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HBS



**Land at Draycott, Cam
Preliminary Land Contamination and
Geotechnical Risk Assessment**

On behalf of Persimmon Homes Severn Valley and Robert
Hitchins Limited
Report 01-12-104884 /DSR1

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- A Site Plan**
- B Proposed Development Plan**
- C Historic Maps**
- D Groundsure Report**

Executive Summary

SITE INFORMATION	
Client	Persimmon Homes Severn Valley and Robert Hitchins Limited.
Site	Land at Draycott, Cam, Draycott.
Location	GL11 5DH (nearest). National Grid Reference: 374552 201522
Approximate area	39 hectares (Persimmon 29ha and RH 9.5ha)
Topography	The RH lands are flat lying. The Persimmon lands slope gently east to meet the RH lands.
Current land use	Agricultural
Proposed development	Low rise residential.

SITE SETTING	
Geology	The RH lands is underlain by the Cheltenham Sand and Gravel Deposits. These will be underlain by the bedrock geology of Blue Lias Formation and Charmouth Mudstone Formation (undifferentiated). The eastern side and western fringe of Persimmon land is underlain by the Cheltenham Sand and Gravel Deposits, these are in turn underlain by the Blue Lias Formation and Charmouth Mudstone Formation. The Sand and Gravels are absent from a north south running strip in the centre of the Persimmon lands, here the Blue Lias Formation and Charmouth Mudstone Formation is present.
Radon	No radon protective measures are required.
Hydrogeology	The site is not located within a Source Protection Zone. The Cheltenham Sand and Gravel Deposits are classified by the EA as Secondary A Aquifers. The Blue Lias Formation and Charmouth Mudstone Formation (undifferentiated) are classified as Secondary (undifferentiated) Aquifers. The depth to groundwater is not known.
Hydrology	Surface waters flows north. The River Cam is located 120m east. The River Severn is located 3km west.
Landfill sites	Former landfills on south west boundary and north eastern boundary of Persimmon lands. No landfills within 250m of RH lands.
History	Ordnance Survey plans show the site to have remained undeveloped
Previous site investigations	HBS has not been made aware of any previous investigations.
Anticipated ground conditions	Sands and Gravels beneath RH Lands. Sands and Gravels and Clays resulting from weathering of Mudstone beneath Persimmon land. Shallow ground may be present in low lying areas.

GEOTECHNICAL	
Foundations	Shallow spread foundations should be suitable. Bearing capacity to be determined from site investigation, but is likely to be sufficient for conventional low rise structures.
Shrinkable soils	RH lands – Soil likely to be non shrinkable. Persimmon lands – Shrinkable clays and non shrinkable.
Buried concrete	Significant concrete protection measures unlikely to be required.
Floor slabs	RH lands - Ground bearing. Persimmon land – Combination of suspended and ground bearing.
Slope stability	Current gradients are considered generally stable but careful assessment of changes of elevation or construction near existing slopes would still be needed.
Pavement	CBR values likely to be adequate for road and car park construction.
Soakaways	Underlying geology likely to be suitable for soakaway drainage, subject to full scale testing to confirm and calculate infiltration rates. Clay in central area of Persimmon lands unlikely to be suitable.
Natural cavities	None expected.
Mining	None expected.

CONTAMINATION	
Human health	RL lands – Risks considered low Persimmon lands – Risks considered moderate, due to localised areas of landfilling, which may contact contaminants with the potential to pose a risk to future users through direct contact.
Controlled waters	RL lands – Risks considered low Persimmon lands – Risks considered low.
Gas protection	RH lands - No significant risks identified. No radon protective measures are required. Persimmon lands – Risk from ground considered high. Assessment and monitoring required. No radon protective measures are required.
Water supply pipes	RL lands - No significant risks identified. Standard pipework likely to be suitable. Persimmon lands – Localised waste possible present with potential to contain hydrocarbons, protection of pipework may be required but considered unlikely.

1 Introduction

In March 2020, Hamson Barron Smith was commissioned by Persimmon Homes Severn Valley and Robert Hitchins' to undertake a Preliminary Land Contamination and Geotechnical Risk Assessment at of a land parcel immediate north of the village of Cam in Gloucestershire.

Persimmon Homes Severn Valley (Persimmon) and Robert Hitchins' (RH) currently control the land which is subject to an emerging allocation within the Stroud Local Plan Review for residential development.

The site comprises a number of fields. The location of the site is shown on Figure 1. A site topographic survey is included in Appendix A.

The current masterplan for the entire emerging allocation, is subject to change, but it is envisaged that the circa 39ha site (Persimmon 29ha and Robert Hitchins' 9.5ha) would achieve in the region of 1,000 dwellings. The masterplan is shown in Appendix B.

1.1 Project Requirements

The purpose of this Phase 1 assessment is to determine the potential risks from contamination and to identify potential geotechnical risks and constraints.

The objectives of the Phase 1 report are to:

- Establish the environmental setting, including sensitivity in relation to human health, surface water, groundwater and ecological receptors.
- Review historical and recent land uses to assess the potential for contamination to be present from past and current land-use.
- Qualitatively assess the potential nature and extent of contamination from those uses and the environmental risks and liabilities that may be posed to the identified receptors (human health and the environment).
- Assess any potential geotechnical risks.

1.2 Information Sources

During the production of this report the following sources have been reviewed:

- Groundsure Enviro+Geo Insight report (Report Number GS-6683458)
- Historic Ordnance Survey maps.
- British Geological Survey maps.
- British Geological Survey borehole records.
- Environment Agency landfill records.
- Environment Agency groundwater data.

1.3 Previous Investigations

Hamson Barron Smith (HBS) has not been made aware of any previous investigations that may have been undertaken at this site.

2 Site Location

Address: Cam, Gloucestershire

Post Code: GL11 5DH (nearest)

National Grid Reference: 374552 201522

The site location is shown on Figure 1.

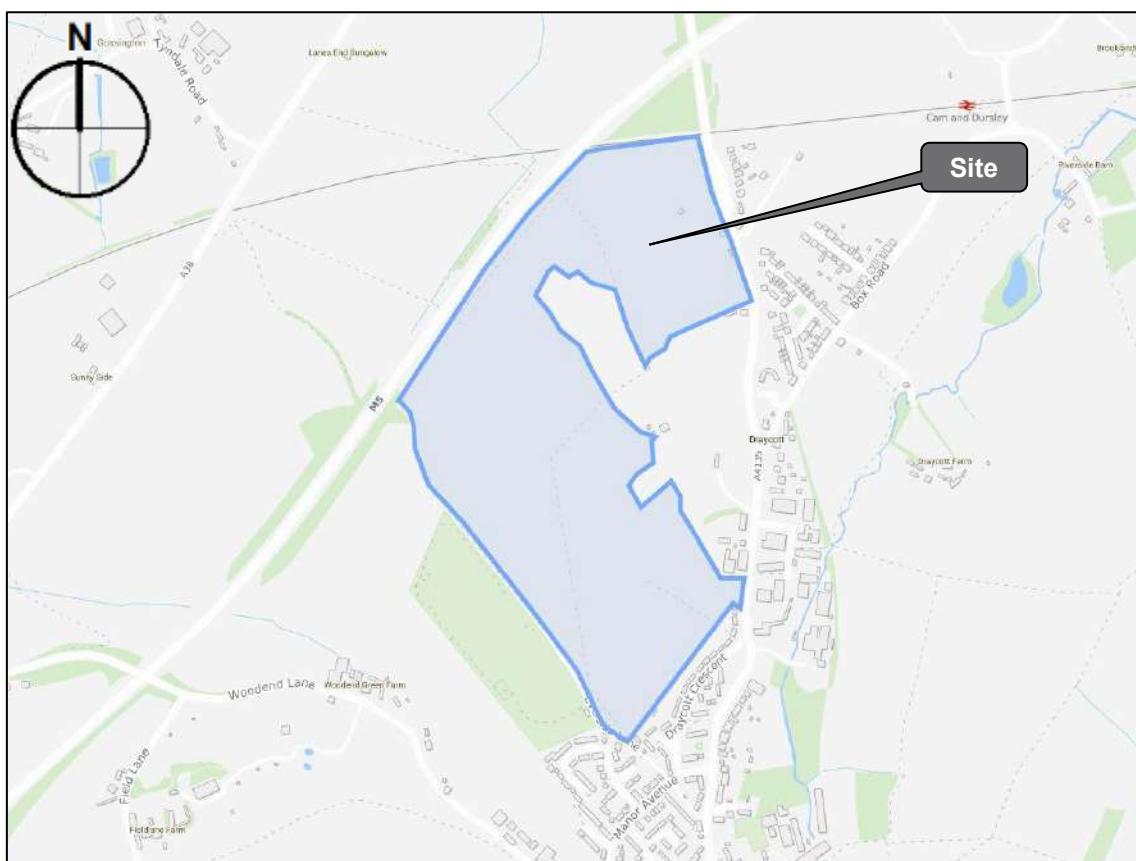


Figure 1 Site location plan

3 Site Description

The site is located to the immediate north of the village of Cam in Gloucestershire. The site occupies circa 39 hectares (Persimmon 29ha and Robert Hitchins' 9.5ha) and currently comprises of a series of fields, the fields appear to be used for growing of crops while the fields to the east abutting the A4135 are used for grazing by horses.

The M5 motorway is located to the north of the site. Towards the north west corner of the site, the M5 is located within a cutting, moving east the M5 is carried by an embankment, this embankment forms the approach to a bridge that crosses a railway line. This railway line forms the boundary of the site in the north east corner. The motorway and the site are separated by a public footpath. This footpath crosses underneath the M5 within an underpass which is located at the midpoint of the northern boundary.

To the east of the site is the highway of the A4135. In the north east corner the road is carried on an embankment and bridge over the railway line the north. From the north east corner A4135 slopes south. The site and road are separated by a hedge line. On the south east boundary of the site is a derelict house, and a yard used for storage by a circus.

To the south of the western section of the site are residential properties of Draycott Crescent. The rear gardens of which back onto the site.

To the west of the site is a public bridleway, this provides access to Jubilee Playing Field and Athletic Track and in its north becomes a footpath, which joins with the footpath on the northern boundary.

Figure 2 shows the site setting and land allocations.



Figure 2 Site layout and land allocations (Red = Persimmon / Blue = RH)

A site walk over was completed on the 14th November 2019 as part of HBS's bid submission.

The site comprises of a number fields, divided by hedge lines with interspersed mature trees both within the hedge lines and in isolation within the fields themselves. The site is relatively flat lying in its eastern side, rising gently to the west.

A series of rhynes / drains are present along the hedge lines particularly in the central and eastern sections of the site. These act to drain surface water flows in a generally northerly direction.

Access to the site is available via three sets of gates along the bridleway that forms the western boundary and from two sets of gates off the A4135. Access was also be available from a track in south east corner.

The fields to the west (Persimmon land) appear to be used for growing of crops, while the fields to the east (Robert Hitchins) appear to be used for grazing by horses.

At the time of the visit the much of the west (Persimmon land) of the site had been ploughed. As a consequence of the waterlogging and ploughing much of the central and western section (Persimmon land) of the site could not be accessed on foot. Plates 2 to 6 show typically conditions at the time of the walkover.

A section of field in the south west corner of the site (Persimmon land) had not been ploughed, it was noted that that this section of the field undulated unnaturally (Plate 1). This may indicate that earthworks have been completed in this area and or that the area has been affected by filling.

A small pond (Plate 7) is present within the north east corner of the site (Robert Hitchins land). In this area, a small stable block is also present, along with a number of outbuildings that are used for the storage of agricultural materials and firewood.

3.1 Surrounding Land Use

Land uses surrounding the site are as follows:

- North – Public footpath and M5 Motorway with fields beyond. A rail line is present in the north east corner of the site.
- South – Conurbation of Cam.
- East – Highway of the A4135.
- West – Public Bridleway on the opposite side public open space and sports fields (Jubilee Playing Field and Athletic Track).

3.2 Photographs

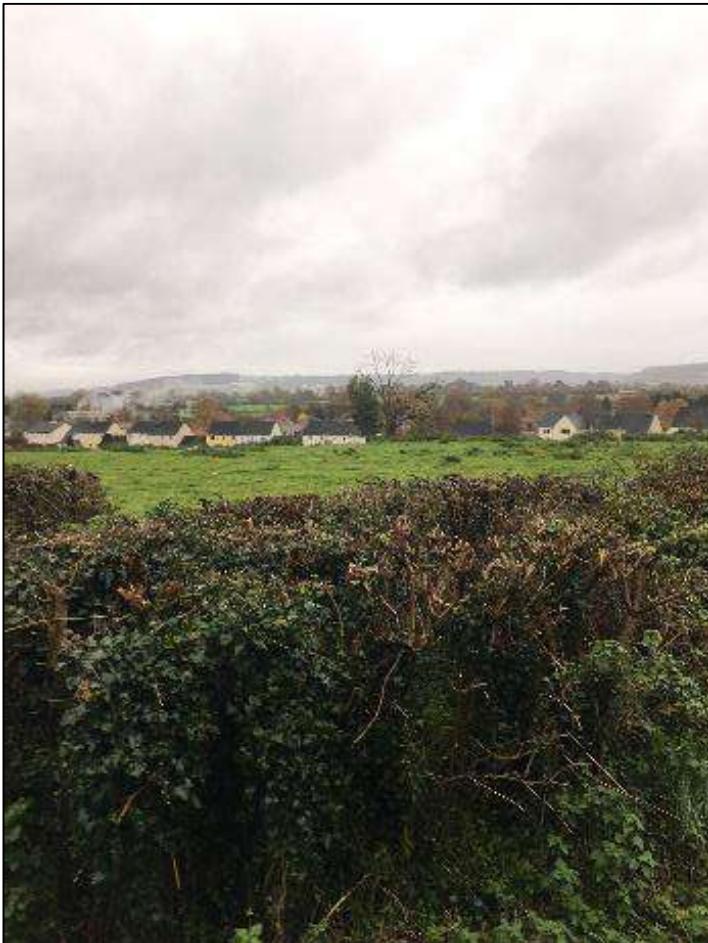


Plate 1 – Undulating Ground in South West Corner (Persimmon land)





Plate 2 View east from south west access point





Plate 3 View south east from northern access point





Plate 5 View south west from northern boundary





Plate 6 View north east toward railway line (low point of site).

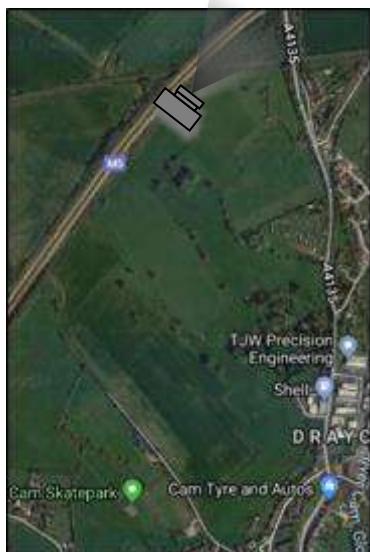
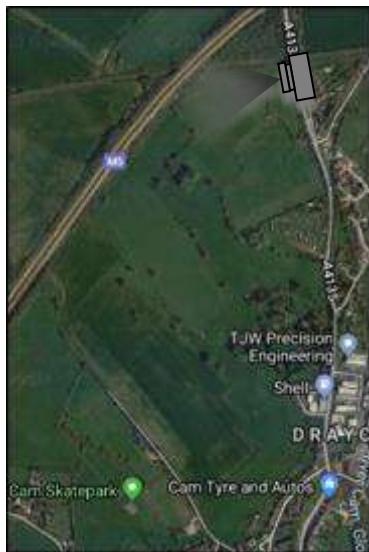




Plate 7 View west of pond in Robert Hitchins Land



4 Environmental Setting

4.1 Geology

Robert Hitchins Land

British Geological Survey (BGS) mapping indicates that the Robert Hitchins site is underlain by superficial deposits comprising of the Cheltenham Sand and Gravel Deposits and that these will be underlain by the bedrock geology of Blue Lias Formation and Charmouth Mudstone Formation (undifferentiated).

Persimmon Land

BGS mapping indicates that the eastern side and western fringe of Persimmon land is underlain by the superficial deposits (Cheltenham Sand and Gravel Deposits), these are in turn underlain by the Blue Lias Formation and Charmouth Mudstone Formation.

The superficial deposits are absent from a north south running strip in the centre of the Persimmon lands, here the Blue Lias Formation and Charmouth Mudstone Formation is mapped as present. The mapped extents of the Sand and Gravel deposits are shown below in Figure 3.



Figure 3 Extent of mapped Superficial Deposits (coloured orange)

The BGS hold records of number of exploratory holes associated with the M5. These suggest that Made Ground deposits overlying a gravelly Silt may be present. With the Made Ground proven to 5m bgl. The boreholes are however dated 2009, which post-dates the M5 construction. The Made Ground is therefore envisaged to be associated with the construction of the motorway embankment and is not likely to be reflective of the site conditions.

4.2 Soil Geochemistry

The BGS “Normal Background Concentrations of Contaminants in English Soils” included as part of the Groundsure report indicates the typical estimated concentrations of each determinant in topsoil in the locality of the site, as summarised in Table 1.

Table 1: Summary of BGS Estimated Soil Geochemistry

Determinant	Concentration Range (mg/kg)
Arsenic	15 – 25
Cadmium	<1.8
Chromium	90 – 120
Lead	100
Nickel	15 – 30

4.3 Hydrogeology

The site is not located within a Source Protection Zone.

Cheltenham Sand and Gravel Deposits are classified by the Environment Agency (EA) as Secondary A Aquifers.

The Blue Lias Formation and Charmouth Mudstone Formation (undifferentiated) are classified by the EA as Secondary (undifferentiated) Aquifers.

The depth to groundwater is not known.

At the time of the walk over extensive surface water was present across the site and water was present in the pond in the north east of the site at circa 0.3m bgl. It is therefore envisaged that shallow groundwater may be present.

4.4 Hydrology

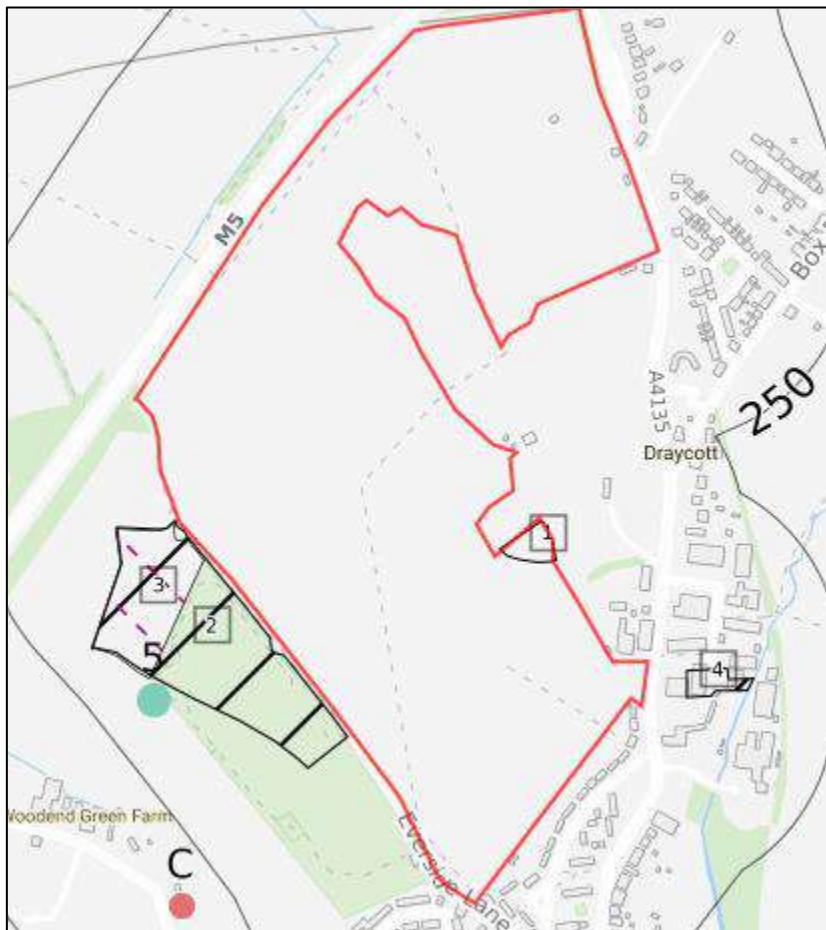
Two small drains are present in the site, these flow north / north west. Surface water bodies are also present to the north west of the M5. A pond is present in north of the RH land parcel. Furthermore, at the time of the walk over extensive surface water was present across the site and water was present in the pond in the north east of the site at circa 0.3m bgl. Surface water is therefore considered to be of high sensitivity to any potential on site sources of contamination.

The water bodies flow west to form tributaries of the River Severn, the main channel of which is located circa 3km west of the site. Given the distance from the site the River Severn is considered to be of low sensitivity

The River Cam is located circa 120m east of the site. Although the site is not within the catchment zone of the River Cam. However, the site is within the operational catchment of the Cam. Given the distance from the site, the Cam is considered to be of moderate sensitivity to any potential land contamination.

4.5 Landfill Sites

There are two recorded areas of landfilling within 250m of site boundary. The locations are shown in the extract from the Groundsure report below.



The first is located on the eastern boundary of the Persimmon land. It is recorded as Everside Lane Refuse Tip, Cam, Dursley, Gloucestershire and was operated by Dursley Rural District Council. Waste type is recorded as Inert, Industrial, Commercial and Household. The site was active from 01/08/1963 with the last recorded waste received on 30/10/1975.

The second is located near to the south west boundary. This records for this area are the same as those recorded on eastern boundary.

Given the proximity to the site, the potential for the generation and migration of ground gas / leachates on to the site cannot be discounted.

4.6 Radon

The Groundsure report states that the site is in an area where the estimated probability of homes being above the action level of 200Bqm^{-3} is less than 1%. Therefore, no

radon protective measures are required in the construction of new buildings. The Groundsure report is presented in Appendix D.

Confirmation of any protection measures should be agreed with the local authority building control and / or warranty provider.

4.7 Statutory Authority Records

A review of public registers contained within the Groundsure report has been undertaken. These entries relate to trade directories, pollution control registers, hazardous sites, enforcement notices etc. A summary of those that might be of relevance to the site is presented below, for full details of all entries, reference should be made to the Groundsure report in Appendix D.

Records of Petrol Stations

- A Shell Petrol station recorded in the Groundsure report; however, its recorded position does not match that of the actual Shell Petrol Station. It is assumed that the mapped location shown within the Groundsure report appears to be incorrect.
- An obsolete record is held for a station 231m SE at High Street, Cam, Dursley, Gloucestershire, GL11 5LE.

Records of Part A(2) and Part B installations regulated under the Environmental Permitting

- Millwood Motor Co Ltd, Cam, Gloucestershire, GL11 5DH recorded as 40m from site). This holds a Part B Environmental Permit for Unloading of Petrol. The location indicated within the Groundsure report matches the location of the actual Shell Petrol station on the A4135.
- VMR Autos Unit J1, Drycott Business Park, Cam, Dursley, GL11 5DQ (100m east) holds a Part B Environmental Permit for Waste Oil Burner 0.4 MW
- Tanks are recorded circa 100m east of the site.

Pollution Incidents

There are two incidents with 250m of the site, both occurred on the opposite side of the A4135 and are therefore unlikely to impact on the conditions beneath the site.

The first occurred 116m east of the site in 2002 (Incident Identification: 65196). The pollutant was Inert Materials and Wastes (Soils and Clay); the impact to water was Minor, no impact to air or land was noted. The second occurred 120m east in 2014 (Incident Identification: 1249387). The pollutant was Inorganic Chemicals/Products (Other Inorganic Chemical or Product); the impact to water was major, no impact to air or land was noted.

4.8 Sensitive Land Uses and Designated Areas

The site is located within a SSSI Impact Risk Zones.

The SSSI of Stinchcombe Hill a Calcareous Grassland (Lowland) is located 1914m South.

4.9 Land Use History

The historical land uses of the site and its surrounding area have been established from superseded editions of Ordnance Survey maps and are detailed in Table 2.

Copies of the maps are included in Appendix C.

Table 2: Summary of Historical Maps

Date	On Site	Offsite
1882-1885	The site is a series of agricultural fields. A very small gravel pit is present on the south west edge of the Persimmon land. Possible small pond present in the centre of the Persimmon land. A pond is present in the northern corner of the RH lands.	The generally surrounding land use agricultural. Draycott Mill (Corn) and associated mill pond is present to the south east. Rail line with good sheds present to north east corner. Rail line present along northern boundary.
1882-1886	No significant changes are evident.	No significant changes are evident.
1901-1903	Gravel pit no longer noted. No other significant changes are evident.	No significant changes are evident. Mill pond has changed shape. Helena House now present on south east corner of RH land.

Date	On Site	Offsite
1924	No significant changes are evident.	Some residential development occurring to south of the mill. No significant changes are evident.
1949 to 45	No significant changes are evident.	Draycott has expanded. Housing now shown on southern boundary. Mill no longer mapped. Residential properties built in north east corner near good sheds,
1975- 78	No significant changes are evident.	M5 now shown on northern boundary. No significant changes are evident.
1975 (1:2,500)	No significant changes are evident.	Orchard House has been constructed in the lands between Persimmon and RH lands. It includes some outbuildings and a tennis court.
1980-81	Pond in RH lands no longer identified. No significant changes are evident.	Garage and electrical substation marked on south east corner of Persimmon land. Playfields identified to the west of the site. A number of tanks are now present to the south east on the opposite side of the highway, near the area of the mill around which further development has occurred. Rail line on east identified as dismantled.
1993 (1:2500)	Pond is shown in RH lands, location maps matches' 1975 map.	No significant changes are evident.
2001	No significant changes are evident.	An access road is shown on the east side of the carriageway opposite the petrol station with a new building layout. No other significant changes are evident.
2010	Pond in Persimmon land no longer identified. No significant changes are evident.	Area around mill identified as business park. No other significant changes are evident.
2020	No significant changes are evident.	No significant changes are evident.

4.9.1 Summary of Development History

On site

The site has been agricultural fields since first mapped in the late 1880s with little to no change noted on either the Persimmon or RH owned lands.

A small gravel pit was present on the western edge of the Persimmon land. This is not recorded after 1901 – 03, it is assumed that this was infilled. A small pond present centrally in the Persimmon parcel is no longer mapped after 2010, again it is assumed this has been infilled.

Off Site

The surrounding land use was typically undeveloped farmland. A mill and associated pond was present to the south east of the Persimmon land this was present until the mid to late 1940s, this area went on to be developed a business park, within which a number of small tanks are noted. By the early 1980s a garage had been constructed to the south east Persimmon land this still remains.

A rail line abutted the north eastern corner of the RH lands until the early 1980s when it was mapped as dismantled.

By 1975-78 the M5 had been constructed along the northern boundary of the site.

5 Geotechnical Assessment

The RH land is underlain by superficial deposits comprising of the Cheltenham Sand and Gravel Deposits and that these will be underlain by the bedrock geology of Blue Lias Formation and Charmouth Mudstone Formation (undifferentiated).

The eastern side and western fringe of Persimmon land is underlain by the superficial deposits (Cheltenham Sand and Gravel Deposits), these are in turn underlain by the Blue Lias Formation and Charmouth Mudstone Formation. The superficial deposits are absent from a north south running strip in the centre of the Persimmon lands, here the Blue Lias Formation and Charmouth Mudstone Formation is mapped as present.

An assessment of potential geotechnical risks based on the information from the Groundsure Report and available geological information is presented in the following sections. The risks are summarised in

Table . The Groundsure Report is reproduced in Appendix D.

5.1 Deep Made Ground

Deep Made Ground resulting from infilling or significant raising of levels is considered unlikely. However, localised areas of deeper Made Ground may be present in the Persimmon lands, associated with potential landfilling on northern boundary, the infilling a former pond and gravel pit and with earthworks in the south corner of the site, where undulating land is noted.

5.2 Buried Structures

Significant buried structures are not envisaged.

5.3 Compressible Soils

The Groundsure report states that the Compressible Ground risk at the site is "negligible to low". Based on the site geology compressible soils are not expected.

5.4 Shrinking / Swelling Clay

The Groundsure report states that the Shrinking or Swelling Clay risk at the site is “negligible to low”.

The near surface soils in the Persimmon lands are anticipated to granular and as a consequence are not considered likely to be shrinkable. The Mudstones in the central area of the Persimmon lands, are likely to weather to clays which may be subject to volume change.

5.5 Collapsible soils

The Groundsure report states that the Collapsible Ground risk at the site is “very low”. Based on the anticipated ground conditions, collapsible soils are not expected.

5.6 Aggressive Ground Conditions for Concrete

Based on the published geology, the anticipated soils are not expected to contain significantly elevated concentrations of soluble sulphates or pyritic materials which may oxidise to form soluble sulphates.

5.7 Running Sands / Excavation Instability

The Groundsure report states that the Running Sand risk at the site is “Negligible”.

Within the RH land and along the eastern part of the Persimmon lands, sands and gravels are anticipated to be present. Inspection of the site has suggested significant waterlogging. If shallow groundwater is present, then HBS consider there is potential for the granular soils to suffer instability during excavation and potentially run.

5.8 Groundwater

Extensive waterlogging was present across the site at the time of the site inspection November 2019. Ponding was noted along the eastern boundary of the Persimmon lands and the northern boundary of the RH lands.

5.9 Slope Stability

The Groundsure report states that the Landslide risk at the site is “very low”. Slopes on the site are gentle and no evidence of instability noted during the walk over. HBS consider that provided no significant alterations to the site’s topography are made no issues with stability are anticipated. Any proposed slopes or temporary cutting for retaining systems should be carefully assessed however.

5.10 Solution Features / Natural Cavities

The site is expected to be underlain by sands and gravel and by Mudstone which is not prone to dissolution.

The Groundsure report states that the Ground Dissolution risk at the site is “negligible” and no solution features are recorded within 1km.

5.11 Mining

The site is not located within a coal mining risk area and there are no recorded coal or non coal mines within 1000m of the site.

Consequently, the risks from underground mining within the site itself are considered to be negligible.

Surface mining of sands and gravels has occurred locally on the south west edge of the Persimmon land.

6 Land Quality Assessment

6.1 Legislative Background

The primary legislative mechanism for contaminated land management in the UK is Part 2A of the Environmental Protection Act, 1990 (EPA). Part 2A was introduced into the EPA under Section 57 of the Environment Act 1995 to help deal with the substantial legacy of land contamination. Local authorities are the principal regulator for inspection of land under Part 2A. In England, Part 2A is described fully in DEFRA Circular 01/2006, which also contains the statutory guidance (DEFRA, 2006). Part 2A defines contaminated land as:

'...any land which appears to the Local Authority in whose area it is situated to be in such a condition, by reason of substances in, on or under the land, that

- a. *significant harm is being caused or there is a significant possibility of such harm being caused; or*
- b. *Pollution of controlled waters is being, or is likely to be, caused.'*

In applying the definition of Contaminated Land, Part 2A states that 'the Local Authority must:

- Identify a 'Pollution Linkage'. That is, a linkage between a contaminant and a receptor, by means of a pathway(s).
- Determine if the contaminant is causing significant harm to that receptor, or there is a significant possibility of such harm being caused by that contaminant to that receptor.

If any one element of the pollutant linkage is not present then the land should not be identified as 'contaminated land'.

Part 2A is designed to 'enable the identification and remediation of land on which contamination is causing unacceptable risks to human health or the wider environment. It does not necessarily include all land where contamination is present, even though such contamination may be relevant in the context of other regimes'. It is not directed

to assessing risks in relation to a future use of the land that would require a specific grant of planning permission.

The control of development and land use in the future is the responsibility of the planning system. A fundamental principle of sustainable development is that the condition of land, its use and its development should be protected from potential hazards. The National Planning Policy Framework (NPPF) states that '*to prevent unacceptable risks from pollution and land instability, planning policies and decisions should ensure that new development is appropriate for its location.*'

Planning policies and decisions should also ensure that the site is suitable for its new use taking account of ground conditions and land instability, including from natural hazards or former activities such as mining, pollution arising from previous uses and any proposals for mitigation including land remediation or impacts on the natural environment arising from that remediation.

NPPF also states that after any required remediation, the land should not be capable of being determined as contaminated land under Part IIA of the Environmental Protection Act 1990.

6.2 Preliminary Conceptual Site Model (CSM)

Following a review of the desk based geo-environmental information on the site and a site reconnaissance, a preliminary CSM has been formulated to identify potential sources of contamination, likely receptors and potential pathways on and in the immediate vicinity of the site.

It should be noted that some uncertainties exist due to the limited site specific data available. However, potential contaminants and receptors have been identified based on this Phase 1 desk study review. Pathways have been established on reasonable scientific knowledge of the behaviour of the contaminants in the ground.

It should also be noted that because the assessment is based on documentary evidence contaminants may be identified, which in practice are not present and contaminants may be present which have not been identified.

The guidance provided in CLR11 indicates the CSM should identify those contaminants, pathways and receptors which are ‘likely’ to represent an ‘unacceptable’ risk either to human health or the surrounding environment.

6.3 Potential Contaminant Sources

6.3.1 On site – RH Lands

No potential sources of land contamination have been identified in the RH lands.

6.3.2 On site - Persimmon Land

- Small infilled pond with the centre of the site.
- Area of possible filling in southern corner of site (area of undulating lands).
- Small infilled gravel pit on south western boundary of site.
- Possible landfilling on eastern boundary of site.

Infilled Ground

The materials used to fill the pond, the area in southern corner, the gravel pit and the area of recorded landfilling on east of are not known. Fill materials may have the potential to act as a source of soil and or groundwater contamination. If the materials used contains putrescible materials then there is the potential for the fill to act as a source of landfill gas.

It is considered given that the infilled areas are small and localised that these areas unlikely to represent significant on-going source of groundwater or landfill gas. The soils present may however contain contaminants with the potential to present a risk to future users of the site via direct contact present near surface.

6.3.3 Off site - RH Lands

The surrounding land use was a mixture of undeveloped farmland and residential land towards the south.

- Rail lines on north and to south east

Rail Way Land

A rail line is present to the north east of and to the north of the RH lands. Potential contaminants associated with the rail lines include a range include metals, phenols, hydrocarbons and polycyclic aromatic hydrocarbons as well as herbicides.

Rail land was also present historically near the south east of the RH lands. The rail line was separated from the site by the road. It is considered that given the distance from the site, that the south east corner is of the RH land is unlikely to have been impacted by the operation of the rail line.

6.3.4 Off Site – Persimmon Land

- Landfilling to south west of the Persimmon lands.
- Petrol station to the south east of the Persimmon land.
- Unspecified tanks circa 100m east of the site.
- Substation on south east boundary

Landfilling

The area to the west of the site now used as playing fields has been subject to landfilling. Waste type recorded included Inert, Industrial, Commercial, Household with landfilling ceasing by 1975. Infill materials may have the potential to act as a source of soil and groundwater contamination and or ground gas, which may have the potential to migrate and impact on the Persimmon lands.

Petrol Station

A petrol station is present circa 40m south east of the site. Spillage and leakages from the site have the potential to result in soil and groundwater contamination. Potential contaminates are dominated by polyaromatic hydrocarbons (PAH), total petroleum hydrocarbons (TPH), and volatile organic compounds (VOCs). If leaks or spillages have occurred then these contaminated may have the potential to migrate and impact on the Persimmon lands.

Unspecified Tanks

An unspecified tank is present circa 100m east of the site. The nature of materials stored in the tank is not known, however it is noted that a Type B Environmental Permit is held by VMR Autos Unit J1 which is also located 100m east holds for a Waste Oil Burner. It is possible therefore that the tank holds oils associated with this operation.

Given the distance from the site and that tank is down topographic gradient from the site it is considered that the oils stored are unlikely to pose a risk to the study site and is therefore not considered further.

Substation

A substation is present on the south east boundary of the site. It was first noted in circa 1979 mapping and is a small. While this may have the potential to act as a localised source hydrocarbons, it is considered unlikely that this modern feature will have resulted in soil and or groundwater contamination.

6.3.5 Potential Contaminants of Concern

On the basis of the identified sources of pollution the contaminants of concern are as identified within industry profiles as follows:

RH Lands

- Metals, phenols, PAHs, TPHs, and herbicides localised near the rail the rail lines on the northern boundary.

Persimmon Lands

- Made Ground with the potential to contain metals, PAHs TPHs, and asbestos containing materials (ACM) in area of infill materials.
- Hydrocarbons, including VOCs in the area abutting the petrol station.
- Soil atmospheres impacted ground gases which may contain methane or carbon dioxide and or reduced oxygen

6.4 Receptors

It is understood that the whole site will be redeveloped with low rise residential properties. Future residents are assumed therefore to occupy the site full time and may be exposed directly to soils within the site, while site visitors may be exposed directly for shorter periods. Construction workers would be directly exposed to soils, however this would only be short term.

- Future residents and site visitors.
- Construction workers.
- Construction materials (including services).
- Groundwater – In Cheltenham Sand and Gravel Deposits -Secondary A Aquifer.
- Groundwater - Blue Lias Formation and Charmouth Mudstone Formation - Secondary (undifferentiated) Aquifer.
- Surface Water - streams within site boundary and to the south west of site.
- Flora and fauna.

6.5 Preliminary Risk Assessment

A preliminary risk assessment was undertaken based on a qualitative assessment of the likely presence of a pollutant linkage. A pollutant linkage is the relationship between a source (or contaminant), a pathway and a target (or receptor). Unless all three elements of a pollutant linkage are present, a significant risk is not considered to exist. The approach adopted is to screen each site based on assigning a simple low, medium or high category.

The preliminary risk assessment for the RH and Persimmon lands is shown in Table 3 & 5 respectively.

Table 3 RH Lands - Site Conceptual Model

Potential Source and Pollutant	Receptor	Pathway	Potential Pollutant Linkage?	Probability of exposure, consequence and magnitude of risk.
Localised Metals, phenols, PAHs, TPHs, and herbicides in soils / groundwater near the rail the rail lines on the northern boundary.	Human Health – Future residents and site visitors.	Direct contact - Dermal contact, soil ingestion and dust inhalation.	Unlikely - No sources on site, only potential is for localised sources of soil contamination near rail line.	Probability: Unlikely Consequence: Medium Magnitude: Low Risk
		Indirect Contact - Vapour inhalation.	Unlikely - No sources on site, only potential is for localised sources of soil contamination near rail line, furthermore significant sources of vapours are not envisaged.	Probability: Unlikely Consequence: Medium Magnitude: Low Risk
		Hydrocarbon tainting of potable water supply pipes.	Unlikely - No sources on site, envisaged that groundwater will flow south, only potential is for localised sources of hydrocarbons near rail line.	Probability: Unlikely Consequence: Medium Magnitude: Low Risk
	Human Health – Construction workers	Direct contact - Dermal contact, soil ingestion and dust inhalation.	Unlikely - No sources on site, only potential is for localised sources of soil contamination near rail line.	Probability: Unlikely Consequence: Medium Magnitude: Low Risk
		Indirect Contact - Vapour inhalation.	Unlikely - No sources on site, only potential is for localised sources of soil contamination near rail line, furthermore significant sources of vapours are not envisaged.	Probability: Possible Consequence: Medium Magnitude: Low Risk
	Controlled Waters – groundwater (Secondary A Aquifer)	Leaching and percolation.	Unlikely - No sources on site, envisaged that groundwater will flow south away from site.	Probability: Possible Consequence: Low Magnitude: Low Risk

Potential Source and Pollutant	Receptor	Pathway	Potential Pollutant Linkage?	Probability of exposure, consequence and magnitude of risk.
	Controlled Waters Streams in Persimmon lands and River Cam to east.	Groundwater migration & run-off to surface waters carrying entrained sediment or diffuse contamination	Unlikely - No sources on site, envisaged that groundwater will flow south away from site.	Probability: Unlikely Consequence: Low Magnitude: Low Risk
	Buried structures – Aggressive ground conditions	Direct contact and/or leaching (sulphate, pH).	Underlying geology unlikely to be aggressive.	Probability: Unlikely Consequence: Medium Magnitude: Low Risk
	Ecology - existing trees and landscaping on site.	Plant uptake.	Unlikely – limited sources of land contamination.	Probability: Unlikely Consequence: Low Magnitude: Low Risk
Ground gases.	Human Health – Future residents and site visitors.	Permeation through ground and intrusion into buildings and structures.	Unlikely – No sources on site.	Probability: Unlikely Consequence: High Magnitude: Low Risk
	Flora	Displacement of oxygen from root systems	Unlikely – No sources on site.	Probability: Unlikely Consequence: Low Magnitude: Low Risk
Radon.	Human Health – Future residents and site visitors.	Permeation through ground floor.	Unlikely - No protection measures required.	Probability: Unlikely Consequence: Medium Magnitude: Low Risk

Table 5 Persimmon Lands - Site Conceptual Model

Potential Source and Pollutant	Receptor	Pathway	Potential Pollutant Linkage?	Probability of exposure, consequence and magnitude of risk.
Localised fill materials with the potential to contain metals, PAHs TPHs, and asbestos containing materials (ACM). Hydrocarbons, including VOCs in the area abutting the petrol station. Former landfill to west of site.	Human Health – Future residents and site visitors.	Direct contact - Dermal contact, soil ingestion and dust inhalation.	Possible – Localised areas of Made Ground may be present.	Probability: Possible Consequence: Medium Magnitude: Medium Risk
		Indirect Contact - Vapour inhalation.	Possible – Localised areas of Made Ground may be present.	Probability: Possible Consequence: Medium Magnitude: Medium Risk
		Hydrocarbon tainting of potable water supply pipes.	Possible – Localised areas of Made Ground may be present,	Probability: Possible Consequence: Medium Magnitude: Low Risk
	Human Health – Construction workers	Direct contact - Dermal contact, soil ingestion and dust inhalation.	Possible – Localised areas of Made Ground may be present.	Probability: Possible Consequence: Medium Magnitude: Medium Risk
		Indirect Contact - Vapour inhalation.	Possible – Localised areas of Made Ground may be present.	Probability: Possible Consequence: Medium Magnitude: Medium Risk
	Controlled Waters – groundwater (Secondary A Aquifer)	Leaching and percolation.	Possible – Localised areas of Made Ground may be present.	Probability: Possible Consequence: Low Magnitude: Medium Risk
	Controlled Waters – on site streams and river Cam circa 120m east	Groundwater migration & run-off to surface waters carrying entrained sediment or diffuse contamination	Possible – Localised areas of Made Ground may be present, however these are generally more than 100m from the surface water bodies.	Probability: Possible Consequence: Low Magnitude: Low Risk
	Buried structures – Aggressive ground conditions	Direct contact and/or leaching (sulphate, pH).	Unlikely - Underlying geology unlikely to be aggressive.	Probability: Unlikely Consequence: Medium Magnitude: Low Risk

Potential Source and Pollutant	Receptor	Pathway	Potential Pollutant Linkage?	Probability of exposure, consequence and magnitude of risk.
	Ecology - existing trees and landscaping on site.	Plant uptake.	Unlikely – sources of land contamination are limited	Probability: Unlikely Consequence: Low Magnitude: Low Risk
Ground gases.	Human Health – Future residents and site visitors.	Permeation through ground and intrusion into buildings and structures.	Possible – Landfill site on western boundary.	Probability: Possible Consequence: High Magnitude: High Risk
	Flora	Displacement of oxygen from root systems	Unlikely - no sensitive fauna present.	Probability: Unlikely Consequence: Low Magnitude: Low Risk
Radon.	Human Health – Future residents and site visitors.	Permeation through ground floor.	Unlikely - No protection measures required.	Probability: Unlikely Consequence: Medium Magnitude: Low Risk

7 Conclusions and Recommendations

7.1 Geotechnical Risks

The potential for geotechnical hazards are summarised in Table 6 and 7.

7.1.1 RH Lands

Table 6: Summary of Geotechnical Hazards – RH Lands

Potential Geological Hazard	Impact on proposed development	Likelihood of presence
Deep Made Ground	High	Unlikely
Buried structures	Moderate	Unlikely
Compressible ground	Moderate	Unlikely
Shrinking / swelling clay	Moderate	Unlikely
Collapsible ground	High	Unlikely
Aggressive ground conditions for concrete	Low	Unlikely
Running sands / excavation instability	Moderate	Unlikely
High water table / groundwater inflows.	High	Possible
Slope stability	Moderate	Unlikely
Underground mining	High	Unlikely
Ground dissolution / natural cavities	High	Unlikely

In summary:

- Conventional spread foundations likely to be suitable for the proposed development.
- The near surface soils are not anticipated to be shrinkable and foundations are therefore unlikely to require deepening in the vicinity of trees.
- Ground bearing ground floor slab may be suitable.
- The soils anticipated to be present may be sufficiently permeable to allow soakaway drainage to be used, however shallow groundwater may be present.

7.1.2 Persimmon Lands

Table 7: Summary of Geotechnical Hazards – Persimmon Lands

Potential Geological Hazard	Impact on proposed development	Likelihood of presence
Deep Made Ground	High	Possible – localised in areas of filling
Buried structures	Moderate	Unlikely
Compressible ground	Moderate	Unlikely
Shrinking / swelling clay	Moderate	Possible within central area associated with weathered mudstone
Collapsible ground	High	Unlikely
Aggressive ground conditions for concrete	Low	Unlikely
Running sands / excavation instability	Moderate	Unlikely
High water table / groundwater inflows.	High	Possible in low lying east of site
Slope stability	Moderate	Unlikely
Underground mining	High	Unlikely
Ground dissolution / natural cavities	High	Unlikely

In summary;

- Conventional spread foundations should be suitable though local deepening and or reinforcement may be required in areas affected by filling.
- The near surface soils may, in the central area, be shrinkable and foundations are therefore likely to require deepening in the vicinity of existing, felled or proposed trees. However, it is noted that trees are in general limited to the site boundaries. Elsewhere the near surface soils are not anticipated to be shrinkable and foundations are therefore unlikely to require deepening in the vicinity of trees.
- A suspended ground floor slab may also be required in the central area where mudstones are present. Ground bearing slabs may be suitable elsewhere.

- The granular soils in west and east may be sufficiently permeable to allow soakaway drainage to be used, however shallow groundwater may be present in the low lying east.
- Cohesive soils possible present in central area may not be sufficiently permeable to allow for soakaways

7.2 Land Quality

7.2.1 RH Lands

Soil and Groundwater

The site is considered to be a low risk with regards soil and groundwater contamination.

It appears to have comprised undeveloped land prior, with no evidence of potentially contaminative processes or materials within the site. A rail line is present near the northern boundary of the site, this may have resulted in localised soil contamination.

Radon

The Groundsure report states that the site is in an area where the estimated probability of homes being above the action level of 200Bqm^{-3} is less than 1%. Therefore, no radon protective measures are required in the construction of new buildings

Landfill Gas

No sources of ground gas identified. Risks are therefore considered low and no further monitoring or assessment is considered warranted.

7.2.2 Persimmon Lands

The site is considered to be a moderate risk with regards soil and groundwater contamination. Potential sources of contamination identified are outlined below.

- Localised fill materials with the potential to contain metals, PAHs TPHs, and asbestos containing materials (ACM).
- Hydrocarbons, including VOCs in the area abutting the petrol station.

- Former landfill to west of site.

Radon

The Groundsure report states that the site is in an area where the estimated probability of homes being above the action level of 200Bqm³ is less than 1%. Therefore, no radon protective measures are required in the construction of new buildings

Landfill Gas

A landfill is present on the east of the site. This has the potential to result in the generation of asphyxiate and or explosive atmospheres, the potential for these to migrate east beneath the Persimmon land cannot be discounted.

8 Notes, Limitations and Uncertainties

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This report has been prepared by HBS with all reasonable skill, care and diligence, and taking account of the manpower and resources devoted to it by agreement with the Client.

The report and /or opinion will be prepared for the specific purpose stated in the document and in relation to the nature and extent of proposals made available to us at the time of your enquiry. The recommendations should not be used for other schemes on or adjacent to the site without further reference to HBS. The assessment of the factual data will be provided to assist the client and his Engineer and/or advisors in the preparation of their designs.

It should be noted that the levels of risk identified in this report are perceived risks based on the information reviewed. No physical investigation or testing has been carried out; actual risks can only be assessed following a physical investigation of the site. Further work, including physical investigation, laboratory testing and ground gas monitoring may be required by the appropriate regulators to confirm actual conditions.

The information reviewed should not be considered exhaustive and has been accepted in good faith as providing true representative data with respect to site conditions. Should additional information become available that may influence the opinions expressed in this report, HBS reserves the right to review such information and, if warranted, to alter the opinions accordingly.

The evaluation and conclusions do not preclude the existence of other site conditions and contamination, which could not reasonably have been revealed by the site

investigation works undertaken at the time of writing. This report should be used for information purposes only and should not be construed as a comprehensive characterisation of all site conditions or potential contaminants.

The economic viability of the proposals referred to in the report, or of the solutions put forward to any problems encountered, will depend on very many factors in addition to geotechnical considerations hence its evaluation will be outside the scope of the report.

Persimmon Homes Severn Valley and Robert Hitchins Limited
Land at Draycott, Cam
01-12-104884/DSR1

Appendix A

Site Plan

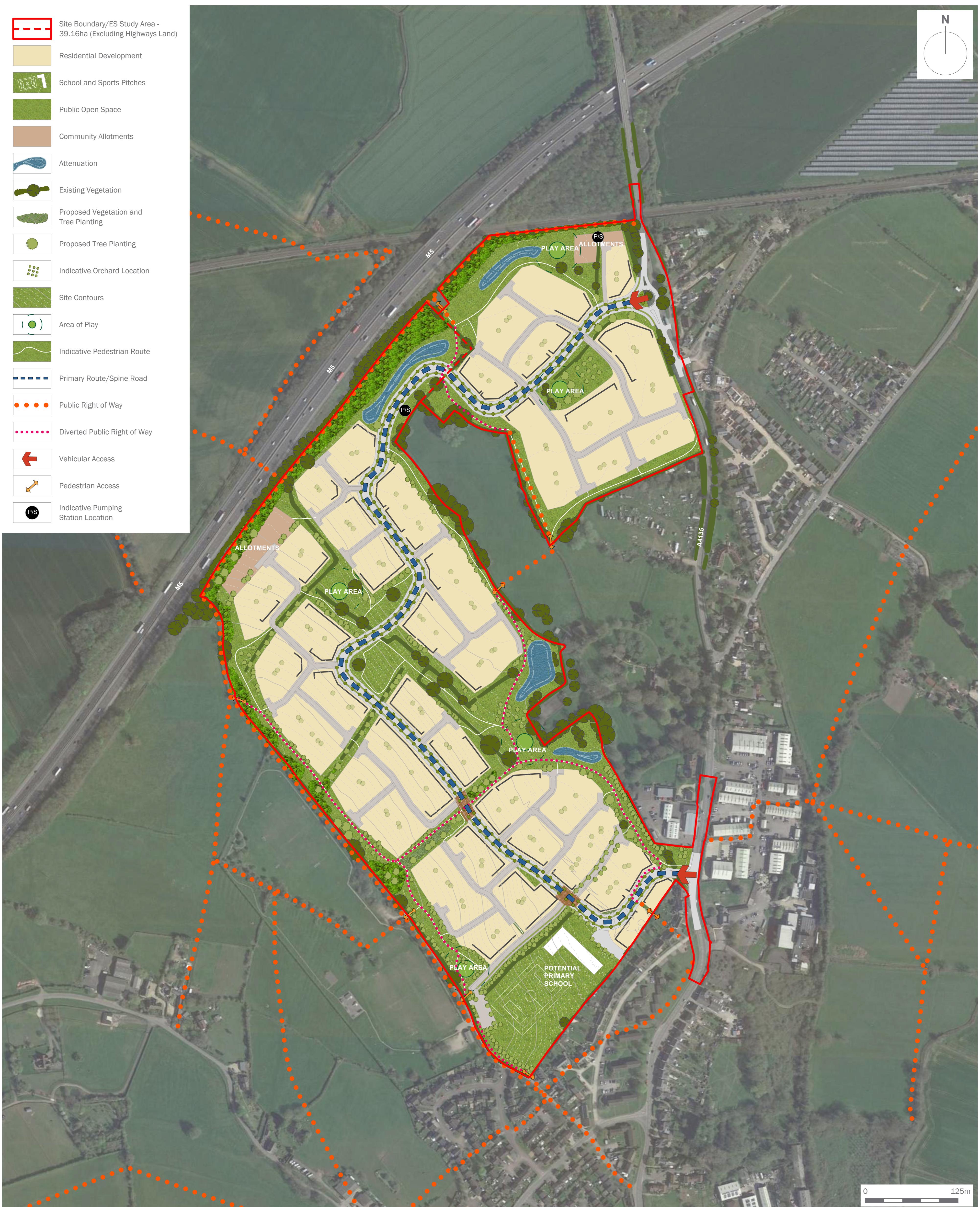


Appendix B

Proposed Development Plan

Land at Draycott, Cam

Framework Plan



Appendix C

Historic Maps



Site Details:

LAND NORTH OF MILLWOOD
PETROL FILLING STATION,
DRAYCOTT, CAM, GL11 5DH

Client Ref: PO01040464
Report Ref: GS-6683457
Grid Ref: 374517, 201519

Map Name: County Series

Map date: 1882-1885

Scale: 1:10,560

Printed at: 1:10,560



Surveyed 1879
Revised N/A
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1882
Revised N/A
Edition 1885
Copyright N/A
Levelled N/A

Surveyed 1882
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Edition N/A
Copyright N/A
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Surveyed 1882
Revised 1882
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Copyright N/A
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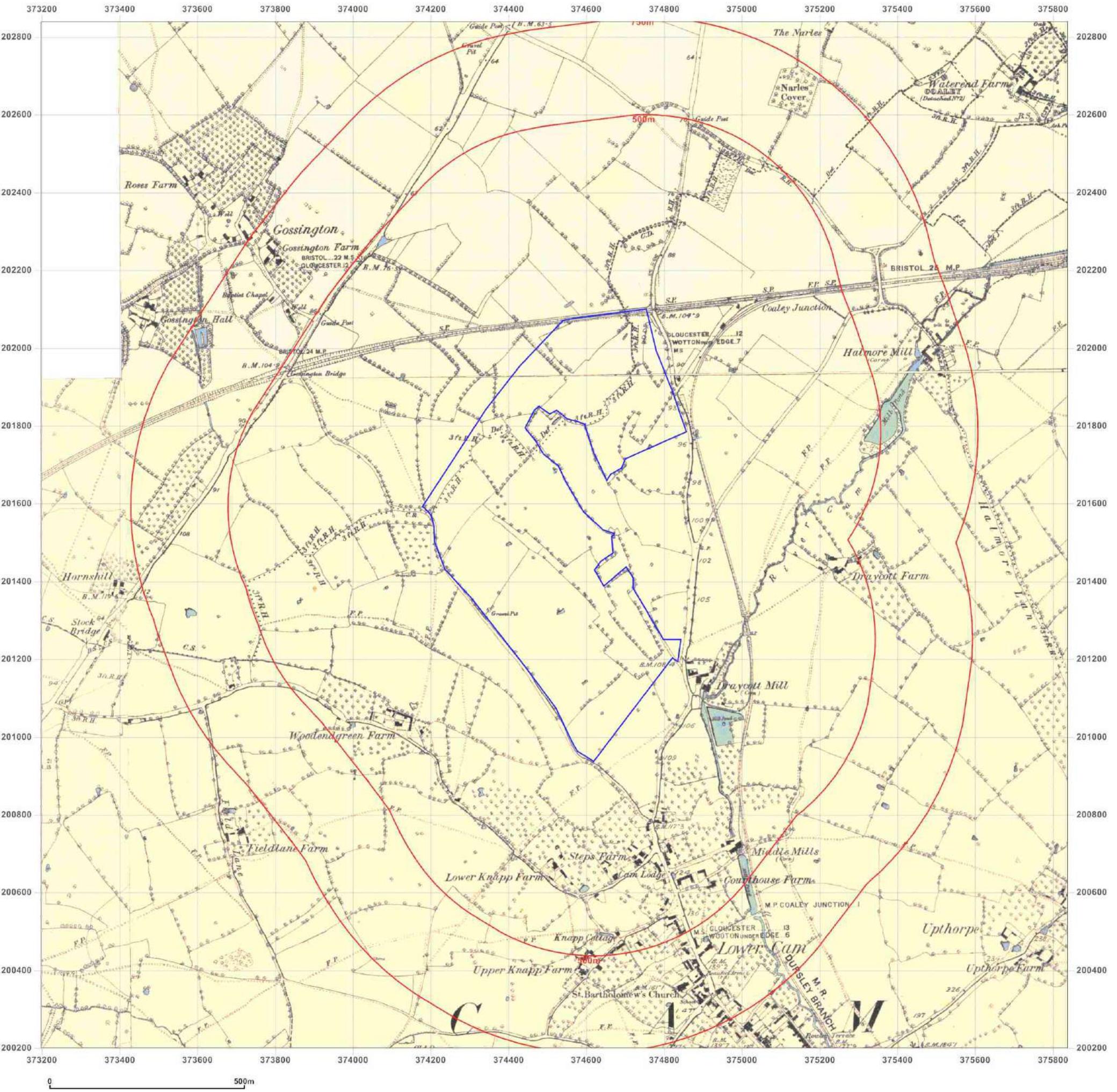


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Production date: 13 March 2020

Map legend available at:
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Site Details:

LAND NORTH OF MILLWOOD PETROL FILLING STATION,
DRAYCOTT, CAM, GL11 5DH

Client Ref: PO01040464
Report Ref: GS-6683457
Grid Ref: 374517, 201519

Map Name: County Series

Map date: 1882-1886

Scale: 1:10,560

Printed at: 1:10,560



Surveyed 1882
Revised 1882
Edition N/A
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Surveyed 1882
Revised N/A
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1882
Revised N/A
Edition 1885
Copyright N/A
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Site Details:

LAND NORTH OF MILLWOOD PETROL FILLING STATION,
DRAYCOTT, CAM, GL11 5DH

Client Ref: PO01040464
Report Ref: GS-6683457
Grid Ref: 374517, 201519

Map Name: County Series

Map date: 1901-1903

Scale: 1:10,560

Printed at: 1:10,560



Surveyed 1881
 Revised 1903
 Edition N/A
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Surveyed 1881
 Revised 1903
 Edition N/A
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 Levelled N/A

Surveyed 1881
 Revised 1901
 Edition N/A
 Copyright N/A
 Levelled N/A

Surveyed 1881
 Revised 1903
 Edition N/A
 Copyright N/A
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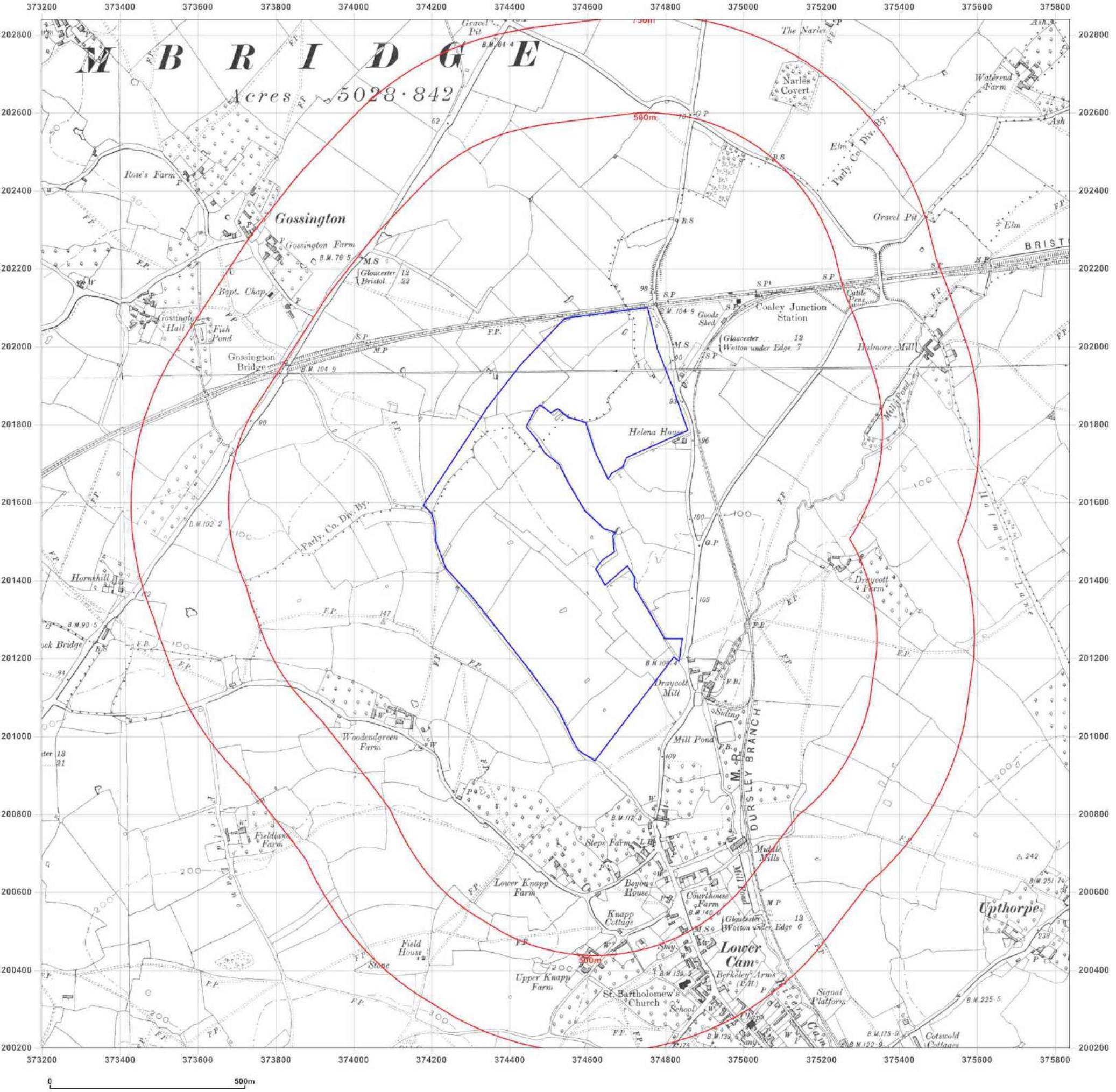


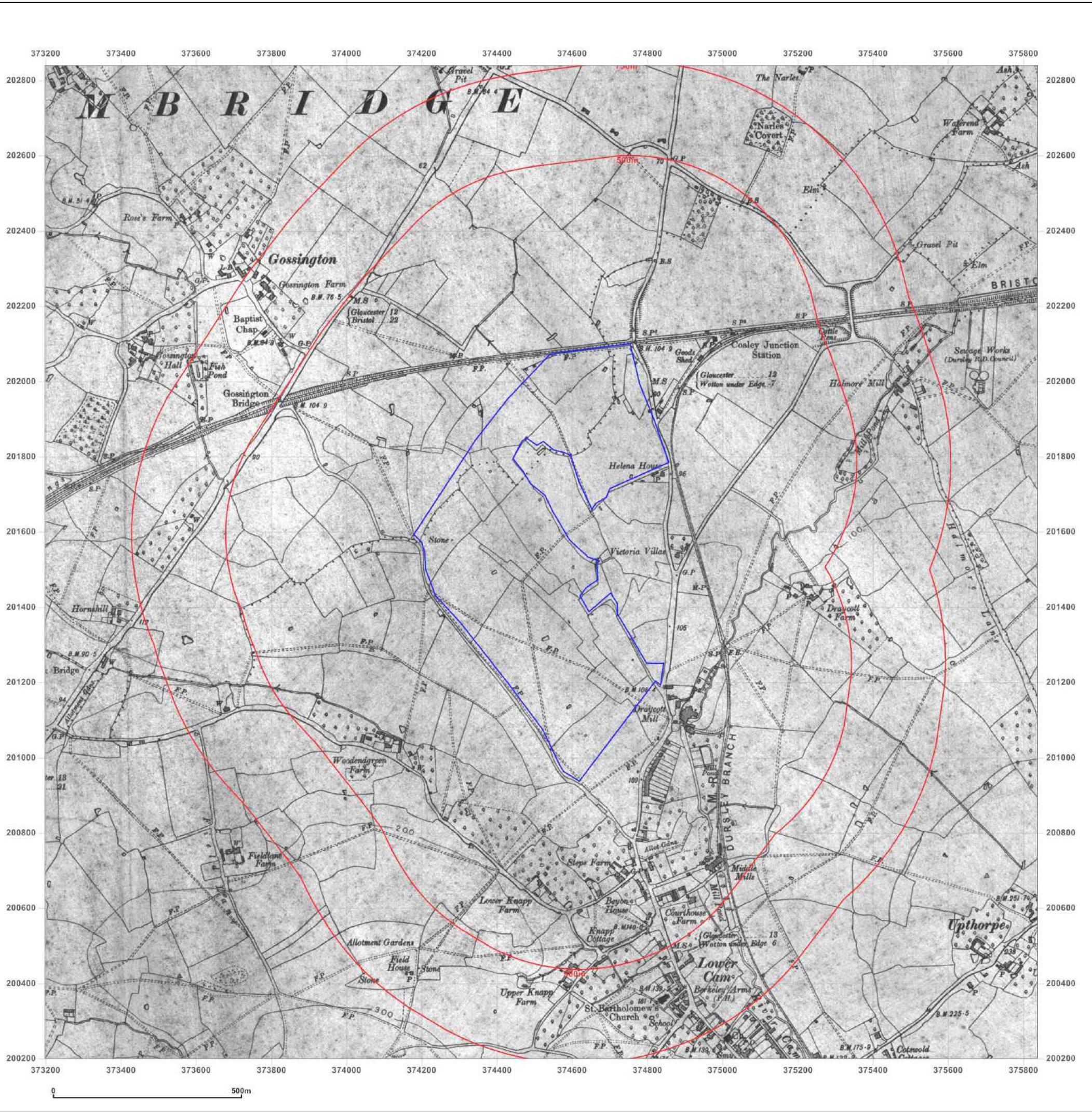
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Site Details:

LAND NORTH OF MILLWOOD
PETROL FILLING STATION,
DRAYCOTT, CAM, GL11 5DH

Client Ref: PO01040464
Report Ref: GS-6683457
Grid Ref: 374517, 201519

Map Name: County Series

Map date: 1924

Scale: 1:10,560

Printed at: 1:10,560



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Revised 1924
Edition N/A
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Site Details:

LAND NORTH OF MILLWOOD PETROL FILLING STATION,
DRAYCOTT, CAM, GL11 5DH

Client Ref: PO01040464
Report Ref: GS-6683457
Grid Ref: 374517, 201519

Map Name: Provisional

Map date: 1949-1954

Scale: 1:10,560

Printed at: 1:10,560



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