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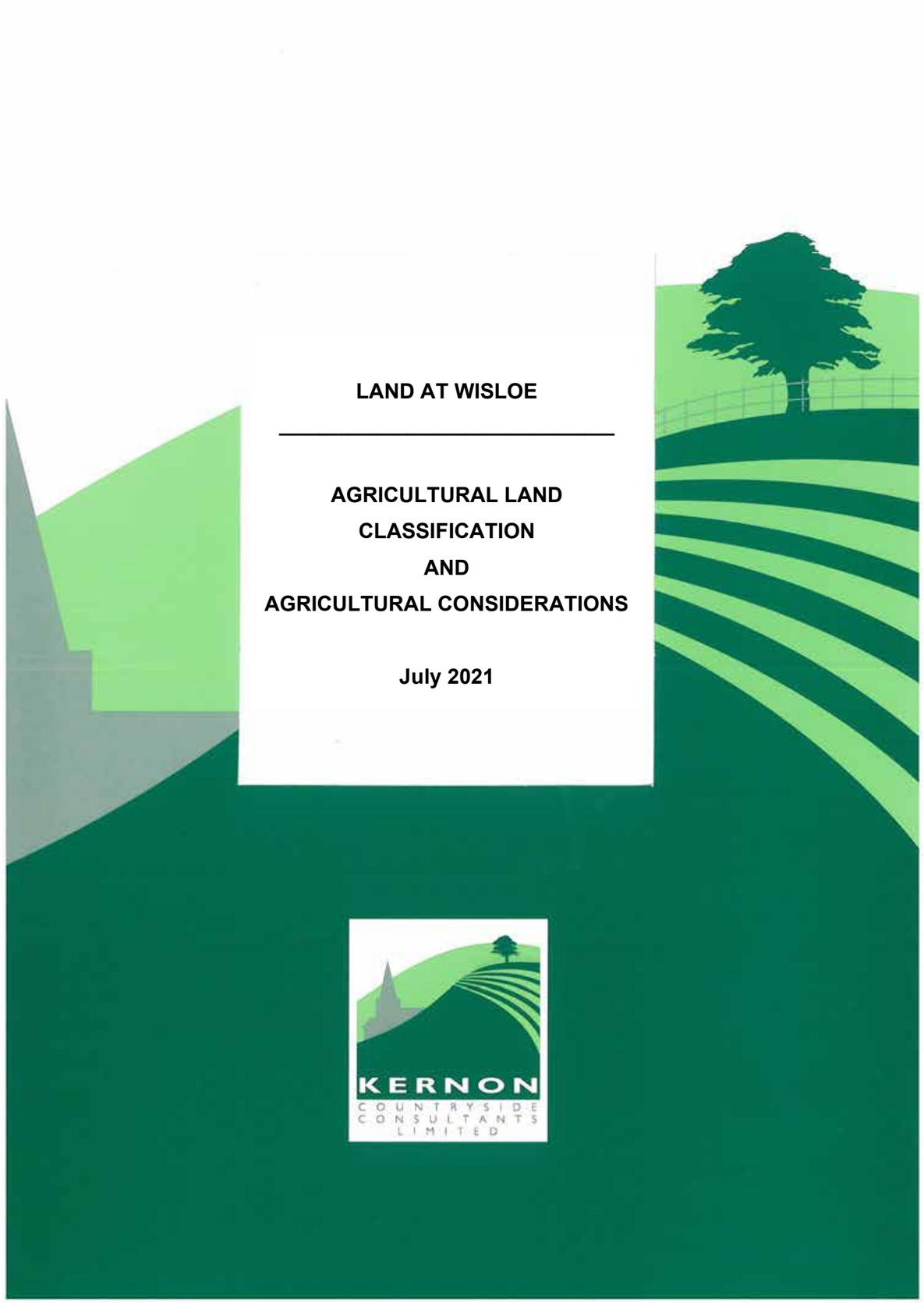
Kernon Countryside Consultants Limited



LAND AT WISLOE

AGRICULTURAL LAND CLASSIFICATION AND AGRICULTURAL CONSIDERATIONS

July 2021

Authorised By APK 07/21

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CONTENTS

1 INTRODUCTION

1.1 This report sets out the findings of a detailed Agricultural Land Classification of approximately 77 ha at Wisloe, and sets those findings in the context of planning policy of relevance, and of land quality generally in the area.

1.2 The land surveyed is under a mixture of land uses, at present mostly agricultural and equestrian. The land is shown on the Google Earth image below, edged in red.

Insert 1: The Site

1.3 As described in this report, the detailed Agricultural Land Classification (ALC) survey has identified that the majority of the land falls into ALC Grade 2 “very good quality” agricultural land.

1.4 As also described in this report, much of the area is of similar quality.

1.5 This report:

(i) describes planning policy of relevance in section 2;

(ii) sets out the ALC field work and analysis, and the findings, in section 3;

(iii) and assesses the implications in policy terms in section 4.

1.6 The report is written by Tony Kernon. I am a Chartered Surveyor and a Fellow of the British Institute of Agricultural Consultants. I have specialised in assessing the effects of development on agricultural land and businesses since 1987.

2 PLANNING POLICY OF RELEVANCE

National Planning Policy

2.1 The National Planning Policy Framework (NPPF) was most recently revised in February 2019, and accordingly forms the starting point.

2.2 Paragraph 170 notes that planning policies and decisions should contribute to and enhance the natural and local environment by, inter alia, recognising "**the wider benefits from natural capital and ecosystem services – including the economic and other benefits of the best and most versatile agricultural land**".

2.3 The best and most versatile (BMV) agricultural land is defined in Annex 2 of the NPPF as that in grades 1, 2 and 3a of the Agricultural Land Classification.

2.4 Paragraph 171 deals with plan making. It requires plans to, inter alia, allocate land with the least environmental or amenity value, where consistent with other policies in the Framework. Footnote 53 of the NPPF identifies that "**where significant development of agricultural land is demonstrated to be necessary, areas of poorer quality land should be preferred to those of a higher quality**".

2.5 There is no definition of what constitutes "significant" development. However the "Guide to assessing development proposals on agricultural land" (Natural England, January 2018) advises local planning authorities to "**take account of smaller losses (under 20 hectares) if they're significant when making your decision**", suggesting that 20 ha is a suitable threshold for defining "significant" in many cases.

Local Plan Policy

2.6 There is no policy that specifically addresses the use of agricultural land for non-agricultural development within the current Local Plan (2015).

3 AGRICULTURAL LAND QUALITY

The ALC System

3.1 The Agricultural Land Classification (ALC) system provides a framework for classifying land according to the extent to which its physical or chemical characteristics impose long-term limitations on agricultural use. The ALC system divides agricultural land into five grades. Grade 1 of the ALC is described as being of excellent quality and Grade 5, at the other end of the scale, is described as being of very poor quality. The current guidelines and criteria for ALC were published by the Ministry of Agriculture, Fisheries and Food (MAFF) in 1988 ('Agricultural Land Classification of England and Wales: Revised Guidelines and Criteria for Grading the Quality of Agricultural Land'[1]).

3.2 The ALC system and methodology is described in Natural England's Technical Information Note 049 (second edition), reproduced in **Appendix KCC1**.

3.3 TIN 049 explains that current estimates are that Grades 1 and 2 together form about 21% of all farmland in England, and subgrade 3a also covers about 21%, such that 42% of farmland is of BMV quality.

3.4 TIN 049 also explains that to determine the land quality of any particular site it is necessary to carry out a field survey.

ALC Survey Results

3.5 The site was surveyed in April and June 2021. To accord with the MAFF ALC Guidelines, we aimed for a regular 100 metre survey pattern. In this case some points were moved slightly to avoid hedges or other fixed features. A gas pipeline runs under the site and we left a wide tranch of land unsurveyed to avoid the pipe. The location of auger points is shown on **Plan KCC3027/01**. As set out in the schedules in **Appendix KCC2**, no records were taken at those points within the pipeline exclusion zone.

3.6 The survey identified that there are no gradient, micro-relief or flooding limitations to land quality. The majority of the site is covered by a very slightly stony, calcareous medium-clay-loam or heavy-clay-loam soil over a heavy-clay or clay subsoil. These soils are limited by both soil wetness and soil droughtiness to Grade 2.

[1] Agricultural Land Classification of England and Wales: Revised Guidelines and Criteria for Grading the Quality of Agricultural Land', October, 1988. The Ministry of Agriculture, Fisheries and Food (MAFF) was incorporated within the Department for Environment, Food and Rural Affairs (Defra) in June 2001

3.7 Some parts of the site are limited to Subgrade 3a where soils are heavier, and two fairly small areas fall into Subgrade 3b due to wetness limitations.

3.8 The survey found that the majority of the site comprises of land that falls into MAFF ALC Grade 2 “very good” quality. There is an area of Subgrade 3a “good quality” in part of the site, and the northern part and very southern tip of the site fall into ALC Subgrade 3b “moderate quality”.

3.9 The distribution of ALC grades is shown on **Plan KCC3027/02**. The proportion of land within each grade is shown below.

Table 1: Proportion of ALC Grades Across the Site

Grade	Description	Area (ha)	Area (%)
2	Very good	59.9	77.9
3a	Good	5.3	6.9
3b	Moderate	3.9	5.1
N/A	Non-agricultural	1.5	2.0
U/S	Unsurveyed	6.3	8.1
Total		**76.9**	**100**

4 ASSESSMENT

4.1 Planning policy in the NPPF sets out that development management decisions should recognise the economic and other benefits of the best and most versatile agricultural land.

4.2 In the context of plan making the NPPF sets out that land should be allocated with the least environmental value. The footnote to paragraph 171advises that, where significant development of agricultural land is demonstrated to be necessary, poorer quality land should be used in preference.

4.3 Whether or not development is necessary is beyond the scope of this report. This assessment assumes that there is a need for the development.

4.4 This assessment also refers only to agricultural land quality, which is only one consideration in the planning balance. The NPPF requires that the Framework should be read as a whole (paragraph 3) and this report provides information to aid the balancing exercising of decision taking. It does not seek to reach conclusions on the merits of development of any particular site.

4.5 In this analysis I consider:

- land quality in the area generally and whether poorer quality land is available;
- whether, in plan making terms, this is significant development;
- what the economic benefits are in broad terms;
- what other land, and of what quality, is available;
- and the weight to be given to the loss of agricultural land in this context.

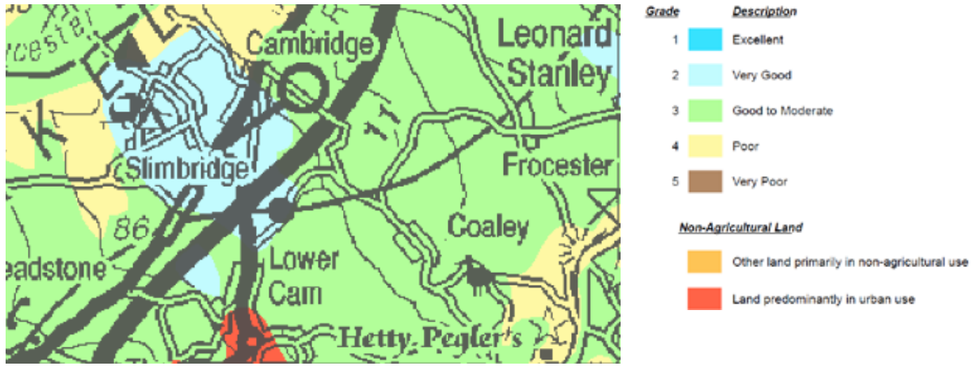
Land Quality in the Local Context

4.6 Any assessment of the significance of losing agricultural land needs to be made in context. Across England an estimated 42% of all farmland is within Grades 1, 2 and 3a (see TIN049, **Appendix KCC1).** Accordingly BMV agricultural land is not a rare resource.

4.7 Statistically about 40% of Grade 3 land falls within Subgrade 3a. However, in parts of the country the proportion is expected to be much higher.

4.8 The old “provisional” ALC maps are of limited use, as explained in TIN 049. They show the site to comprise of Grade 2 surrounded by undifferentiated Grade 3, as shown below.

Insert 2: Provisional ALC Map Extract



4.9 In 2017 Natural England published maps that predict the proportion of land that will be of best and most versatile quality. They have divided the country into three categories:

- low, where less than 20% of land is expected to be of BMV quality;
- medium, where 20-60% of the area is expected to be BMV;
- and high, where more than 60% of land is predicted to be of BMV quality.

4.10 An extract from the predictive BMV map is reproduced below. This shows that the site area is predicted to fall into the "**high likelihood of BMV (>60% area bmv)**" category.

Insert 3: Extract from Predictive BMV Map

4.11 As set out in TIN049 (**Appendix KCC1**) the provisional maps are not sufficiently reliable for site specific use. It is stated that "**these maps are not sufficiently accurate for use in assessment of individual fields or development sites, and should not be used other than as general guidance**". For plan making and planning decisions it is necessary to obtain survey data. TIN049 notes that "**planning authorities should ensure that sufficient detailed site specific ALC survey data is available to inform decision making**".

4.12 Where survey data has been carried out by Defra (or its predecessors or agencies) it is available on www.magic.gov.uk. There is no survey data for this site, but a large area of land to the south east around Cam has been surveyed. It was found to comprise a mixture of mostly Grade 2, Subgrades 3a and 3b and Grade 4, as set out in **Appendix KCC3**.

4.13 As noted earlier, a detailed ALC has been carried out for this site. The detailed ALC survey shows the site to comprise a mix of Grades 2, 3a and 3b, although mostly the site is Grade 2.

Whether This is "Significant Development"

4.14 In the context of plan making, paragraph 171 of the NPPF advises that plans should allocate land with the least environmental or amenity value, consistent with other policies in the Framework. The footnote (53) advises that "**where significant development of agricultural land is demonstrated to be necessary, areas of poorer quality land should be preferred to those of a higher quality**". Local Plan policy 21 takes a similar approach.

4.15 Paragraphs 170 and 171 of the NPPF consider whether poorer quality land is available, with the trigger for assessment being that the proposal involves "**significant development of agricultural land**". What is "**significant development**" is not defined in the NPPF. One threshold for determination of what is significant is the threshold for consultation with Natural England, which is set at the loss of 20 ha or more of BMV land (see TIN049 in **Appendix KCC1**). This has been the threshold for consultation with MAFF since 1987.

4.16 Accordingly this is significant development of agricultural land in policy terms.

Economic Implications

4.17 The NPPF requires recognition of the economic and other benefits of BMV land. There is no published research to assess the economic benefits of BMV land relative to non-BMV land (eg increased crop yield, for example). Accordingly any estimates can only be done in broad and somewhat crude terms.

4.18 Taking published budget books and using the crude measure (for winter wheat and a grazing livestock use) of the difference between average and high performance, the differences are shown below. The figures are taken from the Farm Management Pocketbook (2020).

Table 2: Assessment of Economics of Farmed Land

Item	Winter Wheat		Single – Suckle autumn calving suckler cows	
	Average	High	Average	High
Yield	8.7t/ha	10.0t/ha	1.65t/ha	2.0t/ha
Gross Margin / £/ha	£815	£1010	£217	£430
Fixed costs [1] £/ha	£715	£715	£645[2]	£645
Profit (loss) /ha before labour	£100	£295	(£428)	(215)
Unpaid labour £/ha	£220	£220	£390	£390
Profit (loss) after unpaid labour	(£120)	£75	(£818)	(£605)
Uplift £/ha	--	£195	-	£213

[1]Mainly cereals, under 200 ha, excluding unpaid labour

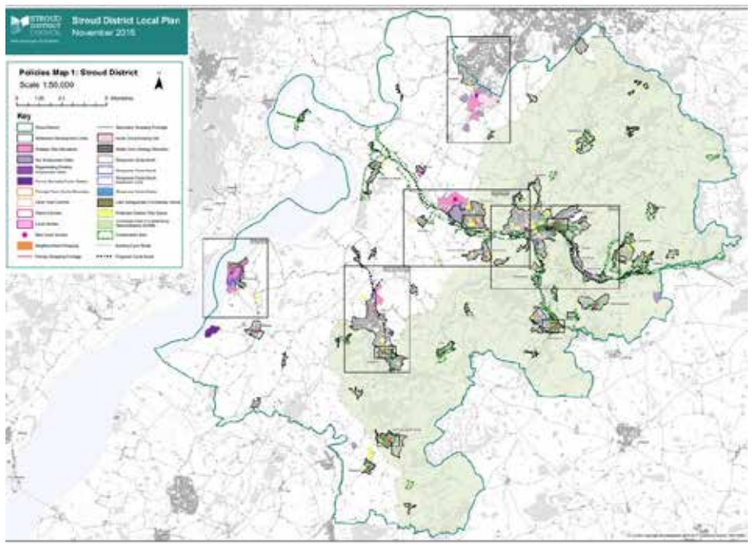
[2] Mainly sheep / cattle (lowland) farms 90-125 ha, including unpaid labour

4.19 A significant part of the site is used for grazing horses, where there is unlikely to be any economic benefit gained from the BMV/non-BMV differentiation, although grass sward damage from hooves may be less. However, for the purposes of determining an order-of-magnitude economic analysis, the economic benefit of 65.2 ha of agricultural land would be £12,700 to £13,900. This is a modest sum, therefore.

Whether Poorer Quality Land is Available

4.20 As a District, Stroud encompasses generally level or gently undulating land beside the Severn and more sloping land (much of which falls within the Cotswold Hills AONB) in the east, as shown below on an extract from the Local Plan Policies Map.

Insert 4: Local Plan (2015) Policies Map 1



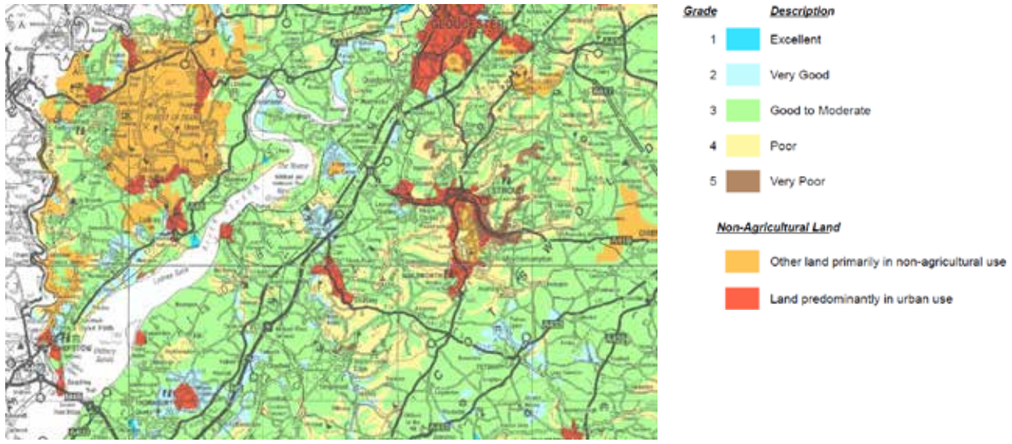
4.21 Statistics from the "provisional" MAFF ALC maps from the 1970s record that, based on the provisional maps, most of the district is undifferentiated Grade 3. The proportion of agricultural land is as follows. These maps were produced before Grade 3 was subdivided, and under a system of ALC which has since been revised.

Table 3: Proportion of ALC Grades Across the District

Grade	Proportion (%)
1	0
2	5.9
3	69.0
4	23.0
5	2.1

4.22 Taking a District-wide view, the Provisional map is shown below.

Insert 5: Provisional ALC Map Extract



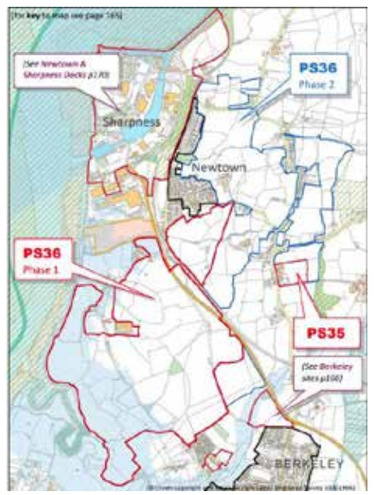
4.23 In 2017 Natural England produced maps which show the likelihood of BMV in different areas, as shown for the site earlier. Across the District the majority of land falls into the "low (<20% area bmv)" or "moderate (20 – 60% area bmv)" categories.

Insert 6: Predictive ALC Map Extract

4.24 In respect of the Stroud District Local Plan Review (Presubmission Draft Plan 2021) we have considered the availability of detailed ALC information for PS36 Sharpness and land at Cam (PS24).

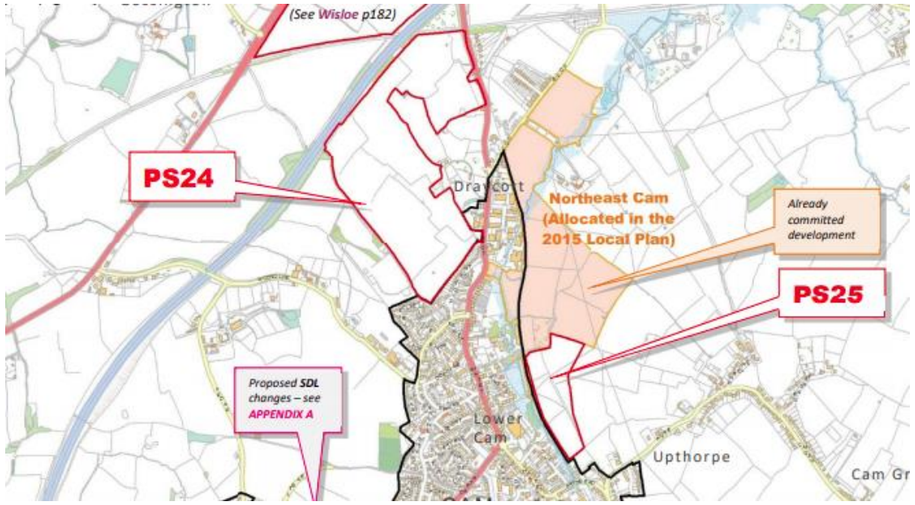
4.25 There is limited ALC information available for the Sharpness area. On the provisional maps the PS36 allocation is shown as undifferentiated Grade 3. On the predictive BMV maps the site is shown as of a "**high likelihood of BMV land (>60% area bmv)**". Available survey data identifies that a small part of the site, the only area for which available data exists, falls into ALC Grade 2, see **Appendix KCC4**. An extract from the Presubmission Local Plan is shown below, alongside an extract from the predictive BMV map.

Insert 7: Predicted ALC for Sharpness Area



4.26 The committed development at northeast Cam, see below, has been permitted on a mixture of Grades 2, 3a and 3b land, as shown in **Appendix KCC3** (compared to the extract below). The Cam presubmission PS24 and PS25 sites (see below) are proposed mostly on Subgrade 3a land, see **Appendix KCC3**.

Insert 8: Extract Showing Cam Sites (extract from Presubmission Local Plan)



4.27 This analysis indicates that despite the apparent availability of land of generally lower quality district-wide, when it comes to identifying sites that meet other development management considerations (eg transport connectivity and sustainability, flooding, landscape, need etc) other sites appear similarly to involve, or be likely to involve, land of BMV quality.

4.28 The NPPF paragraph 170 makes reference to protecting soils. Where BMV land does need to be developed, detailed design consideration should be given to retaining or reusing the soil resource, especially the topsoil, within the site if possible. Guidance from Defra's "Construction Code of Practice for the Sustainable Use of Soils on Construction Sites" (2009) should be followed where possible.

5 SUMMARY AND CONCLUSIONS

5.1 The site extends to 77 ha of agricultural and equestrian grazing land.

5.2 On the provisional MAFF ALC maps the site is shown as Grade 2. On the predictive best and most versatile maps the site is shown as falling into the “high likelihood of BMV land (>60% area bmv)”.

5.3 Detailed ALC survey identifies this to be the case, with the majority of the site comprising land of Grade 2, with small areas of Subgrades 3a and 3b.

5.4 Therefore development of this area involves significant development of BMV agricultural land.

5.5 In a plan making context the policy in the NPPF (paragraph 171 footnote 53) is, where there is a choice between sites, to use land of poorer quality in preference.

5.6 This is not a bar to development of agricultural land, but the existence of significant areas of BMV must be taken into account, and there is preference towards using areas of poorer quality.

5.7 Presubmission allocation proposals at Sharpness involve land shown (similarly to Wisloe) as falling into the “high likelihood of BMV (>60% area bmv)”. Only a small area of survey data is available, but that identified Grade 2. Therefore this would use significant areas of BMV land, it is predicted.

5.8 Existing and proposed allocations on the edge of Cam utilise land of Grades 2, 3a and 3b, and accordingly significant areas of BMV land. The emerging proposed allocations are mostly of subgrade 3a.

5.9 This report therefore sets out the land quality of the site, identities the order of magnitude of the economic benefits involved, and reviews the apparent lack of availability of land of poorer quality that could be used in preference.

APPENDIX KCC1
Natural England Technical Information Note TIN049

Natural England Technical Information Note TIN049

Agricultural Land Classification: protecting the best and most versatile agricultural land

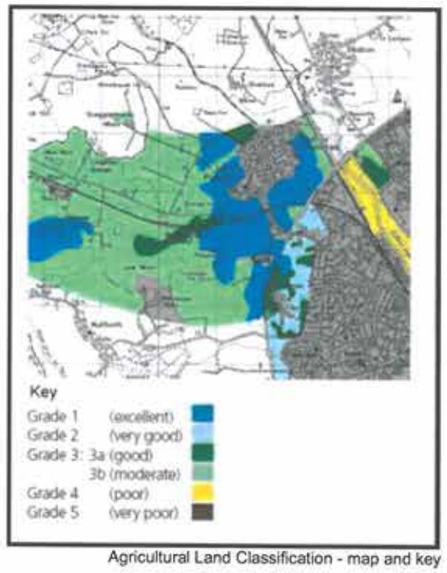
Most of our land area is in agricultural use. How this important natural resource is used is vital to sustainable development. This includes taking the right decisions about protecting it from inappropriate development.

Policy to protect agricultural land

Government policy for England is set out in the National Planning Policy Framework (NPPF) published in March 2012 (paragraph 112). Decisions rest with the relevant planning authorities who should take into account the economic and other benefits of the best and most versatile agricultural land. Where significant development of agricultural land is demonstrated to be necessary, local planning authorities should seek to use areas of poorer quality land in preference to that of higher quality. The Government has also re-affirmed the importance of protecting our soils and the services they provide in the Natural Environment White Paper The Natural Choice:securing the value of nature (June 2011), including the protection of best and most versatile agricultural land (paragraph 2.35).

The ALC system: purpose & uses

Land quality varies from place to place. The Agricultural Land Classification (ALC) provides a method for assessing the quality of farmland to enable informed choices to be made about its future use within the planning system. It helps underpin the principles of sustainable development.



Agricultural Land Classification - map and key

Second edition 19 December 2012
www.naturalengland.org.uk

NATURAL ENGLAND

The ALC system classifies land into five grades, with Grade 3 subdivided into Subgrades 3a and 3b. The best and most versatile land is defined as Grades 1, 2 and 3a by policy guidance (see Annex 2 of NPPF). This is the land which is most flexible, productive and efficient in response to inputs and which can best deliver future crops for food and non food uses such as biomass, fibres and pharmaceuticals. Current estimates are that Grades 1 and 2 together form about 21% of all farmland in England; Subgrade 3a also covers about 21%.

The ALC system is used by Natural England and others to give advice to planning authorities, developers and the public if development is proposed on agricultural land or other greenfield sites that could potentially grow crops. The Town and Country Planning (Development Management Procedure) (England) Order 2010 (as amended) refers to the best and most versatile land policy in requiring statutory consultations with Natural England. Natural England is also responsible for Minerals and Waste Consultations where reclamation to agriculture is proposed under Schedule 5 of the Town and Country Planning Act 1990 (as amended). The ALC grading system is also used by commercial consultants to advise clients on land uses and planning issues.

Criteria and guidelines

The Classification is based on the long term physical limitations of land for agricultural use. Factors affecting the grade are climate, site and soil characteristics, and the important interactions between them. Detailed guidance for classifying land can be found in: *Agricultural Land Classification of England and Wales: revised guidelines and criteria for grading the quality of agricultural land* (MAFF, 1988):

- **Climate:** temperature and rainfall, aspect, exposure and frost risk.
- **Site:** gradient, micro-relief and flood risk.
- **Soil:** texture, structure, depth and stoniness, chemical properties which cannot be corrected.

The combination of climate and soil factors determines soil wetness and droughtiness. Wetness and droughtiness influence the choice of crops grown and the level and consistency of yields, as well as use of land for grazing livestock. The Classification is concerned with the inherent potential of land under a range of farming systems. The current agricultural use, or intensity of use, does not affect the ALC grade.

Versatility and yield

The physical limitations of land have four main effects on the way land is farmed. These are:

- the range of crops which can be grown;
- the level of yield;
- the consistency of yield; and
- the cost of obtaining the crop.

The ALC gives a high grading to land which allows more flexibility in the range of crops that can be grown (its 'versatility') and which requires lower inputs, but also takes into account ability to produce consistently high yields of a narrower range of crops.

Availability of ALC information

After the introduction of the ALC system in 1966 the whole of England and Wales was mapped from reconnaissance field surveys, to provide general strategic guidance on land quality for planners. This Provisional Series of maps was published on an Ordnance Survey base at a scale of One Inch to One Mile in the period 1967 to 1974. These maps are not sufficiently accurate for use in assessment of individual fields or development sites, and should not be used other than as general guidance. They show only five grades: their preparation preceded the subdivision of Grade 3 and the refinement of criteria, which occurred after 1976. They have not been updated and are out of print. A 1:250 000 scale map series based on the same information is available. These are more appropriate for the strategic use originally intended and can be downloaded from the Natural England **website**. This data is also available on 'Magic', an interactive, geographical information website **http://magic.defra.gov.uk/**.

Since 1976, selected areas have been re-surveyed in greater detail and to revised

Page 2

guidelines and criteria. Information based on detailed ALC field surveys in accordance with current guidelines (MAFF, 1988) is the most definitive source. Data from the former Ministry of Agriculture, Fisheries and Food (MAFF) archive of more detailed ALC survey information (from 1988) is also available on **http://magic.defra.gov.uk/**. Revisions to the ALC guidelines and criteria have been limited and kept to the original principles, but some assessments made prior to the most recent revision in 1988 need to be checked against current criteria. More recently, strategic scale maps showing the likely occurrence of best and most versatile land have been prepared. Mapped information of all types is available from Natural England (see *Further information* below).

New field survey

Digital mapping and geographical information systems have been introduced to facilitate the provision of up-to-date information. ALC surveys are undertaken, according to the published Guidelines, by field surveyors using handheld augers to examine soils to a depth of 1.2 metres, at a frequency of one boring per hectare for a detailed assessment. This is usually supplemented by digging occasional small pits (usually by hand) to inspect the soil profile. Information obtained by these methods is combined with climatic and other data to produce an ALC map and report. ALC maps are normally produced on an Ordnance Survey base at varying scales from 1:10,000 for detailed work to 1:50 000 for reconnaissance survey

There is no comprehensive programme to survey all areas in detail. Private consultants may survey land where it is under consideration for development, especially around the edge of towns, to allow comparisons between areas and to inform environmental assessments. ALC field surveys are usually time consuming and should be initiated well in advance of planning decisions. Planning authorities should ensure that sufficient detailed site specific ALC survey data is available to inform decision making.

Consultations

Natural England is consulted by planning authorities on the preparation of all development plans as part of its remit for the natural environment. For planning applications, specific consultations with Natural England are required under the Development Management Procedure Order in relation to best and most versatile agricultural land. These are for non agricultural development proposals that are not consistent with an adopted local plan and involve the loss of twenty hectares or more of the best and most versatile land. The land protection policy is relevant to all planning applications, including those on smaller areas, but it is for the planning authority to decide how significant the agricultural land issues are, and the need for field information. The planning authority may contact Natural England if it needs technical information or advice.

Consultations with Natural England are required on all applications for mineral working or waste disposal if the proposed afteruse is for agriculture or where the loss of best and most versatile agricultural land agricultural land will be 20 ha or more. Non-agricultural afteruse, for example for nature conservation or amenity, can be acceptable even on better quality land if soil resources are conserved and the long term potential of best and most versatile land is safeguarded by careful land restoration and aftercare.

Other factors

The ALC is a basis for assessing how development proposals affect agricultural land within the planning system, but it is not the sole consideration. Planning authorities are guided by the National Planning Policy Framework to protect and enhance soils more widely. This could include, for example, conserving soil resources during mineral working or construction, not granting permission for peat extraction from new or extended mineral sites, or preventing soil from being adversely affected by pollution. For information on the application of ALC in Wales, please see below.

Natural England Technical Information Note TIN049
Agricultural Land Classification: protecting the best and most versatile agricultural land

Further information

Details of the system of grading can be found in: *Agricultural Land Classification of England and Wales: revised guidelines and criteria for grading the quality of agricultural land* (MAFF, 1988).

Please note that planning authorities should send all planning related consultations and enquiries to Natural England by e-mail to **consultations@naturalengland.org.uk**. If it is not possible to consult us electronically then consultations should be sent to the following postal address:

Natural England
Consultation Service
Hornbeam House
Electra Way
Crewe Business Park
CREWE
Cheshire
CW1 6GJ

ALC information for Wales is held by Welsh Government. Detailed information and advice is available on request from Ian Rugg (**ian.rugg@wales.gsi.gov.uk**) or David Martyn (**david.martyn@wales.gsi.gov.uk**). If it is not possible to consult us electronically then consultations should be sent to the following postal address:

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Rhodfa Padarn
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APPENDIX KCC2

Agricultural Land Classification

AGRICULTURAL LAND CLASSIFICATION

Purpose

1 This appendix sets out the findings of the Agricultural Land Classification (ALC). It is based on a desktop study of relevant published information on climate, topography, geology and soil, in conjunction with a soil survey.

Methodology

2 The work has been carried out by an experienced ALC surveyor who is a Chartered Environmentalist (CEnv) and a Member of the Institute of Agricultural Engineers. The ALC surveyor was formerly a Lead Adviser for Natural England and Senior Adviser in the Department for Environment Food and Rural Affairs (Defra) Rural Development Service, and the former of Ministry of Agriculture, Fisheries and Food (MAFF) Farming and Rural Conservation Agency (FRCA). The ALC surveyor meets the requirements of the British Society of Soil Science (BSSS) Professional Competency Standard (PCS) scheme for ALC (see BSSS PCS Document 2 '*Agricultural Land Classification of England and Wales*'). The BSSS PCS scheme is endorsed, amongst others, Defra, Natural England, the Science Council, and the Institute of Environmental Assessment and Management (IEMA).

3 This assessment is based upon the findings of a study of published information on climate, geology and soil in combination with a soil investigation carried out in accordance with the Ministry of Agriculture, Fisheries and Food (MAFF) [2] '*Agricultural Land Classification of England and Wales: Revised Guidelines and Criteria for Grading the Quality of Agricultural Land*', October, 1988 (henceforth referred to as the 'the ALC Guidelines').

4 The ALC system provides a framework for classifying land according to the extent to which its physical or chemical characteristics impose long-term limitations on agricultural use. The ALC system divides agricultural land into five grades (Grade 1 '*Excellent*' to Grade 5 '*Very Poor*'), with Grade 3 subdivided into Subgrade 3a '*Good*' and Subgrade 3b '*Moderate*'. Agricultural land classified as Grade 1, 2 and Subgrade 3a falls in the '*best and most versatile*' category in Paragraph 112 and Annex 2 of the National Planning Policy Framework (NPPF) of March 2012. Further details of the ALC system and national planning policy implications are set out by Natural England in its Technical Information Note 049.

[2] The Ministry of Agriculture, Fisheries and Food (MAFF) was incorporated within the Department for Environment, Food and Rural Affairs (Defra) in June 2001

5 An ALC survey was completed on 15th April, 19th and 26th June 2021. The ALC survey involved examination of the soil's physical properties at seventy-two locations located on an approximate 100m by 100m grid; this equates to a density of one auger boring per ha. The auger locations of the detailed soil survey are shown on **Plan KCC3027/01**.

6 It should be noted that no auger bores were excavated at locations 42, 48, 49, 58, 61, 63 and 71, as this was determined to be a Utilities and Services Exclusion Zone for health and safety purposes.

7 A sample of topsoil was collected at auger locations 7, 36 and 54 as shown on Plan **KCC3027/01**. All three samples were sent to an accredited laboratory for particle size analysis, i.e. the proportions of sand, silt and clay. This is to determine the definitive texture class of the topsoil, especially with regard to distinguishing between medium clay loams (i.e., <27% clay) and heavy clay loams (27% to 35% clay).

8 The sample locations were located using a hand-held Garmin E-Trec Geographic Information System (GIS) to enable the sample locations to be relocated for verification, if necessary.

9 The soil profile was examined at each sample location to a maximum depth of approximately 1.2 m by hand with the use of a 5 cm diameter Dutch (Edleman) soil auger.

10 The soil profile at each sample location was described using the '*Soil Survey Field Handbook: Describing and Sampling Soil Profiles*' (Ed. J.M. Hodgson, Cranfield University, 1997). Each soil profile was ascribed a grade following the ALC Guidelines.

11 As described in the ALC Guidelines, the main physical factors influencing agricultural land quality are:

- climate;
- site;
- soil; and
- interactive limitations.

12 These factors are considered in turn below.

Climate

13 Interpolated climate data relevant to the determination of the ALC grade of land at the Site is given in Table 1 below.

Table 1: ALC Climate Data for National Grid Reference SO747028

Climate Parameter	Data
Average Altitude (m)	19
Average Annual Rainfall (mm)	786
Accumulated Temperature above 0˚C (January – June)	1511
Moisture Deficit (mm) Wheat	101
Moisture Deficit (mm) Potatoes	94
Field Capacity Days (FCD)	175
Grade according to climate	1

14 With reference to Figure 1 '*Grade according to climate*' on page 6 of the ALC Guidelines, the quality of agricultural land at the Site is not limited by climate. As a result, agricultural land at the Site can be graded as high as Grade 1 in the absence of any other limiting factor (i.e. site and/or soil).

15 Due to the average annual rainfall, agricultural land at the Site is predicted to be at field capacity (i.e. near saturation point) for 175 days per year, mainly over the late autumn, winter and early spring. This will, in combination with topsoil texture, cause an 'interactive limitation' to agricultural land quality at the Site - namely soil wetness (see below).

Site

16 The Site is comprises approximately 72 hectares of agricultural land approximately 1km to the south-east of Slimbridge, Gloucestershire. The Site is located to the south-east of the A38, and is bordered by the River Cam along the northern boundary and by the M5 to the south. The Site is bisected by the A4135.

17 With regard to the ALC Guidelines, agricultural land quality can be limited by one or more of three main site factors as follows:

- gradient;
- micro-relief (i.e. complex change in slope angle over short distances); and
- risk of flooding.

18 **Gradient and Micro-Relief**. The Site is located on a north-east facing slope at an altitude of approximately 27 metres (m) above ordnance datum (AOD) in the south-west and approximately 17mAOD near the River Cam in the northeast. Gradient is not

considered to be a limiting factor to agricultural land quality at this Site as the gradient does not exceed 7° as per Table 1 in the ALC guidelines.

19 Likewise, micro-relief, i.e. complex changes in slope angle and direction over short distances, does not affect the quality of the agricultural land at the Site.

20 **Risk of Flooding**. From a Government Flood Map for Planning[3], most of the Site falls in Flood Zone 1 with a low risk of flooding. Some land flanking the River Cam along the northern boundary falls in Flood Zones 2 and 3. However, there is no evidence (data) available to determine whether or not the frequency and duration of flooding in the north of the Site limits the quality of agricultural land in ALC terms, i.e. Table 2 '*Grade according to flood risk in summer*' and Table 3 '*Grade according to flood risk in winter*' of the ALC Guidelines.

Soil

21 **Geology/Soil Parent Material**. British Geological Survey (BGS) information available online has been utilised to identify the Bedrock underlying the Site and the presence of any Superficial (Drift) Deposits[4]. This provides information on soil forming materials at the Site. The geological information shows the Site is underlain by mudstone in the Blue Lias Formation and Charmouth Mudstone Formation (undifferentiated).

22 Most of the bedrock at the Site is covered superficial deposits of Cheltenham Sand and Gravel. The is a narrow band of Alluvium on land along the River Cam in the north of the Site. The far south-western part of the Site is not covered by superficial deposits, and here the soil is developed directly from the mudstone bedrock.

23 **Published Information on Soil**. Provisional information for soils at the Site was gathered from the Soil Survey of England and Wales (SSEW) soil map of South West England (Sheet 5) at a scale of 1:250,000 and accompanying Bulletin No. 12 '*Soils and their Use in South West England'* (D.C. Findlay *et al,* Harpenden, 1984). The provisional SSEW soils information indicates that most of the agricultural land at the Site is covered by well drained, calcareous and non-calcareous fine loamy soils over limestone gravel in the Badsey 1 Association. The land in the far south-west developed on mudstone has fine loamy over clayey and clayey soils which are slowly permeable and seasonally waterlogged in the Oxpasture Association.

[3] Government Flood Risk for Planning available online @ https://flood-map-for-planning.service.gov.uk/
[4] British Geological Survey 'Geology of Britain Viewer'. Available online @ http://www.bgs.ac.uk/discoveringGeology/geologyOfBritain/viewer.html

24 The SSEW describe how the Badsey 1 Association occurs on level or gently sloping river terraces along the Thames and its tributaries above Oxford, along the Severn and Avon in Worcestershire, Warwickshire and Gloucestershire and along the Yeo, Brue and Avon in Somerset, Avon and Wiltshire. The dominant Badsey soils are brown calcareous earths, mainly well drained and fine loamy with limestone river terrace gravel at shallow depth. Gravel is at shallow depth in Badsey soils, and Sacrewell series occurs where it is even shallower. Most of the river terrace gravels overlie clay at depth. Astrop soils are developed in Head on inter-terrace slope and Oxpasture and Holdenby soils are where the Head is thin over clay. Badsey, Sutton and Sacrewell soils are all well drained (Wetness Class I). Oxpasture and Holdenby soils are occasionally or seasonally waterlogged (Wetness Class II or III).

25 The SSEW describes how the Oxpasture Association occurs where thin fine textured drift covers slowly permeable Jurassic clays, silts and mudstones. The fine loamy over clayey Oxpasture series, stagnogleyic argillic brown earths, predominates and the similar but wetter Wickham series, typical stagnogley soils, is locally extensive. Where the drift is clayey Holdenby soils, typical argillic pelosols, are important. Occasionally the thin drift is absent giving wet stoneless Denchworth series, pelo-stagnogley soils. Oxpasture and Holdenby soils have slowly permeable subsoils and even after appropriate drainage are seasonally waterlogged (Wetness Class III). Wickham and Denchworth soils also have slowly permeable subsoils and are waterlogged for long periods in winter (Wetness Class IV). After suitable drainage treatment the regime is improved (Wetness Class III) in drier districts. Because of the moderate permeability of the topsoils and the slowly permeable subsoils, disposal of excess rain is mainly by lateral flow at shallow depth.

26 **Soil Survey**. From the detailed soil survey carried out on 15th April and 19th and 26th June 2021 it was determined that the majority of the Site is covered by a very slightly stony, calcareous, dark yellowish brown (e.g.10YR3/4) or brown (10YR4/3) medium clay loam or heavy clay loam topsoil, overlying a well drained slightly to moderately stony, calcareous, yellowish brown (e.g. 10YR5/4) heavy clay loam or clay subsoil. In this climate area (175 FCD), the soil profiles, which are not gleyed within 70cm below ground level, and where the top of a slowly permeable layer (SPL) occurs below 80cm below ground level, are placed in Wetness Class I (re Appendix 3 of the ALC Guidelines, October 1988).

27 A log of all the soil profiles recorded on Site is given in **Attachment A**. Three soil pits were excavated near auger-bore locations 1, 35 and 54, respectively, and are described in **Attachment B**.

28 In order to substantiate topsoil texture determined during the ALC survey by hand-texturing, three samples of topsoil were collected over the Site (i.e., Auger Locations 7, 36 and 54). The topsoil samples were sent to an accredited laboratory for analysis of particle size distribution (PSD), based on the British Standard Institution particle size grades. The certificate of analysis is provided as **Attachment C**. The findings of the PSD analysis are shown in Table 2 below.

Table 2: Topsoil Texture (re Table 10, ALC Guidelines)

Topsoil Sample Location (See Plan KCC3027/01)	% sand 0.063-2.0 mm	% silt 0.002-0.063 mm	% clay <0.002 mm	ALC Soil Texture Class
7	21	53	26	Medium Clay Loam
36	32	42	26	Medium Clay Loam
54	32	46	22	Medium Clay Loam

Interactive Limitations

29 From the information above, together with the findings of the detailed soil survey (see Soil Profile Log given as **Attachment A**), it has been determined that the main limiting factor to the quality of agricultural land the Site is soil droughtiness, and occasionally soil wetness in parts of the Site.

30 **Soil Droughtiness**. As shown in the soil profile logs given as **Attachment A**, moisture balance (MB) calculations for the ALC reference crops (winter wheat and maincrop potatoes) have determined that the soil profiles mainly have MB values of between +30mm and +5mm for wheat, and between +10mm and -10mm for potatoes. These profiles are limited by soil droughtiness to Grade 2 (re Table 8 'Grade according to droughtiness' of the ALC Guidelines).

31 **Soil Wetness**. From the ALC Guidelines, a soil wetness limitation exists where '*the soil water regime adversely affects plant growth or imposes restrictions on cultivations or grazing by livestock*'. Agricultural land quality is limited by soil wetness as per Table 3 below (based on Table 6 'Grade According to Soil Wetness – Mineral Soils' in the ALC Guidelines).

Table 3: Predicted ALC Grade According to Soil Wetness

Wetness Class	Texture of the Top 25 cm	151-175 Field Capacity Days
I	Sandy Loam, Sandy Silt Loam Medium Clay Loam*, Medium Silty Clay Loam* Heavy Silty Clay Loam**, Heavy Clay Loam** Clay, Silty Clay	1 1 2 3a
II	Sandy Loam, Sandy Silt Loam Medium Clay Loam*, Medium Silty Clay Loam* Heavy Silty Clay Loam**, Heavy Clay Loam** Clay, Silty Clay	1 2 3a 3b
III	Sandy Loam, Sandy Silt Loam Medium Clay Loam*, Medium Silty Clay Loam* Heavy Silty Clay Loam**, Heavy Clay Loam** Clay, Silty Clay	2 3a 3a 3b
IV	Sandy Loam, Sandy Silt Loam Medium Clay Loam*, Medium Silty Clay Loam* Heavy Silty Clay Loam**, Heavy Clay Loam** Clay, Silty Clay	3a 3b 3b 3b
Key * <27% clay; and ** >27% clay		

32 In climate area with between 151-175 Field Capacity Days (FCD), well-drained soil profiles in Wetness Class I which have heavy clay loam topsoil are slightly limited by soil wetness to Grade 2. Soil profiles at the Site which are waterlogged for long periods in the winter (Wetness Class IV), and which have clay topsoil, are limited by soil wetness to Subgrade 3b in this climate area (i.e., 151-175 FCD).

33 In the far south-west (i.e., auger bore 72), the soil developed in mudstone has clay topsoil over slowly permeable clay subsoil which is seasonally waterlogged for long periods during the winter. This type of soil is limited by soil wetness to Subgrade 3b. Likewise, soil profiles developed in Alluvium adjacent to the River Cam in the north of the Site are limited by soil wetness to Subgrade 3b, where the topsoil is heavy clay loam and there is a slowly permeable subsoil is placed in Wetness Class III.

Agricultural Land Classification Grading

Previous ALC

34 The provisional ALC map of the South Western Region (MAFF 1977), at a scale of 1:250,000, indicates that agricultural land developed on Cheltenham Sand And Gravel at the Site is in Grade 2.

35 There is no detailed (post 1988) ALC data available for the Site[5], but MAFF has determined agricultural land of Grade 2 quality on similar land to the southwest of Slimbridge (Reference ALCB08998).

ALC Grading at the Site

36 **Grade 2**. Most of the profiles over the Site with medium clay loam topsoil over slightly to moderately gravelly, medium clay loam, to heavy clay loam and clay subsoil are limited by a slight soil droughtiness limitation to Grade 2.

37 In addition, soil profiles with heavy clay loam topsoil in Wetness Class I are limited by a slight wetness (workability) limitation to Grade 2.

38 **Subgrade 3a**. An area in the northern part of the Site is limited to Subgrade 3a by soil wetness, where the soil profile, with a medium silty clay loam topsoil over a slowly permeable subsoil, is placed in Wetness Class III in a climate area with 175 FCD. There is an isolated occurrence of a soil profile with a clay topsoil overlying a well drained subsoil, which is placed in Wetness Class I and is limited by a workability limitation to Subgrade 3a.

39 **Subgrade 3b**. Agricultural land in the far northern and southern parts of the Site are limited by soil wetness to Subgrade 3b, i.e. where soil profiles with heavy clay loam overlying a slowly permeable layer are placed Wetness Class III in a climate area with 175 FCD.

40 The area and proportion of agricultural land in each ALC grade has been measured from an ALC map given as **Plan KCC3027/02**. The findings are reported in Table 4 below.

[5] MAGIC.gov.uk. Last viewed July 2021

Table 4: Agricultural Land Classification – Wisloe, Gloucestershire

ALC Grade	Area (Ha)	Area (% of Total Site)
Grade 1 (Excellent)	0	0
Grade 2 (Very Good)	59.9	77.9
Subgrade 3a (Good)	5.3	6.9
Subgrade 3b (Moderate)	3.9	5.1
Grade 4 (Poor)	0	0
Grade 5 (Very Poor)	0	0
Non-agricultural / Other land	1.5	2.0
Unsurveyed	6.3	8.1
Total	**76.9**	**100**

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ATTACHMENT A

Soil Profile Logs

Point	G+A1:D213ref.			Alt (m)	Slope °	Aspect	Land use	Depth (cm)			Matrix	Ochreous Mottles		Grey Mottles		Gley	Texture	Stones - type 1				Stones - type 2				Ped			SUBS STR	CaCO3	Mn C	SPL	Drought			Wet		Final ALC				Profile notes	Client Ref.
	NGR	X	Y					Top	Bttm	Thick	Munsell colour	Form	Munsell colour	Form	Munsell colour			%	> 2cm	> 6cm	Type	%	> 2cm	> 6cm	Type	Strength	Size	Shape					MBw	MBp	Gd	WC	Gw	Limitation 1	Limitation 2	Limitation 3	Grade		
1	SO 75000 03200	375000	203200	17	≤7			0	39	39	10YR4/3					No	HCL - Cla	4	4	2	HR - All hard rocks or stones (i.e. those which cannot be scratched wit								Not Applic	VC - Ver	No	No	11	6	2	WC III	3b	Wetness			3b	augered to 42cm; calc fragments; exploratory pit near gleyed 50cm+	N/A
								39	42	3	10YR4/3					No	HCL - Clay loam (heavy)												Moderate	VC - Ver	Yes	No										
								42	50	8							HCL - Clay loam (heavy)												Moderate			No										
								50	120	70							C - Clay	50			GH - Gravel with non-porous (hard) stones								Poor			Yes										
2	SO 75100 03200	375100	203200	17	≤7			0	38	38	10YR4/3					No	MCL - Cla	2	2		HR - All hard rocks or stones (i.e. those which cannot be scratched wit								Not Applic	SC - Slig	No	No	32	17	1	WC III	3a	Wetness			3a		N/A
								38	45	7	10YR4/4					No	C - Clay												Moderate	MC - M	Yes	No										
								45	120	75							C - Clay		50		GH - Gravel with non-porous (hard) stones								Poor			Yes										
3	SO 75300 03100	375300	203100	16	≤7			0	38	38	10YR4/3					No	MCL - Clay loam (medium)												Not Applic	NON - N	No	No	16	3	2	WC I	1	Droughtiness			2	difficult to auger 52cm gravel	N/A
								38	52	14	10YR5/4					No	MCL - Cla	50			GH - Gravel with non-porous (hard) stones								Moderate	VC - Ver	No	No										
								52	120	68							MCL - Cla	50			GH - Gravel with non-porous (hard) stones								Moderate			No										
4	SO 75400 03100	375400	203100	16	≤7			0	35	35	10YR4/3					No	MZCL - Si	3	3		HR - All hard rocks or stones (i.e. those which cannot be scratched wit								Not Applic	NON - N	No	No	25	14	2	WC I	1	Droughtiness			2		N/A
								35	45	10	10YR4/4					No	MZCL - Silty clay loam (medium)												Moderate	NON - N	No	No										
								45	50	5	10YR5/4					No	MZCL - Silty clay loam (medium)												Moderate	VC - Ver	No	No										
								50	120	70							MZCL - Si	50			HR - All hard rocks or stones (i.e. those which cannot be scratched wit								Moderate			No										
5	SO 75500 03100	375500	203100	15	≤7			0	35	35	10YR4/3					No	MZCL - Si	2	2		HR - All hard rocks or stones (i.e. those which cannot be scratched wit								Not Applicable		No	No	35	20	1	WC III	3b	Wetness			3b		N/A
								35	45	10	10YR5/3					Yes	HZCL - Silty clay loam (heavy)												Moderate		No	No										
								45	58	13	10YR5/3					Yes	C - Clay	20			GH - Gravel with non-porous (hard) stones								Moderate		Yes	Yes										
								58	60	2	10YR4/2					Yes	C - Clay	50			GH - Gravel with non-porous (hard) stones								Poor			Yes										
								60	120	60							C - Clay												Poor			Yes										
6	SO 75200 03000	375200	203000	17	≤7			0	30	30	10YR4/2					Yes	HCL - Cla	2	2		HR - All hard rocks or stones (i.e. those which cannot be scratched wit								Not Applicable		No	No	25	8	2	WC I	2	Wetness			3a	difficult to auger 65cm stone ; assume similar subsoil to 120cm not gleyed	N/A
								30	40	10	10YR4/2					Yes	HCL - Clay loam (heavy)												Moderate		Yes	No										
								40	65	25	10YR5/4					No	C - Clay	20			GH - Gravel with non-porous (hard) stones								Poor		Yes	No										
								65	120	55							C - Clay												Poor			No										
7	SO 75300 03000	375300	203000	16	≤7			0	38	38	10YR4/3					No	MCL - Clay loam (medium)												Not Applicable		No	No	25	17	2	WC I	1	Droughtiness			2	NRM sample C** calc fragments 65cm	N/A
								38	58	20	10YR5/4					No	C - Clay												Moderate		Yes	No										
								58	65	7	10YR5/4					No	MCL - Cla	50			HR - All hard rocks or stones (i.e. those which cannot be scratched wit								Moderate			No										
								65	120	55							MCL - Cla	50			HR - All hard rocks or stones (i.e. those which cannot be scratched wit								Moderate			No										
8	SO 75400 03000	375400	203000	16	≤7			0	36	36	10YR4/3					No	MZCL - Silty clay loam (medium)												Not Applicable		No	No	31	24	1	WC I	1	N/A			1		N/A
								36	40	4	10YR5/6					No	C - Clay												Moderate		Yes	No										
								40	58	18	10YR4/4					No	C - Clay	10			GH - Gravel with non-porous (hard) stones								Moderate			No										
								58	68	10	10YR5/4					No	MCL - Cla	10			GS - Gravel with porous stones (mainly soft stone types listed above)								Moderate			No										
								68	120	52							MCL - Cla	50			GH - Gravel with non-porous (hard) stones								Moderate			No										
9	SO 75500 03000	375500	203000	15	≤7			0	38	38	10YR4/3					No	MZCL - Silty clay loam (medium)												Not Applicable		No	No	23	22	2	WC I	1	Droughtiness			2	augered to 75cm stone stopped auger.	N/A
								38	43	5	10YR4/4					No	MZCL - Silty clay loam (medium)												Moderate		No	No										
								43	75	32	10YR5/4					No	C - Clay												Poor		Yes	No										
								75	120	45							C - Clay	50			GH - Gravel with non-porous (hard) stones								Poor			No										
10	SO 75600 03000	375600	203000	15	≤7			0	38	38	10YR4/3					No	MCL - Cla	2	2		HR - All hard rocks or stones (i.e. those which cannot be scratched wit								Not Applic	NON - N	No	No	28	22	2	WC I	1	Droughtiness			2	augered to 70cm; friable at this depth and calc fragments	N/A
								38	45	7	10YR4/4					No	HCL - Clay loam (heavy)												Moderate	NON - N	No	No										
								45	55	10	10YR5/4					No	C - Clay												Moderate	MC - M	No	No										
								55	70	15	10YR5/4					No	MCL - Cla	10			HR - All hard rocks or stones (i.e. those which cannot be scratched wit								Moderate	VC - Ver	No	No										
								70	120	50							MCL - Cla	50			HR - All hard rocks or stones (i.e. those which cannot be scratched wit								Moderate			No										
11	SO 75700 03000	375700	203000	16	≤7			0	38	38	10YR4/3					No	HCL - Clay loam (heavy)												Not Applicable		No	No	31	16	1	WC III	3b	Wetness			3b		N/A
								38	40	2	10YR4/4					No	HZCL - Silty clay loam (heavy)												Moderate		No	No										
								40	45	5	10YR5/3					Yes	HCL - Clay loam (heavy)												Poor		Yes	Yes										
								45	100	55	10YR5/3					Yes	C - Clay												Poor		Yes	Yes										
								100	120	20							C - Clay												Poor			Yes										
12	SO 75100 02900	375100	202900	18	≤7			0	30	30	10YR4/3					No	HCL - Clay loam (heavy)												Not Applic	MC - M	No	No	33	14	1	WC I	2	Wetness			2	difficult to auger 45cm stone/gravel. Grass for haylage	N/A
								30	45	15	10YR4/4					No	HCL - Clay loam (heavy)												Moderate	VC - Ver	No	No										
								45	120	75							HCL - Cla	30			GH - Gravel with non-porous (hard) stones								Moderate			No										

Point	G+A1:D213ref.			Alt (m)	Slope °	Aspect	Land use	Depth (cm)			Matrix	Ochreous Mottles		Grey Mottles		Gley	Texture	Stones - type 1				Stones - type 2				Ped			SUBS STR	CaCO3	Mn C	SPL	Drought			Wet		Final ALC				Profile notes	Client Ref.
	NGR	X	Y					Top	Bttm	Thick	Munsell colour	Form	Munsell colour	Form	Munsell colour			%	> 2cm	> 6cm	Type	%	> 2cm	> 6cm	Type	Strength	Size	Shape					MBw	MBp	Gd	WC	Gw	Limitation 1	Limitation 2	Limitation 3	Grade		
13	SO 75200 02900	375200	202900	18	≤7			0	38	38	10YR4/3					No	HCL - Clay loam (heavy)											Not Applic	NON - N	No	No	18	13	2	WC I	2	Droughtiness	Wetness		2	difficult to augr 52cm stone/gravel ; assume similar texture 52cm+ with gravel	N/A
								38	50	12	10YR5/4	CF - C	7.5YR5/6			No	C - Clay											Moderate	NON - N	No	No											
								50	52	2	10YR4/3					No	C - Clay											Moderate	VC - Ver	No	No											
								52	120	68							C - Clay	50			GH - Gravel with non-porous (hard) stones								Moderate			No									
14	SO 75300 02900	375300	202900	18	≤7			0	38	38	10YR4/3					No	MZCL - Silty clay loam (medium)											Not Applicable		No	No	36	21	1	WC III	3a	Wetness			3a	augered to 85cm	N/A
								38	40	2	10YR4/4					No	HZCL - Silty clay loam (heavy)											Moderate		No	No											
								40	45	5	10YR5/3	CD - C	10YR5/6			Yes	C - Clay									Firm			Poor		Yes	Yes											
								45	85	40	10YR5/3	MP - M	10YR5/6			Yes	C - Clay									Very firm			Poor		Yes	Yes											
								85	120	35							C - Clay												Poor													
15	SO 75400 02900	375400	202900	18	≤7			0	38	38	10YR4/3					No	MZCL - Silty clay loam (medium)											Not Applic	NON - N	No	No	41	21	1	WC III	3a	Wetness			3a	difficult to auger 70cm calc frags Soil colour at 55cm+ 5/3 to 5/4	N/A
								38	43	5	10YR4/4					No	C - Clay											Moderate	NON - N	No	No											
								43	55	12	10YR5/3	MD - M	10YR5/6			Yes	C - Clay												Poor	NON - N	No	Yes											
								55	70	15	10YR5/3	CD - C	10YR5/6			Yes	C - Clay												Poor	VC - Ver	No	Yes											
								70	120	50							C - Clay												Moderate			Yes											
16	SO 75500 02900	375500	202900	17	≤7			0	38	38	10YR4/3					No	HZCL - Sil	2	2		HR - All hard rocks or stones (i.e. those which cannot be scratched wit								Not Applic	NON - N	No	No	57	30	1	WC I	2	Wetness			2	NRM sample C (3a) sexond sample sent SPT difficult to auger 75 cm stone	N/A
								38	65	27	10YR4/3					No	HZCL - Silty clay loam (heavy)											Moderate	NON - N	No	No											
								65	75	10	10YR4/4					No	HZCL - Sil	20			GH - Gravel with non-porous (hard) stones								Moderate	VC - Ver	No	No											
								75	120	45							HZCL - Silty clay loam (heavy)												Moderate			No											
17	SO 75600 02900	375600	202900	17	≤7			0	33	33	10YR4/3					No	MZCL - Si	3	3		HR - All hard rocks or stones (i.e. those which cannot be scratched wit								Not Applic	MC - M	No	No	25	14	2	WC I	1	Droughtiness			2	augered to 55cm gravel	N/A
								33	39	6	10YR4/4					No	MZCL - Silty clay loam (medium)											Moderate	MC - M	No	No											
								39	55	16	10YR5/4					No	MCL - Cla	10			GH - Gravel with non-porous (hard) stones								Moderate	VC - Ver	No	No											
								55	120	65							MCL - Cla	50			GH - Gravel with non-porous (hard) stones								Moderate			No									
18	SO 75000 02800	375000	202800	19	≤7			0	38	38	10YR4/3					No	HCL - Clay loam (heavy)											Not Applic	MC - M	No	No	12	6	2	WC I	2	Droughtiness	Wetness		2	difficult to auger 42cm gravel ;	N/A
								38	42	4	10YR4/4					No	C - Clay											Moderate	VC - Ver	No	No											
								42	120	78							C - Clay	50			GH - Gravel with non-porous (hard) stones								Moderate			No									
19	SO 75100 02800	375100	202800	18	≤7			0	38	38	10YR4/3					No	HCL - Clay loam (heavy)											Not Applic	MC - M	No	No	17	12	2	WC I	2	Droughtiness	Wetness		2		N/A
								38	50	12	10YR4/4					No	C - Clay											Moderate	MC - M	No	No											
								50	120	70							C - Clay	50			GH - Gravel with non-porous (hard) stones								Moderate			No									
20	SO 75200 02800	375200	202800	18	≤7			0	35	35	10YR4/3					No	HCL - Cla	1	1		HR - All hard rocks or stones (i.e. those which cannot be scratched wit								Not Applic	NON - N	No	No	29	18	2	WC I	2	Droughtiness	Wetness		2	augered to 80cm then much gravel	N/A
								35	55	20	10YR5/4					No	C - Clay											Moderate	NON - N	Yes	No											
								55	80	25	10YR5/6					No	MCL - Cla	30			GH - Gravel with non-porous (hard) stones								Moderate	VC - Ver	No	No											
								80	120	40							MCL - Cla	50			GH - Gravel with non-porous (hard) stones								Moderate			No									
21	SO 75300 02800	375300	202800	18	≤7			0	38	38	10YR4/3					No	HCL - Clay loam (heavy)											Not Applic	NON - N	No	No	20	17	2	WC I	2	Droughtiness	Wetness		2		N/A
								38	40	2	10YR4/4					No	C - Clay											Moderate	NON - N	Yes	No											
								40	80	40	10YR5/4	CF - C	7.5YR5/6			No	C - Clay												Poor	VSC - V	No	No											
								80	120	40							C - Clay	50			GH - Gravel with non-porous (hard) stones								Poor			No									
22	SO 75400 02800	375400	202800	18	≤7			0	38	38	10YR4/3					No	HCL - Clay loam (heavy)											Not Applicable		No	No	26	16	2	WC IV	3b	Wetness			3b	patchy crop	N/A
								38	60	22	10YR4/2	CD - C	10YR5/6			Yes	C - Clay											Poor		Yes	Yes											
								60	80	20	10YR5/3	MD - M	10YR5/6			Yes	C - Clay											Poor		No	Yes											
								80	120	40							C - Clay	20			GH - Gravel with non-porous (hard) stones								Poor			Yes									
23	SO 75500 02800	375500	202800	17	≤7			0	38	38	10YR4/3					No	HCL - Clay loam (heavy)											Not Applic	NON - N	No	No	33	21	1	WC I	2	Wetness			2		N/A
								38	40	2	10YR5/4					No	C - Clay											Moderate	NON - N	No	No											
								40	55	15	10YR5/4	CD - C	10YR5/6			No	C - Clay												Moderate	NON - N	Yes	No											
								55	85	30	10YR5/4	MF - M	10YR5/6				MCL - Cla	20			GH - Gravel with non-porous (hard) stones								Moderate	MC - M	No	No											
								85	120	35							MCL - Cla	50			GH - Gravel with non-porous (hard) stones								Moderate												
24	SO 74950 02700	374950	202700	21	≤7			0	38	38	10YR4/3						HCL - Clay loam (heavy)											Moderate	VC - Very calca	No	No	9	3	2	WC I	2	Droughtiness	Wetness		2	difficutl to auger 40cm stone and lmst fragments	N/A
								38	40	2	10YR5/4						C - Clay	50			GH - Gravel with non-porous (hard) stones								Moderate	VC - Very calca	No	No											
								40	120	80							C - Clay	50			GH - Gravel with non-porous (hard) stones								Moderate			No									

Point	G+A1:D213ref.			Alt (m)	Slope °	Aspect	Land use	Depth (cm)			Matrix	Ochreous Mottles		Grey Mottles		Gley	Texture	Stones - type 1				Stones - type 2				Ped			SUBS STR	CaCO3	Mn C	SPL	Drought			Wet		Final ALC				Profile notes	Client Ref.
	NGR	X	Y					Top	Bttm	Thick	Munsell colour	Form	Munsell colour	Form	Munsell colour			%	> 2cm	> 6cm	Type	%	> 2cm	> 6cm	Type	Strength	Size	Shape					MBw	MBp	Gd	WC	Gw	Limitation 1	Limitation 2	Limitation 3	Grade		
25	SO 75000 02700	375000	202700	21	≤7			0	30	30	10YR4/3					No	HCL - Clay loam (heavy)											Not Applic	MC - M	No	No	6	1	2	WC I	2	Droughtiness	Wetness		2		N/A
								30	40	10							HCL - Cla	15			GH - Gravel with non-porous (hard) stones								Moderate			No										
								40	120	80							C - Clay	50			GH - Gravel with non-porous (hard) stones								Moderate			No										
26	SO 75100 02700	375100	202700	19	≤7			0	30	30	10YR3/3						HCL - Clay loam (heavy)											Not Applic	MC - M	No	No	16	4	2	WC I	2	Droughtiness	Wetness		2	very dry podery soil	N/A
								30	40	10	10YR3/3						HCL - Cla	10			GH - Gravel with non-porous (hard) stones								Moderate	MC - M	No	No										
								40	45	5	10YR3/3						HCL - Cla	20			GH - Gravel with non-porous (hard) stones								Moderate	VC - Very calca		No										
								45	120	75							HCL - Cla	50			GH - Gravel with non-porous (hard) stones								Moderate			No										
27	SO 75200 02700	375200	202700	19	≤7			0	38	38	10YR4/3					No	HCL - Clay loam (heavy)											Not Applic	NON - N	No	No	23	13	2	WC I	2	Droughtiness	Wetness		2	V Dry powder. Subsoil AB28 Clay to 80cm	N/A
								38	40	2	10YR4/4					No	C - Clay											Moderate	SC - Slig	No	No											
								40	120	80							C - Clay	30			GH - Gravel with non-porous (hard) stones								Moderate			No										
28	SO 75300 02700	375300	202700	20	≤7			0	30	30	10YR4/3					No	HCL - Cla	1	1		HR - All hard rocks or stones (i.e. those which cannot be scratched wit								Not Applicable		No	No	31	23	1	WC I	2	Droughtiness	Wetness		2	augered to 80cm	N/A
								30	45	15	10YR4/4					No	HCL - Clay loam (heavy)											Moderate		No	No											
								45	80	35	10YR4/4	MD - f	10YR5/6			No	C - Clay											Moderate		No	No											
								80	120	40							C - Clay	30			GH - Gravel with non-porous (hard) stones								Moderate			No										
29	SO 75400 02700	375400	202700	20	≤7			0	38	38	10YR4/3					No	C - Clay											Not Applic	NON - N	No	No	27	22	2	WC I	3a	Wetness			3a	stones present at 70cm ; topsoil C/HCL	N/A
								38	60	22	10YR4/4					No	C - Clay											Moderate	NON - N	No	No											
								60	70	10	10YR5/4					No	C - Clay											Moderate	VC - Ver	No	No											
								70	120	50							C - Clay	30			GH - Gravel with non-porous (hard) stones								Moderate			No										
30	SO 74900 02600	374900	202600	22	≤7			0	30	30	10YR4/2					Yes	HCL - Clay loam (heavy)											Not Applic	VC - Very calca		No	26	14	2	WC I	2	Droughtiness	Wetness		2	Dry augered to 42cm	N/A
								30	42	12	10YR4/3					No	C - Clay	10			GH - Gravel with non-porous (hard) stones								Moderate	VC - Very calca		No										
								42	120	78							C - Clay	20			GH - Gravel with non-porous (hard) stones								Moderate			No										
31	SO 75000 02600	375000	202600	21	≤7			0	30	30	10YR4/3					No	HCL - Clay loam (heavy)											Not Applic	VC - Ver	No	No	29	17	2	WC I	2	Droughtiness	Wetness		2		N/A
								30	40	10	10YR4/4					No	HCL - Clay loam (heavy)											Moderate	VC - Ver	No	Yes											
								40	50	10	10YR4/4					No	C - Clay	10			GH - Gravel with non-porous (hard) stones								Moderate	VC - Ver	No	No										
								50	120	70							C - Clay	20			GH - Gravel with non-porous (hard) stones								Moderate			No										
32	SO 75100 02600	375100	202600	19	≤7			0	38	38	10YR4/3					No	HCL - Clay loam (heavy)											Not Applic	VC - Ver	No	No	10	5	2	WC I	2	Droughtiness	Wetness		2	Difficult to auger 40cm stone	N/A
								38	40	2	10YR4/4					No	C - Clay											Moderate	VC - Ver	No	No											
								40	120	80							C - Clay	50			GH - Gravel with non-porous (hard) stones								Moderate			No										
33	SO 75200 02600	375200	202600	19	≤7			0	38	38	10YR4/3					No	HCL - Clay loam (heavy)											Not Applic	SC - Slig	No	No	22	13	2	WC I	2	Droughtiness	Wetness		2	V Dry difficult to auger 42cm	N/A
								38	42	4	10YR4/4					No	C - Clay	5			HR - All hard rocks or stones (i.e. those which cannot be scratched wit								Moderate	VC - Ver	No	No											
								42	120	78							C - Clay	30			HR - All hard rocks or stones (i.e. those which cannot be scratched wit								Moderate			No										
34	SO 75050 02500	375050	202500	24	≤7			0	30	30	10YR4/3					No	C - Clay											Not Applic	VC - Very calca		No	11	10	2	WC I	3a	Wetness			3a	Soil very dry fell out of auger.	N/A
								30	70	40							C - Clay	20			GH - Gravel with non-porous (hard) stones								Moderate			No										
								70	120	50							C - Clay	50			GH - Gravel with non-porous (hard) stones								Moderate			No										
	END																																								

Point	Grid ref. NGR	X	Y	Alt (m)	Slope °	Aspect	Land use	Depth (cm) Top	Bttm	Thick	Matrix Munsell colour	Ochreous Mottles Form	Munsell colour	Grey Mottles Form	Munsell colour	Gley	Texture	Stones - type 1 %	> 2cm	> 6cm	Type	Stones - type 2 %	> 2cm	> 6cm	Type	Ped Strength	Size	Shape	SUBS STR	CaCO3	Mn C	SPL	Drought MBw	MBp	Gd	Wet WC	Gw	Final ALC Limitation 1	Limitation 2	Limitation 3	Grade	Profile notes	Client Ref.
35	SO 74600	03000	374600	203000	18	≤7		0	30	30	10YR4/3					No	MCL - Clay loam (medium)																											
								30	45	15	10YR4/4					No	MCL - Cla	15			GH - Gravel with non-porous (hard) stones								Not Applic	MC - M	No	No	30	14	1	WC I	1	N/A			1	GRASS/HORSES IN BLOCK D, E ,F ,G ; EXPLORATORY PIT	N/A
								45	80	35	10RY5/4					No	HCL - Cla	20			GH - Gravel with non-porous (hard) stones								Moderate	MC - M	No	No										
								80	100	20	10YR5/4	FF - Fe	10YR5/6			No	HCL - Cla	30			GH - Gravel with non-porous (hard) stones								Moderate	VC - Ver	No	No										
								100	120	20							C - Clay	30			GH - Gravel with non-porous (hard) stones								Moderate			No										
36	SO 74700	03000	374700	203000	17	≤7		0	30	30	10YR4/3					No	MCL - Clay loam (medium)																											
								30	60	30	10YR4/3					No	HCL - Cla	20			GH - Gravel with non-porous (hard) stones								Not Applic	SC - Slig	No	No	28	11	2	WC I	1	Droughtiness			2	augered to 60cm ; dry, stone	N/A
								60	100	40							HCL - Cla	30			GH - Gravel with non-porous (hard) stones								Moderate	MC - M	No	No										
								100	120	20							C - Clay	30			GH - Gravel with non-porous (hard) stones								Moderate			Yes										
37	SO 74800	03000	374800	203000	17	≤7		0	30	30	10YR3/4					No	MCL - Clay loam (medium)																											
								30	45	15	10YR4/3					No	MCL - Cla	5			GH - Gravel with non-porous (hard) stones								Not Applic	MC - M	No	No	29	12	2	WC I	1	Droughtiness			2	augered to 45cm closely grazed grass by horses.	N/A
								45	100	55							HCL - Cla	30			GH - Gravel with non-porous (hard) stones								Moderate	VC - Ver	No	No										
								100	120	20							C - Clay	30			GH - Gravel with non-porous (hard) stones								Moderate			No										
38	SO 74700	02900	374700	202900	19	≤7		0	30	30	10YR3/4					No	MCL - Clay loam (medium)																											
								30	45	15	10YR4/4					No	MCL - Clay loam (medium)												Not Applic	VC - Ver	No	No	35	14	1	WC I	1	N/A			1	augered to 50cm very dry	N/A
								45	50	5	10YR4/4					No	HCL - Cla	20			GH - Gravel with non-porous (hard) stones								Moderate	VC - Ver	No	No										
								50	100	50							HCL - Cla	30			GH - Gravel with non-porous (hard) stones								Moderate		No	No										
								100	120	20							C - Clay												Moderate			Yes										
39	SO 74800	02900	374800	202900	18	≤7		0	38	38	10YR4/3					No	MCL - Clay loam (medium)																											
								38	40	2	10YR4/4					No	HCL - Cla	20			GH - Gravel with non-porous (hard) stones								Not Applic	VC - Ver	No	No	28	12	2	WC I	1	Droughtiness			2	dry difficult to auger 40cm stoney at 40cm?	N/A
								40	100	60							HCL - Cla	30			GH - Gravel with non-porous (hard) stones								Moderate	VC - Ver	No	No										
								100	120	20							C - Clay	35			GH - Gravel with non-porous (hard) stones								Moderate			No										
40	SO 74700	02800	374700	202800	19	≤7		0	38	38	10YR4/3					No	MCL - Clay loam (medium)																											
								38	40	2	10YR4/4					No	HCL - Cla	5			GH - Gravel with non-porous (hard) stones								Not Applic	VC - Ver	No	No	30	13	2	WC I	1	Droughtiness			2	dry difficult to auger to depth	N/A
								40	100	60							HCL - Cla	30			GH - Gravel with non-porous (hard) stones								Moderate	VC - Ver	No	No										
								100	120	20							C - Clay	30			GH - Gravel with non-porous (hard) stones								Moderate			No										
41	SO 74800	02800	374800	202800	18	≤7		0	30	30	10YR5/4					No	HCL - Clay loam (heavy)																											
								30	40	10	10YR4/4					No	HCL - Clay loam (heavy)												Not Applic	VC - Ver	No	No	30	20	2	WC I	1	N/A			1		N/A
								40	70	30	10RY4/4					No	HCL - Cla	10			GH - Gravel with non-porous (hard) stones								Moderate	VC - Ver	No	No										
								70	80	10	2.5Y5/4					No	C - Clay	15			GH - Gravel with non-porous (hard) stones								Moderate	VC - Ver	No	No										
								80	100	20	2.5Y5/3	MD - f	10YR5/6			Yes	C - Clay	20			GH - Gravel with non-porous (hard) stones								Poor	VC - Ver	No	Yes										
								100	120	20							C - Clay	30			GH - Gravel with non-porous (hard) stones								Poor													
42	SO 74800	02700	374800	202700	22	≤7																																					N/A
43	SO 74400	02600	374400	202600	20	≤7		0	30	30	10YR4/3					No	MCL - Clay loam (medium)																											
								30	40	10	10YR4/4					No	HCL - Clay loam (heavy)												Not Applic	VC - Ver	No	No	27	16	2	WC I	1	Droughtiness			2	augered to 40cm dry at 30cm: assume clay to 120cm; moved away from wood area (no spl)	N/A
								40	70	30							C - Clay	20			GH - Gravel with non-porous (hard) stones								Moderate			No										
								70	120	50							C - Clay	20			GH - Gravel with non-porous (hard) stones								Moderate			No										
44	SO 74500	02600	374500	202600	22	≤7		0	30	30	10YR4/3					No	MCL - Clay loam (medium)																											
								30	50	20	10YR4/3					No	HCL - Clay loam (heavy)												Not Applic	MC - M	No	No	30	24	2	WC I	1	Droughtiness			2	EXPLORATORY PIT	N/A
								50	70	20							C - Clay												Moderate	MC - M	No	No										
								70	120	50	10YR5/4						C - Clay	30			GH - Gravel with non-porous (hard) stones								Moderate		No	Yes										
45	SO 74600	02600	374600	202600	22	≤7		0	35	35	10YR4/3					No	MCL - Clay loam (medium)																											
								35	50	15	10YR4/4					No	HCL - Clay loam (heavy)												Not Applic	MC - M	No	No	29	22	2	WC I	1	Droughtiness			2	augered to 70cm stone	N/A
								50	70	20	10RY5/4					No	C - Clay	10			GH - Gravel with non-porous (hard) stones								Moderate	MC - M	No	No										
								70	120	50							C - Clay	30			GH - Gravel with non-porous (hard) stones								Moderate	VC - Ver	No	No										
46	SO 74400	02500	374400	202500	22	≤7		0	30	30	10YR4/3					No	HCL - Clay loam (heavy)																											
								30	35	5	7.5YR4/3					No	HCL - Clay loam (heavy)												Not Applic	NON - N	No	No	26	14	2	WC I	2	Droughtiness Wetness			2	grass/haylage;augered to 35 cm very dry	N/A
								35	50	15							HCL - Cla	20			GH - Gravel with non-porous (hard) stones								Moderate	MC - M	No	No										
								50	120	70							C - Clay	20			GH - Gravel with non-porous (hard) stones								Moderate			No										

Point	Grid ref. NGR	X	Y	Alt (m)	Slope °	Aspect	Land use	Depth (cm) Top	Bttm	Thick	Matrix Munsell colour	Ochreous Mottles Form	Munsell colour	Grey Mottles Form	Munsell colour	Gley	Texture	Stones - type 1 %	> 2cm	> 6cm	Type	Stones - type 2 %	> 2cm	> 6cm	Type	Ped Strength	Size	Shape	SUBS STR	CaCO3	Mn C	SPL	Drought MBw	MBp	Gd	Wet WC	Gw	Final ALC Limitation 1	Limitation 2	Limitation 3	Grade	Profile notes	Client Ref.
47	SO 74500 02500	374500	202500	22	≤7			0	30	30	10YR4/3					No	MCL - Clay loam (medium)												Not Applic	NON - N	No	No	25	16	2	WC I	1	Droughtiness			2	dry augered to 55cm S&G? topsoil m/hcl ; assumed clay to depth	N/A
								30	40	10	10YR4/4					No	HCL - Clay loam (heavy)												Moderate	NON - N	No	No											
								40	55	15	10YR5/4					No	C - Clay	10			GH - Gravel with non-porous (hard) stones								Moderate	MC - M	No	No											
								55	120	65							C - Clay	30			GH - Gravel with non-porous (hard) stones								Moderate			No											
48	SO 74600 02500	374600	202500	22	≤7																																				moved gas pipeline;augered to 90cm	N/A
49	SO 74700 02600	374700	202600	22	≤7																																					N/A
50	SO 74800 02600	374800	202600	22	≤7			0	35	35	10YR4/3					No	MCL - Clay loam (medium)												Not Applic	VC - Ver	No	No	26	17	2	WC I	1	Droughtiness			2	augered to 50cm; dry, stony, gravel	N/A
								35	45	10	10YR5/4					No	HCL - Clay loam (heavy)												Moderate	VC - Ver	No	No											
								45	50	5	10RY5/4					No	C - Clay												Moderate	VC - Ver	No	No											
								50	120	70							C - Clay	30			GH - Gravel with non-porous (hard) stones								Moderate			No											
51	SO 74750 02500	374750	202500	25	≤7			0	30	30	10YR4/3					No	MCL - Clay loam (medium)												Not Applic	MC - Moderat	No	No	40	15	1	WC I	1	N/A			1	augered to 58cm then s+g /scl matrix to 70cm	N/A
								30	40	10	10YR5/4					No	HCL - Clay loam (heavy)												Moderate	MC - Moderat	No												
								40	55	15	10YR5/4	FF - Fe	10YR5/6			No	HCL - Cla	15			GH - Gravel with non-porous (hard) stones								Moderate	VC - Ver	Yes	No											
								55	70	15	10YR5/6					No	SCL - San	20			GH - Gravel with non-porous (hard) stones								Moderate	VC - Very calca		No											
								70	120	50							SCL - San	20			GH - Gravel with non-porous (hard) stones								Moderate			No											
52	SO 74250 02500	374250	202500	21	≤7			0	30	30	10YR3/2					No	HCL - Clay loam (heavy)												Not Applic	VC - Ver	No	No	29	17	2	WC I	2	Droughtiness	Wetness		2	tramlines followed;augered to 40cm	N/A
								30	40	10	10YR3/2					No	HCL - Clay loam (heavy)												Moderate	VC - Ver	No	No											
								40	50	10							HCL - Cla	10			GH - Gravel with non-porous (hard) stones								Moderate			No											
								50	120	70							C - Clay	20			GH - Gravel with non-porous (hard) stones								Moderate			No											
53	SO 74200 02400	374200	202400	21	≤7			0	30	30	10YR3/3					No	HCL - Clay loam (heavy)												Not Applic	VC - Ver	No	No	31	20	1	WC I	2	Wetness			2		N/A
								30	48	18	10YR3/3					No	HCL - Clay loam (heavy)												Moderate	VC - Ver	No	No											
								48	60	12	10YR4/3						C - Clay	10			GH - Gravel with non-porous (hard) stones								Moderate	VC - Ver	Yes	No											
								60	120	60							C - Clay	20			GH - Gravel with non-porous (hard) stones								Moderate			No											
54	SO 74300 02400	374300	202400	21	≤7			0	38	38	10YR3/2					No	MCL - Clay loam (medium)												Not Applic	VC - Ver	No	No	30	18	1	WC I	2	Wetness			2	soil very dry- fell out of auger; topsoil hcl/c	N/A
								38	50	12							C - Clay	10			GH - Gravel with non-porous (hard) stones								Moderate			No											
								50	120	70							C - Clay	20			GH - Gravel with non-porous (hard) stones								Moderate			No											
55	SO 74400 02400	374400	202400	22	≤7			0	30	30	10YR3/3					No	HCL - Clay loam (heavy)												Not Applic	VC - Ver	No	No	29	17	2	WC I	2	Droughtiness	Wetness		2	augered to 50cm dry	N/A
								30	40	10	10YR3/3					No	HCL - Clay loam (heavy)												Moderate	MC - M	No	No											
								40	50	10	2.5Y4/3					No	C - Clay	10			GH - Gravel with non-porous (hard) stones								Moderate	VC - Ver	No	No											
								50	120	70							C - Clay	20			GH - Gravel with non-porous (hard) stones								Moderate			No											
56	SO 74200 02300	374200	202300	21	≤7			0	38	38	10YR3/4					No	HCL - Clay loam (heavy)												Not Applic	VC - Ver	No	No	31	20	1	WC I	2	Wetness			2		N/A
								38	60	22	10YR4/3					No	C - Clay	10			GH - Gravel with non-porous (hard) stones								Moderate	VC - Ver	No	No											
								60	120	60							C - Clay	20			GH - Gravel with non-porous (hard) stones								Moderate			No											
57	SO 74300 02300	374300	202300	21	≤7			0	38	38	10YR3/4					No	C - Clay												Not Applic	MC - M	No	No	25	13	2	WC I	3a	Wetness			3a		N/A
								38	40	2	2.5Y4/3					No	C - Clay	10			GH - Gravel with non-porous (hard) stones								Moderate	VC - Ver	No	No											
								40	120	80							C - Clay	20			GH - Gravel with non-porous (hard) stones								Moderate			No											
58	SO 74400 02300	374400	202300	22	≤7																																					N/A

Point	Grid ref. NGR	X	Y	Alt (m)	Slope °	Aspect	Land use	Depth (cm) Top	Bttm	Thick	Matrix Munsell colour	Ochreous Mottles Form	Ochreous Mottles Munsell colour	Grey Mottles Form	Grey Mottles Munsell colour	Gley	Texture	Stones - type 1 %	> 2cm	> 6cm	Type	Stones - type 2 %	> 2cm	> 6cm	Type	Ped Strength	Size	Shape	SUBS STR	CaCO3	Mn C	SPL	Drought MBw	MBp	Gd	Wet WC	Gw	Final ALC Limitation 1	Limitation 2	Limitation 3	Grade	Profile notes	Client Ref.
59	SO 74200 02200	374200	202200	23	≤7			0	40	40	10YR3/3					No	HCL - Cla	5			GH - Gravel with non-porous (hard) stones							Not Applic	VC - Ver	No	No	28	16	2	WC I	2	Droughtiness	Wetness		2	DRY +STONE DIFFICULT TO AUGER 40CM+	N/A
								40	50	10							HCL - Cla	10			GH - Gravel with non-porous (hard) stones							Moderate			No											
								50	120	70							C - Clay	20			GH - Gravel with non-porous (hard) stones							Moderate			No											
60	SO 74300 02200	374300	202200	23	≤7			0	38	38	10YR3/3					No	HCL - Clay loam (heavy)											Not Applic	VC - Ver	No	No	32	21	1	WC I	2	Wetness			2	AUGERED TO 70CM ; Assume WCI	N/A
								38	70	32	10YR4/3			CF - Cc	10YR5/6	No	C - Clay	10			GH - Gravel with non-porous (hard) stones							Moderate	VC - Ver	No	No											
								70	120	50						No	C - Clay	20			GH - Gravel with non-porous (hard) stones							Moderate			No											
61	SO 74500 02400	374500	202400	22	≤7																																				N/A
62	SO 74600 02400	374600	202400	22	≤7			0	35	35	10YR4/3					No	HCL - Clay loam (heavy)											Not Applicable		No	No	36	24	1	WC I	2	Wetness			2	re-located clear of gas pipeline /exclusion zone ; cereal (wheat) ; augered to 65cm dry from 60cm	N/A
								35	65	30	10YR4/4					No	HCL - Clay loam (heavy)											Moderate		No	No											
								65	120	55							C - Clay	20			GH - Gravel with non-porous (hard) stones							Moderate			No											
63	SO 74500 02300	374500	202300	22	≤7																																				N/A
64	SO 74600 02300	374600	202300	22	≤7			0	30	30	10YR3/4					No	MCL - Cla	5			GH - Gravel with non-porous (hard) stones							Not Applic	VC - Ver	No	No	29	16	2	WC I	1	Droughtiness			2	AUHERED TO 40CM DRY LMST FRAGMENTS ON SURFACE DRY SOIL	N/A
								30	40	10	10YR4/4					No	MCL - Cla	5			GH - Gravel with non-porous (hard) stones							Moderate	VC - Ver	No	No											
								40	65	25							HCL - Cla	10			GH - Gravel with non-porous (hard) stones							Moderate			No											
								65	120	55							C - Clay	20			GH - Gravel with non-porous (hard) stones							Moderate			No											
65	SO 74420 02200	374420	202200	24	≤7																																				N/A
66	SO 74500 02200	374500	202200	26	≤7			0	38	38	10YR4/3					No	HCL - Cla	3			GH - Gravel with non-porous (hard) stones							Not Applic	VC - Ver	No	No	28	16	2	WC I	2	Droughtiness	Wetness		2	DIFFICULT TO AUGER 38CM DRY LMST FRAGMENTS	N/A
								38	50	12							HCL - Cla	10			GH - Gravel with non-porous (hard) stones							Moderate			No											
								50	120	70							C - Clay	20			GH - Gravel with non-porous (hard) stones							Moderate			No											
67	SO 74100 02200	374100	202200	23	≤7			0	38	38	10YR4/3					No	HCL - Clay loam (heavy)											Not Applic	VC - Ver	No	No	29	21	2	WC I	2	Droughtiness	Wetness		2	AUGERED TO 60CM VERY DRY	N/A
								38	60	22	10YR4/4					No	C - Clay											Moderate	VC - Ver	No	No											
								60	120	60							C - Clay	30			GH - Gravel with non-porous (hard) stones							Moderate			No											
68	SO 74000 02100	374000	202100	22	≤7			0	35	35	10YR3/3					No	HCL - Clay loam (heavy)											Not Applic	NON - M	No	No	24	14	2	WC I	2	Droughtiness	Wetness		2	VERY DRY SOIL	N/A
								35	40	5	7.5YR4/3					No	HCL - Clay loam (heavy)											Moderate	NON - M	No	No											
								40	45	5	10YR5/4						C - Clay											Moderate			No											
								45	120	75							C - Clay	30			GH - Gravel with non-porous (hard) stones							Moderate			No											
69	SO 74100 02100	374100	202100	23	≤7			0	35	35	10YR3/3					No	HCL - Clay loam (heavy)											Not Applic	NON - M	No	No	30	18	2	WC I	2	Droughtiness	Wetness		2		N/A
								35	45	10	10YR3/3					No	HCL - Clay loam (heavy)											Moderate	SC - Slig	No	No											
								45	50	5							HCL - Cla	20			GH - Gravel with non-porous (hard) stones							Moderate			No											
								50	120	70							C - Clay	20			GH - Gravel with non-porous (hard) stones							Moderate			No											
70	SO 74200 02100	374200	202100	23	≤7			0	39	39	10YR4/3					No	HCL - Clay loam (heavy)											Not Applic	NON - M	No	No	31	20	1	WC I	2	Wetness			2	topsoil hcl/c; dificult to auger 60cm	N/A

Point	Grid ref.			Alt (m)	Slope °	Aspect	Land use	Depth (cm)			Matrix	Ochreous Mottles		Grey Mottles		Gley	Texture	Stones - type 1				Stones - type 2				Ped			SUBS STR	CaCO3	Mn C	SPL	Drought			Wet		Final ALC				Profile notes	Client Ref.
	NGR	X	Y					Top	Bttm	Thick	Munsell colour	Form	Munsell colour	Form	Munsell colour			%	> 2cm	> 6cm	Type	%	> 2cm	> 6cm	Type	Strength	Size	Shape					MBw	MBp	Gd	WC	Gw	Limitation 1	Limitation 2	Limitation 3	Grade		
								39	60	21	10YR4/4					No	C - Clay	10			GH - Gravel with non-porous (hard) stones								Moderate	MC - M	Yes	No										stone	
								60	120	60							C - Clay	20			GH - Gravel with non-porous (hard) stones								Moderate			No										
71	SO 74280 02100	374280	202100	23	≤7																																					N/A
72	SO 73920 02020	373920	202020	28	≤7			0	30	30	2.5Y4/2					Yes	C - Clay												Not Applic	NON - N	No	No	24	9	2	WC IV	3b	Wetness			3b	BGS viewer Blue Lias Clay and Charmouth Mudstone formation- slight rise to knoll- clay surface hexagonal cracking	N/A
								30	80	50	2.5Y6/2		MD - I	10YR5/6		Yes	C - Clay												Poor	NON - N	Yes	Yes											
								80	120	40							C - Clay												Poor			Yes											
	END																																									

ATTACHMENT B

Soil Pit Descriptions

SOIL PIT DESCRIPTIONS

Wisloe

Pit 1

Grid Reference SO 74985 03204 19th April 2021

Cereal crop

Depth to slowly permeable layer 50cm

Wetness Class III

ALC grade 3b

Depth	Description
0-25cm	Heavy clay loam; brown (10YR4/3);weakly developed fine subangular blocky; friable; calcareous; very slightly stony(>2cm 3% and >6cm 2%)
25-40cm	Heavy clay loam; brown (10YR4/3);weakly developed fine subangular blocky; friable; calcareous; very slightly stony(>2cm 3% and >6cm 2%); > than 0.5% biopores greater than 0.5mm diameter
40-50cm	Medium clay loam; dark yellowish brown (10YR4/4); moderately developed medium subangular blocky; friable;> than 0.5% biopores greater than 0.5mm diameter;calcareous
50-55cm	Clay;grey (10YR6/1) weakly developed coarse angular blocky; many distinct ochreous mottles;very firm; ;< than 0.5% biopores greater than 0.5mm diameter;calcareous; very stony; difficult to dig below 55cm

Pit 2

Grid Reference SO74528 03000 26th June 2021

Grass (horse grazing)

Wetness Class I

ALC grade 1

Depth	Description
0-30 cm	Medium clay loam; brown (10YR4/3); calcareous; very slightly stony 3% >2cm
30-50 cm	Medium clay loam; dark yellowish brown (10YR4/4)weakly developed fine subangular blocky; friable; calcareous; very slightly stony(>2cm 3% and >6cm 2%); > than 0.5% biopores greater than 0.5mm diameter;many roots at 50cm
40-50cm	Medium clay loam; dark yellowish brown (10YR4/4); moderately developed medium subangular blocky; friable;> than 0.5% biopores greater than 0.5mm diameter;calcareous
	Soil very dry; augered to 100cm heavy clay loam yellowish brown (10YR5/4) no signs of gleying

Pit 2
Subsoil Structure
26th June 2021

Pit 3

Grid Reference SO754515 02658 26th June 2021

Grass (for haylage)

Wetness Class I

ALC grade 1

Depth	Description
0-30 cm	Medium clay loam; brown (10YR4/3); calcareous;
30-50 cm	Heavy clay loam; brown (10YR4/43weakly developed fine angular blocky; firm; calcareous; very slightly stony(>2cm 3% and >6cm 2%); > than 0.5% biopores greater than 0.5mm diameter;many roots at 50cm
50cm+	Dry soil; augered to 70cm yellowish brown (10YR5/4) no signs of gleying above 70cm calcareous

ATTACHMENT C

Laboratory Analysis

TEST REPORT

ISSUED BY SOIL PROPERTY TESTING LTD

DATE ISSUED: 16/07/2021

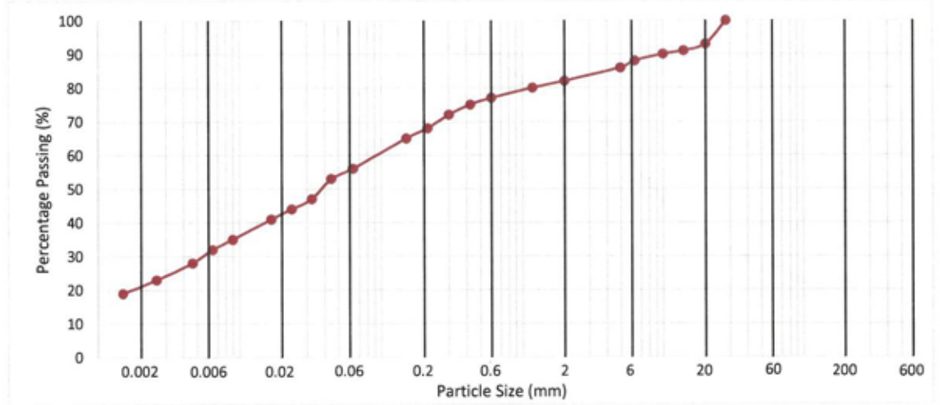
0998

Contract	Wisloe
Serial No.	39026_1

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Pit No.	Depth (m)	Sample Type	Sample Reference	Description	Remarks
-	0.00 - 0.25	J	54	Dark brown slightly gravelly slightly sandy silty CLAY. Gravel is white angular and subangular chalk and rare yellowish brown and brown limestone and sandstone	

Method of Test: Wet Sieve + Hydrometer | Method of Pretreatment: Not required



CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES	BOULDERS
	SILT			SAND			GRAVEL				

Hydrometer

Particle Size (mm)	Passing (%)	Silt by Dry Mass (%)
0.0444	53	35
0.0324	47	
0.0234	44	
0.0168	41	Clay by Dry Mass (%)
0.0089	35	
0.0064	32	
0.0046	28	21
0.0026	23	
0.0015	19	

Sieve Size (mm)	Passing (%)	Sand By Dry Mass (%)
2.00	82	26
1.18	80	
0.600	77	
0.425	75	
0.300	72	
0.212	68	
0.150	65	
0.063	56	

Fines By Dry Mass (%)	
<0.063mm	56

Sieve Size (mm)	Passing (%)	2mm+ By Dry Mass (%)
300		18
125		
90		
63		
50		
37.5		
28	100	
20	93	
14	91	
10	90	
6.3	88	
5	86	

Method of Preparation: BS1377: Part 1: 2016: 8.3 & 8.4.5
Method of test: BS1377: Part 2: 1990: 9.2,9.5
Type of Sample Key: U=Undisturbed, B=Bulk, D=Disturbed, J=Jar, W=Water, SPT=Split Spoon Sample, C=Core Cutter
Comments:

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Page 3 of 5

TEST REPORT

ISSUED BY SOIL PROPERTY TESTING LTD

DATE ISSUED: 16/07/2021

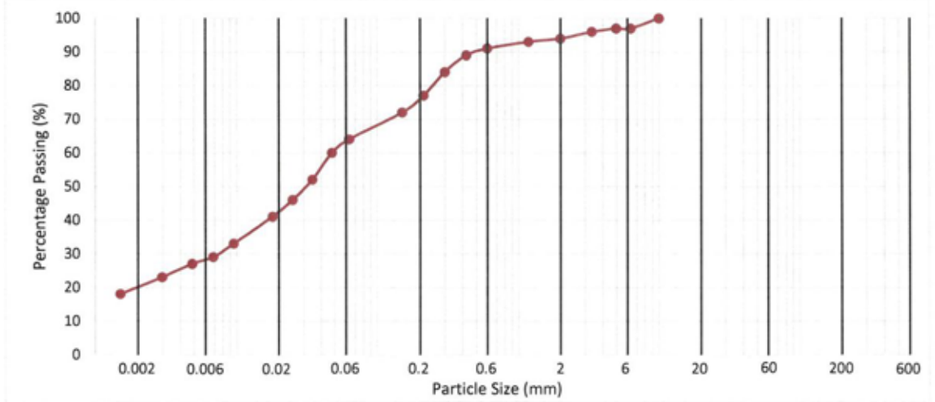
UKAS TESTING 0998

Contract	Wisloe
Serial No.	39026_1

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Pit No.	Depth (m)	Sample Type	Sample Reference	Description	Remarks
-	0.00 - 0.25	D	36	Yellowish brown slightly gravelly slightly sandy silty CLAY with frequent recently active roots. Gravel is white subangular and subrounded chalk	

Method of Test: Hydrometer + Pre-sieve | Method of Pretreatment: Not required



Hydrometer

Particle Size (mm)	Passing (%)	Silt by Dry Mass (%)
0.0476	60	44
0.0346	52	
0.0250	46	
0.0180	41	Clay by Dry Mass (%)
0.0095	33	
0.0068	29	
0.0048	27	20
0.0030	23	
0.0015	18	

Sieve Size (mm)	Passing (%)	Sand By Dry Mass (%)
2.00	94	30
1.18	93	
0.600	91	
0.425	89	
0.300	84	
0.212	77	
0.150	72	
0.063	64	

Fines By Dry Mass (%)	
<0.063mm	64

Sieve Size (mm)	Passing (%)	2mm+ By Dry Mass (%)
300		6
125		
90		
63		
50		
37.5		
28		
20		
14		
10	100	
6.3	97	
5	97	

Method of Preparation: BS1377: Part 1: 2016: 8.3 & 8.4.5
Method of test: BS1377: Part 2: 1990: 9.2,9.5
Type of Sample Key: U=Undisturbed, B=Bulk, D=Disturbed, J=Jar, W=Water, SPT=Split Spoon Sample, C=Core Cutter
Comments:

TEST REPORT

ISSUED BY SOIL PROPERTY TESTING LTD

DATE ISSUED: 16/07/2021

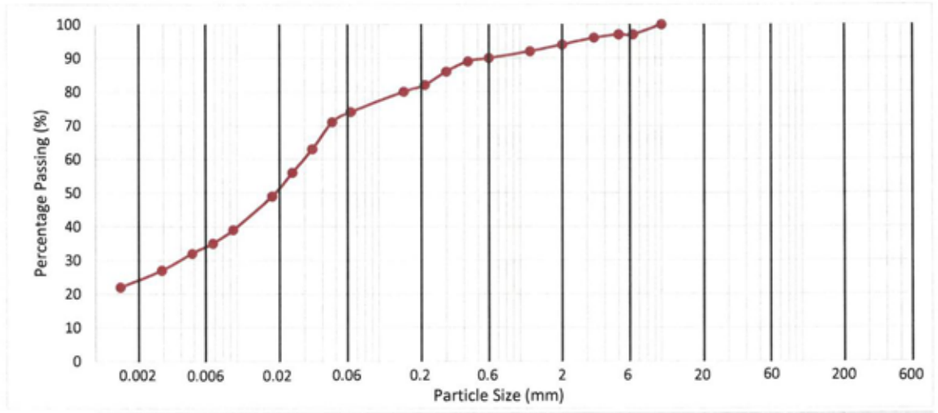
UKAS TESTING 0998

Contract	Wisloe
Serial No.	39026_1

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Pit No.	Depth (m)	Sample Type	Sample Reference	Description	Remarks
-	0.00 - 0.25	B	7	Yellowish brown slightly gravelly slightly sandy silty CLAY with frequent recently active roots. Gravel is white subangular and subrounded chalk	

Method of Test: Hydrometer + Pre-sieve | Method of Pretreatment: Not required



Hydrometer

Particle Size (mm)	Passing (%)	Silt by Dry Mass (%)
0.0467	71	50
0.0339	63	
0.0246	56	
0.0177	49	Clay by Dry Mass (%)
0.0094	39	
0.0068	35	
0.0048	32	24
0.0029	27	
0.0015	22	

Sieve Size (mm)	Passing (%)	Sand By Dry Mass (%)
2.00	94	20
1.18	92	
0.600	90	
0.425	89	
0.300	86	
0.212	82	
0.150	80	
0.063	74	

Fines By Dry Mass (%)	
<0.063mm	74

Sieve Size (mm)	Passing (%)	2mm+ By Dry Mass (%)
300		6
125		
90		
63		
50		
37.5		
28		
20		
14		
10	100	
6.3	97	
5	97	

Method of Preparation: BS1377: Part 1: 2016: 8.3 & 8.4.5
Method of test: BS1377: Part 2: 1990: 9.2,9.5
Type of Sample Key: U=Undisturbed, B=Bulk, D=Disturbed, J=Jar, W=Water, SPT=Split Spoon Sample, C=Core Cutter
Comments:

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Particle size class estimator

Here is a tool that allows you to estimate the particle size class of a soil sample from the proportions of sand, silt and clay. The estimator is based on the texture class intervals of the Soil Survey of England and Wales - note that other international standards also exist, such as the USDA and FAO triangles.

Enter soil sample proportions:

Clay (%): X 22 Sand (%): X 32 Silt (%): X 46 •Calculate: Calculate •F

Top

J54 **Soil sample is a Clay Loam** (Medium)

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» Developments in land information systems: examples demonstrating land resource management capabilities and options: October 23 2017
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Soil Texture Triangle

Particle size class estimator

Here is a tool that allows you to estimate the particle size class of a soil sample from the proportions of sand, silt and clay. The estimator is based on the texture class intervals of the Soil Survey of England and Wales - note that other international standards also exist, such as the USDA and FAO triangles.

Enter soil sample proportions:

Clay (%): X 26 Sand (%): X 32 Silt (%): X 42 •Calculate: Calculate •F

Top

D36 **Soil sample is a Clay Loam** (Medium)

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- CatchIS
- Leacs
- WOSSAC
- SoilsWorldwide
- Soil-Net
- SEISMIC
- Treefit
- PAM
- Tools and utilities
- UK Soil Observatory

Publications
Downloads
News
Links
Feedback
Payment

Tools and utilities

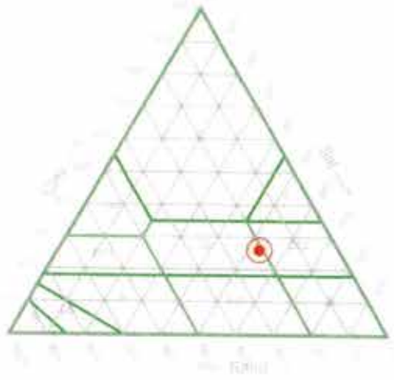
Soil Texture Triangle

Particle size class estimator

Here is a tool that allows you to estimate the particle size class of a soil sample from the proportions of sand, silt and clay. The estimator is based on the texture class intervals of the Soil Survey of England and Wales - note that other international standards also exist, such as the USDA and FAO triangles.

Enter soil sample proportions:

Clay (%): X 26 Sand (%): X 21 Silt (%): X 53 •Calculate Calculate •I



Medium Top

B7 Soil sample is a Clay Loam

Let us know what you think of LandIS.

Access our support videos.

Soils Site Reporter

Download full site-specific soil reports for your neighbourhood, development site, farm, wildlife sanctuary, etc.

Soilscapes Viewer

Our free online simplified interactive soil map for England and Wales.

Soils Guide

An Online Guide to the Soils of England and Wales.

Case Studies

See examples of how LandIS is being used.

FAQ

Answers to frequently asked questions.

News

- Soilscapes Mobile App v1.2.1 launched: January 18 2018
- Easy access to Soils data: January 8 2018
- University wins fifth Queen's Anniversary Prize: December 1 2017
- Design, Development and Impact of the soil educational website Soil-Net.com: October 24 2017
- Developments in land information systems: examples demonstrating land resource management capabilities and options: October 23 2017
- New Soil Site Reports: May 4 2017
- Feeding the nine billion: February 2017
- Soil Site Reporter - Upgrade: January 18 2017
- Radio 4 Interview on Farming Today: January 17 2017

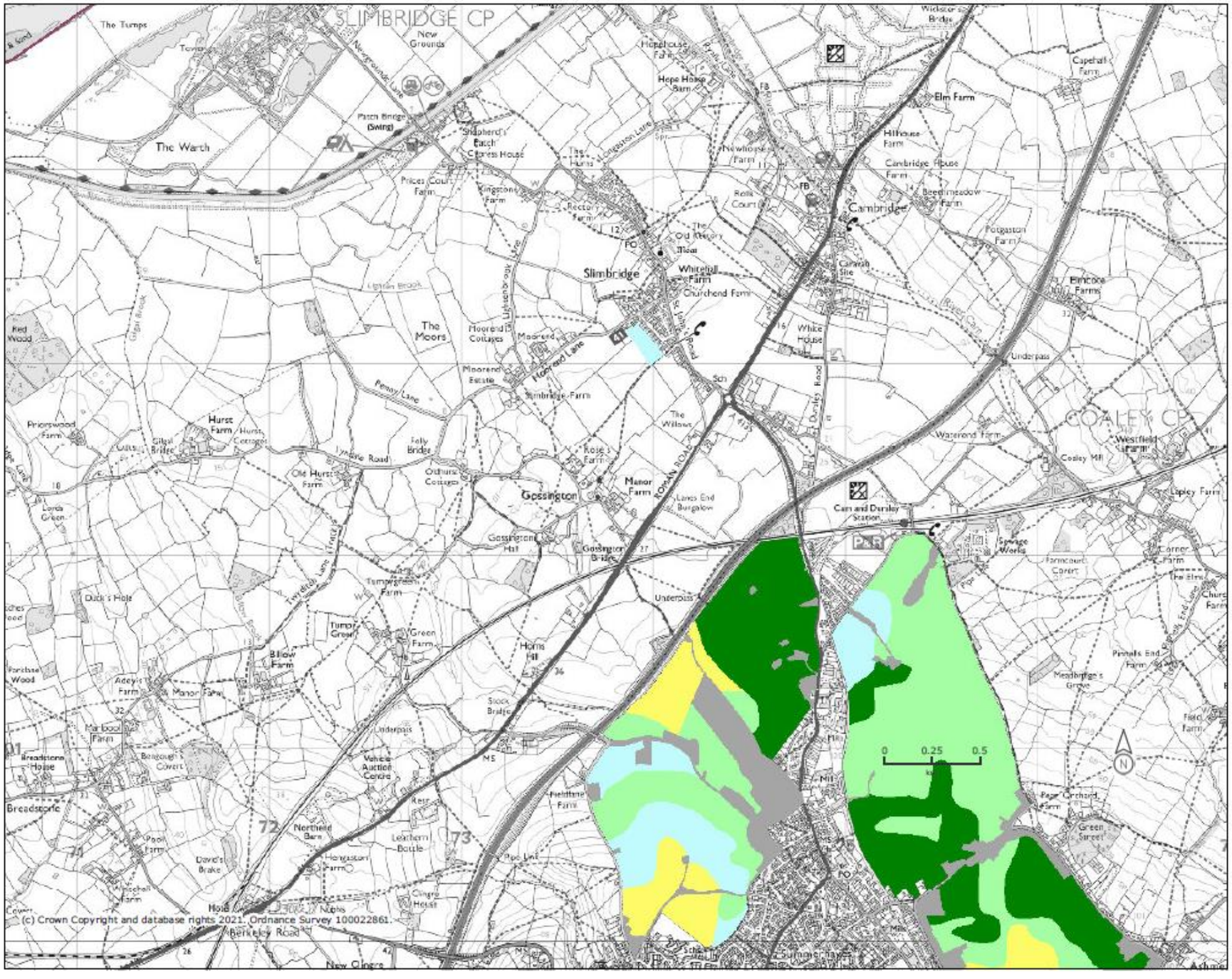
See all news ...

APPENDIX KCC3

ALC Around Cam and Wisloe

MAGIC

Magic Map



Legend

Post 1988 Agricultural Land Classification (England)

- Grade 1
- Grade 2
- Grade 3a
- Grade 3b
- Grade 4
- Grade 5
- Not Surveyed
- Other

Projection = OSGB36
xmin = 370200
ymin = 200600
xmax = 377400
ymax = 204100

0 0.35 0.7 km

Map produced by MAGIC on 29 March, 2021.
Copyright resides with the data suppliers and the map must not be reproduced without their permission. Some information in MAGIC is a snapshot of the information that is being maintained or continually updated by the originating organisation. Please refer to the metadata for details as information may be illustrative or representative rather than definitive at this stage.

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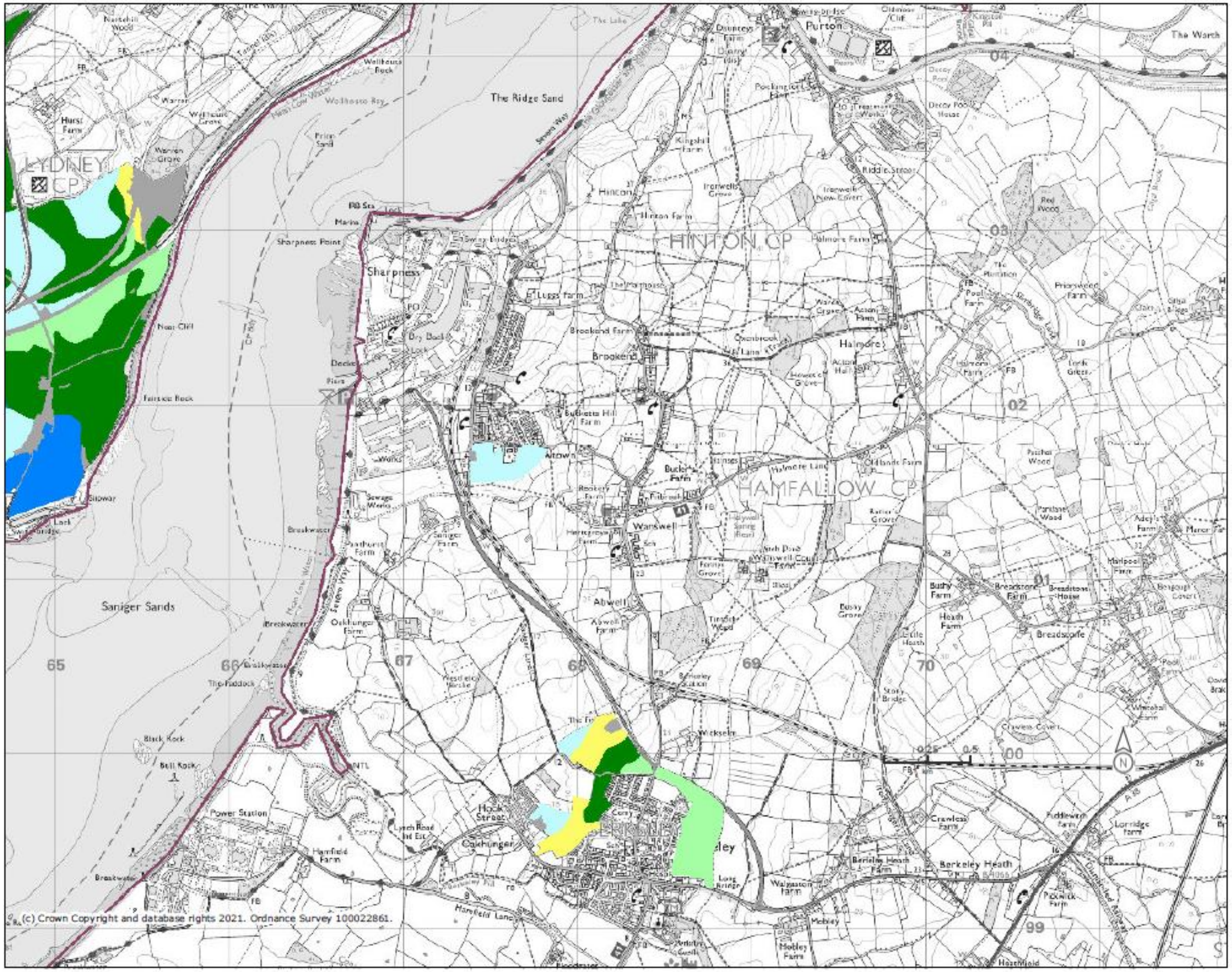
APPENDIX KCC4

ALC Around Sharpness

MAGIC

Magic Map



Legend

Post 1988 Agricultural Land Classification (England)

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- Grade 2
- Grade 3a
- Grade 3b
- Grade 4
- Grade 5
- Not Surveyed
- Other

Projection = OSGB36
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ymin = 198800
xmax = 373800
ymax = 204300

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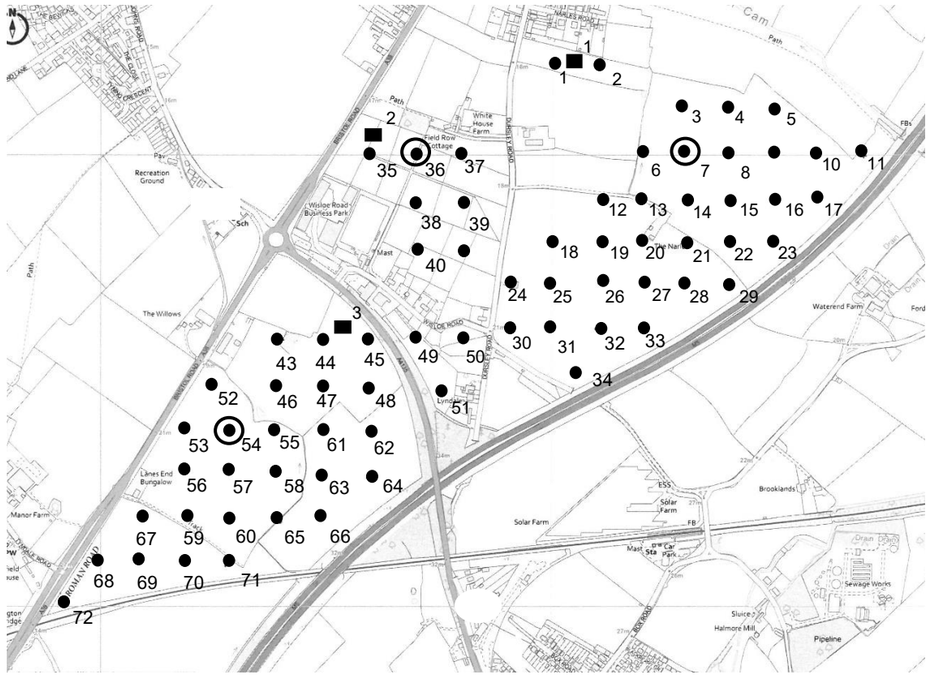
Map produced by MAGIC on 20 July, 2021.

PLAN KCC3027/01

Auger Points Plan



KEY

- ● Auger sample location
- ○ Topsoil texture sample
- ■ Soil Pit

PLAN	**KCC3027/01**		
TITLE	**Auger Points Plan**		
SITE	Wisloe, Nr Stroud		
CLIENT	Stantec		
NUMBER	**KCC3027/01 07/21tk**		
DATE	July 2021	**SCALE**	NTS

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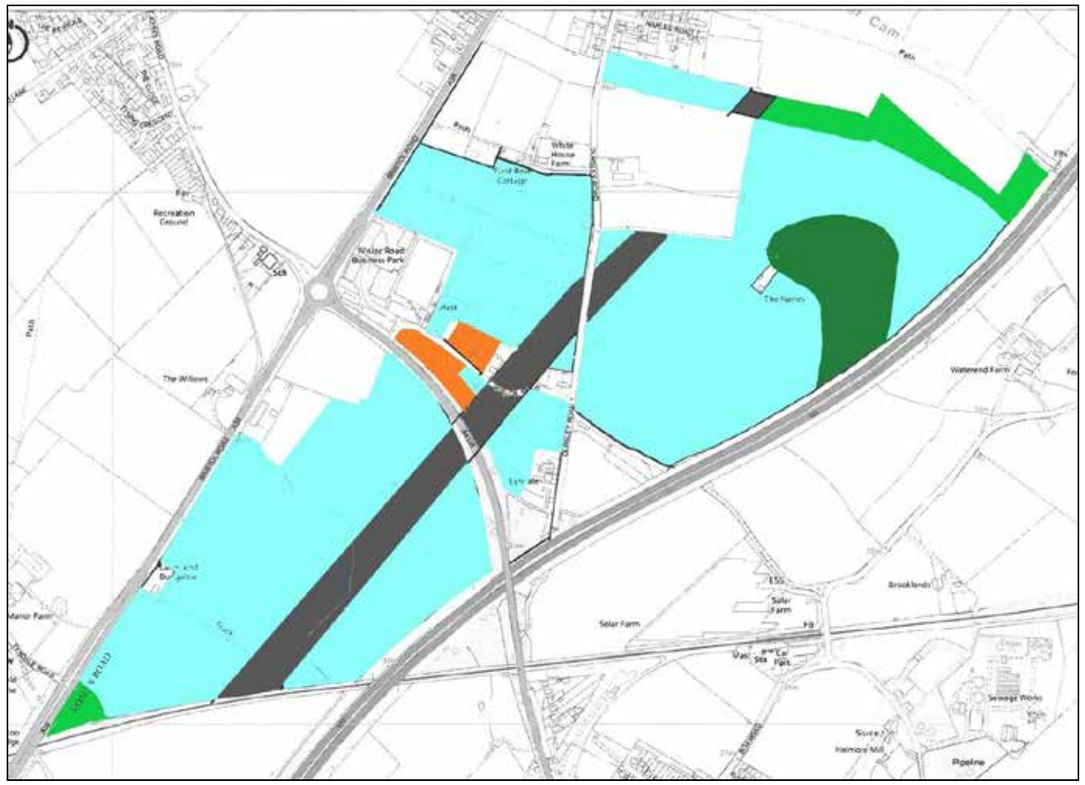
GREENACRES BARN, PURTON STOKE, SWINDON, WILTSHIRE SN5 4LL
Tel 01793 771 333 Email: info@kernon.co.uk

PLAN KCC3027/02

Agricultural Land Classification



KEY		Ha	%	PLAN	KCC3027/02		
	Grade 1			TITLE	Agricultural Land Classification Plan		
	Grade 2	59.9	77.9	SITE	Wisloe, Nr Stroud		
	Grade 3a	5.3	6.9	CLIENT	Stantec		
	Grade 3b	3.9	5.1	NUMBER	KCC3027/02 07/21tk		
	Grade 4			DATE	July 2021	SCALE	NTS
	Grade 5						
	Non-agricultural	1.5	2.0				
	Urban						
	Not surveyed	6.3	8.1				

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WISLOE

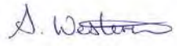
D2. Gas Main Feasibility Study

Fingleton White and Wales & West Utilities

DOCUMENT FACEPLATE

CLIENT:	Wales & West Utilities
PROJECT:	Wisloe Green Feasibility Study
CLIENT PROJECT NO.:	N/A
TITLE:	Feasibility Study
DOCUMENT NO.:	0961-23-RG-1001

APPROVALS FOR THIS ISSUE

REVISION NO.: 0	**PURPOSE: For Issue**		
Name	**Position**	**Signature**	**Date**
Rosa Andrea Mangue **Author**	**Design Engineer**		***16/04/2021***
Scott Western **Approver**	**Project Manager**		***16/04/2021***

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HISTORY OF ISSUES / APPROVALS

REV	DATE	DESCRIPTION OF CHANGES	FILE NUMBER
0	16/04/2021	Issued for Comment	0961-23-RG-1001-R0

EXECUTIVE SUMMARY

This report is a feasibility study investigating the possible route options associated with the diversion of the existing HP gas main at Wisloe Green, Gloucester.

The existing WWU operated 350 NB HP steel gas main crosses the proposed development area from south-west to north-east. The presence of this pipeline in its unmodified state would restrict the development proposal. Therefore, a diversion or relaying of the existing Gloucester to Wickwar gas main is required.

During consultation between FW and the developer on the 1st March 2021, connection point locations for the installation of the new steel pipeline were discussed. Whilst connection point options outside of the developer site boundary were considered, these would introduce third party agreements and further engineering constraints i.e., crossing of railway line, and as such the developer had no objection to locating connection points within the developer site boundary.

Two connection points were considered as tie-in points for the diversion routes as part of this feasibility study. Connection Points A is proposed to be located approximately 10m north of the railway line, within the development site. Connection Point B is proposed to be located within the development site, approximately 160m south-west of Narles Road. These connection points will allow for sufficient space for bypass installation while allowing for the development to be constructed as planned.

In addition to relaying new pipeline with a heavier walled pipe, another key risk mitigation measure is to re-route pipeline within green open space within the proposed development site in order to accommodate the pipeline easement and avoid impact on the safe operation of the pipeline. It was confirmed during consultation with Stantec that green areas running along the eastern boundary of the proposed development will be dedicated as noise buffers.

The assessment of the pipeline diversion routes is detailed in section 5.0 of this study and proposed routes are shown in Figure 7. Route Option 1 was proposed in sympathy with the developers' concept 2 route option, which stays largely within the noise buffer area and land owned by the developer. Route Options 2 & 3 also allow for the development to be built as planned, however these routes would be partially routed within third party land and would require several road crossings. In addition, Route option 2 would cross the existing HP gas main at one location, adding to complexity and safety risks during construction.

Overall, Fingleton White recommends Route Option 1 as the preferred diversion route for the following reasons:

- In accordance with HSE general guidance on risk mitigation measures i.e. designing the network of green open space within proposed development to accommodate the pipeline easement and avoid impact on the safe operation of the pipeline
- Route in sympathy with developers' concept 2 route option
- Route is within designated corridor
- No constraints in terms of existing utilities

In conclusion, the proposed diversion route (Route Option 1) is the most acceptable solution in terms of meeting the requirements of WWU, the developer and IGEM/TD/1 Edition 5.

		Diversion Pipe Length		Ground Category	
Option	Rank	Public Land	Private Land	Public Land	Private Land
1	1st	30	2370 m	Tarmac	Grass
2	3rd	60	1940 m	Tarmac	Grass
3	2nd	60	2440 m	Tarmac	Grass

Table 1 – Diversion Routes Overview

Table of Contents

1.0 INTRODUCTION

Wales & West Utilities (WWU) have appointed Fingleton White (FW) to carry out a feasibility study investigating the possible route options associated with the diversion of an existing High Pressure (HP) gas mains at Wisloe Green, Gloucester.

The purpose of this feasibility study is to review the route option proposed by LHC Design and propose alternative routes, if needed, in order to identify a preferred pipeline diversion option.

1.1 Background

An area at Wisloe Green is being developed for residential use by Stantec. An existing WWU operated 350 NB HP steel gas main crosses the proposed development area from south-west to north-east. The existence of this pipelines belonging to Wales and West Utilities in its unmodified state restricts the development proposal.

For major accident hazard pipelines, the HSE sets a consultation distance (CD) based on available scientific knowledge using hazard /risk assessment models.

The HSE Planning Advice Web App is the name given to the software used to provide HSE's Land Usage Planning (LUP) advice to Planning Authorities on proposed developments near major hazard sites and major accident hazard pipelines. It replaced PADHI+ ((Planning Advice for Developments near Hazardous Installations) in 2015.

For major accident hazard pipelines, HSE Pipelines Inspectors determine if the potential consequences of the pipelines being approved are acceptable. HSE then determine the sizes of the 3 consultation zones to be used for LUP purposes basing their assessment on the pipeline details notified to HSE by the pipeline operator.

The consultation zones are normally determined by a detailed assessment of the risks and/or hazards of the installation or pipeline which takes into account several factors. The risks and hazards from the major hazard are greatest in the Inner Zone and hence the restrictions on development are strictest within that zone. Consultation Zones consist of an Inner Zone, Middle Zone and Outer Zone.

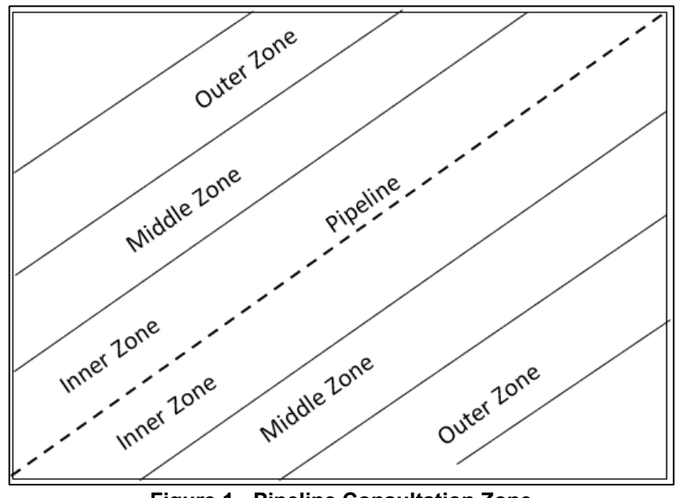

Figure 1 - Pipeline Consultation Zone

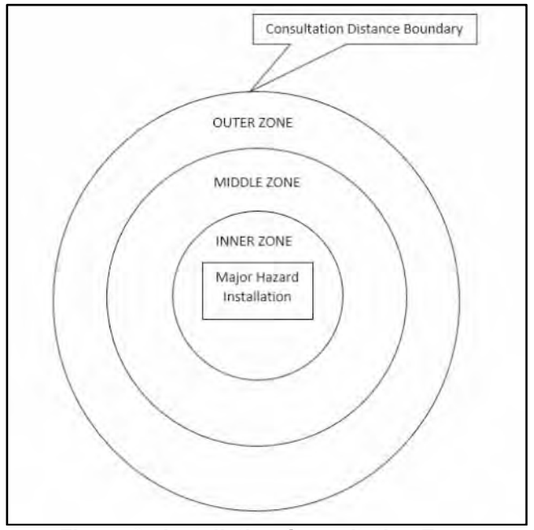

Figure 2 - Installation Consultation Zone

The recommendations of the HSE and in particular the exclusion zones outlined within Planning Advice for Developments near Hazardous Installations (PADHI) methodology require a diversion of the pipeline where it passes through the proposed development area.

The pipeline enters the development area from a location north of an existing railway line, and approximately 160m west of the M5 motorway. The pipeline is routed north-east through fields for about 2.5 km, crossing the A4135 road, Wisloe Road, and Dursley Road. The pipeline exits the development site at a location south-east of Narles Road.

The Gloucester to Wickwar pipeline was constructed prior to 1972, from API Grade X46 steel pipe. Therefore, this pipeline is classified as a P18 pipeline and may require further specialist investigation in accordance with T/SP/P/18 due to the potential of defective girth welds. This installation is not subject to a “lift and shift” agreement.

Given the strategic nature of this pipeline, it cannot be taken out of service and any modification will need to maintain gas supply. WWU records indicate that the pipeline is buried at a nominal depth of cover of 900 mm, but this may vary at crossings.

Figure 3 below shows the proposed development site and the existing HP gas main route overlayed on to google earth.

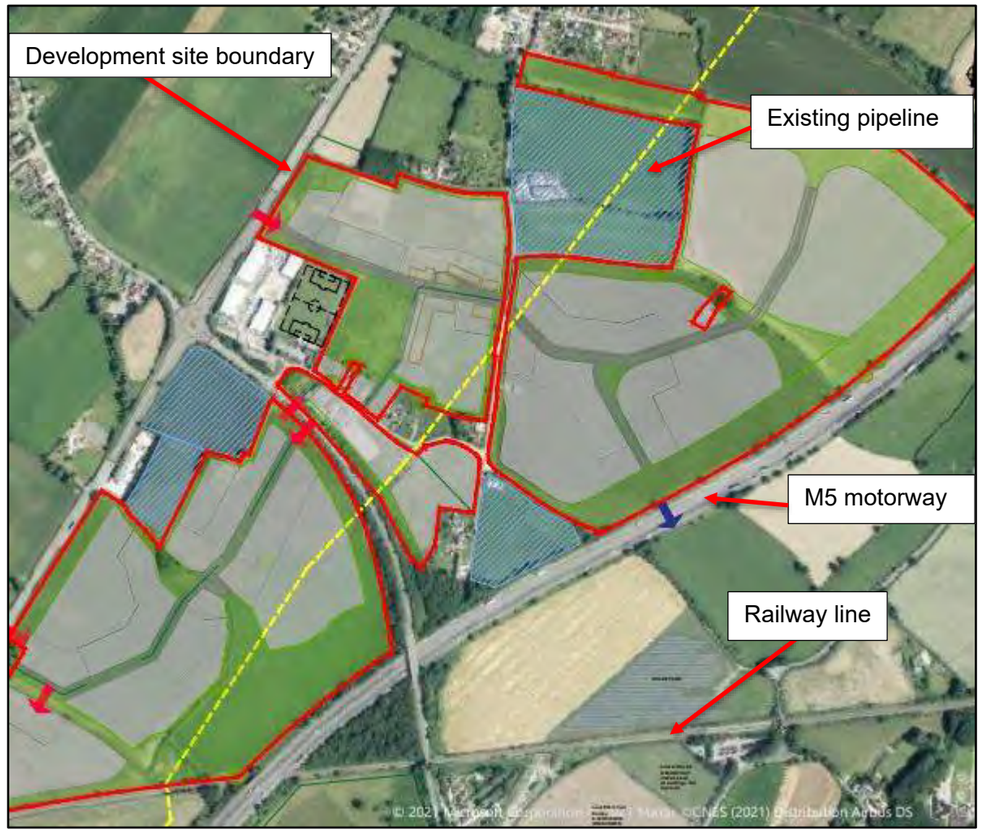

Figure 3 - Existing 350 NB Gloucester-Wickwar Pipeline Route

1.2 Scope of Study

The scope of works for this study has been identified by WWU as:

- Undertaking a site visit
- Identify, assess and review route option presented by Stantec.
- Identify, assess and review potential route options above and beyond those previously identified.
- Identify connection locations to the existing system.
- Identify health, safety and engineering difficulties,
- Identify scope for subsequent conceptual and detail design studies,
- Determine any special operational requirements,
- Review design with respect to Institution of Gas Engineers and Managers (IGEM) and WWU Standards,
- Identify long lead materials,
- Identify budget costs,
- Compilation of a design report to include high level programme, risk assessments, budget costs and option assessment for the options identified.

1.3 Abbreviations

Abbreviation	Definition
BPD	Building Proximity Distance
FW	Fingleton White
HSE	Health and Safety Executive
LUP	Land Usage Planning
MOP	Maximum Operating Pressure
PADHI	Planning Advice for Developments near Hazardous Installations
SSSI	Site of Special Scientific Interest
WWU	Wales & West Utilities

Table 2 - Abbreviations

2.0 DESIGN CRITERIA

2.1 General

This scope makes reference to recognised standards, specifications and codes of practice. Unless otherwise specified the latest editions of these documents including all addenda and revisions shall apply.

It is important to note that the documents listed are not exhaustive and other standards may apply. However, this does not relieve the commitment to carry out the work and/or compliance with the relevant standards.

In the event of a variation from a standard, specification or code of practice, a statement shall be submitted to WWU for approval identifying the area of nonconformity. The terms to be used are as follows:

- Non-compliant- Does not fully meet the requirements of the specification.
- Alternative- A proposal which does not fully comply with the specification but which an alternative solution is available while meeting operational requirements.

Any variations shall clearly state how the proposal differs from the requirements. If clarification of any requirements is required, this shall be sought as soon as possible.

2.2 Design Philosophy

The design philosophy is to provide a pipeline system “fit for purpose” without compromising safety, security, reliability and the environment.

The new pipeline, which is the subject of this report, will match or exceed the design criteria for the existing pipeline and all current design standards as appropriate.

2.3 Legislation

The existing system is designed and operated in accordance with the Pressure Systems Safety Regulations (PSSR):2000.

Additionally, the existing system design takes into account the requirements of:

- The Gas Act 1986 (amended 1995)
- The Pipelines Safety Regulations (PSR):1996
- The Construction (Design and Management) (CDM) Regulations 2015.
- Health and Safety at Work Act (HSWA):1974
- The Public Gas Transporter Pipelines Works (Environmental Impact Assessment) Regulations 1999.

The new Pipeline will be designed to the same legislation and any other legislation which is applicable to the project.

2.4 Principal Design Codes and Application

A list of relevant standards and specifications are outlined in Table 3. The pipeline diversion will be designed in accordance with IGEM/TD/1 Ed 5 and relevant Wales and West specifications.

Document No.	Document Title
IGEM/TD/1 Ed 5	Steel pipelines for high pressure gas transmission
T/SP/P/10	General pipelining designed to operate at pressures greater than 7barg
IGEM/GL/5	Managing New Works, Modifications & Repairs
2014/68/EU	Pressure Equipment Directive
GIS/DAT6:2019	Specification for standard sizes of carbon and carbon manganese steel pipe for operating pressure greater than 7 bar.
T/SP/F/4	Specification for hot tap and stopping off connections (for operating pressures 7 bar to 70 bar inclusive).
T/PM/P/18	Specification for working on pipelines containing defective girth welds of unknown quality.
T/SP/TR/18	Specification for engineering of pipelines and installations operating at [pressures] above 7 barg
T/SP/TR/21	Specification for feasibility studies of pipelines and installations operating at [pressures] above 7 barg.
T/PM/P/11	Management Procedure for Inspection, Assessment and Repair of Damaged Non-leaking Steel Pipelines Designed to Operate at Pressures Greater than 2 bar
T/PM/P/20	Management Procedure for Inspection Assessment and Repair of Damaged (Non-leaking) Steel Pipelines and Pipework up to 150mm Nominal Diameter Designed to Operate at Pressures Greater than 2 bar
T/SP/CW/6	Specification for the External Protection of Steel Line Pipe and Fittings Using Fusion Bonded Powder and Other Coating Systems
T/SP/CW/5	Specification for Field Applied External Coatings for Buried Pipelines and Systems
T/SP/P/9	Specifications for the Welding of Fittings to Pipelines Operating Under Pressure
T/SP/PT/1	Pressure Testing Pipework, Pipelines, Small Bore Pipework and Above Ground Austenitic Stainless-Steel Pipework
T/SP/B/12	Specification for Steel Bends, Tees, Reducers and End Caps for Operating Pressures Greater than 7 bar
T/SP/NDT/2	Specification for Non-Destructive Testing of Welded Joints on Construction and Fabrication Projects

Table 3 - Standards & Specifications

All relevant WWU Specifications, Standards and Codes of Practice applicable to this type of system shall apply and unless otherwise specified the latest editions of these documents including all addenda and revisions.

3.0 MECHANICAL REQUIREMENTS

The works detailed herein have been developed based on information supplied by WWU. The process conditions for the existing pipelines are summarised in Table 4 below. The existing pipelines were designed in compliance with Standards prevalent at the time of construction and considerations now thought of as a norm would not necessarily have been incorporated. Design factors, operating stresses and Building Proximity Distance (BPD) have been assessed against the latest Specifications.

3.1 Existing Pipeline Data

The existing Gloucester to Wickwar pipeline data is outlined in Table 4 below:

Gloucester to Wickwar Pipeline Operating Parameters	
Parameter	**Existing**
Maximum Operating Pressure (MOP)	32.6 barg
Nominal Diameter	350 NB
Outside Diameter	355.6 mm
Pipe Wall thickness	7.9 mm
Material Grade	X46
Pipe Type	Seam Welded (assumed)
Building Proximity Distance	15.6 m
Depth of Cover	0.9m (May very at crossings)

Table 4 - Existing Pipeline Design Parameters

3.2 Design Life

The pipeline diversion will have a design life of 40 years.

3.3 Pipeline Routing

The existing gas pipeline is located within the proposed new housing development at Wisloe Green. To facilitate the development, a diversion of the existing gas pipeline is required, whilst relaying the pipeline with an increased wall thickness and at an increased depth of cover. The pipe wall thickness is required to be ≥11.91 mm to avoid an increase in the BPD.

Properties of New Diversion Pipeline	
Parameter	**Value**
Pipeline Diameter	355.6 mm
Pipe Wall thickness	12.7mm
Material Grade	L360NE
Pipe Type	Seamless
Depth of Cover	1.2 m

Table 5 - Properties of New Diversion Pipelines

Details of pipeline tie-in points are found in section 4.0

3.4 Building Proximity Distance (BPD)

The minimum BPD is calculated in accordance with IGEM/TD/1 for new pipeline and results are presented in Table 6 below. Refer to appendices for detailed calculations.

Parameter	Value
Pipe size	355.6 mm (OD)
MOP	32.6 barg
Wall Thickness	12.7 mm
Area Type	S
Minimum BDP	3 m

Table 6 - Minimum BPD for New Diversion Pipeline

3.5 Pipeline Design Factors

Table 7 outlines the area types and corresponding design factors in accordance with IGEM/TD/1. The number of persons per hectare in the relevant area is > 2.5 (refer to appendices for detailed calculations). Therefore, type S area has been determined for pipeline design, which incorporates a design factor of 0.3.

Area Description	Area Type	Design Factor
Rural Areas with a population density not exceeding 2.5 persons per hectare	R	0.72
Areas intermediate in character between types R and T in which the population exceeds 2.5 persons per hectare and which may be extensively developed with residential properties, schools, shops etc.	S	0.3
Central areas of towns or cities, with a high population density, many multi-storey buildings, dense traffic and numerous underground services.	T	-

Table 7 - Area Design Factor

3.6 Design Wall Thickness

Design wall thickness to be determined as follows:

$$t = \frac{PD}{20fs}$$

Where:

t = minimum allowable wall thickness
P = *design pressure (bar)*
D = *outside diameter of pipe (mm)*
f = *design factor*
s = *specified minimum yield strength (N mm^{-2})*

The following are the wall thickness under-tolerances used to determine the minimum wall thickness of welded steel pipe to EN 3183.

Wall Thickness t (mm)	Tolerance	
Seamless Pipe		
t < 4	+0.6 mm	-0.5 mm
4 < t < 25	+15%	-12.5%
Welded Pipe		
t ≤10	+1.0 mm	-0.5 mm
10 < t < 20	+10%	-5%
t ≥20	+2.0 mm	- 1.0 mm

Table 8 - Tolerances on Wall Thickness (Ref: EN 3183)

Refer to appendices for detailed calculations of allowable pipe wall thicknesses.

3.7 Components & Fittings

The pipe specification, grade and wall thickness are defined in Table 4. All piping components and fittings shall be selected for the proposed design pressures and temperatures specified in the table below with a material composition compatible with the selected adjoining pipe.

Site	Component	Design Pressure (barg)	Rating	Design Temp (°C)	
				Max	Min
Gloucester to Wickwar	Fittings	32.6	CL300	+60	-20

Table 9- Components & Fittings Parameters

3.8 Pipeline Design Velocities

IGEM/TD/1 Edition 5 section 6.2 notes that as long as the gas quality is maintained at the prescribed levels, there is no need to limit the design velocity of gas in pipelines.

3.9 Pipeline Pressure Loss

The pipeline diversions will only have a marginal effect on the total length of the pipeline. Therefore, it is expected that gas pressures will not be adversely affected.

3.10 Pipeline Crossing Methods

Several road crossings were identified in this study. The A413 road, Bristol Road, St. John's Road and Dursley Road. These three roads may be classed as 'Other Traffic Route'. The requirements for crossing 'Other Traffic Routes', defined as those not designated as 'High-Density Traffic Routes' is outlined within IGEM/TD/1 Edition 5 and WWU Specification T/SP/P/10.

3.11 Existing Weld Conditions

WWU have indicated that the existing Gloucester to Wickwar pipeline was constructed prior to 1972 and constructed from API Grade X46 steel pipe. Therefore, there is the potential for defective grith welds. WWU have procedures in place for identifying and addressing such welds (WWU Specification T/SP/P/18).

The T/SP/P/18 procedure provides advice on reduction of risk of grith weld failure when working on buried pipelines and buried installation pipework.

The criteria for classifying weld defects and identifying the potential need for a repair are defined in T/SP/P/18 section 8. All girth welds requiring repair should be repaired in accordance with T/PM/P/11 or T/PM/P/20 as applicable.

Where there is potential for defective grith welds, a preliminary excavation shall be performed to identify weld locations, to establish the quality of welds and to determine their ability to withstand forces. All welds within the excavation should be inspected using NDT inspection techniques such as radiography and/or ultrasonic methods. This is in order to determine weld quality and check for defects that fall outside acceptable levels.

4.0 CONNECTIONS & TIE-INS

4.1 Connection Point Details

Two connection points were considered in this study as shown in Figure 4 below. These connection points were proposed by Stantec and are located within the development site.

Connection Point A is proposed to be located within the greenfield site north of the existing railway line. There is concrete sleeve protection installed at the location where the pipeline crosses the railway. The existence of this railway and the sleeve protection in the vicinity of the proposed location for Connection Point A should be taken into consideration during detail design.

Connection Point B is proposed to be located within a greenfield site south-east of Narles road. This connection is proposed to be located in close proximity to a water crossing.

These connection points would position the associated PADHI zones the furthest away from the proposed dwellings while allowing for sufficient space for bypass installation. Further investigation at connection point A and B would be required at detailed design stage to confirm the depth of cover. As-laids were not available during the feasibility study however a depth of cover of 0.9m has been stated by WWU for the existing HP gas main.

Figure 4 - Connection Point Details

Indicative PADHI zones of 16 m (inner), 49 m (middle) and 70 m (outer), used in this study were provided by Stantec, see Appendix 3.

4.2 Stoppling Arrangement Options

The connection points will require the Gloucester to Wickwar pipeline to be 'line-stopped' ('stoppled') to isolate the connection points and bypasses installed to maintain supply to downstream off-takes. The connection tie-in points will vary depending on factors such as space availability, condition of the existing pipeline, weld locations, etc.

To allow the pipeline to be 'stoppled' and bypassed, these connections will be required upstream of the tie-in point. An excavation in the order of 20 m in length may be expected for such a connection with further potential excavations downstream of the tie-in to allow for a secondary 'stopple' and bypass connection, see Figure 5 and Figure 6 below. Removal of trees and shrubs may be required to accommodate the connections.

A 'bifurcated stopple operation' uses the newly diverted pipeline as a temporary gas conduit while the cut-outs are being made and reduces the number of fittings and connection length as the secondary isolation position is not required. A 'five position stopple' operation entails two close stopples to isolate a section of the parent pipeline. With a bypass around the isolated section, the intermediate section of pipeline can be cut out to accommodate the end of the new diversion.

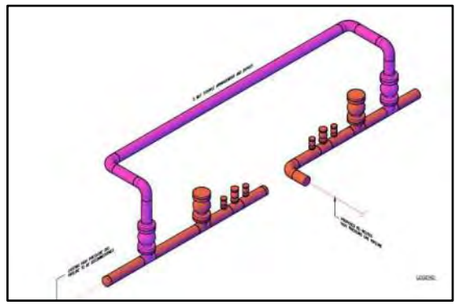

Figure 5 - Typical 'Five Position' Stopple

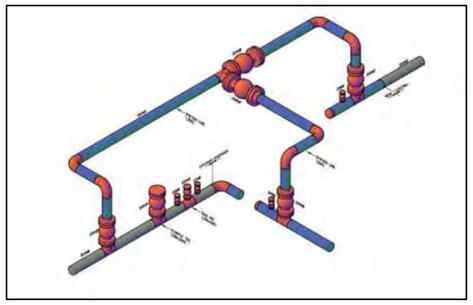

Figure 6 - Typical 'Bifurcated' Stopple

Further analysis of the connections should be done at detail design stages once the diversion route is agreed, and investigations carried out to determine weld locations and straight pipe lengths on the existing pipeline. The exact locations of the connection points should be considered at detailed design to ensure there is sufficient space to carry out the tie-ins in accordance with the governing standards.

5.0 ROUTE DETAILS

To propose a feasible diversion route, several design considerations were established. The main design considerations that influenced the diversion routes proposed are the following:

- Proposed development layout
- Location of connection points
- PADHI Zones and how they affect proposed dwellings.
- Land ownership
- Existing utilities / Constraints
- Diversion route length / shortest route

A diversion route has been proposed by Stantec, however, following a review of the proposed route by Fingleton White during this study, amendments have been applied to the suggested route to address proximity issues with the existing HP gas main during construction.

The diversion routes proposed below are a pipeline corridor, the final routes will be determined at detail design stage. The proposed routes are shown in Figure 7 below, shown along with the engineering features and hazards considered during design.

Pipeline Route Option 1 – Route proposed for diversion is proposed to be installed largely within the land owned by the developer. The route is detailed in section 5.1.

Pipeline Route Option 2 – Route proposed for diversion is proposed to be installed largely within the land owned by the developer. The route is detailed in section 5.2.

Pipeline Route Option 3 – Route proposed for diversion is proposed to be installed partially within the land owned by the developer and partially through a private field. The route is detailed in section 5.3.

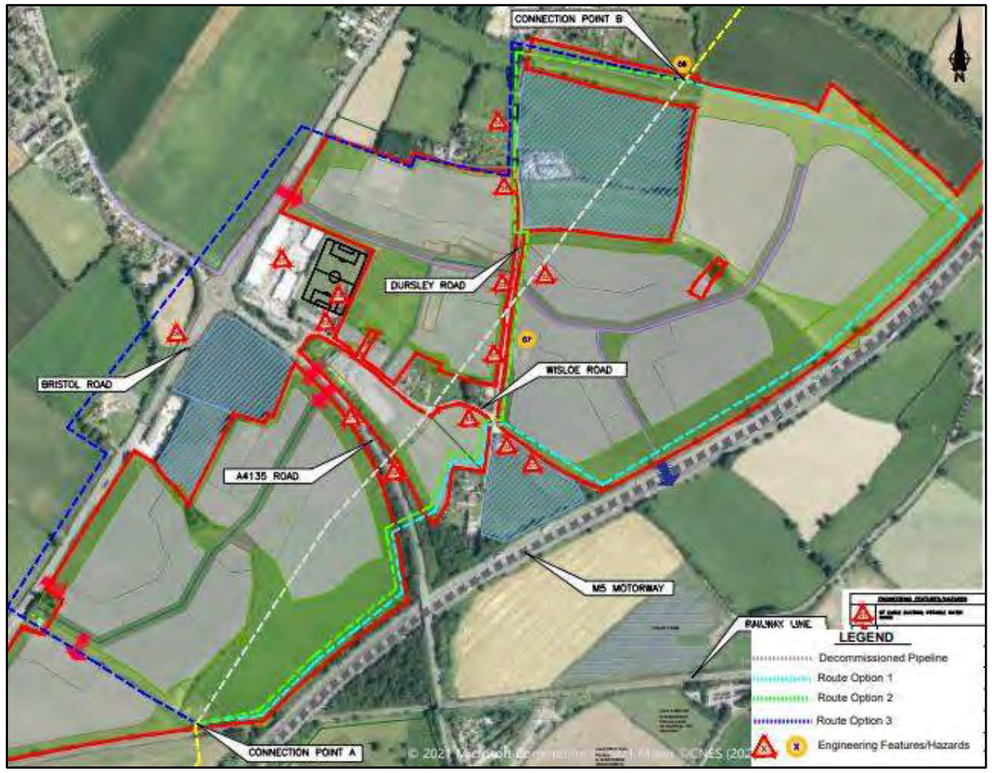

Figure 7 - Diversion Route Options

5.1 Route Option 1

Pipeline Route Option 1 connects to the existing HP gas pipeline within the development site at Connection Point A, located approximately 10m north of the railway line. From the connection point the pipeline is proposed to be routed east, running parallel to the M5 motorway for approximately 450m. It is then routed in a northerly direction, running parallel to the A4135 road for approximately 120m before crossing into the greenfield site, north of the A4135 road. The diversion route then follows a zigzag arrangement avoiding the existing houses that are located to the north-west of Dursley road. The proposed route crosses Dursley road onto the greenfield site west of the M5 and continues for approximately 200m, before turning north and continuing parallel to the M5 for approximately 700m. The proposed route then runs west of the M5 for approximately 520m and connects back into the existing pipeline at connection point B, located approximately 160m south-east of Narles Road.

It should be noted that the crossing of the A4135 road will involve removal of a substantial number of trees and vegetation on both sides of the road. An environmental survey should be conducted prior to construction to avoid works overlapping with bird nesting season and/or other environmental constraints.

This diversion route option is similar to the diversion option proposed by Stantec and has been proposed in sympathy with the development plans. It stays within the proposed noise buffer area where no plots are being planned for development and avoids any third-party land constraints. However, some utilities are routed along the location where this diversion route crosses Dursley road. These utilities include overhead electricity cables and a low-

pressure gas main. In addition, the developer may have to liaise with Highways England due to proposed works within the vicinity of the M5 motorway. This should be taken into consideration at detail design.

The length of this diversion route option is approximately 2,400m.

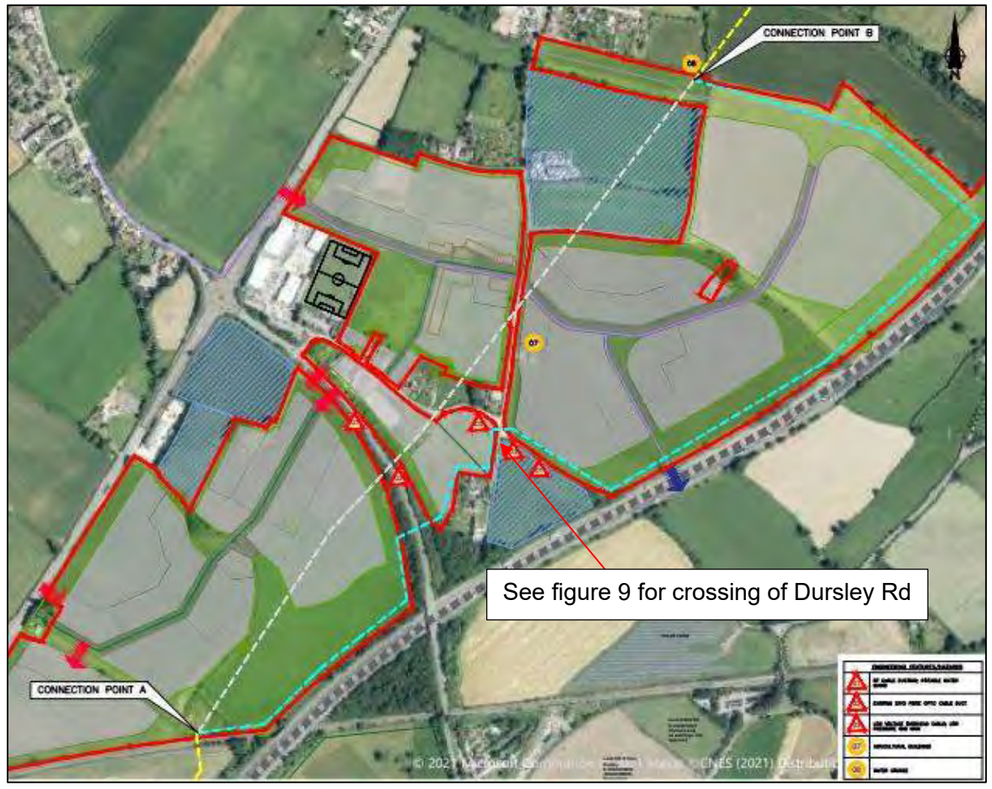

Figure 8 - Diversion Route Option 1

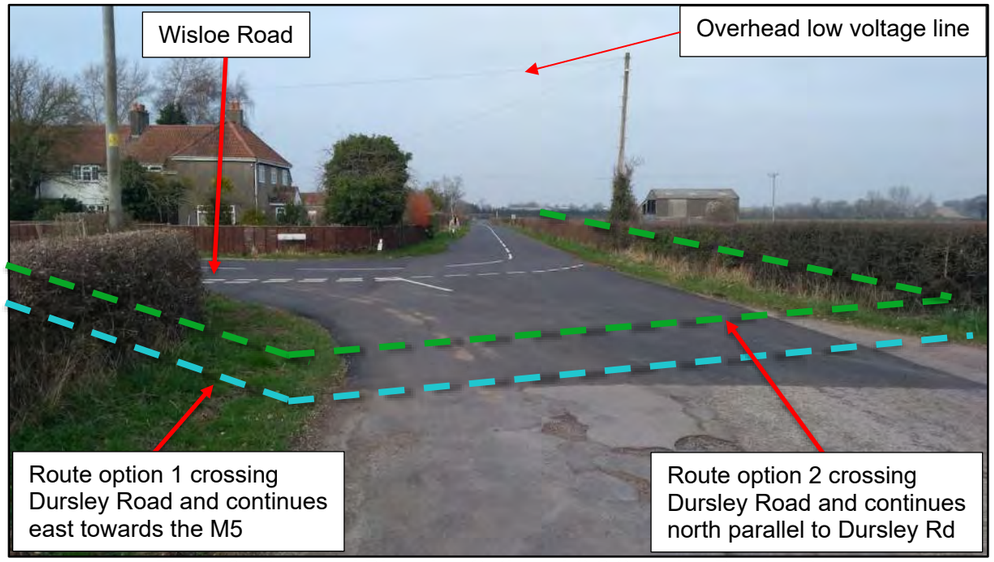

Figure 9 - Proposed Diversion Options 1 & 2 Crossing Dursley Rd.

5.2 Route Option 2

Pipeline Route Option 2 connects to the existing HP gas pipeline at Connection Point A, as per Route Option 1. From the connection point the pipeline is routed east parallel to the M5 motorway for approximately 450m. It then turns north and is routed parallel to the A4135 road for approximately 120m before crossing onto the greenfield site north of the A4135 road. The diversion route then follows a zigzag pattern avoiding the existing houses north-west of Dursley Road, similar to diversion Route Option 1. The diversion route then continues north, along the eastern verge of Dursley Road for approximately 330m before crossing Dursley Road and continuing north on the western verge of it for approximately 320m. The diversion route crosses Dursley Road again, into the greenfield site east of it and continues for approximately 270m, before connecting back into the existing pipeline at connection point B, located approximately 160m south-east of Narles Road.

It should be noted that the crossing of the A4135 road will involve removal of a substantial number of trees and vegetation on both sides of the road. An environmental survey should be conducted prior to construction to avoid works overlapping with bird nesting season and/or other environmental constraints.

This diversion route option has been proposed in sympathy with the development plans. It stays largely within the proposed noise buffer area where no plots are being planned for development. However, approximately 220m of this diversion would be routed within third party land. In addition, it crosses the existing Dursley Road at three locations and the existing 300 NB HP gas main at one location, adding to complexity during construction. Also, several utilities are routed along Dursley Road, including overhead electricity cables, underground electricity cables, potable water mains and low-pressure gas mains. This should be taken into consideration at detail design.

The length of this diversion route is approximately 2,000m.

Figure 10 - Diversion Route Option 2

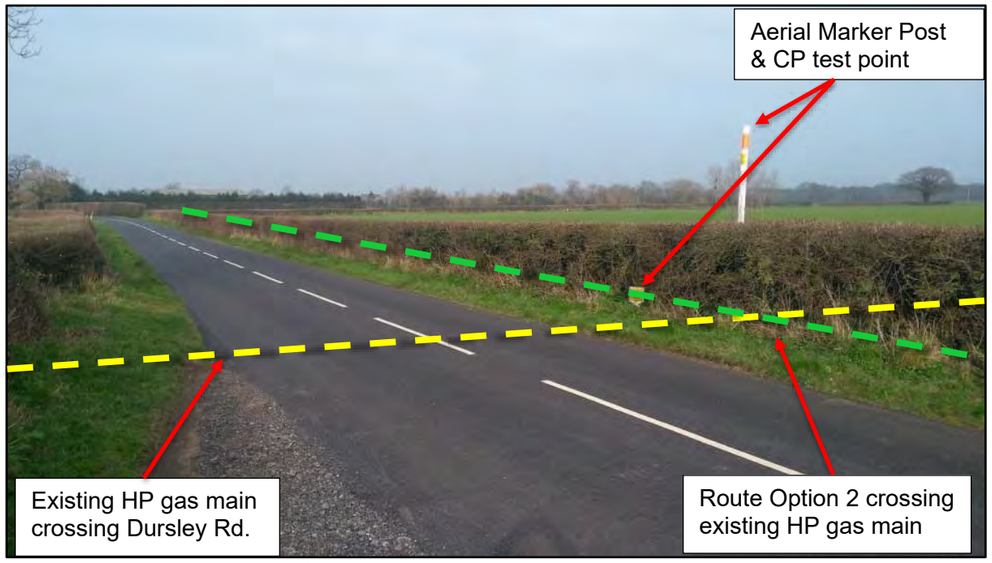

Figure 11 - Location Where Route Option 2 Crosses Existing Pipeline

5.3 Route Option 3

Pipeline Route Option 3 connects to the existing HP gas pipeline at Connection Point A, as per Route Option 1From the connection point the pipeline is routed west through the greenfield site within the development site for approximately 310m before crossing Bristol Road into the greenfield site west of it. The diversion route continues north for approximately 770m along the western verge of Bristol Road avoiding the existing houses on the west of Bristol Road. It then crosses St. John's Road and continues north along the western verge of Bristol Road for approximately 300m before crossing it and continuing onto the greenfield site east of Bristol Road for about 350m. It is then routed north, along the western verge of Dursley Road for approximately 220m before it crosses into the greenfield site located to the east and continues for approximately 270m. The diversion route connects back onto the existing pipeline at connection point B, located approximately 160m south-east of Narles Road.

This route option is partially routed outside the proposed development site and is the longest route option. Sections of the pipeline would be routed within third party land and at least four road crossings have been identified, adding to complexity during construction. In addition, several utilities are routed along Bristol Road and Dursley Road, including electricity cables, potable water mains,low pressure gas mains and overhead BT cables. This should be taken into consideration at detail design.

The length of this diversion route is approximately 2,500m.

Figure 12 - Diversion Route Option 3

Figure 13 – Location Where Route Option 3 Crosses St. John's Rd.

6.0 OPTIONS ASSESMENT

The following table summarises the advantages and disadvantages associated with the options identified for routing of diversion main between the identified start and end points.

6.1 Route Option 1

The option detailed in section 5.1 is proposed to be installed within the proposed development as the diversion connects off and back into the existing main. This option has the least number of road crossings and stays largely within a green area that at initial consultation with Stantec was confirmed to be assigned as a dedicated noise buffer area. In addition, it was the preferred route during initial consultation with Stantec as the route ensured sufficient separation to allow for flexibility when developing a detailed plot layout scheme . For these reasons Route Option 1 ranks first in the SWOT analysis.

Strengths	Weaknesses
•Pipeline fully routed along designated corridor •Shorter route compared with option 3 •Standard opencut technique •Minimal inpact on tree/hedgerows •Least number of road crossings compared with options 2 & 3 •Low house density in the viscinity of proposed route	•Crossing road embankment •Proximity risks to existing utilities, specifically electricity cables and low pressure gas main •Proximity to motorway •Multiple bends

Opportunities	Threats
•Trenchless technique could be used to cross wooded areas and roads	•Potential Environmental issues impacting construction programme •Proximity to existing pipeline during construction

6.2 Route Option 2

The route option detailed in section 5.2 is proposed to be largely routed within the proposed development site as the diversion connects off and back into the existing main. Route option 2 is the shortest route and allows the development to be built as proposed. However, it will require four road crossings, it crosses the existing gas main at one location and is partially routed within third party land. For these reasons Route Option 2 ranks third in the SWOT analysis.

Strengths	Weaknesses
•Standard construction techniques(i.e stable ground conditions etc.) •Pipeline largely routed along designated corridor •Shortest route - lower material/installation costs	•Safety risks to crossing of HP gas pipeline •Route through vegetation, ditches, hedgerows, etc. •Diversion works in vicinity of exsiting building •Works might lead to road closures •Proximity risks to existing utilities, specifically overhead cables and below ground gas line •Highest number of road corssings compared with options 1 & 3

Opportunities	Threats
•Trenchless technique could be used to cross wooded areas and roads	•Potential Environmental issues impacting construction programme •Proximity to existing pipeline during construction

6.3 Route Option 3

The option detailed in section 5.3 is proposed to be partially within the development site and partially parallel to Bristol road as the diversion connects off and back into the existing main. Route option 3 allows the development to be built as proposed. However, it is the longest route option and will require four road crossings. For these reasons Route Option 3 ranks second in the SWOT analysis.

Strengths	Weaknesses
•Standard construction techniques(i.e stable ground conditions etc.) •Minimal inpact on tree/hedgerows •No proximity issues to existing pipeline during construction	•Route through vegetation, ditches, hedgerows, etc. •Diversion works in vicinity of exsiting buildings and utilities •Longest route leading to higher material/installations costs. •Approximately four road crossings •Route within third party land
Opportunities	**Threats**
•Trenchless technique could be used to cross wooded areas and roads •Increase development area due to diversion route further away from development area	•Potential Environmental issues impacting construction programme •Third party consent

7.0 MATERIALS

7.1 General

All materials, fittings and equipment that will form a permanent or temporary part of the pipeline system will be designed to meet the defined process conditions and to withstand the environmental conditions. This will include the requirement to enable continuous service without significant corrosion, erosion or other deterioration. All materials, fittings and equipment will be in accordance with the requirements of the relevant WWU Standards, and where no WWU technical specification exists, consideration of the following should be made:

- National or International Standards
- Industry Recommendations
- Established Industry Codes (particularly IGEM codes), or
- Company Policy

Any deviation from WWU Technical Specifications should be agreed in writing prior to procurement taking place. Materials will be procured in accordance with the European Community (EC) Utilities Directive and will be supplied complete with certification and evidence of an ISO9000 quality review.

7.2 Proposed Pipe

350 NB pipe is considered to be a non-standard pipe diameter for HP gas pipelines. As such 350 NB is not listed within WWU Specification T/SP/DAT/6.

IGEM/TD/1 Edition 5 requires the suitable diversion pipe to have a minimum wall thickness of 11.91 mm and a design factor no greater than 0.3. From the list of available pipe sizes, the corresponding wall thickness immediately higher than 11.9 mm is 12.7 mm. The material parameters for the diversion are given in Table 5.

7.3 Other Materials

In addition to the pipe requirement identified above, a number of forged bends will be needed to negotiate the changes in direction and level. The quantity of bends required will need to be determined at detailed design stage. IGEM/TD/1 Edition 5 recommends the use of 3D bends to allow unrestricted pipeline pigging. Bends shall be in accordance with WWU Specification T/SP/B/12.

7.4 Connections

WWU have indicated that the Gloucester to Wickwar pipeline cannot be taken out of service and therefore WWU will have no option but undertake a live stoppling operation to divert the existing pipeline along the proposed diversion route.

This will require the use of under-pressure tees and fittings fixed to the pipeline by welding. Welded under-pressure fittings shall be in accordance with WWU Specification T/SP/F/4 and specified as ANSI Class 300 to suit the pipeline operating pressure.

Space availability and maintaining a suitable separation between any unmodified parts of the pipeline and normally occupied buildings will be a key issue during detailed design.

7.5 Material Schedule

Larger materials associated with gas pipeline construction are generally not ‘off-the-shelf’ items and a lead-time should be expected between placement of order and delivery to site. Lead-times at present are typically.

Item	Lead Time (Weeks)
Line pipe	40
Under-pressure fittings	24
Bends	24
Forgings	24
Valves	30

Table 10 - Typical Material Lead Time

8.0 CORROSION PROTECTION

Corrosion can be controlled by a combination of protective coatings, paints and Cathodic Protection (CP). These measures are summarised as follows and shall be in accordance with the appropriate WWU Specification:

- Internal Coatings (WWU Specification T/SP/CM/10)
- External Coatings: Pipe and major fittings shall be supplied with a supplier applied factory coating (WWU Specification T/SP/CW/6).
- Following welding and weld inspection the joints shall be coated. The coating system shall be applied in accordance with the appropriate
- Procedure (WWU Specification T/SP/CW/5).
- Cathodic Protection: The existing pipeline CP system will need to be investigated and evaluated during later stages of the design process.

Design of the cathodic protection system will be completed by specialist designers.

The likelihood is that the existing pipeline CP system will need to be monitored and tested following construction. The likelihood is that the existing system would be capable of protecting the minor additional length of steel pipe material involved. However additional CP test posts are likely to be required along the length of the diverted pipeline.

9.0 CIVIL REQUIREMENTS

9.1 General

The civil elements for the project will typically comprise the following:

- Accommodation works, including formation of temporary accesses, hard standings, etc.
- Trench excavation and support.
- Ground dewatering, trench backfill, compaction, and reinstatement.
- Temporary pipe supports as required.

It is envisaged that much of the diverted pipes will be laid using a traditional 'working spread' methodology where the 'spread' will be a defined working area fenced off from adjacent land parcels. The topsoil will be stripped to form a working area, where pipe welding, trenching, pipe lowering, etc will take place.

Trench excavation and support shall be in accordance with Construction Regulations and Codes of Practice and subject to daily and weekly inspections. These shall be recorded in the Health and Safety file register. Support of deep excavations shall be subject to design approval by a competent person on behalf of WWU.

9.2 Ground Conditions

A geotechnical ground investigation has not been undertaken as part of this study. Preliminary Information obtained through investigation in the British Geological Survey (BGS) maps indicate the overall geological composition of the proposed development land, see section 12.3.

It has been assumed that ground surveys have not been done by the developer at this stage.

The presence of aquifers, refuse tips or localised features cannot be determined at this stage. Therefore, it is recommended that developer's survey results (if available) are reviewed, and further boreholes undertaken if appropriate.

10.0 INSTALLATION AND TESTING REQUIREMENTS

10.1 General

All pressure testing in general shall be carried out in accordance with the requirements of the latest edition of IGEM/TD/1 and WWU Specification T/SP/P/10 and T/SP/PT/1.

10.2 Welding

Welded joints shall be made and inspected in accordance with WWU Specification T/SP/P/2.

Welding of the encirclement tees and associated fittings shall be carried out in accordance with T/SP/P/9.

Details of the pipe sizes, wall thickness and materials should be confirmed at the detail design stage.

All welds shall be subject to 100% non-destructive testing (NDT) in accordance with T/SP/NDT/2.

10.3 Hydrostatic Testing

A hydrostatic pressure test shall be undertaken to prove the structural integrity of the pipeline system and redistribute any construction stresses.

Prior to testing, a test drawing will be prepared by the works contractor and submitted to WWU for approval. In addition, the new section of pipeline shall be swabbed and gauged using approved pigging devices. Similarly, approved pigs shall be used for filling, dewatering and final swabbing operations.

The hydrostatic test will exclude the welds designated as "tie-ins". However, the sections shall be pre-tested prior to the tie-in connection being made and the tie-ins shall be subject to NDT to T/SP/NDT/2 and T/SP/PT/1.

10.4 Records & Documentation

All records information, documentation, certification of materials and components and any other appropriate information that can be used as a permanent record of fitness for purpose shall be preserved by WWU.

All fittings shall have sufficient documentation to provide complete traceability. For pressure systems, which will be subject to schemes of examination, there is a requirement to retain sufficient information concerning its design, construction, examination, operation and maintenance. Records shall typically include:

- Fully detailed "as built" drawings.
- Welding and fabrication records
- Full material certification.
- Equipment data sheets.
- Selected suppliers return – e.g. purchase orders.
- Inspection reports.
- Weld acceptance certificates.
- Weld procedures
- Letters of conformity.

- Design calculations.
- Pressure test records

All fittings shall be indelibly marked with a unique identification number and be recorded in a suitable register with the supplier's order numbers to ensure complete traceability.

11.0 SAFETY ENGINEERING

11.1 General

The design and engineering activities for this project will be carried out in accordance with all current Health and Safety Legislation, in particular the Construction (Design and Management) Regulations (CDM).

As part of this study, safety issues to be considered for inclusion in the preliminary Health and Safety Plan should include:

- Works in the vicinity of the existing WWU "live" operational plant.
- Programme of works for development.
- Third party landowner consents
- Potentially defective welds
- Effect on the environment.
- Unknown ground conditions
- Design issues.
- Satisfying permissible minimum building proximity distances between the pipeline and proposed dwellings.
- Transfer of duties from the Designer to the Principal Contractor.
- Tie-in arrangements.
- Working in the vicinity of existing utilities

11.2 HAZID/HAZOP

Safety is considered in the design process. The requirement for HAZID/HAZOP/HAZCON shall be reviewed at later design stages.

12.0 ENVIRONMENTAL CONSTRAINTS

No formal environmental studies have been undertaken as part of this report. It is recommended that a full environmental impact assessment is conducted at detail design.

12.1 Designations

A search of the statutory designations around the proposed development site identified a SSSI (Site of Special Scientific Interest) Impact Risk Zone crossing various sections of the development site. The development site was also identified as being located within a Drinking Water Safe Guard Zone (Surface Water). No other issues have been identified.

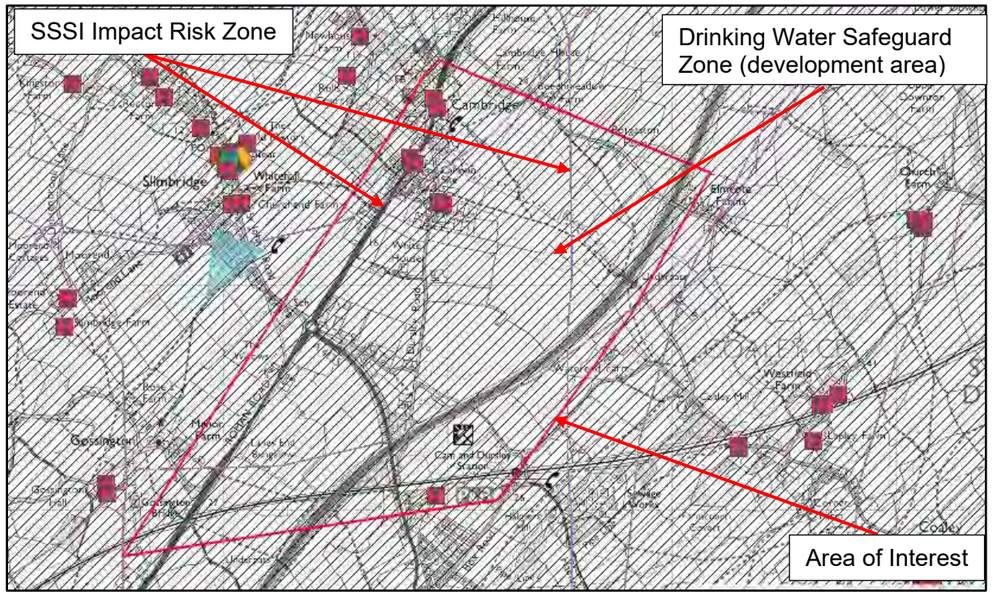

Figure 14 - Designations Mapping https://magic.defra.gov.uk/magicmap.aspx

12.2 Flood Zoning

The development area is located within a “Flood Zone 1” according to the Environmental Agency Data at a high risk. Flood Zone 1 Land having a less than 1 in 1,000 annual probability of river or sea flooding. A formal flood risk assessment should be carried out at detailed design since it may be affected in the future by sources of flooding other than rivers and the sea, for example surface water drains.

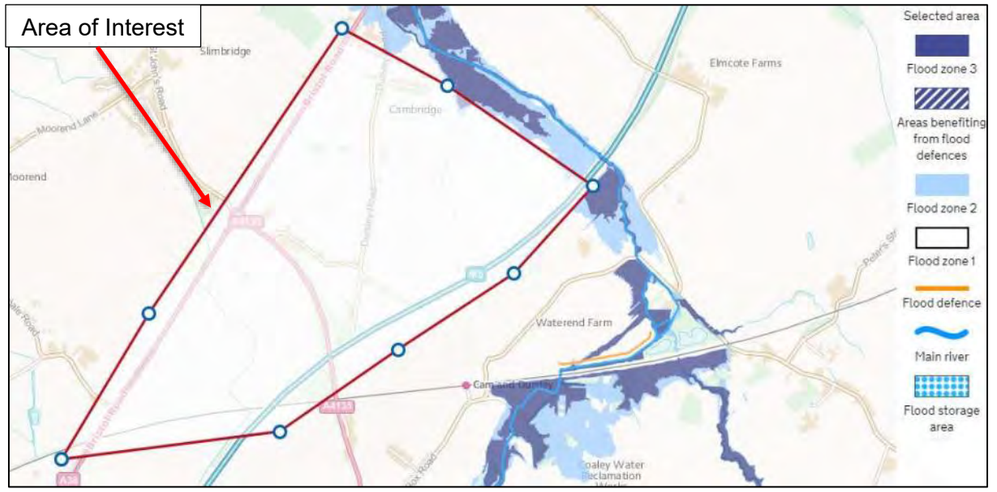

Figure 15 - Flood Zone Mapping https://flood-map-for-planning.service.gov.uk/

12.3 Geology

British Geological Survey (BGS) maps denotes the underlying bedrock of the propose development site as a mixture between mudstone, siltstone and limestone. The superficial deposits are a combination of clay, silt, sand, and gravel.

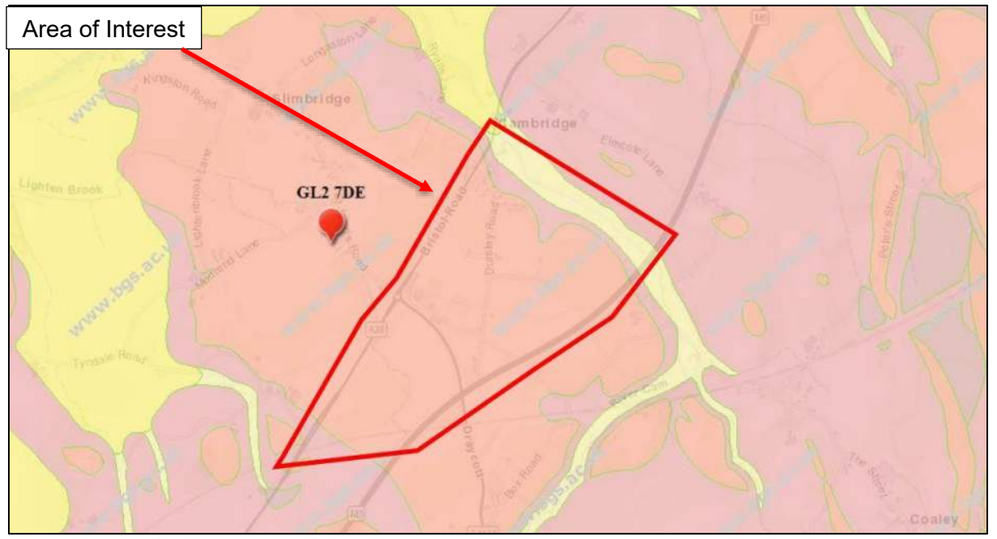

Figure 16 - Geological Data https://mapapps.bgs.ac.uk/geologyofbritain/home.html

A search of the available boreholes in the proposed development site is shown in Figure 17 below. Several 10-30m deep publicly available boreholes have been identified within the development site and along the M5 motorway. These are unlikely to affect the diversion works.

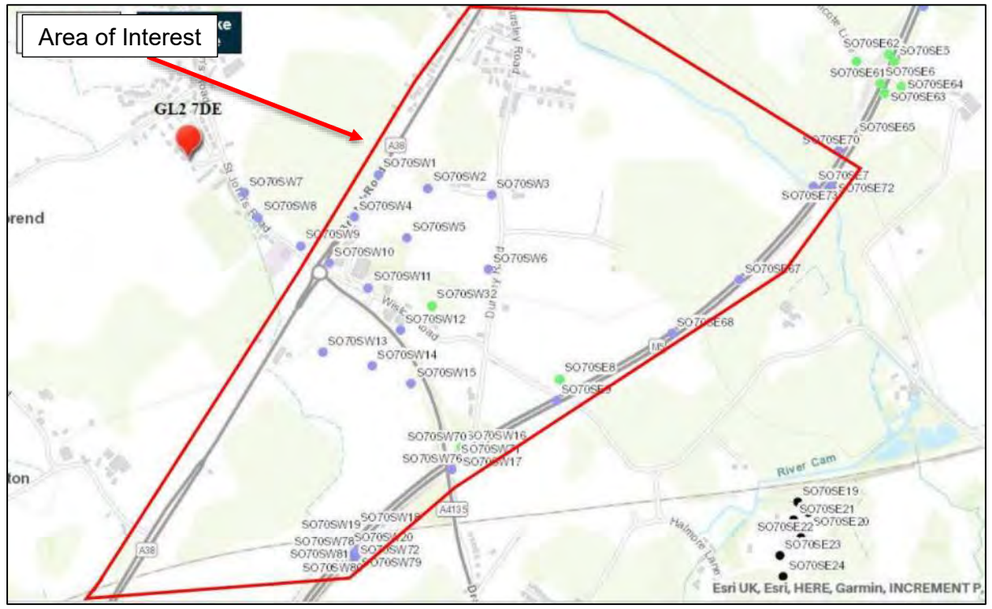

Figure 17 – Available Borehole Ground Investigation

12.4 Abandoned Mines

A search of the listed abandoned mines did not highlight any areas which present a risk to the proposed diversion route.

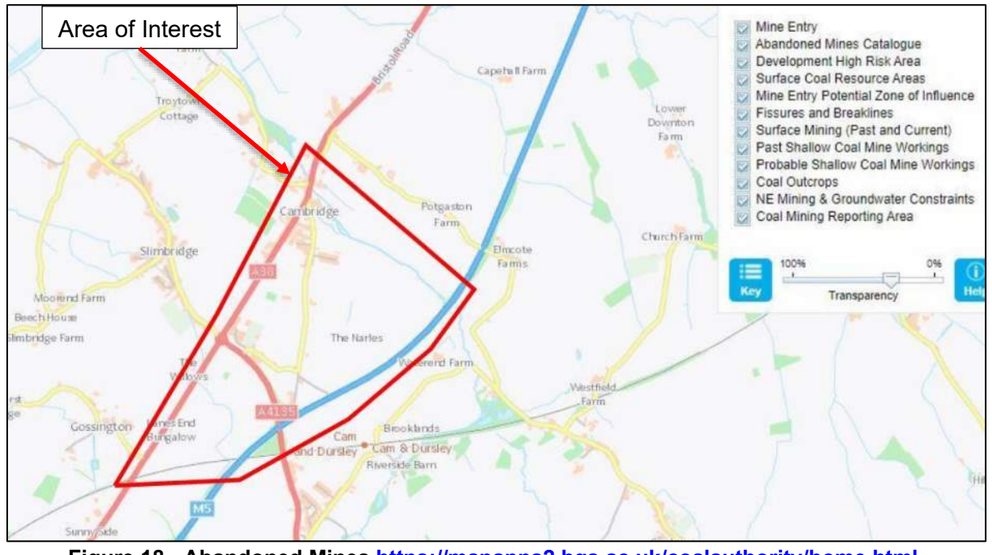

Figure 18 - Abandoned Mines https://mapapps2.bgs.ac.uk/coalauthority/home.html

12.5 Unexploded Ordnance Assessment

A preliminary assessment to determine the potential presence of Unexploded Bomb (UXB) as a result of World War II (WWII) bombings in the region was conducted for the proposed development site.

The development area is shown in the figure below to be a low risk area. Low risk is described as area having 15 bombs per 1000 acres or less. Further specialised assessment by an Unexploded Ordinance (UXO) specialist might be required at detail design.

Figure 19 - UXO Risk Assessment https://zeticauxo.com/downloads-and-resources/risk-maps/

13.0 PROJECT RISKS

The following key issues have been identified as those that potentially present a risk to the successful completion of the project. A project risk workshop should be carried out at the early design stage to further develop the project planning. Key project risks are outlined in Table 11 below:

Project Risks	Description
Long-lead materials	Durations of up to 40 weeks can be expected for some materials that will dictate the start of construction.
External services and contractor appointment	Various sub-contractor services will need to be engaged in a timely manner.
Connections	A number of connection issues have been considered. Installing the required stopples and fittings within the development site can potentially reduce costs and programme delays
Hydrostatic testing	Suitable exclusion zones should be enforced between 'persons at risk' and pipelines under hydrostatic test. Pre-testing pipe and pipe fabrications can mitigate the risk to a more acceptable level.
Venting operations	Gas plumes can present an ignition hazard and venting may be noisy and disruptive to local habited dwellings. Notifying homeowners and carriageway traffic of activities and temporary road closures can partially mitigate the hazard.
Environmental	Unforeseen issues including identification of protected species that require mitigating measures for preservation could impact on the programme.
Weld quality	The pipeline weld quality is unknown at this stage. If substandard welds are found near the proposed connection positions, then this will have a major bearing on successful completion. Shelling or repairing substandard welds could be a costly exercise
Other utilities	Preliminary information has been received from the developer to determine existing utilities in the area. More information will be required at detail design to ensure that there is no conflict between diverted pipeline and any other existing utilities.
Archaeology	Unforeseen issues including the discovery of archaeological finds that require mitigating finds could impact on the programme.
Covid-19	The Covid-19 pandemic may have an impact on the project including programme delays, material delivery etc.

Table 11 - Project Risks

14.0 PROGRAMME

The programme based upon the following assumptions:

- WWU will programme the immediate start of the detail design phase and not undertake a Conceptual Design.
- Investigations on the existing pipeline will begin immediately to establish weld locations and condition to inform the detail design team.
- Pipe is available and can be delivered within a 40-week lead time.
- Unforeseen environmental constraints (protected species windows, consents, etc) have not been factored into the programme.

Item	Description	Programme
1	Feasibility Study	8 Weeks
2	Detailed Design	15 Weeks
3	Planning (Engineering Design)	12 Weeks
4	Legislation and Planning Consents	24 Weeks
5	Procurement	40 Weeks
6	Construction and Fabrication	25 Weeks
7	Testing and Commissioning	4 Weeks
8	Decommission Existing Pipeline	6 Weeks
Total Project Programme		134 Weeks

Table 12 - Outline Programme

The procurement lead time is based on typical lead times for materials. This can be mitigated or reduced by ordering the long lead materials early in the design process

15.0 BUDGET COST ESTIMATE

The budget cost estimate presented below is a high-level cost based upon current costs for the construction of a similar diversion project. The estimate assumes that areas of land will be made available to the Contractor to form a site establishment area and pipe storage.

Item	Description	WWU Overheads	Option 1	Option 2	Option 3
1	Project Management	121%	£71,299	£71,299	£71,299
2	Detailed Design	8%	£115,175	£115,175	£115,175
3	GL5	8%	£16,454	£16,454	£16,454
4	Planning and Consents		WWU to advise	WWU to advise	WWU to advise
5	Materials Procurement	2%	£600,581	£546,285	£596,742
6	Wayleaves		WWU to advise	WWU to advise	WWU to advise
7	Construction Costs	8%	£285,883	£262,190	£285,883
8	Testing and Commissioning Costs	8%	£98,151	£98,151	£98,151
9	Diversion Construction Costs	8%	£789,768	£658,140	£822,675
10	Decommissioning and Demolition	8%	£164,535	£165,535	£164,535
	Total Estimate		**£2,141,844**	**£1,932,226**	**£2,170,912**
	Budget Price +/-40%		**£2,200,000**	**£2,000,000**	**£2,200,000**

Table 13 - Budget Estimate

16.0 ASSUMPTIONS, EXCLUSIONS & CLARIFICATIONS

The following study has been reviewed and assessed against the information provided by WWU, data freely available in the public domain and a site survey.

The existing pipeline parameters are taken as those provided in the study brief by WWU. The design pressure has been assumed to be the same as the MOP provided in the study brief. The exact pipe material parameters are not known and will need to be confirmed prior to ordering under-pressure fittings. The pipeline is considered to be a strategic supply and has been taken to be uninterruptible.

The development land is owned by The Ernest Cook Trust. However, the pipeline is not subject to a 'Lift and Shift agreement', this will have to be addressed at detail design stage.

The diversion and stopple operations will lie within the development area and are unlikely to suffer landowner objections.

Pipeline route coordinates were not provided for this study. It was therefore assumed that no trial holes have been performed to determine the exact location of the existing pipeline. Ground investigations will be required before commencement of works. Existing pipeline route is based on PDF strip maps provided by WWU.

It was confirmed by WWU that the existing pipeline is 'piggable' and the diversion pipeline should be of the same diameter. The ability to pass a Pipeline Inspection Gauge (PIG) has dictated the connection methodologies outlined in the report.

The pipelines was constructed prior to 1972 and may require further specialist investigative procedures in accordance with T/SP/P/18 due to the potential of defective girth welds.

Utility drawings provided by Stantec show several underground and overhead utilities routed at various locations around and within the development site, see Appendix 3. It is assumed in this study that no formal services search has been undertaken by the developer and no formal enquiries have been made to the owner of those services. Therefore, details of their easement and engineering requirements is not known and advice from the relevant bodies should be sought at detail design stage.

No formal environmental surveying has been undertaken as part of this study.

Indicative PADHI zones used in this study were provided by Stantec through correspondence.

17.0 CONCLUSIONS

A review of the presented and available information with regards to the diversion of the existing HP gas main from Gloucester to Wickwar has been undertaken.

It is apparent that a do-nothing approach will restrict the proposed development at Wisloe Green and will require the development plans to be rearranged in order to accommodate for the minimum BPD to nearest occupied building (subject to PADHI assessment). Therefore, a diversion of the existing pipeline is required.

The diversion routes proposed by the developer along with alternative routes were examined in this study. Route Option 1 ranked highest in the SWOT analysis and has been identified as the preferred route.

In terms of constructability of the diversion pipelines, no major obstacles or engineering difficulties were identified, and the pipeline diversions can be constructed using typical pipeline construction techniques.

A site survey and utility drawings provided by the developer identified several underground and overhead utilities routed at various locations around and within the development site. This will present some difficulty during construction since these utilities are route in close proximity to the proposed diversion route corridors.

A site survey and utility drawings provided by the developer identified several utilities routed along the house. This will present some difficulties during construction since these utilities are all in close proximity to the proposed diversion route corridor.

Information obtained through investigations in the public domain has identified an SSSI Impact Risk Zone and the surface water, no other issues were identified.

In conclusion, the diversion route proposed here Route Option 1 is considered to be the most acceptable solution in terms of meeting the requirements of WWU, the developer and IGEM/TD/1 Edition 5.

APPENDIX 1: CALCULATIONS

Wisloe Green Diversion

Calculation Index

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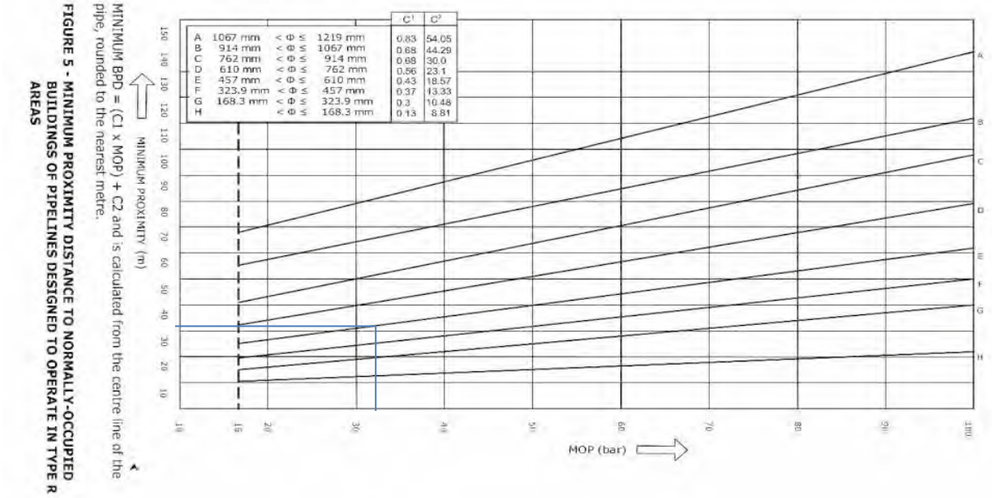
Fingleton White

Project: Wisloe Green Diversion
Document No: 0961-23-TM-0101-R0

Wisloe Green Diversion

Designed by: RAM
Checked by: JF
Date: 01/03/2021
Revision: 0

Building Proximity Distance



Pipesize	350	mm
MOP	32.6	bar
C1	0.12	
C2	12	
Minimum BPD	16	m

ESTIMATION OF POPULATION DENSITY

6.7.2 **Estimation of population density**

6.7.2.1 The population density, expressed as the number of persons per unit area, shall be the average within a 1.6 km strip centred on the pipeline of a width 8 times the minimum BPD for a Type R area pipeline as defined in Figure 5.

Note 1: For MOP exceeding 100 bar, Figure 5 may be extended by linear extrapolation using the correlations provided to define the width of the strip used in calculating population density.

Note 2: The strip width may be defined by the distance to a risk level of 0.3 cpm on the individual risk transect.

6.7.2.2 Measurement of population density shall be based on a survey, for example by aerial photography, of normally occupied buildings and premises where people congregate for significant periods of time, for example schools, public halls, etc.

6.7.2.3 The occupancy of houses should be determined from Census statistics, although the occupancy of typical houses may be assumed to be 3 persons per dwelling.

The occupancy of other buildings shall be assessed.

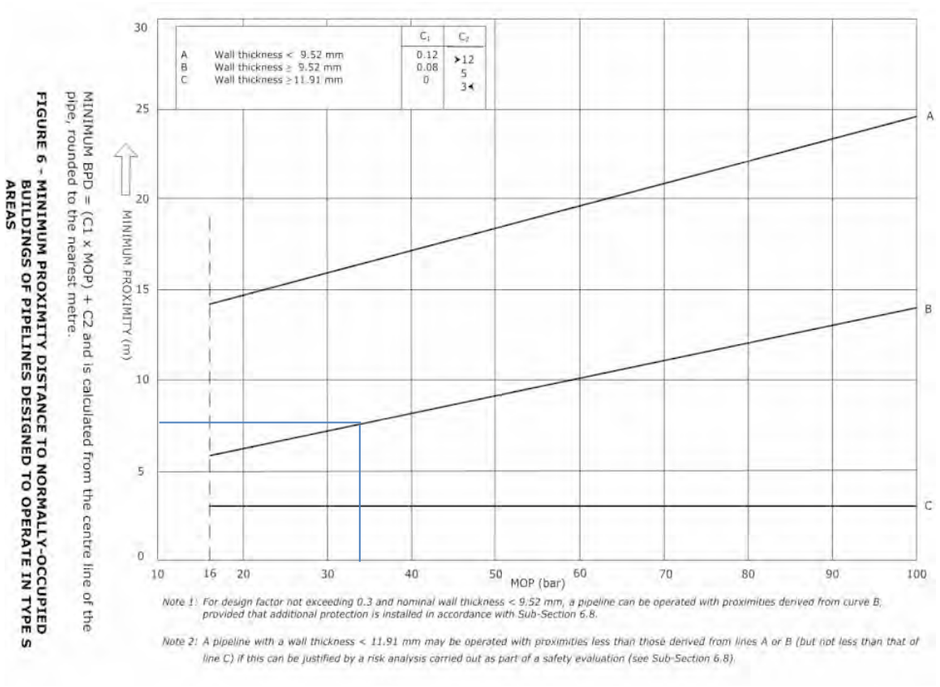
Width of 1.6km strip	127.3	m
No of typical houses	40	
Average no of persons	3	
No of hectares	20	ha
No of persons per hectare	5.89	

No of persons per hectare >2.5, hence Type S area determined for Pipeline and design factor of 0.3

Design Factor **0.3**

Wisloe Green Diversion

Type S Area



MINIMUM BPD = (C1 x MOP) + C2 and is calculated from the centre line of the pipe, rounded to the nearest metre.

FIGURE 6 - MINIMUM PROXIMITY DISTANCE TO NORMALLY-OCCUPIED BUILDINGS OF PIPELINES DESIGNED TO OPERATE IN TYPE S AREAS

Pipesize	350		mm
MOP	32.6		bar
	Existing	**Proposed**	
Wall Thickness	7.9	12.5	mm
C1	0.12	0	
C2	12	3	
Minimum BPD	16	3	m

Fingleton White
Project: Wisloe Green Diversion
Document No: 0961-23-TM-0101-R0

Wisloe Green Diversion

Designed by: RAM
Checked by: JF
Date: 01/03/2021
Revision: 0

Diversion-Existing

INTRODUCTION:

Calculations below are in respect of the Gloucester to Wickwar 350NB pipeline diversion at Wisloe Green
The diversion is required to allow for a proposed development.

CALCULATION:
Existing Pipeline System:

Description	Gloucester to Wickwar		
Diameter	350	mm	
Wall thickness	7.9	mm	
Pipe Grade	X46		317 N/mm2
Max Operating Pressure (MOP)	32.6	barg	
Depth of cover	0.9	m	
Building Proximity Distance (BPD)	16	m	
Diversion Length (approximate)	2.8	km	
Area Classification	Type S		

Wall Thickness / BPD Check

Pipe Type	TBC		
Underthickness tolerance	12.50%		(Assumed)
Design Wall thickness	7.8	mm	
Actual Design Factor (f = PD/20ts)	0.25		
Minimum BPD	16	m	Based on IGEM/TD/1 Ed. 5

Reference

Under Thickness Tolerances

Wall	Tolerance
Seamless Pipe:	
$T < 4$	+0.6 mm / -0.5 mm
$4 < T < 25$	+15 % / -12.5 %
Welded Pipe:	
$T < 10$	+0.5 mm / -0.5 mm
$10 < T < 20$	10 % / -10 %
$T > 20$	+1.5 mm / - 1.5 mm

EN3183:2012

Wisloe Green Diversion

Diversion-New

INTRODUCTION:

Calculations below are in respect of the Gloucester to Wickwar 350NB pipeline diversion at Wisloe Green
The diversion is required to allow for a proposed development.

CALCULATION:
Diversion Pipeline:

Diameter	350	mm	
Wall thickness	12.5	mm	
Pipe Grade	L360	MB	360 N/mm2
Max Operating Pressure (MOP)	32.6	barg	

Wall Thickness / BPD Check

Pipe Type	Seamless	
Underthickness tolerance	12.5%	
Design Wall thickness	10.94	mm
Actual Design Factor (f = PDX/20ts)	0.14	
Minimum BPD	3	m

Reference

Under Thickness Tolerances

Wall	Tolerance
Seamless Pipe:	
$T < 4$	+0.6 mm / -0.5 mm
$4 < T < 25$	+15 % / -12.5 %
Welded Pipe:	
$T < 5$	+0.5 mm / -0.5 mm
$5 < T < 15$	+10 % / -10 %
$T > 15$	+1.5 mm / - 1.5 mm

EN 3183:2012

APPENDIX 2: PROJECT DRAWINGS

Key

- Existing Pipeline
- Site Boundary (78 ha)
- Mixed-Use: Residential Areas, Schools, Pitches and Potential for later living
- Offsite Potential Residential Areas
- GI / Noise Buffer Area (25.8 ha)
- Potential Access points
- Primary routes
- Public Transport Link
- Existing PROW
- Potential Ped/Cycle links
- National Cycle route

DRAFT

REV.	DATE	REVISION	BY	CHKD.	APPR.
0	16/04/21	FINAL ISSUE	LH	RAM	SW

Client

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www.fingleton.ie

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High Pressure Gas Main Diversion

Existing Route

Drawn	Scale	Drawing Number	Rev.
L.HUSSEY	1:2500/A1	961-23-DG-0001	0
Chkd. R.A.MANGUE	Date 16/04/21	sheet 1 of 1	
Apprd. S.WESTERN	Status ISSUED		

Key

- Existing Pipeline
- Proposed Pipeline Diversion
- Site Boundary (78 ha)
- Mixed-Use: Residential Areas, Schools, Pitches and Potential for later living
- Offsite Potential Residential Areas
- GI / Noise Buffer Area (25.8 ha)
- Potential Access points
- Primary routes
- Public Transport Link
- Existing PROW
- Potential Ped/Cycle links
- National Cycle route

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0	16/04/21	FINAL ISSUE	LH	RAM	SW

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High Pressure Gas Main Diversion

Existing & Proposed Route

Drawn L.HUSSEY	Scale 1:2500/A1	Drawing Number 961-23-DG-0002	Rev. 0
Chkd. R.A.MANGUE	Date 16/04/21	sheet 1 of 1	127
Apprd. S.WESTERN	Status ISSUED		

NOTES

Key

- Existing Pipeline
- Site Boundary (78 ha)
- Mixed-Use: Residential Areas, Schools, Pitches and Potential for later living
- Offsite Potential Residential Areas
- GI / Noise Buffer Area (25.8 ha)
- Potential Access points
- Primary routes
- Public Transport Link
- Existing PROW
- Potential Ped/Cycle links
- National Cycle route
- Inner PADHI Zone (16m Buffer)
- Middle PADHI Zone (40m Buffer)
- Outer PADHI Zone (70m Buffer)

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REV.	DATE	REVISION	BY	CHKD.	APPR.
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High Pressure Gas Main Diversion

PADHI Zones

Drawn	Scale	Drawing Number	Rev.
L.HUSSEY	1:2500/A1	961-23-DG-0003	0
Chkd. R.A.MANGUE	Date 16/04/21	sheet 1 of 1	
Apprd. S.WESTERN	Status ISSUED		129

LEGEND

- EXISTING GLOUCESTER TO WICKWAR HP PIPELINE
- PROPOSED DECOMMISSIONED HP PIPELINE
- 16m INNER PADHI ZONE
- 49m MIDDLE PADHI ZONE
- 70m OUTER PADHI ZONE
- SITE BOUNDARY (78 HA)
- MIXED-USE: RESIDENTIAL AREAS, SCHOOLS, PITCHES AND POTENTIAL FOR LATER LIVING
- OFFSITE POTENTIAL RESIDENTIAL AREAS
- GI/NOISE BUFFER AREA (25.8 HA)
- POTENTIAL ACCESS POINTS
- PRIMARY ROUTES
- PUBLIC TRANSPORT LINK
- EXISTING PROW
- POTENTIAL PED/CYCLE LINKS
- NATIONAL CYCLE ROUTE

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High Pressure Gas Main Diversion
Connection Point PADHI Zones
Gloucester to Wickwar - Route Options 1, 2 & 3

Drawn. L.HUSSEY	Scale 1:2500/A1	Drawing Number 961-23-DG-0004	Rev. 0
Chkd. R.A.MANGUE	Date 16/04/21	sheet 1 of 1	131
Apprd. S.WESTERN	Status ISSUED		

LEGEND

- EXISTING GLOUCESTER TO WICKWAR HP PIPELINE
- PROPOSED DECOMMISSIONED HP PIPELINE
- PROPOSED GAS MAIN DIVERSION OPTION 1
- SITE BOUNDARY (78 HA)
- MIXED-USE: RESIDENTIAL AREAS, SCHOOLS, PITCHES AND POTENTIAL FOR LATER LIVING
- OFFSITE POTENTIAL RESIDENTIAL AREAS
- GI/NOISE BUFFER AREA (25.8 HA)
- POTENTIAL ACCESS POINTS
- PRIMARY ROUTES
- PUBLIC TRANSPORT LINK
- EXISTING PROW
- POTENTIAL PED/CYCLE LINKS
- NATIONAL CYCLE ROUTE

DENOTES LOCATION OF EXISTING OVERHEAD POWER LINES, EXISTING UNDERGROUND POWER CABLES, DUCTS, WATER MAIN & DRAINS — X

DENOTES EXISTING ENGINEERING FEATURES — X

ENGINEERING FEATURES/HAZARDS

01	BT CABLE DUCTING; POTABLE WATER MAINS
02	EXISTING ZAYO FIBRE OPTIC CABLE DUCT
03	LOW VOLTAGE OVERHEAD CABLE; LOW PRESSURE GAS MAIN
07	AGRICULTURAL BUILDINGS
08	WATER COURSE

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0	16/04/21	FINAL ISSUE	LH	RAM	SW

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High Pressure Gas Main Diversion
Gloucester to Wickwar - Route Option 1

Drawn L.HUSSEY	Scale 1:2500/A1	Drawing Number 961-23-DG-0005	Rev. 0
Chkd. R.A.MANGUE	Date 16/04/21	sheet 1 of 1	
Apprd. S.WESTERN	Status ISSUED		

LEGEND

- EXISTING GLOUCESTER TO WICKWAR HP PIPELINE
- PROPOSED DECOMMISSIONED HP PIPELINE
- PROPOSED GAS MAIN DIVERSION OPTION 2
- SITE BOUNDARY (78 HA)
- MIXED–USE: RESIDENTIAL AREAS, SCHOOLS, PITCHES AND POTENTIAL FOR LATER LIVING
- OFFSITE POTENTIAL RESIDENTIAL AREAS
- GI/NOISE BUFFER AREA (25.8 HA)
- POTENTIAL ACCESS POINTS
- PRIMARY ROUTES
- PUBLIC TRANSPORT LINK
- EXISTING PROW
- POTENTIAL PED/CYCLE LINKS
- NATIONAL CYCLE ROUTE

DENOTES LOCATION OF EXISTING OVERHEAD POWER LINES, EXISTING UNDERGROUND POWER CABLES, DUCTS, WATER MAIN & DRAINS — X

DENOTES EXISTING ENGINEERING FEATURES — X

ENGINEERING FEATURES/HAZARDS

01	BT CABLE DUCTING; POTABLE WATER MAINS
02	EXISTING ZAYO FIBRE OPTIC CABLE DUCT
03	LOW VOLTAGE OVERHEAD CABLE; LOW PRESSURE GAS MAIN
04	11kV OVERHEAD POWER LINES
07	AGRICULTURAL BUILDINGS
08	WATER COURSE

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0	16/04/21	FINAL ISSUE	LH	RAM	SW

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High Pressure Gas Main Diversion
Gloucester to Wickwar - Route Option 2

Drawn. L.HUSSEY	Scale 1:2500/A1	Drawing Number 961-23-DG-0006	Rev. 0
Chkd. R.A.MANGUE	Date 16/04/21	sheet 1 of 1	
Apprd. S.WESTERN	Status ISSUED		

LEGEND

- EXISTING GLOUCESTER TO WICKWAR HP PIPELINE
- PROPOSED DECOMMISSIONED HP PIPELINE
- PROPOSED GAS MAIN DIVERSION OPTION 3
- SITE BOUNDARY (78 HA)
- MIXED–USE: RESIDENTIAL AREAS, SCHOOLS, PITCHES AND POTENTIAL FOR LATER LIVING
- OFFSITE POTENTIAL RESIDENTIAL AREAS
- GI/NOISE BUFFER AREA (25.8 HA)
- POTENTIAL ACCESS POINTS
- PRIMARY ROUTES
- PUBLIC TRANSPORT LINK
- EXISTING PROW
- POTENTIAL PED/CYCLE LINKS
- NATIONAL CYCLE ROUTE

DENOTES LOCATION OF EXISTING OVERHEAD POWER LINES, EXISTING UNDERGROUND POWER CABLES, DUCTS, WATER MAIN & DRAINS — X

DENOTES EXISTING ENGINEERING FEATURES — X

ENGINEERING FEATURES/HAZARDS

01	BT CABLE DUCTING; POTABLE WATER MAINS
02	EXISTING ZAYO FIBRE OPTIC CABLE DUCT
03	LOW VOLTAGE OVERHEAD CABLE; LOW PRESSURE GAS MAIN
04	11kV OVERHEAD POWER LINES
05	11kV UNDERGROUND CABLE; LOW VOLTAGE BELOW GROUND CABLES
06	EXISTING SERVICES; SSE TELECOMS CABLE DUCT; VODAFONE CABLE DUCT; COLT CABLE DUCT; VIRGIN MEDIA CABLE DUCT
07	AGRICULTURAL BUILDINGS
08	WATER COURSE

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REV.	DATE	REVISION	BY	CHKD.	APPR.
0	16/04/21	FINAL ISSUE	LH	RAM	SW

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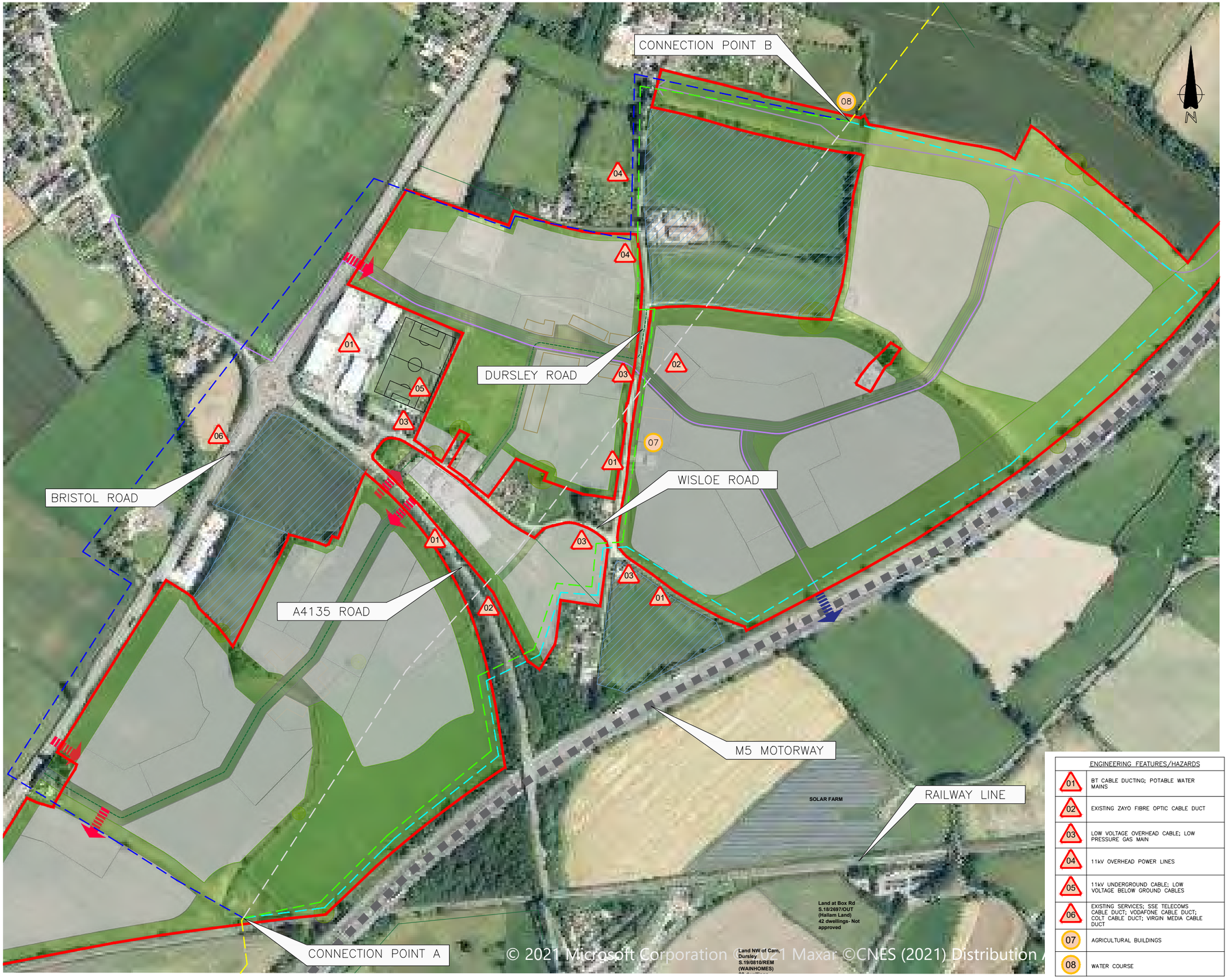
High Pressure Gas Main Diversion
Gloucester to Wickwar - Route Option 3

Drawn: L.HUSSEY	Scale: 1:2500/A1	Drawing Number: 961-23-DG-0007 sheet 1 of 1	Rev.: 0
Chkd: R.A.MANGUE	Date: 16/04/21		
Apprd: S.WESTERN	Status: ISSUED		



LEGEND

- EXISTING GLOUCESTER TO WICKWAR HP PIPELINE
- PROPOSED DECOMMISSIONED HP PIPELINE
- PROPOSED GAS MAIN DIVERSION OPTION 1
- PROPOSED GAS MAIN DIVERSION OPTION 2
- PROPOSED GAS MAIN DIVERSION OPTION 3
- SITE BOUNDARY (78 HA)
- MIXED-USE: RESIDENTIAL AREAS, SCHOOLS, PITCHES AND POTENTIAL FOR LATER LIVING
- OFFSITE POTENTIAL RESIDENTIAL AREAS
- GI/NOISE BUFFER AREA (25.8 HA)
- POTENTIAL ACCESS POINTS
- PRIMARY ROUTES
- PUBLIC TRANSPORT LINK
- EXISTING PROW
- POTENTIAL PED/CYCLE LINKS
- NATIONAL CYCLE ROUTE

DENOTES LOCATION OF EXISTING OVERHEAD POWER LINES, EXISTING UNDERGROUND POWER CABLES, DUCTS, WATER MAIN & DRAINS — X

DENOTES EXISTING ENGINEERING FEATURES — X

ENGINEERING FEATURES/HAZARDS

01	BT CABLE DUCTING; POTABLE WATER MAINS
02	EXISTING ZAYO FIBRE OPTIC CABLE DUCT
03	LOW VOLTAGE OVERHEAD CABLE; LOW PRESSURE GAS MAIN
04	11kV OVERHEAD POWER LINES
05	11kV UNDERGROUND CABLE; LOW VOLTAGE BELOW GROUND CABLES
06	EXISTING SERVICES; SSE TELECOMS CABLE DUCT; VODAFONE CABLE DUCT; COLT CABLE DUCT; VIRGIN MEDIA CABLE DUCT
07	AGRICULTURAL BUILDINGS
08	WATER COURSE

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0	16/04/21	FINAL ISSUE	LH	RAM	SW

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Project
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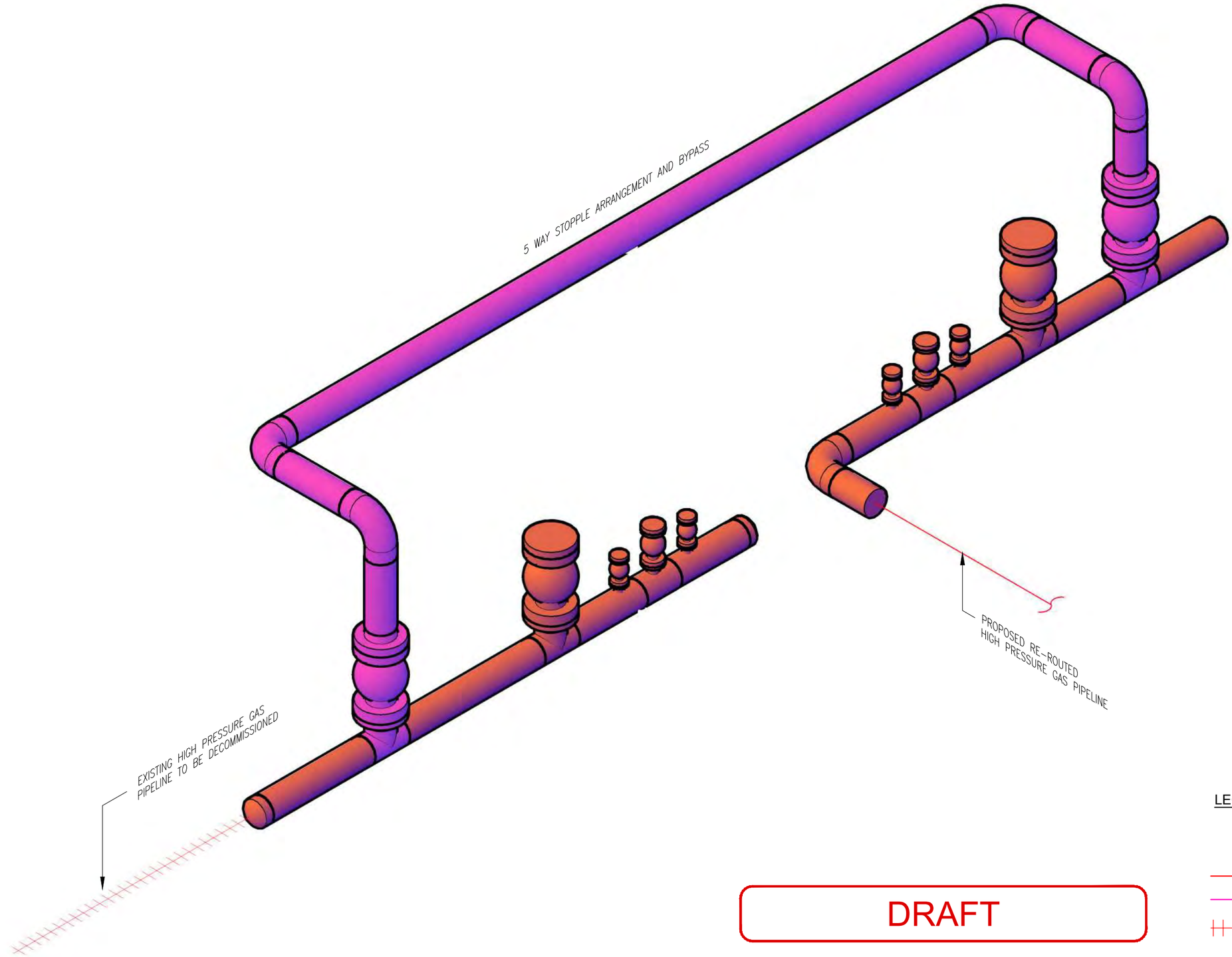
High Pressure Gas Main Diversion
Gloucester to Wickwar - Route Options 1, 2 & 3

Drawn: L.HUSSEY	Scale: 1:2500/A1	Drawing Number: 961-23-DG-0008	Rev.: 0
Chkd.: R.A.MANGUE	Date: 16/04/21	sheet 1 of 1	
Apprd.: S.WESTERN	Status: ISSUED		139



LEGEND:

High Pressure

Temporary Bypass

Low Pressure to be Decommissioned

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STATION NAME: WISLOE GREEN

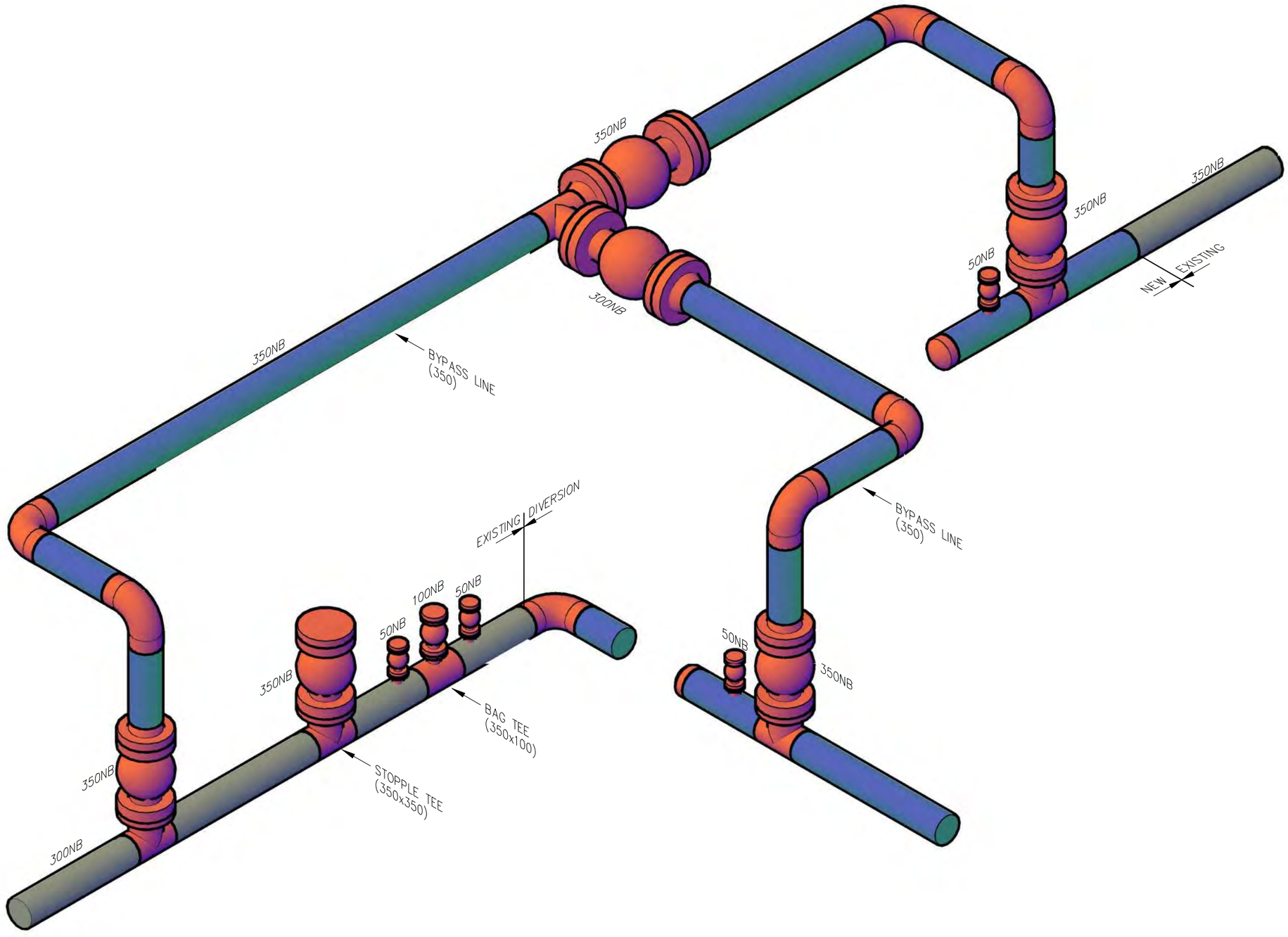
STATION NUMBER: -

DRAWING TITLE: 5 WAY STOPPLE ARRANGEMENT

REV.	DETAILS OF AMENDMENTS	DRAWN	DATE
0	FINAL ISSUE	LH	16/04/21

DRAWN : L.HUSSEY DATE : 16/04/21
CHECKED: R.A. MANGUE DATE : 16/04/21
APPROVED: S.WESTERN DATE : 16/04/21

DRAWING NUMBER: WISLOE GREEN 0961/23
SHEET: 1 OF 1
REVISION: 0



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STATION NAME: WISLOE GREEN

STATION NUMBER: -

DRAWING TITLE: TYPICAL BI-FURICATED STOPPLE ARRANGEMENT

REV.	DETAILS OF AMENDMENTS	DRAWN	DATE
0	FINAL ISSUE	LH	16/04/21

DRAWN :	L.HUSSEY	DATE : 16/04/21
CHECKED:	R.A. MANGUE	DATE : 16/04/21
APPROVED:	S.WESTERN	DATE : 16/04/21

DRAWING NUMBER: WISLOE GREEN 0961/23

SHEET: 1 OF 1

REVISION: 0

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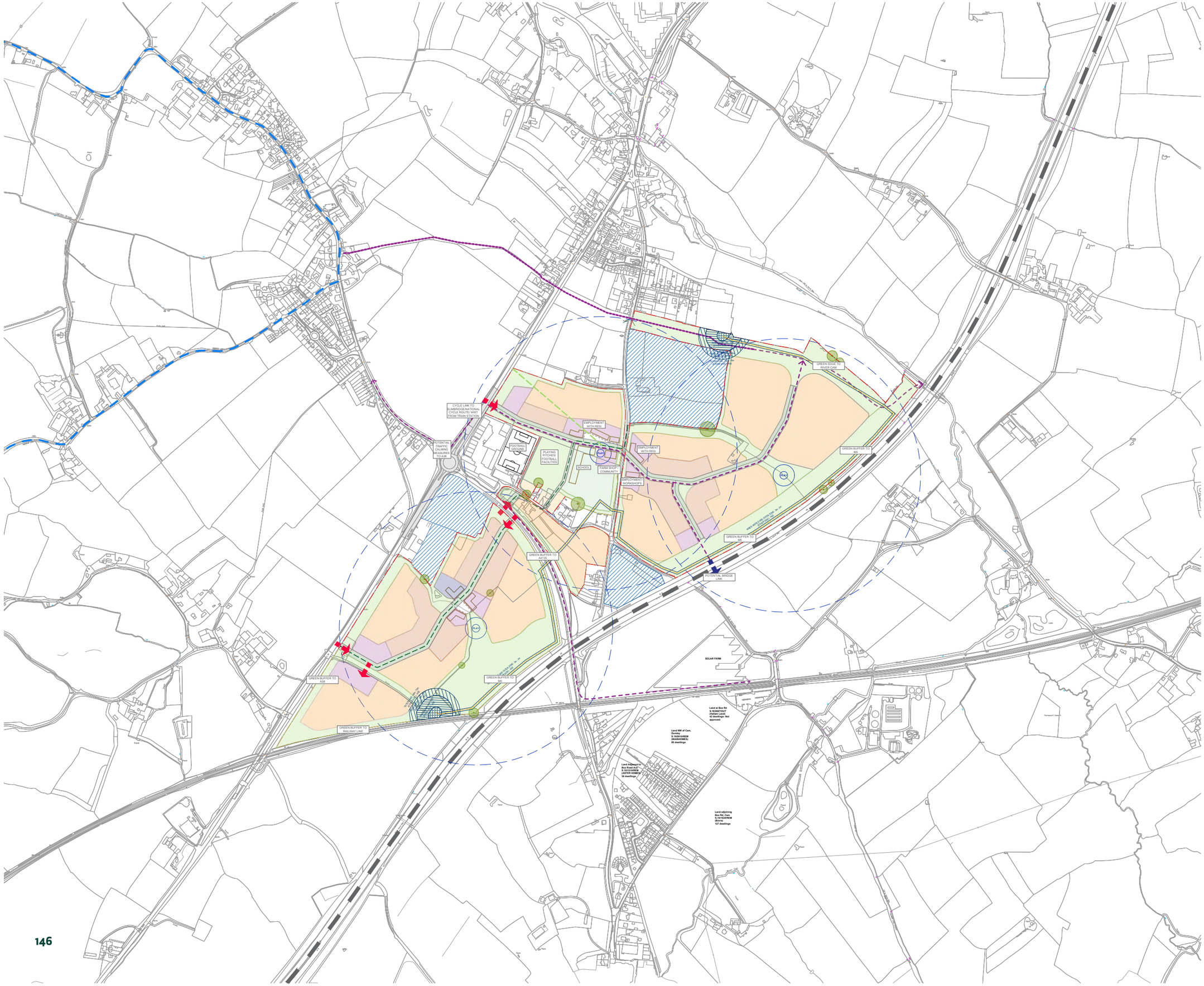
APPENDIX 3: REFERENCE INFORMATION



Key

- Site Boundary (78 ha)
- Residential Area 45 dph (7.5 ha) - 337 dwellings
- Residential Area 35dph (30 ha) - 1050 dwellings
- Residential Area > 25dph (0.45 ha) - 11 dwellings
- Offsite Potential Residential Areas
- School (2 ha)
- Pitches (1.7 ha)
- Mixed-Use Areas (potential up to 120 dwellings)
- Potential for Later Living
- GI / Noise Buffer Area (25.8 ha)
- Potential Access points
- Primary routes
- Public Transport Link
- Existing PROW
- Potential Ped/Cycle links

REV	DATE	COMMENTS	AUTHOR / CHECKED
A	17.07.20	Employment distributed, Gas Main Diversion Added	AS / PO

PROJECT TITLE
Wisloe Green

DETAIL
Concept Option 2

DRAWING NUMBER
(PROJECT-ORIGINATOR-ZONE-LEVEL-TYPE-ROLE-NUMBER)
WIS - LHC - 00 - 00 - DR - UD - SK07

STATUS	STATUS DESCRIPTION	
S2	FOR INFORMATION	
REVISION	DATE	SCALE
X	June 2020	1:5000 @A1

CONTRACTORS MUST CHECK ALL DIMENSIONS ON SITE - ONLY FIGURED DIMENSIONS ARE TO BE WORKED FROM - DISCREPANCIES MUST BE REPORTED TO THE ARCHITECT BEFORE PROCEEDING

LHC PROJECT NUMBER
20006

lhc design
EXETER 01392 444334
PLYMOUTH 01752 [illegible]
ST AUSTELL 01726 213435
lhc.net

Churchend Farm
Moorend Cottages
Moorend Farm
MOOREND LANE
oorend
Beech House
Slimbridge Farm
3054
0.07
LYNDALE ROAD
Chesieres
Rose's Farm
Manor Farm
Gossington
Gossington Hall
Gossington Bridge
Hornshill Farm
ROMAN ROAD
A4135
WISLOE ROAD
DURSLEY ROAD
River Cam
M5
The Narles
Waterend Farm
Ford Farm
2.78
35.16
83.69
34.75
33.15
37.90
32.84
11.40
38.47
29.62

The Ernest Cook Trust

Fairford Park, Fairford, Gloucestershire GL7 4JH

Tel: 01285 712492

Wisloe Development

SCALE :	DATE :	N
1 : 7500 @ A3	10/07/2018	
Slimbridge Estate		

POLE MOUNTED TRANSFORMER
REF: 79/3493 (6784) WHITEHOUSE FM. CAMBRIDGE

POLE MOUNTED TRANSFORMER
REF: 79/3492 (75656) FIELD ROW COTT.

POLE MOUNTED TRANSFORMER
REF: 79/3001 (7944) NARLES COTT.

POLE MOUNTED TRANSFORMER
REF: 79/3013 (6757) WISLOE

CONTINUATION OF POTABLE WATER MAIN NOT KNOWN

OUTER ZONE - 49m - 70m (EITHER SIDE) -HSE

MIDDLE ZONE - 16m - 49m (EITHER SIDE) -HSE

INNER ZONE - 0m - 16m (EITHER SIDE) -HSE

NOTES

1. INFORMATION CONCERNING THE POSITION OF EXISTING UTILITY INFRASTRUCTURE HAS BEEN EXTRACTED FROM RECORD MAPPING PROVIDED BY GCC ON 07.02.2020. .
2. ABANDONED SERVICES MAY NOT BE SHOWN ON THIS PLAN.
3. TRUE POSITION OF THE SERVICES MAY BE DIFFERENT TO THAT SHOWN ON THIS PLAN, WHICH IS INTENDED FOR GENERAL GUIDANCE ONLY. NO GUARANTEE CAN BE GIVEN TO ITS ACCURACY AND IT SHOULD NOT BE RELIED UPON DURING MASTERPLANNING, INTRUSIVE INVESTIGATIONS, EXCAVATIONS AND CONSTRUCTION.
4. THESE SERVICES MAY NOT RUN IN A STRAIGHT LINE EITHER HORIZONTALLY OR VERTICALLY BECAUSE OF GROUND CONDITIONS, OBSTACLES AND OTHER REASONS.
5. BURIED SERVICES MAY EXIST AT VARIOUS DEPTHS AS GROUND LEVEL MAY HAVE BEEN ALTERED SINCE THE UTILITY APPARATUS WAS LAID.
6. UTILITY COMPANY ASSET RECORDS (ASSETS, LOCATION AND DETAILS) ARE VALID FOR UP TO 3 MONTHS. IF WORKS DO NOT COMMENCE WITHIN THIS TIME PERIOD, THE ASSET RECORDS WILL NEED TO BE REFRESHED BEFORE ANY WORKS COMMENCE ON OR NEAR THE SITE.

BEFORE EXCAVATING OR GROUND WORKS

7. ANY SITE INVESTIGATION OR GROUND PENETRATING ACTIVITY SHALL COMPLY WITH THE REQUIREMENTS OF HSE GUIDANCE DOCUMENT HS(G) 47 "AVOIDING DANGER FROM UNDERGROUND SERVICES"
8. ALL UNDERGROUND SERVICES i.e. CABLES, PIPES, DUCTS SHOULD BE LOCATED USING THE FOLLOWING TECHNIQUES;
   a. REFERENCE TO DETAILED LARGER SCALE DRAWINGS AND CABLE ROUTE PROFILES. THESE WILL NEED TO BE REQUESTED FROM THE SERVICE PROVIDER AND REFERRED TO DURING THE DESIGN STAGE AND MADE AVAILABLE ON SITE TO SITE OPERATIVES PRIOR TO THE COMMENCEMENT OF ANY GROUNDWORKS.
   b. SUITABLE INSTRUMENTS i.e. GROUND PENETRATING RADAR, CABLE LOCATING DEVICES WILL NEED TO BE USED TO DETERMINE THE LOCATION AND PRESENCE OF UNDERGROUND SERVICES/OBSTRUCTIONS BEFORE EXCAVATION WORKS PROCEED.
   c. SAFE DIGGING TECHNIQUES (HAND EXCAVATION) AS DETAILED IN HS(G) 47 WILL BE NECESSARY TO DETERMINE THE EXACT POSITION OF BURIED SERVICES AND OBSTRUCTIONS BEFORE WORK CAN PROCEED.
   d. ALL APPARATUS FOUND SHOULD BE CROSS REFERENCED WITH THE DETAILED RECORD PLANS. ANY ABNORMALITIES SHOULD BE REPORTED TO THE PROJECT MANAGER.

KEY

- EXISTING SERVICE CABLE
- EXISTING LV UNDERGROUND CABLES
- EXISTING LV OVERHEAD LINES
- EXISTING 11kV UNDERGROUND CABLE
- EXISTING LOW PRESSURE GAS MAINS
- EXISTING HIGH PRESSURE GAS MAINS
- EXISTING OPENREACH BT CABLE DUCT
- EXISTING OPENREACH BT OVERHEAD LINE
- EXISTING COLT CABLE DUCT
- EXISTING CITY FIBRE CABLE DUCT
- EXISTING SSE TELECOMS CABLE DUCT
- EXISTING VIRGIN MEDIA CABLE DUCT
- EXISTING OVODAFONE CABLE DUCT
- EXISTING ZAYO CABLE DUCT
- EXISTING POTABLE WATER MAINS
- SITE BOUNDARY

Mark	Revision	Date	Drawn	Chkd	Appd

SCALING NOTE: Do not scale this drawing - any errors or omissions shall be reported to Stantec without delay.

UTILITIES NOTE: The position of any existing public or private sewers, utility services, plant or apparatus shown on this drawing is believed to be correct, but no warranty to this is expressed or implied. Other such plant or apparatus may also be present but not shown. The Contractor is therefore advised to undertake their own investigation where the presence of any existing sewers, services, plant or apparatus may affect their operations.

Drawing Issue Status
FOR INFORMATION

WISLOE

EXISTING UTILITIES INFRASTRUCTURE CONSTRAINTS PLAN - SHEET 2 OF 2

Client
THE ERNEST COOK TRUST

Date of 1st Issue	Designed	Drawn
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WISLOE

D3. Access and Movement Framework

Stantec

Wisloe New Settlement

Access & Movement Framework

On behalf of **The Ernest Cook Trust & Gloucestershire County Council**

Project Ref: 332310150 | Rev: | Date: July 2021

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Document Control Sheet

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Date: **July 2021**

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For and on behalf of Stantec UK Limited				

Revision	Date	Description	Prepared	Reviewed	Approved
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Contents

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Appendices

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1 Introduction

1.1 The Brief

1.1.1 Stantec is instructed by Gloucestershire County Council and The Ernest Cook Trust to submit an Access & Movement Framework (AMF) to Stroud District Council in relation to the Regulation 19 consultation on the Stroud District Pre-Submission Draft Local Plan.

1.1.2 It is submitted on their behalf in their capacity as joint landowners of the land which has been identified for a new residential led mixed-use community in the plan under proposed allocation PS37. This framework provides transport representations to set out the access strategy principles that have been used to inform the development of a concept masterplan for Wisloe New Settlement.

1.1.3 Wisloe New Settlement is proposed to deliver a mixed-use community of approximately 1,500 homes, employment, education and community facilities that can be carbon neutral and accord with Garden City Principles. This AMF has been developed to demonstrate that the site allocation is sound and deliverable from a highways and transport perspective in being able to meet the related emerging Local Plan policy requirements.

1.1.4 In the development of the access strategy, Stantec has engaged with Highways England and Gloucestershire County Council, as the relevant highway authorities to discuss the access strategy principles for the site. Engagement has also been undertaken with Stagecoach in their role as the key existing local bus operator.

1.2 The Site

1.2.1 The 80 hectare site is located between the A38 and M5 in Gloucestershire, to the east of Slimbridge and south of Cambridge, with parcels of land to the north and south of the A4135 as shown in **Figure 1** contained in **Appendix A** and broadly indicated in **Figure 1-1** below.

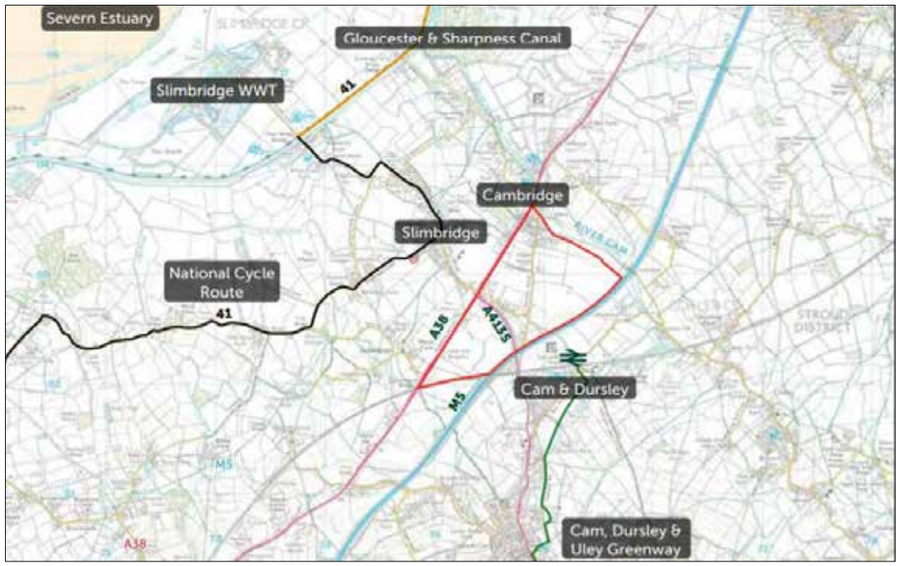

Figure 1-1 Strategic Site Location

1.2.2 As shown, the site is located very close to Cam & Dursley Station to the south of it and separated from it by the M5 motorway. The station is situated on the Bristol – Birmingham line and provides direct services to Bristol, Gloucester and the wider rail network.

1.2.3 The communities of Cam and Dursley are located to the south of the railway station. To the north-west the Gloucestershire and Sharpness Canal (1.5 miles) and Slimbridge Wildfowl & Wetland Trust (2 miles) are popular leisure destinations.

1.3 Report Structure

1.3.1 The remainder of this report is structured as follows:

- **Chapter 2**: Reviews the existing conditions around the site including the local highway network and existing walking, cycling and public transport facilities along with its proximity to surrounding local facilities.
- **Chapter 3**: Sets out details of the emerging policy context and supporting transport evidence base along with the access strategy principles that have been developed to inform the concept masterplan.
- **Chapter 4**: Provides a summary and conclusion to the report.

2 Existing Conditions

2.1 Strategic Highway Network

2.1.1 The M5 motorway abuts the south eastern boundary of the site. Junction 13 is located around six kilometres to the north and Junction 14 is located around 12 kilometres to the south, both of which are accessed via the A38.

2.1.2 The M5 runs between Exeter and Birmingham and includes sections of 3 and 4-lane motorways together with more recent 'smart' motorways. The section of motorway between Junctions 13 and 14 has three mainline lanes and is not smart motorway controlled.

2.2 Local Highway Network

2.2.1 The local highway network is shown on **Figure 1** contained in **Appendix A**.

A38

2.2.2 The A38 abuts the north western boundary of the northern and southern parcels of the site. It extends on a south west - north east alignment next to the site towards Gloucester at M5 Junction 13 in the north, and Bristol and M5 Junction 14 in the south. In the vicinity of the site, it predominately takes the form of a two way single lane carriageway. It is currently subject to a 50mph speed limit along the site frontage, but it reduces to 40mph immediately to the north east of the northern parcel of the site upon entering Cambridge.

2.2.3 Footways are provided along the north western side of the A38 and around the roundabout it forms with the A4135 which is located between the two development parcels. The footway that is present on the opposite side of the A38 from the southern parcel commences at the junction which serves Gossington where it is slightly overgrown as this section is not currently heavily used.

2.2.4 From the above point the footway provision extends to the north east up to the provision that is present around the roundabout with the A4135 where it takes the form of a shared use foot/cycleway which is street lit. All 4 arms of the roundabout have informal pedestrian/cycle crossing facilities which contain refuge islands. From this point the provision continues to the north east in the form of a street lit footway along the same side of the A38 where it is better maintained and used as it extends to provide a continuous provision through Cambridge.

2.2.5 A street lit footway provision is also provided on the south eastern side of the A38 in Cambridge. This commences approximately 400 metres to the north east of the frontage via an informal pedestrian crossing facility that features a refuge island. From this point the footway extends throughout Cambridge up to the junction it forms with Dursley Road where it then recommences to the north of it.

2.2.6 In terms of cycling provision on road advisory cycle lanes commence along the frontage of the southern parcel of the site from which point they extend to the south west. Immediately to the north east of the roundabout with the A4135 advisory cycle lanes recommence on both sides of the carriageway to extend throughout Cambridge and beyond.

A4135

2.2.7 The A4135 is a two way single lane carriageway that bisects the site and forms a roundabout with the A38. It then follows a north west – south east alignment providing access to Cam and Dursley and is subject to a 50mph speed limit in the vicinity of the site.

2.2.8 A footway is provided on the north eastern side of the road between the A38 roundabout to where the A4135 passes over the Bristol - Birmingham railway line. However, due to the restricted width of the bridge the footway narrows down to approximately ½m in order to maintain a lane in each direction across it. Immediately south of the railway bridge, the footway briefly terminates prior to the cul de sac, which provides access to several dwellings parallel to the A4135.

2.2.9 On site observations suggest that pedestrians walk across the bridge and along the verge at which point they use the carriageway of the cul de sac due to its very lightly trafficked nature to access the footway that begins at the junction it forms with the A4135. The above situation where pedestrians have to use the verge is due to be remedied though in the near future by a short section of footway that is due to be delivered by the Millfields consented development on Box Road.

2.2.10 To the south of the above cul de sac, the footway continues along the eastern side of the A4135 up to its junction with Box Road. Again, this junction is one that is proposed to be improved by a committed development scheme along Box Road which is obligated to improve its geometry, extend a new section of footway into Box Road along its northern side and improve the existing informal crossing provision to reduce the distance that pedestrians have to cross.

2.2.11 From the above junction, pedestrians will have the choice in future as to whether they continue south along the A4135 as a continuous footway provision extends into Cam and Dursley or walk / cycle along the Cam, Dursley and Uley Greenway which is proposed to tie in with the southern extent of Box Road once complete.

Dursley Road and Wisloe Road

2.2.12 Dursley Road and Wisloe Road are minor unclassified roads that extend across the site to link the A4135 with Cambridge and the A38 to the north. Both are two way single track lanes which are relatively lightly trafficked and subject to modest speeds based on on-site observations. They are rural in character and of a variable width generally around 5 to 5½m wide for the most part. Both have limited footway facilities beyond their immediate junctions with the A38 and the A4135 respectively and neither have any formal cycle provision.

2.2.13 The roads currently facilitate access to a combination of a modest number of dwellings, small industrial units, and local facilities including Slimbridge football club.

Unnamed Track

2.2.14 An unnamed track which used to form part of Wisloe Road abuts the northern parcel of the site. It extends between the point where Dursley Road and Wisloe Road merge with one another and the embankment next to the M5. Highway adoption mapping confirms that this track is still publicly maintained highway; the through connection of which was stopped up when the M5 was constructed with the extent the other side of it still adopted where it emerges opposite Cam & Dursley railway station.

2.2.15 As a result of this route being severed it results in pedestrians and cyclists having to use the A4135 to access Cam and Dursley along with the railway station. This results in access to the railway station requiring use of the route via Box Road. As a result, the M5 has somewhat of a severance effect on surrounding communities particularly given the lack of a dedicated cycle route being present along the A4135 and the pinch point that exists at the rail overbridge.

St John's Road

2.2.16 St John's Road is a lit, two way single lane carriageway road which provides access into Slimbridge village and onwards to the Slimbridge Wetland Centre. It is subject to a speed limit of 30mph with footways provided on at least one side.

2.2.17 Slimbridge Primary School is located around 60 metres north of the A38/A4135 roundabout. A warning sign with flashing amber warning lights known as Wig-Wags are located on the approach to the school. "School Keep Clear" zig-zag lines and pedestrian barriers to deter parking are present along the school's frontage with further 'keep clear' markings to the north.

Box Road

2.2.18 Box Road forms the minor arm of a priority T junction with the A4135 approximately 600 metres south of the rail overbridge. It extends broadly on a northeast – southwest alignment from the A4135 in the south to serve Cam & Dursley railway station in the north. In terms of its characteristics, it is a street lit, two way single lane carriageway approximately 5½ metres wide which is subject to a 30 mph speed limit.

2.2.19 As part of the ongoing residential and employment development schemes coming forward along Box Road the disused section of railway line which connects Box Road with Draycott Mills to the southeast, is proposed to be converted into a pedestrian/cycleway. This will provide a connection onto Box Road around 100 metres north of the junction with the A4135 but also branch off as part of an upgraded public right of way to extend through the development sites on the southern eastern side of Box Road to connect with Cam & Dursley railway station, some of which has already been completed. The route will comprise part of the '*Cam, Dursley & Uley Greenway*' project, which when complete will provide an 8 kilometre cycle, horse rider & pedestrian route linking Cam (up to Cam & Dursley railway station), Dursley and Uley.

2.2.20 In addition to the improvements cited above the committed development sites along Box Road have already or are due to also deliver a series of highway and transport related improvements including:

(i) works to the A4135 junction with Box Road including a street lighting upgrade, a pedestrian crossing improvement and the provision of a footway on the northern side to provide a continuous provision along this side to the railway station as part of other works further along it.

(ii) two priority chicane arrangements, one of which has been installed along Box Road as a traffic calming measure.

(iii) improvements to the pedestrian network in Cam, including the installation of uncontrolled crossings and upgrading of existing footpaths along the A4135 to the north and south of the junction it forms with Box Road

(iv) a 41 space overflow car park accessed off Box Road to provide additional parking for Cam & Dursley railway station. This has been constructed and is temporarily been used to provide parking for site workers whilst the associated Lister Gardens residential development is being constructed.

2.2.21 Footways are now currently provided on at least one side of the carriageway for its entire length from its junction with the A4135 up to Cam & Dursley railway station. To the north east of the railway station the footway terminates, and the road extends to the north to cross the railway via the Halmore Mill overbridge. After the bridge the road turns through c.90 degrees where it meets the south eastern section of the unnamed track that was bisected by the M5 when it was built. From this point the road continues to the east to serve the village of Coaley.

2.3 Cam Dursley Uley Greenway

2.3.1 The Cam, Dursley and Uley (CDU) Greenway is proposed to be an 8km cycle, horse rider & pedestrian link to connect Uley, Dursley and Cam up to Cam & Dursley railway station. The ultimate aspiration though is that it would eventually be extended to connect with the National Cycle Network Route (NCN) 41 in Slimbridge albeit no route is understood to have been formally identified for this yet given the constraint that is posed by the M5. The intention is that the route would be used for a variety of trips purposes in terms of commuting, leisure, shopping, travelling to/from school and accessing the rail station once complete.

2.3.2 The proposed alignment of the route in the vicinity of the site is shown indicatively in **Figure 3**. It is intended to be delivered in stages with parts of route open already with others due to be completed shortly as part of the development of the land to the south east of Box Road which is obligated to deliver this section.

2.3.3 Provision of a pedestrian and cycle link across the site to connect the CDU Greenway and NCN41 would therefore have strategic benefits as the latter connects Bristol with Gloucester locally as a part of a continuous route that will eventually link with Stratford-upon-Avon and Rugby when complete. Locally the NCN41 combines with NCN45 to serve existing key settlements including Stonehouse and Stroud.

2.4 Existing Public Transport

Bus Services

2.4.1 Given the routes that they serve, the closest pair of key bus stops to both the northern and southern elements of the site are located in its immediate vicinity on the A4135 to the north of the junction with Wisloe Road as shown on **Figure 1.** Additional stops are also located on the A38 to the north of the roundabout it forms with the A4135 and next to the Gossington junction along the frontage of the southern parcel.

2.4.2 Overall, there are a number of bus services which provide access to a range of local facilities, settlements and employment destinations. Services 60, 60F and 61 provide regular commuting services to the likes of Gloucester, Stonehouse and Stroud. They also serve key destinations in the vicinity of the site including Cam & Dursley railway station, Draycott, Lower Cam and Dursley incl. Rednock School (Secondary), employment provision, local hospital, bus station and Sainsburys supermarket. Bus Service 65 operates every two hours to provide additional services to the likes of Lower Cam, Dursley and Stroud whilst also serving some of the surrounding nearby villages such as Coaley.

No.	Route	Weekdays	Saturday	Sunday	Weekday First/Last Bus
60	Gloucester - Dursley via Quedgeley, Whitminster, Draycott, Cam & Dursley Rail Station, Draycott, Lower Cam & Rednock School	Every 2 hours	Every 2 hours	Every 2 hours	0609/1856
60F	Dursley - Gloucester via Lower Cam, Draycott, Cambridge & Quedgeley	1 daily return service	1 daily return service	-	0718/1817
61	Woodmancote - Bussage via Rednock School, Dursley, Lower Cam, Draycott, Stonehouse & Stroud	Hourly	Hourly	-	0616/1829
65	Woodfield - Stroud via Lower Cam, Draycott, Cam & Dursley Rail Station, Coaley, Upper Cam, Rednock School, Dursley, Uley and Nailsworth	Approx. every 2 hours	-	-	0716/1825
346	Whitminster - Rednock School, Dursley	1 daily return service	-	-	0808/1515
X1A	Gossington - Rednock School, Dursley	1 daily return service	-	-	0754/1541
X3	Eastington - Rednock School, Dursley	1 daily return service	-	-	0809/1518

Table 2-1 Local Bus Routes

Rail Services

2.4.1 Cam & Dursley railway station is accessed from Box Road and is located on the Bristol to Birmingham line on the opposing side of the M5 from the site. The station provides hourly direct connections to Bristol Temple Meads, Bristol Parkway, Gloucester, Cheltenham, Ashchurch for Tewkesbury, Worcester and Great Malvern. The fastest journey time for direct services to Gloucester is 15 minutes whilst the quickest to Bristol Temple Meads is 33 minutes. Some services also continue onto Bath, Weymouth, and Brighton. This station is of strategic importance as it provides the only rail access to Bristol and the South West from Stroud District.

2.4.2 The Birmingham-Bristol mainline broadly follows the same alignment as the M5, so it provides a genuine alternative to car-based travel. Whilst the current service frequency is hourly there are proposals to increase it to half hourly as part of the MetroWest2 scheme which would increase its attractiveness.

2.4.3 The station has cycle parking facilities for 30 bicycles and 90 car parking spaces with the latter due to be supplemented with a further 41 car parking spaces within an offsite car park located along Box Road. There is a ticket machine, and each platform has a shelter and seating. A ramped footbridge over the railway line provides access between the two platforms.

2.4.4 It is served by the 60 and 65 bus services and access to it on foot has recently been improved by footway improvements that have been delivered along Box Road. Access to it by active modes will be improved further by additional improvements that are due to be delivered along Box Road and through completion of the CDU Greenway which will extend directly up to the station.

2.5 Local Facilities

2.5.1 The area around the junction of the A4135 and Wisloe Road currently includes an employment area and Slimbridge football club. These facilities are supplemented further by Slimbridge which contain a primary school incl. pre-school, post office, church, village hall, sports field and a playground. Limited facilities are located in Cambridge except for The George public house.

2.5.2 To the south of the site along the A4135 are Draycott, Cam and Dursley with a combined population of c.15,000 which make them a significant conurbation and focus for the District. As a result, they both represent a significant centre for homes, jobs, retail, transport, services and facilities including community, health, leisure and secondary education.

2.5.1 It is generally recognised in guidance documents that walking offers the greatest potential to replace short car journeys, particularly trips under 2 kilometres in length, and similarly cycling has the potential to substitute car trips particularly those under 5 kilometres. On this basis these surrounding settlements in terms of distance are accessible by a combination of walking, cycling and public transport.

3 Proposed Development

3.1 Emerging Local Policy Context

3.1.1 The Stroud District Pre-Submission Draft Local Plan identifies the site for '… *a new garden community, which will deliver a high quality mixed use new settlement, including housing, employment, retail and community uses within a landscaped setting that meets the day to day needs of its residents.* It goes onto propose that the Site,'*…will be developed to accommodate approximately 1,500 dwellings and 5 hectares of office, B2 and B8 employment land and a local centre comprising retail and new community uses, including a new primary school and surgery, to meet the day to day needs of the new community'.*

3.1.2 The Plan goes onto identify a number of objectives for the site including but not limited to education and community provision, green infrastructure, drainage, landscaping, energy and transport related matters.

3.2 Stroud Sustainable Transport Strategy

3.2.1 A Sustainable Transport Strategy (STS) was produced by AECOM in February 2021 on behalf of Stroud District Council to inform and provide a transport evidence base for the Local Plan. Its aim is to ensure that new strategic developments such as this site deliver on the overall objectives of the Plan in order to reduce their transport related impacts and develop a transformational strategy in favour of sustainable forms of transport. It was produced in consultation with the following parties given the strategic nature of the work:

- Stroud District Council - local planning authority
- Gloucestershire County Council – local highway authority
- Highways England – strategic highway authority.

3.2.2 The STS has identified a number of interventions for the site which it recommends should be reflected in the layout and design of the scheme to ensure sustainable transport enhancements are prioritised above the provision of additional highway capacity.

3.2.3 The sustainability measures that have been identified for the site are as follows:

- Provision of a primary school, local centre and employment space to increase the proportion of internalised trips
- Masterplan layout that prioritises pedestrian and cycle movements and provides a walkable/cyclable neighbourhood
- Contributions and support to sustainable transport measures on the A38 and A4135 sustainable transport corridors
- Contributions and support to link the site to the wider pedestrian and cycle network, including to the CDU Greenway to the south and to the NCN 41 to the north.
- Improvements required to pedestrian and cycle accessibility between the site and facilities in Draycott and Lower Cam, as well as to Cam & Dursley Railway Station to the south of the site, increasing the attractiveness of rail as a potential mode of transport.

- Connect with and enhance the nearby bus network through increasing service frequency as well as seeking to divert some services through the site in order to provide a viable alternative to the private car. This should include both longer distance services along the A38, and connections with Cam and Dursley.

3.3 Concept Masterplan

3.3.1 A concept masterplan and an accompanying report have been developed to demonstrate how the site can respond to a combination of the emerging policy context, transport evidence base and in doing so developed with Garden Village Principles and be carbon neutral.

3.3.2 Garden City Principles are defined by the Town and Country Planning Association as, *'A Garden City is a holistically planned new settlement which enhances the natural* environment *and offers high-quality affordable housing and locally accessible work in beautiful, healthy and sociable communities'.* Transport related principles within the framework that has been identified include:

- A wide range of local jobs in the Garden City within easy commuting distance of homes
- Strong cultural, recreational and shopping facilities in walkable, vibrant, sociable neighbourhoods
- Integrated and accessible transport systems, with walking, cycling and public transport designed to be the most attractive forms of local transport.

3.3.3 The masterplan report sets out the background, rationale and vision for the development of a new sustainable community at Wisloe. It confirms proposals to deliver approximately 1,500 dwellings, new employment provision, a new local centre comprising local community facilities, retail provision, health and education provision, public open space and integrated green and blue infrastructure. The provision of these facilities will result in trips being internalised within the site thereby reducing the need to travel off-site.

3.3.4 A number of technical inputs have been undertaken to support the development of the masterplan and demonstrate viability and deliverability. Transport and highway inputs have as a result played a key part in shaping the high level site access strategy that is reflected in the concept masterplan.

Core Principles

3.3.5 The concept site layout proposes two new walkable neighbourhoods within the northern and southern areas of the site, set within a new multifunctional landscape framework that will provide a buffer to the M5, make connections to the wider area and provide separation between the new settlement and Cambridge and Slimbridge.

3.3.6 The proposed new neighbourhood centres are intended to form two of the 'five villages' within the wider area which will allow the existing settlements of Slimbridge, Cambridge and Lower Cam to retain their own separate identities, by creating new distinctive neighbourhood centres set within a strong landscape framework whilst being well connected. The five villages are proposed to be linked by excellent sustainable transport and pedestrian/cycle connections, enabling good connectivity to facilities for both existing and new residents alike.

3.3.7 The development will look to provide an excellent range of on-site facilities and supporting infrastructure which allow for enhanced connectivity for new residents and people within existing neighbouring communities. Strategic pedestrian, cycle and bus links will be integral to the design of proposed layout of the site. The site's proximity to strategic travel corridors will ensure it is well connected with surrounding settlements and facilities, with access to public transport being made a highly desirable option for travel with a focus on high quality walking and cycling links to the station being intrinsic to the framework of the masterplan.

3.3.8 The mix of uses proposed within the new neighbourhood centres, will ensure that proposed and existing residents can meet the majority of their day to day needs without the need for vehicular travel to the wider area. The neighbouring communities of Slimbridge and Cambridge will benefit from the access to these on-site facilities.

3.3.9 A new pedestrian/cycle link can provide an accessible route east-west across the site linking Slimbridge, Cambridge and Gossington to the west of the A38 with Cam & Dursley railway station and their respective settlements to the east. Two new access points can provide vehicular, pedestrian and cycle access from the A38 to the new neighbourhoods without increasing traffic along the northern extent of Dursley Road. Dursley Road itself can be reduced to provide public transport and/or cycle and pedestrian access for the prospective community, with associated high quality provisions provided across the A4135 to allow a connected sustainable transport route to be formed to all of the aforementioned villages.

3.3.10 The residential area can be focused into the two neighbourhood centres, with a higher density core within each and lower density edges adjacent to existing residential areas. It is envisaged that small scale employment and commercial uses can be incorporated within the neighbourhood centres and at key nodes within the development, and feature uses including small shops, a café, workshops and office space to support local working. House designs can also be developed to allow home working and flexible use of internal space.

3.3.11 The primary school is proposed to be located within the northern part of the site, close to the neighbourhood centre, where it will best serve both the new and existing communities. It is proposed that the school could be sited next to Slimbridge AFC and adjacent to the proposed landscape framework to support engagement with the outdoors and other curricula activities.

3.4 Multi Modal Access

3.4.1 The access strategy that has been developed has taken account of the garden city and core principles set out above in order to shape the masterplan to ensure a sustainable and low carbon form of development can be achieved. Initial transport visioning work undertaken helped inform the core principles that were developed for the site early in the design process.

3.4.2 The key objectives of the access strategy complement these principles as they are to reduce the need to travel where possible and manage the car demand generated by the development in looking to provide genuine high quality alternatives to the car through the provision of a package of supporting measures to engender sustainable patterns of movement.

Vehicular, Pedestrian and Cycle Access Strategy

3.4.3 The Stroud District Pre-Submission Draft Local Plan suggests that vehicular access for the site will be primarily from the A38 and potentially from the A4135 as well. Concept highway design work has been undertaken in order to establish how vehicular, pedestrian, cycle and public transport access can be achieved from these locations to support an all-encompassing sustainable access strategy.

3.4.4 Instead of just focussing on vehicular access, the concept access strategy that has been developed seeks to prioritise walking, cycling and public transport use in line with the ambitions of the Plan. The concept masterplan and the supporting access strategy in combination set out how high quality active travel routes can be provided throughout the development to provide walkable and cyclable neighbourhoods. These can then be supplemented with supporting off-site improvements to serve key desire lines to surrounding communities. Existing and improved provisions that could potentially be delivered are shown in **Figure 2**.

3.4.5 The Cam and Dursley corridor is in the top 5 routes in Gloucestershire for the potential to increase cycle flows, even without the development of this site. Should the development come forward along with other nearby allocations then this has significant potential to increase further. According to the Propensity to Cycle Tool (PCT) for England and Wales, which provides an evidence base to inform cycling investment, this corridor is top in terms of 'number of cyclists', potential increase in cyclists (with investment) and health economic gain.

3.4.6 Further to liaison with the local highway authority as to the access strategy, concept design work was undertaken to establish the potential to provide gateway multimodal access points off the A38 and A4135.

A38 – Northern Development Parcel

3.4.7 With sustainable and vehicular connections in mind, concept design work was undertaken to establish the potential to accommodate a signalised junction along the A38 site frontage in order to serve the northern development parcel. Given that traffic flows are higher along the A38 to the north of the roundabout it forms with the A4135, this is considered to represent the most appropriate form of junction to allow traffic to readily and safely exit this element of the site. Two variations have been developed with **Drawing 005** set out in **Appendix B** incorporating a right turn filter lane whilst **Drawing 004** shows this movement being restricted on the basis that traffic could alternatively access this element of the site from the A4135 if necessary.

3.4.8 Another key reason for initially considering this form of junction design was with pedestrians and cyclists in mind in terms of them being able to readily cross the A38 at this point. However, whilst controlled crossing facilities could still be provided in this location as part of a third option it was felt at this stage that they might be better located either side of this junction as there is not a desire line located directly opposite it.

3.4.9 There is also the potential to extend a segregated foot/cycleway facility into the site and run it along the eastern side of the A38 in both directions towards Slimbridge. To the north, this facility can be extended to a point where pedestrians are likely to want to cross in order to access the existing footway and on-road cycle lane located on the opposing side of the A38 in Cambridge.

3.4.10 To the south of the junction there is the potential to extend a foot/cycleway up to the roundabout with the A4135 and tie in with the existing shared use facilities located at this point as indicated on **Drawing 003**. To complement this there is the potential to upgrade some of the existing informal crossing facilities that are present around this roundabout. The crossing on the northern arm of the A38 is shown to be upgraded at this stage to a signalised Toucan facility in order to cater for pedestrian/cyclist movements to and from the likes of Gossington, Slimbridge and NCN41.

3.4.11 Access for private vehicular traffic can be restricted to access being taken from the A38 and A4135. In doing so there is the potential to restrict vehicular access into the northern extent of this parcel from Dursley Road through the provision of a bus gate or a pedestrian and cycle modal filter. Either option would benefit active modes as it would ensure that a lightly trafficked route can be maintained into/from Cambridge as an alternative to using the A38 for the benefit of new and existing residents alike. Not allowing bus access at this point though

may provide more potential to upgrade the existing footway provision along the northern extent of Dursley Road to improve this connection into Cambridge.

A38 – Southern Development Parcel

3.4.12 For the southern parcel whilst another signalised junction could potentially be provided to access it off the A38, it is deemed that a priority T junction incorporating a formalised right lane arrangement would be sufficient as indicated in **Drawing 002**. In order to support the provision of this junction along with the one to the north there is the potential to reduce the existing speed limit from 50mph to 40mph to the south of the junction given that the stretch of A38 which serves Cambridge is currently subject to this limit.

3.4.13 The speed limit reduction set out above could therefore also potentially be extended to cover the A38 frontage of the northern parcel along with that of the A4135. In doing so it would help enhance road safety, aid pedestrian crossing movements, improve the residential amenity of the site and the surrounding area and make it more conducive to cycle along the A38 using existing/upgraded on-road facilities.

3.4.14 As no footway provision is directly located along the frontage of this element of the site, the above drawing demonstrates the potential to provide a shared use foot/cycleway facility to the north. This facility could extend between the site access and the roundabout that the A38 forms with the A4135 in order to connect with the existing provision located at this point. Whilst it is not shown, there is the potential to accommodate a pedestrian refuge island within the hatched area indicated next to the proposed access in order to improve the linkage to/from Gossington.

3.4.15 It is clear that there are a number of ways in which the pedestrian and cycle facilities could be improved along both the A38 and A4135. The options listed therefore are not intended to be exhaustive as to what could be achieved as the STS produced by AECOM, as previously set out, states that the site should provide, *'contributions and support to sustainable transport measures on the A38 and A4135 sustainable transport corridors'*. It is clear that this can be achieved but that any improvements that are ultimately put forward should complement the wider corridor strategy for the A38 and A4135 which may involve a slightly different approach to that set out.

A4135

3.4.16 With a combination of vehicle, pedestrian and cycle access in mind concept design work has been undertaken to confirm the potential to provide a signalised crossroads along the A4135 to serve both the northern and southern development parcels. **Drawing 006** indicates the potential to accommodate a junction being positioned approximately 130 metres to the south east of the existing junction that the A4135 forms with Wisloe Road. The design shows that given that land located either side of the road at this point falls within the site ownership that a junction can readily be formed. This has the potential to include dedicated right lane provisions.

3.4.17 As set out previously there is the potential to reduce the speed limit along the A4135 from 50mph to 40mph particularly given that it already reduces to this limit on the opposing side of the M5 when entering Cam.

3.4.18 The above drawing also shows the potential to extend a foot/cycleway facility into the site from both site access arms located on opposing sides of the A4135. These can be connected via a signalised Toucan crossing facility via either a staggered or a straight over arrangement. From this point there is the potential to upgrade the existing footway that runs along the northern side of A4135 to a shared use foot/cycleway to connect in with the existing provision that is present around the roundabout it forms with the A38. Alternatively, there is the potential to use the wide verge that is present on the opposing side of the road to deliver a similar type of facility.

Internal Connectivity

3.4.19 The proposed development is focused on the provision of two new interconnected walkable neighbourhoods that will provide community facilities, employment and leisure opportunities and high quality open space for new and existing residents / employees to use alike. High quality provision for active modes are intended to be made throughout both the northern and southern extents of the site so that the site is readily accessible and permeable for pedestrians, cyclists and public transport usage.

3.4.20 On key desire lines high quality foot and cycleway facilities can be provided to link the potential site accesses onto the A38 and A4135 for both development parcels which would readily link with one another and serve the proposed local centre. Along with an integrated bus route these provisions would provide a sustainable spine through the site as a whole. In the northern parcel there is the potential to link the aforementioned accesses with the proposed pedestrian and cycle bridge over the M5 with a sustainable connection onto Dursley Road which would prioritise provision for active modes over cars in both instances.

3.4.21 Pedestrian and cycle routes would be designed to ensure legible and direct routes are available throughout the site for commuting and leisure use. These will be integrated within the masterplan to ensure routes are safe and incorporated with the landscape strategy to maximise opportunities for attractive and high quality green space.

M5 Foot and Cycle Bridge

3.4.22 In order to improve the accessibility of the site by active travel modes a high quality foot/cycle bridge can be provided across the M5 to overcome the current severance issue. Given the desire line that exists a new bridge across the M5 would link the rail station, CDU Greenway with the communities and the facilities on either side. The alignment for it is intended to be immediately to the north of the existing tracks that used to comprise of Wisloe Road on both sides of the motorway as this land is within the control of the landowners.

3.4.23 The principle for such a facility was initially discussed with both the local highway authority and Highways England (HE). HE confirmed in principle support for it with the only proviso being that any bridge structure would need to have a clear span across the motorway. Similarly, the local highway was also supportive of it particularly given that they were planning to submit a Local Pinch Point Funding bid to the Department for Transport (DfT) to fund a pedestrian/cycle bridge across the M5 at more or less the same location at the time.

3.4.24 Through further discussions with the local highway authority, it transpired that their bid was intended to be based on looking to provide a bridge to connect the existing tracks located either side of the M5 on the basis that these extents still technically form part of the adopted highway. It was confirmed that their rationale for looking to submit a bid was to support an extension of the CDU Greenway to link in with the NCN41 in Slimbridge, improve the accessibility of the rail station, accelerate delivery of the Greenway between Uley and Cam and improve the accessibility of the site if it were to be allocated albeit it would not be reliant on it. It subsequently emerged though that the bid they submitted was unsuccessful as the DfT unexpectedly decided to withdraw this fund completely.

3.4.25 A bridge feasibility study was still progressed by Stantec. The appended report set out in **Appendix C** confirms the options to provide a bridge on the alignment set out based on the structure having a clear width of 5½m for pedestrians and cyclists to use in accordance with Local Transport Note (LTN) 1/20 Cycle Infrastructure Design.

3.4.26 A number of options were considered but two concept designs were developed as follows:

- Option 1 – Foot/cycle bridge fully spanning HE land based on provision of a single 58m square span bow arch truss bridge
- Option 2 – Foot/cycle bridge with minimum span over existing carriageway based on provision of a single 43m square span bow warren truss bridge.

3.4.27 The bridge design options as set out in the appended feasibility report were developed in consultation with the masterplanner/landscape architect and acoustic consultant in order to integrate them into the landscape and noise bund concept design. As a result, steel ramps do not need to be provided to serve it as there is the potential to incorporate a segregated foot/cycle path into the landscaped bunds that can be sited either side of the bridge.

3.4.28 Provision of a bridge for active travel as part of the development of the site would allow a higher quality and more cost effective design to be provided than would be possible otherwise. The same can also be said of the segregated pedestrian and cycle route that can be provided through the site to connect the A38 with it as well.

Linkage between M5 Foot/Cycle Bridge and Rail Station

3.4.29 In order to complement the range of on and off-site pedestrian and cycle improvements previously set out, consideration has also been given to the pedestrian and cycle desire line to Cam & Dursley railway station and the CDU Greenway from the point where the bridge is intended to land on the southern side of the M5 opposite the site.

3.4.30 Given that there is no foot/cycle provision to connect with the station from this point, there is the potential to provide a segregated foot/cycle path up to the lane that Box Road ties in with that passes over the railway line via Halmore Mill bridge immediately to the east of the railway station. As this lane is lightly trafficked and subject to relatively low speeds there is the potential to introduce a signalised shuttle working system across it in order to provide a continuous pedestrian link to the station. The other option would be to investigate the potential to introduce a modal filter across the bridge to only allow use of it by active modes and buses.

3.4.31 With the above shuttle working arrangement cyclists could use the carriageway at this point for a short distance and then rejoin an off-road provision after the bridge by way of a shared use foot/cycleway. This could then extend up to the station access in order to provide a continuous route to it and tie in with the existing footway facility on Box Road.

3.4.32 In providing a connection to the railway station, this provision would also connect in with where the committed section of CDU Greenway is intended to commence/terminate on the opposing side of Box Road. This linkage when combined with the on-site provision and associated off-site works would effectively extend the Greenway to provide the ‘missing link’ between it and the NCN41 in Slimbridge. In doing so, it would form part of a wider link to the Cotswolds to the south and to the Gloucester and Sharpness Canal and to the north.

3.4.33 Provision of the bridge and associated on/off site pedestrian and cycle infrastructure that could accompany it, would link the station with the site so that is readily accessible by non-car modes in future so as not to increase car parking pressures at Cam & Dursley railway station. This infrastructure would even stand to relieve some of the existing parking pressures as the improved pedestrian, cycle and public transport linkages set out would also help bring about a mode shift amongst existing communities such as Slimbridge and Cambridge.

3.4.34 A combination of the existing and potential cycling infrastructure set out would also be suitable for micro-mobility use given the recent emergence of e-bikes and e-scooters particularly if current trials for the latter are completed successfully. Given the size of e-scooters in particular they stand to lend themselves to help overcome first/last mile connectivity issues which can often be a deterrent to public transport use. One such example of this is where a passenger has to get from their point of origin to their major form of transit (such as the train or a bus), and then get from that mode to their ultimate destination.

3.4.35 With the uptake in use of e-bikes becoming ever more prominent, the issue of distance will become less of a barrier to cycling. E-bikes will also allow greater accessibility for cyclists that are less mobile, or may struggle with a conventional bicycle, opening new sustainable transport opportunities for those users.

Micro-mobility

3.4.36 The '*Inrix: Micromobility Potential in the US, UK and Germany'* report dated September 2019 explains that, *'Driving and public transportation have historically been the most popular ways to travel, but the explosion of micromobility technology has brought a wide variety of new options that could make urban mobility more efficient, accessible and convenient. The emergence of micromobility-as-a-service – defined as shared bikes, e-bikes and e-scooters – highlights both the consumer and commercial appeal'.*

3.4.37 The Inrix report further states that; *"The benefits of micromobility services stem from their higher efficiency in terms of energy and space. For example, the minimum square footage of one parallel parking space is 212 square feet, whereas scooters and bikes require three to six square feet to park. There's also a sharp contrast in energy efficiency; an e-scooter can travel up to 83-miles with the same amount of energy it takes an average gas vehicle to travel one-mile. However, nuance is needed in their adoption".*

3.4.38 The Inrix study concludes that, *'micromobility faces a promising future by replacing short distance vehicle trips and providing currently underserved first- and last-mile solutions for public transit riders. The exceptionally high number of short duration trips found in all three countries highlights micromobility's massive market potential. Their flexible networks enable dynamic management of transportation networks providing travellers with fast, efficient alternatives to driving'.*

3.4.39 The DfT has fast tracked and expanded trials for e-scooter hire schemes in support of a green restart to local travel and to help mitigate reduced public transport capacity in the short term resulting from the COVID-19 pandemic. The DfT believe that e-scooters have potential to offer fast, clean and inexpensive travel, which can also help ease the burden on transport networks. An initial 12 month trial period began in July 2020, following legislative changes to allow it to proceed, which has now been extended until March 2022. Therefore, although not lawful to use on public highways at present (i.e., on highways, adopted footways, cycleways and the like), the growth of personal transport modes is likely to see changes to the way that these are used and lead to a resulting reduction in car usage.

3.4.40 The combination of the proposed on-site cycle provision, pedestrian/cycle bridge, off-site improvements and the CDU Greenway stand to provide just the type of infrastructure required for micro-mobility usage in future. It will also help address first/last mile connectivity issues which can be experienced with use of bus and/or rail thereby helping improve their uptake as well.

Public Transport Strategy

3.4.41 In order to maximise the opportunities for sustainable travel further, there is the potential to improve the existing local bus service provision. In doing so, it would allow for an even greater mode shift to non-car modes to be achieved which in turn will help decarbonise travel to and from the site. It would also complement the promotion of active modes, micro-mobility and the potential to provide improved linkages to Cam & Dursley railway station so that all modes offer a credible alternative to personal car use for both short and longer-distance journeys.

3.4.42 Given that that the site is extremely well located on the junction of two sustainable movement corridors there is scope to readily improve the bus and coach offer. This could be improved as part of a wider strategy with other proposed allocations such as the one at North West Draycott (PS24) and that proposed on the southern fringe of Gloucester around Junction 12. This strategy complements the proposed Local Plan spatial strategy in steering development to corridors such as this as it will enable a greater level of improvement to be achieved in combination rather than what would be possible just for this site or others by themselves.

3.4.43 In evaluating potential public transport improvements, it is anticipated that public transport demand to the south towards Yate and Bristol could be met by the existing rail service from Cam & Dursley railway station given that the pedestrian/cycle accessibility of it is proposed to be improved. This will offer a similar frequency to Gloucester to access the city centre. Therefore, the focus has been on the potential to improve the Dursley to Stonehouse element of the bus corridor setting out the potential to improve the 61 service in consultation with the operator Stageoach.

3.4.1 Of the existing local bus routes the 61 service, which runs past the site on an hourly basis, is the most frequent and well used one in the southern part of the District. To the east it extends along the A4135 directly into Cam and then into Dursley to serve key education, retail and employment sites. To the north the service uses the A38 to serve the major employment area west of Stonehouse, thereafter it extends to serve the town centre and secondary and post-16 education sites, before terminating at the heart of the commercial and employment core of Stroud as the key centre within the District. It is an attractive service to use in that many of the on-bus journey times from Wisloe are broadly comparable to driving, as the route mainly follows the logical driving route between the site and both Dursley (11 minutes) and Stonehouse (18 minutes).

3.4.2 To improve the appeal of the 61 service going forwards there is the potential to increase its frequency to operate at least every 30 minutes during core operating hours (0700-1930) from Monday to Saturday. Beyond Dursley, journeys could either continue along the 61 route to Stroud, or, alternatively, continue to Quedgeley and Gloucester via the B4008 depending on the best means of maximising take-up of the additional capacity created. This intervention would require an additional two-buses to provide. It is therefore acknowledged that developer contributions would be required to fund it until the patronage improves sufficiently for it to be able to be sustained in commercial terms going forwards.

3.4.3 The masterplan has been developed with integrated bus travel in mind with the intention that a bus could extend through both parts of the site rather than simply just run along the periphery of them on the A38 and A4135. Stagecoach have confirmed the potential to divert the 61 service into the site in order to order to improve public transport permeability and increase the attractiveness of using it by prospective residents, employees and visitors. This permeability would also benefit passengers wanting to interchange to and from rail given the improved pedestrian and cycle link that is intended to be forged to Cam & Dursley railway station.

3.4.4 There are a number of ways in which this route could be integrated into the site, but one option discussed with Stagecoach would initially involve diverting the 61 service off the A38 in Cambridge via Dursley Road to serve the northern development parcel. Southbound services could then extend along it and at the point where development frontage starts, there is the potential to introduce a bus gate facility as indicated in **Figure 2**. This facility could provide priority for buses to access/exit the site at this point and ensure that general development / through traffic does not use this section. It would also help bring about benefits for pedestrians and cyclists as previously highlighted.

3.4.5 Upon entering the site via Dursley Road there is the potential for a bus to stop close to the northern extent of the proposed pedestrian/cycle bridge that is intended to be provided to serve the desire line to Cam & Dursley railway station and the CDU Greenway. In doing so rail passengers may look to alight/board at this location as the station could then be within an c.800 metre walk distance with the bridge in place. A bus could then continue to serve the proposed local centre before briefly exiting onto the A38 in order to serve the southern development parcel. It could then route through it and exit via the proposed access onto the A4135 to continue its journey on into Cam and Dursley. Buses travelling in the opposing direction could therefore use this route in reverse.

3.4.6 High quality on-site bus stop infrastructure could be provided at regular intervals at key nodes within both extents of the site to serve the diversion of the 61 service. In addition, existing bus stops in the vicinity of the site on the A38 and A4135 could also be upgraded to increase the attractiveness of using the 60, 60F and 65 bus services. In combination these routes would combine, based on a combination of service frequencies, journey/operating times and destinations served, to provide a very good level of service overall based on the local context.

3.4.7 The potential bus strategy would also complement the walking and cycling strategy for the site particularly in relation to greatly improving the accessibility of Cam & Dursley railway station by these means. The combination of bus and rail would therefore stand to provide an excellent public transport provision for the site based on the local context. This holistic approach would help maximise the opportunities for sustainable travel and secure a low level of private car use amongst future residents of the development. In addition, the benefits would extend far wider than the site residents as people currently living and / or working in surrounding areas will also stand to benefit from this package too.

3.5 Future Ways of Working and Travelling

Overview

3.5.1 There is a growing body of evidence which suggests that the way people in general, and especially younger generations, consider travel and mobility is changing. The rapid development of new technologies is challenging existing travel models and advances such as car clubs, micro-mobility, bike hire systems and mobility as a service (MaaS) are now realities that will play an increasing role in the way people travel in the future.

3.5.2 Furthermore, advances in vehicle technologies such as electric and autonomous vehicles create opportunities to rethink established means of delivering transport solutions. Development in mobile technology also creates a new realm of possibility when considering how the built environment is designed and how people use it. Increased internet access and improved broadband speeds now allow people to work in more ‘agile’ ways as has been shown through the COVID-19 pandemic.

3.5.1 The transport proposals put forward in support of development at Wisloe aim to deliver a framework for access and movement that is sustainable, deliverable and effective based on current technologies but also resilient to future travel patterns and systems.

3.5.2 In this context, the AMF for the site could be supported by Smart Travel Concepts, that would work across the proposed walking and cycling, public transport, and vehicular access strategies. The Smart Travel Concepts are:

- Smart Worker Package
- Smarter Choices Package
- Sharing Economy Package
- Informed Traveller Package.

Smart Worker Package

3.5.3 The number of people working from home has increased in recent times as employers have been encouraged to adopt more flexible working practices.

3.5.4 The recent COVID-19 pandemic has then brought about more of a sudden acceleration in the way people work with many forced to work from home, some for the very first time. As businesses adapt going forwards one of the positive legacies of COVID-19 is that large proportions of the workforce are likely to continue to work from home more often; saving money on travel, improving their work-life balance and helping the environment.

3.5.5 The Government’s Opinion and Lifestyle Survey, presented in one of their early daily COVID-19 briefings, showed an increase in home working from 12% in 2019 to 39% in 2020 during the lockdown. Further, data published by Office of National Statistics established that in April 2020 46.6% of people in employment did some work at home, of which 86% did so as a result of the pandemic.

3.5.6 Furthermore, recent studies conducted in the United States and Norway, estimate around 36% of jobs could be performed from home. Whilst these are international studies, the types of jobs are consistent with that in the UK and the local area. Therefore, it is likely that the ‘new normal’ will include a significant percentage of the workforce continuing to work from home for more than one day a week. A key consideration in people’s ability to work from home is access to fast broadband. Increased internet access allows people to work in more ‘agile’ ways, where ‘work’ is not a place you go to but more something you do.

3.5.7 There is considered to be an opportunity to encourage homeworking as it is expected that telecommunication providers will supply the development with high-speed broadband, high speed mobile phone services and potentially Wi-Fi in public spaces such as in the local centre and at bus stops etc. In addition, there is the potential to provide a high-quality work hub in the development site (potentially as part of an Active Travel Hub), that includes facilities for meetings, conference calls, printing etc. to support home-based businesses and teleworking. Such a facility could also double up and provide a concierge service to accept parcels and deliveries etc for residents.

Smarter Choices

3.5.8 A key element of the transport strategy will be to implement a package of measures / initiatives that are designed to encourage travellers to, from and within the development site to adopt more sustainable patterns of travel and to make optimum use of a package of measures.

3.5.9 Over a number of years, there has been growing interest in a range of transport and travel initiatives, which are now widely described as 'soft' transport policy measures. These seek to give better information and opportunities, aimed at helping people to choose to reduce their car use while enhancing the attractiveness of alternatives.

3.5.10 In this instance, it is proposed to undertake the following:

Framework Travel Plan

3.5.11 A site wide Travel Plan (TP) is proposed to accompany any future planning application for the development of the site. This would look to set out a series of 'soft' measures to compliment the 'hard' infrastructure and public transport related improvements such as those previously outlined. An accompanying strategy to deliver and monitor its effectiveness against defined targets would also be provided.

3.5.12 A TP is a long-term management strategy that seeks to deliver sustainable transport objectives through positive action. It would seek to ensure that the development will be sustainable and integrated with local transport strategies as envisaged. In doing so it would seek to reduce the impact of the development of the site on the surrounding highway network and maximise the use of non-car modes of transport in line with current Government policy.

3.5.13 The Plan would identify a site-specific package of measures aimed at promoting and raising awareness of sustainable travel and reducing the reliance of single occupancy car trips. It would also operate as a management tool, bringing together transport and other organisational issues, providing a package of initiatives to minimise the number and length of car trips generated by the development, while also supporting more sustainable forms of travel and reducing the overall need to travel. It would help bring about behavioural change in influencing and promoting sustainable forms of travel amongst residents and employees of site through initiatives such as personalised travel planning (PTP).

Sharing Economy Package

3.5.14 The Sharing Economy is seen as one of the main game changers in the future of our society. In simple terms, it is a hybrid market model between owning and gift sharing which refers to peer-to-peer based sharing of access to goods and services.

3.5.15 There are considered to be opportunities to promote the Sharing Economy at the proposed development site in the following potential ways:

- Active promotion of existing range of car sharing opportunities such as Gloucestershire liftshare and others if they come forward through the 'Smarter Choices' package
- Build on the success of car clubs in the likes of Stroud, Cheltenham and Gloucester by delivery of an on-site car club thereby providing prospective residents, employees and the surrounding community with a viable alternative to private car ownership
- Provision of a bike hire scheme incl. electric and cargo bikes
- Seek to encourage emerging initiatives where they are seen to benefit sustainable travel and reduce car ownership such as peer-to-peer car hire schemes
- Provision of electric vehicle and bike charging points
- Provision of dedicated car sharing parking spaces for on-site employment provision incl. school.

3.5.16 It is acknowledged that many people choose to own a private car for the convenience that it can provide. This includes the ability to visit friends and family, link trips such as work and shopping or perhaps simply because public transport provision is not available for undertaking certain trips. As such, although residents/staff of the proposed development may wish to walk, cycle or get a bus they may still want access to a vehicle on certain occasions.

3.5.17 A self-service car club would therefore have a role to play as schemes elsewhere offer on-site hybrid/electric vehicles within dedicated car parking spaces to hire for as little as 30 minutes. Several vehicles could be provided and be available all year round for reservation well in advance or at short notice. The provision of car clubs is acknowledged to help reduce the need for households to own a second car, particularly where there is also good active mode and public transport provision as is proposed in this case.

3.5.18 The sharing economy and public transport packages set out stand to provide all the key ingredients to potentially form part of a full MaaS system or a 'lite' version to be provided in the future if an operator/s come forward to provide them. The MaaS model brings together multiple modes of travel, combining options for different transport providers into a single service. From e-scooters to bikes, car clubs and ride sharing to public transport, the idea is to have access to all modes of transport via a single payment platform. It is envisaged it will have an important role to play in the future, contributing to a reduction in both CO2 emissions and air pollution, while improving the overall efficiency of the transport system and reducing reliance on private cars.

Informed Traveller Package

3.5.19 The site could deliver an Informed Traveller package with the aim of providing the information needed for future residents and employees of the site to confidently undertake more sustainable patterns of travel. The ability to implement / deliver some of these potential measures will be dependent on the appropriate opportunities emerging (most likely through the private sector), such as improved journey planning apps already available to smart-phone users.

3.5.20 An Informed Traveller Package could deliver:

- A bespoke community website providing site-specific travel information and advice
- Real time public transport information at key interchanges and bus stops.

3.6 Traffic Impact

3.6.1 The traffic impacts that are forecast to be associated with the development of the site have been considered by the traffic forecasting that has been undertaken in relation to the Draft Local Plan. This exercise was carried out on behalf of Stroud District Council by Mott MacDonald to assess the impact of the proposed site allocation along with all the other ones on both the local and strategic road networks such as the A4135/A38 and M5 respectively to demonstrate that they can be accommodated.

3.6.2 The traffic modelling work undertaken has considered a cumulative assessment of the traffic impacts associated with the draft allocations, rather than just considering each of them individually to ensure the combined impacts are assessed. The Gloucestershire Countywide Traffic Model (GCTM) developed on behalf of Gloucestershire County Council was used to assess the Local Plan proposals based on use of a 2040 future year forecast scenario.

3.6.3 The SATURN traffic modelling work undertaken was done in parallel with development of the STS produced by AECOM on behalf of Stroud District Council as set out previously. In combination these two workstreams identified a package of highway capacity improvements to mitigate the impact of the Local Plan sites along with a strategic approach to achieve more of a mode shift to non-car modes of transport.

3.6.4 In the immediate vicinity of the site this modelling exercise considered the cumulative traffic impacts of the draft Local Plan site allocations upon the A38/A4135 roundabout. With the addition of this traffic onto the network, the A38 northbound approach to this roundabout was forecast to exceed capacity in the local highway network AM peak. Mitigation has therefore been identified consisting of the removal of existing hatch markings and minor carriageway widening to provide a similar level of capacity as to that experienced in the 2040 baseline scenario considered. The latter scenario was provided for comparison purposes as it represents one in which the proposed Local Plan housing and employment allocations are not included but that committed developments and transport schemes are.

3.6.1 The draft Local Plan transport evidence base demonstrates that the traffic impacts of the proposed site allocation along with the cumulative impact of others can be largely addressed to allow junctions on the local and strategic highway network to perform at a similar level to the baseline situation assessed. The development of the site is therefore considered to be deliverable as its associated traffic impact can be mitigated. The conclusions are considered to be robust on the basis that there is a growing evidence base regarding a reduction in car trips in future due to various factors including increased home working, emerging micro-mobility options, increased uptake of active modes, emergence of MaaS/MaaS 'lite' and the changing fleet to electric vehicles beyond what it considered.

3.6.2 It is accepted though that a reasonable proportion of people will continue to travel to work and use private cars and therefore requirement for sustainable development, located close to employment / education facilities with options for sustainable travel as in this case, remains imperative to a new development. Furthermore, evidence suggests that the impact of travel planning measures is greater for shorter journey lengths.

3.6.3 All of this points to the conclusion that a spatial strategy which seeks to locate development at Wisloe is inherently (and quantifiably) sustainable as it will avoid spatial planning mistakes of the past by locking-in car-centric travel patterns, with significantly reduced opportunities for positive travel behaviour change. Development at Wisloe will therefore assist Stroud District Council to make progress on their Climate Emergency and Local Plan objectives.

4 Summary & Conclusion

4.1 Summary

4.1.1 This Access & Movement Framework (AMF) has been prepared on behalf of Gloucestershire County Council and The Ernest Cook Trust as joint landowners to provide transport representations to support the proposed PS37 site allocation for a residential led mixed use development within the Stroud District Local Plan. The framework sets out the access strategy considerations that have been used in the development of the concept masterplan for Wisloe New Settlement.

4.1.2 The purpose of this framework is to demonstrate that the site allocation is sound and deliverable from a highways and transport perspective in being able to meet the related emerging Local Plan policy requirements.

4.2 Conclusion

4.2.1 This framework has proven that a sustainable access strategy can be achieved to ensure that the proposed site allocation is deliverable and can be provided to accord with the overall Local Plan objectives of reducing transport related environmental impacts in being able to deliver a transformative rebalancing of transport provisions in favor of sustainable modes. The access strategy which has informed the concept masterplan has incorporated numerous potential sustainable travel related interventions in relation to a sharing economy package, active modes, micro-mobility and public transport that can be imbedded into the design of a new community.

4.2.2 The concept masterplan and supporting access strategy demonstrates that the development of a new community at Wisloe can provide a self-contained settlement whilst also helping serve the needs of surrounding communities.

4.2.3 Whilst sustainable modes of transport can be prioritised over that of the private car, the access strategy confirms that suitable vehicular site access arrangements can be achieved and that associated traffic impacts of the development can be mitigated.

Appendix A Figures

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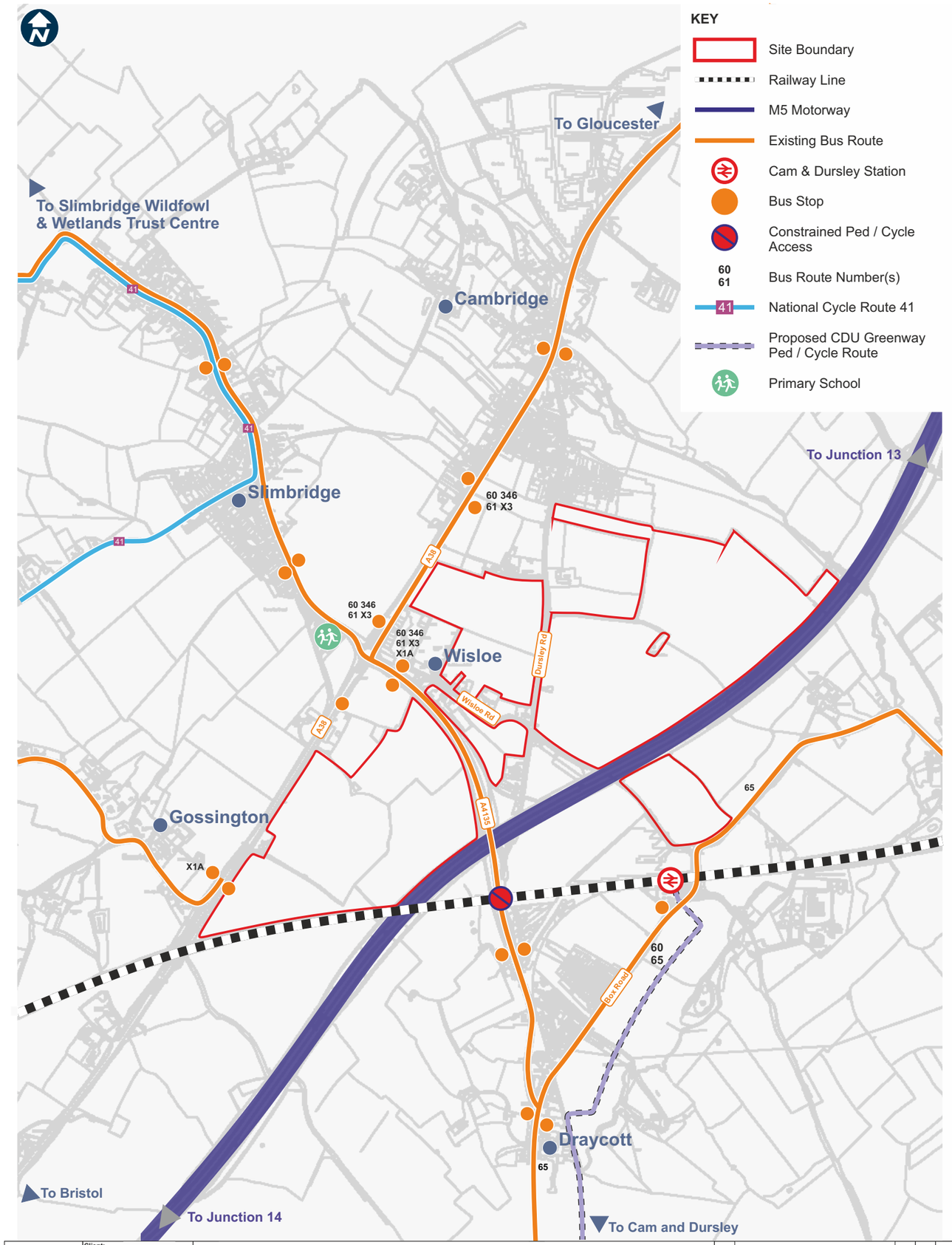

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Wisloe New Settlement
Existing Highway Network

183

Mark	Revision	Drawn	Date	Chkd

Date	03/06/2021
Scale	NTS
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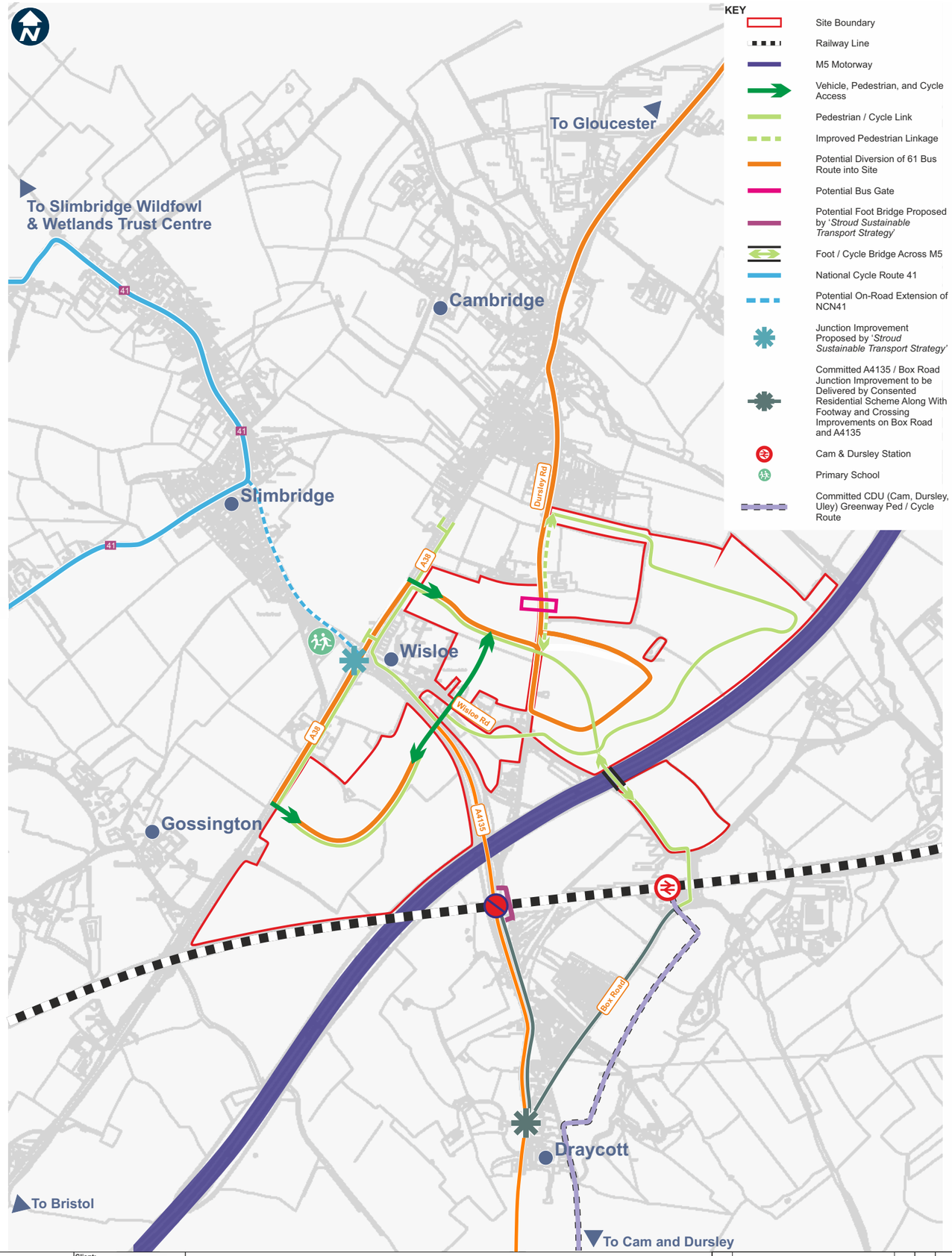
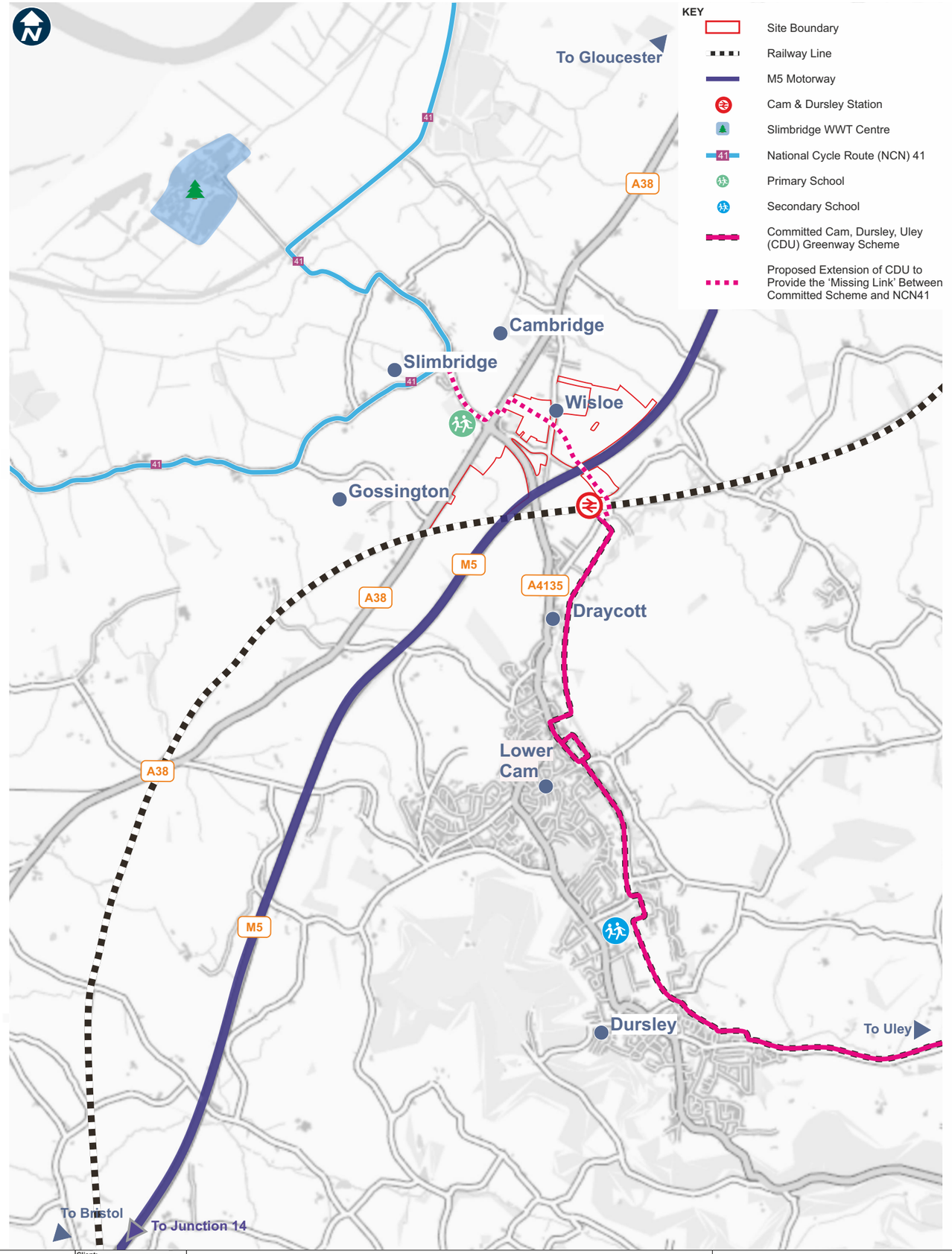
Figure 1





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Client: ECT & Gloucestershire County Council

Wisloe New Settlement

Access Strategy Principles

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Figure 2

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Wisloe New Settlement

Potential Future Connections Between CDU Greenway and NCN Route 41

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Figure 3

Appendix B Drawings

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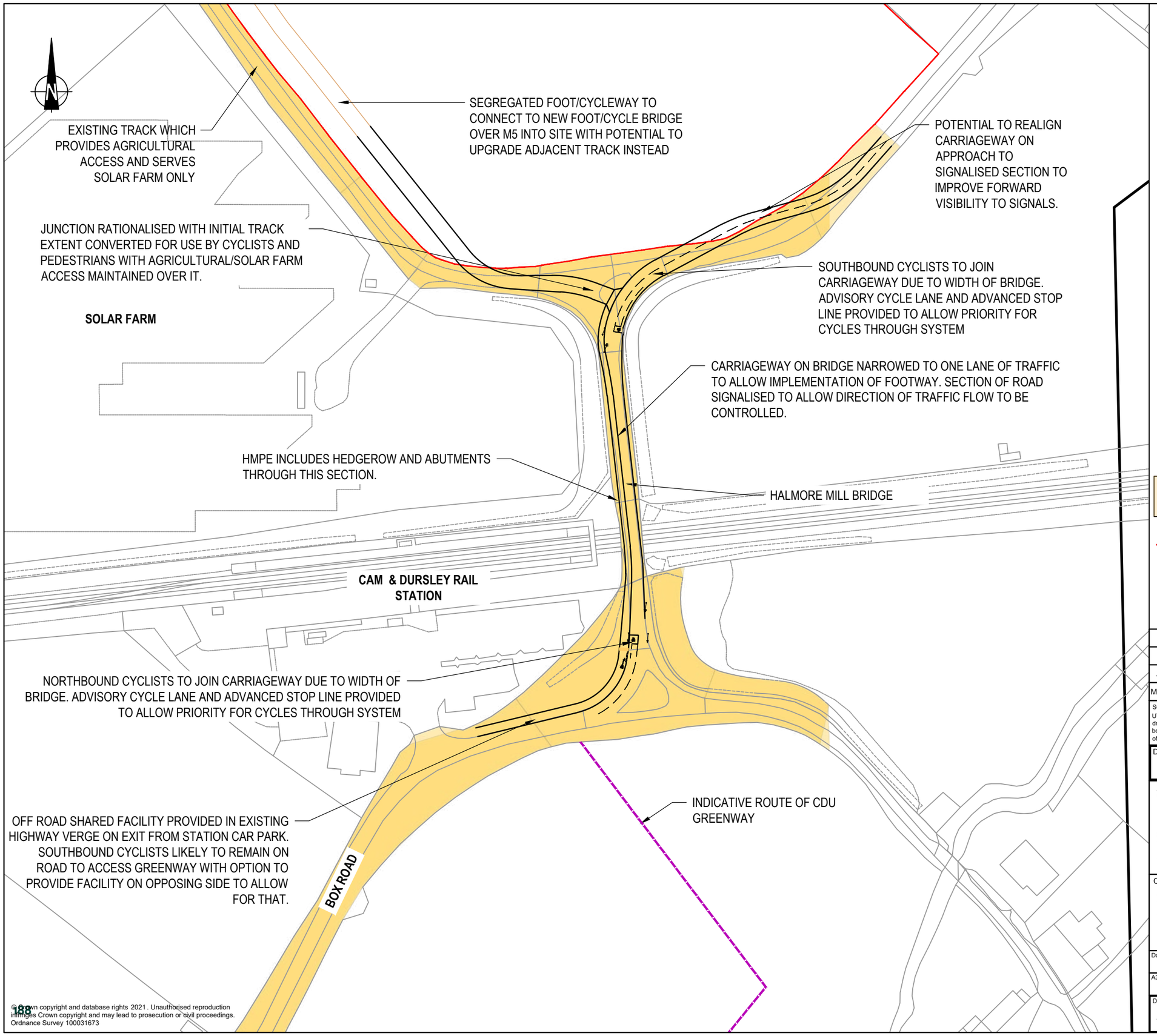

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KEY:

EXTENT OF HIGHWAY LAND MAINTAINED AT PUBLIC'S EXPENSE (HMPE). INTERPRETED FROM GLOUCESTERSHIRE PLAN DATED 20/09/19

EXTENT OF LAND WITHIN CLIENT'S CONTROL

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Drawing Issue Status

CONCEPT

WISLOE NEW SETTLEMENT PROPOSED HALMORE MILL BRIDGE SIGNALISATION SCHEME AND PEDESTRIAN & CYCLE IMPROVEMENTS

Client

GCC & ERNEST COOK TRUST

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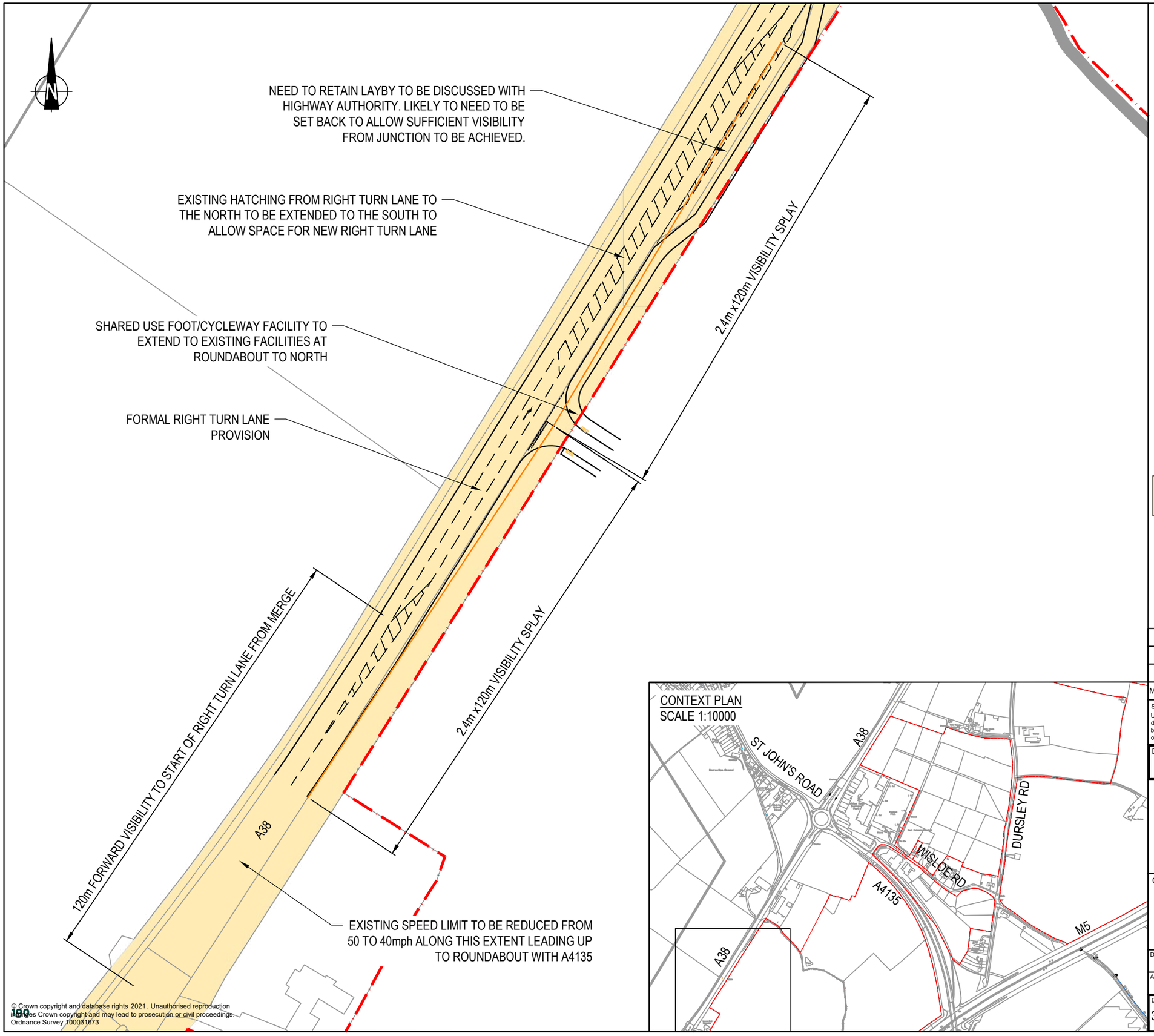

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EXTENT OF LAND WITHIN CLIENT'S CONTROL

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Drawing Issue Status
CONCEPT

WISLOE NEW SETTLEMENT
PROPOSED ACCESS STRATEGY
RIGHT TURN LANE AT SOUTHERN A38 FRONTAGE

Client
GCC & ERNEST COOK TRUST

Date of 1st Issue	Designed	Drawn
11.05.21	SL	SL
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1:1000	JB	JB

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EXISTING FOOTWAY

UNCONTROLLED CROSSING TO BE UPGRADED TO TOUCAN CROSSING FOR ROUTE TO NATIONAL CYCLE NETWORK ROUTE

ST JOHN'S ROAD

A38

SEGREGATED FOOT / CYCLEWAY TO EXTEND TO ROUNDABOUT FROM NORTHERN A38 ACCESS

EXISTING UNCONTROLLED CROSSING

EXISTING SHARED USE FACILITY WIDENED

SHARED USE PEDESTRIAN / CYCLE FACILITY TO EXTEND TO NORTHERN ARM OF ROUNDABOUT FROM A4135 ACCESSES

EXISTING UNCONTROLLED CROSSING TO BE RETAINED BUT POTENTIAL TO UPGRADE TO SIGNALISED FACILITIES IF REQUIRED

POTENTIAL TO INCREASE FLARE SUBJECT TO CAPACITY REQUIREMENTS

A4135

A38

SHARED USE FOOT / CYCLEWAY TO EXTEND TO ROUNDABOUT FROM SOUTHERN A38 ACCESS

CONTEXT PLAN
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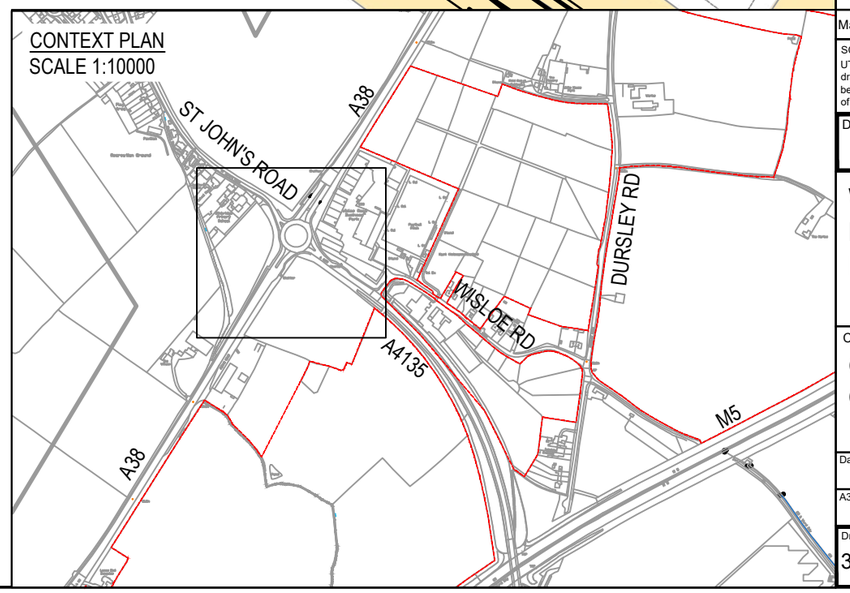

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Drawing Issue Status
CONCEPT

WISLOE NEW SETTLEMENT
PROPOSED ACCESS STRATEGY
IMPROVEMENTS AT A38 ROUNDABOUT

Client
GCC & ERNEST COOK TRUST

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SLIP TO BE PROVIDED FOR CYCLISTS TO RETURN TO NORTHBOUND CARRIAGEWAY THROUGH CAMBRIDGE

TOUCAN CROSSING TO PROVIDE CONNECTION TOWARDS CAMBRIDGE

EXISTING 40/50mph SPEED LIMIT SIGNAGE REMOVED SO THAT ALL SITE ACCESS JUNCTIONS ONTO A38/A4135 ARE SUBJECT TO A 40mph LIMIT

SEGREGATED PEDESTRIAN / CYCLE FACILITY TO EXTEND TOWARDS CAMBRIDGE

EXISTING FOOTWAY

A38

ADVANCED STOP LINES TO ALLOW COMMUTER CYCLISTS TO CONTINUE TO MAKE USE OF ON ROAD FACILITIES

RIGHT TURN MOVEMENT POTENTIAL TO RESTRICT AT JUNCTION TO MAXIMISE CAPACITY ON A38

SEGREGATED PEDESTRIAN/CYCLE FACILITY TO EXTEND TO A38 ROUNDABOUT TO PROVIDE CONNECTION TO NATIONAL CYCLE NETWORK ROUTE IN SLIMBRIDGE

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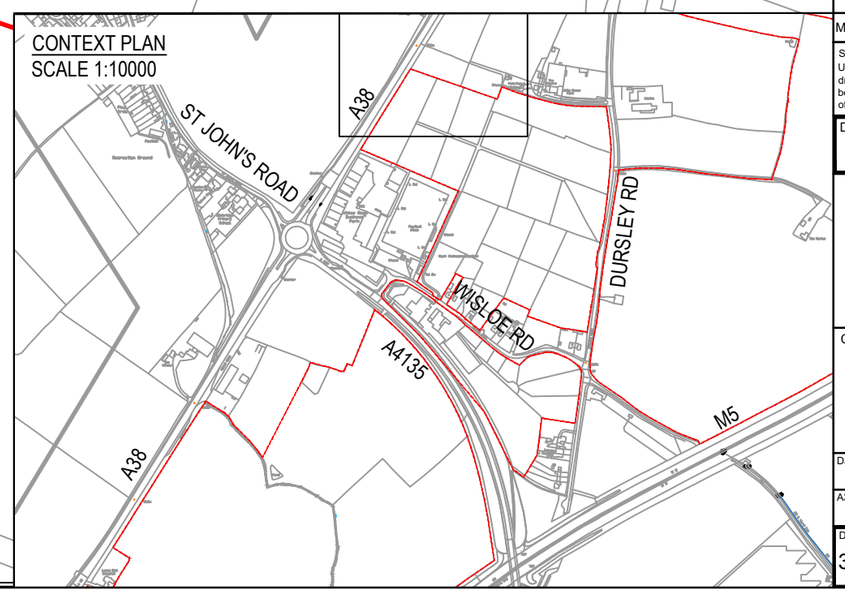

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Drawing Issue Status
CONCEPT

WISLOE NEW SETTLEMENT
PROPOSED ACCESS STRATEGY
SIGNALISED JUNCTION AT NORTHERN A38 FRONTAGE: OPTION 1

Client
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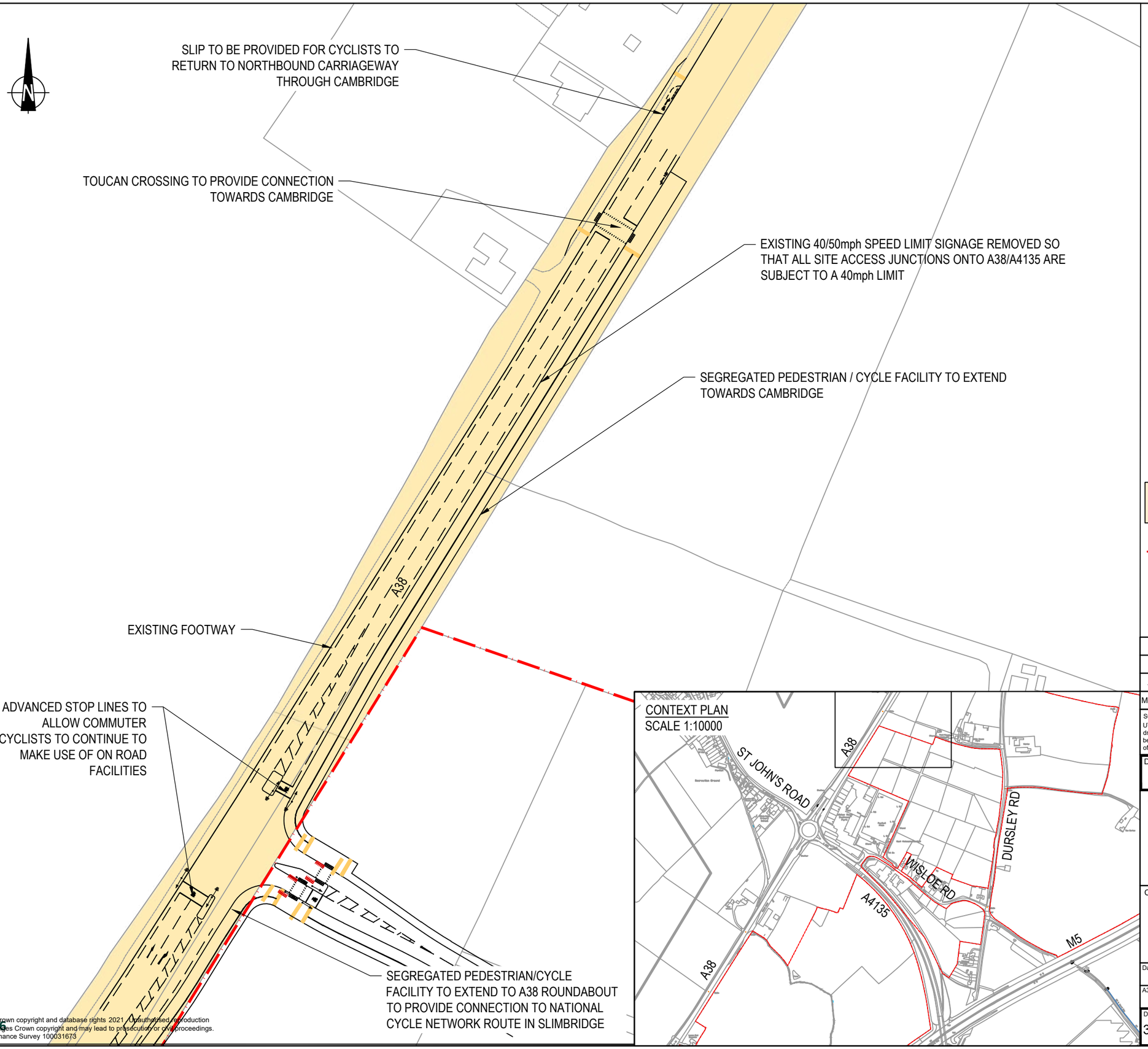

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WISLOE NEW SETTLEMENT
PROPOSED ACCESS STRATEGY
SIGNALISED JUNCTION AT NORTHERN A38 FRONTAGE: OPTION 2

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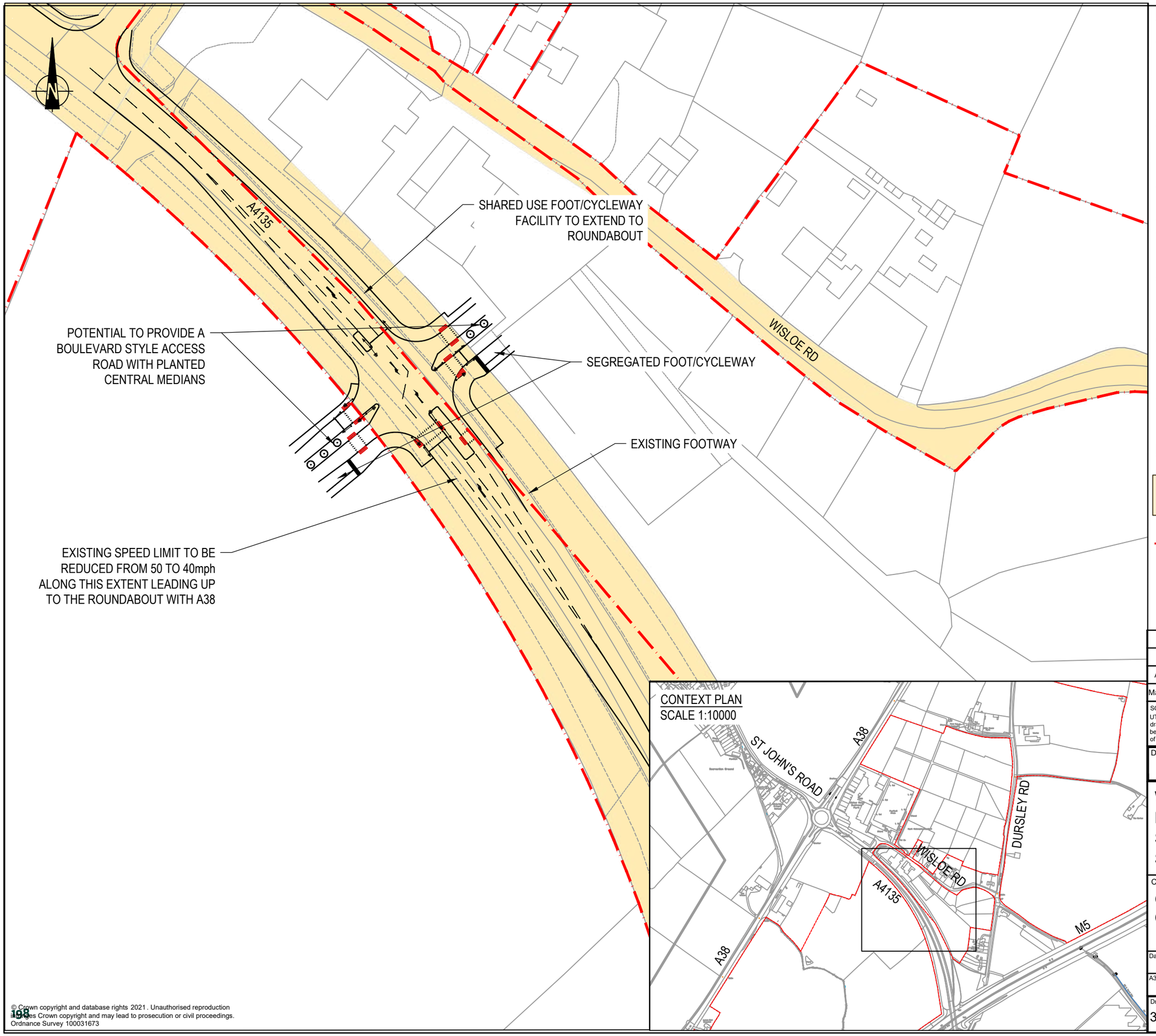

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Drawing Issue Status
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WISLOE NEW SETTLEMENT PROPOSED ACCESS STRATEGY SIGNALISED JUNCTION AT CENTRE OF SITE ON A4135

Client
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Appendix C Non Motorised User M5 Bridge Feasibility Report

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Wisloe New Settlement

Non-Motorised User Route Over M5 - Feasibility Report

On behalf of **Ernest Cook Trust & Gloucestershire County Council**

Project Ref: 332310150 | Rev: P01 | Date: May 2021

Registered Office: Buckingham Court Kingsmead Business Park, London Road, High Wycombe, Buckinghamshire, HP11 1JU
Office Address: Lakeside House, Blackbrook Business Park, Blackbrook Park Avenue, Taunton TA1 2PX
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Document Control Sheet

Project Name: Wisloe New Settlement
Project Ref: 332310150
Report Title: Non-Motorised User Route Over M5 - Feasibility Report
Doc Ref: 332310150-STN-SBR-NMU-RP-CB-0001
Date: May 2021

	Name	Position	Signature	Date
Prepared by:	Gary Philippe	BIM Manager		12.05.2021
Reviewed by:	Stephen Wren	Senior Associate		12.05.2021
Approved by:	Stephen Wren	Senior Associate		12.05.2021
For and on behalf of Stantec UK Limited				

Revision	Date	Description	Prepared	Reviewed	Approved
P01	12 May 2021	First Issue	GCP	SCW	SCW

Contents

Tables

Appendices

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1 Introduction

1.1 Overview

1.1.1 Stantec was instructed by Gloucestershire County Council and the Ernest Cook Trust as the landowners of the site to consider the potential to provide a non-motorised user (NMU) link by way of a bridge between their proposed mixed use residential led scheme known as Wisloe New Settlement and Cam & Dursley Railway Station. To connect the two this link would therefore need to cross the M5 which falls within the control of Highways England.

1.1.2 This report considers two options:

- Option 1 – Foot/cycle bridge fully spanning M5 and Highways England land located either side
- Option 2 – Foot/cycle bridge with minimum span over existing M5 carriageway.

1.1.3 Discounted options and reasons include:

- Underpass – discounted due to topography, NMU experience and disruption to the travelling public on the M5
- 3 span bridge, adding backspans over adjacent land to create a more open structure and reduce the volume of earthworks.

1.1.4 A location plan is included in the option drawings in **Appendix A**.

1.1.5 Headings in this report follow the heading requirements and guidance for a structures option report in line with current Highways England requirements, as laid out in Appendix O of standard CG 300 in the Design Manual for Roads and Bridges (DMRB). Although the current feasibility study does not form a full structures options report, the structure is provided to allow for further development work.

1.2 Consultations and requirements

1.2.1 The main technical requirements are set out in the DMRB published by Highways England. This includes requirements to design to standards published by the British Standards Institution including the Eurocodes.

1.2.2 Stantec's transport planning team consulted both Highways England and Gloucestershire County Council in their role as the strategic highway and local highway authority respectively. This led the former to confirm their in principle support for a foot/cycle bridge with the only proviso being that the structure would need to have a clear span across the motorway. Similarly, the local highway was also supportive particularly given it emerged at the time that they were planning to submit a funding bid for a foot/cycle bridge across the M5 at more or less the same location.

1.2.3 Stantec in their role as the transport planning consultant for the site requested that the bridge have compliance with Local Transport Note (LTN) 1/20 Cycle Infrastructure Design, the key impact of which is requiring a clear width of 5.5m. This is significantly wider than the DMRB minimum requirement in CD 353 for a width of 3.5m and results in the introduction of a site splice joint along the centre of the bridge.

1.3 Geology

1.3.1 British Geological Survey (BGS) Geology of Bridge viewer indicates that the geology consists of Cheltenham Sand and Gravel superficial deposits overlying Blue Lias Formation and Charmouth Mudstone Formation (undifferentiated) – Mudstone.

1.3.2 There are three nearby historical borehole scans available on the BGS website.

1.4 Loading

1.4.1 The feasibility report is based on achieving a standard footbridge headroom of 5.7m over the M5. The Department for Transport (DfT) Heavy and High Routes map does not show the M5 at this location as a high load route.

1.4.2 Foot/cycle bridge structural loading will be in accordance with the Eurocodes and the DMRB.

1.5 Environment

1.5.1 No environmental requirements or constraints are known at this time.

1.6 Land and Property

1.6.1 The land considered either side of the M5 to accommodate a bridge is within the control of the landowners.

2 Bridge Feasibility

2.1 Description of proposed structure options

2.1.1 Proposed options are:

- Option 1 - Single 58m square span over M5 bow arch truss bridge
- Option 2 - Single 42.6m square span over M5 bow warren truss bridge.

2.2 Capital cost and whole life cost

2.2.1 Exclusions:

- Land costs
- Survey costs – topographical and ground investigation
- Legal and professional costs
- Highway Authority adoption costs (commuted sums)
- Contract administration and works examination costs
- Enabling works
- Contractor's preliminaries, overhead and profit
- Traffic Management
- Deep foundation if required
- Earthworks
- Drainage
- Streetlighting
- Hard and soft landscaping
- Parapets and fencing on approach to bridge
- Vehicle Restraint Systems (VRS) on the motorway
- Other aspects of approaches to bridge.

2.2.2 The costing is indicative and has been based on engineering experience of similar highway structures where Stantec have been involved. It should be noted that Stantec are not cost consultants. No bridge scheme is identical to another, bridges are often bespoke to the constraints they address. Constraints discovered during further design stages may have a significant effect on the costs. It should also be noted that steel and other construction material prices are highly volatile.

Option 1 - Single 58m square span over M5 bow arch truss bridge

Element	Quantity	Unit	Rate (£)	Budget Cost (£)
Superstructure Steelwork Deck Plan Area	5.5 x 58 = 319	m^2	3,500	1,116,500
Substructure – Abutment Elevation Area	2 x 190 = 380	m^2	200	76,000
Substructure - Bankseats	2 x 7 x 1 x 1 = 14	m^3	400	5,600
Total				1,198,100 round to: **1,200,000**

Table 2.1 – Option 1 Costs

Option 2 - Single 42.6m square span over M5 bow warren truss bridge.

Element	Quantity	Unit	Rate (£)	Budget Cost (£)
Superstructure Steelwork Deck Plan Area	5.5 x 42.6 = 234	m^2	3,500	819,000
Substructure – Abutment Elevation Area	(52+196x2) + (52+150x2) = 796	m^2	200	159,200
Substructure - Bankseats	2 x 7 x 1 x 1 = 14	m^3	400	5,600
Total				983,800 round to: **1,000,000**

Table 2.2 – Option 2 Costs

2.2.3 Whole life cost to be considered at a future design stage.

2.3 Appearance

2.3.1 The appearance will be considered by the landscape architect, the broader client team and the Local Planning Authority.

2.4 Sustainability and use of natural resources

2.4.1 Most steel is recycled at its end of life and the bridge steelwork will contain the standard proportion of recycled steel in line with the current supply of steel. At the end of its service life the steel will be recycled.

2.4.2 Concrete elements such as the substructure will be able to use cement replacements such as ground granulated blast furnace slag. At the end of its service life the concrete can be crushed and used as an engineered fill.

2.4.3 Where reinforced soil is used, this reduces the use of natural earthworks fill material.

2.5 Durability / design life

2.5.1 The structure with be designed with a 120 year design life.

2.5.2 The structure will be designed to be low maintenance and will consider options of emerging paint coating technology which may be able to increase the interval between repainting.

2.5.3 Water will be managed by collecting the run-off from the bridge into positive drainage system located off the bridge deck.

2.6 Health and safety, and potential risks and constraints to the project

2.6.1 No unusual hazards and risks identified to date.

2.7 Proposed design method

2.7.1 To be confirmed at future stage of design.

2.8 Departures from standards

2.8.1 If piled foundations are required a Departure from Standard is required to use the latest ICE Specification for Piling and Embedded Retaining Walls, as this has been updated for use with Eurocodes whereas the Specification for Highway Works has not yet been updated.

2.8.2 Foot/cycle bridge deck waterproofing is an aspect not covered by standards and would require consideration via the departures from standards system.

2.8.3 Consideration may be given to the use of a more durable paint coating system than the standard systems currently in the Specification for Highway Works.

2.8.4 No other departures are anticipated.

2.9 Construction issues

2.9.1 A full closure of the M5 will be required for installation of the superstructure bridge deck. The standard diversionary route via the A38 will be required between Junctions 13 and 14 of the M5.

2.10 Operation and maintenance

2.10.1 No unusual methods or facilities required for carrying inspections and maintenance.

2.11 Preferred option

2.11.1 To be confirmed in consultation with the client and highway authorities prior to next stage of work.

2.12 Proposed category of check

2.12.1 Check to be undertaken:

- Option 1 – Category 3 due to span
- Option 2 – Category 2

2.13 Role of the works examiner supervising the works

2.13.1 To be confirmed at future stage of design.

2.13.2 The CG 300 template includes text for submission by the designer to Highways England as Technical Approval Authority and agreement by the same. This has been omitted at this stage of the design development.

Appendix A Option Drawings

Non-Motorised User Route Over M5 - Feasibility Report
Wisloe New Settlement

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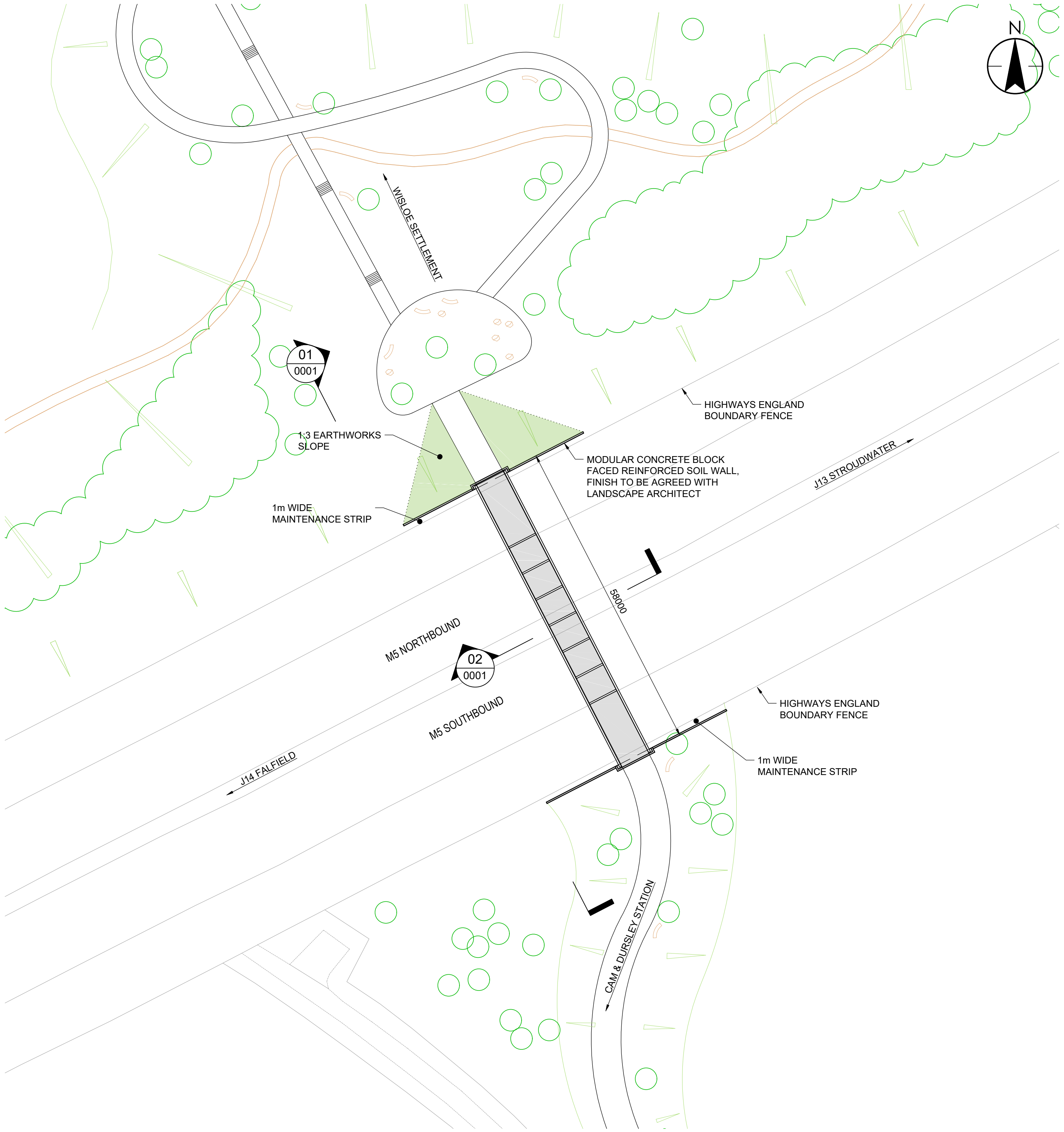

PLAN

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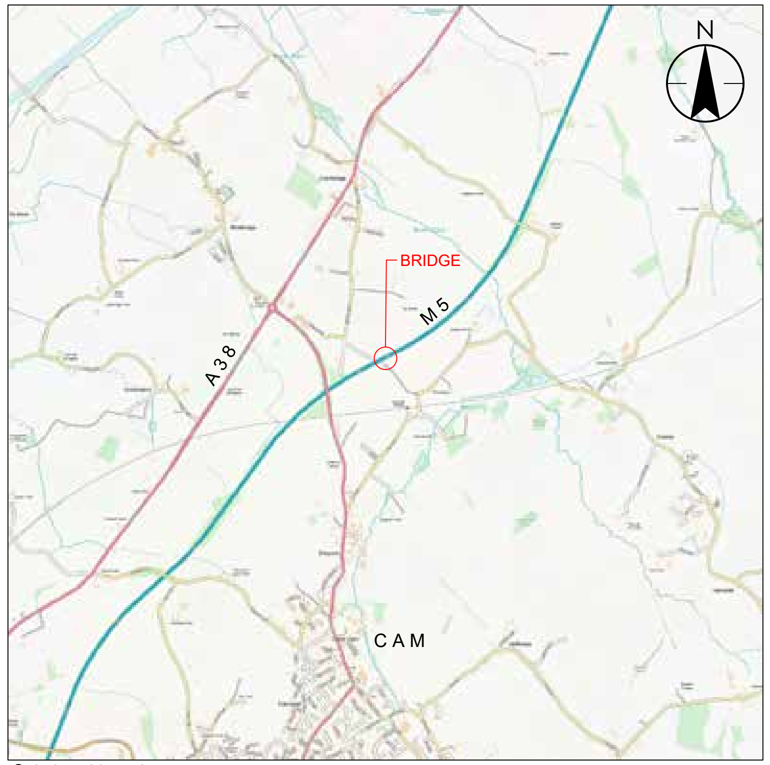

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LOCATION PLAN

BRIDGE CO-ORDINATES
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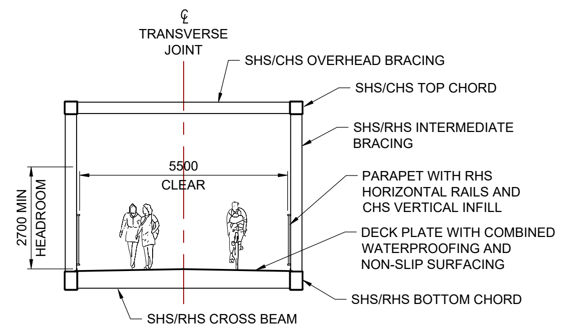
N: 202507.654m



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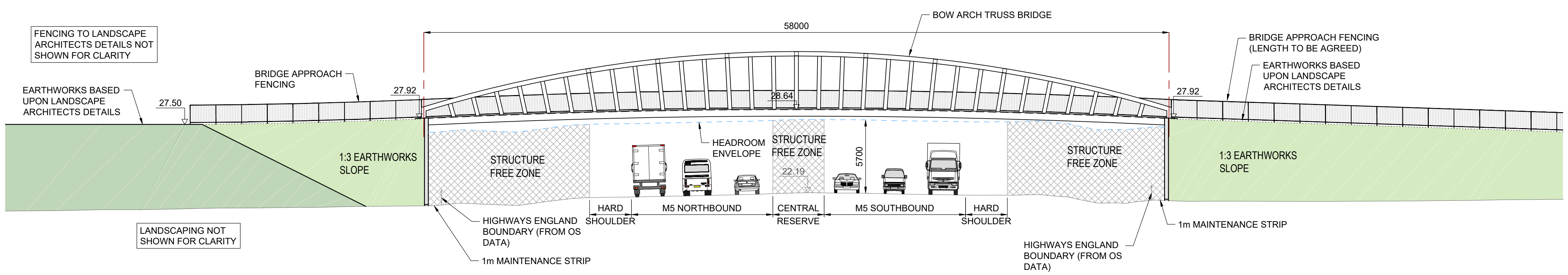

01/0001 SECTION 01

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Notes

UTILITIES NOTE: The position of any existing public or private sewers, utility services, plant or apparatus shown on this drawing is believed to be correct, but no warranty to this is expressed or implied. Other such plant or apparatus may also be present but not shown. The Contractor is therefore advised to undertake their own investigation where the presence of any existing sewers, services, plant or apparatus may affect their operations.

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Issued/Revision	By	Appd	YYYY.MM.DD
P01 FIRST ISSUE	GCP	SCW	2021.05.12

Dwn.	Dsgn.	Chkd.	YYYY.MM.DD
GCP	GCP	SCW	2021.05.12

Issue Status

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WISLOE NEW SETTLEMENT

NMU ROUTE OVER M5

Title

BRIDGE FEASIBILITY OPTION 1

Project No. 332310150 (50753)

Scale As Indicated

Revision P01

Drawing No. 332310150-STN-SBR-NMU-DR-CB-0001

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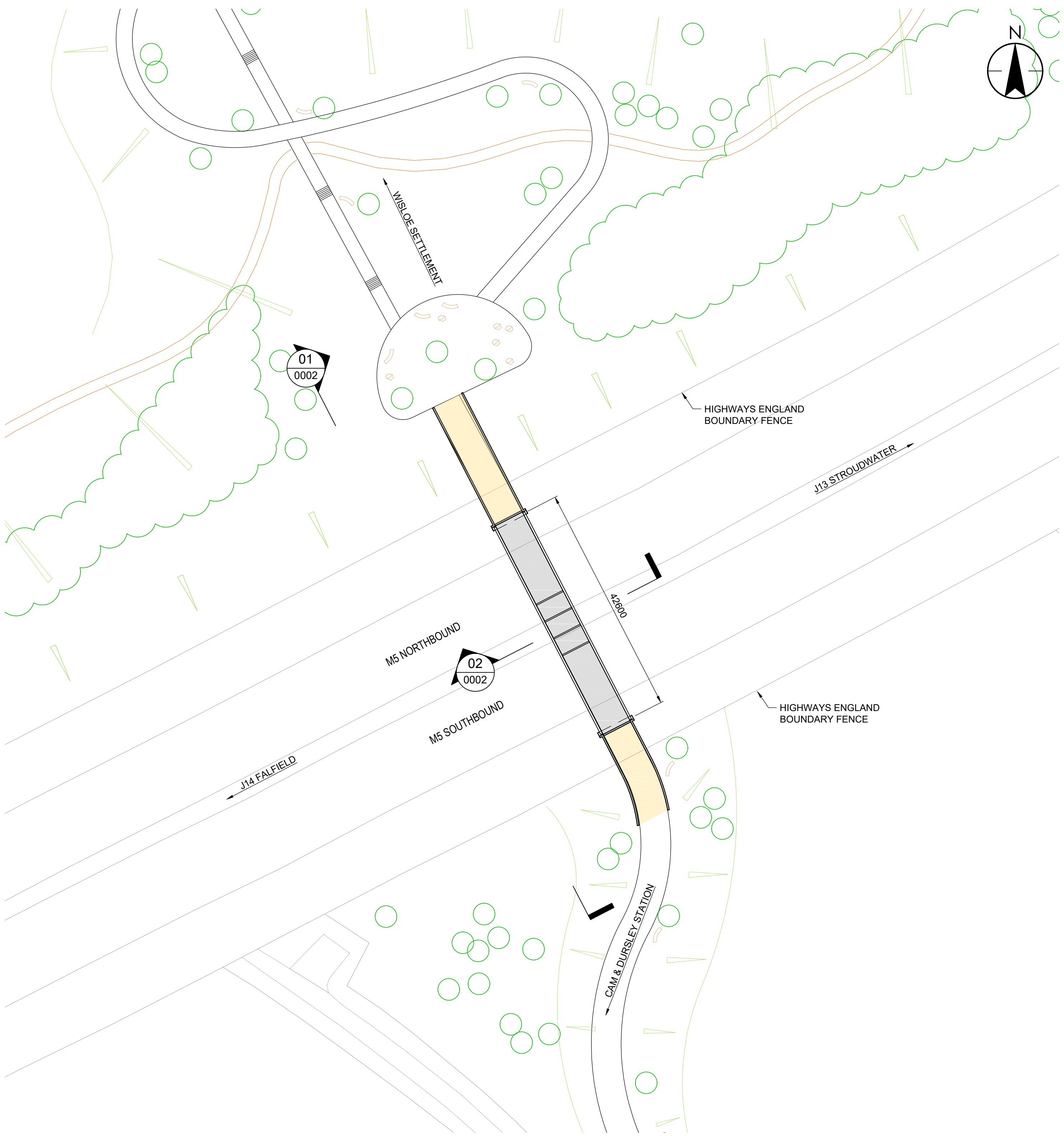

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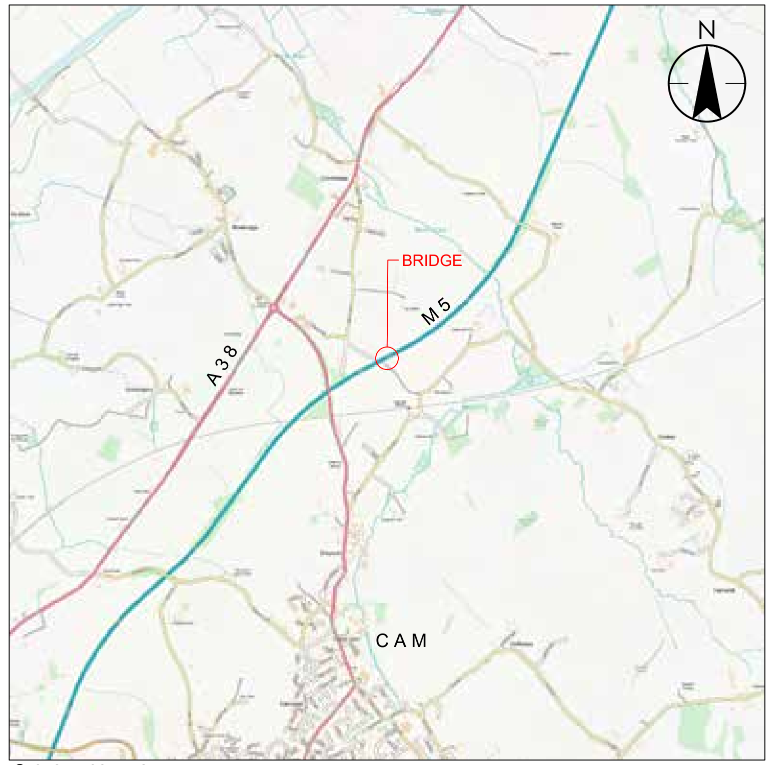

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BRIDGE CO-ORDINATES
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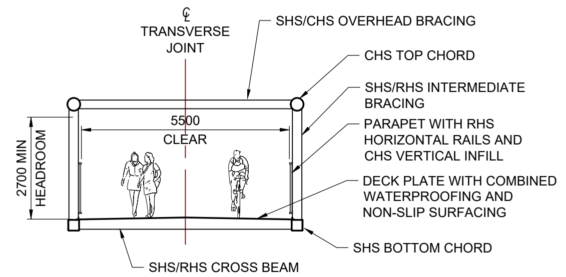

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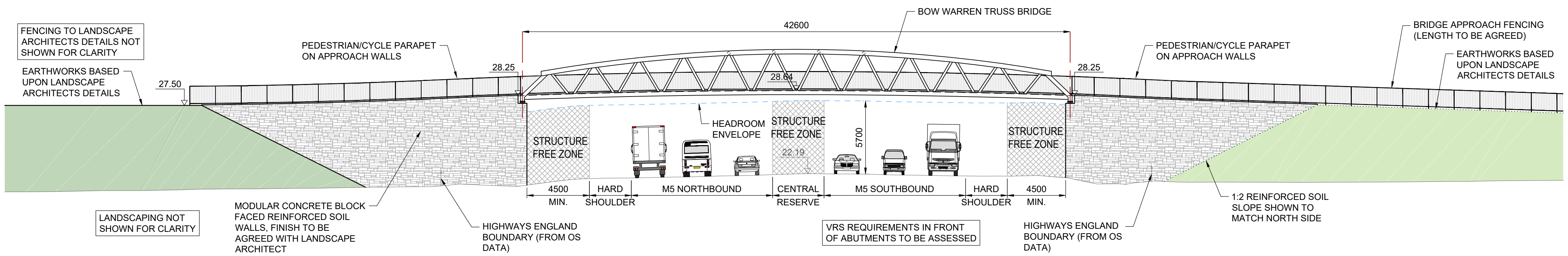

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WISLOE NEW SETTLEMENT

NMU ROUTE OVER M5

Title
BRIDGE FEASIBILITY OPTION 2

Project No. 332310150 (50753)
Scale As Indicated
217

Revision P01
Drawing No. 332310150-STN-SBR-NMU-DR-CB-0002

WISLOE

D4. Air Quality

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TECHNICAL NOTE

Stantec

Job Name: Wisloe New Settlement

Job No: 332310150/3001

Note No: AQ001

Date: July 2021

Prepared By: Daniel Francis

Subject: **Air Quality Constraints Assessment**

1 Introduction

1.1 Proposed Development

1.1.1 The Ernest Cook Trust and Gloucestershire County Council, as landowners, have commissioned Stantec to undertake a preliminary site appraisal to support master planning of Wisloe New Settlement (the 'Site'). The Site is located within the administrative boundary of Stroud District Council (SDC).

1.1.2 The Site was included within the SDC Local Plan Review - Draft Plan for Consultation (SDC, 2019) that was produced in November 2019 with a view to allocating it for a *'new garden community comprising 5 ha employment, approximately 1,500 dwellings, local centre including shops and community uses, primary school(s) and associated community and open space uses and strategic green infrastructure and landscaping'.*

1.2 Scope of Assessment

1.2.1 This report describes existing air quality within the study area and presents contoured isopleth concentration mapping to support the master planning of the Site.

1.2.2 The main air pollutants of concern are NO_2, PM_{10} and $PM_{2.5}$ emissions associated with existing road traffic.

1.2.3 The assessment has been prepared taking into account the requirements of relevant local and national guidance, policy and legislation.

1.3 Consultation

1.3.1 Consultation has been carried out between Stantec and SDC in the form of a telephone conversation and email correspondence with the Environmental Health Department in April 2021, to discuss and agree the scope and methodology of the assessment and obtain the results of the latest air quality monitoring undertaken by the Council.

DOCUMENT ISSUE RECORD

Technical Note No	Rev	Date	Prepared	Checked	Reviewed (Discipline Lead)	Approved (Project Director)
332310150/3001/AQ 001	-	July 2021	DF	KH	KH	AS

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2 Legislation, Policy and Guidance

2.1 Air Quality Regulations

2.1.1 The Air Quality (England) Regulations 2000 (AQR) defined National Air Quality Objectives (NAQOs, a combination of concentration-based thresholds, averaging periods and compliance dates) for a limited range of pollutants. Subsequent amendments were made to the AQR in 2001 and 2002 to incorporate 'limit values' and 'target values' for a wider range of pollutants as defined in European Union (EU) Directives.

2.1.2 These amendments were consolidated by the Air Quality Standards Regulations 2010 (AQSR) (with subsequent amendments most notably in 2016 and for the devolved administrations), which transposed the EU's Directive on ambient air quality and cleaner air for Europe (2008/50/EC).

2.1.3 Following the Transition Period after the UK's departure from the EU in January 2020, the Air Quality (Amendment of Domestic Regulations) (EU Exit) Regulations 2019 (and subsequent amendments for the devolved administrations) have amended the AQ Standards Regulations 2010 to reflect the fact that the UK has left the EU, but do not change the pollutants assessed or the numerical thresholds.

2.1.4 The relevant AQOs for this assessment are shown in **Table 2-1**.

Table 2-1 Relevant Air Quality Objectives / Limit Values

Pollutant	Time Period	Objectives	Source
NO_2	1-hour mean	200 µg/m^3 not to be exceeded more than 18 times a year	NAQO and EU limit value
	Annual mean	40 µg/m^3	NAQO and EU limit value
PM_{10}	24-hour mean	50 µg/m^3 not to be exceeded more than 35 times a year	NAQO and EU limit value
	Annual mean	40 µg/m^3	NAQO and EU limit value
$PM_{2.5}$	Annual mean	25	Stage 1 limit value by 2015 - NAQO and EU limit value
	Annual mean	20	Stage 2 limit value by 2020 - EU Directive

2.1.5 The NAQO's for NO_2 and PM_{10} were to have been achieved by 2005 and 2004 respectively, but also continue to apply in all future years thereafter.

2.1.6 The 2019 Clean Air Strategy includes a commitment to set a "*new, ambitious, long-term target to reduce people's exposure to $PM_{2.5}$*" which the proposed Environment Bill 2019-2021[1] commits the Secretary of State to setting.

2.1.7 For the purposes of this assessment the EU Directive Stage 2 limit value for $PM_{2.5}$ is considered to be appropriate to apply and consideration given to future potential changes.

[1] Yet to be enacted

National Air Pollution Plan for NO_2 in the UK

2.1.8 The national Air Quality Plan for NO_2 (DEFRA, 2018) sets out how the Government plans to deliver reductions in NO_2 throughout the UK, with a focus on reducing concentrations to below the EU Limit Values throughout the UK within the 'shortest possible time'.

2.1.9 The plan requires all Local Authorities (LAs) in England which DEFRA identified as having exceedances of the Limit Values in their areas past 2020 to develop local plans to improve air quality and identify measures to deliver reduced emissions, with the aim of meeting the Limit Values within their area within "*the shortest time possible*". Potential measures include changing road layouts, encouraging public and private ultra-low emission vehicle (ULEV) uptake, the use of retrofitting technologies and new fuels and encouraging public transport. In cases where these measures are not sufficient to bring about the required change within 'the shortest time possible' then LAs may consider implementing access restrictions on more polluting vehicles (e.g. Clean Air Zones (CAZs)). A CAZ is defined within the plan as being "*an area where targeted action is taken to improve air quality and resources are prioritised and coordinated in a way that delivers improved health benefits and supports economic growth*" and may be charging or non-charging.

2.2 Air Quality Management

The Air Quality Strategy

2.2.1 Part IV of the Environment Act 1995 (Environment Act, 1995) required the Secretary of State to prepare and publish and 'strategy' regarding air quality.

2.2.2 The Air Quality Strategy (2007) establishes the policy framework for ambient air quality management and assessment in the UK (DEFRA, 2007). The primary objective of the Air Quality Strategy is to ensure that everyone can enjoy a level of ambient air quality which poses no significant risk to health or quality of life. The Air Quality Strategy sets out the NAQOs and Government policy on achieving these.

2.2.3 The Clean Air Strategy (2019) aims to lower national emissions of pollutants, thereby reducing background pollution and minimising human exposure to harmful concentrations of pollution. The Strategy aims to create a stronger and more coherent framework for action to tackle air pollution (DEFRA, 2019).

Local Air Quality Management

2.2.4 Part IV of the Environment Act 1995 (Environment Act, 1995) introduced a system of Local Air Quality Management (LAQM) which requires local authorities to regularly and systematically review and assess air quality within their boundary and appraise development and transport plans against these assessments.

2.2.5 Where a NAQO is unlikely to be met, the local authority must designate an Air Quality Management Area (AQMA) and draw up an Air Quality Action Plan (AQAP) setting out the measures it intends to introduce in pursuit of the NAQO's within its AQMA.

2.2.6 The Local Air Quality Management Technical Guidance 2016 (LAQM.TG(16); DEFRA, 2021), issued by the Department for Environment, Food and Rural Affairs (DEFRA) for Local Authorities (LAs) provides advice on where the NAQOs apply. These include outdoor locations where members of the public are likely to be regularly present for the averaging period of the objective (which vary from 15 minutes to a year) as summarised in **Table 2-2**.

Table 2-2 Relevant Public Exposure

Averaging Period	NAQOs should apply at:	NAQOs don't apply at:

Annual mean	All locations where members of the public might be regularly exposed For example: Building façades of residential properties, schools, hospitals, care homes etc	Façades of offices or other places of work where members of the public do not have regular access Hotels, unless people live there as their permanent residence Gardens of residences Kerbside sites Any other location where public exposure is expected to be short term
24-hour mean and 8-hour mean	All locations where the annual mean NAQO would apply, together with hotels and gardens of residences	Kerbside sites Any other location where public exposure is expected to be short term
1-hour mean	All locations where the annual mean and 24 and 8-hour mean NAQOs apply as well as: Kerbside sites Those parts of car parks, bus stations and railway stations etc. which are not fully enclosed, where members of the public might reasonably be expected to spend one hour or more. Any outdoor locations where members of the public might reasonably be expected to spend one hour or longer.	Kerbside locations where the public would not be expected to have regular access
15-minute mean	All locations where members of the public might reasonably be regularly exposed for a period of 15 minutes or longer.	

2.3 Planning Policy

National Planning Policy

2.3.1 The National Planning Policy Framework (NPPF) sets out the Government's planning policies for England and how they are expected to be applied (Ministry of Housing, Communities & Local Government, 2019). The following paragraphs are considered relevant from an air quality perspective.

2.3.2 Paragraph 102 on promoting sustainable transport states:

"Transport issues should be considered from the earliest stages of plan-making and development proposals, so that: …

d) the environmental impacts of traffic and transport infrastructure can be identified, assessed and taken into account – including appropriate opportunities for avoiding and mitigating any adverse effects, and for net environmental gains; …"

2.3.3 Paragraph 103 goes on to state:

"Significant development should be focused on locations which are or can be made sustainable, through limiting the need to travel and offering a genuine choice of transport modes. This can help to reduce congestion and emissions, and improve air quality and public health."

2.3.4 Paragraph 170 on conserving and enhancing the natural environment states:

"Planning policies and decisions should contribute to and enhance the natural and local environment by: …

e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land stability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans, and…"

2.3.5 Paragraph 180 within ground conditions and pollution states:

"Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development."

2.3.6 Paragraph 181 states that:

"Planning policies and decisions should sustain and contribute towards compliance with relevant limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas and Clean Air Zones, and the cumulative impacts from individual sites in local areas. Opportunities to improve air quality or mitigate impacts should be identified, such as through traffic and travel management, and green infrastructure provision and enhancement. So far as possible these opportunities should be considered at the plan-making stage, to ensure a strategic approach and limit the need for issues to be reconsidered when determining individual applications. Planning decisions should ensure that any new development in Air Quality Management Areas and Clean Air Zones is consistent with the local air quality action plan."

2.3.7 Paragraph 182 states that:

"Planning policies and decisions should ensure that new development can be integrated effectively with existing businesses and community facilities (such as places of worship, pubs, music venues and sports clubs). Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established. Where the operation of an existing business or community facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or 'agent of change') should be required to provide suitable mitigation before the development has been completed".

National Planning Practice Guidance

2.3.8 Paragraph 005, Reference 32-005-20191101 (revision date 01.11.2019), of the PPG provides guidance on how considerations regarding air quality can be relevant to the development management process as follows:

"Whether air quality is relevant to a planning decision will depend on the proposed development and its location. Concerns could arise if the development is likely to have an adverse effect on air quality in areas where it is already known to be poor, particularly if it could affect the implementation of air quality strategies and action plans and/or breach legal obligations (including those relating to the conservation of habitats and species). Air quality may also be a material consideration if the proposed development would be particularly sensitive to poor air quality in its vicinity.

- *Where air quality is a relevant consideration the local planning authority may need to establish:*
- *The 'baseline' local air quality, including what would happen to air quality in the absence of the development;*

- *Whether the proposed development could significantly change air quality during the construction and operational phases (and the consequences of this for public health and biodiversity); and*

- *Whether occupiers or users of the development could experience poor living conditions or health due to poor air quality."*

2.3.9 Paragraph 006, Reference 32-006-20191101 (revision date 01.11.2019), of the PPG identifies what specific air quality issues need to be considered in determining a planning application:

"Considerations that may be relevant to determining a planning application include whether the development would:

- *Lead to changes (including any potential reductions) in vehicle-related emissions in the immediate vicinity of the proposed development or further afield. This could be through the provision of electric vehicle charging infrastructure; altering the level of traffic congestion; significantly changing traffic volumes, vehicle speeds or both; and significantly altering the traffic composition on local roads. Other matters to consider include whether the proposal involves the development of a bus station, coach or lorry park; could add to turnover in a large car park; or involve construction sites that would generate large Heavy Goods Vehicle flows over a period of a year or more;*

- *Introduce new point sources of air pollution. This could include furnaces which require prior notification to local authorities; biomass boilers or biomass-fuelled Combined Heat and Power plant; centralised boilers or plant burning other fuels within or close to an air quality management area or introduce relevant combustion within a Smoke Control Area; or extraction systems (including chimneys) which require approval or permits under pollution control legislation;*

- *Expose people to harmful concentrations of air pollutants, including dust. This could be by building new homes, schools, workplaces or other development in places with poor air quality;*

- *Give rise to potentially unacceptable impacts (such as dust) during construction for nearby sensitive locations; and*

- *Have a potential adverse effect on biodiversity, especially where it would affect sites designated for their biodiversity value."*

2.3.10 Paragraph 007, Reference 32-007-20191101 (revision date 01.11.2019), of the PPG provides guidance on how detailed an assessment needs to be:

"Assessments need to be proportionate to the nature and scale of development proposed and the potential impacts (taking into account existing air quality conditions), and because of this are likely to be locationally specific".

and

"The following could form part of assessments:

A description of baseline conditions and any air quality concerns affecting the area, and how these could change both with and without the proposed development;

- *Sensitive habitats (including designated sites of importance for biodiversity);*

- *The assessment methods to be adopted and any requirements for the verification of modelling air quality;*

- *The basis for assessing impacts and determining the significance of an impact;*

- *Where relevant, the cumulative or in-combination effects arising from several developments;*

- *Construction phase impacts;*

- *Acceptable mitigation measures to reduce or remove adverse effects; and*

- *Measures that could deliver improved air quality even when legally binding limits for concentrations of major air pollutants are not being breached."*

2.3.11 Paragraph 008, Reference 32-008-20140306 (revision date 01.11.2019), of the PPG provides guidance on how an impact on air quality can be mitigated:

"Mitigation options will need to be locationally specific, will depend on the proposed development and need to be proportionate to the likely impact. It is important that local planning authorities work with applicants to consider appropriate mitigation so as to ensure new development is appropriate for its location and unacceptable risks are prevented. Planning conditions and obligations can be used to secure mitigation where the relevant tests are met.

Examples of mitigation include:

- *Maintaining adequate separation distances between sources of air pollution and receptors;*

- *Using green infrastructure, trees, where this can create a barrier or maintain separation between sources of pollution and receptors;*

- *Appropriate means of filtration and ventilation;*

- *Including infrastructure to promote modes of transport with a low impact on air quality (such as electric vehicle charging points);*

- *Controlling dust and emissions from construction, operation and demolition; and*

- *Contributing funding to measures, including those identified in air quality action plans and low emission strategies, designed to offset the impact on air quality arising from new development."*

Local Planning Policy

Stroud District Local Plan 2015

2.3.12 SDC adopted a new local plan in November 2015 (SDC, 2015). This helps to guide development within the district. One pertinent policy in the plan is Core Policy CP14 – High Quality Sustainable Development which states:

“High quality development, which protects, conserves and enhances the built and natural environment, will be supported. Development will be supported where it achieves the following:

…

No unacceptable levels of air, noise, water, light or soil pollution or exposure to unacceptable risk from existing or potential sources of pollution.”

2.3.13 Policy ES5 - Air Quality States:

“Development proposals which by virtue of their scale, nature or location are likely to exacerbate existing areas of poor air quality, will need to demonstrate that measures can be taken to effectively mitigate emission levels in order to protect public health and well being, environmental quality and amenity. Mitigation measures should demonstrate how they will make a positive contribution to the aims of any Air Quality Strategy for Stroud District and may include:

1. *landscaping, bunding or separation to increase distance from highways and junctions*

2. *possible traffic management or highway improvements to be agreed with the local authority*

3. *abatement technology and incorporating site layout / separation and other conditions in site planning*

4. *traffic routing, site management, site layout and phasing*

5. *managing and expanding capacity in the natural environment to mitigate poor air quality"*

Stroud District Local Plan Review - Draft Plan for Consultation (SDC, 2019)

2.3.14 SDC is in the process of reviewing the current Stroud District Local Plan. There has been no significant change to Core Policy CP14 or Policy ES5 as in **section 2.3.12**.

2.4 Assessment Guidance

2.4.1 The primary guidance documents used in undertaking this assessment are detailed in the section below.

DEFRA 'Local Air Quality Management Technical Guidance (LAQM.TG(16))'

2.4.2 DEFRA LAQM.TG(16) was published for use by local authorities in their LAQM review and assessment work (DEFRA, 2021). The document provides key guidance on aspects of air quality assessment, including screening, use of monitoring data, and use of background data that are applicable to all air quality assessments.

EPUK / IAQM 'Land-Use Planning & Development Control: Planning for Air Quality'

2.4.3 Environmental Protection UK (EPUK) and the Institute of Air Quality Management (IAQM) have together published guidance to help ensure that air quality is properly accounted for in the development control process (EPUK / IAQM 2017). It clarifies when an air quality assessment should be undertaken, what it should contain, and how impacts should be described and assessed including guidelines for assessing the significance of impacts.

3 Methodology

3.1.1 The assessment methodology detailed in the following sections has been applied to ascertain the suitability of the Site for the proposed end- and compliance with policy and regulatory requirements (outlined in **Section 2** of this report), and whether or not additional mitigation is required.

3.1.2 This assessment first defines the 'study area' and outlines the baseline air quality within this study area. The suitability of the site for the proposed end use is then assessed.

3.2 Baseline Air Quality

3.2.1 Any exceedances of the EU Limit Values along roads within the study area have been identified using the 2021 NO_2 and PM Projections Data published by DEFRA (DEFRA, 2020a). Information on baseline air quality in the study area has been obtained by collating the results of monitoring carried out by SDC and their LAQM reports to identify potential AQMAs. Background concentrations for the study area have been defined using the national pollution maps published by DEFRA which cover the whole country on a 1x1 km grid (DEFRA, 2020b).

3.3 Operational Road Traffic Emission Impacts

Human Receptors

3.3.1 Concentrations of pollutants (NO_2, PM_{10} and $PM_{2.5}$) have been predicted for a range of worst-case locations of relevant human receptor exposure both at sensitive existing properties and within the Proposed Development itself to allow comparison with the NAQOs and (for existing receptors only) determination of the significance of impacts at each receptor.

3.3.2 Emissions from road vehicles and their resultant impact at receptor locations have been predicted using the ADMS-Roads dispersion model (v5.0.0.1). The model requires the user to provide various input data, including traffic flows (in AADT format), vehicle composition (i.e. the proportion of Heavy Duty Vehicles (HDVs)), road characteristics (including road width, gradient and street canyon dimensions, where applicable), and average vehicle speed. AADT flows and the proportions of HDVs, for roads within the study area have been taken from WebTRIS (Highways England, 2021) and Department for Transport (DfT) count site data (DfT, 2021). Traffic data used in this assessment are summarised in **Appendix B,** and shown in **Figures 1.1 to 1.2, Appendix D.**

3.3.3 The model also requires meteorological data and has been run using 2019 meteorological data from the Avonmouth meteorological station, which are considered suitable for this area. **Appendix B** provides further details on the model inputs.

3.3.4 Traffic emissions have been calculated using the Emission Factor Toolkit (EFT) v10.1 (DEFRA, 2020c), which utilises NOx emission factors taken from the European Environment Agency (EEA) COPERT 5.3 emission tool. The traffic data were entered into the EFT to provide emission rates for each of the road links entered into the model. Road vehicular emissions are primarily associated with the exhaust emissions but also include particles generated from abrasion (of tyres, brakes and road). The EFT allows users to calculate road vehicle pollutant emission rates for NOx, PM_{10} and $PM_{2.5}$ (exhaust and brake, tyre and road wear) for a specified year, road type, vehicle speed and vehicle fleet composition.

3.3.5 The EFT provides pollutant emission rates for 2018 through to 2030 and takes into consideration bespoke vehicle fleet information as well as the following information available from the National Atmospheric Emissions Inventory (NAEI):

- fleet composition data for motorways, urban and rural roads in the UK (excluding London);
- fleet composition based on European emission standards from pre-Euro I to Euro6/VI (including Euro 6 subcategories);
- scaling factors reflecting improvements in the quality of fuel and some degree of retrofitting; and
- technology conversions in the national fleet.

3.3.6 As a result of this the road vehicle exhaust emissions are projected to decrease year-on-year due to technological advances and improvements to the fleet mix i.e. penetration of Euro VI HDVs, which recent research suggests are performing well. Whilst there has been uncertainty over NOx emissions from vehicle exhausts (particularly from Euro 5 and 6 LDVs it is important to note the EFT is not based on the Euro emission standards. Specifically, the latest version of the EFT (v10.1) includes updated NOx and PM speed emission coefficient equations for Euro 5 and 6 vehicles taken from the EEA COPERT 5.3 emission calculation tool, reflecting emerging evidence on the real-world emission performance of these vehicles.

3.4 Assumptions and Limitations

3.4.1 There are many components that contribute to the uncertainty in predicted concentrations. The model used in this assessment is/are dependent upon the traffic that have been input which will

have inherent uncertainties associated with them. There is then additional uncertainty as the model is required to simplify real-world conditions into a series of algorithms.

3.4.2 There has been an acknowledged disparity between national road transport emissions projections and measured annual mean concentrations of nitrogen oxides (NOx) and NO_2 for many years. Recent monitoring has shown that reductions in concentrations are now being measured in many parts of the country (Air Quality Consultants Ltd., 2020), however, there is still some uncertainty regarding the rate at which emissions will reduce in the future and therefore some consideration must be given to the accuracy of any projection and to appropriately respond to this.

3.4.3 It is not yet known when development might go ahead and therefore 2022 has been used to represent the earliest year of occupation.

3.4.4 The complete Site modelling has been based on 2022 traffic, emission factors and background concentrations. The model has been verified against 2019 monitoring data.

3.4.5 The relevant objectives for human health are set out in **Table 2-1** and **Table 2-2**. There is no official guidance in the UK on how to assess the significance of air quality impacts of existing sources on a new development. The assessment has therefore been limited to predicting air quality at the Site and identifying areas where this is acceptable. In order to take into account the uncertainty associated with any predictions an additional indicator shows areas where concentrations are within 10% of the objective.

4 Baseline Environment

4.1 Site Context

4.1.1 The Site is bound to the west by residential development in Slimbridge; to the south by agricultural use, to the north by Cambridge; and to the east by the M5.

4.2 Study Area

4.2.1 The study area adopted for this assessment is as follows:

- for the road traffic emissions assessment, the study area (based on EPUK / IAQM, 2017 guidance) includes the Site and all roads (and adjacent properties) within 250 m of the Site boundary. The gridded area includes more than 36,000 receptor points focusing primarily upon on the Site and the M5, where the greatest exposure was expected. All major roads within 250m of modelled verification diffusion tubes are also included, where traffic data was available.

4.3 Receptor Locations

4.3.1 Concentrations have also been predicted at two diffusion tube monitoring sites located on Westward Road, Stroud in order to verify the modelled results. **Appendix C** provides further details on the verification method.

4.3.2 In addition, concentrations have been predicted for a 10 m^2 grid of receptors across the Site in order to assess the suitability of the Site for the proposed end-use (shown in **Figure 2 to 4, Appendix D**). Receptor points within the grid have been modelled at a height of 1.5 m representing exposure at ground floor level and a kriging interpolation has been applied to present the isopleth mapping.

4.4 Ambient Air Quality

EU Limit Values

4.4.1 The study area does not contain any predicted or measured exceedances of an EU Limit Values either in the modelled year (2019) or future years. The study area is not within a zone where DEFRA have reported an exceedance of an EU Limit Values either in the 'existing' baseline year (2019) or in future years.

LAQM

4.4.2 SDC has investigated air quality within its area as part of its responsibilities under the LAQM regime. To date, one AQMA has been declared as a result of exceedances of the annual NO_2 NAQOs in 2001 however this was revoked in 2004. The closest AQMA to the Site is Lydney AQMA (Forest of Dean District Council), located approximately 10 km west of the Site.

Local Monitoring Data

NO_2

4.4.3 SDC carries out monitoring at two automatic monitoring stations, the nearest of which, Haresfield, is located 10 km north-east from the Proposed Development. The Council also deploys NO_2 diffusion tubes at 27 locations, none are located within the study area. Site 40 was sited at Slimbridge Primary School near to the site (circa 180 m), however only for 12 months in 2019. 2015-2019 monitoring results for the most representative monitoring location to the Site and those used to verify the model are shown in **Table 4-1** and **Table 4-2**.

Table 4-1 Measured Annual Mean NO_2 Concentrations 2015– 2019

Site ID	Site Type	Height (m)	Annual Mean (µg/m³)				
			2015	2016	2017	2018	2019
Diffusion Tubes							
39[a]	Roadside	2.4	-	-	36.3	39.7	21.7
40 – Slimbridge Primary School	Roadside	2.4	-	-	-	-[b]	10.8
41[a]	Kerbside	2.4	-	-	-	27.1	23.3
NAQO		**40**					

2015 – 2019 data taken from the SDC Air Quality Annual Status Report for 2019 (SDC,2020)
[a] Used for model verification
[b] There is a confirmed mistake in the ASR wherein site 40 has a concentration for 2018, where in fact there was no monitoring for this year at Slimbridge Primary School.

4.4.4 Measured concentrations at the closest monitoring location to the Site, Slimbridge Primary School, were well below the annual mean objective in 2019. Measured concentrations at all monitoring sites within the District have been below the annual mean objective in 2019. Furthermore, measured concentrations at all diffusion tube monitoring sites are below 60 µg/m³, indicating that it is unlikely that any exceedances of the 1-hour mean objective have occurred. The concentrations have generally been decreasing which reflects the national trend (AQC, 2020).

PM_{10}

4.4.5 The results of the PM_{10} and $PM_{2.5}$ monitoring at monitoring location Haresfield and Hardwicke are shown in **Table 4-2** and **Table 4-3**.

Table 4-2 Measured PM_{10} Concentrations 2015 – 2019.

Site ID	Annual Mean PM_{10} (µg/m³)				
	2015	2016	2017	2018	2019
Hardwicke	-	-	-	9.8	10.1
Haresfield	-	-	-	9.9	8.6
NAQO	**40**				

Site ID	Annual Mean PM_{10} (µg/m³)				
	2015	2016	2017	2018	2019
	Number of Days >50µg/m³				
Hardwicke	-	-	-	0	0
Haresfield	-	-	-	0	0
NAQO	**35 (days >50 µg/m³)**				

2015 – 2019 data taken from the SDC Air Quality Annual Status Report for 2019 (SDC, 2020).

4.4.6 Measured PM_{10} concentrations have been below the relevant NAQOs and Limit Values for the duration of the monitoring period presented.

$PM_{2.5}$

Table 4-3 Measured $PM_{2.5}$ Concentrations 2015 - 2019

Site ID	Annual Mean $PM_{2.5}$ (µg/m³)				
	2015	2016	2017	2018	2019
Hardwicke	-	-	-	7.1	6.4
Haresfield	-	-	-		5.8
Limit Value	**20**				

2015 – 2019 data taken from the SDC Air Quality Annual Status Report for 2019 (SDC, 2020).

4.4.7 Measured $PM_{2.5}$ concentrations have been below the relevant Limit Value for the duration of the monitoring period presented.

4.5 Predicted Background Concentrations

4.5.1 Estimated background concentrations for the Site have been obtained from the latest 2018-based national maps provided by DEFRA (DEFRA, 2020b). The DEFRA background concentrations for the study area/identified receptors area are provided in **Table 4-4**.

4.5.2 The background concentrations are all well below the relevant NAQOs both in the 'existing' and future years.

Table 4-4 Estimated Annual Mean Background Concentrations

Year	Location	Annual Mean (µg/m³)		
		NO_2	PM_{10}	$PM_{2.5}$
2019	374_202 [a]	11.9	15.3	9.2
	375_202 [a]	12.8	15.0	9.3
	374_203 [a]	8.3	12.7	8.2
	375_203 [a]	10.2	14.1	8.7
	382_204 [b]	8.9	13.0	8.6
	383_204 [b]	10.1	13.0	8.7
2022	374_202 [a]	10.2	14.8	8.8
	375_202 [a]	10.9	14.5	8.8
	374_203 [a]	7.3	12.2	7.8
	375_203 [a]	8.7	13.6	8.3
	382_204 [b]	7.8	12.4	8.2
	383_204 [b]	9.0	12.4	8.3
NAQOs		**40**	**40**	**20**

[a] Development Site.

[b] Location of monitoring site used for verification.
Note: Projections in the 2018 reference year background maps and associated tools are based on assumptions which were current before the Covid-19 outbreak in the UK. In consequence these tools do not reflect short- or longer-term impacts on emissions in 2020 and beyond resulting from behavioural change during the national or local lockdowns.

5 Predicted Baseline Concentrations

5.1 Site Suitability

Contours

5.1.1 The suitability of the Site for intended use and the need for mitigation has been assessed against the annual mean NO_2 NAQO of 40 µg/m³ as this is the objective most likely to be breached. **Figure 2, Appendix D** shows the annual mean 2022 NO_2 contours for >40, ≤40 and ≤36 µg/m³ for the Site. The >40 µg/m³ objective contour is exceeded up to 10 m into the Site from the M5 (identified in red). Due to model uncertainty, areas with concentrations within 10% of the objective (≤40 µg/m³ contour, identified in yellow) are not considered suitable for residential development at this time however may well become so as emissions are expected to decrease in the future. This 36-40 µg/m³ contour is exceeded 12 m in the Site from the M5. All areas from ≤36 µg/m³ are considered an acceptable level for residential development (identified in green). Therefore, the Site is compliant with the annual mean NO_2 NAQO except for a small strip adjacent to the M5.

5.1.2 PM_{10} annual mean concentrations contours for 2022 are shown in **Figure 3, Appendix D .** PM_{10} within the modelled area have a maximum concentration of 29.45 µg/m³. This shows that the Site is compliant with the PM_{10} NAQO of 40 µg/m³.

5.1.3 $PM_{2.5}$ annual mean concentrations contours for 2022 are shown in **Figure 4, Appendix D**. $PM_{2.5}$ within the modelled area have a maximum concentration of 17.42 µg/m³. This shows that the Site is compliant with the PM10 NAQO of 25 µg/m³.

5.1.4 The Site is suitable for residential development without the need for mitigation across all the site except from a small strip of land adjacent to the M5.

6 Recommendations

6.1 Site Suitability

6.1.1 A site-specific modelling study should be undertaken for any planning application for development within the Site. The site-specific modelling study should be based on development specific traffic data which should reduce some of the uncertainties in the predicted concentrations as well as future emission reduction and may allow development in the areas currently predicted to have annual mean NO_2 concentrations above 36 µg/m³.

6.1.2 Alternatively, mitigation such as mechanical ventilation can be employed to reduce concentrations to an acceptable level.

7 Summary and Conclusions

7.1.1 The air quality constraints associated with a development site of Wisloe New Settlement, located within the boundary of the Stroud District Council have been assessed in order to identify which areas of the Site are likely to be suitable for future residential development.

7.1.2 SDC have no AQMAs within the district. Concentrations at monitoring sites across the District were all below the objectives in 2019 and concentrations at the monitoring site closest to the site were well below the objective in 2019.

7.1.3 Concentrations of NO_2, PM_{10} and $PM_{2.5}$ have been predicted for a grid of 10 m^2 receptors surrounding the Site and presented in contoured isopleth mapping. This assessment has identified that the majority of the Site can be considered to be acceptable for residential development. It has also identified areas where concentrations exceed or are close to the relevant objective and are therefore unsuitable for residential development without mitigation such as mechanical ventilation. There are no exceedances of the PM_{10} or $PM_{2.5}$ objective within the Site Boundary.

7.1.4 Air Quality is considered to be acceptable across the entire Site except from a small strip adjacent to the M5. However, this should be subject to more detailed modelling which should accompany any planning application for development.

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Appendix A Glossary

Abbreviations	Meaning
AADT	Annual Average Daily Traffic
AQAP	Air Quality Action Plan
AQMA	Air Quality Management Area
AURN	Automatic Urban and Rural Network
Defra	Department for Environment, Food and Rural Affairs
DfT	Department for Transport
Diffusion Tube	A passive sampler used for collecting NO_2 in the air
EA	Environment Agency
EFT	Emission Factor Toolkit
EPUK	Environmental Protection UK
HDV	Heavy Duty Vehicle; a vehicle with a gross vehicle weight greater than 3.5 tonnes. Includes Heavy Goods Vehicles and buses
HE	Highways England
IAQM	Institute of Air Quality Management
LA	Local Authority
LAQM	Local Air Quality Management
NAEI	National Atmospheric Emission Inventory
NAQO	National Air Quality Objective as set out in the Air Quality Strategy and the Air Quality Regulations
NO_2	Nitrogen Dioxide
NOx	Oxides of nitrogen generally considered to be nitric oxide and NO_2. Its main source is from combustion of fossil fuels, including petrol and diesel used in road vehicles
NPPF	National Planning Policy Framework
$PM_{10}/PM_{2.5}$	Small airborne particles less than 10/2.5 µm in diameter
PPG	Planning Practice Guidance
Receptor	A location where the effects of pollution may occur
SDC	Stroud District Council
SPG	Supplementary Planning Guidance

Appendix B Model Inputs and Results Processing

B.1 Summary of Model Inputs

Meteorological Data	2019 hourly meteorological data from Avonmouth station has been used in the model. The wind rose is shown in **Appendix B .**
ADMS	Version 5.0.0.1
Time Varying Emission Factors	Based on Department for Transport statistics. Table TRA0307. Motor vehicle traffic distribution by time of day and day of the week on all roads, Great Britain: 2019
Latitude	51°
Minimum Monin-Obukhov length	A value of 30 for 'small towns <50,000' was used to represent the modelled area. A value of 10 for 'small towns <50,000' was used to represent the meteorological station site.
Surface Roughness	A value of 0.3 for 'agricultural areas (max) was used to represent the modelled site as shown in **Figure 1.1**. A value of 0.5 for 'parkland, open suburbia' was used to represent the verification site area, as shown in **Figure 1.2**. A value of 0.2 for 'Agricultural area (min)' was used to represent the meteorological station site.
Street Canyon	ADMS Advanced Street Canyon module was used to represent the effect of trapping and recirculating pollutants. Building heights were taken from 2019 national LIDAR data. (DEFRA, 2021b)
Emission Factor Toolkit (EFT)	V10.1, August 2020. (DEFRA, 2020c)
NOx to NO_2 Conversion	NOx to NO_2 calculator version 8.1, August 2020 (DEFRA, 2020d)
Background Maps	2018 reference year background maps (DEFRA, 2020b)

B.2 Traffic Data

Location	2019 Baseline		2022 Future	
	AADT	HDV (%)	AADT	HDV (%)
A38 Bristol Road North	19077	19	20019	19
A4135	13941	3	14630	3
A38 Bristol Road South	9111	11	9561	11
St Johns Road	3586	2	3764	2
M5 Southbound	41237	22	44376	22
M5 Northbound	42287	20	43274	20
Westward Road	9640	0.74	-*	-*
A419 Cairnscross Road	15248	2	-*	-*
A419 Dudbridge Road	21608	2	-*	-*

*Modelled for verification in 2019 baseline year only

B.3 Windrose

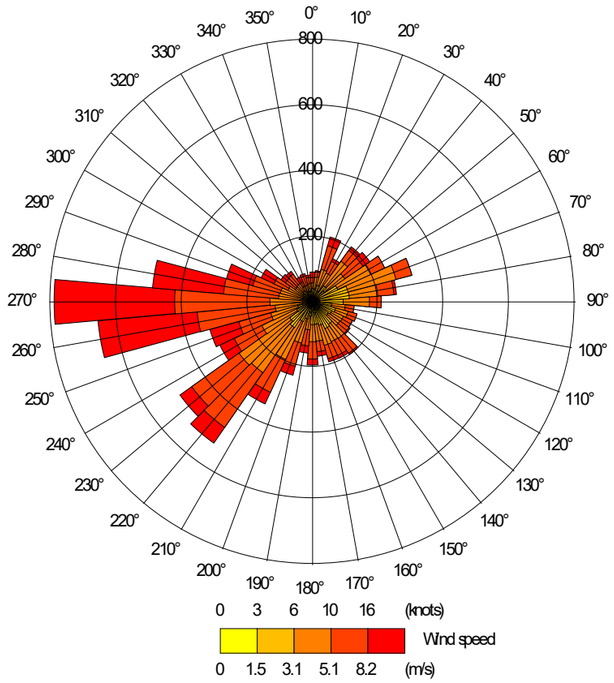

Figure C-1: Windrose for Avonmouth

Appendix C Model Verification

NO_2

Most NO_2 is produced in the atmosphere by the reaction of nitric oxide (NO) with ozone. It is therefore most appropriate to verify the model in terms of primary pollutant emission of nitrogen oxides (NOx = NO + NO_2). The model has been run to predict the 2019 annual mean road-NOx contribution at two monitoring locations (identified in section **4.4.3**). Concentrations have been modelled at a height of 2.4 m for both diffusion tubes.

A primary adjustment factor of **2.827** has been determined as the slope of the best fit line between the modelled road NOx contribution and the 'measured' road-NO_x (which is calculated from the measured and background NO_2 concentrations within DEFRA's NO_x to NO_2 calculator (DEFRA, 2020d)), forced through zero (**Figure C-1**). This factor has then been applied to the raw modelled road-NO_x concentration to provide adjusted modelled road-NO_x concentrations.

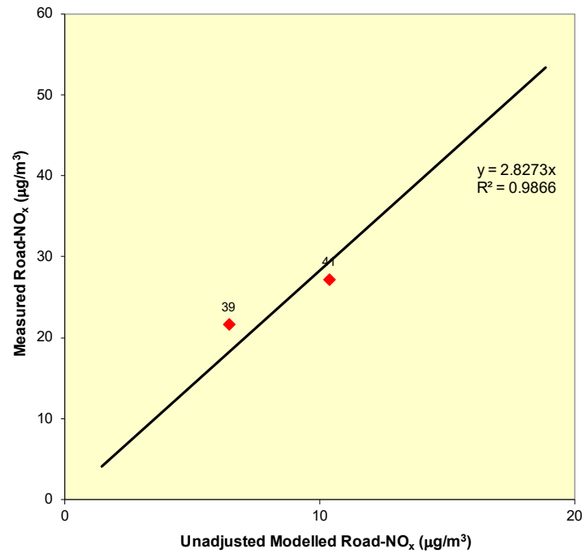

Figure C-1 Measured and Unadjusted Road-NO_x Comparison

The total NO_2 concentrations have then been determined by combining the adjusted modelled road-NO_x concentrations with the background NO_2 concentration within DEFRA's NO_x to NO_2 calculator (DEFRA, 2020d). A secondary adjustment factor of **1.0094** has then been calculated as the slope of the best fit line applied to the adjusted data and forced through zero (**Figure C-2**).

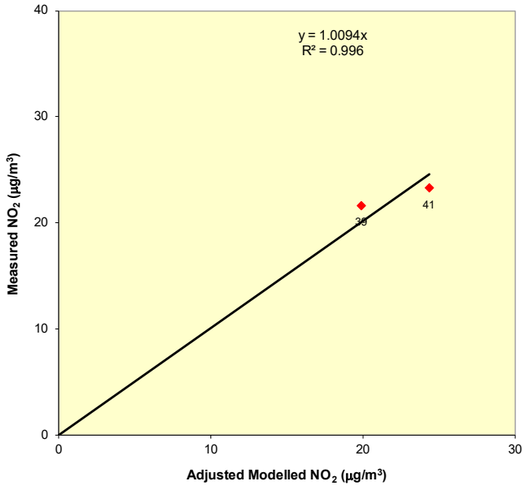

Figure C-2 Measured and Primary Adjusted Modelled NO_2 Comparison

Figure C-3 compares final adjusted modelled total NO_2 at each of the monitoring sites, to measured total NOx and shows the 1:1 relationship, as well as ±10% and ±25% of the 1:1 line.

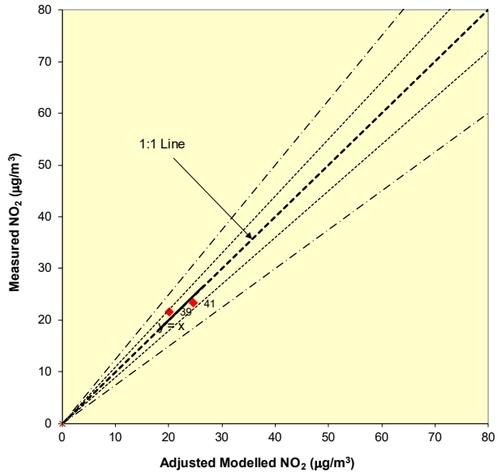

Figure C-3 Measured and Final Adjusted Modelled NO_2 Comparison

The calculated adjustment factors imply that overall, the model has under-predicted the road-NO_x contribution. This is a common experience with this and most other models. The calculated Root Mean Square Error (RMSE) for this verification (1.4 µg/m^3) lies within the range considered to be acceptable by DEFRA (DEFRA, 2021a).

PM_{10} and $PM_{2.5}$

The closest automatic monitoring station to the Site measuring PM_{10} and $PM_{2.5}$ is at Hardwicke. However, as this monitoring location is not considered to be representative of the Site, it has not been used for model

verification and the adjustment factor calculated of NO_2 has been applied to the modelled road-PM_{10} and road-$PM_{2.5}$ concentrations.

Appendix D Figures

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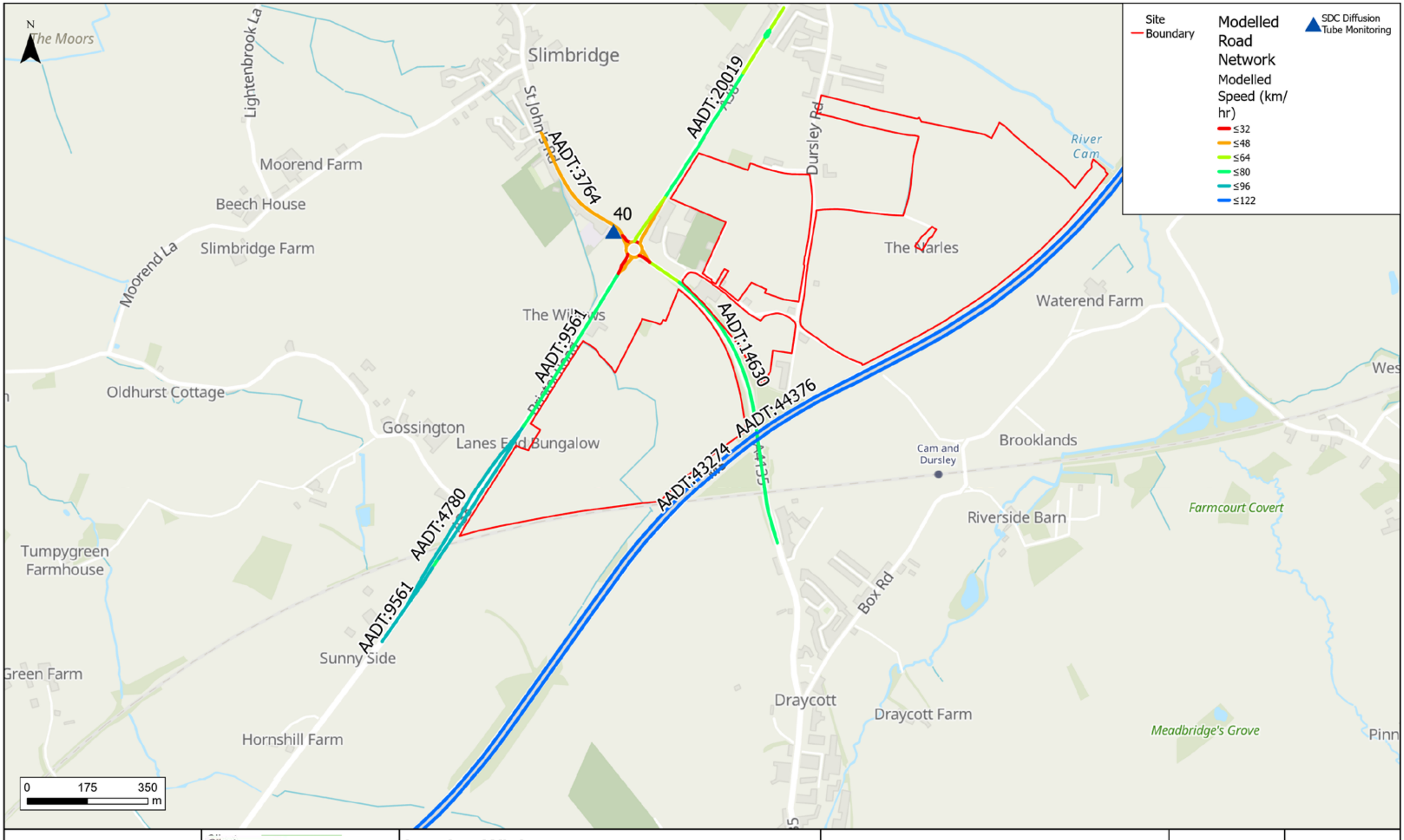

Stantec

Client

Land at Wisloe

Modelled Site Road Network (Labelled by 2022 AADT)

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Drawn: dafrancis	Checked: ERP
Figure 1.1	Rev A

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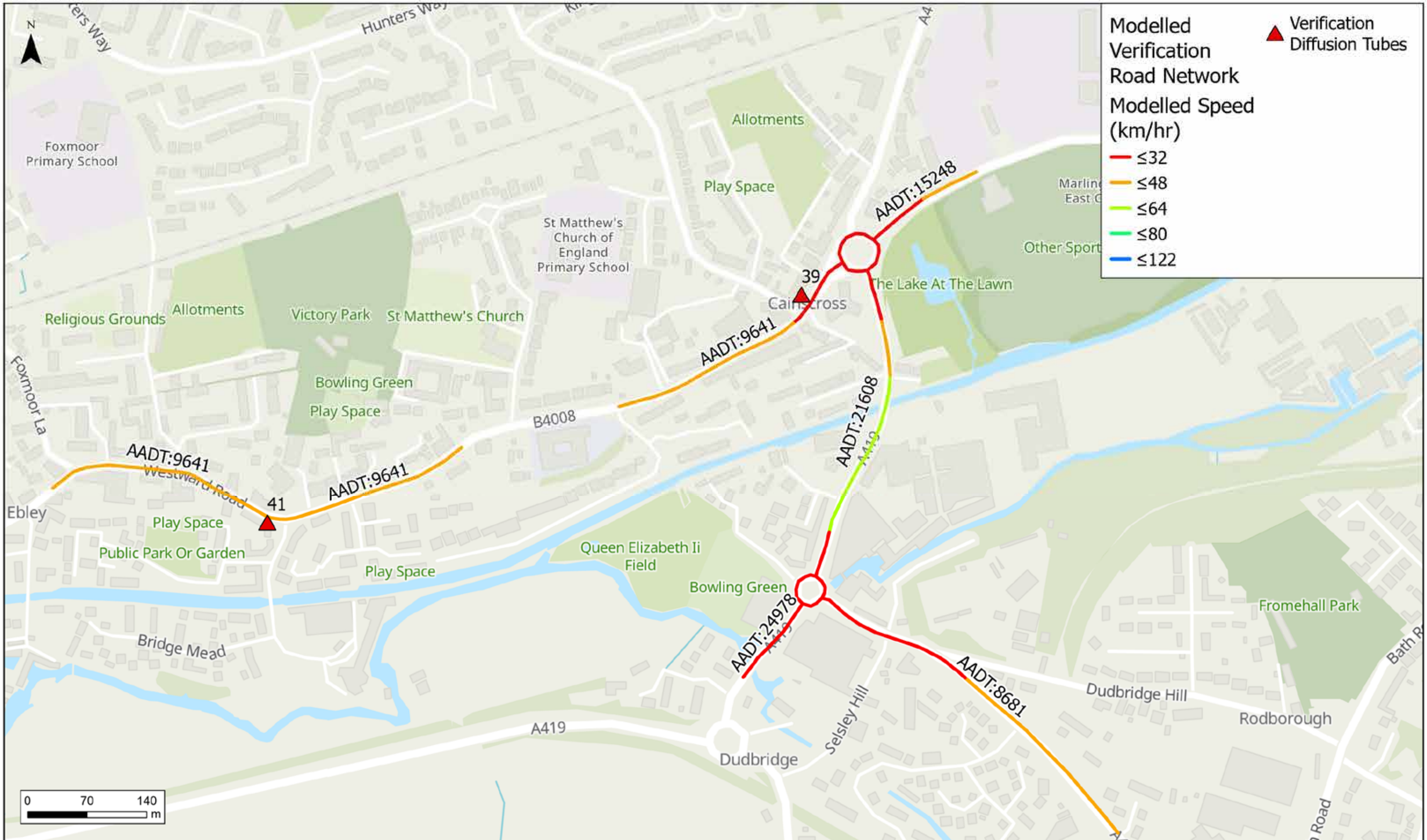

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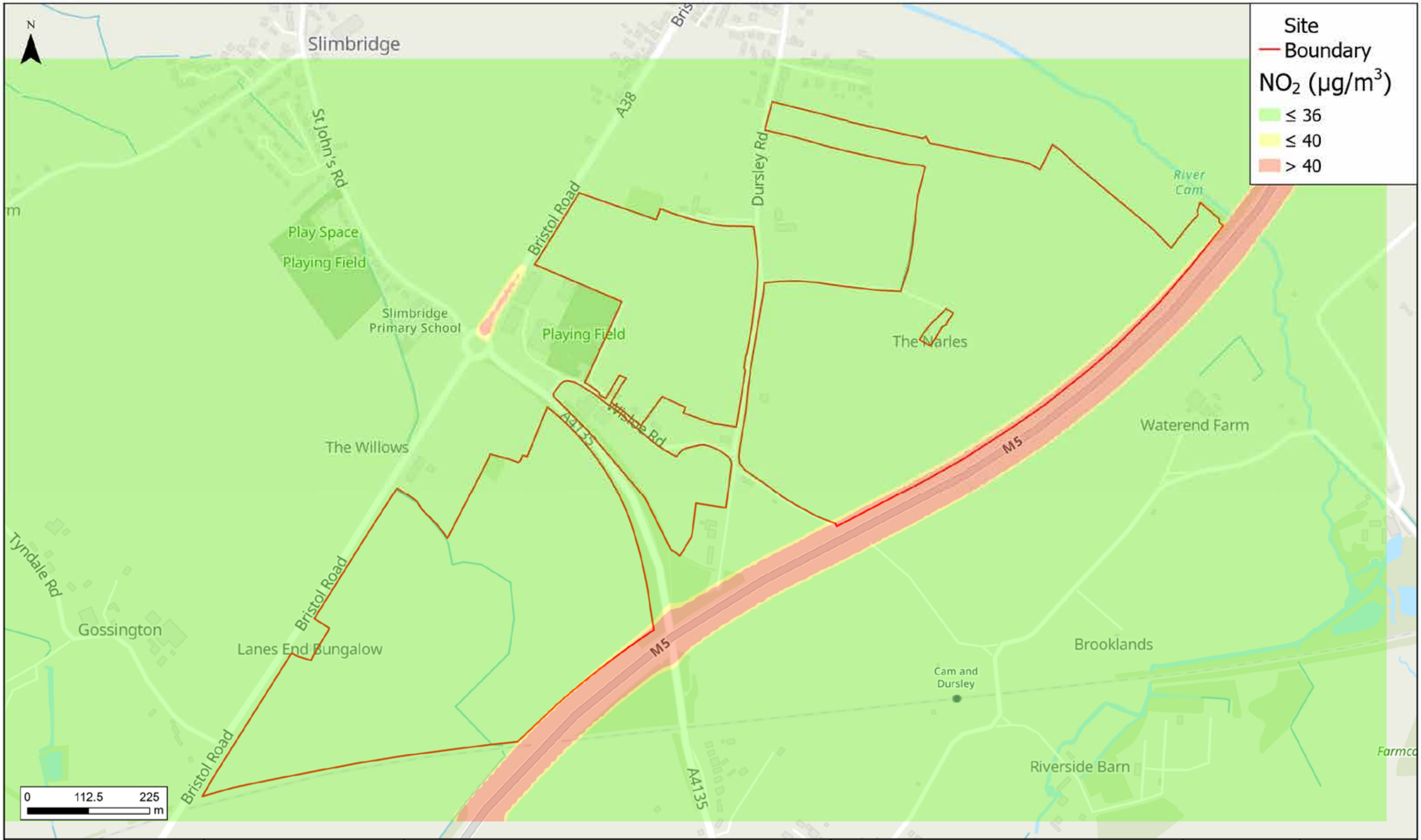

Stantec	Client: The Ernest Cook Trust; Gloucestershire	**Land at Wisloe** Predicted Annual Mean 2022 NO_2 Concentration	GB Topographic: Contains OS data © Crown Copyright and database right 2020 Contains data from OS Zoomstack	1:9,000 @ A4	Date: 24/05/2021
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Gloucestershire

Land at Wisloe

Predicted Annual Mean 2022 PM_{10} Concentration

1:9,000 @ A4	Date: 24/05/2021
Drawn: dafrancis	Checked: ERP
Figure 03	Rev A

Document Path: J:\332310150\Air Quality - Wisloe\Plans and Figures\ArcGIS\Wisloe\Wisloe.aprx

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Client

Gloucestershire

Land at Wisloe

Predicted Annual Mean 2022 $PM_{2.5}$ Concentration

1:9,000 @ A4	Date: 02/06/2021
Drawn: dafrancis	Checked: ERP
Figure 04	Rev A

WISLOE

D5. Acoustics

Stantec

TECHNICAL NOTE

Job Name: Wisloe New Settlement

Job No: 332310150

Note No: ACO/TN01

Date: July 2021

Prepared By: Janec Lillis-James

Subject: **Acoustic Modelling of Proposed Acoustic Bund Adjacent to M5**

1. Introduction

1.1. Stantec has been commissioned by The Ernest Cook Trust and Gloucestershire County Council, as landowners, to undertake a preliminary appraisal of mitigation measures to attenuate noise from the M5 to support the master planning of Wisloe New Settlement. The site is located within the administrative boundary of Stroud District Council (SDC).

1.2. The site was included within the SDC Local Plan Review - Draft Plan for Consultation (SDC, 2019) that was produced in November 2019 with a view to allocating it for a 'new garden community comprising 5 ha employment, up to 1,500 dwellings, local centre including shops and community uses, primary school(s) and associated community and open space uses and strategic green infrastructure and landscaping'.

2. Scope of Technical Note

2.1. The dominant noise source impacting the site is vehicular movements on the surrounding road network, particularly the M5 to the south of the development.

2.2. The effectiveness of potential acoustic mitigation measures to the site boundary have been reviewed based on acoustic modelling of the site and taking account of guidance detailed in BS 8233:2014.

2.3. This review considers noise levels in private external amenity areas. With respect to external noise intrusion to habitable rooms, it is considered that appropriate internal noise levels are likely to be readily achieved by suitably specified building façade and would be considered as part of future planning applications for development parcels as they come forward.

3. Local Policy and Guidance

Local Planning Policy

Stroud District Local Plan 2015

DOCUMENT ISSUE RECORD

Technical Note No	Rev	Date	Prepared	Checked	Reviewed (Discipline Lead)	Approved (Project Director)
332310150/ACO/TN 1	-	July 2021	JLJ	MM	MB	AS

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3.1. SDC adopted a new local plan in November 2015 (SDC, 2015). This helps to guide development within the district. One pertinent policy in the plan is Core Policy CP14 – High Quality Sustainable Development which states:

"High quality development, which protects, conserves and enhances the built and natural environment, will be supported. Development will be supported where it achieves the following:

…

No unacceptable levels of air, noise, water, light or soil pollution or exposure to unacceptable risk from existing or potential sources of pollution."

3.2. Policy ES3 – Maintaining Quality of Life within our Environmental Limits states:

"Permission will not be granted to any development which would be likely to lead to, or result in an unacceptable level of*:*

…

Noise sensitive development in locations where it would be subject to unacceptable noise levels.

Industry Standard Guidance

3.3. With respect to noise levels in outdoor amenity spaces, British Standard BS 8233:2014 states that it is desirable that the external noise level does not exceed 50 dB LAeq,T, with an upper guideline value of 55 dB LAeq,T which would be acceptable in noisier environments.

3.4. The standard goes on to state:

"… it is also recognised that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited."

4. Acoustic Model & Mitigation Proposals

4.1. An acoustic noise model has been created using the noise modelling program SoundPLAN v8.2 to predict the likely noise impact of vehicular movements on the surrounding road network on the proposed development. Site topography has been included within the model.

4.2. Noise levels have been assessed by inputting predicted road traffic data into the acoustic model and producing noise contours for the site. Daytime noise levels have been calculated at 1.5 m above ground floor level, considered typical of a daytime receptor.

4.3. Working with the design team, an acoustic mitigation strategy for the site has been developed which takes into account the available land, and consideration of non-acoustic constraints such as visual impacts.

4.4. As part of the mitigation strategy, an acoustic bund is incorporated in the design directly adjacent the M5. The bund is proposed to be as close to the M5 as practicable, as the closer the mitigation is to the source the more effective the attenuation. The height and extent of the acoustic bund has been optimised to provide a significant level of acoustic attenuation whilst not impacting on visual and other disciplines. The acoustic bund is designed so that the crest of the bund is 4 m above the M5 road level. The bunds have a 1:2 gradient on the M5 side and a varying slope on the development side. The approximate extents of the acoustic bund are provided in Figure 2.

4.5. To illustrate the effect of the acoustic bund, two scenarios have been modelled and presented within this note.

- Scenario 1: Baseline with No Mitigation
- Scenario 2: Baseline with Bund Adjacent to M5

5. Results and Discussion

5.1. **Figures 1** and **2** present the resulting daytime noise contours on the site without and with the proposed acoustic bund respectively.

Figure 1: Scenario 1: Baseline Noise Levels – No Mitigation

Figure 2: Scenario 2: Baseline Noise Levels–Bund Adjacent to M5

5.2. The effect of the acoustic bund on noise levels is significant with a reduction in in noise levels from the M5 of up to 8 dB expected when compared to a 'no-bund' scenario. A 3 dB change in sound level is generally regarded as a perceptible change in sound level.

5.3. The results of the noise modelling presented in Figure 2, show that noise levels across the site are likely to range between 55 dB $L_{Aeq,16hours}$ and 65 dB $L_{Aeq,16hours}$. These levels are above the guidance criteria for private external amenity areas.

5.4. Whilst the use of the site for residential purposes should not be determined on the basis of noise levels in external amenity areas; in keeping with the principles of good acoustic design, noise levels in external amenity areas should be reduced as far as practicable. Therefore, as part of the development of the masterplan, the following design and mitigation measures would be considered:

- Locating external amenity areas behind dwellings fronting M5, so that they are screened by the buildings they serve.
- Using suitably specified acoustic barrier to external amenity areas with a direct line of sight to M5.
- Use of courtyard style development layouts to screen external amenity areas.

5.5. It is considered that by following a good acoustic design process through the detailed design of the scheme, appropriate noise levels can be achieved in private external amenity areas and that the site is appropriate for residential use.

6. Conclusion

6.1. Stantec have been commissioned by The Ernest Cook Trust and Gloucestershire County Council, as landowners, to undertake a preliminary appraisal of mitigation measures to attenuate noise from the M5 to support the master planning of Wisloe New Settlement.

6.2. As part of the mitigation strategy, an acoustic bund is incorporated directly adjacent the M5. The bund is proposed to be as close to the M5 as practicable, as the closer the mitigation is to the source the more effective the attenuation. The height and extent of the acoustic bund has been optimised to provide a significant level of acoustic attenuation whilst not impacting on visual and other disciplines. The acoustic bund is designed so that the crest of the bund is 4 m above the M5 road level.

6.3. The assessment has considered the suitability of the site for residential use. Through incorporation of the acoustic bund and a good acoustic design process being followed for the scheme during any future planning application, the site is deemed acceptable for residential use with regards to noise.

WISLOE

D6. Flood Risk and Drainage

Stantec

TECHNICAL NOTE

Job Name:	Wisloe Garden Village
Job No:	332310150
Note No:	332310150/2001/TN001
Date:	16 July 2021
Prepared By:	Lewis Derrick
Subject:	**Flood Risk & Drainage**

1. Introduction

1.1. This Technical Note has been produced by Stantec as part of the Wisloe Garden Village Masterplan Report, submitted in support of a Regulation 19 Submission to Stroud District Council's Local Plan review. It provides a package of supporting information regarding Flood Risk & Drainage on site, including calculations, sketches and design checklists.

1.2. All designs regarding Flood Risk & Drainage have been developed in collaboration with LHC Design, with the aim of providing a Sustainable Drainage System (SuDS) as part of holistic and integrated Green-Blue Infrastructure on site.

1.3. It should be noted that all information provided is to a standard suitable to support the Regulation 19 Submission. Following review of that submission, the design information included will be developed further to support a potential future planning application, as necessary.

1.4. The following documents are attached to this Technical Note:

- Existing Greenfield Runoff Calculations;
- Attenuation Volume Requirement Calculations;
- Preliminary Surface Water Drainage Strategy (SWDS) Sketch;
- Preliminary Pond Cross-Section Concept Sketch;
- Existing Overland Flow Routes Sketch;
- Individual Pond Design Checklists.

2. Summary of Flood Risk

2.1. To date, only a desk-based study of existing flood risk on site has been undertaken by Stantec. The conclusions of this are outlined within Stantec's previously produced "Flood Risk & Surface Water Site Appraisal". Below is a summary of this information.

2.2. It should be noted that further liaison with the Lead Local Flood Authority (LLFA) (in this case Gloucestershire County Council (GCC)) is currently ongoing. Where pertinent, Stantec will provided additional information to Stroud District Council, following its conclusion.

Public Flood Risk Information

2.3. The majority of the site is shown by the Environment Agency's (EA) "Flood Map for Planning" to lie within Flood Zone 1. The northern boundary of the site lies within Flood Zones 2 and 3, with this increased flood risk associated with the flood extents of the River Cam. The Strategic Flood Risk Assessment (SFRA) indicates that all of Flood Zone in this area is considered as Flood Zone 3b i.e. "Functional Floodplain".

2.4. There are no Flood Zones associated with the Lighten Brook in the southern part of the site. However, this watercourse is relatively minor and therefore it is unlikely that it has been modelled by the EA. Given this ambiguity, an 8m buffer either side of the watercourse has been proposed.

2.5. The EA's "Flood Risk from Surface Water" mapping indicates that the majority of the site lies within an area of "very low" risk. Some areas ranging from "low" to "high" risk are identified, but on review of available mapping and public LiDAR data, these appear to be associated with the Lighten Brook, field boundaries and localise low spots across the site. Therefore, these do not represent overland flow paths originating off site and passing through.

2.6. The EA's "Flood Risk from Reservoirs Mapping" indicates that the northern portion of the site, closely mimicking the Flood Zone extents, lies within flood extents in the event of a reservoir breach. However, the likelihood of this event occurring is limited.

Historic Flooding

2.7. EA datasets do not indicate any historic flooding within the site's boundary. They do, however, indicate some flooding upstream and downstream of the site, along the River Cam and resulting from exceeding the channel's capacity.

2.8. In January 2021, Stantec were forwarded a letter from the Wisloe Action Group which outlined a flooding incident that occurred over late December 2019 and early January 2020. The letter described that there was surface water flooding on all parcels of the site and that some of this flooding extended to the A38 which was then closed.

2.9. We are currently liaising with the LLFA to build the understanding of this specific flooding incident and as well general flood risk in the area.

3. Preliminary Surface Water Drainage Strategy

Discharge Rates

3.1. Existing greenfield runoff rates were calculated for the site using the Flood Estimation Handbook's (FEH) Post-2008 Statistical method, as recommended by CIRIA C753 "The SuDS Manual".

3.2. Owing to slight variations in ground conditions as indicated by the FEH Catchment Descriptor information exported from the FEH Webservice, it was necessary to undertake two runoff calculation; one for plots north of the A4135 and one for plots south of the A4135. These were previously referred to as "Parcels 1-3" and "Parcel 4" respectively.

3.3. These calculations can be found attached to this Technical Note, but are also summarised in the tables below:

Plots North of the A4135	
Return Period	**Existing Greenfield Runoff Rate (l/s/ha)**
1 in 1 year storm event	2.1
QBAR (1 in 2.3 year storm event)	2.7
1 in 30 year storm event	5.4
1 in 100 year storm event	6.6

Plots South of the A4135	
Return Period	**Existing Greenfield Runoff Rate (l/s/ha)**
1 in 1 year storm event	1.7
QBAR (1 in 2.3 year storm event)	2.2
1 in 30 year storm event	4.4
1 in 100 year storm event	5.4

3.4. GCC's current SuDS policy is that runoff from new development should be controlled to not exceed the equivalent greenfield runoff rate for all return periods up to the 1 in 100 year storm event.

3.5. However, given the known flood risk downstream, it is proposed the discharges from this development will be limited to match the QBAR greenfield runoff rate (QBAR represents the mean annual maximum runoff rate and is approximately equivalent to a 1 in 2.3 year storm event). This means that in events in excess of the 1 in 2.3 year storm event, discharge from the development will be less than if the site were left undeveloped i.e. a "do nothing" scenario, helping to reduce downstream flood risk.

3.6. In conclusion, post-development peak discharge rates will be limited to match the existing greenfield QBAR runoff rate for all storm events up to the 1 in 100 year storm event plus an allowance for climate change (current guidance indicates that this allowance should be 40%).

Attenuation Storage Volume

3.7. By restricting post-development discharge rates to match the greenfield QBAR rate, there is no need to provide Long Term Storage, which seeks to limit post-development discharge volumes to match existing greenfield discharge volumes.

3.8. However, the inherent increase in impermeable areas on site will result in the need to temporarily store surface water runoff prior to controlled discharge from the site i.e. attenuation.

3.9. Through a collaborative design process with LHC Design, it is proposed that attenuation on site will be provided by ponds/wetlands. In accordance with CIRIA C753, our calculations have modelled that there will be 0.5m temporary storage depth above the permanent water level within the ponds/wetlands for storm events up to the 1 in 100 year event (plus climate change). These calculations are attached to this Technical Note.

3.10. The calculations indicate that plots north of the A4135 require 944.1m^3 of attenuation storage per hectare of impermeable development (m^3/ha), whilst plots south of the A4135 require 994.3m^3/ha.

Surface Water Drainage Strategy Concept

3.11. In collaboration with LHC Design a SWDS concept has been developed on the basis of utilised ponds/wetlands for attenuation on site. When compared with more conventional detention basins for attenuation storage, these will provide more opportunities for placemaking and biodiversity enhancement on site, contributing to the overall Green-Blue Infrastructure proposals.

3.12. A preliminary layout can be found attached to this Technical Note, alongside an indicative pond cross-section. At this stage, the layout only indicates an initial location and scale of the strategic pond/wetland features, the design of which will be refined as the design progresses.

3.13. Information regarding the design of individual ponds/wetlands can be found in the design checklists attached to this Technical Note.

3.14. The aspiration for the development is that the proposed SWDS and SuDS to form an integral and holistic part of the development, whilst almost mimicking landscape and drainage features typical of the area. As such, in addition to the ponds/wetlands shown that this stage, there will be additional SuDS upstream of these to provide Source Control and Interception of surface water. At this stage, location-specific measures have not yet been identified and this would be confirmed as the design proposals progress.

3.15. By providing Source Control and Interception, these additional SuDS will further contribute to attenuation provision on site, by “slowing the flow” of runoff through the site when compared to a traditional pipe-dominant system. Furthermore, SuDS are typically open, vegetated features and therefore have greater capacity for maximises losses, either through infiltration to the ground (not the main method of surface water disposal but the latent potential can be utilised) and evapotranspiration.

3.16. These additional SuDS will also be vital for providing water quality treatment upstream of the ponds/wetlands. Cleaner water entering the ponds/wetlands is conducive to providing better habitats for wildlife and would likely make these spaces more attractive for visitors.

3.17. Finally, by providing these additional SuDS, there will be further opportunities for the Green-Blue Infrastructure to be embedded within the development itself, augmenting the amenity provision and biodiversity enhancement proposed.

4. Summary

4.1. A desk-study of flood risk has been undertaken for the proposed development site, which concludes that the site is generally at a low risk of flooding from all sources. There are areas of Flood Zone 3b and reservoir breach flood extents in the north of the site, associated with the River Cam corridor, but these are a small proportion of the site.

4.2. Stantec have been made aware of a flooding incident in the vicinity of the site during December 2019 and January 2020, including some surface water flooding on the site itself. Liaison with the LLFA regarding this incident and general flood risk in the local area is ongoing. The outcomes of this liaison will be reported separately in the near future.

4.3. Existing present-day greenfield runoff rates for the site have been calculated. It is proposed to restrict post-development discharge rates to match the greenfield QBAR rate owing to known flood sensitivities downstream. This represents a greater restriction of post-development discharge than currently required by GCC policy and would represent betterment over leaving the site undeveloped.

4.4. Based on this post-development discharge rate, a concept SWDS has been developed. Strategic attenuation of surface water runoff on site will be within pond/wetland features to enhance biodiversity on site and aid in improving amenity to the community. They will form an integral part of wider Green-Blue Infrastructure on site.

4.5. To augment the ponds/wetlands proposed on site, additional SuDS upstream of these features will be provided to help further embed Green-Blue Infrastructure within the development itself. In addition, these will provide Source Control and Interception of rainfall, “slowing the flow” and providing additional water quality treatment. Further detail of these SuDS features will be provided as the development proposals progress.

ATTACHMENTS

- 332310150/4001/SK001-B Preliminary Surface Water Drainage Strategy
- 332310150/4001/SK002 Indicative Pond Cross-Section
- 332310150/4001/SK003 Existing Overland Flow Assessment
- Pond PO-1.1 Design Checklist Rev 3
- Pond PO-2.1 Design Checklist Rev 3
- Pond PO-2.2 Design Checklist Rev 3
- Pond PO-3.1 Design Checklist Rev 3
- Pond PO-4.1 Design Checklist Rev 3
- Pond PO-4.2 Design Checklist Rev 3
- FEH Post-2008 Statistical Method Greenfield Runoff Calculation – North of A4135
- FEH Post-2008 Statistical Method Greenfield Runoff Calculation – South of A4135
- Attenuation Storage Volume per Impermeable Hectare Calculation – North of A4135
- Attenuation Storage Volume per Impermeable Hectare Calculation – South of A4135

DOCUMENT ISSUE RECORD

Technical Note No	Rev	Date	Prepared	Checked	Reviewed (Discipline Lead)	Approved (Project Director)
332310150/2001/ TN001	-	16.07.21	LWD		AJ	AH

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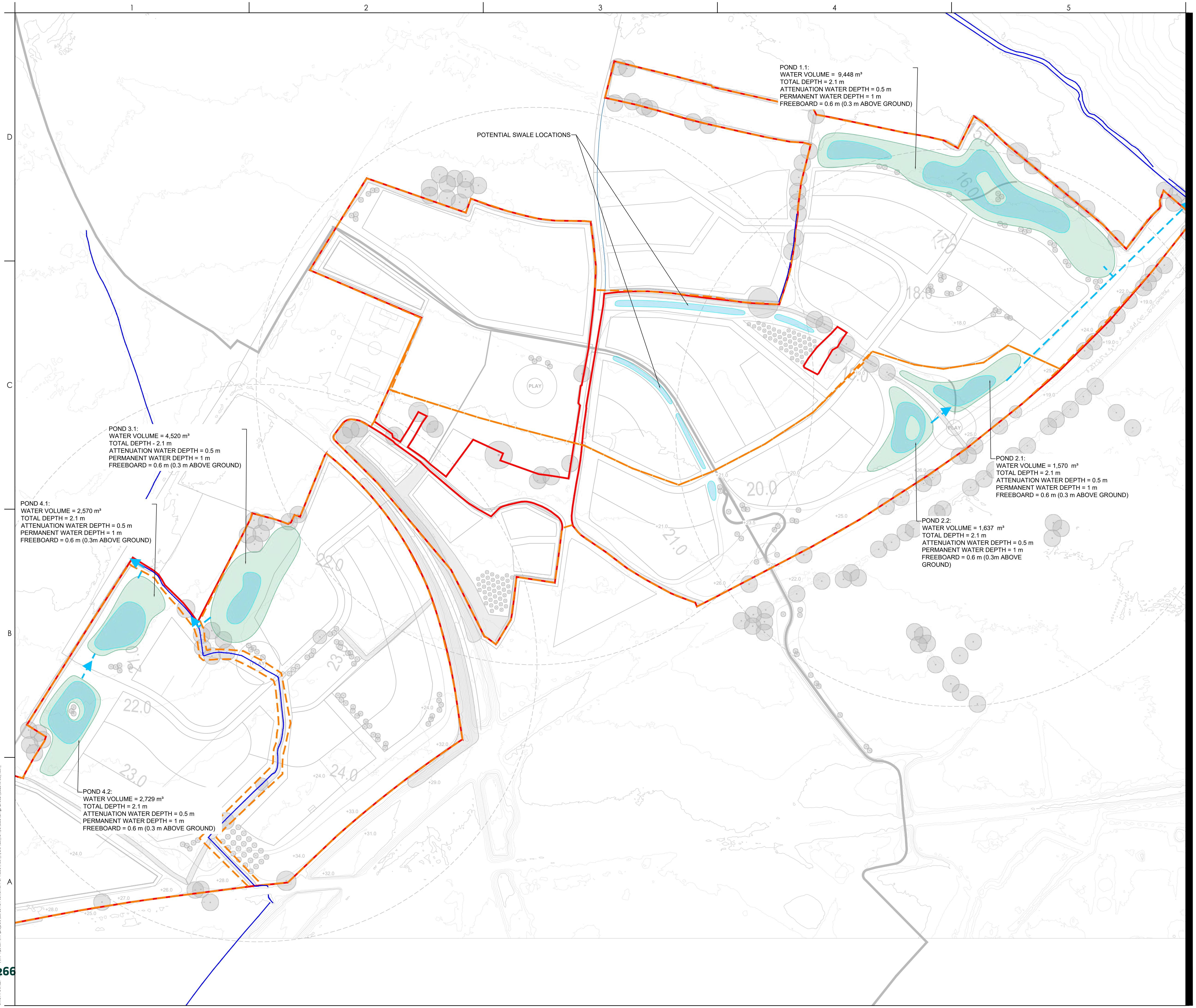

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6. INDICATIVE CROSS-SECTION OF PONDS PROVIDED IN SK002

KEY:

SITE BOUNDARY
CATCHMENT BOUNDARY
WATERCOURSE
WETLAND
OUTFALL ROUTE

Issued/Revision	By	Appd	YYYY.MM.DD
	RR	RR	LWD	2021.06.28
	Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

Issue Status

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THE ERNEST COOK TRUST & GLOUCESTERSHIRE COUNTY COUNCIL
NEW SETTLEMENT AT WISLOE

Title

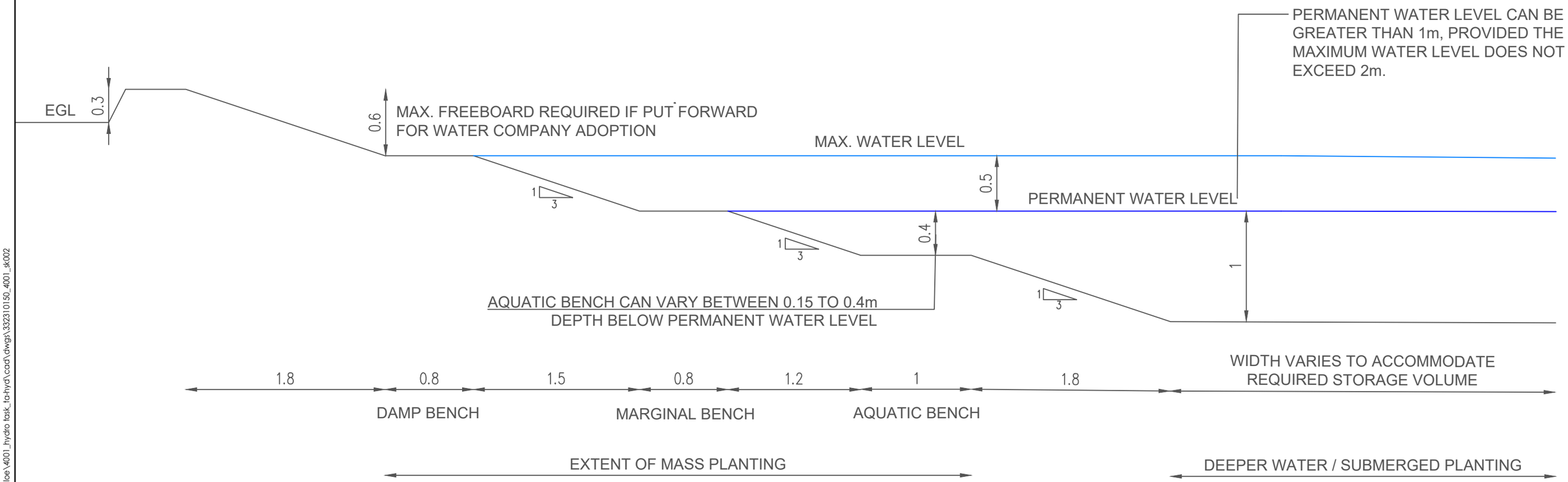
PRELIMINARY SURFACE WATER DRAINAGE STRATEGY

Project No. 332310150

Scale NTS

Revision B

Drawing No. 332310150/4001/SK001-B



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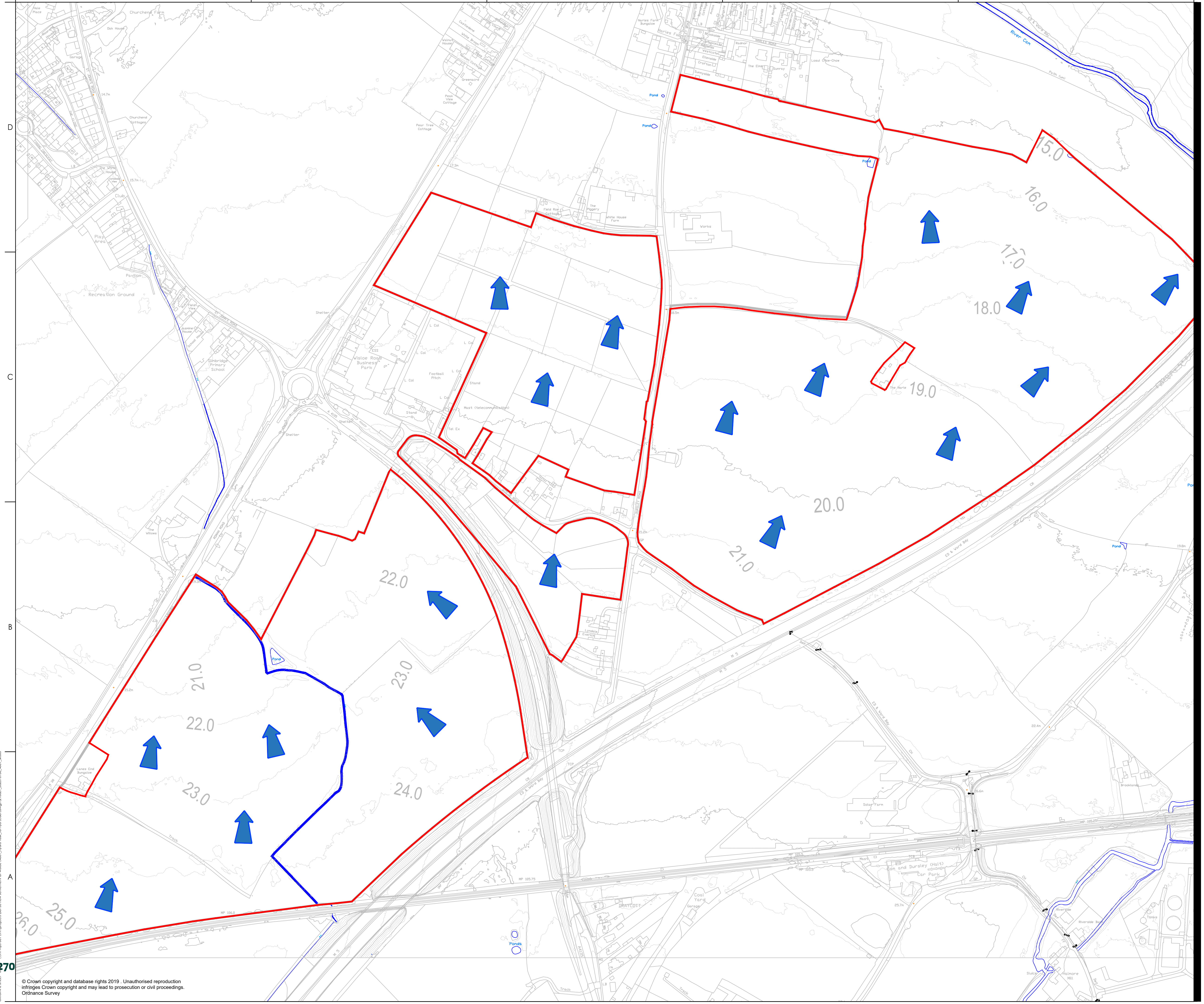
NEW SETTLEMENT AT WISLOE

Project No.:
332310150

Title
INDICATIVE POND CROSS-SECTION

Revision:	Date:	Drawing No.
-	2021.04.09	332310150/4001/SK002



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KEY:

SITE BOUNDARY

WATERCOURSE

OVERLAND FLOW PATH

Issued/Revision		By	Appd	YYYY.MM.DD
	RR	RR	LWD	2021.06.21
	Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

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NEW SETTLEMENT AT WISLOE

Title
EXISTING OVERLAND FLOW ASSESSMENT

Project No.
332310150

Scale
NTS

Revision
-

Drawing No.
332310150/4001/SK003

Plotted: 21.06.2021 2021.06.21 10:04:47 AM By: Rogers, Roberto
ORIGINAL SHEET - ISO A1

Ponds/Wetlands Design Checklist

Project Title	New Settlement at Wisloe
Project Number	332310150

DOCUMENT ISSUE RECORD

Rev	Comments	Prepared	Date	Checked	Date
0	Initial Design	RR	09/03/2021	LWD	10/03/2021
2	Revision following internal comments	RR	06/04/2021	LWD	07/04/2021
3	Revision following test 3D modelling	RR	21/06/2021	LWD	23/06/2021

Ponds/Wetlands - Minimum Design Requirements	
Ponds/Wetlnads Parameter	**Minimum design requirements (MDRs)**
Length to width ratio	>3:1
Maximum depth of permanent water	2 m
Maximum side slopes	1 in 3
Maximum depth of aquatic bench below permanent water level	400 mm
Size of permanent pool	≥ treatment volume, V_t

Ponds/Wetlands - Design Assessment Checklist			
General information			
Asset ID(s)	PO-1.1		
Ponds/Wetlands location(s) and co-ordinates	375538, 203060	Drawing reference(s)	\\tnt-vfps-001\tnt\Projects\50753 New Settlement at Wisloe\4001_Hydro Task_TA-HYD\CAD\DWGS\WIP_
Primary function(s) of pond/wetland:	Attenuation of up to 1:100 (+40%CC) storms, biodiversity and amentiy provision		

Check	MDR	Summary details	Acceptable (Y/N)	Comments/remedial actions
Dimensions				
Length (m)		452m	Y	
Maximum and minimum width - permanent water level (m)				This can be provided when pond 3D modelled for Outline.
Length: maximum width ratio	✓	4.8:1	Y	>3:1 so sufficient flow path length for water quality treatment. Sufficient detail for Pre-Application and Outline, but for Reserved Matters confirm length:width from each inlet to the outlet.
Top surface area (m^2)		26,400m^2	Y	
Side slope (1 in ?)	✓	3	Y	
Depth of permanent water - maximum and minimum (m)	✓	1.0m	Y	Assumed max permanent water depth is the 1.0m quoted, which will avoid stratification issues.
Freeboard (m)		0.6m	Y	In accordnce with DCG requirements for SuDS adoption.
Aquatic bench width and slope (m, 1 in ?)	✓	1m, 1 in 3.	Y	SuDS Manual CIRIA C753 does not make any specific recommendations on width. The width can be varied depending on the extent of vegetation required for safety and aesthetic purposes.
Safety bench width and slope (m, 1 in ?)	✓	1.8m, 1 in 3	Y	The SuDS Manual CIRIA C753 details a suitable width for a safety bench of 3.5m, due to limits in land availability a lower width is provided.
Inflows				
Provide a description of the contributing catchment land use and its size (m^2)		14.43 ha of residential development (assumed 65% PIMP) 1.5ha of mixed use development (assumed 70% PIMP) 2.19ha of Roads (100% PIMP) Total impermeable area = 12.61 ha	Y	
Does the design include suitable silt interception upstream of system?		Silt interception will be provided by upstream SuDS, to be considered at next design stage	Y	"Toolbox" of upstream SuDS to be considered at Outline, whilst specifc types will be indicated for Reserved Matters. Additional measures such as catch-pits etc. may also be required immediately upstream. If these are not included, a forebay should be provided.
Does the design include:				
▪ **a suitable inlet design**		Not yet considered at this stage of works (outline planning)		
▪ **appropriate energy dissipation?**		Not yet considered at this stage of works (outline planning)		
Outfall arrangements				
Provide details of any flow control systems, overflow arrangements and limiting discharge rate from pond/wetland		Hydrobrake set to QBAR 34 l/s (based on 2.2l/s/ha x 12.61ha) Overflows not yet considered	Y	
Is a geomemebrane required to prevent infiltration? If yes, give reason		Not yet considered at this stage of works (outline planning)		
Depth to maximum likely groundwater level (m)		Do not have required information at this stage		

Storage				
Design event return period(s) (years)		100 yr +40%CC	Y	
Maximum rise in water level(s) for the design events(s) (mm)	✓	0.5m	Y	Max water depth during design storm would be 2m, which is acceptable. Can be reduced if desired, but may impact land take.
Maximum water depth(s) at design event conditions (m)		1.5m	Y	
Maximum design storage volume(s) (m^3)		9,448m^3	Y	Assume all below existing ground levels
Levels around the edge of the pond/wetland appropriate to contain design depths of water?		600mm of freeboard is to be provided in accordance with DCG requirements for SuDS adoption. 300mm below and 300mm above ground levels.	Y	
Water quality treatment				
For the 1 year 30 minute event or water quality treatment volume confirm:				
Permanent pool volume is sufficient for effective treatment	✓	Required permanent pool volume 1,892m^3	Y	
OR				
Flow velocity is a acceptable for effective treatment	✓			
Landscape/biodiversity				
Is there sufficient treatment upstream of the pond to allow design amenity and biodiveristy objectives to delivered?		To be advised by Landscape Architect and Ecologist at future design stages		
Does the variation in permanent water depth have the potential to create biodiverse habitats?		To be advised by Landscape Architect and Ecologist at future design stages		
Does the design of the pond fulfil objectives of availablity of different habitats including: deep water, marginal, dry/damp, other		To be advised by Landscape Architect and Ecologist at future design stages		
A planting schedule is provided, showing species and planting preferences. Is the planting demostrated appropriate for the habitat specified?		To be advised by Landscape Architect and Ecologist at future design stages		
Will planting be established or rely on natural colonisation?		To be advised by Landscape Architect and Ecologist at future design stages		
Have locally appropriate native plant species been used?		To be advised by Landscape Architect and Ecologist at future design stages		
Indicate the number of different plant species used (not a monoculture)		To be advised by Landscape Architect and Ecologist at future design stages		
Is the proposed pond/wetland planting appropriate to the location, and with respect to access and maintenance?		To be advised by Landscape Architect and Ecologist at future design stages		
Where relevant, confirm planting design does not adversely impact highway visibility and safety requirements (check with highway authority)		To be advised by Landscape Architect and Ecologist at future design stages		
Is the proposed topsoil profile suitable to sustain the proposed plant species?		To be advised by Landscape Architect and Ecologist at future design stages		
Critical materials and product specifications				
Geomembrane		Not enough design detail at this stage		
Geotextile (non-woven)		Not enough design detail at this stage		
Topsoil		Not enough design detail at this stage		
Other (including proprietary systems)		Not enough design detail at this stage		
Constructability				
Are there any identifiable construction risks? If yes, state and confirm acceptable risk management measures are proposed		Not enough design detail at this stage		
Maintainability				
Confirm that access for maintenance is acceptable and summarise details		A buffer of approximately 2-5m around the top of the pond will be required for maintenance. Suitable access road and turning space will be required in line with paragraph C5.4 and C5.5 of the DCG (2020).		
Are there specific features that are likely to pose maintenance difficulties? If yes, identify mitigation measures required		Crosses HP gas main	Y	Further assessments to be undertaken prior to submission of Outline Plannning Application

Ponds/Wetlands Design Checklist

Project Title	New Settlement at Wisloe
Project Number	332310150

DOCUMENT ISSUE RECORD

Rev	Comments	Prepared	Date	Checked	Date
0	Initial Design	RR	09/03/2021	LWD	10/03/2021
2	Revision following internal comments	RR	06/04/2021	LWD	07/04/2021
3	Revision following test 3D modelling	RR	21/06/2021	LWD	23/06/2021

Ponds/Wetlands - Minimum Design Requirements	
Ponds/Wetlnads Parameter	**Minimum design requirements (MDRs)**
Length to width ratio	>3:1
Maximum depth of permanent water	2 m
Maximum side slopes	1 in 3
Maximum depth of aquatic bench below permanent water level	400 mm
Size of permanent pool	≥ treatment volume, V_t

Ponds/Wetlands - Design Assessment Checklist			
General Information			
Asset ID(s)	PO-2.1		
Ponds/Wetlands location(s) and co-ordinates	375397, 202752	Drawing reference(s)	\\tnt-vfps-001\tnt\Projects\50753 New Settlement at Wisloe\4001_Hydro Task_TA-HYD\CAD\DWGS\WIP_
Primary function(s) of pond/wetland:	Attenuation Volume up to 1:100 (+40%CC) storms, biodiversity and amenity provision		

Check	MDR	Summary details	Acceptable (Y/N)	Comments/remedial actions
Dimensions				
Length (m)		200m	Y	
Maximum and minimum width - permanent water level (m)				This can be provided when pond 3D modelled for Outline.
Length: maximum width ratio	✓	1:4.7	Y	>3:1 so sufficient flow path length for water quality treatment. Sufficient detail for Pre-Application and Outline, but for Reserved Matters confirm length:width from each inlet to the outlet.
Top surface area (m^2)		5,107m²	Y	
Side slope (1 in ?)	✓	3	Y	
Depth of permanent water - maximum and minimum (m)	✓	1.0m	Y	Assumed max permanent water depth is the 1.0m quoted, which will avoid stratification issues.
Freeboard (m)		0.6m	Y	In accordnce with DCG requirements for SuDS adoption.
Aquatic bench width and slope (m, 1 in ?)	✓	1m 1 in 3	Y	SuDS Manual CIRIA C753 does not make any specific recommendations on width. The width can be varied depending on the extent of vegetation required for safety and aesthetic purposes.
Safety bench width and slope (m, 1 in ?)	✓	0.8m 1 in 3	Y	The SuDS Manual CIRIA C753 details a suitable width for a safety bench of 3.5m, due to limits in land availability a lower width is provided.
Inflows				
Provide a description of the contributing catchment land use and its size (m^2)		9.16 ha of residential development (assumed 65% PIMP) 1.21 ha of mixed use development (assumed 70% PIMP) 1.95 ha of School (40% PIMP) 0.48 ha of Roads (100% PIMP) Total impermeable area = 8.06 ha	Y	
Does the design include suitable silt interception upstream of system?		Silt interception will be provided by upstream SuDS, to be considered at next design stage	Y	"Toolbox" of upstream SuDS to be considered at Outline, whilst specifc types will be indicated for Reserved Matters. Additional measures such as catch-pits etc. may also be required immediately upstream. If these are not included, a forebay should be provided.
Does the design include:				
▪ **a suitable inlet design**		Not yet considered at this stage of works (outline planning)		
▪ **appropriate energy dissipation?**		Not yet considered at this stage of works (outline planning)		
Outfall arrangements				
Provide details of any flow control systems, overflow arrangements and limiting discharge rate from pond/wetland		Hydrobrake set to QBAR 21.7l/s (based on 2.2l/s/ha x 8.06ha) Overflows not yet considered	Y	
Is a geomemebrane required to prevent infiltration? If yes, give reason		Not yet considered at this stage of works (outline planning)		
Depth to maximum likely groundwater level (m)		Do not have required information at this stage		

Storage				
Design event return period(s) (years)		100 yr +40%CC	Y	
Maximum rise in water level(s) for the design events(s) (mm)	✓	0.5m	Y	Max water depth during design storm would be 2m, which is acceptable. Can be reduced if desired, but may impact land take.
Maximum water depth(s) at design event conditions (m)		1.5m	Y	
Maximum design storage volume(s) (m^3)		1,594m³	Y	Assume all below existing ground levels
Levels around the edge of the pond/wetland appropriate to contain design depths of water?		600mm of freeboard is to be provided in accordance with DCG requirements for SuDS adoption. 300mm below and 300mm above ground levels.	Y	
Water quality treatment				
For the 1 year 30 minute event or water quality treatment volume confirm:				
Permanent pool volume is sufficient for effective treatment	✓	Required permanent pool volume 1,209m³	Y	
OR				
Flow velocity is a acceptable for effective treatment	✓			
Landscape/biodiversity				
Is there sufficient treatment upstream of the pond to allow design amenity and biodiveristy objectives to delivered?		To be advised by Landscape Architect and Ecologist at future design stages		
Does the variation in permanent water depth have the potential to create biodiverse habitats?		To be advised by Landscape Architect and Ecologist at future design stages		
Does the design of the pond fulfil objectives of availablity of different habitats including: deep water, marginal, dry/damp, other		To be advised by Landscape Architect and Ecologist at future design stages		
A planting schedule is provided, showing species and planting preferences. Is the planting demostrated appropriate for the habitat specified?		To be advised by Landscape Architect and Ecologist at future design stages		
Will planting be established or rely on natural colonisation?		To be advised by Landscape Architect and Ecologist at future design stages		
Have locally appropriate native plant species been used?		To be advised by Landscape Architect and Ecologist at future design stages		
Indicate the number of different plant species used (not a monoculture)		To be advised by Landscape Architect and Ecologist at future design stages		
Is the proposed pond/wetland planting appropriate to the location, and with respect to access and maintenance?		To be advised by Landscape Architect and Ecologist at future design stages		
Where relevant, confirm planting design does not adversely impact highway visibility and safety requirements (check with highway authority)		To be advised by Landscape Architect and Ecologist at future design stages		
Is the proposed topsoil profile suitable to sustain the proposed plant species?		To be advised by Landscape Architect and Ecologist at future design stages		
Critical materials and product specifications				
Geomembrane		Not enough design detail at this stage		
Geotextile (non-woven)		Not enough design detail at this stage		
Topsoil		Not enough design detail at this stage		
Other (including proprietary systems)		Not enough design detail at this stage		
Constructability				
Are there any identifiable construction risks? If yes, state and confirm acceptable risk management measures are proposed		Not enough design detail at this stage		
Maintainability				
Confirm that access for maintenance is acceptable and summarise details		A buffer of approximately 2-5m around the top of the pond will be required for maintenance. Suitable access road and turning space will be required in line with paragraph C5.4 and C5.5 of the DCG (2020).		
Are there specific features that are likely to pose maintenance difficulties? If yes, identify mitigation measures required		5m offset from HP gas main is provided	Y	Utilities team confirm legal easement will be 3m so 5m offset from HP gas main will be sufficient.

Ponds/Wetlands Design Checklist

Project Title	New Settlement at Wisloe
Project Number	332310150

DOCUMENT ISSUE RECORD

Rev	Comments	Prepared	Date	Checked	Date
0	Initial Design	RR	09/03/2021	LWD	10/03/2021
2	Revision following internal comments	RR	06/04/2021	LWD	07/04/2021
3	Revision following test 3D modelling	RR	21/06/2021	LWD	23/06/2021

Ponds/Wetlands - Minimum Design Requirements	
Ponds/Wetlnads Parameter	**Minimum design requirements (MDRs)**
Length to width ratio	>3:1
Maximum depth of permanent water	2 m
Maximum side slopes	1 in 3
Maximum depth of aquatic bench below permanent water level	400 mm
Size of permanent pool	≥ treatment volume, V_t

Ponds/Wetlands - Design Assessment Checklist			
General information			
Asset ID(s)	PO-2.2		
Ponds/Wetlands location(s) and co-ordinates	375359, 202736	Drawing reference(s)	\\tnt-vfps-001\tnt\Projects\50753 New Settlement at Wisloe\4001_Hydro Task_TA-HYD\CAD\DWGS\WIP_
Primary function(s) of pond/wetland:	Attenuation Volume up to 1:100 (+40%CC) storms, biodiversity and amenity provision		

Check	MDR	Summary details	Acceptable (Y/N)	Comments/remedial actions
Dimensions				
Length (m)		150m	Y	
Maximum and minimum width - permanent water level (m)				This can be provided when pond 3D modelled for Outline.
Length: maximum width ratio	✓	1:3.2	Y	>3:1 so sufficient flow path length for water quality treatment. Sufficient detail for Pre-Application and Outline, but for Reserved Matters confirm length:width from each inlet to the outlet.
Top surface area (m^2)		5,323m²	Y	
Side slope (1 in ?)	✓	3	Y	
Depth of permanent water - maximum and minimum (m)	✓	1.0m	Y	Assumed max permanent water depth is the 1.0m quoted, which will avoid stratification issues.
Freeboard (m)		0.6m	Y	In accordnce with DCG requirements for SuDS adoption.
Aquatic bench width and slope (m, 1 in ?)	✓	1m 1 in 3	Y	SuDS Manual CIRIA C753 does not make any specific recommendations on width. The width can be varied depending on the extent of vegetation required for safety and aesthetic purposes.
Safety bench width and slope (m, 1 in ?)	✓	0.8m 1 in 3	Y	The SuDS Manual CIRIA C753 details a suitable width for a safety bench of 3.5m, due to limits in land availability a lower width is provided.
Inflows				
Provide a description of the contributing catchment land use and its size (m^2)		9.16 ha of residential development (assumed 65% PIMP) 1.21 ha of mixed use development (assumed 70% PIMP) 1.95 ha of School (40% PIMP) 0.48 ha of Roads (100% PIMP) Total impermeable area = 8.06 ha	Y	
Does the design include suitable silt interception upstream of system?		Silt interception will be provided by upstream SuDS, to be considered at next design stage	Y	"Toolbox" of upstream SuDS to be considered at Outline, whilst specifc types will be indicated for Reserved Matters. Additional measures such as catch-pits etc. may also be required immediately upstream. If these are not included, a forebay should be provided.
Does the design include:				
▪ **a suitable inlet design**		Not yet considered at this stage of works (outline planning)		
▪ **appropriate energy dissipation?**		Not yet considered at this stage of works (outline planning)		
Outfall arrangements				
Provide details of any flow control systems, overflow arrangements and limiting discharge rate from pond/wetland		Hydrobrake set to QBAR 21.7l/s (based on 2.2l/s/ha x 8.06ha) Overflows not yet considered	Y	
Is a geomemebrane required to prevent infiltration? If yes, give reason		Not yet considered at this stage of works (outline planning)		
Depth to maximum likely groundwater level (m)		Do not have required information at this stage		

Storage				
Design event return period(s) (years)		100 yr +40%CC	Y	
Maximum rise in water level(s) for the design events(s) (mm)	✓	0.5m	Y	Max water depth during design storm would be 2m, which is acceptable. Can be reduced if desired, but may impact land take.
Maximum water depth(s) at design event conditions (m)		1.5m	Y	
Maximum design storage volume(s) (m^3)		1,637m³	Y	Assume all below existing ground levels
Levels around the edge of the pond/wetland appropriate to contain design depths of water?		600mm of freeboard is to be provided in accordance with DCG requirements for SuDS adoption. 300mm below and 300mm above ground levels.	Y	
Water quality treatment				
For the 1 year 30 minute event or water quality treatment volume confirm:				
Permanent pool volume is sufficient for effective treatment	✓	Required permanent pool volume 605m³	Y	
OR				
Flow velocity is a acceptable for effective treatment	✓			
Landscape/biodiversity				
Is there sufficient treatment upstream of the pond to allow design amenity and biodiveristy objectives to delivered?		To be advised by Landscape Architect and Ecologist at future design stages		
Does the variation in permanent water depth have the potential to create biodiverse habitats?		To be advised by Landscape Architect and Ecologist at future design stages		
Does the design of the pond fulfil objectives of availablity of different habitats including: deep water, marginal, dry/damp, other		To be advised by Landscape Architect and Ecologist at future design stages		
A planting schedule is provided, showing species and planting preferences. Is the planting demostrated appropriate for the habitat specified?		To be advised by Landscape Architect and Ecologist at future design stages		
Will planting be established or rely on natural colonisation?		To be advised by Landscape Architect and Ecologist at future design stages		
Have locally appropriate native plant species been used?		To be advised by Landscape Architect and Ecologist at future design stages		
Indicate the number of different plant species used (not a monoculture)		To be advised by Landscape Architect and Ecologist at future design stages		
Is the proposed pond/wetland planting appropriate to the location, and with respect to access and maintenance?		To be advised by Landscape Architect and Ecologist at future design stages		
Where relevant, confirm planting design does not adversely impact highway visibility and safety requirements (check with highway authority)		To be advised by Landscape Architect and Ecologist at future design stages		
Is the proposed topsoil profile suitable to sustain the proposed plant species?		To be advised by Landscape Architect and Ecologist at future design stages		
Critical materials and product specifications				
Geomembrane		Not enough design detail at this stage		
Geotextile (non-woven)		Not enough design detail at this stage		
Topsoil		Not enough design detail at this stage		
Other (including proprietary systems)		Not enough design detail at this stage		
Constructability				
Are there any identifiable construction risks? If yes, state and confirm acceptable risk management measures are proposed		Not enough design detail at this stage		
Maintainability				
Confirm that access for maintenance is acceptable and summarise details		A buffer of approximately 2-5m around the top of the pond will be required for maintenance. Suitable access road and turning space will be required in line with paragraph C5.4		
Are there specific features that are likely to pose maintenance difficulties? If yes, identify mitigation measures required		5m offset from HP gas main is provided	Y	Utilities team confirm legal easement will be 3m so 5m offset from HP gas main will be sufficient.

Ponds/Wetlands Design Checklist

Project Title	New Settlement at Wisloe
Project Number	332310150

DOCUMENT ISSUE RECORD

Rev	Comments	Prepared	Date	Checked	Date
0	Initial Design	RR	09/03/2021	LWD	10/03/2021
2	Revision following internal comments	RR	06/04/2021	LWD	07/04/2021
3	Revision following test 3D modelling	RR	21/06/2021	LWD	23/06/2021

Ponds/Wetlands - Minimum Design Requirements	
Ponds/Wetlnads Parameter	**Minimum design requirements (MDRs)**
Length to width ratio	>3:1
Maximum depth of permanent water	2 m
Maximum side slopes	1 in 3
Maximum depth of aquatic bench below permanent water level	400 mm
Size of permanent pool	≥ treatment volume, V_t

Ponds/Wetlands - Design Assessment Checklist			
General information			
Asset ID(s)	PO-3.1		
Ponds/Wetlands location(s) and co-ordinates	374210, 202423	Drawing reference(s)	\\tnt-vfps-001\tnt\Projects\50753 New Settlement at Wisloe\4001_Hydro Task_TA-HYD\CAD\DWGS\WIP_
Primary function(s) of pond/wetland:	Attenuation Volume up to 1:100 (+40%CC) storms, biodiversity and amenity provision		

Check	MDR	Summary details	Acceptable (Y/N)	Comments/remedial actions
Dimensions				
Length (m)		190m	Y	
Maximum and minimum width - permanent water level (m)				This can be provided when pond 3D modelled for Outline.
Length: maximum width ratio	✓	1:3.1	Y	>3:1 so sufficient flow path length for water quality treatment. Sufficient detail for Pre-Application and Outline, but for Reserved Matters confirm length:width from each inlet to the outlet.
Top surface area (m^2)		11472m²	Y	
Side slope (1 in ?)	✓	3	Y	
Depth of permanent water - maximum and minimum (m)	✓	1.0m	Y	Assumed max permanent water depth is the 1.0m quoted, which will avoid stratification issues.
Freeboard (m)		0.6m	Y	In accordnce with DCG requirements for SuDS adoption.
Aquatic bench width and slope (m, 1 in ?)	✓	1m 1 in 3	Y	SuDS Manual CIRIA C753 does not make any specific recommendations on width. The width can be varied depending on the extent of vegetation required for safety and aesthetic purposes.
Safety bench width and slope (m, 1 in ?)	✓	0.8m 1 in 3	Y	The SuDS Manual CIRIA C753 details a suitable width for a safety bench of 3.5m, due to limits in land availability a lower width is provided.
Inflows				
Provide a description of the contributing catchment land use and its size (m^2)		14.98 ha of residential development (assumed 65% PIMP) 1.78 ha of mixed use development (assumed 70% PIMP) 1.46 ha of Roads (100% PIMP) Total Impermeable Area = 4.65ha	Y	
Does the design include suitable silt interception upstream of system?		Silt interception will be provided by upstream SuDS, to be considered at next design stage	Y	"Toolbox" of upstream SuDS to be considered at Outline, whilst specifc types will be indicated for Reserved Matters. Additional measures such as catch-pits etc. may also be required immediately upstream. If these are not included, a forebay should be provided.
Does the design include:				
▪ **a suitable inlet design**		Not yet considered at this stage of works (outline planning)		
▪ **appropriate energy dissipation?**		Not yet considered at this stage of works (outline planning)		
Outfall arrangements				
Provide details of any flow control systems, overflow arrangements and limiting discharge rate from pond/wetland		Hydrobrake set to QBAR 10.23l/s (based on 2.2l/s/ha x 4.65ha) Overflows not yet considered	Y	
Is a geomemebrane required to prevent infiltration? If yes, give reason		Not yet considered at this stage (outline planning)		
Depth to maximum likely groundwater level (m)		Do not have required information at this stage		

Storage				
Design event return period(s) (years)		100 yr +40%CC	Y	
Maximum rise in water level(s) for the design events(s) (mm)	✓	0.5m	Y	Max water depth during design storm would be 2m, which is acceptable. Can be reduced if desired, but may impact land take.
Maximum water depth(s) at design event conditions (m)		1.5m	Y	
Maximum design storage volume(s) (m^3)		4,520m³	Y	Assume all below existing ground levels
Levels around the edge of the pond/wetland appropriate to contain design depths of water?		600mm of freeboard is to be provided in accordance with DCG requirements for SuDS adoption. 300mm below and 300mm above ground levels.	Y	
Water quality treatment				
For the 1 year 30 minute event or water quality treatment volume confirm:				
Permanent pool volume is sufficient for effective treatment	✓	Required permanent pool volume 698m³	Y	
OR				
Flow velocity is a acceptable for effective treatment	✓			
Landscape/biodiversity				
Is there sufficient treatment upstream of the pond to allow design amenity and biodiveristy objectives to delivered?		To be advised by Landscape Architect and Ecologist at future design stages		
Does the variation in permanent water depth have the potential to create biodiverse habitats?		To be advised by Landscape Architect and Ecologist at future design stages		
Does the design of the pond fulfil objectives of availablity of different habitats including: deep water, marginal, dry/damp, other		To be advised by Landscape Architect and Ecologist at future design stages		
A planting schedule is provided, showing species and planting preferences. Is the planting demostrated appropriate for the habitat specified?		To be advised by Landscape Architect and Ecologist at future design stages		
Will planting be established or rely on natural colonisation?		To be advised by Landscape Architect and Ecologist at future design stages		
Have locally appropriate native plant species been used?		To be advised by Landscape Architect and Ecologist at future design stages		
Indicate the number of different plant species used (not a monoculture)		To be advised by Landscape Architect and Ecologist at future design stages		
Is the proposed pond/wetland planting appropriate to the location, and with respect to access and maintenance?		To be advised by Landscape Architect and Ecologist at future design stages		
Where relevant, confirm planting design does not adversely impact highway visibility and safety requirements (check with highway authority)		To be advised by Landscape Architect and Ecologist at future design stages		
Is the proposed topsoil profile suitable to sustain the proposed plant species?		To be advised by Landscape Architect and Ecologist at future design stages		
Critical materials and product specifications				
Geomembrane		Not enough design detail at this stage		
Geotextile (non-woven)		Not enough design detail at this stage		
Topsoil		Not enough design detail at this stage		
Other (including proprietary systems)		Not enough design detail at this stage		
Constructability				
Are there any identifiable construction risks? If yes, state and confirm acceptable risk management measures are proposed		Not enough design detail at this stage		
Maintainability				
Confirm that access for maintenance is acceptable and summarise details		A buffer of approximately 2-5m around the top of the pond will be required for maintenance. Suitable access road and turning space will be required in line with paragraph C5.4 and C5.5 of the DCG (2020).	Y	
Are there specific features that are likely to pose maintenance difficulties? If yes, identify mitigation measures required				

Ponds/Wetlands Design Checklist

Project Title	New Settlement at Wisloe
Project Number	332310150

DOCUMENT ISSUE RECORD

Rev	Comments	Prepared	Date	Checked	Date
0	Initial Design	RR	09/03/2021	LWD	10/03/2021
2	Revision following internal comments	RR	06/04/2021	LWD	07/04/2021
3	Revision following test 3D modelling	RR	21/06/2021	LWD	23/06/2021

Ponds/Wetlands - Minimum Design Requirements	
Ponds/Wetlnads Parameter	**Minimum design requirements (MDRs)**
Length to width ratio	>3:1
Maximum depth of permanent water	2 m
Maximum side slopes	1 in 3
Maximum depth of aquatic bench below permanent water level	400 mm
Size of permanent pool	≥ treatment volume, V_t

Ponds/Wetlands - Design Assessment Checklist			
General information			
Asset ID(s)	PO-4.1		
Ponds/Wetlands location(s) and co-ordinates	374236, 202454	Drawing reference(s)	\\tnt-vfps-001\tnt\Projects\50753 New Settlement at Wisloe\4001_Hydro Task_TA-HYD\CAD\DWGS\WIP_
Primary function(s) of pond/wetland:	Attenuation Volume up to 1:100 (+40%CC) storms, biodiversity and amenity provision		

Check	MDR	Summary details	Acceptable (Y/N)	Comments/remedial actions
Dimensions				
Length (m)		135m	Y	
Maximum and minimum width - permanent water level (m)				This can be provided when pond 3D modelled for Outline.
Length: maximum width ratio	✓	1:3.4	Y	>3:1 so sufficient flow path length for water quality treatment. Sufficient detail for Pre-Application and Outline, but for Reserved Matters confirm length:width from each inlet to the outlet.
Top surface area (m^2)		6,686m²	Y	
Side slope (1 in ?)	✓	3	Y	
Depth of permanent water - maximum and minimum (m)	✓	1.0m	Y	Assumed max permanent water depth is the 1.0m quoted, which will avoid stratification issues.
Freeboard (m)		0.6m	Y	In accordnce with DCG requirements for SuDS adoption.
Aquatic bench width and slope (m, 1 in ?)	✓	1m 1 in 3	Y	SuDS Manual CIRIA C753 does not make any specific recommendations on width. The width can be varied depending on the extent of vegetation required for safety and aesthetic purposes.
Safety bench width and slope (m, 1 in ?)	✓	0.8m 1 in 3	Y	The SuDS Manual CIRIA C753 details a suitable width for a safety bench of 3.5m, due to limits in land availability a lower width is provided.
Inflows				
Provide a description of the contributing catchment land use and its size (m^2)		14.98 ha of residential development (assumed 65% PIMP) 1.78 ha of mixed use development (assumed 70% PIMP) 1.46 ha of Roads (100% PIMP) Total Impermeable Area = 7.79ha	Y	
Does the design include suitable silt interception upstream of system?		Silt interception will be provided by upstream SuDS, to be considered at next design stage	Y	"Toolbox" of upstream SuDS to be considered at Outline, whilst specifc types will be indicated for Reserved Matters. Additional measures such as catch-pits etc. may also be required immediately upstream. If these are not included, a forebay should be provided.
Does the design include:				
▪ **a suitable inlet design**		Not yet considered at this stage of works (outline planning)		
▪ **appropriate energy dissipation?**		Not yet considered at this stage of works (outline planning)		
Outfall arrangements				
Provide details of any flow control systems, overflow arrangements and limiting discharge rate from pond/wetland		Hydrobrake set to QBAR 17.14l/s (based on 2.2l/s/ha x 7.79ha) Overflows not yet considered	Y	
Is a geomemebrane required to prevent infiltration? If yes, give reason		Not yet considered at this stage (outline planning)		
Depth to maximum likely groundwater level (m)		Do not have required information at this stage		

Storage				
Design event return period(s) (years)		100 yr +40%CC	Y	
Maximum rise in water level(s) for the design events(s) (mm)	✓	0.5m	Y	Max water depth during design storm would be 2m, which is acceptable. Can be reduced if desired, but may impact land take.
Maximum water depth(s) at design event conditions (m)		1.5m	Y	
Maximum design storage volume(s) (m^3)		2,570m³	Y	Assume all below existing ground levels
Levels around the edge of the pond/wetland appropriate to contain design depths of water?		600mm of freeboard is to be provided in accordance with DCG requirements for SuDS adoption. 300mm below and 300mm above ground levels.	Y	
Water quality treatment				
For the 1 year 30 minute event or water quality treatment volume confirm:				
Permanent pool volume is sufficient for effective treatment	✓	Required treatment volume 584m³	Y	
OR				
Flow velocity is a acceptable for effective treatment	✓			
Landscape/biodiversity				
Is there sufficient treatment upstream of the pond to allow design amenity and biodiveristy objectives to delivered?		To be advised by Landscape Architect and Ecologist at future design stages		
Does the variation in permanent water depth have the potential to create biodiverse habitats?		To be advised by Landscape Architect and Ecologist at future design stages		
Does the design of the pond fulfil objectives of availablity of different habitats including: deep water, marginal, dry/damp, other		To be advised by Landscape Architect and Ecologist at future design stages		
A planting schedule is provided, showing species and planting preferences. Is the planting demostrated appropriate for the habitat specified?		To be advised by Landscape Architect and Ecologist at future design stages		
Will planting be established or rely on natural colonisation?		To be advised by Landscape Architect and Ecologist at future design stages		
Have locally appropriate native plant species been used?		To be advised by Landscape Architect and Ecologist at future design stages		
Indicate the number of different plant species used (not a monoculture)		To be advised by Landscape Architect and Ecologist at future design stages		
Is the proposed pond/wetland planting appropriate to the location, and with respect to access and maintenance?		To be advised by Landscape Architect and Ecologist at future design stages		
Where relevant, confirm planting design does not adversely impact highway visibility and safety requirements (check with highway authority)		To be advised by Landscape Architect and Ecologist at future design stages		
Is the proposed topsoil profile suitable to sustain the proposed plant species?		To be advised by Landscape Architect and Ecologist at future design stages		
Critical materials and product specifications				
Geomembrane		Not enough design detail at this stage		
Geotextile (non-woven)		Not enough design detail at this stage		
Topsoil		Not enough design detail at this stage		
Other (including proprietary systems)		Not enough design detail at this stage		
Constructability				
Are there any identifiable construction risks? If yes, state and confirm acceptable risk management measures are proposed		Not enough design detail at this stage		
Maintainability				
Confirm that access for maintenance is acceptable and summarise details		A buffer of approximately 2-5m around the top of the pond will be required for maintenance. Suitable access road and turning space will be required in line with paragraph C5.4 and C5.5 of the DCG (2020).	Y	
Are there specific features that are likely to pose maintenance difficulties? If yes, identify mitigation measures required				

Ponds/Wetlands Design Checklist

Project Title	New Settlement at Wisloe
Project Number	332310150

DOCUMENT ISSUE RECORD

Rev	Comments	Prepared	Date	Checked	Date
0	Initial Design	RR	09/03/2021	LWD	10/03/2021
2	Revision following internal comments	RR	06/04/2021	LWD	07/04/2021
3	Revision following test 3D modelling	RR	21/06/2021	LWD	23/06/2021

Ponds/Wetlands - Minimum Design Requirements	
Ponds/Wetlnads Parameter	**Minimum design requirements (MDRs)**
Length to width ratio	>3:1
Maximum depth of permanent water	2 m
Maximum side slopes	1 in 3
Maximum depth of aquatic bench below permanent water level	400 mm
Size of permanent pool	≥ treatment volume, V_t

Ponds/Wetlands - Design Assessment Checklist			
General information			
Asset ID(s)	PO-4.2		
Ponds/Wetlands location(s) and co-ordinates	374153, 202315	Drawing reference(s)	\\tnt-vfps-001\tnt\Projects\50753 New Settlement at Wisloe\4001_Hydro Task_TA-HYD\CAD\DWGS\WIP
Primary function(s) of pond/wetland:	Attenuation Volume up to 1:100 (+40%CC) storms, biodiversity and amenity provision		

Check	MDR	Summary details	Acceptable (Y/N)	Comments/remedial actions
Dimensions				
Length (m)		146m	Y	
Maximum and minimum width - permanent water level (m)				This can be provided when pond 3D modelled for Outline.
Length: maximum width ratio	✓	1:3.4	Y	>3:1 so sufficient flow path length for water quality treatment. Sufficient detail for Pre-Application and Outline, but for Reserved Matters confirm length:width from each inlet to the outlet.
Top surface area (m^2)		7099m²	Y	
Side slope (1 in ?)	✓	3	Y	
Depth of permanent water - maximum and minimum (m)	✓	1.0m	Y	Assumed max permanent water depth is the 1.0m quoted, which will avoid stratification issues.
Freeboard (m)		0.6m	Y	In accordnce with DCG requirements for SuDS adoption.
Aquatic bench width and slope (m, 1 in ?)	✓	1m 1 in 3	Y	SuDS Manual CIRIA C753 does not make any specific recommendations on width. The width can be varied depending on the extent of vegetation required for safety and aesthetic purposes.
Safety bench width and slope (m, 1 in ?)	✓	0.8m 1 in 3	Y	The SuDS Manual CIRIA C753 details a suitable width for a safety bench of 3.5m, due to limits in land availability a lower width is provided.
Inflows				
Provide a description of the contributing catchment land use and its size (m^2)		14.98 ha of residential development (assumed 65% PIMP) 1.78 ha of mixed use development (assumed 70% PIMP) 1.46 ha of Roads (100% PIMP) Total Impermeable Area = 7.79ha	Y	
Does the design include suitable silt interception upstream of system?		Silt interception will be provided by upstream SuDS, to be considered at next design stage	Y	"Toolbox" of upstream SuDS to be considered at Outline, whilst specifc types will be indicated for Reserved Matters. Additional measures such as catch-pits etc. may also be required immediately upstream. If these are not included, a forebay should be provided.
Does the design include:				
▪ **a suitable inlet design**		Not yet considered at this stage of works (outline planning)		
▪ **appropriate energy dissipation?**		Not yet considered at this stage of works (outline planning)		
Outfall arrangements				
Provide details of any flow control systems, overflow arrangements and limiting discharge rate from pond/wetland		Hydrobrake set to QBAR 17.14l/s (based on 2.2l/s/ha x 7.79ha) Overflows not yet considered	Y	
Is a geomemebrane required to prevent infiltration? If yes, give reason		Not yet considered at this stage (outline planning)		
Depth to maximum likely groundwater level (m)		Do not have required information at this stage		

Storage				
Design event return period(s) (years)		100 yr +40%CC	Y	
Maximum rise in water level(s) for the design events(s) (mm)	✓	0.5m	Y	Max water depth during design storm would be 2m, which is acceptable. Can be reduced if desired, but may impact land take.
Maximum water depth(s) at design event conditions (m)		1.5m	Y	
Maximum design storage volume(s) (m^3)		2,729m³	Y	Assume all below existing ground levels
Levels around the edge of the pond/wetland appropriate to contain design depths of water?		600mm of freeboard is to be provided in accordance with DCG requirements for SuDS adoption. 300mm below and 300mm above ground levels.	Y	
Water quality treatment				
For the 1 year 30 minute event or water quality treatment volume confirm:				
Permanent pool volume is sufficient for effective treatment	✓	Required treatment volume 584m³	Y	
OR				
Flow velocity is a acceptable for effective treatment	✓			
Landscape/biodiversity				
Is there sufficient treatment upstream of the pond to allow design amenity and biodiveristy objectives to delivered?		To be advised by Landscape Architect and Ecologist at future design stages		
Does the variation in permanent water depth have the potential to create biodiverse habitats?		To be advised by Landscape Architect and Ecologist at future design stages		
Does the design of the pond fulfil objectives of availablity of different habitats including: deep water, marginal, dry/damp, other		To be advised by Landscape Architect and Ecologist at future design stages		
A planting schedule is provided, showing species and planting preferences. Is the planting demostrated appropriate for the habitat specified?		To be advised by Landscape Architect and Ecologist at future design stages		
Will planting be established or rely on natural colonisation?		To be advised by Landscape Architect and Ecologist at future design stages		
Have locally appropriate native plant species been used?		To be advised by Landscape Architect and Ecologist at future design stages		
Indicate the number of different plant species used (not a monoculture)		To be advised by Landscape Architect and Ecologist at future design stages		
Is the proposed pond/wetland planting appropriate to the location, and with respect to access and maintenance?		To be advised by Landscape Architect and Ecologist at future design stages		
Where relevant, confirm planting design does not adversely impact highway visibility and safety requirements (check with highway authority)		To be advised by Landscape Architect and Ecologist at future design stages		
Is the proposed topsoil profile suitable to sustain the proposed plant species?		To be advised by Landscape Architect and Ecologist at future design stages		
Critical materials and product specifications				
Geomembrane		Not enough design detail at this stage		
Geotextile (non-woven)		Not enough design detail at this stage		
Topsoil		Not enough design detail at this stage		
Other (including proprietary systems)		Not enough design detail at this stage		
Constructability				
Are there any identifiable construction risks? If yes, state and confirm acceptable risk management measures are proposed		Not enough design detail at this stage		
Maintainability				
Confirm that access for maintenance is acceptable and summarise details		A buffer of approximately 2-5m around the top of the pond will be required for maintenance. Suitable access road and turning space will be required in line with paragraph C5.4 and C5.5 of the DCG (2020).	Y	
Are there specific features that are likely to pose maintenance difficulties? If yes, identify mitigation measures required				

FEH Greenfield Runoff

Using the 2008 Statistical Method QMED Equation

Project Title	Wisloe Green - Parcel 4
Project No	44396/4002

Methodology as set out in SuDS Manual 24.3.2 — SUDS Manual Chapter 24

1 Retrieve FEH Catchment Information

Define BFIHOST definition source		FEH	*see note 1*
Catchment Descriptors	**BFIHOST**	0.636	
	SAAR	719.0	*see note 1*
	FARL	1.0	*see note 2*

2 Derive QBAR (mean annual flood)

Define area	**Site Area**	29.0	ha	
	Applied Area	50.0	ha	*see note 3*
FEH Index Flood (SuDS Manual Equation 24.2)	**QMED (Q_2)**	56.8	l/s	*see note 4*
Calculate QBAR by dividing QMED by 2yr growth factor	**QBAR**	64.5	l/s	*see note 5*

3 Select appropriate growth factors

FSR Hydrological Region		8	*(refer to FSR Hydrological Region tab)*
100yr Growth Curve Factor	GQ_{100}	2.42	
30yr Growth Curve Factor	GQ_{30}	1.98	
10yr Growth Curve Factor	GQ_{10}	1.49	
2yr Growth Curve Factor	GQ_2	0.88	
1yr Growth Curve Factor	GQ_1	0.78	

4 Derive Flood Frequency

Greenfield Runoff per 1ha

100yr Peak Runoff Rate	Q_{100}	156.1	l/s	Q_{100}	5.4 l/s/ha
30yr Peak Runoff Rate	Q_{30}	127.7	l/s	Q_{30}	4.4 l/s/ha
10yr Growth Curve Rate	Q_{10}	96.1	l/s	Q_{10}	3.3 l/s/ha
QBAR Peak Runoff Rate	QBAR	64.5	l/s	Q_{BAR}	2.2 l/s/ha
2yr Peak Runoff Rate	Q_2	56.8	l/s	Q_2	2.0 l/s/ha
1yr Peak Runoff Rate	Q_1	50.3	l/s	Q_1	1.7 l/s/ha

Location of FEH Point Data (as Hyperlink) — ..\..\..\Project Incoming\FEH export\Par

DOCUMENT ISSUE RECORD

Rev	Comments	Prepared	Date	Checked	Date
-	Original calculation	LD	08/10/2019		

Notes — This spreadsheet has been created to allow derivation of greenfield runoff rates using the FEH statistical method applied in a manner consistent with the recommendations of the SuDS Manual. If you have recommendations to improve this spreadsheet please contact Alex Bearne.

Note 1 — FEH Web version 3 allows extraction of BFIHOST and SAAR values for each square kilometre grid Export point data from FEH Webs Service as .XML file and save in project folder and import in the FEH Point Data Import tab. If you do not think the BFIHOST value is representative of your site then it is possible to derive it manually. This should not normally be necessary. BFI can be derived manually using the methodology set out in the Flood Estimation Handbook (see Manual Derivation *of BFIHOST tab)* or can be defined from ground investigation information.
As default the sheet references the imported FEH data

Note 2 — FARL value is a measure of attenuation from reservoirs and lakes for the majority of studies this should be set to 1 (representing no attenuation). If your site includes a large water body with an attenuating affect on runoff please consult a hydrologist.
FARL is a measurement of studies water bodies in the catchment so that their attenuation effects sc this term becomes 1.0 and therefore drops out. (see page 23 of the Preliminary rainfall runoff management for developments EA/Defra 2013)
Rainfall runoff management for developments.pdf

Note 3 — If the site area is less than 50 hectare the spreadsheet will calculate QMED for 50ha and scale the results automatically to the defined Site Area

Note 4 — QMED is calculated using the statistical equation as revised by Kjeldsen in 2008

$$Q_{MED} = 8.3062AREA^{0.8510} .0.1536^{(1000/SAAR)} .FARL^{3.4451} .0.0460^{BFIHOST^2}$$

Rainfall runoff management for developments.pdf
It is reproduced as Equation 24.2 in the SUDS Manual (pg 512)

Note 5 — QBAR is calculated by dividing QMED by the growth factor for the 2 year event, as per the methodology set out in paragraph 6.2.2 of 'Rainfall runoff management for developments' . QBAR is then used as the index flood for the basis of applying the growth factors.

FEH Greenfield Runoff

Using the 2008 Statistical Method QMED Equation

Project Title	Wisloe Green - Parcels 1-3
Project No	44396/4002

Methodology as set out in SuDS Manual 24.3.2 — SUDS Manual Chapter 24

1 Retrieve FEH Catchment Information

Define BFIHOST definition source		FEH		*see note 1*
Catchment Descriptors	**BFIHOST**	0.571		
	SAAR	710.0		*see note 1*
	FARL	1.0		*see note 2*

2 Derive QBAR (mean annual flood)

Define area	**Site Area**	48.9	ha	
	Applied Area	50.0	ha	*see note 3*
FEH Index Flood (SuDS Manual Equation 24.2)	**QMED (Q_2)**	117.9	l/s	*see note 4*
Calculate QBAR by dividing QMED by 2yr growth factor	**QBAR**	134.0	l/s	*see note 5*

3 Select appropriate growth factors

FSR Hydrological Region		8	*(refer to FSR Hydrological Region tab)*
100yr Growth Curve Factor	GQ_{100}	2.42	
30yr Growth Curve Factor	GQ_{30}	1.98	
10yr Growth Curve Factor	GQ_{10}	1.49	
2yr Growth Curve Factor	GQ_2	0.88	
1yr Growth Curve Factor	GQ_1	0.78	

4 Derive Flood Frequency

Greenfield Runoff per 1ha

100yr Peak Runoff Rate	Q_{100}	324.3	l/s	Q_{100}	6.6 l/s/ha
30yr Peak Runoff Rate	Q_{30}	265.4	l/s	Q_{30}	5.4 l/s/ha
10yr Growth Curve Rate	Q_{10}	199.7	l/s	Q_{10}	4.1 l/s/ha
QBAR Peak Runoff Rate	QBAR	134.0	l/s	Q_{BAR}	2.7 l/s/ha
2yr Peak Runoff Rate	Q_2	117.9	l/s	Q_2	2.4 l/s/ha
1yr Peak Runoff Rate	Q_1	104.5	l/s	Q_1	2.1 l/s/ha

Location of FEH Point Data (as Hyperlink) — ..\..\..\Project Incoming\FEH export\Par

DOCUMENT ISSUE RECORD

Rev	Comments	Prepared	Date	Checked	Date
-	Original calculation	LD	08/10/2019		

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	0.142	0.142	2.7	256.4	O K
30 min Summer	0.189	0.189	2.7	343.2	O K
60 min Summer	0.239	0.239	2.7	436.4	O K
120 min Summer	0.289	0.289	2.7	531.8	O K
180 min Summer	0.317	0.317	2.7	584.9	O K
240 min Summer	0.336	0.336	2.7	622.5	O K
360 min Summer	0.364	0.364	2.7	676.9	O K
480 min Summer	0.384	0.384	2.7	714.3	O K
600 min Summer	0.398	0.398	2.7	741.7	O K
720 min Summer	0.408	0.408	2.7	762.5	O K
960 min Summer	0.423	0.423	2.7	791.3	O K
1440 min Summer	0.437	0.437	2.7	819.3	O K
2160 min Summer	0.440	0.440	2.7	824.9	O K
2880 min Summer	0.434	0.434	2.7	813.9	O K
4320 min Summer	0.420	0.420	2.7	786.5	O K
5760 min Summer	0.405	0.405	2.7	755.5	O K
7200 min Summer	0.389	0.389	2.7	724.0	O K
8640 min Summer	0.372	0.372	2.7	691.2	O K
10080 min Summer	0.354	0.354	2.7	657.3	O K
15 min Winter	0.159	0.159	2.7	287.3	O K
30 min Winter	0.211	0.211	2.7	384.7	O K
60 min Winter	0.267	0.267	2.7	489.3	O K
120 min Winter	0.323	0.323	2.7	596.8	O K
180 min Winter	0.354	0.354	2.7	657.1	O K
240 min Winter	0.376	0.376	2.7	699.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	137.645	0.0	174.3	19
30 min Summer	92.379	0.0	218.1	34
60 min Summer	59.033	0.0	372.4	64
120 min Summer	36.298	0.0	431.3	124
180 min Summer	26.843	0.0	443.1	184
240 min Summer	21.596	0.0	438.3	244
360 min Summer	15.886	0.0	423.3	364
480 min Summer	12.754	0.0	412.0	482
600 min Summer	10.747	0.0	403.6	602
720 min Summer	9.338	0.0	396.7	722
960 min Summer	7.475	0.0	385.8	962
1440 min Summer	5.451	0.0	369.9	1442
2160 min Summer	3.967	0.0	791.4	2160
2880 min Summer	3.162	0.0	759.3	2508
4320 min Summer	2.292	0.0	696.3	3244
5760 min Summer	1.823	0.0	1274.8	4040
7200 min Summer	1.528	0.0	1321.4	4896
8640 min Summer	1.323	0.0	1344.3	5712
10080 min Summer	1.172	0.0	1326.1	6560
15 min Winter	137.645	0.0	193.1	19
30 min Winter	92.379	0.0	227.4	34
60 min Winter	59.033	0.0	408.2	64
120 min Winter	36.298	0.0	446.2	122
180 min Winter	26.843	0.0	437.2	182
240 min Winter	21.596	0.0	427.7	240

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
360 min Winter	0.408	0.408	2.7	761.2	O K
480 min Winter	0.429	0.429	2.7	803.7	O K
600 min Winter	0.445	0.445	2.7	835.2	O K
720 min Winter	0.457	0.457	2.7	859.4	O K
960 min Winter	0.475	0.475	2.7	893.7	O K
1440 min Winter	0.493	0.493	2.7	929.9	O K
2160 min Winter	0.500	0.500	2.7	944.1	O K
2880 min Winter	0.495	0.495	2.7	935.3	O K
4320 min Winter	0.476	0.476	2.7	896.3	O K
5760 min Winter	0.455	0.455	2.7	855.5	O K
7200 min Winter	0.433	0.433	2.7	811.4	O K
8640 min Winter	0.409	0.409	2.7	764.8	O K
10080 min Winter	0.385	0.385	2.7	716.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
360 min Winter	15.886	0.0	415.5	358
480 min Winter	12.754	0.0	408.3	478
600 min Winter	10.747	0.0	403.3	596
720 min Winter	9.338	0.0	399.5	712
960 min Winter	7.475	0.0	394.8	944
1440 min Winter	5.451	0.0	390.6	1402
2160 min Winter	3.967	0.0	804.5	2076
2880 min Winter	3.162	0.0	779.9	2712
4320 min Winter	2.292	0.0	734.1	3416
5760 min Winter	1.823	0.0	1418.7	4328
7200 min Winter	1.528	0.0	1456.5	5264
8640 min Winter	1.323	0.0	1437.1	6224
10080 min Winter	1.172	0.0	1370.7	7152

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.800	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.000

Time (mins) From:	To:	Area (ha)
0	4	1.000

Model Details

Storage is Online Cover Level (m) 0.900

Tank or Pond Structure

Invert Level (m) 0.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1775.0	0.500	2006.1	0.900	2201.1

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0085-2700-0500-2700
Design Head (m)	0.500
Design Flow (l/s)	2.7
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	85
Invert Level (m)	0.000
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.500	2.7	Kick-Flo®	0.351	2.3
Flush-Flo™	0.153	2.7	Mean Flow over Head Range	-	2.3

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.6	0.800	3.3	2.000	5.1	4.000	7.1	7.000	9.3
0.200	2.7	1.000	3.7	2.200	5.4	4.500	7.5	7.500	9.6
0.300	2.5	1.200	4.0	2.400	5.6	5.000	7.9	8.000	9.9
0.400	2.4	1.400	4.3	2.600	5.8	5.500	8.2	8.500	10.3
0.500	2.7	1.600	4.6	3.000	6.2	6.000	8.6	9.000	10.6
0.600	2.9	1.800	4.9	3.500	6.7	6.500	9.0	9.500	10.8

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	0.135	0.135	2.2	256.7	O K
30 min Summer	0.180	0.180	2.2	343.8	O K
60 min Summer	0.227	0.227	2.2	437.6	O K
120 min Summer	0.276	0.276	2.2	534.1	O K
180 min Summer	0.303	0.303	2.2	588.3	O K
240 min Summer	0.322	0.322	2.2	627.0	O K
360 min Summer	0.350	0.350	2.2	683.7	O K
480 min Summer	0.369	0.369	2.2	723.6	O K
600 min Summer	0.384	0.384	2.2	753.5	O K
720 min Summer	0.395	0.395	2.2	776.9	O K
960 min Summer	0.412	0.412	2.2	810.8	O K
1440 min Summer	0.430	0.430	2.2	849.0	O K
2160 min Summer	0.440	0.440	2.2	869.2	O K
2880 min Summer	0.439	0.439	2.2	867.3	O K
4320 min Summer	0.429	0.429	2.2	845.5	O K
5760 min Summer	0.417	0.417	2.2	820.9	O K
7200 min Summer	0.405	0.405	2.2	796.2	O K
8640 min Summer	0.392	0.392	2.2	770.4	O K
10080 min Summer	0.379	0.379	2.2	744.0	O K
15 min Winter	0.151	0.151	2.2	287.6	O K
30 min Winter	0.201	0.201	2.2	385.3	O K
60 min Winter	0.254	0.254	2.2	490.5	O K
120 min Winter	0.308	0.308	2.2	599.1	O K
180 min Winter	0.339	0.339	2.2	660.5	O K
240 min Winter	0.360	0.360	2.2	704.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	137.645	0.0	157.3	19
30 min Summer	92.379	0.0	184.8	34
60 min Summer	59.033	0.0	342.6	64
120 min Summer	36.298	0.0	366.9	124
180 min Summer	26.843	0.0	362.0	184
240 min Summer	21.596	0.0	355.8	244
360 min Summer	15.886	0.0	342.4	364
480 min Summer	12.754	0.0	331.9	484
600 min Summer	10.747	0.0	324.4	602
720 min Summer	9.338	0.0	318.7	722
960 min Summer	7.475	0.0	310.3	962
1440 min Summer	5.451	0.0	301.5	1442
2160 min Summer	3.967	0.0	636.1	2160
2880 min Summer	3.162	0.0	613.7	2880
4320 min Summer	2.292	0.0	573.7	3584
5760 min Summer	1.823	0.0	1219.3	4320
7200 min Summer	1.528	0.0	1198.2	5112
8640 min Summer	1.323	0.0	1136.9	5960
10080 min Summer	1.172	0.0	1077.5	6760
15 min Winter	137.645	0.0	171.1	19
30 min Winter	92.379	0.0	186.7	34
60 min Winter	59.033	0.0	362.9	64
120 min Winter	36.298	0.0	364.2	122
180 min Winter	26.843	0.0	354.6	182
240 min Winter	21.596	0.0	345.1	242

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
360 min Winter	0.391	0.391	2.2	768.6	O K
480 min Winter	0.413	0.413	2.2	813.6	O K
600 min Winter	0.430	0.430	2.2	847.7	O K
720 min Winter	0.443	0.443	2.2	874.6	O K
960 min Winter	0.462	0.462	2.2	914.2	O K
1440 min Winter	0.484	0.484	2.2	960.8	O K
2160 min Winter	0.498	0.498	2.2	989.7	O K
2880 min Winter	0.500	0.500	2.2	994.3	O K
4320 min Winter	0.488	0.488	2.2	970.0	O K
5760 min Winter	0.472	0.472	2.2	936.5	O K
7200 min Winter	0.457	0.457	2.2	904.1	O K
8640 min Winter	0.440	0.440	2.2	868.4	O K
10080 min Winter	0.422	0.422	2.2	830.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
360 min Winter	15.886	0.0	333.6	360
480 min Winter	12.754	0.0	327.3	478
600 min Winter	10.747	0.0	323.6	596
720 min Winter	9.338	0.0	321.5	714
960 min Winter	7.475	0.0	321.2	950
1440 min Winter	5.451	0.0	319.1	1414
2160 min Winter	3.967	0.0	649.4	2096
2880 min Winter	3.162	0.0	635.8	2768
4320 min Winter	2.292	0.0	610.6	4020
5760 min Winter	1.823	0.0	1285.8	4552
7200 min Winter	1.528	0.0	1234.9	5472
8640 min Winter	1.323	0.0	1180.8	6400
10080 min Winter	1.172	0.0	1126.2	7360

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.800	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.000

Time From: (mins)	To: (mins)	Area (ha)
0	4	1.000

Model Details

Storage is Online Cover Level (m) 0.900

Tank or Pond Structure

Invert Level (m) 0.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1872.0	0.500	2109.1	0.900	2309.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0078-2200-0500-2200
Design Head (m)	0.500
Design Flow (l/s)	2.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	78
Invert Level (m)	0.000
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.500	2.2	Kick-Flo®	0.345	1.9
Flush-Flo™	0.150	2.2	Mean Flow over Head Range	-	1.9

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.1	0.800	2.7	2.000	4.2	4.000	5.8	7.000	7.5
0.200	2.2	1.000	3.0	2.200	4.3	4.500	6.1	7.500	7.8
0.300	2.0	1.200	3.3	2.400	4.5	5.000	6.4	8.000	8.1
0.400	2.0	1.400	3.5	2.600	4.7	5.500	6.7	8.500	8.3
0.500	2.2	1.600	3.7	3.000	5.0	6.000	7.0	9.000	8.6
0.600	2.4	1.800	4.0	3.500	5.4	6.500	7.3	9.500	8.8

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WISLOE

D7. Ecology Biodiversity Net Gain

Stantec

Stantec

TECHNICAL NOTE

Job Name:	Wisloe Garden Village
Job No:	44396
Date:	14th July 2021
Prepared By:	Duncan McLaughlin
Subject:	**Biodiversity Metric Report**

1. Introduction

1.1. Stantec was commissioned by The Ernest Cook Trust and Gloucestershire County Council to undertake a biodiversity metric calculation to inform the masterplan development and the Regulation 19 Representations for an area of land 'the Site' identified for the Wisloe Garden Village 'the Proposed Development'. The Site and layout for the Proposed Development are shown on the Concept Masterplan in **Section 7**.

1.2. The Ernest Cook Trust and Gloucestershire County Council are seeking to deliver ecological and environmental gains within the Site as part of the development, and this note demonstrates that the Proposed Development is able to deliver net gains in biodiversity, in accordance with planning policy and emerging legislation (the Environment Bill).

1.3. This technical note aims to:

- Set out the legislation and policy framework for the use of Biodiversity Metric 2.0 and the delivery of Biodiversity Net Gain;
- Confirm the steps undertaken through scheme design evolution to implement the mitigation hierarchy, prior to consideration of the Biodiversity Metric;
- Set out the methodology and assumptions used in the application of the biodiversity metric to the Proposed Development;
- Provide a summary of the results of the biodiversity metric calculations; and
- Confirm any required next steps and the mechanism for securing Biodiversity Net Gain.

2. Background and planning context

2.1. The site was included within the SDC Local Plan Review - Draft Plan for Consultation (SDC, 2019) that was produced in November 2019 with a view to allocating it for a 'new garden community comprising 5 ha employment, approximately 1,500 dwellings, local centre including shops and community uses, primary school(s) and associated community and open space uses and strategic green infrastructure and landscaping'.

2.2. .

2.3. The proposed Green Infrastructure Strategy for the site integrates the creation of new habitats including woodland, scrub, orchards, meadows and wetlands and other biodiversity features with the aim of securing long term landscape enhancement and biodiversity net gain.

2.4. Following the submission of the masterplan and additional evidence as part of the Regulation 19 consultation on the Stroud District Local Plan, The Ernest Cook Trust and Gloucestershire County Council intend to continue engagement with the local community and other stakeholders to progress the masterplan and development proposals in advance of the Local Plan Examination stage.

3. Biodiversity Metric and Biodiversity Net Gain: Background, Legislation and Policy Framework

Biodiversity Metrics

3.1. Biodiversity is complex and therefore to simplify the quantification, metrics have been developed. Metrics use habitat features as a proxy measure for biodiversity. They use a simple calculation that takes into account the importance of these habitats features for nature, using criteria such as their size, distinctiveness and ecological condition. Metrics enable assessments to be made of the present and forecast future biodiversity value of a site, by calculating biodiversity gains and losses.

3.2. Metrics enable developers to better understand and quantify the current biodiversity value of a site, and how proposed changes to that site, will impact on that value. Metrics enable developers to see how they might be able to design a site in a way that increases its biodiversity value over time.

3.3. The use of a biodiversity metric assumes the principles of the mitigation hierarchy have been adopted and used when developing measures to address impacts on biodiversity receptors. The principles of the mitigation hierarchy are that, in order of preference, impacts on biodiversity should be subject to avoidance, mitigation, and compensation.

Biodiversity Net Gain: Background, Legislation and Policy Framework

3.4. The UK Government's Natural Environment White Paper: 'The Natural Choice: securing the value of nature' (HM Government 2011) introduced several policies to conserve the environment. One policy included the system of accounting, termed 'biodiversity offsetting'.

3.5. The National Planning Policy Framework (NPPF) (Ministry of Housing, Communities and Local Government, 2019) sets out a broad framework of policies for the planning system in England and how they should be applied. Underpinning the framework is the principal aim of 'sustainable development' which is to be pursued through the fulfilment of interdependent economic, social and environmental objectives.

3.6. Chapter 15 of the NPPF details core policy principles with respect to conserving and enhancing the natural environment. Securing 'net gains' for biodiversity, in accordance with the Government's 'A Green Future; Our 25 Year Plan to Improve the Environment' paper is a key theme running through the chapter, whereby planning decisions are required to contribute to and enhance the natural environment by "minimising impacts and providing net gains for biodiversity", and plans should "identify and pursue opportunities for securing measurable net gains for biodiversity". The chapter also places planning decisions in the context of the mitigation hierarchy where, if impacts on biodiversity cannot be avoided, mitigated, or as a last resort compensated for, then planning permission should be refused.

3.7. The Government has committed to mandate Biodiversity Net Gain in England through the Environment Bill (due to be enacted in autumn 2021), and the revision of the NPPF. The Government has also stated that forthcoming legislation will require development to achieve a 10% net gain for biodiversity.

3.8. In addition, Section 40 of the Natural Environment and Rural Communities (NERC) Act 2006 places duties on public bodies to have regard to the conservation of biodiversity in the exercise of their normal functions. Section 41 of the NERC Act 2006 defines Habitats and Species of Principal Importance to nature conservation in England which should be considered by all public bodies, including Local Planning Authorities, when carrying out their Section 40 duties. 'Planning Practice Guidance for the Natural Environment' (Planning Portal 2014) and the 'British Standard for Biodiversity in Planning' (BS 42020:2013) both recommend the system of biodiversity offsetting as an appropriate mechanism of delivering biodiversity compensation.

3.9. Biodiversity Net Gain requires developers to ensure habitats for wildlife are enhanced and left in a measurably better state than they were pre-development. An assessment must be undertaken, using a biodiversity metric, of the type of habitat and habitat condition within the site before any development; and then it must be demonstrated how the development is improving biodiversity, such as through the creation of new habitats, or the enhancement of existing habitats. Biodiversity improvements on-site are preferable, but where this is not possible, habitat creation or enhancements can be provided off-site.

3.10. Whilst delivery of BNG is not within Stroud's current adopted planning policy, the draft local plan requires new developments to deliver 10% net gains. Accordingly, the Proposed Development, in line with best practice and anticipated forthcoming legislation and Stroud's emerging draft policies, will need to need to demonstrate how 10% BNG can be achieved.

4. Methodology

Overview

4.1. To determine whether the Proposed Development delivers on-site Biodiversity Net Gain, a biodiversity metric has been calculated, taking into account habitat areas within the Site. The methodology for this metric is set out below.

4.2. The following guidance has been used when undertaking the biodiversity metric calculations, and during development of the Proposed Development to ensure it delivers Biodiversity Net Gain:

- The Biodiversity Metric 2.0: User Guide and Technical Supplement (NEJP029) (Natural England, 2019);
- Biodiversity Net Gain. Good practice principles for development: a practical guide (CIEEM, CIRIA, IEMA, 2019); and,
- Biodiversity Net Gain. Good practice principles for development (CIEEM, CIRIA, IEMA, 2016).

Site Baseline, Design Evolution and Mitigation Hierarchy

4.3. A Phase 1 habitat survey following Phase 1 Habitat Survey methodology (Joint Nature Conservation Committee, 2010) was undertaken at the Site in August 2019 (All Ecology Ltd (2019) Wisloe Green Ecological Appraisal). The data from this survey has been used to inform the baseline habitat calculations for the Site. The Phase 1 habitat plan can be viewed within **Section 7**.

4.4. The data from the Phase 1 habitat survey have been used to inform the Concept Masterplan (show in **Section 7**), which seeks to retain features within the site of ecological value. As such the majority of the hedgerow network within the Site is retained, with only small sections removed to facilitate access through the site.

Biodiversity Metric

4.5. The Biodiversity Metric 2.0 tool has been used to undertake the biodiversity metric calculations. The Biodiversity Metric 2.0 was published by Natural England in 2019 as beta test version.

4.6. The metric calculates the biodiversity value of each parcel of habitat within the Site (measured as biodiversity units). Habitat area is used, except for linear habitats, where length is used (i.e. for hedgerows). The value of each habitat type/area is adjusted to site specific circumstances, taking into account rarity, condition, connectivity and if the habitat parcel is located in an area identified as being of significance for nature, typically in a Local Biodiversity Action Plan. The components of habitat value are shown at **Plate 1**. A score is applied to each component, which is then multiplied to produce a score which represents the number of biodiversity units associated with each habitat parcel. The sum of these scores across the whole site represents the overall baseline or "pre-development" value in biodiversity units.

Plate 1. Components of the Biodiversity Net Gain Metric (taken from The Biodiversity Metric 2.0: User Guide, Natural England 2019 (NB note the current version remains a beta version).

Distinctiveness	A score based on the type of habitat present. For example, modified/amenity grassland is given a score of "2"
Condition	A score based on the quality of the habitat. This is determined by condition criteria set out in the technical supplement
Strategic significance	A score based on whether the location of the development and or off-site work has been identified locally as significant for nature
Connectivity	A score based on the proximity of the habitat patch to similar or related habitats.

4.7. The post-intervention (or "post-development") biodiversity unit value is calculated in the same way, but with the addition of factors to take into account risks associated with creating, enhancing or restoring habitats. These factors are detailed in **Plate 2**.

Plate 2. Post-Development Risk Components of the Biodiversity Net Gain Metric (taken from The Biodiversity Metric 2.0: User Guide, Natural England 2019)

Difficulty of creating or restoring a habitat	A standard score based on how difficult the habitat type is to create
Temporal risk	A standard score based on how long the habitat type takes to establish.
Off-site risk	A score based on whether any compensation is undertaken sufficiently nearby to the site at which habitat is lost

4.8. The calculated value of the "post-development" biodiversity units is then deducted from the calculated value of the "pre-development" biodiversity units to give a net change in biodiversity unit value. The complete calculation is summarised in **Plate 3**.

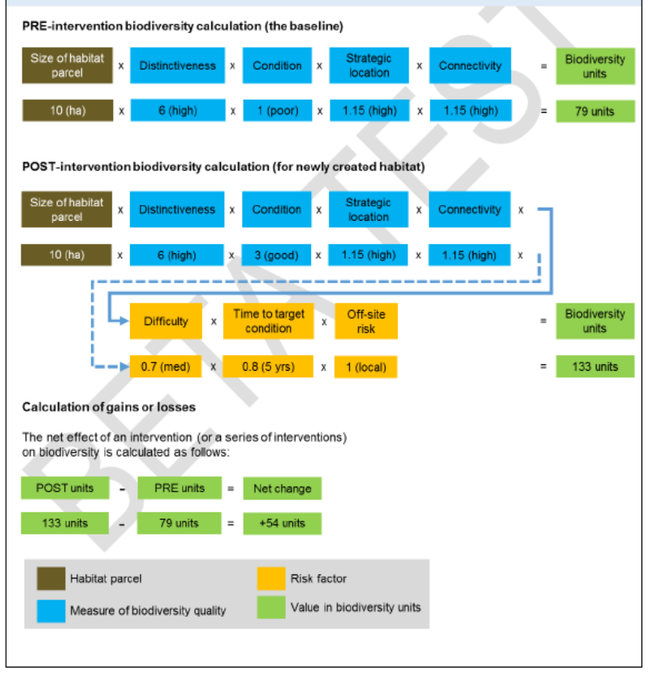
Plate 3. Summary of Biodiversity Net Gain Calculation (taken from The Biodiversity Metric 2.0: User Guide, Natural England 2019)

BOX 2-2: Calculating the biodiversity unit value of a habitat

How we calculate biodiversity value for habitats is illustrated in the scenario below:

- The pre-intervention calculation that establishes the baseline biodiversity unit value of a habitat. In essence, that multiplies the size of a habitat parcel by its 'quality' scores, and
- The post-intervention calculation that gives you the biodiversity unit value of a habitat after it has been changed. This calculation also takes account of the difficulty and time it takes to create the new habitat.

How these calculations are used in an example scenario is illustrated in BOX 2-3. *N.B. In this example the 'high' connectivity score has been derived from local data.*



4.9. Where Biodiversity Net Gain is not achievable within the site, then off-site compensation areas can be used, and the same calculation undertaken. The biodiversity unit value of the off-site habitats is calculated for the "pre-intervention" and "post-intervention" stages. The "pre-intervention" units are then subtracted from the "post-intervention" units to work out how many biodiversity units will result from that habitat change.

Pre-development assumptions

4.10. The biodiversity metric calculations have been undertaken for the Site's pre-development scenario using data collected during the Phase 1 habitat survey in 2019. This data has been interpreted to provide the necessary information for the "pre-development" calculation which is based on the UK Habitat Classification System (UKHab) (for terrestrial habitats). The Phase 1 habitat plan in **Section 7** shows the pre-development scenario used in this assessment.

4.11. In some instances, professional judgement has been required in translating Phase 1 habitat types to UKHab types. In these instances, a precautionary approach has been taken to ensure the baseline habitat value is 'over'- rather than 'under'-valued.

4.12. Improved grassland fields recorded during the Phase 1 habitat survey are agriculturally improved and are dominated by perennial rye-grass, and as such have been classified as 'Modified grassland' within the metric.

4.13. Phase 1 Habitat type 'Buildings' have been listed as UKHab type 'Urban – Developed Land; Sealed Surface' as a 'Buildings' category isn't available.

4.14. In accordance with the user guidance, all high or very high distinctiveness habitats have been assigned "medium" connectivity, with all other habitat types assigned "low" habitat connectivity.

4.15. Hedgerows have been assigned a high strategic significance (i.e. 'within area formally identified in local strategy') as this habitat is included within the Gloucestershire Local Biodiversity Action Plan.

4.16. A small area of the Site to the south of the railway line which is identified for the delivery of a cycle path and green infrastructure has been excluded from the calculations. The 2019 Phase 1 habitat survey did not cover this area and so no baseline data was available to inform the metric calculations.

Post-development assumptions

4.17. The biodiversity metric calculations have been undertaken for the Proposed Development post-development scenario drawing on the BNG Calculation Plan which can be viewed in **Section 7** (LHC 00 00 DR UD 01.03). Further information on lengths of hedgerows which can be provided within the strategic landscaping have been provided by LHC. Given the early stage of design for the scheme, the Concept Masterplan may not represent the final scheme layout, however it is considered sufficient to provide an indication of the likely land use, and to demonstrate an initial BNG score of the Proposed Development.

4.18. No weighting has been given to the suitability of habitats to support protected / notable species.

4.19. In some instances, professional judgement has been required in translating the proposed habitat types to UKHAB types. In these instances, a precautionary approach has again been taken.

4.20. For the 'Residential Blocks' as shown on the Concept Masterplan, two habitat types have been used within the metric:

- 75% of this land area has been assigned as UKHab "Suburban mosaic of developed/natural surface" to reflect mixture of houses/drives etc and back gardens/communal spaces with planting/ drainage etc. As there is unlikely to be much control over what happens to private gardens, the condition has been assigned as "poor"
- 25% of this land area has been assigned as 'Developed Land / Sealed surface' to reflect associated infrastructure such as roads, footpaths, cycleways.

4.21. 'Ponds' have been assigned as 'Sustainable urban drainage feature'. This habitat type is considered precautionary, and if designed well for biodiversity it may be possible to assign the habitat as 'Pond (non-priority)' which would improve the BNG score.

4.22. Where native woodland habitat has been proposed, this has been assigned as 'other woodland – broadleaved'. It is assumed this will be mixed native woodland planting, with favourable management plan to encourage mixed structure, and therefore a 'moderate' habitat condition has been assigned.

4.23. Where native meadow planting has been proposed, this has been assigned as 'other neutral grassland'. Whilst a species rich grassland is the target, a 'moderate' condition chosen due to suburban location and difficulty in managing solely for biodiversity.

4.24. In accordance with the user guidance, all high or very high distinctiveness habitats have been assigned medium connectivity, with all other habitat types assigned low habitat connectivity.

4.25. Hedgerows have been assigned a high strategic significance (i.e. 'within area formally identified in local strategy') as this habitat is included within the Gloucestershire Local Biodiversity Action Plan.

5. Summary of Results of the Biodiversity Metric

5.1. The key findings of the assessment using the Biodiversity Metric 2.0 are that the Proposed Development will result in:

- An **increase of 26.11** habitat units, indicating a **16.78% net gain**.
- An **increase of 12.42** hedgerow units, indicating a **23.25% net gain**.

5.2. A further summary of the results can be found in **Appendix A**, and the detailed results of the biodiversity metric calculations are provided in 'Detailed Results' tab of the accompanying Wisloe Biodiversity Metric 2.0 Calculation Tool.

6. Conclusions and Next Steps

6.1. The biodiversity metric (V2) indicates the Proposed Development could result in **16.78% net gain** in habitats units, and a **23.25% net gain** in hedgerow units based on the assumptions noted in **Section 4**. A minimum of 10% increase in habitat units is likely to be a requirement when the development is brought forward, mandated by the forthcoming Environment Bill, and through the planning system as part of the emerging Local Plan. A 10% increase in biodiversity units would be achieved with the current proposals (and assumptions).

6.2. There is interplay with all habitat types and areas pre-and post-development, so any changes to the Concept Masterplan could alter the results shown. Therefore, the biodiversity metric should be periodically re-calculated to ensure the Proposed Development continues to deliver the required biodiversity gains and meet requirements of forthcoming legislation and planning policy.

6.3. It should be noted that Version 3 of the Defra Biodiversity Metric is due to be released in summer 2021 and will become the standard metric to use. Therefore Version 3 of the Defra Metric should be used for any re-calculation once it is available.

DOCUMENT ISSUE RECORD

Technical Note No	Rev	Date	Prepared	Checked	Reviewed (Discipline Lead)	Approved (Project Director)
44396/eco/1	-	14/07/21	DM	RM	RM	ER

TECHNICAL NOTE

Figures

- Concept Masterplan
- Phase 1 habitat plan
- BNG Measurements Plan

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CAMBRIDGE

SLIMBRIDGE

RIVER CAM

A38

M5

CAM & DURSLEY

KEY

- Wisloe Village Centre
- Key Play Areas
- Allotment/Orchard
- Nest & Bat Boxes
- Wetlands/SUDs
- Pocket Parks
- Amenity Space/Pitches
- Wildflower Meadows
- Informal Open Space
- Acoustic Bund
- Green Infrastructure
- Developable Areas
- Strategic Cycle/Pedestrian Link
- Primary Walking/Cycle Routes
- Proposed Bus Route
- Employment Areas

lhc design

Wisloe Green
Concept Masterplan
1:2000@A0 June 2021

N

Site Boundary
Target Note
Trees
Dry Ditch
Running Water
Fence
Native Species-Rich Hedge
Native species-rich hedge and trees
Species-Poor Hedge
Arable
Improved Grassland
Broadleaved Plantation Woodland
Building
Hardstanding

Stantec

Client: Gloucestershire County Council / The Ernest Cook Trust

WISLOE

Phase 1 Habitat Survey

0 250 500 m

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

1:6,000 @ A3 | Date: 11/06/2021

Drawn: IB | Checked: DM

Figure 01 | Rev A

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Employment Block 1
0.7ha

11.19ha

33.89ha

3.06ha

46.15ha

28.79ha

Existing Stream

Mounding with Native
Structure Planting

Employment Block 2
4.0ha

Key

- Site Boundary
- Existing Trees
- Existing Hedgerows
- Proposed Residential Blocks
- Proposed Employment 0ha
- Proposed Local Centre
- Proposed School 2.7ha
- Proposed Roads
- Proposed Foot/Cycle Paths
- Proposed Foot/Cycle Paths (Outside Boundary)
- Proposed Public Square (Paving & Ornamental Planting)
- Proposed Native Woodland/ Structure Planting
- Proposed Native Meadow Planting
- Proposed Native Wetland Meadow Planting
- Proposed Amenity Grass/Pitches
- Proposed Allotment
- Proposed Orchard
- Proposed Pond
- Proposed Swale
- Proposed Rain Garden
- Proposed >>

N

0 250m

DRAFT

#	DD.MM.YY	#	DD / MM
REV	DATE	COMMENTS	AUTHOR / CHECKED

PROJECT TITLE
Wisloe

DETAIL
BNG Calculation Plan

DRAWING NUMBER
(PROJECT-ORIGINATOR-ZONE-LEVEL-TYPE-ROLE-NUMBER)
WIS - LHC - 00 - 00 - DR - UD - 01.03

STATUS	STATUS DESCRIPTION	
S2	FOR INFORMATION	
REVISION	DATE	SCALE
X	June 2021	1:2500 @A0

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20006

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TECHNICAL NOTE

Appendix A Summary of Metric Results

On-site baseline	*Habitat units*	155.74
	Hedgerow units	53.40
	River units	0.00
On-site post-intervention (Including habitat retention, creation, enhancement & succession)	*Habitat units*	181.85
	Hedgerow units	65.82
	River units	0.00
Off-site baseline	*Habitat units*	0.00
	Hedgerow units	0.00
	River units	0.00
Off-site post-intervention (Including habitat retention, creation, enhancement &	*Habitat units*	0.00
	Hedgerow units	0.00
	River units	0.00
Total net unit change (including all on-site & off-site habitat retention/creation)	*Habitat units*	26.11
	Hedgerow units	12.42
	River units	0.00
Total net % change (including all on-site & off-site habitat creation + retained habitats)	*Habitat units*	16.76%
	Hedgerow units	23.25%
	River units	0.00%

On-site habitat retention and enhancement

	Habitats	Hedgerows	Rivers
Total site area / length	78.24	5.56	0.00
Total site units	155.74	53.40	0.00
Area / length retained	0.18	4.15	0.00
Units Retained	0.72	42.68	0.00
Area / length enhanced	0.00	1.00	0.00
Baseline units enhanced	0.00	4.60	0.00
Area / length succession	0.00		
Units succession	0.00		
Area / length lost	78.06	0.41	0.00
Units lost	155.02	6.12	0.00

lost by distinctiveness

Category	Area lost (hectares)	Area lost (%)
V.High	0	
High	0	
Medium	0.14	0
Low	77.23	100
V.Low	0	

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Stantec Social savills