provided within the permeable paving. Please refer to Section 6.32-6.34 for further details. As such, the long-term storage requirements have been met. As outlined in Section 2.4 above, the whole site area has not been included within these calculations as the grassed/vegetated areas will not be discharging into the proposed drainage system.

Shows where on site exceedance flows are expected to collect and shows how flows will be directed away from buildings.

2.7 Exceedance flow arrows, shown in blue, have been added to the SuDS Layout. As noted in Section 6.37, during an exceedance event, the permeable paving will surcharge and water will pool within this area of the site until it slowly recedes back into the proposed drainage network. Some surface water might disperse into the grassed area in the west of the site.

2.8 The following points will be addressed at Discharge of Condition Stage:

Provides the maintenance tasks for all drainage features proposed as part of the drainage strategy, and names the owner of the maintenance.

2.9 Maintenance tasks for Raingarden Planters and control devices have been outlined in Section 8. An appointed management company will be responsible for maintaining the outlined SuDS features, the name of which will be detailed at Discharge of Conditions Stage.

Shows that Thames Water provide consent for the proposed connection.

2.10 A S106 Application will be made to Thames Water. To confirm, the existing outfall rate in a 1:2yr storm event is 27.6 l/s whilst the proposed in a 1:100yr + Climate Change Event is 2.5 l/s, thus significantly reducing the outfall from the site for all events.

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK ■ TOPOGRAPHICAL SURVEYS
Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG **Tel 01920 871 777 e: contact@eastp.co.uk www.eastp.co.uk**

3 Policy Context

Introduction

3.1 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 2024 and the Planning Practice Guidance (PPG) updated in August 2022.

3.2 Paragraph 181 of the NPPF discusses the use for site-specific flood-risk assessments and what the assessment should demonstrate:

"When determining any planning applications, local planning authorities should ensure that flood risk is not increased elsewhere. Where appropriate, applications should be supported by a site-specific flood-risk assessment[63]. Development should only be allowed in areas at risk of flooding where, in the light of this assessment (and the sequential and exception tests, as applicable) it can be demonstrated that:

a) within the site, the most vulnerable development is located in areas of lowest flood risk, unless there are overriding reasons to prefer a different location;

b) the development is appropriately flood resistant and resilient such that, in the event of a flood, it could be quickly brought back into use without significant refurbishment;

c) it incorporates sustainable drainage systems, unless there is clear evidence that this would be inappropriate;

d) any residual risk can be safely managed; and

e) safe access and escape routes are included where appropriate, as part of an agreed emergency plan."

3.3 Paragraph 181 footnote 63 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."

3.4 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.

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK ■ TOPOGRAPHICAL SURVEYS
Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG **Tel 01920 871 777 e: contact@eastp.co.uk www.eastp.co.uk**

- 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.

3.5 Paragraph 170 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".

3.6 Paragraph 182 of the NPPF discusses the application of sustainable drainage systems:

"Applications which could affect drainage on or around the site should incorporate sustainable drainage systems to control flow rates and reduce volumes of runoff, and which are proportionate to the nature and scale of the proposal. These should provide multifunctional benefits wherever possible, through facilitating improvements in water quality and biodiversity, as well as benefits for amenity. Sustainable drainage systems provided as part of proposals for major development should:

a) *take account of advice from the Lead Local Flood Authority;*

b) *have appropriate proposed minimum operational standards; and*

c) *have maintenance arrangements in place to ensure an acceptable standard of operation for the lifetime of the development."*

3.7 The Flood Map for Planning shows the site to be located entirely in Flood Zone 1, at 'low' risk of flooding from fluvial sources. The EA Flood Map has been enclosed in **Appendix C**. This is considered to be an area with less than 1 in 1000 annual chance of flooding.

Local Policy

3.8 The Hillingdon Local Plan Part 2 was adopted by the Council in January 2020 and provides a development strategy for the borough up until 2026.

3.9 Policy DMEI 9 'Management of Flood Risk' sets out the requirements for a development within Flood Zone 2 and 3. However, as the development is wholly within Flood Zone 1, it is considered that the development meets the requirements of DMEI 9.

3.10 DMEI 10 'Water Management, Efficiency and Quality' states:

"A) Applications for all new build developments (not conversions, change of use, or refurbishment) are required to include a drainage assessment demonstrating that appropriate sustainable drainage systems (SuDS) have been incorporated in accordance with the London Plan Hierarchy (Policy 5.13: Sustainable drainage).

B) All major new build developments, as well as minor developments in Critical Drainage Areas or an area identified at risk from surface water flooding must be designed to reduce surface water run-off rates to no higher than the pre-development greenfield run-off rate in a 1:100 year storm scenario, plus an appropriate allowance for climate change for the worst storm duration. The assessment is required regardless of the changes in impermeable areas and the fact that a site has an existing high run-off rate will not constitute justification.

C) Rain Gardens and non householder development should be designed to reduce surface water run-off rates to Greenfield run-off rates.

D) Schemes for the use of SuDS must be accompanied by adequate arrangements for the management and maintenance of the measures used, with appropriate contributions made to the Council where necessary.

E) Proposals that would fail to make adequate provision for the control and reduction of surface water run-off rates will be refused.

F) Developments should be drained by a SuDS system and must include appropriate methods to avoid pollution of the water environment. Preference should be given to utilising the drainage options in the SuDS hierarchy which remove the key pollutants that hinder improving water quality in Hillingdon. Major development should adopt a 'treatment train' approach where water flows through different SuDS to ensure resilience in the system.

Water Efficiency

G) All new development proposals (including refurbishments and conversions) will be required to include water efficiency measures, including the collection and reuse of rain water and grey water.

H) All new residential development should demonstrate water usage rates of no more than 105 litres/person/day.

I) It is expected that major development8 proposals will provide an integrated approach to surface water run-off attenuation, water collection, recycling and reuse.

Water and Wastewater Infrastructure

J) All new development proposals will be required to demonstrate that there is sufficient capacity in the water and wastewater infrastructure network to support the proposed development. Where there is a capacity constraint the local planning authority will require the developer to provide a detailed water and/or drainage strategy to inform what infrastructure is required, where, when and how it will be delivered."

3.11 DMEI 11 'Protection of Ground Water Resources" states:

"Policy DMEI 11: Protection of Ground Water Resources All development proposals within a Source Protection Zone, Safeguard Zone or Water Protection Zone must assess any risk to groundwater resources and demonstrate that these would be protected throughout the construction and operational phases of development."

West London Strategic Flood Risk Assessment (SFRA) 2018

West London Strategic Flood Risk Assessment (SFRA)

3.12 The West London Boroughs of Barnet, Brent, Ealing, Harrow, Hillingdon and Hounslow commissioned the production of a joint Level 1 SFRA, to provide an update to existing borough specific SFRAs, which were predominantly completed in 2008.

3.13 Paragraph 5.3.2. of the SFRA sets out what is expected from a Drainage Strategy in the Borough:

"1. Ensuring that land within development sites are safeguarded for potential flood mitigation use through the active consideration of predicted flood mapping from all sources at the master planning stage.

2. Developers must submit completed Flood Risk Assessments and Drainage Strategy (with supporting Checklists) to demonstrate compliance with requirements detailed in Sections 2 and 4 for all Major development proposals.

3. Drainage Strategies with the supporting checklist must be provided for all Minor developments and for Change of Use proposals if they impact the proposed development's current drainage regime. Site-specific Flood Risk Assessments with the accompanying checklist must be provided for Minor developments and Change of Use proposals if they:

> *1. Are outside of Flood Zone 1.*
>
> *2. Are inside an EA defined area with a critical drainage problem.*
>
> *3. Change the existing footprint of the building(s).*
>
> *4. Are at risk from any other sources of flooding.*

4. As part of a submitted development proposal, developers must provide evidence to the LPA to demonstrate that the Sequential Test has been undertaken. Developers must also provide evidence that an on-site sequential approach has been taken to direct vulnerable uses to the lowest risk parts of the development site.

5. Where development is proposed for sites within Flood Zones 3a (surface water), evidence must be submitted to demonstrate that:

> *1. There will be no increase of flood risk to properties outside of the development boundary.*
>
> *2. Consultation has been undertaken with the relevant LLFA to consider potential wider impacts or benefits the development could have on the local surface water catchment.*
>
> *3. Relevant strategic documents (such as the Thames CFMP, LFRMS and SWMP) have been reviewed.*
>
> *4. The LLFA has been consulted to determine if the development should contribute to any catchment wide flood alleviation schemes being considered by the LLFA (such as a S106 contribution to wider catchment flood risk management infrastructure).*

6. Development should maximise the use of open spaces to ensure spaces for water to flow during times of flood.

7. Developments that seek to increase impermeable surfaces within a site, including small areas such as front gardens, will be resisted where appropriate.

8. Developers should aim to incorporate permeable paving in hardstanding areas to provide flood mitigation benefits in new and existing developments. In areas where the geology does not facilitate infiltration (e.g. areas underlain with clay), permeable paving should be underlain with gravel or feature an underground storage system.

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK ■ TOPOGRAPHICAL SURVEYS
Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG **Tel 01920 871 777 e: contact@eastp.co.uk www.eastp.co.uk**

9. Development proposed in 'dry islands' should be designed for safe access and egress in a flood event. Dry islands are considered as flood risk areas due to the potential loss of important local services during flood events and lack of safe access routes. They require safe access and egress routes to be developed for the lifetime of the property, factoring in the impacts of climate change."

London Borough of Hillingdon Surface Water Management Plan (SWMP) (2013)

3.14 The London Borough of Hillingdon SWMP was published in 2013 as part of the Drain London Project. The document outlines the preferred surface water management strategy in Hillingdon and considers flooding from sewers, drains, groundwater and runoff from land and identifies Critical Drainage Areas (CDA).

3.15 This site was not identified as being within a CDA within the SWMP.

London Plan 2021

3.16 The London Plan provides an overall strategic plan for the development of London over the next 20-25 years. It sets out the integrated economic, environmental, transport and social framework and is legally part of each of London's Local Planning Authorities' Development Plan. This ensures that all planning decisions within Greater London take into account this plan. There is one main policy that must be incorporated into this report which is Policy SI 12 Flood Risk Management.

3.17 Policy SI 12 Flood Risk Management states:

"A Current and expected flood risk from all sources (as defined in paragraph 9.2.12) across London should be managed in a sustainable and cost-effective way in collaboration with the Environment Agency, the Lead Local Flood Authorities, developers and infrastructure providers.

B Development Plans should use the Mayor's Regional Flood Risk Appraisal and their Strategic Flood Risk Assessment as well as Local Flood Risk Management Strategies, where necessary, to identify areas where particular and cumulative flood risk issues exist and develop actions and policy approaches aimed at reducing these risks. Boroughs should cooperate and jointly address cross-boundary flood risk issues including with authorities outside London.

C Development proposals should ensure that flood risk is minimised and mitigated, and that residual risk is addressed. This should include, where possible, making space for water and aiming for development to be set back from the banks of watercourses.

D Developments Plans and development proposals should contribute to the delivery of the measures set out in Thames Estuary 2100 Plan. The Mayor will work with the Environment Agency and relevant local planning authorities, including authorities outside London, to safeguard an appropriate location for a new Thames Barrier.

E Development proposals for utility services should be designed to remain operational under flood conditions and buildings should be designed for quick recovery following a flood.

F Development proposals adjacent to flood defences will be required to protect the integrity of flood defences and allow access for future maintenance and upgrading. Unless exceptional circumstances are demonstrated for not doing so, development proposals should *be set back from flood defences to allow for any foreseeable future maintenance and upgrades in a sustainable and cost-effective way.*

G Natural flood management methods should be employed in development proposals due to their multiple benefits including increasing flood storage and creating recreational areas and habitat."

3.18 This flood risk assessment has considered this policy in depth to ensure that the proposals fully comply with the requirements of the 2021 London Plan.

3.19 Policy SI 13: Sustainable Drainage states:

"A Lead Local Flood Authorities should identify – through their Local Flood Risk Management Strategies and Surface Water Management Plans – areas where there are particular surface water management issues and aim to reduce these risks. Increases in surface water runoff outside these areas also need to be identified and addressed.

B Development proposals should aim to achieve greenfield run-off rates and ensure that surface water run-off is managed as close to its source as possible. There should also be a preference for green over grey features, in line with the following drainage hierarchy:

1) rainwater use as a resource (for example rainwater harvesting, blue roofs for irrigation)

2) rainwater infiltration to ground at or close to source

3) rainwater attenuation in green infrastructure features for gradual release (for example green roofs, rain gardens)

4) rainwater discharge direct to a watercourse (unless not appropriate)

5) controlled rainwater discharge to a surface water sewer or drain

6) controlled rainwater discharge to a combined sewer.

C Development proposals for impermeable surfacing should normally be resisted unless they can be shown to be unavoidable, including on small surfaces such as front gardens and driveways.

D Drainage should be designed and implemented in ways that promote multiple benefits including increased water use efficiency, improved water quality, and enhanced biodiversity, urban greening, amenity and recreation.

3.20 The proposed drainage strategy below complies with the requirements set out in Policy SI13.

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK ■ TOPOGRAPHICAL SURVEYS
Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG **Tel 01920 871 777 e: contact@eastp.co.uk www.eastp.co.uk**

4 Existing Site Assessment

Site Description

4.1 The site is located on Land at Status Park, Nobel Drive, Hillingdon, UB3 5EY and covers an area of 0.44ha of which 0.27ha is impermeable. A plan showing the application site boundary and the assessment boundary is included in **Appendix B**.

Local Watercourses

4.2 The nearest EA 'Main River' are Frogs Ditch and the River Crane which pass approx. 850m to the east.

Site Levels

4.3 The topographical survey is included in **Appendix D**. Site levels fall from north to south, with levels along the northern boundary ranging from 50.00m and 49.74m and along the southern boundary ranging between 49.52m in the south-east and 48.99m, with an average fall across the site of 1:250.

Geology

4.4 The online British Geological Survey resource (www.bgs.ac.uk) shows the local area to have superficial deposits of River Terrace Deposits. The bedrock layer is comprised of Thames Group – Clay, Silt, Sand and Gravel.

4.5 There are no nearby borehole logs to reference.

Sewers

4.6 A public surface water sewer network is present within the site boundary under Nobel Drive at MH 2905 (CL: N/A; IL: N/A). This sewer crosses the southern site boundary before travelling eastward in a 750mm dia pipe. The nearest borehole with cover and invert levels is present beyond the southern boundary at manhole MH1902 (CL: 24.14m; IL: 22.57m).

4.7 A public foul water sewer network is present within the site boundary, passing to the south of the proposed building at MH 2902 (CL: N/A; IL: N/A). This sewer crosses the southern site boundary before travelling eastward in a 750mm dia pipe under Bath Road.

4.8 The topographical survey and sewer asset map levels do not align. Therefore, the manholes with known levels have been interpolated:

- MH1902 (CL: 49.54m; IL: 47.97m)

4.9 Refer to the wider site sewer network included in **Appendix E.**

4.10 An existing private surface water drainage network serves the site with outfall directed to the adopted surface water sewers. Runoff is currently untreated, unattenuated and unrestricted.

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK ■ TOPOGRAPHICAL SURVEYS

Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG Tel 01920 871 777 e: contact@eastp.co.uk www.eastp.co.uk

5 Potential Sources of Flooding

Fluvial

5.1 A copy of the Environment Agency's Flood Map is enclosed in **Appendix C**. The mapping shows that the site is wholly located within Flood Zone 1, an area at 'very low' risk of flooding from fluvial or tidal sources. Areas in Flood Zone 1 have a less than 1 in 1000 probability of flooding each year.

5.2 The risk from fluvial flooding is therefore deemed to be very low.

Surface Water

5.3 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 including sewers, rivers and watercourses 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'. The EA's surface water flood risk map, DEFRA surface water flood risk mapping can be seen in **Appendix F.**

5.4 A high-risk scenario indicates a greater than 1 in 30 probability of surface water flooding each year, i.e. the most frequently occurring scenario. In a high-risk scenario the majority of the existing car park (where the proposed building is to be located), is subject to flood depths of between 300 and 900mm with a small patch of below 300mm in the south-east corner of the car park.

5.5 A medium risk scenario indicates a probability of surface water flooding between 1 in 30 and 1 in 100 each year. In a medium risk scenario, the majority of the existing car park (where the proposed building is located), is subject to flood depths of between 300 and 900mm.

5.6 A low risk scenario indicates a probability of surface water flooding between 1 in 100 and 1 in 1000 each year (i.e. the least frequent but worst-case scenario). In a low risk scenario, the majority of the existing car park (where the proposed building is to be located), is subject to flood depths of between 300 and 900mm with a small patch of over 900mm depth, which looks to be located in a localised low-spot.

5.7 Referring to the topographical survey, the levels across the car park in this area vary by around 400mm and as such it is considered that the flood depth would therefore vary. A 'blanket' 900mm depth of flooding could therefore not occur. It is recognised that surface water flood risk will need to be assessed and mitigated against. At this stage, the surface water flood level shall be calculated based on the lowest topographical survey level compared with the maximum flood depth in that location. The lowest level in the area identified at flooding over 900mm is 49.030mAOD. With a flood depth of 900mm, the worst case low-risk surface water flood level is estimated to be 49.930mAOD.

5.8 SK01, also in **Appendix F,** shows the QGIS Overlays of the low-risk surface water flood depths against the proposed site layout. It can be seen that the western-most section of the proposed building is located in an area identified as being subject to over 900mm of surface water flood depth. As described above, it is estimated that this low-risk (worst case) surface water flood level is 49.930mAOD.

5.9 It should be noted that the Low-Risk DEFRA surface water mapping is based on a 1 in 1000-year storm event whilst it is required that flood risk is assessed against a 1:100yr + 40% Climate Change Event. The 1:1000yr flood level is anticipated to be greater than a 1:100 + 40% Climate Change level, as such when used to consider mitigation measures will provide a robust assessment.

5.10 Mitigation measures are clearly required to protect the proposed building from ingress of surface water flooding. These shall be discussed in Section 5, below.

Groundwater

5.11 The West London SFRA mapping shows that the site has >= 75% susceptibility to groundwater flooding.

5.12 As the finished floor levels of the building are higher than surrounding ground levels and the SWMP confirms that there are no recorded flooding incidents within the vicinity, the risk of groundwater flooding to the site is considered to be low.

Artificial

5.13 The EA Flood Map for Planning and West London SFRA show the site is not at risk of flooding from artificial sources therefore the risk from artificial sources can be deemed low.

Sewer Flooding

5.14 Sewer flooding generally results from localised short-term intense rainfall events overloading the capacity of the private and public drainage or due to failures within the public sewer.

5.15 The SFRA mapping shows that there have been no instances of sewer flooding at this location.

5.16 Therefore, due to the lack of recorded instances of sewer flooding within the area the risk from sewer flooding is low.

Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG **Tel 01920 871 777 e: contact@eastp.co.uk www.eastp.co.uk**

6 Mitigation Measures

6.1 The site is in Flood Zones 1, with a high risk of surface water flooding. The proposals are construction of a 6-storey 67no. residential unit scheme with associated parking, landscaping, and infrastructure. As discussed above, the low-risk, worst-case estimated surface water flood level in a 1:1000yr event is 49.930mAOD.

6.2 As the ground floor apartments could experience flooding without mitigation, a water exclusion strategy will be adopted.

Raising Ground Floor Levels

6.3 The Finished Floor Level (FFL) is to be set 300mm above the design flood level for the 1 in 100 year +40%CC water level. As the data for a 1 in 100 + 40%CC storm event is unavailable, the 1 in 1000 year flood levels have been used. Therefore, the FFL for the proposed building is to be set at 50.23m (49.930 + 0.300). At the western-most edge of the proposed building, existing ground levels are around 49.250mAOD which will result in the FFL being approximately 980mm above existing levels in this area. Ramps up to thresholds from the surrounding ground levels will therefore be required to ensure Building Regulations Part M requirements are met.

6.4 In addition to raising ground floor levels to the maximum level possible, flood resilience measures will be included as discussed below. It is also recommended that all electrical sockets on the ground floor are set a minimum of 300mm higher than the proposed internal floor levels.

Flood Resilient Construction Methods

6.5 The following flood resilient mitigation measures are proposed in accordance with the DEFRA guidance document entitled '*Improving the Flood Performance of New Buildings*':

- External walls shall utilise facing bricks (pressed) on the exterior side which perform better than most other options with regard to flood resilience. Mortar joints shall be fully filled for improved water exclusion.
- Cavity insulation will incorporate rigid closed cell materials as these retain integrity and have low moisture take-up.
- At the ground storey, cement or lime render with plaster shall be used for internal linings to avoid disintegration of plasterboard in the event of flooding.
- Durable kitchen fittings shall be utilised. Joints between kitchen units and surfaces shall be adequately sealed to prevent any penetration of water behind fittings.
- Where possible, all service entries at ground storey level should be sealed. Closed cell insulation should be used for pipes at ground storey.
- Non-return valve to be incorporated into the drainage system to prevent back-flow.
- Ground storey water, electricity and gas meters shall be raised, electrical services generally shall be installed at a raised level (within the constraints of Part M Cat 2).

- Ground storey heating systems, boiler units and ancillary devices shall be raised.
- Ground storey wiring for telephone, TV, Internet and other services should be protected by suitable insulation in the distribution ducts to prevent damage.

6.6 These measures will improve the resiliency of the proposed development and minimise the impact of any water entry.

6.7 Further details on these methods and more information on flood resilient design is provided in Chapter 6 of the DEFRA document and can be downloaded here: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/7730/flood_performance.pdf

6.8 In addition, the SFRA highlights some flood resilience measures as follows:

- Replacing gypsum plaster with more water-resistant material, such as lime plaster or cement render and renovating plaster to help reduce water damage to walls;
- Replacing the usual chipboard kitchen or bathroom units with plastic or steel equivalents (where these are appropriate and cost-effective), e.g. plastic kitchen units with removable, waxed good quality wooden doors to help reduce water damage to fixtures;
- Replacing timber floors with solid concrete (only where appropriate), using tiles and a water-proof membrane to prevent water penetration into concrete to help reduce water damage to floors.
- Removing patio doors and installing conventional doors and windows with brickwork construction underneath;
- Installing one-way valves into drainage pipes to prevent sewage backing up into the house; and,
- Using sump and pump systems to remove water from buildings faster than it enters.
- Re-organising the inside of the property to see if valuable and functional items (including service meters and boiler) could be raised above the likely level of a future flood.

Flood Barriers

6.9 Demountable flood barriers and doors with water sensors are proposed in addition to the other flood mitigation measures, as sleeping accommodation is proposed on the ground floor levels

Flood Warning Plan

6.10 The proposed mitigation measures are anticipated to ensure flood waters do not enter the proposed building in surface water flood events up to the 1:1000yr event. The probability of ingress of waters is considered to be very low and as such, in most storm events, residents would have safe refuge within their properties.

6.11 Surface water flood progress does not behave in the same way that a fluvial flood progression would. Surface water flooding, particularly in a Flood Zone 1 area where it would not be influenced by fluvial flooding, is more likely to be a 'flash flooding' occurrence, rather than a situation whereby flood waters recede more slowly. Residents would not therefore be expected to evacuate the site as they would be benefitting from safe refuge within their properties and could await the 'flash' flooding to recede. Emergency services could access the proposed building from the north, if required, as no surface water flooding is expected to occur here.

6.12 It is recommended that all residents should subscribe to the Met Office Weather Warning Service, as flood events are linked with weather warnings. A suitably worded advisory note relating to surface water flood risk mitigation should be provided to all residents of the development as part of the 'Welcome' pack when they move into the building. Due to the nature of surface water flooding, a direct flood warning cannot be provided for this type of flood event.

7 Proposed Drainage Strategy

Pre-development Runoff Rate

7.1 The site is previously developed (brownfield), with an impermeable area of 2700m². Surface water runoff currently drains to the adopted surface water sewers via a private drainage system – flows are currently untreated, unattenuated and unrestricted.

7.2 In order to calculate the existing runoff rates and volumes, a 'dummy' drainage system was modelled in Causeway Flow hydraulic modelling software. Pipe sizes no more than 150mm dia were used to give a conservative estimate. The results are contained in **Appendix G** and are summarised below:

- 1 in 2 year – 27.6 l/s
- 1 in 30 year – 55.7 l/s
- 1 in 100 year – 56.2 l/s
- 1 in 100 year + 40%CC – 56.4 l/s
- 1:100yr 360min Winter Storm Discharge Volume: 148.6m³

Greenfield Runoff Rates

7.3 Greenfield runoff rates calculations have been carried out using Causeway Flow, FEH22 rainfall data and the proposed impermeable area of 0.287ha.

- QBar/QMed – 0.26 l/s
- 1 in 1 year – 0.23 l/s
- 1 in 2 year - 0.26 l/s
- 1 in 30 year – 0.55 l/s
- 1 in 100 year – 0.69 l/s
- 1:100yr 360min Winter Storm Discharge Volume: 20.4m³

7.4 The greenfield runoff rates are included in **Appendix H.**

Surface Water Drainage Design Parameters

7.1 Climate Change Allowance – The 2070s 'Upper End' Climate Change allowance is 40% and shall be applied to the hydraulic drainage network design. (London Management Catchment)

7.2 Storm Events - The Hydraulic Model shall be run for a 1:2yr Storm Event, 1:30yr Storm Event, 1:30yr + 35% Climate Change Event, 1:100yr Storm Event and 1:100yr + 40% Climate Change Storm Event.

7.3 Rainfall Data – FEH2022 Rainfall Data has been used in this assessment.

Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG **Tel 01920 871 777 e: contact@eastp.co.uk www.eastp.co.uk**

7.4 CV (Coefficient of volumetric run-off) – The CV Value for Winter and Summer Storms has been set to 1.0 to represent 100% of runoff from impermeable areas entering the proposed drainage system. A robust approach.

7.5 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."

7.6 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 S5 above, the runoff volume must be discharged at a rate that does not adversely affect flood risk."

7.7 As the site is previously developed, and noting that greenfield runoff rates are low, it is not reasonably practical to match the greenfield runoff volume. It is proposed to provide Long Term Storage, which shall be calculated based on the existing Discharge Volume vs. Proposed Volume to ensure volumes "never exceed the runoff volume from the development site prior to redevelopment" in line with S5 of the Non-Technical Standards.

7.8 Half-Drain Time – Lined devices to half-drain within 48hrs (2880mins). If this is not achieved, the storage device shall be sized to accommodate a further 1:30yr + 40% Climate Change Storm Event.

7.9 Urban Creep – Not applicable for flatted development.

SUDS Hierarchy

7.10 SUDS mimic the natural drainage system and provide a method of surface water drainage which can decrease the quantity of water discharged, and hence reduce the risk of flooding. In addition to reducing flood risk, these features can improve water quality and provide biodiversity and amenity benefits.

7.11 The SUDS management train incorporates a hierarchy of techniques and considers all three SUDS criteria of flood reduction, pollution reduction, and landscape and wildlife benefits. 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.

7.12 The philosophy of SuDS is to replicate as closely as possible the natural drainage from a site predevelopment and to treat runoff to remove pollutants, resulting in a reduced impact on the receiving watercourses. The benefits of this approach are as follows:

- Reducing runoff rates, thus reducing the flood risk downstream;

- Reducing pollutant concentrations, thus protecting the quality of the receiving water body;
- Groundwater recharge;
- Contributing to the enhanced amenity and aesthetic value of development areas; and
- Providing habitats for wildlife in developed areas, and opportunity for biodiversity enhancement.

Site Specific SUDS

7.13 The various SUDS methods have been considered in relation to site-specific constraints. Table 7.1 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 are proposed.	Yes
Infiltration devices & Soakaways (source control)	Store runoff and allow water to percolate into the ground via natural infiltration.	The geology is not anticipated to be suitable for infiltration.	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 will provide water quality improvements to the site.	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 may be proposed at a later date.	Maybe
Swales (permeable conveyance)	Broad shallow channels that convey / store runoff, and allow infiltration (ground conditions permitting).	Bio retention swales are proposed where feasible as part of the drainage network	No
Filter drains & perforated pipes (permeable conveyance)	Trenches filled with granular materials (which are designed to take flows from adjacent impermeable areas) that convey runoff while allowing infiltration.	Filter drains are not proposed as part of the drainage strategy	No
Infiltration basins (end of pipe treatment)	Depressions in the surface designed to store runoff and allow infiltration.	Infiltration basins are not suitable due to groundwater vulnerability.	No
Wet ponds & constructed wetlands (end of pipe treatment)	Provide water quality treatment & temporary storage above the permanent water level.	Basins are proposed as part of the development for water quality, amenity and biodiversity purposes.	No
Attenuation Underground (end of pipe treatment	Oversized pipes or geo-cellular tanks designed to store water below ground level.	Attenuation storage is not necessary as part of the site development.	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.	Raingardens have been proposed	Yes

Table 7.1: Site-Specific Sustainable Drainage Techniques

Consideration of SuDS Hierarchy

7.14 Given the presence of London Clay and the site susceptibility to groundwater flooding, infiltration is not deemed to be suitable or viable. There are no nearby watercourses. Following the SuDS Hierarchy, outfall to a surface water sewer is therefore proposed.

7.15 It is determined that the site currently discharges untreated and unrestricted to the surface water sewer in Bath Road via a private surface water drainage system.

7.16 It is proposed to provide a SuDS Drainage System to attenuate and treat surface water runoff from the site with a restricted outfall directed to the surface water sewers in Bath Road and Noble Road. The 1:100yr + 40% Climate Change will be restricted to a maximum 2.5 l/s. NB: The existing 1:2 yr runoff rate is 27.6 l/s, as such the proposed 2.5 l/s will provide a significant betterment against the existing situation in all storm events.

Proposed SuDS Drainage Strategy

7.17 As outlined in Table 7.1 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 – Green Roofs and Raingarden Planters;

Water Quality – Green Roofs, Raingarden Planters and Permeable Paving;

Biodiversity – Green Roofs and Raingarden Planters;

Amenity – Green Roofs and Raingarden Planters;

7.18 The Proposed SuDS Strategy Layout is included in **Appendix I** and the supporting hydraulic calculations are contained in **Appendix J.**

7.19 Raingarden Planters will intercept surface water runoff from 500m² of roof area.

7.20 A Green Roof covers an area of 160m².

7.21 The Lined Permeable Paving Attenuation System (car park and roadway area) covers 1540m².

7.22 The remaining area to be drained comprises other hardstandings and roof area covering 670m².

7.23 The total contributing area is therefore: 2870m².

7.24 The proposed lined Permeable Paving Attenuation System will collect runoff from the Raingarden Planters, Green Roof and all other impermeable areas. Outfall from the Permeable Paving Attenuation System will then be directed to the existing adopted surface water sewer in Noble Road to the east of the site.

7.25 Causeway Flow hydraulic modelling software has been used to model the proposed SuDS Strategy. The results are contained in **Appendix J**.

7.26 Green Roof and Raingarden Planters have been included in the model with the contributing area shown as Design Modifiers in the results. The contributing area for the permeable paving is shown as a Time Area Diagram. It can be seen that the Green Roof and Raingarden Planters outfall to the Lined Permeable Paving, which has a subbase thickness of 650mm. A 41mm dia orifice plate restricts flows from the development site (see Outflow from "Carpark 1" node). The results for each storm are summarised below:

- 1 in 2 year – 1.1 l/s
- 1 in 30 year – 1.8 l/s
- 1 in 30 year plus 35% Climate Change Allowance – 2.2 l/s
- 1 in 100 year – 2.1 l/s
- 1 in 100 year plus 40% Climate Change Allowance – 2.5 l/s
- 1 in 100 year 360min Winter Storm Discharge Volume: 195.0m^3

7.27 It is proposed to connect to the Thames Water public surface water sewer at manhole MH 2905. A pre-development enquiry has been logged and connection permissions is to be sought at a post-planning stage.

Long Term Storage

7.28 The site is previously developed, and noting that greenfield runoff rates are low, it is not reasonably practical to match the greenfield runoff volume. It is proposed to provide Long Term Storage, which shall be calculated based on the existing Discharge Volume vs. Proposed Volume to ensure volumes "never exceed the runoff volume from the development site prior to redevelopment" in line with S5 of the Non-Technical Standards.

7.29 The existing 1:100yr 360min Winter Storm Discharge Volume is 148.6m^3. The proposed 1:100yr 360min Winter Storm Discharge Volume is 195.0m^3. 195 – 148.6 = 46.4. It will be necessary to provide at least 46.4m^3 of Long Term Storage.

7.30 It can be seen in the hydraulic results that the maximum water level within the permeable paving subbase in a 1:100yr + 40% Climate Change Event is 458mm. The proposed subbase thickness is 600mm, meaning 142mm of subbase is available for Long Term Storage. With a 30% void ratio, and covering an area of 1540m^2, the available volume in the 142mm subbase is: 65.6^3. This exceeds the Long Term Storage volume requirement.

Water Quality

7.31 The drainage system has been designed in order 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 7.3 below. Table 7.4 demonstrates that the proposed SuDS strategy exceeds the required treatment stages. In addition to the permeable paving, the raingardens will also provide a treatment stage.

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK ■ TOPOGRAPHICAL SURVEYS
Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG **Tel 01920 871 777** **e: contact@eastp.co.uk** **www.eastp.co.uk**

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

Table 7.3 Land Use Pollution Hazard Ratings. Extracted from the CIRIA SuDS Manual C753 Simple Index Approach Tool

SuDS Component	Pollution Mitigation Indices		
	Suspended Solids	Metals	Hydrocarbons
Permeable Paving Total Pollution Mitigation	0.7	0.6	0.7

Table 7.4 SuDS Component Pollution Mitigation for Permeable Paving and adapted from the CIRIA SuDS Manual C753 Simple Index Approach Tool

7.32 From Table 7.4 above, each individual pollution mitigation component or combination of the above will meet and exceed the required level of pollution mitigation for removing total suspended solids, metals and hydrocarbons from the surface water runoff from the development site.

Exceedance Route

7.33 The drainage scheme has been designed to manage the 100yr+40% climate change flood event. Should an exceedance event occur, the permeable paving would surcharge and water would pool within the site and then slowly recede into the drainage network.

8 Maintenance of the Proposed Drainage System

8.1 The maintenance of the SuDS features will remain the responsibility of an appointed management/maintenance company. The appointed management company will be responsible for maintaining the green roof, permeable paving, raingarden planters, control devices and outfalls.

8.2 Regular inspections and maintenance should be carried out for each of these elements, particularly after periods of heavy rainfall. Maintenance tasks and frequencies for permeable paving, green roofs and raised raingarden planters are detailed in the CIRIA SUDS Manual (C753) and have been summarised below in **Table 8.1, 8.2 and 8.3**.

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	Stabilise and mow contributing and adjacent areas. Removal of weeds.	As required. 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. Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance of a hazard to the user. Rehabilitation of surface and upper sub-surface.	As required As required As required (if infiltration performance is reduced as a result of significant clogging.)
Monitoring	Initial inspection Inspect for evidence of poor operation and/or weed growth. If required, take remedial action. Inspect silt accumulation rates and establish appropriate brushing frequencies. Monitor inspection chambers.	Monthly for 3 months after installation. 3 monthly, 48 hours after large storms. Annually. Annually.

Table 8.1: Maintenance tasks for permeable paving (Source: CIRIA C753, The SUDS Manual)

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK ■ TOPOGRAPHICAL SURVEYS
Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG **Tel 01920 871 777 e: contact@eastp.co.uk www.eastp.co.uk**

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 (ie one year), replace dead plants as required	Monthly (but usually responsibility of manufacturer)
	Post establishment, replace dead plants as required (where >5% 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 8.2: Maintenance tasks for Green roofs (Source: CIRIA C753, The SUDS Manual)

Maintenance Schedule	Required Action	Typical Frequency
Regular Inspections	Inspect infiltration surfaces for silting and ponding, record de-watering time of the facility and assess standing water levels in	Quarterly.

	underdrain (if appropriate) to determine if maintenance is necessary.	
	Check operation of underdrains by inspection of flows after rain.	Annually.
	Assess plants for disease infection, poor growth, invasive species etc and replace as necessary.	Quarterly.
	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 8.3: Maintenance tasks for bioretention systems i.e. Raingarden Planters (Source: CIRIA C753, The SUDS Manual)

8.3 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.

8.4 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

8.5 All inspection chambers and manholes 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.

8.6 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

8.7 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.

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK ■ TOPOGRAPHICAL SURVEYS
Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG **Tel 01920 871 777 e: contact@eastp.co.uk www.eastp.co.uk**

9 Conclusions

9.1 EAS have prepared this Flood Risk Assessment (FRA) and SuDS Drainage Strategy to accompany a planning application for the erection of a residential building together with associated landscaping and car parking, and including the reconfiguration of the Vista Court, Atlantico House and Peninsula House residential car parks on Nobel Drive. The proposed development is on Land at Status Park, Nobel Drive, Hillingdon, UB3 5EY.

9.2 The site covers an area of 1.626ha and comprises Vista Court, Atlantico House and Peninsula House with associated landscaping and parking areas.

9.3 This Flood Risk Assessment and SuDS Drainage Strategy Report assesses the area within the application boundary relating to the new residential building and its associated landscape and parking only. An area of 0.44ha.

Summary of Flood Risk and Mitigation Measures

9.4 The site is located in Flood Zone 1, and is at high risk of surface water flooding. Mitigation Measures are detailed in Section 5. This will consist of flood resilient construction techniques and raising the FFL of the ground floor to a minimum 50.23m.

Summary of SuDS Strategy

9.5 It is proposed to utilise a number of SuDS Features to form the Surface Water Drainage Strategy in order to meet the 4 Pillars of SuDS.

Water Quantity – Green Roofs and Raingarden Planters;

Water Quality – Green Roofs, Raingarden Planters and Permeable Paving;

Biodiversity – Green Roofs and Raingarden Planters;

Amenity – Green Roofs and Raingarden Planters;

9.6 Meeting the SuDS Hierarchy, it is proposed to attenuate surface water runoff within Green Roof, Raingarden Planters and Lined Permeable Paving with a restricted outfall directed to the adopted surface water sewer network.

9.7 Flows are significantly reduced against the existing situation and Long Term Storage is provided in line with Non-Technical Standards S5.

9.8 It is proposed to connect to the Thames Water public surface water sewer at manhole MH 2905. A pre-development enquiry has been logged and connection permissions is to be sought at a post-planning stage.

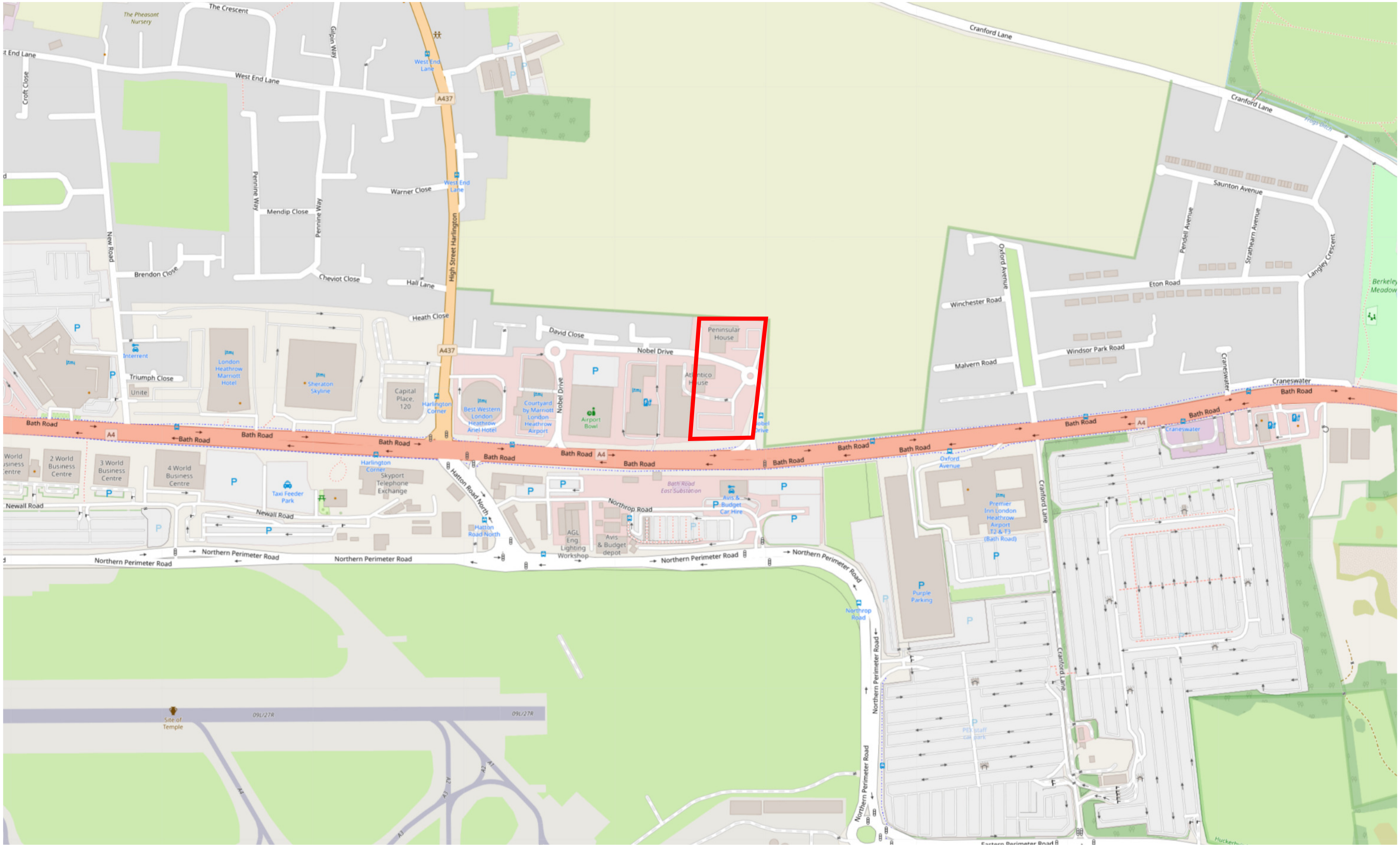
9.9 Maintenance tasks for the permeable paving and green roofs have been discussed, which have been taken from the CIRIA SuDS Manual (C753). It is also important that the proposed SuDS devices are regularly inspected and any debris is removed to prevent a fluvial or surface water flood risk.

10 Appendices

Appendix A – Location Plan
Appendix B – Proposed Development Plans
Appendix C – EA Flood Map for Planning
Appendix D – Topographical Survey
Appendix E – Thames Water Sewer Asset Mapping
Appendix F – DEFRA Surface Water Risk Map Analysis
Appendix G – Brownfield Runoff Calculations
Appendix H – Greenfield Runoff Rates
Appendix I – SuDS Surface Water Drainage Strategy Drawing
Appendix J – Causeway Flow Hydraulic Model Results

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK ■ TOPOGRAPHICAL SURVEYS
Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG **Tel 01920 871 777 e: contact@eastp.co.uk www.eastp.co.uk**

Appendix A – Location Plan



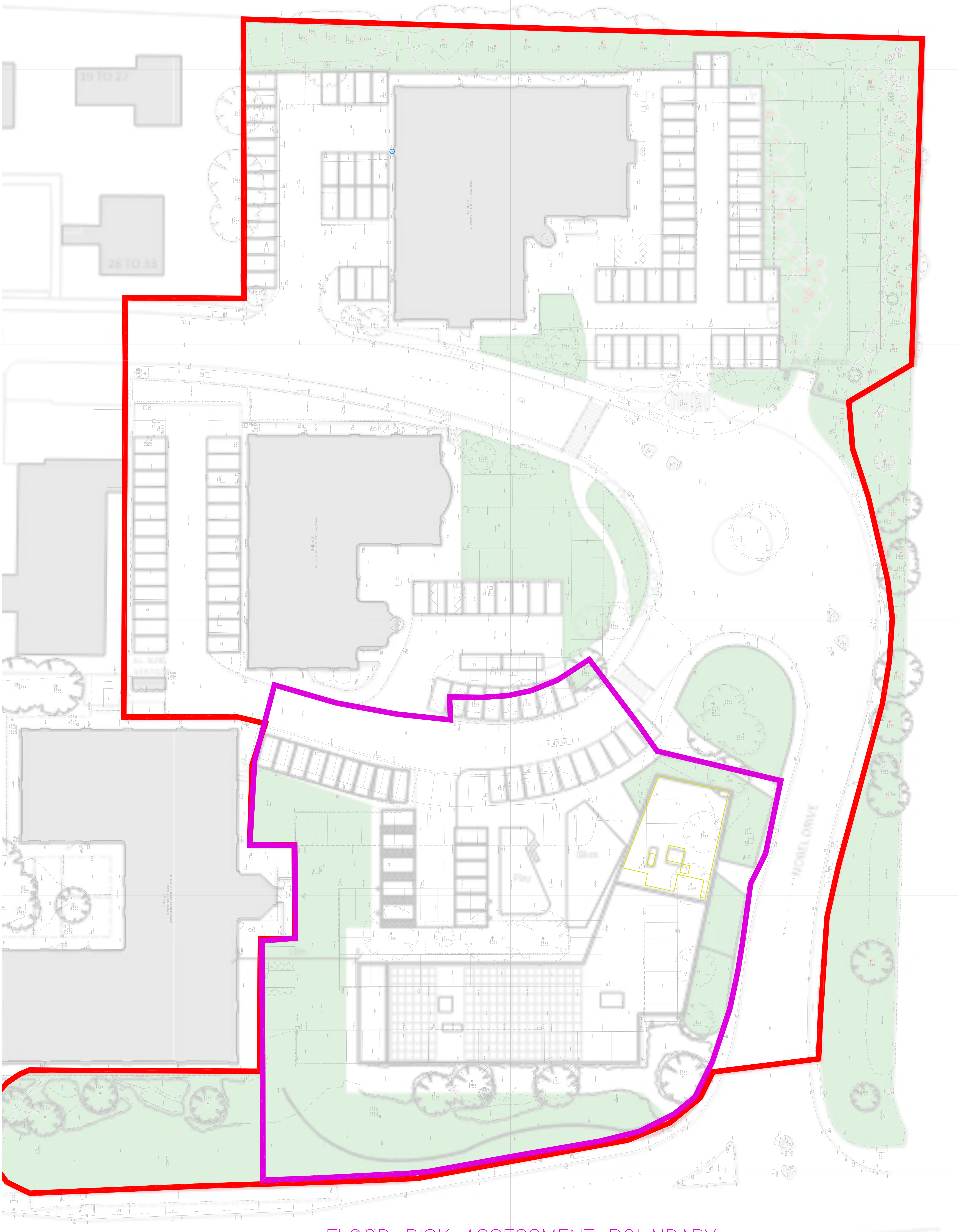
Site Location Plan

EAS

Appendix B – Proposed Development Plans

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK ■ TOPOGRAPHICAL SURVEYS

Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG **Tel 01920 871 777** **e: contact@eastp.co.uk** **www.eastp.co.uk**



FLOOD RISK ASSESSMENT BOUNDARY

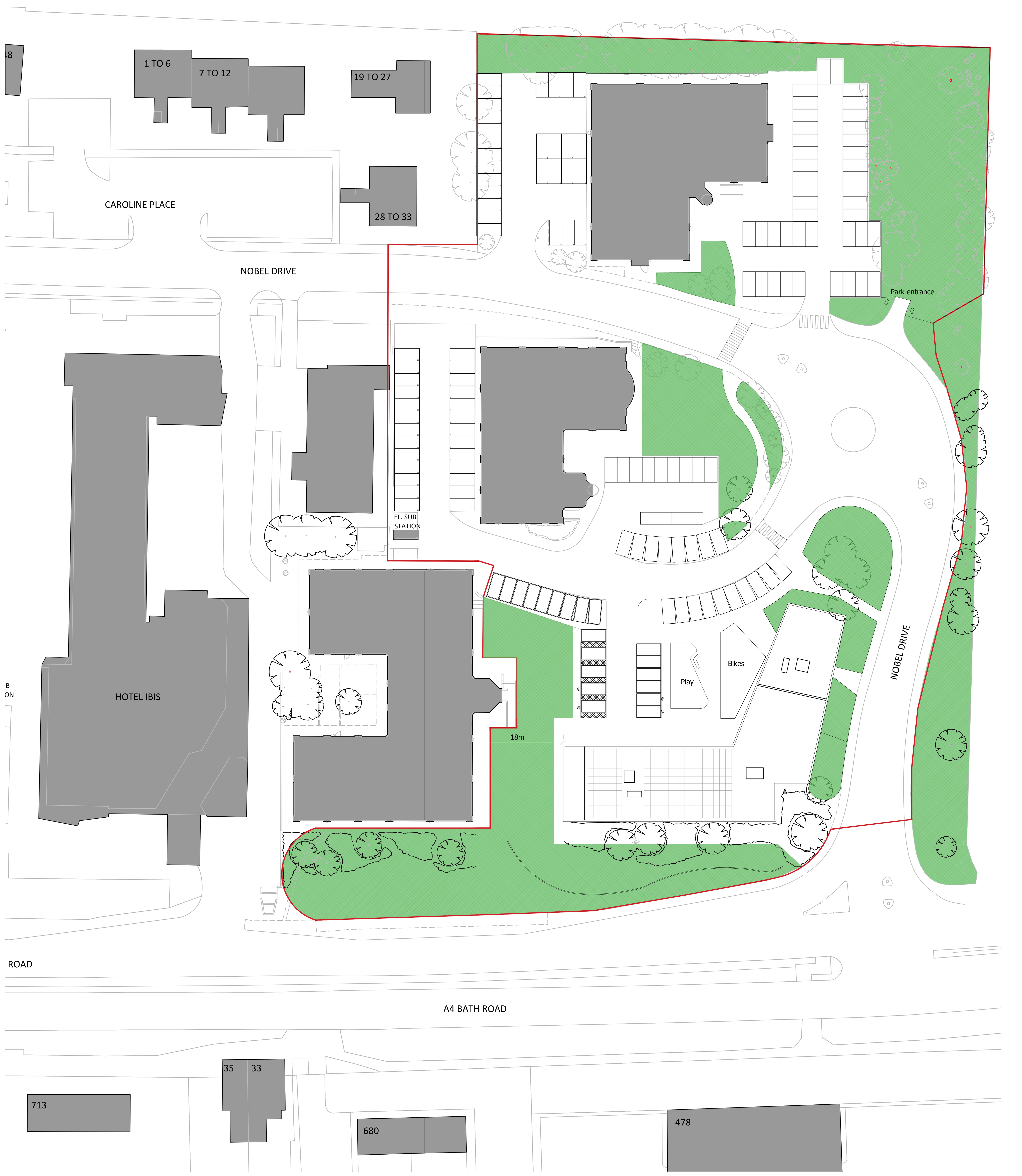
APPLICATION BOUNDARY

SCALE 1:500 0m 5m 10m 20m 30m 40m 50m
SCALE 1:1 0m 10mm 20mm 40mm 60mm 80mm 100mm

N

THE CONTRACTOR MUST VERIFY ALL DIMENSIONS ON SITE BEFORE MAKING SHOP DRAWINGS OR COMMENCING WORK OF ANY KIND.
NO DIMENSIONS TO BE SCALED FROM THIS DRAWING.

REV.	DATE	REVISION
B	06.10.23	Response to planning comments
C	28.05.24	Planning refusal response



01 SITE ESTATE PLAN
Scale 1:500

Key

Soft landscaping/ Usable amenity space. For detail refer to Landscape proposal

PLANNING

Osel architecture

PROJECT:
STATUS PARK
BATH ROAD
HEATHROW

CLIENT:
BMR HEATHROW

DRAWING:
ESTATE MASTER PLAN

DRAWING No.: E21-038/SIT100

REV: C

SCALE: 1:500@A1

DRAWN: WTM

DATE: 12/12/2022

CHECKED:

DATE:

G.04 | The Record Hall | 16-16A Baldwin's Gardens | London | EC1N 7RJ
Tel: 020 7224 2447
E-mail: admin@oselarch.co.uk Web: www.oselarchitecture.co.uk

Appendix C – EA Flood Map for Planning

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK ■ TOPOGRAPHICAL SURVEYS

Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG **Tel 01920 871 777 e: contact@eastp.co.uk www.eastp.co.uk**

Flood map for planning

Your reference	Location (easting/northing)	Created
<Unspecified>	**509181/176999**	**8 Mar 2023 8:59**

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

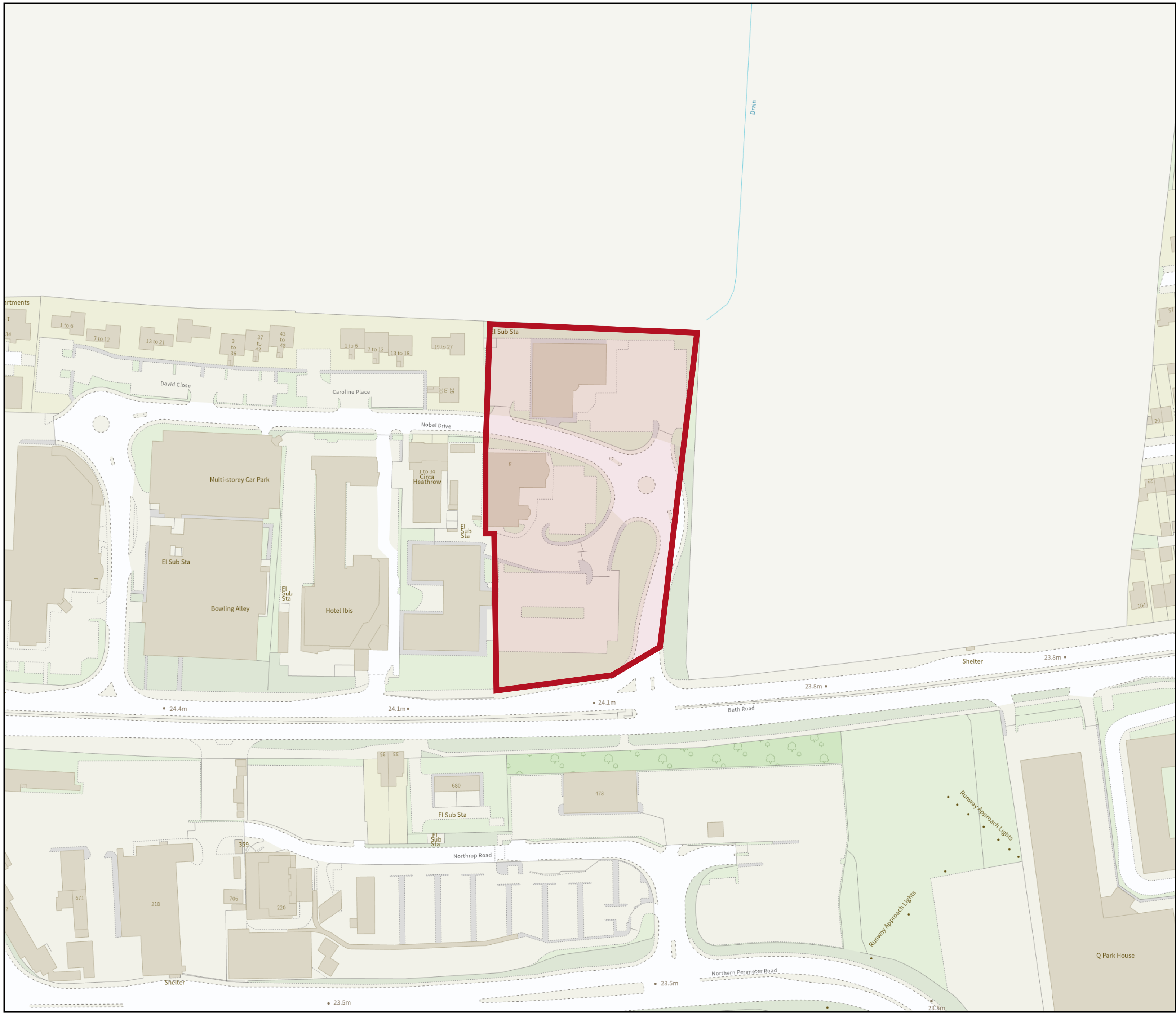
You will need to do a flood risk assessment if your site is **any of the following:**

- 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.



Flood map for planning

Your reference
<Unspecified>

Location (easting/northing)
509181/176999

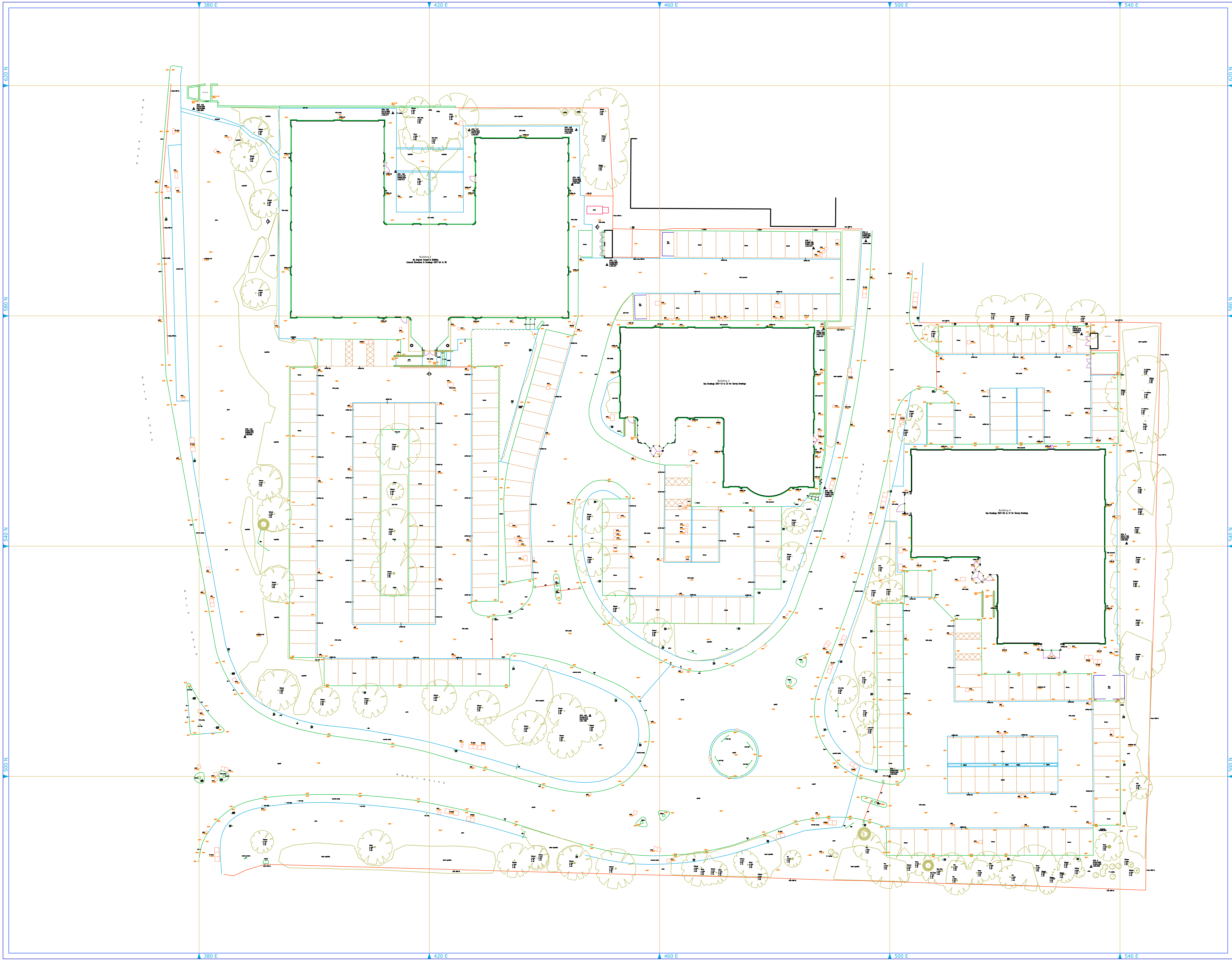
Scale
1:2500

Created
8 Mar 2023 8:59

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

0 20 40 60m

Appendix D – Topographical Survey



Rev.	Description.	Date.

Abbreviations

a/c	Air Conditioning	g	Gully
b	Bollard	bt	British Telecom Cover
boe	Brick on Edge Coping	gv	Gas Valve
bt	British Telecom Cover	ht	Height
catv	Cable TV Cover	ic	Inspection Cover
c/b	Close Board	il	Invert Level
cf	Ceiling Fall	l/a	Limited Access
cl	Cover Level	l/v/a	Limited Visual Access
conc	Concrete	l/l	Low Level
dk	Drop Kerb	l/p	Lamp Post
dp	Down Pipe	n/a	No Access
er	Earth Rod	o/h	Over Head
fai	Fresh Air Inlet	r / rad	Radiator
far	Flat Asphalt Roof	rwp	Rain Water Pipe
f/b	Flower Bed	s/c	Structural Ceiling
f/c	False Ceiling	svp	Soil & Vent Pipe
fh	Fire Hydrant	wc	Toilet
fhr	Fire Hose Reel	whb	Wash Hand Basin

Legend

	Indicates overhead or hidden feature.
	Indicates centre of steel , handrail or as annotated.
dh. 1960	Door height from finished floor level. (mm)
c. 950	Cill height from finished floor level. (mm)
h. 1380	Head height from cill level. (mm)
sp. 2250	Spring height from cill or finished floor level. (mm)
2550	Height to ceiling/beam/soffit. (mm)
	Trees identified and measured approximately only
	Tree species
	d. 0.5m - Trunk diameter in metres
	h. 8m - Height in metres
	s. 10m - Spread in metres

Please Note:

1)	This survey has been produced in accordance with the RICS specifications for Surveys of Land, Buildings and Utility Services.
2)	The accuracy of this survey is dependent upon the scale of the commissioned survey. Users must be careful when re-scaling from any plots, using the grid to verify the scale.
3)	This survey is on an arbitrary grid, both in origin and orientation. Furthermore, the North arrow is indicative only.

North Arrow

W

S N

E

Levels

All levels are related to a Local Site Datum.

Levels are in metres, positions are indicated by a cross or as noted.

Local Datum Level Value 50.000m

Location: Traverse Station 1 nail near entrance to Building 4 car park.

Project Title:	Status Park, Nobel Drive, Hayes, Middlesex UB3 5EY		
Project No.:	3167		
Drawing Title:	Site Plan		
Drawing No.:	3167-01	Revision:	
Client:	Planning & Consulting Ltd.		
	214 Stamford Hill		
	London N16 6RA		
Drawn:	J.G.	Checked:	R.E.M.
Scale:	1:200	Sheet Size:	A0
Date:	March 2017		

NGM SURVEYS
CHARTERED LAND SURVEYORS
LAND & BUILDING SOLUTIONS

Southern Office
Norwich House
14 North Street
Guildford GU1 4AF
Tel: 01483 459 317

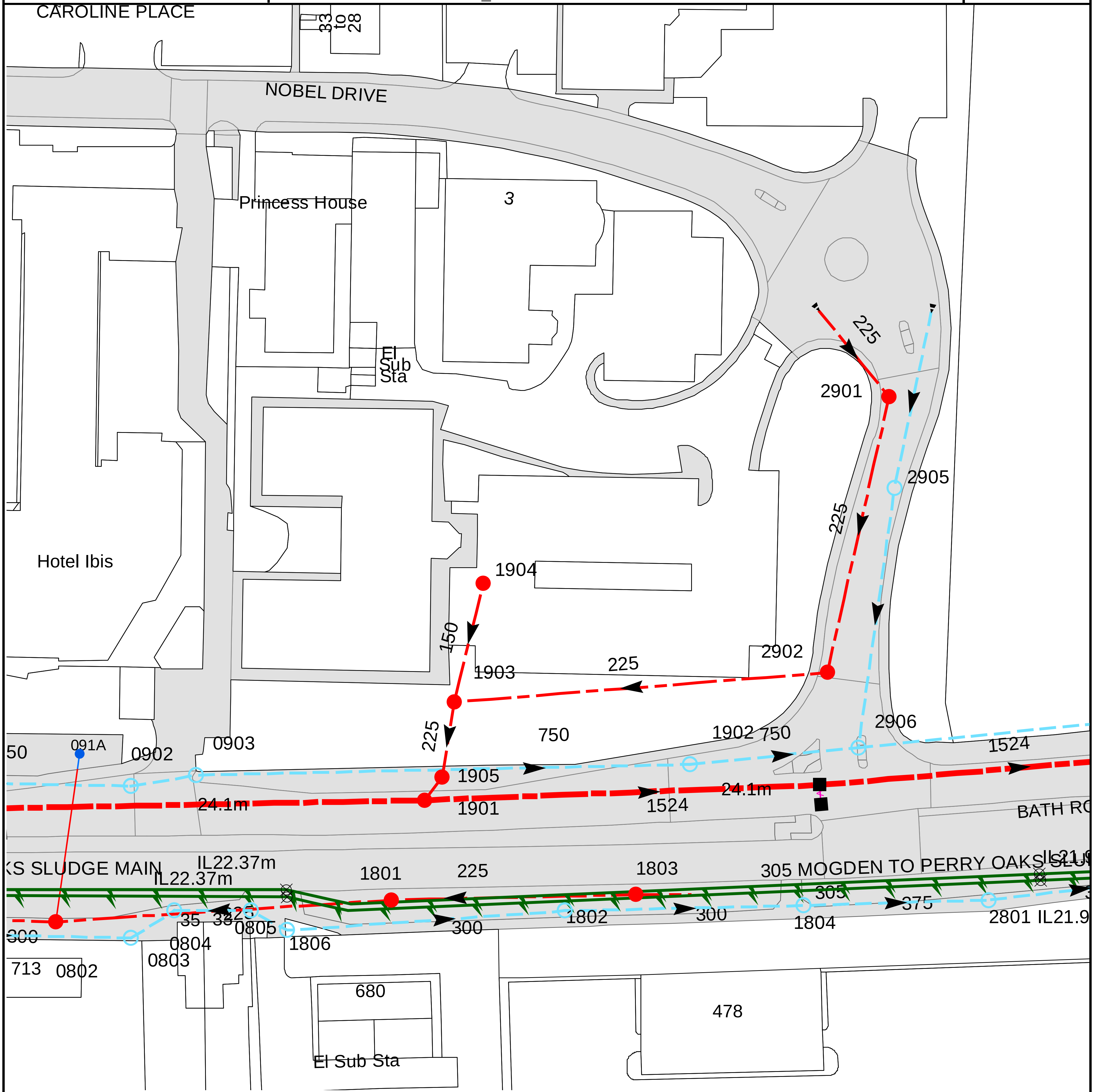
Midlands Office
Williamson Court
2 Foundry Street
Worcester WR1 2BJ
Tel: 01905 233 81

www.ngmsurveys.co.uk

Appendix E – Thames Water Sewer Asset Mapping

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK ■ TOPOGRAPHICAL SURVEYS
Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG Tel 01920 871 777 e: contact@eastp.co.uk www.eastp.co.uk

Asset Location Search Sewer Map - ALS/ALS Standard/2018_3835252



The width of the displayed area is 200 m and the centre of the map is located at OS coordinates 509152,176956

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

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

Manhole Reference	Manhole Cover Level	Manhole Invert Level
0802	24.04	20.49
091A	n/a	n/a
0803	23.9	22.87
0902	24.13	22.73
0804	23.97	22.86
0903	24.38	22.67
0805	24.01	22.81
1806	n/a	n/a
1801	24.18	20.68
1901	24.3	14.9
1905	n/a	n/a
1903	n/a	n/a
1904	n/a	n/a
1802	23.71	22.56
1803	24.03	20.93
1902	24.14	22.57
1804	23.79	22.34
2902	n/a	n/a
2906	n/a	n/a
2901	n/a	n/a
2905	n/a	n/a
2801	24.01	22.36

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

Based on the Ordnance Survey Map with the sanction of the Controller of H.M Stationary Office License Number 10019345

ALS/ALS Standard/2018_3835252

0 10 20 40 60 80
Meters

Scale: 1:1789
Width: 500m
Printed By: dshivaji
Print Date: 13/07/2018
Map Centre: 509152,176955
Grid Reference: TQ0976NW

Comments:

ALS/ALS Standard/2018_3835252

NB: Level quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates no Survey information is available.

REFERENCE	COVER LEVEL	INVERT LEVEL
0901	24.32	22.77
0802	24.04	20.49
0803	23.9	22.87
0804	23.97	22.86
0805	24.01	22.81
1101	24.7	22.51
1901	24.3	14.9
1903		
1802	23.71	22.56
1902	24.14	22.57
2902		
2901		
2801	24.01	22.36
2803	24.09	22.34
0101	24.76	22.6
9001	24.73	22.45
3903	24.08	22.18
3904	24.08	22.13
3902	24.08	22.28
9803	23.97	23.02
9902	24.51	22.8
9906		
9907		

REFERENCE	COVER LEVEL	INVERT LEVEL
0801	24.05	22.96
091A		
0902	24.13	22.73
0903	24.38	22.67
1806		
1801	24.18	20.68
1905		
1904		
1803	24.03	20.93
1804	23.79	22.34
2906		
2905		
2802	24.14	22.14
9151		
9052	24.91	23.14
9051	24.69	23.51
3905		
3901	24.09	14.61
9804	24.07	22.92
9802	24.19	23.19
9905		
9908		

ALS Sewer Map Key

Public Sewer Types (Operated & Maintained by Thames Water)

Foul: A sewer designed to convey waste water from domestic and industrial sources to a treatment works.

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

Combined: A sewer designed to convey both waste water and surface water from domestic and industrial sources to a treatment works.

- Trunk Surface Water
- Trunk Foul
- Storm Relief
- Trunk Combined
- Vent Pipe
- Bio-solids (Sludge)
- Proposed Thames Surface Water Sewer
- Proposed Thames Water Foul Sewer
- Gallery
- Foul Rising Main
- Surface Water Rising Main
- Combined Rising Main
- Sludge Rising Main
- Proposed Thames Water Rising Main
- Vacuum

Sewer Fittings

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

- Air Valve
- Dam Chase
- Fitting
- Meter
- Vent Column

Operational Controls

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

- Control Valve
- Drop Pipe
- Ancillary
- Weir

End Items

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

- Outfall
- Undefined End
- Inlet

Other Symbols

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

- Public/Private Pumping Station
- Change of characteristic indicator (C.O.C.I.)
- Invert Level
- Summit

Areas

Lines denoting areas of underground surveys, etc.

- Agreement
- Operational Site
- Chamber
- Tunnel
- Conduit Bridge

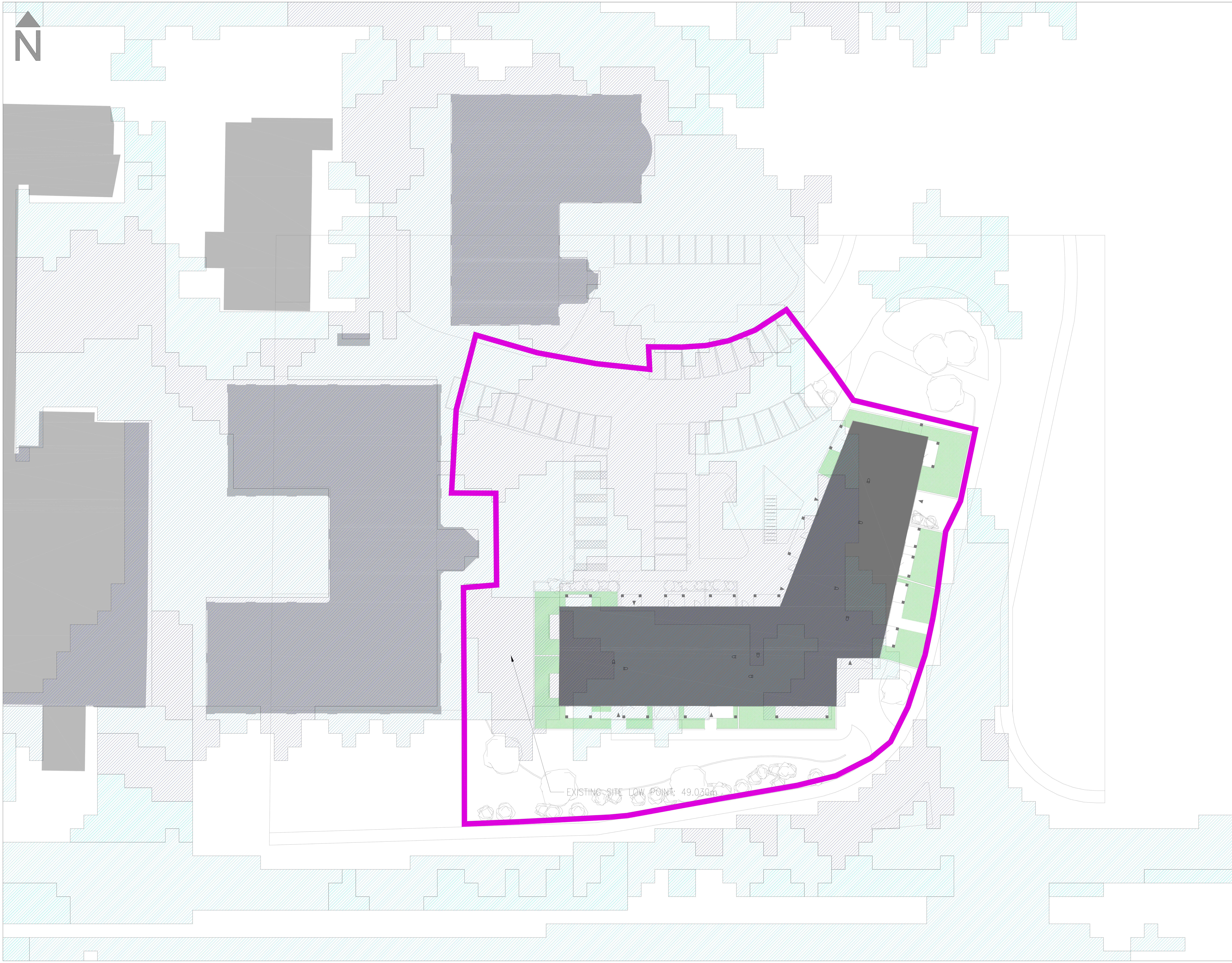
Other Sewer Types (Not Operated or Maintained by Thames Water)

- Foul Sewer
- Surface Water Sewer
- Combined Sewer
- Gulley
- Culverted Watercourse
- Proposed
- Abandoned Sewer

Notes:

1) All levels associated with the plans are to Ordnance Datum Newlyn.
2) All measurements on the plans are metric.
3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate direction of flow.
4) Most private pipes are not shown on our plans, as in the past, this information has not been recorded.
5) 'na' or '0' on a manhole level indicates that data is unavailable.
6) The text appearing alongside a sewer line indicates the internal diameter of the pipe in milimetres. Text next to a manhole indicates the manhole reference number and should not be taken as a measurement. If you are unsure about any text or symbology present on the plan, please contact a member of Property Insight on 0845 070 9148.

Appendix F – DEFRA Surface Water Risk Map Analysis



KEY

- ASSESSMENT BOUNDARY
- EXISTING BUILDING
- PROPOSED BUILDING
- 0.00m–0.15m SW FLOOD DEPTH
- 0.15m–0.30m SW FLOOD DEPTH
- 0.30m–0.60m SW FLOOD DEPTH
- 0.60m–0.90m SW FLOOD DEPTH
- 0.90m–1.20m SW FLOOD DEPTH

ESTIMATED FLOOD LEVEL FOR THE SITE: 49.930m

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

DRAWING STATUS: PRELIMINARY

EAS
Unit 23, The Maltings, Stanstead Abbotts, Hertfordshire, SG12 8HG
Tel: 01920 871777
www.eastp.co.uk

CLIENT: MGH HEATHOW LTD

ARCHITECT: FOR OSEL ARCHITECTURE

PROJECT: STATUS PARK, NOBEL DRIVE
HILLINGDON BC

TITLE: SURFACE WATER FLOOD DEPTHS
1 IN 100 YEAR STORM EVENT

SCALE @ A1:	DESIGN–DRAWN:	DATE:
1:250	JC	18.04.2023

PROJECT No:	DRAWING No:
4401	SK01–A

Appendix G – Brownfield Runoff Calculations

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	30	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	0.750	Preferred Cover Depth (m)	0.900
Time of Entry (mins)	4.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	x
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
mh1	0.060	4.00	49.500	1200	6.974	68.838	1.200
mh2	0.060	4.00	49.500	1200	9.195	68.838	1.200
mh3	0.060	4.00	49.500	1200	11.245	68.813	1.200
mh4	0.060	4.00	49.500	1200	9.245	66.397	1.325
outfall	0.030		49.500	1200	9.258	63.971	1.450

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	mh1	mh4	10.000	0.600	48.300	48.175	0.125	80.0	150	4.15	50.0
1.001	mh4	outfall	10.000	0.600	48.175	48.050	0.125	80.0	150	4.30	50.0
2.000	mh2	mh4	10.000	0.600	48.300	48.175	0.125	80.0	150	4.15	50.0
3.000	mh3	mh4	10.000	0.600	48.300	48.175	0.125	80.0	150	4.15	50.0

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	1.125	19.9	8.1	1.050	1.175	0.060	0.0	67	1.067
1.001	1.125	19.9	32.5	1.175	1.300	0.240	0.0	150	1.146
2.000	1.125	19.9	8.1	1.050	1.175	0.060	0.0	67	1.067
3.000	1.125	19.9	8.1	1.050	1.175	0.060	0.0	67	1.067

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	10.000	80.0	150	Circular	49.500	48.300	1.050	49.500	48.175	1.175
1.001	10.000	80.0	150	Circular	49.500	48.175	1.175	49.500	48.050	1.300
2.000	10.000	80.0	150	Circular	49.500	48.300	1.050	49.500	48.175	1.175
3.000	10.000	80.0	150	Circular	49.500	48.300	1.050	49.500	48.175	1.175

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	mh1	1200	Manhole	Adoptable	mh4	1200	Manhole	Adoptable
1.001	mh4	1200	Manhole	Adoptable	outfall	1200	Manhole	Adoptable
2.000	mh2	1200	Manhole	Adoptable	mh4	1200	Manhole	Adoptable
3.000	mh3	1200	Manhole	Adoptable	mh4	1200	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
mh1	6.974	68.838	49.500	1.200	1200	0	1.000	48.300	150
mh2	9.195	68.838	49.500	1.200	1200	0	2.000	48.300	150
mh3	11.245	68.813	49.500	1.200	1200	0	3.000	48.300	150
mh4	9.245	66.397	49.500	1.325	1200	1	3.000	48.175	150
						2	2.000	48.175	150
						3	1.000	48.175	150
						0	1.001	48.175	150
outfall	9.258	63.971	49.500	1.450	1200	1	1.001	48.050	150

Simulation Settings

Rainfall Methodology	FEH-22	Skip Steady State	x	2 year (l/s)	0.2
Summer CV	0.750	Drain Down Time (mins)	1440	30 year (l/s)	0.5
Winter CV	0.840	Additional Storage (m³/ha)	20.0	100 year (l/s)	0.7
Analysis Speed	Normal	Check Discharge Rate(s)	✓	Check Discharge Volume	x

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
30	0	0	0
100	0	0	0
100	40	0	0

Pre-development Discharge Rate

Site Makeup	Greenfield	Growth Factor 30 year	1.95
Greenfield Method	FEH	Growth Factor 100 year	2.48
Positively Drained Area (ha)	0.218	Betterment (%)	0
SAAR (mm)	610	QMed	0.2
Host	1	QBar	0.2
BFIHost	0.723	Q 1 year (l/s)	
Region	6	Q 30 year (l/s)	
QBar/QMed conversion factor	1.136	Q 100 year (l/s)	
Growth Factor 1 year	0.85		

Results for 2 year Critical Storm Duration. Lowest mass balance: 99.60%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	mh1	11	48.526	0.226	8.6	0.4815	0.0000	SURCHARGED
15 minute winter	mh2	11	48.526	0.226	8.6	0.4815	0.0000	SURCHARGED
15 minute winter	mh3	11	48.526	0.226	8.6	0.4815	0.0000	SURCHARGED
15 minute winter	mh4	11	48.506	0.331	28.1	0.6735	0.0000	SURCHARGED
15 minute winter	outfall	11	48.192	0.142	31.3	0.0000	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 winter	mh1	1.000	mh4	6.9	0.470	0.347	0.1760	
15 minute winter	mh2	2.000	mh4	6.9	0.470	0.347	0.1760	
15 minute winter	mh3	3.000	mh4	6.9	0.470	0.347	0.1760	
15 minute winter	mh4	1.001	outfall	27.6	1.570	1.391	0.1741	15.1

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.60%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	mh1	10	49.500	1.200	25.6	2.5572	1.8251	FLOOD
15 minute winter	mh2	10	49.500	1.200	25.6	2.5572	1.8251	FLOOD
15 minute winter	mh3	10	49.500	1.200	25.6	2.5572	1.8251	FLOOD
15 minute winter	mh4	10	49.464	1.289	61.9	2.6248	0.0000	FLOOD RISK
15 minute summer	outfall	8	48.192	0.142	67.7	0.0000	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 winter	mh1	1.000	mh4	13.6	0.775	0.686	0.1760	
15 minute winter	mh2	2.000	mh4	13.6	0.775	0.686	0.1760	
15 minute winter	mh3	3.000	mh4	13.6	0.775	0.686	0.1760	
15 minute winter	mh4	1.001	outfall	55.7	3.166	2.804	0.1743	39.8

Results for 100 year Critical Storm Duration. Lowest mass balance: 99.60%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	mh1	9	49.500	1.200	33.0	2.5572	4.7609	FLOOD
15 minute winter	mh2	9	49.500	1.200	33.0	2.5572	4.7609	FLOOD
15 minute winter	mh3	9	49.500	1.200	33.0	2.5572	4.7609	FLOOD
15 minute winter	mh4	9	49.483	1.308	63.0	2.6647	0.0000	FLOOD RISK
15 minute summer	outfall	7	48.192	0.142	72.4	0.0000	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 winter	mh1	1.000	mh4	13.5	0.768	0.680	0.1760	
15 minute winter	mh2	2.000	mh4	13.5	0.768	0.680	0.1760	
15 minute winter	mh3	3.000	mh4	13.5	0.768	0.680	0.1760	
15 minute winter	mh4	1.001	outfall	56.2	3.191	2.826	0.1743	43.8

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.60%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	mh1	8	49.500	1.200	46.1	2.5572	10.9204	FLOOD
15 minute winter	mh2	8	49.500	1.200	46.1	2.5572	10.9204	FLOOD
15 minute winter	mh3	8	49.500	1.200	46.1	2.5572	10.9204	FLOOD
15 minute summer	mh4	9	49.497	1.322	75.9	2.6931	0.0000	FLOOD RISK
15 minute summer	outfall	6	48.192	0.142	79.4	0.0000	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 winter	mh1	1.000	mh4	13.6	0.771	0.683	0.1760	
15 minute winter	mh2	2.000	mh4	13.6	0.771	0.683	0.1760	
15 minute winter	mh3	3.000	mh4	13.6	0.771	0.683	0.1760	
15 minute summer	mh4	1.001	outfall	56.4	3.205	2.839	0.1743	46.0

Flow+ - 20240621-Brownfield.pfd

e Help

- Sketch
- Simulation Settings
- Storm Network
- Design Settings
- Nodes
- Links
- Manhole Schedule
- Hydrographs
- Flow Controls
- Storage
- Other

+ | 100 year | 360 minute winter

Results for 100 year 360 minute winter. 1800 minute analysis at 8 minute timestep.

US Node ID	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status	Link ID	DS Node ID	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
mh1	184	48.347	0.047	4.3	0.1008	0.0000	OK	1.000	mh4	4.3	0.427	0.216	0.0991	
mh2	184	48.347	0.047	4.3	0.1008	0.0000	OK	2.000	mh4	4.3	0.427	0.216	0.0991	
mh3	184	48.347	0.047	4.3	0.1008	0.0000	OK	3.000	mh4	4.3	0.427	0.216	0.0991	
mh4	184	48.295	0.120	17.2	0.2439	0.0000	OK	1.001	outfall	17.2	1.201	0.864	0.1427	148.6
outfall	184	48.157	0.107	19.4	0.0000	0.0000	OK							

Appendix H – Greenfield Runoff Rates

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK ■ TOPOGRAPHICAL SURVEYS

Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG **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)	30	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	1.000	Preferred Cover Depth (m)	0.900
Time of Entry (mins)	4.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	x
Maximum Rainfall (mm/hr)	50.0		

Simulation Settings

Rainfall Methodology	FEH-22	Skip Steady State	x	2 year (l/s)	0.0
Rainfall Events	Singular	Drain Down Time (mins)	2880	30 year (l/s)	0.0
Summer CV	1.000	Additional Storage (m³/ha)	0.0	100 year (l/s)	0.0
Winter CV	1.000	Starting Level (m)		Check Discharge Volume	✓
Analysis Speed	Normal	Check Discharge Rate(s)	✓	100 year 360 minute (m³)	

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
30	0	0	0
30	35	0	0
100	0	0	0
100	40	0	0

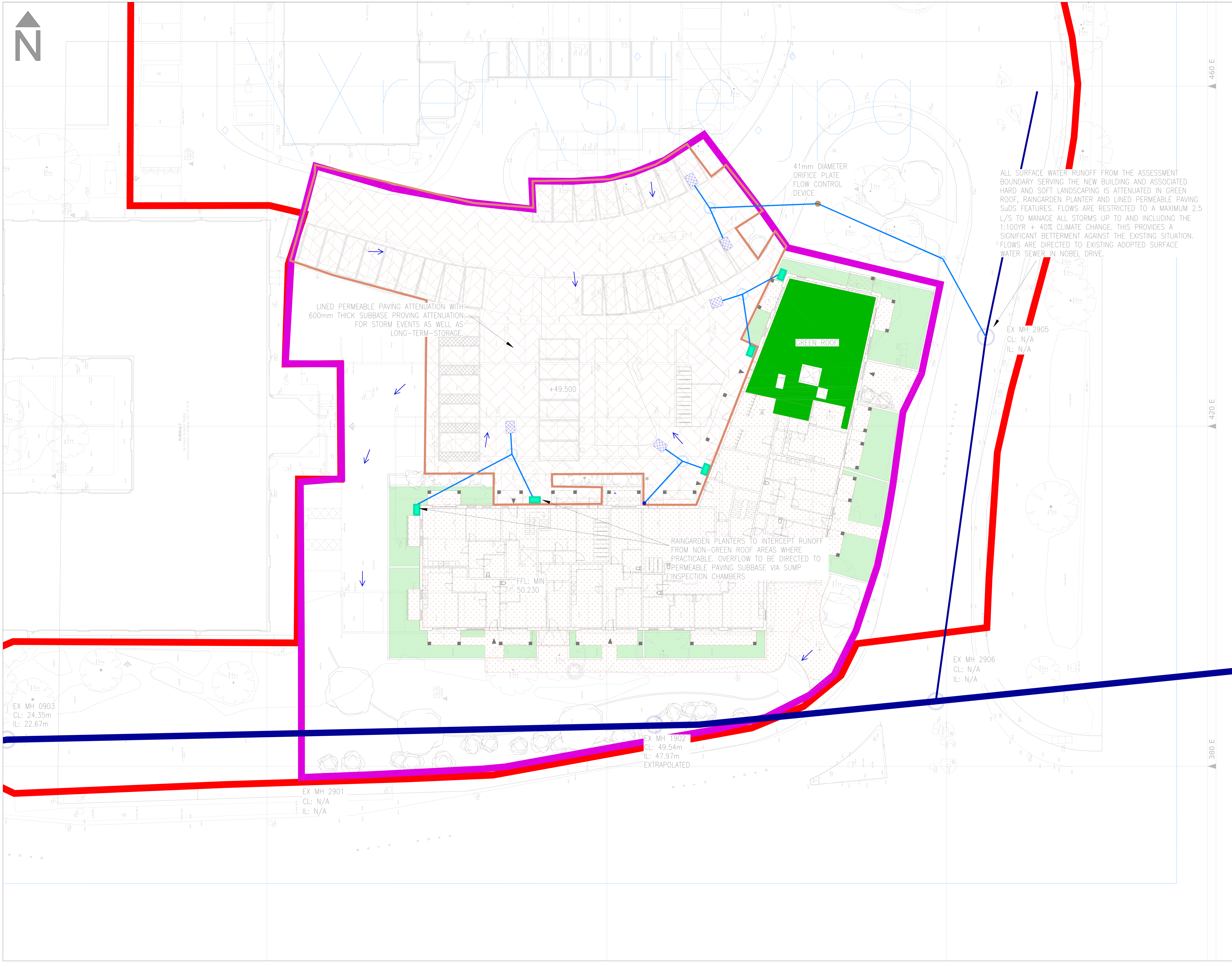
Pre-development Discharge Rate

Site Makeup	Greenfield	Betterment (%)	0
Greenfield Method	ReFH2	Q 1 year (l/s)	1.2
Region	England, Wales, NI	Q 2 year (l/s)	1.5
Include Baseflow	x	Q 30 year (l/s)	4.4
Positively Drained Area (ha)	1.000	Q 100 year (l/s)	6.0

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)	71
Positively Drained Area (ha)	1.000		

Appendix I – SuDS Surface Water Drainage Strategy Drawing



KEY

- SITE BOUNDARY (TOTAL SITE AREA 1.82ha)
- PROPOSED ROOF AND HARDSTANDING AREAS
- PERMEABLE PAVING WITH MIN. 600mm SUB-BASE
- PROPOSED GREEN ROOF (372m^2)
- 150mmø SURFACE WATER PIPE NETWORK LAID AT 1 IN 100
- SURFACE WATER MANHOLE
- PERMAVOID DIFFUSER UNIT
- RAINWATER DOWNPIPE
- 41mm ORIFICE PLATE WITH SUITABLE FILTER TO RESTRICT RUNOFF AT 2.5L/S
- THAMES WATER SURFACE WATER MANHOLE AND SEWER
- THAMES WATER FOUL WATER MANHOLE AND SEWER

ANY REMAINING EXISTING HARDSTANDINGS ARE TO BE UNCHANGED AND ARE TO CONTINUE TO DRAIN TO THE EXISTING PRIVATE DRAINAGE NETWORK

REV	DATE	BY	DESCRIPTION	CHK	APD
B	11.03.25	AW	LLFA COMMENTS	JC	MD

DRAWING STATUS: PRELIMINARY

EAS
Unit 23, The Maltings, Stanstead Abbotts, Hertfordshire, SG12 8HG
Tel: 01920 871777
www.eastp.co.uk

CLIENT: MGH HEATHOW LTD

ARCHITECT: FOR OSEL ARCHITECTURE

PROJECT: STATUS PARK, NOBEL DRIVE HILLINGDON BC

TITLE: SuDS DRAINAGE STRATEGY

SCALE @ A1:	DESIGN-DRAWN:	DATE:
1:200	JC	11.03.25

PROJECT No:	DRAWING No:
4401	SK02-B

EAS

Appendix J – Causeway Flow Hydraulic Model Results

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK ■ TOPOGRAPHICAL SURVEYS

Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG **Tel 01920 871 777 e: contact@eastp.co.uk www.eastp.co.uk**

Design Settings

Rainfall Methodology	FEH-22
Return Period (years)	30
Additional Flow (%)	0
CV	1.000
Time of Entry (mins)	4.00
Maximum Time of Concentration (mins)	30.00
Maximum Rainfall (mm/hr)	50.0

Minimum Velocity (m/s)	1.00
Connection Type	Level Soffits
Minimum Backdrop Height (m)	0.200
Preferred Cover Depth (m)	0.900
Include Intermediate Ground	✓
Enforce best practice design rules	x

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
Carpark 1	0.154	4.00	49.500		9.338	67.533	0.780
standard roof		4.00	49.500	1200	6.517	69.024	0.700
green roof		4.00	49.500	1200	9.381	69.787	0.700
raingardens	0.050	4.00	49.500	1200	12.143	69.203	0.700
demarcation	0.000	4.00	49.500	1200	9.398	64.694	0.900

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	standard roof	Carpark 1	2.000	0.600	48.800	48.720	0.080	25.0	225	4.01	50.0
2.000	green roof	Carpark 1	2.000	0.600	48.800	48.720	0.080	25.0	225	4.01	50.0
3.000	raingardens	Carpark 1	2.000	0.600	48.800	48.720	0.080	25.0	225	4.01	50.0
1.001	Carpark 1	demarcation	5.000	0.600	48.720	48.600	0.120	41.7	150	4.07	50.0

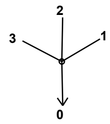
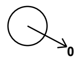
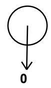
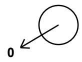
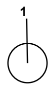
Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	2.627	104.5	0.0	0.475	0.555	0.000	0.0	0	0.000
2.000	2.627	104.5	0.0	0.475	0.555	0.000	0.0	0	0.000
3.000	2.627	104.5	9.0	0.475	0.555	0.050	0.0	44	1.623
1.001	1.563	27.6	36.9	0.630	0.750	0.204	0.0	150	1.592

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	2.000	25.0	225	Circular	49.500	48.800	0.475	49.500	48.720	0.555
2.000	2.000	25.0	225	Circular	49.500	48.800	0.475	49.500	48.720	0.555
3.000	2.000	25.0	225	Circular	49.500	48.800	0.475	49.500	48.720	0.555
1.001	5.000	41.7	150	Circular	49.500	48.720	0.630	49.500	48.600	0.750

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	standard roof	1200	Manhole	Adoptable	Carpark 1		Junction	
2.000	green roof	1200	Manhole	Adoptable	Carpark 1		Junction	
3.000	raingardens	1200	Manhole	Adoptable	Carpark 1		Junction	
1.001	Carpark 1		Junction		demarcation	1200	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
Carpark 1	9.338	67.533	49.500	0.780			1	3.000	48.720	225
							2	2.000	48.720	225
							3	1.000	48.720	225
							0	1.001	48.720	150
standard roof	6.517	69.024	49.500	0.700	1200		0	1.000	48.800	225
green roof	9.381	69.787	49.500	0.700	1200		0	2.000	48.800	225
raingardens	12.143	69.203	49.500	0.700	1200		0	3.000	48.800	225
demarcation	9.398	64.694	49.500	0.900	1200		1	1.001	48.600	150

Simulation Settings

Rainfall Methodology	FEH-22	Skip Steady State	x	2 year (l/s)	0.2
Summer CV	1.000	Drain Down Time (mins)	2880	30 year (l/s)	0.5
Winter CV	1.000	Additional Storage (m³/ha)	20.0	100 year (l/s)	0.7
Analysis Speed	Normal	Check Discharge Rate(s)	✓	Check Discharge Volume	x

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
30	0	0	0
30	35	0	0
100	0	0	0
100	40	0	0

Pre-development Discharge Rate

Site Makeup	Greenfield	Growth Factor 30 year	1.95
Greenfield Method	FEH	Growth Factor 100 year	2.48
Positively Drained Area (ha)	0.218	Betterment (%)	0
SAAR (mm)	610	QMed	0.2
Host	1	QBar	0.2
BFIHost	0.723	Q 1 year (l/s)	
Region	6	Q 30 year (l/s)	
QBar/QMed conversion factor	1.136	Q 100 year (l/s)	
Growth Factor 1 year	0.85		

Node green roof Design Modifiers (Hydrograph)

Overrides Design Area	x	Depression Storage Depth (mm)	5
Overrides Design Additional Inflow	x	Evapo-transpiration (mm/day)	3
Depression Storage Area (m²)	160		

Applies to All storms

Node standard roof Time-Area Diagram

Overrides Design Area	x	Depression Storage Area (m²)	0	Evapo-transpiration (mm/day)	0
Overrides Design Additional Inflow	x	Depression Storage Depth (mm)	0		

Applies to All storms

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-10	0.022	10-20	0.022	20-30	0.023

Node raingardens Design Modifiers (Hydrograph)

Overrides Design Area	x	Depression Storage Depth (mm)	900
Overrides Design Additional Inflow	x	Evapo-transpiration (mm/day)	3
Depression Storage Area (m²)	5		

Applies to All storms

Node raingardens Online Orifice Control

Flap Valve	x	Replaces Downstream Link	✓	Diameter (m)	0.180
Downstream Link	3.000	Invert Level (m)	48.800	Discharge Coefficient	0.600

Node Carpark 1 Online Orifice Control

Flap Valve	x	Replaces Downstream Link	✓	Diameter (m)	0.041
Downstream Link	1.001	Invert Level (m)	48.720	Discharge Coefficient	0.600

Node Carpark 1 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	48.720	Slope (1:X)	1000.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	1088	Depth (m)	0.600
Safety Factor	2.0	Width (m)	39.200	Inf Depth (m)	
Porosity	0.30	Length (m)	39.400		

Results for 2 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Node Vol (m^3)	Flood (m^3)	Status
480 minute winter	Carpark 1	440	48.848	0.128	50.2147	0.0000	OK
480 minute winter	standard roof	384	48.850	0.050	0.1530	0.0000	OK
480 minute winter	green roof	440	48.848	0.048	0.0541	0.0000	OK
120 minute summer	raingardens	66	48.859	0.059	0.1506	0.0000	OK
15 minute summer	demarcation	1	48.600	0.000	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m^3)	Discharge Vol (m^3)
480 minute winter	Carpark 1	Orifice	demarcation	1.1				70.3
480 minute winter	standard roof	1.000	Carpark 1	5.3	0.418	0.050	0.0298	
480 minute winter	green roof	2.000	Carpark 1	0.0	-0.004	0.000	0.0294	
120 minute summer	raingardens	Orifice	Carpark 1	3.8				

Results for 30 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Node Vol (m³)	Flood (m³)	Status
360 minute winter	Carpark 1	352	49.010	0.290	125.4491	0.0000	SURCHARGED
360 minute winter	standard roof	344	49.010	0.210	0.6400	0.0000	OK
360 minute winter	green roof	352	49.010	0.210	0.2375	0.0000	OK
15 minute summer	raingardens	11	49.028	0.228	0.5840	0.0000	SURCHARGED
15 minute summer	demarcation	1	48.600	0.000	0.0000	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)
360 minute winter	Carpark 1	Orifice	demarcation	1.8				151.3
360 minute winter	standard roof	1.000	Carpark 1	18.7	0.703	0.179	0.0784	
360 minute winter	green roof	2.000	Carpark 1	-0.1	-0.005	-0.001	0.0784	
15 minute summer	raingardens	Orifice	Carpark 1	25.2				

Results for 30 year +35% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Node Vol (m³)	Flood (m³)	Status
480 minute winter	Carpark 1	464	49.116	0.396	174.8723	0.0000	SURCHARGED
480 minute winter	standard roof	472	49.117	0.317	0.9649	0.0000	SURCHARGED
480 minute winter	green roof	464	49.116	0.316	0.3576	0.0000	SURCHARGED
15 minute summer	raingardens	10	49.181	0.381	0.9759	0.0000	SURCHARGED
15 minute summer	demarcation	1	48.600	0.000	0.0000	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)
480 minute winter	Carpark 1	Orifice	demarcation	2.2				215.2
480 minute winter	standard roof	1.000	Carpark 1	16.8	0.572	0.161	0.0795	
480 minute winter	green roof	2.000	Carpark 1	-0.1	-0.005	-0.001	0.0795	
15 minute summer	raingardens	Orifice	Carpark 1	36.5				

Results for 100 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Node Vol (m³)	Flood (m³)	Status
480 minute winter	Carpark 1	464	49.096	0.376	165.5607	0.0000	SURCHARGED
480 minute winter	standard roof	464	49.096	0.296	0.9020	0.0000	SURCHARGED
480 minute winter	green roof	464	49.096	0.296	0.3349	0.0000	SURCHARGED
15 minute summer	raingardens	10	49.156	0.356	0.9104	0.0000	SURCHARGED
15 minute summer	demarcation	1	48.600	0.000	0.0000	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)
480 minute winter	Carpark 1	Orifice	demarcation	2.1				204.8
480 minute winter	standard roof	1.000	Carpark 1	15.1	0.457	0.145	0.0795	
480 minute winter	green roof	2.000	Carpark 1	-0.1	-0.005	-0.001	0.0795	
15 minute summer	raingardens	Orifice	Carpark 1	34.8				

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Node Vol (m³)	Flood (m³)	Status
480 minute winter	Carpark 1	472	49.258	0.538	240.7563	0.0000	FLOOD RISK
480 minute winter	standard roof	472	49.258	0.458	1.3932	0.0000	FLOOD RISK
480 minute winter	green roof	472	49.257	0.457	0.5174	0.0000	FLOOD RISK
15 minute summer	raingardens	10	49.408	0.607	1.5552	0.0000	FLOOD RISK
15 minute summer	demarcation	1	48.600	0.000	0.0000	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)
480 minute winter	Carpark 1	Orifice	demarcation	2.5				285.7
480 minute winter	standard roof	1.000	Carpark 1	20.8	0.682	0.199	0.0795	
480 minute winter	green roof	2.000	Carpark 1	-0.1	0.005	-0.001	0.0795	
15 minute summer	raingardens	Orifice	Carpark 1	48.6				