Appendix 15.1

FLOOD RISK ASSESSMENT (FRA)

AXIS J10, M40 JUNCTION 10,

BAYNARDS GREEN, BICESTER

Site Specific Flood Risk Assessment & Drainage Strategy

Issue 3

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Limitations

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(i) The date on which this assessment was undertaken, and
(ii) The date on which the final report is delivered

EXECUTIVE SUMMARY

Background

Bailey Johnson Hayes Limited was commissioned by Albion Land Limited in July 2021 (Updated 2024) to prepare a Flood Risk Assessment (FRA) and Drainage Strategy in support of an outline planning application for the proposed development at Axis J10, Baynard's Green, Bicester.

The site is divided into two parts: the eastern parcel north of Junction 10 of the M40 and western parcel north of Moto Cherwell Valley Services. The current site proposals are for a total of five separate class B8-use buildings with associated, access roads, delivery yards, external storage, car parking, SuDS & Wastewater infrastructure and soft landscaping**.**

This Flood Risk Assessment has been prepared in accordance with the guidelines set out in the National Planning Policy Framework and regional/ local policy and guidance for the whole site. Highway improvement works to the B4100 and A43 to provide access to the site is outside the scope of this report.

Site Location and Description

The site is located adjacent to the north of Junction 10 of the M40, approximately 1km north of the centre of Ardley in Oxfordshire. The Ordnance Survey grid reference for the centre of site is 454583 229025. The site refers to two parcels of agricultural arable land on the east and west sides of the A43. The larger western parcel extends to 43.5 hectares (ha) and the smaller eastern parcel extends to 23.2 hectares (ha). The total site area is 66.7 hectares (ha).

Flood Zone

The Environment Agency mapping shows that the whole site is within Flood Zone 1 which is shown to be at less than 0.1% chance of flooding in any year, otherwise known as having a 1:1000-year chance. There are no recorded instances of the flooding from nearby rivers or watercourses.

Fluvial Flooding

The risk from Fluvial flooding is Very Low to Negligible as described in Section 3.2.

Groundwater Flooding

The risk from Groundwater flooding is Low as described in Section 3.3.

Canal Flooding

The risk from Canal flooding is Very Low to Negligible as described in Section 3.4.

Reservoir & Waterbody Flooding

The risk from Reservoir and Waterbody flooding is Very Low to Negligible as described in Section 3.5.

Sewer Flooding

The risk from Sewer flooding is Very Low to Negligible as described in Section 3.6.

Surface Water Flooding

The risk from Surface Water flooding is Low as described in Section 3.7.

Flood Risk to the Wider Catchment

The flood risk to the wider catchment flooding is Low as described in Section 3.8.

Proposed Development

The erection of Storage and Distribution (Use Class B8) buildings and associated infrastructure including parking, electricity substation(s), new site accesses from the B4100; creation of internal roads and access routes; hard and soft landscaping; and the diversion of an existing public right of way. Phasing of the development will not be significant, with Enabling Works on Western Site first, following commencement of Western Development and then Eastern Development at a similar time.

Proposed Flood Mitigation

An overview of the potential mitigation measures available to address flood risk issues at the development site is provided in Section 4. Some of the generic proposals included are; Raising thresholds and building levels outside of design flood levels, providing safe access and egress around the development, directing overland flows towards areas of low risk, implementation of SuDS to manage runoff at sources thus reducing flood volume, installation of pollution prevention features to prevent contamination at discharge locations, tree planting to increase biodiversity and absorption of water, management and maintenance to ensure correct operation of all drainage systems and managing residual risks post development.

Discharge Hierarchy

The recommended discharge hierarchy approach has been taken. The results of preliminary soakaway testing suggest that infiltration will be suitable for this site, however further localised testing will need to be undertaken at detailed design stage. An alternative discharge strategy to the Padbury Brook watercourse is possible but would require works to provide an outlet restricted to greenfield rates.

Proposed SuDS Features

The following SuDS features are recommended from the SuDS and Water Quality Assessments:

- Swales
- Infiltration Basins
- Permeable Paving
- Petrol Interceptors
- Catchpits, Gullies and Line Drains
- Flows control devices

Non-Technical Surface Water Drainage Summary

The western and eastern parcels of land have been split into three distinct catchments know as;

- Unit 1
- Unit 2&3
- Unit 4&5

For all catchments, a series of swales direct flows to infiltration basins transferring discharge into the ground throughout. Permeable paving in the carparks will discharge flows directly into the ground and designed to provide additional storage volume if required. The large infiltration basin to the south of the western parcel is designed to accommodate runoff from the Unit 1 catchment, as well flow controlled overflows from the Units 2 & 3 catchment using a Hydro-brake device.

Volume Storage Estimates

WinDes preliminary estimated storage volumes for the following catchments are outlined below:

- Unit 1 - 9745 - 20939 m^3
- Unit 2&3 - 5294 - 13518 m^3
- Unit 4&5 - 8442 – 20113 m^3

Non-Technical Foul Drainage Summary

There remains a number of viable options including; gravity or pumped discharge to nearby existing waste treatment plants (subject to reinforcement works), on-site treatment or which will need detailed and extensive discussions and assessments to find the final solution, outside the scope of this assessment. The most suitable option(s) will be defined during the detailed design stage. Three viable options for discharge have been described such as; pumping to a local treatment works, on-site treatment, and discharge to new or upgraded foul wastewater infrastructure.

Recommendations

It is recommended during detailed design that flood mitigation measures are implemented, and drainage design is carried out using the philosophy established in this report. Further design will be required to establish the entire drainage network and to ensure no flooding is created on the site during the 30-year event and flooding is contained on site safely during the 100-year + 40% event.

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FIGURES

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1 INTRODUCTION

1.1 This Flood Risk Assessment (FRA) & Drainage Strategy is compliant with the policy's set out in the National Planning Policy Framework (NPPF), associated Planning Practice Guidance and Regional / Local policy and guidance. This report has been produced on behalf of Albion Land Limited in respect of the Hydrology, Flood Risk and Drainage matters on the site known as Axis J10, Junction 10, M40, Baynard's Green, Bicester.

Table 1.1 – Site Summary

Site Name	Axis J10, Junction 10, M40, Baynard's Green, Bicester
Location	J10 M40, A43, Baynard's Green Roundabout, Bicester
NGR (approx.)	454583, 229025
Development Type	The site is divided into two parts: the eastern parcel north of Junction 10 of the M40 and western parcel north of Moto Cherwell Valley Services. The current site proposals are for a total of five separate class B8-use buildings with associated, access roads, delivery yards, external storage, car parking, SuDS & Wastewater infrastructure and soft landscaping.
NFFP Vulnerability	Less Vulnerable
EA Flood Zone	Flood Zone 1
EA Office	North Thames – Banbury
LPA	Cherwell District Council
LLFA	Oxfordshire County Council

SOURCES OF DATA

1.2 This report is based on the following sources of information:

(i) Proposed Masterplan Layout;
(ii) Topographical Survey Data;
(iii) Ordnance Survey Mapping Data;
(iv) Cherwell Level 1 Strategic Flood Risk Assessment (SFRA);
(v) Environment Agency Flood Map for Planning (Rivers and Sea);
(vi) Geotechnical and Environmental Desk Study
(vii) Ground Investigation and Soil Testing Report
(viii) Sewerage Undertaker Asset Location Plans
(ix) Standing Advise for Flood Risk Assessments

Note: This list could be updated in future issues of this report.

SITE HISTORY

1.3 Historical maps were obtained as part of the desk study by Applied Geology in order to determine any significant past activity or land usage. No significant changes have taken place on the site other than the inclusion of a pump marked in 1900 and then removed on the 1980 map. In the vicinity of the site the construction of the M40 in the early 1990's, construction of Baynard's Green services and Moto Cherwell Valley in the early 2000's and widening of the A43 carried out in the early 2010's remain the only significant works.

EXISTING SITE DESCRIPTION

1.4 The site is located adjacent to the north of Junction 10 of the M40, approximately 1km north of the centre of Ardley in Oxfordshire. The Ordnance Survey grid reference for the centre of site is 454583 229025 as shown on the Site Location Plan in **Appendix A**.

1.5 The site refers to two large parcels of agricultural arable land on the east and west sides of the A43, immediately north of its junction with the M40 motorway (J10) and Cherwell Valley Services and extending north as far as the B4100. The larger western parcel extends to 43.5 hectares (ha) and the smaller eastern parcel extends to 23.2 hectares (ha). The parcels are irregular shapes and overall cover a total area of 66.7 hectares (ha).

1.6 The site is not currently allocated for any form of development in the adopted Cherwell Local Plan 2011-2031. The site is however mentioned in the Cherwell Level 1 Strategic Flood Risk Assessment 2017 as a potential development site under reference SFRA56. The Cherwell local plan review 2040 is currently under consultation and the site is likely to be submitted for consideration for as a potential employment allocated site.

Western Parcel of the Site

1.7 The two most northerly fields in the western section of the site are cropped, with the remaining four fields in the western section recently seeded with crops starting to sprout. A disused stone barn was present in the middle of the western section of the site which was previously used to store hay bales. An electric substation and phone mast were also present in the west corner of the western section of the site. The fields are separated with internal hedgerows and the odd mature and semi-mature trees.

1.8 To the south-west of the site is the M40 motorway with a small field ditch separating the site from the road. The north-west of the site is bounded by dense hedges and further agricultural fields. The north of the site is bounded by the single lane B4100 with farmers gate entrance from the top of the site. To the north-east of the site there is an existing farmhouse and associated landscaping known as Baynard House. In close proximity is also a couple of small cottages. To the east of the site is the A43 dual carriageway with verge and trees separating the site from the road.

1.9 From the Topographical Survey presented in **Appendix B**, it can be seen that the highest level recorded was on the north-western corner of the site at 128.0m AOD. The site generally falls in a south- easterly direction with varying falls of between 1 in 150 to 1 in

25 at the steepest point, with an average fall across the site of 1 in 70. The lowest point recorded was on the south- eastern corner of the site at 111.5m AOD.

Figure 1.1 – Western Parcel Photographs

Eastern Parcel of the Site

1.10 The eastern part of the site is split into three cropped fields separated by mature hedgerows. A drainage ditch runs along the hedge forming the northern & western site boundary filed with nettles and weeds. An approximately 1.0m deep depression was observed just north of the centre filled with nettles and surrounded by trees. The depression may represent a former pond.

1.11 To the east of the site is the A43 dual carriageway with verge separating the site from the road. The north of the site is bounded by the single lane B4100 with a small farmer's gate entrance from the road. To the west the site is bounded by further agricultural fields. Finally on the southern boundary is a significant number of trees on a slightly elevated mound which then slopes down to a watercourse and Moto Cherwell Valley services.

1.12 From the Topographical Survey presented in **Appendix B**, it can be seen that the highest level recorded was on the north-western edge of the site at 117.0m AOD. The site generally falls in a south-easterly direction with varying falls of between 1 in 200 to 1 in 20 at the steepest point, with an average fall across the site of 1 in 65. The lowest point recorded was on the south-eastern corner of the site at 109.0m AOD.

Figure 1.2 – Eastern Parcel Photographs

PROPOSED DEVELOPMENT

1.13 The applications seeks outline planning permission (all matters reserved except for access) for the erection of buildings comprising Storage and Distribution (Use Class B8) and ancillary Office (Use Class E g(i) floorspace; associated infrastructure including electricity substation(s) and noise attenuation measures; construction of new site accesses from the B4100; creation of internal roads and access routes; hard and soft landscaping; and the diversion of an existing public right of way.

1.14 The proposed development is to be arranged across five development zones; as outlined on the Illustrative Masterplan below in Figure 1.3. The first three buildings are proposed on the west side of the A43, in the fields alongside the east of the M40. The other two buildings are proposed on the east side of the A43, just north of the motorway service station. Parameter Plans of the proposals are presented in **Appendix C**.

1.15 In addition to the 265,542m2 GIA of warehouse buildings, 1117 car parking spaces are proposed including disabled spaces and EV charging, delivery yards, dock levellers, soft landscaping, amenity space, SuDS features, and wastewater infrastructure is proposed. Currently there are no phasing plans for the development.

Figure 1.3 – Illustrative Masterplan

1.16 To access the western site, alterations to the B4100 are proposed to allow access into the new development. The current proposals look to provide a simple new roundabout junction as part of a S278 agreement and therefore it is intended that these works will eventually be adopted and maintained by the local highway authority. Flood risk and drainage relating to existing or proposed alterations to public highways are therefore scoped out of this assessment.

1.17 To access the eastern site, alterations to the B4100 and existing A43 roundabout are proposed to allow access into the new development and deal with increased traffic flows. The current proposals involve a slightly more complex new signal controlled junction as part of a S278 agreement and therefore will eventually be adopted and maintained by the local highway authority. Flood risk and drainage relating to existing or proposed alterations to public highways are therefore scoped out of this assessment.

1.18 As the planning application has developed with OCC throughout 2022 & 2023, it has become apparent that it is desirable for improved cyclist provisions traveling to and from Bicester along the B4100. A scheme is currently being developed to provide an off-highway cycle route where possible to improve cyclist safety along the 5km stretch. These works will ultimately increase impermeable area which may affect flood risk and drainage regime. While this is noted, these works are outside the scope of this report.

2 HYDROLOGY, HYDROGEOLOGY AND DRAINAGE

EXISTING WATERCOURSES

Main Rivers

2.1 According to the online Environment Agency (EA) Main River Map accessed in August 2021, the closest main river is the River Cherwell which is located 5.0km west of the site. The River Cherwell is a tributary of the River Thames. It rises near Hellidon, Northamptonshire and flows southwards for 64km to meet the Thames at Oxford in Oxfordshire. No changes are noted in updated revisions of this report.

2.2 The site is located within the Anglian River Basin District. The management catchment for the site is within the Ouse Upper and Bedford region. The operational catchment is within the Great Ouse Upper area.

Ordinary Watercourses

2.3 From the Environment Agency (EA) Catchment Data Explorer it can be seen that the site is located within the Padbury Brook catchment area. The Padbury Brook is located approximately 500m from the centre of the site. It reaches its closest point with the southern boundary of the eastern parcel of land where it passes parallel 35m south of the site. The Padbury Brook is a small tributary of the River Great Ouse. It rises near Fringford, Oxfordshire and flows eastwards for 26km to meet the River Great Ouse near Buckingham.

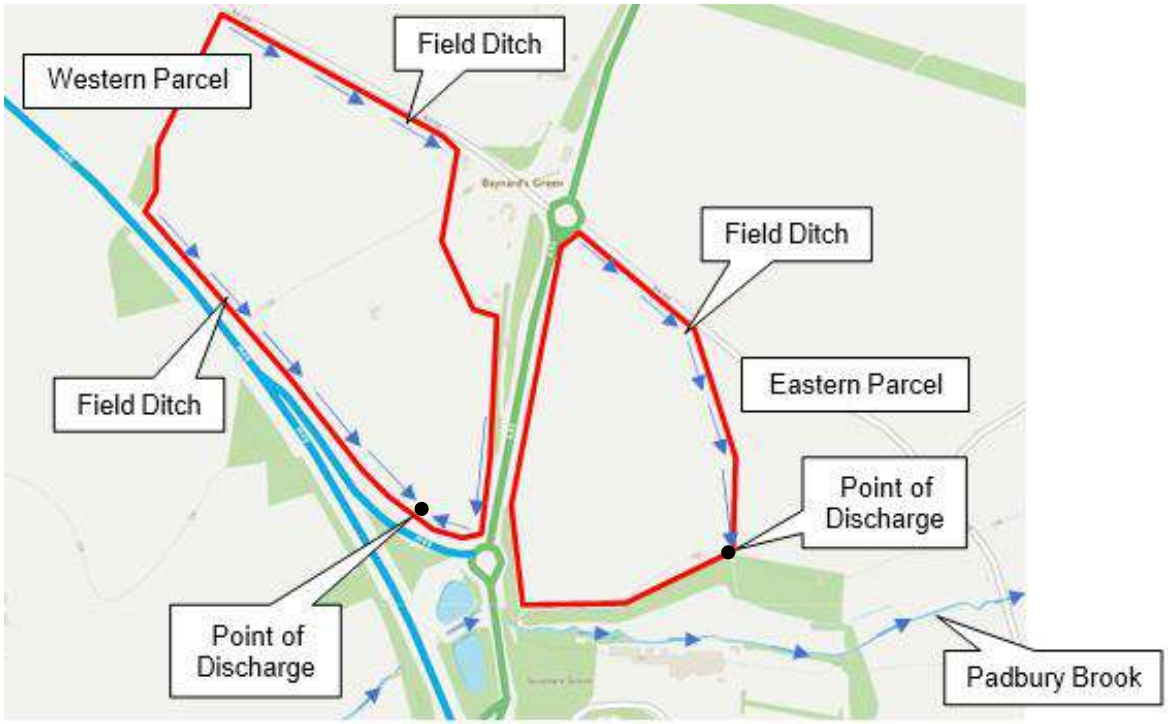


Figure 2.1 – Existing Watercourses

2.4 From the data collected and on-site inspections it appears that there are no formal drainage connections on either site to any main rivers, ordinary watercourses or tributaries. The existing regime outlined in Figure 2.1 indicates that, in most rainfall events surface water is discharged through either through direct ground infiltration or infiltration via field ditches. In heavy rainfall events, surface runoff flows in the direction of the natural slope of the land, in a south-easterly direction, to the potential discharge locations. On further inspection of discharge locations there was no evidence of any formal drainage.

HYDROLOGY

2.5 The nearest surface watercourse is the Padbury Brook which is located approximately 35m south of the site and flows to the east. The Environment Agency Chemical Quality Grade for this watercourse is 'A' (excellent).

According to the GroundSure report there are no surface water abstractions within 2km of the site. There are many licensed discharges within 500m of the site, the nearest one being 30m south of the site of emergency discharges from Cherwell Valley Services into the Padbury Brook. The majority of the other licensed discharges are for storm overflow. The Environment Agency web site indicates that the site lies outside of any flood zone.

HYDROGEOLOGY

2.6 According to the Environment Agency, the Alluvium is classified as a Secondary A Aquifer and the Head deposits as a secondary (undifferentiated) Aquifer. The White Limestone Formation is classified as a Principal Aquifer.

There are three groundwater abstractions within 500m of the centre of the site, the nearest being 146m northwest of the site for household (potable) use and for general farming use. The site is not located within a groundwater Source Protection Zone. The BGS suggest that there is potential for groundwater flooding at surface within 50m of the site. It is expected this relates to the Padbury Brook to the south of the site. Groundwater flooding at surface is considered unlikely across the main site area away from the Brook given existing levels.

GEOLOGY

2.7 An extensive physical examination of the ground was carried out in by Applied Geology in August 2021. The following fieldwork was undertaken:

- 156 No Machine Excavated Trial Pits to depths of between 0.50m and 2.90m bgl.
- 5 No Soakaway infiltration tests.

An initial layer of topsoil was generally encountered across the entire site with localised areas of underlying subsoil, all underlain in turn by the White Limestone Formation, which was found to be weathered in the upper horizons of the stratum. Limited Made Ground and Possible Made Ground was encountered in a couple of localised locations.

GROUNDWATER AND SOAKAWAY TESTS

2.8 Groundwater was encountered in just 15 of the 156 trial pits during excavations. The groundwater occurrence was sometimes observed as discrete seepages or inflows emanating from the sides or base of trial pits or sometimes simply as standing water in the base of the pits. The water table is closest to the surface in the southern most point on the western site where groundwater was encountered at 0.9m – 2.0m bgl.

3 No. Soakaway tests were undertaken on the western site and 2 No. on the eastern site as recorded in Table 2.1 and in **Appendix D**. There are some substantial variations due to the high degree of variability within the weathered rock horizons. The groundwater occurrence and soakaway test suggest variable ground infiltration rates and also some relatively shallow groundwater within the topographically lower areas of the site.

Table 2.1 – Summary of Soakaway Results

Soakaway Test Location	Invert level of Trial Pit (m AOD)	Soil Infiltration Rate (m/s)
North-Central of the Western Parcel	120.0	1.18E-04
South-Central of the Western Parcel	116.0	7.76E-04
South of the Western Parcel	111.5	7.00E-06
South of the Eastern Parcel	109.5	1.12E-03
East-Central of the Eastern Parcel	112.0	2.60E-05

EXISTING DRAINAGE

2.9 A detailed search was conducted to locate existing services using; the topographical survey data, Anglian Water Asset Location maps and Thames Water Asset Location maps. Details of the asset location maps are presented in **Appendix E**.

There are no known existing public storm, foul or effluent connections located on the site. A water main runs northwards under the A43 between the two parcels of land serving the current McDonalds's/Esso Garage at Baynard's Green Roundabout. All mains water services in this area are undertaken by Thames Water.

Two storm water balancing ponds bisect the Padbury Brook to the south of the site at Junction 10 of the M40. These are assumed to be owned and operated by either Highways England or the Oxford County Council and are likely used for storm water drainage attenuation and conveyance for the nearby road network.

The nearest Anglian Water adopted foul water pumping station is located 60m south of the eastern parcel at the Moto Cherwell Service station. Foul water is pumped from the service station approx. 650m, via a 100mm diameter pipe, directly to a wastewater treatment facility in Ardley. There is also a gravity foul system which serves the village of Ardley which is eventually pumped approx. 200m to the wastewater treatment facility.

3 FLOOD RISK ASSESSMENT

3.1 The table below identifies the potential sources of flood risk to the site, and the impacts which the development could have in the wider catchment prior to mitigation. These are discussed in greater detail in the forthcoming section. The mitigation measures proposed to address flood risk issues and ensure the development is appropriate for its location are discussed within **Section 4**.

Table 3.1 – Pre-Mitigation Sources of Flood Risk

Flood Source	Potential Risk				Description
	High	Medium	Low	None	
Fluvial/River/Sea				X	Located within Environment Agency River Flood Zone 1.
Groundwater			X		No recorded history of Groundwater flooding.
Canals				X	None present on or adjacent to site.
Reservoirs				X	The site is outside the zone of reservoir failure risk.
Sewers				X	None present on or adjacent to site.
Surface Water Runoff / Flows			X		Levels locally are shallow falls, significant exceedance runoff unlikely with infiltration
Effect of development on wider catchment			X		Increase in the number of impermeable surfaces such as roofs and yards

3.2 According to the Environment Agency Flood Map for Planning found in **Appendix F**, the site is located entirely within Flood Zone 1. The closest watercourse is the Padbury Brook which is located circa 30m south of the eastern parcel in Flood Zones 2&3. The existing levels of both parcels are significantly higher than the highest predicted flooding level making it virtually impossible to flood the site. The sea is located significantly away from the site and does not pose a risk to flooding.

The Environment Agency describes areas deemed to be in Flood Zone 1 as shown to be at less than 0.1% chance of flooding in any year, this is sometimes known as having a 1:1000-year chance. There are no recorded instances of the flooding from nearby rivers or watercourses. Therefore, the overall risk from fluvial flooding is very low to negligible.

FLOOD RISK FROM GROUNDWATER

3.3 Flooding from groundwater can happen when the level of water within the rock or soil underground – known as the water table – rises. Flooding from groundwater is most common in areas where the underlying bed rock is chalk, but it can also happen in locations with sand and gravel such as in river valleys.

From the trial pits conducted on the site, generally the ground water table is significantly below the topographical levels except on the southern boundary. The BGS suggest that there is potential for groundwater flooding at surface within 50m of the site. It is expected this relates to the Padbury Brook to the south of the site. Given that the site slopes away from the river and there are no records of flooding, groundwater flooding at surface is considered unlikely. Therefore, the overall risk from groundwater flooding is low.

FLOOD RISK FROM CANALS

3.4 The nearest canal is the Oxford Canal which runs adjacent to the River Cherwell approximately 5.0km west of the site. Due to the local topography and distance away from the overall risk from canal flooding is very low to negligible.

FLOOD RISK FROM RESERVOIRS AND WATERBODIES

3.5 Using the Environment Agency's online map for 'Flood Risk from Reservoirs – Flood Extents' it shows that the whole site is not within reservoir flooding extents. The nearest body of water approximately 200m(L) x 100m(W) is on Park Farm grounds, 1.25km north-east from the centre of the site. The lake outlets in a southern direction via a stream before eventual discharge into the Padbury Brook. Overall, the risk from reservoir flooding is very low to negligible.

FLOOD RISK FROM SEWERS

3.6 The local undertaker for foul drainage assets in the area is Anglian Water. Thames Water are responsible for mains water supply. There are no known public sewers located on or adjacent to the site. The B4100 is drained via infiltration verges and/or ditches on either side of the road and does not have sewers in the road. There are highway storm drains on the A43 Baynard's Green Roundabout between the sites. These sewers are well connected to local drainage infrastructure and overland flows would be naturally directed away from the site. Therefore, the overall risk from sewer flooding is very low to negligible.

FLOOD RISK FROM SURFACE WATER

3.7 Risk of flooding from surface water has been assessed using the Environment Agency mapping as shown in Figure 3.1. This shows existing flood potential which could occur when rainwater does not drain away through the normal drainage systems, discharge into rivers or soak into the ground. This can be problematic when water stands on the ground rather than flowing away. Surface water flooding is generally indicated at the low-point of local land forms.

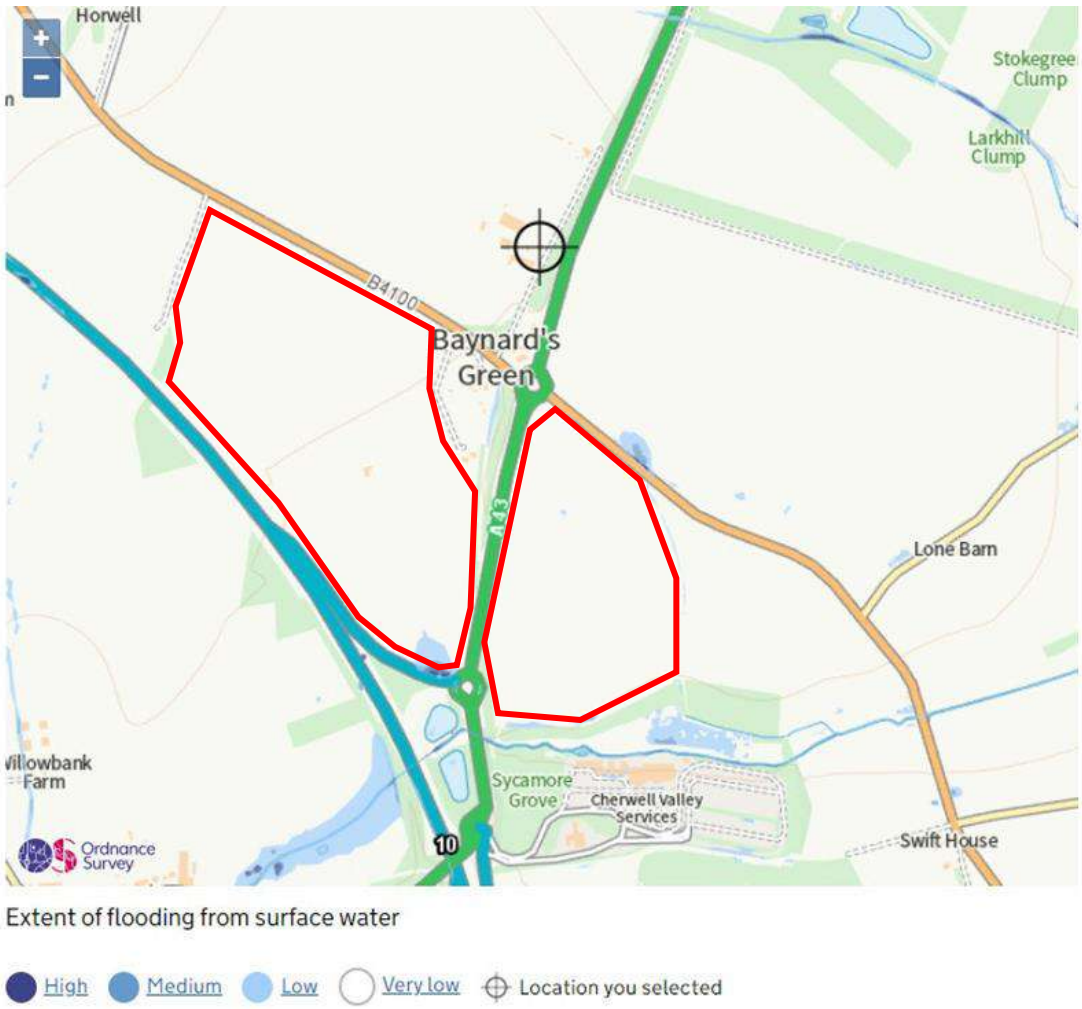


Figure 3.1 – Extent of flooding from Surface Water

3.8 Generally, there is very low risk throughout both parcels of surface water flooding as shown on the Environment Agency map above. There are two area of elevated risk at the natural low points to both parcels on the southern boundaries. These highlight some generally low-medium risk flooding with a very small area of medium-high risk in the western parcel. Therefore, the overall risk from surface water flooding is low.

FLOOD RISK TO THE WIDER CATCHMENT

3.9 From the FEH catchment data it can be seen that the wider catchment all currently drains naturally into Padbury Brook. There have been no recorded instances of flooding in the local area. The site is not located in a Critical Drainage Area (CDA). As the site is currently fairly close to the Padbury Brook the effect of the site on the wider catchment is minimal as overland flows could occur on a small section of the exit to Junction 10 M40 before eventual natural discharge.

3.10 Cherwell Valley Services are also well protected due to its significant elevation over the Padbury Brook. Downstream of the brook are agricultural fields which would not be sensitive to variations in flood levels. Overall, the risk to the wider catchment is low.

4 FLOOD RISK MITIGATION

4.1 This section of the FRA & Drainage Assessment provides an overview of the potential mitigation measures available to address flood risk issues at the development site. The measures listed below are suggested items which could reduce flood risk but are not limited to just these measures. Further measures may come to light later as different stages of the project proceed and flood risk changes over time.

RAISED THRESOLDS

4.2 One method of reducing flood risk is to raise the floor level of buildings and thresholds to above predicted water levels. Generally, car parking and utility areas should be located at lower levels so that failure of storm water systems can store water first. It is current good practice that thresholds to buildings are located at a minimum freeboard of 300-600mm above the 100-year + climate change (CC) design water level in all storm water and river flooding events.

SAFE ACCESS AND EGRESS

4.3 Access roads must remain operational during times of flood. This is to allow occupants of buildings to be able to escape and for maintenance vehicles to access the site. As part of a potential evacuation procedure, alternative locations where cars & HGV's can be parked during a flood event should be identified.

OVERLAND FLOWS

4.4 The drainage system must be designed to accommodate overland flow from adjacent land if this is likely to be intercepted or affected by the development. All development must clearly identify surface water from adjacent land has been considered appropriately and mitigation measures employed to prevent flood risk.

IMPLEMENTATION OF SUDS

4.5 Within true SuDS, rainwater is dealt with close to where it falls (at source), allowing as much water as possible to either evaporate or soak into the ground. The majority of SuDS components provide larger storage volumes than traditional drainage systems. Therefore, these systems will only become overloaded by events occurring over a longer duration, which generally means that "failure" results in less impact.

Flood risk is managed by SuDS reducing the volume, frequency, and flow rate of surface water runoff during extreme events. Exceedance can be managed, with components and schemes "failing gracefully" and in many circumstances they can be visually monitored. The benefits of SuDS on flooding include; better flood water management, easier to maintain, groundwater recharge, treating wastewater and biodiversity and ecology gain.

POLLUTION PREVENTION

4.6 Developments involving industrial processes which involve the use of potentially polluting substances (fuels, chemicals etc) should be designed in a way that these substances will not enter the water environment during a flood, preferably though designing the development such that these chemicals are stored and used outside the flood zone risk. The use of petrol interceptors for all the car parks and delivery yards is recommended to mitigate the risk of accidental spillage which damages water quality.

TREE PLANTING

4.7 Trees reduce flood risk from the top to bottom. Rain droplets that land on leaves evaporate straight into the air- so less water reaches the ground. Leaves intercept rainfall, slowing the rate that water flows into rivers and reducing the risk it'll burst its banks.
The roots of a tree are also important. They create small drainage paths in the soil as they grow, so when it rains water flows into those instead of flowing straight into the river.

The roots also act as a net to hold the soil in place and stop it washing into a river. That can be a problem because the more soil on a riverbed, the less space for water, which means the river is more likely to flood in heavy rainfall. In addition, allocating space for trees and soft landscaping reduces the impermeable area on the site, therefore reducing runoff volume and surface water flooding potential.

MANAGEMENT AND MAINTENANCE

4.8 One of the biggest causes of flooding is incorrect management and maintenance of drainage features and infrastructure. Effective and sustainable surface water runoff management should be considered from the outset and integrated throughout the development. Although specific development information may be limited at outline planning stage, the proposals will still need to consider, and make a commitment to, the requirements outlined by Oxfordshire County Council SuDS guidance.

RESIDUAL RISK AND EXCEEDANCE

4.9 Residual risk is the risk that remains after mitigation actions have been taken. As well as the consideration of the hydraulic modelled events undertaken in the drainage assessment, there should be a qualitative examination of what would happen if any part of the system fails, demonstrate that flood water will have flow routes through the site without endangering property and where possible maintaining emergency access/egress routes.

5 SURFACE WATER DRAINAGE STRATEGY

5.1 This assessment has been carried out in compliance with, Cherwell Local Plan 2011-2031, Oxfordshire County Council SuDS design guidance, the SuDS Manual C753 and NPPF. The site is considered a major development as the development exceeds over a hectare in size. The site is not within a critical drainage area and is within Flood Zone 1.

5.2 A Drainage Strategy is a specific requirement set by the LLFA for all major applications in Oxfordshire. This Drainage Strategy will ensure industry best practice is applied to the drainage design for this major development and includes information on the outline design, management, and maintenance of surface water management systems. The main development is not currently expected to be phased.

STRATEGIC AIMS & OBJECTIVES (SWM)

5.3.1 The first stage of the SuDS design process is setting of the strategic surface water management (SWM) objectives for the development. Consultation with relevant stakeholders such as Cherwell District Council, Oxfordshire County Council, Sewage undertakers and local residents has been established to inform the design. The relevant Policies of Stakeholders are followed in an Approach.

5.3.2 Flood Risk Management Objectives

Some of the site-specific strategic flood risk management objectives, with reference to Policy ESD6 – Sustainable Flood Risk Management, are as follows:

- Development should be safe and remain operational (where necessary) and proposals should demonstrate that surface water will be managed effectively on site and that the development will not increase flood risk elsewhere, including sewer flooding.

- Site specific flood risk assessments will be required to accompany development proposals where the proposals are of 1 hectare or more located in flood zone 1. Flood risk assessments should assess all sources of flood risk and demonstrate:

    - There will be no increase in surface water discharge rates or volumes during storm events up to and including the 1 in 100-year storm event with an allowance for climate change (the design storm event).

    - Developments will not flood from surface water up to and including the design storm event or any surface water flooding beyond the 1 in 30-year storm event, up to and including the design storm event will be safely contained on site.

- Building over or culverting of watercourses should be avoided and the removal of existing culverts will be encouraged.

SUDS MANAGEMENT TRAIN

5.4 The SuDS management train has been adopted in the outline design process as follows:

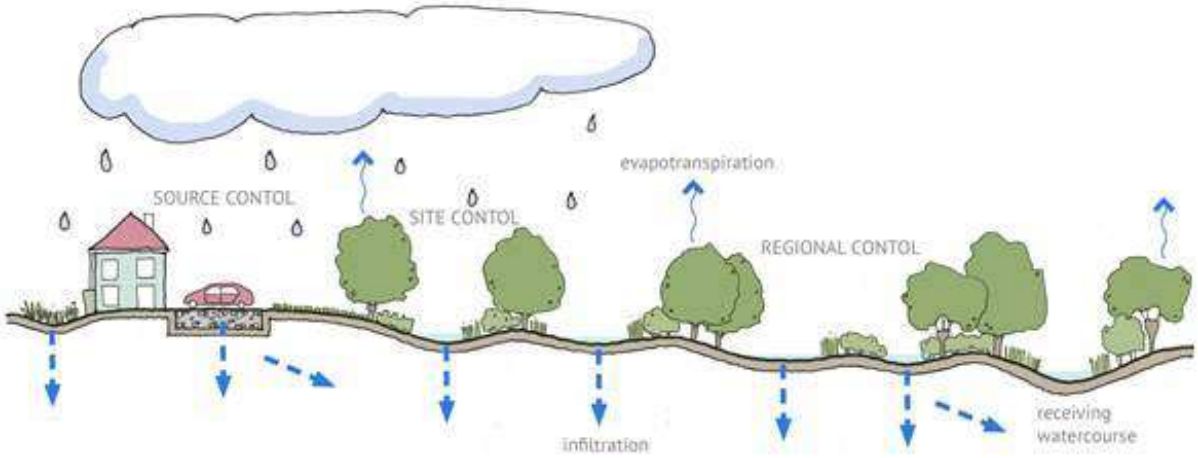


Figure 5.1 – Susdrain SUDS Management Train

1) **Prevention** - Prevention of runoff by good site design, reduction of impermeable areas and good housekeeping measures for reducing pollution.

2) **Source Control** - Dealing with water where and when it falls at source. By dealing with runoff at source the volume of water and the potential amount of contamination is less, which requires smaller SuDS components further downstream (e.g., infiltration techniques).

3) **Site Control** - The management train concept promotes division of the area to be drained into sub-catchments with different drainage characteristics and appropriate SuDS features (e.g., soakaways, swales, basins)

4) **Regional Control** - Management of runoff for the region with consideration of the whole hydrological cycle (e.g., balancing ponds, wetlands).

DRAINAGE HIERACHY & POINTS OF DISCHARGE

5.5 The second stage of the SuDS design process is conceptual design. The key outcome of this stage is to identify and assess potential SuDS components and linkages, in developing management trains for each area of the site. This step has two elements:

- Developing an understanding of the existing features on site that could influence SuDS design such as, topography, discharge points, flow routes etc…
- Developing an understanding of relevant features of the proposed development that could influence SuDS design criteria and design options.

Proposed Discharge Hierarchy

5.6.1 All sites must manage surface water via the following hierarchy:

When managing rainfall, the SuDS network should be designed to match natural drainage routes, infiltration rates and discharge rates as far as possible. In addition to this, with concern over climate change and increasing risk of water scarcity, re-use of rainwater wherever possible should be utilised. Therefore, in accordance with the drainage hierarchy contained in Approved Document H of the Building Regulations, Planning Practice Guidance and the need to mitigate against water scarcity, all surface water run off must aim to be discharged as high up the following hierarchy as possible:

- Firstly, to infiltration/soakaway
- Secondly, to a watercourse or highway ditch (with permission)
- Thirdly, to a surface water sewer or highway drain (with permission)
- Lastly, to a combined sewer (with permission)

5.6.2 From the BRE365 infiltration tests conducted across the site it was observed that variable infiltration is expected with rates for the western section ranging between 7×10^{-4} m/s and 7×10^{-6} m/s and in the eastern section ranging between 1×10^{-3} m/s and 2×10^{-5} m/s. The results of preliminary soakaway testing suggest that infiltration will be suitable for this site, however further localised testing will need to be undertaken at detailed design stage. A drainage design is to be prepared on an 'infiltration only' basis in the first instance.

5.6.3 When a significant portion of the site is to be infiltrated, particularly for large sites, it is prudent to provide an alternative drainage design option and agreed points of discharge should infiltration prove to be unsuitable. Given that no main rivers, watercourses or tributaries have been identified on the site then the next option would be to look at potential points of discharge which could potentially connected to watercourses.

Alternative Points of Discharge

5.7.1 Site contours from the topographical survey indicate that limited flow paths naturally occur on both parcels of the site. During heavy rainfall, when infiltration potential is saturated, modest overland flows are generated across the site in a south-easterly direction. These have been outlined below indicated by light blue arrows on **Figure 5.2**. Furthermore, runoff is directed to natural low points on the southern boundaries of both the western and eastern parcels of land. These appear to be appropriate discharge locations for potential future outlets from the site if they were required.

5.7.2 At the lowest points of the western and eastern parcels in existing ditches, it seems that the existing flows become subterranean and form connectivity to Padbury Brook. At both of these points, and subject to the final design, the outflows would be restricted to Greenfield flow rates to avoid increasing flood risk to others.

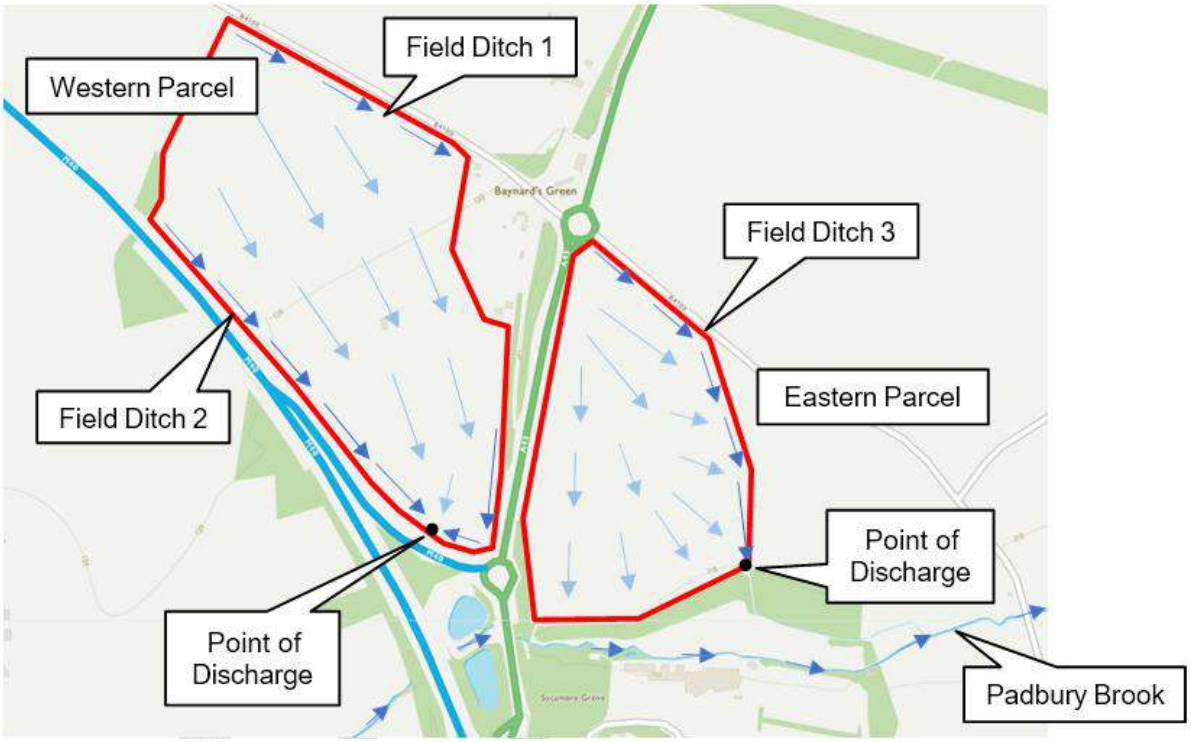


Figure 5.2 – Existing Drainage Flow Paths

Greenfield Runoff Calculations

5.8 An assessment of the existing greenfield rates for each parcel of land has been carried out using the HR Wallingford greenfield runoff estimation tool (Institute of Hydrology IoH124 method). Given that permeability throughout both parcels is variable and topographically there are good to moderate falls, the default SOIL class of 1 appears to be appropriate. The latest SAAR from FEH13 data as been provided as 675mm. When Q_{BAR} < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha. Calculations are presented in **Appendix G** and are summarised in Table 5.1 and 5.2 below:

Table 5.1 – Greenfield runoff rates for the western parcel

Return Period (Years)	Peak Flow (Q)	
	(l/sec)	(l/sec/ha)
Q_{BAR}	7	0.161
1 in 1 year	5.95	0.137
1 in 30 year	16.11	0.370
1 in 100 year	22.32	0.505

Table 5.2 – Greenfield runoff rates for the eastern parcel

Return Period (Years)	Peak Flow (Q)	
	(l/sec)	(l/sec/ha)
Q_{BAR}	3.74	0.161
1 in 1 year	3.17	0.137
1 in 30 year	8.59	0.370
1 in 100 year	11.71	0.505

ASSESSMENT OF SUDS FEATURES

5.9 Given that the site is to be predominantly developed by warehouse type buildings, delivery yards, car parks, footpaths and soft landscaping, the following features, in paragraphs 5.9.1 to 5.9.9 have been considered in concept design:

5.9.1 It is desirable on all sites in the UK, in the first instance that SuDS infiltration systems are considered, to reduce impermeable hard standing and treat run-off at source. Given that the site is underlain White Limestone Formation and that the groundwater table is expected to be of significant depth below ground level then infiltration features have been considered.

Infiltration Basins are flat bottomed, shallow landscape depressions which provide a vegetated channel for the conveyance and storage of surface water. A typical infiltration basin is provided in Figure 5.3. Shallow and variable side slopes to suit landscape design (typically 1:3 max) will encourage growth of grass and increase biodiversity locally.

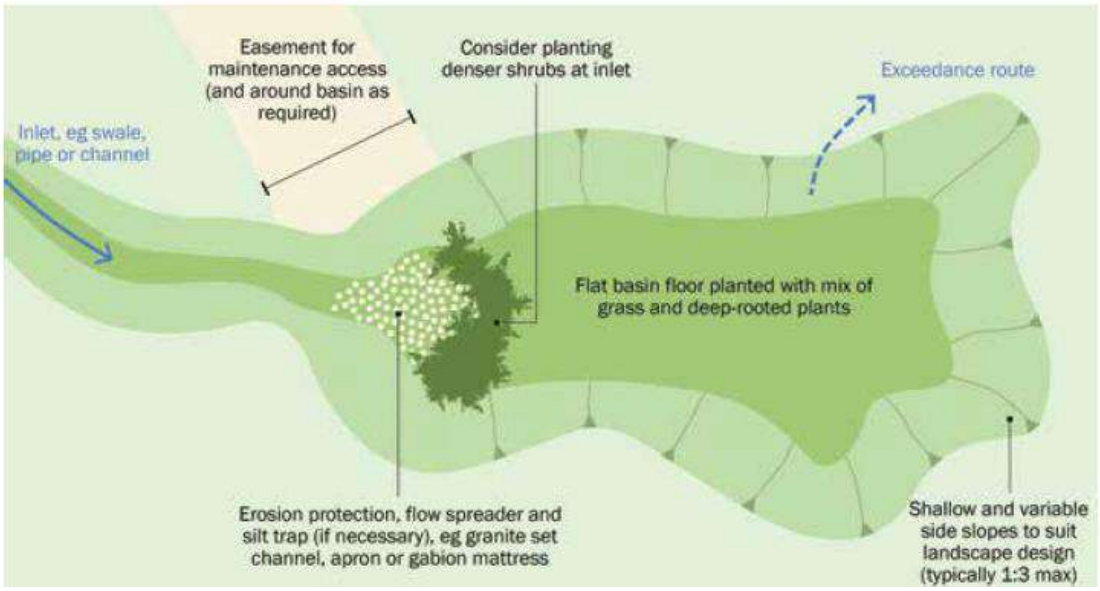


Figure 5.3 – Plan View of Typical Infiltration Basin

5.9.2 At headwall inlet and outlet positions it is suggested erosion protection such as stones set into concrete are introduced to reduce flows and lessen topsoil erosion. Alternatively, swales can be fitted with an underdrain to convey water out of the feature without the need for headwalls. These can be harder to maintain and often become blocked. Exceedance overflow pipes or routes should be provided ideally to a nearby watercourse.

5.9.3 Swales come in two forms either, ‘Dry Swales’ or ‘Wet Swales’. Dry swales could be used on this site to filter runoff to an acceptable level and improving water quality. The top layer of topsoil works like a treatment layer to remove contamination from water. Wet swales can be used to further increase biodiversity offering marshy conditions for a variety of different species. Underdrains can provide additional treatment and conveyance capacity beneath the bases of swales. Nominal longitudinal falls within the swales will prevent ponding of water resulting in reduced maintenance costs and increased performance.

5.9.4 Pervious Pavement systems have been considered for this site in order to reduce impermeable area in line with the SuDS management train. Permeable paving is not considered appropriate in yards which regularly traffic HGV's however, there is an opportunity in car park areas.

Where infiltration is possible a 'Type A' system is to be utilised. This reflects a system where all the rainfall passes into the substructure (where it may be stored temporarily) from where it infiltrates into the soil beneath. Normally, there will be no discharge from the system to a sewer or watercourse. However, an emergency overflow may be required to cater for events in excess of the design event.

5.9.5 Heavy duty line drains with catchpits inspection chambers are recommended in the yards to meet the load requirements of HGV wheels and for easy maintenance. These features can easily be maintained to keep them free of silt and other potential contaminates over the design life. As only light contamination is expected, a class 1 by-pass petrol interceptor is recommended for flows generated in the yards to increase water quality to acceptable levels before discharge into the site and wider-site drainage systems.

5.9.6 Efforts have been made to reduce impermeable area on the site, using permeable paving systems where possible as well significant soft landscaping and ecological buffers. Petrol interceptors are advised to all yards to improve water quality discharge into the wider site. We believe that the SuDS components presented above meet the criteria set out by Oxfordshire County Council (LLFA) and Cherwell District Council (LPA). A landscaping strategy has been developed to increase biodiversity within the Soft Landscaping Zones of this site.

5.9.7 The use of Filter Strips or Filter Drains is not considered appropriate for this site due to the likelihood of HGV's regularly trafficking the yards. The run-off generated from this site is to be collected by a heavy-duty line drain and treated by petrol interceptors before discharge. The construction of gently sloping landscaped areas to drain run-off was not considered practical on this site. If spillages did occur, they could cause contamination issues in surrounding areas.

5.9.8 This site is to be used predominantly for industrial storage facilities. Rainwater Harvesting Systems were not considered on this site due to the buildings low water demand and significant increase in maintenance cost. The height to the roof ridge could be up to 20m in most some cases. Green Roofs are deemed to present an unacceptable risk to those maintaining the SuDS feature for this site. Access to the roof is to be provided for emergency roof maintenance only.

5.9.9 Attenuation Tanks should be avoided on this site where possible. There are multiple suitable alternatives presented above to putting additional plastic in the ground. Geocellular tanks especially can be hard to maintain and do not provide any ecological value on this site. The only reason they might be necessary is if poor infiltration is identified in a sub catchment and additional storage volume is necessary.

WATER QUALITY ASSESSMENT

5.10 A Water Quality Assessment (WQA) has been undertaken below to assess the potential hazards from the site and the appropriateness of the SuDS features considered. The 'Simple Index Approach' from The SuDS Manual is used as follows:

Step 1 – Define Pollution Hazard Indices

5.10.1 An assessment has been undertaken in Table 5.3 to define the potential level of hazard from different drained surfaces within the proposed development.

Table 5.3 – Pollution Hazard indices for different drained areas

Land use	Pollution hazard level	Total suspended solids (TSS)	Metals	Hydro-carbons
Typical Industrial Roof	Low	0.3	0.3	0.05
Non-residential car parking e.g. offices	Low	0.5	0.4	0.4
Commercial Yard and Delivery Area with Parking	Medium	0.7	0.6	0.7
Sites with lorry parks and approaches to industrial estates	High	0.8	0.8	0.9

Note: The indices range from 0 (no pollution hazard) to 1 (high pollution hazard).

Step 2 – Determine SuDS Pollution Mitigation Indices

5.10.2 To deliver adequate treatment, the selected SuDS components should have a total pollution mitigation index (for each contaminant type) that equals or exceeds the pollution hazard index (for each contaminant type):

Total SuDS mitigation index ≥ *Pollution Hazard Index*
(for each contaminant type) (for each contaminant type)

Where the only destination of the runoff is to surface water – that is there is no infiltration from the SuDS to the groundwater – the surface water indices should be used. Where the principal destination of the runoff is to groundwater, but discharges to surface waters may occur once the infiltration capacity is exceeded, the groundwater indices should be used. The risk to surface waters will be low, as dilution will be high for large events, so treatment is not required. Table 5.4 below indicates the mitigation indices of SuDS features used to discharge groundwater.

Table 5.4 – Indicative SuDS mitigation indices for discharges to groundwater

Characteristics of the material overlaying the proposed infiltration surface, through which the runoff percolates	TSS	Metals	Hydrocarbons
A soil with good contaminant attenuation potential of at least 300mm in depth	0.4	0.3	0.3
A layer of dense vegetation underlain by a soil with a good contaminant attenuation potential of at least 300mm in depth	0.6	0.5	0.6
Constructed permeable pavement (where suitable filtration layer is included that provides treatment, and including a geotextile at the base separating the foundation from the subgrade) underlain by a soil with good contaminant attenuation potential of at least 300mm in depth	0.7	0.6	0.7
Proprietary treatment systems	To be assessed on the individual merit for compliance with individual contributing drainage areas up to the 1 in 1-year return period.		

Note: The indices range from 0 (no pollution treatment) to 1 (high pollution treatment).

Step 3 – Conclusions and Recommendations

5.10.3 For roof water drainage it is suggested that flows from this surface type are directed to any of the SuDS options available. Generally, low contamination is expected from the roof and therefore all proposed SuDS solutions satisfy the water quality requirements. It would be preferential to outlet into an open feature so that if any small wildlife became trapped in the system they would be able to escape more easily.

5.10.4 Permeable paving is an option within the car parking areas. In terms of water quality, it is completely satisfied for water quality indices due to the nature of runoff filtering through the open graded stone. Thereafter, it gets a second layer of filtration as it moves into the appropriate soil. Permeable paving would be highly recommended in the car parks as it would also reduce the impermeable area of the site and mimic existing drainage.

5.10.5 Surface water generated by yards and delivery areas is considered a 'Medium' water pollution hazard from Table 5.2. Runoff generated in these areas would not be adequately treated by infiltration basins or swales alone. As a result, a petrol interceptor has been specified to treat runoff to acceptable EA standard levels for each unit. This approach is considered adequate to treat runoff, subject to implementation of a certified petrol interceptors.

5.10.6 As proposals are at outline stage and details or end user requirements remain unclear an assessment has been made based on moderate industrial use at the development. Multiple features benefiting water quality like Permeable paving, Swales and Infiltration Basins have been considered for this site. If these SuDS features were adopted in detailed design then water quality would be discharged at an acceptable quality.

SURFACE WATER DRAINAGE PROPOSALS

5.11 The concept surface water drainage strategy has been prepared based on the proposed Site Layout in line with Oxfordshire County Council's (LLFA) guidance for Surface Water Drainage, together with national guidance and industry best practice. The drainage strategy is summarised below based on this and explanation is provided for sub-catchments allocation, impermeable drained areas, potential discharge strategy, greenfield runoff rates, infiltration rates for design, storage volume estimates and SuDS features application.

The proposed concept drainage & external works schemes are presented by Bailey Johnson Hayes in **Appendix H**. The following SuDS features shown on **Figure 5.4**:

- Swales
- Infiltration Basins
- Permeable Paving
- Petrol Interceptors
- Catchpits, Gullies and Line Drains
- Flows control devices

Figure 5.4 – Extract of Concept Drainage Scheme

Sub-Catchments and Impermeable Areas

5.12 The site has been split into three defined sub-catchments with the approximate quantities of impermeable area for each sub-catchment defined in **Table 5.5** below and illustrated in Figure 5.4 above.

Table 5.5 – Summary of Approximate Impermeable Areas

Sub-Catchment Area	Impervious Area Prior to Development	Positively Drained Area Development	Impermeable Area Post Development
Unit 1 - Western Parcel	0 m^2	185,000 m^2	155,000 m^2
Unit 2&3 - Western Parcel	0 m^2	200,000 m^2	170,000 m^2
Unit 4&5 - Eastern Parcel	0 m^2	215,000 m^2	185,000 m^2
Total	0 m^2	600,000 m^2	510,000 m^2

5.13 Impermeable areas have been calculated inclusive of buildings, yards and roads contributing 100% of their gross area plus a 30% contribution from soft landscaping. Permeable car parks are considered self-draining therefore excluded. An allowance of 10% for urban creep has not been included as this site is commercial and therefore not required. There are no areas of significant public open space.

Non-Technical Drainage Summary

5.14 In the Unit 1 catchment area, the building is located at the lower part of the western plot close to the M40 / A43 with a floor level of 118.0m AOD. A series of swales on the western boundary will direct flows to a large infiltration basin in the south of the catchment. Permeable paving in the carparks will discharge flows directly into the ground and designed to provide additional storage volume if required. The infiltration basin to the south will be designed to accommodate runoff from the Unit 1 catchment, as well limited overflows from the Units 2 & 3 catchment.

5.15 In the Units 2 & 3 catchment area, buildings are located to the higher part of the western plot close to the B4100 with floor levels of 122.0m & 124.0mAOD respectfully. A series of swales on the southern catchment boundary will direct flows to an infiltration basin in the south-west of the catchment. Permeable paving in the carparks will discharge flows directly into the ground and designed to provide additional storage volume if required. An agreed SW overflow from this area has a proposed limit of 35 l/s; which will be taken into the much lower Unit 1 catchment drainage system.

5.16 In the sub-catchment for Units 4 & 5, buildings are located at floor levels of 115.0m and 114.0m AOD. Ground conditions across this plot remain similar with variable potential for pure soakaways. Again, a ‘Infiltration’ approach is proposed with a system of large swales/basins to convey and discharge runoff directly into the ground. Permeable paving in the carparks will discharge flows directly into the ground and designed to provide additional storage volume if required. The runoff in an exceedance event could discharge to local ditches and then to the Padbury Brook.

5.17 The existing road network and the proposed S278 roadworks on both parcels could be drained into infiltration basins, swales or local diches at restricted greenfield rates in a separate system. The final solution will need to be agreed with the Local Authority and County Council. The site has not previously been developed so there are no brownfield flows to be considered on this site.

Proposed External Finishes

5.18 The yards are to be constructed from normal reinforced concrete and therefore are considered non-porous hard standing. These are drained traditionally either via slotted Line Drains, Kerb Drains and road gully's. Each Line/Kerb drain will drain via a catch pit and petrol interceptor before discharge into the wider site drainage system to ensure the satisfactory water quality is achieved.

5.19 All dedicated car parking areas are to be drained by a permeable paving solution. This could take the form of block paving over a permeable stone subgrade constructed on suitable competent formation. This would then allow all flows to drain naturally into the underlaying groundwater table. The commercial building roofs are to be drained via traditional roof gutters or syphonic drain into gravity rainwater pipes. These then feed into larger underground surface water sewers before discharge into the wider drainage system.

Local Habitats and Biodiversity

5.20 Due to the large size of the site, a biodiversity assessment is currently being undertaken to establish areas of that site that are to be protected. It is expected that around the perimeter of the sites where large trees, bushes and hedgerows exist, these areas will need to be protected. Potential SuDS features will need to be located to minimise disturbance in the local area. Existing ditches are to be retained where possible.

5.21 Green buffer zones for new trees are expected in order to provide more local wildlife and to screen the development from the adjacent A43 and M40 roads. Full details of the proposals will be reflected at detailed design stage.

Maintenance and Management

5.22 The site is currently the sole responsibility of the owner of the site. During the construction phase, management & maintenance of the partially developed site will be passed over to the appointed contractor. They will complete their own temporary surface water drainage strategy before construction begins.

5.23 At handover of the project the owner of the site is intending to appoint a managing agent for maintenance of all drainage infrastructure and landscaping. They will provide all future tenants or owners with details of the appointment management company and maintenance regimes. All drainage on site is to remain private and currently not seeking adoption. Specific requirements for maintenance of SuDS features are to be outlined in the reserved matters application at detailed design stage.

STORAGE VOLUMES

5.24 Preliminary sizing of infiltration storage features is based on the three catchments outlined in Table 5.5. Calculation have been completed for the 1% (1 in 100-year) event + climate change. The latest climate change allowances for the 2070s Epoch (50 year design life) indicates a maximum allowance of 40%. Calculations have been carried out using a reduced infiltration rate based on the lowest recorded soakaway results. Calculations have been undertaken using the WinDes Quick Storage Estimate tool.

Preliminary Sizing Parameters and Storage Volume Estimates

5.25 In line with the current best practice, all calculations undertaken for preliminary sizing of drainage attenuation and infiltration features has been undertaken using the latest FEH datasets for rainfall for critical storms up to 60 mins. Where critical duration of storms are less than 60 mins then FSR rainfall data shall be used. The infiltration rate has been conservatively taken as 50% of the lowest recorded result for each catchment.

5.26 A coefficient of runoff (C_v) for both summer and winter storms has been selected as 0.9 which represents 90% of the impermeable area contributing to the drainage system. This is normal practice as a small amount runoff is expected to be intercepted or evaporate.

5.27 A factor of safety of 5 has been selected for all preliminary storage estimates. This is in line with guidance from CIRIA SuDS manual which describes that infiltration systems that are at risk to causing flooding to the development or surrounding areas on sites larger than 1 ha should use an allowance of 5 rather than 1.5 – 3.

5.28 A summary of results including assumptions are presented below. Full details of the calculation result are presented in **Appendix J** and summarised in Table 5.6 below.

Table 5.6 – Summary of Estimated Storage Volumes

Sub-Catchment Area	Impermeable Area (ha)	Infiltration rate (m/hr)	Storage Volumes (m^3)
Unit 1 - Western Parcel	15.5 ha	0.0125 m/hr	9745 – 20939 m^3
Unit 2&3 - Western Parcel	17.0 ha	0.2160 m/hr	5294 – 13518 m^3
Unit 4&5 - Eastern Parcel	18.5 ha	0.0470 m/hr	8442 – 20113 m^3

Expected Storage Depths

5.28 From the concept drainage layout the following areas has been allocated to infiltration basins and swales; Unit 1 – 15,000m^2, Unit 2&3 – 8,000m^2 and Unit 4&5 – 13,000m^2.

Based on the concept scheme the expected maximum depths in SuDS features would be between 0.65 – 1.7m for all catchments. This demonstrates that there is satisfactory allocation of space for appropriate SuDS features. In detailed design stage there could be further efficiency achieved with further localised soakaway testing.

6 FOUL WATER DRAINAGE ASSESSMENT

EXISTING LOCAL DRAINAGE

6.1 There are no known existing public foul or effluent connections located on the site. The nearest Anglian Water adopted foul water pumping station is located 60m south of the eastern parcel at the Moto Cherwell Service station. Foul water is pumped from the service station approx. 650m east, via a 100mm diameter pipe, directly to a wastewater treatment facility in Ardley. There is also a gravity foul system which serves the village of Ardley which is eventually pumped approx. 200m to the wastewater treatment facility.

FOUL WATER DRAINAGE OPTIONS

6.2 There remains a number of viable options which will need detailed and extensive discussions and assessments to find the final solution. Outlined below are some of the preliminary viable options for discharge of foul flows generated on the site. An assessment of anticipated foul flows will be provided at detailed design stage.

Option 1 – Gravity or pumped discharge to existing Wastewater Treatment Works

6.2.1 The eastern and western parcels of land would need their own private on-site drainage to convey flows away from the building. Flows would then either be pumped or gravity fed to the nearby treatment works 500-750m away under the M40 motorway near Ardley. Flows would discharge into a receiving manhole before final gravity connection into the treatment works. This option would be subject to agreement from Anglian Water subject to sufficient capacity and agreement to build over 3rd Party Land.

Option 2 – Off-Mains Private Wastewater Treatment Works

6.2.2 The eastern and western parcel of land would need their own private waste treatment tank. All foul flows would be conveyed on site using a gravity system to the new treatment tank on-site. Sludge is built up and needs to be emptied regularly but this system has the benefit of potential discharge of acceptable treated effluent which can outlet into a soakaway type water system, reducing maintenance costs.

Option 3 – Upgrade of Local Public Wastewater Infrastructure

6.2.3 Given that there could be significant development in the near future in the Baynard's Green area, it is possible that a purpose-built facility for the local area could be constructed, or upgrades provided to the existing Ardley treatment works, that could 'unlock' this area for future development. A potential gravity foul outlet could be provided to each of the potential development sites. This option would be subject to discussions with Anglian Water and local developers to ensure funding would be available in the near future for this type of expansion.

7 CONCLUSIONS AND RECOMMENDATIONS

Flood Zone

7.1 The Environment Agency mapping shows that the whole site is within Flood Zone 1 which is shown to be at less than 0.1% chance of flooding in any year, otherwise known as having a 1:1000-year chance. There are no recorded instances of the flooding from nearby rivers or watercourses.

Fluvial Flooding

7.2 The risk from Fluvial flooding is Very Low to Negligible as described in Section 3.2.

Groundwater Flooding

7.3 The risk from Groundwater flooding is Low as described in Section 3.3.

Canal Flooding

7.4 The risk from Canal flooding is Very Low to Negligible as described in Section 3.4.

Reservoir & Waterbody Flooding

7.5 The risk from Reservoir and Waterbody flooding is Very Low to Negligible as described in Section 3.5.

Sewer Flooding

7.6 The risk from Sewer flooding is Very Low to Negligible as described in Section 3.6.

Surface Water Flooding

7.7 The risk from Surface Water flooding is Low as described in Section 3.7.

Flood Risk to the Wider Catchment

7.8 The flood risk to the wider catchment flooding is Low as described in Section 3.8.

Proposed Flood Mitigation

7.9 An overview of the potential mitigation measures available to address flood risk issues at the development site is provided in Section 4. More measures may become available as the scheme moves into detailed design phase.

7.10 Some of the proposals included are; Raising thresholds and building levels outside of design flood levels, providing safe access and egress around the development, directing overland flows towards areas of low risk, implementation of SuDS to manage runoff at

sources thus reducing flood volume, installation of pollution prevention features to prevent contamination at discharge locations, tree planting to increase biodiversity and absorption of water, management and maintenance to ensure correct operation of all drainage systems and managing residual risks post development.

Discharge Hierarchy

7.11 The results of preliminary soakaway testing suggest that infiltration will be suitable for this site, however further localised testing will need to be undertaken at detailed design stage. A drainage design has been prepared on an 'infiltration only' basis in the first instance. In case that infiltration becomes unfeasible an alternative strategy to discharge to the Padbury Brook at greenfield rates is feasible but requires 3rd party land agreement.

Proposed SuDS Features

7.12 The following SuDS features are recommended from the SuDS and Water Quality Assessment:

- Swales
- Infiltration Basins
- Permeable Paving
- Petrol Interceptors
- Catchpits, Gullies and Line Drains
- Flows control devices

Proposed Surface Water Drainage Strategy

7.13 The western and eastern parcels of land have been split into three distinct catchments know as; Unit 1, Unit 2&3 and Unit 4&5. For all catchments, a series of swales direct flows to infiltration basins transferring discharge into the ground throughout. Permeable paving in the carparks will discharge flows directly into the ground.

Proposed Foul Drainage Strategy

7.14 There remains a number of viable options which will need detailed and extensive discussions and assessments to find the final solution, outside the scope of this assessment. Three viable options for discharge have been described such as; pumping to a local treatment works, on-site treatment, and discharge to new or upgraded foul wastewater infrastructure.

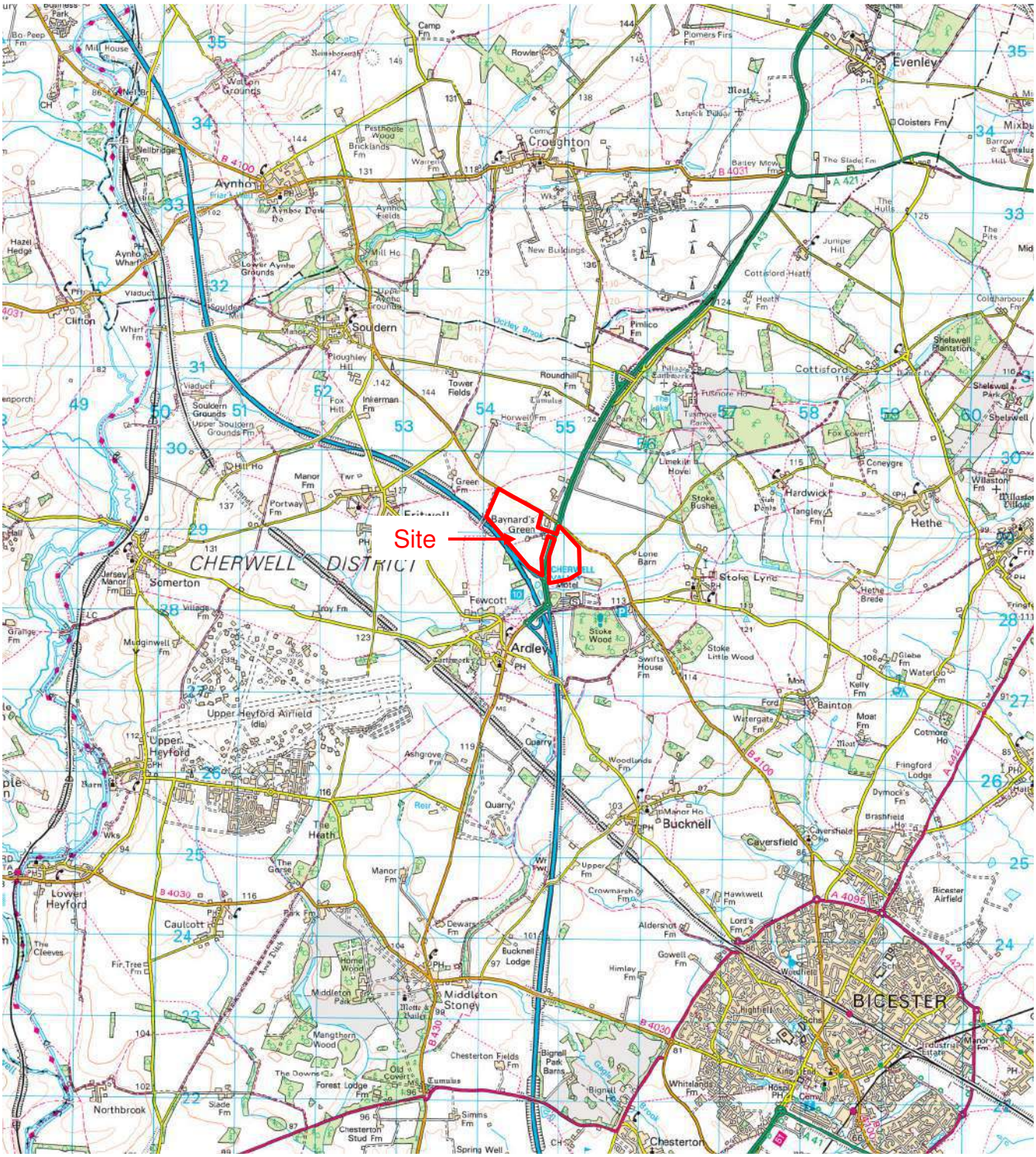
Recommendations

7.15 It is recommended that during detailed design that flood mitigation measures are implemented, and drainage design is carried out using the philosophy established in this report. Further design will be required to establish the entire drainage network and to ensure no flooding is created on the site during the 30-year event and flooding is contained on site safely during the 100-year + 40% event.

APPENDIX A

Site Location Plan

By Applied Geology (August 21)



APPLiED GEOLOGY
Unit 23
Abbey Park
Stareton
Kenilworth
CV8 2LY
Tel: 02476 511822
email: admin@appliedgeology.co.uk

Client: ALBION LAND LTD

Project: LAND ADJACENT TO JUNCTION 10, M40, ARDLEY

Drawn By:	Checked By:	Paper Size:
FD	AS	A4

Scale:	Date:	NGR:
NTS	13.08.2021	454583 229025

Drawing No: AG3268-21-01

Revision: 0

Title: SITE LOCATION PLAN

APPENDIX B

Topographical Survey

By MK Surveys (June 21)

454100 E
454200 E
454300 E
454400 E
454500 E
229600 N
229500 N
229400 N
229300 N

Notes:

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TOPOGRAPHICAL KEY

SURVEY STATION 5
BANKING (TOP / BOTTOM)
HEDGE SPREADS
WOODLAND CANOPY
ARROW ON STEPS / RAMPS INDICATES DIRECTION UP/WARDS
TREES (SPREAD & GIRTH SHOWN TO SCALE)
GATE
KERB CHANNEL
ROAD UNKERBED
FOOTPATH
CHANGE IN SURFACE
FENCE
WALL
OVERHEAD ELECTRIC
OVERHEAD TELECOM
FOUL SEWER
SURFACE SEWER
P-TRAP
BACK DROP (EXTERNAL)
BACK DROP (INTERNAL)
BUILDING
OPEN SIDED BUILDING
OVERHANG / CANOPY
GLASSHOUSE
CONTOUR 25.50
SPOT LEVEL + 127.13
SONAR LEVEL ⊙ 127.13
BORE HOLE BH
TRIAL HOLE TH

GENERAL ABBREVIATIONS

AIR CONDITIONING UNIT	ACU
AIR VALVE	AV
AVERAGE	Av.
BACK DROP	BD
BASS LAMP	BL
BOLLARD BEACON	BB
BOLLARD	BO
BOLLARD LIGHT	BOL
BRICK	BK
BUS STOP	BS
CABLE RISER	CR
CABLE TV COVER	CATV
CABLES TO GROUND	CTG
CATCH PIT	CP
CONTROL BOX	CB
COVER LEVEL	CL
CROSSING CONTROL BUTTON	CCB
CROSS TOP OF COURSE	CTC
DRAINAGE CHANNEL	DCH
DROP KERB	DK
ELECTRICITY POLE	EP
EARTH ROD	ER
FLAG MOUNT	FM
FLOOR LEVEL	FL
FOOTPATH	FP
FOUL WATER	FW
GAS RISER	GR
GAS VALVE	GV
GULLY	GY
HARD BED	HB
INSPECTION COVER	IC
INVERT LEVEL	IL
KERB OUTLET	KO
LAMP POST	LP
MANHOLE	MH
MARKER POST	MP
METER	MT
NO PIPES VISIBLE	NPV
ORDNANCE SURVEY BENCH MARK	OSBM
P-TRAP	PT
POST	PO
POST BOX	PBOX
ROSSING EYE	RE
ROAD SIGN	RS
RAIN WATER PIPE	RWP
RETAINING WALL	RW
SOFT BED	SB
STOP COCK	SC
STOP COCK NAME PLATE	SCNP
STOP VALVE	SV
SOIL PIPE	SP
SOIL VENT PIPE	SVP
SURFACE WATER	SW
TACTILE PAVING	TPC
TELEGRAPH POLE	TP
TELECOM INSPECTION COVER	TEL
TELEPHONE CALL BOX	TCB
TICKET MACHINE	TM
TOP OF WALL	TOW
TRAFFIC LIGHT	TL
TRAFFIC LIGHT COVER	TLC
THRESHOLD LEVEL	THL
UNABLE TO LOCATE	UTL
UNABLE TO RAISE	UTR
UNABLE TO SURVEY	UTS
VENT PIPE	VP
WATER LEVEL	WL
WATER METER	WM
WASH OUT	WO
WATER RISER	WR
WATER TAP	WT

FENCE ABBREVIATIONS

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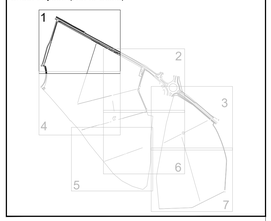
CORRUGATED IRON FENCE	C/I	POST AND WIRE FENCE	P/W
CHAIN LINK FENCE	CL	WIRE MESH FENCE	W/M
CHESTNUT PALING	CNP		

Sheet Layout: (Not to Scale)



Revision	Description	Surv. by	Check. by	Appr. by	Date

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Client: ALBION LAND

Land Adjacent To J10 M40
Ardley
Oxfordshire

Scale:	Sheet Size:	Sheet Number:	Date:
1:500	A0	1	June 2021
Project Number:	**Rev:**	**Surveyed by:**	**Checked by:** / **Approved by:**
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454500 E
454600 E
454700 E
454800 E
454900 E
229300 N
229200 N
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229000 N

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COVER LEVEL	CL
CROSSING CONTROL BUTTON	CCB
CROSS ROOF COURSE	CRC
DRAINAGE CHANNEL	DCH
DROP KERB	DK
ELECTRICITY POLE	EP
EARTH ROD	ER
FLOOD ALERT	FA
FLOOR LEVEL	FL
FOOTPATH	FP
FOUL WATER	FW
GAS RISER	GR
GAS VALVE	GV
GULLY	GY
HARD BED	HB
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INVERT LEVEL	IL
KERB OUTLET	KO
LAMP POST	LP
MANHOLE	MH
MARKER POST	MP
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ORDNANCE SURVEY BENCH MARK	OSBM
P-TRAP	PT
POST	PO
POST BOX	PBOX
ROSSKING EYE	RE
ROAD SIGN	RS
RAIN WATER PIPE	RWP
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STOP COCK	SC
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CHAIN LINK FENCE	CHL	WIRE MESH FENCE	W/M
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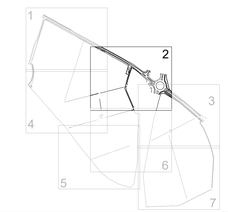
Sheet Layout: (Not to Scale)



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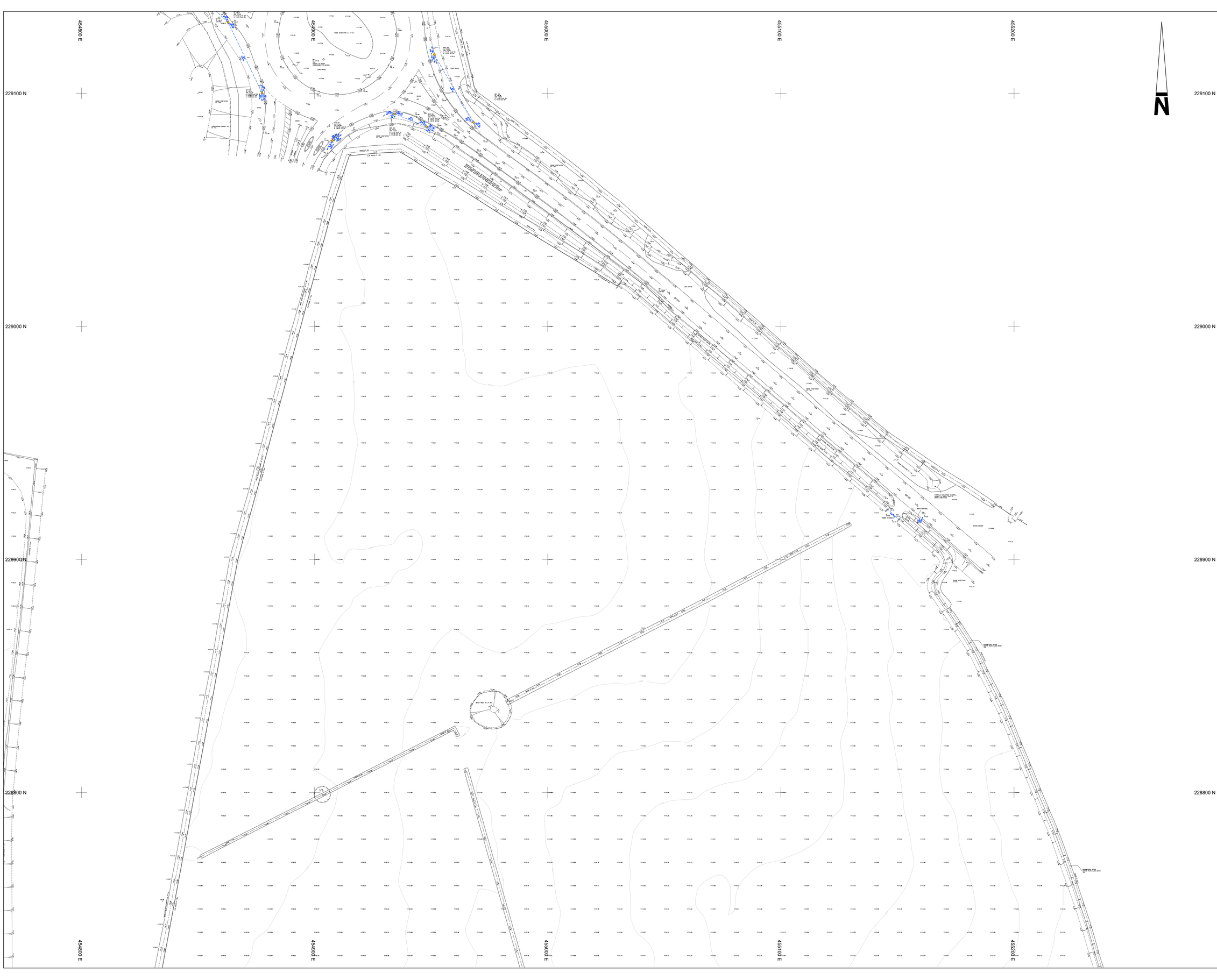

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COVER LEVEL	CL
CROSSING CONTROL BUTTON	CCB
DIRECTION OF COURSE	COC
DRAINAGE CHANNEL	DCH
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EARTH ROD	ER
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ORDNANCE SURVEY BENCH MARK	OSBM
P-TRAP	PT
POST	PO
POST BOX	PBOX
RODDING EYE	RE
ROAD SIGN	RS
RAIN WATER PIPE	RWP
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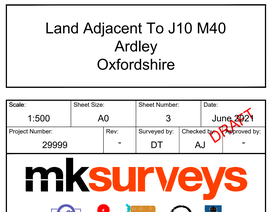

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COVER LEVEL	CL
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STOP COCK	SC
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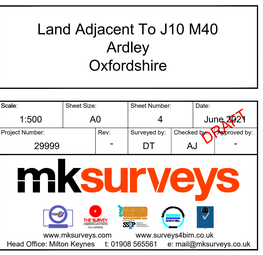

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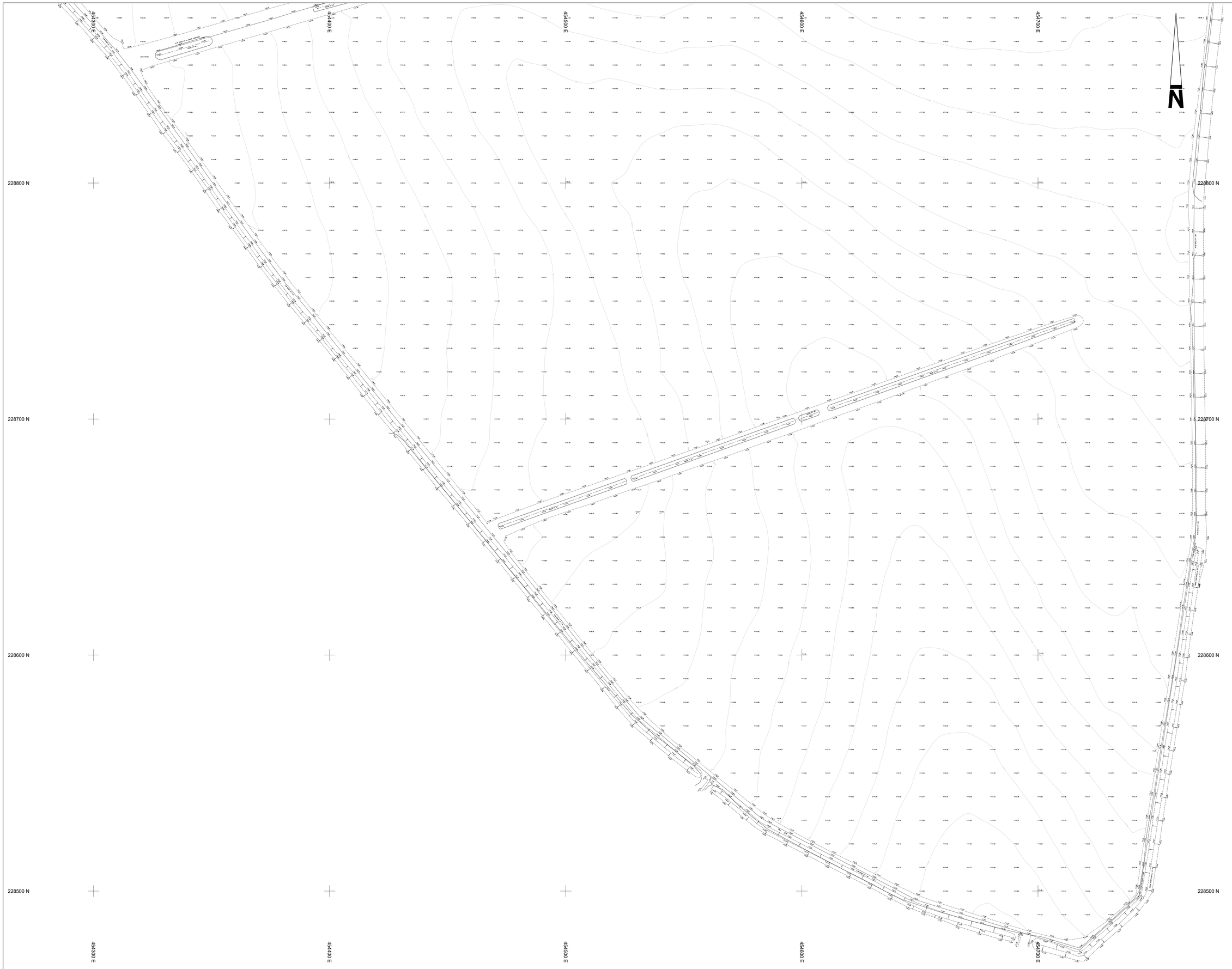

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INSPECTION COVER	IC
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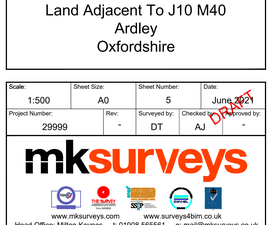

Revision	Description	Surv. by	Check. by	Appr. by	Date

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Topographical Survey

Client: ALBION LAND

Land Adjacent To J10 M40
Ardley
Oxfordshire

Scale:	Sheet Size:	Sheet Number:	Date:
1:500	A0	5	June 2021
Project Number:	**Rev:**	**Surveyed by:**	**Checked by:** / **Approved by:**
29999	-	DT	AJ / -

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Head Office: Milton Keynes t: 01908 565561 e: mail@mksurveys.co.uk

Notes:

1. GRID AND LEVELS BASED ON ORDNANCE DATUM, DERIVED FROM THE NATIONAL GNSS NETWORK. LOCAL SCALE FACTOR OF 0.99964 APPLIED.
2. TREE AND HEDGE SPECIES HAVE BEEN IDENTIFIED AS ACCURATELY AS POSSIBLE BUT SHOULD BE CROSS CHECKED IN CRITICAL AREAS.
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TOPOGRAPHICAL KEY

SURVEY STATION 5
BANKING (TOP / BOTTOM)
HEDGE SPREADS
WOODLAND CANOPY
ARROW ON STEPS / RAMPS INDICATES DIRECTION UP/WARDS
TREES (SPREAD & GIRTH SHOWN TO SCALE)
GATE
KERB CHANNEL
ROAD UNKERBED
FOOTPATH
CHANGE IN SURFACE
FENCE
WALL
OVERHEAD ELECTRIC
OVERHEAD TELECOM
FOUL SEWER
SURFACE SEWER
P-TRAP
BACK DROP (EXTERNAL)
BACK DROP (INTERNAL)
BUILDING
OPEN SIDED BUILDING
OVERHANG / CANOPY
GLASSHOUSE
CONTOUR 25.50
SPOT LEVEL + 127.13
SONAR LEVEL
BORE HOLE BH
TRIAL HOLE TH

GENERAL ABBREVIATIONS

AIR CONDITIONING UNIT	ACU
AIR VALVE	AV
AVERAGE	Av.
BACK DROP	BD
BASS LAKE	BL
BRIDLEWAY BEACON	BB
BOLLARD	BO
BOLLARD LIGHT	BOL
BRICK	BK
BUS STOP	BS
CABLE RISER	CR
CABLE TV COVER	CATV
CABLES TO GROUND	CTG
CATCH PIT	CP
CONTROL BOX	CB
COVER LEVELS	CL
CROSSING CONTROL BUTTON	CCB
DIRECTION OF COURSE	COC
DRAINAGE CHANNEL	DCH
DROP KERB	DK
ELECTRICITY POLE	EP
EARTH ROD	ER
FLOOD ATTENUANT	FA
FLOOR LEVEL	FL
FOOTPATH	FP
FOUL WATER	FW
GAS RISER	GR
GAS VALVE	GV
GULLY	GY
HARD BED	HB
INSPECTION COVER	IC
INVERT LEVEL	IL
KERB OUTLET	KO
LAMP POST	LP
MANHOLE	MH
MARKER POST	MP
METER	MT
NO PIPES VISIBLE	NPV
ORDNANCE SURVEY BENCH MARK	OSBM
P-TRAP	PT
POST	PO
POST BOX	PBOX
ROSSING EYE	RE
ROAD SIGN	RS
RAIN WATER PIPE	RWP
RETAINING WALL	RW
SOFT BED	SB
STOP COCK	SC
STOP COCK COME PLATE	SCP
STOP VALVE	SV
SOIL PIPE	SP
SOIL VENT PIPE	SVP
SURFACE WATER	SW
TACTILE PAVING	TPC
TELEGRAPH POLE	TP
TELECOM INSPECTION COVER	TEL
TELEPHONE CALL BOX	TCB
TICKET MACHINE	TM
TOP OF WALL	TOW
TRAFFIC LIGHT	TL
TRAFFIC LIGHT COVER	TLC
THRESHOLD LEVEL	THL
UNABLE TO LOCATE	UTL
UNABLE TO RAISE	UTR
UNABLE TO SURVEY	UTS
VENT PIPE	VP
WATER LEVEL	WL
WATER METER	WM
WASH OUT	WO
WATER RISER	WR
WATER TAP	WT

FENCE ABBREVIATIONS

BARBED WIRE FENCE	B/W	IRON RAILINGS	I/R
CLOSE BOARDED FENCE	C/B	LARCH LAP FENCE	L/L
CONCRETE PANEL FENCE	C/PL	POST AND RAIL FENCE	P/R
CORRUGATED IRON FENCE	C/I	POST AND WIRE FENCE	P/W
CHAIN LINK FENCE	C/L	WIRE MESH FENCE	W/M
CHESTNUT PALING	CNP		

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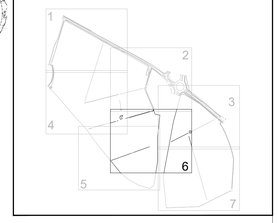

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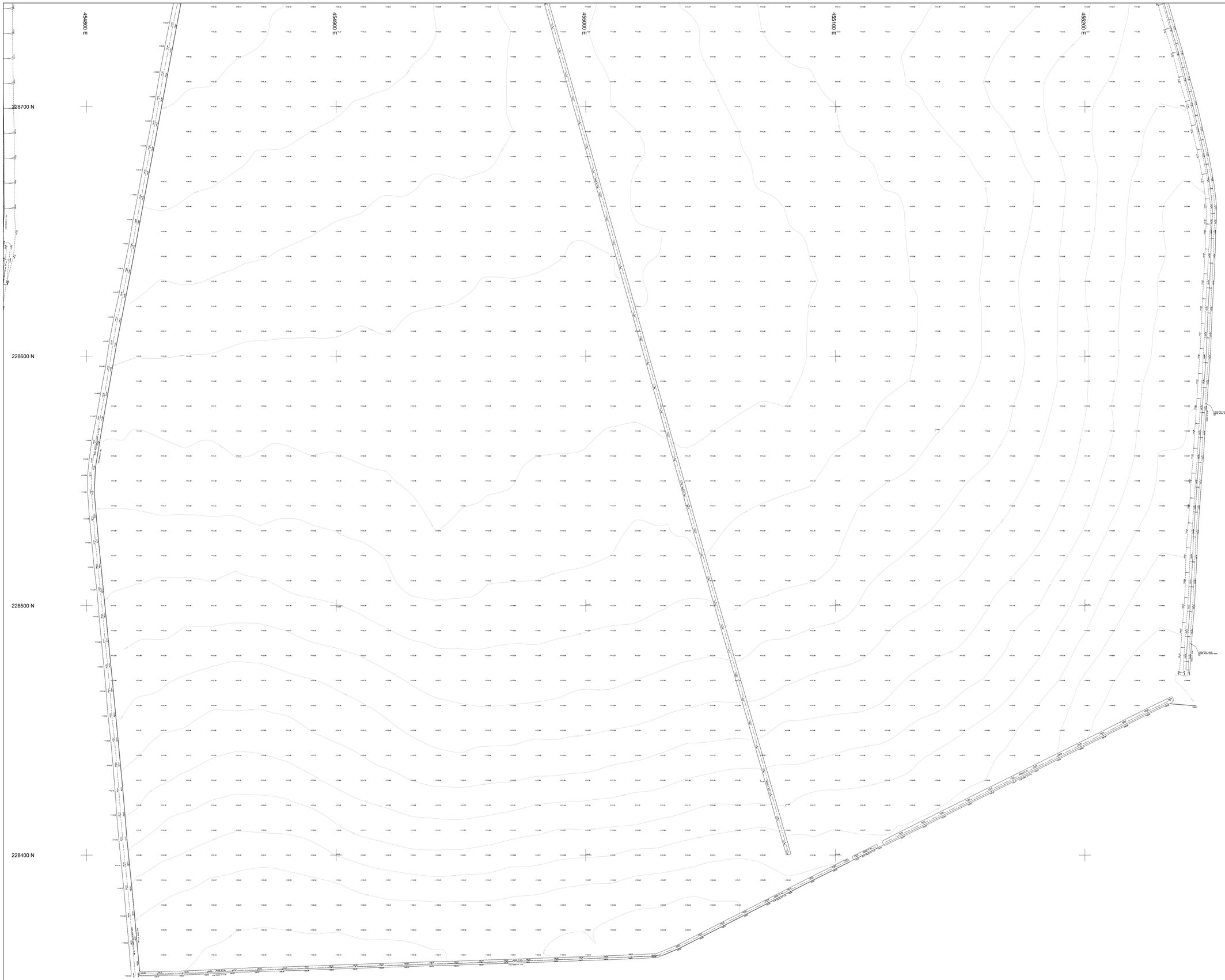

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FOUL WATER	FW
GAS RISER	GR
GAS VALVE	GV
GUIDE	GY
HARD BED	HB
INSPECTION COVER	IC
INVERT LEVEL	IL
KERB OUTLET	KO
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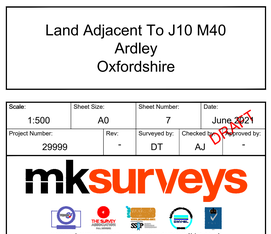

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APPENDIX C

Proposed Site Masterplan & Parameter Plans

By Cornish Architects