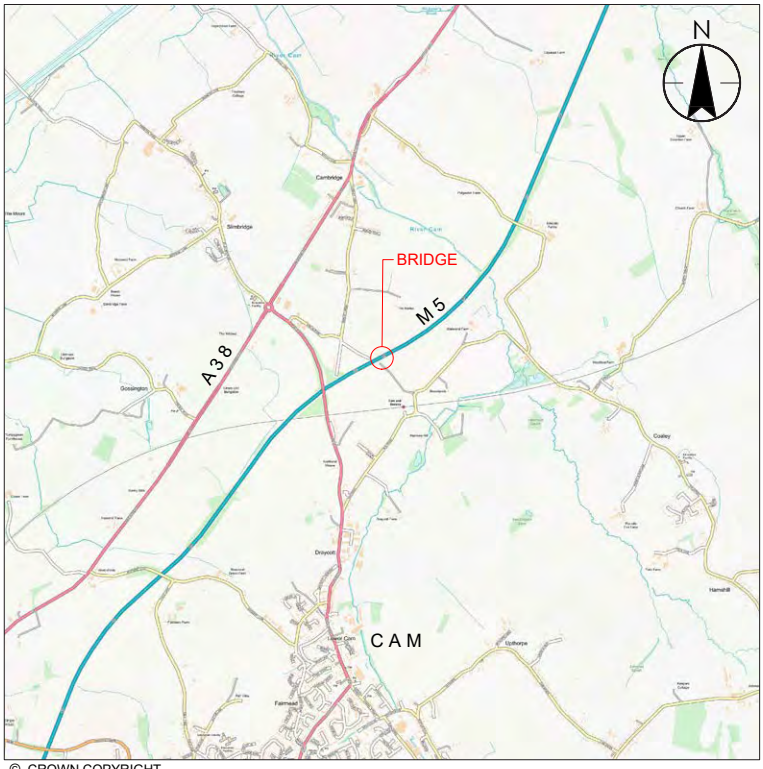
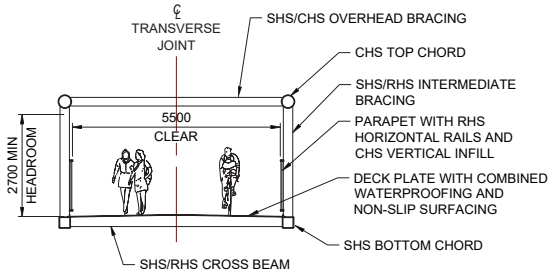
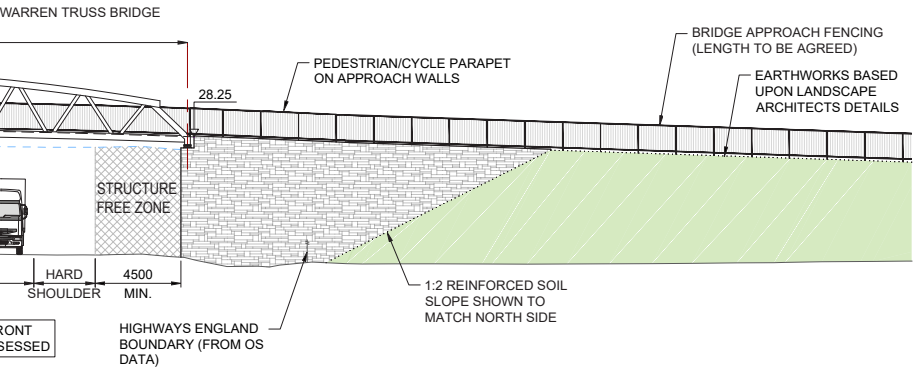


LOCATION PLAN

BRIDGE CO-ORDINATES
E: 375169.064m
N: 202507.654m



02 SECTION 02
0002 1:100



Stantec UK Limited
TAUNTON
Lakeside House, Blackbrook Business Park, Blackbrook
Park Avenue, Taunton TA1 2PX
Tel: +44 1823 218 940
www.stantec.com/uk

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.

0100.1 THIS DRAWING IS BASED UPON PRELIMINARY DATA AND IS FOR ILLUSTRATIVE PURPOSES ONLY

0100.2 ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.

0100.3 ALL LEVELS ARE IN METRES AND RELATIVE TO ORDNANCE DATUM (NEWLYN).

0100.4 THIS DRAWING IS BASED UPON THE FOLLOWING SUPPLIED DIGITAL INFORMATION:
- CONTAINS ENVIRONMENT AGENCY INFORMATION © ENVIRONMENT AGENCY AND DATABASE RIGHTS.
- CONTAINS ORDNANCE SURVEY DATA © CROWN COPYRIGHT AND DATABASE RIGHT 2021.
- © CROWN COPYRIGHT AND DATABASE RIGHTS 2021 ORDNANCE SURVEY 0100031673.
- LANDSCAPE ARCHITECTS PLAN: Drg. REFERENCE: M5 bridge sketch options.dwg

0100.5 THE GEOMETRY DEPICTED IN THIS DRAWING HAS BEEN DETERMINED FROM THE FOLLOWING:
- THE DEPARTMENT FOR TRANSPORTATION / HIGHWAYS ENGLAND DESIGN MANUAL FOR ROADS AND BRIDGES.
- DEPARTMENT FOR TRANSPORT: CYCLE INFRASTRUCTURE DESIGN DOCUMENT LTN1/20.

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

Issue Status

INFORMATION

This document is suitable only for the purpose noted above.
Use of this document for any other purpose is not permitted.

Client/Project Logo

Client/Project
GCC & ERNEST COOK TRUST

WISLOE NEW SETTLEMENT

NMU ROUTE OVER M5

Title
BRIDGE FEASIBILITY OPTION 2

Project No.
332310150 (50753)

Scale
As Indicated

Revision
P01

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

217

WISLOE

D4. Air Quality

Stantec

TECHNICAL NOTE

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

[redacted]

[redacted]

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/m^3)				
			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/m^3, 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/m^3)				
	2015	2016	2017	2018	2019
Hardwicke	-	-	-	9.8	10.1
Haresfield	-	-	-	9.9	8.6
NAQO	**40**				

Site ID	Annual Mean PM_{10} (µg/m^3)				
	2015	2016	2017	2018	2019
	Number of Days >50µg/m^3				
Hardwicke	-	-	-	0	0
Haresfield	-	-	-	0	0
NAQO	**35 (days >50 µg/m^3)**				

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/m^3)				
	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/m^3)		
		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/m^3 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/m^3 for the Site. The >40 µg/m^3 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/m^3 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/m^3 contour is exceeded 12 m in the Site from the M5. All areas from ≤36 µg/m^3 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/m^3. This shows that the Site is compliant with the PM_{10} NAQO of 40 µg/m^3.

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/m^3. This shows that the Site is compliant with the PM10 NAQO of 25 µg/m^3.

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/m^3.

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.

References

Air Quality Consultants Ltd. (2020). '*Nitrogen Oxides Trends in the UK 2013 to 2019*'

Department of the Environment, Food and Rural Affairs (DEFRA) in partnership with the Scottish Executive, The National Assembly for Wales and the Department of the Environment for Northern Ireland (2007). '*The Air Quality Strategy for England, Scotland, Wales, Northern Ireland'* HMSO, London.

Department for Transport (2018). '*The Road to Zero'*. Available at: https://www.gov.uk/government/publications/reducing-emissions-from-road-transport-road-to-zero-strategy

Department for Transport (2021). '*Road Traffic Statistics'* Available at https://roadtraffic.dft.gov.uk/

Department of the Environment, Food and Rural Affairs (DEFRA) (2019). '*Clean Air Strategy 2019*'.

Department of the Environment, Food and Rural Affairs (DEFRA) (2020a) '*2020 NO_2 and PM Projections Data (2018 Reference Year)*' [online] Available at: https://uk-air.defra.gov.uk/library/no2ten/2020-no2-pm-projections-from-2018-data

Department of the Environment, Food and Rural Affairs (DEFRA) (2020b). '*2018 Based Background Maps*

Department of the Environment, Food and Rural Affairs (DEFRA) (2020c). '*Emissions Factor Toolkit (Version 10.1)*' Online, available at: https://laqm.defra.gov.uk/review-and-assessment/tools/emissions-factors-toolkit.html

Department of the Environment, Food and Rural Affairs (DEFRA) (2020d). '*NO_x to NO_2 Conversion* Spreadsheet' [online] Available at: https://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html#NOxNO2calc

Department of the Environment, Food and Rural Affairs (DEFRA) (2021a). *Local Air Quality Management – Technical Guidance (TG16), 2021.*

Department of the Environment, Food and Rural Affairs (DEFRA) (2021b*). Defra Survey Data Download Tool. Available at https://environment.data.gov.uk/DefraDataDownload/?Mode=survey, 2021.*

Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe

Environment Act 1995, Part IV.

Environmental Protection UK and the Institute of Air Quality Management (EPUK / IAQM) (2017). '*Land-use Planning & Development Control: Planning for Air Quality*'. V1.2. The Institute for Air Quality Management, London

Highways England (2021). '*WEBTRIS'* Available at: https://webtris.highwaysengland.co.uk/

Ministry of Housing, Communities & Local Government (2019). '*National Planning Policy Framework'*. Available at: https://www.gov.uk/government/publications/national-planning-policy-framework--2

Planning Practice Guidance (2014). '*Air Quality*'.

Statutory Instrument 2000, No 921, '*The Air Quality (England) Regulations 2000'* HMSO, London.

Statutory Instrument 2002, No 3034, '*The Air Quality (England) (Amendment) Regulations 2002'* HMSO, London.

Statutory Instrument 2010, No. 1001, '*The Air Quality Standards Regulations 2010'* HMSO, London.

Statutory Instrument 2016, No. 1184, '*The Air Quality Standards (Amendment) Regulations 2016*' HMSO, London.

Stroud District Council (2015) *' Stroud Local Plan'*

Stroud District Council (2019) '*Stroud District Local Plan Review Draft Plan for Consultation'*

Stroud District Council *(2020) ' Stroud Air Quality Annual Status Report for 2019'*

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

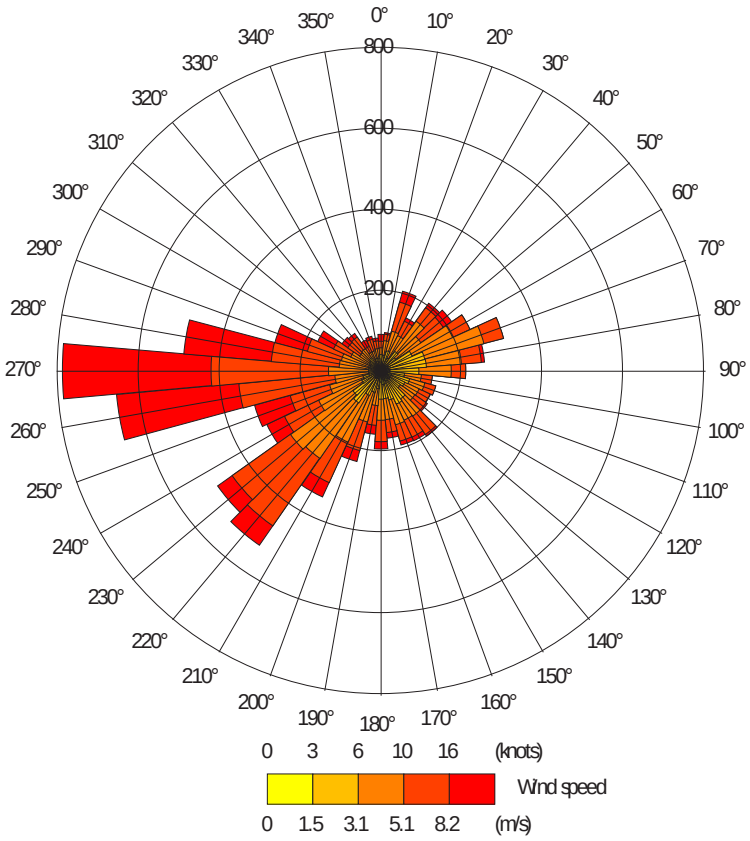


Figure C-1: Windrose for Avonmouth

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.

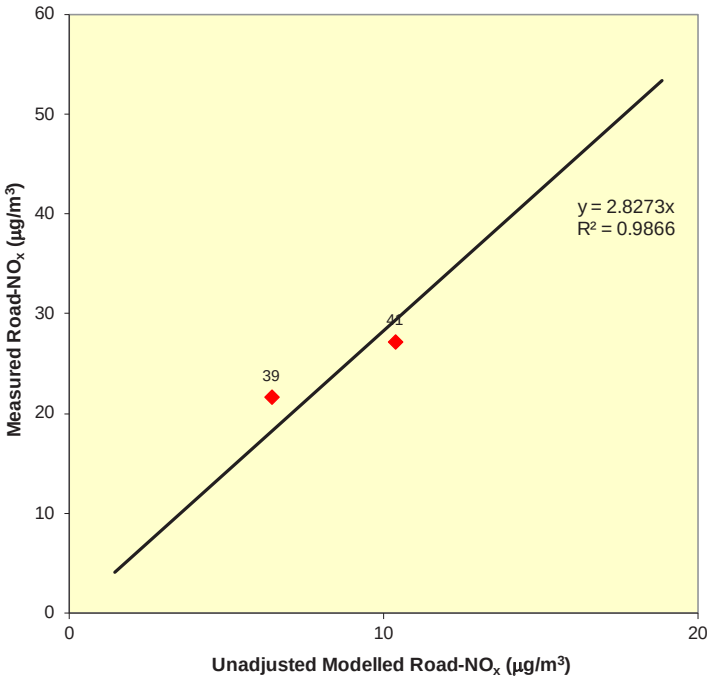


Figure C-1 Measured and Unadjusted Road-NO_x Comparison

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**).

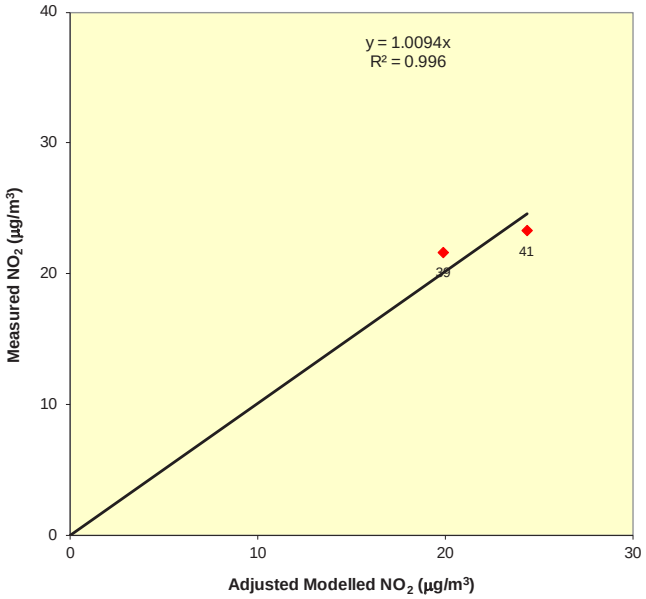


Figure C-2 Measured and Primary Adjusted Modelled NO_2 Comparison

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.

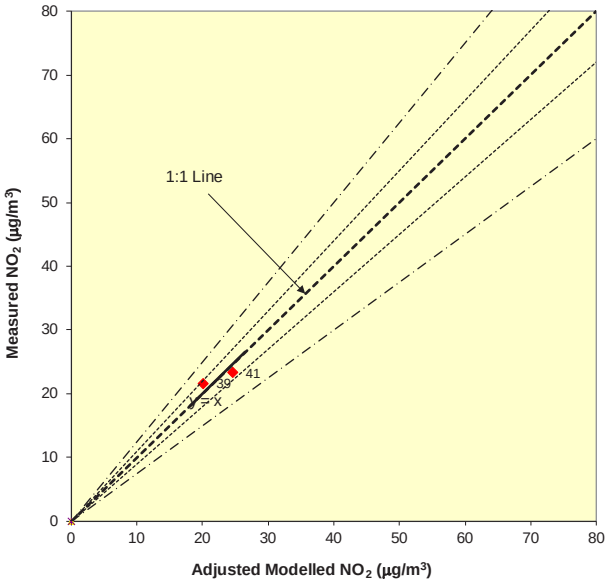


Figure C-3 Measured and Final Adjusted Modelled NO_2 Comparison

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 $PM_{2.5}$

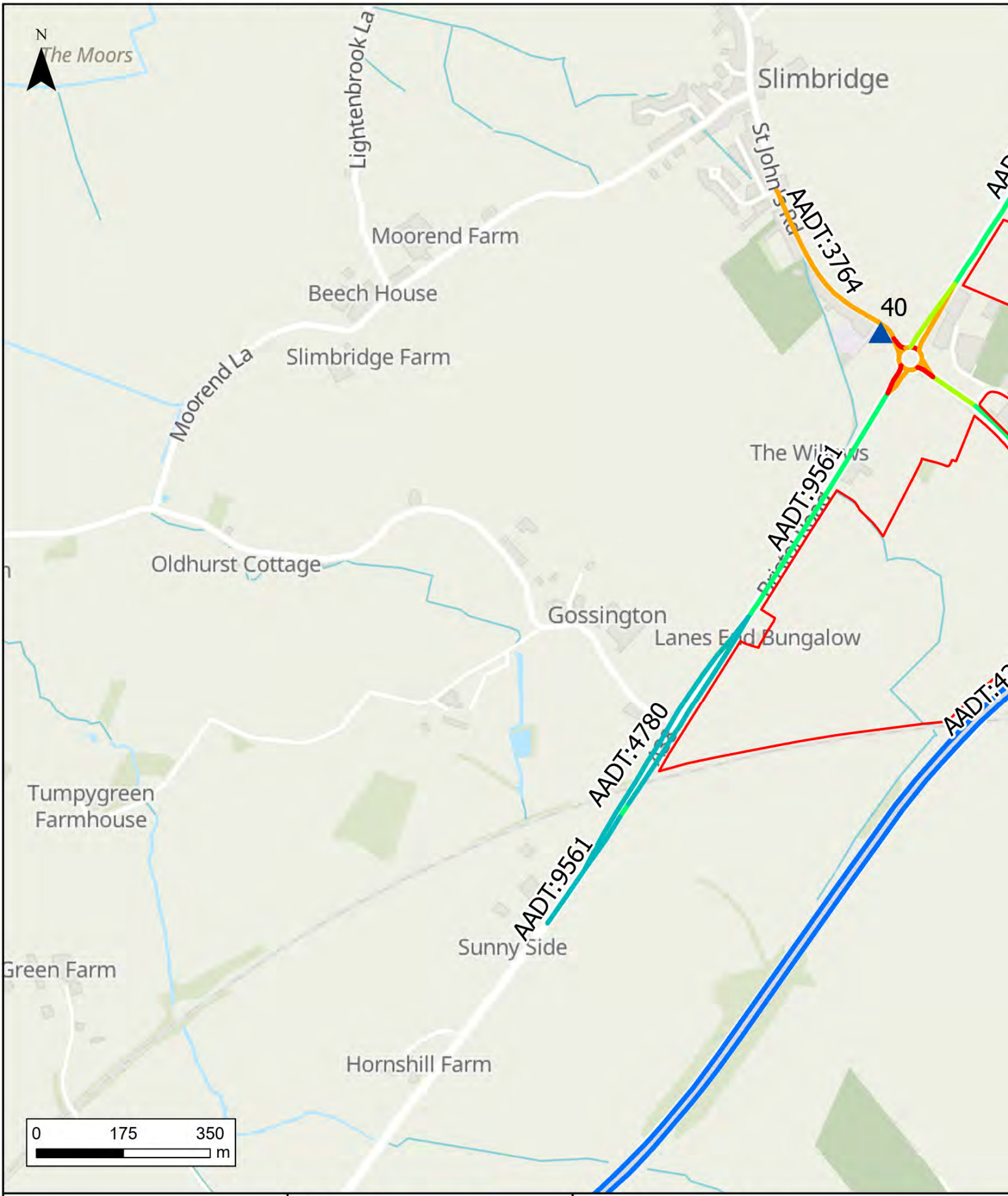
The closest automatic monitoring station to the Site measuring PM_{10} and $PM_{2.5}$ is at Hardwicke. However, as this monitoring location is not considered to be representative of the Site, it has not been used for model

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

THIS PAGE IS LEFT INTENTIONALLY BLANK FOR DOUBLE SIDED PRINTING

Document Path: J:\332310150\Air Quality - Wisloe\Plans and Figures\ArcGIS\Wisloe\Wisloe.aprx



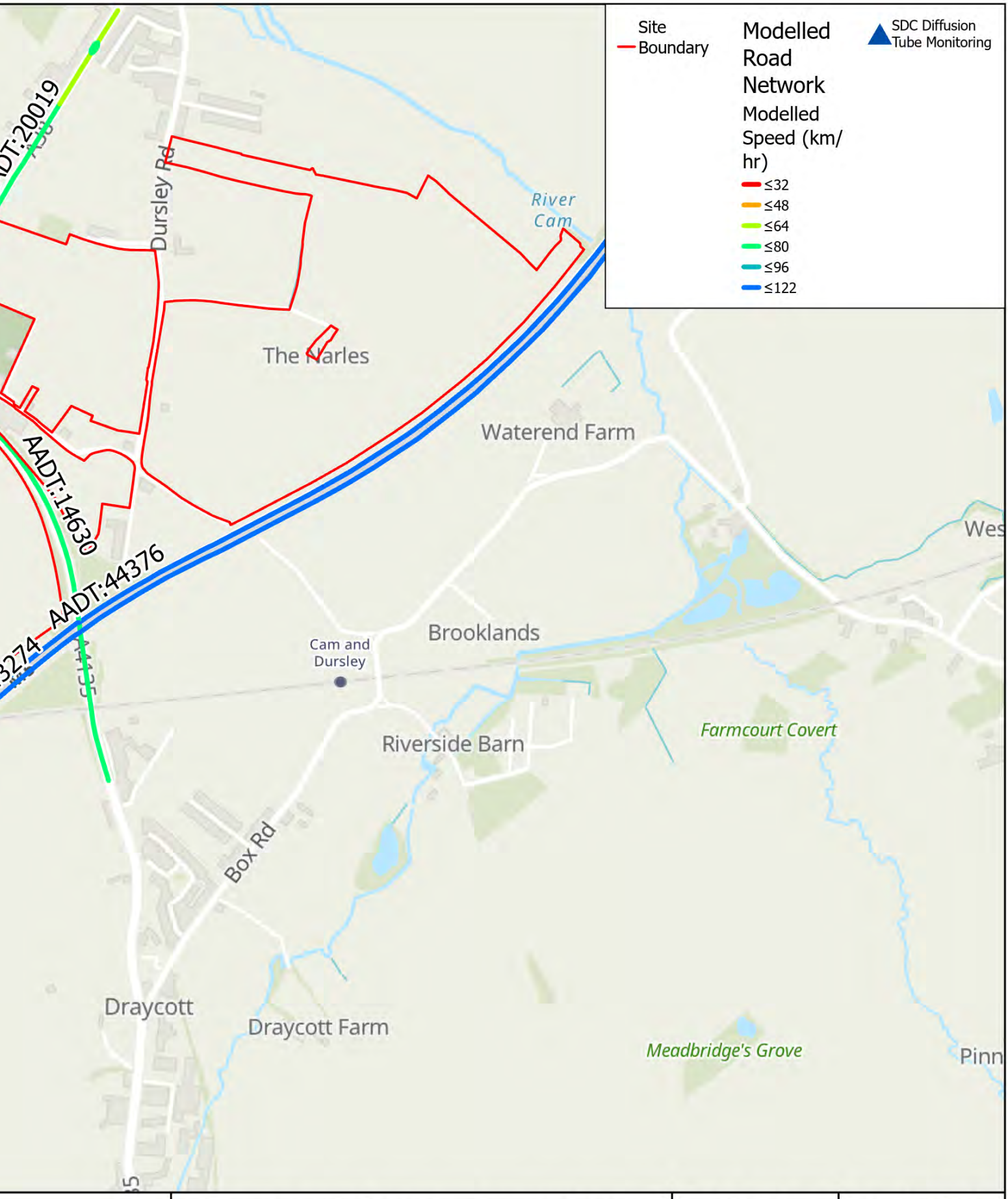
Stantec

Client

Gloucestershire

Land at Wisloe

Modelled Site Road Network (Lab
by 2022 AADT)

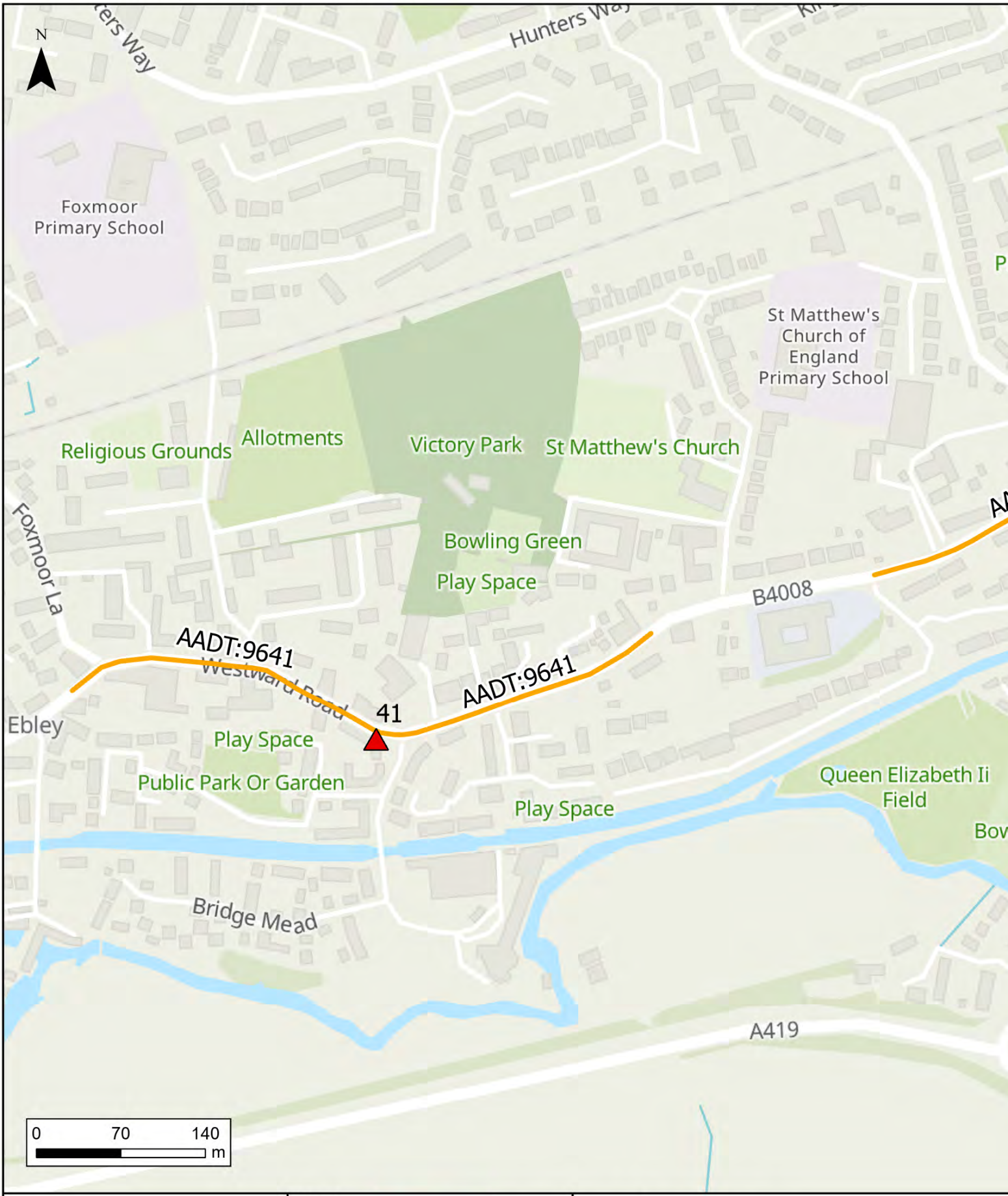


pelled

GB Topographic: Contains OS data © Crown Copyright and database right 2020
Contains data from OS Zoomstack

1:14,000 @ A4	Date: 24/05/2021
Drawn: dafrancis	Checked: ERP
Figure 1.1	Rev A

Document Path: J:\332310150\Air Quality - Wisloe\Plans and Figures\ArcGIS\Wisloe\Wisloe.aprx



Stantec

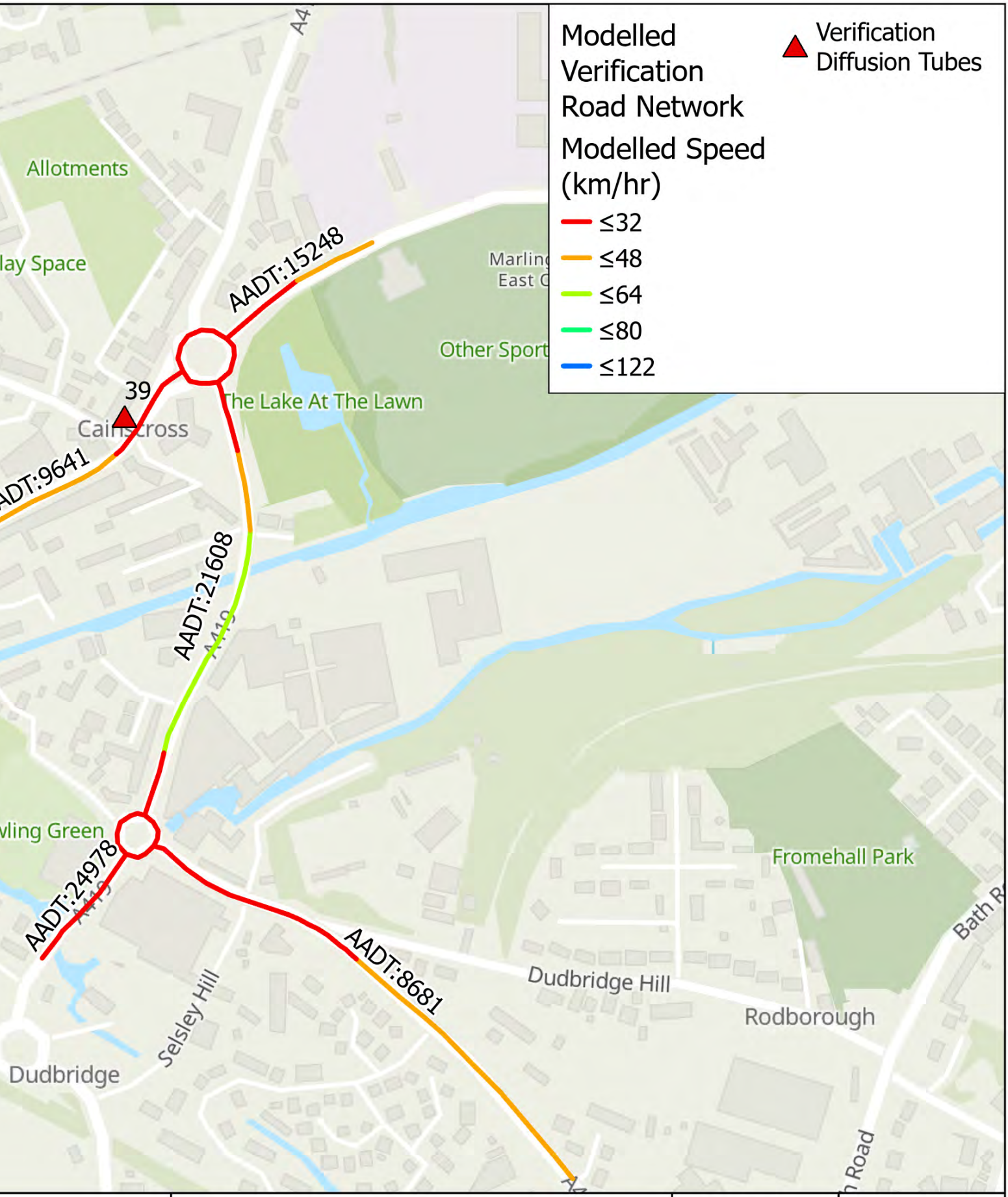
Client

The Ernest Cook Trust

Gloucestershire

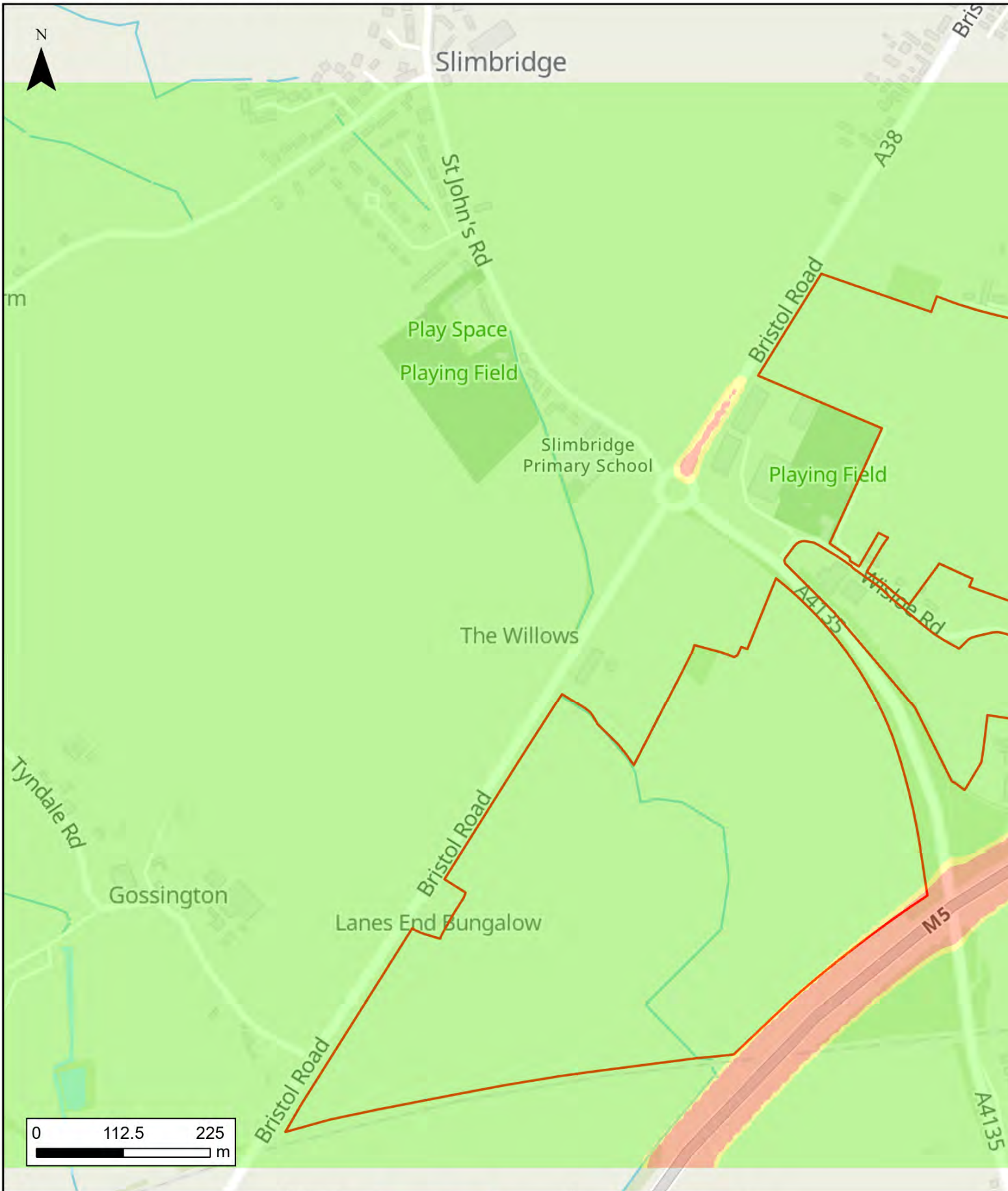
Land at Wisloe

Modelled Verification Road Netwo



ork	GB Topographic: Contains OS data © Crown Copyright and database right 2020 Contains data from OS Zoomstack	1:5,760 @ A4	Date: 13/05/2021
		Drawn: dafrancis	Checked: ERP
		Figure 01.2	Rev A

Document Path: J:\332310150\Air Quality - Wisloe\Plans and Figures\ArcGIS\Wisloe\Wisloe.aprx



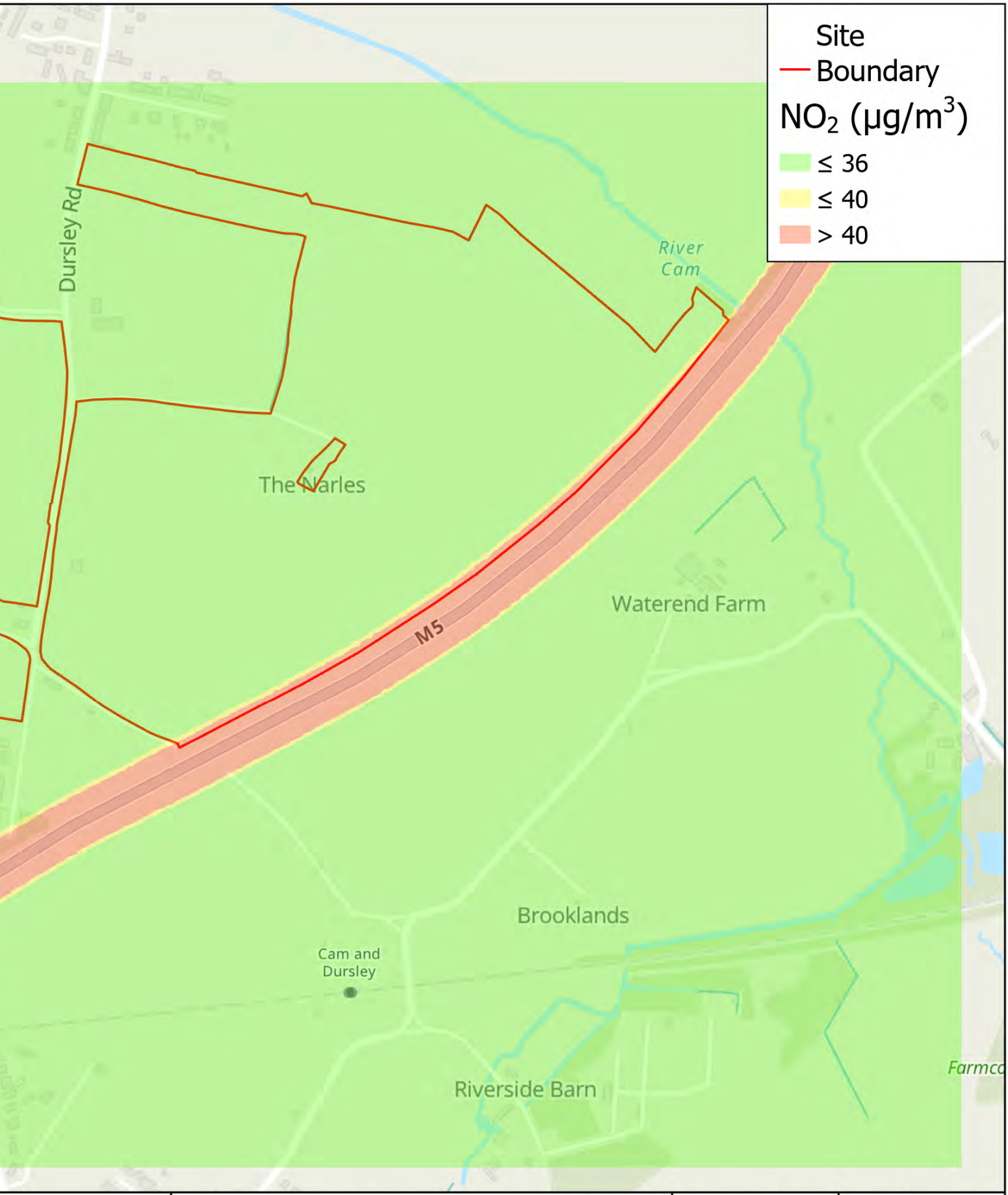
Stantec

Client

Gloucestershire

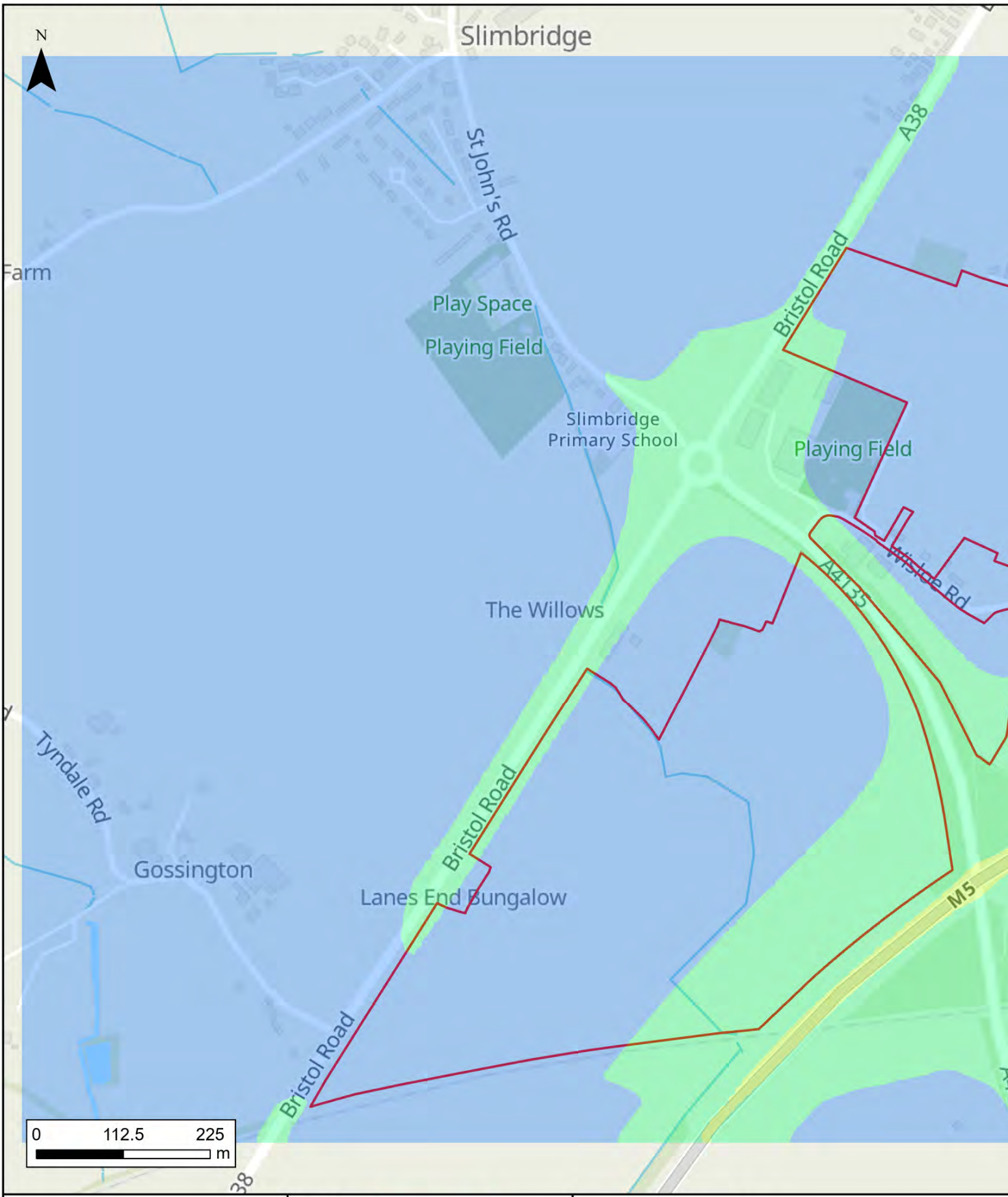
Land at Wisloe

Predicted Annual Mean 2022 NO
Concentration



2	GB Topographic: Contains OS data © Crown Copyright and database right 2020 Contains data from OS Zoomstack	1:9,000 @ A4	Date: 24/05/2021
		Drawn: dafrancis	Checked: ERP
		Figure 02	Rev A

Document Path: J:\332310150\Air Quality - Wisloe\Plans and Figures\ArcGIS\Wisloe\Wisloe.aprx



Stantec

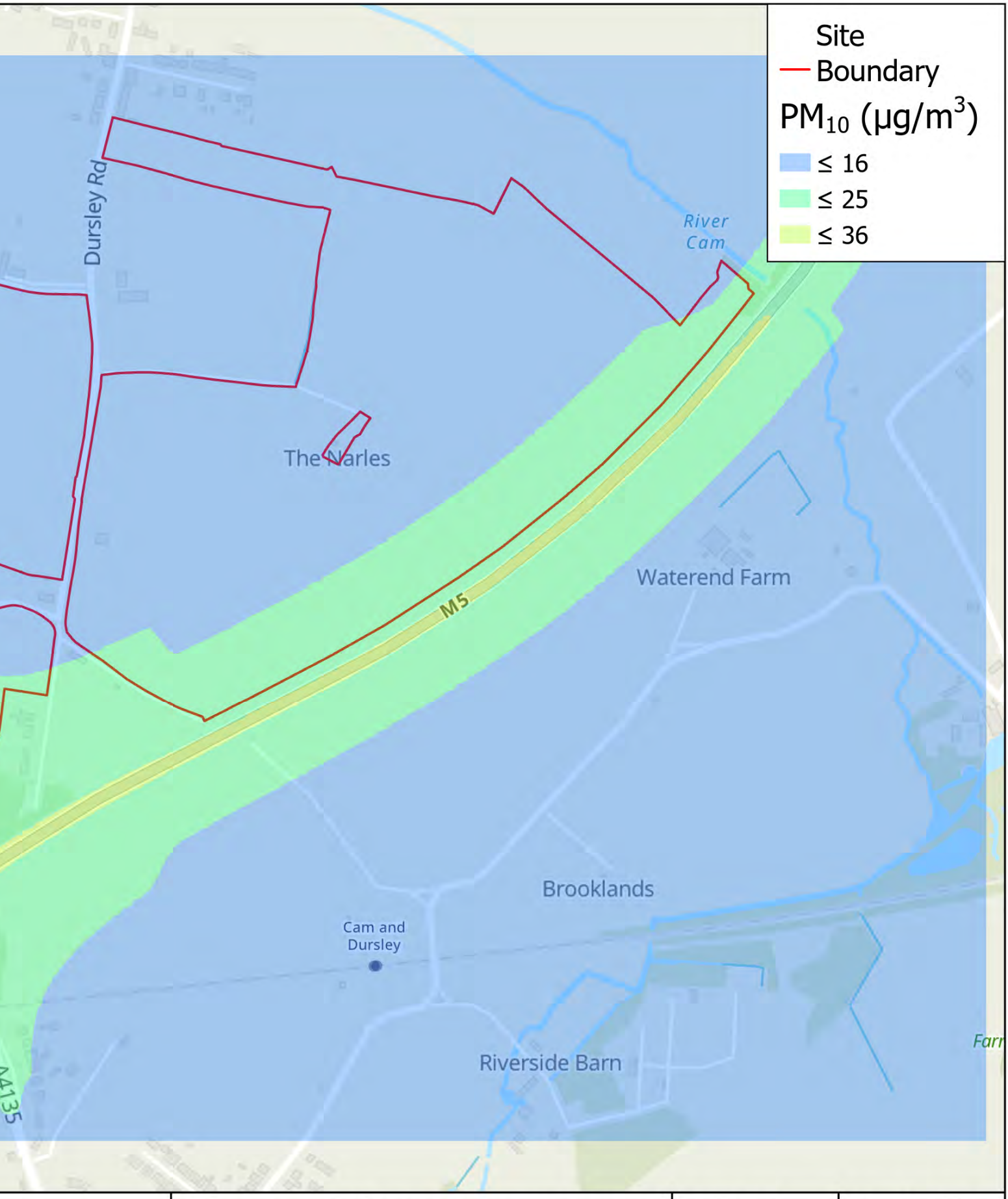
Client

The Ernest Cook Trust

Gloucestershire

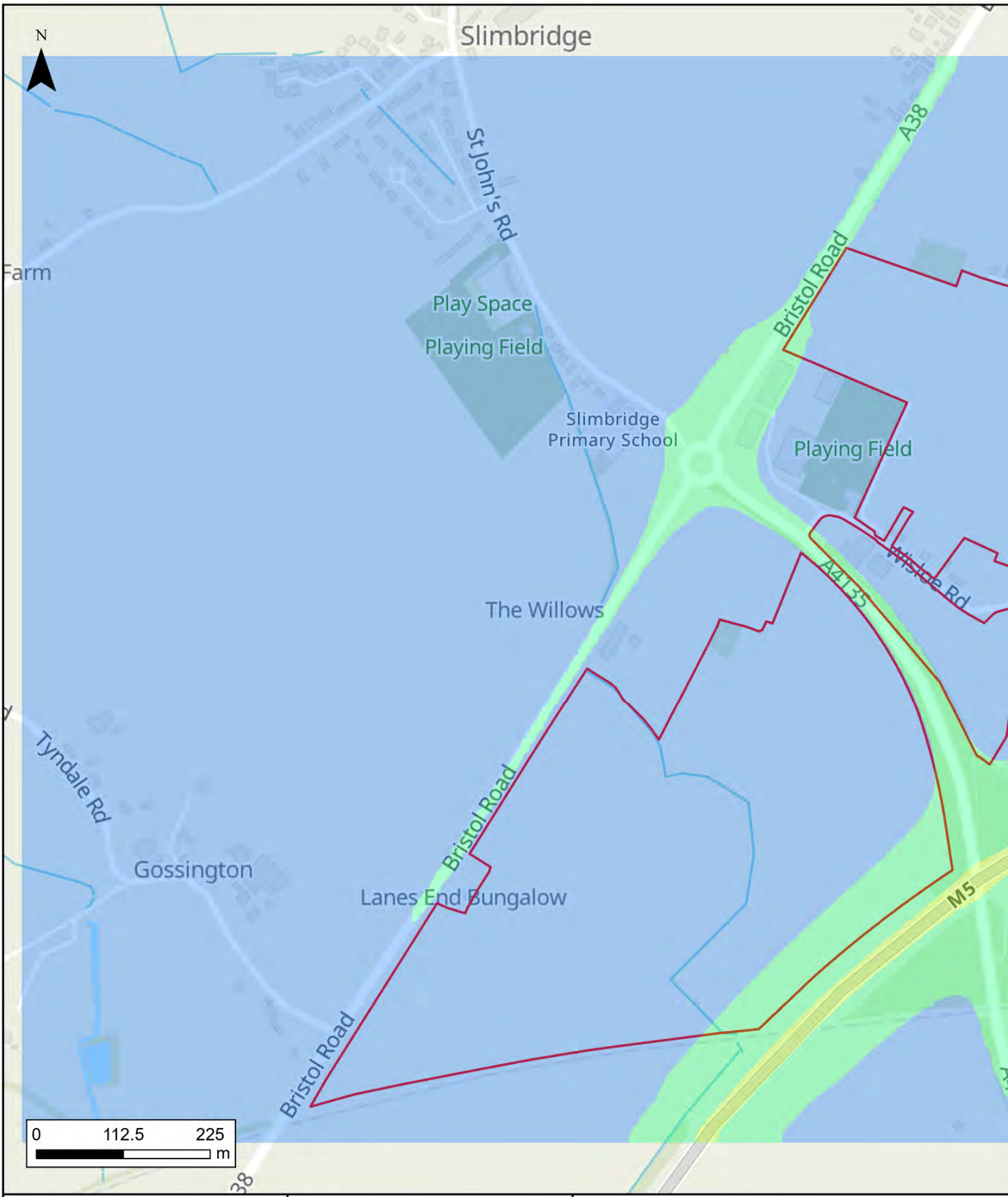
Land at Wisloe

Predicted Annual Mean 2022 PM Concentration



10	GB Topographic: Contains OS data © Crown Copyright and database right 2020 Contains data from OS Zoomstack	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



Stantec

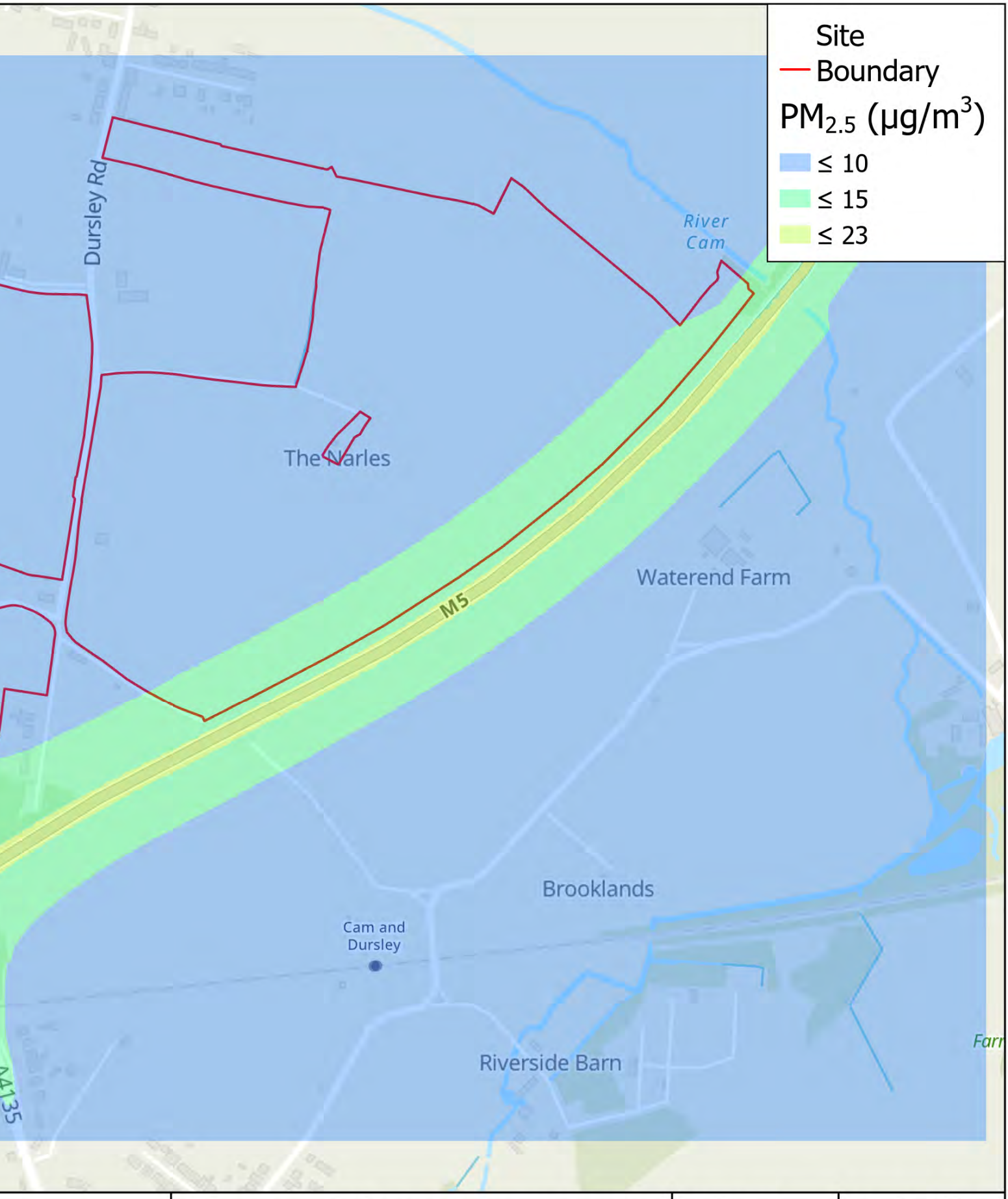
Client

THE ERNEST COOK TRUST

Gloucestershire COUNTY COUNCIL

Land at Wisloe

Predicted Annual Mean 2022 PM Concentration



2.5	GB Topographic: Contains OS data © Crown Copyright and database right 2020 Contains data from OS Zoomstack	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

T: +44 1173 327 840 E: bristolqueensquare@stantec.com

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.

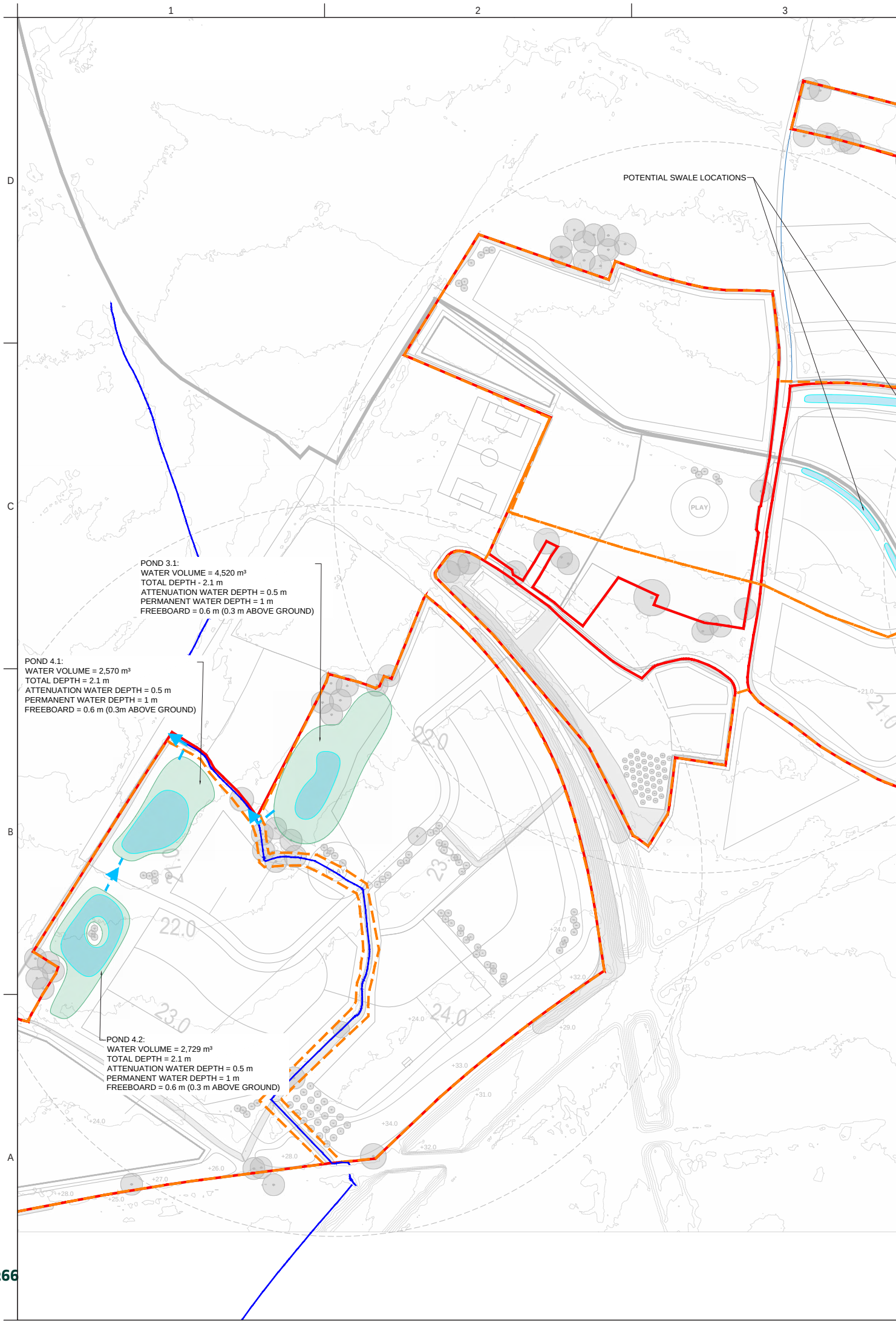
ATTACHMENTS

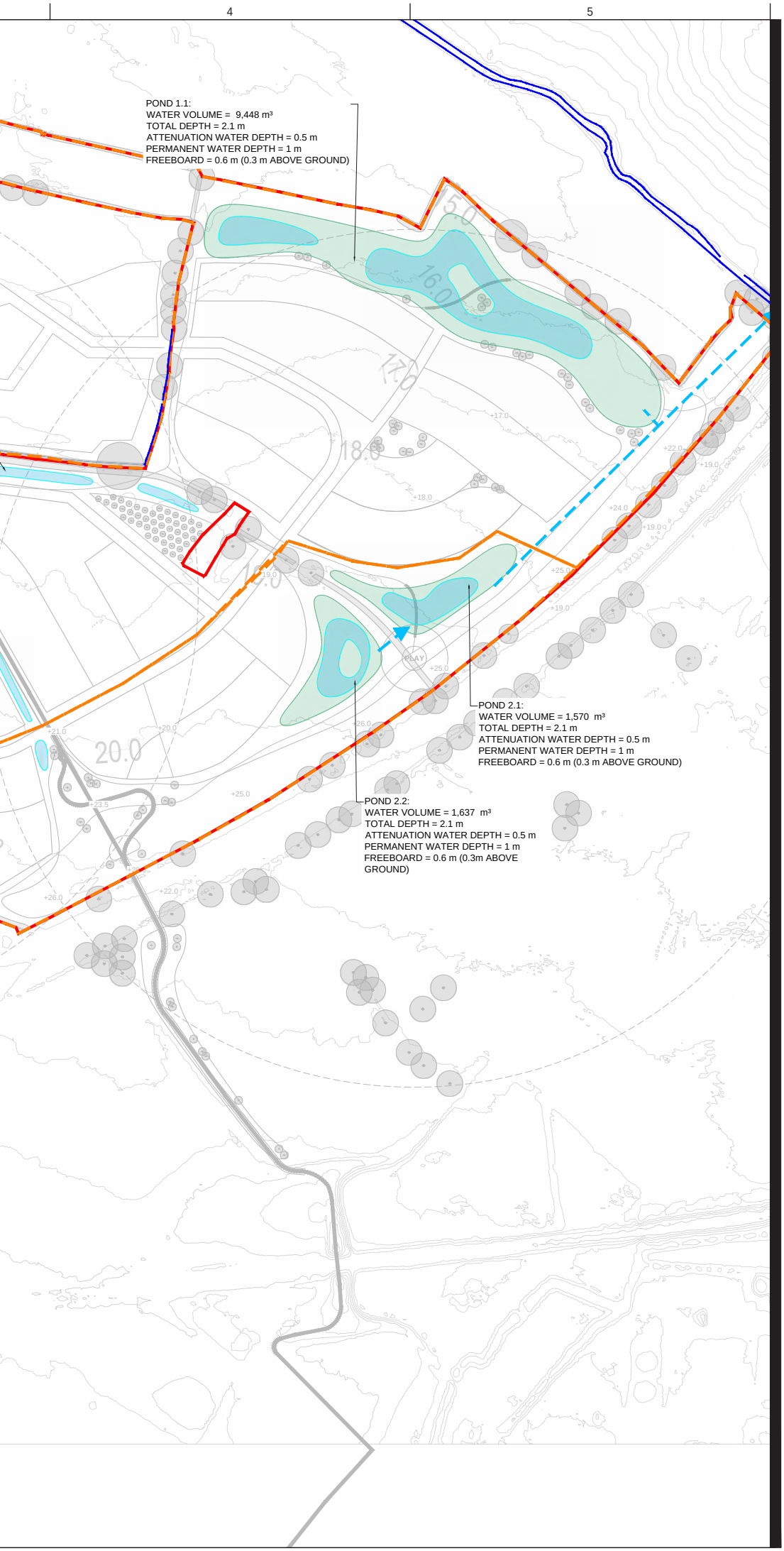
- 332310150/4001/SK001-B Preliminary Surface Water Drainage Strategy
- 332310150/4001/SK002 Indicative Pond Cross-Section
- 332310150/4001/SK003 Existing Overland Flow Assessment
- Pond PO-1.1 Design Checklist Rev 3
- Pond PO-2.1 Design Checklist Rev 3
- Pond PO-2.2 Design Checklist Rev 3
- Pond PO-3.1 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

Stantec UK Limited, Lakeside House, Blackbrook Business Park, Blackbrook Park Avenue Taunton TA1 2PX
T: +44 (0)1823 218 940 E: PBA.taunton@stantec.com


POTENTIAL SWALE LOCATIONS
POND 3.1:
WATER VOLUME = 4,520 m³
TOTAL DEPTH - 2.1 m
ATTENUATION WATER DEPTH = 0.5 m
PERMANENT WATER DEPTH = 1 m
FREEBOARD = 0.6 m (0.3 m ABOVE GROUND)
POND 4.1:
WATER VOLUME = 2,570 m³
TOTAL DEPTH = 2.1 m
ATTENUATION WATER DEPTH = 0.5 m
PERMANENT WATER DEPTH = 1 m
FREEBOARD = 0.6 m (0.3m ABOVE GROUND)
POND 4.2:
WATER VOLUME = 2,729 m³
TOTAL DEPTH = 2.1 m
ATTENUATION WATER DEPTH = 0.5 m
PERMANENT WATER DEPTH = 1 m
FREEBOARD = 0.6 m (0.3 m ABOVE GROUND)
PLAY
1
2
3
A
B
C
D



Stantec

Stantec UK Limited
TAUNTON
Lakeside House, Blackbrook Business Park, Blackbrook Park Avenue, Taunton TA1 2PX
Tel: +44 1823 218 940
www.stantec.com/uk

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.

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER ENGINEERS DRAWINGS.
2. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
3. DO NOT SCALE FROM THIS DRAWING.
4. ALL LEVELS ARE IN METRES ABOVE ORDNANCE DATUM (AOD).
5. LEVELS ARE BASED ON PUBLICLY AVAILABLE LiDAR INFORMATION. NO TOPOGRAPHICAL SURVEY INFORMATION.AVAILABLE AT ISSUE.
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
	Dwn. RR	Dsgn. RR	Chkd. LWD	2021.06.28 YYYY.MM.DD

Issue Status

FOR INFORMATION

This document is suitable only for the purpose noted above.
Use of this document for any other purpose is not permitted.

Client/Project Logo

Client/Project

THE ERNEST COOK TRUST &
GLOUCESTERSHIRE COUNTY COUNCIL

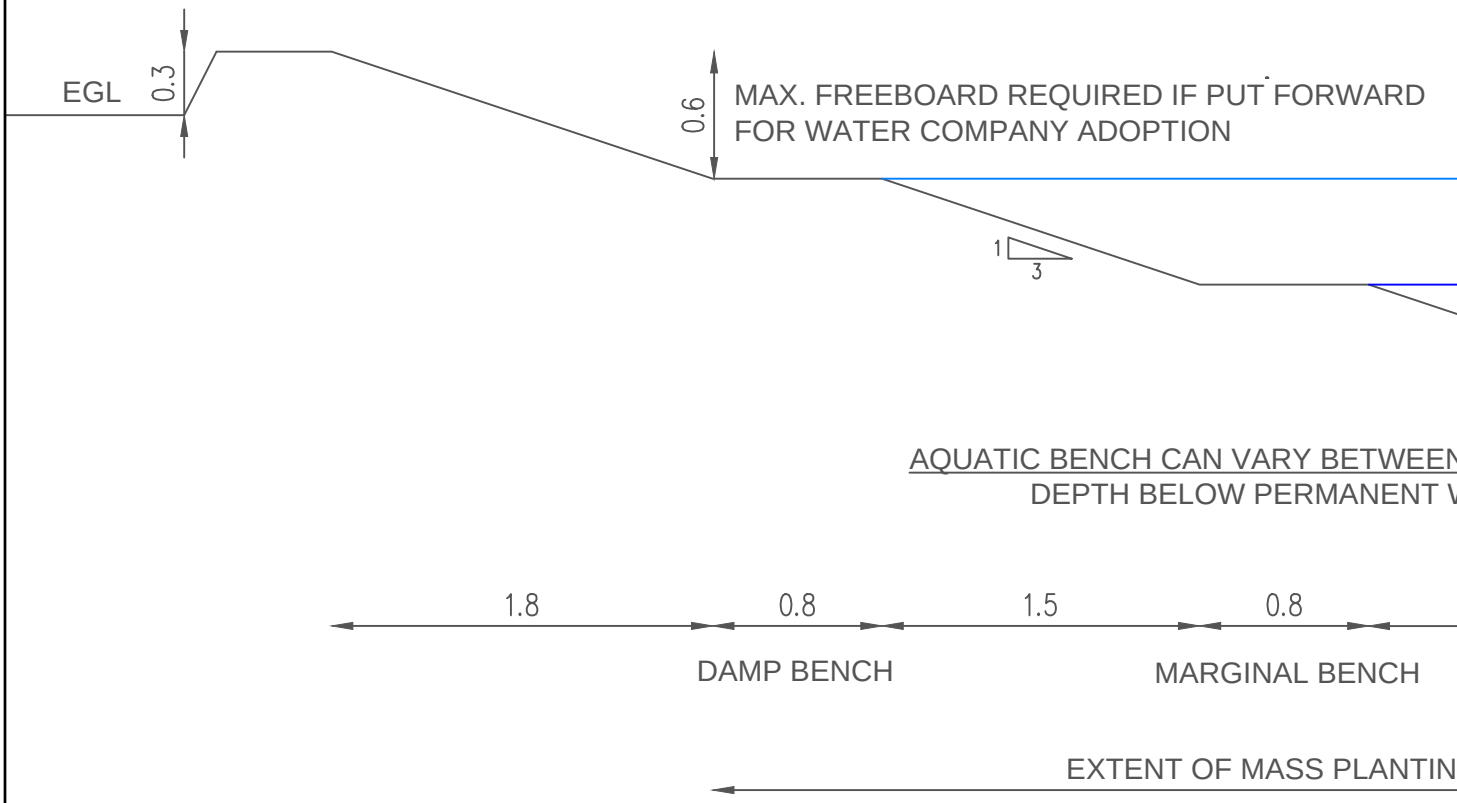
NEW SETTLEMENT AT WISLOE

Title

PRELIMINARY SURFACE WATER DRAINAGE STRATEGY

Project No.	Scale
332310150	NTS

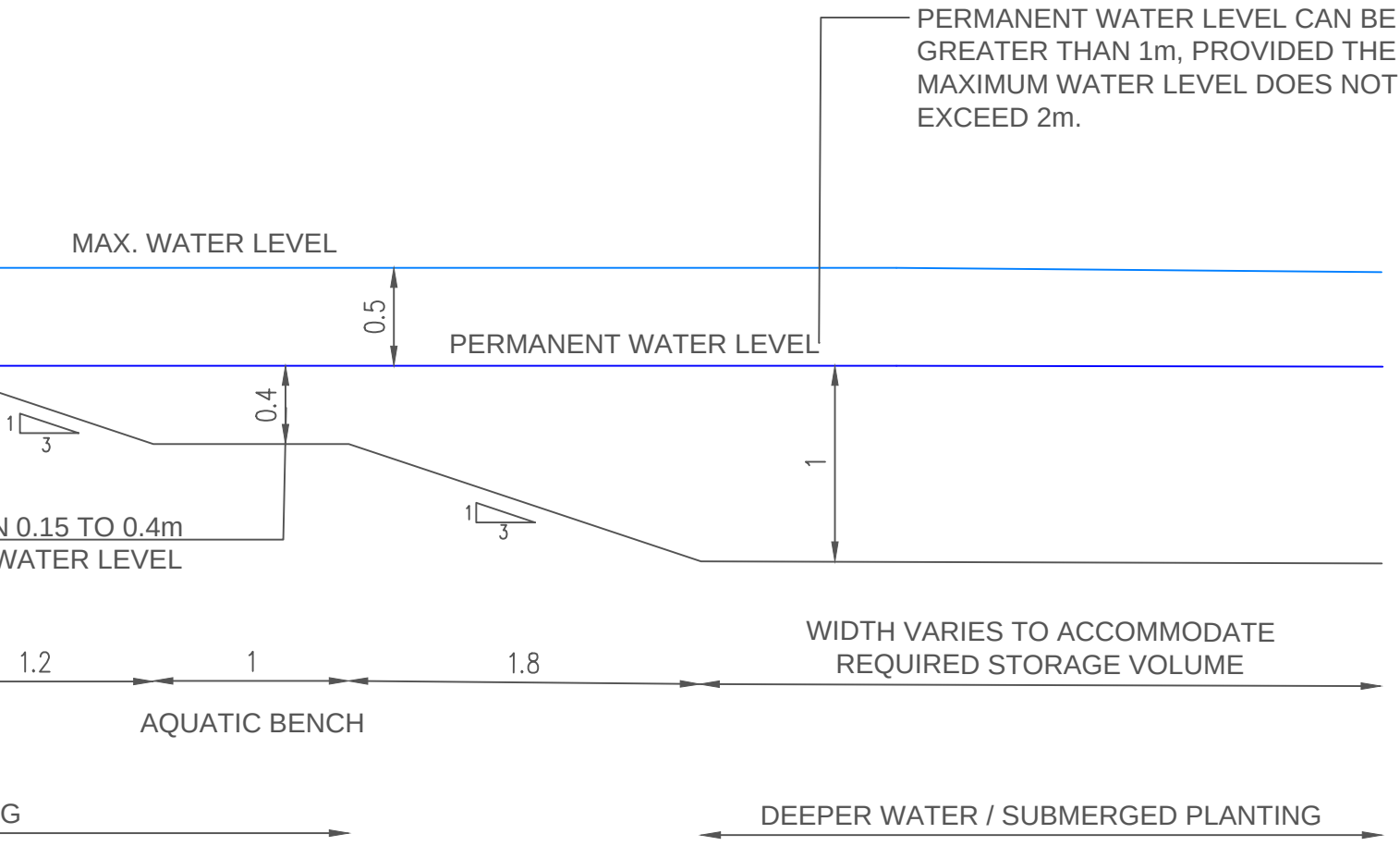
Revision	Drawing No.
B	332310150/4001/SK001-B



Stantec UK Limited
TAUNTON
Lakeside House, Blackbrook Business Park, Blackbrook
Park Avenue, Taunton TA1 2PX
Tel: +44 1823 218 940
www.stantec.com/uk

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER ENGINEERS DRAWINGS.
2. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
3. DO NOT SCALE FROM THIS DRAWING.
4. REFER TO 332310150/4001/SK001 FOR INDICATIVE LOCATION AND SIZING OF PONDS



Client/Project:

THE ERNEST COOK TRUST & GLOUCESTERSHIRE COUNTY COUNCIL

NEW SETTLEMENT AT WISLOE

Project No.:

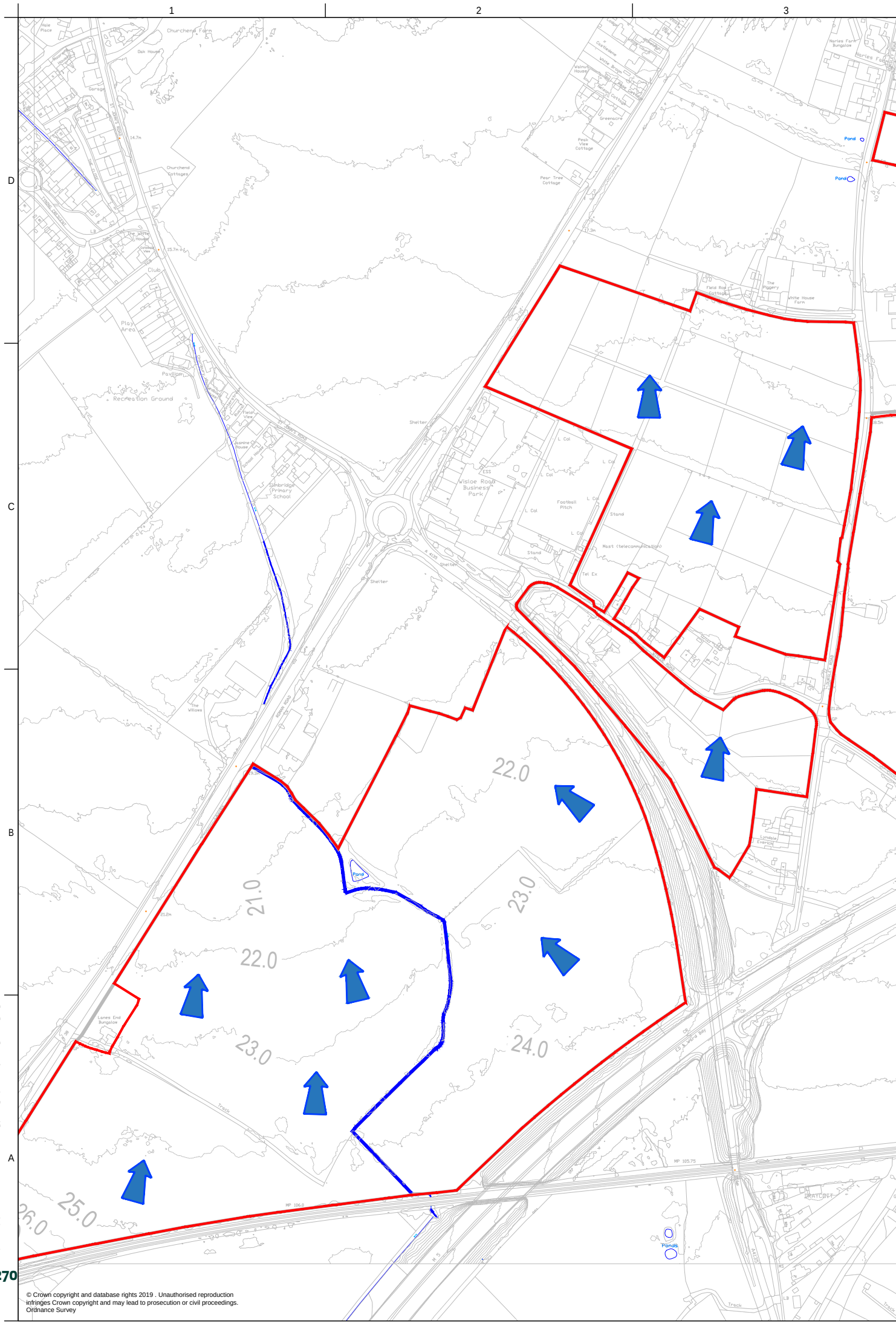
332310150

Title

INDICATIVE POND CROSS-SECTION

269

Revision:	Date:	Drawing No.
-	2021.04.09	332310150/4001/SK002



Stantec

Stantec UK Limited
TAUNTON
Lakeside House, Blackbrook Business Park, Blackbrook
Park Avenue, Taunton TA1 2PX
Tel: +44 1823 218 940
www.stantec.com/uk

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.

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER ENGINEERS DRAWINGS.
2. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
3. DO NOT SCALE FROM THIS DRAWING.
4. ALL LEVELS ARE IN METRES ABOVE ORDNANCE DATUM (AOD).
5. LEVELS ARE BASED ON PUBLICLY AVAILABLE LiDAR INFORMATION. NO TOPOGRAPHICAL SURVEY INFORMATION.AVAILABLE AT ISSUE.

KEY:

SITE BOUNDARY

WATERCOURSE

OVERLAND FLOW PATH

Issued/Revision		By	Appd	YYYY.MM.DD
	Dwn. RR	Dsgn. RR	Chkd. LWD	2021.06.21 YYYY.MM.DD

Issue Status

FOR INFORMATION

This document is suitable only for the purpose noted above.
Use of this document for any other purpose is not permitted.

Client/Project Logo

Client/Project

THE ERNEST COOK TRUST &
GLOUCESTERSHIRE COUNTY COUNCIL

NEW SETTLEMENT AT WISLOE

Title

EXISTING OVERLAND FLOW ASSESSMENT

Project No.	Scale
332310150	NTS 271
Revision	Drawing No.
-	332310150/4001/SK003

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)		1,594m^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 1,209m^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		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)		1,637m^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 605m^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		
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)		2,570m^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 treatment volume 584m^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).	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)		2,729m^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 treatment volume 584m^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).	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

$$Q_{MED} = 8.3062AREA^{0.8510} .0.1536^{(1000/SAAR)} .FARL^{3.4451} .0.0460^{BFIHOST\wedge 2}$$

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\Parc

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 (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	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

This page has intentionally been left blank.

WISLOE

D7. Ecology Biodiversity Net Gain

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**.

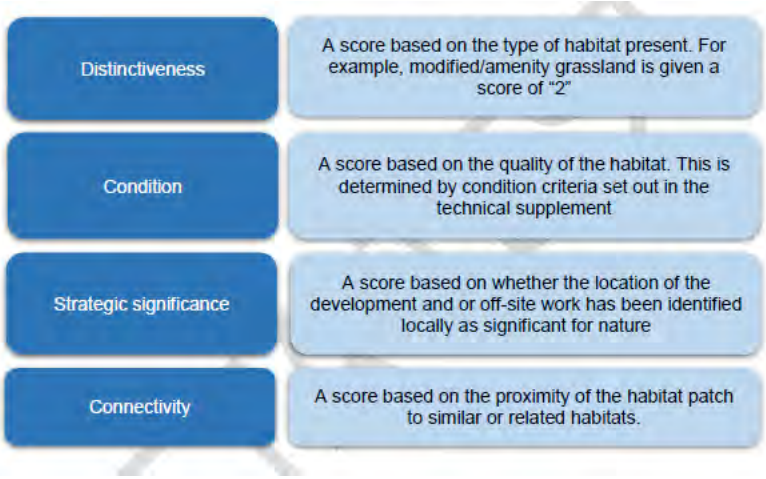
4.4. The data from the Phase 1 habitat survey have been used to inform the Concept Masterplan (show in **Section 7**), which seeks to retain features within the site of ecological value. As such the majority of the hedgerow network within the Site is retained, with only small sections removed to facilitate 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.

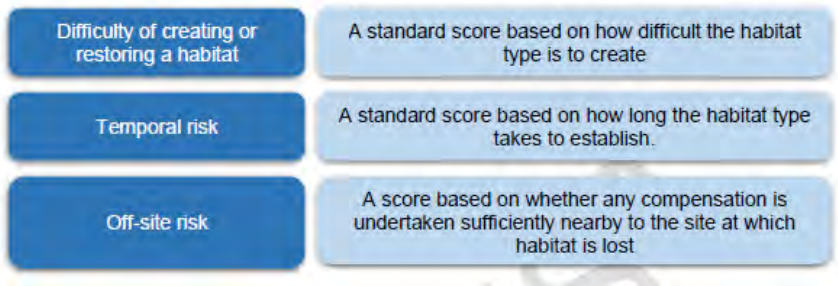
4.6. The metric calculates the biodiversity value of each parcel of habitat within the Site (measured as biodiversity units). Habitat area is used, except for linear habitats, where length is used (i.e. for hedgerows). The value of each habitat type/area is adjusted to site specific circumstances, taking 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).



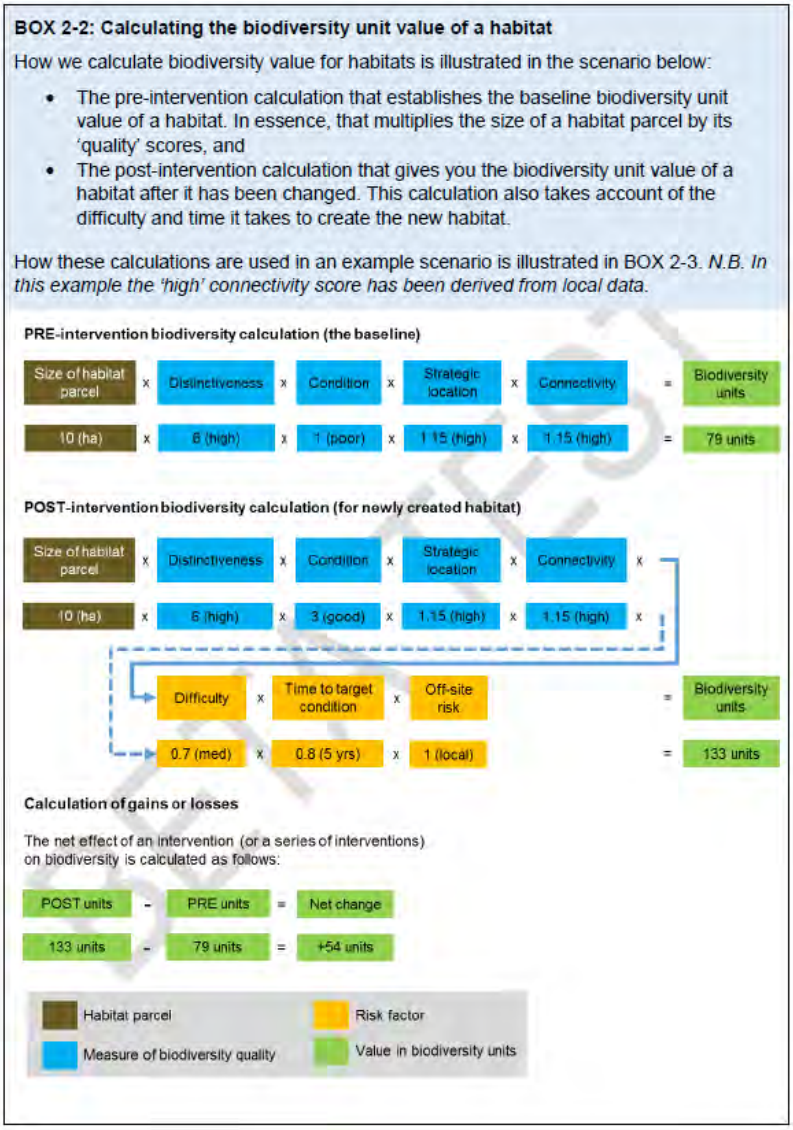
4.7. The post-intervention (or "post-development") biodiversity unit value is calculated in the same way, but with the addition of factors to take into account risks associated with creating, enhancing or restoring habitats. These factors are detailed in **Plate 2**.

Plate 2. Post-Development Risk Components of the Biodiversity Net Gain Metric (taken from The Biodiversity Metric 2.0: User Guide, Natural England 2019)



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)



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.

TECHNICAL NOTE

Figures

- Concept Masterplan
- Phase 1 habitat plan
- BNG Measurements Plan

THIS PAGE IS LEFT INTENTIONALLY BLANK FOR DOUBLE SIDED PRINTING


SLIMBRIDGE
A38

lhc design

Wisloe Green
Concept Masterplan
1:2000@A0_June 2021