

LAND NORTH OF ARBORFIELD ROAD, SHINFIELD
FLOOD RISK ASSESSMENT AND DRAINAGE STRATEGY

BELLWAY HOMES LTD (THAMES VALLEY)

16 AUGUST 2024



Abley Letchford Partnership Limited
3 Tealgate
Charnham Park
Hungerford
RG17 0YT

T: 01488 684390
E: contact@alpce.co.uk
W: www.alpce.co.uk

Quality Management:

Prepared by:	A Simmons
Authorised by:	E Philpott
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1.0 Introduction

Context

- 1.1. This Flood Risk Assessment (FRA) has been prepared by Abley Letchford Partnership Ltd (ALP) on behalf of Bellway Homes Ltd (Thames Valley), to support a full planning application for 191 residential properties at Land North of Arborfield Road, Shinfield in Reading.

Development Proposals

- 1.2. The proposals are for the provision of 191 residential units as depicted on the Illustrative Masterplan within **Appendix 1**.

Requirement for a Flood Risk Assessment

- 1.3. The requirement for an FRA is set out in Section 14 of the revised National Planning Policy Framework (NPPF) as revised in December 2023.
- 1.4. The footnote accompanying Paragraph 172 states:

‘A site-specific flood risk assessment should be provided for all development 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..’
- 1.5. The site is a greenfield site that comprises of open fields with built development beyond the site to the west and north of the site. The A327 Eastern Relief Road is located to the east of the site. The B3349 Arborfield Road is located to the south of the site.
- 1.6. The area of the site is approximately 7 hectares. As the site area extends to greater than 1 hectare, a site-specific flood risk assessment is required. To comply with the requirements of the NPPF, matters related to flood risk and drainage are addressed within this report.

Report Aim and Formation

- 1.7. The principal aims of this report are to demonstrate that the proposed development complies with national and local planning policy in respect to flood risk and to demonstrate that a suitable drainage strategy can be provided as part of development.
- 1.8. This report will also summarise the impacts the development could have on flood risk to the surrounding area and outlines the mitigation strategies that will be implemented, where required, to address this.
- 1.9. The drainage design embraces the guiding principles of Sustainable Drainage Systems (SuDS) which are central to the design of the surface water drainage strategy for the proposed development.



Report Structure

- 1.10. This report addresses the requirements of revised NPPF and considers the following aspects:
- Section 2: Policy and Sources of Information – a review of policy relevant to the assessment and sources of information used to inform the assessment.
 - Section 3: Site Setting – a description of the site location, topography, geology and hydrology.
 - Section 4: Overview of Flood Risk – a review of data for flooding from all sources to determine the baseline flood risk to the site and an assessment of the impacts of the development on flood risk.
 - Section 5: Proposed Development and Sequential Test – a description of the proposed development and a classification of the vulnerability in the context of the Sequential Test.
 - Section 6: Flood Risk Mitigation – the mitigation measures implemented, where required, to manage the potential flood risk to the development.
 - Sections 7 and 8: Drainage Strategy – a summary of appropriate strategies to manage the surface water and foul water from the site in the post development scenario.
 - Section 9: Conclusion – a summary of the development proposals in the context of site vulnerability and the requirements of the NPPF.



2.0 Policy and Sources of Information

Introduction

- 2.1. This chapter provides a review of policy relevant to the assessment and the available information on all sources of flood risk.

National Planning Policy

- 2.2. National Planning Policy in relation to Flood Risk is set out in Section 14 of the National Planning Policy Framework (NPPF) and Planning Practice Guidance (PPG) ID: 7 for Flood Risk and Coastal Change. Flood Risk is discussed in Paragraphs 165-175 of the NPPF.
- 2.3. Paragraphs 165-168 discuss the sequential approach. Paragraph 166 refers to a Strategic Flood Risk Assessment (SFRA) that would form the basis of applying the Sequential Test for local authorities to allocate development, whilst Paragraphs 168-169 relates to the Exception Test.
- 2.4. Paragraph 173 discusses the determination of planning applications stating:
- ‘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. Development should only be allowed in areas at risk of flooding where, in 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.’*
- 2.5. The proposed development comprising of 191 residential units would be classed as a Major development (providing more than 10 homes and the site is greater than 0.5 hectares). Paragraph 175 states:

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

- a) Take account of advice from the lead local flood authority;*
- b) Have appropriate proposed minimum operational standards;*



- c) *Have maintenance arrangements in place to ensure an acceptable standard of operation for the lifetime of the development; and*
- d) *Where possible, provide multifunctional benefits.'*

Environment Agency

- 2.6. The Flood and Water Management Act (2010) provides the Environment Agency (EA) a strategic overview role for all forms of flooding and coastal erosion. They also have direct responsibility for the prevention, mitigation and remediation of flood damage for main rivers and coastal areas. The EA is a statutory consultee in relation to flood risk and planning dependent upon criteria.
- 2.7. The EA Standing Advice has been consulted and reviewed within this FRA.
- 2.8. The EA Flood Map for Planning, EA Long Term Flood Risk Mapping and the Catchment Data Explorer websites have been interrogated in respect to flood risk extents and sources.

Local Authorities

- 2.9. The site lies within the administrative area of Wokingham Borough Council (WBC). WBC is the Local Planning Authority (LPA). WBC is also the Lead Local Flood Authority (LLFA).
- 2.10. Planning guidance published by WBC regarding the flood risk was referred to in order to assess the methodology best suited to suit the local area. The following key documents were reviewed:
 - Wokingham Borough Council Adopted Core Strategy Development Plan (dated 2010)
 - Wokingham Borough Council Local Flood Risk Management Strategy (dated April 2015)
 - Wokingham Borough Council Preliminary Flood Risk Assessment (PFRA) (dated June 2011) and PFRA addendum (dated 2017)
 - WBC Level 1 Strategic Flood Risk Assessment (SFRA) (published May 2024 but dated May 2023)
 - WBC Level 2 Strategic Flood Risk Assessment (SFRA) (published May 2024 but dated August 2023) and
 - WBC SuDS Strategy (dated January 2017).
- 2.11. WBC became the LLFA under the Flood and Water Management Act 2010. WBC provide guidance to assess, manage and inform flood risk.
- 2.12. As LLFA, WBC's Flood and Water Management Team provide Planning Application Drainage Checklists within the Wokingham SuDS Strategy guidance document to assist developers seeking planning permission for new sites by setting criteria to be met as part of the design of the drainage strategy and a list of documentation to be presented in the associated Flood Risk Assessment. A completed checklist for a Major Development Outline Application is included within **Appendix 2**.
- 2.13. WBC has permissive rights over any ordinary watercourses including land drainage ditches. If any work is required within the watercourse (improvements or crossings) then approval from the LLFA is required under the Flood and Water Management Act 1991.



Local Water Authority

- 2.14. Thames Water (TW) is responsible for the supply of clean water and disposal of wastewater for the Shinfield area.
- 2.15. Information with regards to sewer and water main flooding contained within the SFRA has been reviewed as part of this FRA. All Water Companies have a statutory obligation to maintain a register of properties and areas which are at risk of flooding from the public sewerage system and is shown on the DG5 Flood Register.

Other Sources of Information

- 2.16. A desktop study of the site was carried out using the following websites to ascertain local features, hydrology and soil characteristics:
- DEFRA's Magic Map portal,
 - British Geological Survey (BGS) 'Geology of Britain' online viewer, and
 - Cranfield University 'Soilscapes' portal.
- 2.17. A site walkover was conducted during May 2024 which included observations of the general topography across the site and surrounding area as well as inspection of watercourses, ditches and drainage features both within the site and beyond the site boundary.
- 2.18. Guidance with respect to SuDS is contained within DEFRA document Sustainable Drainage Systems, Non-statutory technical standards for sustainable drainage systems March 2015, CIRIA C753 The SuDS Manual and within the NPPF Planning Practice Guidance (PPG) – 'Flood Risk and Coastal Change'.
- 2.19. Additional guidance on development and flood risk is contained within CIRIA C624 Development and Flood Risk – Guidance for the Construction Industry which identifies several key aims for a development to ensure it is sustainable in flood risk terms.

3.0 Site Setting

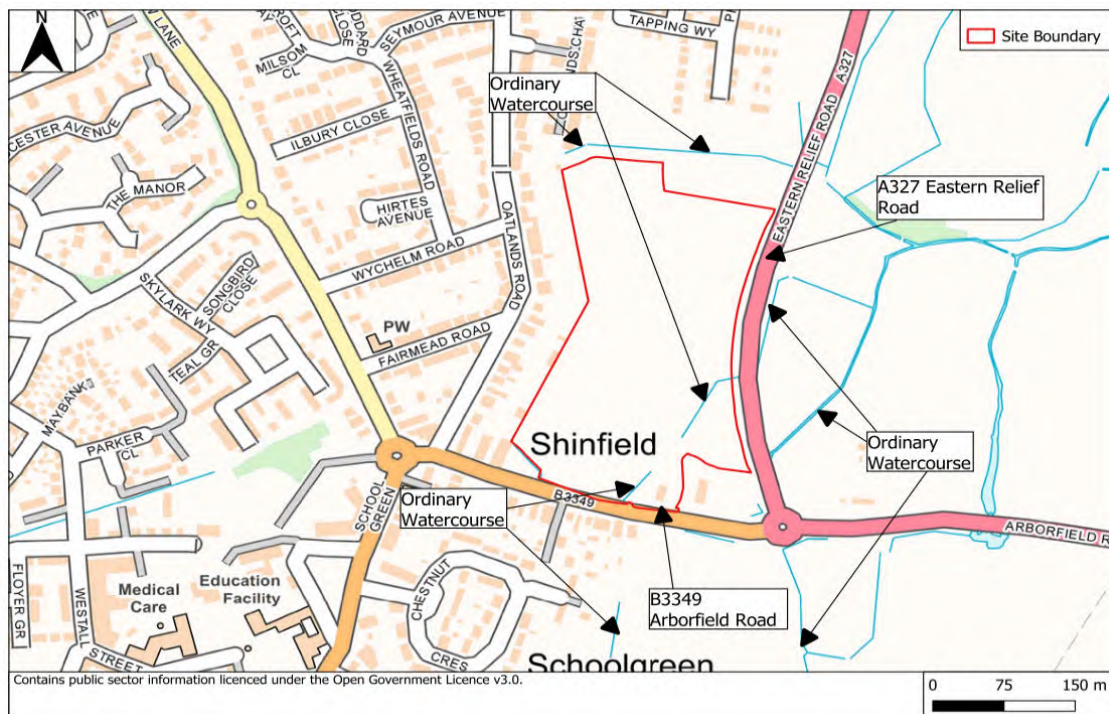
Introduction

- 3.1. This chapter provides a description of the site location, its topography, hydrological context, geology and hydrogeology.

Site Location

- 3.2. The site is located north of the B3349 Arborfield Road, located approximately 0.5km to the northeast of the centre of Shinfield, Reading. The nearest postcode for the site is RD2 9DY. The site centre grid reference is 473697E 168059N. The site location is shown in **Figure 1**.

Figure 1 – Site Location



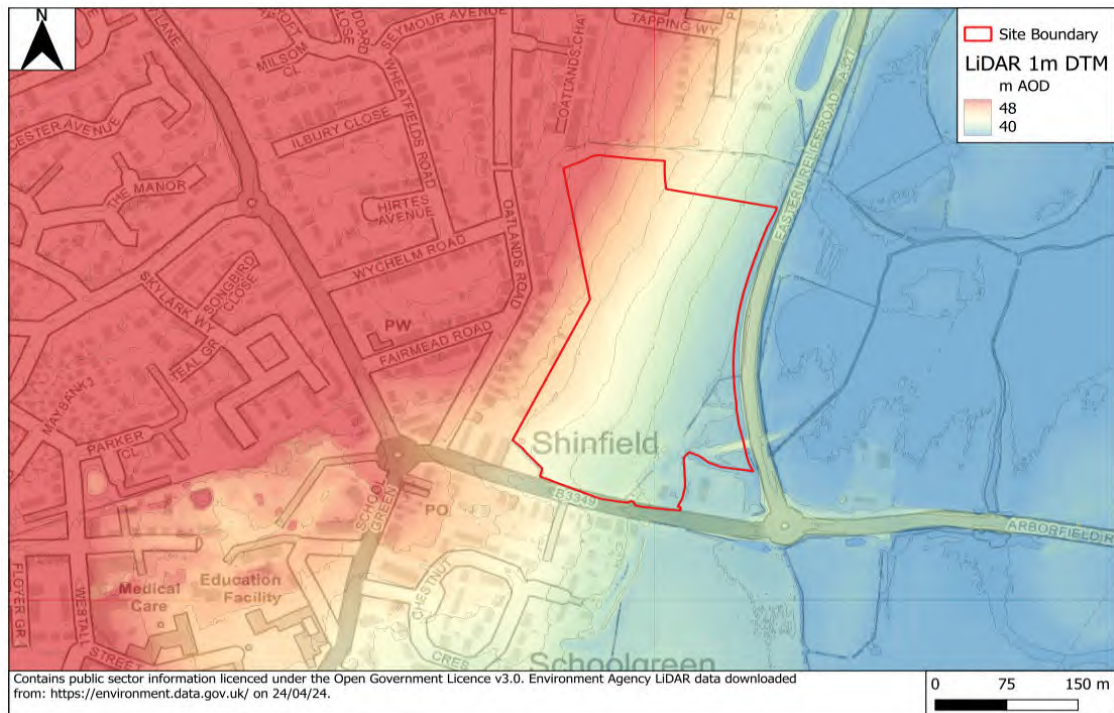
- 3.3. The site is bounded to the east by the A327 Eastern Relief Road and to the south by the B3349 Arborfield Road. There is a residential area to the south of Arborfield Road. To the west of the site is a residential area. To the north of the site is the Cutbush Lane development pursuant to application 181499. This development is nearing completion and comprises a residential development.
- 3.4. The site covers an area of approximately 7 hectares and is currently agricultural land with some trees and hedgerows along the site boundaries.

Topography

- 3.5. Ground levels across the site are shown by LiDAR data in **Figure 2**.

- 3.6. The LiDAR indicates that there is an area of high ground in the northwest of the site and ground levels generally slope down from west to east, with ground levels lowest in the southeast and eastern parts of the site.
- 3.7. Ground levels vary from 49.0m AOD in the northwest to 41.2m AOD to the southeast.

Figure 2 – Site Topography



- 3.8. A topographical survey of the site has been carried out by Encompass Surveys November 2023. A copy of the topographical survey is included in **Appendix 1**.
- 3.9. The topographical survey provides a more detailed representation of the ground levels across the site as well as details of other key features. In general it agrees well with the LiDAR. From the topographical survey, the highest ground level within the site is in the northwest corner with an elevation of 49.2 m AOD and the lowest is in the southeast corner of the site with an elevation of 40.9 m AOD.
- 3.10. The Eastern Relief Road is elevated above the surrounding area. Alongside the site's southern boundary, Arborfield Road generally slopes down to the east towards the roundabout, typically with a grass/vegetated verge at a slightly higher level at the site boundary.

Watercourses and Ditches

- 3.11. The nearest Main River is the River Loddon approximately 600m to the east of the site.
- 3.12. A network of open channel ditches and watercourses form tributaries to the Loddon and some of these extend to the Eastern Relief Road.



- 3.13. Just beyond the site's northern boundary, and at the edge of the Cutbush Lane development is an open channel watercourse. This runs from west to east and is then culverted under the Eastern Relief Road. The culvert has a flap on the eastern side.
- 3.14. Running along both the western and eastern sides of the Eastern Relief Road are open channel features which were, in the main part, brought in when the road was constructed. These run almost the whole length of the road and for a section the western channel runs alongside the site's eastern boundary. There are a number of culverts running under the Eastern Relief Road connecting the two highways ditches and linking these to the network of tributaries of the Loddon to the east. From site observations it was evident that the 'downstream' eastern end of the culverts are flapped, meaning that there is only flow in an easterly direction through the culverts.
- 3.15. On site there are three key features which would be defined as Ordinary Watercourses.
- 3.16. An open watercourse runs from the site's southern boundary along the footpath for a length of approximately 50m, in part culverted and obscured by dense vegetation. From some mapping it is inferred that this watercourse extends upstream along the sites southern boundary, but no evidence of this was found on site. The watercourse commences at the site's boundary where flow emerges from a culvert from the direction of Arborfield Road.
- 3.17. There is a pond in the southeastern part of the site surrounded by dense vegetation. This appears to be a natural feature fed by the watercourse from the site's southern boundary. Survey and site observations were restricted due to the dense vegetation, but the pond appears to spill out towards the site's eastern boundary and the low lying area south of the farm access track. From here any flow joins the highways ditch on the western side of the Eastern Relief Road. There was no evidence of a connection from the southern ditch or the pond to the north under the farm access track.
- 3.18. The third feature is a recently constructed engineered cut off ditch which was part of the work associated with the Eastern Relief Road. It appears to convey any land drainage or surface water flow to the east around the trees. However, site observations showed this to be boggy and heavily vegetated rather than a flowing feature. This connects to the highways ditch alongside the Eastern Relief Road close to a culvert under the road.
- 3.19. In summary there is a natural watercourse and pond in the south eastern part of the site and an engineered cut off ditch north of the farm access track. All these features flow towards the east and join the highways ditch alongside the Eastern Relief Road, eventually flowing east towards the Loddon. As noted, there is a flow route east under the road through various culverts, but these are flapped and would not allow flow back towards the site from the direction of the Loddon.

Surface and Foul Water Sewers

- 3.20. It is currently unclear how the farmhouse and small outlet buildings to the southeast of the site dispose of their surface water. Ditch outfall points and general longitudinal falls were less obvious due to heavy vegetation and restricted access. An open field ditch to west of the Eastern Relief Road was observed during the site walk over.



- 3.21. Sewer Asset Records obtained from TW indicates that there is a foul water sewer running within the site boundary to the west, which connected along Arborfield Road to the south which then runs in an easterly direction. This southern pipe is located outside of the boundary of the site.
- 3.22. A copy of TW Asset Record is included within **Appendix 1**.

Geology and Hydrogeology

- 3.23. British Geological Survey (BGS) 'Geology of Britain' online viewer indicates that the bedrock geology underlying the south of the site is London Clay Formation – clay silt and sand. There are superficial Terrace deposits 3 – sand and gravel in the southern part of the site. There are no records of superficial deposits in the central or northern parts of the site.
- 3.24. The Cranfield University 'Soilscape' online viewer indicates the site overlays 'Soilscape 22' - loamy soils with naturally high groundwater.
- 3.25. The DEFRA Magic Map online viewer indicates that the site lies outside of any groundwater Source Protection Zone (SPZ). The southern part of the site is located within a Secondary A superficial drift aquifer
- 3.26. Minor secondary aquifers are associated with the underlying bedrock and superficial drift layers. These rocks can provide modest amounts of water, but the nature of the rock or the aquifer's structure limits their use. They support water supplies at local rather than strategic scale.

4.0 Overview of Flood Risk

EA Flood Map for Planning

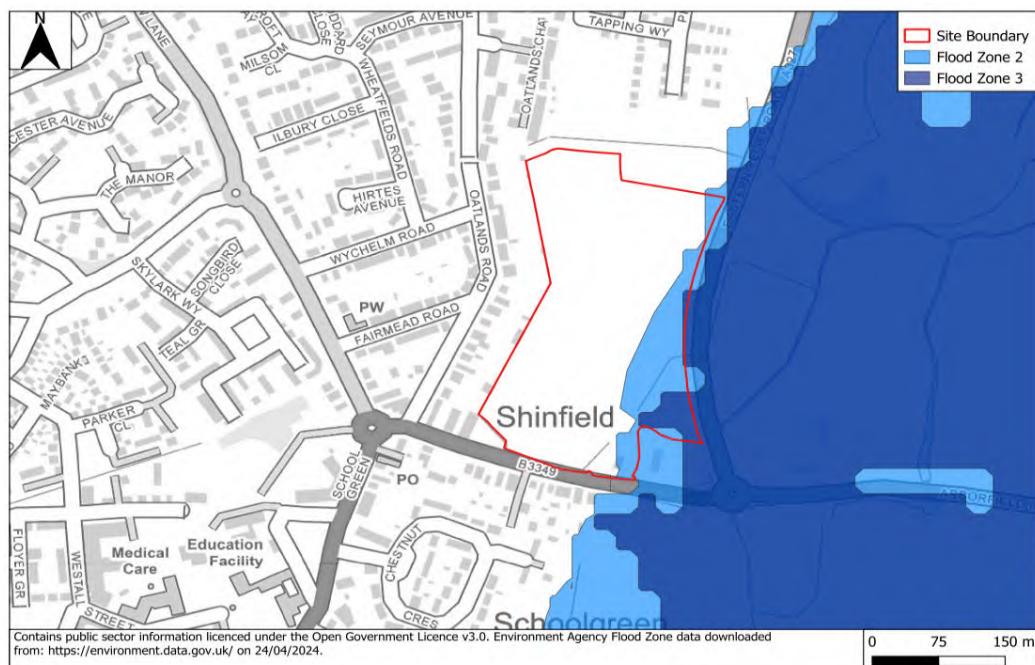
4.1. The EA Flood Map for Planning provides an initial indication of the extent of flood zones. In the NPPF, Flood Zones are defined as follows:

- Flood Zone 1 'Low Probability' – Land less than 1 in 1000 (0.1%) annual probability of river or sea flooding.
- Flood Zone 2 'Medium Probability' – Land between 1 in 100 (1%) and 1 in 1000 (0.1%) annual probability of river flooding, or between 1 in 200 (0.5%) and 1 in 1000 (0.1%) annual probability of sea flooding.
- Flood Zone 3 'High Probability' – Land at 1 in 100 (1%) or greater annual probability of river flooding, or 1 in 200 (0.5%) or greater annual probability of sea flooding.

4.2. **Figure 3** shows the EA flood zone mapping. It confirms that the majority of the site is located within Flood Zone 1 'Low Probability'.

4.3. The eastern part of the site is located within Flood Zone 2 'Medium Probability'. The eastern boundary of the site is located within Flood Zone 3 'High Probability'. This is purely fluvial flooding and associated with the River Loddon to the east. This is discussed in more detail in the following section.

Figure 3 – EA Flood Map for Planning





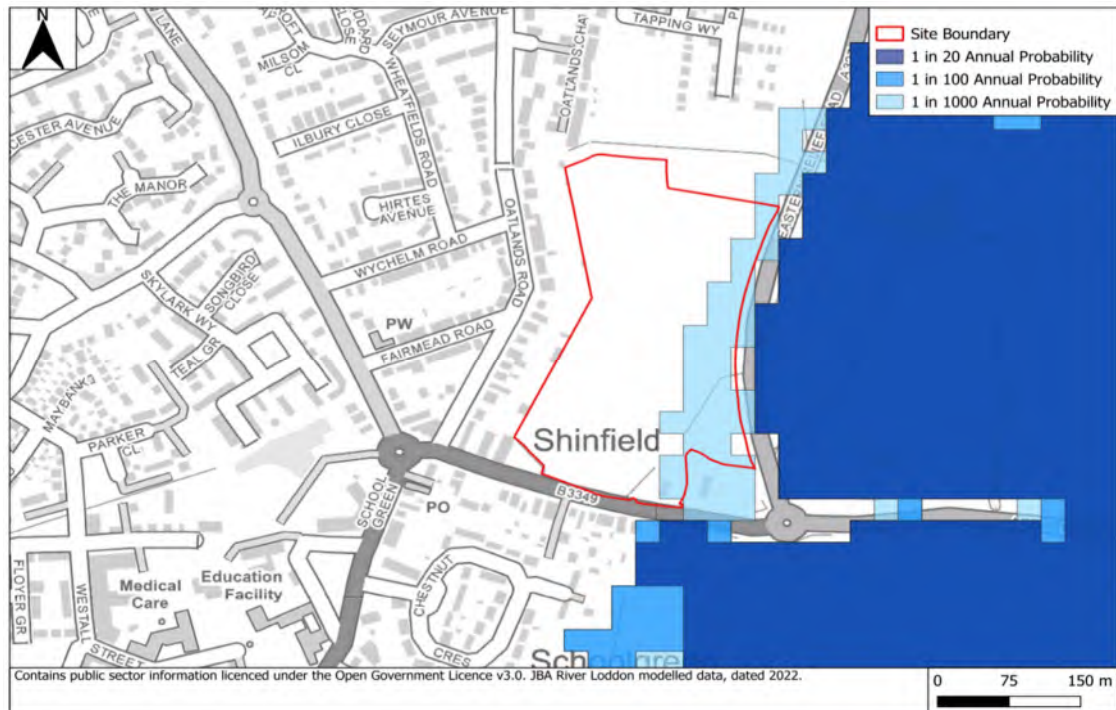
Flood Risk from Fluvial Sources

- 4.4. The eastern part of the site is shown to be within Flood Zone 2 and 3 of the EA Flood Map for Planning. The western and central part of the site is shown to be within Flood Zone 1 of the EA Flood Map for Planning. This indicates that the eastern site is affected by fluvial flooding in the 1 in 100 and 1 in 1000 annual probability scenarios. These maps are based on strategic modelling and do not take into consideration site specific information. Therefore it is appropriate for a site specific FRA to obtain or derive more detailed information to inform the analysis of actual flood risk at the site. The starting point for this is the EA and their detailed modelling, although in this location WBC has also commissioned extensive modelling of the Loddon.
- 4.5. Over the last few years there has been much analysis and modelling of the River Loddon, its floodplain and its contributing watercourses. The EA originally produced a model in 2009, which we understand still forms the basis of the published flood zone maps for planning. It is the 2009 model which was provided to us by the EA on request for modelling suitable to inform this FRA.
- 4.6. However, since 2009, modelling methods and practice have developed and more data has become available. There have also been some changes in the relevant infrastructure both in flood defence terms and the wider road and highway infrastructure. These have been absorbed into a more detailed and refined model produced by WBC, culminating in the model produced for WBC in 2021 (the *2021 SFRA Model*) which added a contemporary assessment of climate change allowances.
- 4.7. Since this date WBC completed an update to their SFRA to support the latest version of the Local Plan and a new model has been produced by JBA which uses the original EA 2009 model as a base but updates the hydrology to contemporary methods with contemporary allowances for climate change (the *2022 Loddon Model*). Critically this does not absorb the changes in data within the 2021 SFRA Model to reflect the physical changes or the more refined model grids.
- 4.8. WBC has confirmed that the 2022 Loddon model has been confirmed by the EA as '*sufficiently robust to inform policy and strategy decisions i.e. robust to underpin the SFRA. For site specific FRAs they have advised that an alternative model could be used to inform future planning applications following validation by the Environment Agency.*'
- 4.9. The 2022 Loddon and 2021 SFRA models have been reviewed and are discussed in turn, along with a commentary on the implications of each model for the site. The 2009 EA model is not discussed further as the later models are both deemed to be more representative as they include more recent information and also include current climate change allowances which directly informs the 'design event' to be considered for a FRA.

2022 Loddon Model

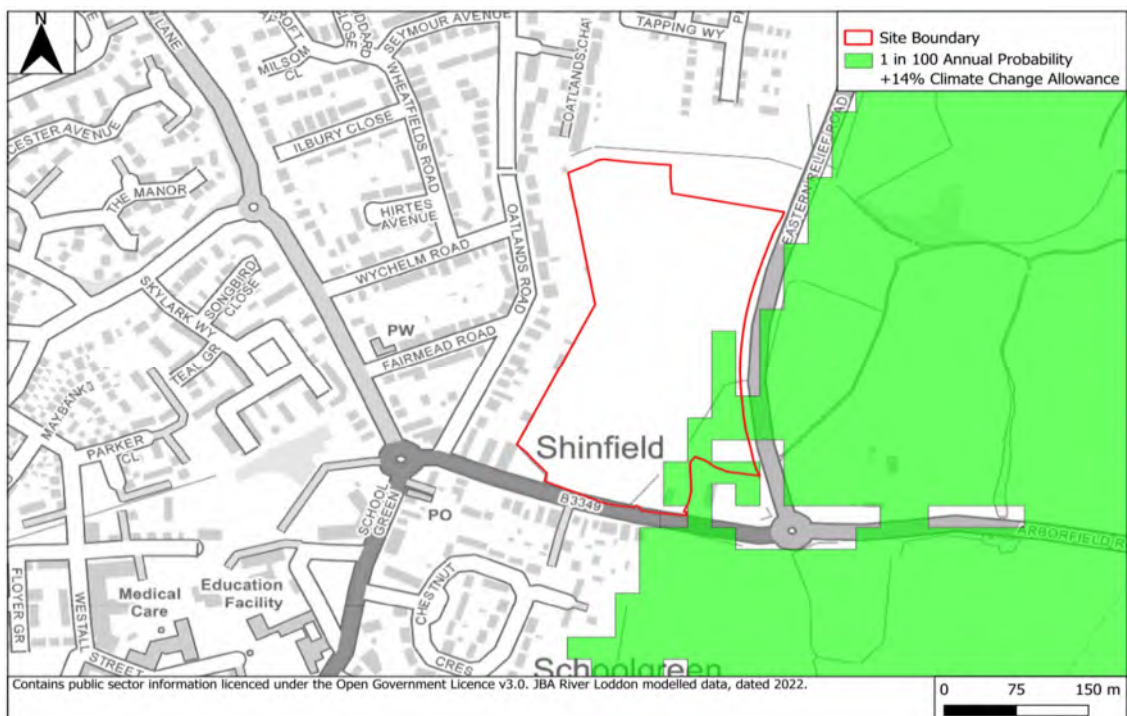
- 4.10. This model is the source of data for the current SFRA. As such it is deemed to be the key information to inform the strategic overview in planning terms of fluvial flood risk for the site.
- 4.11. As noted above this model uses the EA's 2009 model as a base and applies updated hydrology.
- 4.12. The 2023 SFRA present day flood extents are shown in **Figure 4**. This indicates the extents of flood zone 2 and 3 (1 in 1000 and 1 in 100 annual probability respectively).

Figure 4 – 2022 Loddon Present Day Flood Extents



4.13. The 2023 SFRA 14% climate change flood extents are shown in Figure 5.

Figure 5 – 2022 Loddon 14% Climate Change Flood Extent



4.14. Figure 4 and 5 indicate that there is flooding in the south eastern corner of the site and along the eastern boundary in the 1 in 1,000 and the 1 in 100 + climate change flood events.

- 4.15. The 2022 Loddon model uses a coarse, 25m grid size and does not include the Eastern Relief Road as it uses LiDAR data flow prior to the Eastern Relief Road's construction in 2017.
- 4.16. The model results suggest that there are two possible flow routes into the site; from the south and from the east. Each of these possible flow routes has been assessed to confirm whether the flow route into the site is indeed viable.
- 4.17. The flow route from the south would be across Arborfield Road from the south.
- 4.18. **Table 1** shows a summary of the modelled flood levels across Arborfield Road.

Table 1 – Summary of 2022 Loddon Model Maximum Flood Levels Across Arborfield Road

Flood Event	Modelled Flood Level, m AOD
1 in 20 Annual Probability (5%)	No flooding
1 in 100 Annual Probability (1%)	No flooding
1 in 100 Annual Probability +14% Climate Change Allowance	41.59
1 in 1000 (0.1%) Annual Probability	41.74

- 4.19. The 1 in 100 annual probability +14% climate change modelled flood level along Arborfield Road is 41.593m AOD. This flood level was reviewed against the topographical survey and LiDAR data.
- 4.20. From this review it is concluded that the levels along the carriageway are such that floodwater at a level of 41.59mAOD would not exceed the ground levels along the road and there is no flow route into the site in this event.
- 4.21. In the 1 in 1000 annual probability event there could be a flow route into the site. However floodwater would not flow far into the site before entering the southern ditch and the pond area in the south east of the site; then flowing into the highway ditch alongside the Eastern Relief Road. Depths and volumes would be relatively small.
- 4.22. The second possible flow route into the site is from the east is across the Eastern Relief Road.
- 4.23. **Table 2** shows a summary of modelled flood levels at the Eastern Relief Road.

Table 2 – Summary of JBA Model Maximum Flood Levels At the Eastern Relief Road

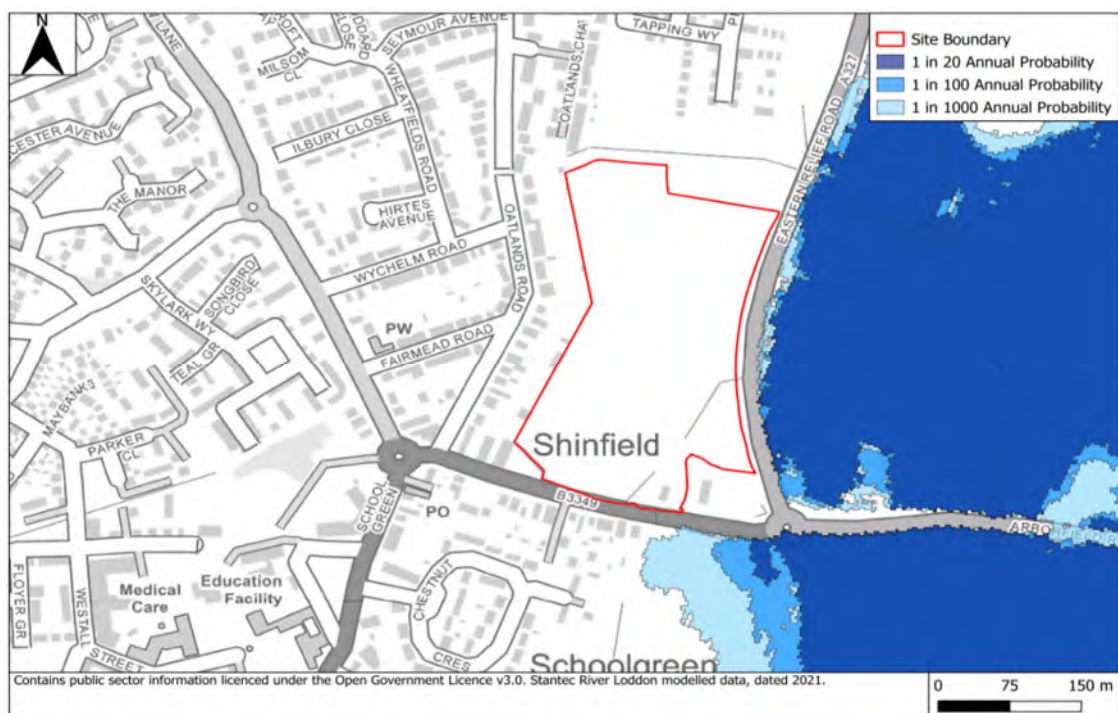
Flood Event	Modelled Flood Level, m AOD
1 in 20 Annual Probability (5%)	40.93
1 in 100 Annual Probability (1%)	41.11
1 in 100 Annual Probability +14% Climate Change Allowance	41.24
1 in 1000 (0.1%) Annual Probability	41.38

- 4.24. Ground levels along the Eastern Relief Road are between 41.99m AOD and 42.67m AOD adjacent to the site. The modelled flood levels are substantially below the Eastern Relief Road ground levels therefore the flooding would not flow freely across the road. There are three culverts under the Eastern Relief Road. However, as noted from the site observations the culverts are flapped on the eastern side. There is, therefore, no flow route under the Eastern Relief Road and into the site.
- 4.25. Therefore the 2022 Loddon modelling results show that the site is not affected by fluvial flooding in the design event (the 1 in 100 annual probability with 14% climate change) and only a small part of the south eastern area of the site could be affected in the 1 in 1000 annual probability. There is a small area of Flood Zone 2 in the site's south eastern corner but the remainder of the site is in Flood Zone 1.

2021 SFRA Model

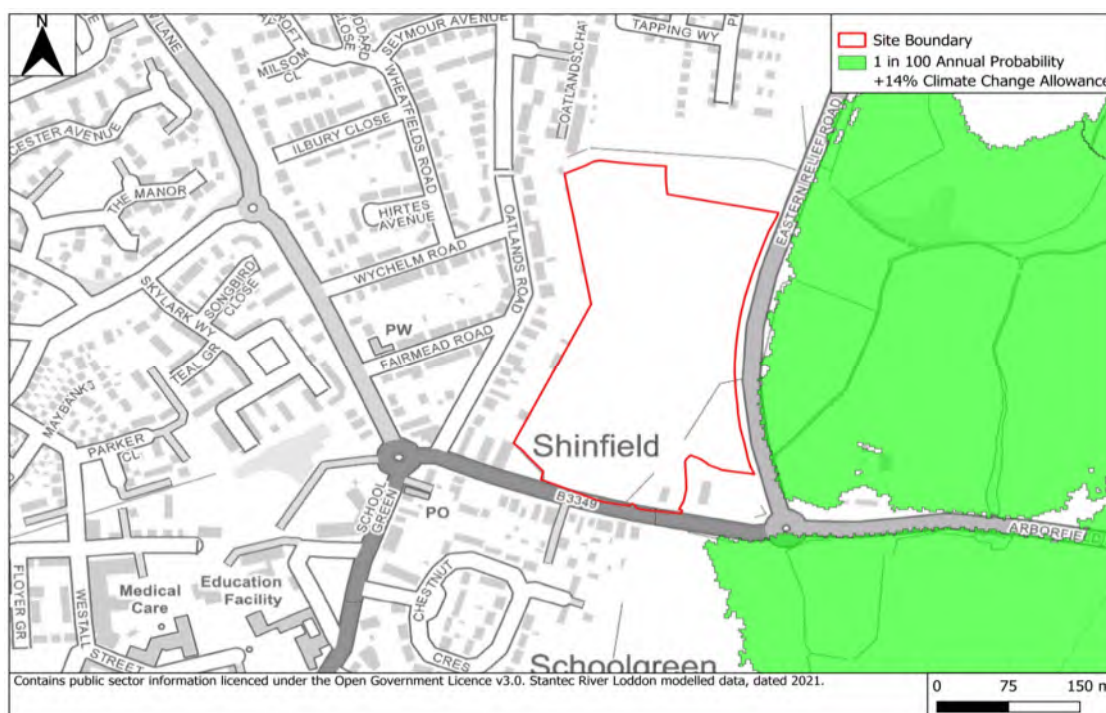
- 4.26. The 2021 SFRA model includes physical changes within the floodplain and catchment which have occurred since 2009, such as the construction of the eastern relief Road.
- 4.27. The 2021 SFRA present day model extents are shown in **Figure 6**.

Figure 6 – 2021 SFRA Present Day Flood Extents



- 4.28. The 2021 SFRA model considered the +70% climate change allowance. However, this allowance no longer adheres to the current guidance. The relevant climate change allowance for the site is +14%. ALP has rerun the 2021 SFRA model for the +14% change allowance.
- 4.29. The 2021 SFRA 14% climate change flood extents are shown in **Figure 7**.

Figure 7 – 2021 SFRA 14% Climate Change Flood Extents



- 4.30. **Figure 6 and 7** shows that the flood extent is located to the east of the Eastern Relief Road for all modelled scenarios using the 2021 SFRA.
- 4.31. **Table 2** summarises the modelled flood levels to the east of the Eastern Relief Road. The flood levels are relatively uniform in this area. The flood level was taken adjacent to the central culvert.

Table 2 – Summary of 2021 SFRA Model Maximum Flood Levels to the east of the Eastern Relief Road

Flood Event	Modelled Flood Level, m AOD
1 in 20 Annual Probability (5%)	40.36
1 in 100 Annual Probability (1%)	40.47
1 in 100 Annual Probability +14% Climate Change Allowance	40.52
1 in 1000 (0.1%) Annual Probability	40.74

- 4.32. The 1 in 100 annual probability +14% climate change scenario is the design event.
- 4.33. The 1 in 100 annual probability +14% climate change allowance flood level is 40.5m AOD. As noted above the Eastern Relief Road would not be overtopped and the flapped culverts under the Eastern Relief Road would prevent any flow towards the site from the eastern side of the road.
- 4.34. The 2021 SFRA model results confirm that the site is located entirely within Flood Zone 1 and is unaffected by flooding from the River Loddon.



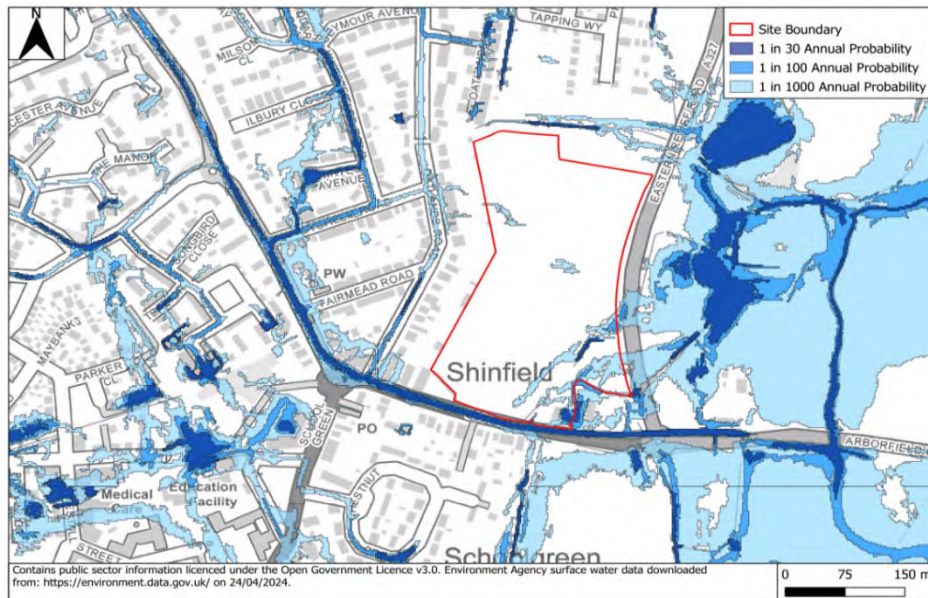
Summary of Fluvial Flood Risk

- 4.35. The 2021 SFRA model which includes the most up to date physical representation of the floodplain and catchment of the River Loddon shows the site to be in Flood Zone 1 and unaffected in the design event (1 in 100 annual probability with 14% climate change). The 2022 Loddon model which does not take account of changes in the catchment since 2009, such as the Eastern Relief Road construction suggests that the majority of the site is in Flood Zone 1 but a small area to the south eastern corner may be within Flood Zone 2, it confirms that the site is unaffected in the design event.
- 4.36. On balance, and given the presence of the Eastern Relief Road, the site is deemed to be within Flood Zone 1 with a Low Probability of fluvial flooding. This agrees with the findings in the Level 2 SFRA where the site, as a draft allocation, is not assessed as being at fluvial flood risk.

Flood Risk from Surface Water

- 4.37. The EA's Risk of Flooding from Surface Water mapping indicates areas that could be susceptible to surface water flooding during extreme rainfall events. The EA surface water mapping defines rainfall events based on the following:
- 1 in 30 (3.3%) annual probability 'High Risk'
 - 1 in 100 (1%) annual probability 'Medium Risk'
 - 1 in 1000 (0.1%) annual probability 'Low Risk'
 - Lower than 1 in 1000 (0.1%) annual probability 'Very Low Risk'.
- 4.38. The NPPF PPG – 'Flood Risk and Coastal Change' includes the 1 in 100 annual probability of surface water flood (including climate change) within the definition of the design flood event to be used to inform an FRA.
- 4.39. **Figure 8** shows the flood risk from surface water. The EA Flood Risk from Surface Water mapping indicates that the majority of the site is at a 'Very Low Risk' of surface water flooding.

Figure 8 – EA Flood Risk from Surface Water



- 4.40. The EA surface water mapping is based on a national scale surface water ground surface model. The model does not consider any site-specific local information or below ground drainage infrastructure. The mapping therefore provides a guide to vulnerable areas based on the topography of the area and not a detailed assessment of surface water flooding for a specific site.
- 4.41. The WBC Level 1 and Level 2 SFRAs indicate that there have been incidents of surface water flooding within the borough but all of these incidents are located outside of the site boundary..
- 4.42. The EA mapping shows possible flow routes for surface water across the site's south eastern corner. It also shows the flow route along the carriageway on Arborfield Road, with more frequent flooding and deeper flooding than that shown within the site.
- 4.43. Generally this suggests that the surface water flow routes within the site have been generated from land drainage and surface water runoff within the site itself rather than conveying surface water from off site.
- 4.44. Any surface water flooding across the site will likely be intercepted by the southern ditch or the cutoff drain associated with the Eastern Relief Road. It will then be conveyed towards the site's eastern boundary and into the highways ditch alongside the Eastern Relief Road. As noted from site observations this ditch is large and runs almost the entire length of the relief road and conveys flow onwards to the east and into the Loddon tributaries.
- 4.45. From a review of ground levels along the site's southern boundary and Arborfield Road, and from site observations confirming the nature of the verge, it is deemed to be unlikely that any surface water flowing along the road would divert into the site. However, even if this did occur, floodwater would likely end up in the southern ditch or pond and be restricted to the site's south eastern corner up to the farm access track. It would tend to flow into the highways ditch alongside the Eastern Relief Road and then onwards to the Loddon tributaries.



- 4.46. The Level 2 SFRA assessment of the draft allocation site confirms that there is 'limited risk on the site itself' of surface water flooding but flags the potential issues in the south eastern corner. This assessment has shown that the flow route is not a key concern due to the presence of physical features to intercept or divert the flow.

Flood Risk from Groundwater

- 4.47. Groundwater flooding has the potential to occur after prolonged periods of unusually high rainfall. During such periods, more water than usual infiltrates through the ground, raising the water table above its normal depth below the surface. Where the water table is at a shallow depth in any case, the water table can reach the surface. This can cause groundwater to merge with rainfall and cause localised flooding.
- 4.48. The WBC Level 1 SFRA has assessed the area for susceptibility to groundwater flooding based off 1km grid squares. The SFRA does not contain any records of groundwater flooding to the site.
- 4.49. The Level 2 SFRA assessment of the draft allocation site suggests that there is a >75% susceptibility to groundwater flooding across the south end of the site; however the remainder of the site is at a <25% susceptibility. As this data is coarse (1km grid squares) it is reasonable to assume that the site itself is likely to be at a lower susceptibility than >75%. The mapping also suggests that groundwater could be less than 5m below the ground surface for a small area in the southern part of the site but this is not clear.
- 4.50. The southern part of the site is on the edge of the area of concern for groundwater flooding and the data is, as stated in the Level 2 SFRA, not a detailed assessment. Furthermore, the area affected is towards the boundary of the site with a large portion of it allocated for open space or roads.
- 4.51. The risk of flooding from groundwater sources to any built development is therefore considered to be low.

Flood Risk from Sewers

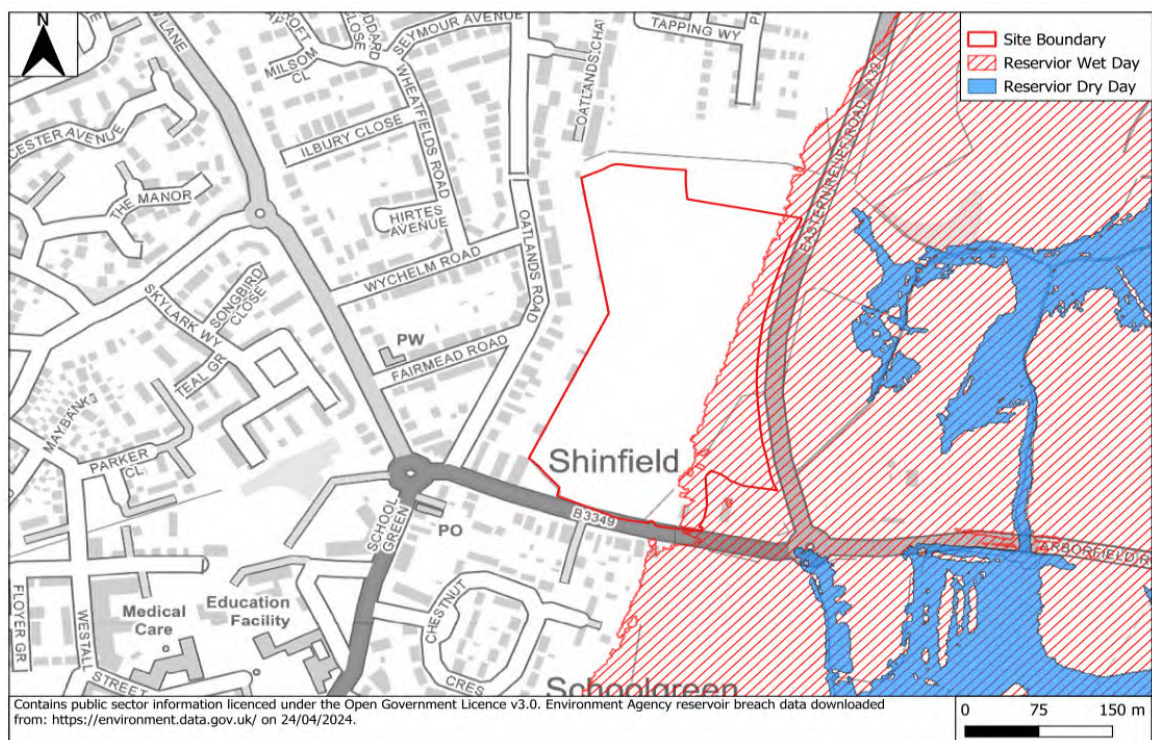
- 4.52. When exceeded, surcharged sewer networks can lead to flooding from backed up manholes and gully connections.
- 4.53. The WBC Level 1 SFRA confirms that the borough has flooded previously due to surcharging of foul, combined or surface water sewers. The number of reported incidents for the RG2 9 postcode area was 172. However, it is unclear if any of these area's affected the site as the SFRA does not specify the locations. The site itself is greenfield although there are sewers nearby. On balance the risk from sewers is deemed to be relatively low although it is recommended that the condition of sewers is confirmed at a later stage potentially as part of detailed design.

Flood Risk from Reservoirs

- 4.54. The EA flood risk from reservoirs mapping indicates areas that would be at risk of flooding in the event of a reservoir breach.

- 4.55. **Figure 9** shows the flood risk from reservoirs. The mapping indicates the site is at risk of flooding from the 'Wet Day' scenario in the event of a reservoir breach. The 'Wet Day' scenario occurs when a reservoir breach occurs at the same time as fluvial flooding. The site is not at risk of flooding in the 'Dry Day' scenario.
- 4.56. The risk of reservoir flooding is primarily from Bearwood Lake which is a reservoir located east of the River Loddon and more than 3km from the site. The Level 2 SFRA assessment of the draft allocation site also suggests that Bramshill House Pond, Tundry Pond and Wellington Country Park Lake could also pose a risk of reservoir flooding for the general area; however these are located between 5 and 10km from the site to the south and are not considered further. If there were to be a breach of the Bearwood Lake reservoir, this flow would likely follow the mechanism of the fluvial event. From a review of levels and a review of the potential for water to reach the site from the eastern side of the relief road, this risk is deemed very low.

Figure 9 – EA Flood Risk from Reservoirs



- 4.57. The probability of flooding from a reservoir breach is very small. The Reservoir Act (1975) set out a mandatory requirement for all large (greater than 25,000m³) raised reservoirs to be supervised and inspected by reservoir engineers.

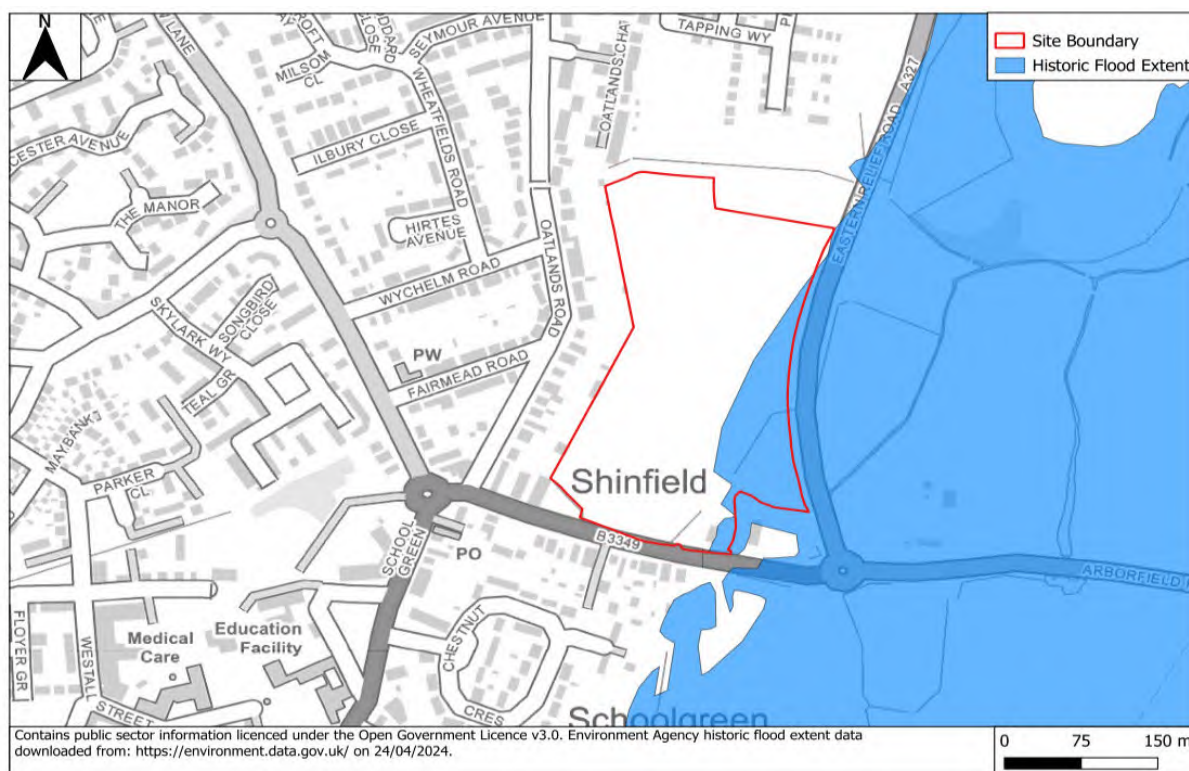
Flood Risk from Other Sources

- 4.58. The EA flood risk maps, WBC Level 1 & 2 SFRA indicate that the site is not at risk of flooding from canals or other artificial sources. The level 2 SFRA confirms that the data used is the National Inundation Reservoir Mapping (long term flood risk map) from the EA.

Historic Flooding

- 4.59. The EA Historic Flood Map shows the maximum extent of recorded flood events. The mapping indicates that the eastern part of the site has been affected by historic flooding. **Figure 10** shows this. It is likely that this flooding occurred before the Eastern Relief Road was constructed and the flow route is no longer achievable to the site.
- 4.60. The WBC Level 1 SFRA reports flooding in the borough but none of this affected the site.

Figure 10 Historic flood Extent



Flood Risk Summary

- 4.61. A summary of flooding from all sources is provided in **Table 4**.

Table 4 – Summary of Flood Risk

Source of Flooding	High	Medium	Low	Comments
Tidal			✓	The site is inland and not influenced by tidal levels.
Fluvial			✓	The Flood map for Planning suggests that the site is predominantly in Flood Zone 1 with an area in Flood Zone 2 and Flood Zone 3 to the site's south eastern corner and eastern boundary. However, analysis of detailed modelling commissioned by WBC suggests that the site is entirely in Flood Zone 1.
Pluvial		✓		The majority of the site is at a 'Very Low' risk of surface water flooding. There are areas of potential surface water flooding within the site and these correspond to potential flow routes for overland flow towards the sites eastern boundary. However it appears that the overland flow is generated purely within the site and is not reaching the site form elsewhere. This can be fully addressed through the site's water management and drainage strategy.
Groundwater			✓	From the available data the potential for groundwater flooding in the areas for built development is generally very low.
Sewers			✓	From the available data the potential for sewer flooding appears to be low.
Reservoirs			✓	The probability of reservoir flooding is very low. The available data suggests that any flooding resulting from a breach would emanate from the Loddon corridor and review of site data confirms that the Eastern Relief Road would likely prevent this from reaching the site.
Canals and other artificial sources			✓	The PFRA confirmed that there are no canals in the Borough and there was no mention in the WBC Level 1 & Level 2 SFRA.

- 4.62. The site is deemed to be at generally low risk of flooding. For the purposes of this FRA, the design flood event should be taken as the fluvial 1 in 100 annual probability scenario plus an allowance for climate change allowance. In this instance the relevant climate change allowance is 14% which is the Upper Central allowance for the Loddon and Tributaries Management Catchment.



- 4.63. The Masterplan for the proposed development has been designed with consideration of the potential for flooding and built development is not located in the site's south eastern corner. It is therefore in accordance with national and local planning policy concerning flood risk and, as such, the site is suitable for the proposed development.



5.0 Proposed Development and the Sequential Test

NPPF Sequential Test

- 5.1. NPPF states that Local Planning Authorities allocating land for development should apply the Sequential Test to demonstrate that there are no reasonably available sites in areas with a lower probability of flooding that would be appropriate to the type of development or land use proposed.
- 5.2. The proposed development is a draft allocation site and will therefore be subject to WBC's Sequential Test process. The Level 2 SFRA has assessed the site as having limited flooding risk and this FRA confirms it is within Flood Zone 1 with a generally low surface water flood risk and low potential of flooding from other sources.

Exception Test

- 5.3. The Level 2 SFRA has classified the draft allocation site as an 'Amber' site given the limited risk of surface water flooding and its location in Flood Zone 1. The Level 2 SFRA confirms that the Exception Test does not apply to these sites.
- 5.4. The proposed development is therefore appropriate for this site with respect to flood risk concerns.



6.0 Flood Mitigation Strategy

Sequential Approach

- 6.1. The NPPF encourages a 'sequential approach' in master planning for new development: locating the more vulnerable uses of the development in the areas of lowest flood risk from all sources. The masterplan for this development has followed this approach.

Ground Floor Levels

- 6.2. The requirements for setting ground floor levels for new developments are set out in BS8533:2017 'Assessing and Managing Flood Risk in New Developments – Code of Practice'. A finished floor level of at least 300mm above the 1 in 100 annual probability plus climate change allowance is recommended.
- 6.3. The WBC Level 1 SFRA states FFL (finished floor levels) should be set 300mm above the 1% AEP plus climate change peak flood level. This site has been shown to be unaffected by the design event for fluvial flooding. Therefore there is no flood level.
- 6.4. Where the site is located outside of the fluvial flood extents, ground floor levels should be set a minimum of 150mm above the surrounding ground level to mitigate the residual flood risk from surface water runoff events. It is recommended that surrounding ground levels are appropriately contoured to direct surface water away from the development.

Floodplain Storage

- 6.5. The site has been shown to be unaffected by fluvial flooding for the design flood event. There is no requirement for floodplain storage as part of the development.

Safe Access

- 6.6. The site has been shown to be unaffected by fluvial flooding for the design flood event. There is no requirement for providing a safe access as part of the development.

Watercourses

- 6.7. To accommodate the proposed access and footpath arrangement at Arborfield Road the southern ditch will be culverted for a short section, essentially an extension of the pipe from which the channel commences. This will be sized to match the existing pipe.
- 6.8. A short section of the engineered cut off ditch north of the farm access track will be removed to provide the SuDS basin. A compensatory ditch of equivalent form will be provided. Details will be confirmed at a later stage and will also address any BNG elements.
- 6.9. The modifications to these watercourses will have no overall impact on the hydrology and conveyance mechanisms for overland flow or flood risk through the site.



Residual Risk

- 6.10. The NPPF PPG – ‘Flood Risk and Coastal Change’ defined residual risk as coming from ‘flood risk management infrastructure’ and the ‘residual risk to a development once any site-specific flood mitigation measures are taken into account’.
- 6.11. Residual risk to the site includes a breach or failure of a reservoir and a flood event greater than the designed standards. The Bearwood Lake is located more than 3km to the northeast of the site, on the eastern side of the River Loddon and beyond the Eastern Relief Road. The mechanism for this to reach the site follows that of the fluvial extent and, as noted earlier, the Eastern Relief Road would prevent this flow route to the site.
- 6.12. The EA AIMS dataset which contains information of flood defences indicates that the site does not benefit from raised flood defences. There are no flood defences within the site boundary.
- 6.13. The EA mapping for reservoir breaches indicates that the eastern part of the site is located within an area at risk of flooding in the event of a reservoir breach occurring at the same time of a fluvial flood event. The probability of flooding from a reservoir breach is very small. The Reservoir Act (1975) set out a mandatory requirement for all large (greater than 25,000m³) raised reservoirs to be supervised and inspected by reservoir engineers. The residual risk is therefore confirmed to be low.



7.0 Surface Water Drainage

Introduction

- 7.1. This chapter provides details on the surface drainage strategy and includes measures to drain the proposed development site.

Overall Strategy

- 7.2. The proposed drainage strategy has been designed in line with the NPPF by providing a comprehensive drainage system which embraces the SuDS philosophy and key principals. The utilisation of Sustainable Drainage Systems (SuDS) not only provides the benefit of controlling waters at source and online treatment of collected surface water but also allows enhanced aesthetics through improved landscaping, biodiversity, and ecological opportunities.
- 7.3. These features offer a holistic treatment train and management system to the benefit of new residents, members of the wider community, downstream receptors and the environment.
- 7.4. The alteration of natural surface water flow patterns through developments can lead to problems elsewhere in the catchment, particularly flooding downstream. Changes of land uses can have significant downstream impacts where existing drainage systems may not have sufficient capacity for any additional surface water flow.
- 7.5. A surface water management strategy is therefore required to manage and reduce the flood risk posed by the surface water runoff from the site. The surface water drainage arrangements for any development site should be such that the volumes and peak flow rates of surface water leaving a developed site are no greater than the rates to the pre-development scenario, unless specific off-site arrangements are made and result in the same net effect.
- 7.6. Sustainable water management measures (SuDS) should be introduced to control the surface water runoff from the proposed development site therefore, managing the flood risk to the site and surrounding areas from the surface water runoff.
- 7.7. The Construction Industry Research and Information Association, CIRIA's C690 states the following:
- **Prevention** – the use of good site design and housekeeping measures on individual sites to prevent runoff and pollution (e.g. minimise areas of hard standing surfaces)
 - **Source Control** – control of runoff at or very near its source (such as the use of rainwater harvesting)
 - **Site Control** – management of water from several sub-catchments (including routing water from roofs and car parks to one or several soakaways for the entire site)
 - **Regional Control** – management of runoff from several sites, typically in a detention basin or wetland.



- 7.8. The SuDS Manual 2015 (C753) provides best practice guidance on the planning, design, construction, operation and maintenance of SuDS. This document provides guidance to ensure that SuDS are planned and designed to maximise the opportunities and benefits of surface water management.
- 7.9. The four main categories of benefits that can be achieved by SuDS, referred to as the four pillars of SuDS design, are:
- **Water quantity** – control the quantity of runoff to support the management of flood risk, and maintain and protect the natural water cycle;
 - **Water quality** – manage the quality of the runoff to prevent pollution
 - **Amenity** – create and sustain better places for people
 - **Biodiversity** – create and sustain better places for nature.
- 7.10. Supplemental to CIRIA guidance, Document H of the Building Regulations 2015 sets out three possible options to discharge surface water runoff. Rainwater shall discharge to one of the following, listed in order of priority:
- An adequate soakaway or some other adequate infiltration system; or where that is not reasonably practicable,
 - A watercourse; or where that is not reasonably practicable
 - A sewer.
- 7.11. As infiltration is highly unlikely to be a viable method of disposal (Ref: Para 3.21 above), the surface water drainage proposals will be designed to attenuate runoff with controlled discharge to the existing local watercourses i.e. the existing open field ditch on site which would be feasible point of discharge.
- 7.12. Implementation of SuDS will ensure that flood risk downstream is not increased due to the proposed development. These features will also provide positive improvements to the quality of surface water runoff.
- 7.13. The following SuDS components are deemed applicable to the site:
- Pervious surfacing systems – structural surfaces that allow water to penetrate into a granular layer thus providing storage and treatment, e.g. pervious paving.
 - Conveyance systems – components that convey flows to downstream storage systems, e.g. swales and filter drains.
 - Storage systems – components that control flow, and possibly volumes, by storing water and releasing it slowly, e.g. geocellular units, attenuation basins and wetlands.
 - Treatment systems – components that remove or facilitate the degradation of contaminants present in runoff, e.g. filter strips and proprietary treatment systems.

Pre and Post Development Areas/Rates

- 7.14. To quantify any potential increase in surface water runoff, the existing Greenfield/Pre-Development runoff rate from the site must be determined. The rates of runoff have been determined using the current 'industry best practice' guidelines as outlined in the Interim Code of Practice for SuDS. The recommended methodology for sites up to 50 hectares in area is the ICP SuDS method.
- 7.15. An assessment of existing surface water runoff has been undertaken, to determine the potential surface water options and attenuation requirements for the site utilising the following parameters.
- Average Annual Rainfall (SAAR): 646mm
 - Soil: 0.470
 - Region No.: 6
- 7.16. With an overall site area of 7.0 hectares (ha), the calculated Greenfield run off discharge rates and volumes are as presented in Figure 8. The corresponding runoff outputs created within Flow can be found within Appendix 3.

Figure 8 – Pre-Development Runoff Rates/Volumes

Annual Probability	Greenfield/Pre-Development Runoff Rate per hectare (l/s)	Greenfield/Pre-Development Volume 360 minute storm
1 in 1 year event	3.8	
QBar	4.4	
1 in 30 year event	10.2	
1 in 100 year event	14.1	2051

- 7.17. Based on the Masterplan, Impermeable areas have been calculated for the development with urban creep added to dwellings as appropriate.
- 7.18. The overall Post developed Impermeable area amounts to 2.90 hectares (ha) plus 0.29 hectares attributed to the proposed attenuation basin.
- 7.19. In order to comply with best practice as stipulated in EA Report SC030219 'Rainfall Runoff Management for Developments', proposed discharge rates should be restricted to one of two methods for all storms up to and including the 1 in a 100 year storm event plus a 40% allowance for climate change. In this instance the development will be attenuated with discharge rates set at greenfield run off rates for each storm event.

1. Greenfield discharge rates

- 7.20. Discharge flows are to be regulated using a complex control manhole system. This manhole includes two hydrobrakes and a weir, which together allow for precise management of flow rates, ensuring they align with the greenfield runoff rate.
- 7.21. For the purposes of this report and to provide a robust analysis, the complex control manhole system is designed to achieve greenfield runoff rates during different storm events. The system ensures that the flow rates during various storm intensities 1 in 1 year, 1 in 30 year, and 1 in 100 year events are controlled to match the pre-development greenfield runoff rates. The achieved flow rates are detailed below:
- 1 in 1 year storm: 12.01 L/s
 - 1 in 30 year storm: 32.44 L/s
 - 1 in 100 year storm: 45.02 L/s
 - Long term Storage output: 6.39 L/s
- 7.22. The design ensures that even during more intense storms, the system controls the discharge to match the greenfield runoff rates, thereby preventing the risk of flooding upstream and discharging at prior development rates.
- 7.23. With the above measures in place, and having assessed the ability to limit the offsite discharge rate using the complex control manhole, the anticipated long term storage volumes for a for the site are as follows:

Formular:
$$VOL = 10 \times RD \times A \times \left[0.8 \times \left(\frac{PIMP}{100} \right) - \left(\frac{PIMP}{100} \right) \times SOIL \right]$$

Figure 9 – Calculated Long Term Storage Volume

Catchment	Catchment Area (ha)	Impermeable Area (ha)	Long Term Storage Required Per Ha (m³)	Long term Storage (m³)
1	5.57	3.19	225.06	717.94
Totals	5.57	3.19		

Surface Water Proposals

- 7.24. It is proposed to provide a network of trapped gullies, pipes and Sustainable Drainage (SuDS) features to collect the surface water runoff from impermeable areas such as roads, roofs and driveways. The traditional system will work in combination with such features as permeable paving and basins to provide attenuation storage and high-quality water benefits.



- 7.25. Minimal sections of existing ditch are to be retained with the exception of those outlined on the application drawings.
- 7.26. Drawings HD008-FA-501 and 502 provide an overview to the proposals, copies of which are included within **Appendix 3**.
- 7.27. The banks of the SuDS basins will be designed in accordance with the SuDS Manual C753 in respect to having a maximum gradient of 1 in 4 and an appropriate freeboard above the maximum water level. This allows landscaping of both wetland and wildflower mixes to provide an appropriate landscape context in the vicinity of the features through the provision of an aquatic shelf.
- 7.28. Open SuDS features will be designed so as not to compromise the safety of residents, visitors and their property. Generally open boundaries are provided, and perimeter planting could be utilised to define the extents of the features.
- 7.29. Discharge rates will be controlled to match greenfield runoff rates for all storm events up to and including the 1 in 100 year storm with a 40% climate change allowance. This is achieved using a complex control manhole with hydrobrakes and a weir. While effective flow control is provided, long-term storage is still required to manage runoff volumes.
- 7.30. The proposals draw reference to the DEFRA document Sustainable Drainage Systems, Non-statutory technical standards for sustainable drainage systems March 2015, as well as CIRIA C753 The SuDS Manual.
- 7.31. Current uncontrolled pluvial runoff exhibited onsite during high rainfall events (Ref: para 3.25 above) will be mitigated as a result of the Development. This will occur by virtue of the change in surface from greenfield to positively drained impermeable areas, which will serve to capture, attenuate and delay surface water runoff eastwards towards the Relief Road. This will be a benefit to downstream receptors.
- 7.32. This proposal provides suitable details of the principal components of the surface water strategy for this application and may be subject to further refinement to address any conditions. These assumptions are subject to evolution as the design is finalised with individual parcels being realised.
- 7.33. There is scope to utilise source control techniques (such as granular strips and permeable paving) which will assist with the reduction of larger attenuation storage features. This should be embraced and investigated as the project progresses.
- 7.34. Subject to the provision of additional geotechnical information, the attenuation basins may require partial lining to protect against the ingress of natural groundwater. Such lining provides the ability to create localised, small permanent bodies of water which adds landscaping and biodiversity opportunities to the scheme.
- 7.35. Simulation results for the proposed surface water network are included within **Appendix 3**.

Exceedance Flood Routing

- 7.36. Flows in excess of the above design storms, which may flood from the network for storms in excess of the 1 in 100 year storm plus 40% climate change, will be kept within the internal road network, until such time as they can be directed into adjacent landscaping areas or existing vegetation/woodland. This ensures that no onsite or offsite residential units are afforded an increased level of protection from flood waters until such time as the rain events become significant.
- 7.37. The attenuation basin on the eastern edge of the Development is designed to provide 300mm freeboard and therefore can accept additional flood water from manholes upstream.

Water Quality Improvements

- 7.38. CIRIA report C753 The SuDS Manual outlines the methodology for assessing water quality risks associated with new development. This is a simple index approach which provides a high-level scoping analysis of the land usage and gives guidelines for appropriate treatment stages.
- 7.39. This process identifies features necessary to provide adequate substance removal in line with Environment Agency requirements. This is a three-step process of Allocation, Mitigation and Review.
- 7.40. Surfaces generating runoff are 'graded' on their potential to contribute to various harmful pollutants and gives each surface a risk of pollution from each element. An extract of Table 26.2 within the SuDS Manual is set out overleaf in **Figure 2**.

Figure 2 – Extract from Table 26.2 SuDS Manual

Land Use	Pollution Hazard Level	Total Suspended Solids	Metals	Hydrocarbons
Residential Roofs	Very Low	0.2	0.2	0.05
Other Roofs	Low	0.3	0.2-0.8	0.05
Low traffic residential roads and non-residential parking with infrequent change.	Low	0.5	0.4	0.4
Commercial yard, parking with frequent change, other roads,	Medium	0.7	0.6	0.7
Sites with heavy pollution	High	0.8	0.8	0.9

- 7.41. Historically, PPG3 documentation would recommend that pollutants were removed utilising oil separators, but since its superseding, more recent guidance has shifted to the use of SuDS features to remove pollutants; thereby providing significant improvements in treatment.
- 7.42. The use of non-mechanical features decreases the requirements for maintenance and increase natural biodiversity. That said, the SuDS Manual does not remove the possibility of utilising separators, so long as they are considered in partnership with a comprehensive overall SuDS regime.
- 7.43. Without adequate treatment, the pollutants would cause damage if they were to enter the watercourse or water table in large volumes. The use of SuDS features to slow down and degrade these pollutants is critical to the provision of an acceptable discharge.

- 7.44. The Residential Roof of the proposed development is classified as 'Very Low' in accordance with the Pollution Hazard Level, which equals to Total Suspended Solids: 0.2, Metals: 0.2 & Hydrocarbons: 0.05.
- 7.45. The Residential Roads and parking of the proposed development is classified as 'Low' in accordance with the Pollution Hazard Level, which equals to Total Suspended Solids: 0.5, Metals: 0.4 & Hydrocarbons: 0.4.
- The respective cleansing abilities of common SuDS features are given by corresponding mitigation indices within the SuDS Manual. An extract of Table 26.3 is set out below in **Figure 3**.

Figure 3 – Extract from Table 26.3 SuDS Manual

Type of SuDS component	Total Suspended Solids	Metals	Hydrocarbons
Filter strip	0.4	0.4	0.5
Filter Drain	0.4	0.4	0.4
Swale	0.5	0.6	0.6
Bioretention system	0.8	0.8	0.8
Permeable Paving	0.7	0.6	0.7
Detention Basin	0.5	0.5	0.6
Pond	0.7	0.7	0.5
Wetland	0.8	0.8	0.8

- 7.46. The pollution indices for the proposed development do not exceed the "Low Pollution Hazard" (TSS:0.5, Metals:0.4, Hydrocarbons:0.4) level and the proposed detention basins (TSS: 0.5, Metals: 0.5, Hydrocarbons: 0.6) provides adequate pollution treatment.
- 7.47. Finally, silt traps will be utilised before the attenuation basin, which will further enhance the water quality of the proposed development.

SuDS Maintenance Strategy

- 7.48. For the water treatment effects of SuDS features to remain effective, a comprehensive maintenance strategy should be implemented. Refer to **Appendix G** for more details.
- 7.49. During construction, maintenance of SuDS features should be undertaken by the Contractor. Upon completion, the assets should be passed over to the client to maintain the features in perpetuity.
- 7.50. As part of the strategy, a regular maintenance regime will be created, which consists of several primary measures required to ensure the longevity of the system. These should be undertaken on a regular basis to ensure consistent performance. Typical maintenance activities consist of:



- Inspecting and reporting; relatively regular review of the condition identifying issues and providing resolutions. Periodic review from the maintenance contractor.
- Litter and debris removal.
- Grass trimming, overall cutting and localised strimming preventing blockages.
- Weed and evasive plant control.
- Shrub management.
- Aquatic and shoreline vegetation management.
- Sweeping pervious surfaces; and
- Oil removal from proprietary systems.

7.51. A remedial maintenance schedule would be recommended as part of the handover of the SuDS features, remedial maintenance is required to provide repairs to the system and monitor long term damage ensuring the system remains consistently productive. The schedule could consist of.

- Structure rehabilitation and repair.
- Infiltration surface rehabilitation.
- Scarifying to remove 'Thatch'.
- Spiking or Tining the soil.
- Air pressure treatment.

Adoption and Ownership

7.52. The drainage system is designed to the appropriate standards including the new Sewerage Sector Guidance (SSG), the Building Regulations and the requirement of the National Planning Policy Framework

7.53. The intention of adoption and ownership of drainage and SuDS is as follows:

- Surface water sewers within development parcels to be offered for adoption to Southern Water under the Section 104 process of the Water Industry Act.
- Surface water highway drains, gullies and leads within adopted roads to be maintained by the Highway Authority.
- Above ground attenuation (i.e. swales and basins) to be maintained by a private maintenance company funded by residential properties or subject to agreement with the Local Authority.
- SuDS features serving single properties, for example, permeable paved driveways to single dwellings, will be owned and maintained by the owner of that property.

7.54. Suitable adoption and maintenance regimes for SuDS will be provided to address any planning conditions.



8.0 Foul Water Drainage

Introduction

- 8.1. This chapter provides details on the proposed foul water drainage strategy and measures to convey effluent.

Overall Strategy

- 8.2. Due to the topography of the site and location of the existing foul sewer point of connection, wastewater from the site can flow entirely by gravity to the receiving public sewer located along the southern boundary of the site
- 8.3. The proposed foul water sewers will be designed in collaboration with Thames Water or independent adopting authority as approving body in accordance with the new Sewerage Sector Guidance (SSG) and will be offered to Thames Water, or alternative, for adoption under S104 Agreement of the Water Industry Act.

Adoption and Ownership

- 8.4. The drainage system is designed to the appropriate standards including the new Sewerage Sector Guidance (SSG), the Building Regulations and British Standards.
- 8.5. Foul water sewers within development parcels and offsite to the point of connection are to be offered for adoption to TW or alternative under the Section 104 process of the Water Industry Act.



9.0 Conclusion

Flood Risk

- 9.1. The EA Flood Risk mapping was reviewed alongside the Wokingham Borough Council (WBC) Preliminary Flood Risk Assessment (PFRA) and Level 1 and Level 2 Strategic Flood Risk Assessment (SFRA).
- 9.2. This Flood Risk Assessment (FRA) concludes that:
- The majority of the site is located within Flood Zone 1 'Low Probability' (land at less than 1 in 1000 (0.1%) annual probability of river or sea flooding'). The east of the site is located within Flood Zone 2 'Medium Probability' (Land between 1 in 100 (1%) and 1 in 1000 (0.1%) annual probability of river or sea flooding. Along the eastern boundary of the site is located within Flood Zone 3 'High probability' land at 1 in 100 (1%) annual probability of river or sea flooding.
 - The site is at negligible risk of tidal flooding due to its inland location.
 - Detailed fluvial flood modelling results and site specific topographical data and site observations confirm that the site is not affected in the 1 in 1000 year annual probability event or in the design event (1 in 100 annual probability event with 14% climate change).
 - The EA Flood Risk from Surface Water mapping indicates that the majority of the site is at a 'Very Low Risk' of surface water flooding. Possible surface water flow routes across the south eastern part of the site are shown to be associated with flow generated within the site and, therefore will be completely accommodated by the development surface water drainage strategy.
 - The Level 2 SFRA suggests that the southern part of the site may be a potential risk of groundwater flooding. However, the site is on the edge of the potential risk area and the data is very coarse. Furthermore, this part of the site is generally providing open space and the access so there is little potential impact on built development.
 - Other sources of flooding are found to be a low risk for the site.
 - No specific flood risk mitigation measures are required and finished floor levels will be set an appropriate level above the surrounding ground level (minimum of 150mm).

Sequential Test and Exception Test

- 9.3. The Sequential Test will be applied by WBC for this draft allocation site. The Level 2 SFRA already confirms the low level of flood risk and the detailed assessment in this FRA demonstrates that the actual risk is even lower than the SFRA mapping suggests.
- 9.4. The Level 2 SFRA confirms that the Exception Test is not required.



Surface Water Drainage Strategy

- 9.5. The proposed surface water drainage strategy will manage the flood risk posed by uncontrolled surface water runoff from the site. Any increase in surface water run-off can be managed using SuDS source control techniques as well as attenuation features to provide storage in extreme storm events. This provides the minimum of two treatment storage stages which is in accordance with the recommendations of CIRIA C753. All surface water drainage systems will be designed to restrict drainage discharge rates to QBAR runoff rates and store the balance of water for all events up to and including the 1 in 100 year event including allowance for a 40% increase in rainfall intensities as a result of climate change and urban creep.

Summary

- 9.6. This FRA demonstrates that the proposed development complies with national and local planning policy with respect to flood risk and drainage. The risk of flooding is adequately managed, and, with the implementation of a suitable surface water drainage strategy, the offsite flood risk is not increased.



Appendices



Appendix 1 - Plans

Illustrative Masterplan

Topographic Survey

Thames Water Sewer Asset Plan

Level 2 SFRA Extract

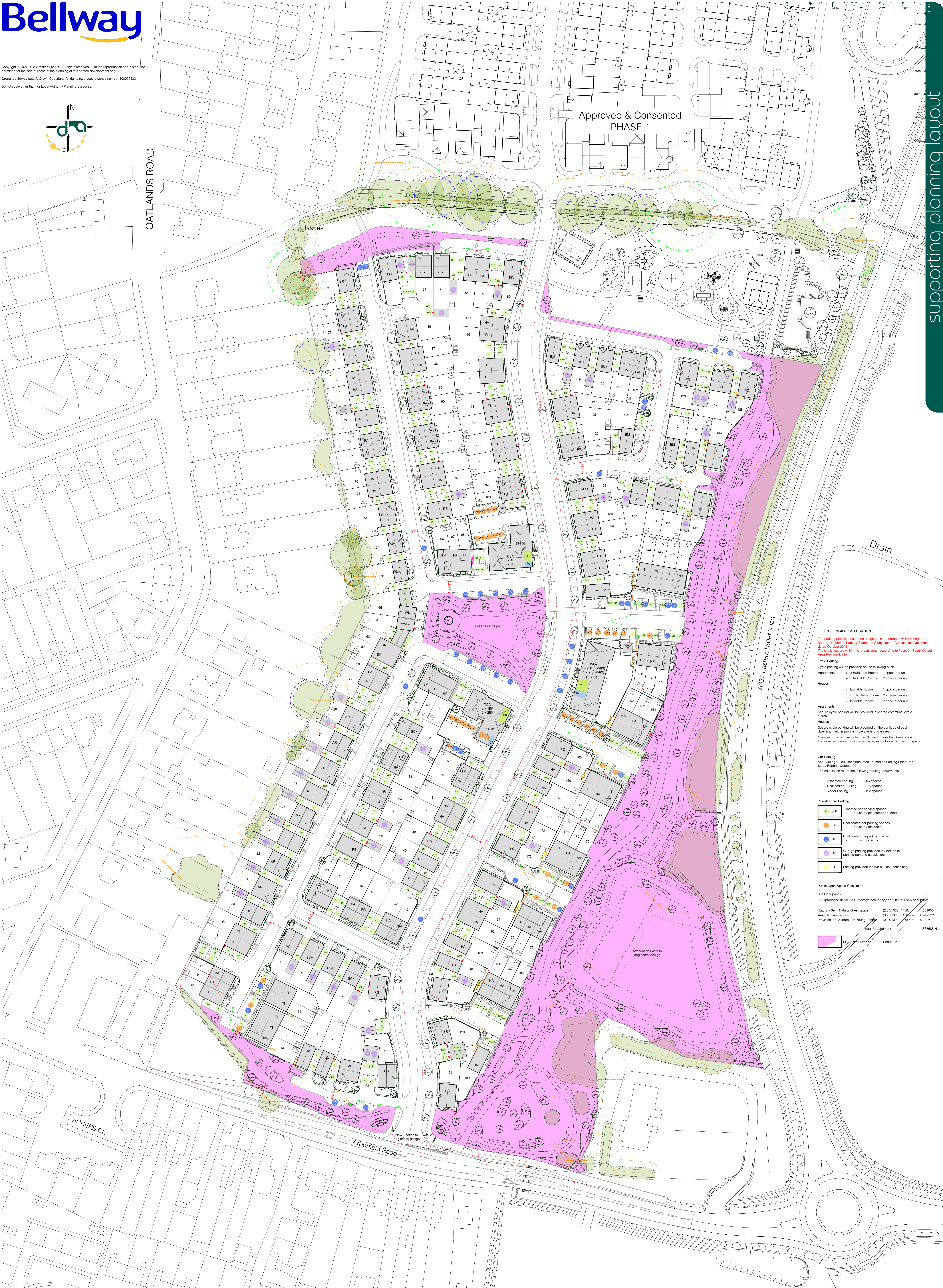
Planting Plans



OATLANDS ROAD

Approved & Consented
PHASE 1

supporting planning layout



LEGEND - PARKING ALLOCATION

The parking provision has been designed in accordance with Wokingham Borough Council's Parking Standards Study Report Consultation Document, dated October 2011.
This site is located within the 'urban' zone, according to figure 3, 'Super Output Area Road Classification'.

Cycle Parking

Cycle parking will be provided on the following basis:

Apartments	1-3 Habitable Rooms	1 space per unit
	4+ Habitable Rooms	2 spaces per unit
Houses	3 Habitable Rooms	1 space per unit
	4 & 5 Habitable Rooms	2 spaces per unit
	6 Habitable Rooms	2 spaces per unit

Secure cycle parking will be provided in shared communal cycle stores.

Secure cycle parking will be provided on the curtilage of each dwelling, in either private cycle sheds or garages.

Garages provided are wider than 3m and longer than 6m and can therefore be counted as a cycle space, as well as a car parking space.

Car Parking

See Parking Calculations document, based on Parking Standards Study Report - October 2011.

The calculation return the following parking requirements:

Allocated Parking	305 spaces
Unallocated Parking	37.5 spaces
Visitor Parking	38.2 spaces

Provided Car Parking

306	Allocated car parking spaces	- for use by plot number quoted
38	Unallocated car parking spaces	- for use by residents
40	Unallocated car parking spaces	- for use by visitors
42	Garage parking provided in addition to parking demand calculations	
1	Parking provided for sub-station access only	

Public Open Space Calculation

Site Occupancy
191 (proposed units) * 2.4 (average occupancy per unit) = 458.4 occupants

Natural / Semi Natural Greenspace
(2.84/1000) * 458.4 = 1.301856

Amenity Greenspace
(0.96/1000) * 458.4 = 0.440232

Provision for Children and Young People
(0.25/1000) * 458.4 = 0.1146

Total Requirement
1.856688 Ha

POSS Area Provided
~1.8506 Ha



Notes:

Drainage: Inspection Covers are fitted where possible and all drainage input inspection has been obtained through visual inspection only, with no entry into manholes. Therefore the complete accuracy cannot be guaranteed. If necessary, the client should be asked to arrange the services of a specialist drainage expert to be used.

Trees:

There has been made to identify and label all trees on plot but where trees are of critical importance we suggest the use of a specialist such as an arborist. Tree spread and heights are indicative.

GPS data: This relates to the time and date of survey. GPS levels and grids are obtained using industry standard guidelines and can vary slightly from actual ground levels. The data is not intended to be used unless stated otherwise, surveys are Scale Factor 1 and Horizontal and Vertical Datum are established from a central point and the coordinate information station utilizing GPS correction data.

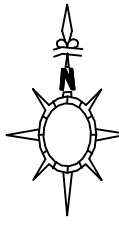
Survey notes:

Survey specification is related to the original purpose of the survey commissioned as source and to be used for its purpose only. It is not intended to be used in situations at site conditions at the time of the survey. In areas difficult to be surveyed to restricted access, lines of sight and other factors may be taken into consideration and positions should be verified following suitable clearance.

Survey plot: obtained and shown is relative to the plotting scale.

Copyright:

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LEGEND

OVERALL TREE SPECIES INFORMATION

ALDER	ALD	LONDON FLAME	LFM
ASH	ASH	MAGNOLIA	MAH
ASPEN	ASP	MAPLE	NPL
BEECH	BCH	OAK	OAK
CHERRY	CHY	PINE	PIN
ELM	ELM	POPLAR	POP
FRUIT	FRF	RHODODENDRONS	RDN
HAZEL	HAT	ROSE	ROS
NORTHERN	NRT	SILVER BIRCH	SIB
HAZ	HAZ	SWEET CHESTNUT	SCN
HOLLY	HLY	WALNUT	WNT
HORSE CHESTNUT	HCH	WILLOW	WLW
LIME	LIM	YEW	YEW
LOCUST	LOC	SPECIES UNKNOWN	SPU
		COPPED	COP

TREE ANNOTATIONS: Tree Species / Tree Bole Size / No. of Boles
Tree Height / Tree Canopy Spread

FENCE INFORMATION		LEVEL INFORMATION	
BARRIED WIRE FENCE	BWF	RED LEVEL	RL
CHAIN LINK FENCE	CLF	COOLER LEVEL	CL
CHICKEN WIRE PALING FENCE	CWF	FLUOR LEVEL	FL
CLOSE BOARD FENCE	CBF	INVERT LEVEL	IL
CONCRETE SLAT FENCE	CSF	OUTFALL LEVEL	OL
CORRUGATED IRON FENCE	CIF	THRESHOLD LEVEL	TL
CRAZ BARRIER	CRB	FOUL WATER	FW
HANDRAIL	HDR	SEALED WATER	SW
IRON RAILINGS	IRL	UNABLE TO LIFT	UL
LARGE LAF FENCE	LSF	WATER LEVEL	WL
MISCELLANEOUS FENCE	MSF		
NU-HADIC FENCE	NHF		
PICKET FENCE	PCF		
POST AND CHAIN FENCE	PCF	CONCRETE	Cc
POST AND RAIL FENCE	PRF	BRICK PAVING	BP
POST AND WIRE FENCE	PWF	FLUOR PAVING	FLP
SECURITY FENCE	SEF	PAVING SLABS	PS
STOCK WIRE FENCE	SWF	RETAINING WALL	RW
TEMP FENCE	TF	SCALPING	Scap
WIRE MESH FENCE	WMF	TACTILE PAVING	Tact

FEATURE INFORMATION			
BOLLARD	BO	NAME PLATE	NP
TELEPHONE XC	BTC	NOTICE BOARD	P
BUS STOP	BTG	POST	P
CABLE TELEVISION IC	CAV	RAIN WATER PIPE	RWP
DARTING BOO	ELR	ROAD SIGN	RS
ELECTRICITY CABLE FIT	ELCP	KIDDOO EYE	KE
ELECTRICITY POLE	EP	SERVICE MANAGER POST	SMP
FLUE HYDRANT	HH	SOFT VENT PIPE	SV
FLAG POLE	FP	STOP VALVE	SV
GUJDE POST	GP	TELEGRAPH POLE	TP
INSPECTION COVER	IC	TRAFFIC SIGNAL	TS
IRON POST	IP	TRAFFIC SIGNALS XC	TSXC
LETTER BOX	LB	WASH OUT	WO
KORIS OUTLET	KO	WATER METER	WM

REVISION

Level Datum:
Levels are related to previous Encompass Surveys Ltd survey control
Ref: 0AAS-Arborfield

Grid:
Grid is related to previous Encompass Surveys Ltd survey control

Northpoint:

Northpoint



Encompass Surveys Ltd
Yarmouth House
1300 Parkway
Solent Business Park
Whiteley, Fareham
Hampshire, PO15 7AX

Tel: (+44)2380 692002 Email: info@encompass-surveys.co.uk
Website: encompass-surveys.co.uk

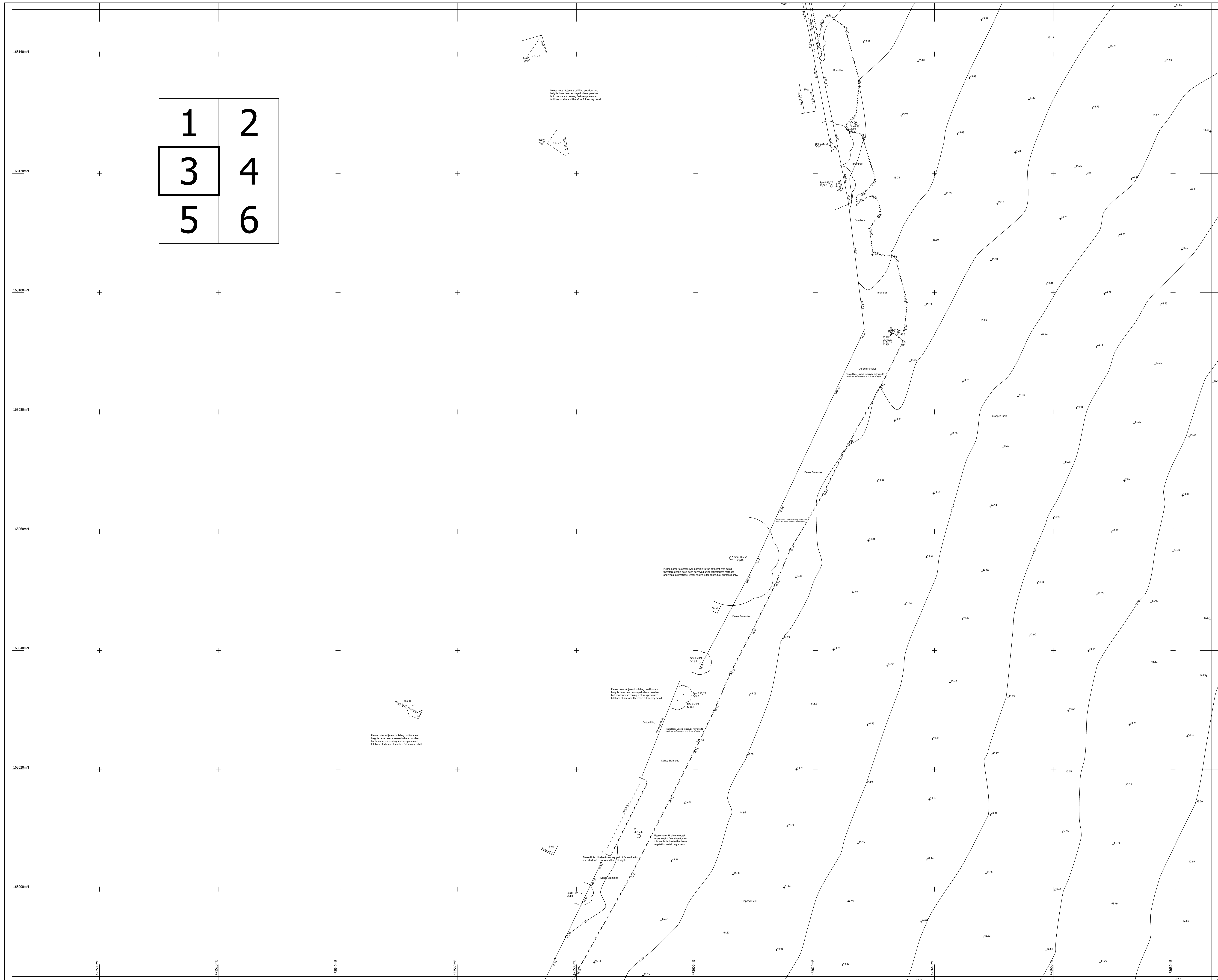
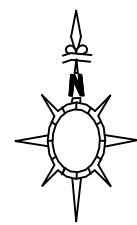
Client: Bellway Homes (Thames Valley)

Survey Location:	Land North of Arborfield Road Shinfield Reading
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Survey type: Topographical	Scale: 1:200@A0
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Drawing ref:	ENC/161123/3064/S1	Date:	November 202
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Drawn/QA:	BF/SH	Plot No.	Plot 2 of 6
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[illegible][illegible]

OBJECTIVE

Level Datum:
Levels are related to previous Encompass Surveys Ltd survey control
Ref: 0AAS-Arborfield

Grid:

Northpoint: _____



Encompass Surveys Ltd
Yarmouth House
1300 Parkway
Solent Business Park
Whiteley, Fareham
Hampshire, PO15 7AX

Tel: (+44)2380 652002 Email: info@encompass-surveys.co.uk
Website: encompass-surveys.co.uk

Client: Bellway Homes (Thames Valley)

Survey Location: Land North of Arborfield Road
Shinfield

Reading	
Survey type: Topographical	Scale: 1:200@A0

Drawing ref:	ENC/161123/3064/S1	Date:	November 2023
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Drawn/QA:	BF/SH	Plot No.	Plot 3 of 6
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1	2
3	4
5	6

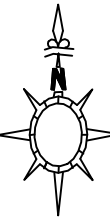
NOTES:
 Inspection Covers are filled where possible and all drainage invert information has been obtained through visual inspection only, with no entry into manholes. Therefore the complete accuracy cannot be guaranteed. The use of manholes for inspection was not suggested by the services of a specialist drainage expert be used.

Services:
 The survey has been made to identify and detail all drains on a plot but where trees are of critical importance we suggest the use of a specialist such as an arborist. Tree spread and hedges are indicative of GPS.

GPS:
 The information is related to the state and date of survey. GPS levels and are obtained using industry standard guidelines and can vary according to the quality of the GPS network at the site. Horizontal and Vertical Datum are established from a known control site fix and the information is stated utilising GCS correction data.

Survey notes:
 A presentation is linked to the original purpose of the survey commissioned at source and is to be used for the purpose only. The survey is taken within limitations of site conditions, the weather, the survey. In areas difficult to survey due to restricted access, lines of sight or dense vegetation, critical dimensions and positions should be taken and noted. The survey is not intended to be a final survey. Survey data obtained and shown is relative to the plotting scale.

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LEGEND

OVERALL TREE SPECIES INFORMATION

ALDER	ALD	LONDON FLAME	LFM
ASH	ASH	MAGNOLIA	MAH
ASPEN	ASP	MAPLE	NPL
BEECH	BCH	OAK	OAK
CHERRY	CHY	PINE	PIN
ELM	ELM	POPLAR	POP
FRUIT	FRF	ROODOODOROWONS	RDN
HAZTHORN	HRT	ROVIAN	RWB
HAZ	HAZ	SILVER BIRCH	SIB
HOLLY	HLY	SWEET CHESTNUT	SCN
HORSE CHESTNUT	HCH	WALNUT	WNT
LIME	LIM	WILLOW	WLW
LOCUST	LOC	YEW	YEW
		SPECIES UNKNOWN	SPU
		COPPED	COP

TREE ANNOTATIONS: Tree Species / Tree Bole Size / No. of Boles
Tree Height / Tree Canopy Spread

RE INFORMATION

LEVEL INFORMATION

BARBED WIRE FENCE	BWF	RED LEAD	RL
CHAIN LINK FENCE	CLF	COVER LEAD	CL
CHESTNUT PAULING FENCE	CPF	FLOOR LEVEL	FL
COAST BOARD FENCE	CBF	INVERT LEVEL	IL
CORNETT ST. FENCE	CSF	CUTTHILL LEVEL	CL
CORRUGATED IRON FENCE	CIF	THRESHOLD LEVEL	TL
CASH BARBER	CBR	FOUL WATER	FW
HANDRAIL	HDL	SURFACE WATER	SW
IRON RAILINGS	IRL	UNABLE TO LIFT	UTL
LAMP LAFCE	LFL	WATER LEVEL	WL
MISCELLANEOUS FENCE	MSF		
MOSAIC FENCE	MSF		
POST AND RAIL FENCE	PRF		
POST AND CHAIN FENCE	PCF	CONCRETE	Co
POST AND RAIL FENCE	PRF	BRICK PAVING	Br
POST AND WIRE FENCE	PWF	FLOWERED	Fw
RAIL FENCE	RF	PAVING SLABS	PS
STOCK WIRE FENCE	SWF	RETAINING WALL	RW
TRELLIS FENCING	TLF	SCAUPING	Scap
WIRE MESH FENCE	WMF	TACTILE PAVING	Tp

FEATURE INFORMATION

\$OLLAR	DO	NAME RATE	NP
TELEPHONE JC	BTIC	NOTICE BOARD	NB
BUS STOP	BS	POST	P
CABLE TELEVISION JC	CATV	RAIN WATER PIPE	RWP
DARTING ROAD	ER	ROAD SIGN	RS
ELECTRICITY CABLE FIT	ELCP	ROOFTOP EYE	RE
FIRE ALARM	FA	SMOKE EXTRACTOR ROST	SHP
FIRE HYDRANT	FH	SOIL VENT PIPE	SV
FLAG POLE	FP	STOP VALVE	SVP
GULCH POST	GP	TELEGRAPH POLE	TP
INSPECTION COVER	ICP	TRAFFIC SIGNAL	TS
LAMP POST	LP	TRAFFIC SIGNAL JC	TSC
LETTER BOX	LB	WASH OUT	WO
KIDS OUTLET	KO	WATER METER	WM

REVISION

Level Datum:
Levels are related to previous Encompass Surveys Ltd survey control
Ref: 0AAS-Arborfield

Grid:
Grid is related to previous Encompass Surveys Ltd survey control

Northpoint:



Encompass Surveys Ltd
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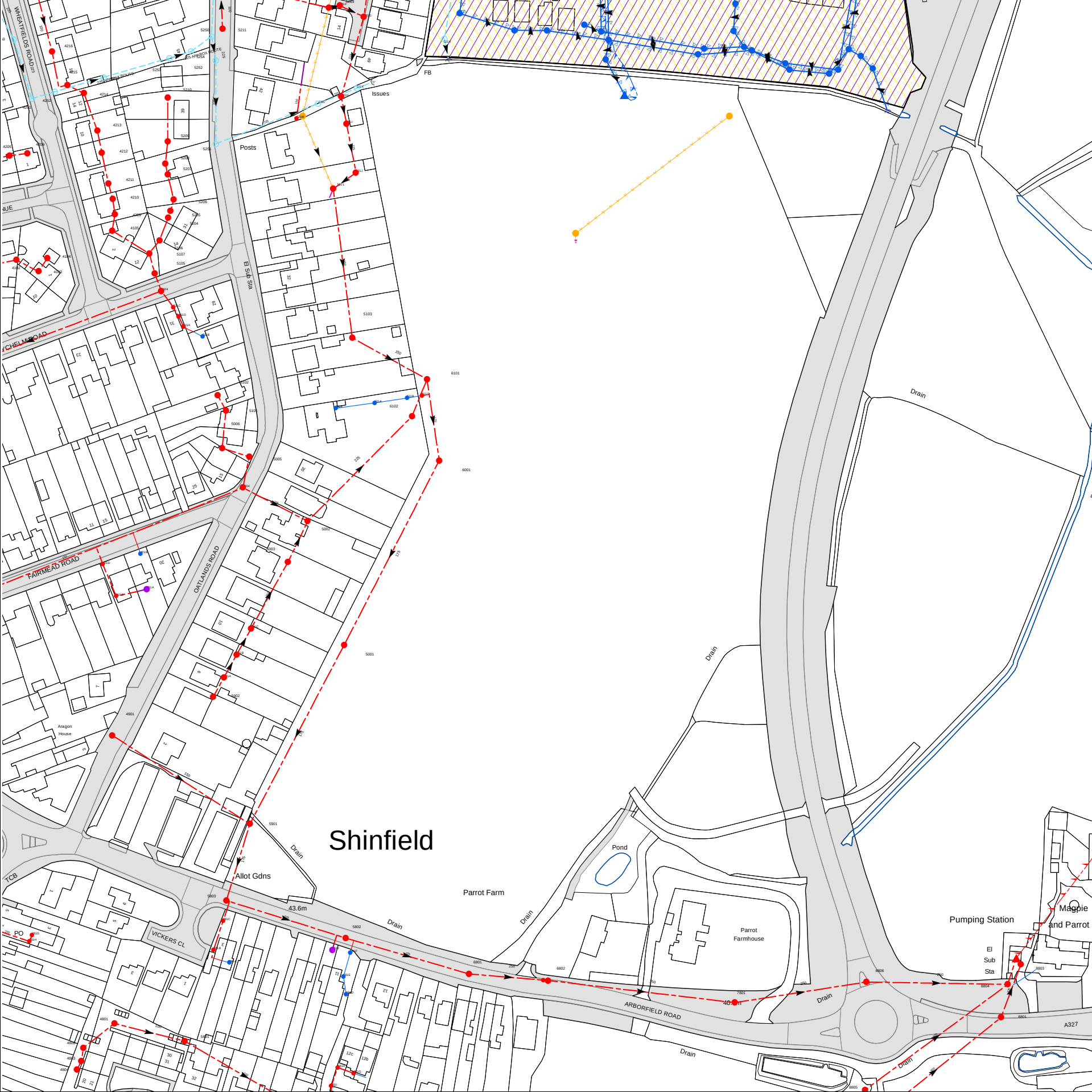
Client: Bellway Homes (Thames Valley)

Survey Location: Land North of Arborfield Road
Shinfield
Reading

Survey type: Topographical	Scale: 1:200@A0
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Drawing ref:	ENC/161123/3064/S1	Date:	November 202
Drawn/DA:	BF/SH	Plot No.	Plot 4 of 6

CommercialDW Drainage and Water Enquiry Sewer Map- CDWS/CDWS Standard/2023 4899188



The width of the displayed area is 500m

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 (2020) with the Sanction of the controller of H.M. Stationery Office, License no. 100019345 Crown Copyright Reserved.

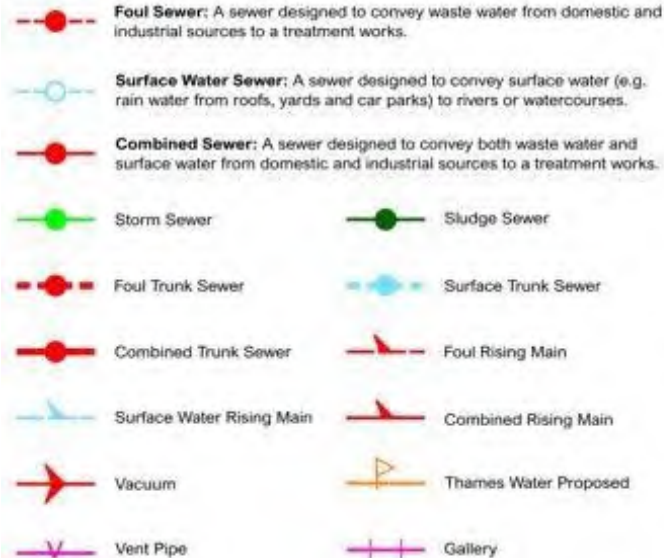
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n/a	n/a	n/a
n/a	n/a	n/a
n/a	n/a	n/a
n/a	n/a	n/a
5250	51.99	51.26
5211	n/a	n/a
4206	52.94	52.18
4251	53.19	52.03
4103	52.17	51.17
4104	52.24	51.58
4216	n/a	n/a
4252	n/a	n/a
4215	53.33	52.4
4214	53.29	52.2
4213	n/a	n/a
4212	n/a	n/a
4253	n/a	n/a
4211	n/a	n/a
4105	52.36	51.63
4210	52.95	51.38
4209	52.6	51.25
5106	n/a	n/a
5105	n/a	n/a
5107	52.17	50.98
5104	51.68	50.07
5208	52.66	51.68
5207	52.5	51.55
5210	52.87	52.11
5209	52.84	51.84
5204	n/a	n/a
5253	n/a	n/a
5205	52.19	51.27
511C	n/a	n/a
5206	52.55	51.37
511D	n/a	n/a
511A	n/a	n/a
5254	n/a	n/a
511B	n/a	n/a
5251	51.64	50.89
5252	n/a	n/a
521M	n/a	n/a
521L	n/a	n/a
5201	49.62	48.37
521H	n/a	n/a
521I	n/a	n/a
5103	47.86	46.64
521J	n/a	n/a
521K	n/a	n/a
6101	46.16	44.87
621A	49.15	47.76
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n/a	n/a	n/a
401D	n/a	n/a
4901	46.38	44.76
401C	n/a	n/a
401B	n/a	n/a
501A	n/a	n/a
5902	47.48	47.12
5102	50.67	49.77
5006	48.68	47.89
591A	n/a	n/a
5101	50.04	49.4
5803	44.22	42.31
501B	n/a	n/a
5004	48.4	45.94
5005	48.76	47.67
5901	n/a	n/a
501C	n/a	n/a
5003	47.22	45.59

Manhole Reference	Manhole Cover Level	Manhole Invert Level
5002	47.11	45.41
511E	n/a	n/a
5001	45.45	43.86
611A	n/a	n/a
611B	n/a	n/a
6102	n/a	n/a
611C	n/a	n/a
6001	45.49	44.32
581E	n/a	n/a
5802	42.89	41.44
581D	n/a	n/a
581F	n/a	n/a
6801	42.19	40.73
6802	41.73	39.21
7801	41.04	38.97
8806	41.03	38.75
8801	41.777	37.957
8804	40.71	38.57
8803	40.84	37.53
481H	n/a	n/a
481G	n/a	n/a
4803	45.76	45.08
4802	45.72	44.88
4801	45.35	44.39
5801	45.4	43.64
581A	n/a	n/a
581J	n/a	n/a
581B	n/a	n/a
581C	n/a	n/a
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.		

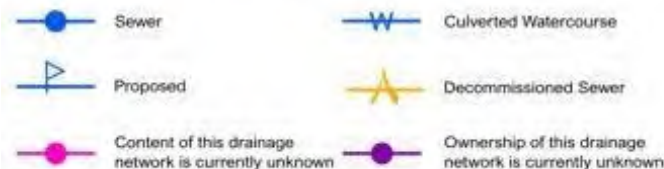


Con29DW Commercial Drainage and Water Search - Sewer Key

Public Sewer Types (Operated and maintained by Thames Water)



Other Sewer Types (Not operated and maintained by Thames Water)



Notes:

- 1) All levels associated with the plans are to Ordnance Datum Newlyn.
- 2) All measurements on the plan are metric.
- 3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate the direction of flow.
- 4) Most private pipes are not shown on our plans, as in the past, this information has not been recorded.

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.



Operational Controls

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



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.



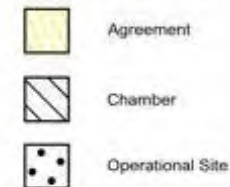
Other Symbols

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

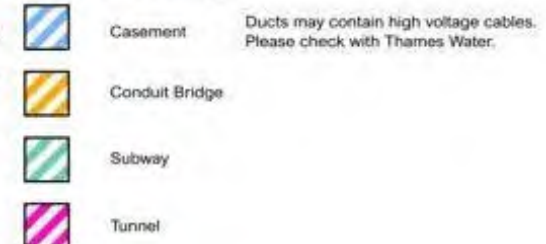


Areas

Lines denoting areas of underground surveys, etc.



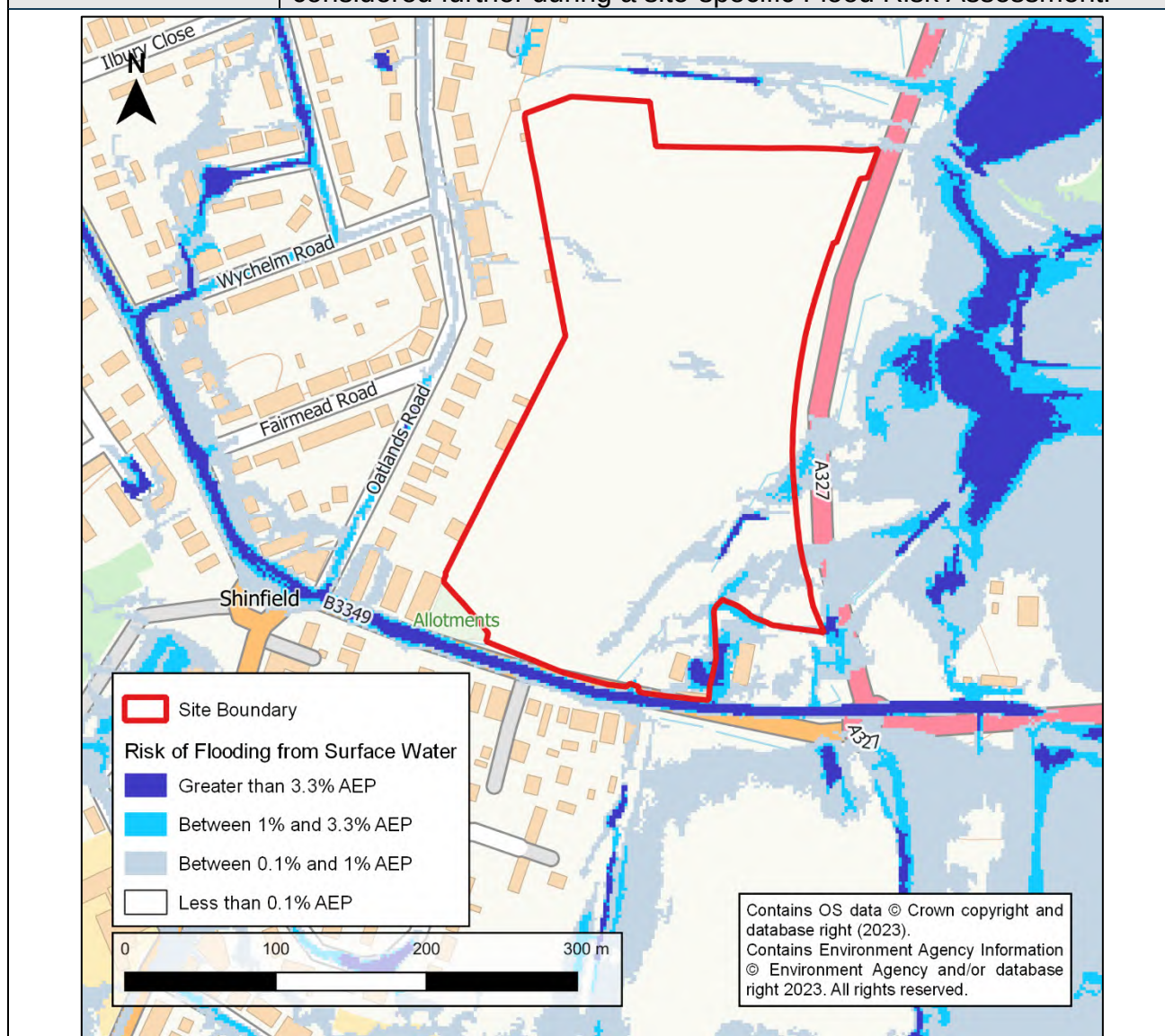
Ducts or Crossings

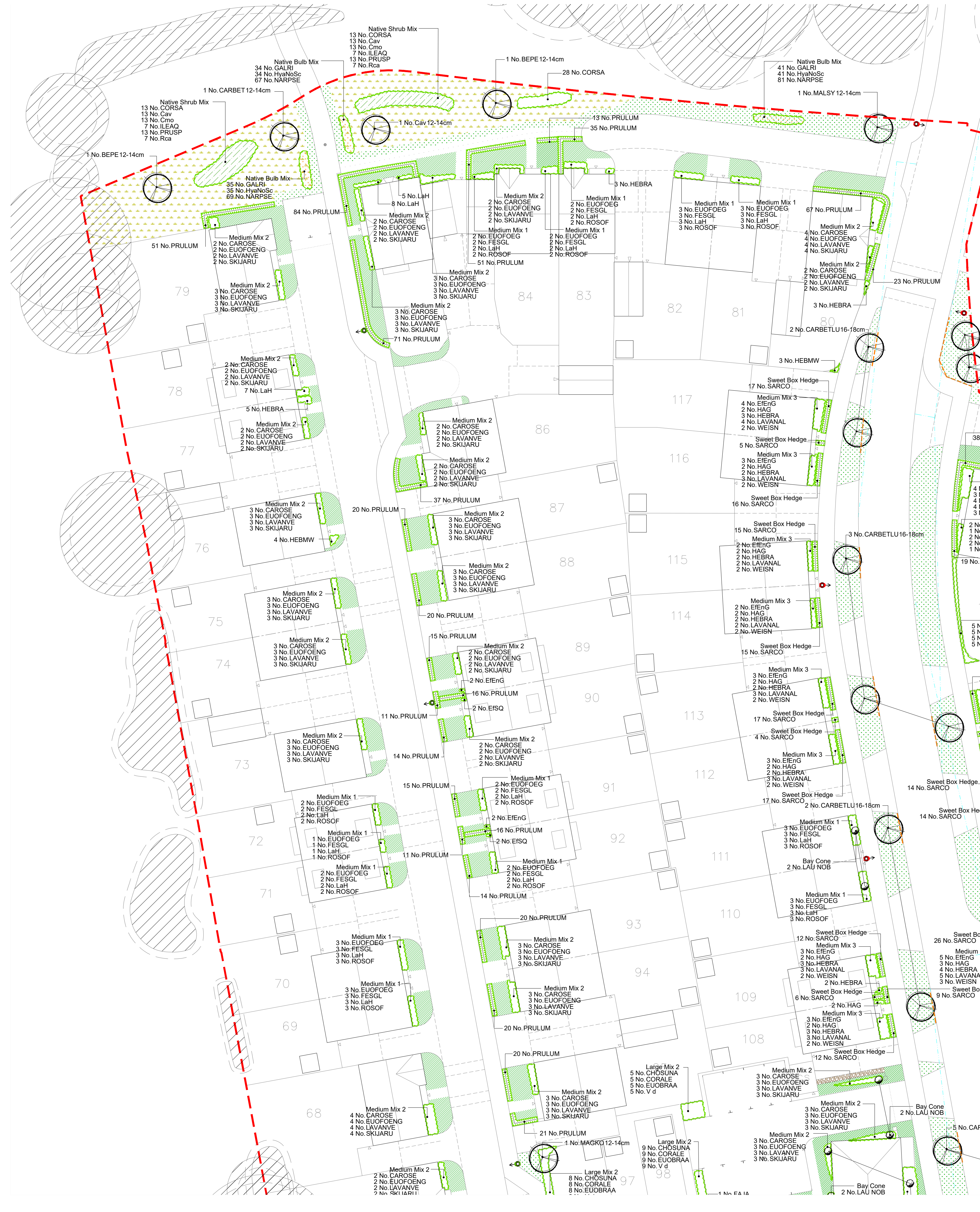


5) 'na' or '0' on a manhole indicates that data is unavailable.

6) The text appearing alongside a sewer line indicates the internal diameter of the pipe in millimeters. 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, please contact Property Searches on 0800 009 4540.

Site Code	5SH025
Location	Land north of Arborfield Road, Shinfield
Description of surface water risk	Limited risk on the site itself but considerable flow path along the road to the south and significant issues to the east of the site which may impede access.
Additional considerations	The AStGWF map shows a >75% susceptibility to groundwater flooding across the south end of the site, with the JBA groundwater map showing groundwater levels are within 0.5m of the surface across the south end of the site. There is also a risk of reservoir flooding along the eastern boundary of the site from Bearwood Lane, Bramshill House Pond, Tundry Pond, and Wellington Country Park Lake during the 'Wet Day' scenario. Potential groundwater issues at the site and the risk of reservoir flooding should be considered further during a site-specific Flood Risk Assessment.





PLANTING NOTES:
All plants to be supplied in accordance with the JTA National Plant Specification and from a JTA certified nursery. All plants and trees to be planted in accordance with BS3098 and BS8545. Delivery and handling of all plant material to be in accordance with BS4293:2014 Code of Practice for Handling and Establishing Landscape Plants Parts 1, 11 and 111 and BS6545.
Planting Pit and Trench Preparation:
Type 1 pit: 1m x 1m x 1m deep prior to excavating and all shrub planting areas excavated to 450mm depth. All proposed hedge planting trenches to be excavated to 600mm depth. Unless otherwise specified, all tree pits in hard landscape to be 2m x 2m x 1m, backfilled with compacted Urban Tree Soil.
The preparation of planting pits, bed or trenches shall comply with the appropriate British Standards, namely BS4043, BS4429, BS5837 and BS6545.
Excavation of planting pits, beds or trenches shall only take place when the ground is frozen or waterlogged and shall be carried out to the structure of the soil. All excavated areas to be backfilled with other than topsoil or imported topsoil to be BS3882 General purpose grade. All topsoiled areas to be clear of rocks and rubble larger than 50mm diameter and any other debris that may interfere with the establishment of plants. The Contractor shall break up and cultivate at the base of the trenches or planting pit. The sides of the trenches or planting pits shall be topped with a fork or other similar implement. All stones and the like over 15mm in any dimension, including roots brought to the surface by any cultivation or digging shall be removed off site. The Contractor shall remove off site the excavated subsoil material, deep preparing planting pits. The imported topsoil should make up any deficiencies caused by the removal of the subsoil material. Trenches and pits shall have the topsoil and any subsoil material thoroughly broken up and mixed prior to backfilling.
All trees shall be supplied root balled, unless otherwise stated. Root balled trees shall be well grown, healthy and with a compact, contained rootball. They shall be nursery grown and have been regularly watered. Prior to planting, all plant material shall be stored and sorted at in accordance with best practice.
Planting
All plants shall be planted in a random fashion avoiding formal regimented lines at densities indicated in the schedule, unless otherwise specified. Unless otherwise specified, all hedgerows shall be planted in single rows and hedgerow mixes shall be planted in groups of 7, 9 & 13 at densities indicated on the schedule. Ornamental shrub planting mixes shall be planted in groups of 5, 7 & 11s and native shrub planting mixes shall be planted in groups of 9, 13 & 15s, with a cane and protective spiral guard included to all native planting. The selection, procurement, handling, storage and planting operations of all proposed trees shall be in accordance with BS8545:2014. Trees from nursery to independence in the landscape, recommendations. Planting and associated operations shall comply with BS4043, BS4428, BS5837 and BS8545. Unless otherwise stated planting shall be carried out during the period of 1 Nov to 31 March when the ground is not frozen or waterlogged. If planting is required outside this period agreement shall be sought and all bare root plants shall be substituted with container grown stock.
Provide Bamboo cane support and 'Treebio Biodegradable Spiral Guards' (Green-Tech product code: 100P5103-PRG) or similar to all native shrubs and hedgerows, young sapling trees, whips and feather planting, ensuring that the main or terminal bud is protruding out above the top of the spirals.
Watering
All plants shall be watered in to field capacity immediately after planting and mulched with 50mm depth of medium grade crushed mulch. The Contractor shall water the trees, shrubs and hedges once planted so that the entire tree pit or planted area is moistened to field capacity, i.e. "the amount of water retained by previously saturated soil once full drainage has ceased". Watering to field capacity shall continue frequently and on a regular basis as considered necessary by the landscape contractor and as necessary to ensure the successful establishment and continued thriving of all planting. Additional watering shall be undertaken during the first summer months and/or periods of drought. Post planting management and maintenance specifically for new tree planting shall include ongoing irrigation and formative pruning as outlined in BS8545. The period over which regular irrigation required for transplanted trees is likely to be at least two full growing seasons to ensure successful establishment. As the root system develops the frequency of irrigation can be reduced.
Staking
All trees within soft landscape areas to be double staked with cross bar and tied, using 1.5m long, 75mm diameter rounded tree stakes 75mm brace, rubber tie and spacer block. Stakes not to extend more than 650mm above ground level. All trees within hardstanding/highways visibility splays to be clear stem to 1.5m high unless otherwise specified. Trees within hardstanding / specific pits to be underground guyed unless otherwise specified.
Root Barriers
Root barriers (ReRoot 1000 or equivalent) to be included adjacent to buildings and services where necessary. Landscape contractor shall check all planting operations comply with appropriate standards and that in the absence of detailed surveys, any necessary underground investigations are undertaken to ensure there are no conflicts with existing or proposed utilities, services or foundations.
PROTECTION OF EXISTING VEGETATION TO BE RETAINED
Existing trees to be retained shall be protected in accordance with BS5837, from commencement to completion of all works on site.
N.B. All planting proposals including tree planting have been developed in order to create a high quality environment and gain planning consent for the development. All tree species have been reviewed in line with NHBC guidance (2017) and in the absence of any building foundation depths or detailed soil analysis information for the site. Where possible only low and moderate water demand species are proposed in close proximity to new buildings. A number of varied cultivars of these species as well as ornamental species that have a smaller overall mature height (which are not currently assessed within NHBC guidance 2017) are proposed to provide variety in the scheme and engineer's should consider these locations & species. Where necessary new building foundation depths shall be designed to accommodate the approved tree species, site specific soil shrinkage and tree water demand in line with NHBC standards 2017 (Chapter 4.2 - Building Near Trees). Planting plans have been prepared for planning purposes and in the absence of fully detailed ground investigations, geological or hydrological surveys and planting design or species choice may be subject to change - suitability should be confirmed on site by the landscape contractor. Detailed site specific soil analysis and suitable site drainage should be checked by landscape contractor to ensure planting can be implemented in accordance with approved drawings prior to implementation.

- NOTES:**
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0m 2m 4m 10m
- KEY:**
- Site Boundary
 - Existing Trees
 - Existing Shrubs
 - Proposed Multistem Trees
 - Proposed Trees (to be positioned 2m from highway boundary and 1m from kerb edge)
 - Proposed Native Hedge (Cane and Rabbit guards added with 50mm bark mulch)
 - Proposed Ornamental Hedge (Initially clipped to 0.5m high and subsequently maintained at 0.6m high, offset 0.5m from back of highway boundary with a 0.5m bark mulch strip)
 - Proposed Feature Shrub
 - Proposed Climbers (Fixed onto pressure-treated golden brown timber fan trellis - Dimensions: H105 x W514mm.)
 - Proposed Ornamental Shrubs (50mm Bark mulch to be included around planting)
 - Proposed Native Shrub Planting (50mm Bark mulch to be included around planting)
 - Proposed Bulb Planting (Scattered Randomly where to be planted)
 - Proposed Premium Grade Turf (150mm min gravel strip with timber edge to be installed along building edge) Turf beds to not frontages
 - Proposed Amenity Grass Seed (Flowering Lawn Mixture: Sown at 40g/m². Strong Lawn Grass Mixture: Sown on mown grass pathways at 250g/m².)
 - Proposed Wildflower Mix (General Purpose Meadow Mixture: Sown at 40g/m²)
 - Proposed Wet/Wildflower Mix (Meadow Mixture for wetlands: Sown at 40g/m²)
 - Small 30mm Decorative Gravel overlaid over geotextile membrane (Gravel to be agreed with Bellway before installation and include a timber edge)
 - Proposed Root Barrier
 - Proposed Mown Grass Footpath 1.2m wide
 - Proposed Tarmac Footpath
 - Proposed Short Span Timber Bridge Finish: FSC Certified Treated Hardwood Width: 2000mm Min. Length: 3000mm
 - Proposed Timber Bench Finish: Treated Softwood timber Size: L2000mm W580mm H770mm Root Fixed Length 300mm
 - 450mm High Timber Square Bollard Size: 200x750mm
 - Canopied Litter Bin Size: Ø560mm H900mm Fixing: Set of 4 Shield Anchor Bolts for Installation Fixed onto Tarmac Capacity: 90 Litres
 - Natural Boulders Approx. L1.2m x W0.8m x H0.8m / 1200kg
 - Indicative Lamppost location Refer to DW Windsor plan for detailed design
 - Visplay

NB: Decorative Bark mulch to be supplied in 30-40mm chip size and applied at a depth of 50mm around landscaping to restrict weed growth and retain moisture.

A	15.08.2024	Updated to comments	SP	CW
REV	DATE	NOTE		Drawn/Chkd

aspect landscape planning

TITLE
Land North of Arborfield Road, Shinfield
Planting Plan 1 of 6

CLIENT
Bellway Homes Limited (Thames Valley)

SCALE 1:250@A1	DATE JUL 2024	DRAWN SP	CHKD CW
DRAWING NUMBER 8395.PP.1.1	REVISION A		

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- 0m 2m 4m 10m
- KEY:
- Site Boundary
 - Existing Trees
 - Existing Shrubs
 - Proposed Multistem Trees
 - Proposed Trees
(to be positioned 2m from highway boundary and 1m from kerb edge)
 - Proposed Native Hedge
(Cared and Rabbit guards added with 50mm bark mulch)
 - Proposed Ornamental Hedge
(Initially clipped to 0.5m high and subsequently maintained at 0.6m high, offset 0.5m from back of highway boundary with a 0.5m bark mulch strip)
 - Proposed Feature Shrub
 - Proposed Climbers
(Fixed onto pressure-treated golden brown timber fan trellis - Dimensions: H1055 x W514mm.)
 - Proposed Ornamental Shrubs
(50mm Bark mulch to be included around planting)
 - Proposed Native Shrub Planting
(50mm Bark mulch to be included around planting)
 - Proposed Bulb Planting
(Scattered Randomly where to be planted)
 - Proposed Premium Grade Turf
(150mm min gravel strip with timber edge to be installed along building edge)
Turf beds to suit footpaths
 - Proposed Amenity Grass Seed
Flowering Lawn Mixture: Sown at 40g/m²
Strong Lawn Grass Mixture: Sown on: mown grass pathways at 250g/m²
 - Proposed Wildflower Mix
General Purpose Meadow Mixture: Sown at 40g/m²
 - Proposed Wet/Wildflower Mix
Meadow Mixture for wetlands: Sown at 40g/m²
 - Small 30mm Decorative Gravel
overlay over geotextile membrane
(Gravel to be agreed with Bellway before installation and include a timber edge)
 - Proposed Root Barrier
 - Proposed Mown Grass Footpath 1.2m wide
 - Proposed Tarmac Footpath
 - Proposed Short Span Timber Bridge
Finish: FSC Certified Treated Hardwood
Width: 2000mm
Min. Length: 3000mm
 - Proposed Timber Bench
Finish: Treated Softwood timber
Size: L2000mm W580mm H770mm
Root Fixed Length 300mm
 - 450mm High Timber Square Bollard
Size: 200x750mm
 - Canopied Litter Bin
Size: Ø560mm H900mm
Fixing: Set of 4 Stainless Anchor Bolts for Installation Fixed onto Tarmac
Capacity: 90 Litres
 - Natural Boulders
Approx. L1.2m x W0.8m x H0.8m / 1200kg
 - Indicative Lamppost location
Refer to DW Windsor plan for detailed design
 - Visplay

NB: Decorative Bark mulch to be supplied in 30-40mm chip size and applied at a depth of 50mm around landscaping to restrict weed growth and retain moisture.

PLANTING NOTES
All plants to be supplied in accordance with the HTA National Plant Specification and from a HTA certified nursery. All plants and trees to be planted in accordance with BS3936 and BS8545. Delivery and handling of all plant material to be in accordance with BS4428/JCL/PCSE Code of Practice for 'Handling and Establishing Landscape Plants' Parts I, II and III and BS8545.
Planting Pit and Trench Preparation
Tree pits in soft landscape to be excavated to 1m x 1m x 1m depth prior to topsoiling and all shrub planting areas excavated to 450mm depth. All proposed hedge planting trenches to be excavated to 500mm depth. Unless otherwise specified, all tree pits in hard landscape to be 2m x 2m x 1m, backfilled with compacted Urban Free Soil.
The preparation of planting pits, beds or trenches shall comply with the appropriate British Standards, namely BS4043, BS4428, BS5837 and BS8545.
Excavation of planting pits, beds or trenches shall not take place when the ground is frozen or waterlogged such that damage may occur to the structure of the soil. All excavated areas to be backfilled with either site won topsoil or imported topsoil to be BS3936 General purpose grade. All topsoiled areas to be clear of rocks and rubble larger than 50mm diameter and any other debris that may interfere with the establishment of plants. The Contractor shall break up and cultivate at the base of the trenches or planting pits. The sides of the trenches or planting pits shall be loosened with a fork or other similar implement. All stones and the like over 75mm in any dimension, deleterious matter, weeds and weed roots brought to the surface by any cultivation or excavation shall be removed off site. The Contractor shall remove off site the excavated subsoil material when preparing planting pits. The imported topsoil should make up any deficiencies caused by the removal of the subsoil material. Trenches and pits shall have the topsoil and any subsoil material thoroughly broken up and mixed prior to backfilling.
All trees shall be supplied root balled, unless otherwise stated. Root balled trees shall be well grown, healthy and with a compact, contained rootball. They shall be nursery grown and have been regularly watered. Prior to planting, all plant material shall be stored and sorted in accordance with best practice.
Planting
All plants shall be planted in a random fashion avoiding formal regimented lines at densities indicated in the schedule, unless otherwise specified. Unless otherwise specified, all hedgerows shall be planted in single rows and hedgerow mixes shall be planted in groups of 7, 9 & 13 at densities indicated on the schedule. Ornamental shrub planting mixes shall be planted in groups of 5, 7 & 11 and native shrub planting mixes shall be planted in groups of 9, 13 & 15, with a cane and protective spiral guard included to all native planting. The selection, procurement, handling, storage and planting operations of all proposed trees shall be in accordance with BS5854:2014 - Trees: from nursery to independence in the landscape, recommendations.
Planting and associated operations shall comply with BS4043, BS4428, BS5837 and BS8545. Unless otherwise stated planting shall be carried out during the period of 1 Nov to 31 March when the ground is not frozen or waterlogged. If planting is required outside this period agreement shall be sought and all bare root plants shall be substituted with container grown stock.
Provide Bamboo cane support and Treebio Biodegradable Spiral Guards (Green-tech Product code: 100P81031-PRO) or similar to all native shrubs and hedgerows, young sapling trees, whips and feather planting, ensuring that the main or terminal bud is protruding out above the top of the spirals.
Watering
All plants shall be watered in to field capacity immediately after planting and mulched with 50mm depth of medium grade crushed mulch. The Contractor shall water the trees, shrubs and hedges once planted so that the entire tree pit or planted area is moistened to field capacity, i.e. 'the amount of water retained by previously saturated soil once full drainage has ceased'. Watering to field capacity shall continue frequently and on a regular basis as considered necessary by the landscape contractor and as necessary to ensure the successful establishment and continued thriving of all planting. Additional watering shall be undertaken during summer months and/or periods of drought. Post planting management and maintenance specifically for new tree planting shall include ongoing irrigation and formative pruning as outlined in BS8545. The period over which regular irrigation required for transplanted trees is likely to be at least two full growing seasons to ensure successful establishment. As the root system develops the frequency of irrigation can be reduced.
Staking
All trees within soft landscape areas to be double staked with cross bar and tied, using 1.5m long, 75mm diameter rounded tree stakes 75mm brace, rubber tie and spacer block. Stakes not to extend more than 600mm above ground level. All trees within hardstanding/highways visibility splays to be clear stem to 1.5m high unless otherwise specified. Trees within hardstanding/ splay pits to be underground guided unless otherwise specified.
Root Barriers
Root barriers (ReRoot 1000 or equivalent) to be included adjacent to buildings and services where necessary. Landscape contractor shall check all planting operations comply with appropriate standards and that in the absence of detailed surveys, any necessary underground investigations are undertaken to ensure there are no conflicts with existing or proposed utilities, services or foundations.
PROTECTION OF EXISTING VEGETATION TO BE RETAINED
Existing trees to be retained shall be protected in accordance with BS5837, from commencement to completion of all works on site.

N.B. All planting proposals including tree planting have been developed in order to create a high quality environment and gain planning consent for the development. All tree species have been reviewed in line with NBSG guidance (2017) and in the absence of any building foundation depths or detailed soil analysis information for the site. Where possible only low and moderate water demand species are proposed in close proximity to new buildings. A number of varied cultivars of these species as well as ornamental species that have a smaller overall mature height (which are not currently assessed within NBSG guidance 2017) are proposed to provide variety in the scheme and engineer's should consider these locations & species. Where necessary new building foundation depths shall be designed to accommodate the approved tree species, site specific soil shrinkage and tree water demand in line with NBSG standard 2017 (Chapter 4.2 - Building Near Trees). Planting plans have been prepared for planning purposes and in the absence of fully detailed ground investigations, geological or hydrological surveys and planting design or species choice may be subject to change - suitability should be confirmed on site by the landscape contractor. Detailed site specific soil analysis and suitable site drainage should be checked by landscape contractor to ensure planting can be implemented in accordance with approved drawings prior to implementation.

aspect landscape planning

TITLE
Land North of Arborfield Road, Shinfield
Planting Plan 2 of 6

CLIENT				
Bellway Homes Limited (Thames Valley)				
SCALE	DATE	DRAWN	CHKD	
1:250@A1	JUL 2024	SP	CW	
DRAWING NUMBER	REVISION			
8395.PP.1.2	A			

PLANTING NOTES

All plants to be supplied in accordance with the HTA 'National Plant Specification' and from a HTA certified nursery. All plants and trees to be planted in accordance with BS9306 and BS8545. Delivery and handling of all plant material to be in accordance with BS4428/JCLICPSE Code of Practice for 'Handling and Establishing Landscape Plants' Parts I, II and III and BS8545.

Planting Pit and Trench Preparation
Tree pits in soft landscape to be excavated to 1m x 1m x 1m depth prior to topsoiling and all shrub planting areas excavated to 450mm depth. All proposed hedge planting trenches to be excavated to 600mm depth. Unless otherwise specified, all tree pits in hard landscape to be 2m x 2m x 1m, backfilled with compacted Urban Tree Soil.

The preparation of planting pits, beds or trenches shall comply with the appropriate British Standards, namely BS4443, BS4428, BS5837 and BS8545.
Excavation of planting pits, beds or trenches shall not take place when the ground is frozen or waterlogged such that damage may occur to the structure of the soil. All excavated areas to be backfilled with either site won topsoil or imported topsoil to be BS3882-General purpose grade. All topsoiled areas to be clear of rocks and rubble larger than 50mm diameter and any other debris that may interfere with the establishment of plants. The Contractor shall break up and cultivate at the base of the trenches or planting pits. The sides of the trenches or planting pits shall be loosened with a fork or other similar implement. All stones and the like over 75mm in any dimension, deleterious matter, weeds and weed roots brought to the surface by any cultivation or excavation shall be removed off site. The Contractor shall remove off site the excavated subsoil/fill material when preparing planting pits. The imported topsoil should make up any deficiencies caused by the removal of the subsoil/fill material. Trenches and pits shall have the topsoil and any subsoil/fill material thoroughly broken up and mixed prior to backfilling.
All trees shall be supplied root balled, unless otherwise stated. Root balled trees shall be well grown, healthy and with a compact, contained rootball. They shall be nursery grown and have been regularly watered. Prior to planting, all plant material shall be stored and sorted at in accordance with best practice.

Planting
All plants shall be planted in a random fashion avoiding formal regimented lines at densities indicated in the schedule, unless otherwise specified. Unless otherwise specified, all hedgerows shall be planted in single rows and hedgerow mixes shall be planted in groups of 7, 9 & 13 at densities indicated on the schedule. Ornamental shrub planting mixes shall be planted in groups of 5, 7 & 11s and native shrub planting mixes shall be planted in groups of 9, 13 & 15s, with a cane and protective spiral guard included to all native planting. The selection, procurement, handling, storage and planting operations of all proposed trees shall be in accordance with BS8545:2014 - Trees: from nursery to independence in the landscape, recommendations.

Planting and associated operations shall comply with BS4043, BS4428, BS5837 and BS8545. Unless otherwise stated planting shall be carried out during the period of 1 Nov to 31 March when the ground is not frozen or water logged. If planting is required outside this period agreement shall be sought and all bare root plants shall be substituted with container grown stock.
Provide Bamboo cane support and 'Treebio Biodegradable Spiral Guards' (Green-tech Product code: 10FPS1031-PRO) or similar to all native shrubs and hedgerows, young sapling trees, whips and feather planting, ensuring that the main or terminal bud is protruding out above the top of the spirals.

Watering
All plants shall be watered in to field capacity immediately after planting and mulched with 50mm depth of medium grade crushed mulch. The Contractor shall water the trees, shrubs and hedges once planted so that the entire tree pit or planted area is moistened to field capacity, i.e. "the amount of water retained by previously saturated soil once full drainage has ceased". Watering to field capacity shall continue frequently and on a regular basis as considered necessary by the landscape contractor and as necessary to ensure the successful establishment and continued thriving of all planting. Additional watering shall be undertaken during summer months and/or periods of drought. Post planting management and maintenance specifically for new tree planting shall include ongoing irrigation and formative pruning as outlined in BS8545. The period over which regular irrigation required for transplanted trees is likely to be at least two full growing seasons to ensure successful establishment. As the root system develops the frequency of irrigation can be reduced.

Staking
All trees within soft landscape areas to be double staked with cross bar and tied, using 1.5m long, 75mm diameter rounded tree stakes 75mm brace, rubber tie and spacer block. Stakes not to extend more than 650mm above ground level. All trees within hardstanding/highways visibility plays to be clear stem to 1.5m high unless otherwise specified. Trees within hardstanding / specific pits to be underground guyed unless otherwise specified.

Root Barriers
Root barriers (ReRoot 1000 or equivalent) to be included adjacent to buildings and services where necessary. Landscape contractor shall check all planting operations comply with appropriate standards and that in the absence of detailed surveys, any necessary underground investigations are undertaken to ensure there are no conflicts with existing or proposed utilities, services or foundations.

PROTECTION OF EXISTING VEGETATION TO BE RETAINED
Existing trees to be retained shall be protected in accordance with BS5837, from commencement to completion of all works on site.

N.B. All planting proposals including tree planting have been developed in order to create a high quality environment and gain planning consent for the development. All tree species have been reviewed in line with NHC guidance (2017) and in the absence of any building foundation depths or detailed soil analysis information for the site. Where possible only low and moderate water demand species are proposed in close proximity to new buildings. A number of varied cultivars of these species as well as ornamental species that have a smaller overall mature height (which are not currently assessed within NHC guidance 2017) are proposed to provide variety in the scheme and engineer's should consider these locations & species. Where necessary new building foundation depths shall be designed to accommodate the approved tree species, site specific soil shrinkage and tree water demand in line with NHC standards 2017 (Chapter 4.2 - Building Near Trees). Planting plans have been prepared for planning purposes and in the absence of fully detailed ground investigations, geological or hydrological surveys and planting design or species choice may be subject to change - suitability should be confirmed on site by the landscape contractor. Detailed site specific soil analysis and suitable site drainage should be checked by landscape contractor to ensure planting can be implemented in accordance with approved drawings prior to implementation.

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- KEY:**
- Site Boundary
 - Existing Trees
 - Existing Shrubs
 - Proposed Multistem Trees
 - Proposed Trees
(to be positioned 2m from highway boundary and 1m from kerb edge)
 - Proposed Native Hedge
(Cane and Rabbit guards added with 50mm bark mulch)
 - Proposed Ornamental Hedge
(Initially clipped to 0.5m high and subsequently maintained at 0.6m high, offset 0.5m from boundary of highway boundary with a 0.5m bark mulch strip)
 - Proposed Feature Shrub
 - Proposed Climbers
(Fixed onto pressure-treated golden brown timber fan trellis - Dimensions: H1055 x W614mm.)
 - Proposed Ornamental Shrubs
(50mm Bark mulch to be included around planting)
 - Proposed Native Shrub Planting
(50mm Bark mulch to be included around planting)
 - Proposed Bulb Planting
(Scattered Randomly where to be planted)
 - Proposed Premium Grade Turf
(150mm min gravel strip with timber edge to be installed along building edge)
 - Proposed Amenity Grass Seed
(Flowering Lawn Mixture: Sown at 40g/m².
Strong Lawn Grass Mixture: Sown on mown grass pathways at 250g/m².)
 - Proposed Wildflower Mix
(General Purpose Meadow Mixture: Sown at 40g/m²)
 - Proposed Wet/Wildflower Mix
(Meadow Mature for wetlands: Sown at 40g/m²)
 - Small 30mm Decorative Gravel
overlay over geotextile membrane
(Gravel to be agreed with Bellway before installation and include a timber edge)
 - Proposed Root Barrier
 - Proposed Mown Grass Footpath 1.2m wide
 - Proposed Tarmac Footpath
 - Proposed Short Span Timber Bridge
Finish: FSC Certified Treated Hardwood
Width: 2000mm
Min. Length: 3000mm
 - Proposed Timber Bench
Finish: Treated Softwood timber
Size: L2000mm W580mm H770mm
Root Fixed Length 300mm
 - 450mm High Timber Square Bollard
Size: 200x750mm
 - Canopied Litter Bin
Size: Ø560mm H900mm
Fixing: Set of 4 Shield Anchor Bolts
for Installation Fixed onto Tarmac
Capacity: 90 Litres
 - Natural Boulders
Approx. L1.2m x W0.8m x H0.8m / 1200kg
 - Indicative Lamppost location
Refer to DW Windsor plan for detailed design
 - Visplay

NB: Decorative Bark mulch to be supplied in 30-40mm chip size and applied at a depth of 50mm around landscaping to restrict weed growth and retain moisture.

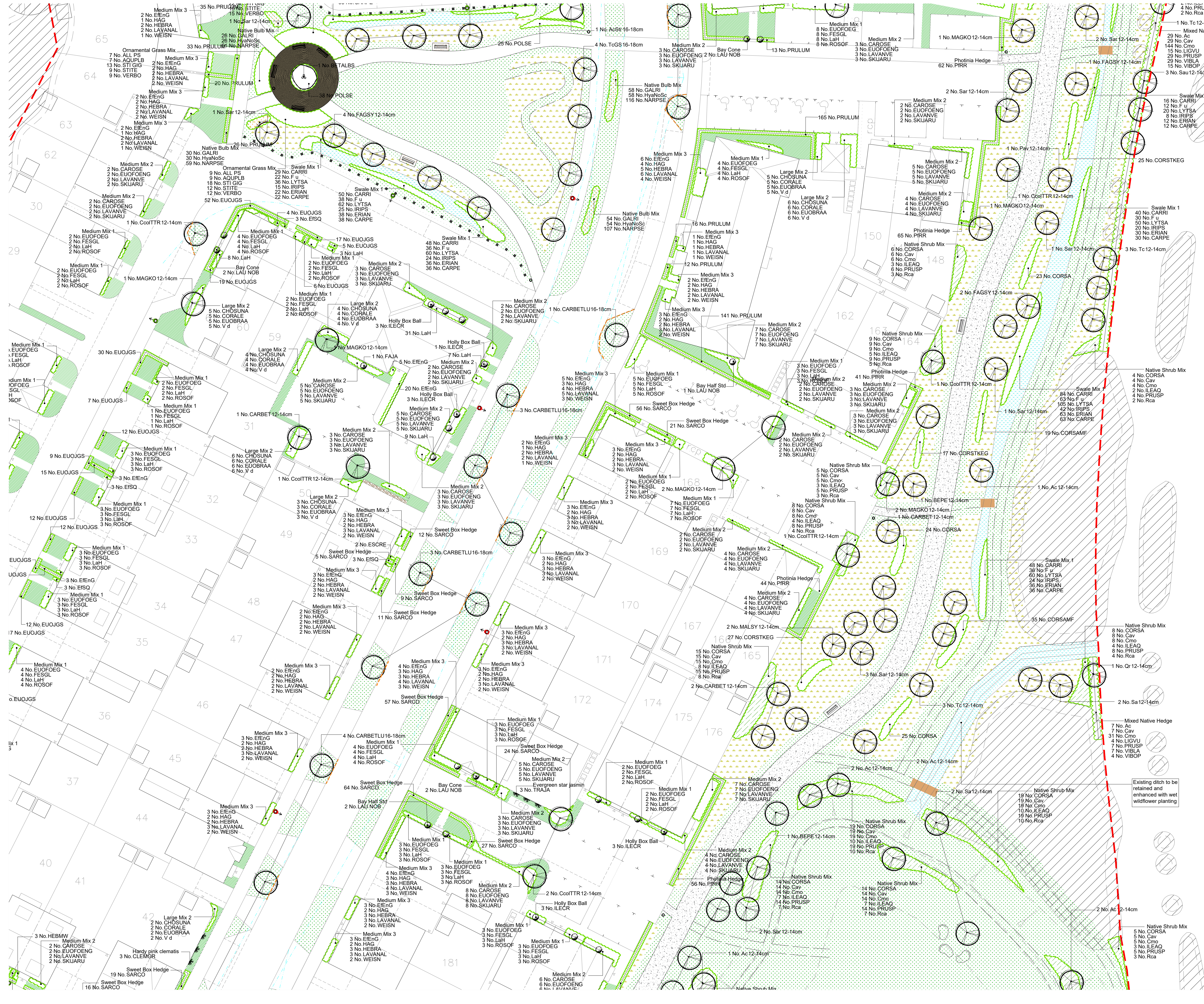
A	15.08.2024	Updated to comments	SP	CW
REV	DATE	NOTE	Drawn	Chkd

aspect landscape planning

TITLE
Land North of Arborfield Road, Shinfield
Planting Plan 3 of 6

CLIENT
Bellway Homes Limited (Thames Valley)

SCALE 1:250@A1	DATE JUL 2024	DRAWN SP	CHKD CW
DRAWING NUMBER 8395.PP.1.3	REVISION A		



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0m 2m 4m 10m

1:250 @ A1

KEY:

Site Boundary

Existing Trees

Existing Shrubs

Proposed Multistem Trees

Proposed Trees
(to be positioned 2m from highway boundary and 1m from kerb edge)

Proposed Native Hedge
(Cared and Rabbit guards added with 50mm bark mulch)

Proposed Ornamental Hedge
(Initially clipped to 0.5m high and subsequently maintained at 0.6m high, offset 0.5m from back of highway boundary with a 0.5m bark mulch strip)

Proposed Feature Shrub

Proposed Climbers
(Fixed onto pressure-treated golden brown timber fan trellis - Dimensions: H1055 x W514mm.)

Proposed Ornamental Shrubs
(50mm Bark mulch to be included around planting)

Proposed Native Shrub Planting
(50mm Bark mulch to be included around planting)

Proposed Bulb Planting
(Scattered Randomly where to be planted)

Proposed Premium Grade Turf
(150mm min gravel strip with timber edge to be installed along building edge)
Turf beds to soil frontage

Proposed Amenity Grass Seed
Flowering Lawn Mixture: Sown at 40g/m².
Strong Lawn Grass Mixture: Sown on mown grass pathways at 250g/m².

Proposed Wildflower Mix
General Purpose Meadow Mixture: Sown at 40g/m²

Proposed Wet/Wildflower Mix
Meadow Mixture for wetlands: Sown at 40g/m²

Small 30mm Decorative Gravel
overlayd over geotextile membrane
(Gravel to be agreed with Bellway before installation and include a timber edge)

Proposed Root Barrier

Proposed Mown Grass Footpath 1.2m wide

Proposed Tarmac Footpath

Proposed Short Span Timber Bridge
Finish: FSC Certified Treated Hardwood
Width: 2000mm
Min. Length: 3000mm

Proposed Timber Bench
Finish: Treated Softwood timber
Size: L2000mm W580mm H770mm
Root Fixed Length 300mm

450mm High Timber Square Bollard
Size: 200x750mm

Canopied Litter Bin
Size: Ø560mm H900mm
Fixing: Set of 4 Shield Anchor Bolts
for Installation Fixed onto Tarmac
Capacity: 90 Litres

Natural Boulders
Approx. L1.2m x W0.8m x H0.8m / 1200kg

Indicative Lamppost location
Refer to DW Windsor plan for detailed design

Visplay

NB: Decorative Bark mulch to be supplied in 30-40mm chip size and applied at a depth of 50mm around landscaping to restrict weed growth and retain moisture.

A	15.08.2024	Updated to comments	SP	CW
REV	DATE	NOTE	Drawn	Chkd

aspect

landscape planning

TITLE

Land North of Arborfield Road, Shinfield

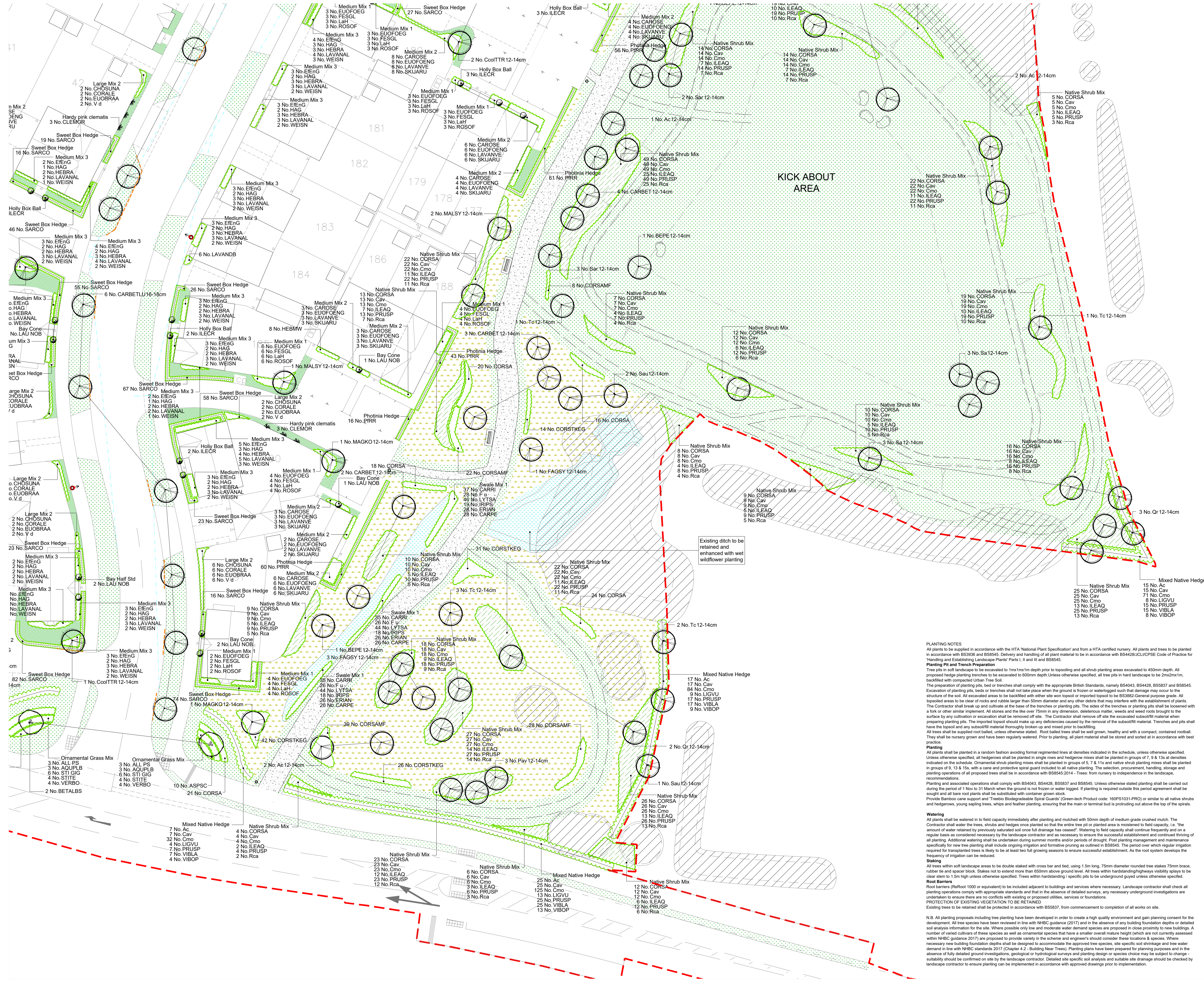
Planting Plan 4 of 6

CLIENT

Bellway Homes Limited (Thames Valley)

SCALE	DATE	DRAWN	CHKD
1:250@A1	JUL 2024	SP	CW

DRAWING NUMBER	REVISION
8395.PP.1.4	A



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0m 2m 4m 10m

KEY:

- Site Boundary
- Existing Trees
- Existing Shrubs
- Proposed Multistem Trees
- Proposed Trees
(to be positioned 2m from highway boundary and 1m from kerb edge)
- Proposed Native Hedge
(Cane and Rabbit guards added with 50mm bark mulch)
- Proposed Ornamental Hedge
(Initially clipped to 0.5m high and subsequently maintained at 0.6m high, offset 0.5m from back of highway boundary with a 0.5m bark mulch strip)
- Proposed Feature Shrub
- Proposed Climbers
(Fixed onto pressure-treated golden brown timber fan trellis - Dimensions: H105x W614mm.)
- Proposed Ornamental Shrubs
(50mm Bark mulch to be included around planting)
- Proposed Native Shrub Planting
(50mm Bark mulch to be included around planting)
- Proposed Bulb Planting
(Scattered Randomly where to be planted)
- Proposed Premium Grade Turf
(150mm min gravel strip with timber edge to be installed along building edge)
Turf beds to frontage
- Proposed Amenity Grass Seed
Flowering Lawn Mixture. Sown at 40g/ha.
Strong Lawn Grass Mixture. Sown on mown grass pathways at 250g/ha.
- Proposed Wildflower Mix
General Purpose Meadow Mixture. Sown at 40g/ha
- Proposed Wet/Wildflower Mix
Meadow Mixture for wetlands. Sown at 40g/ha
- Small 30mm Decorative Gravel
overlay over geotextile membrane
(Gravel to be agreed with Bellway before installation and include a timber edge)
- Proposed Root Barrier
- Proposed Mown Grass Footpath 1.2m wide
- Proposed Tarmac Footpath
- Proposed Short Span Timber Bridge
Finish: FSC Certified Treated Hardwood
Width: 2000mm
Min. Length: 3000mm
- Proposed Timber Bench
Finish: Treated Softwood timber
Size: L2000mm W580mm H770mm
Root Fixed Length 300mm
- 450mm High Timber Square Bollard
Size: 200x750mm
- Canopied Litter Bin
Size: Ø560mm H900mm
Fixing: Set of 4 Shield Anchor Bolts
for Installation Fixed onto Tarmac
Capacity: 90 Litres
- Natural Boulders
Approx. L1.2m x W0.8m x H0.8m / 1200kg
- Indicative Lamppost location
Refer to DW Windsor plan for detailed design
- Visplay

NB: Decorative Bark mulch to be supplied in 30-40mm chip size and applied at a depth of 50mm around landscaping to restrict weed growth and retain moisture.

PLANTING NOTES
All plants to be supplied in accordance with the HTA 'National Plant Specification' and from a HTA certified nursery. All plants and trees to be planted in accordance with BS3936 and BS8545. Delivery and handling of all plant material to be in accordance with BS4428/JCL/CPSE Code of Practice for Handling and Establishing Landscape Plants' Parts I, II and III and BS8545.
Planting Pit and Trench Preparation
Tree pits in soft landscape to be excavated to 1m x 1m x 1m depth prior to topsoiling and all shrub planting areas excavated to 450mm depth. All proposed hedge planting trenches to be excavated to 600mm depth. Unless otherwise specified, all tree pits in hard landscape to be 2m x 2m x 1m, backfilled with compacted Urban Tree Soil.
The preparation of planting pits, beds or trenches shall comply with the appropriate British Standards, namely BS4043, BS4428, BS5837 and BS8545. Excavation of planting pits, beds or trenches shall not take place when the ground is frozen or waterlogged such that damage may occur to the structure of the soil. All excavated areas to be backfilled with either site won topsoil or imported topsoil to be BS3883 General purpose grade. All topsoiled areas to be clear of rocks and rubble larger than 50mm diameter and any other debris that may interfere with the establishment of plants. The Contractor shall break up and cultivate at the base of the trenches or planting pits. The sides of the trenches or planting pits shall be loosened with a fork or other similar implement. All stones and the like over 75mm in any dimension, deleterious matter, weeds and weed roots brought to the surface by any cultivation or excavation shall be removed off site. The Contractor shall remove off site the excavated subsoil/fill material when preparing planting pits. The imported topsoil should make up any deficiencies caused by the removal of the subsoil/fill material. Trenches and pits shall have the topsoil and any subsoil/fill material thoroughly broken up and mixed prior to backfilling.
All trees shall be supplied root balled, unless otherwise stated. Root balled trees shall be well grown, healthy and with a compact, contained rootball. They shall be nursery grown and have been regularly watered. Prior to planting, all plant material shall be stored and sorted at in accordance with best practice.
Planting
All plants shall be planted in a random fashion avoiding formal regimented lines at densities indicated in the schedule, unless otherwise specified. Unless otherwise specified, all hedgerows shall be planted in single rows and hedgerow mixes shall be planted in groups of 7, 9, 13s at densities indicated on the schedule. Ornamental shrub planting mixes shall be planted in groups of 5, 7, 8, 11s and native shrub planting mixes shall be planted in groups of 9, 13 & 15s, with a cane and protective spiral guard included to all native planting. The selection, procurement, handling, storage and planting operations of all proposed trees shall be in accordance with BS8545:2014 - Trees: from nursery to independence in the landscape, recommendations.
Planting and associated operations shall comply with BS4043, BS4428, BS5837 and BS8545. Unless otherwise stated planting shall be carried out during the period of 1 Nov to 31 March when the ground is not frozen or water logged. If planting is required outside this period agreement shall be sought and all bare root plants shall be substituted with container grown stock.
Provide Bamboo cane support and 'Treebio Biodegradable Spiral Guard' (Green-tech Product code: 160PS1031-PRO) or similar to all native shrubs and hedgerows, young sapling trees, whips and feather planting, ensuring that the main or terminal bud is protruding out above the top of the spirals.
Watering
All plants shall be watered in to field capacity immediately after planting and mulched with 50mm depth of medium grade crushed mulch. The Contractor shall water the trees, shrubs and hedges once planted so that the entire tree pit or planted area is moistened to field capacity, i.e. 'the amount of water retained by previously saturated soil once full drainage has ceased'. Watering to field capacity shall continue frequently and on a regular basis as considered necessary by the landscape contractor and as necessary to ensure the successful establishment and continued thriving of all planting. Additional watering shall be undertaken during summer months and/or periods of drought. Post planting management and maintenance specifically for new tree planting shall include ongoing irrigation and formative pruning as outlined in BS8545. The period over which regular irrigation required for transplanted trees is likely to be at least two full growing seasons to ensure successful establishment. As the root system develops the frequency of irrigation can be reduced.
Staking
All trees within soft landscape areas to be double staked with cross bar and tied, using 1.5m long, 75mm diameter rounded tree stakes 75mm brace, rubber tie and spacer block. Stakes not to extend more than 650mm above ground level. All trees within hardstanding/highways visibility splay to be clear stem to 1.5m high unless otherwise specified. Trees within hardstanding / specific pits to be underground guyed unless otherwise specified.
Root Barriers
Root barriers (ReRoot 1000 or equivalent) to be included adjacent to buildings and services where necessary. Landscape contractor shall check all planting operations comply with appropriate standards and that in the absence of detailed surveys, any necessary underground investigations are undertaken to ensure there are no conflicts with existing or proposed utilities, services or foundations.
PROTECTION OF EXISTING VEGETATION TO BE RETAINED
Existing trees to be retained shall be protected in accordance with BS5837, from commencement to completion of all works on site.
N.B. All planting proposals including tree planting have been developed in order to create a high quality environment and gain planning consent for the development. All tree species have been reviewed in line with NHC guidance (2017) and in the absence of any building foundation depths or detailed soil analysis information for the site. Where possible only low and moderate water demand species are proposed in close proximity to new buildings. A number of varied cultivars of these species as well as ornamental species that have a smaller overall mature height (which are not currently assessed within NHC guidance 2017) are proposed to provide variety in the scheme and engineer's should consider these locations & species. Where necessary new building foundation depths shall be designed to accommodate the approved tree species, site specific soil shrinkage and tree water demand in line with NHC standards 2017 (Chapter 4.2 - Building Near Trees). Planting plans have been prepared for planning purposes and in the absence of fully detailed ground investigations, geological or hydrological surveys and planting design or species choice may be subject to change - suitability should be confirmed on site by the landscape contractor. Detailed site specific soil analysis and suitable site drainage should be checked by landscape contractor to ensure planting can be implemented in accordance with approved drawings prior to implementation.

A		15.08.2024	Updated to comments	SP	CW
REV		DATE	NOTE	Drawn	Chkd
TITLE					
Land North of Arborfield Road, Shinfield					
Planting Plan 6 of 6					
CLIENT					
Bellway Homes Limited (Thames Valley)					
SCALE		DATE	DRAWN	CHKD	
1:250@A1		JUL 2024	SP	CW	
DRAWING NUMBER			REVISION		
8395.PP.1.6			A		



Appendix 2 - LLFA Developer Checklist

Major Development Full Application (and/or discharge of conditions or reserved matters)

Full planning applications for Major Development and/or discharge of conditions or reserved matters must include the following information and details on the proposed drainage strategy and system(s).

Ref.	Documentation required	Requirement met/included
	In addition to documentation required for outline applications, the applicant shall also submit: ■ Confirmation of the destination of discharge(s) (in accordance with Building Regulation Part H hierarchy) with appropriate justification for the(ir) selection; ■ Details of any offsite works required, together with any necessary consents; ■ Where necessary, a full planting schedule with accompanying plan; ■ Where proposing to discharge to ground the results of site specific ground investigation (accounting for the variability in ground conditions), including geo-environmental characterisation and infiltration test results shall be provided. These investigations shall account for: • Evidence of infiltration tests, providing representative results, at the location and depth of any intended infiltration device; • Records of recorded groundwater levels over a number of visits to establish confidence in seasonal variability on groundwater levels. ■ Exceedence routes – confirmation that exceedence routes will remain clear of development in perpetuity; ■ Confirmation of the arrangements for the adoption, management / operation and maintenance of the drainage system, including but not necessarily limited to: • Details of which body will be responsible for operating and maintenance for the drainage proposals including their written confirmation; • A management statement to outline the management goals for the site and required maintenance; • Description of maintenance schedule and materials and tools needed; • A maintenance schedule; • Legal agreements to ensure the continued operation and maintenance of the drainage system for the lifetime of the development; • Health and safety plan, if appropriate, considering all potential health and safety risks posed by the proposed drainage system including but not limited to areas of open water, confined spaces, and steep slopes; • Access arrangements for maintenance of all aspects of the proposed drainage systems; and • Operational characteristics of any mechanical features including maintenance and energy requirements.	Included in report Included in report Plan Included in Appendix 1, completed by others. Included in report Included in report Included in report Included in report

Plans & Drawings Required

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	In addition to plan and drawing required for outline applications, the applicant shall also submit: ■ Detail drawings of connections (including flow control devices) to water bodies, sewers, public surface water sewers, highway drains and SuDS; ■ Phasing plans for implementation of the drainage system(s); ■ Details of source control measures including location, type levels and detail drawing; ■ Details of site control measures including location, type levels and detail drawing; ■ Where appropriate, details of regional control measures including location, type levels and detail drawing; ■ Details of all other drainage features including levels, detail location and detail drawings; ■ Details of those components of the drainage system(s) comprising the 'management train' for the site; ■ Conveyance and exceedance routes; ■ The destination of runoff with clearly defined outfall locations; and ■ Any surface water/groundwater flow routes entering the development from adjacent land.	Plans are included in Appendix 3 Shown in Plans Not applicable Shown in Plans Shown in Plans Shown in Plans Shown in Plans Shown in Plans Included in report Shown in Plans Not applicable
	Calculations Required	
	In addition to calculations required for outline applications, the applicant shall also submit: ■ Full design calculations and design parameters to demonstrate conformity with best practice standards. This shall include a calculation pack for the following storm events: • 1:1 year; • 1:30 year; • 1:100 year; and, • 1:100 year with climate change. The calculations shall be able to be referenced to appropriate drawings of the drainage system with pipe and manhole references and clearly labelled storage and conveyance features (basins, swales, tanks etc.); and, ■ Confirmation of attenuation volumes provided in each storage feature along with details of freeboard allowance for each feature.	Shown In Appendix 3 FEH-22 uses 1:2 year storm, there for this was used instead of 1:1 year Attenuation Volume shown in plans and shown in calcs

Additional requirements for a large site or multi-plot development.

Ref.	Detail required	Requirement met/included
	Plans demonstrating the phasing of drainage infrastructure (in keeping with wider development phasing proposals, demonstrating how flood risks and drainage will be managed throughout and on completion of the development.	Site is small, phasing plan is not applicable



Appendix 3 – Drainage Strategy

Calculations

Drainage Layout

Drainage Catchment Areas

Drainage Construction Details



Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	2	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	9.999
CV	1.000	Preferred Cover Depth (m)	1.400
Time of Entry (mins)	5.00	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)
16	0.059	5.00	43.415	1350	473756.912	168154.199	1.942
3	0.138	5.00	46.300	1200	473641.833	168162.945	1.700
10			43.332	1500	473712.741	168091.144	1.982
39		5.00	42.000		473747.927	167974.766	1.500
40_OUT			41.900	1200	473755.657	167988.657	1.500
40			41.900	1500	473752.169	167983.437	1.450
19			42.500	1200	473761.372	168056.711	1.701
18	0.100	5.00	42.700	1500	473770.743	168089.394	1.775
11			43.083	1350	473746.708	168090.053	2.122
17	0.015	5.00	42.809	1350	473782.826	168149.246	1.610
15	0.062	5.00	43.538	1350	473752.022	168158.412	1.888
14	0.106	5.00	43.955	1350	473760.005	168201.109	2.127
13	0.010	5.00	44.170	1350	473755.765	168208.766	1.700
12	0.077	5.00	44.965	1350	473723.914	168214.610	1.625
21	0.089	5.00	42.300	1200	473748.242	168025.342	1.546
38_OUT			42.100		473736.931	167960.705	1.450
38	0.071	5.00	42.300	1350	473722.052	167969.344	1.627
37	0.167	5.00	43.343	1800	473673.465	167994.340	2.514
36	0.125	5.00	43.280	1350	473702.569	168052.319	2.067
34	0.015	5.00	44.533	1350	473657.163	168075.472	1.763
33	0.053	5.00	44.759	1350	473649.333	168073.065	1.948
32	0.141	5.00	45.482	1350	473632.565	168041.161	2.383
9	0.081	5.00	43.546	1350	473712.144	168104.844	2.053
5	0.035	5.00	44.807	1350	473658.315	168103.117	1.928
4	0.124	5.00	44.974	1350	473651.962	168108.036	1.775
1	0.124	5.00	47.428	1350	473631.498	168219.390	1.644
8	0.163	5.00	44.296	1350	473704.517	168150.040	1.850
7	0.118	5.00	45.039	1350	473696.155	168202.906	1.730
6	0.125	5.00	45.672	1350	473703.712	168246.678	1.732
29	0.090	5.00	43.048	1500	473645.568	167922.785	1.935
28	0.059	5.00	42.746	1350	473649.797	167898.321	1.582
27	0.008	5.00	42.564	1350	473648.779	167882.714	1.368
30	0.156	5.00	43.309	1350	473647.411	167942.703	2.312
31	0.077	5.00	43.610	1350	473659.377	167968.034	2.736
25	0.052	5.00	44.768	1350	473596.793	167968.320	2.330
22	0.060	5.00	45.479	1350	473622.867	168021.479	2.263
24	0.123	5.00	44.349	1350	473576.136	167929.409	1.775

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
35	0.065	5.00	43.209	1200	473710.031	168073.379	1.639
23	0.106	5.00	45.046	1200	473607.305	167991.277	2.105
2	0.050	5.00	46.959	1200	473636.799	168190.367	1.700
26	0.070	5.00	43.186	1200	473612.951	167887.530	1.610

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	1	2	29.503	0.600	45.784	45.334	0.450	65.6	225	5.30	49.8
1.001	2	3	27.880	0.600	45.259	44.600	0.659	42.3	300	5.50	49.0
1.002	3	4	55.835	0.600	44.600	43.274	1.326	42.1	300	5.88	47.5
1.003	4	5	8.035	0.600	43.199	42.954	0.245	32.7	375	5.92	47.3
1.004	5	9	53.857	0.600	42.879	41.643	1.236	43.6	450	6.21	46.3
2.000	6	7	44.420	0.600	43.940	43.384	0.556	79.9	225	5.51	49.0
2.001	7	8	53.523	0.600	43.309	42.596	0.713	75.1	300	6.00	47.0
2.002	8	9	45.835	0.600	42.446	41.643	0.803	57.1	450	6.28	46.1
1.005	9	10	13.713	0.600	41.493	41.350	0.143	95.9	600	6.37	45.8
1.006	10	11	33.985	0.600	41.350	41.036	0.314	108.2	600	6.61	45.0
1.007	11	18	24.044	0.600	40.961	40.925	0.036	667.9	675	7.01	43.7
3.000	12	13	32.383	0.600	43.340	42.545	0.795	40.7	225	5.26	49.9
3.001	13	14	8.753	0.600	42.470	41.828	0.642	13.6	300	5.30	49.8
3.002	14	15	43.437	0.600	41.828	41.650	0.178	244.0	300	6.02	46.9
3.003	15	16	6.455	0.600	41.650	41.623	0.027	239.1	300	6.13	46.6
3.004	16	17	26.383	0.600	41.473	41.274	0.199	132.7	450	6.38	45.8
3.005	17	18	61.059	0.600	41.199	41.075	0.124	492.4	525	7.39	42.6
1.008	18	19	34.000	0.600	40.925	40.874	0.051	666.7	675	7.95	41.0
1.009	19	21	34.006	0.600	40.799	40.754	0.045	755.7	750	8.51	39.6

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	1.617	64.3	22.2	1.419	1.400	0.124	0.0	91	1.471
1.001	2.424	171.3	30.7	1.400	1.400	0.173	0.0	85	1.846
1.002	2.429	171.7	53.5	1.400	1.400	0.312	0.0	115	2.153
1.003	3.176	350.8	74.5	1.400	1.478	0.436	0.0	117	2.544
1.004	3.085	490.7	78.8	1.478	1.453	0.471	0.0	121	2.288
2.000	1.464	58.2	22.1	1.507	1.430	0.125	0.0	96	1.367
2.001	1.816	128.4	41.4	1.430	1.400	0.243	0.0	117	1.625
2.002	2.695	428.6	67.7	1.400	1.453	0.406	0.0	120	1.990
1.005	2.487	703.1	158.4	1.453	1.382	0.958	0.0	192	2.027
1.006	2.340	661.6	155.7	1.382	1.447	0.958	0.0	197	1.928
1.007	1.006	360.1	151.1	1.447	1.100	0.958	0.0	305	0.965
3.000	2.055	81.7	13.8	1.400	1.400	0.077	0.0	62	1.535
3.001	4.280	302.5	15.5	1.400	1.827	0.086	0.0	46	2.289
3.002	1.002	70.8	32.6	1.827	1.588	0.192	0.0	143	0.981
3.003	1.012	71.6	42.8	1.588	1.492	0.254	0.0	167	1.056
3.004	1.763	280.4	51.7	1.492	1.085	0.313	0.0	130	1.356
3.005	1.002	217.0	50.4	1.085	1.100	0.328	0.0	171	0.823
1.008	1.007	360.5	205.3	1.100	0.951	1.386	0.0	366	1.039
1.009	1.010	446.2	198.4	0.951	0.796	1.386	0.0	350	0.981

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)
1.010	21	38	61.820	0.600	40.754	40.673	0.081	763.2	750	9.54	37.3
4.000	22	23	33.976	0.600	43.216	43.016	0.200	169.9	225	5.57	48.7
4.001	23	25	25.249	0.600	42.941	42.513	0.428	59.0	300	5.77	47.9
5.000	24	25	44.054	0.600	42.574	42.438	0.136	323.9	375	5.73	48.1
4.002	25	30	56.731	0.600	42.438	41.222	1.216	46.7	375	6.13	46.6
6.000	26	27	36.150	0.600	41.576	41.421	0.155	233.2	300	5.59	48.6
6.001	27	28	15.640	0.600	41.196	41.164	0.032	488.8	525	5.85	47.6
6.002	28	29	24.827	0.600	41.164	41.113	0.051	486.8	525	6.26	46.1
6.003	29	30	20.003	0.600	41.113	41.072	0.041	487.9	525	6.59	45.1
4.003	30	31	28.015	0.600	40.997	40.949	0.048	583.6	600	7.05	43.5
4.004	31	37	29.841	0.600	40.874	40.829	0.045	663.1	675	7.55	42.1
7.000	32	33	36.042	0.600	43.099	42.886	0.213	169.2	225	5.60	48.6
7.001	33	34	8.192	0.600	42.811	42.770	0.041	199.4	300	5.72	48.1
7.002	34	36	50.968	0.600	42.770	41.363	1.407	36.2	300	6.05	46.8
8.000	35	36	22.343	0.600	41.570	41.438	0.132	169.3	225	5.37	49.5
7.003	36	37	64.874	0.600	41.213	41.054	0.159	408.0	450	7.13	43.3
4.005	37	38	54.640	0.600	40.829	40.748	0.081	674.6	675	8.46	39.8
1.011	38	38_OUT	17.205	0.600	40.673	40.650	0.023	748.0	750	9.82	36.7
9.000	39	40	9.653	0.600	40.500	40.450	0.050	193.1	300	5.14	50.0
9.001	40	40_OUT	6.278	0.600	40.450	40.400	0.050	125.6	300	5.22	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)
1.010	1.005	443.9	198.8	0.796	0.877	1.475	0.0	351	0.978
4.000	1.000	39.8	10.6	2.038	1.805	0.060	0.0	80	0.851
4.001	2.050	144.9	28.8	1.805	1.955	0.167	0.0	91	1.612
5.000	1.001	110.6	21.4	1.400	1.955	0.123	0.0	111	0.779
4.002	2.658	293.6	57.5	1.955	1.712	0.341	0.0	112	2.080
6.000	1.025	72.5	12.3	1.310	0.843	0.070	0.0	83	0.767
6.001	1.006	217.8	13.3	0.843	1.057	0.077	0.0	87	0.565
6.002	1.008	218.3	22.7	1.057	1.410	0.136	0.0	114	0.662
6.003	1.007	218.0	36.9	1.410	1.712	0.226	0.0	145	0.756
4.003	1.001	282.9	113.9	1.712	2.061	0.724	0.0	265	0.949
4.004	1.010	361.4	122.1	2.061	1.839	0.802	0.0	269	0.915
7.000	1.002	39.8	24.7	2.158	1.648	0.141	0.0	129	1.055
7.001	1.109	78.4	33.8	1.648	1.463	0.194	0.0	137	1.069
7.002	2.620	185.2	35.4	1.463	1.617	0.209	0.0	88	2.032
8.000	1.002	39.8	11.6	1.414	1.617	0.065	0.0	83	0.871
7.003	1.000	159.0	62.5	1.617	1.839	0.399	0.0	196	0.942
4.005	1.001	358.3	196.5	1.839	0.877	1.367	0.0	357	1.023
1.011	1.015	448.5	386.4	0.877	0.700	2.913	0.0	540	1.135
9.000	1.128	79.7	0.0	1.200	1.150	0.000	0.0	0	0.000
9.001	1.401	99.1	0.0	1.150	1.200	0.000	0.0	0	0.000

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	29.503	65.6	225	ADOPTABLE	47.428	45.784	1.419	46.959	45.334	1.400
1.001	27.880	42.3	300	ADOPTABLE	46.959	45.259	1.400	46.300	44.600	1.400
1.002	55.835	42.1	300	ADOPTABLE	46.300	44.600	1.400	44.974	43.274	1.400
1.003	8.035	32.7	375	ADOPTABLE	44.974	43.199	1.400	44.807	42.954	1.478
1.004	53.857	43.6	450	ADOPTABLE	44.807	42.879	1.478	43.546	41.643	1.453
2.000	44.420	79.9	225	ADOPTABLE	45.672	43.940	1.507	45.039	43.384	1.430
2.001	53.523	75.1	300	ADOPTABLE	45.039	43.309	1.430	44.296	42.596	1.400
2.002	45.835	57.1	450	ADOPTABLE	44.296	42.446	1.400	43.546	41.643	1.453
1.005	13.713	95.9	600	ADOPTABLE	43.546	41.493	1.453	43.332	41.350	1.382
1.006	33.985	108.2	600	ADOPTABLE	43.332	41.350	1.382	43.083	41.036	1.447
1.007	24.044	667.9	675	ADOPTABLE	43.083	40.961	1.447	42.700	40.925	1.100
3.000	32.383	40.7	225	ADOPTABLE	44.965	43.340	1.400	44.170	42.545	1.400
3.001	8.753	13.6	300	ADOPTABLE	44.170	42.470	1.400	43.955	41.828	1.827
3.002	43.437	244.0	300	ADOPTABLE	43.955	41.828	1.827	43.538	41.650	1.588
3.003	6.455	239.1	300	ADOPTABLE	43.538	41.650	1.588	43.415	41.623	1.492
3.004	26.383	132.7	450	ADOPTABLE	43.415	41.473	1.492	42.809	41.274	1.085
3.005	61.059	492.4	525	ADOPTABLE	42.809	41.199	1.085	42.700	41.075	1.100
1.008	34.000	666.7	675	ADOPTABLE	42.700	40.925	1.100	42.500	40.874	0.951
1.009	34.006	755.7	750	ADOPTABLE	42.500	40.799	0.951	42.300	40.754	0.796
1.010	61.820	763.2	750	ADOPTABLE	42.300	40.754	0.796	42.300	40.673	0.877
4.000	33.976	169.9	225	ADOPTABLE	45.479	43.216	2.038	45.046	43.016	1.805
4.001	25.249	59.0	300	ADOPTABLE	45.046	42.941	1.805	44.768	42.513	1.955
5.000	44.054	323.9	375	ADOPTABLE	44.349	42.574	1.400	44.768	42.438	1.955
4.002	56.731	46.7	375	ADOPTABLE	44.768	42.438	1.955	43.309	41.222	1.712
6.000	36.150	233.2	300	ADOPTABLE	43.186	41.576	1.310	42.564	41.421	0.843

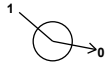
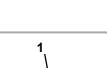
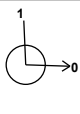
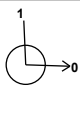
Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	1	1350	Manhole	Adoptable	2	1200	Manhole	Adoptable
1.001	2	1200	Manhole	Adoptable	3	1200	Manhole	Adoptable
1.002	3	1200	Manhole	Adoptable	4	1350	Manhole	Adoptable
1.003	4	1350	Manhole	Adoptable	5	1350	Manhole	Adoptable
1.004	5	1350	Manhole	Adoptable	9	1350	Manhole	Adoptable
2.000	6	1350	Manhole	Adoptable	7	1350	Manhole	Adoptable
2.001	7	1350	Manhole	Adoptable	8	1350	Manhole	Adoptable
2.002	8	1350	Manhole	Adoptable	9	1350	Manhole	Adoptable
1.005	9	1350	Manhole	Adoptable	10	1500	Manhole	Adoptable
1.006	10	1500	Manhole	Adoptable	11	1350	Manhole	Adoptable
1.007	11	1350	Manhole	Adoptable	18	1500	Manhole	Adoptable
3.000	12	1350	Manhole	Adoptable	13	1350	Manhole	Adoptable
3.001	13	1350	Manhole	Adoptable	14	1350	Manhole	Adoptable
3.002	14	1350	Manhole	Adoptable	15	1350	Manhole	Adoptable
3.003	15	1350	Manhole	Adoptable	16	1350	Manhole	Adoptable
3.004	16	1350	Manhole	Adoptable	17	1350	Manhole	Adoptable
3.005	17	1350	Manhole	Adoptable	18	1500	Manhole	Adoptable
1.008	18	1500	Manhole	Adoptable	19	1200	Manhole	Adoptable
1.009	19	1200	Manhole	Adoptable	21	1200	Manhole	Adoptable
1.010	21	1200	Manhole	Adoptable	38	1350	Manhole	Adoptable
4.000	22	1350	Manhole	Adoptable	23	1200	Manhole	Adoptable
4.001	23	1200	Manhole	Adoptable	25	1350	Manhole	Adoptable
5.000	24	1350	Manhole	Adoptable	25	1350	Manhole	Adoptable
4.002	25	1350	Manhole	Adoptable	30	1350	Manhole	Adoptable
6.000	26	1200	Manhole	Adoptable	27	1350	Manhole	Adoptable

Pipeline Schedule

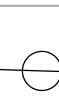
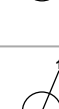
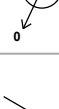
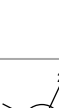
Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
6.001	15.640	488.8	525	ADOPTABLE	42.564	41.196	0.843	42.746	41.164	1.057
6.002	24.827	486.8	525	ADOPTABLE	42.746	41.164	1.057	43.048	41.113	1.410
6.003	20.003	487.9	525	ADOPTABLE	43.048	41.113	1.410	43.309	41.072	1.712
4.003	28.015	583.6	600	ADOPTABLE	43.309	40.997	1.712	43.610	40.949	2.061
4.004	29.841	663.1	675	ADOPTABLE	43.610	40.874	2.061	43.343	40.829	1.839
7.000	36.042	169.2	225	ADOPTABLE	45.482	43.099	2.158	44.759	42.886	1.648
7.001	8.192	199.4	300	ADOPTABLE	44.759	42.811	1.648	44.533	42.770	1.463
7.002	50.968	36.2	300	ADOPTABLE	44.533	42.770	1.463	43.280	41.363	1.617
8.000	22.343	169.3	225	ADOPTABLE	43.209	41.570	1.414	43.280	41.438	1.617
7.003	64.874	408.0	450	ADOPTABLE	43.280	41.213	1.617	43.343	41.054	1.839
4.005	54.640	674.6	675	ADOPTABLE	43.343	40.829	1.839	42.300	40.748	0.877
1.011	17.205	748.0	750	ADOPTABLE	42.300	40.673	0.877	42.100	40.650	0.700
9.000	9.653	193.1	300	ADOPTABLE	42.000	40.500	1.200	41.900	40.450	1.150
9.001	6.278	125.6	300	ADOPTABLE	41.900	40.450	1.150	41.900	40.400	1.200

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
6.001	27	1350	Manhole	Adoptable	28	1350	Manhole	Adoptable
6.002	28	1350	Manhole	Adoptable	29	1500	Manhole	Adoptable
6.003	29	1500	Manhole	Adoptable	30	1350	Manhole	Adoptable
4.003	30	1350	Manhole	Adoptable	31	1350	Manhole	Adoptable
4.004	31	1350	Manhole	Adoptable	37	1800	Manhole	Adoptable
7.000	32	1350	Manhole	Adoptable	33	1350	Manhole	Adoptable
7.001	33	1350	Manhole	Adoptable	34	1350	Manhole	Adoptable
7.002	34	1350	Manhole	Adoptable	36	1350	Manhole	Adoptable
8.000	35	1200	Manhole	Adoptable	36	1350	Manhole	Adoptable
7.003	36	1350	Manhole	Adoptable	37	1800	Manhole	Adoptable
4.005	37	1800	Manhole	Adoptable	38	1350	Manhole	Adoptable
1.011	38	1350	Manhole	Adoptable	38_OUT		Junction	
9.000	39		Junction		40	1500	Manhole	Adoptable
9.001	40	1500	Manhole	Adoptable	40_OUT	1200	Manhole	Adoptable

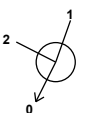
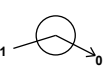
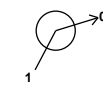
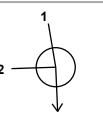
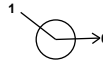
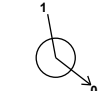
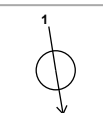
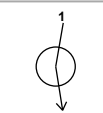
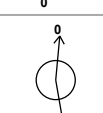
Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
16	473756.912	168154.199	43.415	1.942	1350		1 3.003	41.623	300
							0 3.004	41.473	450
3	473641.833	168162.945	46.300	1.700	1200		1 1.001	44.600	300
							0 1.002	44.600	300
10	473712.741	168091.144	43.332	1.982	1500		1 1.005	41.350	600
							0 1.006	41.350	600
39	473747.927	167974.766	42.000	1.500			0 9.000	40.500	300

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)	
40_OUT	473755.657	167988.657	41.900	1.500	1200		1	9.001	40.400	300
40	473752.169	167983.437	41.900	1.450	1500		1	9.000	40.450	300
							0	9.001	40.450	300
19	473761.372	168056.711	42.500	1.701	1200		1	1.008	40.874	675
							0	1.009	40.799	750
18	473770.743	168089.394	42.700	1.775	1500		1	3.005	41.075	525
							2	1.007	40.925	675
							0	1.008	40.925	675
11	473746.708	168090.053	43.083	2.122	1350		1	1.006	41.036	600
							0	1.007	40.961	675
17	473782.826	168149.246	42.809	1.610	1350		1	3.004	41.274	450
							0	3.005	41.199	525
15	473752.022	168158.412	43.538	1.888	1350		1	3.002	41.650	300
							0	3.003	41.650	300
14	473760.005	168201.109	43.955	2.127	1350		1	3.001	41.828	300
							0	3.002	41.828	300
13	473755.765	168208.766	44.170	1.700	1350		1	3.000	42.545	225
							0	3.001	42.470	300
12	473723.914	168214.610	44.965	1.625	1350					
							0	3.000	43.340	225
21	473748.242	168025.342	42.300	1.546	1200		1	1.009	40.754	750
							0	1.010	40.754	750
38_OUT	473736.931	167960.705	42.100	1.450			1	1.011	40.650	750
38	473722.052	167969.344	42.300	1.627	1350		1	4.005	40.748	675
							2	1.010	40.673	750
							0	1.011	40.673	750

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)	
37	473673.465	167994.340	43.343	2.514	1800		1	7.003	41.054	450
							2	4.004	40.829	675
							0	4.005	40.829	675
36	473702.569	168052.319	43.280	2.067	1350		1	8.000	41.438	225
							2	7.002	41.363	300
							0	7.003	41.213	450
34	473657.163	168075.472	44.533	1.763	1350		1	7.001	42.770	300
							0	7.002	42.770	300
33	473649.333	168073.065	44.759	1.948	1350		1	7.000	42.886	225
							0	7.001	42.811	300
32	473632.565	168041.161	45.482	2.383	1350		0	7.000	43.099	225
9	473712.144	168104.844	43.546	2.053	1350		1	2.002	41.643	450
							2	1.004	41.643	450
							0	1.005	41.493	600
5	473658.315	168103.117	44.807	1.928	1350		1	1.003	42.954	375
							0	1.004	42.879	450
4	473651.962	168108.036	44.974	1.775	1350		1	1.002	43.274	300
							0	1.003	43.199	375
1	473631.498	168219.390	47.428	1.644	1350		0	1.000	45.784	225
8	473704.517	168150.040	44.296	1.850	1350		1	2.001	42.596	300
							0	2.002	42.446	450
7	473696.155	168202.906	45.039	1.730	1350		1	2.000	43.384	225
							0	2.001	43.309	300
6	473703.712	168246.678	45.672	1.732	1350		0	2.000	43.940	225
29	473645.568	167922.785	43.048	1.935	1500		1	6.002	41.113	525
							0	6.003	41.113	525

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
28	473649.797	167898.321	42.746	1.582	1350	 1	6.001	41.164	525
27	473648.779	167882.714	42.564	1.368	1350	 0	6.002	41.164	525
30	473647.411	167942.703	43.309	2.312	1350	 1	6.000	41.421	300
31	473659.377	167968.034	43.610	2.736	1350	 0	6.001	41.196	525
25	473596.793	167968.320	44.768	2.330	1350	 1	6.003	41.072	525
22	473622.867	168021.479	45.479	2.263	1350	 2	4.002	41.222	375
24	473576.136	167929.409	44.349	1.775	1350	 0	4.003	40.997	600
35	473710.031	168073.379	43.209	1.639	1200	 1	4.003	40.949	600
23	473607.305	167991.277	45.046	2.105	1200	 0	4.004	40.874	675
2	473636.799	168190.367	46.959	1.700	1200	 1	5.000	42.438	375
26	473612.951	167887.530	43.186	1.610	1200	 2	4.001	42.513	300
						 0	4.002	42.438	375
						 0	4.000	43.216	225
						 0	5.000	42.574	375
						 0	8.000	41.570	225
						 1	4.000	43.016	225
						 0	4.001	42.941	300
						1	1.000	45.334	225
						0	1.001	45.259	300
						0	6.000	41.576	300

Simulation Settings

Rainfall Methodology	FEH-22	Skip Steady State	x	2 year (l/s)	6.4
Summer CV	1.000	Drain Down Time (mins)	240	30 year (l/s)	32.4
Winter CV	1.000	Additional Storage (m³/ha)	0.0	100 year (l/s)	45.0
Analysis Speed	Detailed	Check Discharge Rate(s)	✓	Check Discharge Volume	x

Storm Durations

60 | 120 | 180 | 240 | 360 | 480 | 600 | 720 | 960 | 1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	5	0
30	0	5	0
100	0	5	0
100	40	5	0

Pre-development Discharge Rate

Site Makeup	Greenfield	Growth Factor 30 year	1.95
Greenfield Method	IH124	Growth Factor 100 year	2.48
Positively Drained Area (ha)	1.000	Betterment (%)	0
SAAR (mm)		QBar	
Soil Index	4	Q 1 year (l/s)	
SPR	0.47	Q 30 year (l/s)	
Region	1	Q 100 year (l/s)	
Growth Factor 1 year	0.85		

Node 40 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	40.450	Product Number	CTL-SHE-0123-6400-0676-6400
Design Depth (m)	0.676	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	6.4	Min Node Diameter (mm)	1200

Node 40 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	41.128	Product Number	CTL-SHE-0226-2520-0500-2520
Design Depth (m)	0.500	Min Outlet Diameter (m)	0.300
Design Flow (l/s)	25.2	Min Node Diameter (mm)	1200

Node 40 Online Weir Control

Flap Valve	x	Design Depth (m)	0.180	Discharge Coefficient	0.590
Replaces Downstream Link	x	Design Flow (l/s)	10.0		
Invert Level (m)	41.517	Width (m)	0.075		

Node 39 Flow through Pond Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Main Channel Length (m)	56.000
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	40.500	Main Channel Slope (1:X)	365.0
Safety Factor	2.0	Time to half empty (mins)		Main Channel n	0.035

Inlets

38_OUT

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	1782.0	0.0	1.500	2854.0	0.0

Results for 2 year +5% A Critical Storm Duration. Lowest mass balance: 99.38%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
60 minute summer	16	33	41.584	0.111	35.0	0.1585	0.0000	OK
60 minute summer	3	33	44.694	0.094	35.4	0.1058	0.0000	OK
60 minute summer	10	33	41.520	0.170	107.5	0.2998	0.0000	OK
720 minute winter	39	705	40.919	0.419	31.5	0.0000	0.0000	SURCHARGED
60 minute summer	40_OUT	224	40.451	0.051	6.4	0.0000	0.0000	OK
720 minute winter	40	705	40.919	0.469	6.5	0.8285	0.0000	SURCHARGED
60 minute summer	19	35	41.137	0.338	150.3	0.3821	0.0000	OK
60 minute summer	18	35	41.229	0.304	154.5	0.5366	0.0000	OK
60 minute summer	11	34	41.254	0.293	107.5	0.4190	0.0000	OK
60 minute summer	17	34	41.346	0.147	36.5	0.2100	0.0000	OK
60 minute summer	15	33	41.795	0.145	28.7	0.2072	0.0000	OK
60 minute summer	14	33	41.940	0.112	21.8	0.1610	0.0000	OK
60 minute summer	13	33	42.507	0.037	9.8	0.0527	0.0000	OK
60 minute summer	12	33	43.390	0.050	8.7	0.0719	0.0000	OK
60 minute summer	21	36	41.099	0.345	158.3	0.3903	0.0000	OK
720 minute winter	38_OUT	705	40.919	0.269	50.3	0.0000	0.0000	OK
60 minute summer	38	36	41.052	0.379	309.3	0.5419	0.0000	OK
60 minute summer	37	35	41.140	0.311	149.2	0.7906	0.0000	OK
60 minute summer	36	34	41.379	0.166	45.0	0.2373	0.0000	OK
60 minute summer	34	33	42.843	0.073	23.7	0.1046	0.0000	OK
60 minute summer	33	33	42.922	0.111	22.0	0.1583	0.0000	OK
60 minute summer	32	33	43.200	0.101	16.0	0.1450	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)
60 minute summer	16	3.004	17	34.9	1.194	0.124	0.7708	
60 minute summer	3	1.002	4	35.2	1.911	0.205	1.0292	
60 minute summer	10	1.006	11	107.5	1.426	0.162	2.6766	
720 minute winter	39	9.000	40	6.5	0.183	0.082	0.6798	
720 minute winter	40	9.001	40_OUT	6.4	0.763	0.065	0.0527	289.0
60 minute summer	19	1.009	21	149.7	0.783	0.336	6.6296	
60 minute summer	18	1.008	19	150.3	1.116	0.417	4.8303	
60 minute summer	11	1.007	18	106.9	0.722	0.297	3.6544	
60 minute summer	17	3.005	18	36.8	0.752	0.170	3.0713	
60 minute summer	15	3.003	16	28.4	0.908	0.397	0.2020	
60 minute summer	14	3.002	15	21.7	0.752	0.306	1.2544	
60 minute summer	13	3.001	14	9.8	0.717	0.032	0.1271	
60 minute summer	12	3.000	13	8.7	1.336	0.106	0.2108	
60 minute summer	21	1.010	38	156.7	0.745	0.353	13.0009	
720 minute winter	38_OUT	Flow through pond	39	31.5	0.045	0.000	654.8580	
60 minute summer	38	1.011	38_OUT	292.2	2.837	0.652	2.0219	
60 minute summer	37	4.005	38	146.9	0.966	0.410	8.6215	
60 minute summer	36	7.003	37	44.4	0.919	0.279	3.1382	
60 minute summer	34	7.002	36	23.5	1.801	0.127	0.6662	
60 minute summer	33	7.001	34	22.0	1.207	0.281	0.1508	
60 minute summer	32	7.000	33	15.9	0.940	0.400	0.6115	

Results for 2 year +5% A Critical Storm Duration. Lowest mass balance: 99.38%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
60 minute summer	9	33	41.670	0.177	107.6	0.2539	0.0000	OK
60 minute summer	5	33	42.980	0.101	53.3	0.1446	0.0000	OK
60 minute summer	4	33	43.307	0.108	49.3	0.1538	0.0000	OK
60 minute summer	1	33	45.857	0.073	14.0	0.1044	0.0000	OK
60 minute summer	8	33	42.547	0.101	45.9	0.1442	0.0000	OK
60 minute summer	7	33	43.404	0.096	27.6	0.1367	0.0000	OK
60 minute summer	6	33	44.017	0.077	14.2	0.1098	0.0000	OK
60 minute summer	29	34	41.244	0.131	25.1	0.2318	0.0000	OK
60 minute summer	28	34	41.261	0.097	15.3	0.1391	0.0000	OK
60 minute summer	27	34	41.273	0.077	8.7	0.1098	0.0000	OK
60 minute summer	30	34	41.223	0.226	80.1	0.3231	0.0000	OK
60 minute summer	31	34	41.158	0.284	87.9	0.4058	0.0000	OK
60 minute summer	25	33	42.530	0.092	38.7	0.1322	0.0000	OK
60 minute summer	22	33	43.280	0.064	6.8	0.0910	0.0000	OK
60 minute summer	24	33	42.665	0.091	14.0	0.1298	0.0000	OK
60 minute summer	35	33	41.637	0.067	7.3	0.0755	0.0000	OK
60 minute summer	23	33	43.016	0.075	18.8	0.0847	0.0000	OK
60 minute summer	2	33	45.327	0.068	19.7	0.0771	0.0000	OK
60 minute summer	26	33	41.643	0.067	7.9	0.0762	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)
60 minute summer	9	1.005	10	107.5	1.593	0.153	0.9255	
60 minute summer	5	1.004	9	52.9	2.032	0.108	1.4032	
60 minute summer	4	1.003	5	49.3	2.072	0.140	0.1912	
60 minute summer	1	1.000	2	14.0	1.282	0.218	0.3222	
60 minute summer	8	2.002	9	45.6	1.763	0.106	1.1862	
60 minute summer	7	2.001	8	27.4	1.445	0.213	1.0146	
60 minute summer	6	2.000	7	14.2	1.204	0.243	0.5225	
60 minute summer	29	6.003	30	24.6	0.595	0.113	0.9328	
60 minute summer	28	6.002	29	14.9	0.440	0.068	0.8629	
60 minute summer	27	6.001	28	8.6	0.374	0.039	0.3670	
60 minute summer	30	4.003	31	79.6	0.917	0.281	2.5768	
60 minute summer	31	4.004	37	86.9	0.582	0.240	4.5121	
60 minute summer	25	4.002	30	38.2	1.846	0.130	1.1754	
60 minute summer	22	4.000	23	6.8	0.745	0.170	0.3081	
60 minute summer	24	5.000	25	14.0	0.675	0.127	0.9152	
60 minute summer	35	8.000	36	7.3	0.758	0.183	0.2151	
60 minute summer	23	4.001	25	18.7	1.401	0.129	0.3377	
60 minute summer	2	1.001	3	19.7	1.289	0.115	0.4284	
60 minute summer	26	6.000	27	7.8	0.675	0.108	0.4200	

Results for 30 year +5% A Critical Storm Duration. Lowest mass balance: 99.38%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
60 minute summer	16	35	41.700	0.227	107.6	0.3248	0.0000	OK
60 minute summer	3	33	44.780	0.180	108.8	0.2033	0.0000	OK
60 minute summer	10	35	41.751	0.401	331.8	0.7082	0.0000	OK
480 minute winter	39	464	41.266	0.766	78.5	0.0000	0.0000	SURCHARGED
480 minute winter	40_OUT	464	40.488	0.088	19.1	0.0000	0.0000	OK
480 minute winter	40	464	41.262	0.812	19.1	1.4344	0.0000	SURCHARGED
60 minute summer	19	35	41.543	0.744	448.5	0.8413	0.0000	OK
60 minute summer	18	35	41.654	0.729	448.2	1.2882	0.0000	SURCHARGED
60 minute summer	11	35	41.699	0.738	326.6	1.0559	0.0000	SURCHARGED
60 minute summer	17	35	41.690	0.491	113.3	0.7023	0.0000	OK
60 minute summer	15	33	41.953	0.303	87.3	0.4336	0.0000	SURCHARGED
60 minute summer	14	33	42.098	0.271	67.3	0.3873	0.0000	OK
60 minute summer	13	33	42.534	0.064	30.2	0.0910	0.0000	OK
60 minute summer	12	33	43.431	0.091	26.8	0.1307	0.0000	OK
60 minute summer	21	35	41.482	0.728	474.9	0.8236	0.0000	OK
480 minute winter	38_OUT	464	41.266	0.616	146.9	0.0000	0.0000	OK
60 minute summer	38	35	41.384	0.711	927.6	1.0176	0.0000	OK
60 minute summer	37	35	41.507	0.678	425.6	1.7262	0.0000	SURCHARGED
60 minute summer	36	35	41.593	0.380	138.6	0.5444	0.0000	OK
60 minute summer	34	33	42.899	0.129	72.5	0.1845	0.0000	OK
60 minute summer	33	33	43.016	0.205	67.4	0.2933	0.0000	OK
60 minute summer	32	33	43.406	0.307	49.2	0.4393	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
60 minute summer	16	3.004	17	108.1	1.476	0.386	3.0755	
60 minute summer	3	1.002	4	108.7	2.538	0.633	2.3905	
60 minute summer	10	1.006	11	326.6	1.472	0.494	8.1853	
480 minute winter	39	9.000	40	19.1	0.271	0.239	0.6798	
480 minute winter	40	9.001	40_OUT	19.1	1.021	0.192	0.1174	443.1
60 minute summer	19	1.009	21	448.5	1.024	1.005	14.8972	
60 minute summer	18	1.008	19	448.5	1.257	1.244	12.1290	
60 minute summer	11	1.007	18	315.9	0.888	0.877	8.5832	
60 minute summer	17	3.005	18	108.5	0.752	0.500	13.0068	
60 minute summer	15	3.003	16	87.1	1.316	1.217	0.4143	
60 minute summer	14	3.002	15	65.9	0.954	0.930	2.9824	
60 minute summer	13	3.001	14	30.2	0.844	0.100	0.3404	
60 minute summer	12	3.000	13	26.8	1.817	0.328	0.4778	
60 minute summer	21	1.010	38	476.5	1.103	1.073	26.8305	
480 minute winter	38_OUT	Flow through pond	39	78.5	0.075	0.001	1399.5753	
60 minute summer	38	1.011	38_OUT	1097.6	4.698	2.448	4.6584	
60 minute summer	37	4.005	38	429.7	1.222	1.199	19.2694	
60 minute summer	36	7.003	37	131.8	1.059	0.828	9.7745	
60 minute summer	34	7.002	36	72.3	2.169	0.390	2.1749	
60 minute summer	33	7.001	34	67.3	1.671	0.858	0.3286	
60 minute summer	32	7.000	33	48.7	1.242	1.222	1.3425	

Results for 30 year +5% A Critical Storm Duration. Lowest mass balance: 99.38%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
60 minute summer	9	34	41.866	0.373	334.4	0.5331	0.0000	OK
60 minute summer	5	33	43.059	0.180	164.3	0.2578	0.0000	OK
60 minute summer	4	33	43.414	0.215	152.0	0.3078	0.0000	OK
60 minute summer	1	33	45.926	0.142	43.2	0.2036	0.0000	OK
60 minute summer	8	33	42.627	0.181	141.7	0.2590	0.0000	OK
60 minute summer	7	33	43.494	0.185	85.0	0.2645	0.0000	OK
60 minute summer	6	33	44.091	0.151	43.7	0.2158	0.0000	OK
60 minute summer	29	35	41.583	0.470	71.8	0.8301	0.0000	OK
60 minute summer	28	35	41.587	0.423	44.2	0.6052	0.0000	OK
60 minute summer	27	35	41.588	0.392	27.1	0.5615	0.0000	OK
60 minute summer	30	35	41.577	0.580	233.7	0.8293	0.0000	OK
60 minute summer	31	35	41.536	0.662	248.4	0.9470	0.0000	OK
60 minute summer	25	33	42.602	0.164	119.3	0.2345	0.0000	OK
60 minute summer	22	33	43.336	0.120	21.1	0.1716	0.0000	OK
60 minute summer	24	33	42.741	0.167	43.0	0.2393	0.0000	OK
60 minute summer	35	33	41.697	0.127	22.6	0.1438	0.0000	OK
60 minute summer	23	33	43.081	0.140	58.2	0.1585	0.0000	OK
60 minute summer	2	33	45.381	0.122	60.6	0.1383	0.0000	OK
60 minute summer	26	33	41.699	0.123	24.4	0.1392	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)
60 minute summer	9	1.005	10	331.8	1.943	0.472	2.6057	
60 minute summer	5	1.004	9	164.4	2.563	0.335	3.6442	
60 minute summer	4	1.003	5	152.0	2.667	0.433	0.4579	
60 minute summer	1	1.000	2	43.2	1.692	0.672	0.7532	
60 minute summer	8	2.002	9	141.8	2.217	0.331	3.1087	
60 minute summer	7	2.001	8	84.7	1.917	0.660	2.3666	
60 minute summer	6	2.000	7	43.7	1.585	0.750	1.2238	
60 minute summer	29	6.003	30	75.8	0.584	0.348	4.1714	
60 minute summer	28	6.002	29	46.9	0.440	0.215	4.8449	
60 minute summer	27	6.001	28	26.7	0.373	0.122	2.8116	
60 minute summer	30	4.003	31	225.5	0.906	0.797	7.8289	
60 minute summer	31	4.004	37	247.4	0.694	0.685	10.6235	
60 minute summer	25	4.002	30	119.1	2.243	0.406	4.2914	
60 minute summer	22	4.000	23	21.1	1.004	0.530	0.7128	
60 minute summer	24	5.000	25	43.1	0.919	0.390	2.0647	
60 minute summer	35	8.000	36	22.5	1.005	0.566	0.5578	
60 minute summer	23	4.001	25	58.1	1.882	0.401	0.7798	
60 minute summer	2	1.001	3	60.6	1.706	0.354	0.9903	
60 minute summer	26	6.000	27	24.4	0.920	0.336	1.1545	

Results for 100 year +5% A Critical Storm Duration. Lowest mass balance: 99.38%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
60 minute summer	16	33	42.133	0.660	138.9	0.9445	0.0000	SURCHARGED
60 minute summer	3	33	44.820	0.220	142.9	0.2485	0.0000	OK
60 minute summer	10	33	42.272	0.922	442.9	1.6288	0.0000	SURCHARGED
360 minute winter	39	352	41.374	0.874	125.5	0.0000	0.0000	SURCHARGED
360 minute winter	40_OUT	352	40.515	0.115	31.6	0.0000	0.0000	OK
360 minute winter	40	352	41.363	0.913	31.6	1.6141	0.0000	SURCHARGED
60 minute summer	19	33	41.762	0.963	632.5	1.0890	0.0000	SURCHARGED
60 minute summer	18	34	41.986	1.061	630.2	1.8742	0.0000	SURCHARGED
60 minute summer	11	33	42.090	1.129	438.3	1.6149	0.0000	SURCHARGED
60 minute summer	17	34	42.053	0.854	148.5	1.2220	0.0000	SURCHARGED
60 minute summer	15	33	42.275	0.625	113.4	0.8944	0.0000	SURCHARGED
60 minute summer	14	34	42.575	0.747	87.6	1.0687	0.0000	SURCHARGED
60 minute summer	13	34	42.564	0.094	39.5	0.1350	0.0000	OK
60 minute summer	12	33	43.447	0.107	35.1	0.1528	0.0000	OK
60 minute summer	21	32	41.702	0.948	673.0	1.0727	0.0000	SURCHARGED
360 minute winter	38_OUT	352	41.374	0.724	232.5	0.0000	0.0000	OK
60 minute summer	38	32	41.449	0.776	1329.8	1.1099	0.0000	SURCHARGED
60 minute summer	37	33	41.768	0.939	654.4	2.3910	0.0000	SURCHARGED
60 minute summer	36	33	41.984	0.771	185.4	1.1034	0.0000	SURCHARGED
60 minute summer	34	33	42.922	0.152	95.2	0.2171	0.0000	OK
60 minute summer	33	33	43.056	0.245	88.5	0.3506	0.0000	OK
60 minute summer	32	33	43.684	0.585	64.6	0.8375	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
60 minute summer	16	3.004	17	141.6	1.456	0.505	4.1802	
60 minute summer	3	1.002	4	142.6	2.668	0.830	2.9832	
60 minute summer	10	1.006	11	438.3	1.556	0.662	9.5728	
360 minute winter	39	9.000	40	31.6	0.448	0.396	0.6798	
360 minute winter	40	9.001	40_OUT	31.6	1.161	0.318	0.1707	653.2
60 minute summer	19	1.009	21	634.2	1.441	1.421	14.9667	
60 minute summer	18	1.008	19	632.5	1.772	1.755	12.1373	
60 minute summer	11	1.007	18	439.5	1.231	1.220	8.5832	
60 minute summer	17	3.005	18	147.2	0.751	0.678	13.1907	
60 minute summer	15	3.003	16	113.3	1.609	1.584	0.4546	
60 minute summer	14	3.002	15	86.5	1.228	1.221	3.0588	
60 minute summer	13	3.001	14	39.3	0.845	0.130	0.3911	
60 minute summer	12	3.000	13	35.1	1.944	0.430	0.5848	
60 minute summer	21	1.010	38	672.8	1.529	1.515	27.2052	
360 minute winter	38_OUT	Flow through pond	39	125.5	0.085	0.002	1650.3171	
60 minute summer	38	1.011	38_OUT	1388.1	4.976	3.095	6.1499	
60 minute summer	37	4.005	38	645.8	1.809	1.802	19.5030	
60 minute summer	36	7.003	37	187.8	1.186	1.181	10.2789	
60 minute summer	34	7.002	36	95.1	2.187	0.513	2.7048	
60 minute summer	33	7.001	34	88.4	1.789	1.128	0.3986	
60 minute summer	32	7.000	33	64.0	1.611	1.607	1.3992	

Results for 100 year +5% A Critical Storm Duration. Lowest mass balance: 99.38%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
60 minute summer	9	33	42.402	0.909	437.8	1.3009	0.0000	SURCHARGED
60 minute summer	5	33	43.083	0.205	215.5	0.2932	0.0000	OK
60 minute summer	4	33	43.460	0.261	199.5	0.3731	0.0000	OK
60 minute summer	1	33	45.960	0.176	56.7	0.2522	0.0000	OK
60 minute summer	8	32	42.650	0.204	185.9	0.2914	0.0000	OK
60 minute summer	7	33	43.536	0.227	111.7	0.3251	0.0000	OK
60 minute summer	6	33	44.132	0.192	57.4	0.2741	0.0000	OK
60 minute summer	29	33	41.957	0.844	120.1	1.4921	0.0000	SURCHARGED
60 minute summer	28	33	41.978	0.814	68.2	1.1645	0.0000	SURCHARGED
60 minute summer	27	33	41.966	0.770	45.7	1.1018	0.0000	SURCHARGED
60 minute summer	30	33	41.961	0.964	345.9	1.3796	0.0000	SURCHARGED
60 minute summer	31	33	41.842	0.968	393.3	1.3852	0.0000	SURCHARGED
60 minute summer	25	33	42.631	0.193	156.7	0.2767	0.0000	OK
60 minute summer	22	33	43.359	0.143	27.7	0.2051	0.0000	OK
60 minute summer	24	33	42.771	0.197	56.5	0.2820	0.0000	OK
60 minute summer	35	33	42.104	0.534	29.6	0.6036	0.0000	SURCHARGED
60 minute summer	23	33	43.107	0.166	76.3	0.1879	0.0000	OK
60 minute summer	2	33	45.404	0.145	79.6	0.1635	0.0000	OK
60 minute summer	26	33	42.018	0.442	32.0	0.5001	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
60 minute summer	9	1.005	10	442.9	1.949	0.630	3.8626	
60 minute summer	5	1.004	9	215.3	2.576	0.439	6.1578	
60 minute summer	4	1.003	5	199.4	2.813	0.568	0.5679	
60 minute summer	1	1.000	2	56.7	1.770	0.882	0.9443	
60 minute summer	8	2.002	9	185.5	2.234	0.433	5.2254	
60 minute summer	7	2.001	8	111.1	2.014	0.865	2.9580	
60 minute summer	6	2.000	7	57.4	1.641	0.986	1.6190	
60 minute summer	29	6.003	30	120.2	0.585	0.552	4.3213	
60 minute summer	28	6.002	29	78.8	0.438	0.361	5.3634	
60 minute summer	27	6.001	28	42.6	0.372	0.196	3.3788	
60 minute summer	30	4.003	31	357.8	1.270	1.265	7.8912	
60 minute summer	31	4.004	37	390.2	1.093	1.080	10.6526	
60 minute summer	25	4.002	30	154.0	2.263	0.524	4.7532	
60 minute summer	22	4.000	23	27.7	1.066	0.696	0.8811	
60 minute summer	24	5.000	25	56.6	0.977	0.512	2.5532	
60 minute summer	35	8.000	36	32.8	1.017	0.824	0.8886	
60 minute summer	23	4.001	25	76.3	2.005	0.527	0.9612	
60 minute summer	2	1.001	3	79.6	1.780	0.465	1.2390	
60 minute summer	26	6.000	27	42.2	0.917	0.582	2.5457	

Results for 100 year +40% CC +5% A Critical Storm Duration. Lowest mass balance: 99.38%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
60 minute summer	16	34	42.817	1.344	180.6	1.9236	0.0000	SURCHARGED
60 minute summer	3	34	45.704	1.104	193.8	1.2492	0.0000	SURCHARGED
60 minute summer	10	34	43.062	1.712	562.9	3.0246	0.0000	FLOOD RISK
360 minute winter	39	352	41.651	1.151	166.3	0.0000	0.0000	SURCHARGED
360 minute winter	40_OUT	352	40.529	0.129	38.7	0.0000	0.0000	OK
360 minute winter	40	352	41.634	1.184	38.7	2.0929	0.0000	FLOOD RISK
60 minute summer	19	34	42.210	1.411	805.7	1.5953	0.0000	FLOOD RISK
60 minute summer	18	34	42.588	1.663	807.5	2.9377	0.0000	FLOOD RISK
60 minute summer	11	34	42.735	1.774	561.1	2.5386	0.0000	SURCHARGED
60 minute summer	17	34	42.701	1.502	188.3	2.1489	0.0000	FLOOD RISK
60 minute summer	15	34	43.040	1.390	146.7	1.9898	0.0000	SURCHARGED
60 minute summer	14	35	43.549	1.721	111.6	2.4623	0.0000	SURCHARGED
60 minute summer	13	35	43.582	1.112	52.1	1.5911	0.0000	SURCHARGED
60 minute summer	12	35	43.854	0.514	49.2	0.7351	0.0000	SURCHARGED
60 minute summer	21	35	41.983	1.229	859.0	1.3901	0.0000	SURCHARGED
360 minute winter	38_OUT	352	41.651	1.001	313.7	0.0000	0.0000	OK
360 minute winter	38	352	41.651	0.978	319.1	1.4000	0.0000	SURCHARGED
60 minute summer	37	34	42.132	1.303	818.0	3.3152	0.0000	SURCHARGED
60 minute summer	36	34	42.550	1.337	242.9	1.9127	0.0000	SURCHARGED
60 minute summer	34	34	43.299	0.529	128.1	0.7576	0.0000	SURCHARGED
60 minute summer	33	34	43.464	0.653	120.4	0.9338	0.0000	SURCHARGED
60 minute summer	32	34	44.593	1.494	90.4	2.1380	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
60 minute summer	16	3.004	17	179.9	1.455	0.642	4.1802	
60 minute summer	3	1.002	4	180.8	2.673	1.053	3.9319	
60 minute summer	10	1.006	11	561.1	1.992	0.848	9.5728	
360 minute winter	39	9.000	40	38.7	0.550	0.486	0.6798	
360 minute winter	40	9.001	40_OUT	38.7	1.222	0.391	0.1991	893.6
60 minute summer	19	1.009	21	806.1	1.832	1.807	14.9667	
60 minute summer	18	1.008	19	805.7	2.257	2.235	12.1373	
60 minute summer	11	1.007	18	559.7	1.568	1.554	8.5832	
60 minute summer	17	3.005	18	189.7	0.878	0.874	13.1907	
60 minute summer	15	3.003	16	146.3	2.077	2.044	0.4546	
60 minute summer	14	3.002	15	110.8	1.574	1.565	3.0588	
60 minute summer	13	3.001	14	56.7	0.847	0.188	0.6164	
60 minute summer	12	3.000	13	46.2	1.999	0.566	1.2879	
60 minute summer	21	1.010	38	858.0	1.950	1.933	27.2083	
360 minute winter	38_OUT	Flow through pond	39	166.3	0.090	0.002	2327.5518	
360 minute winter	38	1.011	38_OUT	313.7	2.327	0.700	7.5723	
60 minute summer	37	4.005	38	817.0	2.289	2.280	19.5053	
60 minute summer	36	7.003	37	239.1	1.509	1.503	10.2789	
60 minute summer	34	7.002	36	125.9	2.189	0.680	3.5891	
60 minute summer	33	7.001	34	118.6	1.822	1.513	0.5769	
60 minute summer	32	7.000	33	86.1	2.166	2.162	1.4334	

Results for 100 year +40% CC +5% A Critical Storm Duration. Lowest mass balance: 99.38%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
60 minute summer	9	34	43.255	1.762	564.4	2.5211	0.0000	FLOOD RISK
60 minute summer	5	34	43.726	0.847	275.7	1.2121	0.0000	SURCHARGED
60 minute summer	4	34	43.994	0.795	256.1	1.1383	0.0000	SURCHARGED
60 minute summer	1	34	46.651	0.867	79.4	1.2408	0.0000	SURCHARGED
60 minute summer	8	34	43.573	1.127	245.2	1.6126	0.0000	SURCHARGED
60 minute summer	7	34	44.614	1.305	147.5	1.8670	0.0000	SURCHARGED
60 minute summer	6	34	45.631	1.690	80.3	2.4191	0.0000	FLOOD RISK
60 minute summer	29	34	42.447	1.334	140.3	2.3564	0.0000	SURCHARGED
60 minute summer	28	34	42.460	1.296	87.4	1.8539	0.0000	FLOOD RISK
60 minute summer	27	34	42.464	1.268	51.4	1.8150	0.0000	FLOOD RISK
60 minute summer	30	34	42.418	1.421	431.2	2.0339	0.0000	SURCHARGED
60 minute summer	31	34	42.253	1.379	477.3	1.9733	0.0000	SURCHARGED
60 minute summer	25	34	43.077	0.639	213.9	0.9139	0.0000	SURCHARGED
60 minute summer	22	35	43.479	0.263	38.8	0.3766	0.0000	SURCHARGED
60 minute summer	24	34	43.173	0.599	79.1	0.8567	0.0000	SURCHARGED
60 minute summer	35	34	42.705	1.135	41.5	1.2837	0.0000	SURCHARGED
60 minute summer	23	34	43.316	0.375	106.8	0.4238	0.0000	SURCHARGED
60 minute summer	2	34	45.988	0.729	109.3	0.8240	0.0000	SURCHARGED
60 minute summer	26	34	42.526	0.950	44.7	1.0747	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
60 minute summer	9	1.005	10	562.9	1.999	0.801	3.8626	
60 minute summer	5	1.004	9	274.0	2.575	0.558	8.5333	
60 minute summer	4	1.003	5	254.3	2.912	0.725	0.8862	
60 minute summer	1	1.000	2	77.3	1.943	1.202	1.1734	
60 minute summer	8	2.002	9	241.3	2.233	0.563	7.2623	
60 minute summer	7	2.001	8	143.6	2.039	1.118	3.7691	
60 minute summer	6	2.000	7	73.7	1.852	1.265	1.7666	
60 minute summer	29	6.003	30	141.4	0.655	0.649	4.3213	
60 minute summer	28	6.002	29	85.1	0.435	0.390	5.3634	
60 minute summer	27	6.001	28	49.6	0.369	0.228	3.3788	
60 minute summer	30	4.003	31	430.2	1.527	1.521	7.8912	
60 minute summer	31	4.004	37	477.5	1.338	1.321	10.6526	
60 minute summer	25	4.002	30	201.5	2.255	0.686	6.2573	
60 minute summer	22	4.000	23	38.6	1.150	0.971	1.3513	
60 minute summer	24	5.000	25	75.9	1.001	0.687	4.8590	
60 minute summer	35	8.000	36	40.5	1.022	1.017	0.8886	
60 minute summer	23	4.001	25	105.4	2.042	0.727	1.7780	
60 minute summer	2	1.001	3	105.2	1.806	0.614	1.9633	
60 minute summer	26	6.000	27	46.5	0.920	0.641	2.5457	



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- All adoptable drainage works to be constructed as detailed in design and construction guidance or as stipulated in the water authorities addendum.
- All public sewers are to be the subject of a section 104 agreement of the water industry act 1991.
- Invert levels of existing manholes and sewers are to be checked on site before construction commences and results reported to engineers.
- The contractor is responsible for maintaining continuity of flow for all existing sewers within the site boundary and limit of works for the duration of the project.
- All drainage ironworks to comply with bs en124, and be stamped with bsl kitemark. covers to suit loading as below;
 - carriageways and roads - d400
 - driveways and verges - c250
 - footways and pedestrian areas - b125
 - gardens/landscaping - a15
- All sewer pipes, up to, and including 225mm are to be vitrified clay to BS EN295. All sewer pipes 300mm diameter and above to be concrete pipes to BS EN1916. Where agreed with adopting authority pipes up to and including 600mm diameter can be PVC-U to BS EN1401.
- All drainage shall be installed and tested strictly in accordance with the manufacturers' printed instructions, bs en 752, bs en 1601, local water authority requirements and the building regulations.
- All bedding shall be class s unless noted otherwise.
- All trenches under existing and proposed public highways are to be backfilled with thoroughly compacted type 1 granular sub-base material.
- Drainage laid beneath roads and areas of vehicular access (car parking etc) with less than 1200mm of cover shall be encased in concrete bed and surround with associated movement joints. drainage laid beneath paths, footways and pedestrian areas with less than 900mm of cover shall be similarly treated.
- Chambers with outgoing pipes greater than 600mm diameter shall be fitted with guard bars, safety chains or other approved safety devices.
- The use of precast concrete products made with sulphate resisting cement is mandatory, unless a laboratory report proves such precautions are not necessary.
- All sewers to be abandoned must be surveyed to identify any lateral connections that are still live with any found to be reported to the engineer.
- All foul and storm water drains which are not to be adopted as public sewers shall be in accordance with document h of the building regulations, together with nhbc standards chapter 5.3 and bs8301.
- Where pipes pass through footings, retaining or screen walls, lintels to be provided over drains.
- Where inverters are less than 0.6m deep inspection chambers (min dia. 190mm) or access fittings (225 x 100mm) to be used, elsewhere proprietary plastic, brick or pcc is to be used and sized in accordance with table 11 of document h of the building regulations (<0.6m to invert min dn300, >0.6m to invert min dn475).
- Where required 1m deep root barrier of an approved type to be installed vertically along the back edging kerb of all areas of footway/ demarcation to protect from both proposed and future plantation.
- Construction details subject to refinement through detailed design/technical approval process

ALL PIPE BEDDING TO BE CLASS 'S' GRANULAR SURROUND UNLESS NOTED OTHERWISE ON THE DRAWING

Manhole cover levels are derived from a 3D digital terrain model, final cover levels to suit finished surfaces onsite.

Manhole covers to be located wholly within one surface i.e grass or hard standing/road. Manhole covers are to be fully accessible to users.

0510

0

5

10

15

20

25m

Scale 1:500

D	08.24	Contours updated to suit latest layout	LC	DS
C	08.24	Updated Layout	TC	EP
B	07.24	Updated Design	TC	EP
A	07.24	First Issue	LC	DS
Rev	Date	Description	Drawn	Checked

AL

ABLEY LETCHFORD PARTNERSHIP

Consulting Engineers

3 Tealgate, Charnham Park
Hungerford, Berkshire RG17 0YT
www.alpce.co.uk Tel: 01488 684390

Client

BELLWAY HOMES

Project

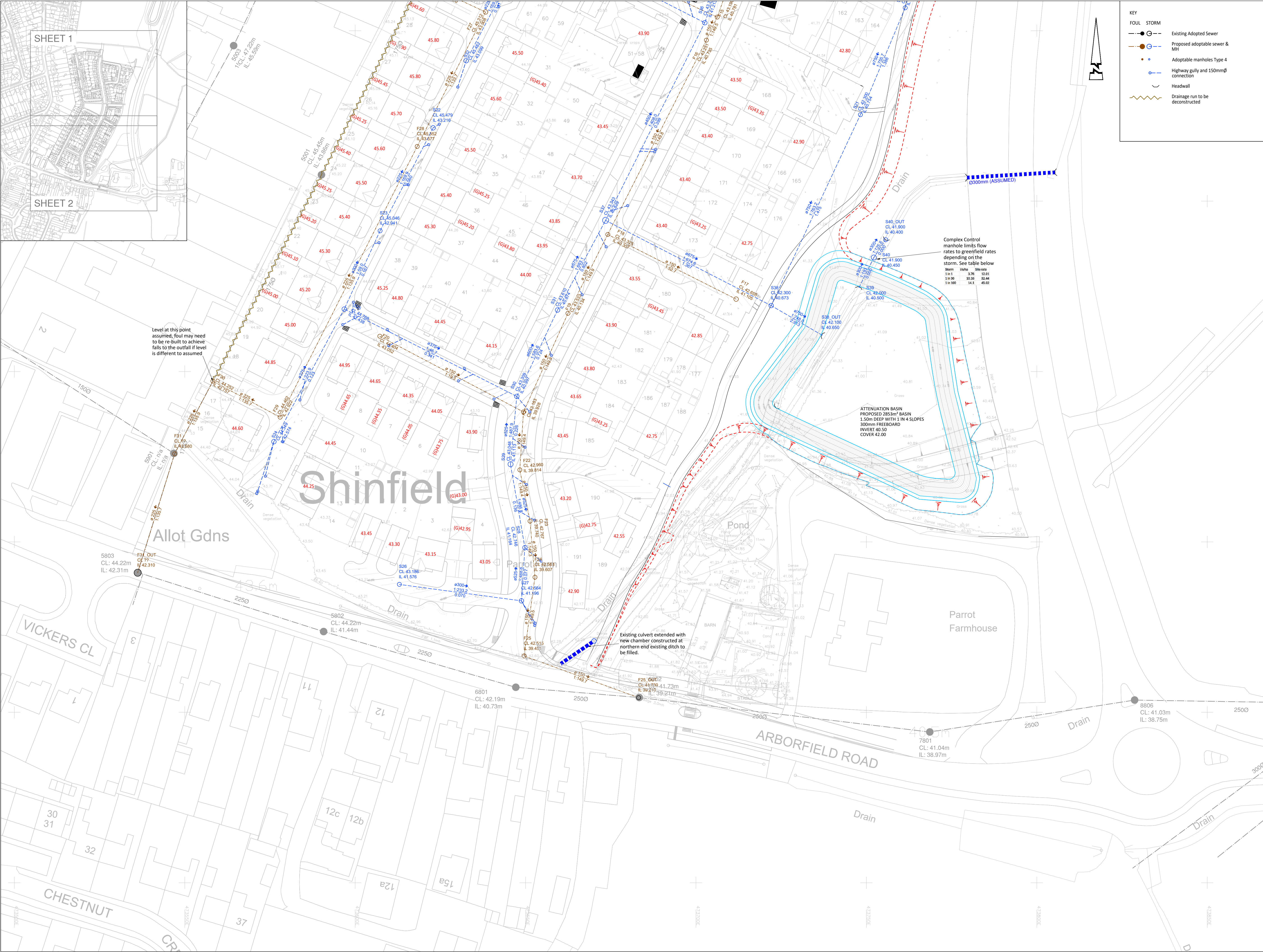
LAND NORTH OF ARBORFIELD ROAD, SHINFIELD

Title

FULL APPLICATION DRAINAGE LAYOUT SHEET 1

Status

Scale	Date	Drawn	Checked
1:500 @ A1	JUNE 2024	LC	DS
Drawing No	HD008-FA-501		Revision
		D	



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- All public sewers are to be the subject of a section 104 agreement of the water industry act 1991.
- Invert levels of existing manholes and sewers are to be checked on site before construction commences and results reported to engineers.
- The contractor is responsible for maintaining continuity of flow for all existing sewers within the site boundary and limit of works for the duration of the project.
- All drainage ironworks to comply with bs en124, and be stamped with bsi kitemark. covers to suit loading as below;
 - carriageways and roads - d400
 - driveways and verges - c250
 - footways and pedestrian areas - b125
 - gardens/landscaping - a15
- All sewer pipes, up to, and including 225mm are to be vitrified clay to BS EN252. All sewer pipes 300mm diameter and above to be concrete pipes to BS EN1916. Where agreed with adopting authority pipes up to and including 600mm diameter can be PVC-U to BS EN1401.
- All drainage shall be installed and tested strictly in accordance with the manufacturers' printed instructions, bs en 752, bs en 1601, local water authority requirements and the building regulations.
- All bedding shall be class s unless noted otherwise.
- All trenches under existing and proposed public highways are to be backfilled with thoroughly compacted type 1 granular sub-base material.
- Drainage laid beneath roads and areas of vehicular access (car parking etc) with less than 1200mm of cover shall be encased in concrete bed and surround with associated movement joints. drainage laid beneath paths, footways and pedestrian areas with less than 900mm of cover shall be similarly treated.
- Chambers with outgoing pipes greater than 600mm diameter shall be fitted with guard bars, safety chains or other approved safety devices.
- The use of precast concrete products made with sulphate resisting cement is mandatory, unless a laboratory report proves such precautions are not necessary.
- All sewers to be abandoned must be surveyed to identify any lateral connections that are still live with any found to be reported to the engineer.
- All foul and storm water drains which are not to be adopted as public sewers shall be in accordance with document h of the building regulations, together with nhbc standards chapter 5.3 and bs8301.
- Where pipes pass through footings, retaining or screen walls, lintels to be provided over drains.
- Where inverts are less than 0.6m deep inspection chambers (min dia. 190mm) or access fittings (225 x 100mm) to be used, elsewhere proprietary plastic, brick or pcc is to be used and sized in accordance with table 11 of document h of the building regulations (<0.6m to invert min dn300, >0.6m to invert min dn475).
- Where required 1m deep root barrier of an approved type to be installed vertically along the back edging kerb of all areas of footway/ demarcation to protect from both proposed and future plantation.
- Construction details subject to refinement through detailed design/technical approval process

ALL PIPE BEDDING TO BE CLASS 'S' GRANULAR SURROUND UNLESS NOTED OTHERWISE ON THE DRAWING

Manhole cover levels are derived from a 3D digital terrain model, final cover levels to suit finished surfaces onsite.

Manhole covers to be located wholly within one surface i.e grass or hard standing/road. Manhole covers are to be fully accessible to users.

0510152025m

Scale 1:500

D	08.24	Updated Outfall information	TC	DS
C	08.24	Updated Layout	TC	EP
B	07.24	Updated Design	TC	EP
A	07.24	First Issue	LC	DS
Rev	Date	Description	Drawn	Checked

AL

ABLEY LETCHFORD PARTNERSHIP

Consulting Engineers

3 Tealgate, Charnham Park
Hungerford, Berkshire RG17 0YT
www.alpce.co.uk Tel: 01488 684390

Client

BELLWAY HOMES

Project

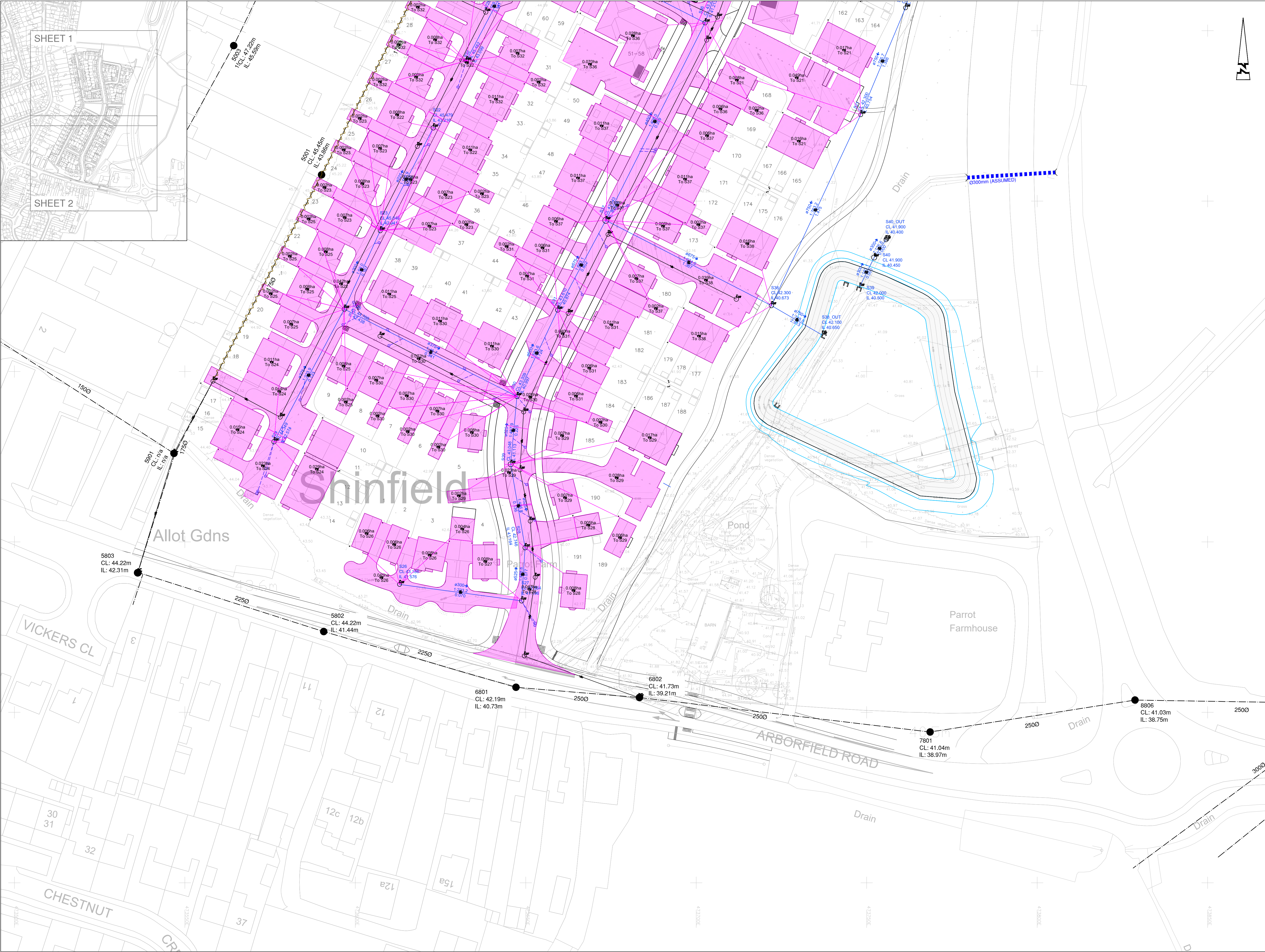
LAND NORTH OF ARBORFIELD ROAD, SHINFIELD

Title

FULL APPLICATION DRAINAGE LAYOUT SHEET 2

Status

Scale	Date	Drawn	Checked
1:500 @ A1	JUNE 2024	LC	DS
Drawing No	HD008-FA-502		Revision
		D	



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SURFACE WATER CATCHMENT NOTES:

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2. This drawing is to be read in conjunction with and checked against all other drawings, Engineering details, Specification and any structural, Geotechnical or other specialist document provided.
3. Total catchment areas shown do not include urban creep. Refer to drainage calculations.
4. Catchment areas refer only to parcels under current RM application.
5. Coefficient of discharge (Cv) has been modelled at 1.0 for robustness.

KEY

- Existing Adopted Sewer
- Proposed adoptable sewer & MH
- Adoptable manholes Type 4
- Highway gully and 150mmØ connection
- Headwall
- Drainage Area of 65% hardstanding

Scale 1:500

Rev	Date	Description	Drawn	Checked
D	08.24	Catchments updated	TC	DS
C	08.24	Updated Layout	TC	EP
B	07.24	Updated Drainage Design	AS	DS
A	06.24	First Issue	LC	DS

AL ABLEY LETCHFORD PARTNERSHIP
Consulting Engineers

3 Tealgate, Charnham Park
Hungerford, Berkshire RG17 0YT
www.alpce.co.uk Tel: 01488 684390

Client
BELLWAY HOMES

Project
LAND NORTH OF ARBORFIELD ROAD, SHINFIELD

Title
FULL APPLICATION SW CATCHMENT PLAN SHEET 2

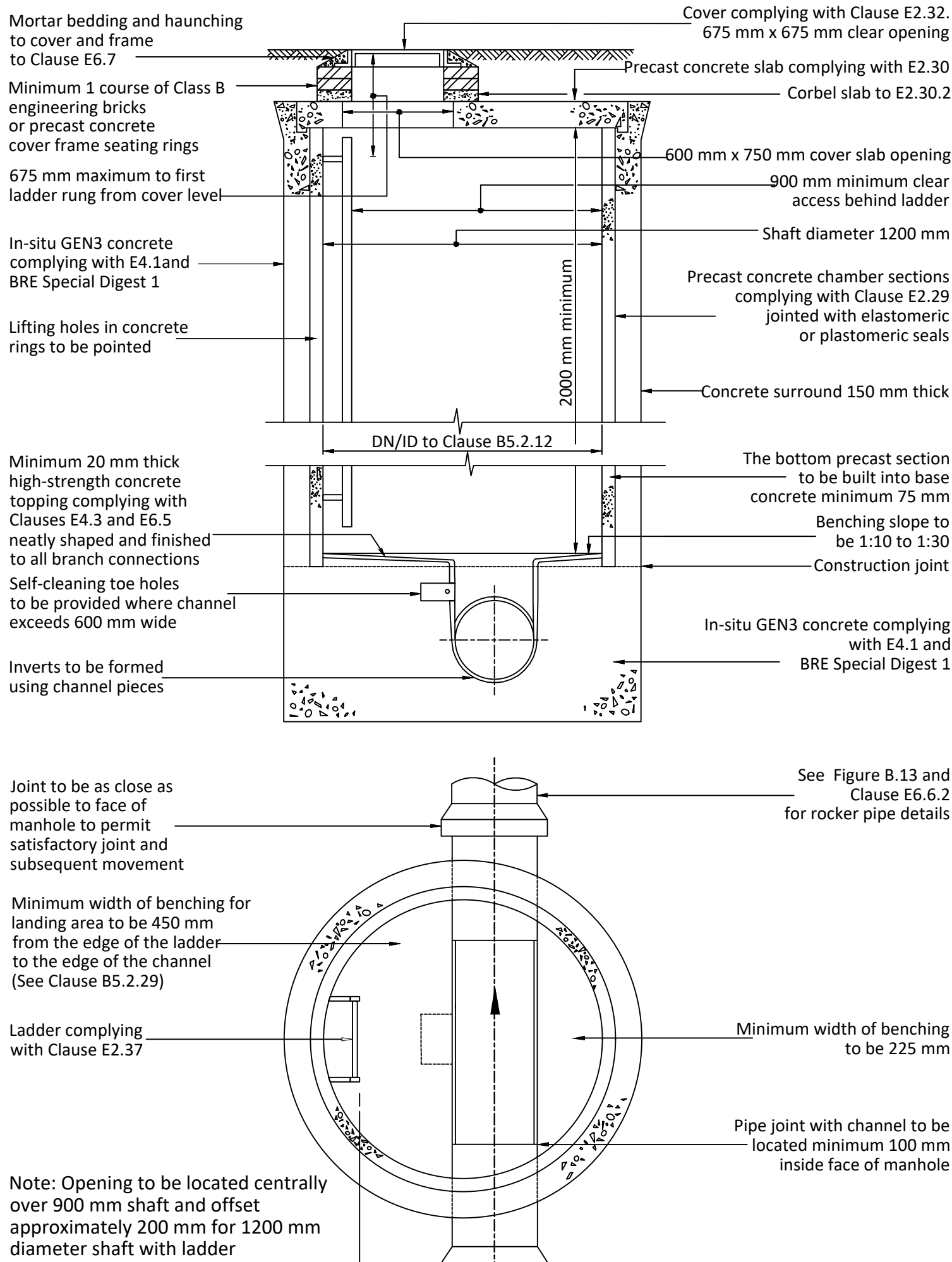
Status

Scale	Date	Drawn	Checked
1:500 @ A1	JUNE 2024	LC	DS

Drawing No.
HD008-FA-512

Revision
D

Figure B 7
Typical manhole cover - Type A2
Depth from cover level to soffit of pipe 3 m to 6 m with ladder
Alternative rigid material construction with concrete surround



CLASS S BEDDING
(On trafficked areas)

CLASS S BEDDING
(Verges & Landscaping)

GRANULAR BEDDING

Nominal bore of pipe (mm)	Alternative Aggregate sizes (mm)	
	Single sized	Graded
100	10	-
150	10 or 14	14-5
225-300	14 or 20	14-5 or 20-5
375-525	14 or 20	14-5 or 20-5
>525	14, 20 or 40	14-5, 20-5 or 40-5

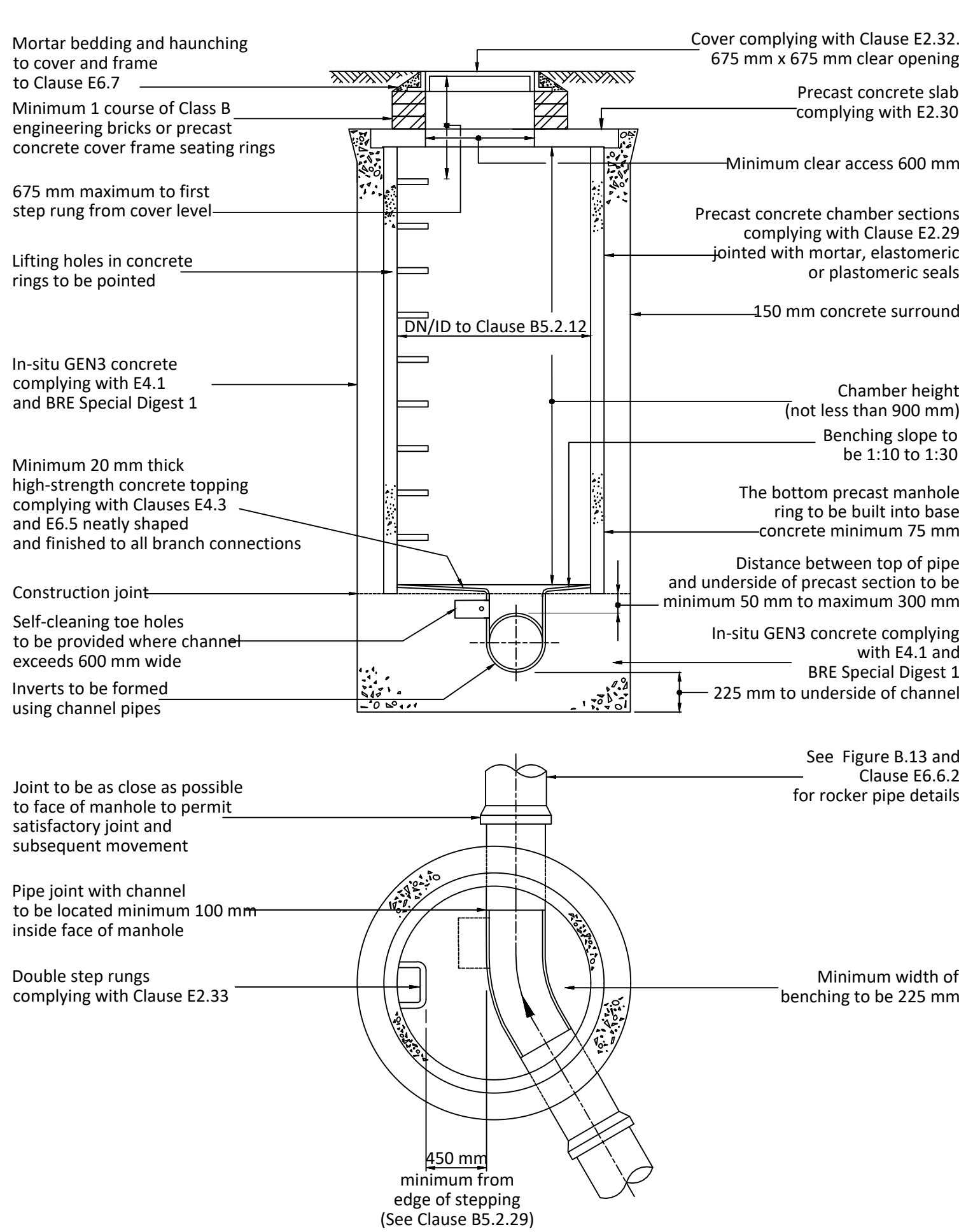
Granular bedding for pipes and backfilling material for temporary drains (trench sub-drains) shall consist of aggregates from natural sources to BS EN 13242 and BS EN 1744-1 or sintered pulverised fuel ash complying with the relevant provisions of BS 3892; sized in accordance with the above table

Selected fill material, whether selected from locally excavated material or imported, shall consist of uniform, readily compactible material, free from vegetable matter, building rubbish and frozen material, or materials susceptible to spontaneous combustion, and excluding clay of liquid limit greater than 80 and/or plastic limit greater than 55 and materials of excessively high moisture content. Clay lumps and stones shall be retained on 100mm and 40mm sieves respectively.

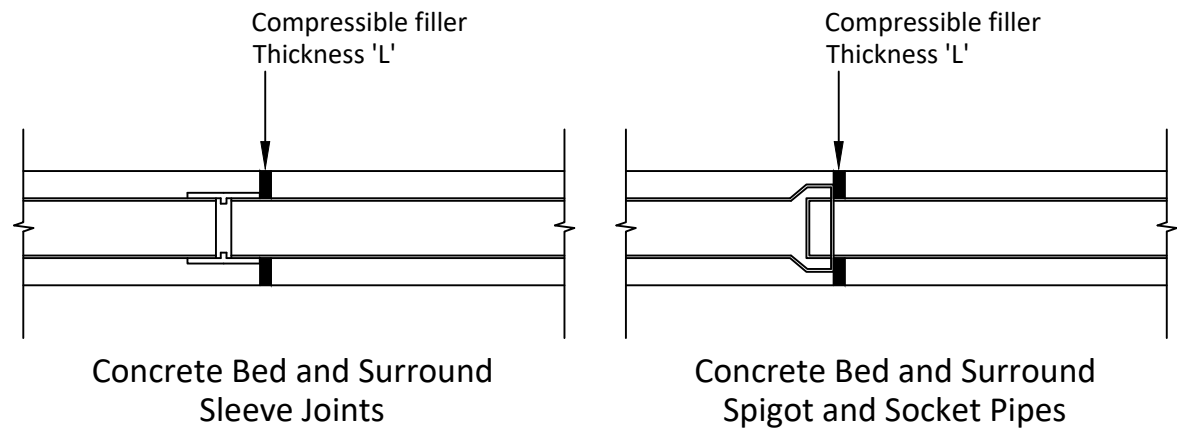
TRENCH WIDTHS & KEY DIMENSIONS

Dia Dn (mm)	Width Bc (mm)		Y (mm)		L (mm)	Z MIN (mm)
	Max	Min	Y1 (Uniform Soil)	Y2 (Rock)		
100	550	450	100	200	18	150
150	600	490	150	200		150
225	700	580	150	200		150
300	750	680	150	200	18	150
375	1050	950	150	200		150
450	1150	1030	150	200		150
525	1200	1120	150	200	36	150
600	1350	1240	150	200		150
675	1450	1330	150	200		225
750	1500	1400	150	200	36	225
825	1600	1490	150	225		225
900	2100	1900	150	225		225
975	2150	1950	175	250	300	300
1050	2250	2050	175	275		300
1200	2500	2250	200	300		300
OVER 1200	O.D+1000	O.D+800	I.D/6	I.D/4	54	400

Figure B 10
Typical manhole detail - Type B
Depth from cover level to soffit of pipe 1.5 m to 3.0 m
Alternative Rigid material construction with concrete surround



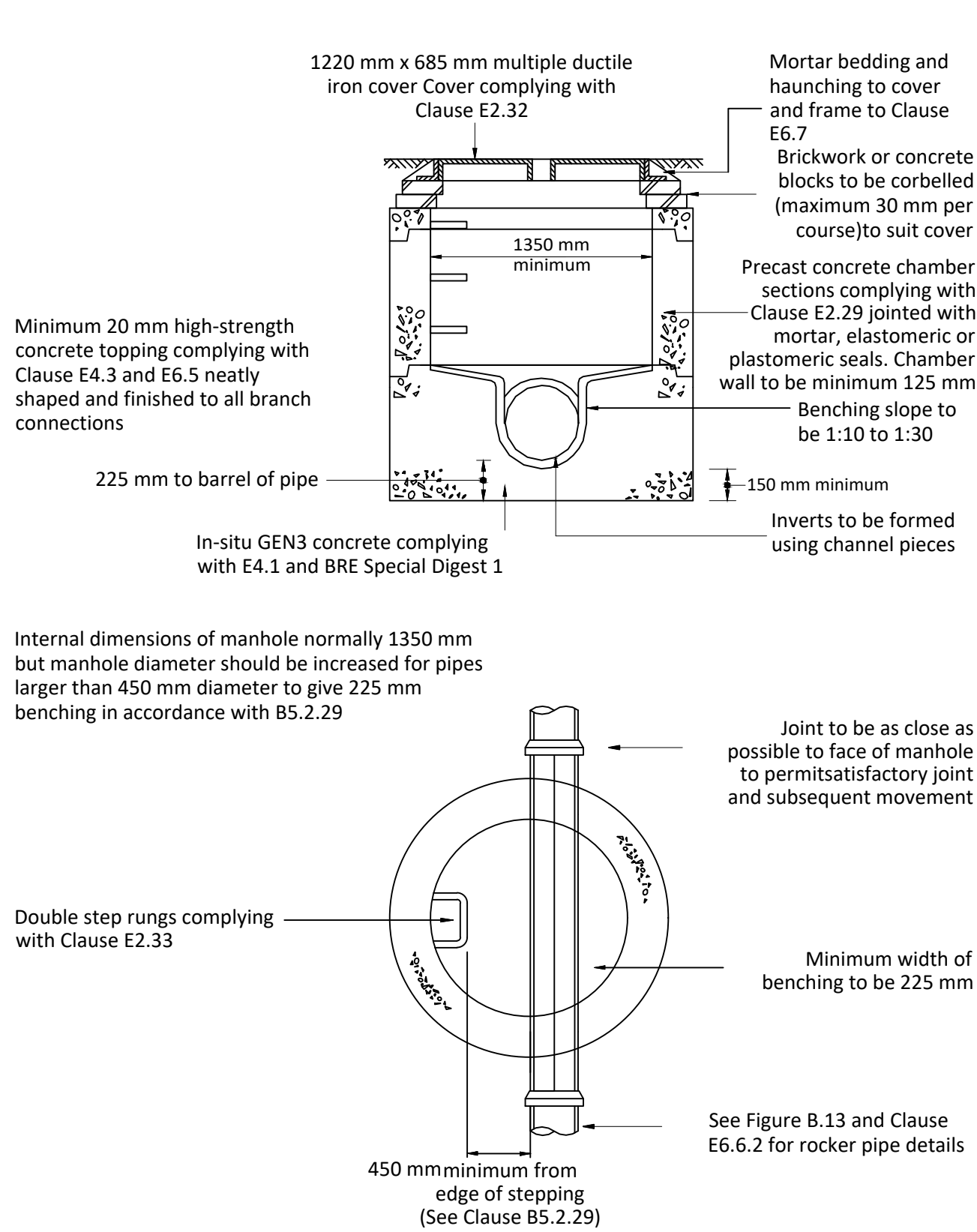
CLASS Z BEDDING
(Cover to pipe <1.2m or as specified)



Flexible Joint Details

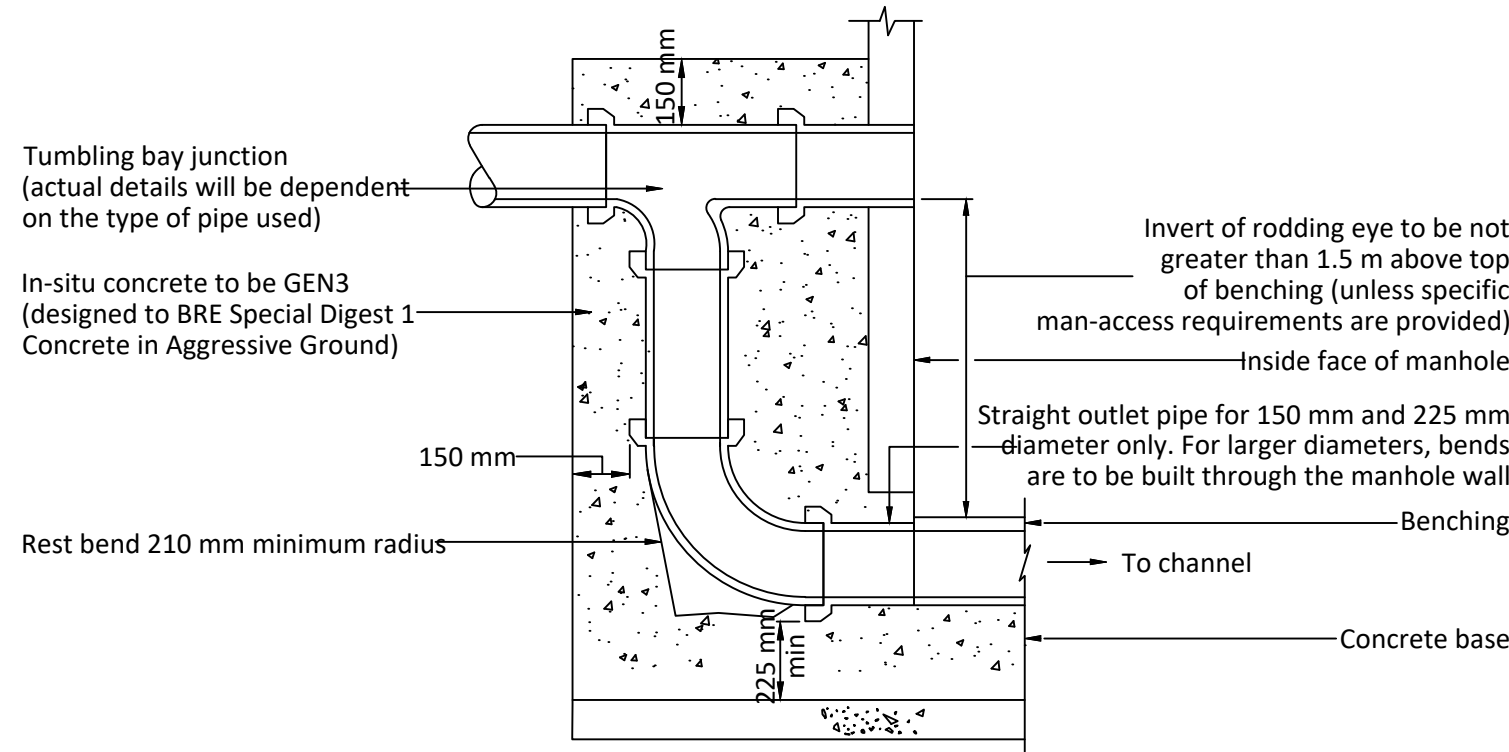
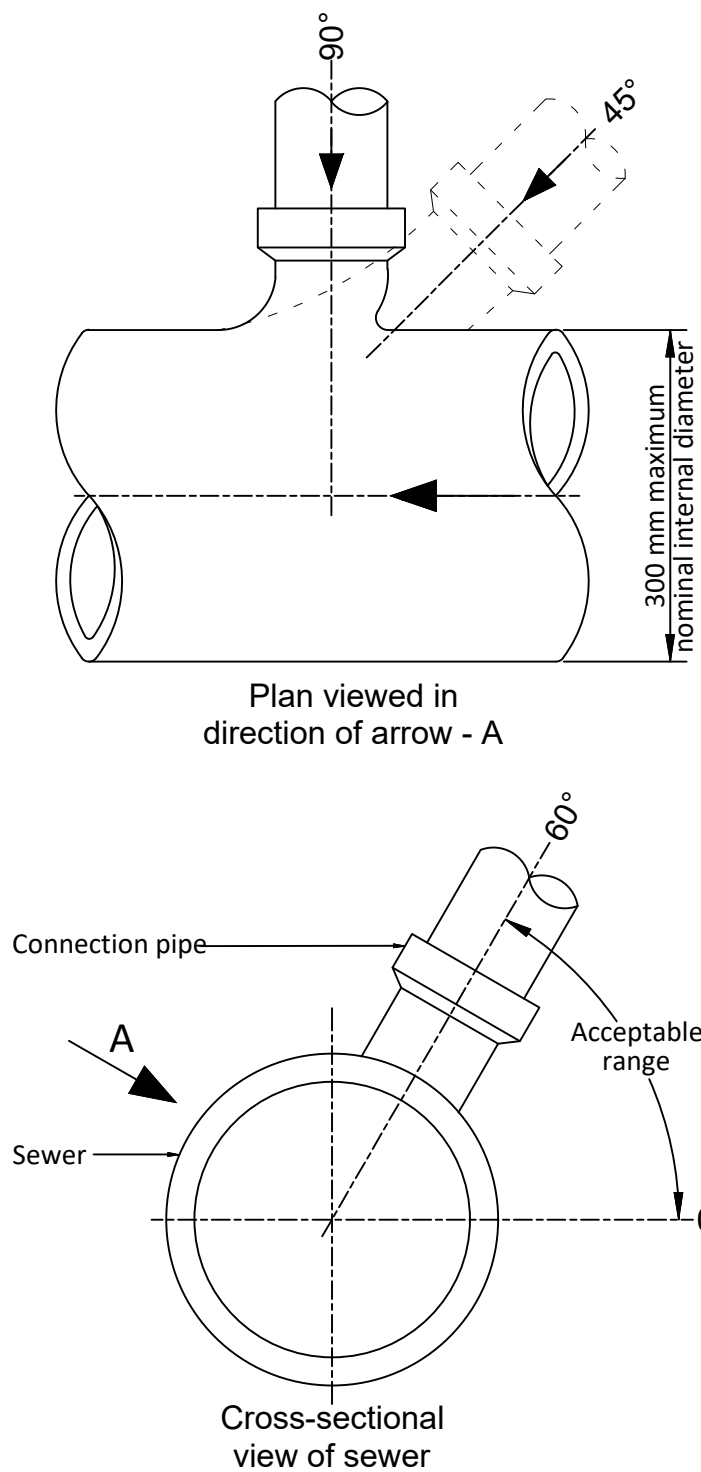
Form vertical construction joints in GEN3/ST4 concrete surround at face of every pipe joint using compressible board (refer to table for thickness 'L', precut to finished profile of concrete and pipe. Fill any gap between spigot and socket with resilient material to prevent entry.

Figure B 15
Typical manhole detail - Type C
Depth from cover level to soffit of pipe less than 1.5 m
Rigid material construction

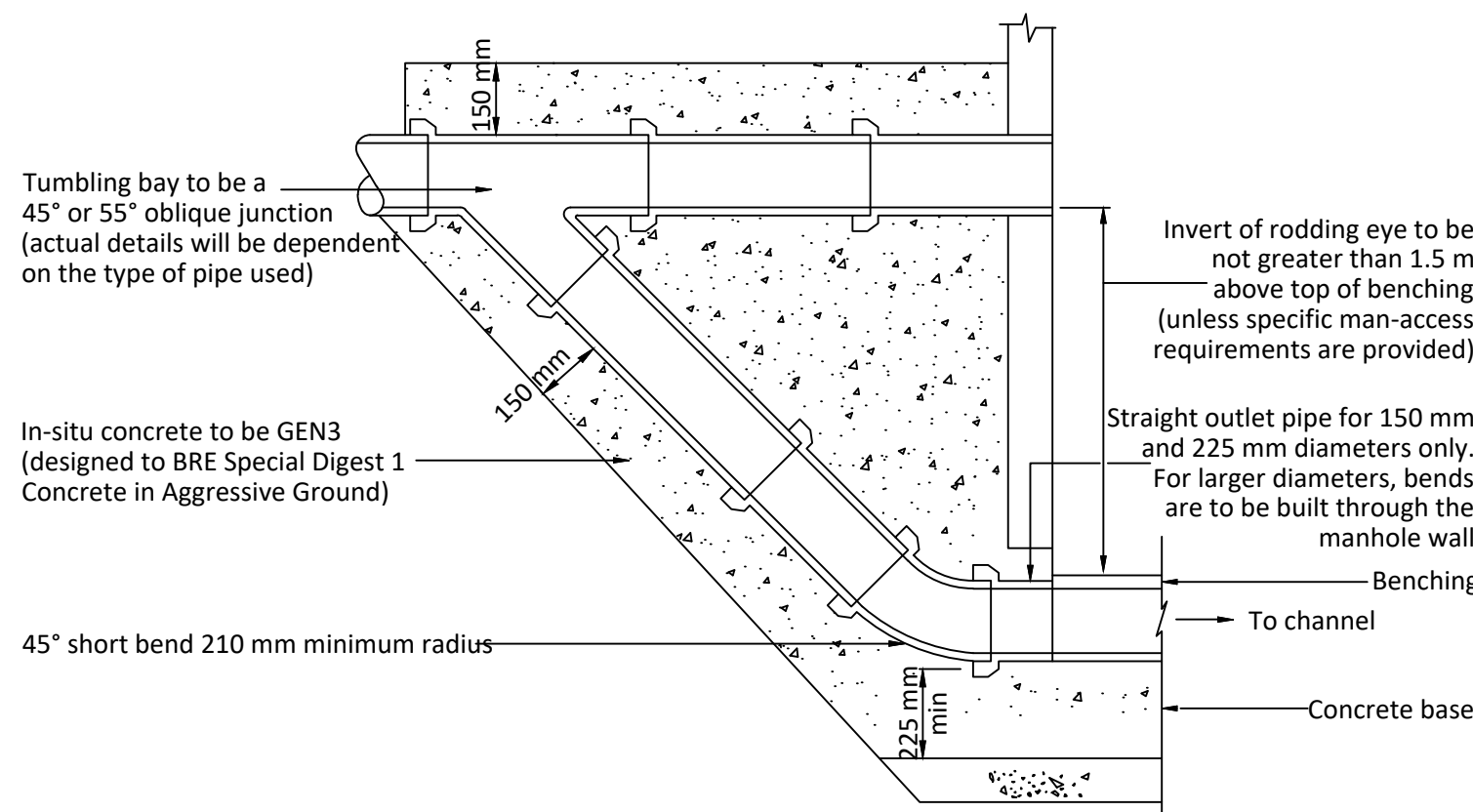


Note: The use of precast concrete chamber units to E2.29 with 150 mm GEN3 in-situ concrete complying with E4.1 and BRE Special Digest 1 in place of brickwork construction is permitted.

Figure B 26
Connections to sewer



External Vertical Backdrop



External Ramped Backdrop

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5. All public sewers are to be the subject of a section 104 agreement of the water industry act 1991.
6. Invert levels of existing manholes and sewers are to be checked on site before construction commences and results reported to engineers.
7. The contractor is responsible for maintaining continuity of flow for all existing sewers within the site boundary and limit of works for the duration of the project.
8. All drainage ironworks to comply with bs en124, and be stamped with bsi kitemark. covers to suit loading as below; -carriageways and roads - d400 -driveways and verges - c250 -footways and pedestrian areas - b125 -gardens/landscaping - a15
9. All sewer pipes, up to, and including 225mm are to be vitrified clay to BS EN295. All sewer pipes 300mm diameter and above to be concrete pipes to BS EN1916. Where agreed with adopting authority pipes up to and including 600mm diameter can be PVC-U to BS EN1404.
10. All drainage shall be installed and tested strictly in accordance with the manufacturers' printed instructions, bs en 752, bs en 1601, local water authority requirements and the building regulations.
11. All bedding shall be class s unless noted otherwise.
12. All trenches under existing and proposed public highways are to be backfilled with thoroughly compacted type 1 granular sub-base material.
13. Drainage laid beneath roads and areas of vehicular access (car parking etc) with less than 1200mm of cover shall be encased in concrete bed and surround with associated movement joints. drainage laid beneath paths, footways and pedestrian areas with less than 900mm of cover shall be similarly treated.
14. Chambers with outgoing pipes greater than 600mm diameter shall be fitted with guard bars, safety chains or other approved safety devices.
15. The use of precast concrete products made with sulphate resisting cement is mandatory, unless a laboratory report proves such precautions are not necessary.
16. All sewers to be abandoned must be surveyed to identify any lateral connections that are still live with any found to be reported to the engineer.
17. All foul and storm water drains which are not to be adopted as public sewers shall be in accordance with document h of the building regulations, together with rhbc standards chapter 5.3 and bs8301.
18. Where pipes pass through footings, retaining or screen walls, lintels to be provided over drains.
19. Where inverts are less than 0.6m deep inspection chambers (min dia. 190mm) or access fittings (225 x 100mm) to be used, elsewhere proprietary plastic, brick or pcc is to be used and sized in accordance with table 11 of document h of the building regulations (<0.6m to invert min dn300, >0.6m to invert min dn475).
20. Where required 1m deep root barrier of an approved type to be installed vertically along the back edging kerb of all areas of footway/ demarcation to protect from both proposed and future plantation.
21. Construction details subject to refinement through detailed design/technical approval process

ALL PIPE BEDDING TO BE CLASS
'S' GRANULAR SURROUND
UNLESS NOTED OTHERWISE ON
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3 Tealgate, Charnham Park
Hungerford, Berkshire RG17 0YT
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Client

BELLWAY HOMES

Project
LAND NORTH OF
ARBORFIELD ROAD,
SHINFIELD

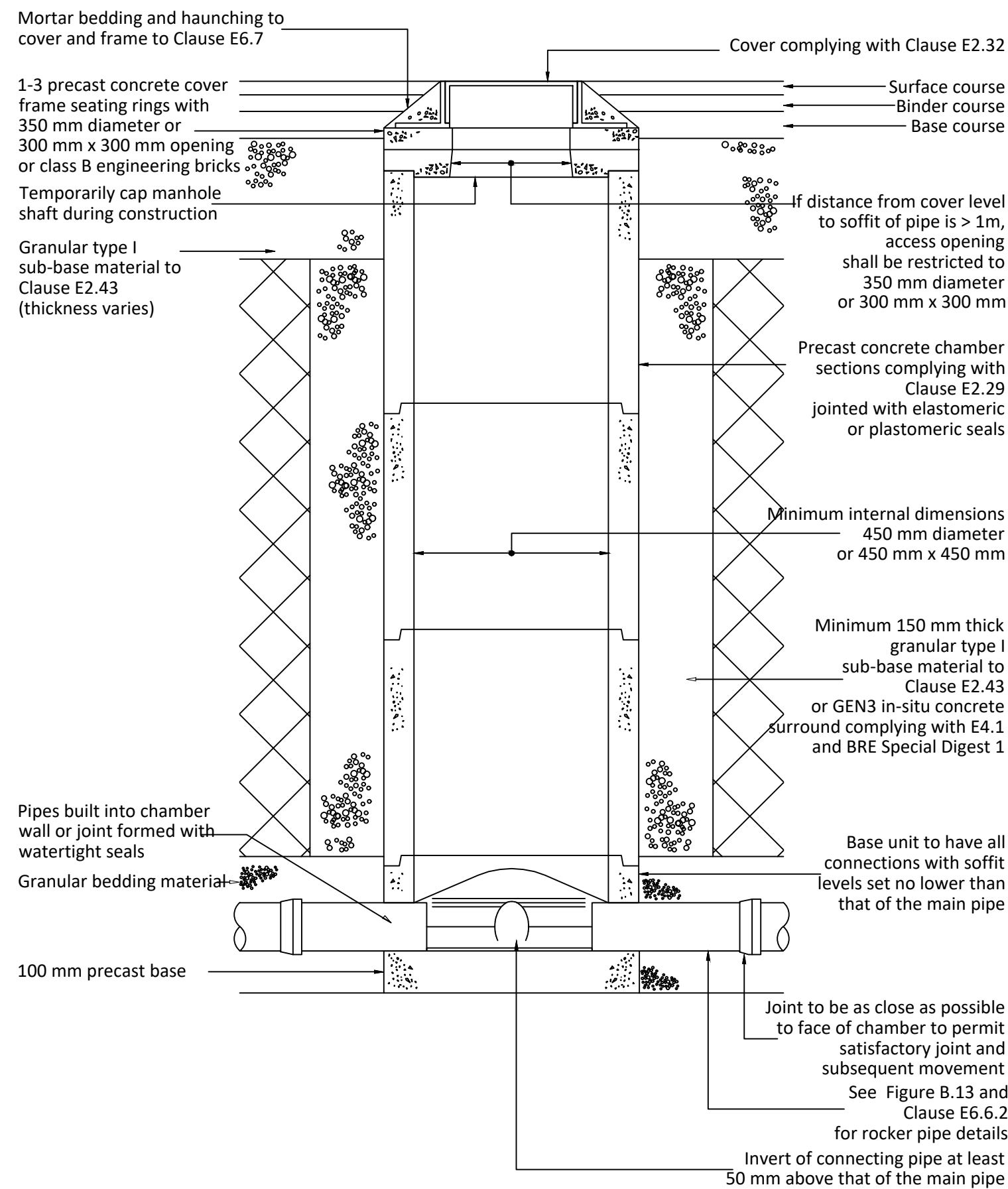
Title
FULL APPLICATION
DRAINAGE CONSTRUCTION
DETAILS SHEET 1

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HD008-FA-551	A

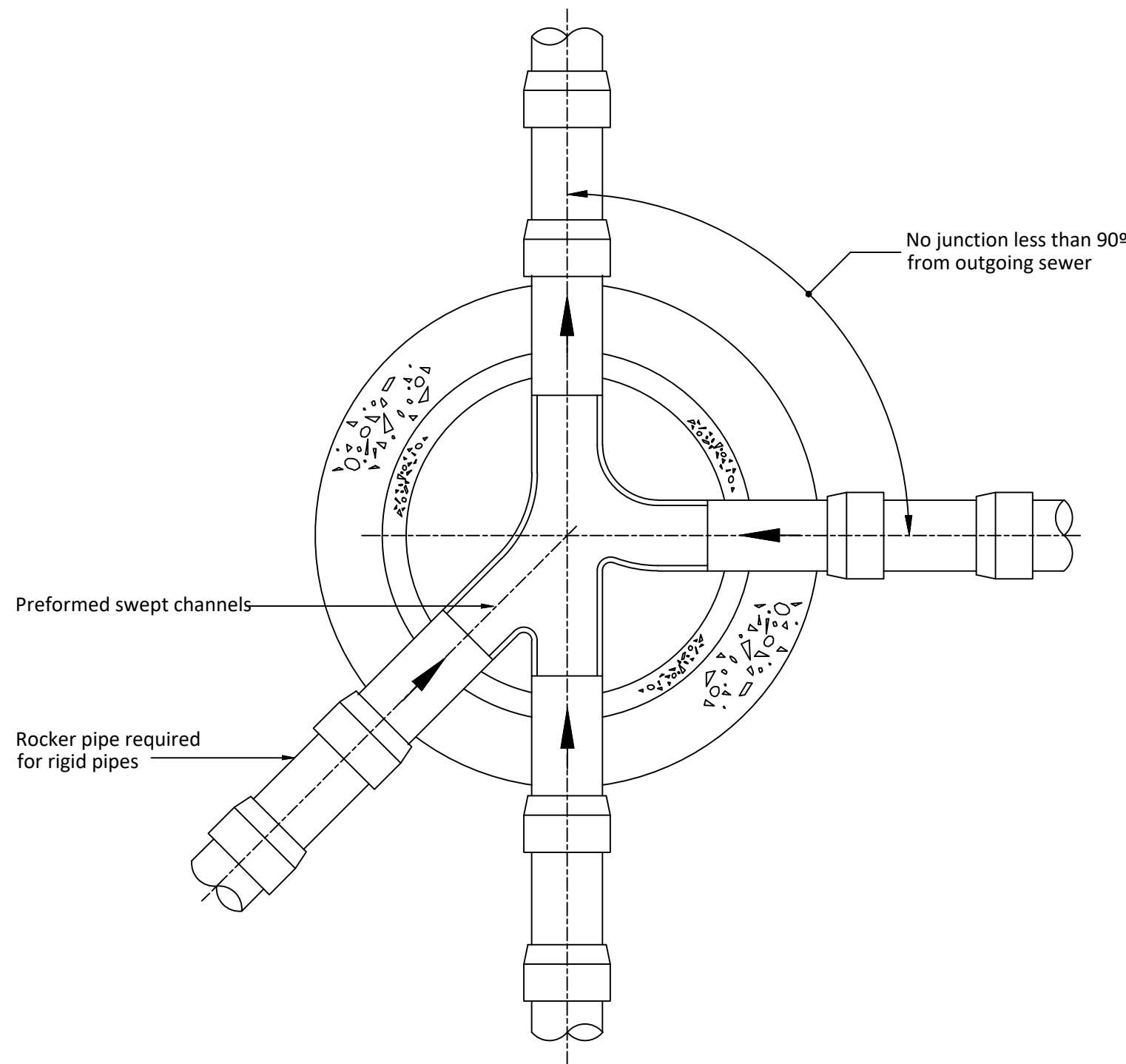
FIGURE B.20
TYPICAL INSPECTION CHAMBER DETAIL - TYPE D
Depth from cover level to soffit of pipe up to 3 m
Rigid material construction for use in areas subject to vehicle loading



Note: Where the access chamber is in the highway (including any footway), the highway authority can have specific requirements.

Not to scale

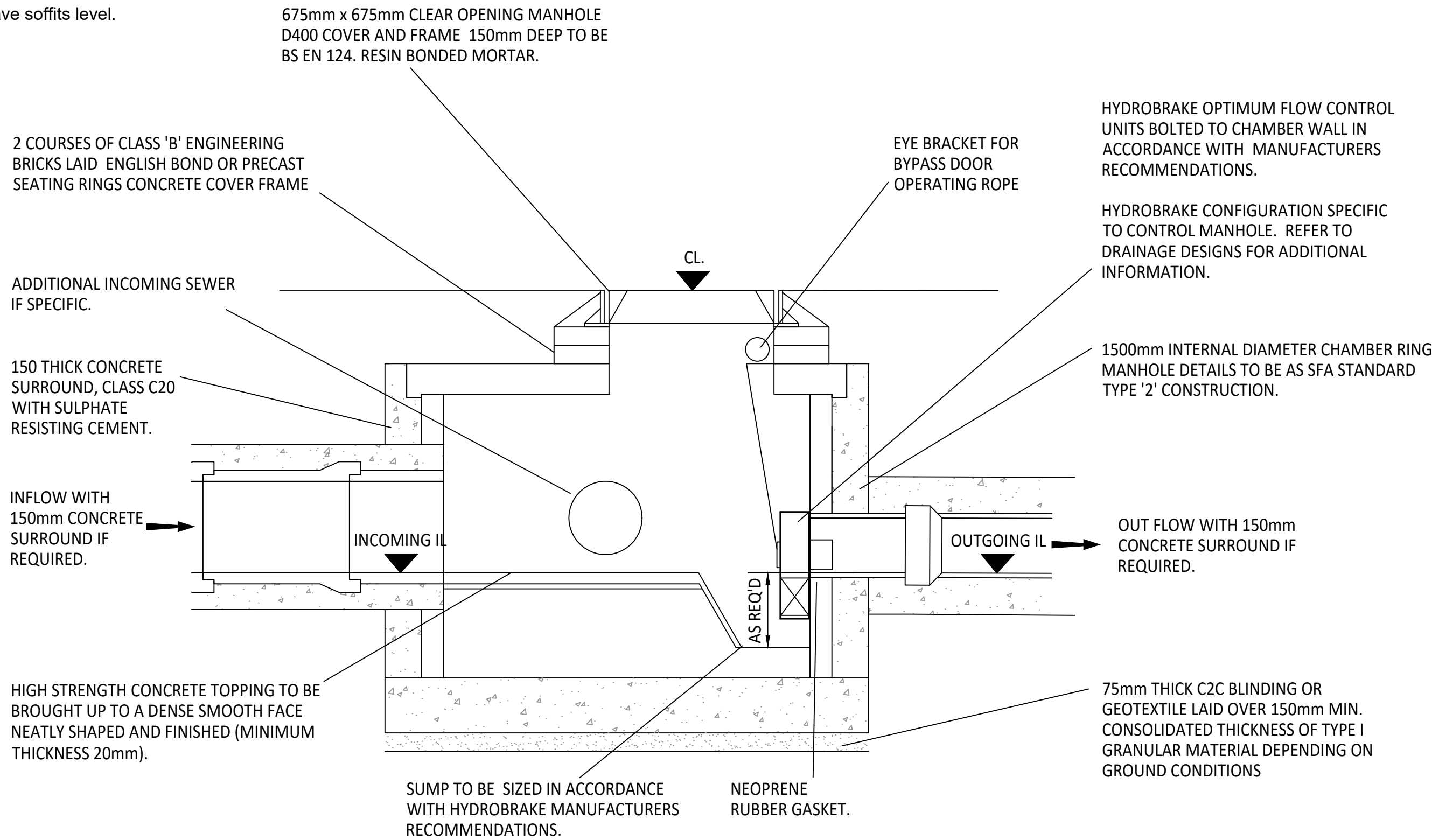
Figure B 13
Typical arrangement of pipe junctions within manholes



Rigid pipes built into manhole should have a flexible joint as close as feasible to the external face of the structure and the length of the next rocker pipe should be as shown.

Nominal diameter (mm)	Maximum effective length (m)
150 - 600	0.6
601 - 750	1.00
over 750	1.25

All pipes entering the bottom of the manhole to have soffits level.



NTS TYPICAL CONTROL MANHOLE DETAIL

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DRAINAGE NOTES:

- Do not scale.
- This drawing is to be read in conjunction with and checked against all other drawings, Engineering details, Specification and any structural, Geotechnical or other specialist document provided.
- Site layout shown for context only, refer to other project drawings for details.
- All adoptable drainage works to be constructed as detailed in design and construction guidance or as stipulated in the water authorities addendum.
- All public sewers are to be the subject of a section 104 agreement of the water industry act 1991.
- Invert levels of existing manholes and sewers are to be checked on site before construction commences and results reported to engineers.
- The contractor is responsible for maintaining continuity of flow for all existing sewers within the site boundary and limit of works for the duration of the project.
- All drainage ironworks to comply with bs en124, and be stamped with bsi kitemark. covers to suit loading as below;
 - carriageways and roads - d400
 - driveways and verges - c250
 - footways and pedestrian areas - b125
 - gardens/landscaping - a15
- All sewer pipes, up to, and including 225mm are to be vitrified clay to BS EN295. All sewer pipes 300mm diameter and above to be concrete pipes to BS EN1916. Where agreed with adopting authority pipes up to and including 600mm diameter can be PVC-U to BS EN1404.
- All drainage shall be installed and tested strictly in accordance with the manufacturers' printed instructions, bs en 752, bs en 1601, local water authority requirements and the building regulations.
- All bedding shall be class s unless noted otherwise.
- All trenches under existing and proposed public highways are to be backfilled with thoroughly compacted type 1 granular sub-base material.
- Drainage laid beneath roads and areas of vehicular access (car parking etc) with less than 1200mm of cover shall be encased in concrete bed and surround with associated movement joints. drainage laid beneath paths, footways and pedestrian areas with less than 900mm of cover shall be similarly treated.
- Chambers with outgoing pipes greater than 600mm diameter shall be fitted with guard bars, safety chains or other approved safety devices.
- The use of precast concrete products made with sulphate resisting cement is mandatory, unless a laboratory report proves such precautions are not necessary.
- All sewers to be abandoned must be surveyed to identify any lateral connections that are still live with any found to be reported to the engineer.
- All foul and storm water drains which are not to be adopted as public sewers shall be in accordance with document h of the building regulations, together with nhbc standards chapter 5.3 and bs8301.
- Where pipes pass through footings, retaining or screen walls, lintels to be provided over drains.
- Where inverts are less than 0.6m deep inspection chambers (min dia. 190mm) or access fittings (225 x 100mm) to be used, elsewhere proprietary plastic, brick or pcc is to be used and sized in accordance with table 11 of document h of the building regulations (<0.6m to invert min dn300, >0.6m to invert min dn475).
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