

**Conditions 31 and 32:
Baseline Scheme of Further
Assessment of Air Quality in
relation to Oxford Meadows
SAC and Hook Meadow and
Trap Grounds SSSI**

January 2014

Conditions 31 and 32: Baseline Scheme of Further Assessment of Air Quality in relation to Oxford Meadows SAC and Hook Meadow and Trap Grounds SSSI

January 2014

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CONTENTS

	EXECUTIVE SUMMARY	1
1	INTRODUCTION	3
1.1	BACKGROUND	3
1.2	PLANNING CONTEXT	4
1.3	PURPOSE OF THIS DOCUMENT	5
1.4	CONSULTATION	5
1.5	STRUCTURE OF THIS DOCUMENT	6
2	BASELINE SURVEYS	7
2.1	INTRODUCTION	7
2.2	BASELINE SURVEYS	7
2.3	SURVEY ACCESS	8
2.4	SURVEY TIMING	8
2.5	BASELINE LIMITATIONS	9
3	AIR QUALITY BASELINE	10
3.1	INTRODUCTION	10
3.2	TRANSECT LOCATIONS	10
3.3	DIFFUSION TUBE PLACEMENT	11
3.4	DIFFUSION TUBE USE	12
3.5	SURVEY TIMING AND ANALYSIS OF RESULTS	12
3.6	COMPARISON WITH LOCAL AND NATIONAL MONITORING SCHEMES	13
3.7	LIMITATIONS	15
4	HABITAT AND SOIL BASELINE	16
4.1	INTRODUCTION	16
4.2	SITE CONDITION ASSESSMENT (SCA)	16
4.2.1	Survey Timing and Results Analysis	17
4.3	NATIONAL VEGETATION CLASSIFICATION (NVC)	18
4.3.1	Survey Timing and Results Analysis	18
4.4	PLANT TISSUE COLLECTIONS	20
4.4.1	Survey Timing and Analysis of Results	21
4.5	LICHEN TRANSPLANT BIOMONITORING	21
4.5.1	Survey Timing and Results Analysis	22
4.6	SOIL CONDITION ANALYSIS	22
4.6.1	Survey Timing and Analysis of Results	23
5	TRAFFIC BASELINE	24
5.1	INTRODUCTION	24
5.2	AUTOMATED TRAFFIC COUNTERS (ATC)	24
5.2.1	Survey Timing and Analysis of Results	25

5.3	<i>RAIL PASSENGER SURVEYS</i>	25
5.3.1	<i>Survey Timing and Analysis of Results</i>	25
6	<i>OTHER BASELINE DATA REQUIREMENTS</i>	27
7	<i>BASELINE REPORTING</i>	28
8	<i>SUMMARY OF BASELINE SURVEYS AND PROGRAMME</i>	29

EXECUTIVE SUMMARY

This document solely focuses on characterising the baseline conditions of the Oxford Meadow Special Area of Conservation (SAC) and Hook Meadow and Trap Grounds Site of Special Scientific Interest (SSSI), without influence of the Scheme. As such it sets out an approach to partially discharge Conditions 31 (sections (i), (v) and reporting elements of section (viii)) and 32 (sections (i), (ii) and reporting elements of section (vii)) of the Chiltern Railways (Bicester to Oxford Improvements) Order 2012 (“the Order”). The development is to construct improvements to the existing railway line between Bicester and Oxford and to construct a new station at Water Eaton.

Conditions 31 and 32 requires an up to date and detailed baseline to be established (without the Scheme being operational) against which potential future changes (with the Scheme being operational) can be compared. The baseline surveys will include:

- **air quality baseline** using diffusion tubes to record NO_x levels;
- **habitat and soil baselines** at predefined sampling locations, through:
 - Site Condition Assessments (SCA) of the designated sites;
 - National Vegetation Classification (NVC) surveys;
 - lichen transplant biomonitoring;
 - plant tissue collection; and
 - soil sampling and condition analysis;
- **traffic baselines** through:
 - automated traffic counting along the A40 and A34 (T); and
 - rail passenger surveys at Bicester North Station and Oxford Station.

The air quality baseline survey will measure the baseline air quality conditions within the Oxford Meadows SAC and Hook Meadow and Trap Grounds SSSI. The habitat and soils baseline survey will assess the condition of the designated sites and characterise the plant communities present and elements of the growing conditions which are influenced by nitrogen deposition. The traffic baseline will quantify the traffic flows on the A34 (T) and A40, adjacent to the Oxford Meadows SAC and infer the baseline number of London bound rail passengers currently travelling by car to Oxford railway station using these roads.

The air quality, habitat and soil surveys detailed above form a ‘biomonitoring chain’ ⁽¹⁾ for each designated site. A biomonitoring chain represents the logical sequence of stages in biomonitoring from potential pollutant source to

(1) Hicks, W.L., Whitfield, C.P., Bealey, W.J and Sutton, M.A. (eds).(2011). *Nitrogen Deposition and Natura 2000: Science & practice in determining environmental impacts*. COST729/Nine/ESF/CCW/JNCC/SEI Workshop Proceedings, published by COST.

eventual environmental effects. As such, the baseline surveys are both 'source orientated' (nitrogen emissions) and 'receptor oriented' (interest features of the designated sites).

The baseline data collection will occur over a 12 month period prior to the opening of the Scheme to rail passengers and the opening of the new Water Eaton Station (due to be opened mid-2015). Access to Oxford Meadows SAC and Hook Meadow and Trap Grounds SSSI will be secured through powers convened under the Order. The traffic baseline will quantify the traffic flows on the A34 (T) and A40, adjacent to the Oxford Meadows SAC and infer the baseline number of London bound rail passengers currently travelling by car to Oxford railway station using these roads.

The results of the baseline surveys will be reported in a single document which will be submitted within three months of the completion of the 12 month baseline surveys (subject to the successful completion of the baseline surveys). A draft version will be discussed with Natural England (NE), Oxford City Council (OCC) and Cherwell District Council (CDC) prior to the final report being submitted.

The approach to establishing the baseline conditions has been developed by ecology and air quality specialists at Environmental Resources Management (ERM) in consultation with specialists at Centre of Ecology and Hydrology (CEH). The baseline components have been developed in consultation with air quality and habitat specialists at CEH and discussed with NE and OCC at a meeting in July 2013.

The proposed approach to monitoring the designated sites under the '*Scheme of Further Assessment*,' in accordance with Condition 31 and 32, will be the subject of a later submission once the baseline monitoring has been completed and reported.

1 INTRODUCTION

1.1 BACKGROUND

Chiltern Railways Company Limited (CRCL) was granted a Transport and Works Act Order by the Secretary of State for Transport on 23rd October 2012 for improvements works of the Chiltern Branch line in accordance with the Order. The Scheme is to construct improvements to the existing railway line between Bicester and Oxford, including a new track alongside the existing mainline between Oxford North Junction and Oxford station and to construct a new station at Water Eaton, described as the Scheme (See *Plan 1.1:Proposed Scheme*).

The Scheme will result in changes to air quality through exhaust emissions from the increased number and frequency of the trains following the improvements. Increases in exhaust emission will also occur from changes in road traffic, with increases in traffic along the A40 from commuters travelling to the proposed new station at Water Eaton, and decreases in traffic along the A34(T) due to commuter modal shift to the railway. The key change will be in terms of emissions of oxides of nitrogen (NO_x), and subsequently nitrogen deposition.

Nitrogen oxides NO and NO₂ (nitric oxide and nitrogen dioxide (NO_x)), are produced from fossil fuel combustion (*e.g.* cars and trains), which together with nitric acid and nitrates (NO₃), produced through atmospheric reactions, constitute oxidised nitrogen (NO_y). This total reactive nitrogen (NO_y⁽¹⁾) contributes to local N deposition loads including dry deposition (direct deposition of gases closer to the source) and wet deposition (scavenging of gases by precipitation which can be washed out by rain further from the source) to the biosphere.

Increased nitrogen loads can lead to several detrimental effects on semi-natural ecosystems that are adapted to low nitrogen availability, specifically in this situation changes to plant species diversity, species composition and species number.

The environmental effects associated with the Scheme were reported in an Environmental Statement (ES) (December 2009) prepared by Environmental Resources Management (ERM) and submitted with the Transport and Works Act Order (TWAO) application in January 2010. Additional information concerning environmental effects of the Scheme and more specifically the effects of gaseous emissions to air of the proposed Scheme on the Oxford Meadows Special Area of Conservation (SAC) and the Hook Meadow and Trap Grounds Site of Special Scientific Interest (SSSI) was submitted as post-

(1) Reactive nitrogen is the sum of NO_x, plus the compounds produced from the oxidation of NO_x, which include nitric acid.

application submissions at the Transport and Works Act (TWA) Inquiry in November 2010 and during the subsequent re-opened TWA Inquiry in May 2012.

A Habitat Regulations Screening Assessment (HRSA) was undertaken in 2009 in relation to the Oxford Meadows SAC. In agreement with Natural England, the HRSA adopted a precautionary approach. This precautionary approach identified the need for mitigation and that this should take the form of a monitoring regime, including air quality monitoring, with provision for appropriate mitigation to be implemented. The details of this arrangement were discussed extensively at the TWA Inquiry (2010) and addressed by introducing a planning Condition (Condition 31) requiring the implementation of such a regime in relation to the Oxford Meadows SAC. The Inspector considered that, subject to compliance with Condition 31, the air emissions associated with the Scheme were not likely to have any significant effect on the integrity of the SAC. The Secretary of State agreed with this conclusion and considered it unnecessary to carry out an Appropriate Assessment under the Habitats Regulations.

The re-opened TWA Inquiry (2012), amongst other matters, considered the proposed wording of two Conditions relating to the effects of air emissions on the Oxford Meadows SAC and the Hook Meadow and Trap Grounds SSSI (Conditions 31 (SAC) and 32 (SSSI) respectively) and if these conditions would serve to ensure that the Scheme in operation would not be likely to have an adverse effect on the integrity of the SAC or the notified special interest features of the SSSI. An agreement was reached in relation to the wording of Conditions 31 and 32 between CRCL and Natural England during the re-opened Inquiry. The Inspector subsequently concluded that Condition 31 would serve to ensure that the Scheme, in operation, would not be likely to have an adverse effect on the integrity of Oxford Meadows SAC by reason of air pollution and that Condition 32 would serve to ensure that the Scheme in operation would not be likely to have an adverse effect on the notified special interest features of the SSSI.

Following the 2012 re-opened TWA Inquiry the Secretary of State directed that planning permission be granted subject to a set of planning conditions (including Condition 31 and Condition 32).

A challenge to the Order was lodged in March 2013 and a subsequent judicial review was undertaken by the High Court in relation to Condition 31 and the requirement of an appropriate assessment (Case No. CO/12946/2012). Mr Justice Ouseley dismissed the application and approved the judgement of the Secretary of State to grant the Order including Conditions 31 and 32.

1.2

PLANNING CONTEXT

Approval for the Scheme was granted by the Secretary of State subject to a number of conditions. Two of these conditions relate specifically to the effects

of gaseous emissions resultant from the Scheme, and contain measures to protect the designated sites. Condition 31 relates to the Oxford Meadows SAC, and Condition 32 to the Hook Meadow and Trap Grounds SSSI (see below and *Annex 1* for full Condition text, and *Annex 2* for details of the designated sites).

- **Condition 31** - *'Development shall not commence on the Individual Section or Sections between Oxford North Junction and Rewley Abbey Stream ("the relevant sections") until a Scheme of Further Assessment of Air Quality in relation to the Cassington Meadows SSSI, the Pixey and Yarton Meads SSSI and the Wolvercote Meadow SSSI that are co-terminous with part of the Oxford Meadows SAC ("the relevant parts of the SAC") has been submitted to and approved in writing by the local planning authority for the relevant parts of the SAC (in consultation with Natural England).'*
- **Condition 32** - *'Development shall not commence on the Individual Section or Sections between Oxford North Junction and Rewley Abbey Stream ("the relevant sections") until a Scheme of Further Assessment of air quality in relation to the Hook Meadow and Trap Grounds SSSI ("the SSSI") has been submitted to and approved by the local planning authority (in consultation with Natural England).'*

1.3

PURPOSE OF THIS DOCUMENT

This document sets out the approach that will be used to partially discharge Conditions 31 (sections (i), (v) and reporting elements of section (viii)) and 32 (sections (i), (ii) and reporting elements of section (vii)), in respect of establishing the baseline conditions of the designated sites in the absence of the Scheme. This is a requirement of Conditions 31 and 32 as part of the *"Scheme of Further Assessment"*. The Conditions state that *"The development shall not be opened to passenger rail traffic until the approved assessment of baseline conditions has been completed as approved and reported to the local planning authority"*. It describes the approach to establishing a robust baseline and the baseline survey methodologies that will be used.

The proposed approach to monitoring the designated sites under the *'Scheme of Further Assessment'*, in accordance with Condition 31 and 32, will be detailed in a separate document for future submission.

1.4

CONSULTATION

The baseline components have been developed in consultation with air quality and habitat specialists at Centre for Ecology and Hydrology (CEH) and discussed with Natural England (NE) and Oxford City Council (OCC) at a meeting in July 2013.

The remainder of this document is set out as listed below.

- *Section 2* Baseline Conditions.
- *Section 3* Air Quality Baseline.
- *Section 4* Habitat and Soil Baseline.
- *Section 5* Transport Baseline.
- *Section 6* Other Baseline Data Requirements.
- *Section 7* Baseline Reporting.
- *Section 8* Summary of Baseline Surveys and Programme.

This document includes the Figures, Plans and Annexes listed below.

- *Figure 2.1* Biomonitoring Chain.
- *Plan 1.1* Proposed Schemes.
- *Plan 1.2* Designated Sites and Relevant Section of the Scheme.
- *Plan 2.1* Main Line and Chiltern Branch Line.
- *Plan 2.2* Oxford Meadows SAC – Land Ownership.
- *Plan 2.3* Hook Meadow and Trap Grounds SSSI – Land Ownership.
- *Plan 2.4* Oxford Meadow SAC – Sampling Locations.
- *Plan 2.5* Hook Meadow and Trap Grounds SSSI – Sampling Locations.
- *Plan 2.6* Oxford Meadows SAC - Site Condition Assessment.
- *Plan 2.7* Hook Meadow and Trap Grounds SSSI - Site Condition Assessment.
- *Plan 2.8* Traffic Baseline – Automated Traffic Counter Sample Points.
- *Annex 1* Condition 31 and Condition 32 of The Chiltern Railways (Bicester to Oxford Improvements) Order 2012.
- *Annex 2* Designated Sites Information and Management Prescriptions.

2 *BASELINE SURVEYS*

2.1 *INTRODUCTION*

Conditions 31 and 32 require an up to date and detailed baseline to be established (without the Scheme being operational) against which potential future changes (with the Scheme being operational) can be compared. This section provides an overview of the baseline surveys that will be undertaken and timescales of completion.

2.2 *BASELINE SURVEYS*

A combination of surveys will be used to gather the baseline information as follows:

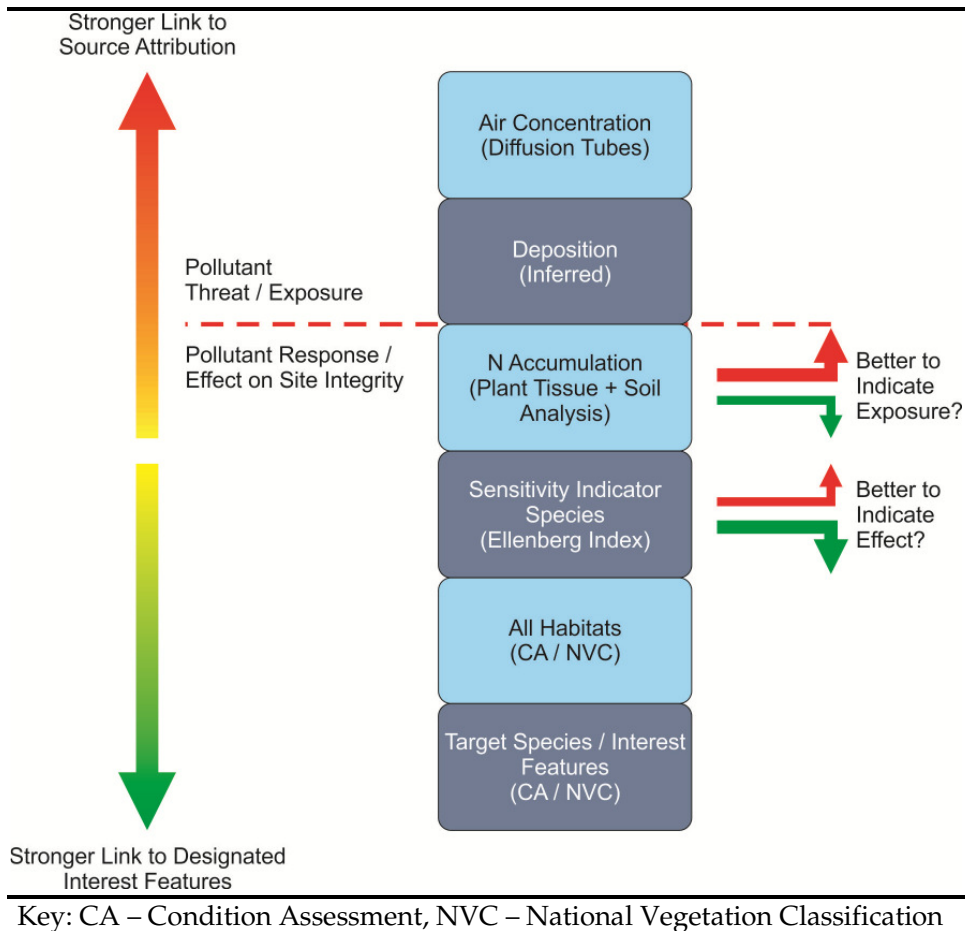
- **air quality baseline** (see Section 3) using diffusion tubes to record nitrogen oxides (NO₂ and NO);
- **habitat and soil baselines** (see Section 4) at predefined sampling locations, through:
 - Site Condition Assessments (SCA) of the designated sites;
 - National Vegetation Classification (NVC) surveys (including recording nitrophobe and nitrophile species and allowing the Ellenberg Nitrogen Index to be calculated) ;
 - lichen transplant biomonitoring;
 - plant tissue collection (to allow testing for total tissue nitrogen and stable isotopes $\delta^{15}\text{N}$), and
 - soil sampling and condition analyses (to allow testing for various elements including: plant available nitrogen (N), phosphorous (P), potassium (K) and pH).
- **traffic baselines** (see Section 5) through:
 - automated traffic counting along the A40 and A34(T); and
 - rail passenger surveys at Bicester North Station and Oxford Station.

The air quality, habitat and soil surveys form a 'biomonitoring chain' ⁽¹⁾ for each designated site which has source and receptor links (see *Figure 2.1*). A biomonitoring chain represents the logical sequence of stages (and links) in biomonitoring from potential pollutant source to eventual environmental effects. The biomonitoring chain includes methods that are 'source oriented' such as air quality monitoring which have a strong link to quantifying the pollution source (airborne nitrogen) and 'receptor oriented' methods such as

(1) Hicks, W.L., Whitfield, C.P., Bealey, W.J and Sutton, M.A. (eds). (2011). *Nitrogen Deposition and Natura 2000: Science & practice in determining environmental impacts*. COST729/Nine/ESF/CCW/JNCC/SEI Workshop Proceedings, published by COST (page 60).

vegetation monitoring which has a stronger link to the designated sites interest features and identifying potential impacts on these receptors. A combination of these biomonitoring methods together from a number of stages along the chain will form a robust baseline data set.

Figure 2.1 *Biomonitoring Chain*



2.3 *SURVEY ACCESS*

Access to Oxford Meadows SAC and Hook Meadow and Trap Grounds SSSI will be secured through powers convened under the Chiltern Railways (Bicester to Oxford Improvements) Order 2012, as advised by Ardent Ltd (Property consultancy). The relevant land owners will be contacted by Ardent Ltd to secure access and to communicate the aims and objectives of the baseline surveys (see *Plan 2.2* and *Plan 2.3: Landowners*). Throughout this process lines of communication will be kept open with NE and the appropriate Reserve and Land Managers.

2.4 *SURVEY TIMING*

The existing passenger services between Bicester Town and Oxford are to be suspended from February 2014, with a replacement bus service put in place.

Works in North Oxford, between the Oxford City boundary and Oxford North Junction, including those at Wolvercot Tunnel, are programmed to take place in spring 2015. Chiltern Railways passenger services from the new station at Water Eaton to and from London Marylebone are planned to commence mid-2015. The car park and station are likely to open at that time. The construction programme for works from Oxford North Junction to Oxford Station has yet to be confirmed, but these are due to be completed by March 2016. These works will be dictated by the wider Oxford Station improvement works which is a separate project. This project is still in the development stage so the construction programme is not as yet confirmed.

Railway services along the Oxford – Birmingham mainline will continue as usual, although the level of services will vary and be dependent on train operator schedules and timetables (see *Plan 2.1: Main line and Chiltern Branch Line*). The exact timetable for Chiltern Railway services will be finalised closer to the opening of the Scheme.

The baseline data collection will occur over a 12 month period prior to the opening of the Scheme to rail passengers and the opening of Water Eaton Station (due to be opened mid-2015).

2.5

BASELINE LIMITATIONS

The reduction in train movements along the Chiltern Branch Line from February 2014 onwards is not expected to have a detrimental effect of the quality of the baseline data gathered. In reality, the number of passenger trains using the branch line represents a small proportion of the total train movements on the Oxford-Birmingham mainline, which are made up of both passenger and freight trains. Per train, the passenger services emit considerably less emissions compared to the freight services on the branch line ⁽¹⁾, as such any reduction in air emissions will be negligible and would in essence give a more precautionary baseline.

(1) Based on unit emission factors provided by AEA Technology for Diesel Multiple Units for passenger trains (14.7 g/unit/km/ train movement) and locomotives for freight (120 g/unit/km/train movement) as set out in Environmental Statement 2009, Table 13.5. Original sources *Rail Emission Model* (2001) for Strategic Rail Authority and *Estimation of Rail Environmental Costs* (2007) for the Department of Transport.

3.1 INTRODUCTION

The air quality baseline survey will characterise the baseline air quality conditions within the Oxford Meadows SAC and Hook Meadow and Trap Grounds SSSI. The aims are to:

- establish an air quality baseline of both gaseous concentrations and deposited nitrogen levels using diffusion tubes to monitor NO_x at the Oxford Meadows SAC and Hook Meadow and Trap Grounds SSSI;
- establish how the air quality baseline varies spatially across the Oxford Meadows SAC and Hook Meadow and Trap Ground SSSI at different distances from the transport corridors;
- review the baseline data collected against other appropriate reference sites from published data sources and meteorological data to determine if it represents a typical year;
- calculate deposition of nutrient nitrogen (using the Environment Agency approach ⁽¹⁾).

Survey methods to establish the nitrogen availability in the soil are considered in *Section 4.6* and the uptake of nitrogen by plants is covered in *Section 4.4* and *4.5*.

3.2 TRANSECT LOCATIONS

A total of eight diffusion tube transects (up to 200 m in length) will be used across Oxford Meadows SAC and Hook Meadow and Trap Grounds SSSI. Each transect will be perpendicular (as far as practical) to the railway line and/ or road to allow reductions in the levels of air pollutants with increasing distance from the railway and A40/ A34 (see *Plans 2.4* and *2.5: Sampling Locations*) to be recorded. These locations have been chosen as they are points within the habitat where potential impacts from rail/ road emissions can most likely be determined, giving representative coverage. In addition, meteorological data from Brize Norton included in the ES indicated that the prevailing wind direction is from the southwest, as such perpendicular transects are considered to be appropriate at these locations.

At Oxford Meadows SAC transects will be established across the Pixey and Yarnton Meads (three transects) and Wolvercote Meadows SSSI (one transect)

(1) AQTAG06 – Technical Guidance on Detailed Modelling Approach for an Appropriate Assessment for Emissions to Air, Environment Agency, produced 06/02/04, Version 8.

components of the Oxford Meadows SAC (see *Plans 2.4* and *2.5*). These include two transects away from the A40 (to the south) and two transects away from the A34 (one to the northwest and one to the south east). At these locations the SAC abuts the roads and can accommodate a 200m transect perpendicular to the roads, unobstructed by significant landscape features.

Cassington Meadows SSSI is excluded from the baseline surveys due to its distance and separation from the A40 (around 190m). At this distance, NO_x emissions associated with traffic on the A40 are likely to be indiscernible from the general background ⁽¹⁾ and as such no detrimental effects on the habitat are likely.

At Hook Meadow and Trap Grounds SSSI three transects will be established to cover the areas which are split by the Oxford – Birmingham mainline and Chilterns Branch line (as illustrated in *Plan 2.5*). To the east of the mainline the designated site is bisected by the Chilterns Branch line and remains narrow on both sides. At these locations three shorter transects (east and west of the Branch line) will be established, between 50 – 100m in length. West of the Oxford – Birmingham mainline a further transect of 200m length can be accommodated.

The indicative locations of the transects in both designated sites were established during a site visit undertaken in March 2013 and discussed with NE and OCC in a meeting in July 2013. The best locations for the diffusion tube transects were determined considering a number of factors, including:

- areas that are accessible and not waterlogged (particularly at Hook Meadow and Trap Grounds SSSI); and
- utilising existing fence lines and hedgerows where possible to minimise effects on agricultural fields (and the SSSIs) and reduce the risks of livestock damage.

3.3 *DIFFUSION TUBE PLACEMENT*

Sample points along the transects will be located, where possible, at intervals of 10m, 20m, 50m, 100m and 200m ⁽²⁾ from the respective road / railway line (see *Plans 2.4* and *2.5*). Diffusion tubes will be sited where there will be a free flow of air around the tube and away from dense foliage or beneath overhanging trees. Should hedgerows and trees be considered to be too high, or obstructive to allow good air quality sampling at the given distances the sample posts will be placed in a more open areas (at least 10m from overhanging trees and large bushes).

(1) Defra (2009) Local Air Quality Management Technical Guidance Note TG(09) Page A3-20.

(2) Observations from the site visit identified that at the closest point, the sites are no less than 10m from the kerbside of the roads of interest, and railway line. Following guidance provided in the UK Highways Agency (Highways Agency (2007) Design Manual for Roads and Bridges Volume 11, Section 3, Part 1: Air quality), at distances of greater than 200m from roads, impacts to air quality are anticipated to be negligible.

Upon completion of the survey, the tubes and supporting structures will be removed so there will be no long term effects on the fields and the SAC/SSSIs.

3.4 *DIFFUSION TUBE USE*

The approach will adhere to published guidelines for the use of diffusion tubes ⁽¹⁾, and the following protocol:

- a single diffusion tube (Palmer-type, widely used in the UK) will be used at each sampling point, held vertically with the open end downwards during sampling;
- tubes will be placed 2 – 4 m above the ground to reduce the risk of theft. All tubes used during the baseline survey will be placed at similar heights, to ensure consistency;
- the immediate area around the diffusion tube will be open to allow free circulation of air around the tube, but avoiding areas of higher than usual turbulence. Tubes should be placed away from bushes or overhanging trees, unless this would affect fields, or increase the risk from interference by livestock/theft;
- the tubes (two per sample location – one sampling for NO and one sampling for NO₂) will be attached to a wooden post. If required, a steel tree guard can be used to minimise the risk of damage from livestock, the most appropriate method will be agreed with NE and the relevant landowners; and
- the exposure of the samples will be carried out in accordance with best practice quality assurance (QA) as set out in standard guidelines ⁽²⁾, including handling, storage, labelling, deployment and transport of the tubes.

3.5 *SURVEY TIMING AND ANALYSIS OF RESULTS*

Baseline surveys will take place over a 12 month period to capture seasonal variations. Tubes will be changed every month, in line with the UK national diffusion tube calendar provided by Defra (*i.e.* on the Wednesday nearest to the first day of the month ⁽²⁾). This approach ensures, as far as possible, parity

(1) AEA Energy and Environment (2008) *Diffusion Tubes for Ambient NO Monitoring: Practical Guidance for Laboratories and Users*. AEA

(2) Some monitoring sites may be flooded at some point during the survey period. Should this occur it may not be possible to change the tubes where a site is inaccessible on foot. Diffusion tubes can be deployed for a period of up to 8 weeks before sample quality significantly reduces. Therefore, a delay in changing samples will not necessarily compromise the integrity of the survey.

with other diffusion tube surveys that will be used in the validation process. A Gradko Air Pollution Monitoring laboratory (accredited to ISO 17025) will be used to analyse all diffusion tubes to ensure consistency.

Mean concentrations (units) of NO_x will be calculated directly from the diffusion tubes to provide air quality gradients along each transect up to 200m from the roads or railway lines. The NO_x concentration data will be used to estimate nitrogen deposition along the transects, based on the Environment Agency's approach ⁽¹⁾.

The baseline findings will be compared with the Critical Levels for airborne NO_x (currently 30µg/m³ ⁽²⁾) and Critical Load range for deposited nitrogen (currently 20-30 kg N/ha/yr ⁽³⁾) for the designated sites. Critical Loads are set under the Convention on Long-Range Transboundary Air Pollution, whilst Critical Levels of air pollutants for the protection of vegetation have been set by the Air Quality Strategy for England, Scotland, Wales and Northern Ireland (2011, Volume 2). Critical Levels and Loads are regularly revised; as such both the Critical Level and Load for the Oxford Meadow SAC and Hook Meadow and Trap Grounds SSSI will be obtained through the Air Pollution Information System (APIS) to inform the analysis of the air quality baseline data once this is collated.

The baseline results will also be compared to the Concentration Based Estimated Deposition (CBED) reported in APIS for Low and Medium altitude hay meadows which is based on measured-interpolated data for a three year average 2009 – 2011, currently reporting a maximum total nitrogen deposition of 18.62 kg N/ha/yr.

3.6

COMPARISON WITH LOCAL AND NATIONAL MONITORING SCHEMES

The results of the site specific baseline surveys will be considered as part of a considerably wider set of monitoring data from other published sources. The comparator data are available from local authorities who routinely monitor ambient pollution and from the extensive UK government monitoring network. The data will form part of a review of background data in relation to air quality of the local area and will be collated for the previous five years where possible ⁽⁴⁾. The data will help to determine both longer term trends in air quality, and also determine how the results from the baseline survey, compare to other locations. In addition, a bias adjustment factor will be used to allow comparison with surveys that have been collected using active

(1) AQTAG06 – Technical Guidance on Detailed Modelling Approach for an Appropriate Assessment for Emissions to Air, Environment Agency, produced 06/02/04, Version 8.

(2) www.apis.ac.uk

(3) www.apis.ac.uk

(4) The Environment Agency for England determine that five years of meteorological data is adequate when undertaking air quality impact assessments to capture year on year variations in air quality. This guidance has been used to determine the period for which comparisons will be made with air quality monitoring from other sites.

samplers (eg denuders) as part of other monitoring programmes, as set out within Defra guidance ⁽¹⁾.

Data from the UK Government Automatic Urban and Rural Network (AURN) and data from local authority monitoring will be reviewed. The following sources have been reviewed to identify specific sites that may be of interest to this study:

- the Harwell AURN site is located in rural Oxfordshire to the south of Abingdon. This is the nearest rural AURN site to the survey site, and is expected to demonstrate the same general trends in air quality that will be observed at the survey sites.
- The Wicken Fen AURN site is located in rural Cambridgeshire to the northeast of Cambridge. This AURN site will be used to reflect regional trends in air quality that will be observed at the survey sites.
- the Bottesford AURN site is located in rural Lincolnshire to the west of Grantham. This AURN site will be used to reflect regional trends in air quality that will be observed at the survey sites.
- the Oxford Centre Roadside site is located in Central Oxford, at a roadside location. This site will be used to reflect primarily the influence of traffic related sources and will show a strong diurnal profile associated with fluctuating daily, weekly and seasonal traffic. The pollution concentrations monitored at this location will be considerably higher than those at the survey sites, but will be influenced by the same local and regional meteorology as at the survey sites.
- the Oxford St Ebbes Urban Background site is located in south Oxford, at a location greater than 50m from any major roads. This site will be used to reflect the influence of general and traffic related sources in Oxford. The pollution concentrations monitored at this location will be influenced by the same local and regional meteorology as at the survey sites.

In addition to the AURN data sources, an initial review of monitoring undertaken by local authorities in the vicinity of the survey sites, at West Oxfordshire, Cherwell, Aylesbury Vale, South Oxfordshire, Vale of White Horse, and Oxford has identified a small number of longer term monitoring sites using diffusion tubes that would be suitable for long term comparison of monitoring trends. The sites of particular interest are those in rural areas. Using this approach, the baseline year will be characterised in the context of longer term air quality trends, and year on year variations will be identified. This will allow the survey results from the Scheme to be 'calibrated' against the longer term baseline, so that meaningful interpretation of the results is possible into the future. On the basis of this, any deviation away from the overall regional trend in the survey data can be identified.

(1) Part IV of Environment Act 1995: *Local Air Quality Management Technical Guidance*. LAQM.TG(03). Produced by Defra, 2003.

AURN monitoring sites (in the wider area) monitor both NO_x and NO₂, whereas the local authority sites (which are closer to the site) measure only NO₂. The diffusion tubes at Oxford Meadows SAC and Hook Meadow and Trap Grounds SSSI will report both NO₂ and NO_x (as the sum of NO₂ and NO). On this basis, the local authority diffusion tube data can be used to calibrate the baseline surveys on the basis that there is unlikely to be any significant uncoupling of the trend in NO_x and NO₂.

3.7

LIMITATIONS

There are some practical limitations which may affect the baseline surveys, as the ability to monitor spatial changes in air quality away from transport corridors requires a number of sampling points with samplers at each point. The need to provide air quality monitors at set distances away from the transport corridor may be compromised, for example, by:

- limitations in access to site at the correct distances;
- the presence of obstructions, fences, walls, boundaries ; and/or
- the presence of obstructing or overhanging vegetation as diffusion tubes cannot be placed underneath trees.

This may lead to a sub-optimal survey design, which in turn may increase uncertainty in the results, or increase the difficulty in interpreting results.

The methodology is designed to reduce error and uncertainty, but should this not be possible for the reasons already stated these can be quantified. By using the same laboratory (likely a Gradko laboratory) and survey technique (diffusion tubes) throughout the survey, consistency in survey equipment response, and analysis error is minimised. Similarly, the approach adopted follows guidance used in other Defra diffusion tube studies to facilitate comparison. The analysis will be based upon a year worth of data to reduce the effect of month on month variability and the comparison of the survey results with other monitoring sites will also assist in reducing uncertainty and identifying the true trend.

It is known that there may be factors affecting the survey that are not possible to control as part of the survey approach e.g. the change in primary nitrogen dioxide production and conversion to NO_x, meteorology, and effects of dispersion and atmospheric chemistry.

4.1 *INTRODUCTION*

The habitat and soils baseline survey will characterise the baseline conditions within the Oxford Meadows SAC and Hook Meadow and Trap Grounds SSSI in relation to the plant communities present and elements of the growing conditions which are influenced by nitrogen deposition. This will be achieved by undertaking site wide Site Condition Assessments underpinned with more detailed NVC survey. These will be complemented by bioindicator methods including the analysis of plant tissue and soil samples.

The aims of this baseline are to:

- establish the current condition of the SSSIs which underpin the SAC and Hook Meadow and Trap Grounds SSSI (SCA) and also existing botanical communities (NVC) at sample locations;
- establish the existing levels of soil nitrogen availability (plus phosphorus (P) and potassium (K) availability and pH) at each sampling point; and
- establish the concentrations of nitrogen within plant tissue, which has been taken up into plant species typical of lowland hay meadow and the transplanted lichen.

4.2 *SITE CONDITION ASSESSMENT (SCA)*

The SCA will follow the 'Rapid Assessment Method' used by NE ⁽¹⁾ and the Common Standards Monitoring Guidance ⁽²⁾ for determining the condition status of SSSIs, and will be undertaken at Oxford Meadows SAC (Pixey and Yarnton Meads and Wolvercote Meadows SSSI) and Hook Meadow and Trap Grounds SSSI.

The main purpose of the baseline surveys is to allow a judgment to be made about whether the desired condition of the specific nature conservation interest features of the designated site is being achieved and if the current management regime is appropriate.

The SCA method provides a high level assessment of the designated site in relation to its condition status and does not allow for detailed botanical characterisation of the habitats that are present. This method is used by Natural England to assess each SSSI in England on a six year rotation, as part of a long-term monitoring commitment to track the overall status of the

(1) Robertson, H. J. and Jefferson, R.G. (2000). *Monitoring the condition of lowland grassland SSSIs – English Nature's rapid assessment method*. English Nature Research Report No. 315.

(2) JNCC. (2004). *Common Standards Monitoring Guidance for Lowland Grassland Habitats*. JNCC

designated site over time and identify any trends in declining or improving condition. This survey methodology does not allow the fine scale changes in vegetation communities to be detected. As such, undertaking this survey as part of the baseline will allow each designated site to be assessed as a whole and its baseline condition to be determined prior to the commencement of the scheme.

The exact methodology utilised by NE previously at Oxford Meadow SAC and Hook Meadow and Trap Grounds SSSI will be replicated in order to allow a direct comparison to be made with previous SCAs undertaken at these sites by NE, and the SCA undertaken for ERM at the Hook Meadow and Trap Grounds SSSI in 2010.

Key that will be recorded are:

- **Extent** of interest feature (lowland hay meadow)/ broad habitat types.
- **Sward composition and structure** to determine the ratio of grass: forbs, the presence and frequency of positive indicator species of the habitat type (such as *Filipendula ulmaria*, *Centaurea nigra* and *Galium verum*) and negative indicator species (such as *Cirsium arvense*, *Rumex obtusifolius*, *Lolium perenne* and *Trifolium repens*) and sward height (this tends to increase with N enrichment). This will be based on a structured walk with up to 20 stopping points a set distance apart (approx. 20m) along a pre-determined route in a 'W' shape across each SSSI unit area (See *Plans 2.6* and *2.7*). At each stopping point a quadrat of 2x2m will define the 'search area'.
- **The presence and extent of nitrogen sensitive species** to establish their presence and map their locations. This will provide a benchmark for potential future monitoring of the SSSIs.

See *Plans 2.6* and *2.7: Site Condition Assessment*.

4.2.1 *Survey Timing and Results Analysis*

The SCA will be undertaken at Oxford Meadows SAC (Pixey and Yarnton Meads and Wolvercote Meadows SSSI) and Hook Meadow and Trap Grounds SSSI between May and July 2014.

Condition Assessments of each of the designated sites will be used to determine the status of the qualifying features present on the site. This will be achieved by comparing the attributes surveyed during the SCA against a set of favourable conditions which have been defined by Natural England ⁽¹⁾. Each habitat attribute will be assessed and a conclusion drawn in relation to the pass/failure of the SSSI units and an overall condition will be produced for the SSSI as a whole. This will be compared with the previous condition

(1) Natural England website - <http://www.sssi.naturalengland.org.uk/Special/sssi/index.cfm>

assessment carried out by Natural England at the designated sites and by ERM's assessment of Hook Meadow and Trap Grounds SSSI in 2010.

4.3

NATIONAL VEGETATION CLASSIFICATION (NVC)

NVC is the main habitat classification used for SSSI selection and to interpret the *Annex I* habitats listed under the *EC Habitats Directive*. It is also used to inform monitoring programmes and to develop management options for designated sites. NVC surveys will be carried out in accordance with standard guidance ^{(1) (2)} at each sample locations on the air quality transects (see *Plans 2.4* and *2.5*) within the Oxford Meadows SAC (Pixey and Yarnton Meads SSSI and Wolvercote Meadow SSSI) and Hook Meadow and Trap Grounds SSSI.

Sample points will be located at intervals of 10m, 20m, 50m, 100m and 200m (where achievable) from the railway line and A40/ A34 cutting across the air pollutant contour gradients at same location as the diffusion tube sample points. The vegetation communities recorded will be representative of the habitats at each sampling point.

The NVC surveys represent a more detailed classification of vegetation communities at each sampling point that can be linked directly to the diffusion tube, soil sampling and plant tissue sampling undertaken at each sampling point. The NVC method allows a more detailed analysis of the results to be undertaken providing metrics for determining nitrogen deposition impacts (see *Table 4.1*). This sampling will allow the habitat to be recorded in more detail than the SCA, which is a more holistic approach to assessing the condition of designated sites as a whole.

A single 2x2 m quadrat placed within a 5 m radius of the diffusion tube will be subject to NVC survey. The exact location of the quadrat will be recorded using GPS to aid subsequent survey visits. At each location the broad habitat type will be recorded together with a species list (identifying all taxa to species level, including bryophytes), and cover/ abundance of species recorded using the DOMIN scale. To further link the NVC survey with the SCA and enable subtle changes to be detected during potential future monitoring, the percentage grass cover, percentage of forbs (grass:forbs cover ratio), height of vegetation, percentage of unfavourable plant species (nitrophiles) and neighbouring vegetation types will also be recorded.

4.3.1

Survey Timing and Results Analysis

The NVC survey will be undertaken between May and July 2014 to ensure the floristic character of the vegetation has been characterised fully prior to the

(1) Rodwell, J.S.(2006). *National Vegetation Classification: User's handbook*. JNCC.

(2) Rodwell ed. (1992). *British plant communities. Vol 3. Grassland and montane communities*. JNCC

annual cut for hay (July each year) and seasonal grazing by cattle (autumn/winter each year).

Each NVC quadrat will be allocated specific British plant community types and a conclusion drawn from that as to the conservation value of the NVC communities present. The communities recorded will form the baseline condition of each sampling location within the designated sites.

The Ellenberg N score for each NVC quadrat will be calculated as will an average Ellenberg N score for each designated site. The Ellenberg Index was devised as an indicator system to describe the response of individual plant species to a range of ecological conditions (light, temperature, pH, moisture and nutrients). The Index is a useful tool in detecting shifts in vegetation communities consistent with increased nutrient availability and ecosystem eutrophication. It has been shown to be a robust indicator of enhanced nitrogen deposition and has been used extensively in Europe to indicate vegetation change due to increased atmospheric nitrogen deposition ⁽¹⁾. The Index (weighted and unweighted) is calculated by allocating an 'N score'⁽²⁾ to each plant species, which relates to where that species sits along a productivity/macro-nutrient availability gradient.

As such, the Ellenberg N Index can be used to categorise the status of a vegetation community on a scale ranging from nutrient poor (1) to nutrient rich (10), with differences being attributed to the impact of varying nutrient availability, primarily nitrogen. An increase in the Ellenberg N score of a site can indicate a shift in species composition consistent with greater availability of nitrogen due to nitrogen deposition. The Ellenberg Index is suited to detect large changes in vegetation community composition, usually as a result of many years of elevated nitrogen deposition.

The spatial and temporal metrics listed in *Table 4.1* will be included within the analysis of the Condition Assessment and NVC surveys.

Table 4.1 *Metrics for Determining Nitrogen Deposition Impact with Different Data Types from NVC and SCA Surveys*

Survey Type	Metric/ Analysis
Spatial	
NVC quadrats	Species richness and Shannon diversity / evenness index ⁽³⁾ Mean Ellenberg N Value (unweighted ⁽⁴⁾) Grass:forb cover ratio
SCA Structured walk	Indicator species

(1) Leith, ID. et al. (2005). *Biomonitoring methods for assessing the impacts of nitrogen pollution: refinement and testing*. JNCC Report 386.

(2) using the MAVIS computer programme which can be used to analyse vegetation data using different types of classifications (including the Ellenberg Index) developed for Great Britain.

(3) The Shannon diversity index is a commonly used diversity index that takes into account both abundance and evenness of species present in the community.

(4) Mean Ellenberg Index

Survey Type	Metric/ Analysis
Temporal	
NVC quadrats	Species richness and Shannon diversity / evenness index Mean Ellenberg N Value (weighted ⁽¹⁾) and change in Ellenberg N over time Grass:forb cover ratio and changes in grass:forb cover ratio
SCA Structured walk	Indicator species and change in presence of indicator species

4.4

PLANT TISSUE COLLECTIONS

Nitrogen can accumulate in plant tissue when its availability exceeds the growth demands and when growth is restricted. This excess can be estimated from tissue nitrogen concentrations. The foliar nitrogen concentration of many plants (trees, shrubs, herbs, mosses and lichen) has been found to be related to atmospheric inputs ⁽²⁾, and thus can be used as an indicator of nitrogen deposition.

In addition, the ratio ($\delta^{15}\text{N}$) of the two naturally occurring stable isotopes of nitrogen (^{14}N and ^{15}N) can be used to indicate the source of the nitrogen found. This ratio varies according to the source of the fixed nitrogen, with combustion processes being ^{15}N positive (railway and roads) and that from agricultural processes being ^{15}N negative (livestock). The levels of $\delta^{15}\text{N}$ within the plant tissue collected, when assessed in conjunction with the air pollutant findings from the diffusion tube surveys, may help identify the source of the nitrogen accumulating in the plant tissue (i.e. from transport sources or agricultural sources).

The methods used to sample nitrogen in plant tissue will follow those in the JNCC Report 356 ⁽³⁾. Tissue samples will be collected at each NVC sampling location from three of the more common qualifying interest plant species of lowland hay meadow (such as from the grass species: *Alopecurus pratensis* (Meadow Foxtail), *Festuca rubra* (Red Fescue) and *Holcus lanatus* (Yorkshire Fog) and forb: *Sanguisorba officinalis* (Great Burnet)) which occur in the SAC and SSSI being assessed, as agreed with NE. These are consistent with the positive indicator species listed in the conservation objectives of each designated site and the 'constant species' listed in the NVC MG4 Community type.

It is expected that each of the three target species will be present within each NVC quadrat sampling location to allow consistency of sampling. Three replicate samples will be collected from these three species to ensure that

(1) Mean abundance weighted Ellenberg Index

(2) C. Pitcairn et al. (2004). Bioindicator Methods based on Foliar Nitrogen Accumulation: Total Tissue Nitrogen in 'Bioindicator and biomonitoring methods for assessing the effects of atmospheric nitrogen on statutory nature conservation sites'. JNCC Report 356.

(3) Sutton MA, Pitcairn CER, Leith ID, van Dijk N, Tang YS, Skiba U, Smart S, Mitchell R, Wolseley P, James P, et al. (2004). Bioindicator and biomonitoring methods for assessing the effects of atmospheric nitrogen on statutory nature conservation sites. JNCC Report 356.

approximately 3g of fresh weight of material is collected to provide a minimum of 0.5g of dried material for chemical analysis. The samples will be collected from growth initiated in the sampling year, from leaves exposed to direct sunlight. The neighbouring species will also be recorded. The quantity of plant tissue required, the sampling containers, delivery to the laboratory and overall sample preparation protocol will be agreed with the CEH Lancaster laboratory used for analysis. The samples will be tested for total tissue nitrogen, % nitrogen, Phosphorous (P) content and $\delta^{15}\text{N}$.

4.4.1 *Survey Timing and Analysis of Results*

The plant tissue collection will be undertaken during the NVC survey between May and July 2014.

The results will be used to indicate the potential source of the nitrogen and distinguish between nitrogen input from livestock (NH_3) and that from transport (NO_x). The plant tissue sampling points will be located along the diffusion tube transects and will, therefore, be most readily influenced by local nitrogen sources including livestock manure, directly deposited on the designated sites and nitrogen deposited from the atmosphere, predominantly from sources within 200m of the sample point. As such, for the Oxford Meadows SAC this will focus on the A40 and A34 (the railway lines are located approximately 450m away) and for Hook Meadow and Trap Grounds SSSI the railway line (the A40 and A34 are located approximately 1.3km away) as potential local nitrogen sources that will have a ^{15}N positive signature.

Also the results will provide baseline information relating to nitrogen accumulation in plants located within the designated sites from all sources of nitrogen.

4.5 *LICHEN TRANSPLANT BIOMONITORING*

Lichens, which are known to be sensitive to air pollution, will be used as a more direct indicator of the effects of air borne emissions on vegetation. Lichens are highly dependent on the atmosphere for nutrients which are absorbed over the whole thallus surface over the whole year (not varying with season). Accumulation of elements, such as nitrogen, is a dynamic process involving uptake and release until an equilibrium is reached with the surrounding environment. A lichen transplant method will be followed at the site during the baseline surveys. The *Melanelixia* lichen species will be used. This lichen species has been recommended by CEH drawing on research carried out by OPAL (Open Air Laboratories) ⁽¹⁾. These lichen species have been identified as intermediate species which are relatively tolerant of air pollution ⁽²⁾ and are considered to be common and widespread within the UK.

(1) <http://www.opalexplorenature.org/AirSurvey>

(2) Davies, L., Bates, J. W., Bell, J. N. B., James, P. W., Purvis, W. O. (2007). *Diversity and sensitivity of epiphytes to oxides of nitrogen in London*. Environmental Pollution 146(2): 299-310.

A local donor site will be identified for the *Melanelixia* species (*Melanelia exasperatula* and *Melanelia subaurifera*) by an experienced botanist. Once a donor site is identified, samples of the *Melanelixia* lichen will be taken along with an area of bark. Donor samples will be analysed to determine the initial N concentrations prior to transplantation. The lichen samples (approx. diameter 3-4 cm) will be transplanted on to posts, contained within a synthetic net, at a height of 2-3m, along representative air quality transects in the Oxford Meadow SAC and Hook Meadow and Trap Grounds SSSI (i.e. a single transect away from the A40, the A34(T) and the railway lines).

4.5.1 *Survey Timing and Results Analysis*

The lichen will be transplanted in March 2014 and left in place for four to six months to minimise any potential leaching effects by rain (avoiding winter months). After four to six months exposure, the lichen tissue will be analysed to establish the pH and range of N% and $\delta^{15}\text{N}$ in the tissue.

The lichen survey will provide information relating to nitrogen accumulation in plant tissue more directly linked to airborne nitrogen sources acting as an indicator of exposure to airborne nitrogen. This will allow the peaks of influence from airborne nitrogen to be identified with the results providing spatial information on the impacts of nitrogen emission on the vegetation.

The lichen biomonitoring results will be used to compliment the results provided by tissues samples of other plant species which will be affected not only by airborne nitrogen, but also by nitrogen and nutrient present in the soil which may be affected by external factors such as infrequent flooding and agricultural nitrogen inputs.

4.6 *SOIL CONDITION ANALYSIS*

The soil from each sample location will be analysed for plant available nutrients and soil pH. Soil pH will be tested by taking and analysing soil samples. Plant Root Simulator (PRS) Probes ⁽¹⁾ will be used to provide data on plant available nutrients within the soil at each sample location. The probes provide a relevant measure of soil nutrient bioavailability as experienced by plant roots. A cation and anion PRS probe will be buried at each sample location for a period of 4-8 weeks. Following this period the PRS Probes will be collected and sent to the Western Agg. Laboratory for analysis.

A composite soil sample comprising a mix of six sub-samples (i.e. cluster sampling) will be taken at sample location, in accordance with the approach in the British Standard BS10175:2001⁽²⁾ (See *Plans 2.4* and *2.5*). The composite sample will be taken within a defined 1 m² area located within a 5m diameter

(1) <http://www.westernag.ca/innovations>

(2) British Standard 10175:2011. *Investigating Potentially Contaminated Sites – Code of Practice*. BSI

of the diffusion tube location. The location of the soil sample area relative to the NVC quadrats will also be recorded. Each sample will contain soils from the top 15cm of the soil profile, the depth likely to be affected by N deposition and comparable to Countryside Survey soil dataset, which also collects from the 0-15cm stratum. Samples will be collected using a soil corer and will be taken from one soil horizon. Prior to the excavation the surface layer of vegetation will be lifted, and then replaced after the soil sampling is completed.

The soil samples will be analysed for pH at a laboratory. The quantity of soil required, the sampling containers, delivery to the laboratory and overall sample preparation protocol will be agreed with Jones Environmental Laboratory. PRS Probes will be tested for plant available NO_3^- -N, NH_4^+ -N, P, K, S, Ca, Mg, Mn, Al, Fe, Cu, Zn, B, Pb, and Cd at Western Agg. Laboratories.

4.6.1 *Survey Timing and Analysis of Results*

The soil sampling will be undertaken during the NVC survey between May and July 2014.

The soil monitoring will provide information relating to nitrogen availability for plants in the soil at each sampling location, moving away from the potential pollution source (A40, A34 and railway lines). This will provide an indication of the current nitrogen in the soil that is available to be taken up by plants within the designated sites.

5.1 *INTRODUCTION*

The traffic baseline will quantify the traffic flows on the A34 (T) and A40, adjacent to the Oxford Meadows SAC and infer the baseline number of London bound rail passengers currently travelling by car to Oxford railway station using these roads.

The aims of this baseline are to:

- establish baseline flows on the A34 (T) and A40 (using Automated Traffic Counters). Local traffic surveys (of the A40 and A34(T)) will capture any local changes in traffic that may affect the Oxford Meadows SAC;
- establish the proportion of London bound passengers using Oxford and Bicester North Stations that travelled by car and if the route they used was either the A34 (T) or the A40; and
- establish the level of traffic using the A34(T) and A40 (recorded by the local traffic surveys) that is attributable to the Scheme using the results of the passenger survey.

5.2 *AUTOMATED TRAFFIC COUNTERS (ATC)*

ATCs are used to quantify vehicular traffic passing along a given stretch of road. Traffic data will be collected for a continuous seven day period each month over the 12 month baseline air quality monitoring period, in accordance with the Department for Transport's Transport Analysis Guidance on using ATCs. The traffic data are required to be collected over the entire 12 month period to ensure that data on vehicle movements is available for comparison to the air quality data to determine any relationship between the datasets.

The A34(T) ATC would be located approximately 740m southwest of the road bridge over the railway line and approximately 900m southwest of the road bridge over the A40. The A40 ATC would be located approximately 900m west of the A34(T) overbridge and approximately 1.6km west of Wolvercote Roundabout (see *Plan 2.10: Automated Traffic Counter Locations*). The ATCs will be installed by a specialist survey company with data collected every month. If there are any errors or missing data, the seven day survey will be repeated to ensure seven days' worth of data is collected in any one month.

The ATC will provide absolute counts of traffic utilising the A34(T) and A40 during the allocated data collection periods. Nationally available traffic flow data will be used as a comparator to ascertain whether the increase is due to

local factors (which may include the Scheme), or general increases in traffic that reflect regional and national trends.

5.2.1 *Survey Timing and Analysis of Results*

The automated traffic counting will take place over a 12 month period to capture variations throughout the year. The survey will commence at the same time as the air quality surveys (provisionally scheduled to start in March or April 2014, dependant on access).

The baseline traffic flows on the A34(T) and the A40 will be established from the traffic data collected, as Annual Average Daily Traffic (AADT) flows. By monitoring the traffic flows regularly over the 12 month baseline air quality monitoring period, it will also be possible to produce monthly flow profiles for the roads, to show how the traffic flow varies over the 12 month baseline survey period.

In the event that increased concentrations of air pollutants are recorded, it will be necessary to analyse any changes in traffic flows that have occurred over the same period. Train movements are timetabled and these will be checked with operators (as will the type and size of train, if appropriate) in relation to the Hook Meadow and Trap Grounds SSSI, but the Scheme will result in changes to road traffic movements along the A34 (T) and A40 due to the creation of a new station at Water Eaton.

5.3 *RAIL PASSENGER SURVEYS*

The rail passenger surveys will be undertaken at Oxford and Bicester North Stations. The surveys will establish the proportion of London bound passengers using Oxford and Bicester North Stations that travelled by car and if these passengers used the A34 (T) or the A40. Interviews will be undertaken with passengers on the London bound platforms by a specialist survey company and will be combined with platform/station entry and exit passenger counts.

5.3.1 *Survey Timing and Analysis of Results*

The rail passenger surveys will be undertaken at Oxford and Bicester North Stations over a 12 hour survey period (07:00 – 19:00) on one day, every other month over a 12 month period. The survey will commence to fit with the air quality surveys (provisionally scheduled to start in April 2014).

The rail passenger travel data extrapolated from the interviews will establish the number of vehicles on the A34(T) and A40 used by rail passengers travelling to London over the baseline 12-month period. The frequency of survey (every other month) is required to ensure that the quality of the data is not compromised when used to extrapolate passenger movements over the 12 month period. This together with the road traffic flow data obtained from the

ATCs would establish the proportion of traffic on these routes which can be attributed to rail passengers accessing Oxford Station and Bicester North Station.

Other supporting information will be collated to inform the baseline including:

- existing road traffic data from the A40 and A34(T) from local and regional data sets held by the Department for Transport and the Highways Agency;
- existing air quality data from national databases, such as those held by Defra;
- land management information from NE and landowners about the Oxford Meadows SAC and Hook Meadow and Trap Grounds SSSI;
- inundation and flooding information (if available) for Oxford Meadows SAC and Hook Meadow and Trap Grounds SSSI from NE and/or Environment Agency;
- numbers of train movements and frequencies (type and size of train, if appropriate) along the Oxford – Birmingham main line and Chilterns Branch Line from rail operators; and
- meteorological data from the local met station at Brize Norton but also, if possible, data from Reading University's meteorological station located on the Oxford Meadows SAC (see *Plan 2.4*).

This information will be reviewed and assessed as part of the baseline data analysis.

The findings of the surveys described above and analyses of the data will be contained in a single report which will be submitted within three months of the completion of the baseline surveys (subject to the successful completion of the baseline surveys). The report is likely to be structured as follows:

- introduction;
- aims and objectives;
- survey methods (split by topic) – including air quality, vegetation and soil and traffic baselines;
- survey findings (split by topic) – including air quality, vegetation and soil and traffic baselines;
- assessment / implications of findings;
- future monitoring approach; and
- summary.

A draft of the report (in electronic format) will be submitted to Natural England (Rebecca Tibbetts and Charlotte Frizzell), Oxford City Council (Fiona Bartholomew and Hannah Revell) and Cherwell District Council (Linda Griffiths) in advance of a meeting to discuss it. A final version of the report will be produced taking account of comments from the meeting.

This document sets out the approach that will be used to partially discharge Conditions 31 (sections (i), (v) and reporting elements of section (viii)) and 32 (sections (i), (ii) and reporting elements of section (vii)) in order to establish the baseline conditions of the Oxford Meadow SAC and Hook Meadow and Trap Grounds SSSI in the absence of the Scheme. The surveys will be undertaken to characterise the baseline conditions of the designated sites and will include, air quality surveys, habitat and soil surveys, traffic and rail passenger surveys.

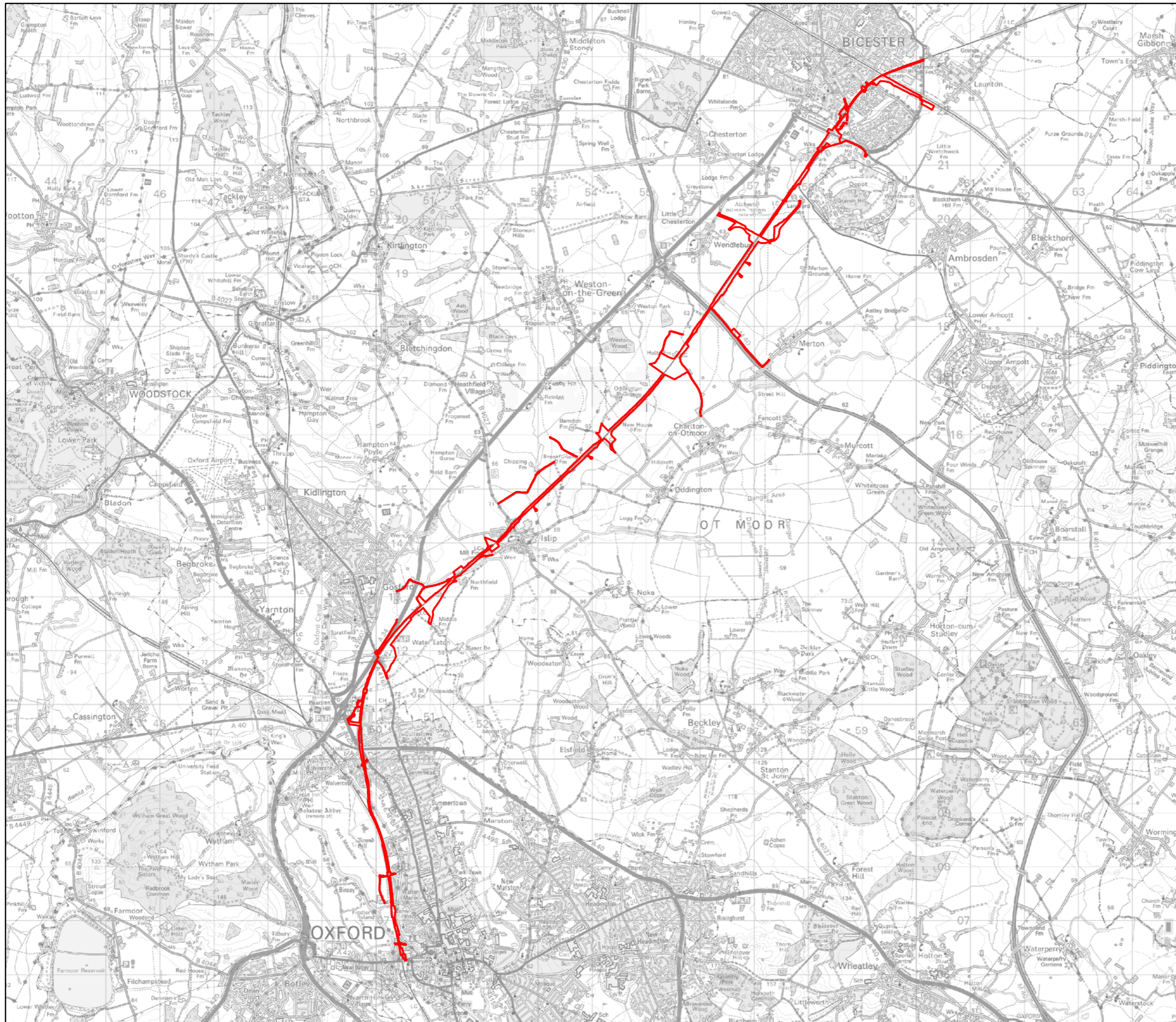
The baseline data collection will occur over a 12 month period prior to the opening of the Scheme to rail passengers and the opening of Water Eaton Station (due to be opened mid-2015).


Table 8.1 provides a summary of the indicative baseline surveys and reporting programme that will form the baseline assessment under Conditions 31 and 32 for the Oxford Meadows SAC and Hook Meadow and Trap Grounds SSSI.

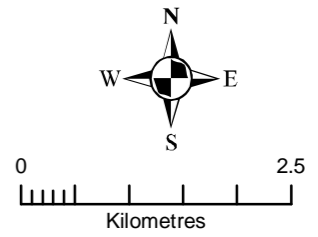
Table 8.1 Indicative Baseline Survey and Reporting Programme

Surveys	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	
	2014										2015					
Diffusion Tube Survey	■	■	■	■	■	■	■	■	■	■	■	■				
Site Condition Assessment			■	■	■											
National Vegetation Classification			■	■	■											
Soil Sample Analysis			■	■	■											
Plant Tissue Analysis			■	■	■											
Lichen biomonitoring	■	■	■	■	■	■										
Automatic Traffic Count	■	■	■	■	■	■	■	■	■	■	■	■				
Rail Passenger Survey		■		■		■		■		■		■				
Baseline Reporting to NE & LPA																■

Plans



KEY:
 Scheme Boundary and
 Extent of Rail Improvement Works



TITLE:
Plan 1.1
Proposed Scheme

CLIENT: **Chiltern Railways** SIZE: **A3**

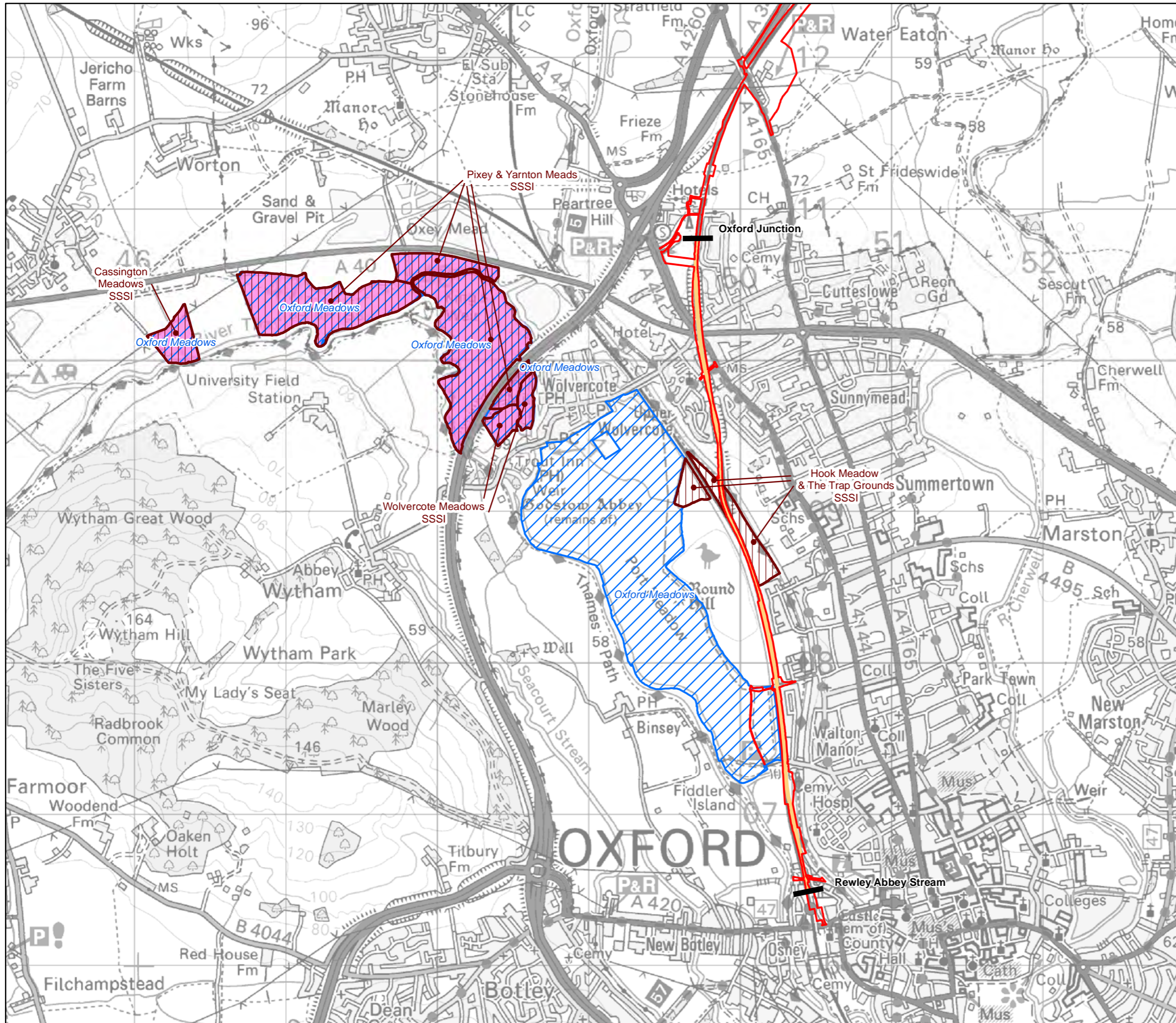
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DRAWING: **Plan 1_1 - Proposed Scheme.mxd** REV: **0**

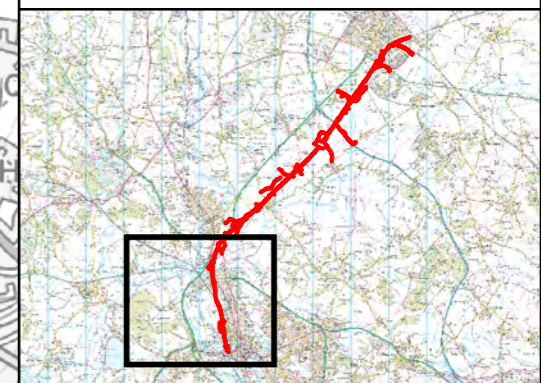
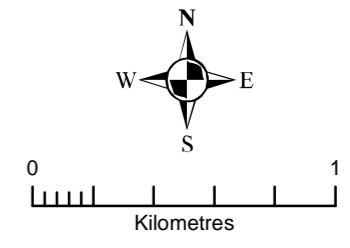
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 PROJECTION: British National Grid



- KEY:
- Scheme Boundary and Extent of Rail Improvement Works
 - The Relevant Section of Development Under Conditions 31 and 32
 - Sites of Special Scientific Interest
 - Special Area of Conservation
 - Parts of SAC as Including Annex I Habitats Lowland Hay Meadows



TITLE:
Plan 1.2
Designated Sites and Relevant
Section of the Scheme

CLIENT: **Chiltern Railways** SIZE: **A3**

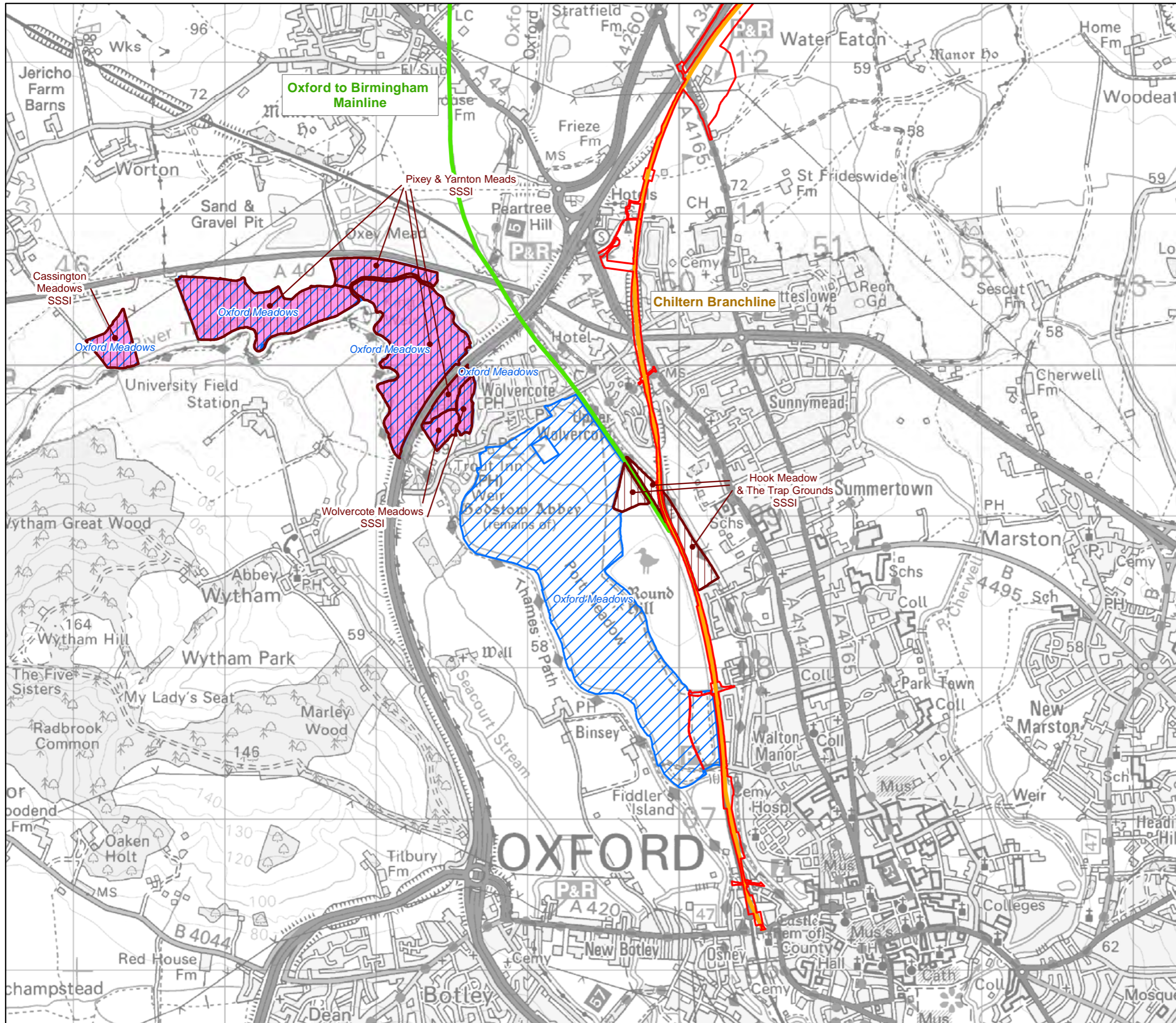
DATE: 12/07/2013 CHECKED: RM PROJECT: 0172205
 DRAWN: AZ APPROVED: SG SCALE: As Scale Bar

DRAWING: Plan 1_2 - Designated Sites and Relevant Section of the Scheme.mxd REV: 0

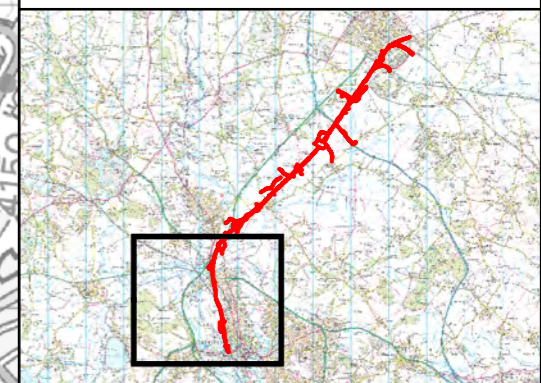
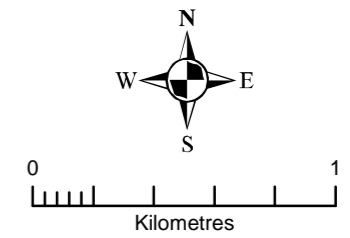
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 PROJECTION: British National Grid



- KEY:
- Scheme Boundary and Extent of Rail Improvement Works
 - Oxford to Birmingham Mainline
 - Chiltern Branchline
 - Sites of Special Scientific Interest
 - Special Area of Conservation
 - Parts of SAC supporting Annex I Habitat Lowland Hay Meadow



TITLE:
Plan 2.1
Mainline and Chiltern Branchline

CLIENT: **Chiltern Railways** SIZE: **A3**

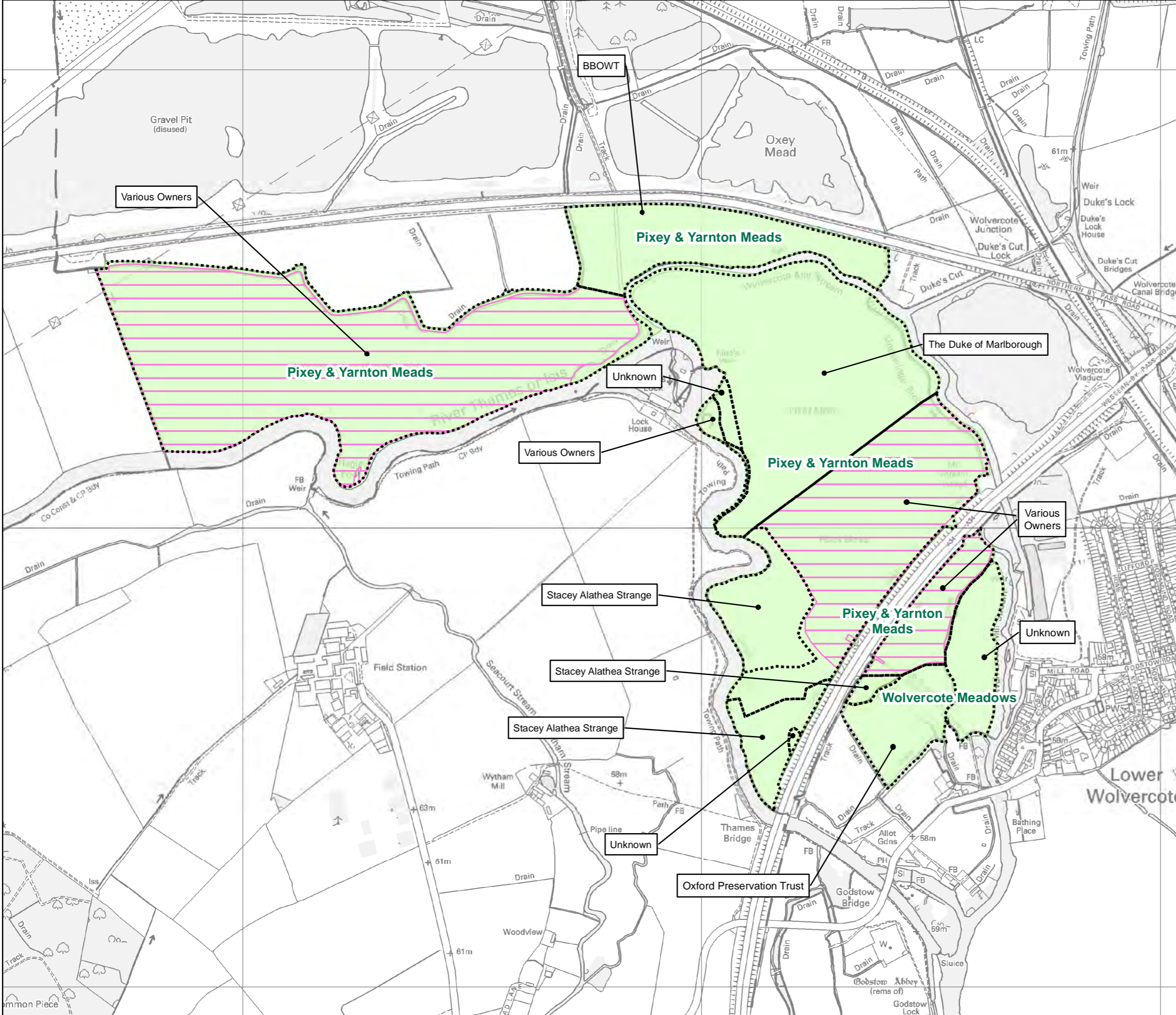
DATE: 24/07/2013 CHECKED: RM PROJECT: 0172205
 DRAWN: AZ APPROVED: SG SCALE: As Scale Bar

DRAWING: **Plan 2_1 - Main Line and Chiltern Branch** REV: **0**
 Line.mxd

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 PROJECTION: British National Grid



KEY:

- Registered Common Land
- Land Ownership Parcels
- Oxford Meadows SAC & SSSI


 0 0.25
 Kilometres

TITLE:
 Plan 2.2
 Oxford Meadows SAC - Land Ownership

CLIENT: **Chiltern Railways** SIZE: **A3**

DATE: 17/07/2013	CHECKED: RM	PROJECT: 0172205
DRAWN: JL	APPROVED: SG	SCALE: As Scale Bar

DRAWING: Plan 2.2 - Oxford Meadows SAC Land Ownership.mxd	REV: 0
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 PROJECTION: British National Grid



KEY:

- Scheme Boundary
- Land Ownership Parcels
- Hook Meadow and the Trap Grounds SSSI


TITLE:
Plan 2.3
Hook Meadow and Trap Grounds
SSSI - Land Ownership

CLIENT: **Chiltern Railways** SIZE: **A3**

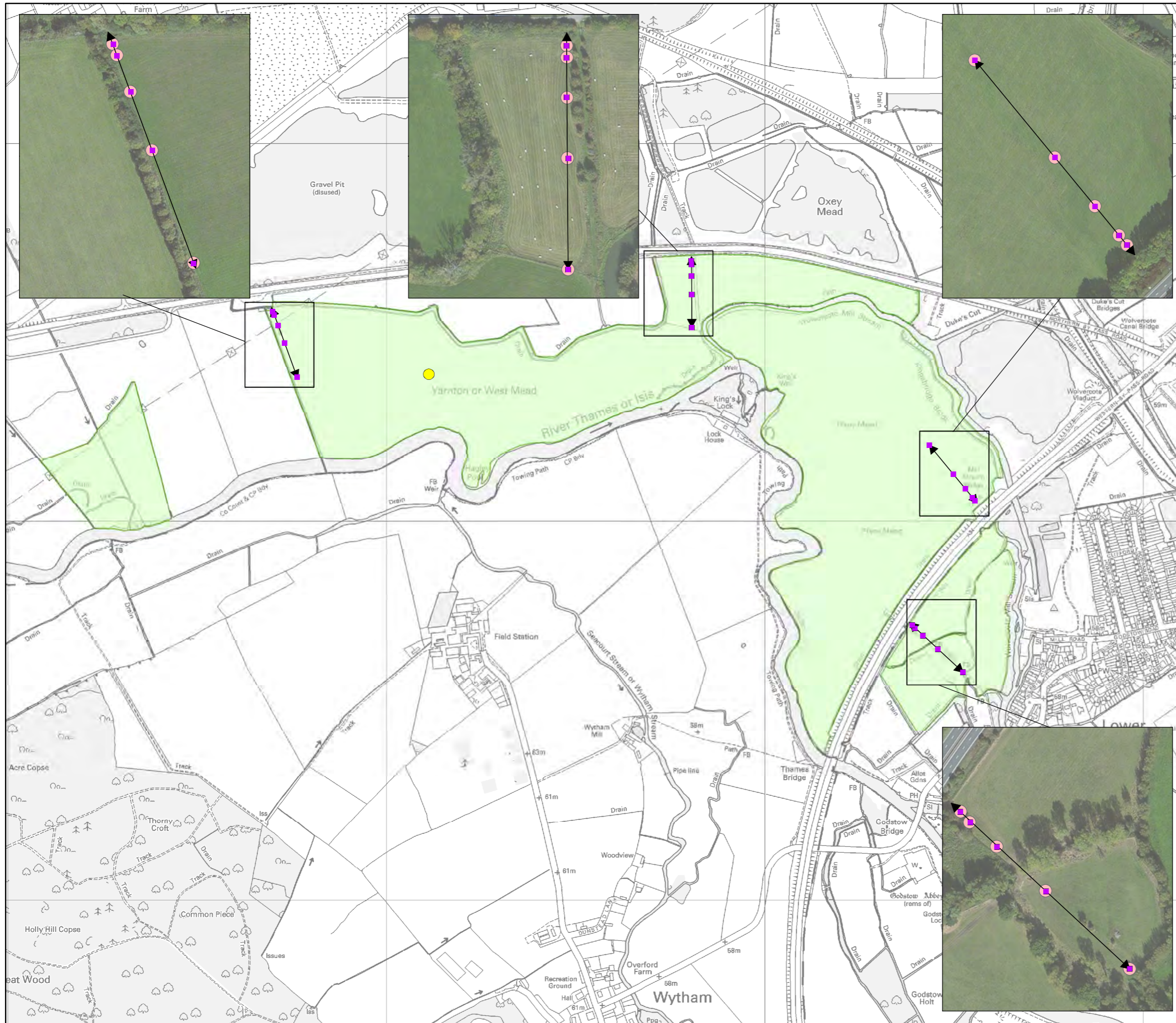
DATE: 17/07/2013 CHECKED: RM PROJECT: 0172205
 DRAWN: JL APPROVED: SG SCALE: As Scale Bar

DRAWING:
 Plan 2_3 - Hook Meadow and Trap Grounds SSSI
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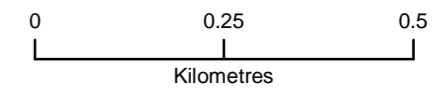
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- KEY:
- Diffusion Tube Sample Location
 - \longleftrightarrow Air Quality Transect
 - Reading University Met Station
 - NVC Plant Tissue and Soil Sample Area - 5m Radius of Air Quality Sample Point
 - Oxford Meadows SAC



TITLE:
Plan 2.4
Oxford Meadow SAC -
Sampling Locations

CLIENT: **Chiltern Railways** SIZE: **A3**

DATE: 17/07/2013 CHECKED: RM PROJECT: 0172205
 DRAWN: JL APPROVED: SG SCALE: As Scale Bar

DRAWING:
 Plan_2_4 - Oxford Meadow SAC Diffusion Tube Sample Points.mxd REV: 0

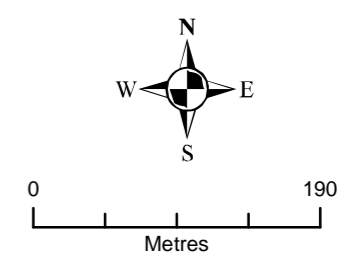
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 PROJECTION: British National Grid



- KEY:
- Scheme Boundary
 - Diffusion Tube Sample Location
 - ↔ Air Quality Transect
 - NVC Plant Tissue and Soil Sample Area - 5m Radius of Air Quality Sample Point
 - Hook Meadow and the Trap Grounds SSSI




TITLE:
Plan 2.5
Hook Meadow and Trap Grounds
SSSI - Sampling Locations

CLIENT: **Chiltern Railways** SIZE: **A3**

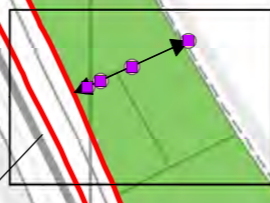
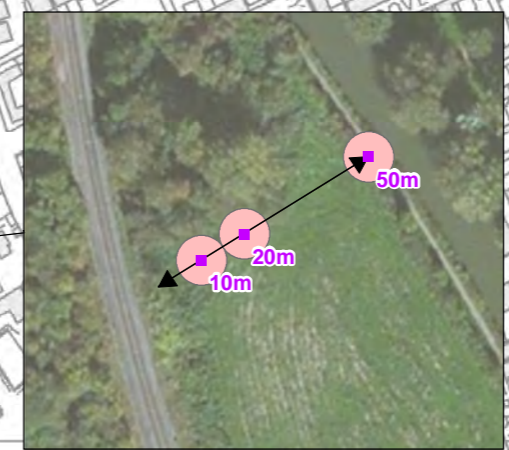
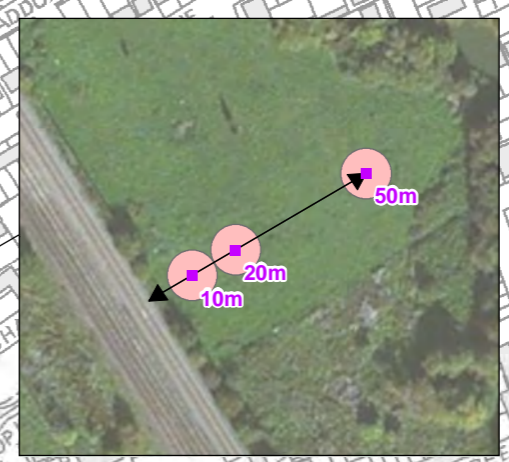
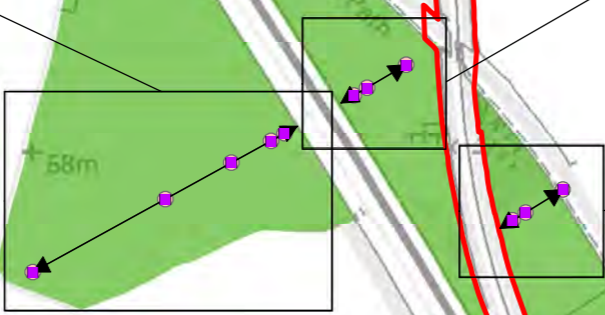
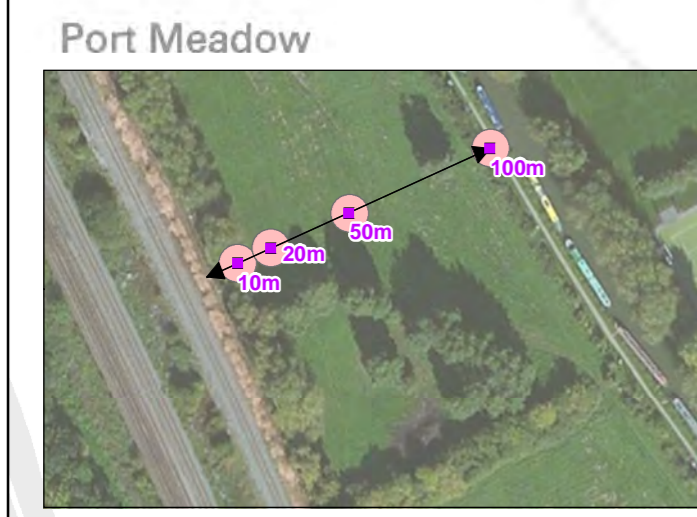
DATE: 17/07/2013 CHECKED: RM PROJECT: 0172205
 DRAWN: JL APPROVED: SG SCALE: As Scale Bar

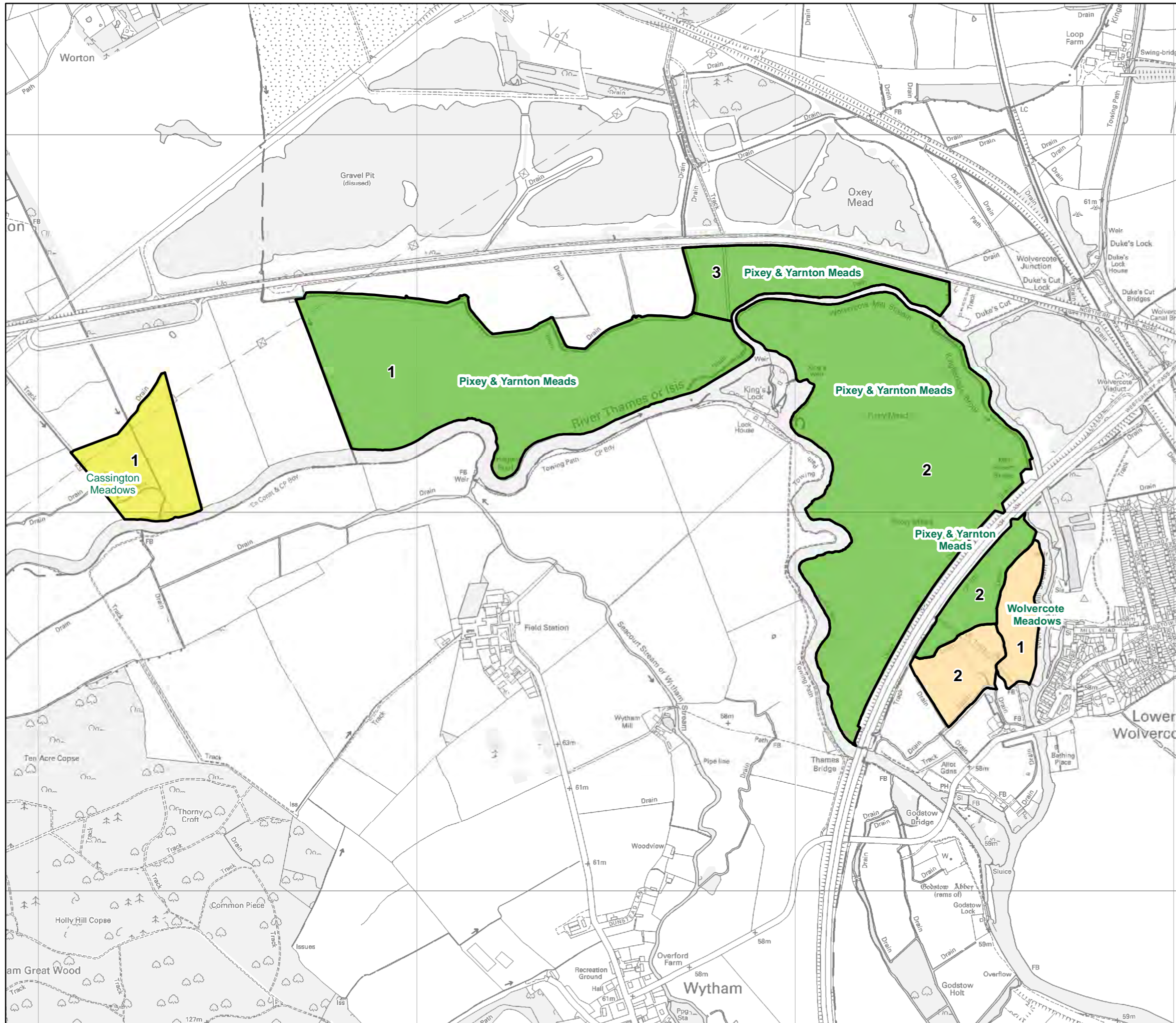
DRAWING: **Plan 2.5 - Hook Meadow and Trap Grounds SSSI - Diffusion Tube Sample Points.mxd** REV: **0**

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 PROJECTION: British National Grid





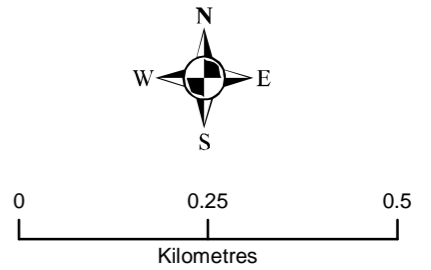
KEY:

- Site Condition
- Assessment Area

Sites of Special Scientific Interest within Oxford Meadows SAC

- Cassington Meadows
- Pixey & Yarnton Meads
- Wolvercote Meadows

1 SSSI Site Unit used by NE for Monitoring Purposes



TITLE:
Plan 2.6
Oxford Meadow SAC -
Site Condition Assessment

CLIENT: **Chiltern Railways** SIZE: **A3**

DATE: 17/07/2013 CHECKED: RM PROJECT: 0172205
DRAWN: JL APPROVED: SG SCALE: As Scale Bar

DRAWING: Plan 2_6 - Oxford Meadows SAC - Site Condition Assessment.mxd REV: 0

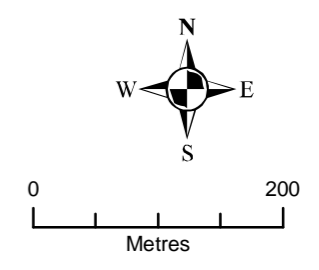
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PROJECTION: British National Grid



- KEY:
- Scheme Boundary
 - Hook Meadow and the Trap Grounds SSSI
 - Site Condition Assessment Area
 - 1** SSSI Site Unit used by NE for Monitoring Purposes




TITLE:
Plan 2.7
Hook Meadow and Trap Grounds
SSSI - Site Condition Assessment

CLIENT: **Chiltern Railways** SIZE: **A3**

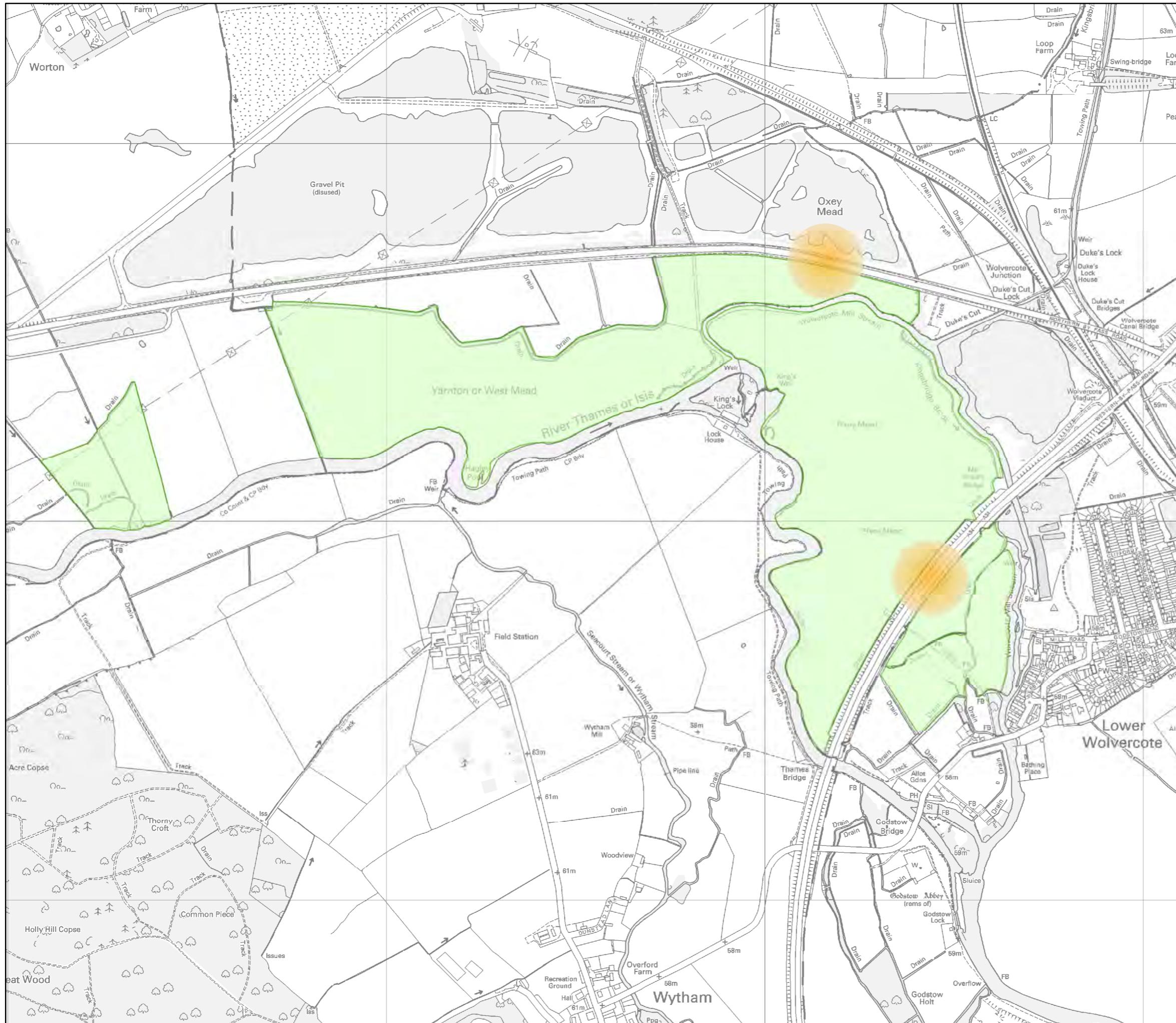
Date: 24/07/2013 CHECKED: RM PROJECT: 0172205
 DRAWN: AZ APPROVED: SG SCALE: As Scale Bar

DRAWING: **Plan 2_7 - Hook Meadow and Trap Grounds SSSI - Site Condition Assessment.mxd** REV: **0**

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 Telephone: 01865 384800
 Facsimile: 01865 204982

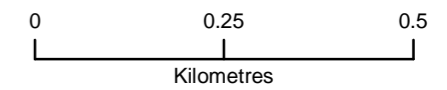


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 PROJECTION: British National Grid



KEY:

- Automatic Traffic Counters (ATCs)
- Indicative Locations Along A34 & A40
- Oxford Meadows SAC



TITLE:
Plan 2.8
 Automated Traffic Counter
 Sample Points

CLIENT: **Chiltern Railways** SIZE: **A3**

DATE: 17/07/2013 CHECKED: RM PROJECT: 0172205
 DRAWN: JL APPROVED: SG SCALE: As Scale Bar

DRAWING: Plan 2_8 - Traffic Baseline ATC Sample Points.mxd REV: **0**

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 PROJECTION: British National Grid

Annex 1

Condition 31 and Condition
32 of The Chiltern Railways
(Bicester to Oxford
Improvements) Order 2012

Condition 31 –Measures for the protection of the lowland hay meadow habitat at the Oxford Meadow Special Area of Conservation (“SAC”)

‘Development shall not commence on the Individual Section or Sections between Oxford North Junction and Rewley Abbey Stream (“the relevant sections”) until a scheme of Further Assessment of Air Quality in relation to the Cassington Meadows SSSI, the Pixey and Yarnon Meads SSSI and the Wolvercote Meadow SSSI that are co-terminous with part of the Oxford Meadows SAC (“the relevant parts of the SAC”) has been submitted to and approved in writing by the local planning authority for the relevant parts of the SAC (in consultation with Natural England).’

The Scheme of Further Assessment shall include the following:

- i. a methodology and programme for assessing the baseline exposure to oxides of nitrogen and inferring deposition of the relevant parts of the SAC including appropriate field observations of nitrogen oxide concentrations;
- ii. a methodology and programme for monitoring the rates of exposure to oxides of nitrogen (and inferring deposition) of the relevant parts of the SAC that may be emitted from such additional road traffic, which is using the A34 and A40 close to the relevant parts of the SAC, and such additional trains as are attributable to the opening of the relevant sections of the development to passenger rail traffic;
- iii. predictions, based on the air quality monitoring, for a period of 10 years after opening of the relevant sections of the development to passenger rail traffic, of the likely additional rates of exposure to oxides of nitrogen (and inferred nitrogen deposition) of the relevant parts of the SAC, that are likely to arise as a result of passenger rail traffic and the developments associated road traffic;
- iv. a methodology for attributing the relevant proportions of the recorded exposures to oxides of nitrogen of the relevant sections of the development once opened for rail passengers based on road traffic counts, railway operations data and surveys of modes of transport and routes used by users of the development;
- v. a methodology and programme for a baseline vegetation survey of the SSSI and SAC and evaluation of the designated Annex 1 lowland hay meadow habitat situated on the relevant parts of the SAC and for subsequent vegetation surveys, if such are demonstrated to be necessary following steps (i) to (iv);
- vi. criteria and threshold for determining the inferred nitrogen deposition from oxides of nitrogen which can be attributed to the opening of the development to passenger rail traffic that are designed to protect the designated Annex 1 lowland hay meadow habitat in the relevant parts of the SAC;
- vii. the proposed means of mitigation (which is likely to include changes to the management regimes for the relevant parts of the SAC) in the event

that the criteria of thresholds referred to in (vi) are not met or are exceeded; and

- viii. the arrangements for the reporting of the monitoring and mitigation to be undertaken in accordance with the Scheme of Further Assessment.

The approved Scheme of Further Assessment shall be implemented as approved.

The development shall not be opened to passenger rail traffic, nor shall the car park or station at Water Eaton Parkway be opened for public use, until the approved assessment of baseline conditions referred to in i) above has been completed as approved and reported to the local planning authority for the relevant parts of the SAC, and any other reports made in accordance with viii) above, and the local planning authority has issued written acceptance that the report complies with the approved Scheme.

Reason: to ensure that the development does not have a likely significant effect on the designated lowland hay meadow habitat of the SAC by virtue of deposition of nitrogen from emitted oxides of nitrogen.

Condition 32 – Measures for the protection of the Hook Meadow and Trap Grounds SSSI

‘Development shall not commence on the Individual Section or Sections between Oxford North Junction and Rewley Abbey Stream (“the relevant sections”) until a Scheme of Further Assessment of air quality in relation to the Hook Meadow and Trap Grounds SSSI (“the SSSI”) has been submitted to and approved by the local planning authority (in consultation with Natural England).’

The Scheme of Further Assessment shall include the following:

- i. a methodology and programme for assessing the baseline exposure to oxides of nitrogen and inferring deposition on those parts of the SSSI that are identified to be assessed at the date of assessment, including appropriate field observations of nitrogen oxide concentrations;
- ii. a methodology and programme for a baseline vegetation survey;
- iii. a methodology and programme for monitoring the rates of exposure to oxides of nitrogen (and inferring deposition) that may arise from emissions from such additional train operations as are attributable to the use of the relevant sections of the development by passenger rail traffic (“the additional train operations”);
- iv. predictions, based on the air quality monitoring, railway operations and other data, for a period of 10 years after opening of the relevant sections of the development to passenger rail traffic, of the likely additional rates of exposure to oxides of nitrogen (and inferred nitrogen deposition) of

the SSSI, that can be attributed to the opening and use of the relevant sections of the development for passenger rail traffic;

- v. criteria and threshold, designed to protect the SSSI, for determining the rates of exposure to oxides of nitrogen (and inferred nitrogen deposition) which can be attributed to the use of the development by passenger rail traffic;
- vi. the proposed means of mitigation in the event that the criteria of thresholds referred to in (v) are not met or are exceeded; and
- vii. the arrangements for the reporting of the monitoring and mitigation to be undertaken in accordance with the Scheme of Further Assessment.

The approved Scheme of Further Assessment shall be implemented as approved.

The development shall not be opened to passenger rail traffic until the approved assessment of baseline conditions referred to in i) above has been completed as approved and reported to the local planning authority, and any other reports made in accordance with viii) above, and the local planning authority has issued written acceptance that the report complies with the approved Scheme.

Reason: to ensure that the development does not cause harm or prevent restoration of the designated features of the SSSI by virtue of nitrogen deposition from the emitted oxides of nitrogen to the SSSI.

Annex 2

Designated Sites
Information and
Management Prescriptions

NATURA 2000

STANDARD DATA FORM

FOR SPECIAL PROTECTION AREAS (SPA)
FOR SITES ELIGIBLE FOR IDENTIFICATION AS SITES OF COMMUNITY IMPORTANCE (SCI)
AND
FOR SPECIAL AREAS OF CONSERVATION (SAC)

1. Site identification:

1.1 Type 1.2 Site code

1.3 Compilation date 1.4 Update

1.5 Relationship with other Natura 2000 sites

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
--------------------------	--------------------------	--------------------------	--------------------------	--------------------------	--------------------------	--------------------------	--------------------------

1.6 Respondent(s)

1.7 Site name

1.8 Site indication and designation classification dates

date site proposed as eligible as SCI	199506
date confirmed as SCI	200412
date site classified as SPA	
date site designated as SAC	200504

2. Site location:

2.1 Site centre location

longitude	latitude
01 17 12 W	51 46 37 N

2.2 Site area (ha) 2.3 Site length (km)

2.5 Administrative region

NUTS code	Region name	% cover
UK523	Oxfordshire	100.00%

2.6 Biogeographic region

Alpine

Atlantic

Boreal

Continental

Macaronesia

Mediterranean

3. Ecological information:

3.1 Annex I habitats

Habitat types present on the site and the site assessment for them:

Annex I habitat	% cover	Representativity	Relative surface	Conservation status	Global assessment
Lowland hay meadows (<i>Alopecurus pratensis</i> , <i>Sanguisorba officinalis</i>)	40	B	B	B	A

3.2 Annex II species

Species name	Population				Site assessment			
	Resident	Migratory			Population	Conservation	Isolation	Global
		Breed	Winter	Stage				
<i>Apium repens</i>	Present	-	-	-	A	A	A	A

4. Site description

4.1 General site character

Habitat classes	% cover
Marine areas. Sea inlets	
Tidal rivers. Estuaries. Mud flats. Sand flats. Lagoons (including saltwork basins)	
Salt marshes. Salt pastures. Salt steppes	
Coastal sand dunes. Sand beaches. Machair	
Shingle. Sea cliffs. Islets	
Inland water bodies (standing water, running water)	
Bogs. Marshes. Water fringed vegetation. Fens	
Heath. Scrub. Maquis and garrigue. Phygrana	
Dry grassland. Steppes	
Humid grassland. Mesophile grassland	87.0
Alpine and sub-alpine grassland	
Improved grassland	13.0
Other arable land	
Broad-leaved deciduous woodland	
Coniferous woodland	
Evergreen woodland	
Mixed woodland	
Non-forest areas cultivated with woody plants (including orchards, groves, vineyards, dehesas)	
Inland rocks. Screes. Sands. Permanent snow and ice	
Other land (including towns, villages, roads, waste places, mines, industrial sites)	
Total habitat cover	100%

4.1 Other site characteristics

<p>Soil & geology: Alluvium, Clay, Neutral</p> <p>Geomorphology & landscape: Floodplain, Lowland</p>
--

4.2 Quality and importance

<p>Lowland hay meadows (<i>Alopecurus pratensis</i>, <i>Sanguisorba officinalis</i>)</p> <ul style="list-style-type: none"> for which this is considered to be one of the best areas in the United Kingdom. <p><i>Apium repens</i></p> <ul style="list-style-type: none"> for which this is the only known outstanding locality in the United Kingdom. which is known from 15 or fewer 10 x 10 km squares in the United Kingdom.

4.3 Vulnerability

The special interest of the site is critically dependent upon groundwater levels and annual flooding, and the site is very sensitive to changes in groundwater levels. Several of the component parts are dependent upon traditional hay-cutting and aftermath grazing. ESA payments provide financial support for this management. Gravel extraction is taking place adjacent to one of the component parts. Safeguards and monitoring are in place to minimise the risk of damage to the site due to groundwater changes arising from this activity. Port Meadow is registered Common Land with common grazing rights administered by the Freemen of Oxford and Wolvercote Commoners' Committee. Stocking levels are high and grazing takes place throughout the year. The impact of this high grazing pressure upon *Apium repens* is under investigation as part of a wider programme of research into the ecology of the species. At present, it is thought that *A. repens* is tolerant if not dependent upon this management regime. Groundwater levels and flooding events on Port Meadows are monitored, as is the distribution of *A. repens* on the site.

5. Site protection status and relation with CORINE biotopes:

5.1 Designation types at national and regional level

Code	% cover
UK04 (SSSI/ASSI)	100.0

COUNTY: OXFORDSHIRE

SITE NAME: CASSINGTON MEADOWS

Status: Site of Special Scientific Interest (SSSI) notified under Section 28 of the Wildlife and Countryside Act 1981

Local Planning Authorities: West Oxfordshire District Council

National Grid Reference: SP463101

Ordnance Survey Sheet 1:50,000: 164 **1:10,000:** SP40 NE, SP41 SE

Date Notified (Under 1981 Act): 1 October 1993 **Date of Last Revision:**

Area: 7.03 ha 17.37 ac

Description and Reasons for Notification

Cassington Meadows are a cluster of neutral hay meadows and fen, which are surviving remnants of semi-natural vegetation in an area now characterised by intensive arable farming and gravel extraction. This type of meadow grassland was once widespread in the Thames valley and other parts of lowland Britain, but is now a nationally threatened habitat largely restricted to a few areas in Oxfordshire, the Midlands and the Vale of York.

Situated adjacent to the River Thames, north-west of Oxford, the meadows lie on seasonally flooded alluvial soils overlying gravel. Two hay fields are largely a rare grassland type. They are dominated by grasses characteristic of old meadows such as meadow foxtail, crested dog's tail *Cynosurus cristatus*, sweet vernal grass *Anthoxanthum odoratum*, yellow oat grass *Trisetum flavescens* and meadow barley *Hordeum secalinum*. Amongst these, larger herbs characteristic of such swards include the great burnet *Sanguisorba officinalis*, pepper saxifrage *Silaum silaus*, meadowsweet *Filipendula ulmaria* and dropwort *F. vulgaris*. In spring, when the grass is still short, the smaller herbs such as adder's-tongue *Ophioglossum vulgatum*, bugle *Ajuga reptans* and cowslip *Primula veris* are more prominent.

The fen is of a type quite widespread in Oxfordshire, but largely restricted to small scattered patches. Reed sweet-grass *Phalaris arundinacea*, meadowsweet and lesser pond sedge *Carex acutiformis* are all common components of this habitat whilst marsh marigold *Caltha palustris*, yellow iris *Iris pseudacorus* and common meadow-rue *Thalictrum flavum* are abundant in places.

Many of the fen plants are found in the ditches where common frog also breeds. Mature hawthorn hedges surround parts of the site and crack willow trees *Salix fragilis* are common within the hedgerows and along the river bank.

Condition of SSSI units

Compiled: 01 Jun 2013

See the [SSSI glossary](#) for an explanation of terms.

Team - South East - Western Area - **SSSI name** - Cassington Meadows - **Staff member responsible for site** - Rebecca Tibbetts

Region	County	District	Main habitat	Staff member responsible for unit	Unit number	Unit ID	Unit area (ha)	Latest assessment date	Assessment description	Condition assessment comment
South East	Oxfordshire	West Oxfordshire	Neutral grassland - lowland	Rebecca Tibbetts	1	1002174	7.03	17 Aug 2011	Favourable	There is no loss of extent. With both fields the sward is more grass dominated in the north with rye grass and soft brome, but the fields become more species-rich in the southern halves with meadowsweet, greater burnet, pepper saxifrage, common knapweed, dropwort and lady's bedstraw being occasional or frequent. The sward height averaged approx 40cm. The wetter areas to the south were not obvious, possibly due to the very dry year; however, reed (<i>Glyceria</i> and <i>Phlaris</i>), iris and marsh marigold were occasional with rare meadow-rue. There were few negative indicators although an area of creeping thistle was recorded in the western field (see file for details). The files note a clear drainage ditch across the western field but this was not evident. The site will be cut for hay and appears to be well managed.

Report completed.

COUNTY: OXFORDSHIRE

SITE NAME: PIXEY AND YARNTON MEADS

Status: Site of Special Scientific Interest (SSSI) notified under Section 28 of the Wildlife and Countryside Act 1981

Local Planning Authorities: Cherwell District Council

National Grid Reference: SP480105

Ordnance Survey Sheet 1:50,000: 164 **1:10,000:** SP41 SE, SP40 NE

Date Notified (Under 1949 Act): 1955 **Date of Last Revision:** 1977

Date Notified (Under 1981 Act): 1986 **Date of Last Revision:**

Area: 85.6 ha 211.5 ac

Other information: Formerly notified with Port Meadow. Part of the site is registered as Common Land (CL71). Described in a Nature Conservation Review. English Nature has a small freehold interest in Pixey Mead.

Description and Reasons for Notification

These unimproved floodplain meadows on alluvium over calcareous gravel on the first terrace bordering the River Thames are internationally renowned. They are amongst the best remaining examples of neutral grassland in lowland England.

The documentation of past management is particularly good. It is known that the meadows have been cut annually for hay and the aftermath grazed for well over a thousand years. This regime has produced botanically rich grassland. The type which occupies the largest area is characterised by cuckoo flower *Cardamine pratensis* with bird's-foot trefoil *Lotus corniculatus*, oxeye daisy *Leucanthemum vulgare*, adder's tongue *Ophioglossum vulgatum*, the local meadow dandelions *Taraxacum subundulatum* and *T. fulgidum*, the marsh orchid *Dactylorhiza incarnata*, devil's-bit scabious *Succisa pratensis*, greater burnet *Sanguisorba officinalis* and the grasses sweet vernal *Anthoxanthum odoratum*, soft brome *Bromus hordeaceus*, meadow and red fescues *Festuca pratensis* and *F. rubra*, quaking grass *Briza media*, Yorkshire fog *Holcus lanatus*, rye grass *Lolium perenne* and glaucous sedge *Carex flacca*. The notable plants, green-winged orchid *Orchis morio*, autumn crocus *Colchicum autumnale*, saw-wort *Serratula tinctoria*, pepper saxifrage *Silaum silaus* and meadow rue *Thalictrum flavum* also occur in a list of at least 150 species. Other meadow grassland communities recognised include that characterised by yellow rattle *Rhinanthus minor* with meadow vetchling *Lathyrus pratensis*, another on the drier river dredgings along the bank where meadow brome *Bromus commutatus* and cowslips *Primula veris* occur and a fen type with common reed *Phragmites australis*, meadowsweet *Filipendula ulmaria*, common sedge *Carex nigra* and marsh marigold *Caltha palustris*. The watercourses surrounding the Meads have tall emergent vegetation frequented by dragon and damselflies, the most noticeable throughout the summer being the banded demoiselle *Calopteryx splendens*.

The Meads have been the subject of detailed botanical research and hydrological investigation. Material is collected regularly for agricultural plant breeding purposes. The meadow flora has been compared with that of Port Meadow, where the contrast with a constantly grazed sward provides valuable information for investigating different grassland management systems.

Condition of SSSI units

Compiled: 01 Jun 2013

See the [SSSI glossary](#) for an explanation of terms.

Team - South East - Western Area - **SSSI name** - Pixey And Yarnton Meads - **Staff member responsible for site** - Rebecca Tibbetts

Region	County	District	Main habitat	Staff member responsible for unit	Unit number	Unit ID	Unit area (ha)	Latest assessment date	Assessment description	Condition assessment comment
South East	Oxfordshire	Cherwell	Neutral grassland - lowland	Rebecca Tibbetts	1	1002088	32.61	27 Jul 2010	Favourable	There is not loss of community extent although sward is less species-rich as dominated by <i>Carex riparia</i> towards the river. Sward composition remains 70-80% throughout . The exact species composition varies across the unit, but Greater Burnet was frequent throughout sward with all other key species being frequent except meadowsweet which was occasional. No negative indicator species or scrub/tree encroachment was recorded; however the sward supported species more tolerant of waterlogging towards the river. The height of the sward averaged 60cm pre-hay cut. Litter and bare ground were not of concern. Condition assessment document on file.
South East	Oxfordshire	Cherwell	Neutral grassland - lowland	Rebecca Tibbetts	2	1002089	46.33	20 Dec 2012	Favourable	
South East	Oxfordshire	Cherwell	Neutral grassland - lowland	Rebecca Tibbetts	3	1002090	8.01	20 Dec 2012	Favourable	

Report completed.

COUNTY: OXFORDSHIRE

SITE NAME: WOLVERCOTE MEADOWS

Status: Site of Special Scientific Interest (SSSI) notified under Section 28 of the Wildlife and Countryside Act 1981

Local Planning Authorities: Oxford City Council

National Grid Reference: SP484096

Ordnance Survey Sheet 1:50,000: 164 **1:10,000:** SP40 NE

Date Notified (Under 1981 Act): 1986 **Date of Last Revision:**

Area: 9.2 ha 22.7 ac

Other information: Part of the land is owned by Oxford Preservation Trust.

Description and Reasons for Notification

These meadows bordering the River Thames consists of unimproved and semi-improved neutral grassland which continued to be managed traditionally for hay and pasture and support a rich flora. Situated on alluvium overlying calcareous gravels, these meadows share many of the characteristics of the ancient meadowland of Pixey Mead, which borders the site to the west.

The largest of the three meadows, known as Great Baynham's Meadow, is managed as permanent pasture. Despite localised poaching by horses, the flora is rich with an abundance herbs such as ox-eye daisy *Leucanthemum vulgare*, meadowsweet *Filipendula ulmaria*, greater burnet *Sanguisorba officinalis*, pepper saxifrage *Silaum silaus*, devil's-bit scabious *Succisa pratensis*, adder's-tongue fern *Ophioglossum vulgatum* and at least eighteen species of wild grasses. The neighbouring meadows separated by willow-lined ditches are normally managed for hay with subsequent autumn grazing, a regime which produces a wealth of wild flowers in unimproved pastures during early summer. The flora is one of damp, somewhat calcareous soils dominated by tall cock's-foot *Dactylis glomerata* and Yorkshire fog *Holcus lanatus* grasses but with a diverse list of other meadowland grasses and herbs including at least eight species indicative of ancient grassland, such as sneezewort *Achillea ptarmica*. Parts of the meadow border on fenland conditions with species such as the common reed *Phragmites australis*, greater pond-sedge *Carex riparia*, hard rush *Juncus inflexus*, water forget-me-not *Myosotis scorpioides* and marsh. helleborine *Epipactis palustris*. The watercourses surrounding the meadows have tall emergent vegetation frequented by dragonflies, the most conspicuous of which is the banded demoiselle *Calopteryx splendens*.

Condition of SSSI units

Compiled: 01 Jun 2013

See the [SSSI glossary](#) for an explanation of terms.

Team - South East - Western Area - **SSSI name** - Wolvercote Meadows - **Staff member responsible for site** - Rebecca Tibbetts

Region	County	District	Main habitat	Staff member responsible for unit	Unit number	Unit ID	Unit area (ha)	Latest assessment date	Assessment description	Condition assessment comment
South East	Oxfordshire	Oxford	Neutral grassland - lowland	Rebecca Tibbetts	1	1002448	3.32	05 Aug 2010	Favourable	The whole field has been grazed with horses for a number of years and in 2010 it was grazed earlier on in the year with horses. However, over the summer the horses have been removed and it is currently grazed by 3 cows and 4 calves. Due to the grazing, it is difficult to fully assess the unit using the Conservation Objectives. The whole field looks grazed, but throughout the field the flower heads of Black knapweed, Great burnet, Devil's-bit scabious, Oxeye daisy, Crested dog's-tail, Pepper-saxifrage are all frequent. The field is now included within the hay management with aftermath cattle grazing under an HLS agreement so the future management for the unit is good and a further assessment next year (2011) would help to clarify the condition of the sward further. This field is much drier than unit 2 fields.
South East	Oxfordshire	Oxford	Neutral grassland - lowland	Rebecca Tibbetts	2	1002449	3.76	05 Aug 2010	Favourable	This unit consists of 3 fields The Conservation Objectives state that this is wholly MG4 which it is not. The site supports a more MG11/13 (fenland) with Yorkshire fog dominating. The citation supports these findings. Both fields are wet supporting Common reed (locally abundant). The western field has Common reed and Greater pond sedge abundant, although the sward is more species-rich in the centre.

Report completed.

COUNTY: OXFORDSHIRE **SITE NAME:** HOOK MEADOWS AND THE TRAP GROUNDS

Status: Site of Special Scientific Interest (SSSI) notified under Section 28 of the Wildlife and Countryside Act 1981

Local Planning Authorities: Oxford City Council, Oxfordshire County Council

National Grid Reference: SP496092-SP502087

Ordnance Survey Sheet 1:50,000: 164 **1:10,000:** SP40 NE, SP50 NW

Date Notified (Under 1949 Act): 1955 (Hook Meadow only) **Date of Last Revision:** 1972

Date Notified (Under 1981 Act): 1986 **Date of Last Revision:**

Area: 11.3 ha 27.9 ac

Other information: Hook Meadow was previously included within the SSSI known as Pixey and Yarnton Meads cum Port Meadow.

Description and Reasons for Notification

This site consists of a series of unimproved neutral meadows of a type which were widespread in southern England at the turn of the century, but have become increasingly rare following agricultural improvement and intensification. They contain a wide range of plant species typically associated with grasslands which have received traditional management without ploughing, reseeding or the application of fertilisers or herbicides. Individual differences in the flora are attributable to variations in management (usage for hay or summer grazing), the extent of ground waterlogging and changes in soils.

The meadows are situated along the eastern edge of a flat plain bordering the River Thames. They are naturally poorly drained and have wet alluvial calcareous clay soils of the Thames series.

Hook Meadow (the north-western field) is a hay meadow, bordering the large pastures of Wolvercote Common and Port Meadow. The sward is dominated by meadow foxtail *Alopecurus pratensis*, sweet vernal grass *Anthoxanthum odoratum*, crested dog's tail *Cynosurus cristatus*, Yorkshire fog *Holcus lanatus* and rough stalked meadow grass *Poa trivialis*. Broadleaved herbs present include abundant hard-head *Centaurea nigra* and yellow rattle *Rhinanthus minor*. Species relatively intolerant of spring grazing which are rare on the adjoining pastures include sneezewort *Achillea ptarmica* and pepper saxifrage *Silaum silaus*, together with large stands of meadow rue *Thalictrum flavum*.

The field opposite was formerly probably part of Hook Meadow until becoming isolated by the construction of the railway. Although now managed as a pasture, it has a flora more typical of hay fields or low intensity grazing. Plant species indicative of traditional management include adder's tongue *Ophioglossum vulgatum*, cowslip *Primula veris* and greater burnet *Sanguisorba officinalis*. A pond at the southern end of the field supports water plantain *Alisma plantago-aquatica*, greater pond sedge *Carex riparia*, creeping Jenny *Lysimachia nummularia* and celery-leaved water crowfoot *Ranunculus sceleratus*.

The southernmost field is the wettest of the group and holds standing water for part of the year. Water derived from rain may be supplemented by leakage from mains supplies in the city of Oxford and from the adjoining canal. The sward consists of an irregular mix of marsh foxtail *Alopecurus geniculatus*, common bent *Agrostis capillaris*, timothy *Phleum pratense* and meadow grasses *Poa* spp. The field contains nine species of sedge, including carnation, tawny and brown sedge *Carex panicea*, *C. hostiana* and *C. disticha* which are distributed amongst the general sward, and slender tufted sedge *C. acuta* which occurs in occasional dense stands. Other wetland species include five species of rush dominated by sharp-flowered rush *Juncus acutiflorus*, common spike-rush *Eleocharis palustris*, marsh arrow grass *Triglochin palustris* and early marsh orchid *Dactylorhiza incarnata*.

The other fields included within the site are drier and with fewer sedges and rushes. The mown areas, which are used for low-intensity recreation, are locally dominated by glaucous sedge *Carex flacca*. Uncut areas, some of which are lightly grazed, contain abundant ragged robin *Lychnis flos-cuculi*, ox-eye daisy *Leucanthemum vulgare* and yellow vetchling *Lathyrus pratensis*, together with occasional hoary ragwort *Senecio erucifolius* and spotted orchid *Dactylorhiza fuchsii*.

Many of the fields are bordered by thick hedges and pollarded willows with occasional stands of common reed *Phragmites australis* and reed canary-grass *Phalaris arundinacea*, and these provide nesting places and song posts for warblers including whitethroat and reed warbler. The wetter fields are used by feeding and wintering snipe.

The fields have an invertebrate fauna typical of unimproved neutral meadows. Insects recorded include the hoverflies *Chrysogaster hirtella* which is associated with marshes and *Platycheirus fulviventris* which is uncommon in Oxfordshire.

Condition of SSSI units

Compiled: 01 Jun 2013

See the [SSSI glossary](#) for an explanation of terms.

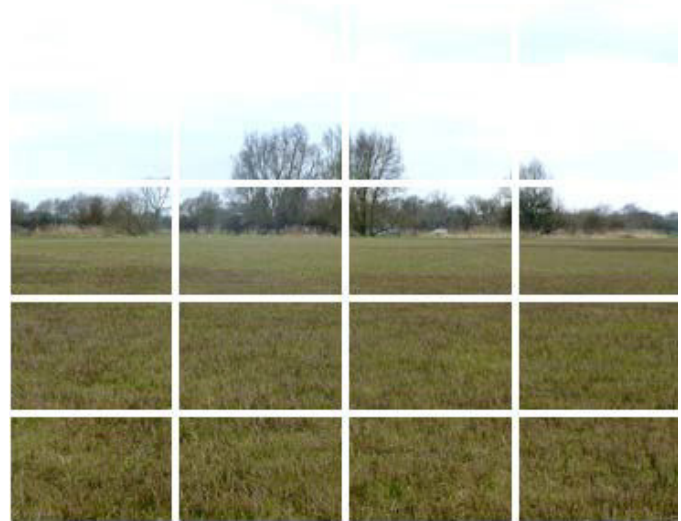
Team - South East - Western Area - **SSSI name** - Hook Meadow And The Trap Grounds - **Staff member responsible for site** - Rebecca Tibbetts

Region	County	District	Main habitat	Staff member responsible for unit	Unit number	Unit ID	Unit area (ha)	Latest assessment date	Assessment description	Condition assessment comment
South East	Oxfordshire	Oxford	Neutral grassland - lowland	Rebecca Tibbetts	1	1002078	3.71	10 Mar 2010	Unfavourable no change	This part of the site formerly supported species-rich grassland. It has not been grazed for some time and several key targets are not met. Sward height and proportion of leaf litter are above target because of the lack of grazing. There is also lower than target proportion of herbs to grasses and plant diversity is lower than desirable. Some of the plants which add to the special interest are still present at low frequency so prospects for recovery with suitable management are considered good.
South East	Oxfordshire	Oxford	Neutral grassland - lowland	Rebecca Tibbetts	2	1002079	8.01	10 Mar 2010	Unfavourable recovering	This part of the site includes a range of community types including dry grassland, rush pasture and sedge swamp. Management to promote recovery of species diversity in parts of the site is in place. The extent of species-rich grassland and rush pasture is being maintained. Targets for sward height and proportion of leaf litter are generally met although the dominance of rush in parts continues to be an issue of concern as this may be having adverse impacts on plant diversity. A range of characteristic indicator plants is present and cover of scrub is within target.

Report completed.

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