A303 Amesbury to Berwick Down

TR010025

6.3 Environmental Statement Appendices

Volume 6

Appendix 10.4 Preliminary Sources Study Report

APFP Regulation 5(2)(a)

Planning Act 2008

Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

October 2018

A303 Amesbury to Berwick Down

Preliminary Sources Study Report

HAGDMS No. 29300

Arup Atkins Joint Venture

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P05, S3

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Highways England Approval

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Foreword

Note that figures are embedded in the text for ease of reference. Larger scale versions are presented at the back of the report where the figure title in the report is marked with an asterisk.

1 Introduction

1.1.1 Highways England have commissioned the Arup-Atkins Joint Venture (AAJV) to carry out Project Control Framework (PCF) Stages 1 and 2 for the A303 Amesbury to Berwick Down (A303 ABD) scheme.

1.1.2 The scheme covers the section of the A303 between Amesbury and Berwick Down in Wiltshire, as shown in Figure 1-1. This 13km section traverses the Stonehenge and Avebury World Heritage Site (WHS) and has a detrimental effect on the setting and landscape of the Stonehenge monument and the WHS. The scheme currently experiences severe road traffic congestion and has a poor road traffic accident record. The A303 Amesbury to Berwick Down scheme is proposed to be an upgrade of the existing A303 to a dual carriageway to achieve Expressway Standard as part of a wider package of proposals for the A303/A30/A358 corridor. The works are listed as a priority project in the National Infrastructure Plan 2014.

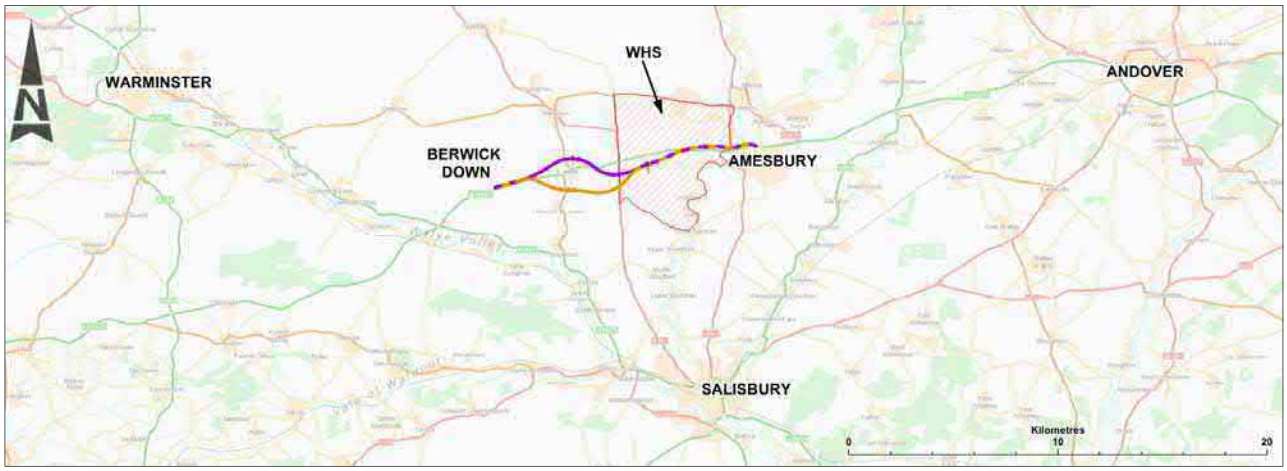

Figure 1-1* Location of scheme with route alignment options

1.1.3 The key objectives of Highways England for the Scheme are as follows:

- ***Cultural heritage***: to contribute to the conservation and enhancement of the World Heritage Site by improving access both within and to the site.
- ***Environment and community***: to contribute to the enhancement of the historic landscape within the World Heritage Site (WHS), to improve biodiversity along the route and to provide a positive legacy to communities adjoining the road.
- ***Economic growth***: in combination with other schemes on the route, to enable growth in jobs and housing by providing a free flowing and reliable connection between the East and the South West peninsula.
- ***Transport***: to create a high quality route that resolves current and predicted traffic problems and contributes towards the creation of an expressway between London and the south west.

1.1.4 This Preliminary Sources Study Report (PSSR) has been produced in accordance with HD22/08 ‘Managing Geotechnical Risk’ and forms part of the PCF Stage 2 documentation.

1.2 Scheme Programme

1.2.1 The scheme programme is set to achieve start of construction in early 2020. Key dates are:

- Single route announcement mid 2017
- Commence preliminary design (PCF3) mid-2017
- Commence statutory procedures (PCF4) mid-2018
- Commence construction (PCF6) early 2020

1.3 Reporting strategy and objectives of this report

1.3.1 The objectives of this Preliminary Sources Study are to:

- Collate and review the existing available geotechnical, hydrological and geo-environmental information;
- Summarise the anticipated ground conditions including local and regional groundwater regime;
- Provide a preliminary engineering assessment for the proposed infrastructure and structures based on the available geotechnical and hydrogeological data;
- Outline the geotechnical risks; and
- Inform the scoping of a ground investigation to reduce geotechnical risk at PCF Stage 3.

1.3.2 The review summarises relevant information and provides commentary specific to the route alignments D061 and D062 being progressed to Public Consultation.

1.4 Route options

1.4.1 The two route options are shown on Figure 1-2 below comprising surface and tunnelled sections. One of the options, D061, bypasses Winterbourne Stoke to the north and the other, D062, to the south.

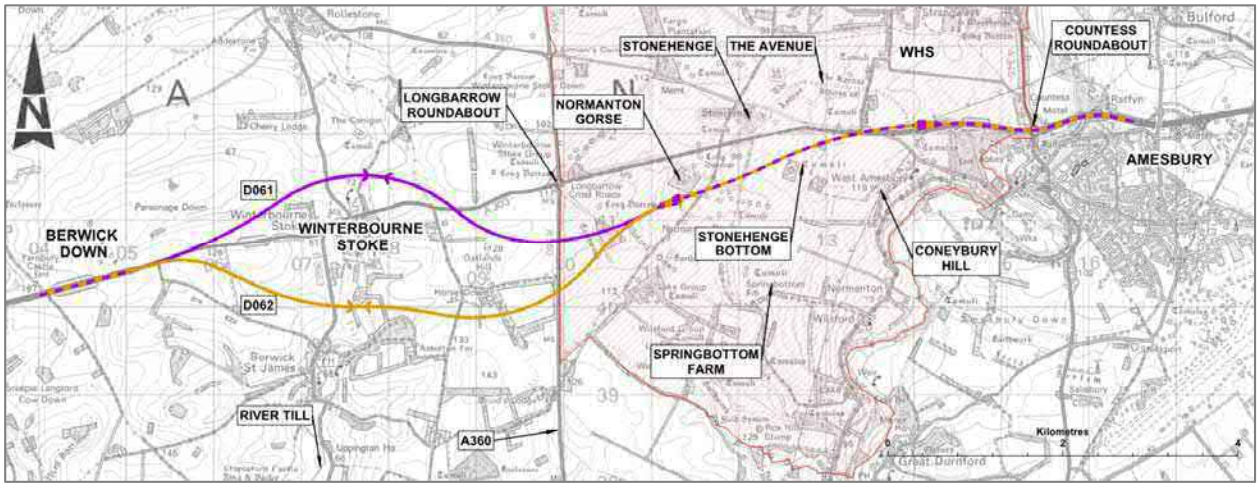

Figure 1-2* Route options

1.4.2 Both options start at the end of the existing A303 dual carriageway and depart from the existing A303 at Berwick Down to the west of Winterbourne Stoke and re-join the A303 to the west of Amesbury flowing into an upgrade of the existing A303 through Countess Roundabout. They both pass through the Stonehenge and

Avebury World Heritage Site (WHS) and both include a 2.9km tunnelled section through part of the WHS.

1.4.3 The two route options are shown in more detail with chainages marked Figure 1-3 (a) and Figure 1-3 (b) respectively. Both routes are approximately 13.2km long with D061 marginally shorter than D062.

1.4.4 Route option D061 (Figure 1-3 (a)) heads northeast from Berwick Down crossing a dry valley and the B3083 as it descends into the River Till valley on sidelong ground. After crossing the river on a viaduct structure it ascends on to Oatlands Hill, crossing the existing A303 where an interchange is proposed. The alignment crosses the A360 south of the existing Longbarrow Roundabout and in doing so passes into the WHS.

1.4.5 The route continues across a dry valley and towards Normanton Gorse where it descends into a tunnel passing to the south of Stonehenge and crossing beneath Stonehenge Bottom at its vertical low point. From Stonehenge Bottom, the route rises to emerge from the tunnel within a dry valley to the north of the existing A303 and east of the Avenue heritage feature, continuing eastwards and merging with the existing A303 before crossing over the Countess Roundabout junction, and then continuing along the existing A303 alignment and crossing the River Avon.

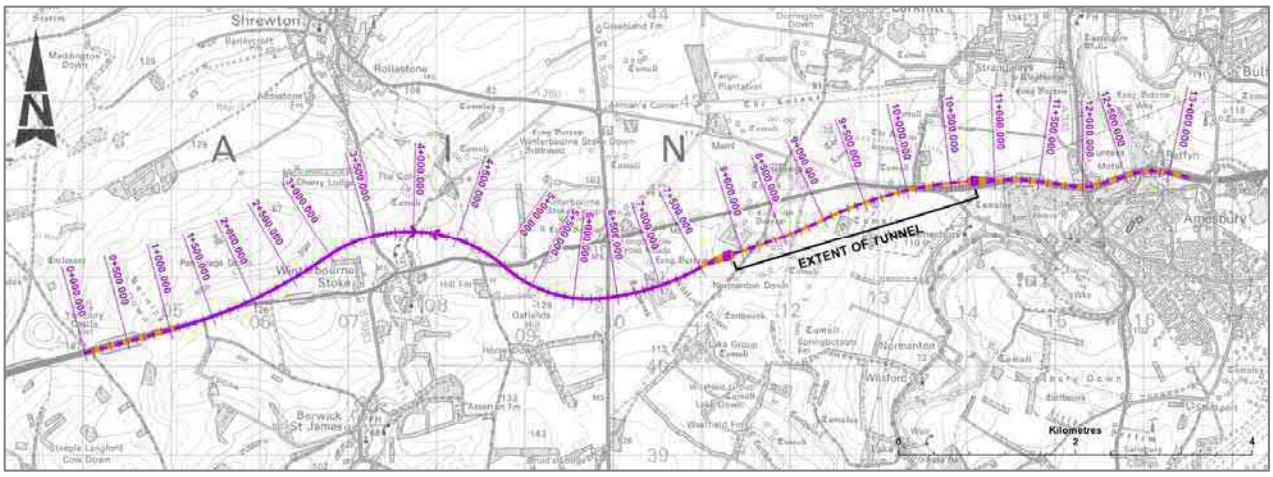

Figure 1-3* (a) Route Option D061

Figure 1-3* Route Options D061 and D062 (2 part figure)

1.4.6 Route option D062 (Figure 1-3 (b)) heads south east from Berwick Down descending along a dry valley into the River Till valley. It crosses the B3083 and river and then climbs initially along a dry valley onto Horse Down passing to the south of farm buildings and crossing The Park. It then crosses the A360 south of the location of route D061 where an interchange is proposed. It continues north east to join and then follow the same alignment as route D061 described above east of Diamond Wood.

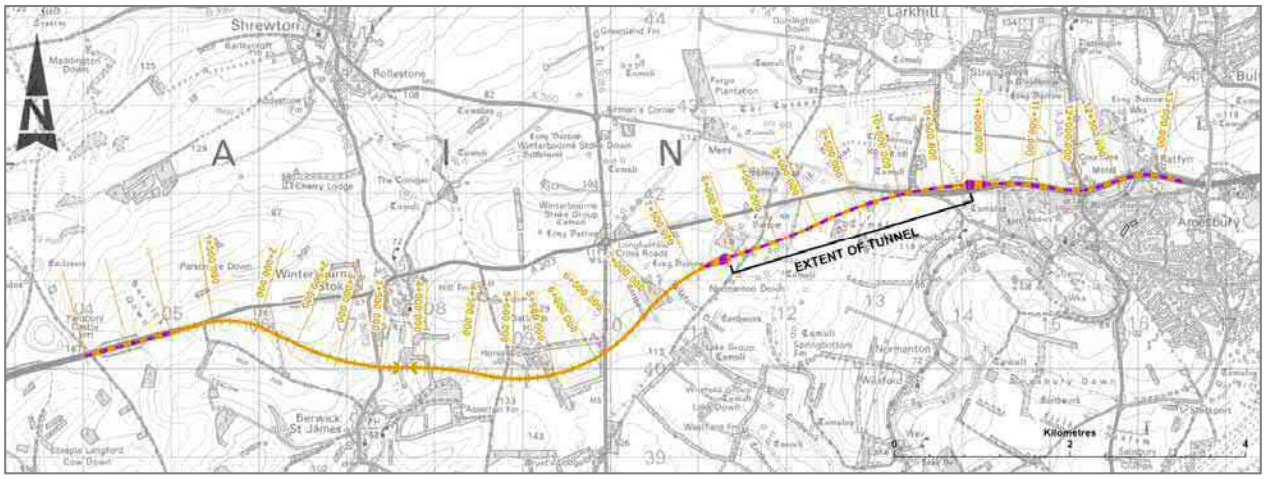

Figure 1-3* (b) Route Option D062

Figure 1-3* Route Options D061 and D062

2 Scheme History

2.1.1 There is a long history of proposed improvement to the A303, with earliest announcements dating back to 1971 when an upgrade was announced for the entire length under the new roads programme to improve the national network by 1980. Studies and consultations into alternatives for the A303 between Amesbury and Berwick Down section have been underway since 1991. An outline of key activities and outcomes in this time is presented in Table 2.1.

Table 2.1 Summary of scheme history

Date	Activity	Consultant	Description
1991 - 1993	Initial route identification	Halcrow	Over 50 routes were considered including routes as far north as Larkhill and as far south as Stapleford.
1993	Public Consultation and scheme assessment	Halcrow	Routes were presented at a public consultation in April 1993. These included a 500m cut and cover tunnel option running to the south of Stonehenge. The consultation was inconclusive for the Stonehenge section.
1994 - 1995	Further route identification	Halcrow	Alternative tunnel options and northern routes considered.
1995	Planning conference		Reviewed all previously proposed options and its findings supported in principle, a long tunnel under the Stonehenge site, and strongly supported the need for the Winterbourne Stoke Bypass.
1998	Exceptional environmental scheme announcement	Halcrow	Government announced that the A303 Stonehenge scheme would be included in the Roads Programme with a 2km cut and cover tunnel past Stonehenge, a by-pass of Winterbourne Stoke and dualling of the section.
1999	Preferred route announcement		In June 1999 the Highways Agency announced that a 2.0km cut and cover tunnel was the Preferred Route for the A303 Stonehenge scheme improvement. For the first time this option won support from National Trust and English Heritage.
2001	Ground investigation	Mott MacDonald	Ground investigation completed to cater for both a cut and cover and bored tunnel option and a northern bypass of Winterbourne Stoke.
2001-2002	Tunnel options review	Halcrow Gifford	Review of tunnel options that would provide even better benefits to the WHS[1]. This review also collected all the additional information available at the time gained through geodetic survey, ground investigation, groundwater levels and discussions with the TDSCG. Comparison of tunnel alternatives broadly showed both bored and cut & cover methods to be feasible but with some additional environmental benefits associated with the bored tunnel at an additional cost of £23.3M. Based on this the cut & cover method was rejected in favour of the bored tunnel.

Date	Activity	Consultant	Description
2002-2003	Published Scheme announced		Joint decision by the Department of Culture, Media and Sport (DCMS) and Department for Transport (DfT) announced on 10th December 2002, adopting a 2.1km bored tunnel with total route length of 12.4km for the scheme.
2002-2003	Phase 1A Supplementary ground investigation	Halcrow Gifford	Additional ground investigation completed.
2004	Public Inquiry		Public Inquiry based on the 2.1km long tunnel option.
2005	Public Inspector's Report		Recommended in favour of the Published Scheme.
2006	Review of scheme options and new Public Consultation		The continuing development of the scheme through the Inquiry led to the identification of a number of cost increases. As a result the Minister of State for Transport announced a review of the scheme options and a public consultation which began in 2006.
2007	Scheme cancelled		In light of the increased cost of the Published Scheme On 6 December 2007 it was announced that the scheme was cancelled.
2010			The Government's National Infrastructure Plan announced that the scheme had become a priority.
2014	New scheme	Mott MacDonald (PCF0)	The Government commissioned a feasibility study to consider options for improvements along the route in January 2014. The tunnel options considered include a bored tunnel between 2.5km and 2.9km in length. This formed PCF0 for the current scheme.

Current AAJV commission - A303 Amesbury to Berwick Down PCF stage 1 & 2

2.1.2 A new iteration of the route selection process began in 2016 to take the scheme through Project Control Framework (PCF) stages 1 and 2, which represent the 'Option Identification' and 'Option Selection' phases respectively.

2.1.3 PCF1 comprised a fresh generation of around 50 route options and filtering down to a small number to take to Public Consultation.

2.1.4 It has been recognised that the geotechnical aspects do not form a significant differentiator between schemes in this filtering process [1]. Therefore the focus of geotechnical review in PCF stages 1 and 2 has been on understanding ground conditions to inform key engineering decisions and planning commitments and to mitigate risk at PCF Stage 3 (Preliminary Design and preparation of the DCO application) for the routes to be carried to Public Consultation.

3 Sources of Information & Desk Study

3.1 Introduction

3.1.1 This section summarises enquiries made and documents referenced in the geotechnical and geo-environmental review of the available information.

3.1.2 Previous reports relevant to the route options that have been obtained are summarised in the following tables:

- Historic scheme Desk Studies (Table 3.1);
- Historic scheme Factual Reports (Table 3.2), and
- Historic scheme Interpretive Reports (Table 3.3).

3.1.3 The route options now being taken to public consultation are different to those that have previously been considered; specifically, the tunnel alignment for both options is further to the south than in the previous published scheme and include an option for a southern bypass of Winterbourne Stoke. Consequently the previous studies have been augmented where appropriate to take account of this.

3.2 Desk studies

3.2.1 In the scheme's long history, a number of desk studies have been carried out (Table 3.1). In the reports various sources of information have been referenced, including ground investigations, historical maps and aerial photography. Some of these sources have been obtained through HAGDMS or directly through Highways England for review against the alignments to be put forward for Public Consultation in January 2017.

3.2.2 A gap analysis review has been carried out considering the information that has been obtained in the past, what has been reviewed previously by others and new information that is available. Table 3.4 provides a summary of this review.

3.2.3 Notably, there are three historical military airfields which have not been discussed in previous scheme reports: RAF Stonehenge (also known as RFC Stonehenge), RAF Oatlands Hill and RFC Lake Down.

Table 3.1 Summary of existing desk studies reviewed

HAGDMS reference	Report title	Date	Consultant	Summary
2351	A303 Amesbury – Berwick Down Geotechnical Desk Study Report	Feb 1992	Halcrow	Geotechnical desk study report for improvement of corridor between Amesbury and Wylye bypasses.
16850	A303 Amesbury-Berwick Down Geotechnical Desk Study Report	Jan 1996	Halcrow	
17031	Technical Note A303	March 2000	Halcrow	

HAGDMS reference	Report title	Date	Consultant	Summary
	Stonehenge – Countess Roundabout Geotechnical Review			
20543	A303 Stonehenge Improvement Preliminary Geotechnical Report	March 2006	Halcrow-Gifford	This preliminary geotechnical report provides updated desk study information for the corridor between Amesbury and Wylye bypasses.

3.3 Previous Ground Investigations

3.3.1 A phased sequence of major ground investigations were undertaken to support the design development of the former published scheme between 2000 and 2004. These comprised:

- A Preliminary ground investigation undertaken in 2000 consisting of 3 no. boreholes. This investigation was commissioned to enable greater confidence in construction cost estimates for a tunnel at an early stage and to evaluate the use of the optical televiewer.
- A Main ground investigation undertaken in 2001. This comprised boreholes and trial pits together with in situ testing including SPTs, packer tests, high pressure dilatometer tests and wireline logging/optical televiewer in the boreholes, and plate bearing tests and in situ CBR tests at trial pits. This investigation was interrupted by an outbreak of foot and mouth disease and so was undertaken in two phases. Phase I covered the area between Longbarrow crossroads and Countess Roundabout. Phase II mostly covered the section west of the Longbarrow crossroads and included investigation of two alternative alignments for a northern by pass of Winterbourne Stoke.
- A Supplementary ground investigation undertaken with early contractor involvement between 2002 and 2004. Phase 1A comprised additional boreholes and trial pits, including packer tests and wireline logging/optical televiewer in the boreholes and plate bearing tests, in situ CBR tests and infiltration tests at trial pits in 2002/2003. Phase 1B comprised two pumping tests carried out in winter 2002 and repeated in summer 2004. Phase 2 comprised limited trials of gamma CPT testing and surface geophysics.

3.3.2 Smaller investigations have been undertaken to inform improvements at the Countess and Longbarrow Roundabouts in 2009 and 2010 respectively and an investigation was undertaken to the north of Countess Roundabout for a proposed Stonehenge visitors centre in 2002. Data are also available in the vicinity of Countess Roundabout from the ground investigation carried out in 1965 for the construction of the Amesbury bypass.

3.3.3 The available factual reports are summarised in Table 3.2. Drawings showing the distribution of exploratory holes and in situ testing carried out as part of the previous ground investigations are included in Appendix A.

Table 3.2 Existing Factual Ground Investigation reports

HAGDMS reference	Report title	Date	Contractor	Consultant	Summary
17439	A303 Preliminary Ground Investigation	2000/ 2001	Soil Mechanics	Mott MacDonald	Three boreholes
16175	A303 Stonehenge Ground Investigation Factual Report on Phase I Main Ground Investigation Volume 1 to 5.	June 2001	Soil Mechanics	Mott MacDonald	Factual report presenting the results of a GI carried out along and to the south of the A303 between the 'Avenue' and Normanton Gorse.
16174	A303 Stonehenge Ground Investigation Factual Report on Phase II Main Ground Investigation, Volume 1 and 2.	Nov 2001	Soil Mechanics	Mott MacDonald	Factual report presenting the results of a GI carried out along and to the south of the A303 between the Avenue and Normanton Gorse and around Winterbourne Stoke.
16966	Stonehenge Visitors Centre, Amesbury, Wiltshire - Ground Investigation Factual Report	July 2002	John Grimes Partnership	Anthony Hunt Associates	Factual report presenting the results of a GI carried out to the north of Countess Roundabout.
21762	Factual Report Phase 1A Supplementary Ground Investigation for A303 Stonehenge Improvement Volume 1 to 5	May 2003	Soil Mechanics	Halcrow-Gifford	Factual report presenting the results of a ground investigation carried out along and to the south of the A303.
N/A	A303 Stonehenge Supplementary Investigation Phase 2		Soil Mechanics	Halcrow-Gifford	Trials of CPT and surface geophysics including gamma cone
24930	A303 Longbarrow Roundabout Improvement Scheme	2010	Soil Mechanics	Mott MacDonald	Factual report presenting the results of a GI at Longbarrow crossroads (Junction between the A303 and A360).
24822	A303 Countess Roundabout - Safety Scheme	2011	Soil Mechanics	Mott MacDonald	Factual report presenting the results of a GI carried out around Countess Roundabout (Junction between the A303 and A345).
N/A	A303 Stonehenge Improvements: Pumping Test Factual Report Ref 312/1089	2003	WJ Groundwater	Halcrow-Gifford	Factual report presenting the results of two pumping tests and a recharge trial for the A303 Stonehenge Improvements.
N/A	A303 Stonehenge Improvements; Summer Pumping Tests Factual Report	2003	WJ Groundwater	Halcrow-Gifford	Factual report presenting the results of two summer pumping tests and a recharge trial for the A303 Stonehenge Improvements.

3.3.4 At key stages in the historic scheme development, and for recent improvement schemes, the ground investigation data have been reviewed and presented in interpretive reports. The available reports are summarised in Table 3.3.

Table 3.3 Existing Ground Investigation interpretive reports

HAGDMS reference	Report title	Date	Consultant
17317	A303 Stonehenge Site Investigation Interpretative Report: Preliminary Investigation and Phase I of main ground investigation	2001	Mott MacDonald
16182	A303 Stonehenge Site Investigation Interpretative Report Phase II of Main Ground Investigation	2002	Mott MacDonald
20543	A303 Stonehenge Improvement Preliminary Geotechnical Report	2006	Halcrow-Gifford
N/A	A303 Stonehenge Improvement Relationships between Aquifer recharge, Groundwater levels and Springflow [2]	2006	Halcrow-Gifford
24822	A303 Countess Roundabout – Safety Scheme Ground Investigation Report	2010	Mott MacDonald
24822	A303 Countess Roundabout – Human health Risk Assessment and Waste Classification Report	2009	Mott MacDonald
24824	A303 Countess Roundabout – Geotechnical Design Report	2010	Mott MacDonald
24930	A303 Longbarrow Roundabout – Improvement Scheme Ground Investigation Report	2010	Mott MacDonald
24930	A303 Longbarrow Roundabout – Human health Risk Assessment and Waste Classification Report	2010	Mott MacDonald
24956	A303 Longbarrow Roundabout – Geotechnical memorandum	2010	Mott MacDonald

3.4 Additional information

3.4.1 Table 3.4 summarises a gap analysis of key source information, and identifies information that was not available from HAGDMS or Highways England together with additional information that has been obtained to augment previous studies.

Table 3.4 Summary of gap analysis of key source information

Information Source	Available from HE/ HAGDMS?	Comment	Reference
Factual report for Amesbury Bypass ground Investigation	No	Includes area in vicinity of Countess Roundabout, but stratigraphy has been altered by excavation of Alluvium during construction of the bypass. May be available from Wiltshire County Council	

AGS data from previous Preliminary and Main Investigations	No	The GI contractor (Soil Mechanics Ltd) has not been able to provide AGS data files. Data manually entered by AAJV to generate complete AGS files.	Appendix G
Digital Data from wireline geophysical logging in previous Preliminary, Main and Supplementary Investigations	No	Obtained from Robertsons Geologging (Preliminary and Main Investigations) and EGS (Supplementary Investigation)	Appendix H
Contamination testing (Main Investigation Phase 2)	No	Full test results are not included in available factual or interpretative reports	
Data from groundwater level monitoring	In [2]	Digital data for P1, P2, W1 & R158 obtained from WJ Groundwater	Appendix I
AGS data from previous investigation for Visitor Centre north of Countess Roundabout	No	AGS data files not available. Data manually entered by AAJV	Appendix G
Flood risk mapping	Out of date	Obtained from new Groundsure search*	Appendix F
Environmental (potential contamination and pollution) mapping	Out of date	Obtained from new Groundsure search*	Appendix F
Historical maps	No	Obtained from new Landmark Envirocheck Basic Historical Map search*	Appendix E
Aerial photographs	No	Obtained from the National Archives Swindon*	Appendix B
* Note: Figure 3-1 shows the search area specified in relation to the alignment options. It should be noted that D062 extends beyond the search area locally near to where it intersects the A360 as the route options evolved after the search areas had been fixed. The searches should be reviewed once a preferred route has been selected to ensure appropriate coverage.			

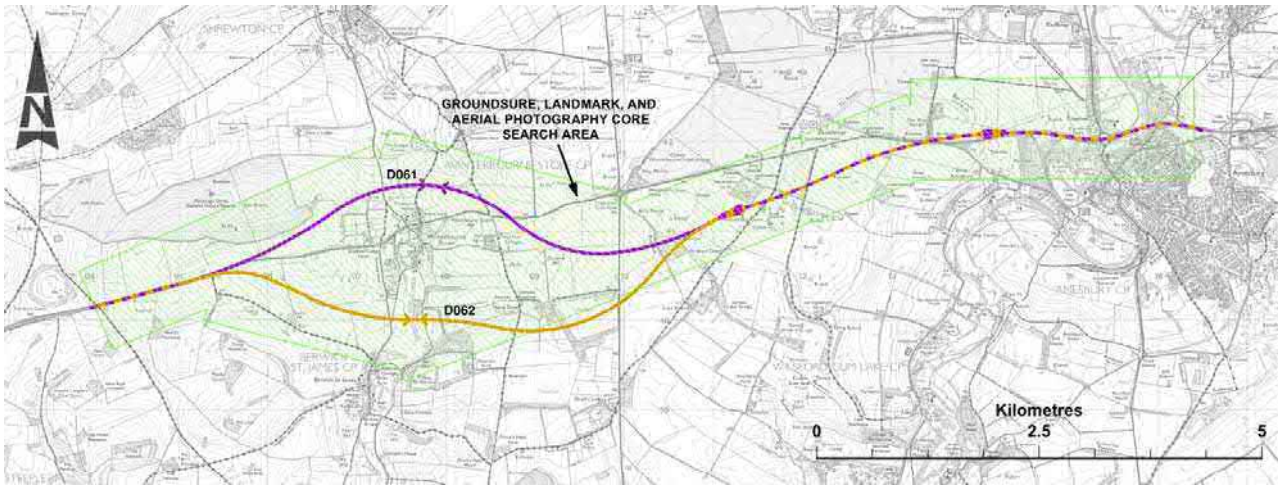

Figure 3-1 Specified search area relative to alignment options D061 and D062

3.5 Statutory Enquiries

3.5.1 The following statutory bodies have been consulted as part of the preparation of this PSSR:

Wiltshire County Council

3.5.2 Enquiries have been made with Wiltshire Council via Groundsure regarding records of land impacted by contamination, mining and ground instability hazards.

3.5.3 Historic Environment Records (HER) have been consulted to inform the heritage assessment. The results from this are reported separately.

Environment Agency and other environmental bodies

3.5.4 Publicly available records have been accessed via the Environment Agency (EA) website. In addition, an initial data enquiry was made with the EA on February 2016 for historic ground water level monitoring data from the region, see Appendix I.

3.5.5 A Groundsure search was commissioned which consulted EA records on hydrogeology, landfill sites and pollution incidents and Integrated Pollution Prevention and Control (IPPC) permits amongst other records, see Appendix F.

3.5.6 Industry Profiles produced by the former Department of Environment [3] have been reviewed to identify likely contaminants associated with former or current industrial land uses.

4 Field Studies

4.1 General

4.1.1 This section lists the field studies undertaken that have been used to inform this report. This includes field studies conducted by others in historic phases of the scheme. Previous ground investigations are described in Section 3.

Historic field studies

4.1.2 The principal field studies reported as part of earlier phases of the scheme are:

- 1991 Inspection of Till Valley chalk exposures (Halcrow)
- 1995 Slope and cutting survey (Halcrow)
- 2003 Cutting survey (Halcrow-Gifford)

2016 Options phase field studies

4.1.3 Site walkover visits by AAJV have included:

- 14th March 2016 walkover survey covering
  - Site setting at Stonehenge Bottom
  - Visit to locate previous groundwater monitoring points to check condition and access for re-use

- 6th and 24th May 2016 walkover visits to review access for additional ground investigation and for ground water monitoring at borehole R158 and R22.

4.1.4 The findings from the 14th March 2016 walkover survey are described in Appendix D.

4.2 Geophysical Survey - Archaeological

4.2.1 A programme of non-intrusive archaeological geophysical surveys and intrusive trial trenching (field evaluation) to inform the PCF Stage 2 Options Assessment Phase has been prepared by the AAJV and commenced in August 2016. The results of these surveys will be reported separately.

4.3 Flora and Fauna Survey - Ecological

4.3.1 Ecological field surveys to generate baseline (and/or update existing baseline surveys produced for the previous published scheme) commenced in spring 2016. This work will continue through 2017. Surveys include but are not limited to quail, bats, hazel dormouse, great crested newt, water vole and otter. Phase 1 habitat survey verification, and reptile and crayfish habitat assessments are also underway. The results of these surveys will be reported separately.

5 Site Description

5.1 Site location and description

5.1.1 The alignment options being progressed to Public Consultation (D061 and D062) extend from Amesbury westwards through the UNESCO designated Stonehenge and Avebury World Heritage Site (WHS) to Berwick Down. The A303 corridor that is proposed for improvement comprises approximately 13km of the existing A303. This includes the existing at grade roundabout junction with the A345 at Countess, the existing at grade roundabout junction with the A360 at Longbarrow, the crossing of the B3083 at Winterbourne Stoke, and other minor connections to the A303. The alignments are described in Section 1.

5.1.2 The archaeological and cultural significance of the WHS area will have a considerable influence on the scheme, principally through the contribution made by designated and non-designated heritage assets towards the outstanding universal value of the site. This is discussed further in Section 5.10. The Stonehenge monument itself attracts over 1 million visitors annually.

5.1.3 The area is also of considerable ecological interest to national and local conservation bodies as the alignment options are within a habitat and species rich landscape that has potential for landscape-scale restoration. This is discussed further in Section 5.11.

5.1.4 Historically, much of the area around the two route options was utilised for military purposes during World War 1 and 2. Buildings and an aerodrome were located to the west and south west of the Stonehenge monument forming RAF Stonehenge which was operational during World War 1. The former RAF Oatlands Hill airfield, operational during World War 2, was located to the south of the Longbarrow Roundabout junction.

5.2 Topography

5.2.1 A topographic relief map is shown in Figure 5-1 covering the area of routes D061 and D062, and depicts low relief, gently sloping chalk down topography. The maximum elevation is approximately 160 metres above Ordnance Datum (mAOD) between Berwick Down and Yarnbury Castle at the western extent of the alignment options, and the minimum is around 70mAOD in the Avon valley.

5.2.2 The region is dissected by the south flowing Rivers Avon and Till. The River Till joins the south east flowing River Wylye, which joins with the River Avon to the south of the area included in Figure 5-1. These rivers split the region into major chalk interfluve areas which are dissected by numerous dry valleys which are generally oriented West-Southwest-East Northeast or North-South.

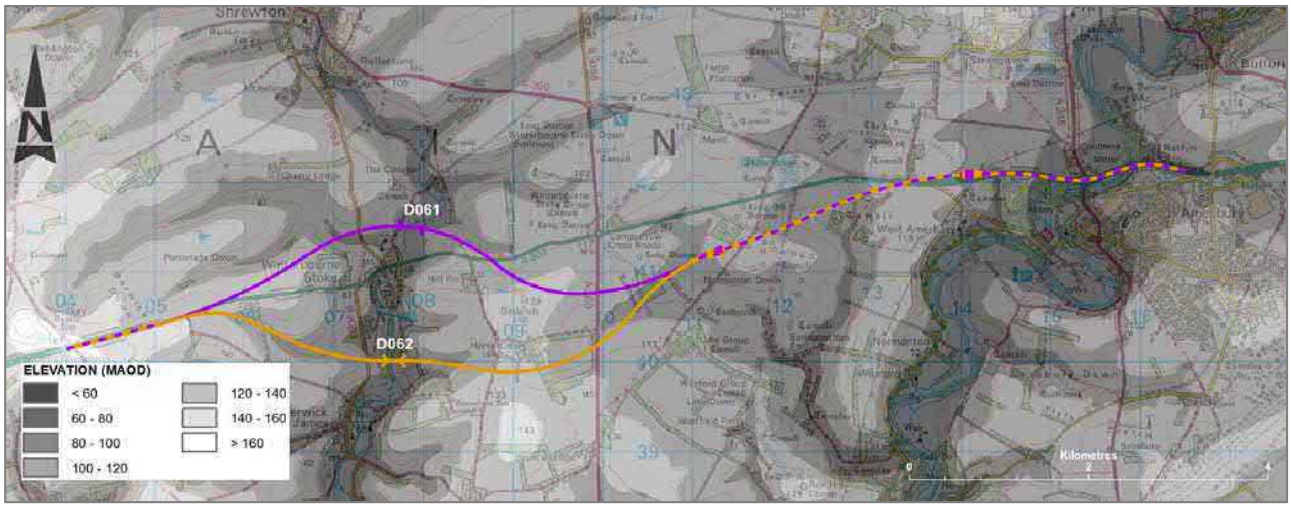

Figure 5-1* Regional topography

5.3 Regional geology

5.3.1 Information on the regional geology has been derived primarily from two sources: the geological map published by the British Geological Survey (BGS) [4] and accompanying memoir [5], and from Professor Mortimore's interpretations based on previously conducted ground investigation (Mortimore 2003, 2012) [6], [7].

5.3.2 The bedrock of the area comprises an Upper Cretaceous succession of the White Chalk Subgroup, including the Newhaven, Seaford, and Lewes Nodular Chalk Formations. The majority of chalk lithologies exposed along the route corridor belong to the Seaford and Newhaven Formations (Figure 5-2).

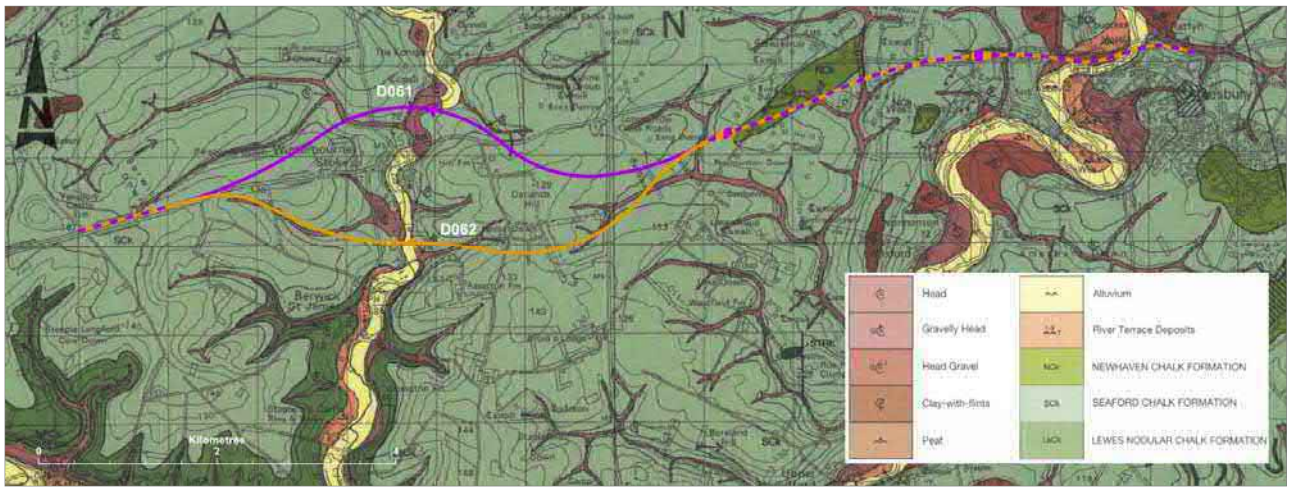

Figure 5-2* Regional geology (Extract from 1:50,000 map, [4])

5.3.3 The two outcrops of Newhaven Chalk in Figure 5-2 appear to be associated with the topographic highs of the interfluves, and are located on the route option alignments and in the vicinity of Coneybury Hill to the south east. The Newhaven Chalk is described on the geological map [4] as soft to medium hard, smooth white chalk with numerous marl seams and flint bands.

5.3.4 The Seaford Chalk Formation underlies the Newhaven Chalk, and is described on the geological map as 'firm white chalk with conspicuous semi-continuous nodular

and tabular flint seams' [6]. This is the predominant formation along the alignment options.

5.3.5 The Lewes Chalk is the oldest formation that may be encountered along the alignment options, and comprises hard nodular chalks and hardgrounds interbedded with softer grainy chalks and marls, and widespread sheet flints [7]. This unit outcrops some 2km south of Winterbourne Stoke.

5.3.6 A schematic geological section approximately along the line of the existing A303 developed by Mortimore [6] showing the stratigraphical sequence is given in Figure 5-4. This was developed from fossil and marker bed correlations between previous ground investigation boreholes.

5.3.7 The superficial deposits within the area typically comprise alluvial clays, sands and gravels, localised River Terrace Deposits, and Head deposits largely comprising remobilised weathered chalk material deposited as a result of periglacial processes. These superficial deposits are concentrated around and within the active and dry valleys, as shown in Figure 5-2.

Phosphatic Chalk

5.3.8 Brown, sandy, pelletal phosphatic chalk deposits were encountered in boreholes during the 2001 Main and 2002/3 Supplementary ground investigations adjacent to the existing A303 to the west of Stonehenge Bottom, see Figure 5-4. The existence of phosphatic chalk in this area had not been known prior to these investigations.

5.3.9 The origin of the phosphatic chalk has been described by Mortimore [6] [7]. It is believed to have been deposited in scoured marine channels (known as cuvettes) in an organic rich environment.

5.3.10 Deposits of phosphatic chalk are known from other locations in England and northern France. A field visit to view exposures at Beauval in northern France led by Mortimore is reported by Halcrow-Gifford (2006) [8].

5.3.11 Lenticular cuvettes have been observed to be up to 1 km in length, 250 m in width, and 30 m in depth, at other locations and may be superimposed on one another (Jarvis 1980, 2006) [9] [10]).

5.3.12 Alternative conceptual models for the deposition and spatial distribution of the phosphatic chalk near Stonehenge are discussed in Section 6.4.

5.4 Structural geology

General

5.4.1 The understanding of the structural geology is based on published sources, including the BGS memoir on the Geology of the Salisbury District [5], and the interpretation of the local structural geology by Mortimore [6].

5.4.2 The scheme lies within the Wessex Basin. This was formed within sub Permian strata that were strongly deformed during the Variscan Orogeny. Sedimentary rocks from the Permian through to the Cretaceous, including the Chalk Group that currently underlies the scheme, were subsequently deposited within the basin [5].

Folding

5.4.3 Regionally, the chalk strata to the north of the scheme dip at approximately 2 degrees to the south, while local to the scheme the structure is more complex, see Figure 5-3. To the east of the scheme the chalk strata are affected by a broad low amplitude east-west orientated, eastward plunging syncline. In the vicinity of the scheme this separates into the Amesbury Syncline and another syncline that passes through Bulford Camp to the north east of the route options. An unnamed east-west trending anticline separates the two synclines, the axis of which extends parallel to the A303 [4].

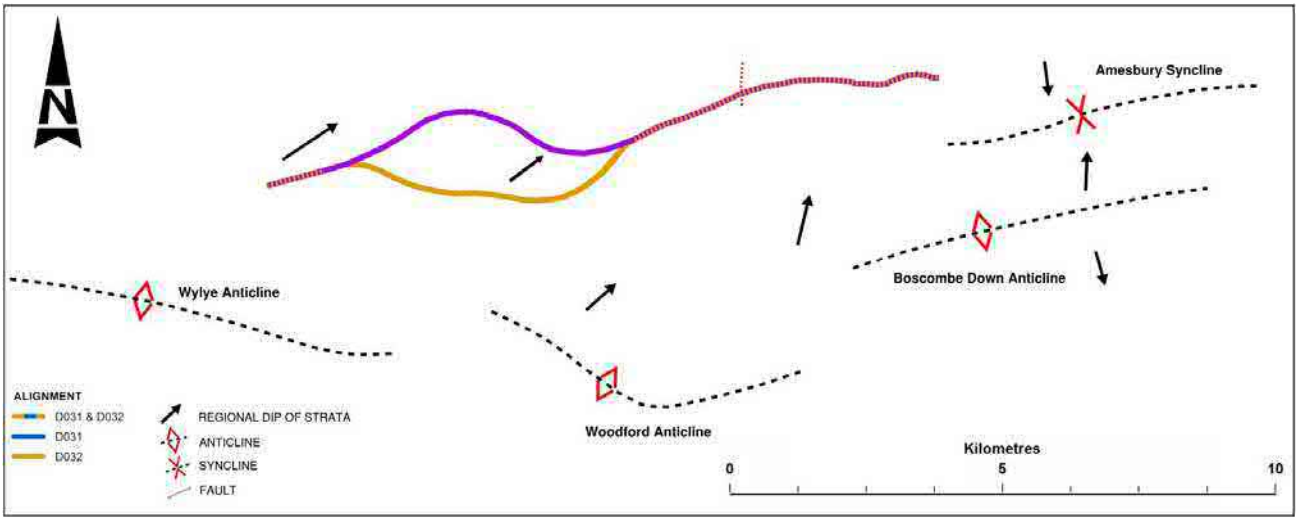

Figure 5-3 Schematic structural map of the region

5.4.4 Detailed stratigraphical logging of core recovered during previous ground investigations by Mortimore [6] confirmed the presence of broad folding within the local area as illustrated in the conceptual geological model in Figure 5-4. Mortimore's studies also indicated that Winterbourne Stoke and Stonehenge lie along the boundary between an anticlinal structure to the south and a synclinal structure to the north under Salisbury Plain.

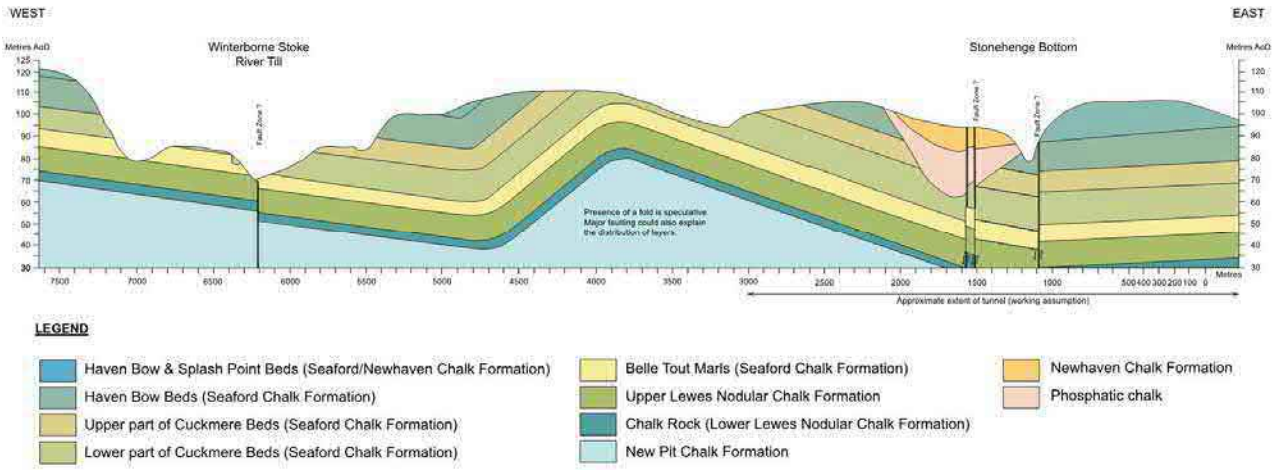

Figure 5-4* Conceptual geological model after Mortimore reproduced from Halcrow-Gifford [8]

Faulting

5.4.5 Whilst regionally there are a number of faults that have been mapped at the surface, on the basis of the published geological map [4], the Seaford Chalk and

Newhaven Chalk do not appear to be significantly affected by regional or local faulting within the vicinity of the route options. A north-south trending fault is indicated to be present crossing the existing A303 within Stonehenge Bottom (Figure 5-3), and this is also captured by Mortimore's long section (Figure 5-4).

5.4.6 It is generally understood that current drainage lines tend to follow major fracture zones within the chalk [5]. It is therefore anticipated that dry valleys and fluvial valleys will be affected by faulting or at least a higher degree of fracturing.

5.4.7 The presence of the deep seated Warminster Thrust and the identification of conjugate joint sets in several boreholes from previous investigations (most notably to the east of Stonehenge Bottom) suggests considerable local tectonic activity may have overprinted the general features of the chalk [6].

5.5 Geomorphology

5.5.1 The area covered by the alignment options may be divided into two distinct zones, approximately divided by the River Till valley. To the west, the topography is characterised by a higher elevation and deeply incised asymmetric dry valleys. To the east, lower undulating chalk has a denser network of more symmetrical shallow dry valleys and shallower dry tributary swales. In both zones, the dry valley network is rectilinear and appears to be controlled by a major joint system which likely focussed drainage, erosion and infiltration, and thus deep weathering.

5.5.2 The landscape can be broadly described in terms of three different types of geomorphological features or terrain systems: interfluves; dry valleys; and active fluvial valleys.

5.5.3 Interfluves are areas of high ground between valleys, and are low relief, gently rounded, convex to plateau-like topographic highs. The points of maximum elevation occur in these areas.

5.5.4 Dry valleys are a feature typical of the chalk landscape of southern Britain. Their characteristics derive from the periglacial conditions in this area during the last ice age. They may be asymmetric which is possibly related to the different slope aspects influencing periglacial processes or dip of the chalk and tend to have a flat bottom. The pattern of dry valleys identified from interpretation of aerial photographs is shown in Appendix B Figures B1 and B2 and are also indicated by the mapped Head deposits in Figure 5-2. The most prominent dry valley crossed by the route options is that at Stonehenge Bottom.

5.5.5 Active fluvial valleys are valleys which have persistent surface water flow. There are two active fluvial valleys traversed by the scheme, the River Till valley and the River Avon valley:

- The River Till, the upper part of which is a winterbourne, rises in Shrewton some 3 kilometres north of the current A303 and takes a meandering route southward through Winterbourne Stoke to a confluence with the River Wylye to the south. The alluvial tract is between 100 and 250 m wide and is mainly in pasture. Numerous springs occur over a 600 m stretch of the River Till just north of Winterbourne Stoke. The water is probably associated with the top of the Lewes Nodular Chalk Formation that sub crops or occurs at shallow depth in the valley floor. In summer, these springs may form the perennial head of

the stream, but in very dry periods this stretch of the river is dry and water does not emerge until further down the valley [5].

- The River Avon is a perennial river that flows in a southerly direction. The river crosses the existing A303 at the eastern end of the scheme, upstream of Amesbury.

5.5.6 Conceptual ground models for each terrain type are given in Figure 5-5.

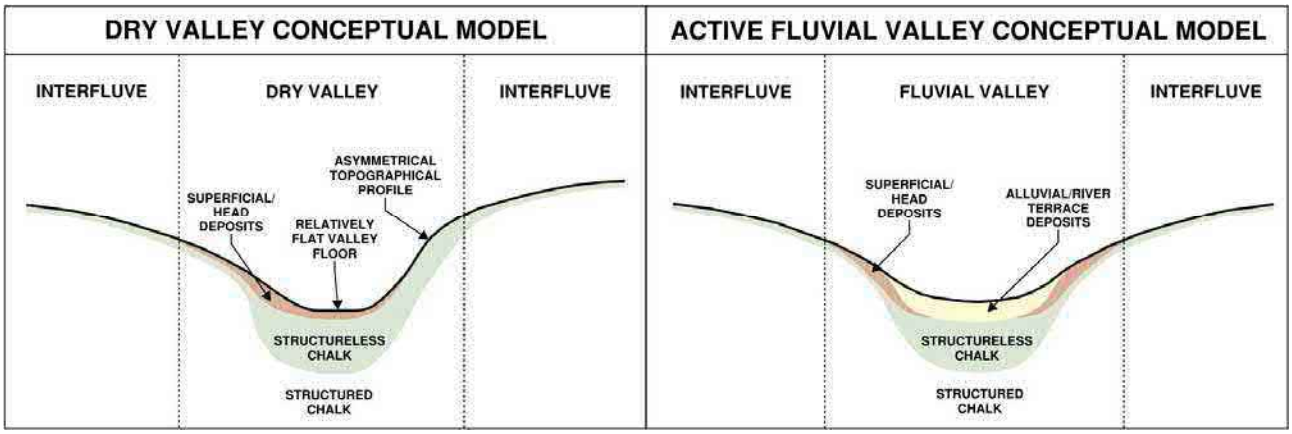

Figure 5-5 Terrain Type Conceptual models

5.5.7 The interfluve terrains predominantly consist of a thin mantle of topsoil, overlying weathered structureless chalk which is underlain by structured chalk.

5.5.8 The base of dry valleys have a thin topsoil layer which may be underlain by Head deposits originating from the valley sides, thinning up the valley side. These superficial deposits are underlain by weathered, structureless, chalk of increased thickness compared to the areas of interfluve, over the structured chalk.

5.5.9 Alluvial and River Terrace Deposits overly Head and/or structureless chalk in the active fluvial valleys. This is underlain by structured chalk and there is again a greater depth of weathering of the chalk compared to the interfluves.

5.6 Geohazards

Mining and Quarrying

5.6.1 The absence of authorised mining activity in the vicinity of the scheme was confirmed in a 1994 discussion between Halcrow-Gifford and Wiltshire County Council [8], and it is understood that since then no new mineral extractions have been licensed (see Appendix F).

5.6.2 Minor unauthorised ground excavations are known to exist in the area (primarily in the Till Valley), though these chalk excavation points are limited to the surface and are considered to be of little significance to the proposed scheme.

5.6.3 Review of historical mapping has indicated the existence of a former small quarry to the west of Countess Roundabout (1901 to 1961), see Appendix A Drawing HE551506-AA-HGT-D_SWI-DR-CX-000059. The 1971-72 map shows this lies on the line of the existing A303 and it is therefore assumed that this feature has been infilled. There are a number of other quarries noted, the closest being Ratfyn Chalk Pit to the east of the River Avon approximately 60m from the alignment centreline. Three other chalk or gravel pits have been identified however these are in excess of 300m from the alignment option centrelines.

Landslides

5.6.4 The BGS geology map [4] does not indicate the presence of any landslide deposits in the area, and walkover surveys (see Section 4.1) did not encounter any evidence of landsliding. Aerial photograph Interpretation (API) conducted along the alignment options also did not reveal any indication of slope instability (see Appendix B).

5.6.5 An area of reworked chalk was encountered in the side of a dry valley to the north west of Winterbourne Stoke in previous ground investigations. This is discussed in Section 6.6. There is no evidence of instability.

Dissolution Features

5.6.6 The Department for Environment, Food, and Rural Affairs (DEFRA) Natural and Artificial Cavities Database indicates that there are no recorded large cavities in the vicinity of the alignment options (Mott MacDonald, 2001) [11]. Evidence for small scale dissolution features is discussed in Section 6.5.

5.7 Regional hydrology and hydrogeology

Aquifer classification

5.7.1 The project lies within the geological feature known as the Wessex Basin and is underlain by the Salisbury Plain chalk aquifer, see Figure 5-6. This is classified by the Environment Agency as a Principal aquifer which is of regional importance for private and public water supply. A Principal aquifer may support water supply and/or river base flow on a strategic scale. The aquifer also supports a number of sensitive habitats and groundwater-dependent ecological features including fisheries.

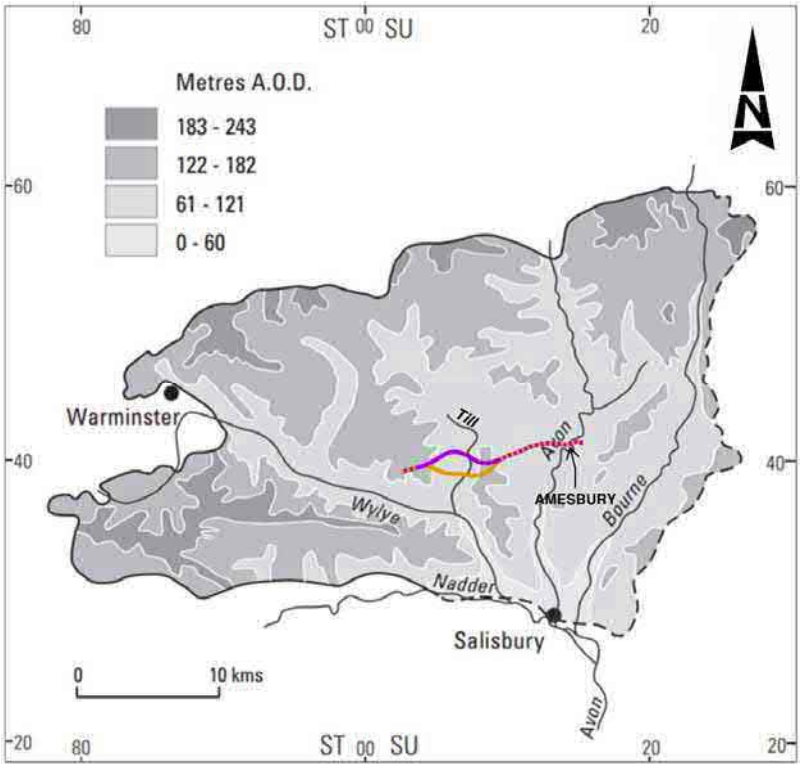

Figure 5-6 Location map of the Chalk aquifer of the Salisbury Plain (BGS, [12]) with alignment options indicated

5.7.2 Effective rainfall (rainfall minus evapotranspiration) infiltrates the chalk to provide recharge to the aquifer. Due to the permeable nature of the chalk, direct runoff of rainfall is negligible.

5.7.3 Groundwater within the Head deposits is classified as a Secondary (undifferentiated) aquifer. The Environment Agency classifies groundwater within Alluvium and River Terrace Deposits associated with the channels of the River Avon and River Till as Secondary A aquifers. These are defined as permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.

Groundwater Source Protection Zones

5.7.4 Environment Agency records indicate that the nearest designated groundwater Source Protection Zone (SPZ) [2] to the proposed alignments is more than 2km away. The locations of these zones are given in the Water Resources chapter of the Environmental Assessment Report (EAR) [13].

Licensed Groundwater Abstractions and Discharge Consents

5.7.5 Environment Agency information contained in the Groundsure report indicates that there is one licensed groundwater abstraction located within the vicinity of D062, off Berwick Road in the south west of Winterbourne Stoke. The abstraction relates to general farming and domestic use in agriculture. The presence of unlicensed groundwater abstractions for potable supply within the area cannot be ruled out at this stage. Further licensed abstractions are known to be present outside of the contaminated land study area and will require consideration during future dewatering assessments.

5.7.6 The Bell Inn public house in Winterbourne Stoke has a licensed consent to discharge final/treated sewage effluent by soakaway at a location to the far south of the D061.

5.7.7 There is a licensed consent to discharge final/treated sewage effluent to groundwater via soakaway at a property in Berwick St James located to the far south of the D062 alignment. Two further consents to discharge final/treated sewage effluent to groundwater via soakaway are located to the south of Oatlands Hill to the south of the D062.

Chalk Principal Aquifer Characteristics

5.7.8 Groundwater flow in the Chalk occurs principally in fractures and fissures. Much of the most permeable chalk has been subject to solution enlargement of existing discontinuities (of tectonic and sedimentological origin) by exposure to groundwater over a long period of time. The permeability of the chalk is generally high but spatially variable. In unconfined parts of the Chalk aquifer in southeast England (Salisbury Plain is such an area) permeability is generally lowest beneath interfluve areas, and highest beneath river valleys and dry valleys.

5.7.9 Groundwater in the Chalk aquifer responds rapidly to recharge events at the surface and significant changes in groundwater level can occur over a short period of time. The low storage capacity of the Chalk leads to rapid and large rises in groundwater level in response to rainfall, see Figure 5-7. Note that the data logger

[2] Source Protection Zones are designated zones around all significant public water supply and private wells or boreholes that supply water to potable or equivalent standards, for example mineral water, breweries, food processing, etc.

in borehole W1 was not able to record water levels below 71mAOD [2]. Fractures are highly transmissive but have a small volume and fill rapidly; the rock mass has low permeability and is already close to saturation.

5.7.10 Groundwater levels in the Chalk aquifer are highly seasonal, rising in response to annual recharge during the winter and declining during the summer when recharge is lower. The magnitude of fluctuations in groundwater level between seasonal high and low is greatest in interfluve areas, reducing toward valleys where transmissivity is higher and discharge to the surface may act as a control on groundwater level[3]. The annual fluctuation is typically 8 to 10m beneath dry valleys (such as Stonehenge Bottom), rising to about 15m below topographic divides.

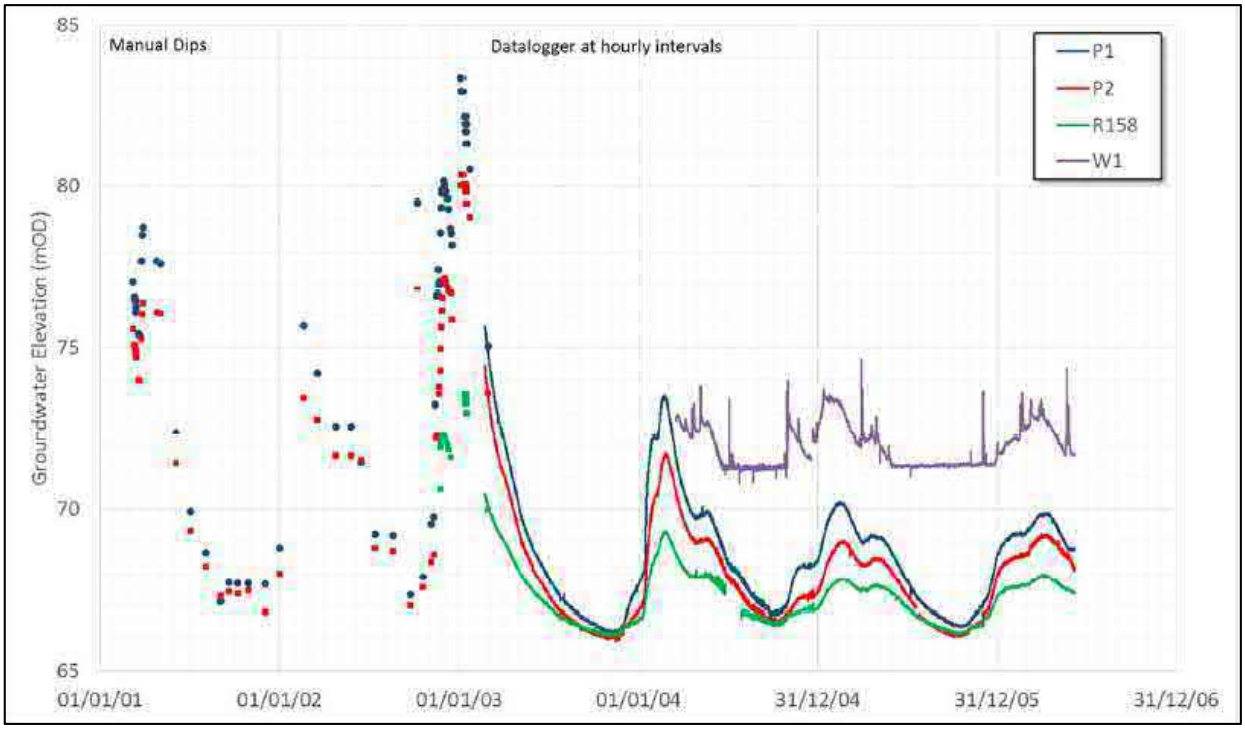

Figure 5-7 Groundwater level hydrographs for observation wells P1, P2, R158 and W1 from previous ground investigation monitoring (see also Figure 5-8)

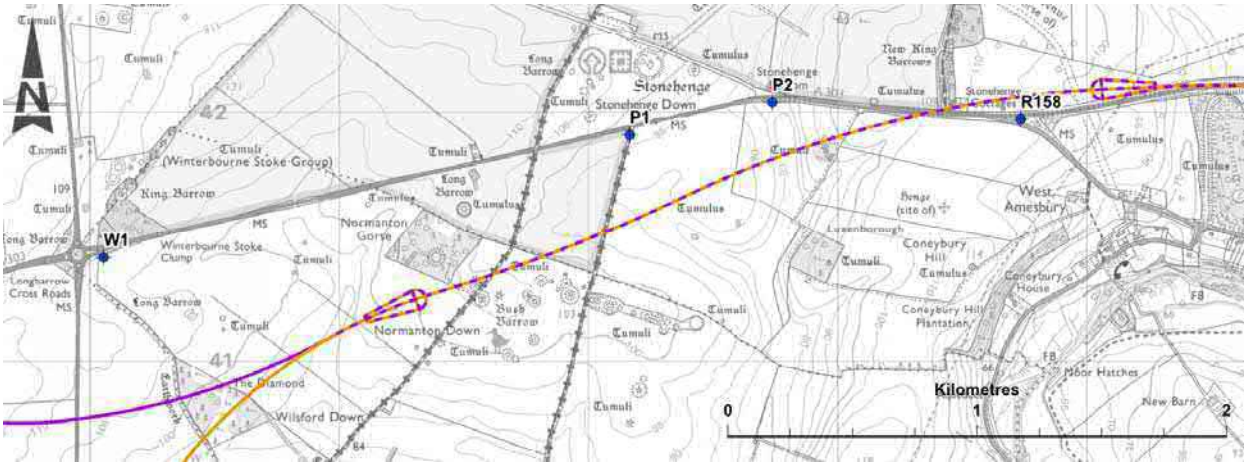

Figure 5-8 Hydrograph location plan

[3] The depth to groundwater in interfluve areas also tends to be greater due to the topography in these areas being higher.

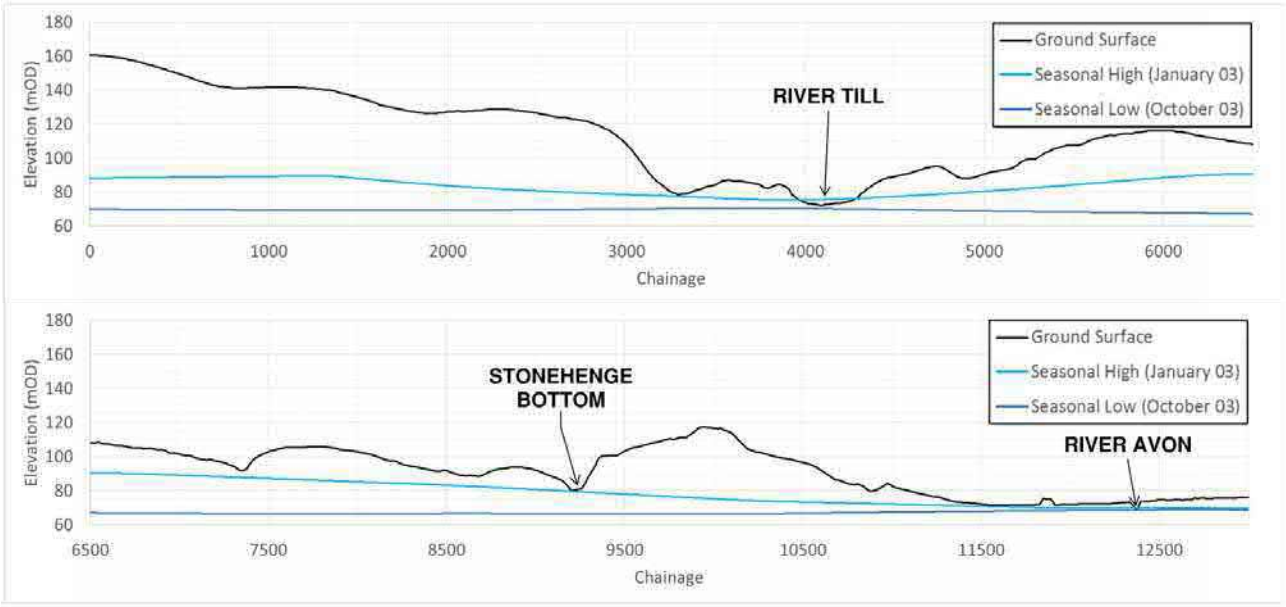

Figure 5-9* Seasonal variation in groundwater elevations along alignment option D061

5.7.11 The results of groundwater level monitoring in the Till valley between September 2001 and September 2005 have been reported by Halcrow-Gifford (2006) [2].

Hydrological Features

5.7.12 The Salisbury Plain chalk aquifer drains to the Hampshire Avon and its tributaries the Bourne and the Wylye. Nearly all the flow in the Avon at Amesbury is derived from groundwater issuing from the chalk aquifer (the river rises in the Upper Greensand just off the chalk to the north), and there are springs adjacent to the river at West Amesbury as well as further up the catchment. The average daily flow in the Avon over the period 1965 to 2013 at the gauging station at Amesbury was 290 Ml/d (megalitres per day); the typical seasonal minimum flow in that period was about 100 Ml/d rising to a typical winter maximum of about 1000 Ml/d.

5.7.13 The A303 project extends into the fluvial sub-catchment of the River Till, a tributary of the Wylye and largely groundwater-fed, and Stonehenge, which is a groundwater catchment containing no surface water flows at all. The Stonehenge catchment drains to the Avon through Stonehenge Bottom, which is a dry valley[4]. The Till flows into the Avon at Salisbury via the Rivers Wylye and Nadder (Figure 5-6), and groundwater flow from the Stonehenge catchment follows the course of the dry valley to discharge to the Avon at Lake[5].

5.7.14 In general, groundwater baseflow enters the rivers as seepage, not at discrete spring points but there are some springs, notably at the following locations:

- West Amesbury on the west bank of the Avon;
- Springbottom Farm (at times of peak seasonal groundwater levels only);
- the pond at Lake with outflow to the Avon (seasonal); and

[4] "Dry valley" is a misleading term, deriving from the fact that flow is below the ground surface, with surface flow occurring only occasionally, when the water table reaches the surface. Sub-surface flow in a dry valley can be substantial, and spring discharge downstream of a dry valley can contribute significant flows to a groundwater-fed river (as is the case with Stonehenge Bottom and the Avon).
[5] This interpretation assumes that the chalk beneath Coneybury Hill is relatively low permeability, forming a hydraulic barrier preventing flow taking a more easterly course to the Avon.

- springs feeding the Till upstream of Berwick St James

5.7.15 Flood zone maps for the Avon and Till valleys produced by the Environment Agency have been obtained through Groundsure (Appendix F) and are reproduced in the EAR [13].

5.7.16 The approximately 11km^2 topographic catchment of Stonehenge Bottom is funnelled through the dry valley feature (Figure 5-10). Transmissivity in a dry chalk valley can be extremely high but can also vary greatly within a short distance (metres) both horizontally and vertically. Water levels can fluctuate by several metres in quite a short time, in response to hydrological events in the upstream catchment.

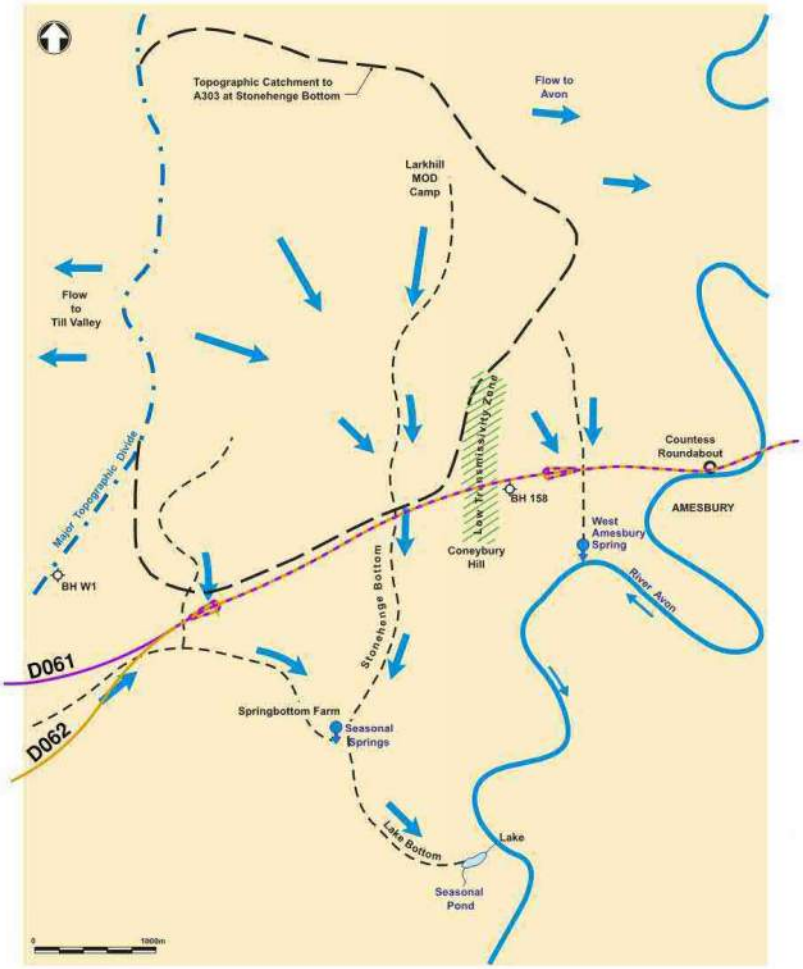

Figure 5-10 Conceptual hydrogeological model for Stonehenge Bottom catchment after Halcrow-Gifford [8]

Licensed Surface Water Abstractions and Discharge Consents

5.7.17 There are no licensed surface water abstractions located near to the alignments.

5.7.18 A domestic property has a licensed consent to discharge final/treated sewage effluent to the River Avon approximately 80 m to the south of the D061 and D062 route options in Amesbury.

5.8 Historical land uses

5.8.1 An historical maps search has been carried out through Envirocheck (see Appendix E) alongside a review of historic aerial photography of the area (vertical

and oblique) to determine historic land use along the alignment options D061 and D062 (see Appendix B). Please refer to Section 3 for details of search limits.

5.8.2 Ordnance Survey maps at 1:2500 scale have been reviewed and key features are marked on Drawings HE551506-AA-HGT-D_SWI-DR-000057 to 000059 in Appendix A. The dates of mapping available were as follows (not all dates were available for each map):

- 1878-88
- 1901
- 1924-25
- 1937-39
- 1971-72
- 1977-90
- 1993-96

5.8.3 Enquiries for availability of aerial photographs were sent to commercial and institutional sources, and limited to vertical photographs taken at 1:10,000 scale or larger and oblique photographs. This revealed that vertical photographs cover the period from 1943 to 2009 and that oblique photographs between 1921 and 2013 targeting features of archaeological interest cover most of the route. Selected photographs were chosen for interpretation and the findings of this review are reported in Appendix B and annotated onto a plan of the routes on Figures B1 and B2.

5.8.4 The area is currently largely agricultural outside the limits of Winterbourne Stoke and Amesbury.

Northern bypass of Winterbourne Stoke (D061)

5.8.5 This alignment option passes approximately 400m to the north of the centre of the village. A pumphouse is shown to the west of the B3083 at approximately ch 3+300[6] on the 1977 and 1995 maps. Sluices for active management of water meadows in the Till valley are shown on maps up to the 1939 edition.

5.8.6 A chalk pit is shown on the 1877 map on the south side of the A303 to the east of Winterbourne Stoke which was enlarged on later editions of the map. A barn which is no longer present is shown on the north side of the A303 on the maps from 1877 to 1939 to the north east of the proposed interchange between ch 5+000 and 5+500.

5.8.7 The former RAF Oatlands Hill is located between the A303, A360 and 'The Park' and is intersected by alignment D061 [14]. It is understood to have been a World War II satellite site for RAF Old Sarum, and comprised a grass airfield, operational between 1941 and 1946. As a satellite site there were limited facilities, however underground fuel storage was known to be present [15]. A review of aerial photographs has revealed that there were four blister hangers around the edge of the presumed airfield together with a concrete track and hardstanding but there is no visible evidence of aircraft use on the open grass field or in the vicinity of the hangars on aerial photographs taken in 1945. However an active airfield has been

[6] Refer to Figure 1-3 for chainages

identified to the south on the east side of the A360 (See Appendix B and Section 5.8.11).

5.8.8 The alignment crosses the existing A303 at ch 5+100 and the A360 at ch 6+400. Old chalk pits are shown close to the A360 on the 1877 to 1939 edition maps but not on later editions. The Longbarrow crossroads is first shown as a roundabout on the1972 map and was remodelled some time after 2010.

Southern bypass of Winterbourne Stoke (D062)

5.8.9 This alignment option passes approximately 1km to the south of the centre of Winterbourne Stoke and about 700m north of the centre of Berwick St James. It crosses the B3083 at approximately ch 3+500. Sluices for the active management of water meadows in the vicinity of the River Till crossing are shown on the maps up to 1939.

5.8.10 The alignment passes approximately 150m to the south of Oatlands Dairy Unit which is first seen on the 1995 edition map and then crosses The Park and then the A360 at ch 6+150.

5.8.11 To the east of the A360 the alignment crosses an area identified from aerial photographs as an active airfield forming part of RAF Oatlands Hill -in World War II (see Appendix B). This may also have formed part of the site of Lake Down World War I airfield the main facilities of which were located to the south near to Druids Lodge. Based on information accessed through the Historic England website [16], RFC Lake Down was used for day-bombing training by the RFC and the United States Air Force. The airfield and its facilities covered an area of 160 acres, comprising a technical site to the east of the A360 and a domestic site on the west of the A360 around the location of Druid's Lodge, but their exact extents are unclear.

East of A360 (D061 and D062)

5.8.12 The alignment options converge at about ch 7+500. The rest of this section refers to the chainage relating to alignment D061. The tunnelled section is from approximately ch 7+850 to 10+750.

5.8.13 The line of the Larkhill Military Light Railway is shown on the 1924 map to the east of the A360 extending almost as far south as D061 but is shown as already having been dismantled. A review of the military history indicates that this railway originally extended further south to Druid's Lodge serving RFC Lake Down [14].

5.8.14 RAF Stonehenge, comprising a World War I military airbase and airfield, was located approximately 150m north of the route to the east of Normanton Gorse (see Drawing HE551506-AA-HGT-D_SWI-DR-000058 and Appendix B). Information relating to this facility is limited but it is understood to have come into operation in 1917, closed in 1921, and structures demolished between 1923 and 1930 [14] [17]. RAF Stonehenge was extensive, covering an area of 360 acres [18] with infrastructure such as Bessonneau hangars, aeroplane sheds, general repair sheds and workshops. A spur of the Larkhill Military Light Railway served RAF Stonehenge during its operation and a railway terminal and goods yard were historically present within the technical area of the airbase, to the north of the A303 [18]. The associated domestic part of RAF Stonehenge was located to the south of the A303.

5.8.15 A sewage treatment works associated with the airbase was located at about ch 8+350 directly on the route alignment. It is shown on the 1924 map but already marked as disused. Aerial photographs indicate that this was dismantled sometime between 1943 and 1970 (see Appendix B) and was no longer present on the 1972 Ordnance Survey map. The maps and aerial photographs show a linear mound to the south east of the works following the line of a dry valley, interpreted as soakaway beds. Only the south eastern extremity is still shown on the 1972 map where it is marked as a 'disused tip'. It is not shown on the 1994 map.

5.8.16 A well is shown in Stonehenge Bottom close to the alignment on maps from 1877 to 1924.

5.8.17 The alignment re-joins the existing A303 at approximately ch 11+100. From here it follows the existing A303 route until the end of the scheme. This section of the A303 is part of the Amesbury bypass constructed in the late 1960's. At about ch 11+500 the A303 crosses the location of a quarry marked on the maps dated 1901 to 1937, partly in cutting at this point.

5.8.18 The Countess services first appear on the map dated 1990 and the filling station on the map dated 1994. The 1879 and 1901 maps show a gas works and gasometer to the south of the location of Countess roundabout on the south side of the River Avon.

5.8.19 To the east of the Countess roundabout at about ch 12+600 the A303 crosses the River Avon which was diverted eastward and culverted at this location during construction of the Amesbury bypass.

5.8.20 The 1879 map shows a gravel pit approximately 50m north of the A303 at about ch 12+850 with the village of Ratfyn to the north. The 1901 map marks this as a chalk pit and it is still evident on the 1994 map.

5.8.21 At about ch 12+950 the A303 crosses the line of the former Amesbury and Military Camp Light Railway which is shown on the 1924 and 1937 maps. The houses on Ratfyn Road and Beacon Close to the south of the A303 at this location first appear on the 1971 map.

5.8.22 Existing construction is summarised in Table 5.1 and Table 5.2, and is shown on Drawings HE551506-AA-HGT-D_SWI-DR-CX-000060 to 63. These drawings indicate the locations of a high pressure oil pipeline and HV overhead power line crossed by the route options but do not include other utilities for which reference should be made to the utilities searches that have been undertaken separately.

5.8.23 Along the existing A303, existing drainage systems to collect highway surface water runoff discharge into soakaway ditches, which run adjacent to the highway verges. Within the limits of the proposed routes, culverts are only known to have been constructed beneath the A303 at Countess Roundabout, to connect soakaway ditches located adjacent to the eastbound and westbound carriageways. These are positioned on both the west and east of the roundabout, but their precise locations have yet to be confirmed.

Table 5.1 A303 ABD Existing man-made features encountered on Route D061

Approximate D061 Chainage	Map/photograph feature appears in	Feature
3+250		Esso high pressure oil pipeline
3+550	1877-present day	Alignment crosses existing B3083
5+100		Alignment crosses existing A303
6+400	1877-present day	Alignment crosses A360
10+850		High voltage overhead power lines
11+100		Vespasian's Underpass
12+100	1971-2 to the present day	Countess Roundabout including a pedestrian subway and pumping station
12+600		Bridge across River Avon

Table 5.2 A303 ABD Existing man-made features encountered on Route D062

Approximate D062 Chainage	Map/photograph feature appears in	Feature
3+500	1877-present day	Alignment crosses existing B3083.
4+300		Esso high pressure oil pipeline
7+500	As Table 5.1 from Chainage 7+500 onwards	

5.9 Potentially contaminated land

5.9.1 Historical and current maps, previous ground investigation reports, aerial photography and information provided by Groundsure (see Appendices E and F) have been reviewed to identify the presence of landfills, waste facilities, pollution incidents, permitted industrial facilities and contemporary trades which may represent potentially contaminative land uses and activities. The corridor width considered comprises a zone of 150m either side of the alignment option centrelines which represents an assumed construction footprint, plus an additional radial buffer of 250m beyond this in line with industry practice.

5.9.2 The Groundsure data show the following features to be absent from the D061 and D062 study areas:

- authorised landfills;
- recorded historical landfills;
- industrial facilities with Integrated Pollution Prevention and Control;
- Registered waste transfer, treatment and disposal sites;
- Control of Major Accident Hazards facilities; and
- Hazardous substance consents.

5.9.3 In addition, no recorded pollution incidents to controlled waters or entries on the national pollution incident register are located within the D061 and D062 study areas.

5.9.4 Records of contemporary trades provided by Groundsure, located in the alignment D061 and D062 study areas, are summarised in Table 5.3.

Table 5.3 Records of Contemporary Trades

Trade	Alignment	Location
Motorcycle trading facility	D062	In vicinity of D062 120m to the north of the D062 footprint on the southern edge of Winterbourne Stoke
Petrol filling station	D061	In the far south of D061 in Winterbourne Stoke
Petrol filling station	D061 and D062	In the north of the D061 and D062 footprints at Countess Roundabout
Scaffolding Contractor	D061 and D062	130m to the south of D061 and D062 footprints in Amesbury
Rubbish Clearance	D061 and D062	30m to the south of the D061 and D062 footprints in Amesbury
Gear reconditioning facility	D061 and D062	In the south of the D061 and D062 footprints in Amesbury
Engineering services	D061 and D062	In the south of the D061 and D062 footprints in Amesbury
Vehicle repair garage	D061 and D062	10m to the south of the D061 and D062 footprints in Amesbury

5.9.5 The identified potentially contaminative land uses are summarised in Table 5.4, from west to east along the alignment. The locations of these localised potentially contaminative land uses are shown on Drawings HE551506-AA-HGT-D_SWI-DR-CX-000057 to 59 in Appendix A.

Table 5.4 Summary of potential sources of contamination near to the route options

Feature	Location	Potential Associated Contamination
Unnamed farm with slurry pit and sheep wash	South of the assumed D062 footprint to the north west of Berwick St James	Fuels and a range of chemicals such as fertilisers, herbicides and pesticides may be stored and used and contamination may be present in the soil and groundwater and as vapours. Slurry is a source of gases including carbon dioxide, methane and hydrogen sulphide and these may be present in the ground if leaks have occurred.
Motorcycle trading facility	North of the assumed D062 footprint in the south of Winterbourne Stoke	This is indicated to be a dealer rather than a maintenance/repair facility and it is considered unlikely that there has been large scale storage of fuels, oils, solvents and other chemicals which would commonly be associated with maintenance and repair. This potential source of contamination has therefore not been considered further on this basis.
Esso high pressure oil pipeline	Intersected by D061 to the north west of Winterbourne Stoke and D062 to the	This has not been considered further on the basis that the high pressure oil pipeline can reasonably be assumed to be managed and monitored by Esso to prevent leakage. Furthermore there are no recorded

Feature	Location	Potential Associated Contamination
	south east of Winterbourne Stoke	pollution incidents on or around the route of this pipeline in the vicinity.
Petrol filling station	South of the assumed D061 footprint off the A303 in Winterbourne Stoke	There is the potential for above ground spillages of petroleum hydrocarbons to have occurred during refuelling as well as leakages from below ground fuel storage tanks and pipework, which may have resulted in contamination of soils and groundwater. Petroleum hydrocarbon contamination may be present in the non-aqueous (free) phase, the dissolved phase and/or the vapour phase.
Manor Farm	In Winterbourne Stoke, located within the vicinity of D061	Fuels and a range of chemicals such as fertilisers, herbicides and pesticides may be stored and used and contamination may be present in the soil and groundwater and as vapours.
Demolition rubble	In the assumed D061 footprint approximately 600m to the north east of Winterbourne Stoke	A range of inorganic and organic contaminants may be present in soil and groundwater associated with waste materials which have historically been deposited in this area.
Hill Farm	South of the assumed D061 footprint, to the east of Winterbourne Stoke.	Fuels and a range of chemicals such as fertilisers, herbicides and pesticides may be stored and used and, as such, contamination may be present in the soil and groundwater and as vapours.
Oatlands Dairy Unit	Located in the north of the assumed D062 footprint	Fuels and a range of chemicals such as fertilisers, herbicides and pesticides may be stored and used and, as such, contamination may be present in the soil and groundwater and as vapours.
Former RAF Oatlands Hill	Intersected by D061 and D062	A grass airstrip, blister hangars and underground fuel storage were known to have been present during the airfield's operation in World War II. *Published Guidance* [19] Activities which may have taken place include bulk storage and use of chemicals and fuels, engineering and maintenance of aircraft and other infrastructure, storage and use of ammunition and bombs, and burial or burning of waste materials. As such, a wide range of potential contaminants may be present in this area in soil, groundwater and as vapours, although the length of time since the main operation of the site (circa 95 years) means that degradation and attenuation of contamination will have occurred. Unexploded Ordinance (UXO) and asbestos may also be present. Aerial photography indicates that there were few facilities with little use in the area intersected by D061 and D062.
Former RFC Lake Down	To the south of the assumed D062 footprint	RFC Lake Down was used for day-bombing training by the RFC and the United States Air Force. The airfield and its facilities covered an area of 160 acres, comprising a technical site to the east of the A360 and a domestic site on the west of the A360 around the location of Druid's Lodge. *Published Guidance* [19] Activities which may have taken place include bulk storage and use of chemicals and fuels, engineering and maintenance of aircraft and other infrastructure, storage and use of ammunition

Feature	Location	Potential Associated Contamination
		and bombs, and burial or burning of waste materials. As such, a wide range of potential contaminants may be present in this area in soil, groundwater and as vapours, although the length of time since the main operation of the site (circa 95 years) means that degradation and attenuation of contamination will have occurred. Unexploded Ordnance (UXO) and asbestos may also be present.
Dismantled railway (former Larkhill Military Light Railway)	Approximately 50 m to the east of the A360, intersected by D061 and D062	Contaminants usually associated with operational rail lines include hydrocarbons, metals and sulphates.
Former RAF Stonehenge	North of D061 and D062 tunnelled section	RAF Stonehenge covered an area of 360 acres and included Bessonneau hangars, aeroplane sheds, general repair sheds and workshops. A spur of the Larkhill Military Light Railway served RAF Stonehenge and there was an associated railway terminal and goods shed within the facility to the north of the A303. *Published Guidance* [19]: Activities which may have taken place include bulk storage and use of chemicals and fuels, engineering and maintenance of aircraft and other infrastructure, storage and use of ammunition and bombs, and burial or burning of waste materials. As such, a wide range of potential contaminants may be present in this area in soil, groundwater and as vapours, although the length of time since the main operation of the site (circa 95 years) means that degradation and attenuation of contamination will have occurred. Unexploded Ordinance (UXO) and asbestos may also be present. The Military Risk Assessment [20] indicates that small arms ammunition stores, a semi-underground bomb store and underground petrol tank would have been present at RAF Stonehenge but their locations are not known. Contaminants usually associated with operational rail lines include hydrocarbons, metals and sulphates.
Disused sewage works and a linear mound (understood to be a disused tip)	Above the D061 and D062 tunnelled section	*Published Guidance* [3]: Potential contaminants: metals, other inorganics, acids and alkalis, a range of organic compounds and micro-organisms in soil and groundwater as well as gases such as methane, carbon dioxide and hydrogen sulphide. Anecdotal evidence contained in the Military Risk Assessment [20] suggests that building demolition debris which may have included asbestos, may have been used to infill sewage beds. Decomposition of organic materials in-situ results in the generation of gases such as methane and carbon dioxide. The sewage plant has been out of use for about 90 years and any tip was disused by the early 1970s. Thus any gas generation may have subsided.
Old quarry	On the route of the existing A303, approximately 500 m to the west of	The feature is labelled as an old quarry on the 1901 Ordnance Survey map and remains until at least 1961. The next available map dated 1971-1972 shows the existing A303 to have been constructed directly through the location of the quarry and, on this basis, it

Feature	Location	Potential Associated Contamination
	Countess Roundabout	is considered unlikely that the quarry was infilled with waste and it is therefore unlikely that residual contamination is present.
Countess Farm	North of the existing A303 at Countess Roundabout.	Fuels and a range of chemicals such as fertilisers, herbicides and pesticides may be stored and used and contamination may be present in the soil and groundwater and as vapours.
Petrol filling station	At Countess Services directly to the north east of Countess Roundabout	There is the potential for above ground spillages of petroleum hydrocarbons to have occurred during refuelling as well as leakages from below ground fuel storage tanks, which may have resulted in contamination of soils and groundwater. Petroleum hydrocarbon contamination may be present in the non-aqueous (free) phase, the dissolved phase and/or the vapour phase.
Ratfyn Farm	Located directly to the north of the existing A303.	Fuels and a range of chemicals such as fertilisers, herbicides and pesticides may be stored and used and contamination may be present in the soil and groundwater and as vapours.
Former gas works	Located to the south of the existing A303 in Amesbury	The maps dated 1877 to 1901 show a gas works located to the south of the River Avon in Amesbury. The facility comprised a gasometer and an associated building. This has not been considered further on the basis that the River Avon passes between the D061 and D062 footprints and the former gas works and it is considered unlikely that there is a plausible pathway for residual contamination to migrate into the scheme footprints.
Rubbish clearance facility	Groundsure indicates this to be located 30m to the south of the existing A303 in Amesbury	Current mapping and aerial photography for the area shows the location as a residential property with similar properties in the surrounding area. It is likely that the company is registered to this address but does not operate from this location and the potential contamination source has not been considered further on this basis.
Amesbury and Military Camp Light Railway and current light industrial facilities	Former railway intersected by existing A303, light industrial facilities located in the wider area	The railway historically passed beneath the A303 in cutting to the east of Amesbury at the eastern extent of the D061 and D062 alignments. Contaminants potentially associated with operational railway lines include hydrocarbons, metals and sulphates however there is considered to be low potential for such contamination to be present. There are three contemporary trades now operating from a section of the former railway route to the south of the existing A303, a gear reconditioning facility, an engineering services facility, and a vehicle repair garage. A range of contaminants potentially associated with these operational light industrial facilities include metals, hydrocarbons and solvents and contamination may be present in the soil and groundwater and as vapours.
Depot and warehousing	Directly to the south of the existing A303 in Amesbury	A range of inorganic and organic contaminants may be stored and/or used at the depot and warehouses and leaks or spills to ground may have occurred resulting in

Feature	Location	Potential Associated Contamination
		the presence of contamination in soil and groundwater and as vapours.
Unnamed farm	150m northeast of the existing A303	Fuels and a range of chemicals such as fertilisers, herbicides and pesticides may be stored and used and contamination may be present in the soil and groundwater and as vapours.

5.10 Archaeology and cultural heritage

5.10.1 The WHS is internationally important for its complexes of outstanding prehistoric monuments and it is this collection of monuments that forms the overall Outstanding Universal Value (OUV) of the WHS. The stone circles at Stonehenge and Avebury together with their inter-related monuments show a continuous use of the landscape spanning around 2000 years of Neolithic and Bronze Age ceremonial and mortuary practices.

5.10.2 Within the Stonehenge WHS there are 175 Scheduled Monuments which include approximately 415 individual monuments or archaeological features. At Stonehenge WHS monuments such as the Avenue, the Cursuses, Durrington Walls, Woodhenge and the dense concentration of burial mounds all contribute to the OUV.

5.10.3 Within the WHS the alignment options D061 and D062 have the potential to impact on significant monuments. Table 5.5 below gives a list of significant archaeological features or monument groups close to the alignments (also see Drawings HE551506-AA-HGT-D_SWI-DR-CX-000049 to 52 in Appendix A which show the locations of scheduled monuments[7]).

Table 5.5 Significant archaeological features within the WHS

Scheduled Monument	List Entry Number
Stonehenge, the Avenue, and three barrows adjacent to the Avenue forming part of a round barrow cemetery on Countess Farm	1010140
Three bowl barrows 350m north of The Avenue forming part of a linear round barrow cemetery known as the Old King Barrows	1012379
Long barrow and 18 round barrows, forming the greater part of Normanton Down round barrow cemetery	1009614
Lake Barrow Group, North Kite earthwork enclosure, four sections of linear boundary, and a bowl barrow within the North Kite	1010863
Eighteen round barrows forming the greater part of the Winterbourne Stoke crossroads round barrow cemetery	1012368
Lake Barrow Group, North Kite earthwork enclosure, four sections of linear boundary, and a bowl barrow within the North Kite	1010863
Long barrow on Wilsford Down 300m north of The Diamond	1010830

[7] Drawings HE551506-AA-HGT-D_SWI-DR-CX-000049 to 52 also show listed buildings which comprise a range features including mileposts adjacent to the existing A303. See also the EAR [13].

5.10.4 The above table is not exhaustive and also only refers to monuments within the WHS boundary. There is the possibility of the routes affecting monuments of 'schedulable' quality not yet protected by law as Scheduled Monuments, and it also has to be considered that the boundary of the WHS may be amended in the future. The 2015 Management Plan of the WHS refers to the possibility of the boundary being reviewed.

5.10.5 The Heritage Impact Assessment (HIA) to be produced by the AAJV will provide a comprehensive assessment of OUV and outline all key attributes of OUV.

5.11 Ecology

5.11.1 Detailed ecological baseline information as well as valuation of key receptors can be found in the Environmental Assessment Report (EAR) [13].

5.11.2 The alignment options are within a habitat- and species-rich landscape that includes:

- Two river corridors: the Avon Site of Special Scientific Interest (SSSI) & Special Area of Conservation (SAC) and Till SSSI. A SSSI is protected by law to conserve their wildlife or geology, while a SAC is a strictly protected site that will make a significant contribution to conserving habitat types and species that are considered to be most in need of conservation at a European level (excluding birds); and
- Extensive areas of chalk downland, including parts of the Salisbury Plain SSSI & SAC and Parsonage Down SSSI & National Nature Reserve (NNR). A NNR is designated by Natural England as a key place for wildlife and natural features; and
- Normanton Down (Royal Society Protection of Birds) RSPB reserve former arable conversion to chalk grassland being managed to anchorage breeding Stone Curlews and other birds; and
- A series of woodlands/copses, much of which is within the Stonehenge World Heritage Site; and
- Large areas of chalk downland that are recognised as SSSI; and
- Areas under ecological restoration and likewise recognised as local wildlife sites in Wiltshire; and
- Interstitial farmland comprising extensively-managed pasture and extensive arable land.

5.11.3 The designated areas are denoted on Drawings HE551506-AA-HGT-D_SWI-DR-CX-000053 to 56 in Appendix A.

5.12 UXO risk assessment

5.12.1 A military risk assessment has been carried out by AAJV [20] and a Stage 1 UXO risk assessment was commissioned for the route options through Groundsure and

Bactec[8]. The Bactec report [21] gave a medium level of risk for the area, mainly due to the proximity of military facilities. According to CIRIA C681 [22] this indicates that a more detailed assessment is required, considering the works to be carried out.

5.12.2 Consequently a Stage 2 assessment was commissioned again through Groundsure and Bactec specifically for the archaeological and ground investigation works being carried out in late 2016/early 2017. An assessment of 'low risk' was generally returned [23].

5.12.3 A Stage 2 assessment for the scheme will be required before the start of works, once the final details of the scheme are confirmed.

[8] Refer to Section 3.4 for limitations on searches carried out.

6 Ground Conditions

6.1 Introduction

6.1.1 As described in Section 3, two major ground investigations have been undertaken in connection with the former published scheme between 2000 and 2004. The results from the first investigation (comprising a Preliminary investigation and Main investigation undertaken in two phases) have been reviewed and interpreted in reports prepared by Mott MacDonald (2001 & 2002) [11] [24].

6.1.2 The results from the second investigation (the Supplementary investigation) have been reviewed and interpreted in combination with those from the first investigation in a report by Halcrow-Gifford (2006) [8].

6.1.3 This section draws on and summarises the previous work, highlighting remaining areas of risk and uncertainty including potential variations resulting from the selection of alignments that deviate from the former published scheme. Reference should be made to the Mott MacDonald and Halcrow-Gifford reports for a detailed collation and interpretation of the ground investigation data.

6.2 Overview

6.2.1 As described in Section 5.3, the entire area of the scheme is underlain by chalk of the White Chalk sub group. This is typically an almost pure calcium carbonate made up predominantly of clay and silt size particles.

6.2.2 The chalk is overlain by Head deposits in dry valleys and alluvial deposits in the active fluvial valleys of the Rivers Till and Avon.

6.2.3 The chalk may be classified for engineering purposes based on the intact dry density (IDD) and CIRIA grade which depends on the discontinuity spacing and aperture. The classifications are given in Table 6.1 to Table 6.3.

Table 6.1 Intact dry density scales of chalk (CIRIA C574 [25])

Density scale	Intact dry density (Mg/m^3)
Low density	< 1.55
Medium density	1.55 to 1.7
High density	1.7 to 1.95
Very high density	> 1.95

Table 6.2 CIRIA chalk grading scheme

Classification of chalk by discontinuity aperture		Subdivisions of Grades A to C by discontinuity spacing	
		Suffix	Typical discontinuity spacing
Grade A	Discontinuities closed	1	t > 600mm
Grade B	Typical discontinuity aperture < 3mm	2	200 < t < 600mm
Grade C	Typical discontinuity aperture > 3mm	3	60 < t < 200mm
Grade D	Structureless or remoulded mélange	4	20 < t < 60mm
		5	t < 20mm

Table 6.3 Subdivisions of Grade D chalk by engineering behaviour

Suffix	Engineering behaviour	Dominant element	Comminuted chalk matrix	Coarser fragments
m	fine soil	matrix	approx. > 35%	approx. < 65%
c	coarse soil	clasts	approx. < 35%	approx. > 65%

6.2.4 Degraded chalk without structure (Grade D) is subdivided by suffices m or c depending on whether it is matrix or clast dominated.

6.2.5 The chalk outcrops at the surface in the interfluve zones where the near surface (generally up to 1m depth) has been weathered to a structureless chalk, mostly of Grade Dc but including some grade Dm. This is underlain by structured chalk.

6.2.6 In dry valleys and the active fluvial valleys of the Rivers Till and Avon the thickness of structureless chalk tends to be greater. The variation in thickness is summarised in Table 6.4.

Table 6.4 Variation in thickness of structureless chalk

Location	Thickness of structureless chalk
Interfluve zones	< 1m
Dry valleys Stonehenge Bottom Valley NE of Winterbourne Stoke Valley side NW of Winterbourne Stoke*	 Up to 7m Up to 5m Up to 6m
Avon valley at Countess Roundabout	Up to 10m
Till valley north of Winterbourne Stoke	Up to 3m

* See Section 6.6

6.2.7 Head deposits comprising solifluction or water transported deposits are found in many of the dry valleys overlying the structureless chalk. These are generally no more than 1 to 2m thick in the base of the valley, thinning up the valley sides.

6.2.8 The combined thickness of Head and structureless chalk encountered in the most prominent dry valley at Stonehenge Bottom was about 9m. This location is described in more detail in Section 6.8 below.

6.2.9 In the active fluvial valleys of the Rivers Till and Avon the chalk is overlain by alluvial deposits. These vary in thickness up to about 3m in the Till valley north of Winterbourne Stoke and about 7.5m in the Avon valley in the vicinity of the Countess Roundabout.

6.2.10 The majority of the structured chalk encountered in the previous investigations, and expected to be encountered along routes D061 and D062, is from the Newhaven and Seaford formations and has similar engineering characteristics. Chalk from the Lewes Nodular Formation, which is stronger, was encountered below the Till valley.

6.2.11 A zone of phosphatic chalk was encountered to the west of Stonehenge Bottom during the previous investigations, the presence of which had not been known in this area prior to the investigations. The distribution and characteristics of this deposit are described in more detail in Section 6.3 below.

6.2.12 The reports by Mott MacDonald [11] [24] and Halcrow Gifford [8] give more detailed descriptions of the distribution of these materials along the former published scheme.

6.3 Structured Chalk

Chalk Grade

6.3.1 The results of intact dry density tests from the Main and Supplementary ground investigations are plotted and reviewed in the Halcrow-Gifford report [8]. The results for the Newhaven and Seaford formation generally lie within the range 1.55 to 1.7Mg/m^3 (corresponding to medium density) but 24% of all test results were below 1.55Mg/m^3 (corresponding to low density). The results in the Lewes Nodular Beds near Winterbourne Stoke are mostly greater than 1.7Mg/m^3 (corresponding to high density).

6.3.2 The distribution of chalk grades is also reviewed in the Halcrow-Gifford report [8]. About 21% of the structured chalk was logged as Grade A (closed discontinuities), about 63% Grade B (discontinuity aperture less than 3mm) and 16% as Grade C (discontinuity aperture greater than 3mm).

6.3.3 Grade A chalk was mostly encountered at depth and within the Lewes Nodular Beds but sometimes above 5m below ground level on the elevated interfluves. However from comparison of logging in trial pits and boreholes, Halcrow-Gifford concluded that some core logged as grade A at shallow depth may actually be grade B.

6.3.4 Grade B chalk was the most commonly encountered, and about two thirds was grade B2 or B3 (discontinuity spacing between 60 and 600mm).

6.3.5 Grade C chalk was typically encountered at shallow depth (above 5m below ground level and within the upper 3m of the structured chalk). However it was encountered at depth in Stonehenge Bottom and in the Till and Avon valleys, associated with deeper weathering at these locations. Grade C chalks were also encountered in the vicinity of the phosphatic chalk. About two thirds of grade C chalk was grade C3 (discontinuity spacing between 60 and 200mm).

6.3.6 Outside of the fluvial and dry valley zones, the structured chalk is typically recorded as varying between Grade C/B and 4/3 below structureless chalk to B/A and 3/2 with depth, generally decreasing in fracture aperture and increasing fracture spacing with depth.

6.3.7 The occurrence of grade C chalk at depth at valley locations may be associated with dissolution widening of discontinuities and/or faulting.

Discontinuities

6.3.8 Two types of discontinuities were identified in previous studies and also described by Mortimore [6]:

- A basin wide group of discontinuities trending NW-SE, NE-SW, E-W and N-S (sets 2 to 5 in Table 6.5). Those trending NW-SE and NE-SW form the principal set of sub vertical discontinuities at a typical spacing of about 0.2m, and together with the bedding partings at a typical spacing of about 1m (set 1 in Table 6.5), form a broadly orthogonal set. The discontinuities are described as generally planar to undulose, rough to smooth, clean or with silty infill.
- Additional discontinuities within the Newhaven and transitional Newhaven-Seaford chalks. These form an inclined conjugate set orientated NW-SE and NE-SW at a typical spacing of 5 to 10m and tend to be slickensided (sets 6 and 7 in Table 6.5).

Table 6.5 Discontinuities in the chalk, from Halcrow – Gifford [8]

Set No.	Dip (°)	Dip direction (°)	Typical spacing (m)	Comments
1	<30	-	1	Principal - bedding
2	70 - 90	NW - SE	0.2	Principal. Silt infill
3	70 - 90	NE - SW	0.2	Principal. Silt infill
4	70 - 90	E - W	0.2	Subsidiary. Silt infill
5	70 - 90	N - S	0.2	Subsidiary. Silt infill
6	40 - 70	NW - SE	5 - 10	Minor. Slickensided, clayey infill and stained
7	40 - 70	NE - SW	5 - 10	Minor. Slickensided, clayey infill and stained

Strength

6.3.9 The results of unconfined compression tests gave intact compressive strengths mostly between 1 and 3MPa with an average of 2MPa, corresponding to the description ‘very weak’ rock. The correlation between unconfined compressive strength and point load index is reviewed in Mott Macdonald [11].

6.3.10 Mott MacDonald [11] and Halcrow-Gifford [8] have noted that the relationship between intact strength and intact dry density for the chalk is not consistent with

published correlations from other locations, with the intact strength being low in comparison to the intact dry density.

Flints

6.3.11 Bands of flint nodules or tabular flints are associated with the bedding partings which occur at approximately 1m vertical intervals. The flint nodules are typically 100mm to 200mm diameter and the tabular flint 20mm to 40mm thick. Rare larger masses in excess of 500mm diameter were reported.

6.3.12 Flints were recorded within exploratory holes everywhere except in the phosphatic chalk where flint was largely absent.

Hardgrounds and marl seams

6.3.13 Hardgrounds were encountered in the Lewes Nodular Beds and as sponge beds elsewhere.

6.3.14 Marl seams, mostly less than 20mm thick, were encountered locally (correlated with the Belle Tout Marls, see Figure 5-4).

6.4 Phosphatic Chalk

Background

6.4.1 The phosphatic chalk encountered to the west of Stonehenge Bottom in the Main and Supplementary investigations for the former published scheme is a variably, and often weakly, cemented brown sandy chalk with pelletal phosphatic grains. It contains up to about 50% of fine to medium sand size particles and may thus be described as a calcarenite. The maximum thickness encountered was about 21m.

6.4.2 The cores of phosphatic chalk recovered in the previous ground investigations tended to be friable and disintegrate on handling and the phosphatic chalk has been assessed as generally weaker than the (normal) white chalks. There is limited data relating to the engineering properties of the phosphatic chalk which are not well understood.

6.4.3 Furthermore, the previous investigations were along a single alignment. Consequently the spatial extent of the phosphatic chalk is not known.

6.4.4 The presence of phosphatic chalk leads to additional risks for tunnel construction. The risks have been reviewed and discussed in documents prepared during development of the previous published scheme by Halcrow-Gifford [8] [26] [27], and by Mortimore [6].

Previous studies

6.4.5 The engineering logging on the factual report borehole logs describes the phosphatic chalk as either calcarenite (Main investigation) or sandy chalk (Supplementary investigation). Selected boreholes were also logged by Mortimore [6] [7].

6.4.6 A standard classification scheme has not been developed for the phosphatic chalks. Mortimore has noted that darker, more phosphate rich deposits are the most friable, whilst paler, ‘near normal’ deposits are firmer. He has used a colour shading system on his logs to classify the phosphatic chalk, with the darker coloured shades indicating the greater levels of phosphate concentration and more friable materials.

6.4.7 Halcrow-Gifford [8] classified the phosphatic chalk into three types tentatively related to a range of representative SPT N values as follows.

- Richly phosphatic: N < 20
- Moderately phosphatic: 20 ≤ N < 40
- Weakly phosphatic or 'near-normal': N ≥ 40

However these correlations were made using a small number of SPT-N values from four boreholes, and the relationship does not appear to be well supported by the data.

6.4.8 The phosphatic chalk contains small quantities of radioactive uranium and thorium impurities. This gives elevated natural gamma counts on geophysical logs. The correlation reported in Halcrow-Gifford [8] is illustrated in Figure 6-1.

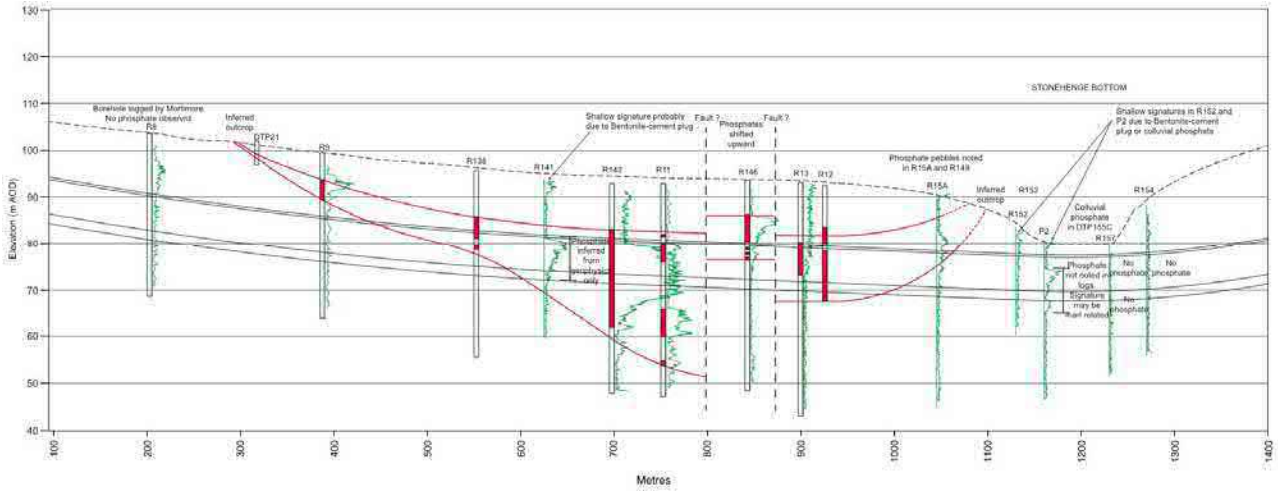

Figure 6-1* Correlation between natural gamma count and logged phosphatic chalk (after Halcrow-Gifford [26])

6.4.9 The distribution of phosphatic chalk along the alignment investigated is complex and two alternative models are developed in the Halcrow-Gifford report [8], reproduced in Figure 6-2 and Figure 6-3. In the first model (Figure 6-2) the phosphatic chalk is deposited in a single large cuvette with the observed distribution being fault controlled.

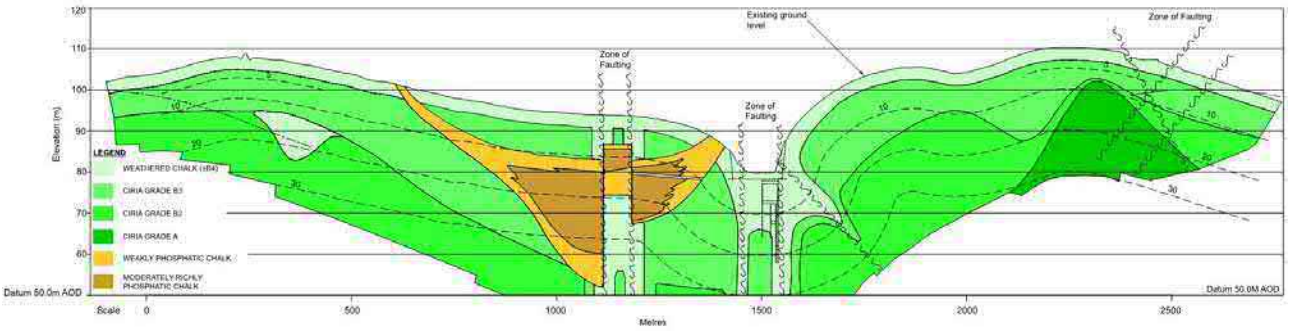

Figure 6-2* Single cuvette – fault constrained model (after Halcrow-Gifford [8])

6.4.10 In the second model (Figure 6-3) the observed distribution is accounted for by a sequence of overprinted erosion and deposition events.

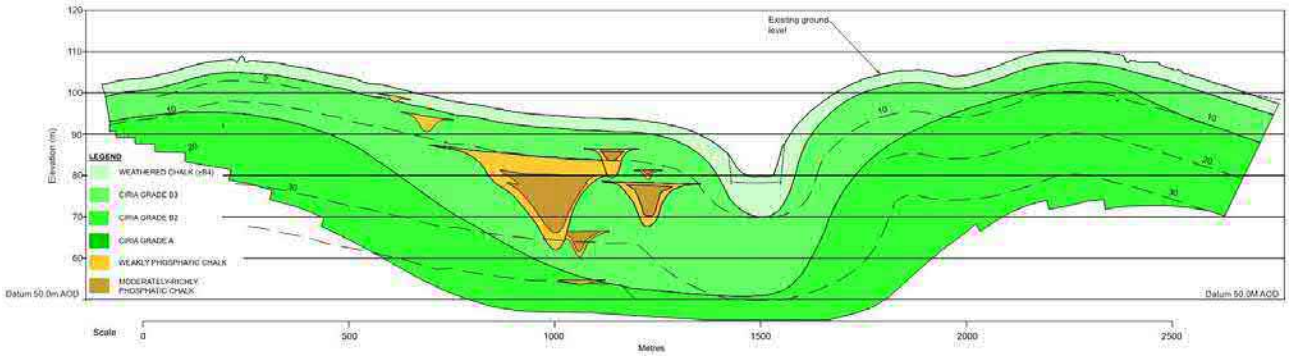

Figure 6-3* Multiple cuvette model (after Halcrow-Gifford [8])

Plan orientation of phosphatic chalk body

6.4.11 The previous ground investigations provide no information on how the phosphatic chalk may be distributed along alignment D061/D062 to the south of the former published scheme. Following discussion with Professor Mortimore two alternative conceptual models have been identified which are illustrated in Figure 6-4.

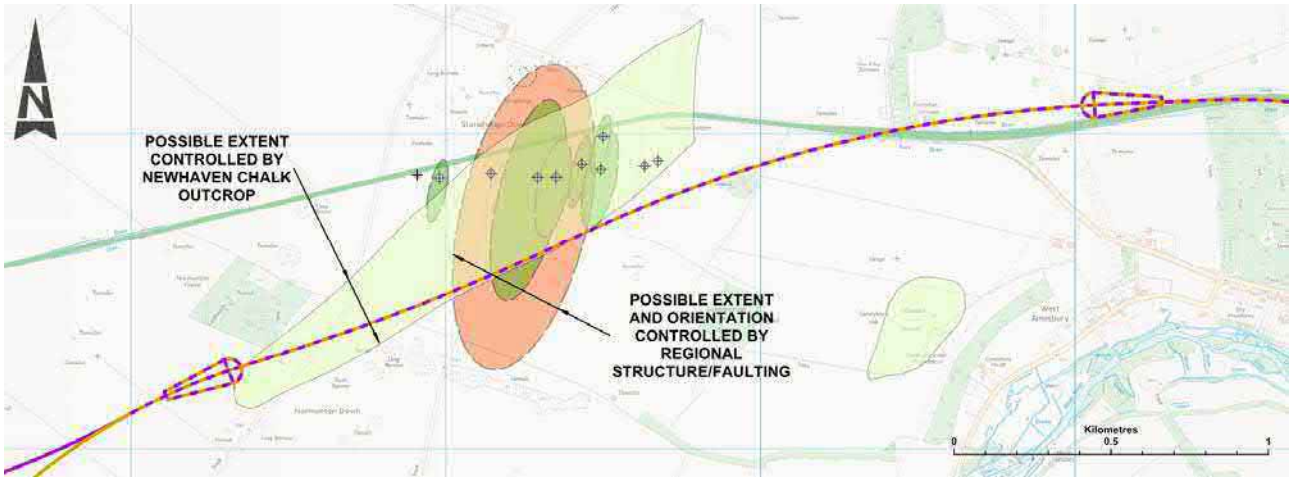

Figure 6-4* Alternative conceptual models for plan orientation of phosphatic chalk

6.4.12 In the first model it is assumed that the orientation of the cuvettes corresponds to the regional structural controls (faulting) and is approximately north – south. Figure 6-4 shows the cuvettes to be lenticular features with an axis length of up to 1km based on reported channel geometries elsewhere (Jarvis 1980, 2006) [28] [10]. However this is conjectural.

6.4.13 The second model is based on correlation with the mapped Newhaven chalk outcrop. In this model the cuvette cut into the underlying Seaford chalk is assumed not to have been completely filled with phosphatic material. Thus the Newhaven chalk subsequently deposited on top of the Seaford chalk also fills the upper part of the cuvette. Later erosion would then lead to the Newhaven chalk exposure correlating with the location of the phosphatic chalk.

6.4.14 Figure 6-4 shows the locations where phosphatic chalk has been encountered in previous ground investigations. Both of the alternative conceptual models are compatible with the existing ground investigation data.

Additional observations from previous studies

6.4.15 The possible presence of small scale dissolution features is discussed in previous reports by Halcrow-Gifford [8] [26].This appears to be mainly based on the interpretation of the televiewer image for borehole R142 but the evidence from this was limited and inconclusive.

6.4.16 The decay of radioactive uranium and thorium impurities within the phosphatic chalk (which leads to the increased gamma count) is likely to lead to the release of radon. Halcrow-Gifford [8] give an assessment of the health risks from exposure to radon based on advice from the National Radiological Protection Board (NRPB) and a study by the Florida Institute of Phosphate Research (FIPR). They concluded that whilst the risk to construction and long term maintenance staff cannot be reliably quantified at the pre-construction stage and thus a programme of in-tunnel monitoring will be required, the risk from radon is likely to be very low.

6.5 Dissolution features

6.5.1 Existing reports record little evidence for solution features. Evidence for possible dissolution within the phosphatic chalk has been noted in 6.4.15 above.

6.5.2 Minor, small scale features are reported by Halcrow-Gifford [8] to have been observed in a few trial pits. Examples given include a steeply dipping planar feature (solution pipe) tens of millimetres wide and more than 3m deep with infilling of dark brown sandy silt and irregular dissolution features up to 1m across infilled with sandy silt within reworked chalk on the side of a dry valley north west of Winterbourne Stoke (see Section 6.7).

6.5.3 Geophysical surveys carried out for the proposed Visitors Centre north of Countess Roundabout by John Grimes Partnership [29] were interpreted to indicate the presence of dolines, where solution weathering or karstification has occurred along discontinuities to depths of up to about 5m.

6.5.4 Geophysical surveys carried out by GSB Prospecting for Wessex Archaeology in 2001 [30] [31] note the presence of some ‘pit type anomalies’ that may be of natural origin.

6.6 Reworked chalk

6.6.1 Previous investigations between chainage 3+600 and 3+900 on route D061 have identified reworked structureless chalk with a chaotic arrangement of chalk clasts and flint nodules extending to a depth of about 6m over structureless chalk extending to a depth of up to about 12m.

6.6.2 The locations of the exploratory holes where this deposit was encountered are shown on Figure 6-5.

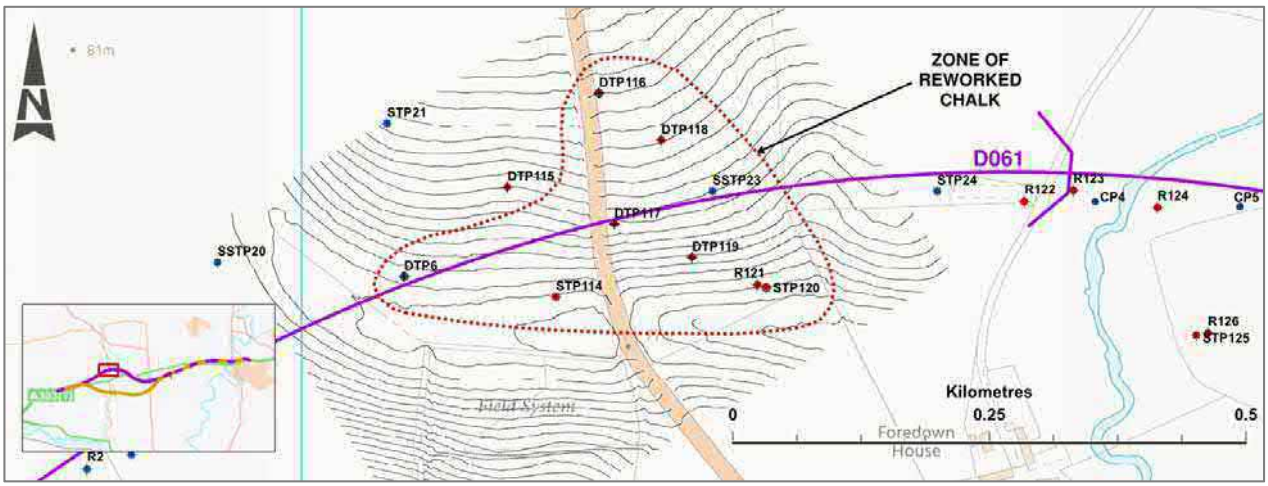

Figure 6-5 Location where reworked chalk was encountered during previous ground investigation

6.7 Superficial deposits

Head deposits

6.7.1 Halcrow-Gifford [8] report that the Head is highly variable ranging from a sandy silt to a well graded sandy gravel, and includes segregations or layers of clay.

6.7.2 There is some evidence that the distribution of Head in dry valleys may tend to be asymmetric and depend on the aspect of the slope.

Alluvium – Till valley

6.7.3 The alluvial deposits north of Winterbourne Stoke extend to a depth of 3 to 5m and predominantly comprise a medium dense flint gravel with some chalk clasts, but also contain lenses/layers of silt, sand and clay.

6.7.4 It is possible that the gravel is largely a gravelly Head deposit from which fine material has been washed out by stream flow.

6.7.5 The deposits have been classified as generally medium dense with average SPT N values of 20 in the gravel and around 15 in the silt.

Alluvium – Avon valley

6.7.6 Within the River Avon valley the Alluvium comprises three distinct units: peat, cohesive Alluvium and granular Alluvium. The combined thickness of the Alluvium units is up to 7.5m, with up to 3m of soft cohesive Alluvium and peat overlying more granular Alluvium.

6.7.7 A ground model for the superficial deposits within the vicinity of Countess Roundabout has been presented by the BGS [5] and is reproduced in Figure 6-6. The sequence consists of typically a basal layer of variably chalky flint gravel, overlain by an upper layer of soft, brown, silty peat and/or green-brown, sandy organic silt, with rare gravel.

6.7.8 However it appears that the peat was largely removed from beneath the chalk fill placed for the construction of the Amesbury bypass leaving remnants of the cohesive Alluvium beneath the fill.

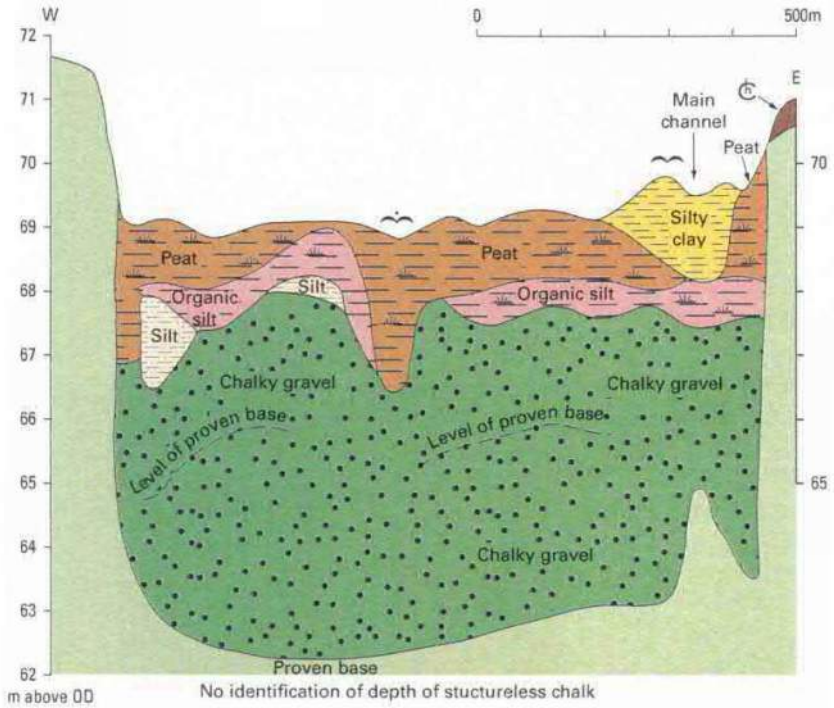

Figure 6-6 Ground model for alluvial deposits in Avon Valley (BGS [5])

Additional observations from previous studies

6.7.9 Halcrow-Gifford [8] note that poor recoveries were experienced in many of the floodplain boreholes which hindered determination of the base of the alluvial deposits.

6.8 Stonehenge Bottom

Engineering geology

6.8.1 Stonehenge Bottom is a prominent dry valley immediately to the east of Stonehenge. A conceptual ground model based on the information reported in Halcrow-Gifford [8] and Mortimore [6] is given in Figure 6-7.

6.8.2 Mortimore has described the difficulty of determining the depth of weathering and destructuring from the boreholes at this location and resulting ambiguity.

6.8.3 Some core loss was recorded at borehole R157 and Mott MacDonald report that borehole R16 collapsed when the casing was withdrawn [11].

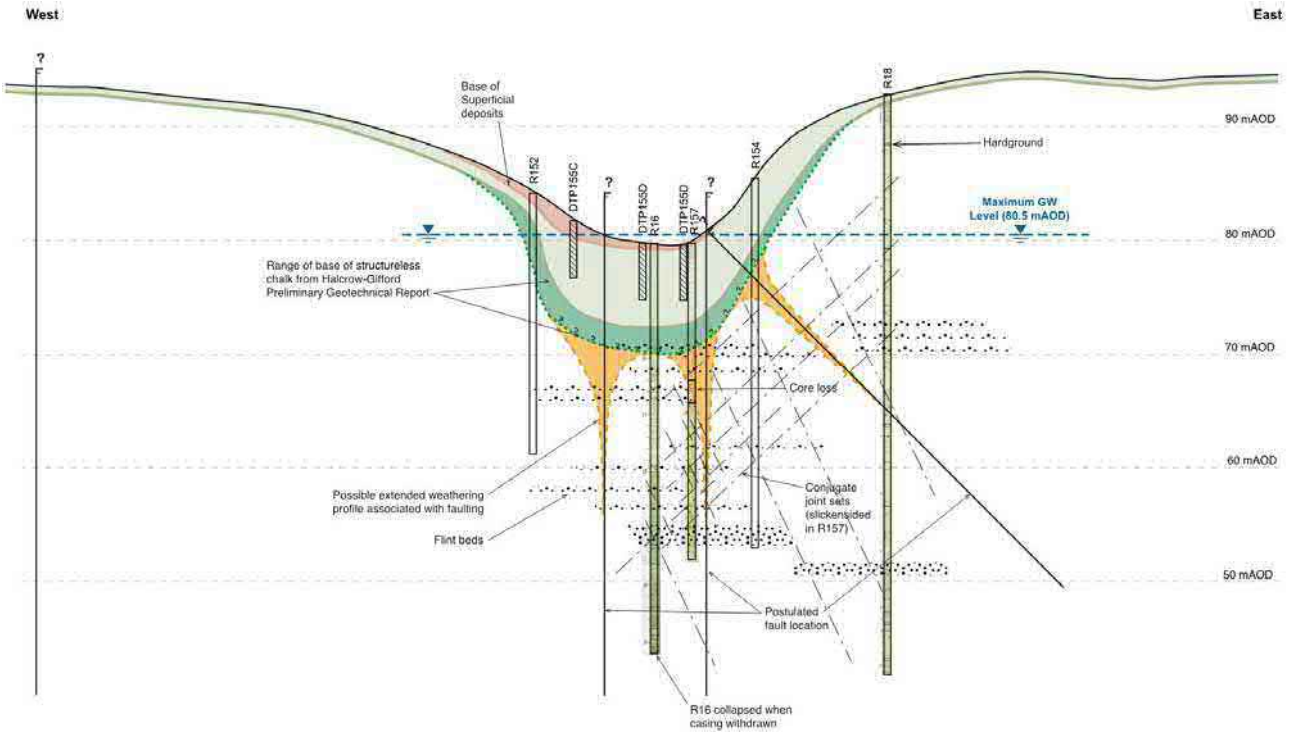

Figure 6-7* Conceptual ground model at Stonehenge Bottom after Halcrow-Gifford [8]

Hydrogeology

6.8.4 Groundwater levels measured in Stonehenge Bottom during previous investigations for the former published scheme between 2001 and 2006, see Figure 5-7, varied from a seasonal low of about 66mAOD to a maximum in an extremely wet year (2003) of about 80mAOD. The groundwater level can rise to ground surface where the A303 crosses Stonehenge Bottom under extremely wet conditions (anecdotally every 5 or 6 years).

6.8.5 The change in groundwater level can be very rapid. Fluctuations of several metres in a few days have been recorded near Stonehenge Bottom. Between the beginning of November 2002 and December 2002 the water level at monitoring well P2 in Stonehenge Bottom rose by 10m (see also Section 5.7).

6.8.6 The chalk is very permeable in Stonehenge Bottom itself and beneath the flanks of the valley. The results of packer testing carried out during the Main and Supplementary ground investigations for the former scheme are summarised in Figure 6-8 . These suggest that the base of the most permeable part of the aquifer probably lies at about 50mAOD (30 metres depth) in the centre of the valley and 55mAOD elsewhere.

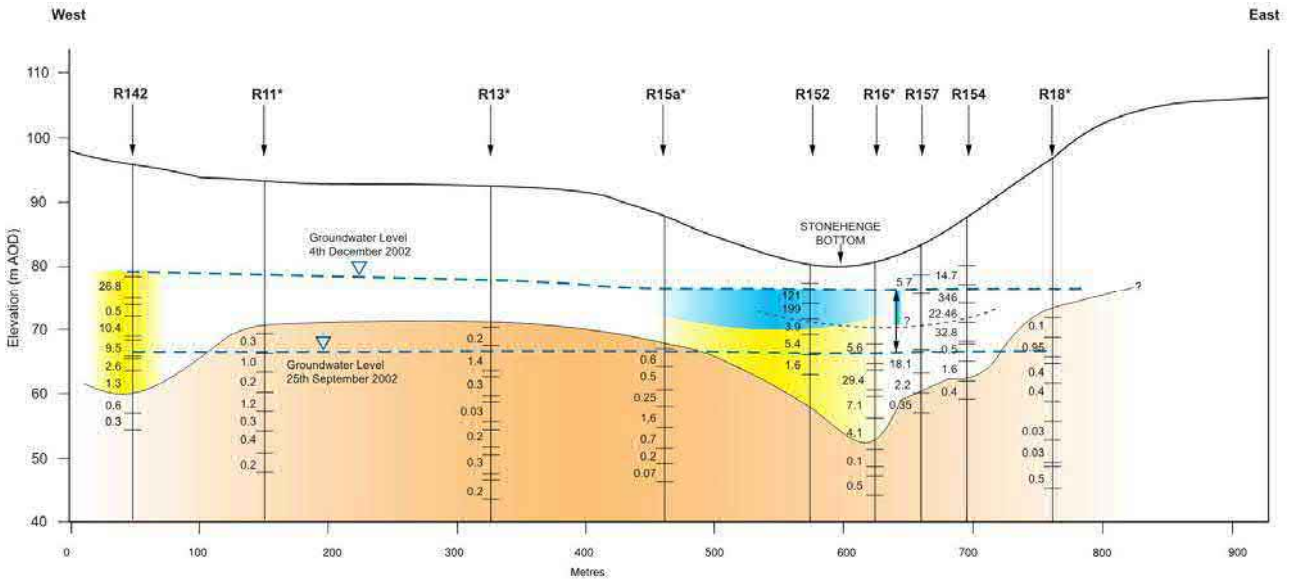

Figure 6-8* Summary of permeability results in Stonehenge Bottom and near interfluve area (after Halcrow-Gifford [8])

6.8.7 Pumping tests were carried out between 2002 and 2004 at two locations as part of the Supplementary ground investigation for the former published scheme (W J Groundwater, 2003 & 2004). [32] [33]. The locations of the tests are shown on Figure 6-9. Well W148 was located in Stonehenge Bottom and well W137 on the interfluve to the west, towards the western limit of the phosphatic chalk.

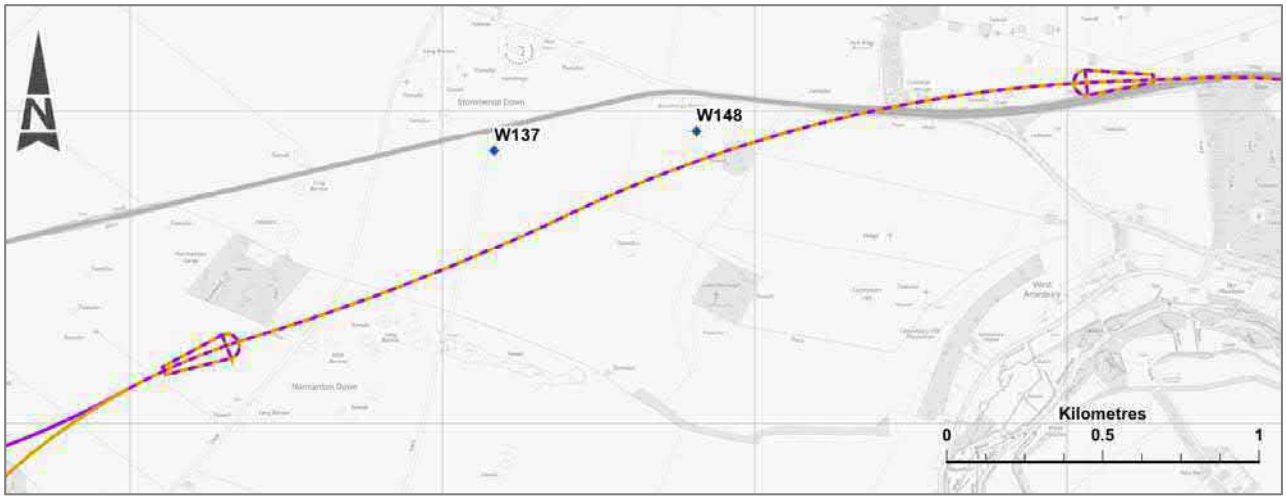

Figure 6-9 Plan showing the location of pumping tests

6.8.8 The tests were carried out on two occasions; in November/December 2002 (winter) and September 2004 (summer). Rest water levels on the two occasions differed by several metres and the tests gave quite different results. The difference was interpreted as representing the contribution of the part of the aquifer which was dry when the water level was lower.

6.8.9 The transmissivity determined from these tests is summarised in Table 6.6.

Table 6.6 Summary of pumping test results

/d	Location	Derived transmissivity	
		November/December 2002 test (winter conditions) m^2/day	September 2004 test (end-of-summer conditions) m^2/day
W148	Dry valley	2,650	1,430
W137	Interfluve	850	400

6.8.10 The transmissivity values at Stonehenge Bottom are very high (a value of 2,650m^3/d implies an average permeability of about 100m/d or 1.2 x 10^{-3}m/s) but are less than a third of this value some 650m to the west. This is consistent with the general observation that borehole yields in the chalk are higher in the valleys than the interfluves.

6.8.11 Groundwater flow is generally from north to south, following the topography (see Section 5.7). Saturated flow is concentrated beneath the centre and flanks of the valley where the permeability is highest. In Stonehenge Bottom the valley narrows further concentrating groundwater flow. The catchment discharges into the River Avon at Lake, from ephemeral springs at Spring Bottom Farm just above the confluence of the two valleys.

6.8.12 Groundwater flows will be very high during wet periods, when the hydraulic gradient is steeper, and much less in the summer when the slope of the water table is gentle. Estimates of the throughput in Stonehenge Bottom were given by Halcrow-Gifford [8] as follows[9]:

- Seasonal minimum groundwater flow (baseflow) 1,000m^3/d (11.5l/s)
- Groundwater flow during peak water levels in Jan 2003 19,000m^3/d (220l/s)
- Extreme recharge event groundwater flow 30,000m^3/d (350l/s)

6.8.13 These estimates are subject to uncertainty in view of the lack of groundwater monitoring data within the catchment.

6.9 Groundwater levels

6.9.1 Existing information on groundwater levels is reviewed in Section 5.7. Figure 5-9 shows minimum and maximum groundwater levels along alignment D061 interpreted from the monitoring locations and measurements made between the end of fieldwork and September 2005.

6.9.2 Groundwater levels respond to recharge from rainfall, with maximum and minimum levels expected in March or April and September or October respectively. Depth below ground level varies as the topography varies.

6.10 Contamination Assessments

6.10.1 Existing available reports containing contamination assessments are summarised below. Assessment of existing laboratory analytical data against current Generic Assessment Criteria, and background to the assessment and conceptual site

[9] Independent validation of these calculations has not been undertaken by AAJV

models for the identified potentially contaminative land uses are included in Appendix C.

Main ground investigation for former published scheme Phase I [11]

6.10.2 Four soil samples were collected from agricultural fields to the north west of Winterbourne Stoke and south east of Stonehenge and four groundwater samples were collected from boreholes R01, R02, R13 and R16 (see Appendix A Drawings HE551506-AA-HGT-D_SWI-DR-CX-000057 to 59) and subjected to laboratory analysis. The analytical suite for soil samples comprised:

- Inorganics: metals, metalloids, pH, anions, asbestos; and
- Organics: gasoline range organics (GRO), diesel range organics, (DRO), Polycyclic Aromatic Hydrocarbons (PAH), phenols, organochlorine pesticides, organophosphorus pesticides, triazines, polychlorinated biphenyls (PCB), volatile organic compounds (VOC).

6.10.3 Groundwater samples were analysed for the following contaminants:

- Inorganics: metals, metalloids, pH, anions, total dissolved solids, chemical oxygen demand (COD), biological oxygen demand (BOD); and
- Organics: faecal coliforms, total coliforms, PCB, DRO, GRO, PAH, phenols, organochlorine pesticides, organophosphorus pesticides, triazines, VOC.

6.10.4 Soil laboratory analytical results were compared with ICRCL levels which were current at the time and none of the recorded concentrations were found to exceed the lowest category values, those for a domestic garden scenario which represented a conservative assessment. Soils were considered to be ‘uncontaminated’.

6.10.5 The results of laboratory analysis on groundwater samples were compared with the threshold values in the UK Water Supply Regulations (UKWSR) which were current at the time of the assessment. Exceedances of the UKWSR were recorded for iron (two samples), faecal coliforms (one sample) and total coliforms (two samples). The concentrations of iron elevated above the UKWSR threshold were attributed to iron-containing silt-sized particles within the samples. The presence of coliforms were considered attributable to soil bacteria and faecal coliforms to recent animal activity. It was noted that the laboratory method detection limit was higher than the UKWSR for cyanide, thiocyanate, GRO, DRO, PAH, PCB and phenol.

6.10.6 The report concluded that ‘no contamination was revealed by chemical testing of the soil’ and ‘no contamination of the groundwater was encountered’.

Main ground investigation for former published scheme Phase II [24]

6.10.7 The soil sampling strategy in the investigation involved taking soil samples at regular intervals along the length of the route, although it was noted that the presence of predominantly agricultural land meant that the risk of contamination was likely to be low.

6.10.8 Five soil samples were collected and analysed during Phase II of this investigation for the following contaminants:

- Inorganics: metals, metalloids, anions, COD, BOD;
- Organics: PCB, DRO, GRO, PAH, phenols, organochlorine pesticides, organophosphorus pesticides, triazines, VOC.

6.10.9 No laboratory analytical certificates are included in the report.

6.10.10 Made Ground encountered in a trial pit located in the far west of the scheme, included tarmac and brick to a depth of 0.6m and made Ground encountered in a trial pit located in the far east of the scheme included tarmac to a depth of 0.35m. In addition, an area of rough ground adjacent to borehole CP3 located 670m to the north east of Winterbourne Stoke (see Appendix A Drawing HE551506-AA-HGT-D_SWI-DR-CX-000057), was observed to have been historically used for tipping.

6.10.11 Mott MacDonald [24] report discussions with the landowner for the CP3 location who believed this area to contain demolition debris from a nearby hotel, potentially including asbestos. It was noted that the rough ground was on farmland and therefore the presence of carcasses and fertilisers could not be ruled out.

6.10.12 Soil laboratory analytical data were initially compared with ICRCL values that followed Dutch Standards current at the time of the assessment. Concentrations of PAH (US EPA 16) were recorded above the ICRCL trigger threshold for domestic gardens and above the Dutch intervention level in the soil sample taken from borehole CP2 at a depth of 0.2m, located adjacent to the River Till. It was noted that there was no visual or olfactory evidence in the borehole arisings of 'hydrocarbon type product'. It was thus considered that the sample may have been cross-contaminated with fragments of coated timber originating from wooden boards which were placed at the borehole location for the temporary storage of arisings.

6.10.13 Groundwater samples were obtained on one occasion from five boreholes (CP1 to CP5, see Appendix A Drawing HE551506-AA-HGT-D_SWI-DR-CX-000057) and analysed for the following contaminants:

- Inorganics: metals, metalloids, anions, total dissolved solids;
- Organics: faecal coliforms, total coliforms, GRO, DRO, PAH, speciated phenols, PCB, organochlorine pesticides organophosphorus pesticides, triazines, VOC.

6.10.14 Laboratory analytical data for groundwater samples were compared with UKWSR and Water Quality Objectives Regulations (WQOR), protective of groundwater and surface water receptors respectively. A small number of exceedances of the adopted thresholds were recorded.

6.10.15 A single exceedance of the WQOR for ammoniacal nitrogen was recorded in the groundwater sample taken from borehole CP2. Exceedances of the UKWSR were recorded in at least one sample for fluoride, chloride, iron, ferrous iron, total iron, selenium, calcium and sodium. Microbiological analytical results were compared with the standards contained in the EC Directive on Drinking Water (75/440/EEC) and no exceedances were recorded for faecal coliforms or total coliforms. The groundwater quality was considered representative of the baseline conditions in the area and typical of unfiltered samples.

Countess Roundabout - Safety Scheme [34]

6.10.16 Made Ground was encountered in all exploratory holes and the following anthropogenic inclusions were recorded:

- Rare pipe fragments TP2 (0.3-1.8m)
- Ash and clinker with strong hydrocarbon odour (TP4 (0.6-0.8m)
- Rare fragments of geotextile material TP6 (0.3-1.5m)
- Rare fragments of barbed wire TP6 (1.5-2.6m)
- Rare metal bars TP11 (0.3-2.4m)

6.10.17 Soil samples were taken from 11 exploratory holes for laboratory analysis, see Figure Appendix A Drawing HE551506-AA-HGT-D_SWI-DR-CX-000059. Analyses for the following suite of contaminants were undertaken:

- Inorganics: pH, metals and metalloids, anions, asbestos, total organic carbon,
- Organics: GRO, TPH, PAH.

6.10.18 Soil laboratory analytical data were compared with GAC for a residential with gardens land use. This represents a conservative assessment of the data given the use of the site as a roundabout. Concentrations of PAH and TPH were recorded above the GAC in the sample taken from trial pit TP4 at 0.6m. The assessment aimed to identify risks posed to construction workers involved in the scheme and it was noted that use of GAC which assess chronic rather than acute risks was overly conservative.

6.10.19 A waste classification assessment carried out on the 11 soil samples analysed indicated that the sample taken from trial pit TP4 at 0.6m would be classified as hazardous waste for the purposes of off-site disposal.

6.10.20 Contamination identified in the location of TP4 was considered to have potentially resulted from a localised spillage during the site's ongoing use as a roundabout and highways. It was noted that tar-bound planings would likely be generated during highway re-profiling works.

Longbarrow Roundabout Improvement Scheme [35]

6.10.21 Made Ground was encountered in all five exploratory holes excavated at Longbarrow Roundabout and the following anthropogenic inclusions were recorded:

- Rare brick fragments TP2 (0-0.7m)
- Bitumen, concrete and tarmac fragmentsTP4 (0-0.9m)

6.10.22 Soil samples taken from three trial pits (see Appendix A Drawing HE551506-AA-HGT-D_SWI-DR-CX-000058) were subjected to laboratory analysis for the following suite of contaminants:

- Inorganics: pH, metals, water soluble sulphate, soil organic matter;
- Organics: PAH, TPH.

6.10.23 Soil laboratory analytical data were compared with GAC for a residential with gardens land use. Concentrations of PAH and TPH were noted to be 'elevated' above background levels. Three exceedances of the GAC for benzo(a)pyrene and a single exceedance for chrysene were recorded. The assessment aimed to

identify risks posed to construction workers involved in the scheme and it was noted that use of GAC which assess chronic rather than acute risks was overly conservative.

6.10.24 A waste classification assessment carried out on the soil samples analysed indicated that none would be classified as hazardous waste for the purposes of off-site disposal.

7 Preliminary Engineering Assessment

7.1 General

7.1.1 The preliminary assessments given in this section are based on data available from previous ground investigations for the former published scheme and other nearby locations, and draw on the work previously undertaken by Mott MacDonald (2001 & 2002) [11] [24] and Halcrow-Gifford (2006) [8]. The ground conditions encountered in previous investigations are considered to be generally representative of the geology and ground conditions likely to be encountered along routes D061 and D062.

7.2 Tunnel

7.2.1 Key geotechnical considerations for the proposed tunnel are the impact of ground conditions and hydrogeology on

- the selection of tunnel construction method, and
- the selection of vertical alignment.

Tunnel construction methods

7.2.2 There are two principal categories of bored tunnel construction method that may be adopted; open face methods and closed face methods. These are described and compared in the Tunnel Options Report [HE551506-AA-GEN-SWI-RP-CX-000003]. The geotechnical considerations influencing the choice of method are summarised below:

Open face methods

7.2.3 These require excavation in dry conditions and thus require temporary dewatering during construction. They include methods in which a sprayed concrete lining (SCL) is used for both temporary and permanent support of the ground and methods in which an open face shield machine provides temporary support behind the excavation face with permanent support provided by a precast concrete segmental lining erected behind the shield.

7.2.4 The excavation at the tunnel face is typically undertaken using a roadheader or bucket excavator.

7.2.5 Open face methods require the face to be stable during construction and the SCL method also requires the excavated crown and sides to be stable in the temporary condition prior to spraying the concrete lining. The key factors affecting the risk of instability are:

- The orientation, spacing and characteristics of discontinuities in the chalk (see Section 6.3.8).
- The extent and characteristics of phosphatic chalk bodies. The current understanding and uncertainties relating to the phosphatic chalk are discussed in Section 6.3.

- The depth of destructured chalk, particularly at Stonehenge Bottom which may be associated with faulting. A conceptual ground model for this location is described in Section 6.8.

7.2.6 Temporary stability can be improved by measures such as a staged excavation sequence to reduce the unsupported area, fore-poling ahead of the excavation for support at the crown and dowels for face support.

Closed face methods

7.2.7 Excavation is carried out with a tunnel boring machine (TBM) which may be an earth pressure balance machine (EPB TBM) or a slurry tunnel boring machine (Slurry TBM). These are both closed face machines in which the tunnel lining is built using precast concrete segments erected at the rear of the shield.

7.2.8 The EPB TBM turns the excavated material into a soil paste using a rotating cutter head which is used to balance the ground and groundwater pressure at the face.

7.2.9 The Slurry TBM is similar to an EPB TBM except that the face support is provided by bentonite slurry.

7.2.10 With closed face methods the ground is fully supported during construction10. However with low cover there is a risk of loss of face pressure and/or blowout. A key factor affecting this risk is the fissuring within the chalk and the degree to which this may have been widened by dissolution.

7.2.11 Temporary dewatering is not required for the main tunnel excavation but groundwater control would be required for construction of cross passages and sumps.

Vertical alignment

7.2.12 There are two principal factors that may impact on the selection of vertical alignment:

- ***Minimum cover above tunnel crown*.** The temporary stability with open face construction methods and risk of blowout with closed face construction methods is influenced by the depth of cover above the tunnel crown. Locations where this will be least and therefore provide constraints on the vertical alignment are at the portals and at Stonehenge Bottom.

- ***Effective depth of aquifer***. The discontinuity spacing and permeability of the chalk tends to decrease with depth and becomes markedly lower below an elevation of about -50mOD in Stonehenge Bottom and -55mOD either side of this. The efficiency of dewatering wells penetrating below this depth decreases leading to a requirement for more wells or other techniques such as vacuum assistance or ejector wells to draw down the groundwater level to close to the base of the higher permeability zone. This provides a constraint on the lowest invert level at Stonehenge Bottom for a practical dewatering scheme.

[10] The TBM could potentially be operated in open face mode at commencement near the portals where above the water table.

Spoil from tunnel construction

7.2.13 The characteristics of the spoil generated by each construction method varies as summarised in Table 7.1.

Table 7.1 Spoil characteristics from tunnel construction

Construction method	Spoil characteristics	Potential Contamination
Open face SCL	Broken into variably sized fragments but use of road-headers will tend to give a high proportion of fines	May contain steel fibres from shotcreting and fibreglass if used for face reinforcement
Open face shield machine	Broken into variably sized fragments but use of road-headers will tend to give a high proportion of fines	May contain fibreglass if used for face reinforcement
EPB TBM	Paste possibly with small fragments of chalk. Will require drying to improve handling	Chemical agents or bentonite may be required to achieve workable ground
Slurry TBM	Slurry. Will require treatment to dry and remove bentonite	Mixed with bentonite

7.2.14 The potential for re-use of the arisings from tunnel construction is discussed in section 7.4.

Temporary Dewatering

7.2.15 For construction methods that require temporary dewatering an array of wells will be required designed to drawdown the groundwater water level at the tunnel excavation. As well as handling the flow due to the cone of depression and associated hydraulic gradients, the wells will need to be able to handle the groundwater flow through Stonehenge Bottom from a hydrological catchment of about 11km^2 to the north of the proposed tunnel.

7.2.16 The feasibility of discharging pumped water into a soakaway to the south of the tunnel excavation will depend on the infiltration characteristics of the ground. It will be necessary to ensure that the recharging is carried out far enough from the abstraction to avoid the risk of re-circulation.

7.2.17 Recharging to an aquifer can be more problematic than abstraction because there is less scope for creating a head difference to induce flow and because recharge infrastructure can suffer from physical and chemical clogging. Also, it is likely that the highest flows will be generated during the winter, when the ground will be saturated and consequently least able to accept infiltration.

7.2.18 Alternatively direct discharge into the River Avon may be considered. This will need to be discussed with the Environment Agency and appropriate discharge licences will need to be obtained

Additional considerations

7.2.19 Other geotechnical and hydrogeological considerations for the proposed tunnel include:

- The potential for the tunnel to obstruct groundwater flow at Stonehenge Bottom and any consequential impacts on groundwater levels upstream or downstream of the tunnel
- The presence of flints and potential impact on tunnel excavation and equipment wear
- Radon emission from the phosphatic chalk (see Section 6.4.8).
- Risk of dissolution features (see Section 6.4.15).
- Mobilisation of contaminants within groundwater/soil leachate.

7.3 Cuttings

7.3.1 It is anticipated that the scheme will require the formation of cuttings up to about 15m deep. These will generally be located within the interfluves where there is a thin mantle of structureless chalk (typically up to 1 to 2m thick) over structured chalk. A notable exception is any cutting between ch3+600 and 3+900 on route D061 which will be within reworked structureless chalk.

7.3.2 The seasonal highest groundwater level is expected to be below the base of the cuttings, but this will require confirmation when the vertical alignment has been finalised.

7.3.3 Factors that influence the design of cutting slopes within the structured chalk include:

- Potential presence of unfavourable discontinuity orientations
- Control and mitigation of surface degradation/ravelling
- Visual impact within the WHS

7.3.4 Unless stability is governed by unfavourable discontinuity orientations, relatively steep cut slopes are feasible in the structured chalk, but the slope surface is susceptible to frost degradation which leads to progressive ravelling of steeper slopes. Consequently, the control and mitigation of degradation/ravelling is a key factor in the selection of cut slopes.

7.3.5 The principal discontinuity set comprises orthogonal sub vertical joints with sub horizontal bedding (see Section 6.3.8). As such these will generally not be critical for slope stability. An additional inclined conjugate set of discontinuities is associated with the Newhaven and transitional Newhaven-Seaford chalk. These would need to be considered for the assessment of steeper slopes.

7.3.6 Empirical guidance (CIRIA C574 [25] and Williams (1990) [36]) based on the observed performance of chalk slopes within the Middle and Upper Chalk in Southern England is summarised in Figure 7-1.

7.3.7 Halcrow [37] report that existing cut slopes on the A303 in the vicinity of Winterbourne Stoke and Amesbury vary between 30 to 45° with no evidence of instability. Halcrow-Gifford [38] subsequently conducted a survey of eighteen chalk

cut slopes at various sites in Southeast England and their findings are summarised in Figure 7-2.

7.3.8 The Halcrow-Gifford survey included two cutting slopes 10 to 15m high on the A303 near Vespasian's Camp to the west of Countess Roundabout. Both the north and south faces of the cutting were surveyed, and were characterised by slope angles varying from 31 to 35 degrees on the south-facing cutting, and 40 degrees on the north-facing cutting. Both cuttings also had a thin layer of topsoil, a ~40mm thick carpet of loose chalk gravel, similar moderate vegetation cover, and rock trap ditches with no debris.

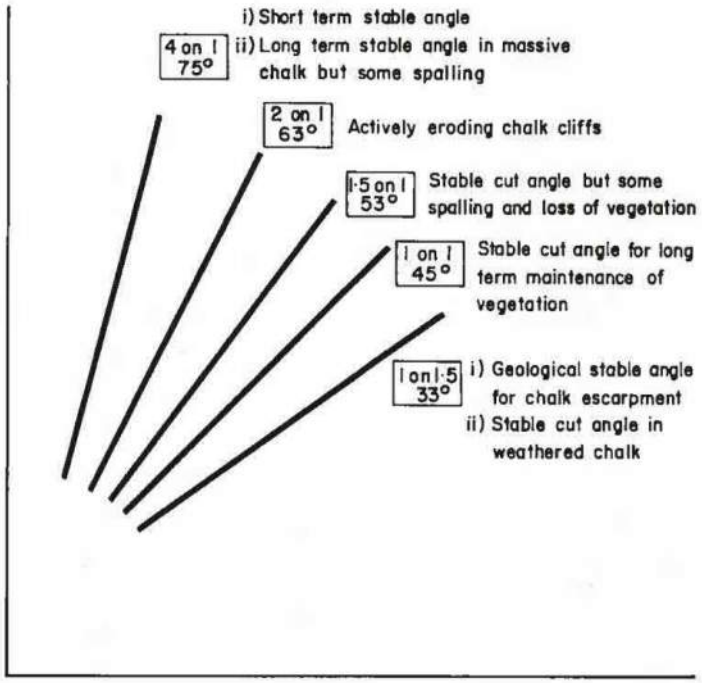

Figure 7-1 Performance of chalk slopes in southern England from Williams (1990)

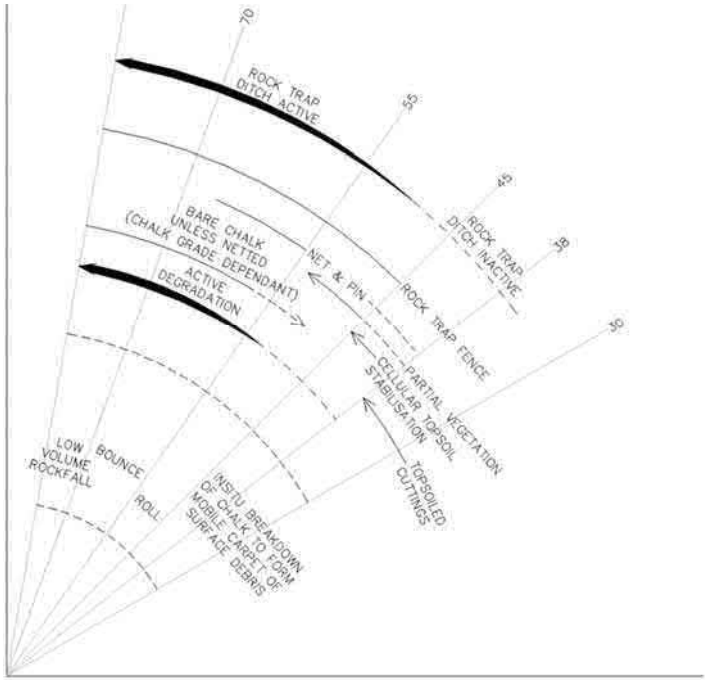

Figure 7-2 Observed chalk cutting performance from Halcrow-Gifford (2003)

7.3.9 The recommendations given by Halcrow-Gifford [36] are reproduced in Table 7.2.

Table 7.2 Summary of chalk slope performance and protection requirements from Halcrow-Gifford (2003)

Inclination	Slope Protection Requirements	Effects
Less than 45°	Topsoil up to 38°. Topsoil retention/stabilisation possible using three- dimensional cellular geotextiles to protect poor chalk grades. Generally no rock trap required. Low height rock trap with rock catch fence may be required in short term or in poor grade chalks.	Reasonably dense vegetated cover likely to be achieved, depending on establishment methods, time, slope conditions etc. Spalling prior to vegetation possible particularly in poor grade chalks. Little or no spalling likely in long term. Spreading of topsoil on slope may speed up establishment of vegetation cover but is not advised if wildflower seeding is required as nutrient levels are likely to be too high.
Between 45° and 53°	Rock trap and rock catch fence may be required in poor chalk grades. Note rock trap ditch inactive in most cases. Rock trap catch fence may be adequate in better grade chalks. Netting and dowelling is an alternative to the rock trap ditch and catch fence in poorer chalk grades.	Partially vegetated cover with bare chalk patches likely. Some spalling likely, particularly in winter in poor chalk grades. Topsoil application unlikely to be retained without special measures. Netting may provide more stable chalk surface for patchy vegetation establishment.
Between 53° and 70°	Rock trap ditch and rock catch fence required, or Netting and dowelling to limit spalling.	Slope likely to be predominantly bare chalk. Extensive spalling likely, particularly in severe winters in poor chalk grades unless netted. Greening over by lichen less likely as slope steepens. Topsoil application unlikely to be retained. Netting may provide more stable chalk face for establishment of patchy vegetation.

7.3.10 A cut slope of 1:2 (vertical to horizontal) can be adopted within structureless chalk of grades Dm and Dc.

7.3.11 Options for cuttings within the WHS developed for the former published scheme following consultation with English Heritage, National Trust, the Countryside Agency, and Wiltshire County Council are discussed in Halcrow-Gifford (2003) [38]. The selected option at that time (Option A), comprised a slope of 42° (1:1.1) in the structured chalk, reducing to a 26.5° (1:2) slope through the structureless mantle. This option also included setting the boundary fences down 2m below the existing ground level in order to reduce visibility from key viewpoints from within the World Heritage Site (WHS), with a slope at 14° (1:4) behind the fence line for pasture restoration, see Figure 7-3 below.

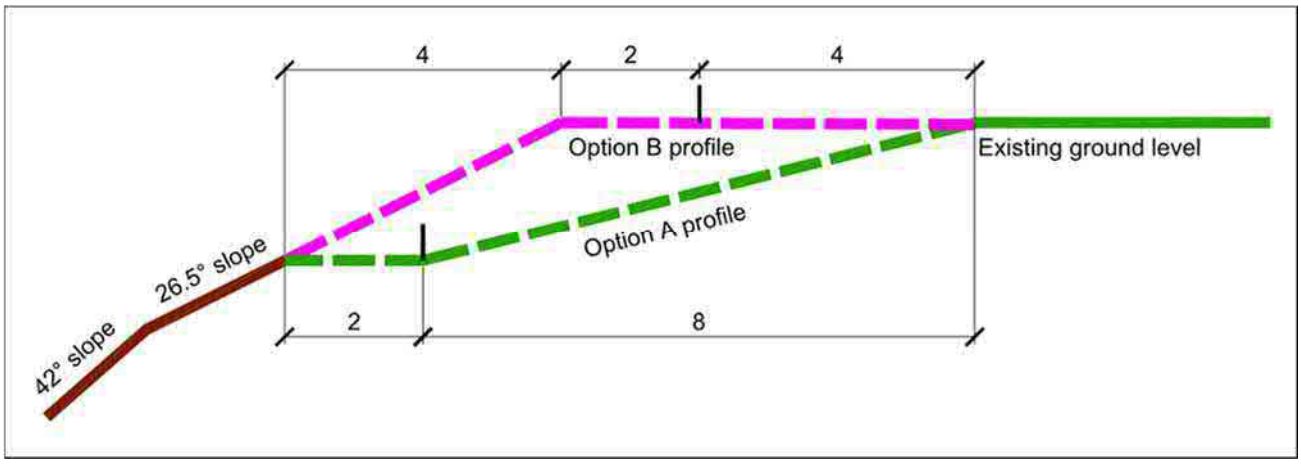

Figure 7-3 Cut slopes previously considered by Halcrow-Gifford [38] within the WHS

7.3.12 Cut slopes above tunnel portals will need to be graded or detailed to ensure that any loosened material cannot fall onto the road carriageway surface.

7.3.13 A cutting between chainage 3+600 and 3+900 on route D061 would be within reworked structureless chalk that extends to a depth of about 6m. This has been interpreted as a solifluction lobe[11] but review of aerial photographs and field inspection by Halcrow-Gifford (2006) [8] has not revealed any evidence of instability. A cut slope no steeper than 1:2 should be assumed for this location.

7.4 Re-use of excavated materials

Background

7.4.1 The chalk has been assessed by Mott MacDonald [24] and Halcrow-Gifford [8] as Class 3 material in accordance with the Specification for Highway Works (SHW) based on 10% fines test results and the results of intact dry density and natural moisture content tests. Class 3 materials are susceptible to loss of strength (instability) during handling, trafficking and compaction due to crushing and release of entrapped water. Because of this the method specification for handling and placing Class 3 materials in the SHW imposes constraints on the methods of excavation and handling and times of year when earthworks may be undertaken.

7.4.2 The risk of temporary instability during placing and compaction increases with reducing intact dry density and increasing moisture content.

Cutting arisings

7.4.3 Assessments of likely earthworks characteristics based on the results from the Main ground investigation are given by Mott MacDonald [11] [24], and further assessment taking account of the results of the Supplementary investigation by Halcrow-Gifford [8].

7.4.4 The chalk has been classified by Halcrow-Gifford using the approaches given by Greenwood [39] and Tombs & Snowdon [40] based on moisture content and intact dry density for assessing the risk of temporary instability, suitability of plant and compaction methods and impact of weather conditions.

[11] Halcrow-Gifford concluded that whilst local solifluction/gelifluction was likely the geomorphology of this feature was unclear.

7.4.5 The classification based on Greenwood placed about 85% of samples in class CBs or better for which temporary instability is unlikely (but 70% in class CBs which is not workable in light rain). The classification of Toombs & Snowdon placed 89% in group C for which temporary instability is unlikely. The classifications indicate the remaining 11 to 15% of samples have increasing risk of temporary instability with potentially more constraints on working.

7.4.6 Mott MacDonald [11] [24] and Halcrow-Gifford [8] discuss the observed correlation between IDD and strength for the chalk from the Amesbury to Berwick Down area and differences with published correlations. It was concluded that this did not affect the classifications and it was proposed by Halcrow-Gifford that Class 3 chalk acceptability could be controlled by moisture content.

Tunnel arisings

7.4.7 Tunnel excavation using open face methods is not expected to be compliant with the SHW specification for Class 3 materials. It may therefore be appropriate to consider development of an end product specification for use of tunnel arisings as discussed in CIRIA C574 [25]. Excavated chalk from the North Downs tunnel on High Speed 1 was successfully used in earthworks for the M2 motorway using this approach (Phear et al, 2003 [41]).

7.4.8 A comparison of the chalk from the North Downs tunnel and from the proposed tunnel location is given in Table 7.3.

Table 7.3 Comparison of chalk index test results from North Downs tunnel and A303

	HS1 North Downs tunnel			A303
Formation	Lewes	New Pit	Holywell	Newhaven Seaford
IDD Mg/m^3	1.53 (1.33-1.66)	1.54 (1.40-1.66)	1.65 (1.55-1.78)	1.57 (1.43-1.75)
Water content %	26	27	23	24 (12-32)
Saturation %	93	96	96	96 (89-99)
UCS MPa	2.3 (1.0-3.6)	2.3 (1.1-3.4)	3.3 (1.0-7.9)	2.0 (0.5-5.2)

7.4.9 Based on this comparison there is likely to be potential for reuse of arisings from an open face tunnel subject to adoption of a project specific specification developed from earthworks trials and dependent on being able to manage rate of production of material, stockpiling and reuse.

7.4.10 No case histories have been found of chalk arisings from EPB or slurry TBMs having been used in highway embankments. The arisings have generally been treated to reduce the moisture content sufficiently for handling and then sent for landfill restoration, landraising or disposal.

7.4.11 The phosphatic chalk has different characteristics to the normal white chalks and the potential for reuse of this material will require specific investigation. It is

possible that there will be ecological constraints on where/how this material is used due to concern over leaching of phosphates and detrimental impact on the establishment of chalk grassland [24] – see below under environmental considerations in reuse of materials.

Environmental considerations in re-use of materials

7.4.12 There may be additional constraints on the reuse of material if they pose a potential risk to human health or the environment.

7.4.13 The level of contamination which may be present associated with the identified potentially contaminative land uses is unknown. There is a risk that some construction arisings from these locations could be unsuitable for reuse because of elevated concentrations of contaminants.

7.5 Embankments

7.5.1 It is anticipated that the scheme will require the construction of embankments up to about 13m high. These tend to follow or cross dry valleys but will include embankments across the Till floodplain and within the Avon valley.

7.5.2 Embankment side slopes of 1:2 (vertical to horizontal) can be adopted for embankments constructed from chalk fill. Shallower slopes may be required for landscaping. These would typically be:

Establishment of chalk grassland	1:3
Pasture restoration	1:4
Arable restoration	1:10

7.5.3 Within the interfluves and dry valleys embankments will be founded on structureless chalk or Head deposits of limited thickness overlying the structured chalk. This is expected to generally provide stable foundation conditions and settlement is likely to occur rapidly during construction.

7.5.4 Within the River Till and Avon valleys, embankments will be founded on alluvial deposits.

7.5.5 In the Till valley north of Winterbourne Stoke Alluvium extends to a depth of 3 to 5m and overlies structureless chalk (grade Dc) about 3m thick. The Alluvium is predominantly a medium dense flint gavel with some chalk clasts but also contains lenses/layers of silt, sand and clay. The Alluvium is expected to consolidate rapidly and unlikely to require special measures to maintain stability.

7.5.6 There is currently no ground investigation data in the Till valley south of Winterbourne Stoke.

7.5.7 In the Avon valley embankments will be required at the approaches to structures over the Countess Roundabout. The Alluvium at this location is up to about 7.5m thick, and typically comprises a sandy silt or clay and peat overlying flint rich gravel. However it appears that the peat was removed at the time of construction of the Amesbury bypass leaving remnants of up to about 2.5m of sandy silt or clay beneath the existing chalk fill. The Alluvium is underlain by about 10m of structureless chalk (grades Dm and Dc).

7.5.8 The extent and characteristics of remaining soft Alluvium at the Countess Roundabout will need detailed consideration in the evaluation of embankment design and performance at this location.

7.6 Structure Foundations

7.6.1 The structures required for the scheme will be established during further design development. However they will include

- Crossing of the B3083
- Crossing of the River Till
- Structures associated with a grade separated junction with the A360
- Structures to flyover Countess Roundabout
- Structures associated with tie ins to the existing A303

7.6.2 Spread foundations on the chalk are likely generally to be suitable for structures except at the following locations where piled foundations should be assumed:

- the proposed crossing of the B3083 on route D061 where there is up to about 7m of reworked destructured chalk over the structured chalk
- the crossing of the River Till
- structures at the Countess Roundabout

At the River Till crossing and Countess Roundabout the chalk is more deeply weathered, and is overlain by alluvial deposits. At the Countess Roundabout the Alluvium is overlain by chalk fill. Groundwater will be encountered at shallow depth.

7.6.3 SLS (allowable) bearing stresses for spread foundations on chalk are governed by limiting the bearing stress to below the yield stress of the chalk[12]. The following allowable bearing pressures are given in CIRIA C574 [25]:

Medium/high density chalk	300kPa
Low density chalk (Grades A, B and C)	240kPa
Low density chalk (Grade Dc)	225kPa*

*To be confirmed by plate bearing tests

7.6.4 Whilst in situ plate loading tests have been carried out in previous investigations for the former published scheme, these were targeted at pavement design and only loaded to a maximum stress of 200kPa. This was generally too low to establish the yield stress of the chalk.

[12] The stiffness of the chalk decreases markedly at stresses above the yield stress.

7.6.5 Where piled foundations are required, bored cast in situ, CFA or driven precast concrete piles may be considered. However the possible adverse effect of flints on constructability will need to be taken into account in the selection of pile type.

7.7 Buried concrete

7.7.1 Evaluation of Design Sulfate Class and Aggressive Chemical Environment Class was undertaken by Halcrow – Gifford for the former published scheme and subsequently by Mott MacDonald for the Countess and Longbarrow Roundabout improvement schemes. These all gave DS-1 and AC-1 assessments. Testing carried out by Grimes for the proposed Visitor's Centre site to the north of the Countess Roundabout was also consistent with these assessments.

7.8 Pavement – subgrade conditions

7.8.1 Pavement design to IAN73/06 may either follow a Restricted Design or a Performance Design but both approaches require evaluation of the Subgrade Surface Modulus which is generally estimated from CBR values. For restricted designs a capping layer is required if the CBR is less than 15%.

7.8.2 The main and supplementary ground investigations for the former published scheme included in situ CBR tests, in situ plate tests, and laboratory CBR tests on compacted samples. The results of these tests have been summarised and reviewed by Mott MacDonald [24] and Halcrow Gifford [8].

7.8.3 CBR values derived by correlation from the plate tests were found to be markedly higher than those determined directly. The reasons for this are not clear (although the possibility of flints affecting plate tests has been suggested) and thus attention has been focussed on the CBR results in previous assessments of subgrade conditions.

7.8.4 Results of in situ CBR tests gave a mean value of 15%, but tended to give lower values in the more weathered, lower grades of chalk. As the mean moisture content of the chalk at the test locations was lower than typically determined in the investigations it was considered that these test results may be not conservative (Halcrow-Gifford [8]).

7.8.5 Results of laboratory CBR tests on compacted samples[13] at optimum moisture content (±1%) gave widely varying results with an overall mean of about 14%. Approximately 50% of the test results gave CBR below 15%. However the laboratory test results were considered likely to underestimate the CBR that could be achieved on compacted fills in reality and that a value of at least 15% could be assumed (Mott MacDonald and Halcrow-Gifford [24] [8]).

7.8.6 The available in situ CBR data indicates that a capping layer may be required, particularly at transitions between cut and fill where the subgrade is likely to be a lower grade of chalk than at greater cutting depths.

7.8.7 It should be assumed that the chalk is susceptible to frost heave. As such a minimum protection thickness will be required. The general requirement is for 450mm thickness but previous assessments have indicated this may be reduced

[13] Using 2.5kg rammer method

to 350mm based on a Mean Annual Frost Index (MAFI) of less than 50 at this location.

7.9 Land impacted by contamination

7.9.1 Potentially contaminative land uses, representing sources of contamination with potential contaminant linkages (PCLs), have been identified in Table 5.4 and are detailed in Appendix C.

7.9.2 It is considered unlikely that for the majority of the identified potentially contaminative land uses remediation works over and above removal of localised contamination in the form of hot spots would be required. However little is known about the potential for and extent of contamination associated with the former RAF facilities. Further investigation is required in order to evaluate the risk from potentially contaminative land uses. Where contamination is found to present an unacceptable risk to receptors, a Tier 3 detailed quantitative risk assessment will be required or a remediation strategy developed.

7.9.3 Dewatering risk assessment will be required to assess the potential for mobilisation of contaminants within and to controlled waters.

7.10 Surface Drainage

7.10.1 The DMRB guidance for Highways Drainage (HD33/16) encourages a hierarchy of discharge types, with infiltration being the preferred type of discharge. This is because other means of discharge, such as discharge to watercourse, could potentially increase flood risk for an area.

7.10.2 Adopting an infiltration solution highway runoff is collected and conveyed to Drainage Treatment Areas (DTAs) across the scheme, where the water is treated and discharged into infiltration basins. The sizing of these will be influenced by the infiltration characteristics of the ground Table 7.4.

Table 7.4 Infiltration rates from previous testing

Ground Investigation	Ground conditions	Infiltration rate x 10^{-4} m/s
Former published scheme Supplementary Investigation	Chalk Grade Dm/Dc	0.37 to 1.3
	Chalk Grade Dc	0.86 to 4.3
	Alluvium/Chalk Grade Dc	2.5 to 3.1
Longbarrow Roundabout	Chalk Grade B3	0.04 to 0.1
Proposed Visitors Centre north of Countess Roundabout	Terrace Gravel	0.32 to 1.09
	Reworked chalk (Head)	0.06

7.11 Geotechnical Category

7.11.1 The route options for the A303 Amesbury to Berwick Down section include a range of structures and earthworks as well as a tunnel approximately 2.9km long.

7.11.2 The tunnel will fall into Geotechnical Category 3 in accordance with BS EN 1997-1. At this stage the remaining structures and earthworks should be considered as falling into Geotechnical Category 2. This assessment should be reviewed as the scheme is developed through preliminary design.

8 Comparison of Project Options & Risks

8.1 Comparison of options

8.1.1 The Preliminary Sources Study has shown that there is little geotechnical differentiation between the D061 and D062 route options. However, there has not been any previous ground investigation along route option D062 around Winterbourne Stoke - the southern bypass.

8.2 Geotechnical Risk

8.2.1 A geotechnical risk register (Halcrow-Gifford, 2005) [27] prepared for the former published scheme and other documents produced at that time (Halcrow-Gifford, 2006) [26] reviewed the geotechnical risks in relation to those proposals. The risks identified generally remain relevant to the D061 and D062 route options.

8.2.2 Key geotechnical risks are similar for both route options and are summarised in Table 8.1.

8.3 Environmental Risk

Construction Phase Risks

8.3.1 Key construction phase risks are similar for both route options and are summarised in Table 8.1.

Operational Phase Risks

8.3.2 Operational phase risks are likely to relate to run-off of storm water, which may include contaminants such as glycol (associated with de-icers), salts, hydrocarbons and certain metals, from the road surface into watercourses. These risks are considered to be low to negligible on the assumption that an adequate drainage system is in place to prevent pollution of rivers and watercourses from potential contaminated run-off.

8.4 Early Phase Ground Investigation

8.4.1 An ‘Early Phase’ ground investigation has been proposed to be undertaken during PCF2 to better understand the ground related risks. This is required in advance of PCF3 to acquire groundwater data covering seasonal variation over a period of at least 12 months. Details of the approach and proposed scope for the Early Phase investigation are outlined in Annex A of this report.

8.4.2 Further ground investigation will subsequently be required for detailed design.

Table 8.1 Preliminary geotechnical project risk register

Description of risk	Potential impact	Mitigation in PCF2	Further action required
Extent and characteristics of the phosphatic chalk along proposed tunnel alignment are not well understood (Section 6.4).	May influence selection of tunnel construction method.	Early ground investigation to develop conceptual ground model and further investigate characteristics of phosphatic chalk.	Further ground investigation including trial shaft for detailed design. Design and construction planning to take account of range of anticipated conditions.
Suitability of tunnel arisings for intended use, (Section 7.4).	Will impact on cut/fill balance and quantity of material for disposal. May influence selection of tunnel construction method.	Allow for a range of scenarios with regard to classification and re-use of arisings.	Consider undertaking studies and trials to investigate options for re-use of TBM arisings. Adopt end product specification with trial compaction/demonstration area to enable arisings from open face tunnelling to be incorporated in embankment fill. Include appropriate allowances for processing and stockpiling in construction planning.
Uncertainty and variability in the transmissivity of the ground including the Coneybury Hill interfluve between the Avon and Stonehenge Bottom (para 5.7.16 & Section 6.8).	May impact on design of dewatering system and assessment of temporary and permanent impacts on groundwater levels.	Additional pumping and permeability tests as part of Early investigation.	Include appropriate contingencies in planning and design of temporary dewatering for tunnel construction.
Uncertainty in volume of groundwater flow through Stonehenge Bottom (Section 5.7).	May impact on design of dewatering system and assessment of temporary and permanent impacts on groundwater levels.	Installation of monitoring wells with data loggers in catchment as part of Early ground investigation.	Incorporate results from monitoring in design and assessment of dewatering and assessment of permanent impacts of tunnel on groundwater levels.
Recharge capability around Spring Bottom (para 7.2.16 to 7.2.18).	Feasibility of recharge to soakaway during temporary dewatering uncertain.	Infiltration tests in Early ground investigation.	Develop alternative of direct discharge into River Avon.

Description of risk	Potential impact	Mitigation in PCF2	Further action required
Groundwater response to rainfall events (para 5.7.3).	May impact on design of dewatering system.	Installation of monitoring wells with data loggers in catchment as part of Early ground investigation.	Incorporate results from monitoring in design and assessment of dewatering and assessment of permanent impacts of tunnel on groundwater levels.
Depth and characteristics of structureless Chalk, particularly at tunnel portals and in Stonehenge Bottom is uncertain (Section 6.8).	May influence temporary support requirements for tunnel. May influence cut slope design in portal areas.	Early ground investigation at portal locations and in Stonehenge Bottom.	Further ground investigation for detailed design.
Joint characteristics and/or orientations within chalk vary from existing data set (Section 6.3).	May influence temporary support requirements for tunnel. May influence cut slope design (Section 7.3).	Further investigation within tunnel zone as part of Early ground investigation including televiewer in selected boreholes.	Further ground investigation for detailed design.
Effect of tunnel on groundwater flow through Stonehenge Bottom (para 7.2.19).	The construction of the tunnel could affect post construction groundwater levels in Stonehenge Bottom.		Incorporate results from monitoring in design and assessment.
Potentially contaminated land (Section 7.9)	Exposure of site operatives and general public to contaminants that pose risk to their health and safety. Potential for mobilisation of contaminants within and to controlled waters Materials classified as hazardous waste.	Targeted contamination sampling and laboratory testing in Early ground investigation to investigate the presence of potential contamination. Baseline groundwater sampling and analysis from monitoring wells installed as part of Early investigation. Groundwater sampling and analysis during pumping tests in Early Phase ground investigation	Further ground investigation and testing to better delineate any areas of significant contamination. Tier 2 and Tier 3 risk assessments depending on the ground investigation findings. Include contingencies for mitigation in ground investigation and construction planning if required.
Uncertainty and variability in infiltration characteristics (Section 7.10).	May impact on sizing of Drainage Treatment Areas and landtake required.	Infiltration tests in Early ground investigation.	Incorporate appropriate contingencies in preliminary design. Further infiltration tests for detailed design.

Description of risk	Potential impact	Mitigation in PCF2	Further action required
Dissolution features (Section 6.5 & para 7.2.19).	May influence temporary support requirements for tunnel.		Design and construction planning to take account of range of anticipated conditions.
Potential for radon emission from phosphatic chalk (Section 6.4 para Section 7.2.19).	Health and safety of site operatives and general public.		In tunnel radon monitoring during construction with any necessary controls introduced as required.
No previous ground investigation for southern bypass of Winterbourne Stoke - route option D062.	There will be greater uncertainty in ground conditions at PCF3 and more ground investigation will be required in later stages if this is selected as the preferred option.		Include contingencies for uncertainty in preliminary design. Ground investigation for detailed design.
Soft or compressible alluvial deposits in Till or Avon valleys (Section 6.7 & para 7.5.8).	May impact on design and construction of approach embankments at Countess Roundabout junction and River Till crossing (D062 option).		Include contingencies for uncertainty in preliminary design. Further ground investigation for detailed design.
Extent and nature of flint bands (para 6.3.12 & 7.2.19).	May impact on requirements for TBM.		Allow for uncertainty in selection of tunnel construction method. Include appropriate contingencies.
UXO (Section 5.12).	Possible requirement for risk mitigation during construction.		Undertake detailed UXO risk assessment.

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Annex A

Introduction

9.1.1 An Annex A (HAGDMS No 29170) was prepared in advance of this PSSR in order to meet programme constraints for procuring an 'Early Phase' ground investigation. This sets out the rationale and proposed scope of investigation to mitigate geotechnical risk impact on the planning process and preliminary design during PCF3.

Development of Ground Investigation Strategy

9.1.2 Following preparation of the Annex A the scope was developed to incorporate additional investigation and ground water monitoring but was subsequently reduced to meet budget constraints. The overall changes that have been made are:

- Additional groundwater monitoring wells in the Till catchment and at Spring Bottom to inform environmental assessments.
- Reduction of scope at potential tunnel portal locations focussing on a single working assumption location for each portal. The deep trial pits proposed at these locations, and provisionally in the phosphatic chalk zone, have also been deferred to the detailed design stage investigation.
- Reduction of in situ testing. Some in situ testing and laboratory testing that had been included to maximise value from the investigation has been deleted. This data is not required for PCF3 but the reduction in scope may increase the scope of future investigation and associated disruption to landowners when ground investigation is undertaken for detailed design. This has included a reduction in televiewer surveys, deletion of high pressure dilatometer testing and a reduction in the quantity of packer testing.
- Reduction of coring in phosphatic boreholes. Six of the 16 boreholes investigating the extent of phosphatic chalk have been changed from cored to open holed. This relies on correlation with natural gamma logging to identify the presence of phosphatic chalk.
- Reduction in number of dedicated pumping test monitoring boreholes. The provision for monitoring boreholes for the pumping test planned within phosphatic chalk has been reduced on the basis that some of the other holes may be used for this purpose. The monitoring holes have been changed from cored to open holed.
- Reduction of coring at Stonehenge Bottom. Two of the 5 pumping test monitoring holes in Stonehenge Bottom have been changed from cored to open holed. This will reduce the information obtained on the rock mass quality in Stonehenge Bottom which and may lead to a requirement for increased scope of investigation and associated disruption to landowners when ground investigation is undertaken for detailed design.

Future Ground Investigation

Investigation for Detailed Design

9.1.3 The existing Annex A covers an early phase of investigation to inform PCF3 design development and support DCO application. It does not cover all investigation that will be needed for detailed design and construction of the scheme and a further phase of investigation for detailed design will be required.

9.1.4 This investigation will need to target geotechnical information required for design of specific structures and earthworks along the alignment. It should be scoped and carried out after selection of a single preferred route, once there is more certainty on the alignment and locations of structures.

9.1.5 Programming of the detailed design investigation will need to take account of the timescales associated with agreeing access for fieldwork, procurement, execution of the fieldwork and laboratory testing and reporting such that the data is available in good time to suit the detailed design programme.

9.1.6 An addendum Annex A should be produced for the detailed design investigation in PCF3 following selection of the single preferred route.

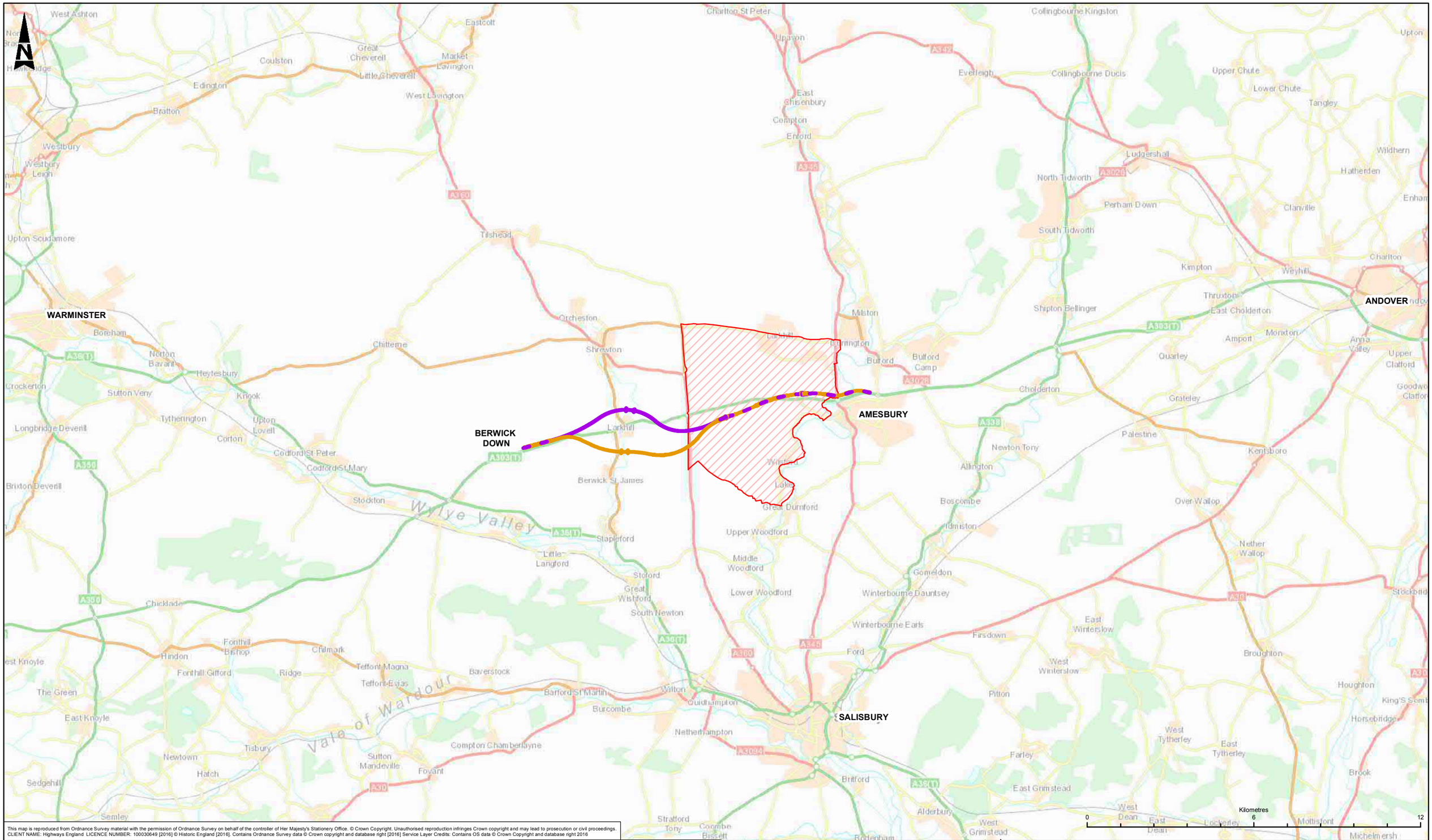
Trial Shaft

9.1.7 Depending on the findings of the early phase investigation and proposed tunnel construction method, excavation of a trial shaft to investigate the phosphatic chalk for the purposes of tunnelling should be considered as part of a further phase of investigation. The trial shaft should be constructed in the summer when the groundwater table is at its lowest.

Tunnel Arisings Re-use Studies

9.1.8 Further studies and trials would be required to evaluate the technical, practical and logistical aspects of re-using chalk spoil from tunnel excavations with TBMs.

Figures



LEGEND

- ROUTE OPTION D061 & D062
- ROUTE OPTION D061
- ROUTE OPTION D062
- WORLD HERITAGE SITE

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made in the design hazard log)

Construction	None
Maintenance / Cleaning	None
Use	None
Decommission / Demolition	None

Rev	Date	Description	By	Chk'd	App'd
P01	19/12/16	FIRST ISSUE	EB	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3

Client: highways england

Designers: ARUP ATKINS

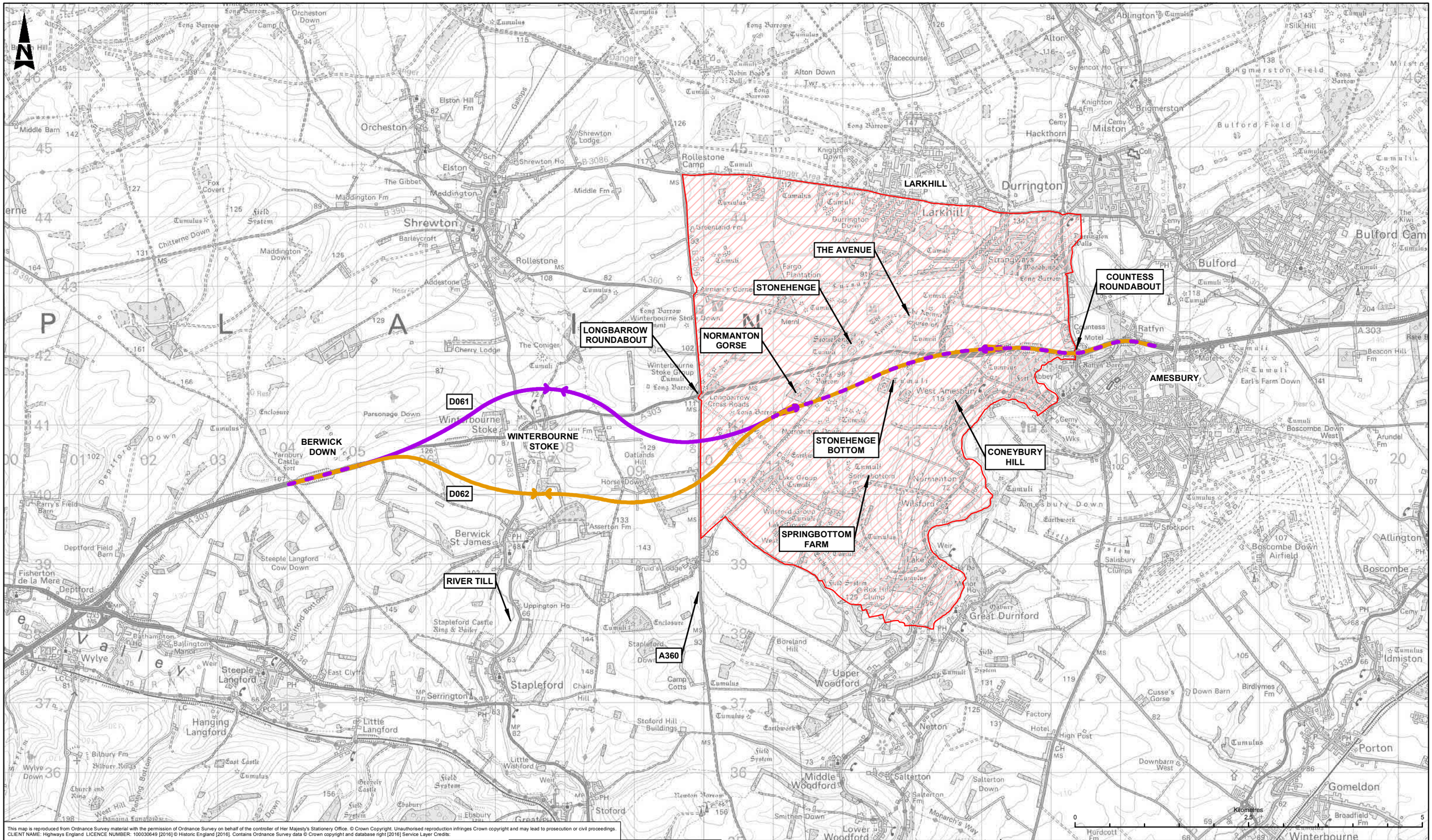
Project Title: A303 AMESBURY TO BERWICK DOWN

Drawing Title: FIGURE 1-1 LOCATION OF SCHEME WITH ROUTE ALIGNMENT OPTIONS

Scale	Designed / Drawn	Checked	Approved	Authorised
1:125,000	EB	PD	AK	AK
Original Size	**Date**	**Date**	**Date**	**Date**
A3	19/12/16	19/12/16	19/12/16	19/12/16

Drawing Number: HE551506-AA-HGT-D_SWI-DR-CX-000072
(Project | Originator | Volume | Location | Type | Role | Number)

Revison: P01



LEGEND

- ROUTE OPTION D061 & D062
- ROUTE OPTION D061
- ROUTE OPTION D062
- WORLD HERITAGE SITE

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made in the design hazard log)
Construction
None
Maintenance / Cleaning
None
Use
None
Decommission / Demolition
None

Rev	Date	Description	By	Chk'd	App'd
P01	22/11/16	FIRST ISSUE	EB	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3

Client: highways england

Designers: ARUP ATKINS

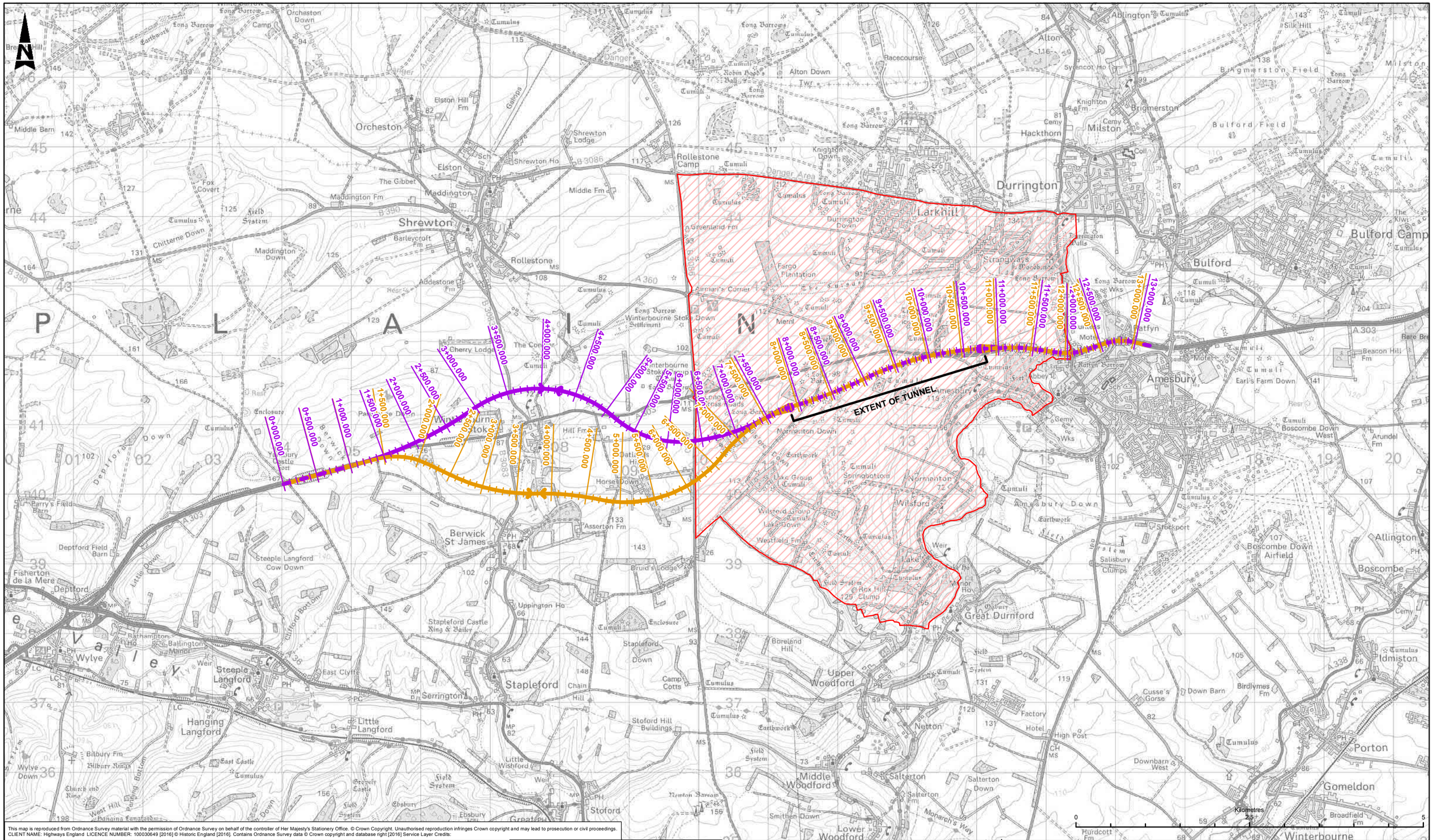
Project Title: A303 AMESBURY TO BERWICK DOWN

Drawing Title: FIGURE 1-2 ROUTE OPTIONS

Scale	Designed / Drawn	Checked	Approved	Authorised
1:50,000	EB	PD	AK	AK
Original Size	**Date**	**Date**	**Date**	**Date**
A3	22/11/16	22/11/16	22/11/16	22/11/16

Drawing Number: Project | Originator | Volume | Location | Type | Role | Number
HE551506-AA-HGT-D_SWI-DR-CX-000073

Revison: P01



LEGEND

- ROUTE OPTION D061 & D062
- ROUTE OPTION D061
- ROUTE OPTION D062
- WORLD HERITAGE SITE

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made in the design hazard log)
Construction
None
Maintenance / Cleaning
None
Use
None
Decommission / Demolition
None

Rev	Date	Description	By	Chk'd	App'd
P01	01/12/16	FIRST ISSUE	EB	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3

Client: highways england

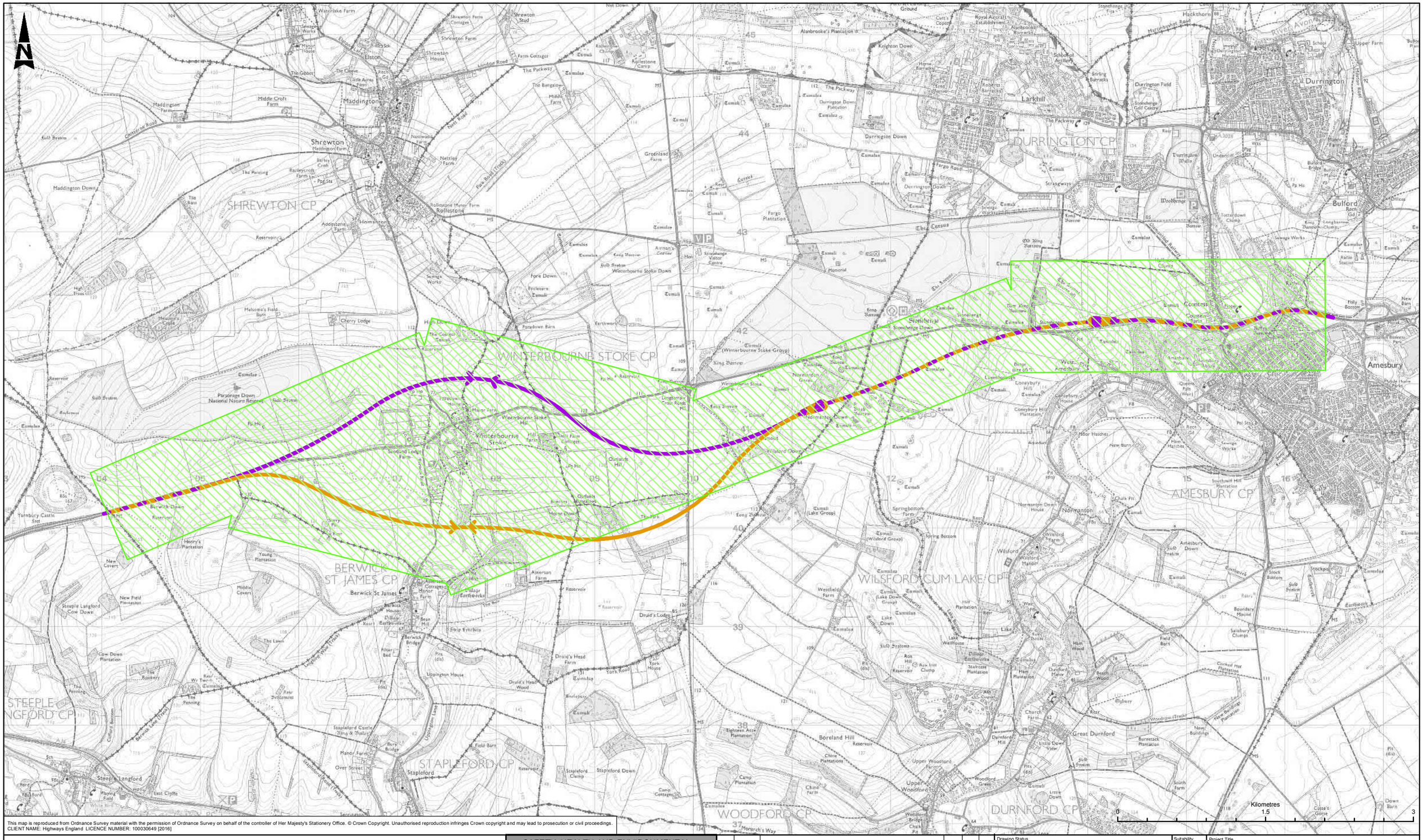
Designers: ARUP ATKINS

Project Title: A303 AMESBURY TO BERWICK DOWN

Drawing Title: FIGURE 1-3
ROUTES D061 & D062

Scale	Designed / Drawn	Checked	Approved	Authorised
1:50,000	EB	PD	AK	AK
Original Size: A3	Date: 01/12/16	Date: 01/12/16	Date: 01/12/16	Date: 01/12/16

Drawing Number: HE551506-AA-HGT-D_SWI-DR-CX-000074
(Project | Originator | Volume | Location | Type | Role | Number)
Revison: P01



LEGEND

- ROUTE OPTION D061 & D062
- ROUTE OPTION D061
- ROUTE OPTION D062
- GROUNDSURE, LANDMARK, AND AERIAL PHOTOGRAPHY CORE SEARCH AREA

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made in the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommission / Demolition
None

Rev	Date	Description	By	Chk'd	App'd
P01	19/12/16	FIRST ISSUE	DI	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3

Client: highways england

Designers: ARUP ATKINS

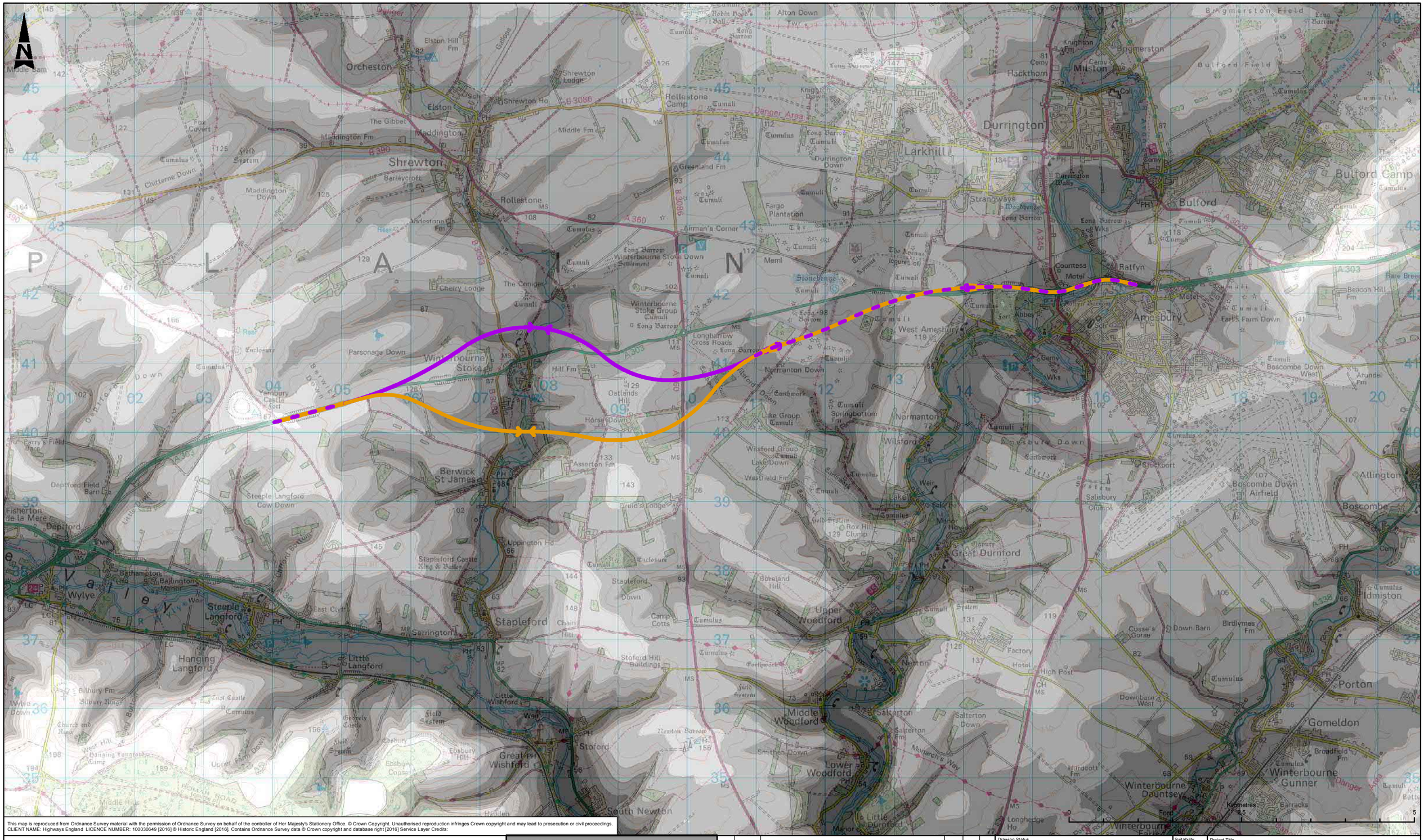
Project Title: A303 AMESBURY TO BERWICK DOWN

Drawing Title: FIGURE 3-1
SPECIFIED SEARCH AREA RELATIVE TO ALIGNMENT OPTIONS D061 & D062

Scale	Designed / Drawn	Checked	Approved	Authorised
1:35,000	DI	PD	AK	AK
Original Size: A3	Date: 19/12/16	Date: 19/12/16	Date: 19/12/16	Date: 19/12/16

Drawing Number: HE551506-AA-HGT-D_SWI-DR-CX-000101
(Project | Originator | Volume | Location | Type | Role | Number)

Revison: P01



LEGEND

ALIGNMENT

- ROUTE OPTION D061 & D062
- ROUTE OPTION D061
- ROUTE OPTION D062

ELEVATION (MAOD)

- < 60
- 60 - 80
- 80 - 100
- 100 - 120
- 120 - 140
- 140 - 160
- > 160

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made in the design hazard log)

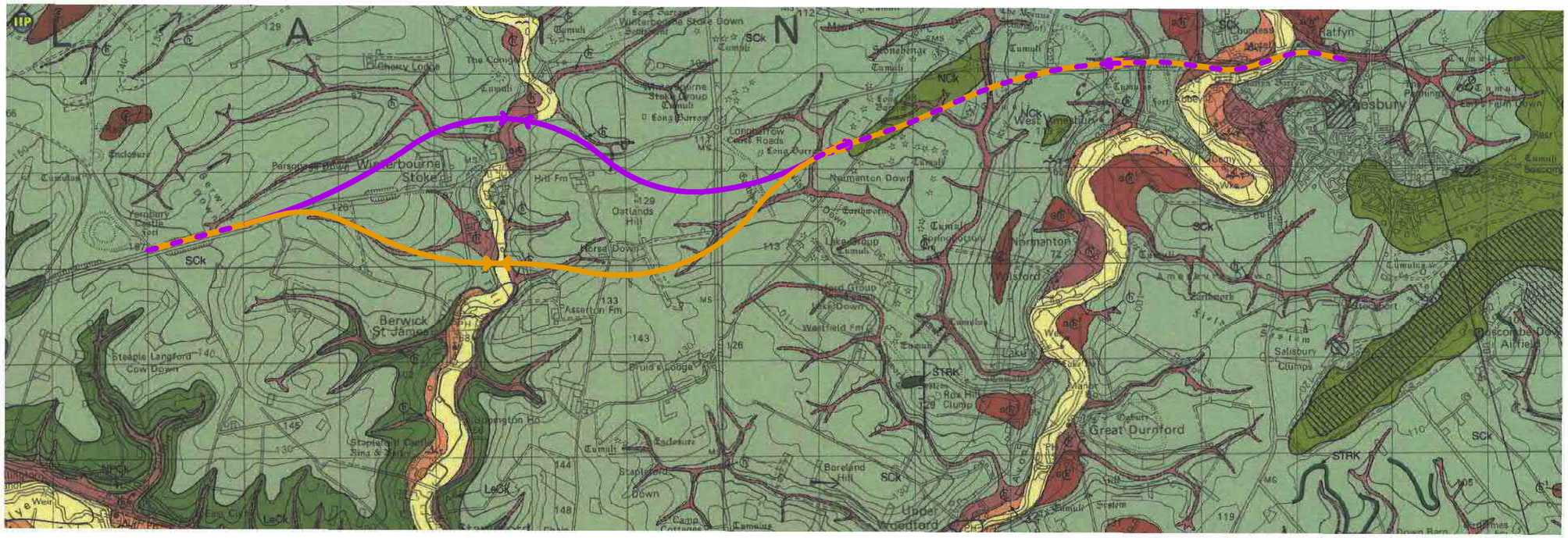
Construction	None
Maintenance / Cleaning	None
Use	None
Decommission / Demolition	None

Rev	Date	Description	By	Chk'd	App'd
P01	22/11/16	FIRST ISSUE	EB	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3
Project Title: A303 AMESBURY TO BERWICK DOWN
Client: highways england
Drawing Title: FIGURE 5-1 REGIONAL TOPOGRAPHY
Designers: ARUP ATKINS

Scale	Designed / Drawn	Checked	Approved	Authorised
1:50,000	EB	PD	AK	AK
Original Size	Date	Date	Date	Date
A3	22/11/16	22/11/16	22/11/16	22/11/16

Drawing Number: Project | Originator | Volume | Location | Type | Role | Number
HE551506-AA-HGT-D_SWI-DR-CX-000075
Revison: P01



Kilometres
0 2.5 5

LEGEND

- ROUTE OPTION D061 & D062
- ROUTE OPTION D061
- ROUTE OPTION D062

Head		Alluvium	
Gravelly Head		River Terrace Deposits	
Head Gravel	NCk	NEWHAVEN CHALK FORMATION	
Clay-with-flints	SCk	SEAFORD CHALK FORMATION	
Peat	LeCk	LEWES NODULAR CHALK FORMATION	

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made in the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommission / Demolition
None

Rev	Date	Description	By	Chk'd	App'd
P01	22/11/16	FIRST ISSUE	EB	DI	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3

Client: highways england

Designers: ARUP ATKINS

Project Title: A303 AMESBURY TO BERWICK DOWN

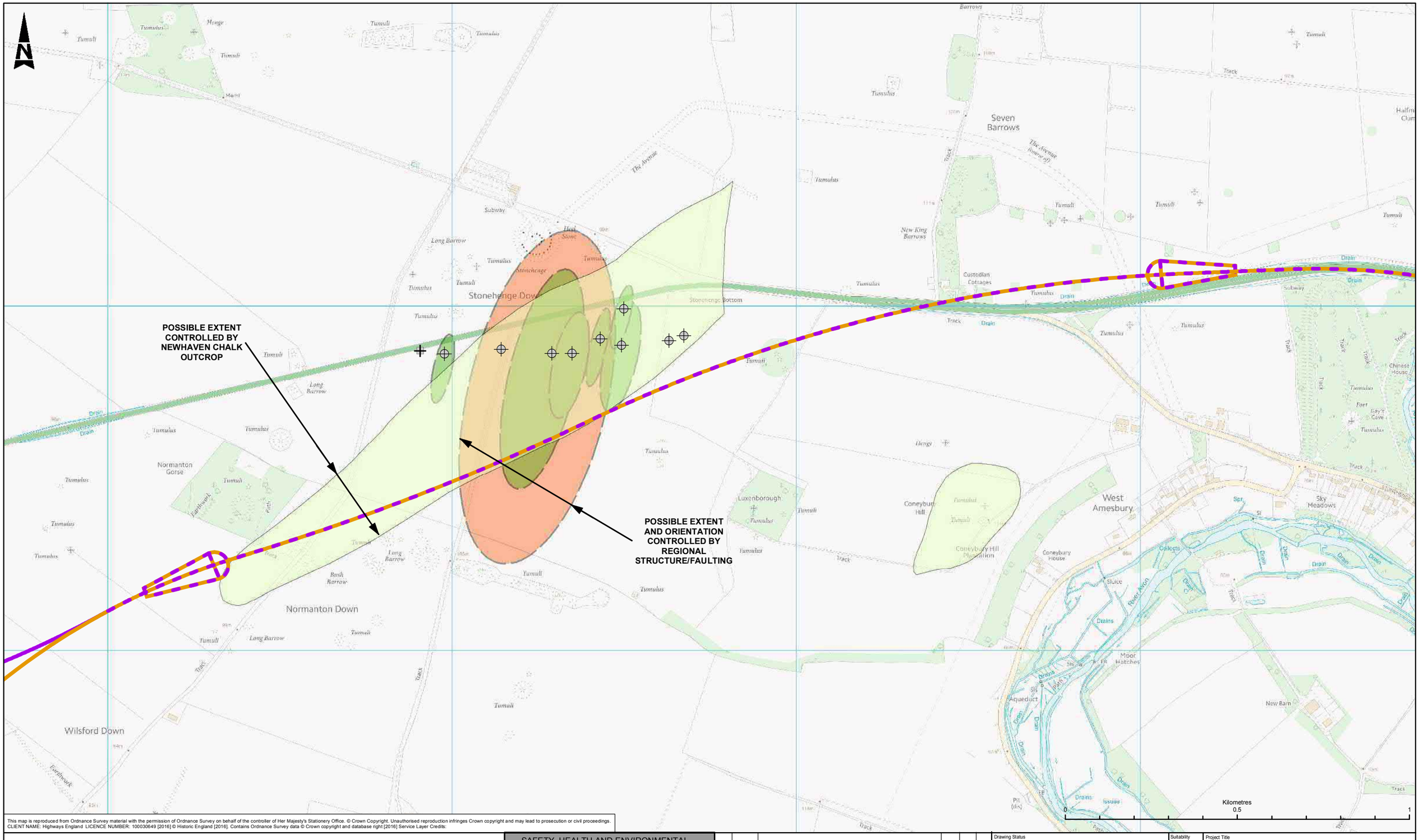
Drawing Title: FIGURE 5-2 REGIONAL GEOLOGY

Scale	Designed / Drawn	Checked	Approved	Authorised
1:50,000	EB	PD	AK	AK

Original Size	Date	Date	Date	Date
A3	22/11/16	22/11/16	22/11/16	22/11/16

Drawing Number: Project | Originator | Volume | Location | Type | Role | Number
HE551506-AA-HGT-D_SWI-DR-CX-000076

Revison: P01



LEGEND

ALIGNMENT

- ROUTE OPTION D061 & D062
- ROUTE OPTION D061
- ROUTE OPTION D062

CONCEPTUAL MODELS

- NEWHAVEN CHALK EXTENTS
- MULTIPLE CUVETTE MODEL
- SINGLE CUVETTE MODEL

GROUND INVESTIGATION THAT ENCOUNTERED PHOSPHATIC CHALK

- DEEP TRIAL PIT
- ROTARY CORED BOREHOLE

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made in the design hazard log)
Construction
None
Maintenance / Cleaning
None
Use
None
Decommission / Demolition
None

Rev	Date	Description	By	Chk'd	App'd
P01	19/12/16	FIRST ISSUE	EB	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3
Client: highways england
Designers: ARUP ATKINS

Project Title: A303 AMESBURY TO BERWICK DOWN
Drawing Title: FIGURE 6-4 CONCEPTUAL MODELS FOR PLAN ORIENTATION OF PHOSPHATIC CHALK

Scale	Designed / Drawn	Checked	Approved	Authorised
1:10,000	EB	PD	AK	AK
Original Size	Date	Date	Date	Date
A3	19/12/16	19/12/16	19/12/16	19/12/16

Drawing Number: HE551506-AA-HGT-D_SWI-DR-CX-000077 (Project | Originator | Volume | Location | Type | Role | Number)
Revison: P01

DO NOT SCALE

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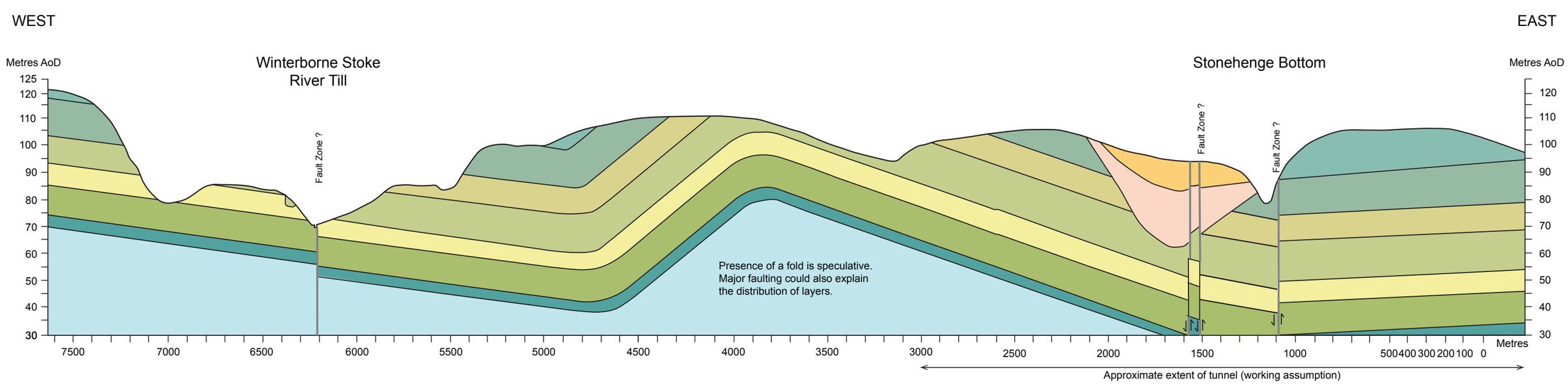


From Halcrow-Gifford (2006)

LEGEND

- Haven Bow & Splash Point Beds (Seaford/Newhaven Chalk Formation)
- Haven Bow Beds (Seaford Chalk Formation)
- Upper part of Cuckmere Beds (Seaford Chalk Formation)
- Lower part of Cuckmere Beds (Seaford Chalk Formation)
- Belle Tout Marls (Seaford Chalk Formation)
- Upper Lewes Nodular Chalk Formation
- Chalk Rock (Lower Lewes Nodular Chalk Formation)
- New Pit Chalk Formation
- Newhaven Chalk Formation
- Phosphatic chalk

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log).

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chk'd	App'd
P01	02/12/16	FIRST ISSUE	JS	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3

Client: highways england

Designers: ARUP ATKINS

Project Title: A303 AMESBURY TO BERWICK DOWN

Drawing Title: FIGURE 5-4 CONCEPTUAL GEOLOGICAL MODEL (AFTER MORTIMORE)

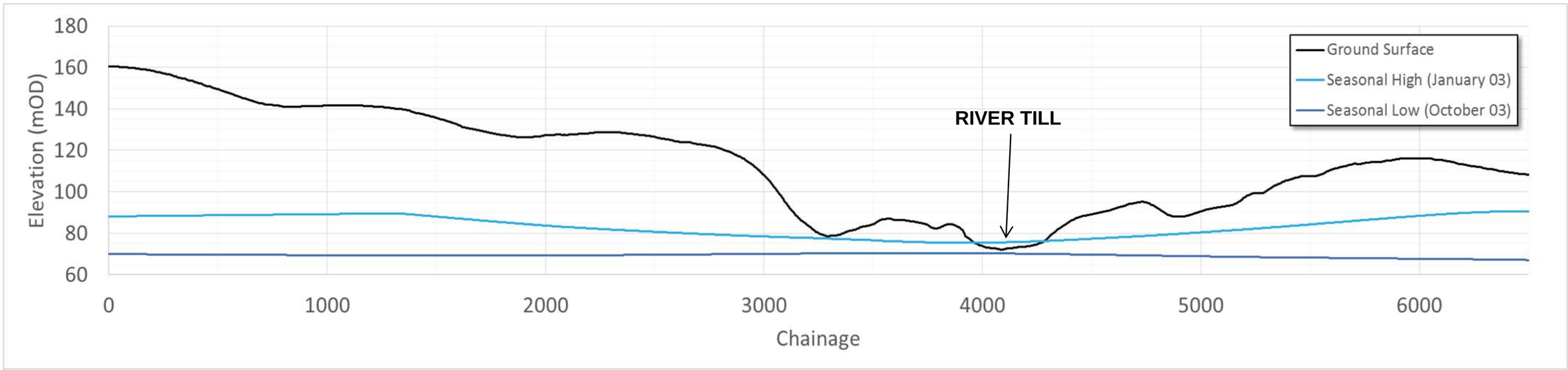
Scale	Designed / Drawn	Checked	Approved	Authorised
NTS	JS	PD	AK	AK
Original Size	Date	Date	Date	Date
A3	02/12/16	02/12/16	02/12/16	02/12/16

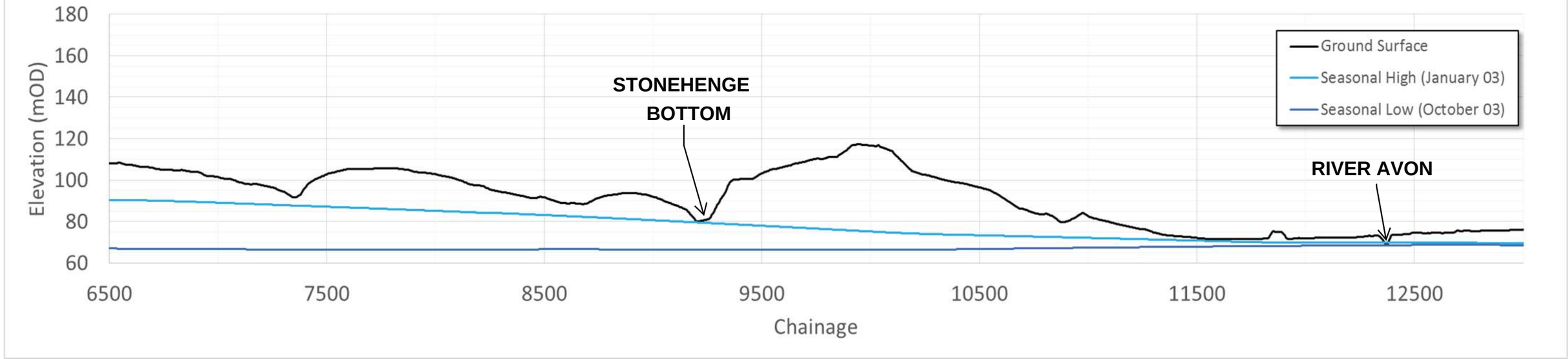
Drawing Number: Project | Originator | Volume | Location | Type | Role | Number
HE551506-AA-HGT-D_SWI-DR-CX-000078

Revision: P01

DO NOT SCALE

Millimetres 0 10 100





LEGEND

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log).
Construction
None
Maintenance / Cleaning
None
Use
None
Decommissioning / Demolition
None

Rev.	Date	Description	By	Chk'd	App'd
P01	02/12/16	FIRST ISSUE	JS	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3

Client: highways england

Designers: ARUP ATKINS

Project Title: A303 AMESBURY TO BERWICK DOWN

Drawing Title: FIGURE 5-9
SEASONAL VARIATION IN GROUNDWATER ELEVATIONS.
ALONG ALIGNMENT OPTION DO61

Scale	Designed / Drawn	Checked	Approved	Authorised
NTS	JS	PD	AK	AK
Original Size	**Date**	**Date**	**Date**	**Date**
A3	02/12/16	02/12/16	02/12/16	02/12/16

Drawing Number: HE551506-AA-HGT-D_SWI-DR-CX-000079
(Project | Originator | Volume | Location | Type | Role | Number)

Revision: P01

DO NOT SCALE

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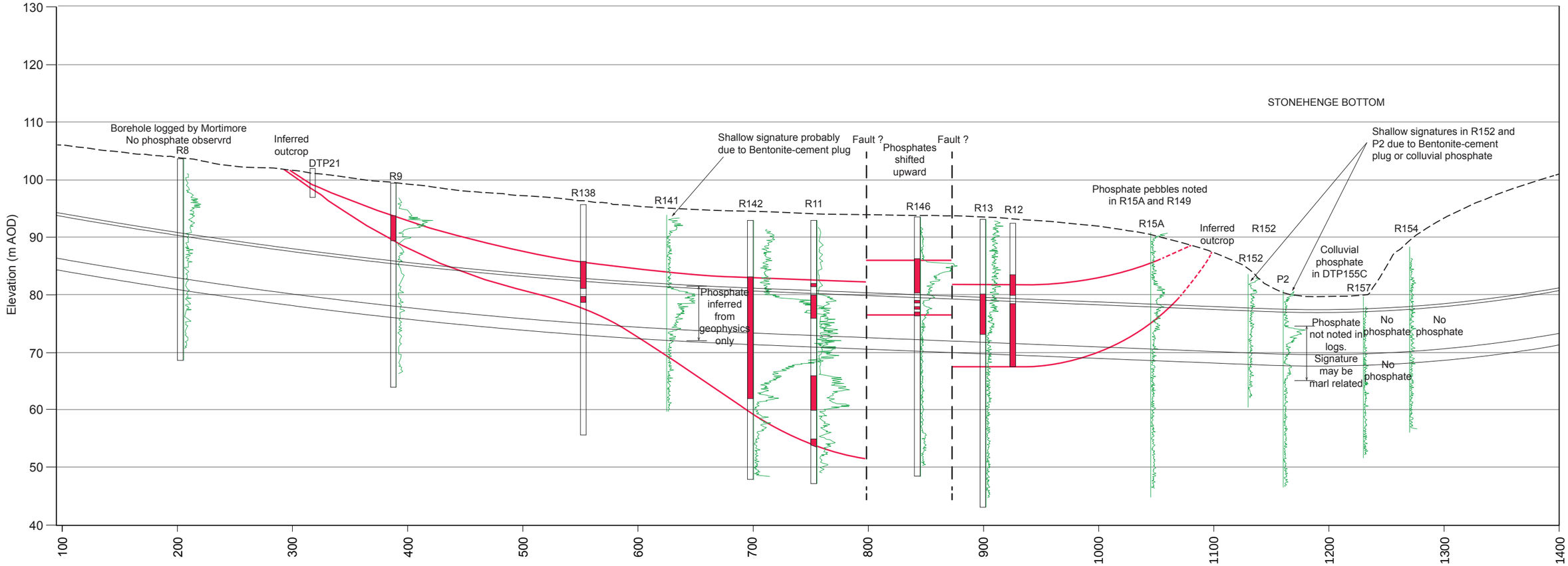
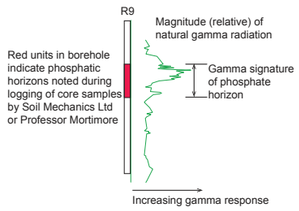


From Halcrow-Gifford (2006)

LEGEND



SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log).
Construction
None
Maintenance / Cleaning
None
Use
None
Decommissioning / Demolition
None

Rev.	Date	Description	By	Chk'd	App'd
P01	02/12/16	FIRST ISSUE	JS	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3

Client: highways england

Designers: ARUP ATKINS

Project Title: A303 AMESBURY TO BERWICK DOWN

Drawing Title: FIGURE 6-1
CORRELATION BETWEEN NATURAL GAMMA COUNT AND LOGGED PHOSPHATIC CHALK (AFTER HALCROW-GIFFORD)

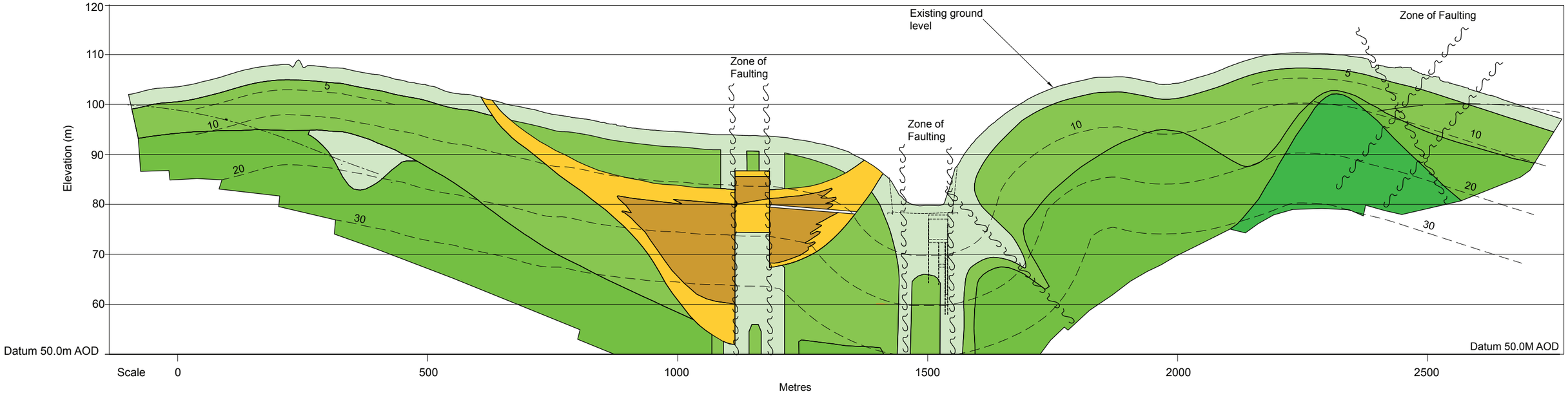
Scale	Designed / Drawn	Checked	Approved	Authorised
NTS	JS	PD	AK	AK
Original Size	Date	Date	Date	Date
A3	02/12/16	02/12/16	02/12/16	02/12/16

Drawing Number: Project | Originator | Volume | Location | Type | Role | Number
HE551506-AA-HGT-D_SWI-DR-CX-000080

Revision: P01

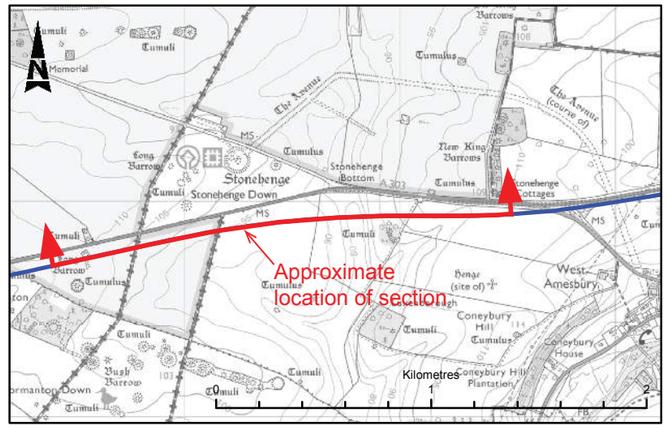
DO NOT SCALE

Millimetres 0 10 100



ENGINEERING GEOLOGICAL SECTION SHOWING SINGLE CUVETTE MODEL INTERPRETATION

Scales H = 1:5000, V =1:500



From Halcrow-Gifford (2006)

LEGEND

- WEATHERED CHALK (≥B4)
- CIRIA GRADE B3
- CIRIA GRADE B2
- CIRIA GRADE A
- --10-- DEPTH CONTOURS 10
- WEAKLY PHOSPHATIC CHALK
- MODERATELY-RICHLY PHOSPHATIC CHALK

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log).

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chk'd	App'd
P01	02/12/16	FIRST ISSUE	JS	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3

Client: highways england

Designers: ARUP ATKINS

Project Title: A303 AMESBURY TO BERWICK DOWN

Drawing Title: FIGURE 6-2 PHOSPHATIC CHALK - SINGLE CUVETTE FAULT CONSTRAINED MODEL (AFTER HALCROW-GIFFORD)

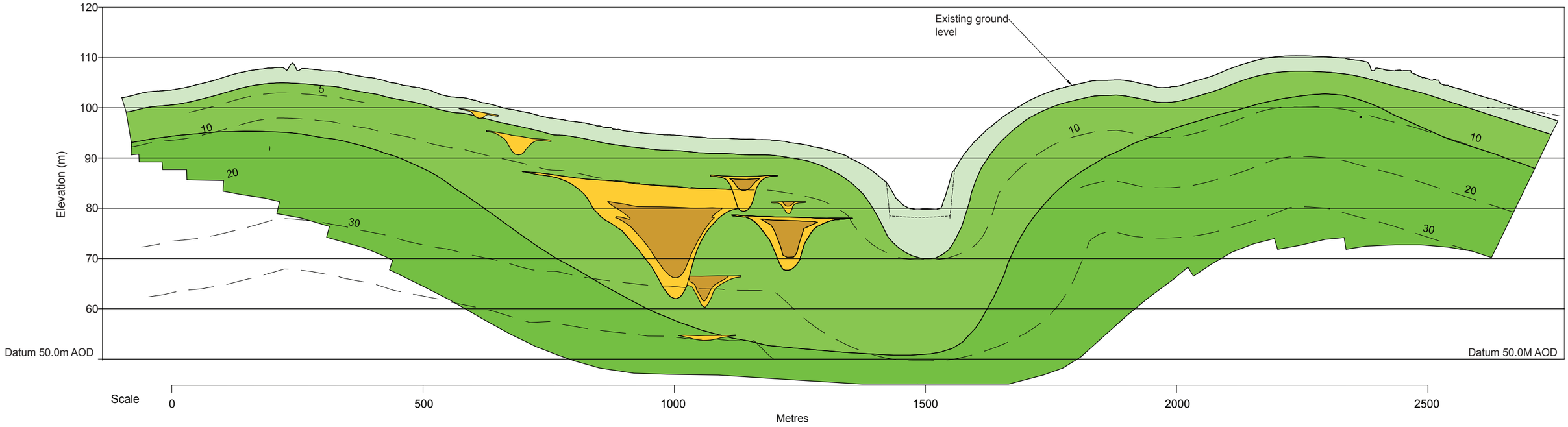
Scale	Designed / Drawn	Checked	Approved	Authorised
NTS	JS	PD	AK	AK
Original Size	**Date**	**Date**	**Date**	**Date**
A3	02/12/16	02/12/16	02/12/16	02/12/16

Drawing Number: Project | Originator | Volume | Location | Type | Role | Number
HE551506-AA-HGT-D_SWI-DR-CX-000081

Revision: P01

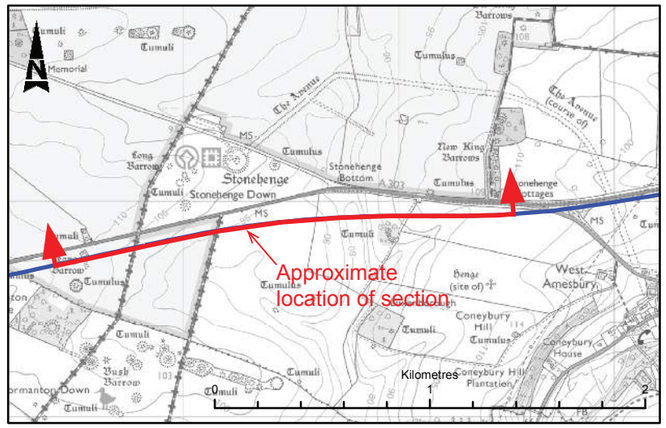
DO NOT SCALE

Millimetres 0 10 100



ENGINEERING GEOLOGICAL SECTION SHOWING MULTIPLE CUVETTE MODEL INTERPRETATION

Scales H = 1:5000, V =1:500



From Halcrow-Gifford (2006)

LEGEND

- WEATHERED CHALK (≥B4)
- CIRIA GRADE B3
- CIRIA GRADE B2
- CIRIA GRADE A
- --10-- DEPTH CONTOURS 10
- WEAKLY PHOSPHATIC CHALK
- MODERATELY-RICHLY PHOSPHATIC CHALK

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log).

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chk'd	App'd
P01	02/12/16	FIRST ISSUE	JS	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3

Client: highways england

Designers: ARUP ATKINS

Project Title: A303 AMESBURY TO BERWICK DOWN

Drawing Title: FIGURE 6-3 PHOSPHATIC CHALK - MULTIPLE CUVETTE MODELL (AFTER HALCROW-GIFFORD)

Scale	Designed / Drawn	Checked	Approved	Authorised
NTS	JS	PD	AK	AK
Original Size	**Date**	**Date**	**Date**	**Date**
A3	02/12/16	02/12/16	02/12/16	02/12/16

Drawing Number: Project | Originator | Volume | Location | Type | Role | Number
HE551506-AA-HGT-D_SWI-DR-CX-000082

Revision: P01

DO NOT SCALE

Millimetres 100 0 10

West

East

?

Base of Superficial deposits

R152

DTP155C

?

DTP155D R16

DTP155D R157

?

R154

Structureless chalk

R18

Hardground

90 mAOD

Maximum GW Level (80.5 mAOD)

80 mAOD

Range of base of structureless chalk from Halcrow-Gifford Preliminary Geotechnical Report

70 mAOD

Core loss

60 mAOD

Possible extended weathering profile associated with faulting

Conjugate joint sets (slickensided in R157)

Flint beds

50 mAOD

Postulated fault location

R16 collapsed when casing withdrawn

LEGEND

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log).
Construction
None
Maintenance / Cleaning
None
Use
None
Decommissioning / Demolition
None

Rev.	Date	Description	By	Chk'd	App'd
P01	02/12/16	FIRST ISSUE	JS	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT

Suitability: S3

Client: highways england

Designers: ARUP ATKINS

Project Title: A303 AMESBURY TO BERWICK DOWN

Drawing Title: FIGURE 6-7 CONCEPTUAL GROUND MODEL AT STONEHENGE BOTTOM

Scale	Designed / Drawn	Checked	Approved	Authorised
NTS	JS	PD	AK	AK
Original Size	Date	Date	Date	Date
A3	02/12/16	02/12/16	02/12/16	02/12/16

Drawing Number: Project | Originator | Volume | Location | Type | Role | Number: HE551506-AA-HGT-D_SWI-DR-CX-000083

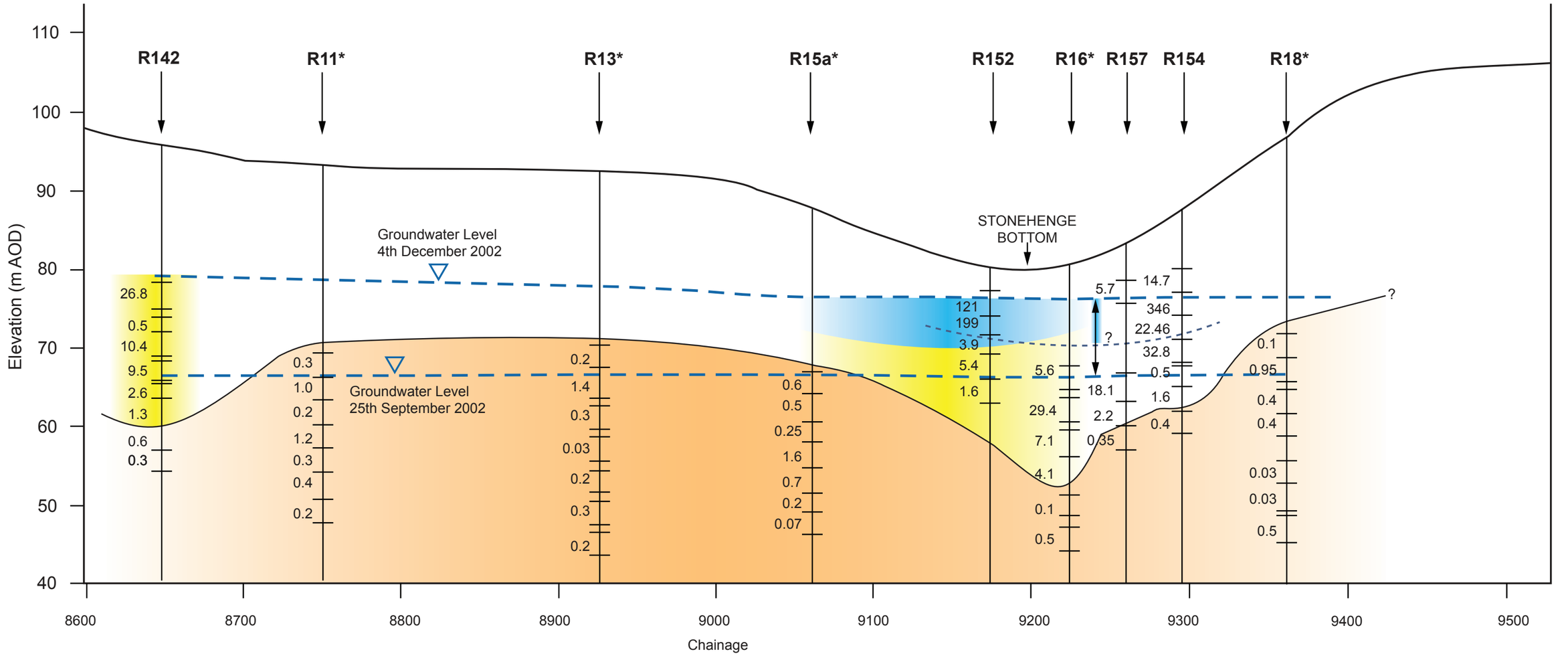
Revision: P01

DO NOT SCALE

Millimetres 0 10 100

West

East



LEGEND

Permeability Zones

- High
- Moderate
- Low

R11* Borehole tested during first ground Investigation (2000/2001)

R142 Borehole tested during second ground investigation (2002/2003)

0.2 Test interval and permeability (m/d)

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log).

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chk'd	App'd
P01	02/12/16	FIRST ISSUE	JS	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3

Client: highways england

Designers: ARUP ATKINS

Project Title: A303 AMESBURY TO BERWICK DOWN

Drawing Title: FIGURE 6-8 SUMMARY OF PERMEABILITY TEST RESULTS IN STONEHENGE BOTTOM AND NEAR INTERFLUVE AREA

Scale	Designed / Drawn	Checked	Approved	Authorised
NTS	JS	PD	AK	AK
Original Size	**Date**	**Date**	**Date**	**Date**
A3	02/12/16	02/12/16	02/12/16	02/12/16

Drawing Number: Project | Originator | Volume | Location | Type | Role | Number
HE551506-AA-HGT-D_SWI-DR-CX-000084

Revision: P01

Appendices

Appendix A Drawings

Drawing No.	Description
HE551506-AA-HGT-D_SWI-DR-CX-000024	Previous Ground Investigations
HE551506-AA-HGT-D_SWI-DR-CX-000025	Previous Ground Investigations
HE551506-AA-HGT-D_SWI-DR-CX-000026	Previous Ground Investigations
HE551506-AA-HGT-D_SWI-DR-CX-000027	Previous Ground Investigations
HE551506-AA-HGT-D_SWI-DR-CX-000028	Previous Ground Investigations – Wireline Geophysics
HE551506-AA-HGT-D_SWI-DR-CX-000029	Previous Ground Investigations – Wireline Geophysics
HE551506-AA-HGT-D_SWI-DR-CX-000030	Previous Ground Investigations - High Pressure Dilatometer tests
HE551506-AA-HGT-D_SWI-DR-CX-000031	Previous Ground Investigations - Packer Testing
HE551506-AA-HGT-D_SWI-DR-CX-000032	Previous Ground Investigations - Variable Head Permeability Tests
HE551506-AA-HGT-D_SWI-DR-CX-000033	Previous Ground Investigations - Variable Head Permeability Tests
HE551506-AA-HGT-D_SWI-DR-CX-000034	Previous Ground Investigations - Standpipe Piezometers
HE551506-AA-HGT-D_SWI-DR-CX-000035	Previous Ground Investigations - Standpipe Piezometers
HE551506-AA-HGT-D_SWI-DR-CX-000036	Previous Ground Investigations - Standpipe Piezometers
HE551506-AA-HGT-D_SWI-DR-CX-000037	Previous Ground Investigations - Plate Load Tests
HE551506-AA-HGT-D_SWI-DR-CX-000038	Previous Ground Investigations - Plate Load Tests
HE551506-AA-HGT-D_SWI-DR-CX-000039	Previous Ground Investigations - Plate Load Tests
HE551506-AA-HGT-D_SWI-DR-CX-000040	Previous Ground Investigations – In situ California Bearing Ratio tests
HE551506-AA-HGT-D_SWI-DR-CX-000041	Previous Ground Investigations – In situ California Bearing Ratio tests
HE551506-AA-HGT-D_SWI-DR-CX-000042	Previous Ground Investigations – In situ California Bearing Ratio tests
HE551506-AA-HGT-D_SWI-DR-CX-000043	Previous Ground Investigations - Infiltration Tests

Drawing No.	Description
HE551506-AA-HGT-D_SWI-DR-CX-000044	Previous Ground Investigations - Infiltration Tests
HE551506-AA-HGT-D_SWI-DR-CX-000045	Previous Ground Investigations - Infiltration Tests
HE551506-AA-HGT-D_SWI-DR-CX-000046	Previous Ground Investigations – Boreholes with SPT
HE551506-AA-HGT-D_SWI-DR-CX-000047	Previous Ground Investigations – Boreholes with SPT
HE551506-AA-HGT-D_SWI-DR-CX-000048	Previous Ground Investigations – Boreholes with SPT
HE551506-AA-HGT-D_SWI-DR-CX-000049	Scheduled monuments and listed buildings
HE551506-AA-HGT-D_SWI-DR-CX-000050	Scheduled monuments and listed buildings
HE551506-AA-HGT-D_SWI-DR-CX-000051	Scheduled monuments and listed buildings
HE551506-AA-HGT-D_SWI-DR-CX-000052	Scheduled monuments and listed buildings
HE551506-AA-HGT-D_SWI-DR-CX-000053	Ecology: Designated areas
HE551506-AA-HGT-D_SWI-DR-CX-000054	Ecology: Designated areas
HE551506-AA-HGT-D_SWI-DR-CX-000055	Ecology: Designated areas
HE551506-AA-HGT-D_SWI-DR-CX-000056	Ecology: Designated areas
HE551506-AA-HGT-D_SWI-DR-CX-000057	Historical Land Use and Chemical Testing
HE551506-AA-HGT-D_SWI-DR-CX-000058	Historical Land Use and Chemical Testing
HE551506-AA-HGT-D_SWI-DR-CX-000059	Historical Land Use and Chemical Testing
HE551506-AA-HGT-D_SWI-DR-CX-000060	Existing Structures
HE551506-AA-HGT-D_SWI-DR-CX-000061	Existing Structures
HE551506-AA-HGT-D_SWI-DR-CX-000062	Existing Structures
HE551506-AA-HGT-D_SWI-DR-CX-000063	Existing Structures

The drawings in this appendix comprise:

- Locations of previous ground investigations and associated in situ testing (drawings HE551506-AA-HGT-D_SWI-DR-CX-000024 to 000048)

These drawings have been compiled from information in the following factual reports:

HAGDMS reference	Report title	Date	Contractor
17439	A303 Preliminary Ground Investigation	2000/2001	Soil Mechanics
16175	A303 Stonehenge Ground Investigation Factual Report on Phase I Main Ground Investigation Volume 1 to 5.	June 2001	Soil Mechanics
16174	A303 Stonehenge Ground Investigation Factual Report on Phase II Main Ground Investigation, Volume 1 and 2.	Nov 2001	Soil Mechanics
16966	Stonehenge Visitors Centre, Amesbury, Wiltshire - Ground Investigation Factual Report	July 2002	John Grimes Partnership
21762	Factual Report Phase 1A Supplementary Ground Investigation for A303 Stonehenge Improvement Volume 1 to 5	May 2003	Soil Mechanics
N/A	A303 Stonehenge Improvements: Pumping Test Factual Report Ref 312/1089	2003	WJ Groundwater
24930	Area 2, A303 Longbarrow Roundabout Improvement Scheme	2010	Soil Mechanics
24822	A303 Countess Roundabout - Safety Scheme	2011	Soil Mechanics

- Locations of existing or historical features (drawings HE551506-AA-HGT-D_SWI-DR-CX-000049 to 000063)

These drawings have been compiled using data obtained from Groundsure (Appendix F), historical Ordnance Survey maps (Appendix E) and the following reports:

HAGDMS reference	Report title	Date	Produced by
17317	A303 Stonehenge Site Investigation Interpretative Report: Preliminary Investigation and Phase I of main ground investigation. [11]	2001	Mott MacDonald
16182	A303 Stonehenge Site Investigation Interpretative Report Phase II of Main Ground Investigation [24]	2002	Mott MacDonald
16966	Stonehenge Visitors Centre, Amesbury, Wiltshire - Ground Investigation Factual Report	July 2002	John Grimes Partnership
24930	A303 Longbarrow Roundabout Improvement Scheme	2010	Soil Mechanics
24822	A303 Countess Roundabout - Safety Scheme Investigation	2011	Soil Mechanics

LEGEND

ALIGNMENT
- D061 & D062
- ROUTE OPTION D061
- ROUTE OPTION D062

1965 AMESBURY BYPASS
- CABLE PERCUSSION

2000 PRELIMINARY GI
- ROTARY CORE

2001 MAIN GI
- CABLE PERCUSSION
- DEEP TRIAL PIT
- ROTARY CORE
- ROTARY OPEN HOLE
- SHALLOW TRIAL PIT

2002 VISITOR CENTRE
- DEEP TRIAL PIT
- ROTARY CORE
- SHALLOW TRIAL PIT

2002/3 SUPPLEMENTARY GI
- CABLE PERCUSSION
- DEEP TRIAL PIT
- ROTARY CORE
- SHALLOW TRIAL PIT
- WINDOW SAMPLING

2009 COUNTESS ROUNDABOUT IMPROVEMENT
- CABLE PERCUSSION
- SHALLOW TRIAL PIT

2010 LONGBARROW ROUNDABOUT IMPROVEMENT
- SHALLOW TRIAL PIT

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made in the design hazard log)

Construction	None
Maintenance / Cleaning	None
Use	None
Decommission / Demolition	None

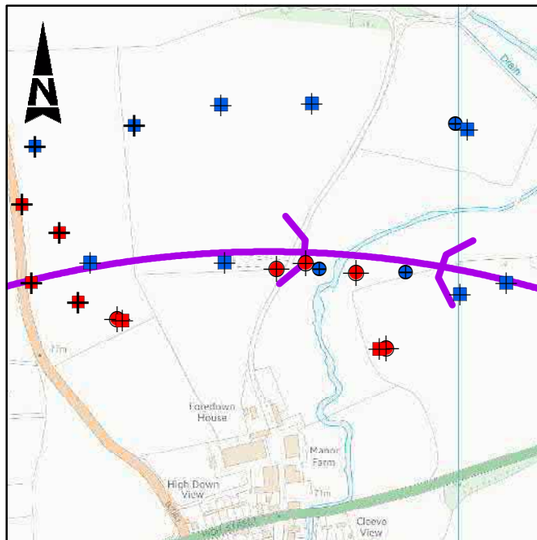
Rev	Date	Description	By	Chk'd	App'd
P03	21/11/16	SECOND ISSUE	DI	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3
Project Title: A303 AMESBURY TO BERWICK DOWN
Client: highways england
Drawing Title: PREVIOUS GROUND INVESTIGATIONS
Designers: ARUP ATKINS

Scale	Designed	Drawn	Checked	Authorised
1:10,000	N/A	DI	PD	AK

Original Size	Date	Date	Date	Date
A3	N/A	21/11/16	21/11/16	21/11/16

Drawing Number: HE551506-AA-HGT-D_SWI-DR-CX-000024 (Project | Originator | Volume | Location | Type | Role | Number)
Revison: P03



LEGEND

ALIGNMENT
- D061 & D062
- ROUTE OPTION D061
- ROUTE OPTION D062

1965 AMESBURY BYPASS
- CABLE PERCUSSION

2000 PRELIMINARY GI
- ROTARY CORE

2001 MAIN GI
- CABLE PERCUSSION
- DEEP TRIAL PIT
- ROTARY CORE
- ROTARY OPEN HOLE
- SHALLOW TRIAL PIT

2002 VISITOR CENTRE
- DEEP TRIAL PIT
- ROTARY CORE
- SHALLOW TRIAL PIT

2002/3 SUPPLEMENTARY GI
- CABLE PERCUSSION
- DEEP TRIAL PIT
- ROTARY CORE
- SHALLOW TRIAL PIT
- WINDOW SAMPLING

2009 COUNTESS ROUNDABOUT IMPROVEMENT
- CABLE PERCUSSION
- SHALLOW TRIAL PIT

2010 LONGBARROW ROUNDABOUT IMPROVEMENT
- SHALLOW TRIAL PIT

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made in the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommission / Demolition
None

Rev	Date	Description	By	Chk'd	App'd
P03	21/11/16	SECOND ISSUE	DI	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3
Client: highways england
Designers: ARUP ATKINS

Project Title: A303 AMESBURY TO BERWICK DOWN
Drawing Title: PREVIOUS GROUND INVESTIGATIONS

Scale	Designed	Drawn	Checked	Authorised
1:10,000	N/A	DI	PD	AK

Original Size	Date	Date	Date	Date
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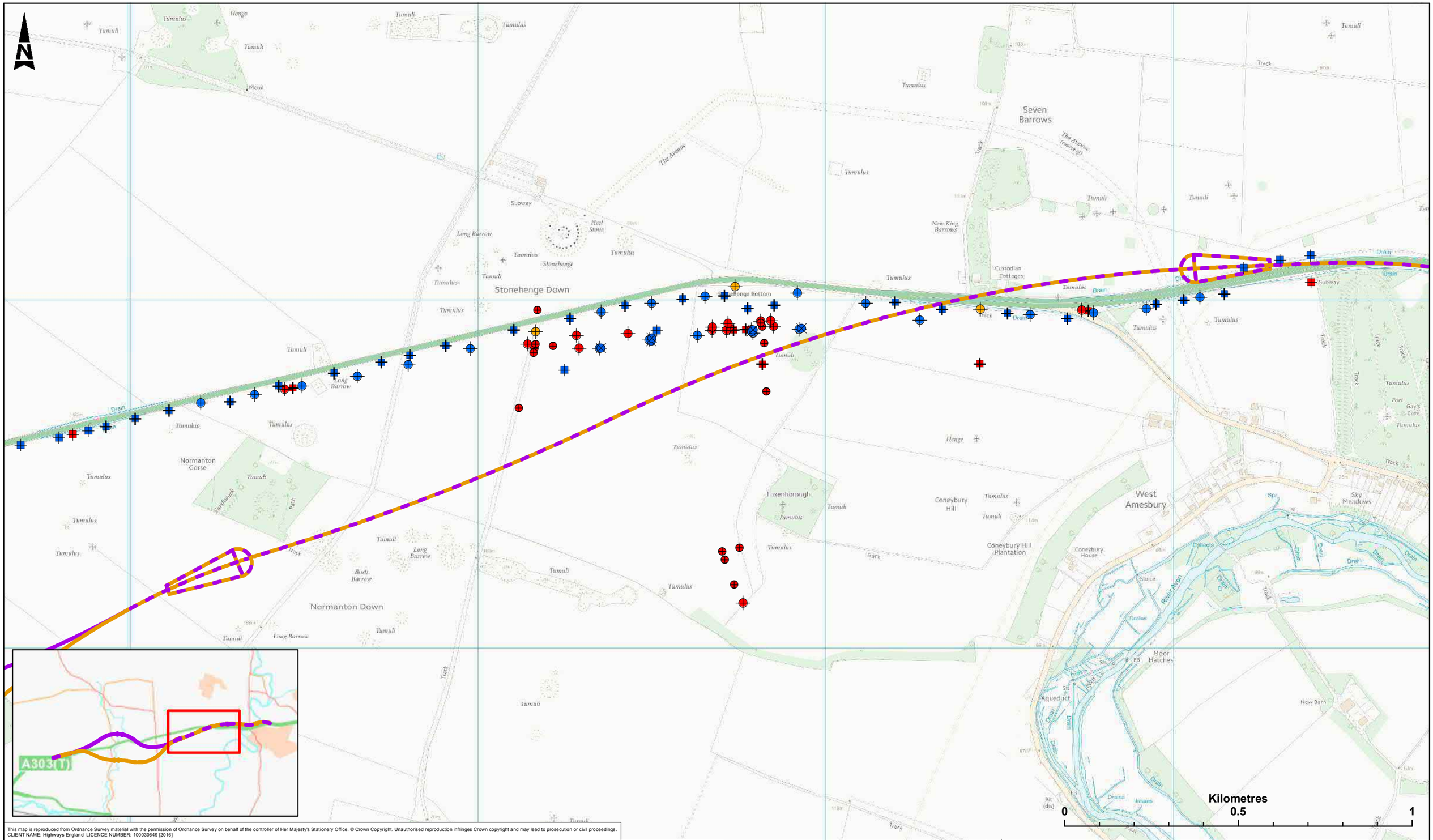
Drawing Number: HE551506-AA-HGT-D_SWI-DR-CX-000025
(Project | Originator | Volume | Location | Type | Role | Number)
Revison: P03



LEGEND

ALIGNMENT
- D061 & D062
- ROUTE OPTION D061
- ROUTE OPTION D062

1965 AMESBURY BYPASS
- CABLE PERCUSSION

2000 PRELIMINARY GI
- ROTARY CORE

2001 MAIN GI
- CABLE PERCUSSION
- DEEP TRIAL PIT
- ROTARY CORE
- ROTARY OPEN HOLE
- SHALLOW TRIAL PIT

2002 VISITOR CENTRE
- DEEP TRIAL PIT
- ROTARY CORE
- SHALLOW TRIAL PIT

2002/3 SUPPLEMENTARY GI
- CABLE PERCUSSION
- DEEP TRIAL PIT
- ROTARY CORE
- SHALLOW TRIAL PIT
- WINDOW SAMPLING

2009 COUNTESS ROUNDABOUT IMPROVEMENT
- CABLE PERCUSSION
- SHALLOW TRIAL PIT

2010 LONGBARROW ROUNDABOUT IMPROVEMENT
- SHALLOW TRIAL PIT

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made in the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommission / Demolition
None

Rev	Date	Description	By	Chk'd	App'd
P03	21/11/16	SECOND ISSUE	DI	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3

Client: highways england

Designers: ARUP ATKINS

Project Title: A303 AMESBURY TO BERWICK DOWN

Drawing Title: PREVIOUS GROUND INVESTIGATIONS

Scale	Designed	Drawn	Checked	Authorised
1:10,000	N/A	DI	PD	AK

Original Size	Date	Date	Date	Date
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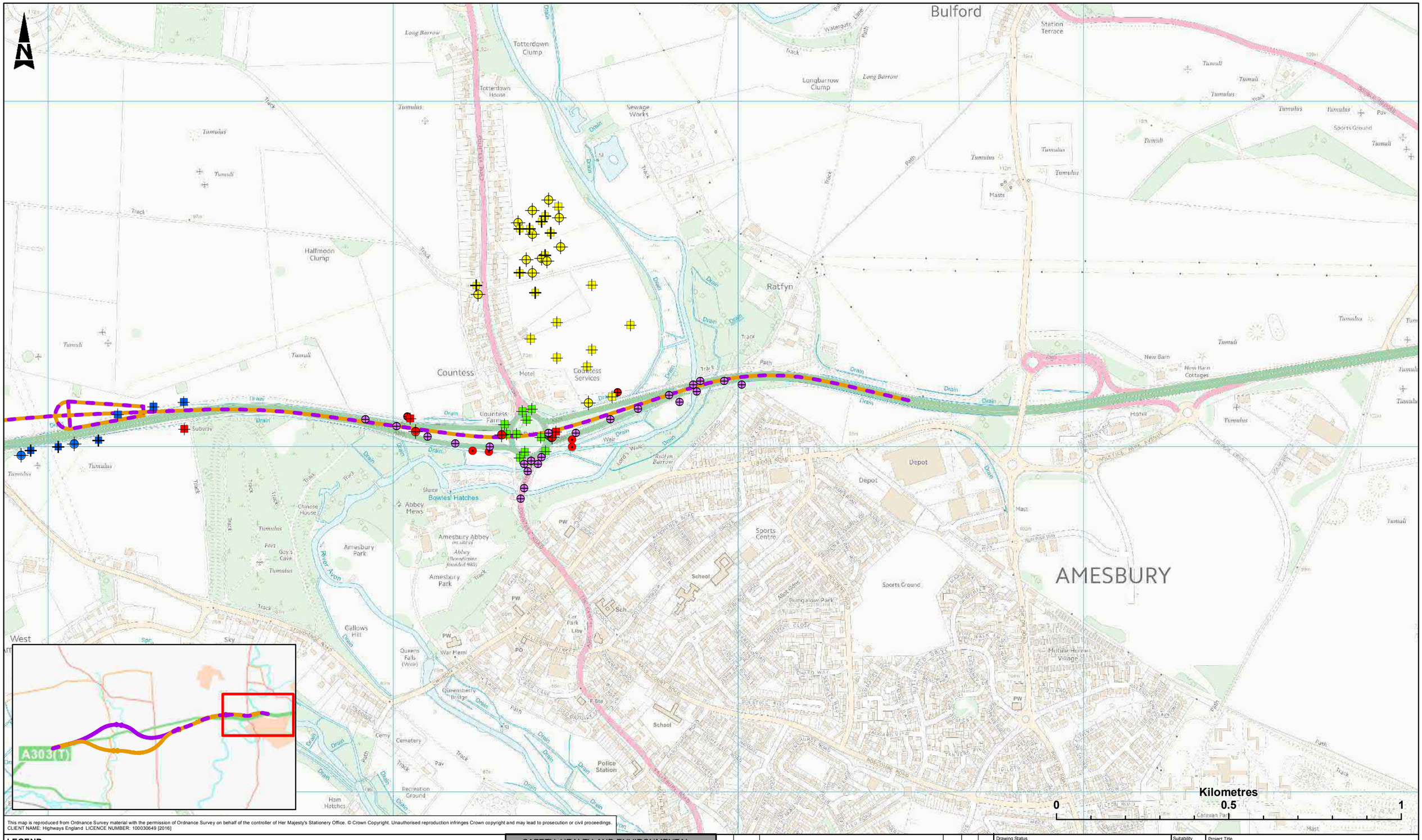
(Project | Originator | Volume | Location | Type | Role | Number)

Revison: P03



LEGEND

ALIGNMENT
- D061 & D062
- ROUTE OPTION D061
- ROUTE OPTION D062

1965 AMESBURY BYPASS
- CABLE PERCUSSION

2000 PRELIMINARY GI
- ROTARY CORE

2001 MAIN GI
- CABLE PERCUSSION
- DEEP TRIAL PIT
- ROTARY CORE
- ROTARY OPEN HOLE
- SHALLOW TRIAL PIT

2002 VISITOR CENTRE
- DEEP TRIAL PIT
- ROTARY CORE
- SHALLOW TRIAL PIT

2002/3 SUPPLEMENTARY GI
- CABLE PERCUSSION
- DEEP TRIAL PIT
- ROTARY CORE
- SHALLOW TRIAL PIT
- WINDOW SAMPLING

2009 COUNTESS ROUNDABOUT IMPROVEMENT
- CABLE PERCUSSION
- SHALLOW TRIAL PIT

2010 LONGBARROW ROUNDABOUT IMPROVEMENT
- SHALLOW TRIAL PIT

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made in the design hazard log)
Construction
None
Maintenance / Cleaning
None
Use
None
Decommission / Demolition
None

Rev	Date	Description	By	Chk'd	App'd
P03	21/11/16	SECOND ISSUE	DI	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3
Project Title: A303 AMESBURY TO BERWICK DOWN
Client: highways england
Drawing Title: PREVIOUS GROUND INVESTIGATIONS
Designers: ARUP ATKINS

Scale	Designed	Drawn	Checked	Authorised
1:10,000	N/A	DI	PD	AK

Original Size	Date	Date	Date	Date
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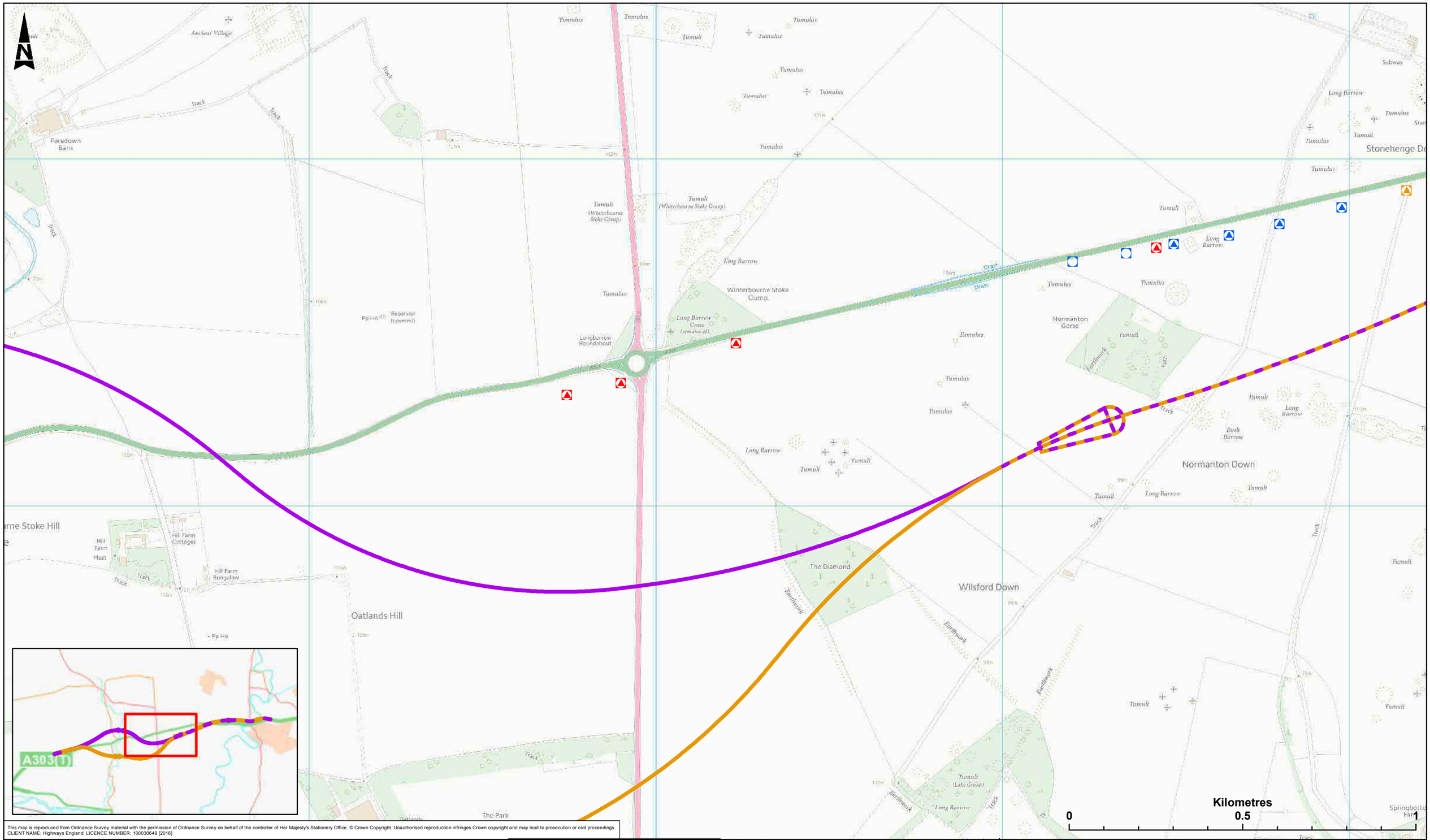
Drawing Number: HE551506-AA-HGT-D_SWI-DR-CX-000027
(Project | Originator | Volume | Location | Type | Role | Number)
Revison: P03



LEGEND

ALIGNMENT

- D061 & D062
- ROUTE OPTION D061
- ROUTE OPTION D062

CALLIPER & NATURAL GAMMA SURVEY

- 2000 PRELIMINARY GI
- 2001 MAIN GI
- 2002/3 SUPPLEMENTARY GI

OPTICAL TELEVIEWER SURVEY

- 2000 PRELIMINARY GI
- 2001 MAIN GI
- 2002/3 SUPPLEMENTARY GI

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made in the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommission / Demolition
None

Rev	Date	Description	By	Chk'd	App'd
P03	21/11/16	SECOND ISSUE	DI	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3

Client: highways england

Designers: ARUP ATKINS

Project Title: A303 AMESBURY TO BERWICK DOWN

Drawing Title: PREVIOUS GROUND INVESTIGATIONS WIRELINE GEOPHYSICS

Scale	Designed	Drawn	Checked	Authorised
1:10,000	N/A	DI	PD	AK

Original Size	Date	Date	Date	Date
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Drawing Number: HE551506-AA-HGT-D_SWI-DR-CX-000028
(Project | Originator | Volume | Location | Type | Role | Number)

Revision: P03

LEGEND

ALIGNMENT
- D061 & D062
- ROUTE OPTION D061
- ROUTE OPTION D062

CALLIPER & NATURAL GAMMA SURVEY
- 2000 PRELIMINARY GI
- 2001 MAIN GI
- 2002/3 SUPPLEMENTARY GI

OPTICAL TELEVIEWER SURVEY
- 2000 PRELIMINARY GI
- 2001 MAIN GI
- 2002/3 SUPPLEMENTARY GI

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made in the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommission / Demolition
None

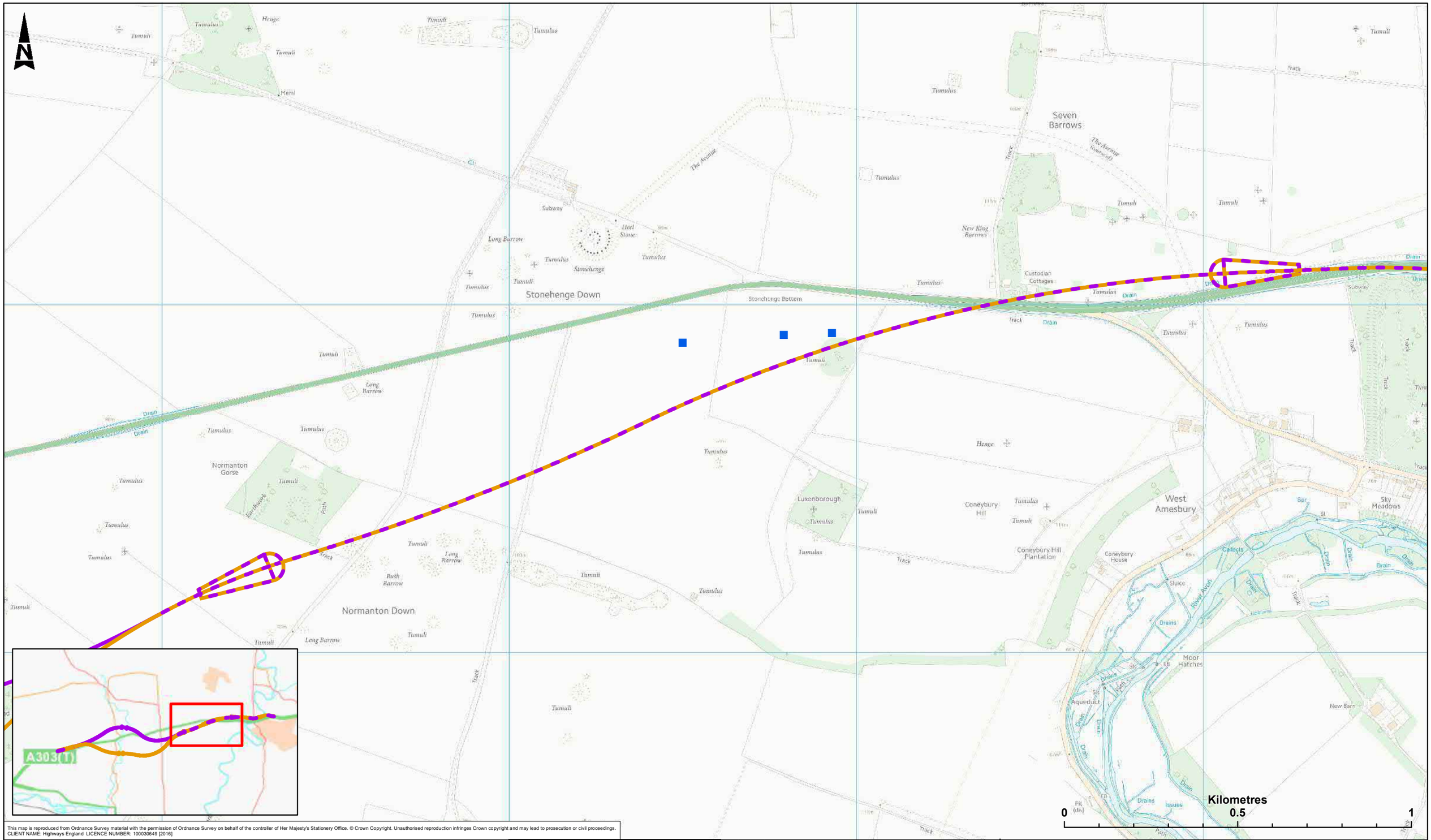
Rev	Date	Description	By	Chk'd	App'd
P03	21/11/16	SECOND ISSUE	DI	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3
Project Title: A303 AMESBURY TO BERWICK DOWN
Client: highways england
Drawing Title: PREVIOUS GROUND INVESTIGATIONS WIRELINE GEOPHYSICS
Designers: ARUP ATKINS

Scale	Designed	Drawn	Checked	Authorised
1:10,000	N/A	DI	PD	AK

Original Size	Date	Date	Date	Date
A3	N/A	21/11/16	21/11/16	21/11/16

Drawing Number: HE551506-AA-HGT-D_SWI-DR-CX-000029
Project | Originator | Volume | Location | Type | Role | Number
Revison: P03



LEGEND

ALIGNMENT

- D061 & D062
- ROUTE OPTION D061
- ROUTE OPTION D062

HIGH PRESSURE DILATOMETER TEST

- 2001 MAIN GI

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made in the design hazard log)
Construction
None
Maintenance / Cleaning
None
Use
None
Decommission / Demolition
None

Rev	Date	Description	By	Chk'd	App'd
P03	21/11/16	SECOND ISSUE	DI	PD	--

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3

Client: highways england

Designers: ARUP ATKINS

Project Title: A303 AMESBURY TO BERWICK DOWN

Drawing Title: PREVIOUS GROUND INVESTIGATIONS HIGH PRESSURE DILATOMETER TESTS

Scale	Designed	Drawn	Checked	Authorised
1:10,000	N/A	DI	PD	AK

Original Size	Date	Date	Date	Date
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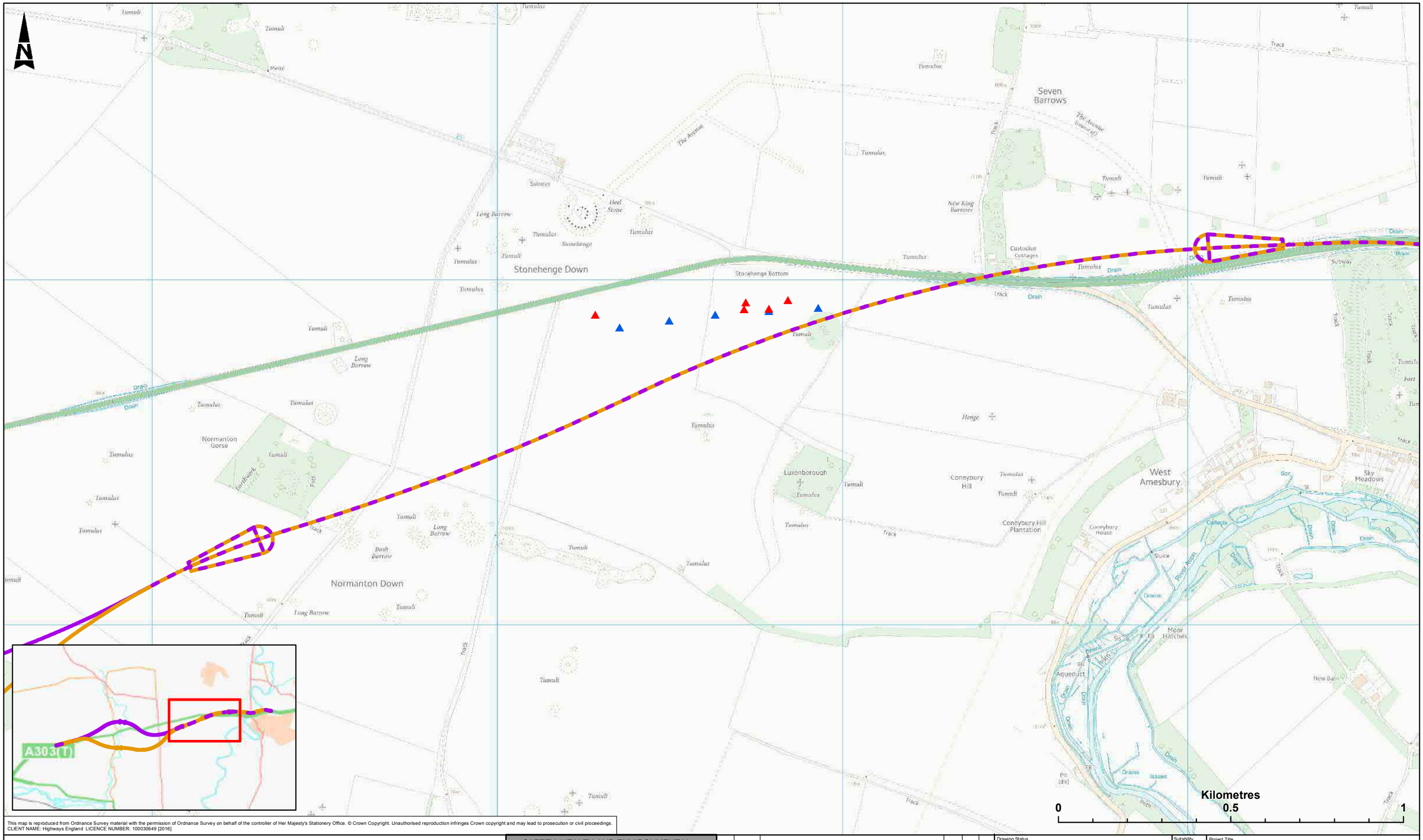
Drawing Number: HE551506-AA-HGT-D_SWI-DR-CX-000030
(Project | Originator | Volume | Location | Type | Role | Number)

Revison: P03



LEGEND

ALIGNMENT

- D061 & D062
- ROUTE OPTION D061
- ROUTE OPTION D062

PACKER TEST

- 2001 MAIN GI
- 2002/3 SUPPLEMENTARY GI

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made in the design hazard log)
Construction
None
Maintenance / Cleaning
None
Use
None
Decommission / Demolition
None

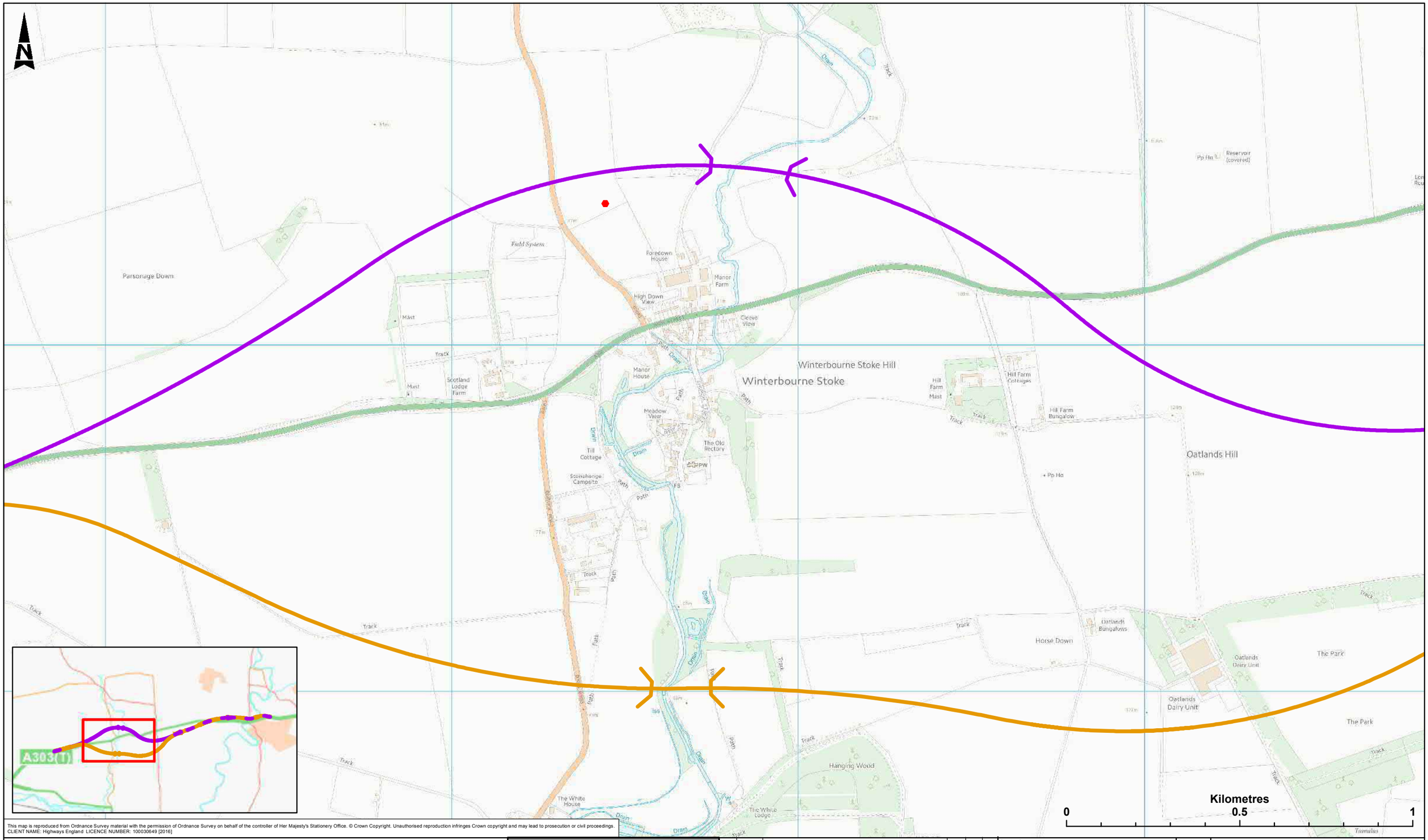
Rev	Date	Description	By	Chk'd	App'd
P03	21/11/16	SECOND ISSUE	DI	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3
Project Title: A303 AMESBURY TO BERWICK DOWN
Client: highways england
Drawing Title: PREVIOUS GROUND INVESTIGATIONS PACKER TESTING
Designers: ARUP ATKINS

Scale	Designed	Drawn	Checked	Authorised
1:10,000	N/A	DI	PD	AK

Original Size	Date	Date	Date	Date
A3	N/A	21/11/16	21/11/16	21/11/16

Drawing Number: Project | Originator | Volume | Location | Type | Role | Number
HE551506-AA-HGT-D_SWI-DR-CX-000031
Revison: P03



LEGEND

ALIGNMENT

- D061 & D062
- ROUTE OPTION D061
- ROUTE OPTION D062

FALLING HEAD TEST

- 2002/3 SUPPLEMENTARY GI

RISING HEAD TEST

- 2002/3 SUPPLEMENTARY GI

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made in the design hazard log)
Construction
None
Maintenance / Cleaning
None
Use
None
Decommission / Demolition
None

Rev	Date	Description	By	Chk'd	App'd
P03	21/11/16	SECOND ISSUE	DI	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3

Client: highways england

Designers: ARUP ATKINS

Project Title: A303 AMESBURY TO BERWICK DOWN

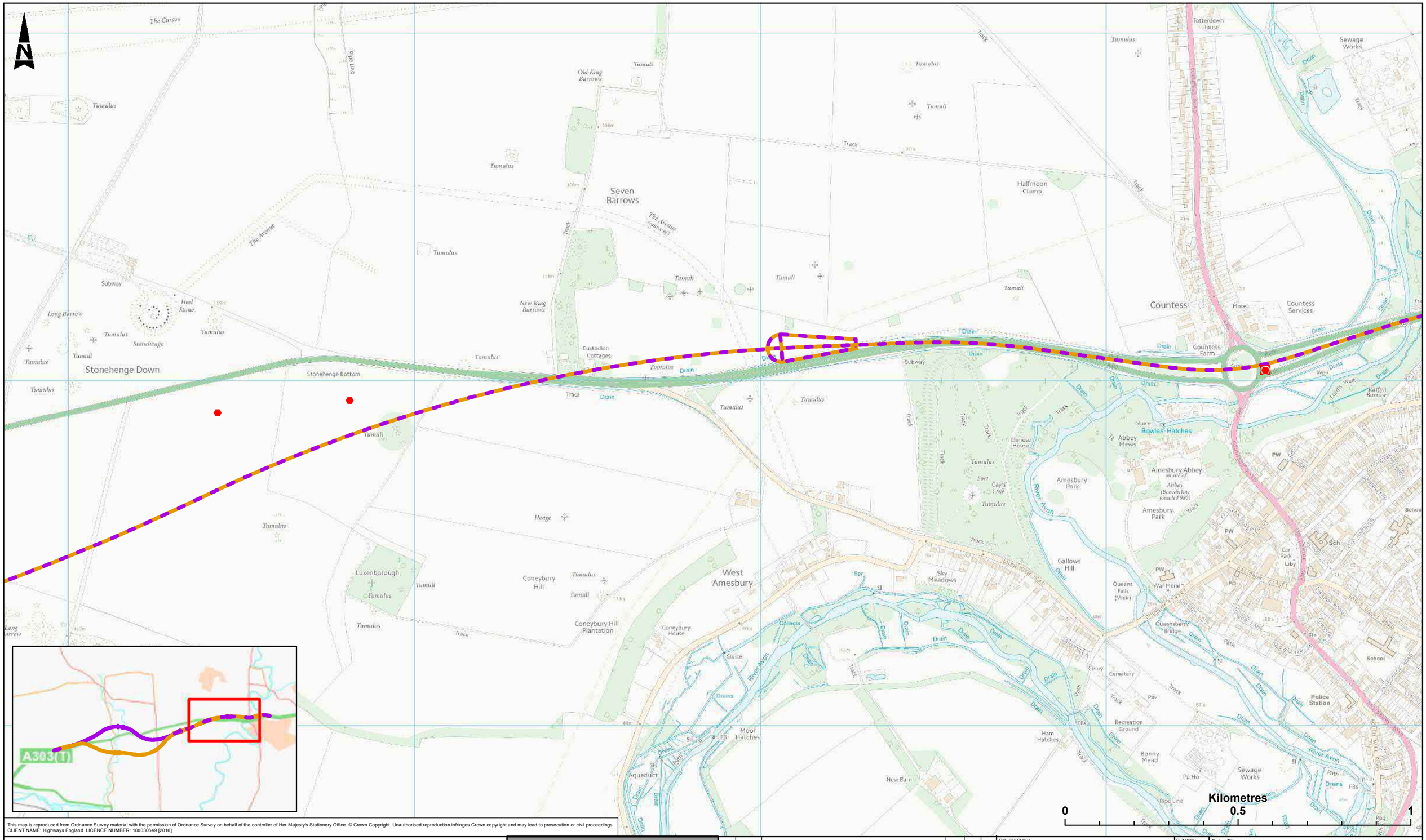
Drawing Title: PREVIOUS GROUND INVESTIGATIONS VARIABLE HEAD PERMEABILITY TESTING

Scale	Designed	Drawn	Checked	Authorised
1:10,000	N/A	DI	PD	AK

Original Size	Date	Date	Date	Date
A3	N/A	21/11/16	21/11/16	21/11/16

Drawing Number: HE551506-AA-HGT-D_SWI-DR-CX-000032
(Project | Originator | Volume | Location | Type | Role | Number)

Revison: P03



LEGEND

ALIGNMENT

- D061 & D062
- ROUTE OPTION D061
- ROUTE OPTION D062

FALLING HEAD TEST

- 2002/3 SUPPLEMENTARY GI

RISING HEAD TEST

- 2002/3 SUPPLEMENTARY GI

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made in the design hazard log)
Construction
None
Maintenance / Cleaning
None
Use
None
Decommission / Demolition
None

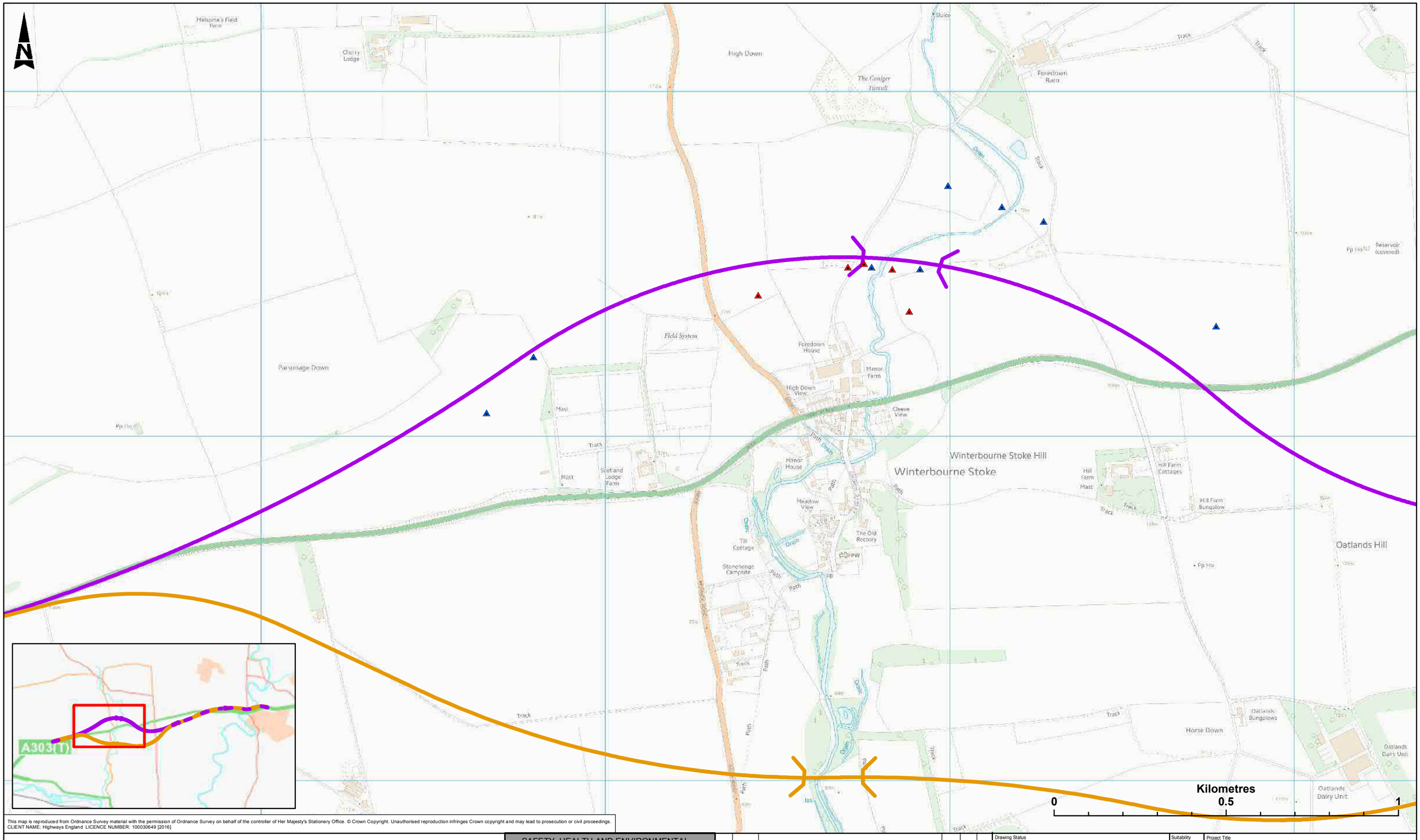
Rev	Date	Description	By	Chk'd	App'd
P03	21/11/16	SECOND ISSUE	DI	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3
Project Title: A303 AMESBURY TO BERWICK DOWN
Client: highways england
Drawing Title: PREVIOUS GROUND INVESTIGATIONS VARIABLE HEAD PERMEABILITY TESTING
Designers: ARUP ATKINS

Scale	Designed	Drawn	Checked	Authorised
1:10,000	N/A	DI	PD	AK

Original Size	Date	Date	Date	Date
A3	N/A	21/11/16	21/11/16	21/11/16

Drawing Number: HE551506-AA-HGT-D_SWI-DR-CX-000033
(Project | Originator | Volume | Location | Type | Role | Number)
Revison: P03



LEGEND

ALIGNMENT
- D061 & D062
- ROUTE OPTION D061
- ROUTE OPTION D062

PUMPING TEST WELL
- 2002/3 SUPPLEMENTARY GI

REINSTATED PIEZOMETER
- 2002/3 SUPPLEMENTARY GI

STANDPIPE PIEZOMETER
- 2000 PRELIMINARY GI
- 2001 MAIN GI
- 2002 VISITOR CENTRE
- 2002/3 SUPPLEMENTARY GI

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made in the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommission / Demolition
None

Rev	Date	Description	By	Chk'd	App'd
P03	21/11/16	SECOND ISSUE	DI	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3

Client: highways england

Designers: ARUP ATKINS

Project Title: A303 AMESBURY TO BERWICK DOWN

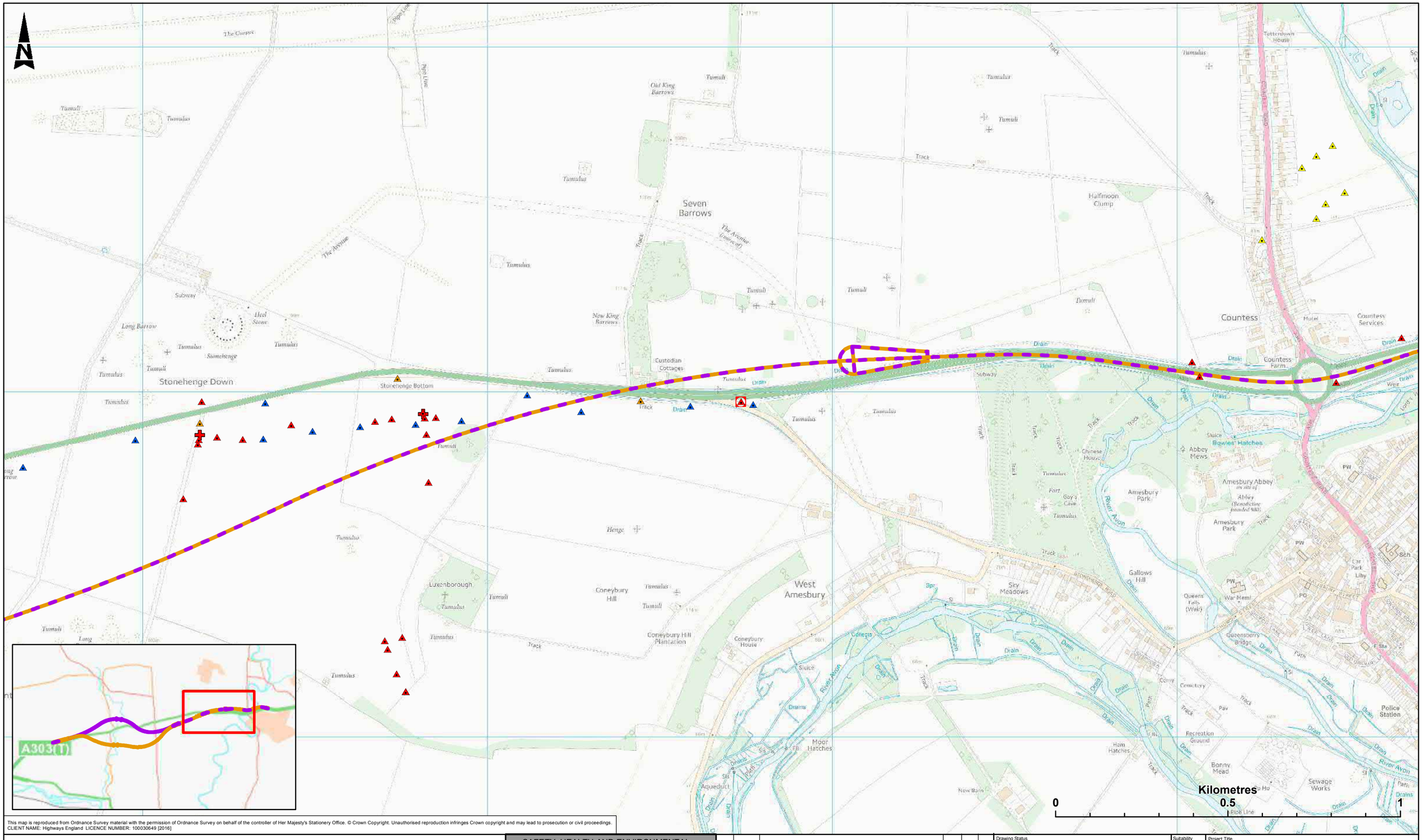
Drawing Title: PREVIOUS GROUND INVESTIGATIONS STANDPIPE PIEZOMETERS

Scale	Designed	Drawn	Checked	Authorised
1:10,000	N/A	DI	PD	AK

Original Size	Date	Date	Date	Date
A3	N/A	21/11/16	21/11/16	21/11/16

Drawing Number: HE551506-AA-HGT-D_SWI-DR-CX-000034
(Project | Originator | Volume | Location | Type | Role | Number)

Revison: P03



LEGEND

ALIGNMENT
- D061 & D062
- ROUTE OPTION D061
- ROUTE OPTION D062

PUMPING TEST WELL
- 2002/3 SUPPLEMENTARY GI

REINSTATED PIEZOMETER
- 2002/3 SUPPLEMENTARY GI

STANDPIPE PIEZOMETER
- 2000 PRELIMINARY GI
- 2001 MAIN GI
- 2002 VISITOR CENTRE
- 2002/3 SUPPLEMENTARY GI

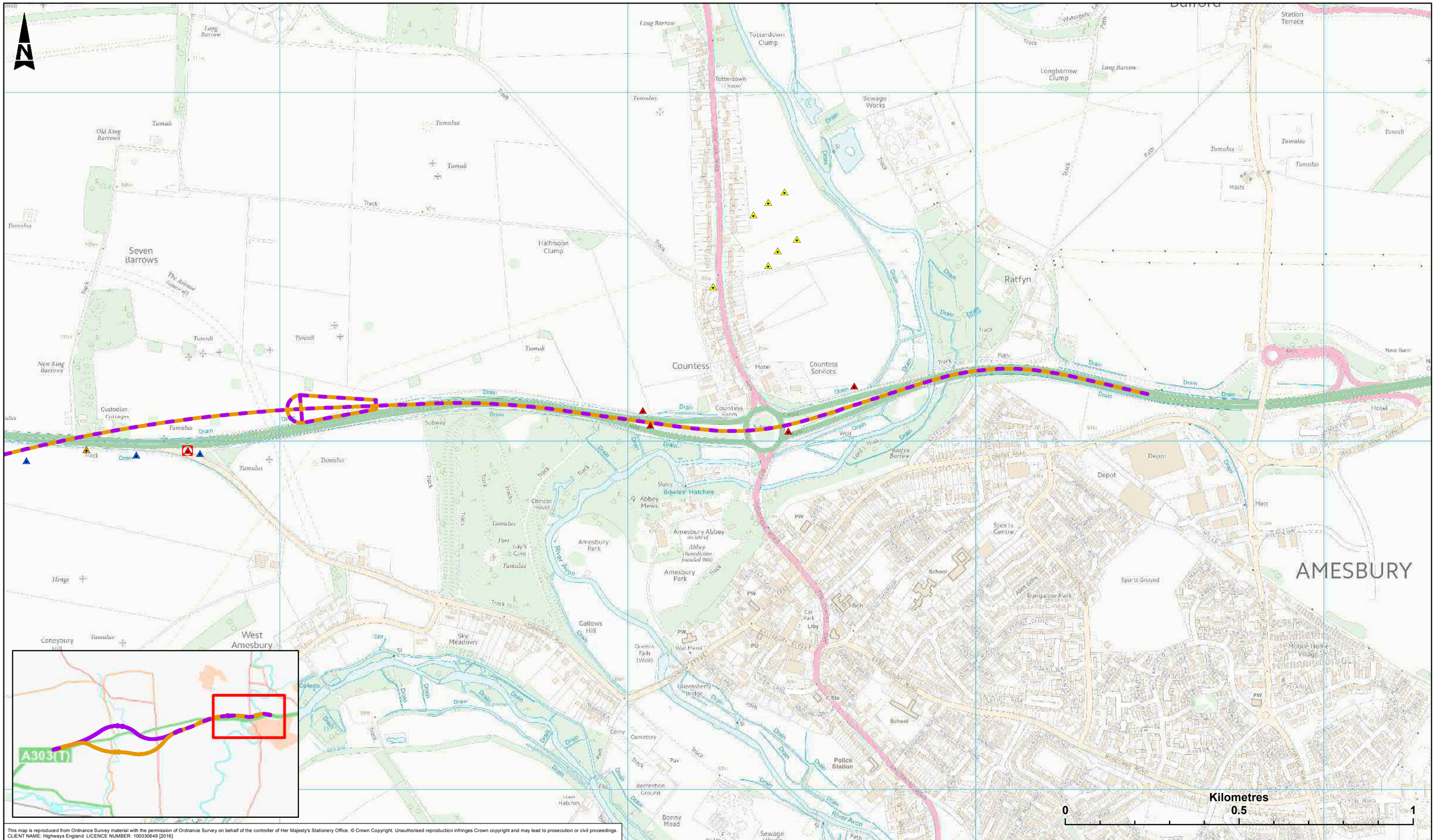
SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made in the design hazard log)
Construction
None
Maintenance / Cleaning
None
Use
None
Decommission / Demolition
None

Rev	Date	Description	By	Chk'd	App'd
P03	21/11/16	SECOND ISSUE	DI	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3
Project Title: A303 AMESBURY TO BERWICK DOWN
Client: highways england
Drawing Title: PREVIOUS GROUND INVESTIGATIONS STANDPIPE PIEZOMETERS
Designers: ARUP ATKINS

Scale	Designed	Drawn	Checked	Authorised
1:10,000	N/A	DI	PD	AK
Original Size	**Date**	**Date**	**Date**	**Date**
A3	N/A	21/11/16	21/11/16	21/11/16

Drawing Number: HE551506-AA-HGT-D_SWI-DR-CX-000035 (Project | Originator | Volume | Location | Type | Role | Number)
Revision: P03



LEGEND

ALIGNMENT
- D061 & D062
- ROUTE OPTION D061
- ROUTE OPTION D062

PUMPING TEST WELL
- 2002/3 SUPPLEMENTARY GI

REINSTATED PIEZOMETER
- 2002/3 SUPPLEMENTARY GI

STANDPIPE PIEZOMETER
- 2000 PRELIMINARY GI
- 2001 MAIN GI
- 2002 VISITOR CENTRE
- 2002/3 SUPPLEMENTARY GI

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made in the design hazard log)
Construction
None
Maintenance / Cleaning
None
Use
None
Decommission / Demolition
None

Rev	Date	Description	By	Chk'd	App'd
P03	21/11/16	SECOND ISSUE	DI	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3

Project Title: A303 AMESBURY TO BERWICK DOWN

Client: highways england

Drawing Title: PREVIOUS GROUND INVESTIGATIONS STANDPIPE PIEZOMETERS

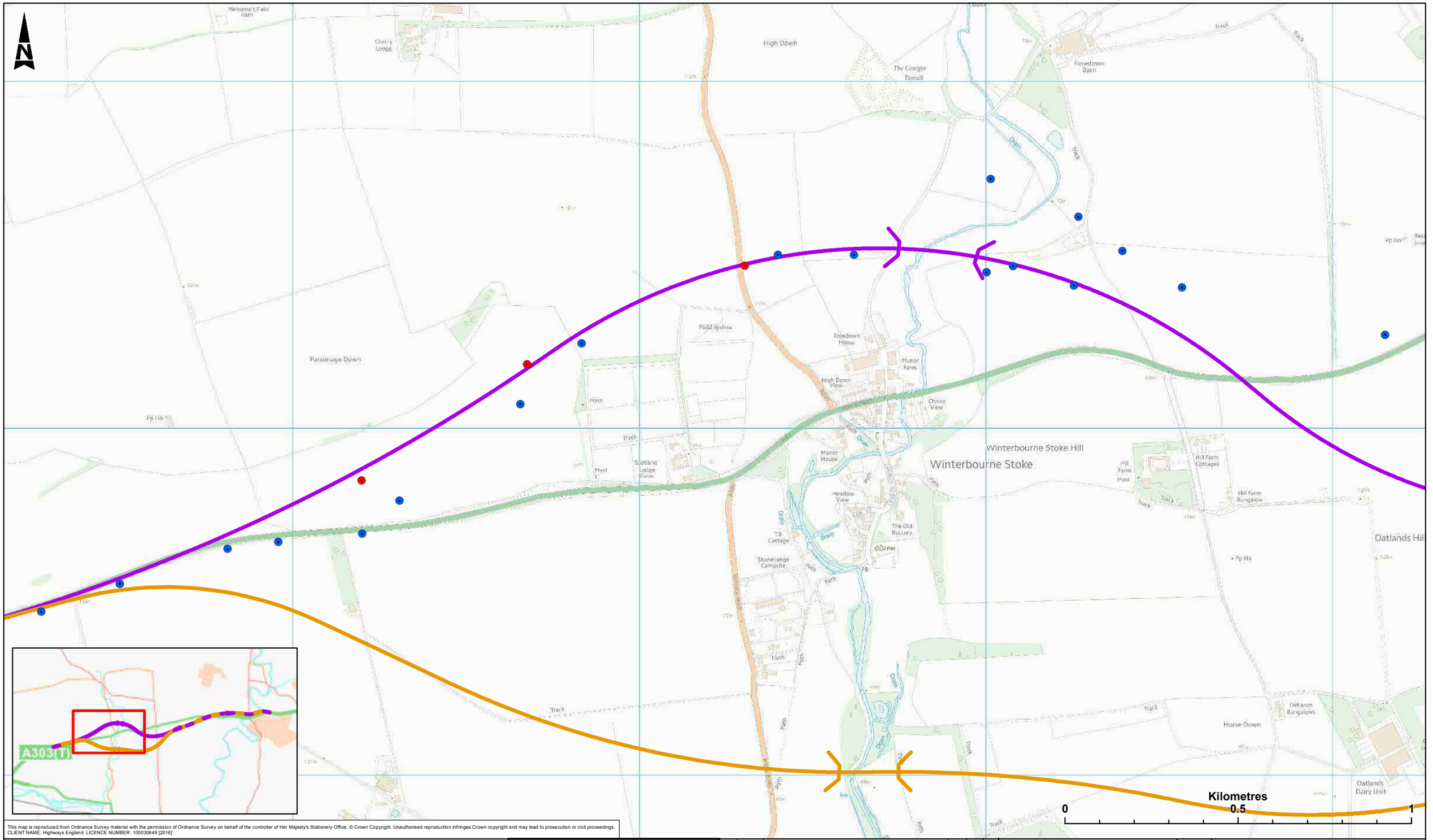
Designers: ARUP ATKINS

Scale	Designed	Drawn	Checked	Authorised
1:10,000	N/A	DI	PD	AK

Original Size	Date	Date	Date	Date
A3	N/A	21/11/16	21/11/16	21/11/16

Drawing Number: HE551506-AA-HGT-D_SWI-DR-CX-000036
(Project | Originator | Volume | Location | Type | Role | Number)

Revison: P03



LEGEND

ALIGNMENT

- D061 & D062
- ROUTE OPTION D061
- ROUTE OPTION D062

PLATE LOAD TEST

- 2001 MAIN GI
- 2002/3 SUPPLEMENTARY GI

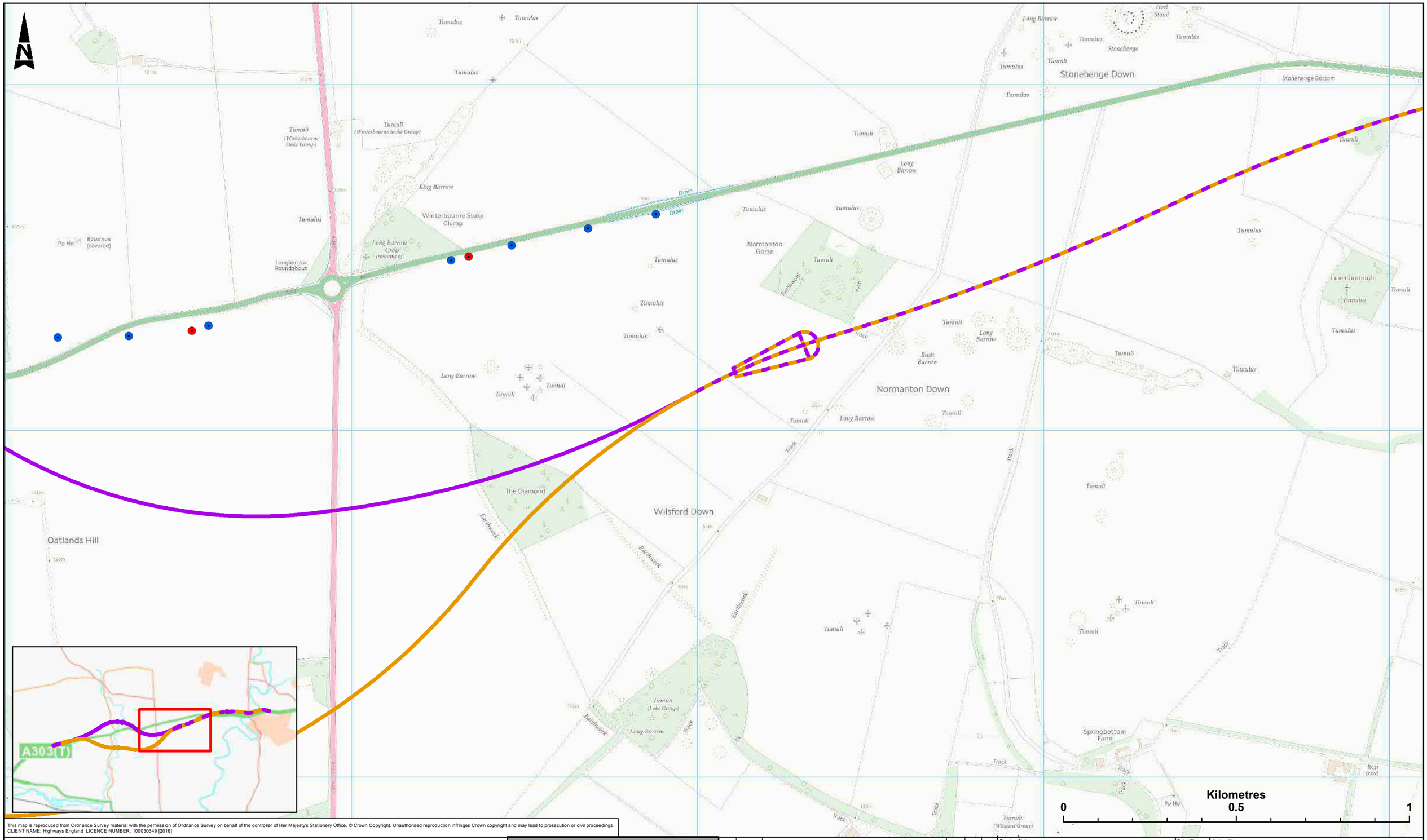
SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made in the design hazard log)
Construction
None
Maintenance / Cleaning
None
Use
None
Decommission / Demolition
None

Rev	Date	Description	By	Chk'd	App'd
P03	21/11/16	SECOND ISSUE	DI	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3
Project Title: A303 AMESBURY TO BERWICK DOWN
Client: highways england
Drawing Title: PREVIOUS GROUND INVESTIGATIONS PLATE LOAD TESTS
Designers: ARUP ATKINS

Scale	Designed	Drawn	Checked	Authorised
1:10,000	N/A	DI	PD	AK
Original Size	**Date**	**Date**	**Date**	**Date**
A3	N/A	21/11/16	21/11/16	21/11/16

Drawing Number: HE551506-AA-HGT-D_SWI-DR-CX-000037
(Project | Originator | Volume | Location | Type | Role | Number)
Revison: P03



LEGEND

ALIGNMENT

- D061 & D062
- ROUTE OPTION D061
- ROUTE OPTION D062

PLATE LOAD TEST

- 2001 MAIN GI
- 2002/3 SUPPLEMENTARY GI

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made in the design hazard log)
Construction
None
Maintenance / Cleaning
None
Use
None
Decommission / Demolition
None

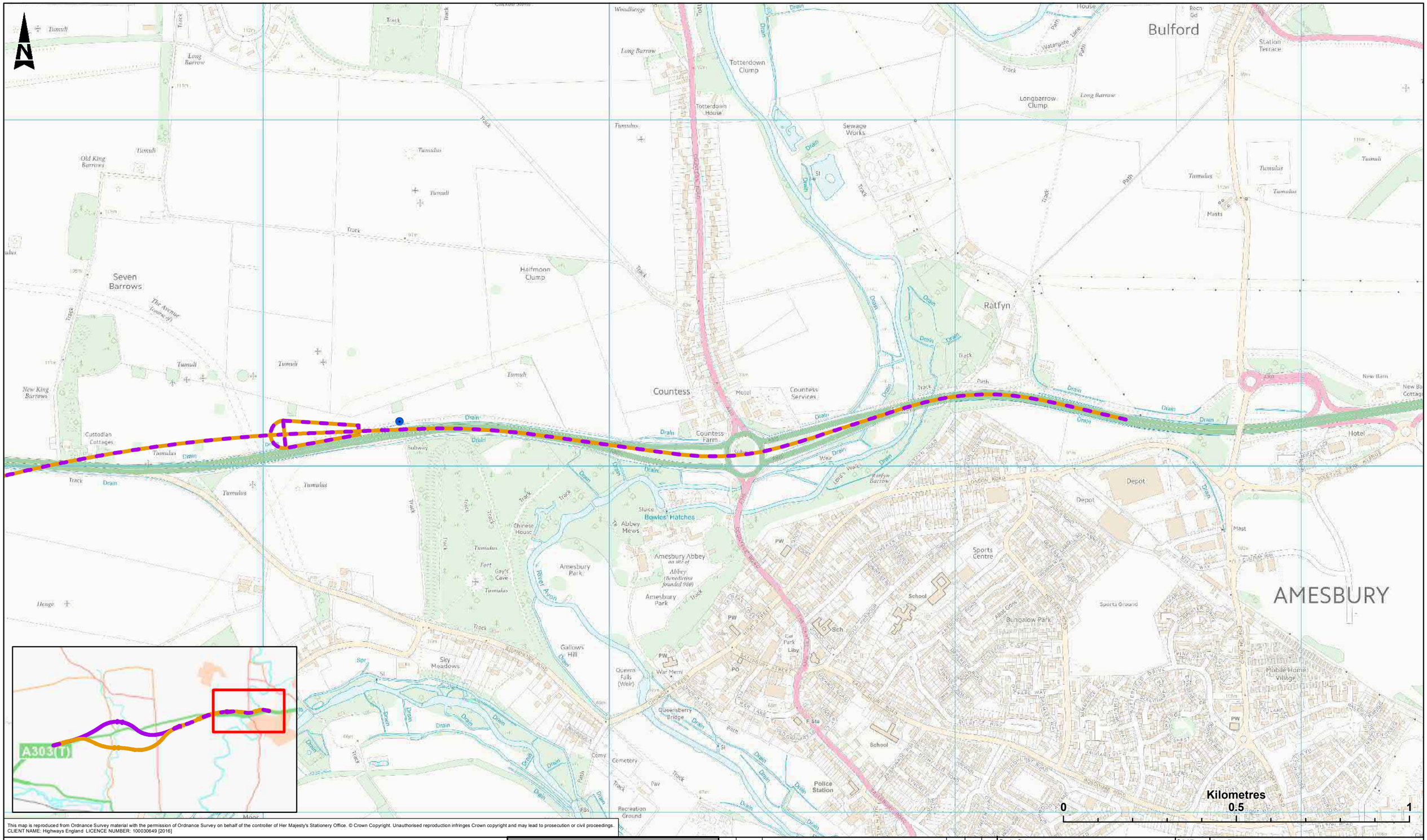
Rev	Date	Description	By	Chk'd	App'd
P03	21/11/16	SECOND ISSUE	DI	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3
Project Title: A303 AMESBURY TO BERWICK DOWN
Client: highways england
Drawing Title: PREVIOUS GROUND INVESTIGATIONS PLATE LOAD TESTS
Designers: ARUP ATKINS

Scale	Designed	Drawn	Checked	Authorised
1:10,000	N/A	DI	PD	AK

Original Size	Date	Date	Date	Date
A3	N/A	21/11/16	21/11/16	21/11/16

Drawing Number: HE551506-AA-HGT-D_SWI-DR-CX-000038 (Project | Originator | Volume | Location | Type | Role | Number)
Revison: P03



LEGEND

ALIGNMENT

- D061 & D062
- ROUTE OPTION D061
- ROUTE OPTION D062

PLATE LOAD TEST

- 2001 MAIN GI
- 2002/3 SUPPLEMENTARY GI

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made in the design hazard log)
Construction
None
Maintenance / Cleaning
None
Use
None
Decommission / Demolition
None

Rev	Date	Description	By	Chk'd	App'd
P03	21/11/16	SECOND ISSUE	DI	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3

Client: highways england

Designers: ARUP ATKINS

Project Title: A303 AMESBURY TO BERWICK DOWN

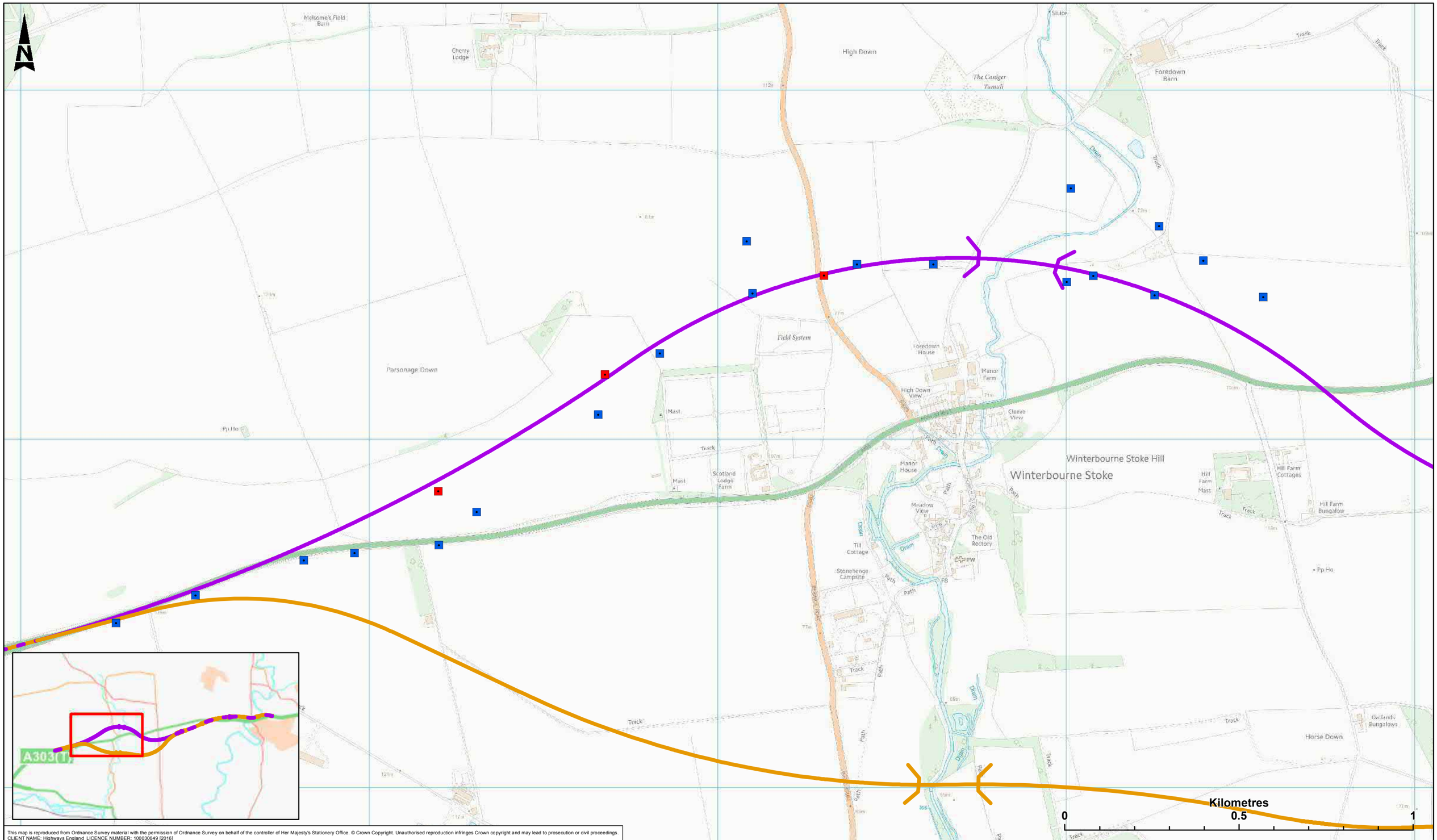
Drawing Title: PREVIOUS GROUND INVESTIGATIONS PLATE LOAD TESTS

Scale	Designed	Drawn	Checked	Authorised
1:10,000	N/A	DI	PD	AK

Original Size	Date	Date	Date	Date
A3	N/A	21/11/16	21/11/16	21/11/16

Drawing Number: Project | Originator | Volume | Location | Type | Role | Number
HE551506-AA-HGT-D_SWI-DR-CX-000039

Revison: P03



LEGEND

ALIGNMENT

- D061 & D062
- ROUTE OPTION D061
- ROUTE OPTION D062

IN SITU CBR TEST

- 2001 MAIN GI
- 2002/3 SUPPLEMENTARY GI

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made in the design hazard log)
Construction
None
Maintenance / Cleaning
None
Use
None
Decommission / Demolition
None

Rev	Date	Description	By	Chk'd	App'd
P03	21/11/16	SECOND ISSUE	DI	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3

Client: highways england

Designers: ARUP ATKINS

Project Title: A303 AMESBURY TO BERWICK DOWN

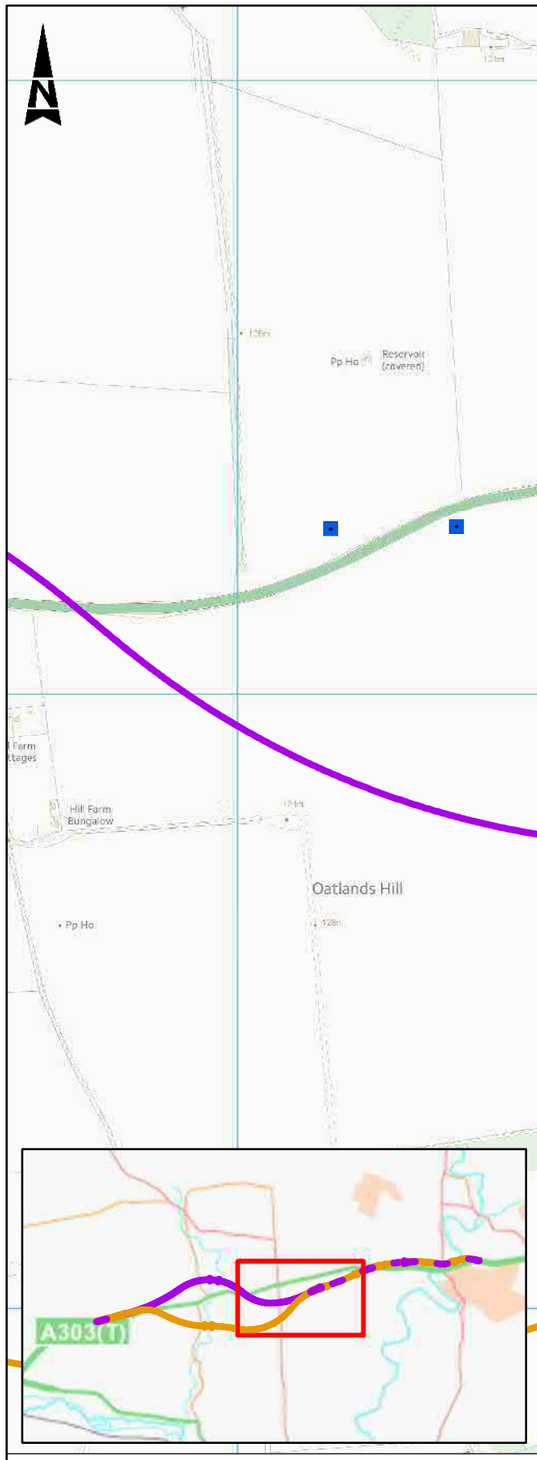
Drawing Title: PREVIOUS GROUND INVESTIGATIONS IN SITU CALIFORNIA BEARING RATIO

Scale	Designed	Drawn	Checked	Authorised
1:10,000	N/A	DI	PD	AK

Original Size	Date	Date	Date	Date
A3	N/A	21/11/16	21/11/16	21/11/16

Drawing Number: Project | Originator | Volume | Location | Type | Role | Number
HE551506-AA-HGT-D_SWI-DR-CX-000040

Revison: P03



LEGEND

ALIGNMENT

- D061 & D062
- ROUTE OPTION D061
- ROUTE OPTION D062

IN SITU CBR TEST

- 2001 MAIN GI
- 2002/3 SUPPLEMENTARY GI

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made in the design hazard log)

Construction	None
Maintenance / Cleaning	None
Use	None
Decommission / Demolition	None

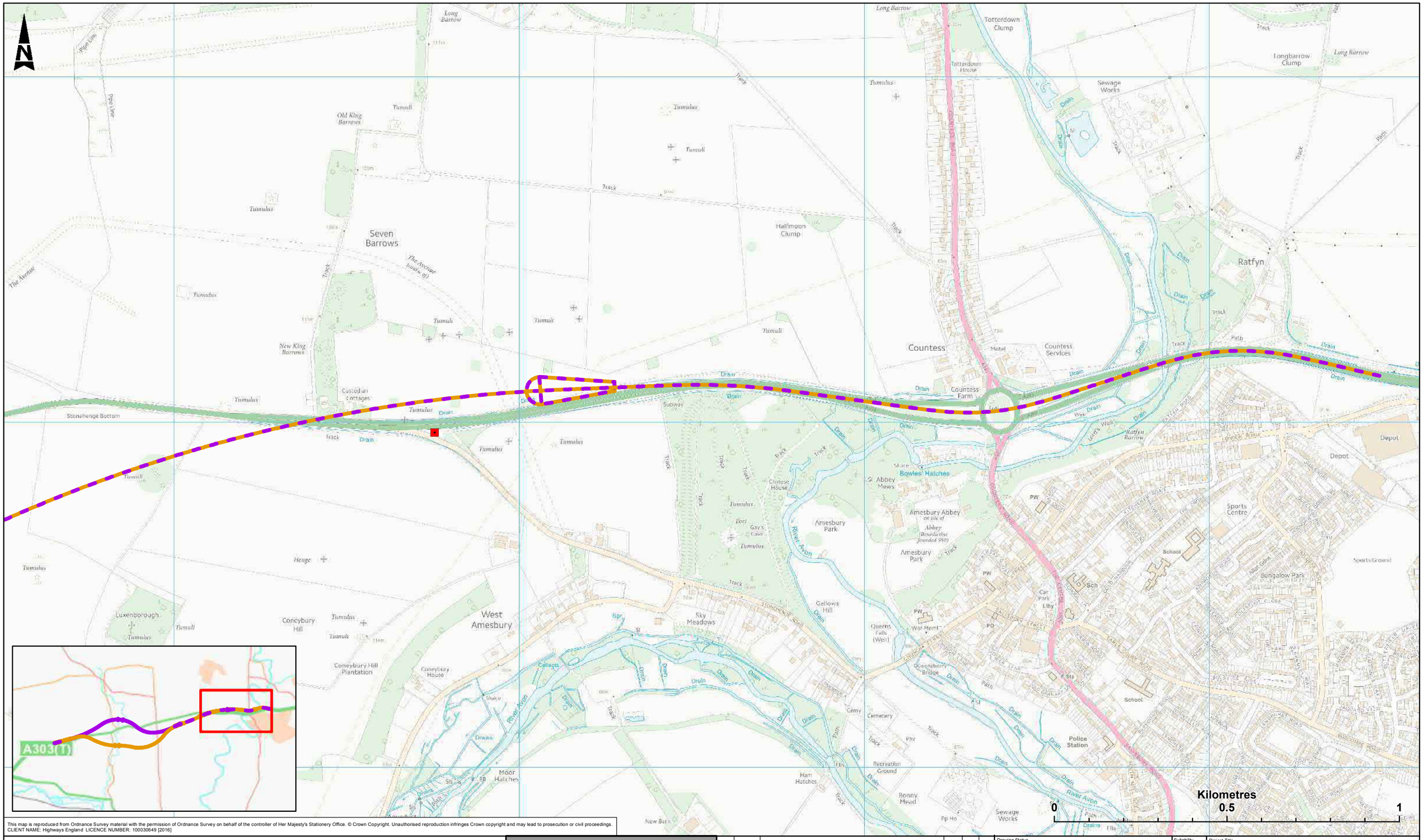
Rev	Date	Description	By	Chk'd	App'd
P03	21/11/16	SECOND ISSUE	DI	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3
Project Title: A303 AMESBURY TO BERWICK DOWN
Client: highways england
Drawing Title: PREVIOUS GROUND INVESTIGATIONS IN SITU CALIFORNIA BEARING RATIO
Designers: ARUP ATKINS

Scale	Designed	Drawn	Checked	Authorised
1:10,000	N/A	DI	PD	AK

Original Size	Date	Date	Date	Date
A3	N/A	21/11/16	21/11/16	21/11/16

Drawing Number: HE551506-AA-HGT-D_SWI-DR-CX-000041 (Project | Originator | Volume | Location | Type | Role | Number)
Revison: P03



LEGEND

ALIGNMENT

- D061 & D062
- ROUTE OPTION D061
- ROUTE OPTION D062

IN SITU CBR TEST

- 2001 MAIN GI
- 2002/3 SUPPLEMENTARY GI

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made in the design hazard log)
Construction
None
Maintenance / Cleaning
None
Use
None
Decommission / Demolition
None

Rev	Date	Description	By	Chk'd	App'd
P03	21/11/16	SECOND ISSUE	DI	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3

Client: highways england

Designers: ARUP ATKINS

Project Title: A303 AMESBURY TO BERWICK DOWN

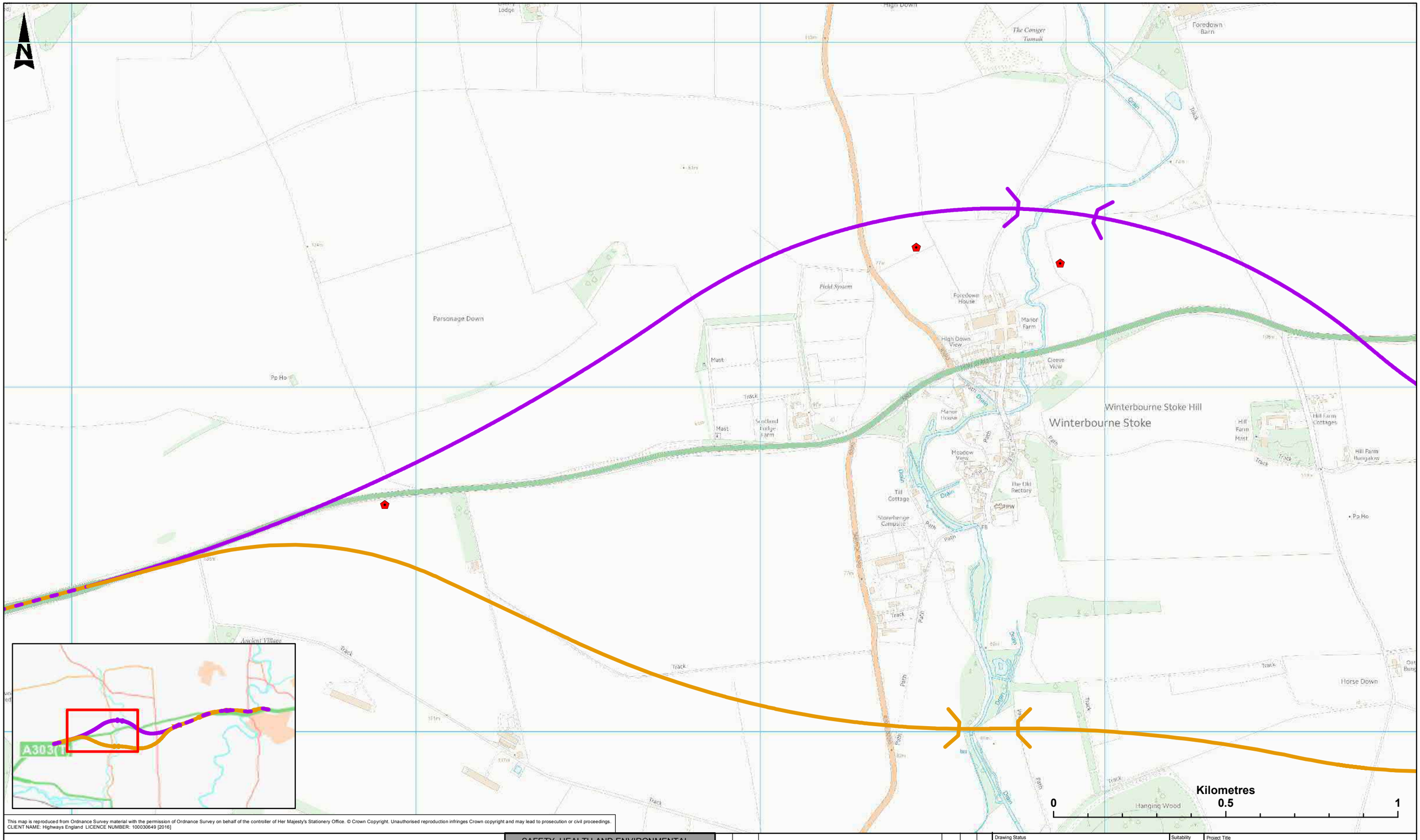
Drawing Title: PREVIOUS GROUND INVESTIGATIONS IN SITU CALIFORNIA BEARING RATIO

Scale	Designed	Drawn	Checked	Authorised
1:10,000	N/A	DI	PD	AK

Original Size	Date	Date	Date	Date
A3	N/A	21/11/16	21/11/16	21/11/16

Drawing Number: HE551506-AA-HGT-D_SWI-DR-CX-000042 (Project | Originator | Volume | Location | Type | Role | Number)

Revison: P03



LEGEND

ALIGNMENT

- D061 & D062
- ROUTE OPTION D061
- ROUTE OPTION D062

INFILTRATION TEST

- 2002 VISITOR CENTRE
- 2002/3 SUPPLEMENTARY GI
- 2010 LONGBARROW ROUNDABOUT IMPROVEMENT

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made in the design hazard log)
Construction
None
Maintenance / Cleaning
None
Use
None
Decommission / Demolition
None

Rev	Date	Description	By	Chk'd	App'd
P03	21/11/16	SECOND ISSUE	DI	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3

Client: highways england

Designers: ARUP ATKINS

Project Title: A303 AMESBURY TO BERWICK DOWN

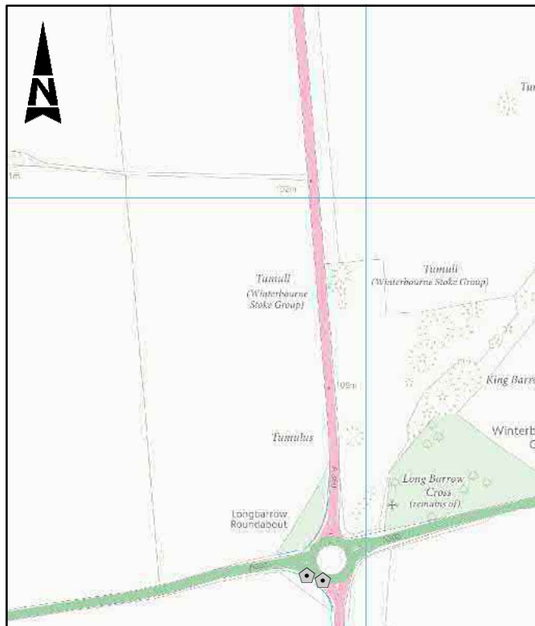
Drawing Title: PREVIOUS GROUND INVESTIGATIONS INFILTRATION TESTS

Scale	Designed	Drawn	Checked	Authorised
1:10,000	N/A	DI	PD	AK

Original Size	Date	Date	Date	Date
A3	N/A	21/11/16	21/11/16	21/11/16

Drawing Number: HE551506-AA-HGT-D_SWI-DR-CX-000043
(Project | Originator | Volume | Location | Type | Role | Number)

Revison: P03



LEGEND

ALIGNMENT

- D061 & D062
- ROUTE OPTION D061
- ROUTE OPTION D062

INFILTRATION TEST

- 2002 VISITOR CENTRE
- 2002/3 SUPPLEMENTARY GI
- 2010 LONGBARROW ROUNDABOUT IMPROVEMENT

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made in the design hazard log)

Construction	None
Maintenance / Cleaning	None
Use	None
Decommission / Demolition	None

Rev	Date	Description	By	Chk'd	App'd
P03	21/11/16	SECOND ISSUE	DI	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3

Client: highways england

Designers: ARUP ATKINS

Project Title: A303 AMESBURY TO BERWICK DOWN

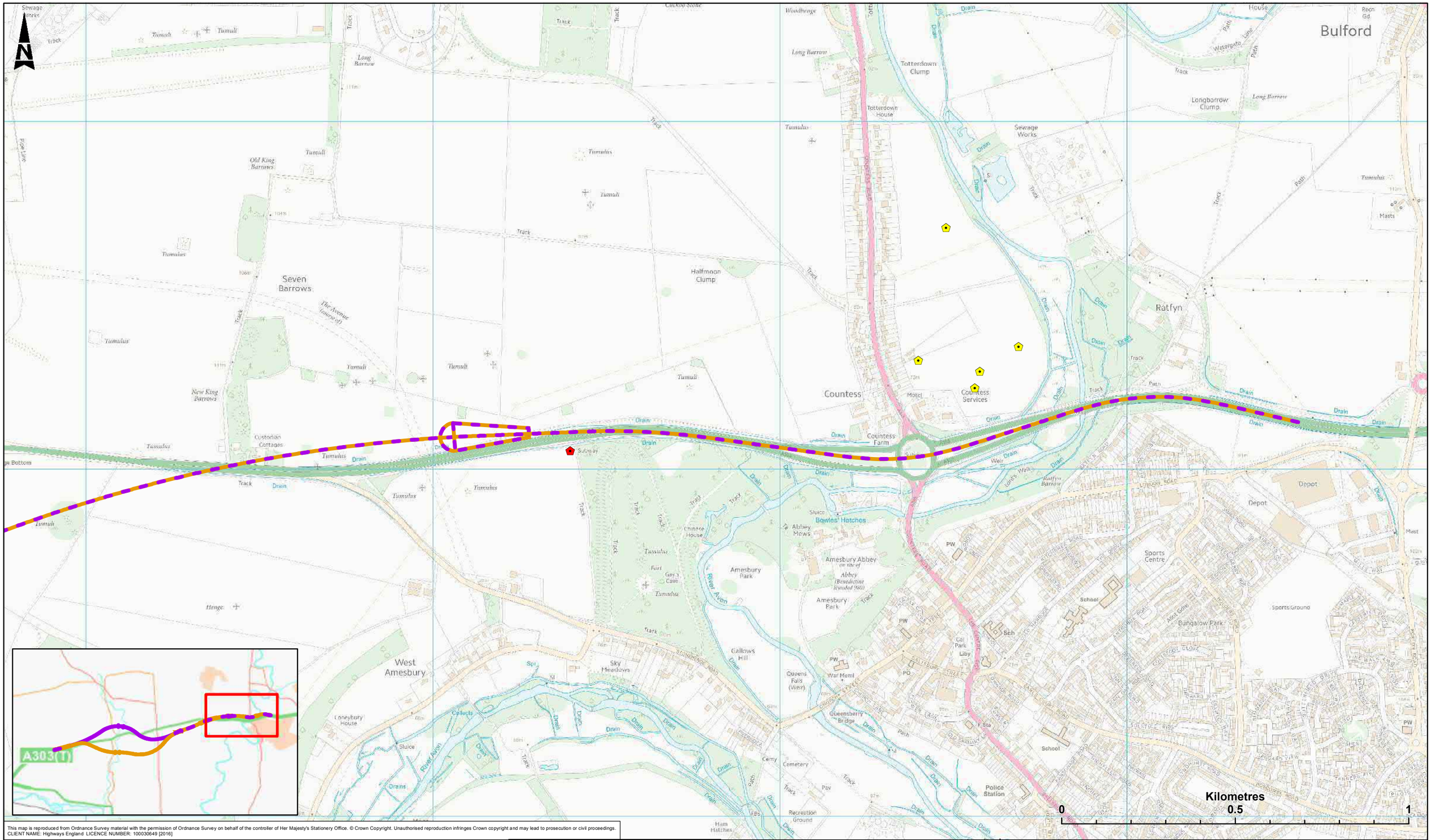
Drawing Title: PREVIOUS GROUND INVESTIGATIONS INFILTRATION TESTS

Scale	Designed	Drawn	Checked	Authorised
1:10,000	N/A	DI	PD	AK

Original Size	Date	Date	Date	Date
A3	N/A	21/11/16	21/11/16	21/11/16

Drawing Number: Project | Originator | Volume
HE551506-AA-HGT-D_SWI-DR-CX-000044
Location | Type | Role | Number

Revison: P03



LEGEND

ALIGNMENT

- D061 & D062
- ROUTE OPTION D061
- ROUTE OPTION D062

INFILTRATION TEST

- 2002 VISITOR CENTRE
- 2002/3 SUPPLEMENTARY GI
- 2010 LONGBARROW ROUNDABOUT IMPROVEMENT

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made in the design hazard log)
Construction
None
Maintenance / Cleaning
None
Use
None
Decommission / Demolition
None

Rev	Date	Description	By	Chk'd	App'd
P03	21/11/16	SECOND ISSUE	DI	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3

Client: highways england

Designers: ARUP ATKINS

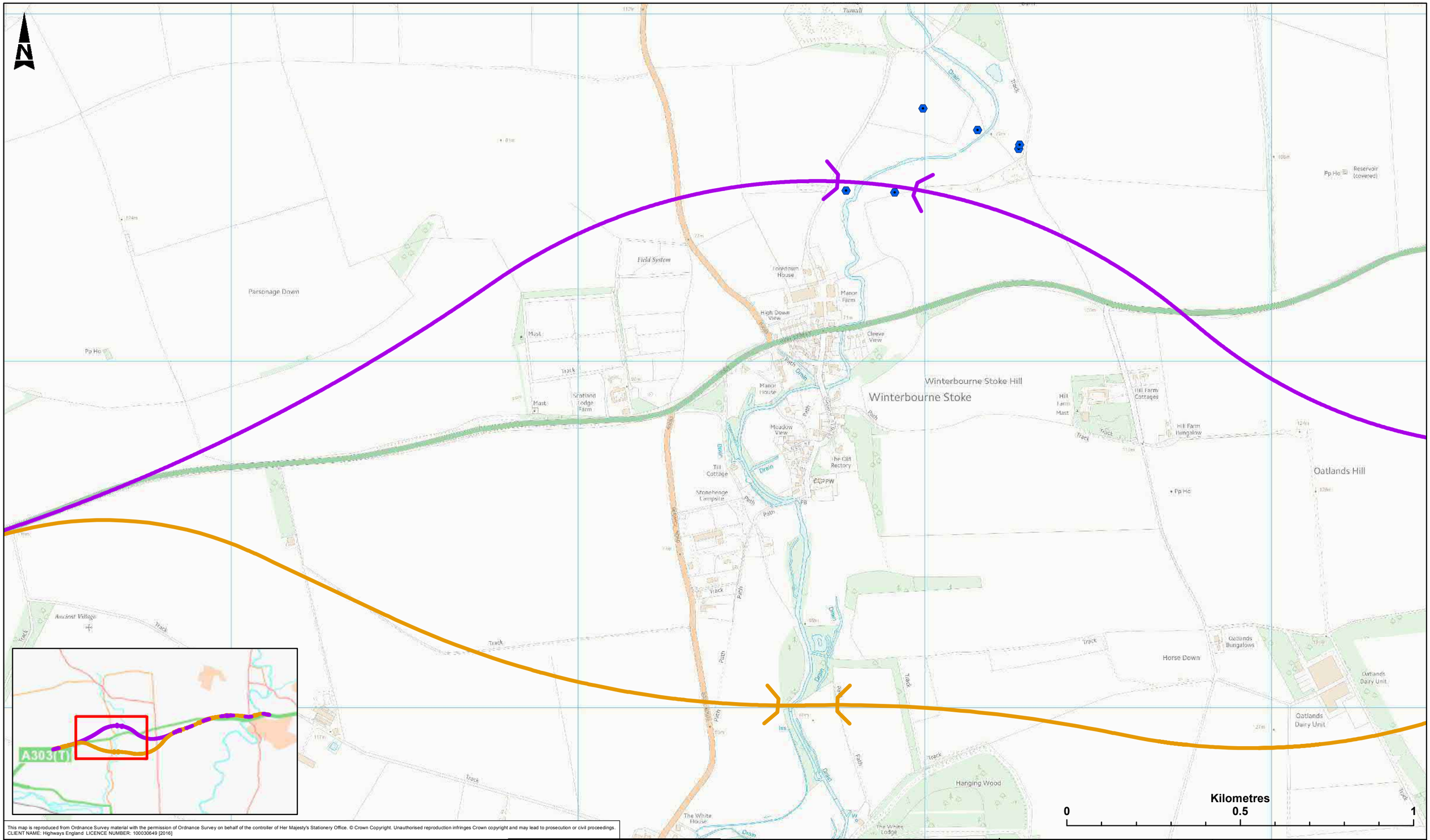
Project Title: A303 AMESBURY TO BERWICK DOWN

Drawing Title: PREVIOUS GROUND INVESTIGATIONS INFILTRATION TESTS

Scale	Designed	Drawn	Checked	Authorised
1:10,000	N/A	DI	PD	AK
Original Size	**Date**	**Date**	**Date**	**Date**
A3	N/A	21/11/16	21/11/16	21/11/16

Drawing Number: HE551506-AA-HGT-D_SWI-DR-CX-000045
(Project | Originator | Volume | Location | Type | Role | Number)

Revison: P03



LEGEND

ALIGNMENT

- D061 & D062
- ROUTE OPTION D061
- ROUTE OPTION D062

STANDARD PENETRATION TEST

- 2001 MAIN GI
- 2002 VISITOR CENTRE
- 2002/3 SUPPLEMENTARY GI
- 2009 COUNTESS ROUNDABOUT IMPROVEMENT

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made in the design hazard log)
Construction
None
Maintenance / Cleaning
None
Use
None
Decommission / Demolition
None

Rev	Date	Description	By	Chk'd	App'd
P03	21/11/16	SECOND ISSUE	DI	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3

Client: highways england

Designers: ARUP ATKINS

Project Title: A303 AMESBURY TO BERWICK DOWN

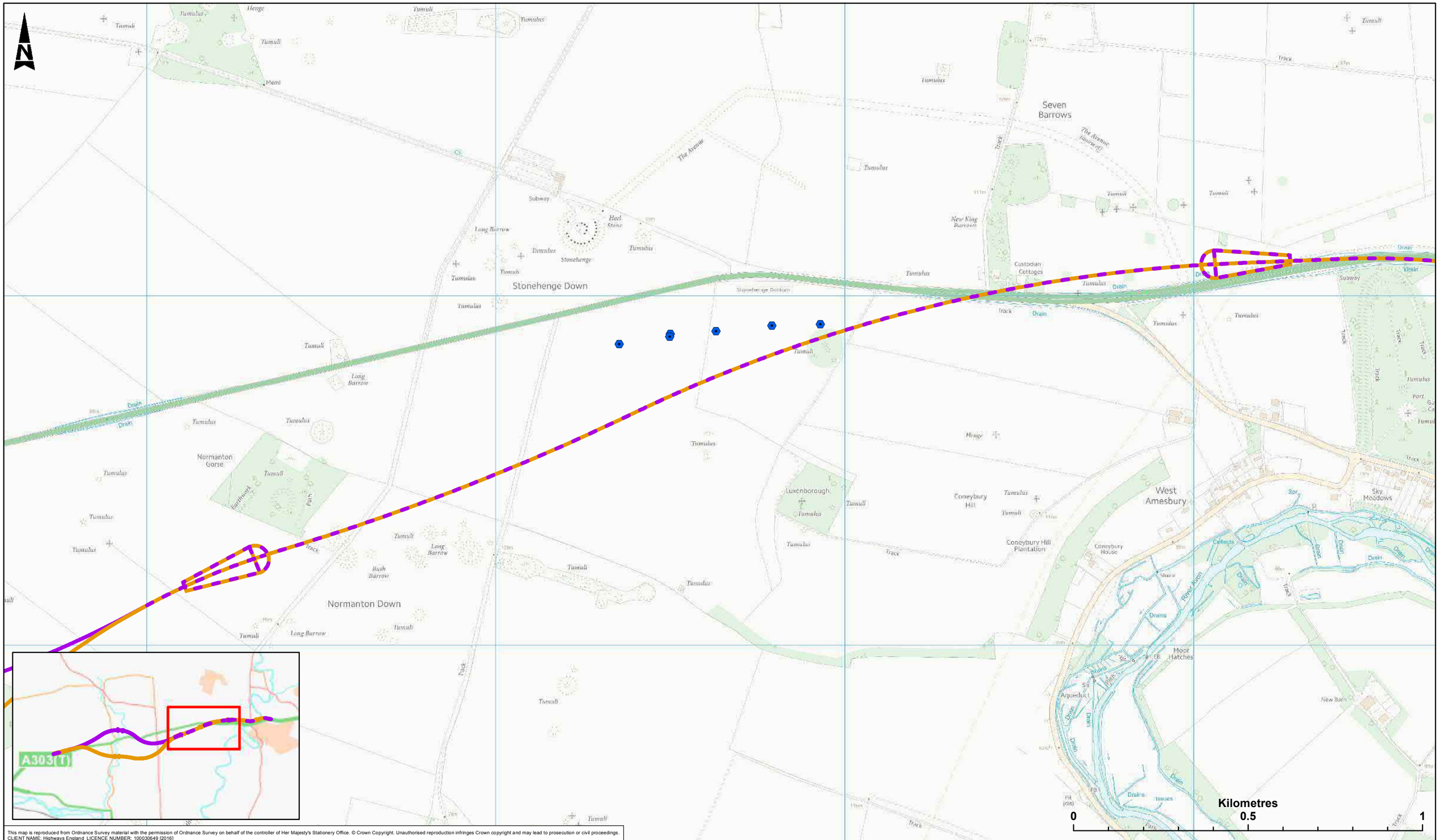
Drawing Title: PREVIOUS GROUND INVESTIGATIONS BOREHOLES WITH SPT

Scale	Designed	Drawn	Checked	Authorised
1:10,000	N/A	DI	PD	AK

Original Size	Date	Date	Date	Date
A3	N/A	21/11/16	21/11/16	21/11/16

Drawing Number: Project | Originator | Volume
HE551506-AA-HGT-D_SWI-DR-CX-000046
Location | Type | Role | Number

Revison: P03



LEGEND

ALIGNMENT

- D061 & D062
- ROUTE OPTION D061
- ROUTE OPTION D062

STANDARD PENETRATION TEST

- 2001 MAIN GI
- 2002 VISITOR CENTRE
- 2002/3 SUPPLEMENTARY GI
- 2009 COUNTESS ROUNDABOUT IMPROVEMENT

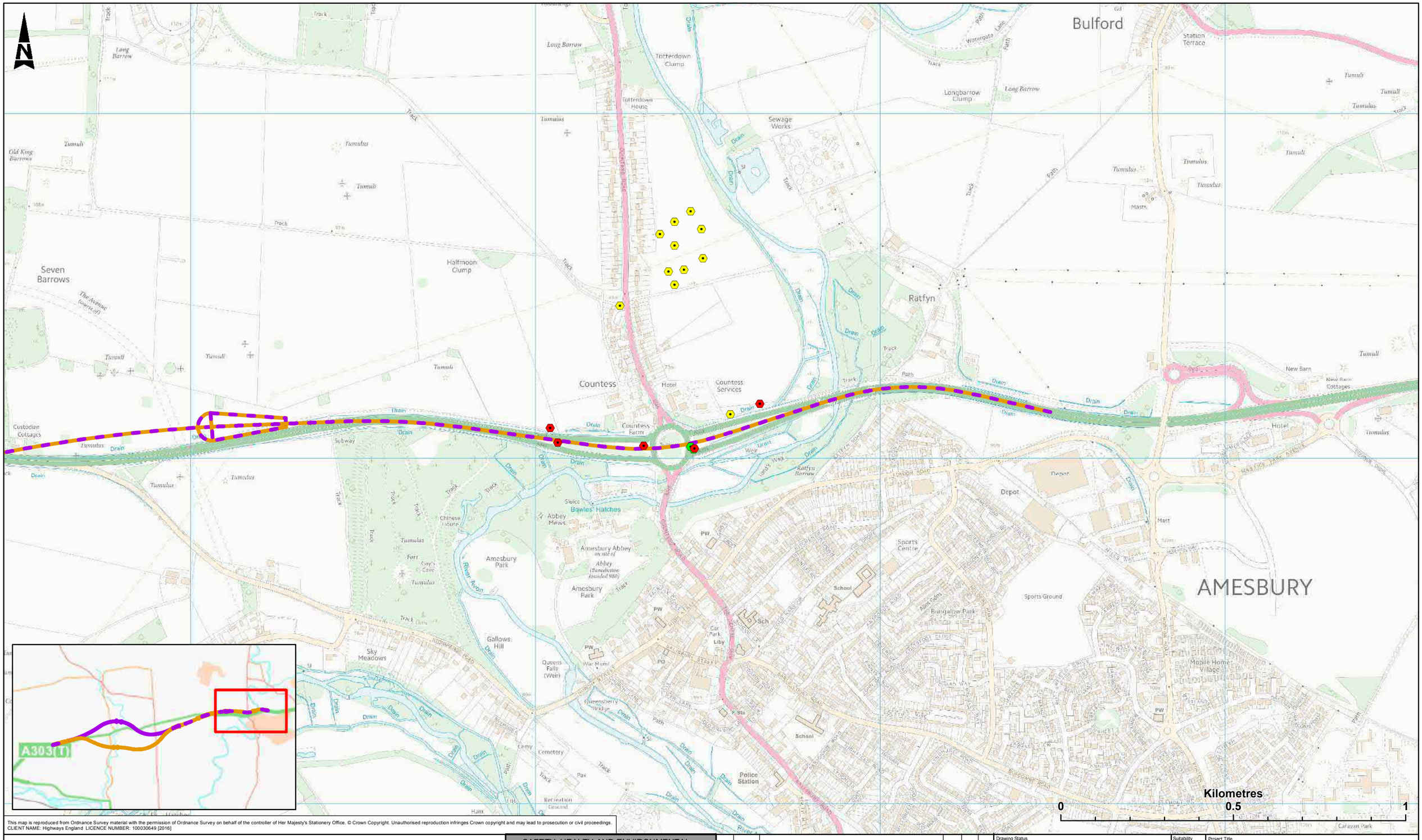
SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made in the design hazard log)
Construction
None
Maintenance / Cleaning
None
Use
None
Decommission / Demolition
None

Rev	Date	Description	By	Chk'd	App'd
P03	21/11/16	SECOND ISSUE	DI	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3
Project Title: A303 AMESBURY TO BERWICK DOWN
Client: highways england
Drawing Title: PREVIOUS GROUND INVESTIGATIONS BOREHOLES WITH SPT
Designers: ARUP ATKINS

Scale	Designed	Drawn	Checked	Authorised
1:10,000	N/A	DI	PD	AK
Original Size	**Date**	**Date**	**Date**	**Date**
A3	N/A	21/11/16	21/11/16	21/11/16

Drawing Number: HE551506-AA-HGT-D_SWI-DR-CX-000047
(Project | Originator | Volume | Location | Type | Role | Number)
Revison: P03



LEGEND

ALIGNMENT

- D061 & D062
- ROUTE OPTION D061
- ROUTE OPTION D062

STANDARD PENETRATION TEST

- 2001 MAIN GI
- 2002 VISITOR CENTRE
- 2002/3 SUPPLEMENTARY GI
- 2009 COUNTESS ROUNDABOUT IMPROVEMENT

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made in the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommission / Demolition
None

Rev	Date	Description	By	Chk'd	App'd
P01	21/11/16	SECOND ISSUE	DI	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3
Project Title: A303 AMESBURY TO BERWICK DOWN
Client: highways england
Drawing Title: PREVIOUS GROUND INVESTIGATIONS BOREHOLES WITH SPT
Designers: ARUP ATKINS

Scale	Designed	Drawn	Checked	Authorised
1:10,000	N/A	DI	PD	AK

Original Size	Date	Date	Date	Date
A3	N/A	21/11/16	21/11/16	21/11/16

Drawing Number: HE551506-AA-HGT-D_SWI-DR-CX-000048
(Project | Originator | Volume | Location | Type | Role | Number)
Revison: P03

LEGEND

ALIGNMENT

- D061 & D062
- ROUTE OPTION D061
- ROUTE OPTION D062

- LISTED BUILDINGS
- SCHEDULED MONUMENTS
- CONSERVATION AREAS
- WORLD HERITAGE SITE

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made in the design hazard log)

Construction	None
Maintenance / Cleaning	None
Use	None
Decommission / Demolition	None

Rev	Date	Description	By	Chk'd	App'd
P03	04/11/16	SECOND ISSUE	DI	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3

Client: highways england

Designers: ARUP ATKINS

Project Title: A303 AMESBURY TO BERWICK DOWN

Drawing Title: SCEHDULED MONUMENTS AND LISTED BUILDINGS

Scale	Designed	Drawn	Checked	Authorised
1:10,000	N/A	DI	PD	AK

Original Size	Date	Date	Date	Date
A3	04/11/16	04/11/16	04/11/16	04/11/16

Drawing Number: Project | Originator | Volume
HE551506-AA-HGT-D_SWI-DR-CX-000049
Location | Type | Role | Number

Revision: P03

LEGEND

ALIGNMENT

- D061 & D062
- ROUTE OPTION D061
- ROUTE OPTION D062

- LISTED BUILDINGS
- SCHEDULED MONUMENTS
- CONSERVATION AREAS
- WORLD HERITAGE SITE

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made in the design hazard log)

Construction	None
Maintenance / Cleaning	None
Use	None
Decommission / Demolition	None

Rev	Date	Description	By	Chk'd	App'd
P03	21/11/16	SECOND ISSUE	DI	PD	AK

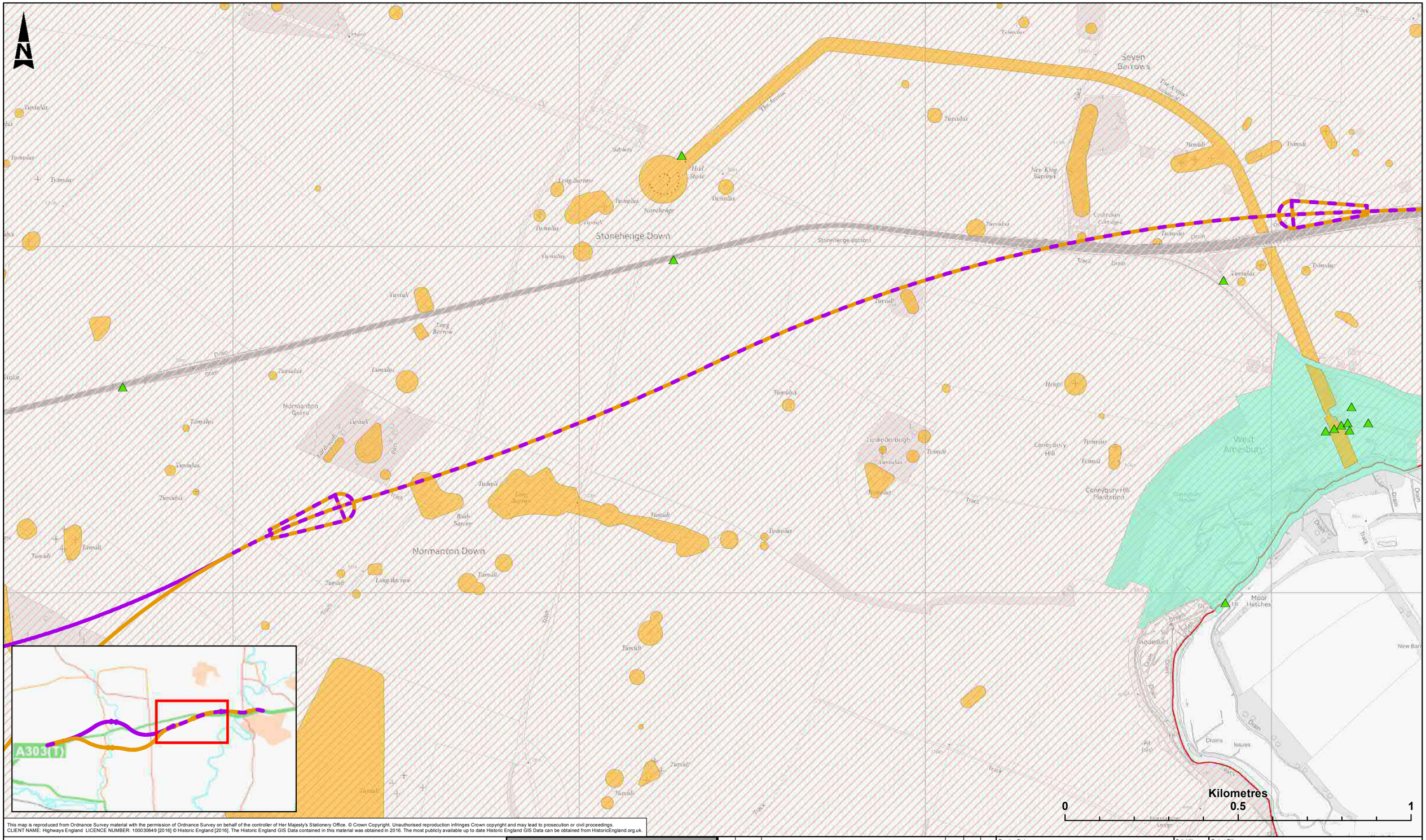
Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3
Client: highways england
Designers: ARUP ATKINS

Project Title: A303 AMESBURY TO BERWICK DOWN
Drawing Title: SCEHDULED MONUMENTS AND LISTED BUILDINGS

Scale	Designed	Drawn	Checked	Authorised
1:10,000	N/A	DI	PD	AK

Original Size	Date	Date	Date	Date
A3	21/11/16	21/11/16	21/11/16	21/11/16

Drawing Number: HE551506-AA-HGT-D_SWI-DR-CX-000050
(Project | Originator | Volume | Location | Type | Role | Number)
Revison: P03



LEGEND

ALIGNMENT

- D061 & D062
- ROUTE OPTION D061
- ROUTE OPTION D062

- LISTED BUILDINGS
- SCHEDULED MONUMENTS
- CONSERVATION AREAS
- WORLD HERITAGE SITE

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made in the design hazard log)

Construction	None
Maintenance / Cleaning	None
Use	None
Decommission / Demolition	None

Rev	Date	Description	By	Chk'd	App'd
P03	21/11/16	SECOND ISSUE	DI	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3

Client: highways england

Designers: ARUP ATKINS

Project Title: A303 AMESBURY TO BERWICK DOWN

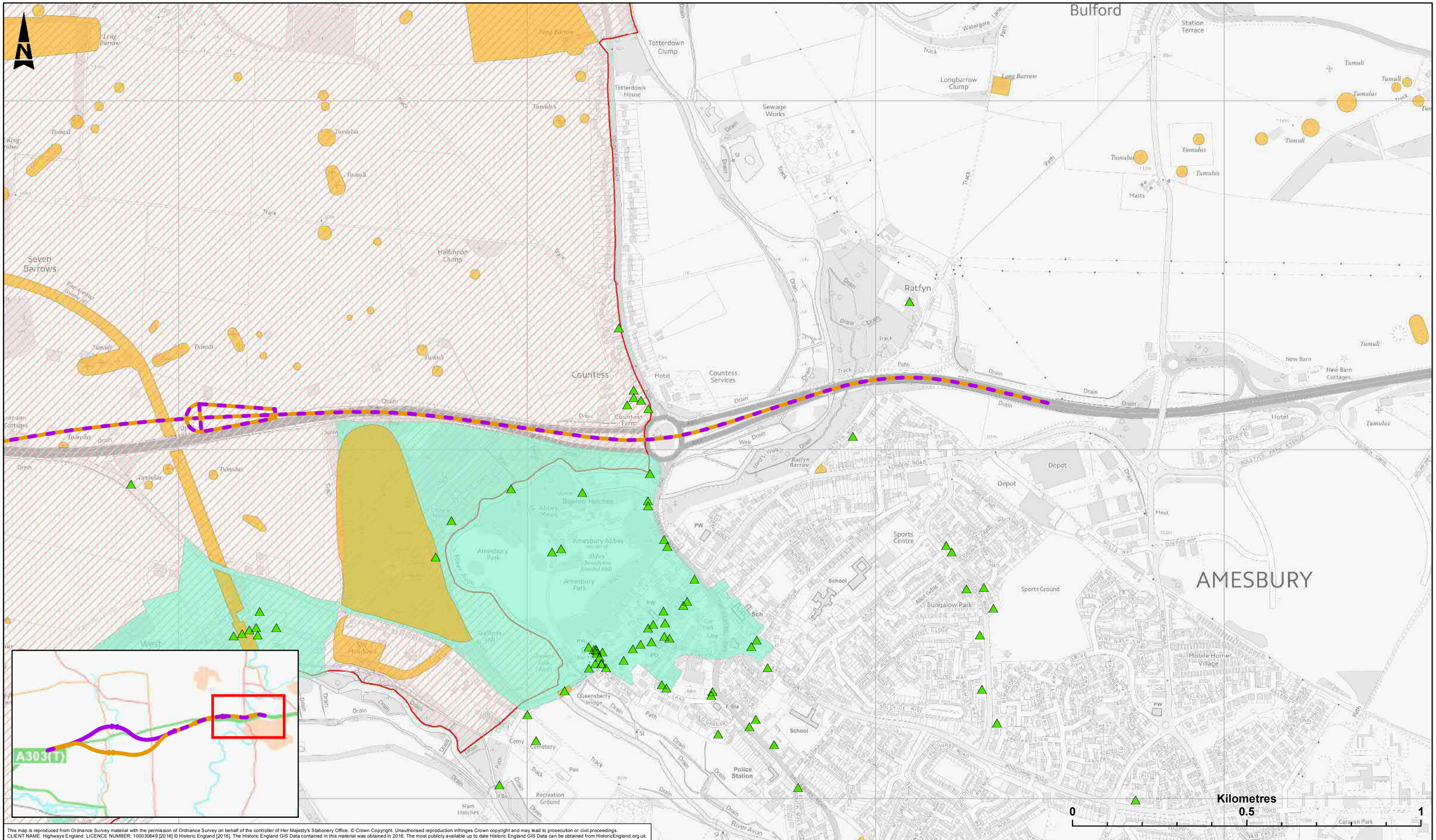
Drawing Title: SCEHDULED MONUMENTS AND LISTED BUILDINGS

Scale	Designed	Drawn	Checked	Authorised
1:10,000	N/A	DI	PD	AK

Original Size	Date	Date	Date	Date
A3	21/11/16	21/11/16	21/11/16	21/11/16

Drawing Number: Project | Originator | Volume
HE551506-AA-HGT-D_SWI-DR-CX-000051
Location | Type | Role | Number

Revison: P03



LEGEND

ALIGNMENT

- D061 & D062
- ROUTE OPTION D061
- ROUTE OPTION D062

- LISTED BUILDINGS
- SCHEDULED MONUMENTS
- CONSERVATION AREAS
- WORLD HERITAGE SITE

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made in the design hazard log)

Construction	None
Maintenance / Cleaning	None
Use	None
Decommission / Demolition	None

Rev	Date	Description	By	Chk'd	App'd
P03	21/11/16	SECOND ISSUE	DI	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3

Client: highways england

Designers: ARUP ATKINS

Project Title: A303 AMESBURY TO BERWICK DOWN

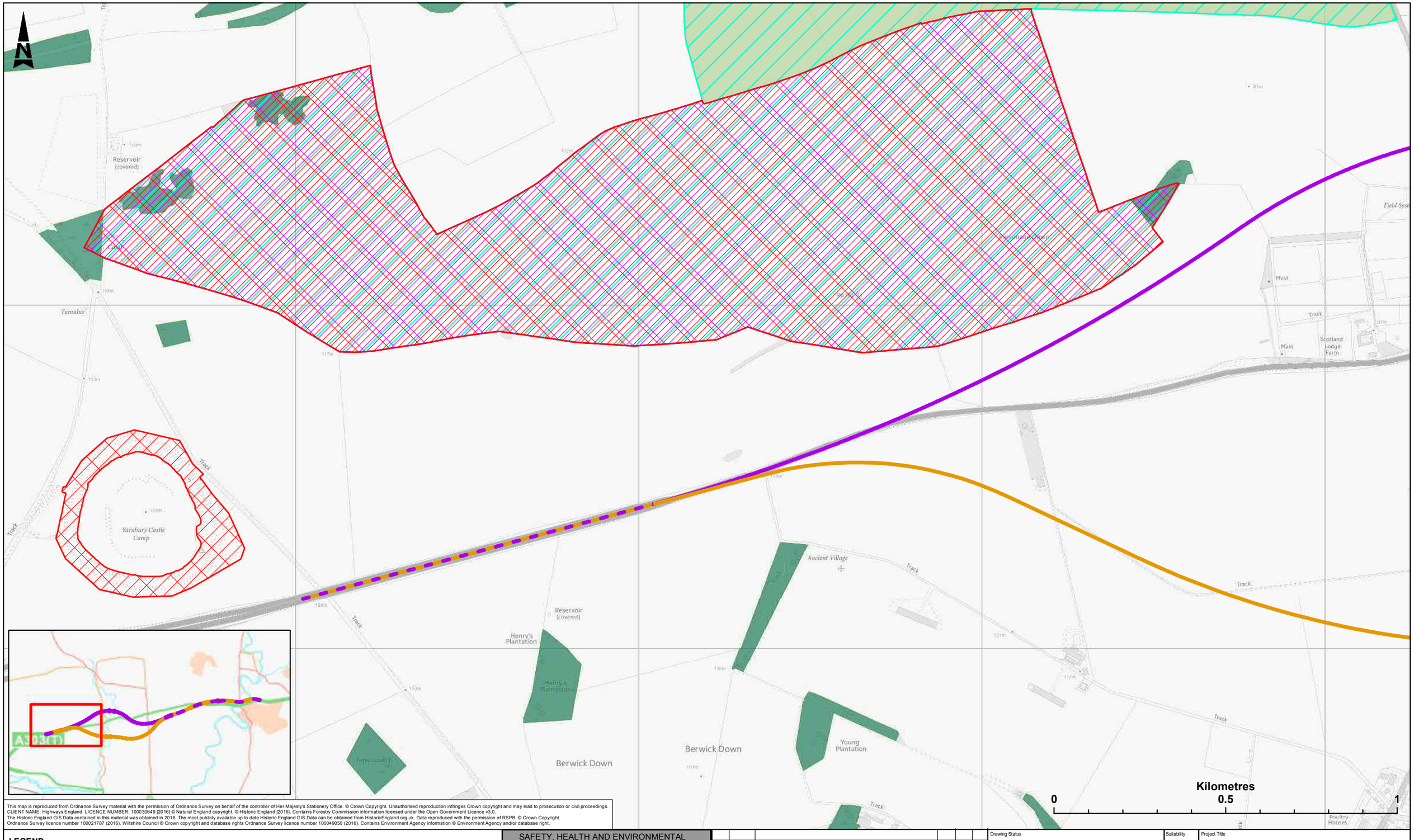
Drawing Title: SCEHDULED MONUMENTS AND LISTED BUILDINGS

Scale	Designed	Drawn	Checked	Authorised
1:10,000	N/A	DI	PD	AK

Original Size	Date	Date	Date	Date
A3	21/11/16	21/11/16	21/11/16	21/11/16

Drawing Number: Project | Originator | Volume
HE551506-AA-HGT-D_SWI-DR-CX-000052
Location | Type | Role | Number

Revison: P03



LEGEND

ALIGNMENT

- D061 & D062
- ROUTE OPTION D061
- ROUTE OPTION D062

- ANCIENT WOODLANDS
- SITES OF SPECIAL SCIENTIFIC INTEREST (SSSI)
- SPECIAL AREAS OF CONSERVATION (SAC)
- NATIONAL NATURE RESERVES (NNR)
- COUNTY WILDLIFE SITES (CWS)
- RSPB RESERVES
- NATIONAL FOREST INVENTORY
- AREAS OF OUTSTANDING NATURAL BEAUTY (AONB)
- SPECIAL PROTECTION AREAS (SPA)

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made in the design hazard log)
Construction
None
Maintenance / Cleaning
None
Use
None
Decommission / Demolition
None

Rev	Date	Description	By	Chk'd	App'd
P03	21/11/16	SECOND ISSUE	DI	PD	AK

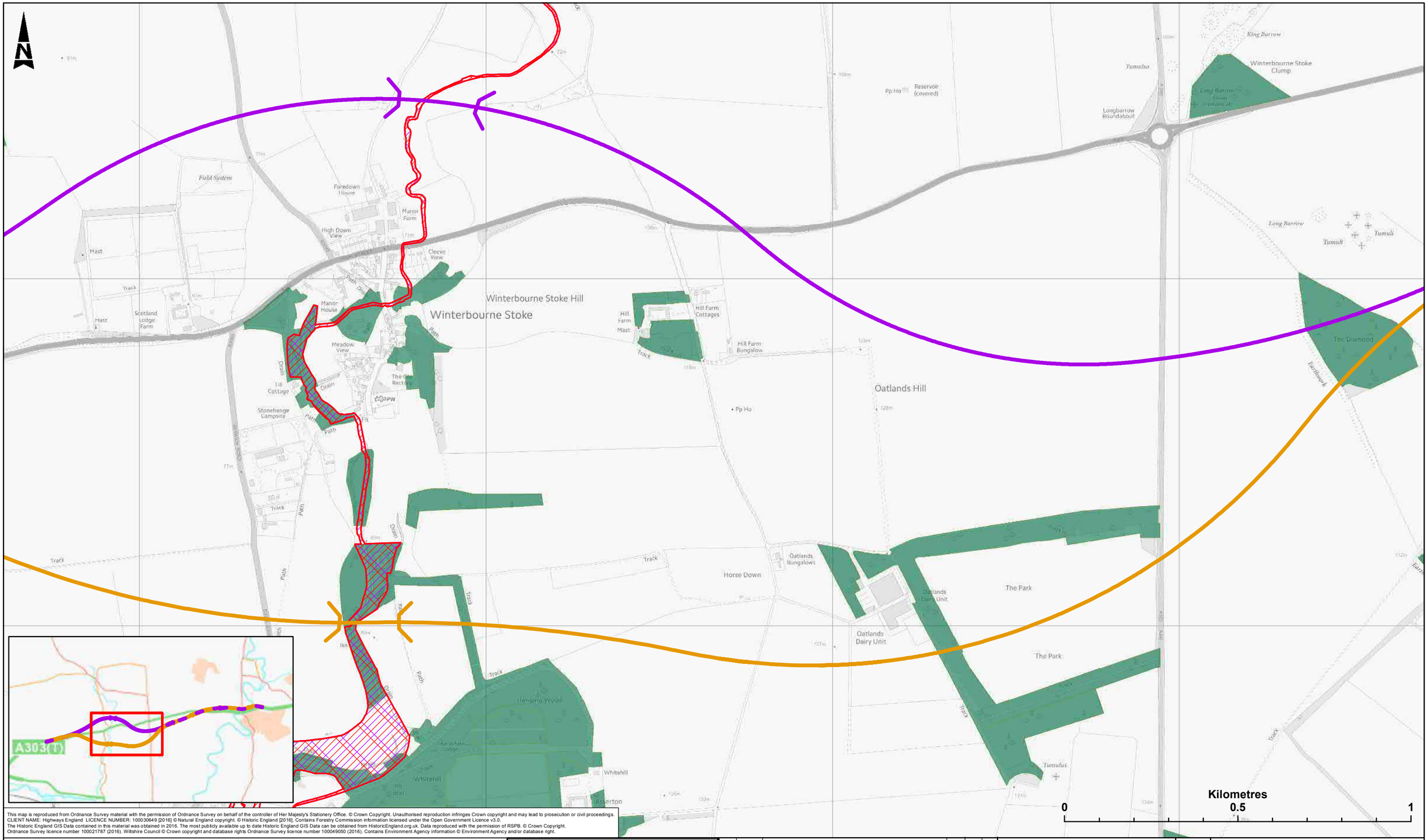
Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3
Client: highways england
Designers: ARUP ATKINS

Project Title: A303 AMESBURY TO BERWICK DOWN
Drawing Title: ECOLOGY: DESIGNATED AREAS

Scale	Designed	Drawn	Checked	Authorised
1:10,000	N/A	DI	PD	AK

Original Size	Date	Date	Date	Date
A3	21/11/16	21/11/16	21/11/16	21/11/16

Drawing Number: Project | Originator | Volume | Location | Type | Role | Number
HE551506-AA-HGT-D_SWI-DR-CX-000053
Revison: P03



LEGEND

ALIGNMENT

- D061 & D062
- ROUTE OPTION D061
- ROUTE OPTION D062

- ANCIENT WOODLANDS
- SITES OF SPECIAL SCIENTIFIC INTEREST (SSSI)
- SPECIAL AREAS OF CONSERVATION (SAC)
- NATIONAL NATURE RESERVES (NNR)
- COUNTY WILDLIFE SITES (CWS)
- RSPB RESERVES
- NATIONAL FOREST INVENTORY
- AREAS OF OUTSTANDING NATURAL BEAUTY (AONB)
- SPECIAL PROTECTION AREAS (SPA)

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made in the design hazard log)

Construction	None
Maintenance / Cleaning	None
Use	None
Decommission / Demolition	None

Rev	Date	Description	By	Chk'd	App'd
P03	21/11/16	SECOND ISSUE	DI	PD	AK

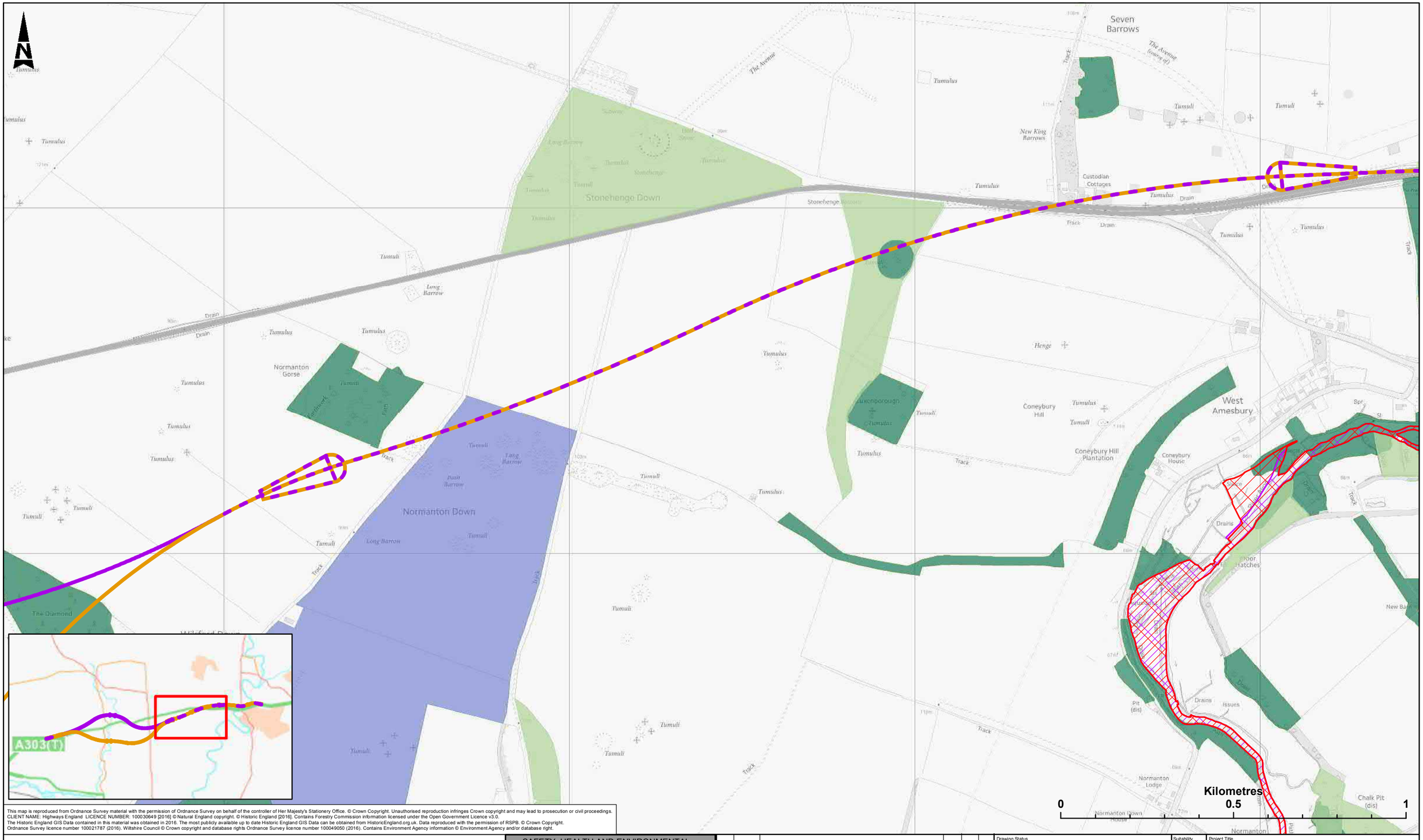
Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3
Client: highways england
Designers: ARUP ATKINS

Project Title: A303 AMESBURY TO BERWICK DOWN
Drawing Title: ECOLOGY: DESIGNATED AREAS

Scale	Designed	Drawn	Checked	Authorised
1:10,000	N/A	DI	PD	AK

Original Size	Date	Date	Date	Date
A3	21/11/16	21/11/16	21/11/16	21/11/16

Drawing Number: Project | Originator | Volume | Location | Type | Role | Number
HE551506-AA-HGT-D_SWI-DR-CX-000054
Revison: P03



LEGEND

ALIGNMENT

- D061 & D062
- ROUTE OPTION D061
- ROUTE OPTION D062

- ANCIENT WOODLANDS
- SITES OF SPECIAL SCIENTIFIC INTEREST (SSSI)
- SPECIAL AREAS OF CONSERVATION (SAC)
- NATIONAL NATURE RESERVES (NNR)
- COUNTY WILDLIFE SITES (CWS)
- RSPB RESERVES
- NATIONAL FOREST INVENTORY
- AREAS OF OUTSTANDING NATURAL BEAUTY (AONB)
- SPECIAL PROTECTION AREAS (SPA)

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made in the design hazard log)

Construction	None
Maintenance / Cleaning	None
Use	None
Decommission / Demolition	None

Rev	Date	Description	By	Chk'd	App'd
P03	21/11/16	SECOND ISSUE	DI	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3
Client: highways england
Designers: ARUP ATKINS

Project Title: A303 AMESBURY TO BERWICK DOWN
Drawing Title: ECOLOGY: DESIGNATED AREAS

Scale	Designed	Drawn	Checked	Authorised
1:10,000	N/A	DI	PD	AK

Original Size	Date	Date	Date	Date
A3	21/11/16	21/11/16	21/11/16	21/11/16

Drawing Number: HE551506-AA-HGT-D_SWI-DR-CX-000055
(Project | Originator | Volume | Location | Type | Role | Number)
Revison: P03

Kilometres
0 0.5 1

LEGEND

ALIGNMENT

- D061 & D062
- ROUTE OPTION D061
- ROUTE OPTION D062

- ANCIENT WOODLANDS
- SITES OF SPECIAL SCIENTIFIC INTEREST (SSSI)
- SPECIAL AREAS OF CONSERVATION (SAC)
- NATIONAL NATURE RESERVES (NNR)
- COUNTY WILDLIFE SITES (CWS)
- RSPB RESERVES
- NATIONAL FOREST INVENTORY
- AREAS OF OUTSTANDING NATURAL BEAUTY (AONB)
- SPECIAL PROTECTION AREAS (SPA)

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made in the design hazard log)

Construction
None

Maintenance / Cleaning
None

Use
None

Decommission / Demolition
None

Rev	Date	Description	By	Chk'd	App'd
P03	21/11/16	SECOND ISSUE	DI	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3

Client: highways england

Designers: ARUP ATKINS

Project Title: A303 AMESBURY TO BERWICK DOWN

Drawing Title: ECOLOGY: DESIGNATED AREAS

Scale	Designed	Drawn	Checked	Authorised
1:10,000	N/A	DI	PD	AK

Original Size	Date	Date	Date	Date
A3	21/11/16	21/11/16	21/11/16	21/11/16

Drawing Number: HE551506-AA-HGT-D_SWI-DR-CX-000056
(Project | Originator | Volume | Location | Type | Role | Number)

Revison: P03

CP1
CP2
CP3
CP3
CP4
CP5
AREA OF FILL (DEMOLITION RUBBLE)
MANOR FARM
PUMP HOUSE (1977-1995 MAPS)
OLD CHALK PIT (1877 MAP)
FILLING STATION
HILL FARM
LOCATION OF BARN (1877-1939 MAPS)
LOCATION OF LARKHILL MILITARY LIGHT RAILWAY (DISMANTLED BY 1924)
TP1
TP2
TP4
OLD CHALK PITS (1877 - 1939 MAPS)
LOCATION OF BLISTER HANGAR
LOCATION OF RAF OATLANDS HILL (OPERATIONAL 1941-1946)
OLD CHALK PIT (1877 - 1925 MAPS)
OLD CHALK PIT (1877 - 1939 MAPS)
LOCATION OF BLISTER HANGAR
LOCATION OF BLISTER HANGAR
UNNAMED FARM
LOCATION OF BLISTER HANGAR
OATLANDS DAIRY UNIT
OLD CHALK PITS (1877 MAP)
LOCATION OF RAF LAKE DOWN (OPERATIONAL 1917-1924)
A303(T)
Kilometres
0
0.5
1

LEGEND

ALIGNMENT
- D061 & D062
- ROUTE OPTION D061
- ROUTE OPTION D062

GROUNDWATER SAMPLING
- 2000 PRELIMINARY GI
- 2001 MAIN GI

SOIL SAMPLING
- 2001 MAIN GI
- 2009 COUNTESS ROUNDABOUT IMPROVEMENT
- 2010 LONGBARROW ROUNDABOUT IMPROVEMENT
- HISTORICAL LAND USE FEATURES
- AREAS OF POTENTIALLY CONTAMINATIVE LAND USE

NOTE: THE LOCATIONS AND EXTENTS OF THE IDENTIFIED POTENTIALLY CONTAMINATIVE LAND USES ARE BASED ON THE AVAILABLE INFORMATION REVIEWED AT THE TIME OF REPORTING

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made in the design hazard log)

Construction	None
Maintenance / Cleaning	None
Use	None
Decommission / Demolition	None

Rev	Date	Description	By	Chk'd	App'd
P03	05/12/16	SECOND ISSUE	DI	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3
Client: highways england
Designers: ARUP ATKINS

Project Title: A303 AMESBURY TO BERWICK DOWN
Drawing Title: HISTORICAL LAND USE AND CHEMICAL TESTING

Scale	Designed	Drawn	Checked	Authorised
1:10,000	N/A	DI	PD	AK

Original Size	Date	Date	Date	Date
A3	05/12/16	05/12/16	05/12/16	05/12/16

Drawing Number: Project | Originator | Volume | Location | Type | Role | Number
HE551506-AA-HGT-D_SWI-DR-CX-000057
Revison: P03

LOCATION OF RAF STONEHENGE* (OPERATIONAL 1917-1921)

P1

P2

R13

R16

WELL (1877-1924 MAPS)

LOCATION OF RAF STONEHENGE SEWAGE WORKS* (DISUSED BY 1924, REMOVED BY 1970)

END OF MOUND SHOWN AS DISUSED TIP ON 1974 MAP

*Map overlay from 1924 Wiltshire OS Map

Kilometres
0 0.5 1

LEGEND

ALIGNMENT
- D061 & D062
- ROUTE OPTION D061
- ROUTE OPTION D062

GROUNDWATER SAMPLING
- 2000 PRELIMINARY GI
- 2001 MAIN GI

SOIL SAMPLING
- 2001 MAIN GI
- 2009 COUNTESS ROUNDABOUT IMPROVEMENT
- 2010 LONGBARROW ROUNDABOUT IMPROVEMENT

- HISTORICAL LAND USE FEATURES
- AREAS OF POTENTIALLY CONTAMINATIVE LAND USE

NOTE: THE LOCATIONS AND EXTENTS OF THE IDENTIFIED POTENTIALLY CONTAMINATIVE LAND USES ARE BASED ON THE AVAILABLE INFORMATION REVIEWED AT THE TIME OF REPORTING

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made in the design hazard log)
Construction
None
Maintenance / Cleaning
None
Use
None
Decommission / Demolition
None

Rev	Date	Description	By	Chk'd	App'd
P03	05/12/16	SECOND ISSUE	DI	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3

Client: highways england

Designers: ARUP ATKINS

Project Title: A303 AMESBURY TO BERWICK DOWN

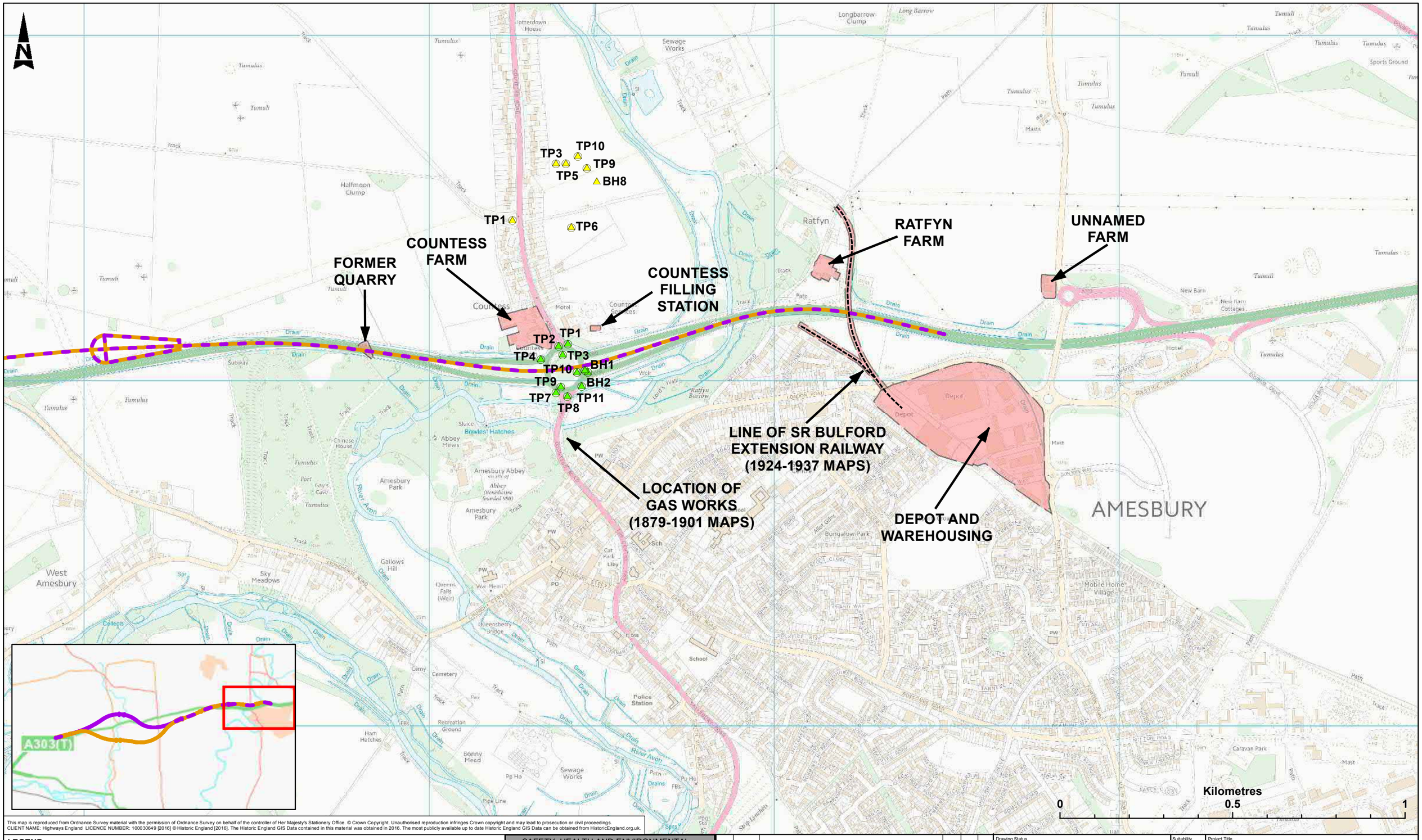
Drawing Title: HISTORICAL LAND USE AND CHEMICAL TESTING

Scale	Designed	Drawn	Checked	Authorised
1:10,000	N/A	DI	PD	AK

Original Size	Date	Date	Date	Date
A3	05/12/16	05/12/16	05/12/16	05/12/16

Drawing Number: Project | Originator | Volume | Location | Type | Role | Number
HE551506-AA-HGT-D_SWI-DR-CX-000058

Revison: P03



LEGEND

ALIGNMENT
- D061 & D062
- ROUTE OPTION D061
- ROUTE OPTION D062

GROUNDWATER SAMPLING
- 2000 PRELIMINARY GI
- 2001 MAIN GI
- 2002 VISITOR CENTRE

SOIL SAMPLING
- 2001 MAIN GI
- 2002 VISITOR CENTRE
- 2009 COUNTESS ROUNDABOUT IMPROVEMENT
- 2010 LONGBARROW ROUNDABOUT IMPROVEMENT
- HISTORICAL LAND USE FEATURES
- AREAS OF POTENTIALLY CONTAMINATIVE LAND USE

NOTE: THE LOCATIONS AND EXTENTS OF THE IDENTIFIED POTENTIALLY CONTAMINATIVE LAND USES ARE BASED ON THE AVAILABLE INFORMATION REVIEWED AT THE TIME OF REPORTING

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made in the design hazard log)

Construction	None
Maintenance / Cleaning	None
Use	None
Decommission / Demolition	None

Rev	Date	Description	By	Chk'd	App'd
P03	05/12/16	SECOND ISSUE	DI	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3
Client: highways england
Designers: ARUP ATKINS

Project Title: A303 AMESBURY TO BERWICK DOWN
Drawing Title: HISTORICAL LAND USE AND CHEMICAL TESTING

Scale	Designed	Drawn	Checked	Authorised
1:10,000	N/A	DI	PD	AK

Original Size	Date	Date	Date	Date
A3	05/12/16	05/12/16	05/12/16	05/12/16

Drawing Number: HE551506-AA-HGT-D_SWI-DR-CX-000059 (Project | Originator | Volume | Location | Type | Role | Number)
Revison: P03

LEGEND

ALIGNMENT

- D061 & D062
- ROUTE OPTION D061
- ROUTE OPTION D062
- OVERHEAD HV LINES
- INDICATIVE PATH OF ESSO PIPELINE

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made in the design hazard log)
Construction
This ESSO line on this map must not be used to locate the pipe. The location of the Pipe must be verified and pegged on site by the Pipeline Operator before any excavation or disturbance of the ground near it commences, except for normal cultivation no deeper than 12" or 300mm. Telephone 0800136812 to arrange.
Maintenance / Cleaning
None
Use
None
Decommission / Demolition
None

Rev	Date	Description	By	Chk'd	App'd
P03	21/11/16	SECOND ISSUE	DI	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3

Client: highways england

Designers: ARUP ATKINS

Project Title: A303 AMESBURY TO BERWICK DOWN

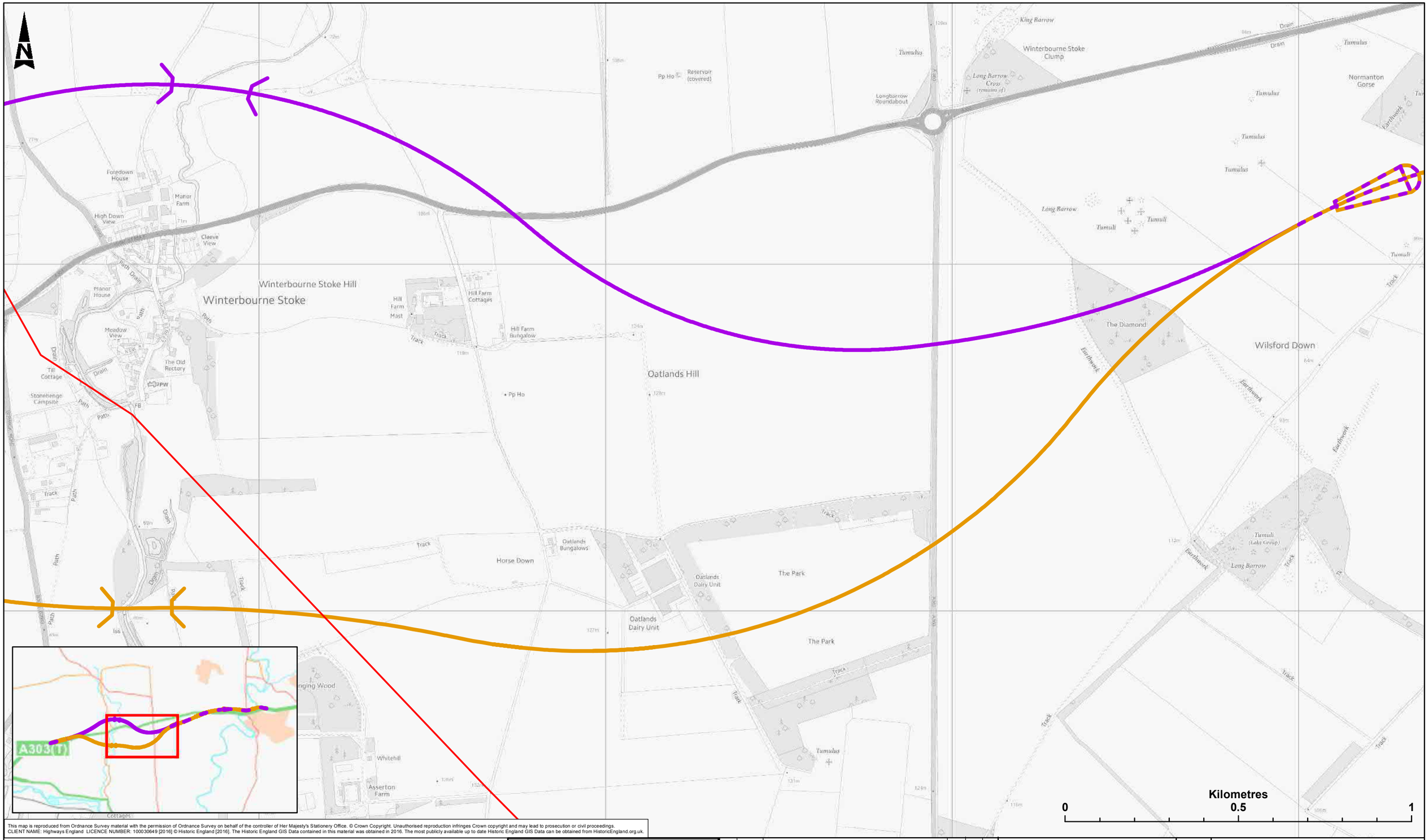
Drawing Title: EXISTING STRUCTURES

Scale	Designed	Drawn	Checked	Authorised
1:10,000	N/A	DI	PD	AK

Original Size	Date	Date	Date	Date
A3	21/11/16	21/11/16	21/11/16	21/11/16

Drawing Number: HE551506-AA-HGT-D_SWI-DR-CX-000060
(Project | Originator | Volume | Location | Type | Role | Number)

Revison: P03



LEGEND

ALIGNMENT

- D061 & D062
- ROUTE OPTION D061
- ROUTE OPTION D062
- OVERHEAD HV LINES
- INDICATIVE PATH OF ESSO PIPELINE

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made in the design hazard log)
Construction
This ESSO line on this map must not be used to locate the pipe. The location of the Pipe must be verified and pegged on site by the Pipeline Operator before any excavation or disturbance of the ground near it commences, except for normal cultivation no deeper than 12" or 300mm. Telephone 0800136812 to arrange.
Maintenance / Cleaning
None
Use
None
Decommission / Demolition
None

Rev	Date	Description	By	Chk'd	App'd
P03	21/11/16	SECOND ISSUE	DI	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3

Client: highways england

Designers: ARUP ATKINS

Project Title: A303 AMESBURY TO BERWICK DOWN

Drawing Title: EXISTING STRUCTURES

Scale	Designed	Drawn	Checked	Authorised
1:10,000	N/A	DI	PD	AK

Original Size	Date	Date	Date	Date
A3	21/11/16	21/11/16	21/11/16	21/11/16

Drawing Number: HE551506-AA-HGT-D_SWI-DR-CX-000061
(Project | Originator | Volume | Location | Type | Role | Number)

Revison: P03

VESPASIAN'S UNDERPASS

Wilsford Down

A303(T)

Kilometres
0 0.5 1

LEGEND

ALIGNMENT

- D061 & D062
- ROUTE OPTION D061
- ROUTE OPTION D062
- OVERHEAD HV LINES
- INDICATIVE PATH OF ESSO PIPELINE
- EXISTING STRUCTURES

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made in the design hazard log)
Construction
This ESSO line on this map must not be used to locate the pipe. The location of the Pipe must be verified and pegged on site by the Pipeline Operator before any excavation or disturbance of the ground near it commences, except for normal cultivation no deeper than 12" or 300mm. Telephone 0800136812 to arrange.
Maintenance / Cleaning
None
Use
None
Decommission / Demolition
None

Rev	Date	Description	By	Chk'd	App'd
P03	21/11/16	SECOND ISSUE	DI	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3

Client: highways england

Designers: ARUP ATKINS

Project Title: A303 AMESBURY TO BERWICK DOWN

Drawing Title: EXISTING STRUCTURES

Scale	Designed	Drawn	Checked	Authorised
1:10,000	N/A	DI	PD	AK

Original Size	Date	Date	Date	Date
A3	21/11/16	21/11/16	21/11/16	21/11/16

Drawing Number: Project | Originator | Volume | Location | Type | Role | Number
HE551506-AA-HGT-D_SWI-DR-CX-000062

Revison: P03

VESPASIAN'S UNDERPASS

PUMPING STATION

BRIDGE ACROSS RIVER AVON

COUNTESS ROUNDABOUT PEDESTRIAN SUBWAY

Bulford

AMESBURY

Countess

Ratfyn

Kilometres
0 0.5 1

LEGEND

ALIGNMENT

- D061 & D062
- ROUTE OPTION D061
- ROUTE OPTION D062
- OVERHEAD HV LINES
- INDICATIVE PATH OF ESSO PIPELINE
- EXISTING STRUCTURES

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made in the design hazard log)
Construction
This ESSO line on this map must not be used to locate the pipe. The location of the Pipe must be verified and pegged on site by the Pipeline Operator before any excavation or disturbance of the ground near it commences, except for normal cultivation no deeper than 12" or 300mm. Telephone 0800136812 to arrange.
Maintenance / Cleaning
None
Use
None
Decommission / Demolition
None

Rev	Date	Description	By	Chk'd	App'd
P03	21/11/16	SECOND ISSUE	DI	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3

Client: highways england

Designers: ARUP ATKINS

Project Title: A303 AMESBURY TO BERWICK DOWN

Drawing Title: EXISTING STRUCTURES

Scale	Designed	Drawn	Checked	Authorised
1:10,000	N/A	DI	PD	AK

Original Size	Date	Date	Date	Date
A3	21/11/16	21/11/16	21/11/16	21/11/16

Drawing Number: HE551506-AA-HGT-D_SWI-DR-CX-000063
(Project | Originator | Volume | Location | Type | Role | Number)

Revison: P03

Appendix B Aerial photography review

B.1 Introduction

B.1.1.1 The proposed A303 route D061 and D062 options have been examined on selected dates of vertical aerial survey and oblique aerial photography in order to interpret ground conditions. Ground conditions observed include geology, slope and drainage conditions of geotechnical significance, and recent historical land uses. Pre-modern historic land use and features of potential archaeological significance are not covered by this review.

B.1.1.2 The discovered aerial photographic record goes back to 1943 for vertical cover and to 1921 for oblique. The early photographs show the site before recent modern development, principally the 1960s A303 bypass and development to the north of Amesbury. The vertical cover enables the site to be observed in three dimensions over a period of 70 years. For the majority of the site where little modern development has occurred, the great strength of the aerial photographic record – vertical and oblique – is that the site may be examined in different seasons with varying soil moisture contrasts, sun angles and orientations that reveal features by crop marks and shadows; these ephemeral traces are generally not apparent on the ground.

B.1.1.3 Examined photo frame reference numbers are listed in Tables B1 and B2 and a full catalogue of aerial surveys discovered in Table B3.

B.1.1.4 Geologically, the route lies entirely within Chalk with occasional thin colluvium and Alluvium in the several dry valleys and alluvial fill in the river valleys north of Amesbury and through Winterbourne Stoke. West of Winterbourne Stoke, the Chalk rises to higher elevations and is more deeply incised by dry valleys. To the East of Winterbourne Stoke, the Chalk is lower and more undulating with a denser network of shallow dry valleys and tributaries revealed as much by darker soils as slight topographic swales. The pattern of the dry valley system is rectilinear and is interpreted to be controlled by a major joint system.

B.1.1.5 Recent and contemporary agricultural land use is mainly pastoral grazing with low impact, apart from a limited area of modern intensive hog-rearing west of the tunnel section. North of Amesbury the existing A303 has suburban ribbon development around its junction with the A345.

B.1.1.6 Historical military land use is evident in the outlines of WW1 airbase buildings south west of Stonehenge and small hangars of a recorded but little used WW2 grass airfield at Oatlands Hill. No evidence of ordnance trials or damage was detected.

B.2 Method

B.2.1.1 Enquiries were sent to known commercial and institutional sources of vertical and oblique aerial photography. Vertical photographs taken at 1:10,000 scale or larger, only, were requested as smaller scales generally do not reveal the level of detail required.

B.2.1.2 The results are listed in Table B1 and cover the period 1943 to 2009. The vertical photography was taken in parallel overlapping flight lines with 60% overlaps in line to provide continuous stereoscopic cover. They were originally taken for the purpose of topographic mapping and map revision. Ordnance Survey (OS),

Royal Air Force (RAF) and, occasionally, commercial sources are archived at the National Monument Record Centre (NMRC) within Historic England at Swindon.

B.2.1.3 To accomplish a comprehensive overview of the ground conditions in the time available, block coverage was selected for time frames identified in 1945, 1967-1973, 1996 and 2002. The concept was that if the selected sorties indicated that more detail was required, intervening dates could be viewed as an additional separate exercise.

B.2.1.4 Within the four selected time frames, 234 vertical photographs along the centre-line were examined using a mirror stereo scope with x3 binoculars.

B.2.1.5 Oblique photographs taken between 1921 and 2013 cover most of the route. The selected oblique aerial photographs date from 1921 to 2013 and are listed in Table B2. Of over 1600 oblique photographs covering the search blocks along the route, 225 of the route centre line were examined.

B.2.1.6 Geological observations, slope features and evidence of historical land use from the vertical and oblique photographs have been plotted on 1:10,000 OS base maps along the proposed route centre line, see Figures B1 and B2. Selected annotated photographs are given in Figures B3 to B16.

B.3 Route Segment Descriptions

B.3.1.1 The route runs largely in chalk with occasional thin alluvial or colluvial deposits. The chalk may be divided into two distinct zones, approximately divided by the River Till valley which flows intermittently through Winterbourne Stoke. To the west, the chalk is characterised by a higher elevation, reaching 159 m by the Yarnbury Castle milestone, and deeply incised dry valleys. To the east, lower undulating chalk has a denser network of shallow dry valleys and shallower dry tributary swales revealed as much by soil tonal contrast in spring photography as by topography. In both zones, the dry valley network is rectilinear and appears to be controlled by a major joint system which initially focussed drainage and erosion, infiltration, and deep weathering.

B.3.2 Berwick Down to Normanton Gorse – D061 North by-pass (Figures B3 to B6)

B.3.2.1 The route begins on a broad summit where five dry valleys meet. The valleys are short and deeply incised with asymmetric cross-sections indicating a stratigraphic dip to the south southeast. Within the route corridor they drain eastward with prominent WSW-ENE lengths and short NNW-SSE tributaries that tend to align across intervening divides. The drainage plan suggests major joint control, with past drainage following a more erodible course in weaker rock. The steep sides and headwalls of the tributary dry valleys are remarkable given their short length and potentially suggest rapid headward erosion of springs when the water table was higher and supported permanent or more prolonged seasonal flow.

B.3.2.2 The route follows a drainage divide on a prominent spur for 2,750m, the first 1,400m along the existing A303. Between 500 and 650m from the beginning, the route runs along the top of a tributary dry valley slope where the tributary dry valleys on either side of the valley align and indicate the probable presence of a zone of weaker rock along a major joint. Here the existing route is in a shallow sidelong cut to fill bench; the cut face is bare on the 2001 photography but shows no evidence of instability. The embankment is scrub-vegetated and appears

stable as well. Eastward of the bench the existing A303 descends at grade for 650m at a 1:65 gradient, and the proposed route D061 continues across Parsonage Down for 800m at a very gentle gradient before dropping 50m over 700m to a dry valley floor.

B.3.2.3 Parallel to and adjacent within 75m of the alignment, a steep natural chalk slope of 1:5 is stable with the apparent dip into the slope. The opposite side of this dry valley has a natural slope of 1:15 with the dip out of the slope. The dip of the chalk strata controls the natural asymmetry of the valley.

B.3.2.4 Terrace gravels are mapped on the dry valley floor which the proposed route traverses. These have a limited outcrop and are likely to be thin. The route continues along the contour in chalk to the narrow flood plain of the River Till north of Winterbourne Stoke. Although mapped by the OS as a continuous water feature, the place name indicates that it flows in the winter and the autumnal and summer photographs of 1945 and 1996, respectively, show that flow is ephemeral as the stream channel itself disappears as the 'river' dries up. The terrace is very low and generally indistinguishable from the Alluvium topographically or tonally.

B.3.2.5 The present channel at the crossing point is a ditch on all dates from 1945. A dry pond on an earlier ditch is visible to the north and a dry meandering natural channel to the south of the crossing point. The channel contains water on the 2001 photographs.

B.3.2.6 The route continues from the River Till flood plain on a low chalk spur then along a shallow dry valley course to cross the existing A303 at an acute angle. Adjacent to and north of the route at the chalk – terrace boundary there is a steep low bank that was vegetated in 1945 but which appears in June 1996 to have been recently worked. To the south of the proposed route, on the existing A303, a steep wooded slope, on the south side of the approach into Winterbourne Stoke, appears to be an excavated slope.

B.3.2.7 Gentle undulating chalk continues to Normanton Gorse. The dry tributary valleys are shallow and symmetrical, indicating a dip close to horizontal and/or a more uniform unstratified chalk. Some dry tributaries are very shallow and tend to be revealed in some years by crop marks or soil tones when there is sufficient soil moisture contrast. One such shallow dry valley feature is intersected at the proposed west tunnel approach cutting and portal.

B.3.2.8 RAF Oatlands airfield was operational from June 1941 to 13 May 1946 when it closed (Airfields of Britain Conservation Trust). It was a satellite to Old Sarum airfield, 8.5km to the southeast. It is reported to have had three grass airstrips, four blister hangars, a control tower in the northwest corner of the 'flying field', and a cluster of domestic buildings on the western 'outside' edge of the airfield. (Historic England Past Landscapes).

B.3.2.9 Vertical photographs from 1943 (partial) and 1945, do show the four blister hangars around the field designated on the ABCT website and named on the OS map as Oatlands Hill, but no wheel marks or airfield layout are visible in the grass. There was a farm lane into the central west area of the field with a small shed in a wider turning area at the end of the lane and one hardstanding for a single aircraft on the north side of this lane; the lane, hardstanding and turning area were still visible as an empty concrete pavement in 2009; the turning area appears to have manure piled on it in 2005 and 2009.The four hangars were still present in 1970, but only one remained in 1996, in the southeast corner of the airfield and beside the A360, still evidently in use as a farm outbuilding. It was

removed between end of January and the summer of 2005, leaving a white chalky scar. None of the hangars or the midfield lane and concreted areas are on the route centre lines.

B.3.2.10 A Blister hanger was a sheet metal arch, later corrugated sheet metal, stretched over wooden, later steel, ribs. It did not require foundations and could be anchored with iron stakes. It was designed for rapid deployment; many survived the war as sheds and farm outbuildings. They came in various sizes; the ones on Oatlands Hill airfield had a span of approx 25m and a width of 20m.These hangers, apart from the one by the A303, could be approached on farm lanes.

B.3.2.11 Adjacent to the south and east of Oatlands Hill and the proposed route, there is clear evidence of a disused airfield with grass strips, taxi ways, a shooting range, a wind sock and a helicopter landing pad. The helicopter landing pad area is still maintained in private grounds on the 2009 photography.

B.3.2.12 Although it had four hangars around its edge and hardstanding for two aircraft, Oatlands Hill had no visible record of aircraft use on the open grass field or in the vicinity of the hangars during the war, whereas the airfield to the southeast was evidently well used. Oatlands Hill appears to have been only very lightly used during its brief support role.

B.3.2.13 Until the late 1960s the land was used primarily for grazing or cutting hay for winter feed. Subsequently, the land came gradually under the plough. For a period in the 1970s a curious agricultural or horticultural experiment took place in the central area of Oatlands Hill field. It may have been a seed trial as it is far from the periphery. In 1970, three narrow rectangular areas were ploughed or scraped exposing the chalky subsoil. In one of these scrapes, along the lane into the field centre, there were neat strips and small neat rectangles of soil. In 1975, this particular scrape had been restored to pasture, but the other two scrapes remained and one of these had similar neat rectangles of soil piled in the white scraped area. In 1976, these remaining scrapes were grassed. Elsewhere in the area to the south similar dimensioned scrapes were observed on single occasions but not with the neat soil piles. These appear to have been completely ephemeral agricultural experiments, but are mentioned as they lie on the proposed centre-line. Berwick Down to Normanton Gorse – D061 North by-pass (Figures B3 to B6)

B.3.2.14 The route follows the centre line (thalweg) of a dry valley from the divide of Berwick Down to the point where the dry valley widens as it meets the valley of the River Till. Following very wet years, seepage may be expected on the valley floor. The rectilinear pattern of the dry valleys indicates that major joint systems influenced their location; the chalk is likely to be more deeply weathered, with possible dissolution features along the thalweg of the dry valley.

B.3.2.15 The River Till has observed cut channels in its flood plain to the north of the route centreline which become obscured on the aerial photographs by vegetation across the centreline.

B.3.2.16 East of the River Till, the steep side slopes of a chalk spur and divide appear to be stable. On Oatlands Hill, the gentle chalk slopes are geologically featureless as far as the convergence of routes D061 and D062.

B.3.3 Proposed tunnel section D061 and D062 (Figures B7 to B13)

B.3.3.1 In the vicinity of the proposed west tunnel portal the land was in arable use still in 2005. In early 2009, the land was in use for hog rearing, laid out in rectilinear plots, although near the A303, the lay out was in long triangular pens radiating

from central feeding points. This particular configuration continued in 2010, but by 2012 these feed lots had reverted to arable land and the feed lots had moved towards the triangular wood noted above. Evidently a field rotation of temporary feed lots and arable crops and/or hay was in practice here. This was not observed elsewhere along the route.

B.3.3.2 The tunnel section runs under gently sloping chalk that is characterised at the surface by a relatively dense rectilinear network of dry valleys, some of which are topographically obvious and others that are shallow and more clearly evident by soil tone in winter photographs and by crop marks in some years. The short minor tributaries nearly meet at low divides. The density of the drainage pattern indicates a relatively less permeable chalk (than west of the River Till) that leads to greater run-off. The rectilinear pattern of the dry valley tributaries suggests a joint control of weathering and dissolution of the chalk. Below the surface the generally uniform character of the chalk may be relatively weaker and more permeable. The tunnel alignment intersects this joint system in four places: obliquely at the west portal; at right angles 1,000m from the west portal (below the former sewage works soakaway, see Section B.3.3.5); at right angles 1,550m from the west portal; and on the line of the east tunnel portal. Depending on the width of the tunnels the first 200-400m in from the east portal will follow the line of a dry valley tributary.

B.3.3.3 Previous site investigation works along two parallel lines on the south side of the A303 opposite Stonehenge are set out on 21 April 2001 vertical photography. The Google Earth imagery, dated 1/1/2002 but obviously taken during early summer, shows crop marks in the vicinity of these same works but not following the same access tracks; these 2002 tracks cover additional works to the east of the 2001 observed works.

B.3.3.4 Low angled sunlight on some winter dates reveals hummocky ground on the west valley side of Stonehenge Bottom, a dry valley. Usually hummocky ground indicates solifluction but this is uncharacteristic of chalk and is not observed on the other dry valley profiles in the area. The hummocks have a pronounced toe, almost a bench, along the base and are interpreted as very old workings in the area where phosphatic chalk has been revealed by previous site investigations. The workings appear only on the west valley side, east boundary of the exposure.

B.3.3.5 A sewage treatment plant for a WW 1 barracks lay just north of the tunnel centre-line within a dry valley. The barracks was aligned with the original road, since removed. Down valley from the barracks a raised soakaway bed was located over the tunnel centre line, approx. 1,000m from the west portal. The barracks is visible on May, 1923 photography, when it was still mostly standing, although several of the dormitory blocks had been removed. The sewage treatment plant consisted of a block of three settling tanks which fed three interlocking circular aeration beds. At the downstream end of the compound there was an open inspection chamber. Downstream of the compound there was a white linear scar, in 1923, as if a pipe had been excavated, but this detail disappeared off the edge of the photo.

B.3.3.6 On the same photograph, the original north-south track that had served the barracks and, to the north, intersected the outer ring of Stonehenge, was being relocated further west to the position visible in 1943 and 1945. Between 1945 and 1970, the track was relocated westward, again, to its present position Low angled winter sunlight reveals the outlines of completely dismantled barracks in

the 1943 photography; the disused sewage treatment plant settling and aeration tanks remained but the inspection chamber and the fence of the original compound were gone. The narrow soakaway bed was still visible. The 1970 photograph shows that the concrete settlement and aeration tanks and the soakaway bed had been removed leaving light toned, level, disturbed soil areas. What appears to be a shed in 1970 at the end of the levelled area of the former soakaway, was in fact a haystack.

B.3.4 Eastern section to Amesbury D061 and D062 (Figures B14 to B16)

B.3.4.1 The proposed east portal emerges in a landscaped park east of Stonehenge Cottages and beside the existing A303 bypass north of Amesbury. The tunnel, portal and tunnel approach cutting are on the line of a dry valley. As discussed above in Section B.3.3.1, the Chalk may be more deeply weathered here. The proposed route merges with the A303 as it enters a cutting through a low chalk ridge. The 1968 and 1970 photographs show the cutting under construction and completed. The cut slopes appear stable and without visible sign of infilled dissolution features.

B.3.4.2 The Amesbury by-pass was built over water meadows on the north side of the River Avon which was diverted eastward and culverted prior to embankment construction and southward to its present course to accommodate the road works. Water meadows were designed to be flooded and drained using sluice gates on ditches to retain and then drain water to produce lush grazing. They are characterised by swales which disperse the water between raised parallel beds. The water meadows were constructed on low terraces and flood plain of the River Avon. Prior to the by-pass construction the Avon appears to have flowed in a cut channel.

B.4 Tables

Table B1 Existing vertical aerial survey cover of proposed route D062. Interpreted sorties in bold text

Date	Scale	Source/sorties	Comment
1943-12-24	**1:10,000**	**USAF/7PH/GP/LOC122**	**Covers archaeologically rich area east of B3086. Excellent stereo.**
1945-04-15	1:10,000	RAF/106G/UK1418	Low quality rating.
1945-9-25	**1:10,200**	**RAF/106G/UK839**	**Several dates combined provide good full cover.**
1945-10-11	**1:10,000**	**RAF/106G/UK915**	
1945-10-19	**1:10,800**	**RAF/106G/UK942**	
1946-04-02	1:9,400	RAF/106G/UK942	
1946-10-07	1:9,800	RAF/CPE/UK1769	
1946-10-29	1:9,840	RAF/CPE/UK1811	
1946-11-04	1:10,000	RAF/CPE/UK1821	36” lens. Limited stereo expression.
1954-09-07	1:8,000	RAF/540/1402	
1955-10-02	1:10,000	RAF/82/1297	
1967-06-13	1:10,600	RAF/58/103	36” lens. Limited stereo expression.
1967-07-17	1:10,600	RAF/58/182	36” lens. Limited stereo expression.
1968-06-13	**1:7,500**	**OS/68207**	

Date	Scale	Source/sorties	Comment
1970-05-03	**1:7,500**	**OS/70067**	**Several dates combined provide good full cover.**
1973-06-06	**1:7,700**	**OS/73233**	
1973-06-23	**1:7,700**	**OS/73338 & 339**	
1973-06-06	1:7,700	OS/73223	Overhead sun, low contrast.
1981	1:10,000	BlueSky International Ltd.	Full cover.
1988-08-03	1:3,200	OS/80288	
1991-08-19	1:8,000	OS/91176	
1991/92	1:10,000	BlueSky International Ltd.	Full cover.
1996-06-16	**1:7,800**	**OS/96638 & 639**	**Full cover**
2000	1:10,000	BlueSky	Full cover.
2001-04-21	**1:8,000**	**OS/01905**	**Full cover**
2002-09-30	1:5,500	OS/02657	
2002	1:10,000	BlueSky International Ltd.	80% of route.
2003-10-21	variable	Digital Globe/Google Earth	Two different seasons on same given date. West of Winterbourne was during summer.
2005-01-26	variable	Digital Globe/Google Earth	Two different seasons on same given date. East of Winterbourne was during summer.
Summer/05	variable	Getmapping plc/Google Earth	Full cover
2008	1:10,000	BlueSky International Ltd.	Full cover.
24/03/09	variable	Digital Globe/Google Earth	Full cover but with 40% cloud.

Table B2 Oblique photographs examined

Photo ref. (1km NGR & index no.)	Film and frame number		Date
SU 0540 / 1	WAB 11656	/ 3724	1965
SU 0540 / 2	NMR 73	/ 092-104	20 APR 1968
SU 0540 / 4	NMR 15831	/ 03	22 OCT 1997
SU 0639 / 2	NMR 930	/ 141-144	12 MAY 1976
SU 0739 / 5	NMR 26551	/ 14	30 JAN 2010
SU 0740 / 38	NMR 26715	/ 10	16 AUG 2010
SU 0742 / 2	ALK 7413	/ 14	28 MAY 1924
SU 0742 / 3	ACA 7120	/ 1401	30 APR 1933
SU 0840 / 14	NMR 1865	/ 272	12 NOV 1980
SU 0840 / 15	NMR 1865	/ 273	12 NOV 1980
SU 0840 / 16	NMR 1865	/ 274	12 NOV 1980
SU 0841 / 1	CCC 5203	/ 05678	Unknown
SU 0841 / 11	NMR 27747	/ 25	26 JUL 2013
SU 0841 / 12	NMR 27747	/ 26	26 JUL 2013
SU 0940 / 1	NMR 811	/ 239-244	17 MAR 1975
SU 0940 / 2	NMR 816	/ 90	03 MAY 1975
SU 0940 / 3	NMR 882	/ 183-187	27 JUL 1975
SU 0940 / 5	NMR 930	/ 77	12 MAY 1976
SU 0940 / 6	NMR 930	/ 78-85	12 MAY 1976
SU 0940 / 11	NMR 968	/ 199	18 JUL 1976

Photo ref. (1km NGR & index no.)	Film and frame number		Date
SU 0940 / 12	NMR 968	/ 200-202	18 JUL 1976
SU 0940 / 13	NMR 968	/ 204	18 JUL 1976
SU 0940 / 20	NMR 1352	/ 285-288	11 OCT 1978
SU 0940 / 29	NMR 1865	/ 249	12 NOV 1980
SU 0940 / 30	NMR 1865	/ 250	12 NOV 1980
SU 0940 / 31	NMR 1865	/ 251	12 NOV 1980
SU 0941 / 3	NMR 474	/ 30	13 MAR 1973
SU 0941 / 4	NMR 474	/ 31-33	13 MAR 1973
SU 0941 / 5	NMR 474	/ 34-35	13 MAR 1973
SU 0941 / 6	NMR 474	/ 36-37	13 MAR 1973
SU 1040 / 9	NMR 1352	/ 313-317	11 OCT 1978
SU 1040 / 10	NMR 1865	/ 159	12 NOV 1980
SU 1040 / 11	NMR 1865	/ 237	12 NOV 1980
SU 1040 / 12	NMR 1865	/ 282	12 NOV 1980
SU 1040 / 13	CCC 5203	/ 05684	09 FEB 1934
SU 1040 / 14	CCC 5203	/ 05685	09 FEB 1934
SU 1040 / 31	NMR 1865	/ 283	12 NOV 1980
SU 1040 / 32	NMR 1865	/ 284	12 NOV 1980
SU 1040 / 33	NMR 1865	/ 285	12 NOV 1980
SU 1040 / 34	NMR 1865	/ 286	12 NOV 1980
SU 1040 / 35	NMR 1865	/ 287	12 NOV 1980
SU 1040 / 36	NMR 1865	/ 288	12 NOV 1980
SU 1040 / 37	NMR 14955	/ 04	07 JUL 1993
SU 1040 / 38	NMR 21140	/ 13	17 APR 2001
SU 1040 / 39	NMR 21140	/ 14	17 APR 2001
SU 1041 / 14	NMR 41	/ 14	26 JUL 1967
SU 1041 / 31	NMR 930	/ 59-62	12 MAY 1976
SU 1041 / 91	NMR 15750	/ 32	08 SEP 1997
SU 1041 / 94	NMR 15767	/ 12	08 SEP 1997
SU 1041 / 95	NMR 15767	/ 13	08 SEP 1997
SU 1041 / 98	NMR 15828	/ 14	22 OCT 1997
SU 1041 / 99	NMR 15828	/ 15	22 OCT 1997
SU 1041 / 100	NMR 15810	/ 01	22 OCT 1997
SU 1041 / 101	NMR 15810	/ 02	22 OCT 1997
SU 1041 / 102	NMR 15810	/ 03	22 OCT 1997
SU 1041 / 103	NMR 15810	/ 04	22 OCT 1997
SU 1041 / 148	NMR 26461	/ 22	27 AUG 2009
SU 1041 / 149	NMR 26461	/ 23	27 AUG 2009
SU 1041 / 158	NMR 26548	/ 16	30 JAN 2010
SU 1041 / 159	NMR 26548	/ 19	30 JAN 2010
SU 1141 / 1	WAB 11656	/ 3711	1965
SU 1141 / 2	WAB 11656	/ 3714	1965
SU 1141 / 3	WAB 11656	/ 3715	1965
SU 1141 / 4	WAB 11656	/ 3716	1965
SU 1141 / 11	ACA 7368	/ 851	1930s
SU 1141 / 12	ACA 7094	/ 855	Unknown
SU 1141 / 13	ACA 7094	/ 856	Unknown
SU 1141 / 23	NMR 11002	/ 204-207	12 MAY 1976
SU 1141 / 24	CAP 8148	/ 74	27 MAR 1954
SU 1141 / 25	CAP 8148	/ 75	27 MAR 1954
SU 1141 / 26	CAP 8148	/ 76	27 MAR 1954

Photo ref. (1km NGR & index no.)	Film and frame number		Date
SU 1141 / 27	NMR 1352	/ 247-257	11 OCT 1978
SU 1141 / 28	NMR 1352	/ 258-263	11 OCT 1978
SU 1141 / 29	NMR 1352	/ 318-322	11 OCT 1978
SU 1141 / 30	NMR 1352	/ 323-328	11 OCT 1978
SU 1141 / 31	NMR 1352	/ 329-330	11 OCT 1978
SU 1141 / 32	NMR 1865	/ 172	12 NOV 1980
SU 1141 / 33	NMR 1865	/ 178	12 NOV 1980
SU 1141 / 34	NMR 1865	/ 215	12 NOV 1980
SU 1141 / 35	NMR 1865	/ 218	12 NOV 1980
SU 1141 / 36	NMR 1865	/ 219	12 NOV 1980
SU 1141 / 37	CAP 8249	/ 132	18 MAR 1955
SU 1141 / 38	NMR 10621	/ 27	10 MAY 1976
SU 1141 / 39	NMR 10621	/ 28	10 MAY 1976
SU 1141 / 40	NMR 10621	/ 29	10 MAY 1976
SU 1141 / 46	NMR 10621	/ 34A	10 MAY 1976
SU 1141 / 47	NMR 11083	/ 165	11 OCT 1978
SU 1141 / 48	NMR 11083	/ 181-182	11 OCT 1978
SU 1141 / 49	NMR 11083	/ 183-185	11 OCT 1978
SU 1141 / 50	NMR 11083	/ 186-188	11 OCT 1978
SU 1141 / 57	CCC 8591	/ OS 1030	03 MAY 1923
SU 1141 / 58	NMR 1865	/ 179	12 NOV 1980
SU 1141 / 59	NMR 1865	/ 216	12 NOV 1980
SU 1141 / 60	NMR 1865	/ 217	12 NOV 1980
SU 1141 / 61	NMR 1865	/ 220	12 NOV 1980
SU 1141 / 78	NMR 21171	/ 01	25 FEB 2001
SU 1141 / 79	NMR 21171	/ 02	25 FEB 2001
SU 1141 / 93	NMR 21959	/ 22	04 FEB 2003
SU 1141 / 98	NMR 21960	/ 05	04 FEB 2003
SU 1141 / 102	NMR 21960	/ 11	04 FEB 2003
SU 1141 / 113	NMR 21961	/ 18	04 FEB 2003
SU 1141 / 114	NMR 21961	/ 19	04 FEB 2003
SU 1141 / 141	NMR 26461	/ 32	27 AUG 2009
SU 1141 / 142	NMR 26461	/ 33	27 AUG 2009
SU 1141 / 143	NMR 26461	/ 27	27 AUG 2009
SU 1141 / 144	NMR 26461	/ 28	27 AUG 2009
SU 1141 / 149	NMR 26548	/ 17	30 JAN 2010
SU 1141 / 150	NMR 26548	/ 18	30 JAN 2010
SU 1141 / 166	NMR 27520	/ 14	05 SEP 2012
SU 1241 / 1	CCC 8586	/ 1664	02 MAR 1923
SU 1241 / 2	CCC 11752	/ 1094	Unknown
SU 1241 / 30	NMR 1865	/ 183	12 NOV 1980
SU 1241 / 93	NMR 18646	/ 03	09 JAN 2000
SU 1241 / 145	NMR 26556	/ 25	30 JAN 2010
SU 1241 / 146	NMR 26556	/ 26	30 JAN 2010
SU 1241 / 147	NMR 26556	/ 27	30 JAN 2010
SU 1241 / 148	NMR 26556	/ 28	30 JAN 2010
SU 1241 / 149	NMR 26845	/ 31	27 MAY 2010
SU 1241 / 150	NMR 26845	/ 32	27 MAY 2010
SU 1241 / 151	NMR 26850	/ 03	27 MAY 2010
SU 1241 / 160	NMR 27525	/ 06	16 OCT 2012
SU 1242 / 34	CCC 11752	/ 1731	Unknown

Photo ref. (1km NGR & index no.)	Film and frame number		Date
SU 1242 / 369	WAP 14077	/ 03	1978
SU 1242 / 436	NMR 21920	/ 10	19 DEC 2002
SU 1242 / 725	NMR 27525	/ 29	16 OCT 2012
SU 1341 / 3	CCC 8550	/ 82	12 JUL 1921
SU 1341 / 6	NMR 881	/ 419-421	27 JUL 1975
SU 1341 / 69	NMR 26706	/ 14	16 AUG 2010
SU 1341 / 70	NMR 26706	/ 17	16 AUG 2010
SU 1341 / 71	NMR 26706	/ 18	16 AUG 2010
SU 1341 / 75	NMR 27526	/ 44	16 OCT 2012
SU 1341 / 92	NMR 27746	/ 05	26 JUL 2013
SU 1341 / 93	NMR 27746	/ 14	26 JUL 2013
SU 1341 / 94	NMR 27746	/ 15	26 JUL 2013
SU 1342 / 1	NMR 42	/ 34	04 AUG 1967
SU 1342 / 2	NMR 42	/ 35	04 AUG 1967
SU 1342 / 3	NMR 42	/ 36	04 AUG 1967
SU 1342 / 4	NMR 42	/ 37	04 AUG 1967
SU 1342 / 5	NMR 42	/ 38	04 AUG 1967
SU 1342 / 6	CCC 8563	/ 61	09 MAR 1922
SU 1342 / 9	CCC 8563	/ 1029	09 MAR 1922
SU 1342 / 10	CCC 8561	/ 69	10 FEB 1922
SU 1342 / 11	CCC 8546	/ 83	08 JUL 1921
SU 1342 / 12	CCC 8563	/ 63	09 MAR 1922
SU 1342 / 13	CCC 11752	/ 341	Unknown
SU 1342 / 16	CCC 11752	/ 1032	Unknown
SU 1342 / 19	CCC 8545	/ 1003	05 JUL 1921
SU 1342 / 28	CCC 8548	/ 1006	11 JUL 1921
SU 1342 / 30	CCC 8563	/ 64	09 MAR 1922
SU 1342 / 31	AEE 7380	/ ORACLEE1	Unknown
SU 1342 / 47	NMR 881	/ 422	27 JUL 1975
SU 1342 / 52	CCC 8622	/ SACA 445	07 NOV 1923
SU 1342 / 92	NMR 21920	/ 15	19 DEC 2002
SU 1342 / 114	NMR 26706	/ 13	16 AUG 2010
SU 1342 / 115	NMR 26707	/ 02	16 AUG 2010
SU 1342 / 116	NMR 26707	/ 03	16 AUG 2010
SU 1342 / 118	NMR 26707	/ 06	16 AUG 2010
SU 1342 / 119	NMR 26707	/ 07	16 AUG 2010
SU 1342 / 120	NMR 26707	/ 08	16 AUG 2010
SU 1342 / 121	NMR 26707	/ 09	16 AUG 2010
SU 1342 / 122	NMR 26707	/ 10	16 AUG 2010
SU 1342 / 123	NMR 26707	/ 11	16 AUG 2010
SU 1342 / 124	NMR 26707	/ 12	16 AUG 2010
SU 1342 / 130	NMR 26707	/ 18	16 AUG 2010
SU 1342 / 131	NMR 26707	/ 19	16 AUG 2010
SU 1342 / 132	NMR 26707	/ 20	16 AUG 2010
SU 1342 / 133	NMR 26707	/ 21	16 AUG 2010
SU 1342 / 134	NMR 26707	/ 22	16 AUG 2010
SU 1342 / 135	NMR 26707	/ 23	16 AUG 2010
SU 1342 / 136	NMR 26707	/ 24	16 AUG 2010
SU 1342 / 137	NMR 26707	/ 25	16 AUG 2010
SU 1342 / 138	NMR 26707	/ 26	16 AUG 2010
SU 1342 / 141	NMR 26707	/ 32	16 AUG 2010

Photo ref. (1km NGR & index no.)	Film and frame number		Date
SU 1342 / 142	NMR 26707	/ 33	16 AUG 2010
SU 1342 / 177	NMR 27690	/ 01	04 JUN 2013
SU 1342 / 178	NMR 27690	/ 02	04 JUN 2013
SU 1342 / 179	NMR 27690	/ 03	04 JUN 2013
SU 1342 / 180	NMR 27690	/ 04	04 JUN 2013
SU 1342 / 181	NMR 27690	/ 05	04 JUN 2013
SU 1342 / 182	NMR 27690	/ 06	04 JUN 2013
SU 1342 / 199	NMR 27746	/ 19	26 JUL 2013
SU 1442 / 5	CCC 8557	/ 1015	06 SEP 1921
SU 1442 / 6	CCC 8544	/ 1014	15 JUN 1921
SU 1442 / 7	CCC 8545	/ 1004	05 JUL 1921
SU 1442 / 12	AEE 7381	/ ORACLEE1	Unknown
SU 1442 / 13	AEE 7380	/ ORACLEE4	Unknown
SU 1442 / 14	AEE 7380	/ ORACLEE5	Unknown
SU 1442 / 16	CCC 11752	/ 4526	Unknown
SU 1442 / 21	NMR 968	/ 172-173	18 JUL 1976
SU 1442 / 61	NMR 26547	/ 14	30 JAN 2010
SU 1442 / 79	NMR 27525	/ 33	16 OCT 2012
SU 1442 / 80	NMR 27525	/ 34	16 OCT 2012
SU 1442 / 81	NMR 27525	/ 35	16 OCT 2012
SU 1442 / 83	NMR 27525	/ 38	16 OCT 2012
SU 1442 / 84	NMR 27526	/ 04	16 OCT 2012
SU 1442 / 85	NMR 27526	/ 05	16 OCT 2012
SU 1442 / 86	NMR 27526	/ 06	16 OCT 2012
SU 1442 / 87	NMR 27526	/ 49	16 OCT 2012
SU 1541 / 1	CCC 8603	/ 1688	07 NOV 1923
SU 1541 / 11	NMR 1865	/ 207	12 NOV 1980
SU 1542 / 6	NMR 26708	/ 01	16 AUG 2010
SU 1542 / 7	NMR 26708	/ 02	16 AUG 2010
SU 1542 / 8	NMR 26708	/ 03	16 AUG 2010
SU 1542 / 9	NMR 26708	/ 04	16 AUG 2010
SU 1542 / 10	NMR 26708	/ 05	16 AUG 2010
SU 1542 / 11	NMR 26708	/ 06	16 AUG 2010
SU 1542 / 12	NMR 26708	/ 07	16 AUG 2010
SU 1542 / 13	NMR 26708	/ 08	16 AUG 2010
SU 1542 / 14	NMR 26708	/ 09	16 AUG 2010
SU 1542 / 15	NMR 26708	/ 10	16 AUG 2010
SU 1542 / 16	NMR 26708	/ 11	16 AUG 2010
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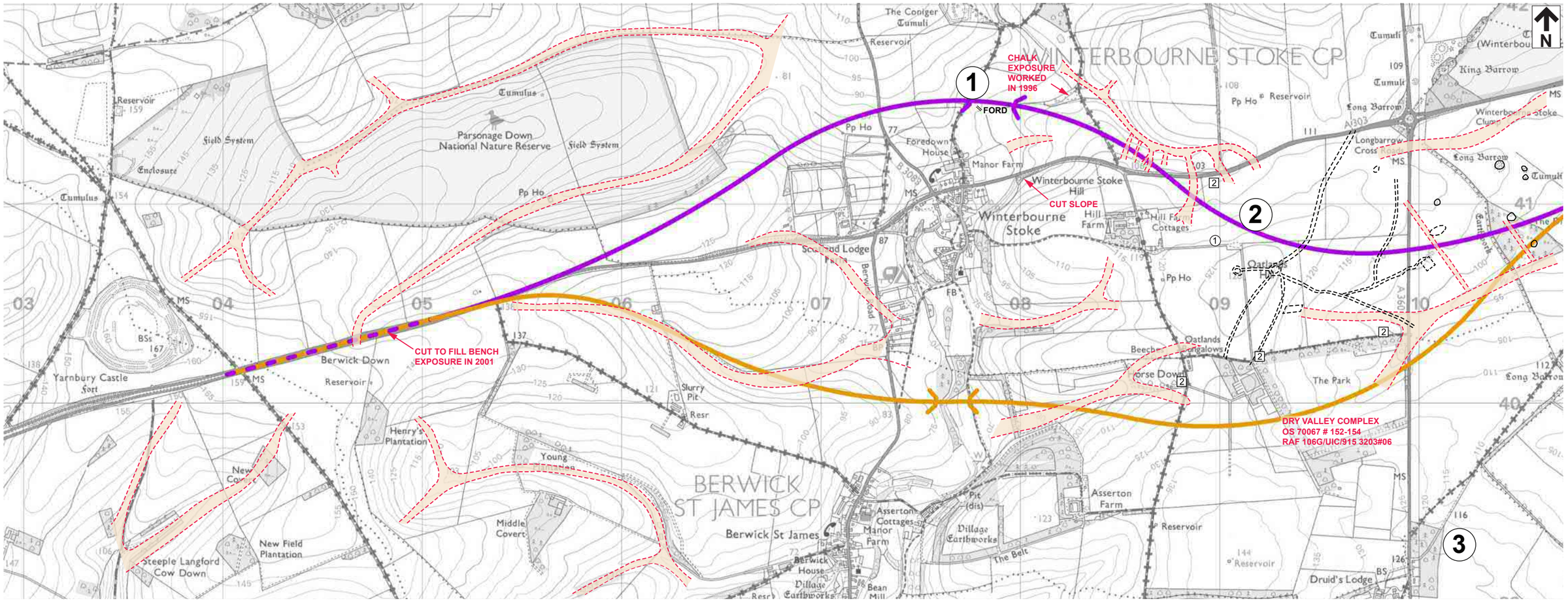
SU 1542 / 18	NMR 26708	/ 13	16 AUG 2010

DO NOT SCALE

Millimetres 0 10 100



LEGEND

1. RIVER TILL, DITCHED CHANNEL AT ℄, 1945 DRY ON 25/9/45
2. OATLANDS AIR BASE IN 1945 - NOT ACTIVE
   - ① HARD STANDINGS
   - ② 'BLISTER' HANGARS

   NO TRACKS AROUND HANGARS OR INDICATION OF RUNWAYS
   RAF UK839 #3041
3. ACTIVE GRASS AIR FIELD RUNWAYS,WINDSOCK, HELICOPTER PAD
   RAF 106G / UK 942 #4004
   19/10/45

Dry Valley floors
D061
D062
D061 and D062

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log).

Construction: None

Maintenance / Cleaning: None

Use: None

Decommissioning / Demolition: None

Rev.	Date	Description	By	Chk'd	App'd
P01	02/12/16	FIRST ISSUE	JS	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3

Client: highways england

Designers: ARUP ATKINS

Project Title: A303 AMESBURY TO BERWICK DOWN

Drawing Title: FIGURE B-1
SCHEMATIC MARK UP OF FEATURES IDENTIFIEDFROM AERIAL PHOTOGRAPHY REVIEW (WEST OF A360)

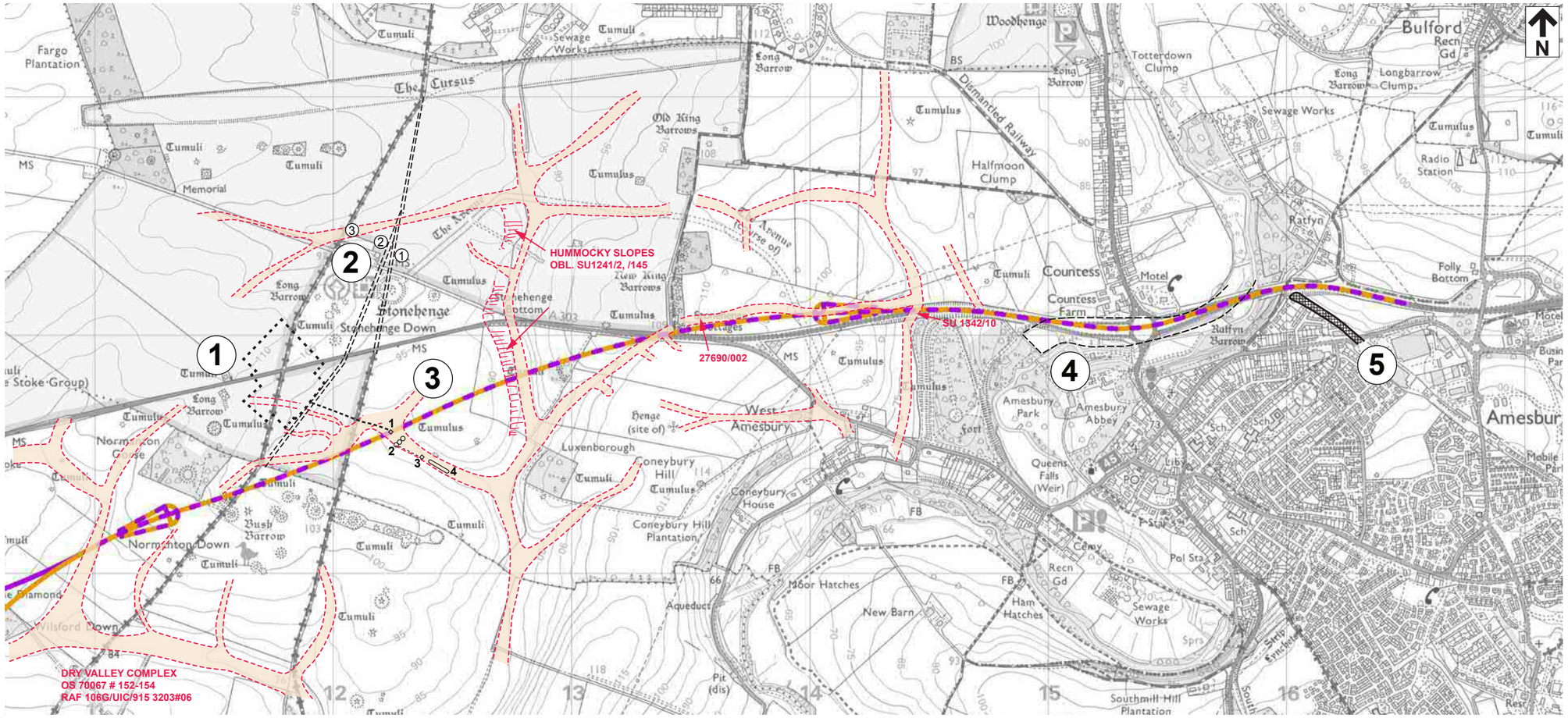
Scale	Designed / Drawn	Checked	Approved	Authorised
NTS	JS	PD	AK	AK
Original Size	**Date**	**Date**	**Date**	**Date**
A3	02/12/16	02/12/16	02/12/16	02/12/16

Drawing Number: Project | Originator | Volume
HE551506-AA-HGT-D_SWI-DR-CX-000085
Location | Type | Role | Number

Revision: P01

DO NOT SCALE

Millimetres 0 10 100



LEGEND

1. BUILDINGS ALIGNED WITH ORIGINAL TRACK ON NORMANTON DOWN. BEING DISMANTLED 1923. PRESENT ALIGNMENT OF TRACK IS POST 1945. 437PH/122 #1022 24/12/43
   - OBL. SU1141/057 03/05/23
   - RAF 106G/UK/915 #3203 11/10/45
   - OBL. SU1141/79 25/02/01
2. TRACKS AT STONEHENGE
   ① PRE WW1
   ② WW1
   ③ WW2
3. SEWAGE PLANT
   1. SETTLING TANKS } PRESENT
   2. AERATION TANKS } 1945
   3. INSPECTION CHAMBER
   4. SOAKAWAY - REMOVED BY 03/05/70
   OBL.SU 1241/1 02/03/23
   SU 1141/057 03/05/23
   RAF 106G/UK/915 #3203
   OS 70067 #141
4. WATER MEADOWS
   RAF 106G/UK915 #3198
   A303 AMESBURY BY-PASS
   U/C OS 68207 #408
5. RAIL SIDING IN CUTTING, 1945 INFILLED BY 1968
   MAY INTERSECT ROAD CUTTING IF WIDENED
   RAF 10G/UK/915 #3197 ?/10/45
   OS 68207 #409 13/06/68

Dry Valley floors

D061 and D062

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log).

Construction	None
Maintenance / Cleaning	None
Use	None
Decommissioning / Demolition	None

Rev.	Date	Description	By	Chk'd	App'd
P01	02/12/16	FIRST ISSUE	JS	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3

Client: highways england

Designers: ARUP ATKINS

Project Title: A303 AMESBURY TO BERWICK DOWN

Drawing Title: FIGURE B-2
SCHEMATIC MARK UP OF FEATURES IDENTIFIED FROM AERIAL PHOTOGRAPHY REVIEW (EAST OF A360)

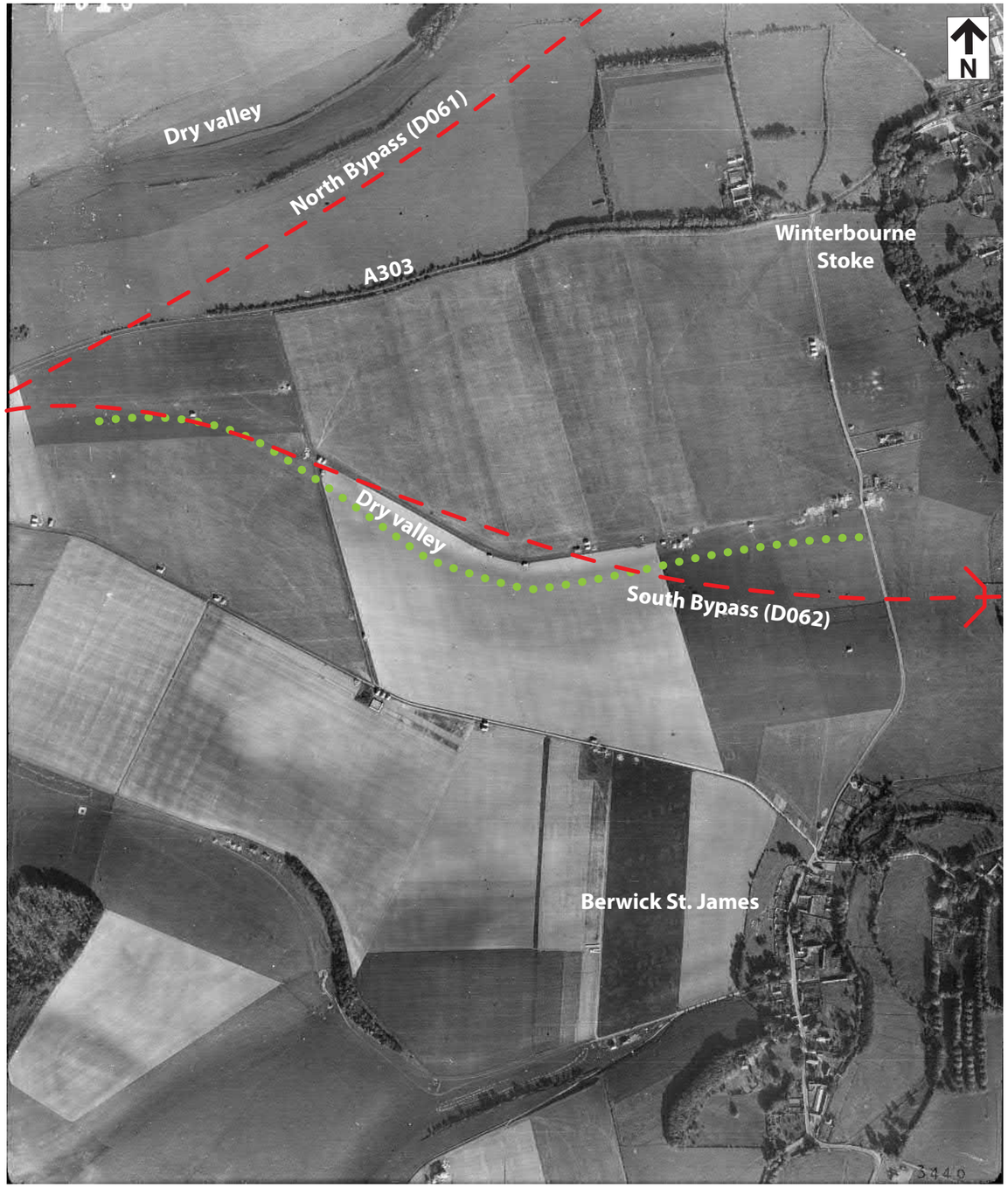
Scale	Designed / Drawn	Checked	Approved	Authorised
NTS	JS	PD	AK	AK
Original Size	**Date**	**Date**	**Date**	**Date**
A3	02/12/16	02/12/16	02/12/16	02/12/16

Drawing Number: Project | Originator | Volume
HE551506-AA-HGT-D_SWI-DR-CX-000086
Location | Type | Role | Number

Revision: P01

DO NOT SCALE

Millimetres 0 10 100



1945

Vertical view to west of Winterbourne Stoke. The south bypass route follows the dry valley thalweg (centre-line) indicated by a line of dots. The north bypass route follows the drainage divide near the top of the side slope of the dry valley to the north.
Photo reference is RAF/106G/UK/942/4010 taken 19/10/45.

LEGEND

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log).
Construction
None
Maintenance / Cleaning
None
Use
None
Decommissioning / Demolition
None

Rev.	Date	Description	By	Chk'd	App'd
P01	02/12/16	FIRST ISSUE	JS	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3

Client: highways england

Designers: ARUP ATKINS

Project Title: A303 AMESBURY TO BERWICK DOWN

Drawing Title: FIGURE B-3
1945 ANNOTATED VERTICAL AERIAL PHOTOGRAPH - WINTERBOURNE STOKE

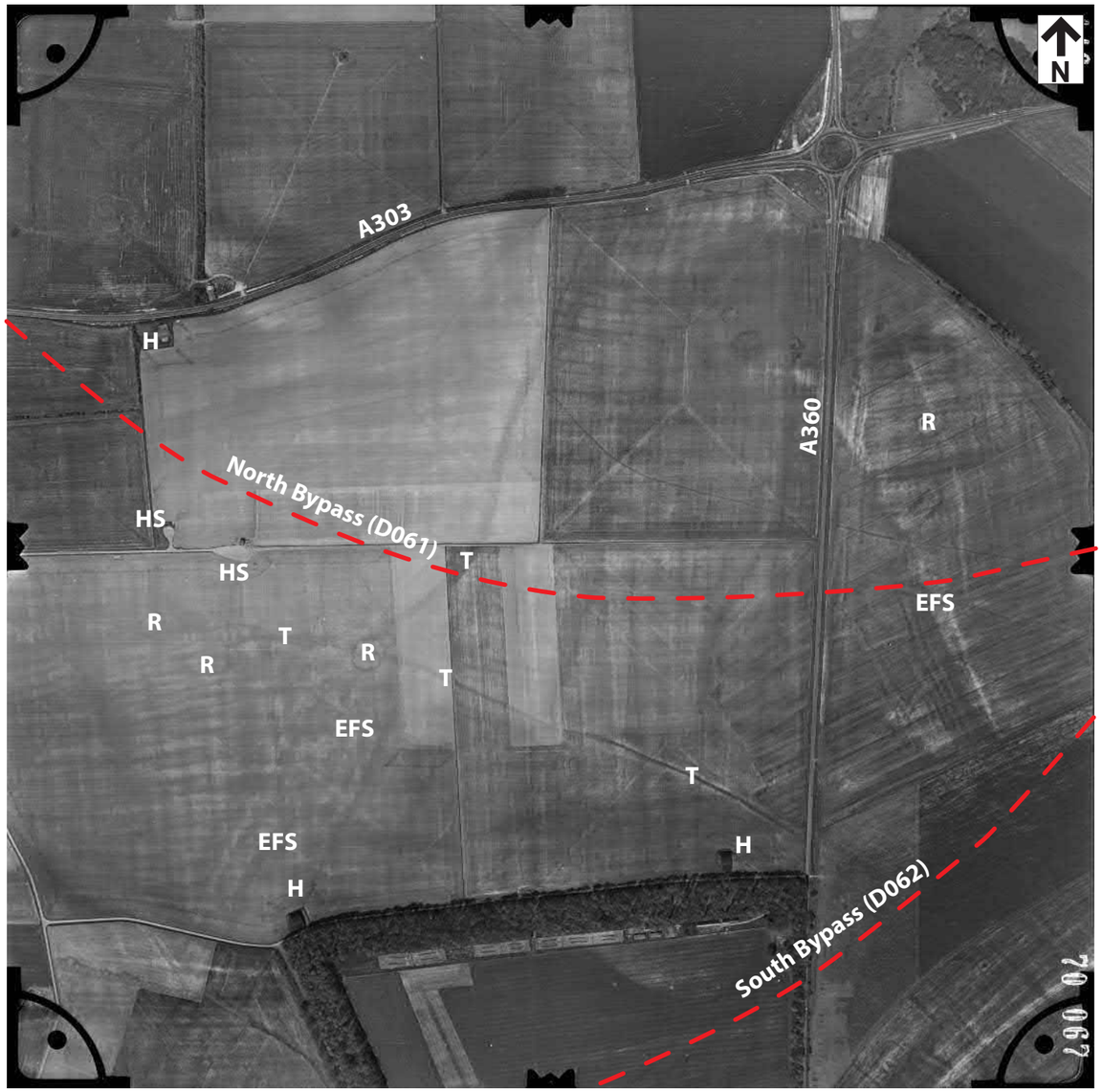
Scale	Designed / Drawn	Checked	Approved	Authorised
NTS	JS	PD	AK	AK
Original Size	**Date**	**Date**	**Date**	**Date**
A3	02/12/16	02/12/16	02/12/16	02/12/16

Drawing Number: Project | Originator | Volume | Location | Type | Role | Number
HE551506-AA-HGT-D_SWI-DR-CX-000087

Revision: P01

DO NOT SCALE

Millimetres 0 10 100



1970

Vertical view centred on Oatlands Hill, southwest of junction of A303 and A360. Cropmarks reveal trackways (T) and ring features (R) and more recent early field systems (EFS). Blister hangars (H) and hard standings (HS) of the little used WW2 satellite airfield still remained in 1970.
Photo reference OS/70067/146 taken 03/05/70.

LEGEND

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log).
Construction
None
Maintenance / Cleaning
None
Use
None
Decommissioning / Demolition
None

Rev.	Date	Description	By	Chk'd	App'd
P01	02/12/16	FIRST ISSUE	JS	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3

Client: highways england

Designers: ARUP ATKINS

Project Title: A303 AMESBURY TO BERWICK DOWN

Drawing Title: FIGURE B-4
1970 ANNOTATED VERTICAL AERIAL PHOTOGRAPH – OATLANDS HILL (WEST OF A360)

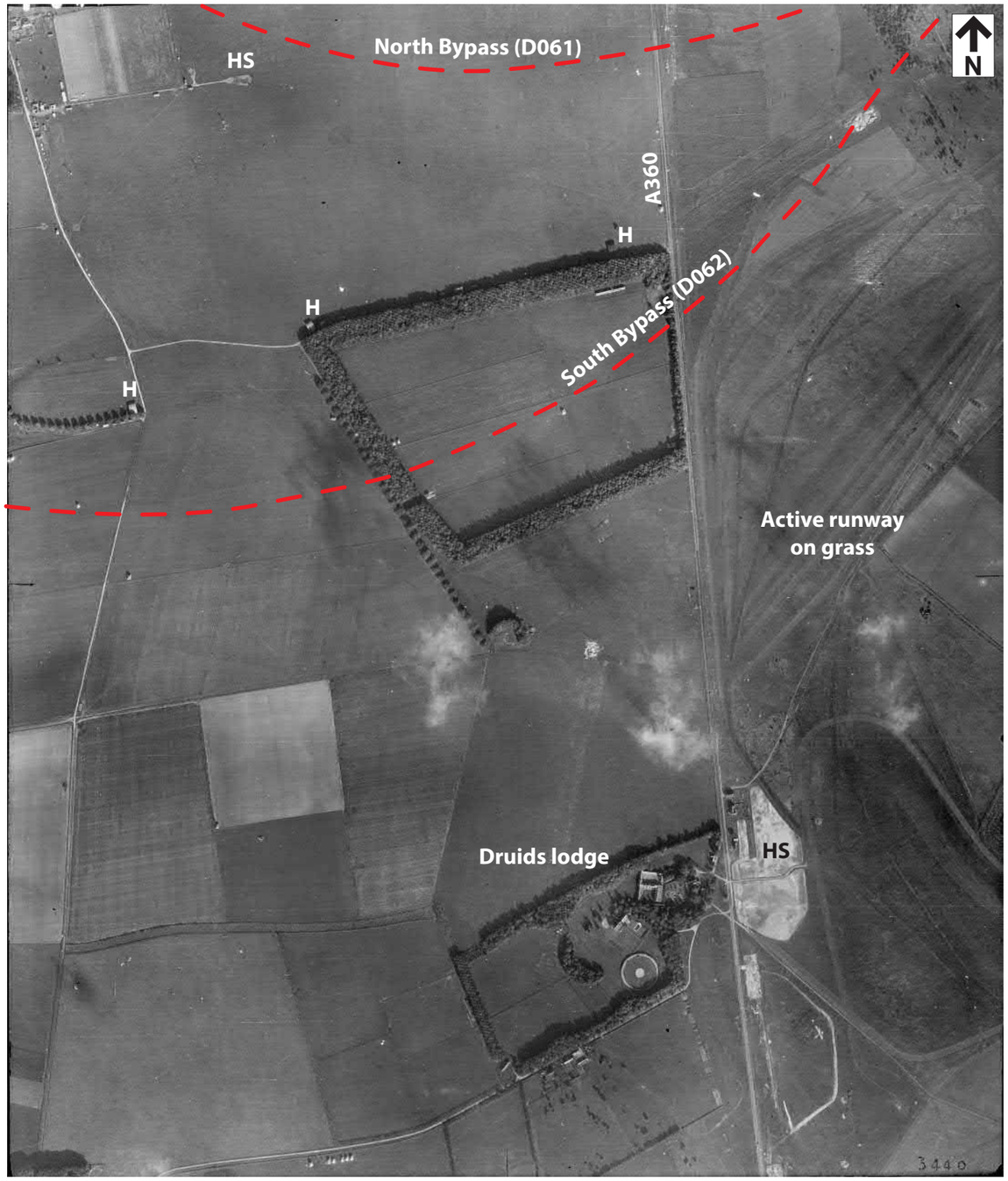
Scale	Designed / Drawn	Checked	Approved	Authorised
NTS	JS	PD	AK	AK
Original Size	Date	Date	Date	Date
A3	02/12/16	02/12/16	02/12/16	02/12/16

Drawing Number: HE551506-AA-HGT-D_SWI-DR-CX-000088
(Project | Originator | Volume | Location | Type | Role | Number)

Revision: P01

DO NOT SCALE

Millimetres 0 10 100



1945

Vertical view of active grass airfield to south of Oatlands Hill along A360. By comparison, at Oatlands Hill there were no marks on the turf indicating very little use of the latter. (H) blister hangar, (HS) hard standing.
Photo reference RAF/106G/UK/942/4005 taken 19/10/45.

LEGEND

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log).
Construction
None
Maintenance / Cleaning
None
Use
None
Decommissioning / Demolition
None

Rev.	Date	Description	By	Chk'd	App'd
P01	02/12/16	FIRST ISSUE	JS	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3

Client: highways england

Designers: ARUP ATKINS

Project Title: A303 AMESBURY TO BERWICK DOWN

Drawing Title: FIGURE B-5
1945 ANNOTATED VERTICAL AERIAL PHOTOGRAPH – OATLANDS HILL (WEST OF A360)

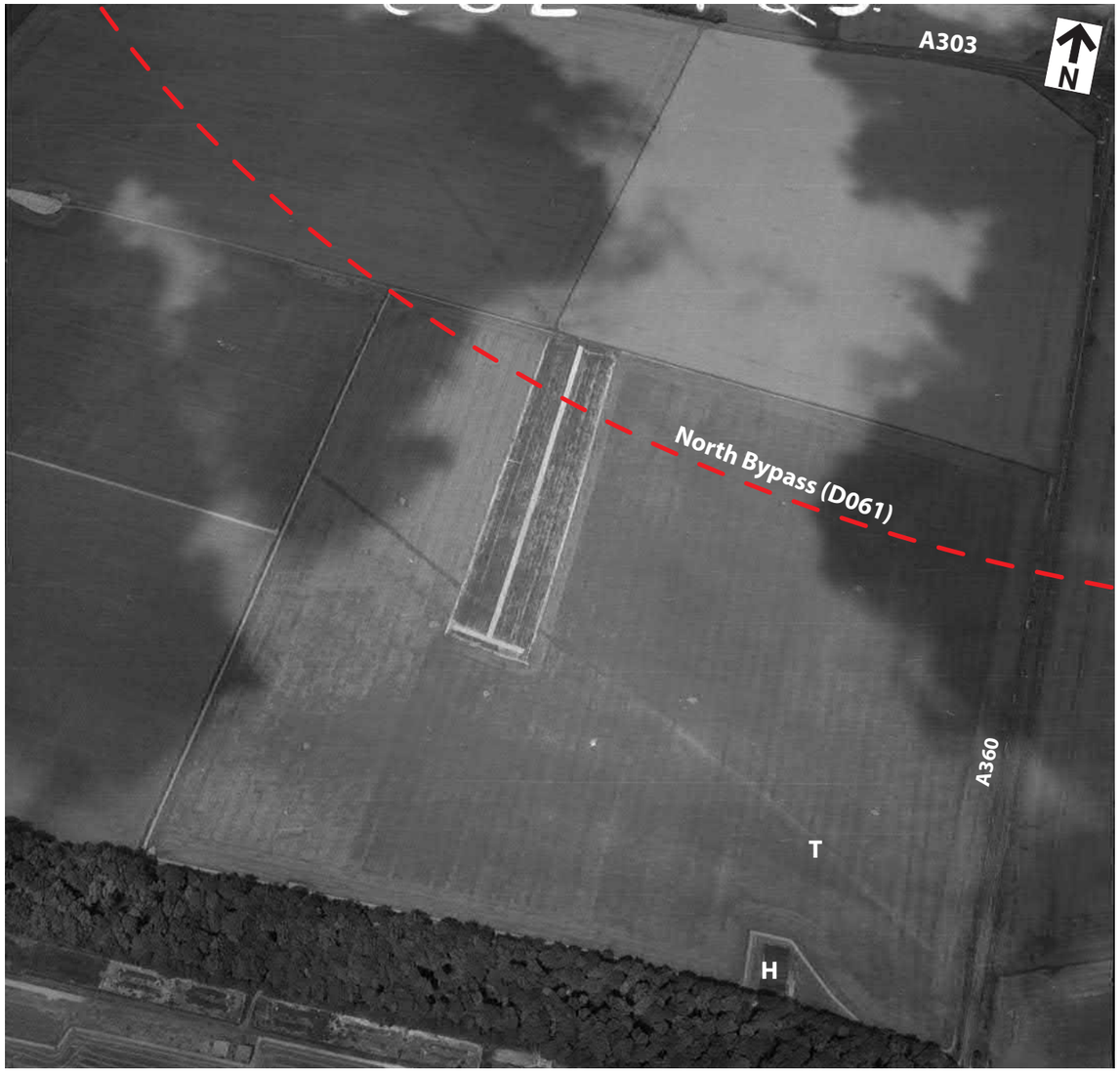
Scale	Designed / Drawn	Checked	Approved	Authorised
NTS	JS	PD	AK	AK
Original Size	**Date**	**Date**	**Date**	**Date**
A3	02/12/16	02/12/16	02/12/16	02/12/16

Drawing Number: Project | Originator | Volume
HE551506-AA-HGT-D_SWI-DR-CX-000089
Location | Type | Role | Number

Revision: P01

DO NOT SCALE

Millimetres 0 10 100



2005

Oblique view to North at Oatlands Hill adjacent to west of A360. The linear field in the centre was a temporary feature, probably a seed trial; similar ephemeral linear fields, generally located away from roads, were planted in this area in the 1970s and may be mistaken, after removal, as possible grass runways. (H) blister hangar, (T) trackway.
Photo reference NMR882/185 taken 27/07/05.

LEGEND

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log).
Construction
None
Maintenance / Cleaning
None
Use
None
Decommissioning / Demolition
None

Rev.	Date	Description	By	Chk'd	App'd
P01	02/12/16	FIRST ISSUE	JS	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3

Client: highways england

Designers: ARUP ATKINS

Project Title: A303 AMESBURY TO BERWICK DOWN

Drawing Title: FIGURE B-6
2005 ANNOTATED VERTICAL AERIAL PHOTOGRAPH - OATLANDS HILL (WEST OF A360)

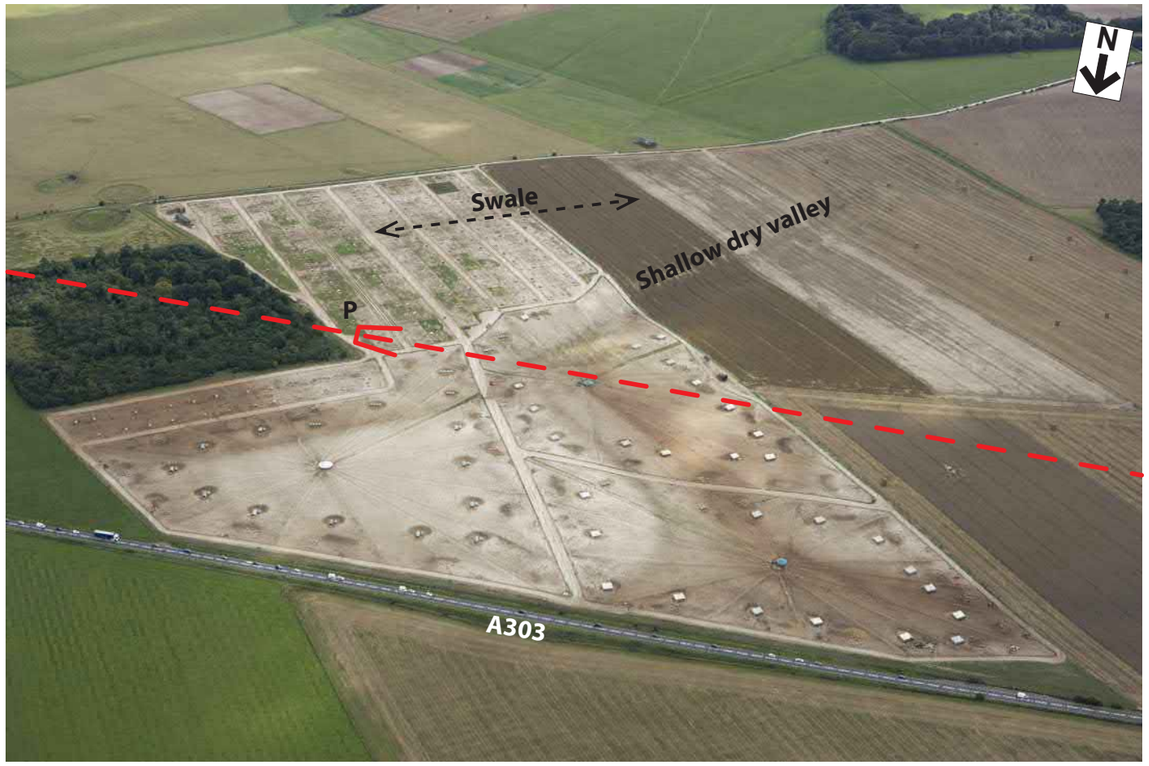
Scale	Designed / Drawn	Checked	Approved	Authorised
NTS	JS	PD	AK	AK
Original Size	**Date**	**Date**	**Date**	**Date**
A3	02/12/16	02/12/16	02/12/16	02/12/16

Drawing Number: Project | Originator | Volume
HE551506-AA-HGT-D_SWI-DR-CX-000090
Location | Type | Role | Number

Revision: P01

DO NOT SCALE

Millimetres 0 10 100



2009

Oblique view to south of west tunnel portal area. Intensive hog rearing has rectangular pens in portal (P) area and larger radial pens in foreground. A shallow dry valley is traversed in the approach to the tunnel. A shallow swale visible as a darker soil in several spring photographs intersects the alignment in the portal area.
Photo reference is NMR 26461/033 taken 27/08/09.

LEGEND

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log).
Construction
None
Maintenance / Cleaning
None
Use
None
Decommissioning / Demolition
None

Rev.	Date	Description	By	Chk'd	App'd
P01	02/12/16	FIRST ISSUE	JS	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3

Client: highways england

Designers: ARUP ATKINS

Project Title: A303 AMESBURY TO BERWICK DOWN

Drawing Title: FIGURE B-7
2009 ANNOTATED OBLIQUE PHOTOGRAPH – NORMANTON GORSE AND PIG FARM EAST OF A360

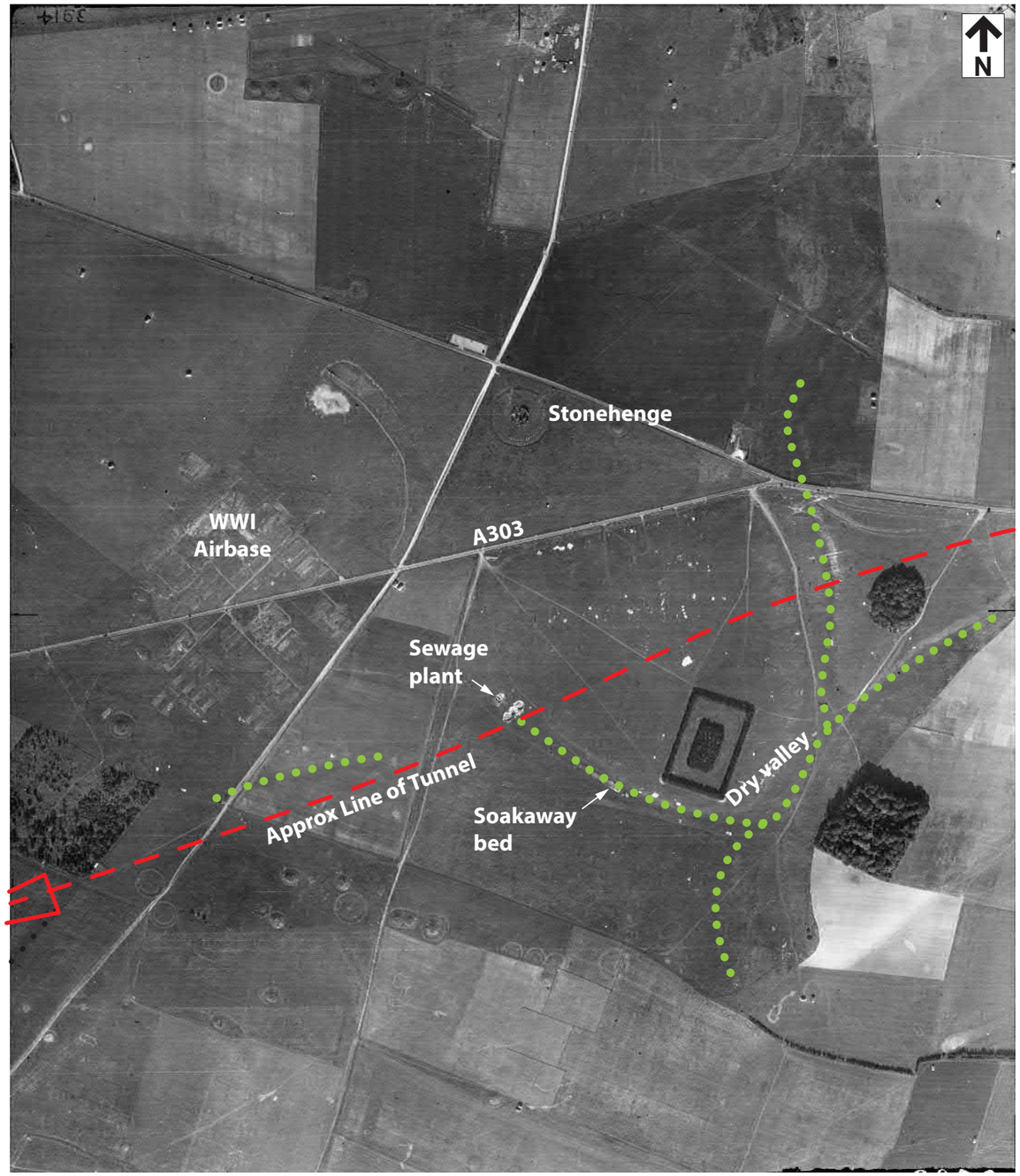
Scale	Designed / Drawn	Checked	Approved	Authorised
NTS	JS	PD	AK	AK
Original Size	**Date**	**Date**	**Date**	**Date**
A3	02/12/16	02/12/16	02/12/16	02/12/16

Drawing Number: Project | Originator | Volume
HE551506-AA-HGT-D_SWI-DR-CX-000091
Location | Type | Role | Number

Revision: P01

DO NOT SCALE

Millimetres 0 10 100



1945

Vertical view of Stonehenge and outline of former WW1 airbase, disused sewage works and soakaway bed. Floors of dry valleys indicated by dotted lines. Track to west of Stonehenge was removed by 1968.
Photo reference is RAF/106G/UK/915/3203 taken 11/10/45.

LEGEND

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log).
Construction
None
Maintenance / Cleaning
None
Use
None
Decommissioning / Demolition
None

Rev.	Date	Description	By	Chk'd	App'd
P01	02/12/16	FIRST ISSUE	JS	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3

Client: highways england

Designers: ARUP ATKINS

Project Title: A303 AMESBURY TO BERWICK DOWN

Drawing Title: FIGURE B-8
1945 ANNOTATED VERTICAL
AERIAL PHOTOGRAPH - STONEHENGE

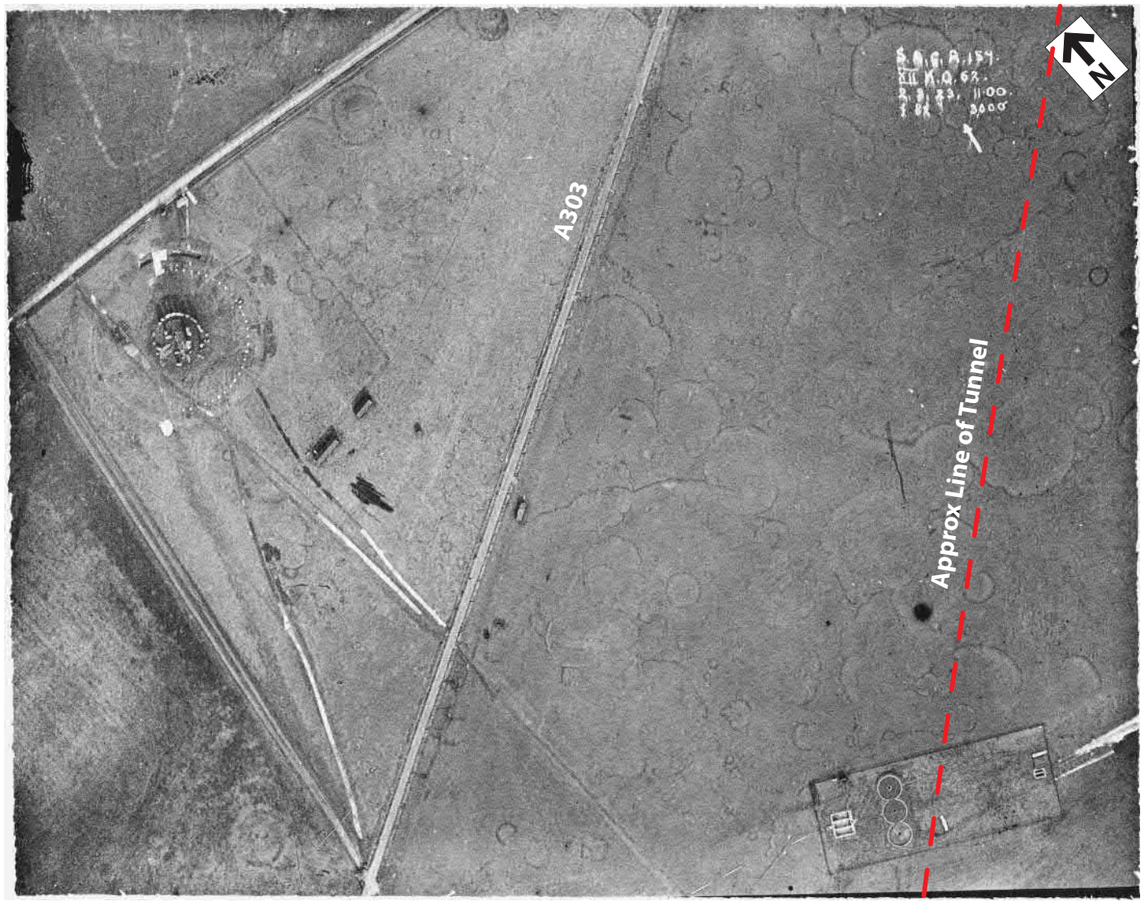
Scale	Designed / Drawn	Checked	Approved	Authorised
NTS	JS	PD	AK	AK
Original Size	**Date**	**Date**	**Date**	**Date**
A3	02/12/16	02/12/16	02/12/16	02/12/16

Drawing Number: Project | Originator | Volume | Location | Type | Role | Number
HE551506-AA-HGT-D_SWI-DR-CX-000092

Revision: P01

DO NOT SCALE

Millimetres 0 10 100



1923

Oblique view to northeast showing Stonehenge and sewage treatment plant. The former tracks through Stonehenge have been relocated just to the west of it. The original tracks appear to have temporary duck boards or protective cover over segments in the west corner of the field. The numerous irregular circles are 'fairy' ring patterns produced by the spreading mycelium of some species of mushrooms.
Photo reference is CCC 8586/1664 taken 02/03/23.

LEGEND

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log).
Construction
None
Maintenance / Cleaning
None
Use
None
Decommissioning / Demolition
None

Rev.	Date	Description	By	Chk'd	App'd
P01	02/12/16	FIRST ISSUE	JS	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3
Client: highways england
Designers: ARUP ATKINS

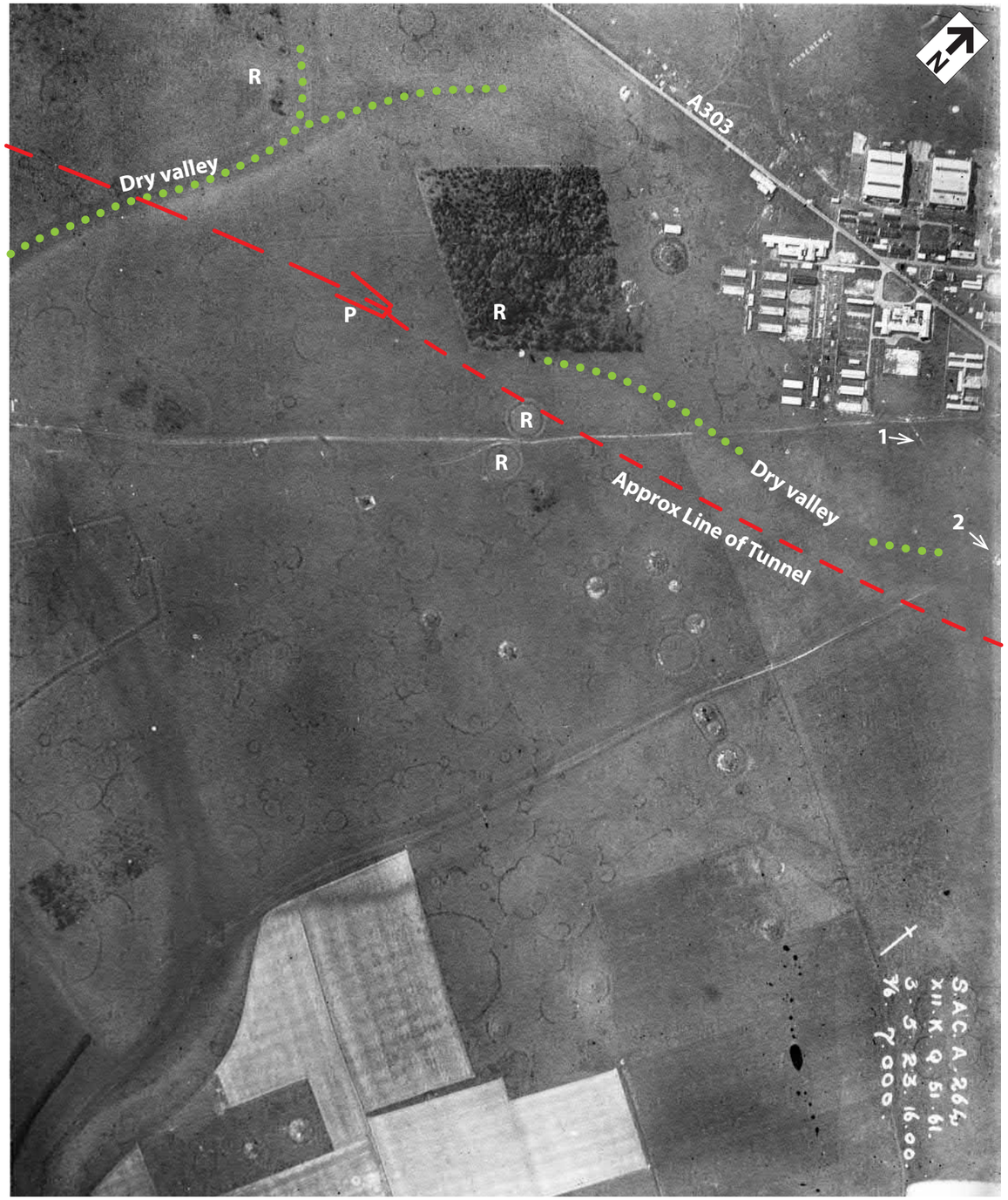
Project Title: A303 AMESBURY TO BERWICK DOWN
Drawing Title: FIGURE B-9
1923 ANNOTATED OBLIQUE PHOTOGRAPH - STONEHENGE

Scale	Designed / Drawn	Checked	Approved	Authorised
NTS	JS	PD	AK	AK
Original Size	Date	Date	Date	Date
A3	02/12/16	02/12/16	02/12/16	02/12/16

Drawing Number: Project | Originator | Volume | Location | Type | Role | Number
HE551506-AA-HGT-D_SWI-DR-CX-000093
Revision: P01

DO NOT SCALE

Millimetres 0 10 100



1923

Oblique view to northwest of WW1 airbase at Stonehenge (note sign on ground in upper right corner). The buildings were being removed at this time; the white rectangles are foundations if no shadow is cast, otherwise they are awaiting demolition. The faint line indicated (1) is the sewage outfall running to the sewage treatment works (2) noted at the right edge of the image. Numerous ring features (R) are visible. (P) Tunnel portal area
Photo reference RAF/106G/UK/839/3063 taken 03/05/23.

LEGEND

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log).
Construction
None
Maintenance / Cleaning
None
Use
None
Decommissioning / Demolition
None

Rev.	Date	Description	By	Chk'd	App'd
P01	02/12/16	FIRST ISSUE	JS	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3

Client: highways england

Designers: ARUP ATKINS

Project Title: A303 AMESBURY TO BERWICK DOWN

Drawing Title: FIGURE B-10
1923 ANNOTATED OBLIQUE PHOTOGRAPH – NORMANTON GORSE AND STONEHENGE AIRBASE

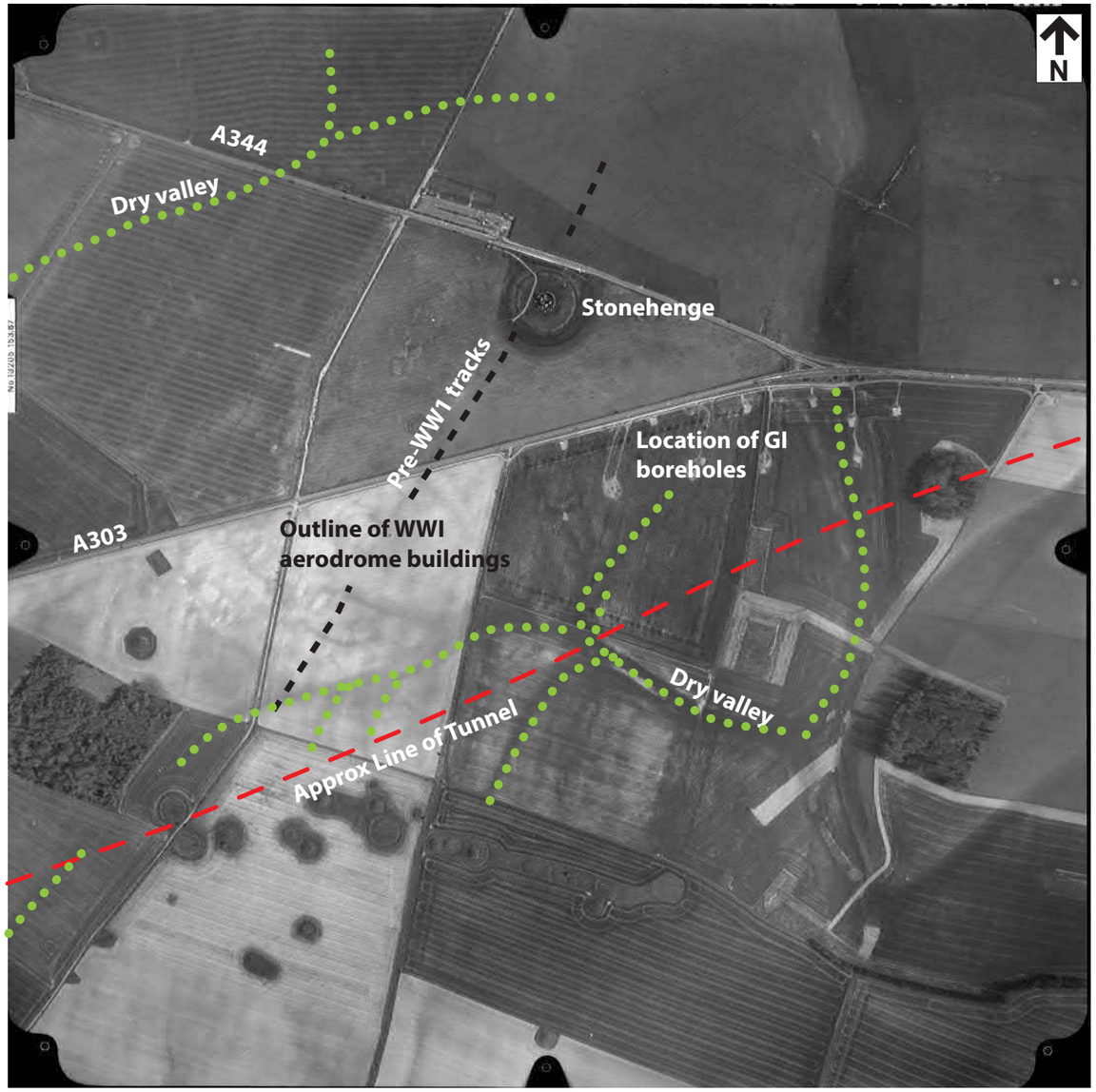
Scale	Designed / Drawn	Checked	Approved	Authorised
NTS	JS	PD	AK	AK
Original Size	Date	Date	Date	Date
A3	02/12/16	02/12/16	02/12/16	02/12/16

Drawing Number: HE551506-AA-HGT-D_SWI-DR-CX-000094
(Project | Originator | Volume | Location | Type | Role | Number)

Revision: P01

DO NOT SCALE

Millimetres 0 10 100



2001

Vertical view of tunnel section south of Stonehenge. Contrasting soil tones reveal WW1 aerodrome building outlines and dry valleys and swales. South of the junction of the A303 and the A344 the pads of several borehole locations are linked by access tracks .
Photo reference is OS 01905 taken 21/04/01

LEGEND

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log).
Construction
None
Maintenance / Cleaning
None
Use
None
Decommissioning / Demolition
None

Rev.	Date	Description	By	Chk'd	App'd
P01	02/12/16	FIRST ISSUE	JS	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3

Client: highways england

Designers: ARUP ATKINS

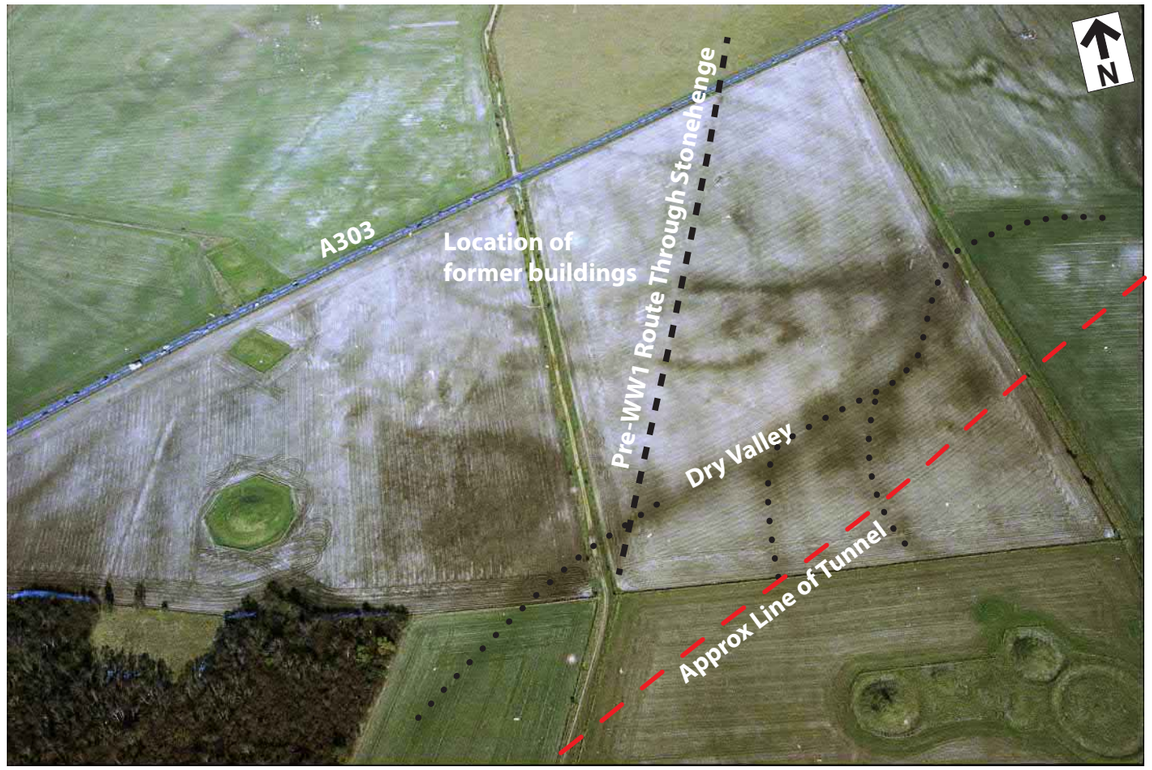
Project Title: A303 AMESBURY TO BERWICK DOWN

Drawing Title: FIGURE B-11
2001 ANNOTATED VERTICAL AERIAL PHOTOGRAPH –STONEHENGE

Scale	Designed / Drawn	Checked	Approved	Authorised
NTS	JS	PD	AK	AK
Original Size	Date	Date	Date	Date
A3	02/12/16	02/12/16	02/12/16	02/12/16

Drawing Number: Project | Originator | Volume
HE551506-AA-HGT-D_SWI-DR-CX-000095
Location | Type | Role | Number

Revision: P01



2001

Oblique view from south over tunnel centre line to the south of Stonehenge. Dark soil tones reveal shallow dry valleys and the outlines of earlier buildings. Photo reference is NMR 21171/02 taken 25/02/01.

DO NOT SCALE

Millimetres 0 10 100

LEGEND

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log).

Construction
None

Maintenance / Cleaning
None

Use
None

Decommissioning / Demolition
None

Rev.	Date	Description	By	Chk'd	App'd
P01	02/12/16	FIRST ISSUE	JS	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3

Client: highways england

Designers: ARUP ATKINS

Project Title: A303 AMESBURY TO BERWICK DOWN

Drawing Title: FIGURE B-12
2001 ANNOTATED OBLIQUE PHOTOGRAPH - STONEHENGE

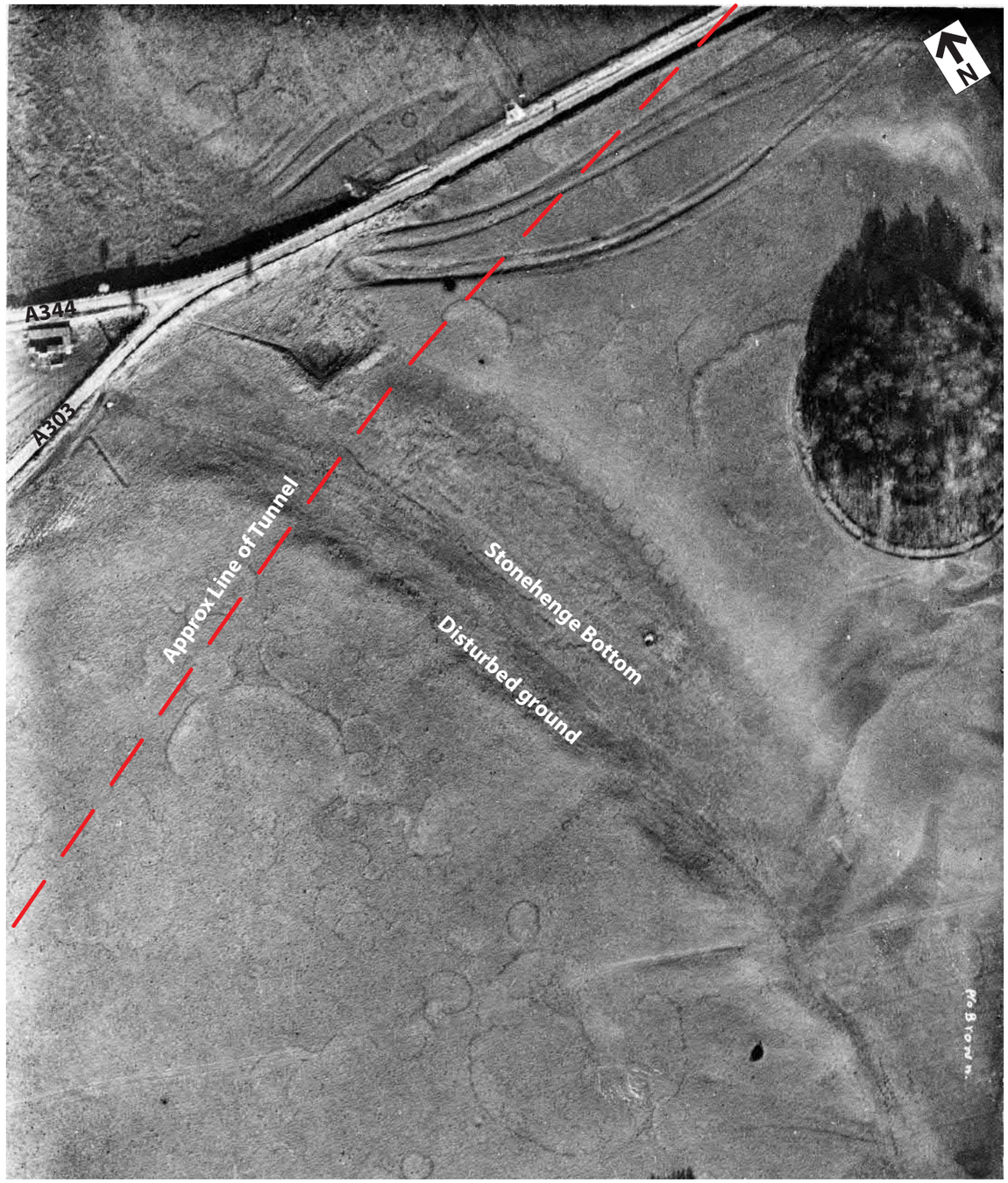
Scale	Designed / Drawn	Checked	Approved	Authorised
NTS	JS	PD	AK	AK
Original Size	**Date**	**Date**	**Date**	**Date**
A3	02/12/16	02/12/16	02/12/16	02/12/16

Drawing Number: HE551506-AA-HGT-D_SWI-DR-CX-000096
(Project | Originator | Volume | Location | Type | Role | Number)

Revision: P01

DO NOT SCALE

Millimetres 0 10 100



1920's

Oblique view of Stonehenge Bottom showing disturbed ground interpreted as early workings of phosphatic chalk.
Photo reference is CCC 11752/1094 date unknown but taken in 1920s.

LEGEND

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log).
Construction
None
Maintenance / Cleaning
None
Use
None
Decommissioning / Demolition
None

Rev.	Date	Description	By	Chk'd	App'd
P01	02/12/16	FIRST ISSUE	JS	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3

Client: highways england

Designers: ARUP ATKINS

Project Title: A303 AMESBURY TO BERWICK DOWN

Drawing Title: FIGURE B-13
1920 ANNOTATED OBLIQUE PHOTOGRAPH – EAST OF STONEHENGE

Scale	Designed / Drawn	Checked	Approved	Authorised
NTS	JS	PD	AK	AK
Original Size	**Date**	**Date**	**Date**	**Date**
A3	02/12/16	02/12/16	02/12/16	02/12/16

Drawing Number: Project | Originator | Volume
HE551506-AA-HGT-D_SWI-DR-CX-000097
Location | Type | Role | Number

Revision: P01

2013

Oblique view to northwest of Stonehenge Cottages and east tunnel portal in shallow dry valley. (T) Trackway. Photo reference is NMR 27690/002 taken 04/06/13.

LEGEND

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log).
Construction
None
Maintenance / Cleaning
None
Use
None
Decommissioning / Demolition
None

Rev.	Date	Description	By	Chk'd	App'd
P01	02/12/16	FIRST ISSUE	JS	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3

Client: highways england

Designers: ARUP ATKINS

Project Title: A303 AMESBURY TO BERWICK DOWN

Drawing Title: FIGURE B-14
2013 ANNOTATED OBLIQUE PHOTOGRAPH – EAST OF STONEHENGE

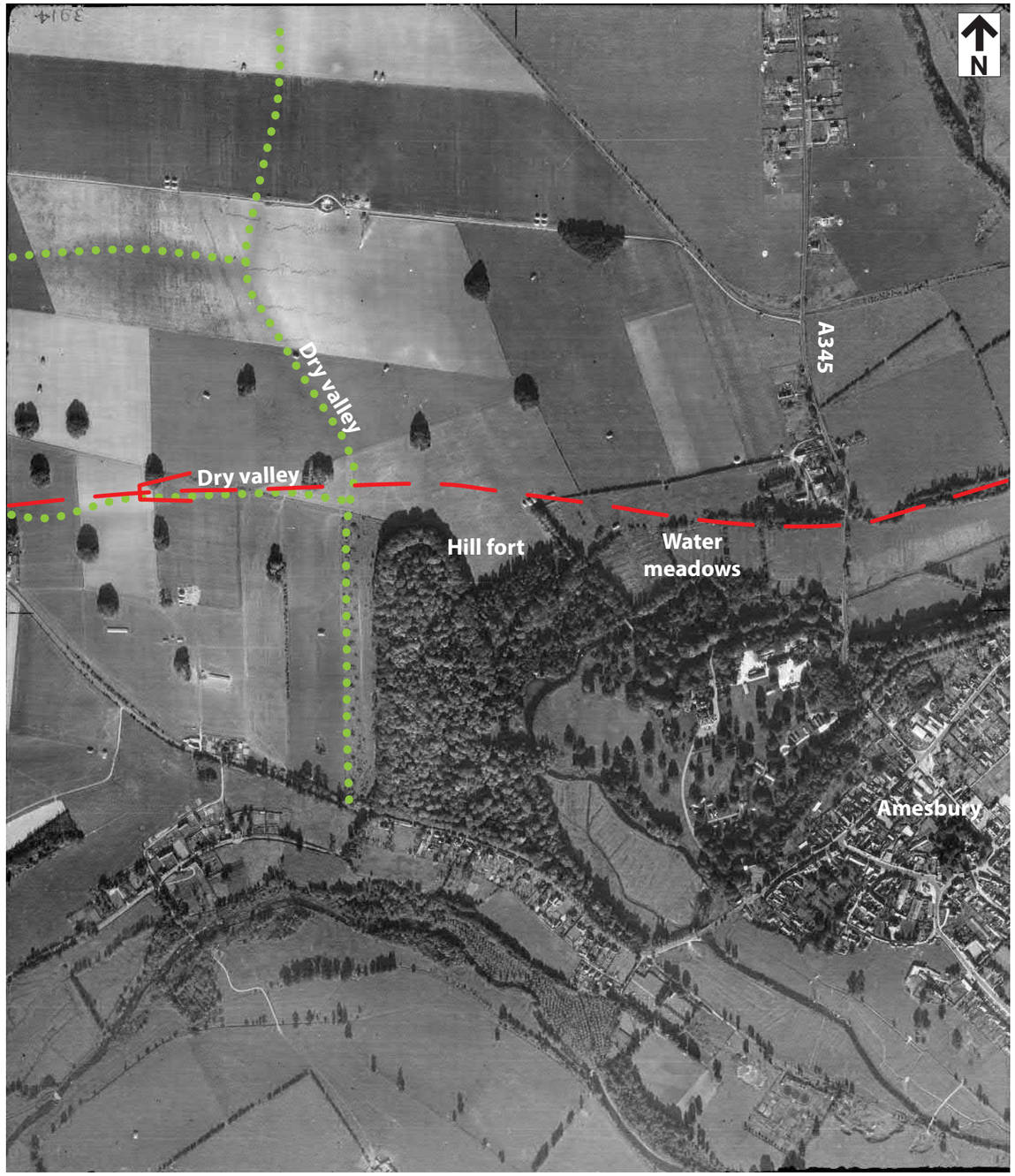
Scale	Designed / Drawn	Checked	Approved	Authorised
NTS	JS	PD	AK	AK
Original Size	**Date**	**Date**	**Date**	**Date**
A3	02/12/16	02/12/16	02/12/16	02/12/16

Drawing Number: Project | Originator | Volume
HE551506-AA-HGT-D_SWI-DR-CX-000098
Location | Type | Role | Number

Revision: P01

DO NOT SCALE

Millimetres 0 10 100



1945

Vertical view of proposed route from the east tunnel portal to the A345 prior to construction of the current A303 Amesbury bypass, showing dry valley network, afforested hill fort and watermeadows.
Photo reference is RAF/106G/UK/915/3199 taken 11/10/45.

LEGEND

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log).
Construction
None
Maintenance / Cleaning
None
Use
None
Decommissioning / Demolition
None

Rev.	Date	Description	By	Chk'd	App'd
P01	02/12/16	FIRST ISSUE	JS	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3

Client: highways england

Designers: ARUP ATKINS

Project Title: A303 AMESBURY TO BERWICK DOWN

Drawing Title: FIGURE B-15
1945 ANNOTATED VERTICAL AERIAL PHOTOGRAPH - AMESBURY

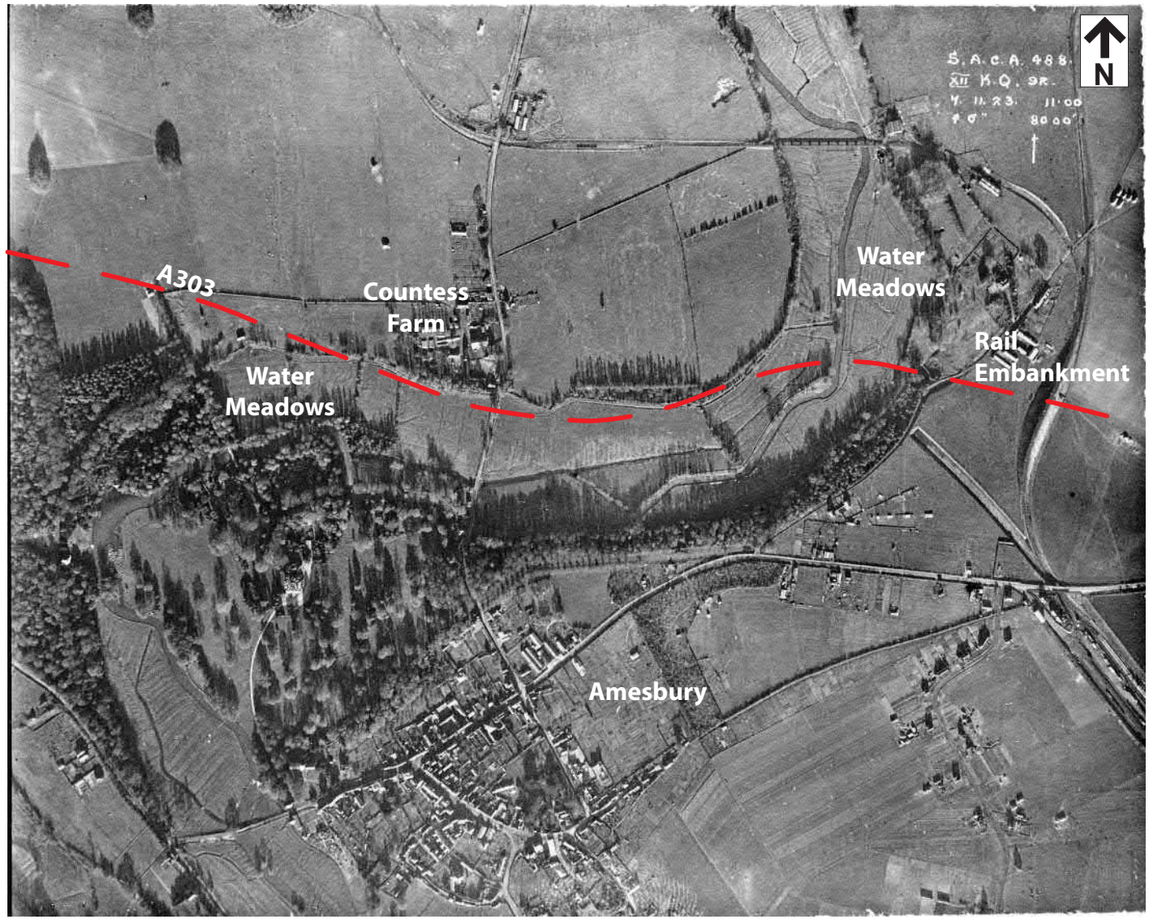
Scale	Designed / Drawn	Checked	Approved	Authorised
NTS	JS	PD	AK	AK
Original Size	Date	Date	Date	Date
A3	02/12/16	02/12/16	02/12/16	02/12/16

Drawing Number: Project | Originator | Volume
HE551506-AA-HGT-D_SWI-DR-CX-000099
Location | Type | Role | Number

Revision: P01

DO NOT SCALE

Millimetres 0 10 100



1923

Vertical view of River Avon at Amesbury showing extent of water meadows before construction of A303 bypass north of Amesbury. Photo references is CCC 8603/1688 taken 07/11/23.

LEGEND

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log).
Construction
None
Maintenance / Cleaning
None
Use
None
Decommissioning / Demolition
None

Rev.	Date	Description	By	Chk'd	App'd
P01	02/12/16	FIRST ISSUE	JS	PD	AK

Drawing Status: FIT FOR INTERNAL REVIEW AND COMMENT
Suitability: S3

Client: highways england

Designers: ARUP ATKINS

Project Title: A303 AMESBURY TO BERWICK DOWN

Drawing Title: FIGURE B-16
1923 ANNOTATED VERTICAL AERIAL PHOTOGRAPH - AMESBURY

Scale	Designed / Drawn	Checked	Approved	Authorised
NTS	JS	PD	AK	AK
Original Size	Date	Date	Date	Date
A3	02/12/16	02/12/16	02/12/16	02/12/16

Drawing Number: HE551506-AA-HGT-D_SWI-DR-CX-000100
(Project | Originator | Volume | Location | Type | Role | Number)

Revision: P01

Appendix C Land Contamination assessment

C.1 Introduction

C.1.1.1 'Land affected by contamination' is defined in Contaminated Land Report (CLR) 11 [42] as 'land that might have contamination present which may, or may not, meet the statutory definition of contaminated land'.

C.1.1.2 Assessment of contamination and its effects are assessed through the identification and assessment of risk presented by potential contaminant linkages, or Source – Pathway – Receptor relationships. Where all three are present, they are termed a potential contaminant linkage (PCL) and form the conceptual site model (CSM). Guidance provided by the Environment Agency in CLR11 [42] and the Guiding Principles for Land Contamination (GPLC) document [43] provides the technical framework for the development of such CSMs and the application of risk assessment (qualitative or quantitative) to consider whether PCLs are significant and require management or mitigation.

C.1.1.3 The approach to risk assessment follows the principles given in CLR11 [42] and GPLC, that is, decisions regarding a site may be informed by:

- Tier 1 preliminary risk assessment - typically a desk study review and site walkover inspection to develop the preliminary CSM (PCSM), with an assessment of risk considering the likelihood and severity of the potential consequences associated with the contaminant linkage(s);
- Tier 2 Generic Quantitative Risk Assessment (GQRA), typically a review of ground investigation and monitoring data, development of a CSM with an assessment of risk using precautionary, generic assessment criteria (GAC) relevant to the PPLs that represent minimal or tolerable risk; and
- Tier 3 detailed quantitative risk assessment.

C.1.1.4 A 'Tier 1 Preliminary Risk Assessment' has been completed in accordance with CLR11 [42] and has been based on the desk study information described in the preceding sections.

C.1.1.5 In addition to this, NHBC/Environment Agency guidance R&D66 [44] provides an assessment methodology for the development and application of the consequence and probability matrix (as presented in Table C1 below) for contaminated land risk assessment.

Table C1 Estimation of the Level of Risk by Comparison of Consequence and Probability

Probability (Likelihood)	Consequence				
		Severe	**Medium**	**Mild**	**Minor**
	High Likelihood	Very High Risk	High Risk	Moderate Risk	Moderate/Low Risk
	Likely	High Risk	Moderate Risk	Moderate/Low Risk	Low Risk
	Low Likelihood	Moderate Risk	Moderate/Low Risk	Low Risk	Very Low Risk
	Unlikely	Moderate/Low Risk	Low Risk	Very Low Risk	Very Low Risk

C.2 Preliminary Conceptual Site Models

C.2.1 Sources

C.2.1.1 Potentially contaminative land uses representing sources of contamination are identified in Table 5 4 in the main body of this report.

C.2.2 Identified Receptors

C.2.2.1 Human health receptors in the alignment options areas are considered to comprise residents, workers in and visitors to commercial properties, and members of the public accessing areas of open space and community facilities. Occupants of residential properties are considered to be the most sensitive receptors to land contamination; workers in commercial properties and people accessing areas of public open space are of lower sensitivity.

C.2.2.2 Controlled waters receptors comprise:

- Groundwater
  - Secondary (undifferentiated) aquifer associated with the Head deposits;
  - Secondary A aquifer associated with the Alluvium, River Terrace Deposits and rare peat associated with the channels of the River Avon and River Till; and
  - Principal aquifer associated with the Chalk bedrock.
- Surface Water
  - River Avon at the eastern extent of the alignment options; and
  - River Till flowing southwards through Winterbourne Stoke at the western extent of the alignment options.

C.2.2.3 Ecological receptors have been identified in the area of all option alignments and comprise the River Till in the west, which is a designated SSSI, and the River Avon in the east, which is a designated SSSI and SAC.

C.2.2.4 Property receptors in the vicinity of alignment options comprise residential and commercial properties, crops, livestock and infrastructure such as below ground utilities.

C.2.3 Pathways

C.2.3.1 On-site human health receptors may be exposed to contamination by the following pathways:

- dermal contact with contaminants in soil, soil-derived dust and/or contamination entrained in surface water run-off from areas where soil (and contamination) is exposed, or in shallow groundwater if excavation takes place below the groundwater table;
- ingestion of contaminants in soil, soil-derived dust, abstracted groundwater used for potable purposes, and/or contamination entrained in surface water run-off from areas where soil (and contamination) is exposed, or in shallow groundwater if excavation takes place below the groundwater table;
- inhalation of contaminants in soil-derived dust from areas where soil (and contamination) is exposed;
- indoor and outdoor inhalation of ground/landfill gas and/or vapours; and
- accumulation and ignition of ground/landfill gas in enclosed spaces.

C.2.3.2 Off-site human receptors may be exposed to contamination by the following pathways:

- dermal contact with contaminants in windblown, soil-derived dust and/or contamination entrained in surface water run-off from areas where soil (and contamination) is exposed or in migrating shallow groundwater if off-site excavation takes place below the groundwater table;
- ingestion of contaminants in windblown, soil-derived dust, abstracted groundwater used for potable purposes, and/or contamination entrained in surface water run-off from areas where soil (and contaminant) is exposed or in migrating groundwater if off-site excavation takes place below the groundwater table;
- inhalation of contaminants in windblown, soil-derived dust from areas where soil (and contamination) is exposed;
- indoor and outdoor inhalation of migrating ground/landfill gas and/or vapours; and
- accumulation and ignition of ground/landfill gas in enclosed spaces.

C.2.3.3 Potential pathways between contamination sources and the identified groundwater receptors comprise:

- Leaching from unsaturated soil and migration of contaminants through unsaturated zone to deeper groundwater;
- Leaching from unsaturated zone and lateral migration of contaminants within the wider aquifer.

C.2.3.4 Potential pathways between contamination sources and the identified surface water receptors comprise:

- discharge of contaminants in laterally migrating groundwater as baseflow to the surface waters;
- migration of contaminants along preferential pathways such as service runs; and
- migration of contaminants entrained in surface runoff.

C.2.3.5 On-site property receptors may be exposed to contamination by:

- Direct contact with contaminants in soil and shallow groundwater; and
- accumulation and ignition of ground/landfill gas in enclosed spaces.

C.2.3.6 Off-site property receptors may be exposed to contamination by:

- Direct contact with contaminants in migrating shallow groundwater; and
- accumulation and ignition of migrating ground/landfill gas in enclosed spaces.

C.2.3.7 Ecological receptors, identified as the River Avon and River Till SSSIs, may be exposed to contamination by:

- Discharge of contaminants in laterally migrating groundwater as baseflow to the surface waters,
- migration of contaminants along preferential pathways such as service runs; and

- migration of contaminants entrained in surface runoff.

C.2.3.8 Preliminary conceptual site models have been developed for each of the potentially contaminative land uses identified in Table 5.4 through identification of potential contamination sources, migration/exposure pathways and potential receptors which are specific to each potentially contaminative land use.

Baseline Preliminary Conceptual Site Model – Unnamed Farm (D062)					
Source	**Receptor**	**Pathway**	**Probability**	**Consequence**	**Baseline Risk**
An unnamed farm with a slurry pit and sheep wash is located 195m to the south of the D062 alignment footprint to the north west of the village of Berwick St James. This is assumed to be an operational farm. Fuels and a range of chemicals such as fertilisers, herbicides and pesticides may be stored and used. Slurry is a source of gases including carbon dioxide, methane and hydrogen sulphide and these may be present in the ground if leaks have occurred. A reasonable worst case scenario is assumed that chemicals used at the farm have leaked to ground and contamination is present in the soil and groundwater and as vapours.	**On-site human receptors:** Farm workers Members of the public accessing the area	Dermal contact with and ingestion of contaminants in soil and soil-derived dust, abstracted groundwater used for potable purposes, entrained in surface water runoff from areas where soil (and contaminant) is exposed and in shallow groundwater if excavation takes place below the groundwater table.	Unlikely	Medium	Low risk
		Inhalation of contaminants in soil-derived dust.	Unlikely	Medium	Low risk
		Outdoor inhalation of vapours and gas from contaminated soil and/or groundwater.	Unlikely	Medium	Low risk
	Off-site human receptors: Members of the public accessing the surrounding area Farm workers	Dermal contact with and ingestion of contaminants in windblown soil-derived dust, abstracted groundwater used for potable purposes, entrained in surface water runoff from areas where soil (and contaminant) is exposed and in migrating shallow groundwater if excavation takes place below the groundwater table.	Unlikely	Mild	Very low risk
		Inhalation of contaminants in windblown soil-derived dust.	Unlikely	Mild	Very low risk
		Indoor and outdoor inhalation of migrating vapours and gas.	Unlikely	Mild	Very low risk
	Abstracted groundwater: Potentially used for potable water, domestic and agricultural use	Leaching from unsaturated soil and migration of contaminants through unsaturated zone to and within groundwater which may be abstracted.	Unlikely	Severe	Moderate/low risk
	Controlled Waters: Groundwater in the Principal Bedrock Aquifer Groundwater in Secondary (undifferentiated) Aquifer associated with superficial deposits	Leaching from unsaturated soil and migration of contaminants through unsaturated zone to deeper groundwater and lateral migration of contaminants within the wider aquifer.	Low likelihood	Medium	Moderate/low risk
	On-site property: Crops	Direct contact with contaminants in soil and shallow groundwater and	Unlikely	Mild	Very low risk

Baseline Preliminary Conceptual Site Model – Unnamed Farm (D062)					
Source	**Receptor**	**Pathway**	**Probability**	**Consequence**	**Baseline Risk**
	Belowground infrastructure	accumulation of gas into enclosed spaces.			
	Off-site property: Crops Belowground infrastructure Residential properties	Direct contact with contaminants in migrating shallow groundwater and accumulation of gas into enclosed spaces.	Unlikely	Mild	Very low risk

Notes:

An unnamed farm is located 195m to the south of the D062 alignment footprint to the north west of the village of Berwick St James. This is assumed to be an operational farm. Fuels and a range of chemicals such as fertilisers, herbicides and pesticides may be stored and used. Slurry is a source of gases including carbon dioxide, methane and hydrogen sulphide and these may be present in the ground if leaks have occurred. The construction of the slurry pit is not known.

A reasonable worst case scenario is assumed that chemicals used at the farm have leaked to ground and contamination is present in the soil and groundwater and as vapours, and that the slurry pit is unlined and contaminants including gases are present.

'The site' for the purposes of this assessment is defined as the 150m footprint around the option alignments.

The unnamed farm may be up-hydraulic gradient of the option alignments and there is the potential for contamination to have migrated on to the site.

Baseline Preliminary Conceptual Site Model – Winterbourne Stoke Filling Station (D061)					
Source	**Receptor**	**Pathway**	**Probability**	**Consequence**	**Baseline Risk**
Winterbourne Stoke petrol filling station located 190m to the south of the site extent within the study area. A reasonable worst case scenario is assumed that underground storage tanks at the filling station have leaked and above ground spillages have occurred at the surface during fuelling activities. Petroleum hydrocarbon contamination may be present in the soil and groundwater in the non-aqueous (free) phase, the dissolved phase and/or the vapour phase.	**On-site human receptors:** Members of the public accessing the D061 site Agricultural workers at the D061 site	Dermal contact with and ingestion of contaminants in soil and soil-derived dust, abstracted groundwater used for potable purposes, entrained in surface water runoff from areas where soil (and contaminant) is exposed and in shallow groundwater if excavation takes place below the groundwater table.	Unlikely	Medium	Low risk
		Inhalation of contaminants in soil-derived dust.	Unlikely	Medium	Low risk
		Outdoor inhalation of vapours from contaminated soil and/or groundwater.	Unlikely	Medium	Low risk
	Off-site human receptors: Occupants of residential properties within 25m of the south of the D061 site extent Workers at Manor Farm Workers at petrol filling station Members of the public accessing the surrounding area Agricultural workers in the surrounding area	Dermal contact with and ingestion of contaminants in windblown soil-derived dust, abstracted groundwater used for potable purposes, entrained in surface water runoff from areas where soil (and contaminant) is exposed and in migrating shallow groundwater if excavation takes place below the groundwater table.	Unlikely	Mild	Very low risk
		Inhalation of contaminants in windblown soil-derived dust.	Unlikely	Mild	Very low risk
		Indoor and outdoor inhalation of migrating vapours.	Low likelihood	Medium	Moderate/low risk
	Abstracted groundwater: Potentially used for potable water, domestic and agricultural use	Leaching from unsaturated soil and migration of contaminants through unsaturated zone to and within groundwater which may be abstracted.	Unlikely	Severe	Moderate/low risk
	Controlled Waters: Groundwater in the Secondary A and Secondary (Undifferentiated) Superficial Aquifers and Principal Bedrock Aquifer	Leaching from unsaturated soil and migration of contaminants through unsaturated zone to deeper groundwater, and lateral migration of contaminants within the wider aquifer.	Unlikely	Medium	Low risk

Baseline Preliminary Conceptual Site Model – Winterbourne Stoke Filling Station (D061)					
Source	**Receptor**	**Pathway**	**Probability**	**Consequence**	**Baseline Risk**
	Controlled Waters: River Till	Discharge of contaminants in laterally migrating groundwater as baseflow to the surface waters, migration of contaminants along preferential pathways such as service runs and migration of contaminants entrained in surface runoff.	Unlikely	Medium	Low risk
	On-site property: Belowground infrastructure	Direct contact with contaminants in soil and shallow groundwater.	Unlikely	Mild	Very low risk
	Off-site property: Belowground infrastructure and residential/farm properties located within 25m of the south of the site extent Petrol Filling Station infrastructure Crops	Direct contact with contaminants in migrating shallow groundwater.	Low likelihood	Mild	Low risk
	Ecological receptors: River Till SSSI	Discharge of contaminants in laterally migrating groundwater as baseflow to the surface waters, migration of contaminants along preferential pathways such as service runs and migration of contaminants entrained in surface runoff.	Unlikely	Medium	Low risk

Notes:

Winterbourne Stoke petrol filling station is located 190m to the south of the site extent within the study area.

A reasonable worst case scenario is assumed that underground storage tanks at the filling station have leaked and above ground spillages have occurred at the surface during fuelling activities.

'The site' for the purposes of this assessment is defined as the 150m footprint around the D061 option alignment.

It is considered unlikely that contamination from the petrol filling station has migrated into the D061 site extents because the petrol filling station is located in the south of the study areas for D061 and the predominant groundwater flow in the area is to the south.

Baseline Preliminary Conceptual Site Model – Manor Farm (D061)					
Source	**Receptor**	**Pathway**	**Probability**	**Consequence**	**Baseline Risk**
Manor Farm located in Winterbourne Stoke 130m to the south of the site extent within the study area of D061. A reasonable worst case scenario is assumed that this is an operational farmstead and fuels and a range of chemicals such as fertilisers, herbicides and pesticides may be stored and used. Contamination may be present in the soil and groundwater and as vapours.	**On-site human receptors:** Members of the public accessing the area	Dermal contact with and ingestion of contaminants in soil and soil-derived dust, abstracted groundwater used for potable purposes, entrained in surface water runoff from areas where soil (and contaminant) is exposed and in shallow groundwater if excavation takes place below the groundwater table.	Unlikely	Medium	Low risk
		Inhalation of contaminants in soil-derived dust.	Unlikely	Medium	Low risk
		Outdoor inhalation of vapours from contaminated soil and/or groundwater.	Unlikely	Medium	Low risk
	Off-site human receptors: Occupants of residential properties within 25m of the south of the site extent Workers at Manor Farm	Dermal contact with and ingestion of contaminants in windblown soil-derived dust, abstracted groundwater used for potable purposes, entrained in surface water runoff from areas where soil (and contaminant) is exposed and in migrating shallow groundwater if excavation takes place below the groundwater table.	Unlikely	Mild	Very low risk
		Inhalation of contaminants in windblown soil-derived dust.	Unlikely	Mild	Very low risk
		Indoor and outdoor inhalation of migrating vapours.	Unlikely	Mild	Very low risk
	Abstracted groundwater: Potentially used for potable water, domestic and agricultural use	Leaching from unsaturated soil and migration of contaminants through unsaturated zone to and within groundwater which may be abstracted.	Unlikely	Severe	Moderate/low risk
	Controlled Waters: Groundwater in the Secondary A and Secondary (Undifferentiated) Superficial Aquifers and Principal Bedrock Aquifer	Leaching from unsaturated soil and migration of contaminants through unsaturated zone to deeper groundwater, and lateral migration of contaminants within the wider aquifer.	Unlikely	Medium	Low risk
	Controlled Waters: River Till	Discharge of contaminants in laterally migrating groundwater as baseflow to the surface waters, migration of contaminants along preferential	Unlikely	Medium	Low risk

		pathways such as service runs and migration of contaminants entrained in surface runoff.			
	On-site property: Belowground infrastructure Crops	Direct contact with contaminants in soil and shallow groundwater.	Unlikely	Mild	Very low risk
	Off-site property: Belowground infrastructure Residential/farm properties located within 25m of the south of the site extent Crops	Direct contact with contaminants in migrating shallow groundwater.	Unlikely	Mild	Very low risk
	Ecological receptors: River Till SSSI	Discharge of contaminants in laterally migrating groundwater as baseflow to the surface waters, migration of contaminants along preferential pathways such as service runs and migration of contaminants entrained in surface runoff.	Unlikely	Medium	Low risk

Notes:

Manor Farm located in Winterbourne Stoke 130m to the south of the site extent within the study area of D061.

A reasonable worst case scenario is assumed that this is an operational farmstead and fuels and a range of chemicals such as fertilisers, herbicides and pesticides may be stored and used. Contamination may be present in the soil and groundwater and as vapours.

'The site' for the purposes of this assessment is defined as the 150m footprint around the D061 option alignment.

It is considered unlikely that contamination from Manor Farm has migrated into the D061 site extent because the farm is located in the south of the study areas for D061 and the predominant groundwater flow in the area is to the south.

Baseline Preliminary Conceptual Site Model – Area of Demolition Rubble (D061)					
Source	**Receptor**	**Pathway**	**Probability**	**Consequence**	**Baseline Risk**
An area of demolition rubble was identified based on anecdotal evidence obtained during ground investigations carried out in 2002 by Mott MacDonald. This is located in the north of the D061 option footprint approximately 600m to the north east of Winterbourne Stoke. A range of inorganic and organic contaminants may be present in soil and groundwater associated with waste materials which have historically been deposited in this area. A reasonable worst case scenario is assumed that the deposited materials contained contaminants which have leached in to the ground and remain in soil and groundwater.	**On-site human receptors:** Members of the public accessing the area	Dermal contact with and ingestion of contaminants in soil and soil-derived dust, abstracted groundwater used for potable purposes, entrained in surface water runoff from areas where soil (and contaminant) is exposed and in shallow groundwater if excavation takes place below the groundwater table.	Unlikely	Mild	Very low risk
		Inhalation of contaminants in soil-derived dust.	Low likelihood	Mild	Low risk
		Outdoor inhalation of vapours from contaminated soil and/or groundwater.	Unlikely	Mild	Very low risk
	Off-site human receptors: Members of the public accessing the area	Dermal contact with and ingestion of contaminants in windblown soil-derived dust, abstracted groundwater used for potable purposes, entrained in surface water runoff from areas where soil (and contaminant) is exposed and in migrating shallow groundwater if excavation takes place below the groundwater table.	Unlikely	Mild	Very low risk
		Inhalation of contaminants in windblown soil-derived dust.	Low likelihood	Mild	Low risk
		Outdoor inhalation of migrating vapours.	Unlikely	Mild	Very low risk
	Abstracted groundwater: Potentially used for potable water, domestic and agricultural use	Leaching from unsaturated soil and migration of contaminants through unsaturated zone to and within groundwater which may be abstracted.	Unlikely	Severe	Moderate/low risk
	Controlled Waters: Groundwater in the Principal Bedrock Aquifer	Leaching from unsaturated soil and migration of contaminants through unsaturated zone to deeper groundwater, and lateral migration of contaminants within the wider aquifer.	Low likelihood	Medium	Moderate/low risk
	Controlled Waters: River Till	Discharge of contaminants in laterally migrating groundwater as baseflow to the surface waters, migration of contaminants along preferential pathways such as service runs and	Low likelihood	Medium	Moderate/low risk

		migration of contaminants entrained in surface runoff.			
	On-site property: Belowground infrastructure	Direct contact with contaminants in soil and shallow groundwater.	Low likelihood	Mild	Low risk
	Off-site property: Belowground infrastructure	Direct contact with contaminants in migrating shallow groundwater.	Low likelihood	Mild	Low risk
	Ecological receptors: River Till SSSI	Discharge of contaminants in laterally migrating groundwater as baseflow to the surface waters, migration of contaminants along preferential pathways such as service runs and migration of contaminants entrained in surface runoff.	Low likelihood	Medium	Moderate/low risk

Notes:

An area of demolition rubble was identified based on anecdotal evidence obtained during ground investigations carried out in 2002 by Mott MacDonald. This is located in the D061 option footprint approximately 600m to the north east of Winterbourne Stoke.

A range of inorganic and organic contaminants may be present in soil and groundwater associated with waste materials which have historically been deposited in this area. A reasonable worst case scenario is assumed that the deposited materials contained contaminants which have leached in to the ground and remain in soil and groundwater.

'The site' for the purposes of this assessment is defined as the 150m footprint around the D061 option alignment.

The area of demolition rubble is located up-hydraulic gradient of the D061 option alignment and there is the potential for contamination to have migrated on to the site.

Baseline Preliminary Conceptual Site Model – Hill Farm (D061)					
Source	**Receptor**	**Pathway**	**Probability**	**Consequence**	**Baseline Risk**
Hill Farm is located 100m to the south of the D061 option footprint, to the east of Winterbourne Stoke. This is assumed to be an operational farm. Fuels and a range of chemicals such as fertilisers, herbicides and pesticides may be stored and used. A reasonable worst case scenario is assumed that chemicals used at the farm have leaked to ground and contamination is present in the soil and groundwater and as vapours.	**On-site human receptors:** Farm workers Members of the public accessing the area	Dermal contact with and ingestion of contaminants in soil and soil-derived dust, abstracted groundwater used for potable purposes, entrained in surface water runoff from areas where soil (and contaminant) is exposed and in shallow groundwater if excavation takes place below the groundwater table.	Unlikely	Medium	Low risk
		Inhalation of contaminants in soil-derived dust.	Unlikely	Medium	Low risk
		Outdoor inhalation of vapours from contaminated soil and/or groundwater.	Unlikely	Medium	Low risk
	Off-site human receptors: Members of the public accessing the surrounding area Farm workers Residents at Hill Farm	Dermal contact with and ingestion of contaminants in windblown soil-derived dust, abstracted groundwater used for potable purposes, entrained in surface water runoff from areas where soil (and contaminant) is exposed and in migrating shallow groundwater if excavation takes place below the groundwater table.	Unlikely	Mild	Very low risk
		Inhalation of contaminants in windblown soil-derived dust.	Unlikely	Mild	Very low risk
		Indoor and outdoor inhalation of migrating vapours.	Unlikely	Mild	Very low risk
	Abstracted groundwater: Potentially used for potable water, domestic and agricultural use	Leaching from unsaturated soil and migration of contaminants through unsaturated zone to and within groundwater which may be abstracted.	Unlikely	Severe	Moderate/low risk
	Controlled Waters: Groundwater in the Principal Bedrock Aquifer	Leaching from unsaturated soil and migration of contaminants through unsaturated zone to deeper groundwater and lateral migration of contaminants within the wider aquifer.	Unlikely	Medium	Low risk
	On-site property: Crops Belowground infrastructure	Direct contact with contaminants in soil and shallow groundwater.	Unlikely	Mild	Very low risk

	Off-site property: Crops Belowground infrastructure Existing properties	Direct contact with contaminants in migrating shallow groundwater.	Unlikely	Mild	Very low risk

Notes:

Hill Farm is located 100m to the south of the D061 option footprint, to the east of Winterbourne Stoke.

This is assumed to be an operational farm. Fuels and a range of chemicals such as fertilisers, herbicides and pesticides may be stored and used.

A reasonable worst case scenario is assumed that chemicals used at the farm have leaked to ground and contamination is present in the soil and groundwater and as vapours.

'The site' for the purposes of this assessment is defined as the 150m footprint around the option alignments.

Hill Farm is likely to be down-hydraulic gradient of the D061 alignment and it is therefore considered unlikely that contamination has migrated on to the site.

Baseline Preliminary Conceptual Site Model – Oatlands Dairy Unit (D062)					
Source	**Receptor**	**Pathway**	**Probability**	**Consequence**	**Baseline Risk**
Oatlands Dairy Unit is located in the north of the D062 option footprint at Oatlands Hill. This is assumed to be an operational and fully automated with a range of plant and equipment. Fuels, oils and solvents may be stored and used. A reasonable worst case scenario is assumed that chemicals used at the farm and milk have leaked to ground and contamination is present in the soil and groundwater and as vapours.	**On-site human receptors:** Agricultural workers Members of the public accessing the area	Dermal contact with and ingestion of contaminants in soil and soil-derived dust, abstracted groundwater used for potable purposes, entrained in surface water runoff from areas where soil (and contaminant) is exposed and in shallow groundwater if excavation takes place below the groundwater table.	Low likelihood	Medium	Moderate/low risk
		Inhalation of contaminants in soil-derived dust.	Low likelihood	Medium	Moderate/low risk
		Outdoor inhalation of vapours from contaminated soil and/or groundwater.	Unlikely	Medium	Low risk
	Off-site human receptors: Agricultural and dairy workers Members of the public accessing the surrounding area	Dermal contact with and ingestion of contaminants in windblown soil-derived dust, abstracted groundwater used for potable purposes, entrained in surface water runoff from areas where soil (and contaminant) is exposed and in migrating shallow groundwater if excavation takes place below the groundwater table.	Low likelihood	Mild	Low risk
		Inhalation of contaminants in windblown soil-derived dust.	Low likelihood	Mild	Low risk
		Indoor and outdoor inhalation of migrating vapours.	Unlikely	Mild	Very low risk
	Abstracted groundwater: Potentially used for potable water, domestic and agricultural use	Leaching from unsaturated soil and migration of contaminants through unsaturated zone to and within groundwater which may be abstracted.	Unlikely	Severe	Moderate/low risk
	Controlled Waters: Groundwater in the Principal Bedrock Aquifer	Leaching from unsaturated soil and migration of contaminants through unsaturated zone to deeper groundwater, and lateral migration of contaminants within the wider aquifer.	Low likelihood	Medium	Moderate/low risk
	On-site property: Crops Belowground infrastructure	Direct contact with contaminants in soil and shallow groundwater.	Low likelihood	Mild	Low risk

	Off-site property: Crops Belowground infrastructure Existing properties	Direct contact with contaminants in migrating shallow groundwater.	Low likelihood	Mild	Low risk

Notes:

Oatlands Dairy Unit is located in the north of the D062 option footprint at Oatlands Hill. It is not clear whether the facility is a dairy for milking cattle only or if it also undertakes milk processing.

This is assumed to be an operational and fully automated with a range of plant and equipment. Fuels, oils and solvents may be stored and used. If milk processing is undertaken milk may have been discharged to ground which may cause anaerobic conditions in groundwater.

'The site' for the purposes of this assessment is defined as the 150m footprint around the option alignment.

Oatlands Dairy Unit is located up-hydraulic gradient of the option alignment and there is the potential for contamination to have migrated on to the site.

Baseline Preliminary Conceptual Site Model – RAF Oatlands Hill and RFC Lake Down (D061, D062)					
Source	**Receptor**	**Pathway**	**Probability**	**Consequence**	**Baseline Risk**
	On-site human receptors: Agricultural workers Members of the public accessing the area	Dermal contact with and ingestion of contaminants in soil and soil-derived dust, abstracted groundwater used for potable purposes, entrained in surface water runoff from areas where soil (and contaminant) is exposed and in shallow groundwater if excavation takes place below the groundwater table.	Low likelihood	Medium	Moderate/low risk
		Inhalation of contaminants in soil-derived dust.	Low likelihood	Medium	Moderate/low risk
		Outdoor inhalation of vapours from contaminated soil and/or groundwater.	Unlikely	Medium	Low risk
	Off-site human receptors: Agricultural workers Members of the public accessing the area Occupants of residential properties and workers at farms located adjacent to the site but outside of the study area.	Dermal contact with and ingestion of contaminants in windblown soil-derived dust, abstracted groundwater used for potable purposes, entrained in surface water runoff from areas where soil (and contaminant) is exposed and in migrating shallow groundwater if excavation takes place below the groundwater table.	Unlikely	Mild	Very low risk
		Inhalation of contaminants in windblown soil-derived dust.	Low likelihood	Mild	Low risk
		Indoor and outdoor inhalation of migrating vapours.	Unlikely	Mild	Very low risk
	Abstracted groundwater: Potentially used for potable water, domestic and agricultural use	Leaching from unsaturated soil and migration of contaminants through unsaturated zone to and within groundwater which may be abstracted.	Unlikely	Severe	Moderate/low risk
	Controlled Waters: Groundwater in the Secondary (Undifferentiated) Aquifer associated with Head Deposits and in the Principal Bedrock Aquifer	Leaching from unsaturated soil and migration of contaminants through unsaturated zone to deeper groundwater, and lateral migration of contaminants within the wider aquifer.	Low likelihood	Medium	Moderate/low risk
	On-site property: Belowground infrastructure Crops	Direct contact with contaminants in soil and shallow groundwater.	Low likelihood	Mild	Low risk

The former RAF Oatlands Hill is understood to have been a World War 2 satellite site for RAF Old Sarum, and it comprised a grass airfield, hangars and underground fuel storage. The airfield was operational between 1941 and 1946. The former RFC Lake Down was a World War 1 airbase comprising a grass airfield and extensive associated infrastructure covering an area of 160 acres. Activities which may have taken place include bulk storage and use of chemicals and fuels, engineering and maintenance of aircraft and other infrastructure, storage and use of ammunition and bombs, and burial or burning of waste materials. As such, a wide range of potential contaminants may be present in this area in soil, groundwater and as vapours, although the length of time since the main operation of the site (circa 70 years) means that degradation and attenuation of contamination will have occurred. Unexploded	**Off-site property:** Residential and farm properties adjacent to the site but outside of the study area Belowground infrastructure Crops	Direct contact with contaminants in migrating shallow groundwater.	Low likelihood	Mild	Low risk

Ordinance (UXO) and asbestos may also be present. A reasonable worst case scenario is assumed that contaminants entered the ground while the airfield was operational and contamination remains in soil and groundwater.					

Notes:

The former RAF Oatlands Hill is located directly to the south of the A303 Longbarrow Roundabout to the east and west of the A360 and is intersected by the option alignments. The former RFC Lake Down is located to the south and east of RAF Oatlands Hill but may have extended across part of the area later occupied by RAF Oatlands Hill. It is also likely to be intersected by the option alignments.

A reasonable worst case scenario is assumed that contaminants entered the ground while the airfield was operational and contamination remains in soil and groundwater.

'The site' for the purposes of this assessment is defined as the 150m footprint around the option alignments.

Baseline Preliminary Conceptual Site Model – Dismantled Larkhill Military Light Railway (D061, D062)					
Source	**Receptor**	**Pathway**	**Probability**	**Consequence**	**Baseline Risk**
A dismantled railway was located approximately 50m to the east of the A360 at Longbarrow roundabout. This first appears on the 1924-1925 historical Ordnance Survey map and is not shown as operational on preceding maps. Contaminants potentially associated with operational rail lines include hydrocarbons, metals and sulphates. A reasonable worst case scenario is assumed that contaminants entered the ground while the railway was operational and contamination remains in soil and groundwater.	**On-site human receptors:** Agricultural workers Members of the public accessing the area	Dermal contact with and ingestion of contaminants in soil and soil-derived dust, abstracted groundwater used for potable purposes, entrained in surface water runoff from areas where soil (and contaminant) is exposed and in shallow groundwater if excavation takes place below the groundwater table.	Low likelihood	Mild	Low risk
		Inhalation of contaminants in soil-derived dust.	Low likelihood	Mild	Low risk
		Outdoor inhalation of vapours from contaminated soil and/or groundwater.	Unlikely	Mild	Very low risk
	Off-site human receptors: Agricultural workers Members of the public accessing the area	Dermal contact with and ingestion of contaminants in windblown soil-derived dust, abstracted groundwater used for potable purposes, entrained in surface water runoff from areas where soil (and contaminant) is exposed and in migrating shallow groundwater if excavation takes place below the groundwater table.	Unlikely	Mild	Very low risk
		Inhalation of contaminants in windblown soil-derived dust.	Unlikely	Mild	Very low risk
		Outdoor inhalation of migrating vapours.	Unlikely	Mild	Very low risk
	Abstracted groundwater: Potentially used for potable water, domestic and agricultural use	Leaching from unsaturated soil and migration of contaminants through unsaturated zone to and within groundwater which may be abstracted.	Unlikely	Severe	Moderate/low risk
	Controlled Waters: Groundwater in the Principal Bedrock Aquifer	Leaching from unsaturated soil and migration of contaminants through unsaturated zone to deeper groundwater, and lateral migration of contaminants within the wider aquifer.	Low likelihood	Medium	Moderate/low risk
	On-site property: Belowground infrastructure Crops	Direct contact with contaminants in soil.	Low likelihood	Mild	Low risk

	Off-site property: Belowground infrastructure Crops	Direct contact with contaminants in migrating shallow groundwater.	Unlikely	Mild	Very low risk

Notes:

A dismantled railway was located approximately 50m to the east of the A360 at Longbarrow roundabout and is intersected by the option alignments.

A reasonable worst case scenario is assumed that contaminants entered the ground while the railway was operational and contamination remains in soil and groundwater.

'The site' for the purposes of this assessment is defined as the 150m footprint around the option alignments.

Baseline Preliminary Conceptual Site Model – RAF Stonehenge (D061, D062)					
Source	**Receptor**	**Pathway**	**Probability**	**Consequence**	**Baseline Risk**
	On-site human receptors: Agricultural workers Members of the public accessing the area	Dermal contact with and ingestion of contaminants in soil and soil-derived dust, abstracted groundwater used for potable purposes, entrained in surface water runoff from areas where soil (and contaminant) is exposed and in shallow groundwater if excavation takes place below the groundwater table.	Low likelihood	Medium	Moderate/low risk
		Inhalation of contaminants in soil-derived dust.	Low likelihood	Medium	Moderate/low risk
		Outdoor inhalation of vapours from contaminated soil and/or groundwater.	Unlikely	Medium	Low risk
	Off-site human receptors: Agricultural workers Members of the public accessing the area	Dermal contact with and ingestion of contaminants in windblown soil-derived dust, abstracted groundwater used for potable purposes, entrained in surface water runoff from areas where soil (and contaminant) is exposed and in migrating shallow groundwater if excavation takes place below the groundwater table.	Unlikely	Mild	Very low risk
		Inhalation of contaminants in windblown soil-derived dust.	Unlikely	Mild	Very low risk
		Indoor and outdoor inhalation of migrating vapours.	Unlikely	Mild	Very low risk
	Abstracted groundwater: Potentially used for potable water, domestic and agricultural use	Leaching from unsaturated soil and migration of contaminants through unsaturated zone to and within groundwater which may be abstracted.	Unlikely	Severe	Moderate/low risk
	Controlled Waters: Groundwater in the Secondary (Undifferentiated) Aquifer associated with Head Deposits and in the Principal Bedrock Aquifer	Leaching from unsaturated soil and migration of contaminants through unsaturated zone to deeper groundwater, and lateral migration of contaminants within the wider aquifer.	Low likelihood	Medium	Moderate/low risk
	On-site property: Belowground infrastructure Crops	Direct contact with contaminants in soil and shallow groundwater.	Low likelihood	Mild	Low risk

The former RAF Stonehenge, comprising a World War I military airbase and airfield, was historically located to the west of Stonehenge. Information relating to this facility is limited but it is understood to have come into operation in 1917 and was earmarked for disposal by 1921. Activities which may have taken place include bulk storage and use of chemicals and fuels, engineering and maintenance of aircraft and other infrastructure, storage and use of ammunition and bombs, and burial or burning of waste materials. UXO and asbestos may be present. A reasonable worst case scenario is assumed that contaminants entered the ground while the airfield was operational and contamination remains in soil and groundwater, although the length of time since the main operation of the site (circa 70 years) means that degradation and attenuation of contamination will have occurred.	**Off-site property:** Belowground infrastructure Crops	Direct contact with contaminants in migrating shallow groundwater.	Unlikely	Mild	Very low risk

Unexploded Ordinance (UXO) and asbestos may also be present.					

Notes:

The former RAF Stonehenge was historically located to the west and south west of Stonehenge, spanning the current A303, and is intersected by the option alignments.

A reasonable worst case scenario is assumed that contaminants entered the ground while the airfield was operational and contamination remains in soil and groundwater, although the length of time since the main operation of the site (circa 70 years) means that degradation and attenuation of contamination will have occurred.

'The site' for the purposes of this assessment is defined as the 150m footprint around the option alignments.

Baseline Preliminary Conceptual Site Model – Former Sewage Works (D061, D062)					
Source	**Receptor**	**Pathway**	**Probability**	**Consequence**	**Baseline Risk**
The Ordnance Survey map dated 1924 shows a disused sewage works located approximately 420m to the south of Stonehenge. This is understood to have been associated with the former RAF Stonehenge. Potential associated contaminants include metals and other inorganics, acids and alkalis, a range of organic compounds and micro-organisms in soil and groundwater as well as gases such as methane, carbon dioxide and hydrogen sulphide. A reasonable worst case scenario is assumed that sewage and associated chemicals used in the operation of the sewage works entered the ground and contaminants remain in soil and groundwater and as ground gas.	**On-site human receptors:** Members of the public accessing the area Agricultural workers	Dermal contact with and ingestion of contaminants in soil and soil-derived dust, abstracted groundwater used for potable purposes, entrained in surface water runoff from areas where soil (and contaminant) is exposed and in shallow groundwater if excavation takes place below the groundwater table.	Low likelihood	Medium	Moderate/low risk
		Inhalation of contaminants in soil-derived dust.	Low likelihood	Medium	Moderate/low risk
		Outdoor inhalation of vapours/gas from contaminated soil and/or groundwater.	Unlikely	Medium	Low risk
	Off-site human receptors: Members of the public accessing the area Agricultural workers	Dermal contact with and ingestion of contaminants in windblown soil-derived dust, abstracted groundwater used for potable purposes, entrained in surface water runoff from areas where soil (and contaminant) is exposed and in migrating shallow groundwater if excavation takes place below the groundwater table.	Unlikely	Mild	Very low risk
		Inhalation of contaminants in windblown soil-derived dust.	Unlikely	Mild	Very low risk
		Outdoor inhalation of migrating vapours/gas.	Unlikely	Mild	Very low risk
	Abstracted groundwater: Potentially used for potable water, domestic and agricultural use	Leaching from unsaturated soil and migration of contaminants through unsaturated zone to and within groundwater which may be abstracted.	Unlikely	Severe	Moderate/low risk
	Controlled Waters: Groundwater in the Secondary (Undifferentiated) Aquifer associated with Head Deposits and Principal Bedrock Aquifer	Leaching from unsaturated soil and migration of contaminants through unsaturated zone to deeper groundwater, and lateral migration of contaminants within the wider aquifer.	Low likelihood	Medium	Moderate/low risk
	On-site property: Belowground infrastructure Crops	Direct contact with contaminants in soil and shallow groundwater and accumulation of gas into enclosed spaces.	Low likelihood	Mild	Low risk

	Off-site property: Belowground infrastructure Crops	Direct contact with contaminants in migrating shallow groundwater and accumulation of gas into enclosed spaces.	Unlikely	Mild	Very low risk

Notes:

A disused sewage works located approximately 420m to the south of Stonehenge intersected by the option alignments.

A reasonable worst case scenario is assumed that sewage and associated chemicals used in the operation of the sewage works entered the ground and contaminants remain in soil and groundwater and as ground gas.

'The site' for the purposes of this assessment is defined as the 150m footprint around the option alignments.

Baseline Preliminary Conceptual Site Model – Former Disused Tip					
Source	**Receptor**	**Pathway**	**Probability**	**Consequence**	**Baseline Risk**
A linear mound is labelled as a disused tip on the 1971-1972 Ordnance Survey map, approximately 420m to the south of Stonehenge. This feature is understood to be associated with the former RAF Stonehenge. The tip may have been used for the disposal of a range of organic and inorganic materials, which it is assumed will still remain *in situ*. Decomposition of organic materials results in the generation of gases such as methane and carbon dioxide. However, given that the tip was disused by the early 1970s it is considered that gas generation would have subsided.	**On-site human receptors:** Members of the public accessing the area Agricultural workers	Dermal contact with and ingestion of contaminants in soil and soil-derived dust, abstracted groundwater used for potable purposes, entrained in surface water runoff from areas where soil (and contaminant) is exposed and in shallow groundwater if excavation takes place below the groundwater table.	Low likelihood	Medium	Moderate/low risk
		Inhalation of contaminants in soil-derived dust.	Low likelihood	Medium	Moderate/low risk
		Outdoor inhalation of gas/vapours from contaminated soil and/or groundwater.	Unlikely	Medium	Low risk
	Off-site human receptors: Members of the public accessing the area Agricultural workers	Dermal contact with and ingestion of contaminants in windblown soil-derived dust, abstracted groundwater used for potable purposes, entrained in surface water runoff from areas where soil (and contaminant) is exposed and in migrating shallow groundwater if excavation takes place below the groundwater table.	Unlikely	Mild	Very low risk
		Inhalation of contaminants in windblown soil-derived dust.	Unlikely	Mild	Very low risk
		Outdoor inhalation of migrating gas/vapours.	Unlikely	Mild	Very low risk
	Abstracted groundwater: Potentially used for potable water, domestic and agricultural use	Leaching from unsaturated soil and migration of contaminants through unsaturated zone to and within groundwater which may be abstracted.	Unlikely	Severe	Moderate/low risk
	Controlled Waters: Groundwater in the Secondary (Undifferentiated) Aquifer associated with Head Deposits and Principal Bedrock Aquifer	Leaching from unsaturated soil and migration of contaminants through unsaturated zone to deeper groundwater, and lateral migration of contaminants within the wider aquifer.	Low likelihood	Medium	Moderate/low risk
	On-site property: Belowground infrastructure Crops	Direct contact with contaminants in soil and shallow groundwater and accumulation of gas into enclosed spaces.	Low likelihood	Mild	Low risk

	Off-site property: Belowground infrastructure Crops	Direct contact with contaminants in migrating shallow groundwater and accumulation of gas into enclosed spaces.	Unlikely	Mild	Very low risk

Notes:

A linear mound is labelled as a disused tip on the 1971-1972 Ordnance Survey map, approximately 420m to the south of Stonehenge and in the southern site extent of the option alignments. This feature is understood to be associated with the former RAF Stonehenge.

The tip may have been used for the disposal of a range of organic and inorganic materials, which it is assumed will still remain *in situ*. Decomposition of organic materials results in the generation of gases such as methane and carbon dioxide. However, given that the tip was disused by the early 1970s it is considered that gas generation would have subsided.

'The site' for the purposes of this assessment is defined as the 150m footprint around the option alignments.

Baseline Preliminary Conceptual Site Model – Potentially infilled quarry					
Source	**Receptor**	**Pathway**	**Probability**	**Consequence**	**Baseline Risk**
A quarry was located on the route of the existing A303, approximately 480m to the west of Countess Roundabout. The feature is labelled as an old quarry on the 1901 Ordnance Survey map and the map dated 1971-1972 shows a dualled section of the existing A303 to have been constructed directly through the location of the quarry. On this basis, it is considered unlikely that the quarry was infilled with waste and it is therefore unlikely that residual contamination is present.	**On-site human receptors:** Maintenance workers accessing the existing A303 Members of the public who may occasionally access the verges of the A303 Members of the public accessing the area Agricultural workers	Dermal contact with and ingestion of contaminants in soil and soil-derived dust, abstracted groundwater used for potable purposes, entrained in surface water runoff from areas where soil (and contaminant) is exposed and in shallow groundwater if excavation takes place below the groundwater table.	Unlikely	Medium	Low risk
		Inhalation of contaminants in soil-derived dust.	Unlikely	Medium	Low risk
		Outdoor inhalation of vapours/landfill gas from contaminated soil and/or groundwater.	Unlikely	Medium	Low risk
	Off-site human receptors: Agricultural workers Members of the public accessing the surrounding area Agricultural workers	Dermal contact with and ingestion of contaminants in windblown soil-derived dust, abstracted groundwater used for potable purposes, entrained in surface water runoff from areas where soil (and contaminant) is exposed and in migrating shallow groundwater if excavation takes place below the groundwater table.	Unlikely	Mild	Very low risk
		Inhalation of contaminants in windblown soil-derived dust.	Unlikely	Mild	Very low risk
		Indoor and outdoor inhalation of migrating vapours/landfill gas.	Unlikely	Mild	Very low risk
	Abstracted groundwater: Potentially used for potable water, domestic and agricultural use	Leaching from unsaturated soil and migration of contaminants through unsaturated zone to and within groundwater which may be abstracted.	Unlikely	Medium	Low risk
	Controlled Waters: Groundwater in the Principal Bedrock Aquifer	Leaching from unsaturated soil and migration of contaminants through unsaturated zone to deeper groundwater, and lateral migration of contaminants within the wider aquifer.	Unlikely	Medium	Low risk
	Controlled Waters: River Avon	Discharge of contaminants in laterally migrating groundwater as baseflow to the surface waters, migration of contaminants along preferential pathways such as	Unlikely	Medium	Low risk

		service runs and migration of contaminants entrained in surface runoff.			
	On-site property: Highway infrastructure Belowground infrastructure	Direct contact with contaminants in soil and shallow groundwater and accumulation of gas into enclosed spaces.	Unlikely	Mild	Very low risk
	Off-site property: Belowground infrastructure Highway infrastructure Crops	Direct contact with contaminants in migrating shallow groundwater and accumulation of gas into enclosed spaces.	Unlikely	Mild	Very low risk
	Ecological receptors: River Avon SSSI and SAC	Discharge of contaminants in laterally migrating groundwater as baseflow to the surface waters, migration of contaminants along preferential pathways such as service runs and migration of contaminants entrained in surface runoff.	Unlikely	Medium	Low risk

Notes:

A quarry was located on the route of the existing A303, approximately 480m to the west of Countess Roundabout on the route of the option alignments. The feature is labelled as an old quarry on the 1901 Ordnance Survey map and the map dated 1971-1972 shows a dualled section of the existing A303 to have been constructed directly through the location of the quarry.

On this basis, it is considered unlikely that the quarry was infilled with waste and it is therefore unlikely that residual contamination is present.

'The site' for the purposes of this assessment is defined as the 150m footprint around the option alignments.

Baseline Preliminary Conceptual Site Model – Countess Farm (D061, D062)					
Source	**Receptor**	**Pathway**	**Probability**	**Consequence**	**Baseline Risk**
Countess Farm is located in the north of the D061 and D062 option footprint at Countess roundabout. This is assumed to be an operational farm. Fuels and a range of chemicals such as fertilisers, herbicides and pesticides may be stored and used. A reasonable worst case scenario is assumed that chemicals used at the farm have leaked to ground and contamination is present in the soil and groundwater and as vapours.	**On-site human receptors:** Farm workers Maintenance workers accessing the existing A303 Members of the public who may occasionally access the verges of the A303 Members of the public accessing the area Agricultural workers	Dermal contact with and ingestion of contaminants in soil and soil-derived dust, abstracted groundwater used for potable purposes, entrained in surface water runoff from areas where soil (and contaminant) is exposed and in shallow groundwater if excavation takes place below the groundwater table.	Low likelihood	Medium	Moderate/low risk
		Inhalation of contaminants in soil-derived dust.	Low likelihood	Medium	Moderate/low risk
		Outdoor inhalation of vapours from contaminated soil and/or groundwater.	Unlikely	Medium	Low risk
	Off-site human receptors: Occupants of residential properties Members of the public accessing the surrounding area Agricultural workers	Dermal contact with and ingestion of contaminants in windblown soil-derived dust, abstracted groundwater used for potable purposes, entrained in surface water runoff from areas where soil (and contaminant) is exposed and in migrating shallow groundwater if excavation takes place below the groundwater table.	Unlikely	Mild	Very low risk
		Inhalation of contaminants in windblown soil-derived dust.	Low likelihood	Mild	Low risk
		Indoor and outdoor inhalation of migrating vapours.	Unlikely	Mild	Very low risk
	Abstracted groundwater: Potentially used for potable water, domestic and agricultural use	Leaching from unsaturated soil and migration of contaminants through unsaturated zone to and within groundwater which may be abstracted.	Unlikely	Severe	Moderate/low risk
	Controlled Waters: Groundwater in the Secondary (Undifferentiated) Aquifer associated with River Terrace Deposits and Principal Bedrock Aquifer	Leaching from unsaturated soil and migration of contaminants through unsaturated zone to deeper groundwater, and lateral migration of contaminants within the wider aquifer.	Low likelihood	Medium	Moderate/low risk
	Controlled Waters: River Avon	Discharge of contaminants in laterally migrating groundwater as baseflow to the surface waters, migration of contaminants along preferential pathways such as service runs and	Low likelihood	Medium	Moderate/low risk

		migration of contaminants entrained in surface runoff.			
	On-site property: Highway infrastructure Farm buildings Belowground infrastructure	Direct contact with contaminants in soil and shallow groundwater.	Low likelihood	Mild	Low risk
	Off-site property: Residential properties Belowground infrastructure Crops	Direct contact with contaminants in migrating shallow groundwater.	Low likelihood	Mild	Low risk
	Ecological receptors: River Avon SSSI and SAC	Discharge of contaminants in laterally migrating groundwater as baseflow to the surface waters, migration of contaminants along preferential pathways such as service runs and migration of contaminants entrained in surface runoff.	Low likelihood	Medium	Moderate/low risk

Notes:

Countess Farm is located in the north of the D061 and D062 option footprint at Countess roundabout.

This is assumed to be an operational farm. Fuels and a range of chemicals such as fertilisers, herbicides and pesticides may be stored and used. A reasonable worst case scenario is assumed that chemicals used at the farm have leaked to ground and contamination is present in the soil and groundwater and as vapours.

'The site' for the purposes of this assessment is defined as the 150m footprint around the option alignments.

Countess Farm is located up-hydraulic gradient of the option alignments and there is the potential for contamination to have migrated on to the site.

Baseline Preliminary Conceptual Site Model – Countess Services Filling Station (D061, D062)					
Source	**Receptor**	**Pathway**	**Probability**	**Consequence**	**Baseline Risk**
Countess Services petrol filling station is located directly to the north east of Countess roundabout in the service station within the alignment footprint. A reasonable worst case scenario is assumed that underground storage tanks at the filling station have leaked and above ground spillages have occurred at the surface during fuelling activities. Petroleum hydrocarbon contamination may be present in the soil and groundwater in the non-aqueous (free) phase, the dissolved phase and/or the vapour phase.	**On-site human receptors:** Users of the service station Maintenance workers accessing the existing A303 Members of the public who may occasionally access the verges of the A303 Members of the public accessing the area Agricultural workers	Dermal contact with and ingestion of contaminants in soil and soil-derived dust, abstracted groundwater used for potable purposes, entrained in surface water runoff from areas where soil (and contaminant) is exposed and in shallow groundwater if excavation takes place below the groundwater table.	Low likelihood	Medium	Moderate/low risk
		Inhalation of contaminants in soil-derived dust.	Low likelihood	Medium	Moderate/low risk
		Outdoor inhalation of vapours from contaminated soil and/or groundwater.	Likely	Medium	Moderate risk
	Off-site human receptors: Occupants of residential properties Members of the public accessing the surrounding area Agricultural workers	Dermal contact with and ingestion of contaminants in windblown soil-derived dust, abstracted groundwater used for potable purposes, entrained in surface water runoff from areas where soil (and contaminant) is exposed and in migrating shallow groundwater if excavation takes place below the groundwater table.	Unlikely	Mild	Very low risk
		Inhalation of contaminants in windblown soil-derived dust.	Unlikely	Mild	Very low risk
		Indoor and outdoor inhalation of migrating vapours.	Low likelihood	Medium	Moderate/low risk
	Abstracted groundwater: Potentially used for potable water, domestic and agricultural use	Leaching from unsaturated soil and migration of contaminants through unsaturated zone to and within groundwater which may be abstracted.	Low likelihood	Severe	Moderate risk
	Controlled Waters: Groundwater in the Secondary A Superficial Aquifer and Principal Bedrock Aquifer	Leaching from unsaturated soil and migration of contaminants through unsaturated zone to deeper groundwater, and lateral migration of contaminants within the wider aquifer.	Likely	Medium	Moderate risk
	Controlled Waters: River Avon	Discharge of contaminants in laterally migrating groundwater as baseflow to the surface waters, migration of contaminants along preferential pathways such as service runs and migration of contaminants entrained in surface runoff.	Low likelihood	Medium	Moderate/low risk

	On-site property: Service station buildings Highway infrastructure Belowground infrastructure	Direct contact with contaminants in soil and shallow groundwater.	Likely	Minor	Low risk
	Off-site property: Residential properties Belowground infrastructure Crops	Direct contact with contaminants in migrating shallow groundwater.	Likely	Minor	Low risk
	Ecological receptors: River Avon SSSI and SAC	Discharge of contaminants in laterally migrating groundwater as baseflow to the surface waters, migration of contaminants along preferential pathways such as service runs and migration of contaminants entrained in surface runoff.	Low likelihood	Medium	Moderate/low risk

Notes:

Countess Services petrol filling station is located directly to the north east of Countess roundabout in the service station within the site extents of the option alignments.

A reasonable worst case scenario is assumed that underground storage tanks at the filling station have leaked and above ground spillages have occurred at the surface during fuelling activities. Petroleum hydrocarbon contamination may be present in the soil and groundwater in the non-aqueous (free) phase, the dissolved phase and/or the vapour phase.

'The site' for the purposes of this assessment is defined as the 150m footprint around the option alignments.

Baseline Preliminary Conceptual Site Model – Ratfyn Farm (D061, D062)					
Source	**Receptor**	**Pathway**	**Probability**	**Consequence**	**Baseline Risk**
Ratfyn Farm is located directly to the north of the existing A303, approximately 135m to the north of Amesbury within the alignment footprint of both D061 and D062. This is assumed to be an operational farmstead. Fuels and a range of chemicals such as fertilisers, herbicides and pesticides may be stored and used. A reasonable worst case scenario is assumed that chemicals used at the farm have leaked to ground and contamination is present in the soil and groundwater and as vapours.	**On-site human receptors:** Farm workers Maintenance workers accessing the existing A303 Members of the public who may occasionally access the verges of the A303 Members of the public accessing the area Agricultural workers	Dermal contact with and ingestion of contaminants in soil and soil-derived dust, abstracted groundwater used for potable purposes, entrained in surface water runoff from areas where soil (and contaminant) is exposed and in shallow groundwater if excavation takes place below the groundwater table.	Low likelihood	Medium	Moderate/low risk
		Inhalation of contaminants in soil-derived dust.	Low likelihood	Medium	Moderate/low risk
		Outdoor inhalation of vapours from contaminated soil and/or groundwater.	Unlikely	Medium	Low risk
	Off-site human receptors: Occupants of residential properties Members of the public accessing the surrounding area Agricultural workers	Dermal contact with and ingestion of contaminants in windblown soil-derived dust, abstracted groundwater used for potable purposes, entrained in surface water runoff from areas where soil (and contaminant) is exposed and in migrating shallow groundwater if excavation takes place below the groundwater table.	Unlikely	Mild	Very low risk
		Inhalation of contaminants in windblown soil-derived dust.	Low likelihood	Mild	Low risk
		Indoor and outdoor inhalation of migrating vapours.	Unlikely	Mild	Very low risk
	Abstracted groundwater: Potentially used for potable water, domestic and agricultural use	Leaching from unsaturated soil and migration of contaminants through unsaturated zone to and within groundwater which may be abstracted.	Unlikely	Severe	Moderate/low risk
	Controlled Waters: Groundwater in the Secondary (Undifferentiated) Aquifer associated with Head Deposits and Principal Bedrock Aquifer	Leaching from unsaturated soil and migration of contaminants through unsaturated zone to deeper groundwater, and lateral migration of contaminants within the wider aquifer.	Low likelihood	Medium	Moderate/low risk
	Controlled Waters: River Avon	Discharge of contaminants in laterally migrating groundwater as baseflow to the surface waters, migration of contaminants along preferential pathways such as service runs and migration of contaminants entrained in surface runoff.	Low likelihood	Medium	Moderate/low risk

	On-site property: Farm buildings Highway infrastructure Belowground infrastructure	Direct contact with contaminants in soil and shallow groundwater.	Low likelihood	Mild	Low risk
	Off-site property: Residential properties Belowground infrastructure Crops	Direct contact with contaminants in migrating shallow groundwater.	Unlikely	Mild	Very low risk
	Ecological receptors: River Avon SSSI and SAC	Discharge of contaminants in laterally migrating groundwater as baseflow to the surface waters, migration of contaminants along preferential pathways such as service runs and migration of contaminants entrained in surface runoff.	Low likelihood	Medium	Moderate/low risk

Notes:

Ratfyn Farm is located directly to the north of the existing A303, approximately 135m to the north of Amesbury within the site extents of the option alignments.

This is assumed to be an operational farmstead. Fuels and a range of chemicals such as fertilisers, herbicides and pesticides may be stored and used. A reasonable worst case scenario is assumed that chemicals used at the farm have leaked to ground and contamination is present in the soil and groundwater and as vapours.

'The site' for the purposes of this assessment is defined as the 150m footprint around the option alignments.

Ratfyn Farm is located up-hydraulic gradient of the option alignments and there is the potential for contamination to have migrated on to the site.

Baseline Preliminary Conceptual Site Model – Depot and Warehouses (D061, D062)					
Source	**Receptor**	**Pathway**	**Probability**	**Consequence**	**Baseline Risk**
A depot and warehouses are located within the alignment footprint directly to the south of the existing A303 in Amesbury within the alignment of both D061 and D062). A range of inorganic and organic contaminants may be stored and/or used at the depot and warehouses. A reasonable worst case scenario is assumed that leaks or spills to ground have occurred during operation resulting in the presence of contamination in soil and groundwater and as vapours.	**On-site human receptors:** Workers at and visitors to the depot and warehouses Maintenance workers accessing the existing A303 Members of the public who may occasionally access the verges of the A303 Members of the public accessing the area	Dermal contact with and ingestion of contaminants in soil and soil-derived dust, abstracted groundwater used for potable purposes, entrained in surface water runoff from areas where soil (and contaminant) is exposed and in shallow groundwater if excavation takes place below the groundwater table.	Low likelihood	Medium	Moderate/low risk
		Inhalation of contaminants in soil-derived dust.	Low likelihood	Medium	Moderate/low risk
		Outdoor inhalation of vapours from contaminated soil and/or groundwater.	Unlikely	Medium	Low risk
	Off-site human receptors: Occupants of residential properties Agricultural workers	Dermal contact with and ingestion of contaminants in windblown soil-derived dust, abstracted groundwater used for potable purposes, entrained in surface water runoff from areas where soil (and contaminant) is exposed and in migrating shallow groundwater if excavation takes place below the groundwater table.	Unlikely	Mild	Very low risk
		Inhalation of contaminants in windblown soil-derived dust.	Unlikely	Mild	Very low risk
		Indoor and outdoor inhalation of migrating vapours.	Unlikely	Mild	Very low risk
	Abstracted groundwater: Potentially used for potable water, domestic and agricultural use	Leaching from unsaturated soil and migration of contaminants through unsaturated zone to and within groundwater which may be abstracted.	Unlikely	Severe	Moderate/low risk
	Controlled Waters: Groundwater in the Secondary (Undifferentiated) Aquifer associated with Head Deposits and Principal Bedrock Aquifer	Leaching from unsaturated soil and migration of contaminants through unsaturated zone to deeper groundwater, and lateral migration of contaminants within the wider aquifer.	Low likelihood	Medium	Moderate/low risk
	On-site property: Depot and warehouse buildings Highway infrastructure Belowground infrastructure Crops	Direct contact with contaminants in soil and shallow groundwater.	Low likelihood	Mild	Low risk

	Off-site property: Belowground infrastructure Residential properties Crops	Direct contact with contaminants in migrating shallow groundwater.	Unlikely	Mild	Very low risk

Notes:

A depot and warehouses are located in the site extents of the option alignments directly to the south of the existing A303 in Amesbury.

A range of inorganic and organic contaminants may be stored and/or used at the depot and warehouses. A reasonable worst case scenario is assumed that leaks or spills to ground have occurred during operation resulting in the presence of contamination in soil and groundwater and as vapours.

'The site' for the purposes of this assessment is defined as the 150m footprint around the option alignments.

Baseline Preliminary Conceptual Site Model – Former Amesbury and Military Camp Light Railway and current light industry (D061, D062)					
Source	**Receptor**	**Pathway**	**Probability**	**Consequence**	**Baseline Risk**
The Amesbury and Military Camp Light Railway historically passed beneath the A303 in cutting to the east of Amesbury at the eastern extent of the D061 and D062 alignments. Light industrial facilities are now present on the route of the railway to the south of the A303 Contaminants potentially associated with operational rail lines include hydrocarbons, metals and sulphates. A range of contaminants potentially associated with the operational light industrial facilities include metals, hydrocarbons and solvents and contamination may be present in the soil and groundwater and as vapours. A reasonable worst case scenario is assumed that contaminants entered the ground while the railway was operational and contamination remains in soil and groundwater.	**On-site human receptors:** Maintenance workers accessing the existing A303 Members of the public who may occasionally access the verges of the A303 Members of the public accessing the area	Dermal contact with and ingestion of contaminants in soil and soil-derived dust, abstracted groundwater used for potable purposes, entrained in surface water runoff from areas where soil (and contaminant) is exposed and in shallow groundwater if excavation takes place below the groundwater table.	Unlikely	Medium	Low risk
		Inhalation of contaminants in soil-derived dust.	Unlikely	Medium	Low risk
		Outdoor inhalation of vapours from contaminated soil and/or groundwater.	Unlikely	Medium	Low risk
	Off-site human receptors: Occupants of residential properties Agricultural workers Workers at commercial/light industrial facilities	Dermal contact with and ingestion of contaminants in windblown soil-derived dust, abstracted groundwater used for potable purposes, entrained in surface water runoff from areas where soil (and contaminant) is exposed and in migrating shallow groundwater if excavation takes place below the groundwater table.	Unlikely	Mild	Very low risk
		Inhalation of contaminants in windblown soil-derived dust.	Unlikely	Mild	Very low risk
		Indoor and outdoor inhalation of migrating vapours.	Unlikely	Mild	Very low risk
	Abstracted groundwater: Potentially used for potable water, domestic and agricultural use	Leaching from unsaturated soil and migration of contaminants through unsaturated zone to and within groundwater which may be abstracted.	Unlikely	Severe	Moderate/low risk
	Controlled Waters: Groundwater in the Secondary (Undifferentiated) Aquifer associated with Head Deposits and Principal Bedrock Aquifer	Leaching from unsaturated soil and migration of contaminants through unsaturated zone to deeper groundwater, and lateral migration of contaminants within the wider aquifer.	Low likelihood	Medium	Moderate/low risk
	On-site property: Depot and warehouse buildings Highway infrastructure Belowground infrastructure Crops	Direct contact with contaminants in soil and shallow groundwater.	Low likelihood	Mild	Low risk

	Off-site property: Belowground infrastructure Residential properties Crops	Direct contact with contaminants in migrating shallow groundwater.	Unlikely	Mild	Very low risk

Notes:

The Amesbury and Military Camp Light Railway historically passed beneath the A303 in cutting to the east of Amesbury at the eastern extent of the D061 and D062 alignments. Light industrial facilities are now present on the route of the railway to the south of the A303.

Contaminants potentially associated with operational rail lines include hydrocarbons, metals and sulphates. A range of contaminants potentially associated with the operational light industrial facilities include metals, hydrocarbons and solvents and contamination may be present in the soil and groundwater and as vapours.

A reasonable worst case scenario is assumed that contaminants entered the ground while the railway was operational and contamination remains in soil and groundwater.

'The site' for the purposes of this assessment is defined as the 150m footprint around the option alignments.

Baseline Preliminary Conceptual Site Model – Unnamed Farm (D061, D062)					
Source	**Receptor**	**Pathway**	**Probability**	**Consequence**	**Baseline Risk**
An unnamed farm is located north of the existing A303 150m to the north east of the alignment footprint. This is assumed to be an operational farmstead. Fuels and a range of chemicals such as fertilisers, herbicides and pesticides may be stored and used. A reasonable worst case scenario is assumed that chemicals used at the farm have leaked to ground and contamination is present in the soil and groundwater and as vapours.	**On-site human receptors:** Farm workers Maintenance workers accessing the existing A303 Members of the public who may occasionally access the verges of the A303 Members of the public accessing the area Agricultural workers	Dermal contact with and ingestion of contaminants in soil and soil-derived dust, abstracted groundwater used for potable purposes, entrained in surface water runoff from areas where soil (and contaminant) is exposed and in shallow groundwater if excavation takes place below the groundwater table.	Low likelihood	Medium	Moderate/low risk
		Inhalation of contaminants in soil-derived dust.	Low likelihood	Medium	Moderate/low risk
		Outdoor inhalation of vapours from contaminated soil and/or groundwater.	Unlikely	Medium	Low risk
	Off-site human receptors: Members of the public accessing the surrounding area Agricultural workers	Dermal contact with and ingestion of contaminants in windblown soil-derived dust, abstracted groundwater used for potable purposes, entrained in surface water runoff from areas where soil (and contaminant) is exposed and in migrating shallow groundwater if excavation takes place below the groundwater table.	Unlikely	Mild	Very low risk
		Inhalation of contaminants in windblown soil-derived dust.	Low likelihood	Mild	Low risk
		Indoor and outdoor inhalation of migrating vapours.	Unlikely	Mild	Very low risk
	Abstracted groundwater: Potentially used for potable water, domestic and agricultural use	Leaching from unsaturated soil and migration of contaminants through unsaturated zone to and within groundwater which may be abstracted.	Unlikely	Severe	Moderate/low risk
	Controlled Waters: Groundwater in the Principal Bedrock Aquifer	Leaching from unsaturated soil and migration of contaminants through unsaturated zone to deeper groundwater, and lateral migration of contaminants within the wider aquifer.	Low likelihood	Medium	Moderate/low risk
	On-site property: Farm buildings Highway infrastructure Belowground infrastructure	Direct contact with contaminants in soil and shallow groundwater.	Low likelihood	Mild	Low risk

	Off-site property: Belowground infrastructure Crops	Direct contact with contaminants in migrating shallow groundwater.	Unlikely	Mild	Very low risk

Notes:

An unnamed farm is located north of the existing A303 150m to the north east of the site extents for the option alignments.

This is assumed to be an operational farmstead and fuels and a range of chemicals such as fertilisers, herbicides and pesticides may be stored and used. A reasonable worst case scenario is assumed that chemicals used at the farm have leaked to ground and contamination is present in the soil and groundwater and as vapours.

'The site' for the purposes of this assessment is defined as the 150m footprint around the option alignments.

The unnamed farm may be up-hydraulic gradient of the option alignments and there is the potential for contamination to have migrated on to the site.

C.3 Generic Quantitative Risk Assessment

C.3.1.1 A Generic Quantitative Risk Assessment (GQRA) has been undertaken on the limited available historical laboratory analytical data obtained during investigation associated with historically proposed route alignments, to provide an indication of the levels of contaminants historically present based on current guidance. This provides a quantitative indication of PCL which may be present.

C.4 Human Health Generic Quantitative Risk Assessment

C.4.1.1 Detailed guidance on human health risk assessment is available in Science Reports SR2 [45], SR3 [46] and the Contaminated Land Exposure Assessment (CLEA) Model [47]. Atkins GQRA for current and future human receptors has compared soil concentration data with Generic Acceptance Criteria (GAC) to identify whether a potential risk is posed by the contaminant concentrations detected. The GAC considered include:

- Soil Guideline Values: The Environment Agency has previously published of Soil Guideline Values (SGVs).SGVs are trigger values for screening out low risk areas of land contamination. They give an indication of representative average concentrations of chemicals in soil below which the long-term health risks are likely to be minimal. The SGVs have been developed for a range of inorganic and organic contaminants assuming sandy loam soil with 6% soil organic matter (SOM) content; and
- Atkins' Soil Screening Values: Atkins has derived a set of Soil-Screening Values (SSVs) to supplement the SGVs following the CLEA Model. Atkins'-derived SSVs are available for the CLEA standard land-uses for a wider range of typical indicator contaminants. SSVs have also been derived for a sandy soil with 1% SOM and for parks, playing fields and open spaces.
- Category 4 Screening Levels: DEFRA has published Category 4 Screening Levels (C4SLs) for arsenic, benzo(a)pyrene, benzene, cadmium, hexavalent chromium, and lead [48]. C4SLs give an indication of concentrations of contaminants in soil below which the long-term health risks can be considered 'low'. The Department for Communities and Local Government has not yet published central guidance on whether C4SLs can be used and the decision on their use in planning rests with the Local Planning Authority. For the purposes of this assessment, recorded contaminant concentrations have been compared with C4SLs in addition to the screening values described above.

C.4.1.2 GAC have been selected for the site based on the proposed development as a highway and the soil concentration data have been screened against GAC for an open space land use. These GAC relate to chronic (long-term) risk and are considered protective of current and future site users but they cannot be used to assess the risks to construction workers as they relate to acute (short-term) risks.

C.4.1.3 Eighteen soil samples underwent laboratory analysis for a range of contaminants across three phases of investigation carried out between 2000 and 2010. The analytical suites varied between investigations, but all eighteen included metals and metalloids, pH, Total Petroleum Hydrocarbons and Polycyclic Aromatic Hydrocarbons. The samples obtained during the 2000 investigation also underwent analysis for phenols, organochlorine pesticides, organophosphorus pesticides, triazines (varieties of herbicide), Polychlorinated Biphenyls (PCB), and Volatile Organic Compounds (VOC).

C.4.1.4 The concentration of benzo(a)pyrene exceeded the open space C4SL in the sample taken from trial pit TP4 at a depth of 0.60m, during the 2010 Countess Roundabout Ground Investigation. Trial pit TP4 was located on the northwestern side of Countess Roundabout adjacent to the northbound off-slip of the A303 to Countess Road. The recorded concentration was 43.8 mg/kg compared with the C4SL of 10 mg/kg.

C.4.1.5 It is noted that pesticides, triazines, PCB and phenols were not recorded above the laboratory method detection limit in the soil samples analysed. There is no commentary in the relevant historical site investigation report on the sampling and chain of custody procedures followed.

C.5 Preliminary Controlled Waters Risk Assessment

C.5.1.1 The selection of screening criteria is dependent on the nature of the potential controlled waters receptors identified in the CSMs, included in Section C.5. The site is located on a Principal Chalk Aquifer and groundwater within the localised superficial deposits associated with dry valleys and river channels are classified as Secondary A Aquifers and Secondary (Undifferentiated) Aquifers. The Chalk Principal Aquifer is of regional importance in the supply of drinking water across the south of England. The nearest surface water features are the River Till and the River Avon which are crossed by the scheme.

C.5.1.2 On the basis that there are both groundwater and surface water receptors on the site, water quality standards (WQS) have been derived based on Drinking Water Standards (DWS) and Environmental Quality Standards (EQS). The WQS have been sourced from the following regulations, where available:

- River Basin Districts Surface Water and Groundwater Classification (Water Framework Directive) (England and Wales) Direction 2015;
- Directive ‘2013/39/EU’ of the European Parliament and of the Council of 12th August 2013 amending directives 2000/60/EC and 2008/105/EC as regards priority substances in the field of water policy; and
- Council Directive ‘98/83/EC’ of the European Council of 25 December 1998 on the quality of water intended for human consumption (Drinking Water Directive).

C.5.1.3 Available groundwater analytical data has been compared with the WQS. Soil leachate analytical data are not available.

C.5.1.4 Groundwater samples were taken from four boreholes located in two discrete areas of the scheme on one occasion in 2001. One area was 780m the north west of Winterbourne Stoke (R01 and R02) and the second area was approximately 380m to the south east of Stonehenge, south of the existing A303 (R13 and R16).

C.5.1.5 Exceedances of both the DWS and EQS were recorded for lead and total cyanide. The exceedances for lead were recorded in the groundwater sample taken from borehole R01 and the exceedances for total cyanide were recorded in the groundwater sample taken from borehole R13, as summarised in Table C2. The response zone in both these boreholes was installed in the Chalk. It should be noted that this is a conservative assessment of total cyanide in respect of surface water receptors because the EQS is based on the concentration of free, rather than total, cyanide.

Table C2 – Exceedances of Current WQS in Historical Groundwater Samples

Contaminant	Location	WQS	Recorded Concentration
Lead	R01	DWS 0.01 mg/l	0.013 mg/l
		EQS 0.0072 mg/l	
Total Cyanide	R13	DWS 0.05 mg/l	0.6 mg/l
		EQS 0.001 mg/l	

C.5.1.6 It is noted that phenols, PAH, pesticides, triazines and VOC were not recorded above the laboratory method detection limit in the four groundwater samples analysed. There is no commentary in the relevant historical site investigation report on the method of groundwater sampling implemented and the chain of custody procedures followed and the recorded concentrations of organic contaminants may not be fully representative.

C.6 Preliminary Waste Classification

C.6.1.1 Excavated materials that are surplus to the requirements of the scheme, and destined to become a waste, are required to be classified as either inert, non-hazardous or hazardous.

C.6.1.2 An initial assessment has been undertaken of whether any of the 18 soil samples in the historical dataset would be classified as hazardous.

C.6.1.3 CAT-WASTE^{SOIL}, a software tool developed by Atkins, was used to screen the analytical results from the 18 soil samples obtained from historical ground investigation, in accordance with Environment Agency guidance.

C.6.1.4 The results indicate that of the 18 samples assessed, the sample from trial pit TP4 at a depth of 0.60m, obtained during the 2010 Countess Roundabout Ground Investigation is considered hazardous for the purpose of off-site disposal. The risk drivers for this classification are the recorded concentrations of benzo(a)anthracene and TPH with the respective hazard properties HP14 (ecotoxic) and HP7 (carcinogenic) and hazard statements H410 (very toxic to aquatic life with long term effects) and H350 (may cause cancer).

Appendix D Field study notes

D.1 Site walkover

D.1.1.1 A site walkover was carried out on Monday 14th March 2016 by AAJV hydrogeologists. Access was made via public rights of way, including footpaths and byways.

D.1.1.2 In addition, a number of locations of former ground investigation boreholes were visited to determine whether installations were still present in the ground, which might be used for groundwater monitoring.

D.1.1.3 A map showing the site walkover areas visited is presented in Figure D1.

D.1.1.4 The locations of the following groundwater standpipes were visited using GPS; R158, W148, P2, P1, W137. A groundwater standpipe was found at the location of R158, protected by a small wooden fence (note, a second well has since been found on the same parcel of land – the two bores are R158 and R22).

D.1.1.5 No standpipes were found at any of the other locations.

D.1.1.6 The following features were also visited observed during the site walkover:

- ***Coneybury Hill*** – A steep ridgeline separating the River Avon and Stonehenge Bottom dry valley. Coneybury Hill is a prominent feature in the landscape with a very steep eastern facing (toward the Avon) slope, particularly around the Coneybury House area. The ridgeline runs in a roughly southerly direction.

- ***Stonehenge Bottom*** – The dry valley feature runs in a roughly N-S direction and is a prominent feature of the landscape. The eastern side of the dry valley feature tends to be steeper than the western side. The valley floor is relatively broad and flat. There are a number of dry valley spurs which appear to feed into the main Stonehenge dry valley. The feature extends from the area observed in the walkover to Lake in the south and to Larkhill in the north.

- No surface water was observed (other than the Avon River) along the site of the walkover, as expected given the well-draining chalk soils.

D.1.1.7 No public access to the Avon was available at Lake to look for springs. Access to the West Amesbury Spring was not attempted during the site visit.

D.1.1.8 Photographs are given in Figures D2 to D9.

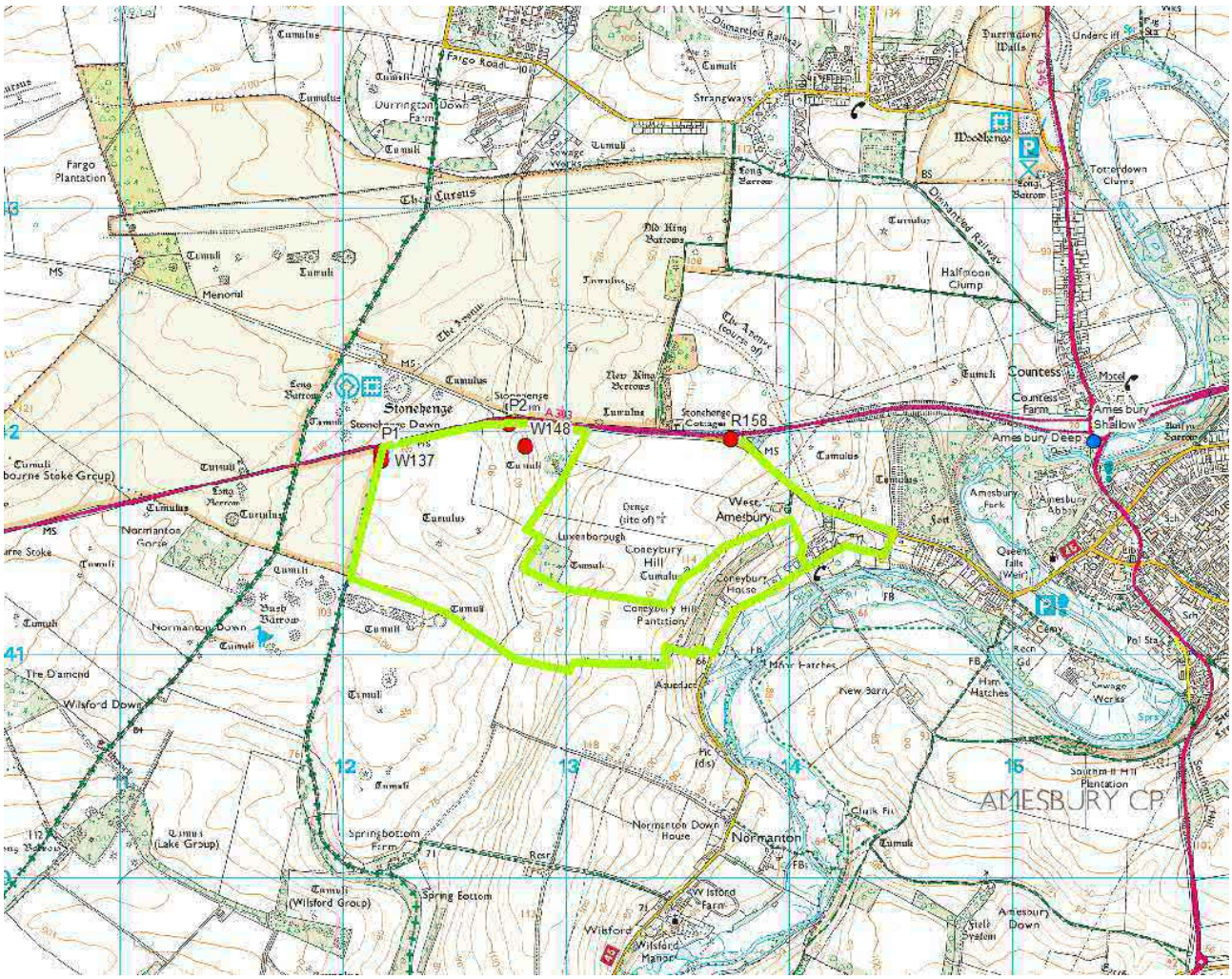


Figure D1 Site walkover (shown by green line)

Site Walkover Photographs

Figure D2 View of standpipe piezometer R22

Figure D3 Photo from Coneybury Hill looking NE

Figure D4 View from Coneybury Hill Tumulus looking W

Figure D5 View toward Stonehenge bottom looking NW adjacent to diamond woods

Figure D6 View of Stonehenge Bottom looking N from NW corner of diamond woods

Figure D7 View from inside Stonehenge Bottom looking south taken from near to location of W148

Figure D8 View of Stonehenge Bottom and spurs looking NW

Figure D9 View from Coneybury Hill toward the SE showing the River Avon valley

Appendix E Historical maps

Refer to Envirocheck package folder references:

95704268.zip

95704374.zip

95704420.zip

Appendix F Groundsure Search results

List of Groundsure shape files:

Dataset	A303 Shapefile Name
Ground Dissolution	HE551506_CH_EGT_D_SWI_PG_YE_GroundDissolution_Current
Nitrate Vulnerable Zones	HE551506_DE_EWE_D_SWI_PG_YE_NitrateVulnerableZones_Current
Environment Agency and Natural Resources Wales Regions	HE551506_EA_EGN_D_SWI_PG_YE_EARegions_Current
National Pollution Incident Records (List 2)	HE551506_EA_EGN_D_SWI_PT_YE_NatPollutionIncidentList2_Current
Detailed River Network	HE551506_EA_EWE_D_SWI_LN_YE_DetailedRiverNetwork_Current
Risk of Flooding from Rivers and the Sea	HE551506_EA_EWE_D_SWI_PG_LM_RoFRaS_Current
River and Coastal Zone 2 Flooding	HE551506_EA_EWE_D_SWI_PG_YE_FloodZone2_Current
River and Coastal Zone 3 Flooding	HE551506_EA_EWE_D_SWI_PG_YE_FloodZone3_Current
Groundwater Vulnerability	HE551506_EA_EWE_D_SWI_PG_YE_GroundwaterVulnerability_Current
General River Quality Assessment - Biology	HE551506_EA_EWE_D_SWI_PT_YE_GeneralRiverQualityBio_Current
General River Quality - Chemistry	HE551506_EA_EWE_D_SWI_PT_YE_GeneralRiverQualityChem_Current
Licensed Discharge Consents	HE551506_EA_EWE_D_SWI_PT_YE_LicensedDischargeConsents_Current
World Heritage Sites	HE551506_EH_EHR_D_SWI_PG_LM_WorldHeritageSites_Current
Historical Energy Features	HE551506_GR_EGN_D_SWI_PG_YE_HistoricalEnergyFeatures_Current
Historical Garages	HE551506_GR_EGN_D_SWI_PG_YE_HistoricalGarages_Current
Historical Land Uses - 1:10,000 scale	HE551506_GR_EGN_D_SWI_PG_YE_HistoricalLandUses10k_Current
Historical Petrol Stations	HE551506_GR_EGN_D_SWI_PG_YE_HistoricalPetrolStations_Current
Historical Tanks	HE551506_GR_EGN_D_SWI_PG_YE_HistoricalTanks_Current
Potentially Infilled Land - 1:10,000 scale	HE551506_GR_EGN_D_SWI_PG_YE_PotentiallyInfilledLand_Current
Historical Surface Ground Working Features	HE551506_GR_EGT_D_SWI_PT_YE_HistroricGroundWorkings_Current
Faults 10k Scale	HE551506_GS_EGT_D_SWI_LN_YE_Faults10k_Current
Linear Geology 50k Scale	HE551506_GS_EGT_D_SWI_LN_YE_LinearGeology50k_Current
Artificial Geology 10k Scale	HE551506_GS_EGT_D_SWI_PG_YE_ArtificialGeology10k_Current
Artificial Geology 50k Scale	HE551506_GS_EGT_D_SWI_PG_YE_ArtificialGeology50k_Current
Permeability of Artificial Ground	HE551506_GS_EGT_D_SWI_PG_YE_ArtificialGroundPermeability_Current
Bedrock Geology 10k Scale	HE551506_GS_EGT_D_SWI_PG_YE_BedrockGeology10k_Current
Bedrock Geology 50k Scale	HE551506_GS_EGT_D_SWI_PG_YE_BedrockGeology50k_Current
Permeability of Bedrock Geology	HE551506_GS_EGT_D_SWI_PG_YE_BedrockGeologyPermeability_Current
Collapsible Rocks	HE551506_GS_EGT_D_SWI_PG_YE_CollapsibleRocks_Current
Compressible Ground	HE551506_GS_EGT_D_SWI_PG_YE_CompressibleGround_Current
Availability of BGS 1:10,000 scale geology data	HE551506_GS_EGT_D_SWI_PG_YE_Geology10kCoverage_Current
Geolgy Map Grid	HE551506_GS_EGT_D_SWI_PG_YE_GeologyMapGrid_Current
Mining Hazards	HE551506_GS_EGT_D_SWI_PG_YE_MiningHazards_Current

Dataset	A303 Shapefile Name
Non Coal Mining Hazards	HE551506_GS_EGT_D_SWI_PG_YE_NonCoalMiningHazards_Current
Radon Affected Areas	HE551506_GS_EGT_D_SWI_PG_YE_RadonPotential_Current
Running Sands	HE551506_GS_EGT_D_SWI_PG_YE_RunningSands_Current
Shrink Swell	HE551506_GS_EGT_D_SWI_PG_YE_ShrinkSwell_Current
Slope Instability	HE551506_GS_EGT_D_SWI_PG_YE_SlopeInstability_Current
Superficial Geology 10k Scale	HE551506_GS_EGT_D_SWI_PG_YE_SuperficialGeology10k_Current
Superficial Geology 50k Scale	HE551506_GS_EGT_D_SWI_PG_YE_SuperficialGeology50k_Current
Permeability of Superficial Geology	HE551506_GS_EGT_D_SWI_PG_YE_SuperficialGeologyPermeability_Current
Borehole Records	HE551506_GS_EGT_D_SWI_PT_YE_BoreholeRecords_Current
Active and inactive mines; quarries; oil wells; gas wells and mineral wharves; and rail	HE551506_GS_EGT_D_SWI_PT_YE_CurrentGroundWorkings_Current
Confidence of Groundwater Flooding Susceptibility Areas	HE551506_GS_EWE_D_SWI_PG_YE_ConfGroundwaterFSA_Current
Groundwater Flooding Susceptibility Areas	HE551506_GS_EWE_D_SWI_PG_YE_GroundwaterFSA_Current
Principal Bedrock Aquifer	HE551506_GS_EWE_D_SWI_PG_YE_PrincipalBedrockAquifer_Current
Secondary (A) Superficial Aquifer - Permeable Layers	HE551506_GS_EWE_D_SWI_PG_YE_SecSuperficialAquiferPerm_Current
Secondary Superficial Aquifer - Undifferentiated Layers	HE551506_GS_EWE_D_SWI_PG_YE_SecSuperficialAquiferUndifLayers_Current
Unproductive Superficial Aquifer	HE551506_GS_EWE_D_SWI_PG_YE_SuperficialAquiferUnproductive_Current
Environmentally Senstive Areas	HE551506_NE_EGN_D_SWI_PG_LM_ESAs_Current
National Nature Reserves	HE551506_NE_EGN_D_SWI_PG_LM_NNRs_Current
Special Areas of Conservation	HE551506_NE_EGN_D_SWI_PG_LM_SACs_Current
Sites of Special Scientific Interest	HE551506_NE_EGN_D_SWI_PG_LM_SSSIs_Current
Current Industrial Sites	HE551506_OS_EGN_D_SWI_PT_YE_CurrentIndustrialSites_Current
Surface Water Line Features	HE551506_OS_EWE_D_SWI_LN_YE_SurfaceWaterLineFeatures_Current
Surface Water Area Features	HE551506_OS_EWE_D_SWI_PG_YE_SurfaceWaterAreaFeatures_Current
Air Pollution Consent Permits	HE551506_WC_EAQ_D_SWI_PT_YE_AirPollutionConsentPermit_Current
Local Authority Regions	HE551506_WC_EGN_D_SWI_PG_YE_LocalAuthorityRegions_Current

Appendix G AGS Data

Refer to AGS package:

A303_ ABD_Archive_GI_Database.ags

Appendix H Geophysical Data

See folder references:

2016-08-22 EGS Downhole geophysics.zip

2016-10-28 Env Sci Group (ESG) downhole geophysics data.zip

2016-10-31 ESG downhole geophysics.zip

Appendix I Groundwater monitoring

See folder reference:

A303 ABD Groundwater monitoring data.zip

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