High Speed 2 - 1MC06 - Stage One C2 - MWCC – North Portal of Chiltern Tunnels to Brackley

Acoustic Mitigation Design Report – Wendover Green Tunnel N Portal to Aylesbury North Cutting

1MC06-CEK-EV-REP-CS03-000002

Rev	Date	Author	Checked by	Approved by	Revision Details	EKFB Reviewer
C03	20/05/2022	M.V.D.Merwe	C.Cobbing	S.Wilkins	Revised in line with comments	Zara Rostance
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Stakeholder review required (SRR)	Purpose of SRR
☐ County / District / London Borough Council	☐ Acceptance
☐ LOV	☐ Approval
☐ LUL	☐ No Objection
☐ NRL	☐ Consent
☐ TFL	
☐ Utilities Company	
☐ Other (please specify)	

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List of Abbreviations

CBA	Cost Benefit Analysis
dB	Decibel
DS	Do Something
DN	Do Nothing
ES	Environmental Statement
SES	Supplementary Environmental Statement
LOAELs	Lowest Observed Adverse Effect Levels
SOAELs	Significant Observed Adverse Effect Levels
NPV	Net Present Value
ToR	Top of Rail
U&A	Undertakings and Assurances

EXECUTIVE SUMMARY

This report presents the civil engineering asset acoustic analysis for C2 IDR– Wendover Green Tunnel North Portal to Aylesbury North Cutting (Ch 55+084 to Ch 62+435). However, the model has been extended to include the area between the Oxford Road overbridge to the Thame Valley Viaduct (Ch 62+435 to Ch 64+000 which lies in IDR Oxford Road Embankment to Quainton South Embankment) as the continuous barriers form part of a composite mitigation design crossing the IDR areas; this approach was agreed with HS2.

Where noise barriers are to be constructed on the track platform, offsets are as shown in the Typical MWCC Routewide Cross Section, Doc No's 1MC07-CEK-CV-DSE-C003-000011 to 15. The noise modelling will be further refined at detailed design. The packaging of this is currently under review but likely to be centred on geographical grouping of receptors.

This report covers the prediction of airborne noise as set out in standard HS2-HS2-EN-STD-000-000002 Technical Standard – Prediction of ground-borne sound, vibration and airborne sound from operation

Section 3 details a methodology that meets the requirements of "Technical Standard – Acoustic design of civil engineering assets" and discusses the comparison of whole-life costs and benefits of noise barrier options as per 'HS2 Phase 1 Operational Noise and Vibration EMRs – Material Difference'. Whole life costs used are based on EK noise barrier costs compiled in May 2019. Section 4 summarises how the methodology has been effectively applied to C3 IDR E.

Noise model sources terms and technical assumptions are in accordance with the technical assumptions issued by HS2 limited in Technical Note: Assumption for Phase 1 operational ground-borne sound, vibration and airborne sound assessment. Document no: PH1-HS2-EN-PPR-000-000052 (issued in August 2018).

The report concludes by recommending acoustic mitigation design, presented in Section 5, as follows:

Location	Start Chainage	End Chainage	Up/Down Line	Length (m)	Height above ToR (m)
Wendover Embankment to Stoke Mandeville Bypass Overbridge	57+400	59+100	Up	1700	4
	57+380	58+500	Down	1120	4
Stoke Mandeville Bypass Overbridge to Oxford Road Embankment	59+800	62+250	Up	1400	5
	62+250	62+880	Up		2m Barrier in Green Banks Scheme
	61+880	64+200	Up	1320	5
	64+200	64+382	Up	182	1.25m (to tie in with Thame Valley Viaduct parapet
	61+200	62+250	Down	1050	5
	62+250	62+700	Down	450	4m Barrier in Green Banks Scheme
	62+700	63+300	Down	600	4

*The barrier between Oxford Road Embankment to Thame Valley Viaduct (IDR C) has been assessed as part of a composite barrier system to afford protection to the Aylesbury community and the appraisal of the composite barrier has been presented in this Acoustic Design Compliance Report for IDR E.

Table 1 Noise barrier design summary

At Stoke Mandeville the mitigation design includes the Undertaking and Assurance that indicated the need for noise barriers at 4m above ToR:

1 Ch 57+500 to Ch 58+500 Barrier 4m above ToR on East and West side
2 Ch 57+800 to Ch 59+100 Barrier 4m above ToR on East Side

Introduction

This report presents the civil engineering asset acoustic analysis for C2 IDR– Wendover Green Tunnel North Portal to Aylesbury North Cutting (Ch 55+084 to Ch 62+435). However, the model has been extended to include the area between the Oxford Road overbridge to the Thame Valley Viaduct (Ch 62+435 to Ch 64+000 which lies in IDR Oxford Road Embankment to Quainton South Embankment) as the continuous barriers form part of a composite mitigation design crossing the IDR areas; this approach was agreed with HS2.

The report summarises the noise modelling undertaken at Scheme Design and includes Scheme Design updates incorporating optimisations identified in the OPT and VE work streams. The noise modelling will be further refined at detailed design; the packaging of this is currently under review but likely to be centred on geographical groupings of receptors.

Design development is captured in the *Scheme Design Configuration Report, Doc. No. 1MC06-CEK-DS-REP-C002-000005*. Scheme Design updates are based on track alignment PMA1.2, revision C02 which incorporates the instructed VE changes and reduction of track centres from 5,000mm to 4,700mm centre/centre (c/c).

Where noise barriers are to be constructed on the track platform, offsets are as shown in the Typical MWCC Routewide Cross Section, Doc No's 1MC06-CEK-CV-DSE-C002-000010 to 000014/ 1MC07-CEK-CV-DSE-C003-000011 to 000015.

This report recommends an acoustic mitigation solution based on an evaluation of the whole-life costs and benefits of noise barrier options that form the acoustic mitigation design, and consideration of material change in accordance with *HS2 Phase 1 Operational Noise and Vibration EMRs – Material Difference* (1TS01-ARP-CN-NOT-000-000001).

The acoustic design of HS2 civil engineering assets which could affect noise and/or vibration in the surrounding environment has been undertaken using "*Technical Standard – Acoustic design of civil engineering assets*", document no.: HS2-HS2-EN-STD-000-000003-P05. This document requires that "*Where there are no robust monetary costs (e.g. for visual impacts) or monetary benefits (e.g. for vibration levels) available, the above process should be methodically followed to highlight uncertainties and compare options on an equal basis with reference to guidance contained in Defra NANR 201*". The appraisal has therefore been carried out in accordance with this requirement.

The modelling of rail noise has been carried out in the NoiseMap$_{TM}$ noise modelling software which accords with the noise modelling procedures adopted for the HS2 ES, updated to use the November 2018 HS2 Ltd noise source terms, service patterns and modelling assumptions (*Technical Note: Assumption for Phase 1 operational ground-borne sound, vibration and airborne sound assessment Document no. PH1-HS2-EN-NOT-000-000002*).

The noise model results have been assessed against the HS2 Environmental Statement (including any AP commitments) and the Environmental Minimum Requirements. The provisions in Planning Forum Note 14 - Operational Noise from the Railway and Altered Roads have been adopted. Guidance on material difference

presented in "*HS2 Phase 1 Operational Noise and Vibration EMRs – Material Difference*", document no.: 1TS01-ARP-CN-NOT-000-000001-P01 has been adopted within he scope of the study.

When considering if all reasonable steps have been taken to control noise in accordance with HS2 Ltd.'s objectives, the design procedure outlined in the Technical Standard requires a list of potential mitigation measures to be identified and a proportionate Cost Benefit Analysis (CBA) to be undertaken in accordance with HM Treasury guidelines, and take into account all relevant acoustic and non-acoustic costs and benefits including:

1. Monetary benefit of noise reduction compared to cost;
2. Engineering practicability;
3. Impacts on other environmental disciplines, including landscape and visual; and
4. Consultation and stakeholder engagement responses.

The appraisal has been carried out in accordance with this requirement.

The methodology set out in Department for Transport's Transport Analysis Guidance (TAG) Unit A3.2 has been followed in determining the monetary benefit of the noise reduction provided by the civil engineering asset. The appraisal has been carried out using the guidance issued by HS2 Ltd. on the version of TAG to be used and its application to ensure consistency across the project. Guidance on the application of TAG as found in "*WebTAG application for the assessment of operational airborne noise control*", document no.: 1TS01-ARP-CN-NOT-000-000002-P01 has been followed.

The noise mitigation design is summarised in Section 5.

1 Asset Area

1.1 Asset Area

1.1.1 Description of Design for Wendover Green Tunnel to Wendover North Cutting

This Acoustic Mitigation Design Assessment supports the Schedule 17 submission for the approval of the Plans and Specifications submission for Nash Lee and associated earthworks between Ch 54+000 and Ch 57+100.

The application site boundary is located to the north west of Bacombe Lane, passing along the south western edge of Wendover, to the area north of Nash Lee Road. It is located between the settlements of Nash Lee and Wendover. Wendover is the nearest largest settlement.

The application broadly follows the alignment of the London to Aylesbury Railway Line which runs parallel to the B4009 Nash Lee Road. The site passes between Wendover and Bacombe Hill and intersects Elleborough Road, Nash Lee Road and Nash Lee Lane.

The site is centred on National Grid Reference X (Easting): 485845, Y (Northing): 207879. The location of the application site in relation to the surrounding area is shown on the Nash Lee Site Location Plan (Drawing No. 1MC06-CEK-TP-DLO-CS03_CL06-000002).

The nearest residential properties are located on the southern and western edge of Wendover, particularly those on the north western side of Nash Lee Lane and a row of properties along Ellesborough Road. There are also several scattered residential properties and farmsteads that surround the site, and clusters of properties along the roads that lead into Wendover from the surrounding area.

The site is partly within the Chilterns Area of Outstanding Natural Beauty (AONB), the Wendover Foothills (West) Landscape Character Area, the Risborough Foothills Landscape Character Area and the Southern Vale and Wendover Gap Landscape Character Areas.

The nearest residential properties are located on the southern and western edge of Wendover, particularly those on the north western side of Nash Lee Lane and a row of properties on Ellesborough Road. There are also scattered residential properties and farmsteads that surround the site, with clusters of properties along the roads that lead into Wendover from the surrounding area.

The application site is typically rural in character, with agriculture being the main land use. The area outside of the application site boundary is similarly characterised as rural, predominantly comprising of arable land and a scattering of isolated residential properties and farmsteads that surround the site.

The relevant scheduled works as set out under Schedule 1 of *the Act* to which this Schedule 17 submission relates are:

- **Work No. 2/28** – A railway (8.98 kilometres in length) partly in tunnel, commencing at the termination of Work No. 2/14, and extending to a point 540 metres south-west of the roundabout junction of the A418 Oxford Road with Coldharbour Way. Work No. 2/28 includes bridges over Chalkshire Stream, Stoke Brook and Sedrup Ditch.

- **Work No. 2/29** – A temporary road diversion of Bacombe Lane, commencing on Ellesborough Road at a point 305 metres south-west of the bridge carrying that road over the A413 London Road and terminating on Bacombe Lane at a point 325 metres south-west of the bridge carrying that road over the A413 London Road;
- **Work No. 2/30** – A realignment of Ellesborough Road commencing at a point 438 metres south-west of the bridge carrying that road over the A413 London Road and terminating at a point 60 metres south-west of the A413 London Road bridge;
- **Work No. 2/31** – A temporary road diversion of Ellesborough Road commencing at Work No. 2/30 and terminating at Work No. 2/30;
- **Work No. 2/33** – An accommodation access road, being a realignment of an existing track, commencing on footpath WEN/55/1 at a point 67 metres north-east of the junction of that footpath with footpath WEN/6/2; and terminating on that footpath and accommodation track at a point 5 metres south-west of the bridge carrying that footpath over the A413 Wendover Bypass.
- **Work No. 2/34** – A diversion of Nash Lee Road, commencing on the roundabout at the junction of that road with the A413 Wendover Bypass and terminating on that road at a point 230 metres west of the junction with Nash Lee Lane. Work No. 2/34 includes a bridge over Work No. 2/28.
- **Work No. 2/34A** – A spur road, commencing at Work No. 2/34 (at a point 178 metres west of the roundabout at the junction of Nash Lee Road with the A413 Wendover Bypass) and terminating on Nash Lee Lane at a point 205 metres north-east of the junction of that road with Nash Lee Road.
- **Work No. 2/35** – A footbridge over Work No. 2/28, being a diversion of footpath ELL/20/1, commencing on that footpath at a point 377 metres north of the junction of that footpath with Nash Lee Road and terminating by a junction with footpath SMA/6/1 at a point 136 metres west of the junction of that footpath with footpath ELL/20/1.

After entering the Wendover Green Tunnel from the south, and continuing through the tunnel to the northern portal (320m to the south west of Wendover) within the site boundary, the HS2 line will continue in a south east to north west direction, passing the western edge of Wendover. The Wendover Green Tunnel is a proposed within the Chilterns Area of Outstanding Beauty designed to screen the HS2 line from sight. Earthworks are required to construct the tunnel and to provide graded slopes to integrate this feature into the surrounding landscape. In accordance with HS2 Planning Forum Note 1, design information on the Wendover Green tunnel is provided separately in an accompanying Design and Access Statement, as this is a Key Design Element (KDE).

The earthworks cross sections for Wendover Green Tunnel North Portal are shown on Drawing 1MC06-CEK-TP-DSE-CS03_CL06-000004 and Image 4 below. Image 4 shows the cross section at Ch 55+400 with the cutting 10m deep to the east (slope 1:2) and additional landscaping earthworks at the top of the cutting with a 1:4 slope.

Wendover North Cutting (055-L1) has changed from 1V:4H at ERD to 1V:2H (55+098–55+636) and 1V:3.5H (55+636–56+730) at Scheme Design, representing a steepening of the cutting slopes. This has the potential to reduce the width of the cutting and reduce the volume of material excavated.

Other earthworks within this area include regrading to form the diversions of Nash Lee Road and Ellesborough Road, and to accommodate access routes and footways. There are also minor earthworks at Stoke Grove Auto Transformer Station to provide a level plateau for this structure.

1.1.2 Description of Design for Wendover North Cutting to Stoke Mandeville Bypass Overbridge

This Acoustic Mitigation Design Assessment supports the Schedule 17 submission for the approval of the Plans and Specifications submission for Stoke Mandeville and associated earthworks (Ch 57+100 to Ch 59+500).

The Schedule 17 Applications are submitted to Buckinghamshire Council (BC), formerly Aylesbury Vale District Council (AVDC) (SNC) for approval.

The application site extends from the east of St Mary's Church, Stoke Mandeville to the Risborough to Aylesbury Railway line south-east of Aylesbury. The site is predominantly rural with mixed agricultural land use, comprising of mainly arable fields with some small irregular paddocks and pastures enclosed by hedgerows. The area is typified by scattered farmsteads and villages. The Princes Risborough to Aylesbury Railway Line intersects the area.

The site is located between the settlements of Aylesbury, Wendover and Stoke Mandeville. Stoke Mandeville is the closest settlement, with development at the southern edge of the village located immediately adjacent to the northern edge of the site. The closest residential properties are the residential properties and farmsteads located along the southern edge of Stoke Mandeville and accessed from Marsh Lane, Risborough Road and North Lee Lane.

The site runs parallel to North Lee Lane and encompasses part of the Aylesbury Railway. The site also intersects Risborough Road.

Plans and Specifications submission under Schedule 17 to the High-Speed Rail (London – West Midlands) Act 2017 for works comprising of:

- Princes Risborough Underpass
- Princes Risborough to Aylesbury Rail Overbridge
- A4010 Stoke Mandeville Bypass Overbridge
- Footpath SMA/9 Accommodation Overbridge
- Risborough Road Underpass
- Stoke Mandeville South Embankment (Part of)
- Aylesbury South Cutting (Part of)
- Removal of embankment and earthworks along Princes Risborough to Aylesbury Railway Line
- Access Track 1 – Access from Stoke House to Pond 1
- Access Track 2 – Access from Risborough Road to Pond 2

- Access Track 3 – Access from Stoke Mandeville to Pond 3, Pond 4 and the UKPN Substation
- Earthworks Associated with the Stoke Mandeville A4010 Bypass,
- Earthworks associated with the realignment of PRoW SMA5/2 PRoW SMA 8/2, PRoW SMA/9and PRoW SMA/11/2,
- Earthworks associated with the HS2 maintenance loop and access track
- Watercourse diversions at Stoke Brook and a tributary of Stoke Brook
- 4 No. Drainage Ponds
- Drainage Ditches
- No. of Culverts (above ground elements only)
- Mill House North Culvert
- Mill House South Culvert
- Risborough Road Culvert
- Noise Barriers
- Location of Vehicle Restraint Barriers
- Location of permanent fencing

The HS2 line runs in a south-east to north-west direction intersecting Risborough Road to the south of Stoke Mandeville and running under the Princes Risborough to Aylesbury Railway Line. The removal of earthworks along the Princes Risborough to Aylesbury Railway Line require approval, as well the earthworks associated with the proposed A4010 Stoke Mandeville Bypass, these comprise of Stoke Mandeville South Embankment (Part of) and Aylesbury South Cutting (Part of).

The main works for approval are described below and are shown on the Stoke Mandeville General Arrangement Plan for Approval Sheets 1 and 2 (Drawing Nos. 1MC06-CEK-TP-DGA-CS03_CL17-000001 and 1MC06-CEK-TP-DGA-CS03_CL17-000002).

Proposed Structures for Approval

The location and appearance of the structures for approval are shown on the following drawings for approval.

- Stoke Mandeville General Arrangement Plan For Approval - Sheet 1 - 1MC06-CEK-TP-DGA-CS03-_CL17-000001
- Stoke Mandeville General Arrangement Plan For Approval - Sheet 2 - 1MC06-CEK-TP-DGA-CS03-_CL17-000002
- Stoke Mandeville Bypass Overbridge – Plan on Deck – For Approval - 1MC06-CEK-TP-DPL-CS04_CL18-000032

- A4010 Stoke Mandeville Bypass Overbridge - Longitudinal Section and Elevation For Approval - 1MC06-CEK-TP-DSE-CS04_CL18-000013
- A4010 Stoke Mandeville Bypass Overbridge - Cross Section and Parapet Details For Approval - 1MC06-CEK-TP-DDE-CS04_CL18-000007
- Footpath SMA9 Accommodation Overbridge - Plan on Deck For Approval - 1MC06-CEK-TP-DPL-CS04_CL18-000030
- Footpath SMA9 Accommodation Overbridge – Cross Section and Parapet Details For Approval - 1MC06-CEK-TP-DDE-CS04_CL18-000005
- Footpath SMA9 Accommodation Overbridge - Longitudinal Section and Elevation For Approval - 1MC06-CEK-TP-DSE-CS04_CL18-000012
- Princes Risborough to Aylesbury Rail Overbridge - Plan on Deck For Approval - 1MC06-CEK-TP-DPL-CS04_CL18-000034
- Princes Risborough to Aylesbury Rail Overbridge - Longitudinal Section and Elevation For Approval - 1MC06-CEK-TP-DSE-CS04_CL18-000015
- Princes Risborough to Aylesbury Rail Overbridge - Cross Section and Parapet Details For Approval - 1MC06-CEK-TP-DDE-CS04_CL18-000009
- Princes Risborough Underpass - Plan on Deck and Plan on Road For Approval - 1MC06-CEK-TP-DPL-CS04_CL18-000025
- Risborough Road Underpass – Sections and Elevations For Approval - 1MC06-CEK-TP-DSE-CS04_CL18-000007
- Princes Risborough Underpass – Plan on Deck For Approval - 1MC06-CEK-TP-DPL-CS04_CL18-000036
- Princes Risborough Underpass – Plan on Road For Approval - 1MC06-CEK-TP-DPL-CS04_CL18-000038
- Princes Risborough Underpass – Sections and Elevations For Approval - 1MC06-CEK-TP-DSE-CS04_CL18-000018
- Noise Barrier Transition Details - 1MC06-CEK-TP-000004
- Mill House North Culvert – Plans and Sections For Approval - 1MC06-CEK-TP-000001

Princes Risborough to Aylesbury Rail Overbridge

The Princes Risborough to Aylesbury Rail Overbridge is required to carry the Princes Risborough to Aylesbury Rail line over the HS2 line. The Princess Risborough to Aylesbury Overbridge will be located at HS2 line chainage 59+440.

The overbridge will be approximately 10m wide and up to 2m above existing ground level. The existing ground level is approximately 91m AOD. The Overbridge length is 100m between abutment bearings. It is designed as a three-span structure, with the deck comprising of a pair of weathering steel girders spanning

longitudinally with cross girders spanning transversally. These in turn support a concrete deck slab and the track above. The deck is supported on concrete abutments set back into the railway approach embankments and concrete intermediate piers. A 1.8m high parapet will be located on both sides of the Overbridge and extend across its full length. The parapet will be formed in pre-cast concrete and will act as a noise barrier.

Details of Princes Risborough to Aylesbury Rail Overbridge are shown on the following drawings:

- Princes Risborough to Aylesbury Rail Overbridge - Plan on Deck For Approval - 1MC06-CEK-TP-DPL-CS04_CL18-000034
- Princes Risborough to Aylesbury Rail Overbridge - Longitudinal Section and Elevation For Approval - 1MC06-CEK-TP-DSE-CS04_CL18-000015
- Princes Risborough to Aylesbury Rail Overbridge - Cross Section and Parapet Details For Approval - 1MC06-CEK-TP-DDE-CS04_CL18-000009

The construction of the Overbridge will involve land clearance earthworks surrounding the intersection of the HS2 line with the Princes Risborough to Aylesbury Railway to create approach embankments for the Overbridge.

A4010 Stoke Mandeville Bypass Overbridge

The A4010 Stoke Mandeville Bypass Overbridge is required to carry the proposed Stoke Mandeville Bypass over the HS2 line. It will be located at HS2 line chainage 59+300.

The Overbridge will form a skew crossing over HS2 with a span length of 24m, sitting square to the HS2 line between abutments and a deck width of approximately 20m, sitting square to the Bypass. The Overbridge will be up to 6m above existing ground level. The existing ground level ranges between 91m AOD adjacent to the north abutment and 92m AOD at the south abutment.

The Overbridge will comprise of a single carriageway road, that will be 7.3m wide with variable width verges on both sides of the road. A footpath and cycleway sit within the northern verge. A 1.8m high parapet will be located on both sides of the overbridge and extend across its full length. On both sides of the approach embankments there will be vehicle restraint barriers.

Details of A4010 Stoke Mandeville Bypass Overbridge are shown on the following drawings:

- Stoke Mandeville Bypass Overbridge – Plan on Deck – For Approval - 1MC06-CEK-TP-DPL-CS04_CL18-000032
- A4010 Stoke Mandeville Bypass Overbridge - Longitudinal Section and Elevation For Approval - 1MC06-CEK-TP-DSE-CS04_CL18-000013
- A4010 Stoke Mandeville Bypass Overbridge - Cross Section and Parapet Details For Approval - 1MC06-CEK-TP-DDE-CS04_CL18-000007

The construction of the Overbridge will involve land clearance and the construction of the Stoke Mandeville Bypass and approach embankments. The approach embankments either side of the Overbridge will provide a ramp from existing ground level to deck level.

Noise Barriers

The noise barriers have a standardised appearance to give HS2 a recognisable look but have also been designed to be sensitive to the specific surroundings and how they will be visible to the public.

The general design of the noise barriers will be that of steel posts and concrete panels.

The noise barriers have been designed to maximise the use of precast concrete panels to ensure a high-quality form and surface is achieved. Precast concrete panels also provide a durable and long-lasting structural solution requiring minimal maintenance.

- Type A barriers are proposed where the barriers are not visible to the public. The steel posts will be visible and the barrier will not include a curved top panel.
- Type C barriers are proposed where the barrier is visible to the public and the height exceeds 3m above top of rail. The steel posts will be hidden from view to give the barrier a more seamless and coherent appearance, and the top section of the noise barrier will be cranked towards the HS2 tracks at approximately 25° from the vertical.

Facing the HS2 line, the internal surface of the noise barrier will be lined with acoustically absorptive material. The finish to the inner and outer face on the concrete panels of the noise barriers, including the absorptive material will be agreed with the LPA via a planning condition.

Where a change in height is required, a 45-degree transition panel has been used to avoid a sudden stop or step in the barrier. The noise barrier drops to 1.0m ToR at its termination.

Stoke Mandeville South Embankment (Part of)

Stoke Mandeville South Embankment extends from chainage 57+100 to 58+320 and will be approximately 1,220m in length. The total length of the embankment extends beyond the application site to chainage 56+690 and is approximately 1,630m long in total.

The embankment will be up to approximately 4m above existing ground level. Existing ground levels across the area range from 101m at chainage 57+100 to 98m AOD at chainage 58+320.

The engineered profile of the embankment has a slope gradient of 1 in 2. The HS2 line will be located at the top of the embankment.

On the northern side of the HS2 line between Risborough Road Underpass and Footpath SMA/9 Accommodation Overbridge, the landscape mitigation earthworks will be up to 6m in height above existing ground level. The inward slope will be 1 in 4 and the outward slope of the landscape mitigation earthworks variable ranging from 1 in 8, to 1 in 10.

The width of the embankment at its crest is approximately 70m at the southern end to accommodate the HS2 maintenance loop and access track. At the northern end, the earthworks on the eastern side extends towards the Package boundary to create gentle graded slopes with a natural appearance.

The earthwork design for Stoke Mandeville South Embankment is shown on the Stoke Mandeville Earthworks Cross Sections Sheets 1 and 2 (Drawing Nos. 1MC06-CEK-TP-DSE-CS03_CL17-000001 and 1MC06-CEK-TP-DSE-CS03_CL17-000002).

Aylesbury South Cutting (Part of)

Aylesbury South Cutting will extend from chainage 58+320 to 59+460 and will be 1,140m in length. The total length of the Cutting extends beyond the site boundary to chainage 60+500 and will be approximately 2,180m long in total.

Within the site the Cutting will be between 0m and 7m deep with the HS2 line located at the base of the Cutting; and will be between 40m to 80m wide. The existing ground level through the Cutting ranges from 98m to 92m AOD.

The landscape mitigation earthworks will be up to 6m in height above existing ground level. The inward slope will be 1 in 4 whilst the outward slope is variable, ranging from 1 in 8 to 1 in 10 and slacker near the tie in with SMA/9.

The earthwork design for Aylesbury South Cutting is shown on the Stoke Mandeville Earthworks Cross Sections Sheets 3 and 4 (Drawing Nos. 1MC06-CEK-TP-DSE-CS03_CL17-000003 and 1MC06-CEK-TP-DSE-CS03_CL17-000004).

Removal of existing embankment and proposed earthworks along Princes Risborough to Aylesbury (PRA) Railway Line

Earthworks along the PRA Railway are required to achieve the necessary ground levels for the Princes Risborough to Aylesbury Rail Overbridge to carry the railway over the HS2 line. The realignment of the PRA line within the site will extend from chainage 40+900 to 42+622 (PRA chainages) and will be 1,722m in length. Within the site, the existing embankment will be removed to ground level.

The realigned PRA line will be supported on an embankment offset to the north of the existing alignment. The proposed earthwork will be between 0m to 4m in height depending on existing ground levels and between 30m to 70m wide. The existing ground level through the embankment ranges from approximately 86m to 91m AOD.

The engineered profile of the embankment slopes will be 1 in 3. The PRA line will be located at the top of the embankment.

The earthwork design for the PRA line is shown on the Stoke Mandeville Earthworks Cross Sections Sheet 4 (Drawing No. 1MC06-CEK-TP-DSE-CS03_CL17-000004).

Earthworks Associated with Stoke Mandeville A4010 Bypass

Earthworks associated with Stoke Mandeville A4010 Bypass will extend from chainage 57+500 to 49+450 as shown on the Stoke Mandeville General Arrangement Plan – For Approval Sheets 1 and Sheet 2 (Drawing No. 1MC06-CEK-TP-DGA-CS03-_CL17-000001 and 1MC06-CEK-TP-DGA-CS03-_CL17-000002).

The earthworks extend along the proposed Stoke Mandeville Bypass route. The formation of new accesses and the route of the Bypass will be the subject of a separate consent under Schedule 4 of the HS2 Act.

The total length of the section of the Bypass that requires earthworks associated with HS2 is approximately 2,350m in length. The Bypass will be supported on a proposed embankment which will be between 0m to 6m

in height depending on existing ground levels, and between 40m to 70m wide. The existing ground level across the area ranges from 105m to 88m AOD. The slope gradients along the route range from 1:2 to 1:4.

To the east of the Bypass between Risborough Road and Footpath SMA/9 Accommodation Overbridge, an earthwork bund is located to provide acoustic mitigation and visual screening of the road. The earthwork will vary in height between 2m and 2.5m above existing ground level. The slope of the earthwork facing the Bypass will be 1:3 whilst the outer slope will vary ranging between 1 in 8 and 1 in 10 and extend to the site boundary.

The earthwork design for Stoke Mandeville Bypass is shown on the Stoke Mandeville Earthworks Cross Sections Sheet 4 (Drawing Nos. 1MC06-CEK-TP-DSE-CS03_CL17-000004).

Earthworks associated with the HS2 maintenance loop and access track

A maintenance loop and an associated access track are required to provide access for operatives to maintain HS2. The loop comprises of an additional HS2 line and access track running parallel with the HS2 main line. The earthworks associated with Stoke Mandeville embankment have been widened to accommodate the maintenance loop and access track.

The maintenance loop and associated access track are shown on the Stoke Mandeville General Arrangement Plan – For Approval Sheet 2 (Drawing No. 1MC06-CEK-TP-DGA-CS03-_CL17-000002).

1.1.3 Description of Design for Stoke Mandeville Bypass Overbridge to Oxford Road Overbridge

The site is located approximately 200m to the west of Aylesbury and extends from the area east of the A418 Oxford Road across the western edge of Aylesbury passing to the east of Sedrup, and Lower and Upper Hartwell, extending as far as the Thame Valley Walk long distance route. The site crosses Aylesbury Park Golf Club and Lower Hartwell Ditch passing to the east of Hartwell House Hotel and Spa. The site crosses the A418 Oxford Road and a private access track to Whaddon Hill Farm.

The relevant scheduled works as set out under Schedule 1 of the Act to which this Schedule 17 submission relates are:

- **Work No. 2/28** – A railway (8.98 kilometres in length) partly in tunnel, commencing at the termination of Work No. 2/14, and extending to a point 540 metres south-west of the roundabout junction of the A418 Oxford Road with Coldharbour Way. Work No. 2/28 includes bridges over Chalkshire Stream, Stoke Brook and Sedrup Ditch.
- **Work No. 2/49** – A railway (33.55 kilometres in length), partly in tunnels and partly on viaducts, commencing by a junction with Work No. 2/28 and extending to a point 220 metres north-west of the junction of The River Great Ouse with Well Stream. Work No. 2/49 includes viaducts over the River Thame, Padbury Brook and the River Great Ouse and bridges over Fleet Marston Brook, the River Ray and Muxwell Brook.
- **Work No. 2/50A** – A footbridge over Work No. 2/49, being a diversion of footpath SBH/32/1, commencing on that footpath at a point 200 metres north-east of the junction of that footpath with the

road leading to Lower Hartland Farm and terminating on that footpath at a point 130 metres north-west of its junction with footpath AYL/39/1.

- **Work No. 2/51A** - An accommodation access road, being a realignment of a track, commencing at the junction of footpaths SBH/3/2 and SBH/31/1 and terminating on bridleway SBH/2/4 at the termination of Work No. 2/51.
- **Work No. 2/51B** - An access road commencing by a junction with the centre line of Work No. 2/51A at a point 735 metres north-west from the junction of the road leading to Lower Hartwell Farm and footpath SBH/32/1 and terminating at a point 290 metres north-west of that junction.

A value engineering and optimisation exercise was carried out to eliminate the need for a pumping station at the current low spot in the track alignment in Aylesbury South Cutting (VE30). The objective of VE30 Aylesbury is to eliminate the need for a pumping station at the current low spot in the track alignment at Aylesbury South Cutting. The original VE raised the track by a maximum of 2.2m and impacted 7.62km of the alignment and the assets in this region.

VE 30 has been implemented so that the track will be raised approximately 1,470mm at chainage 60+000, and approximately 1,000mm at chainage 61+400 to enable the omission of the proposed pumping station.

Aylesbury Embankment (060-L1) slopes have been slightly steepened from a gradient of 1V:2.5H at ERD to 1V:2H at Scheme Design with a slight elevation in embankment height in line with VE30. This includes increasing the height of the landscape earthworks false cuttings on both sides to maintain a crest height above track similar to the original false cutting in the FPD design.

The Thame Valley South Embankment (064-L1) is designed with 1V:2H slopes (from 1V:2.5H slopes at ERD) and has been reduced by 16,000mm in line with the reduction in viaduct length. There are no other changes to the Thame Valley South Embankment from ERD.

Aylesbury Oxford Road Embankment is approximately 865km in length, of which the entirety falls within this submission. Whaddon Hill Cutting is approximately 1.05km in length in total, of which 598m falls within this submission.

Aylesbury North Cutting (Part of), Aylesbury Oxford Road Embankment, and Whaddon Hill Cutting (Part of) are required because the HS2 line will be set above ground level through the embankment and below ground level through the cuttings. One overbridge (Footpath SBH/32 Overbridge) is therefore required in this area to ensure PRoWs are maintained. The overbridge requires approval.

1.2 Hybrid Bill Summary

Key areas and features identified in the Hybrid bill are presented and discussed below.

1.2.1 Wendover Green Tunnel North Portal to Wendover North Cutting (AVDC Package 4)

This Acoustic Mitigation Design Assessment supports the Schedule 17 submission under AVDC Package 4 for the approval of the Plans and Specifications submission for Wendover Green Tunnel North Portal (Nash Lee) between Ch 54+000 and Ch 57+100. The asset area forms part of the Nash Lee Schedule 17 Application to be submitted to Buckinghamshire Council (BC), formerly Aylesbury Vale District Council (AVDC) for approval.

The assessment area as presented in the "*London-West Midlands Environmental Statement, Volume 5 Map books Sound, noise and vibration (Part 2 of 4) November 2013*" and as revised in the *Supplementary Environmental Statement 4* and *Additional Provision 5 ES Volume 5 Technical Appendices Map Book (December 2015)* is shown in Image 1 (CFA10).

Image 1 indicates mitigation in the form of earthworks (engineered cutting) to the east of the HS2 alignment around the portal building. The ES assessment indicates that all receptor locations to the east of the alignment, within Wendover, lie outside of the LOAEL contour.

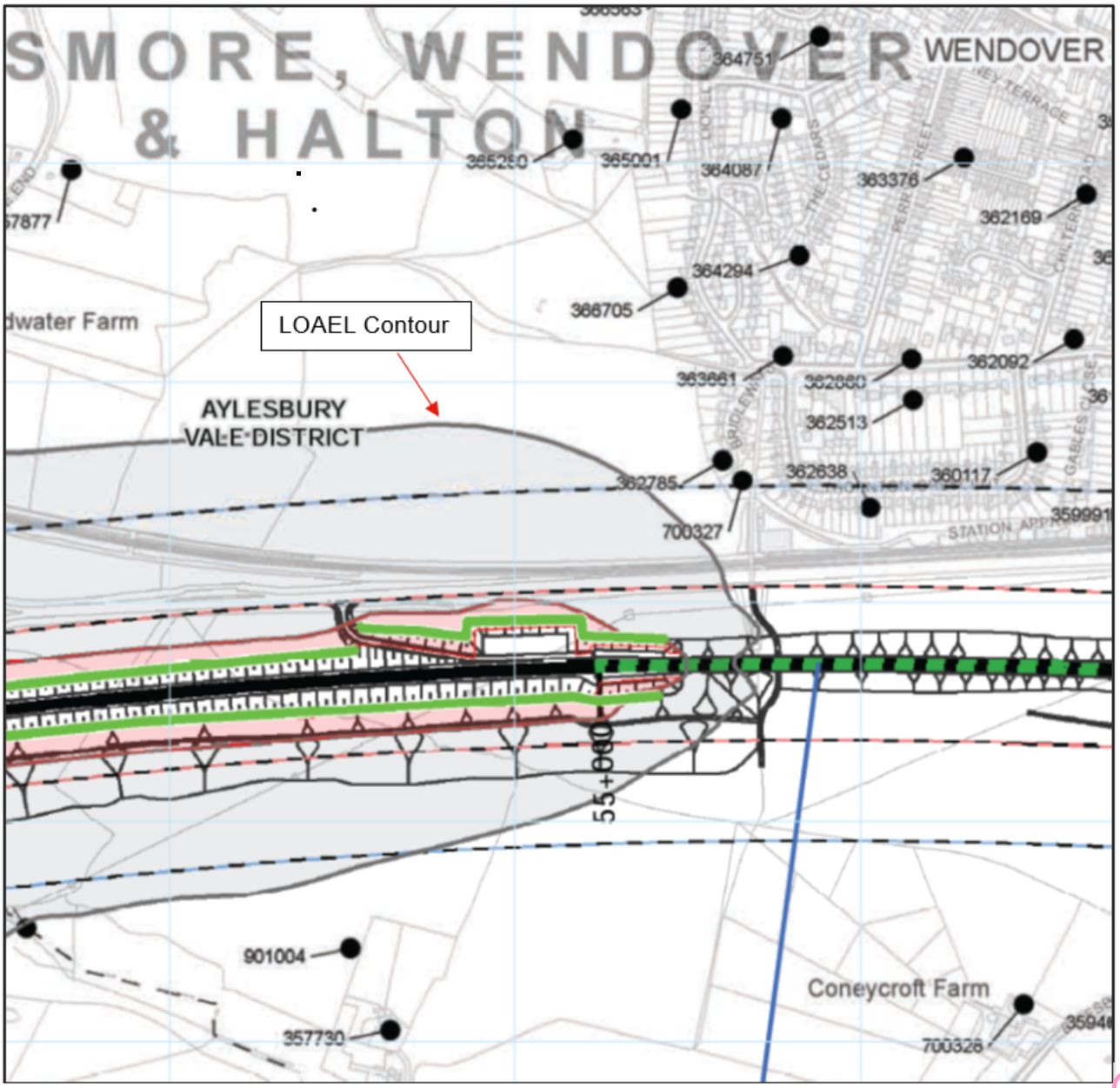


Image 1 ES Assessment Area for Nash Lee presenting LOAEL Rail Noise Contour

As part of SES 4 AP5 (SES4-010-001) the mitigation was shown in the form of a noise barrier around the tunnel portal building ranging in height from 1m above ToR along the access road to the portal building to 6m above ToR (indicated by the blue line on Image 2 below).

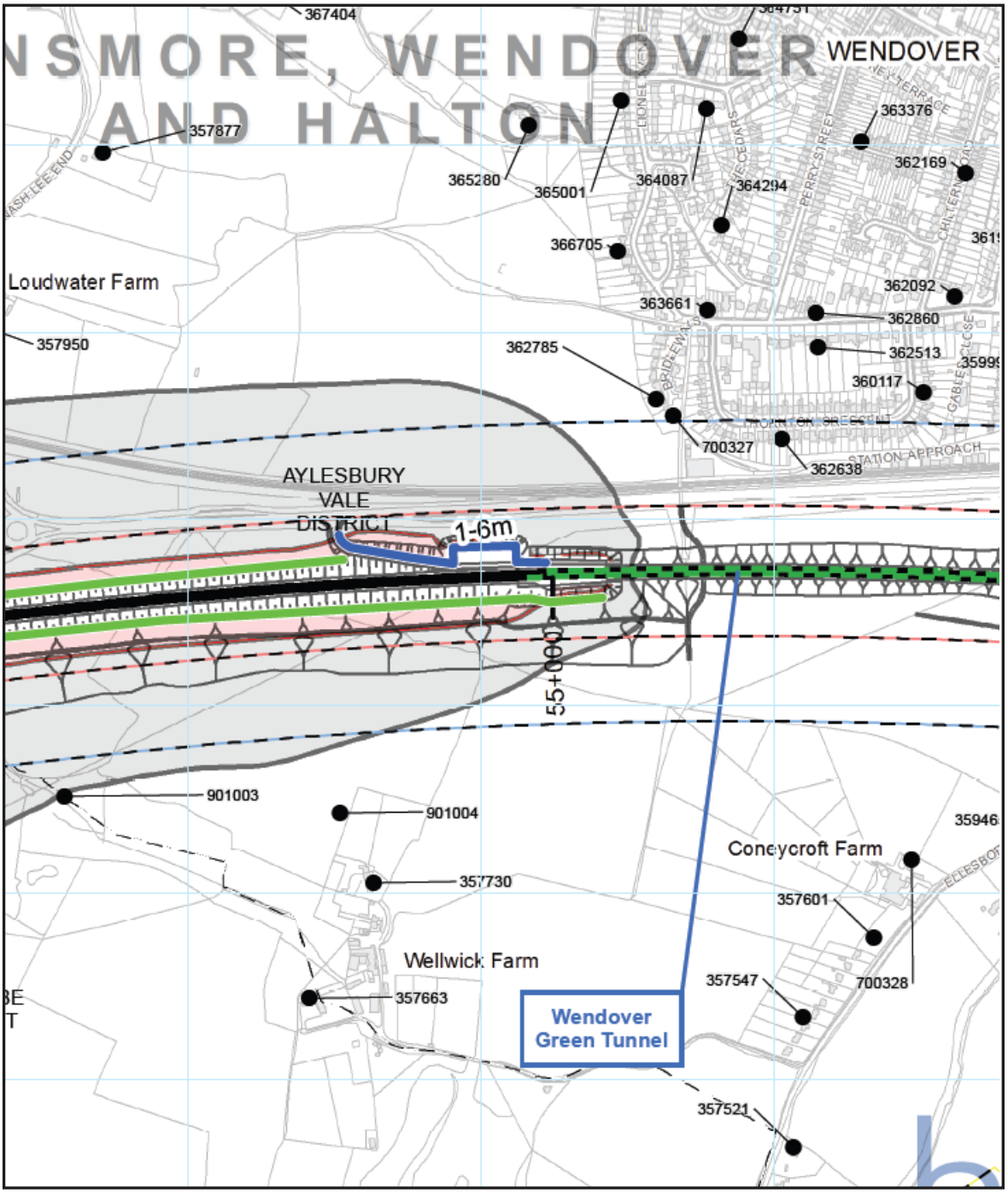


Image 2 SES 4 AP5 (SES4-010-001) Noise Barrier Location

The receptor locations used in the considered of the mitigation design for the AVDC P4 Nash Lee (Up Side) area are presented in Image 3 below.

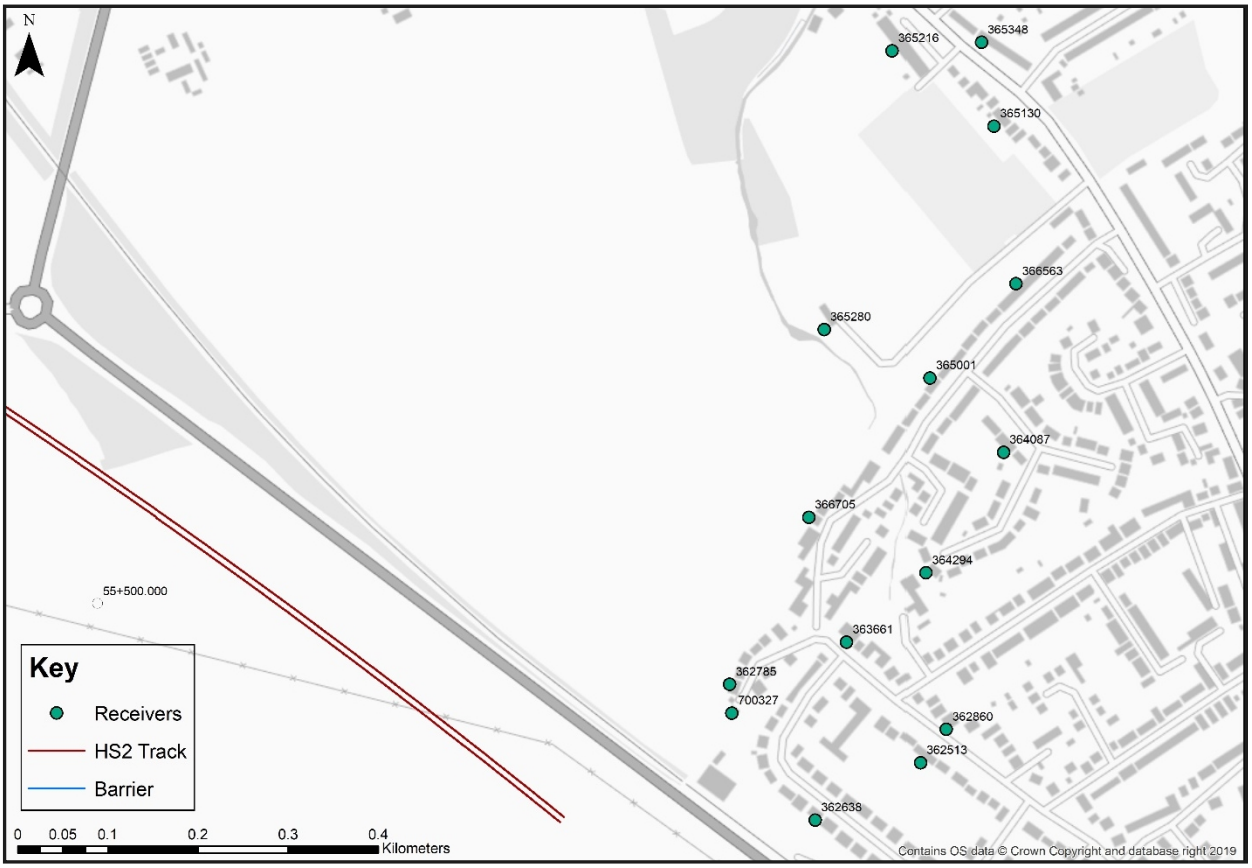


Image 3 Noise Receptor Locations for AVDC P4 Nash Lee

Wendover Cutting

The AVDC Package 4 Nash Lee Schedule 17 Application area extends to Ch 57+100, which means the package includes Wendover Cutting.

This assessment area as presented in the "*London-West Midlands Environmental Statement, Volume 5 Map books Sound, noise and vibration (Part 2 of 4) November 2013*" and as revised in the *Supplementary Environmental Statement 4* and *Additional Provision 5 ES Volume 5 Technical Appendices Map Book (December 2015)* is shown on Image 4.

Image 4 from CFA10 of the ES Assessment shows the area for Wendover Cutting (SES 4 and additional Provision 5 Environmental Statement) from the Technical Appendices Map Book, and indicates a significant effect at OSV10-C04, with mitigation in the form of a 3m barrier to the east of the HS2 alignment. To the west of the HS2 alignment mitigation in the form of earthworks is indicated.

The OSV community impact presented below is the same as that presented in the ES as part of *Map Book Volume 5 Map books Sound, noise and vibration* (Part 2 of 4).

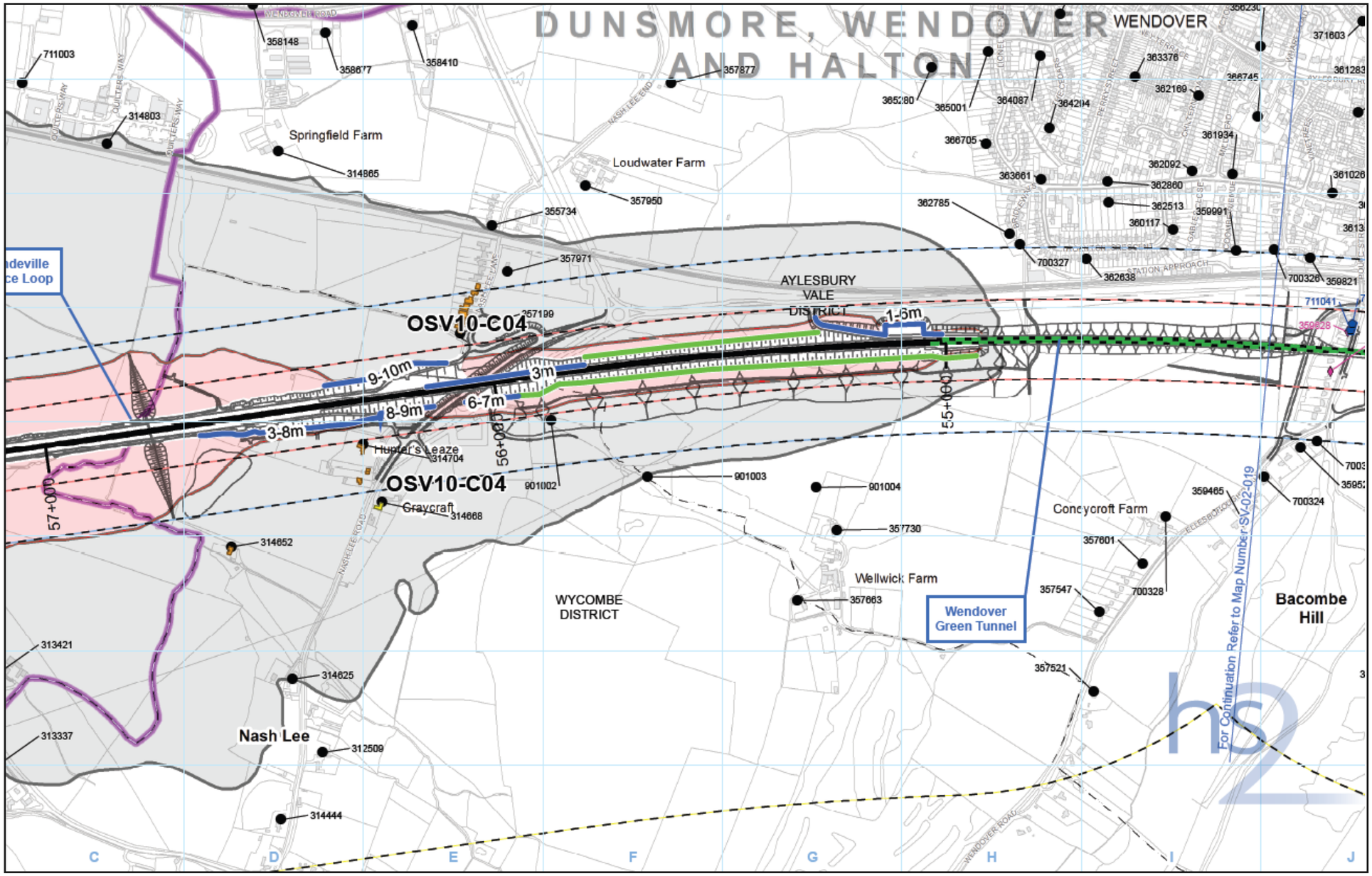


Image 4 ES Assessment Area for Wendover Cutting (SES 4 and additional Provision 5 Environmental Statement)

OSV10 C04 in Nash Lee is reported in the ES to be as a result of an airborne noise increase as a result of the new train services and covers approximately 15 dwellings in the vicinity of Nash Lee Lane. Forecast increases in sound from the railway are likely to cause a moderate adverse effect on the acoustic character of the area around these properties.

No shared open spaces have been identified as being affected in this community area.

The receptor locations considered for the full Nash Lee application under AVDC Package 4 are shown on Image 5 below.

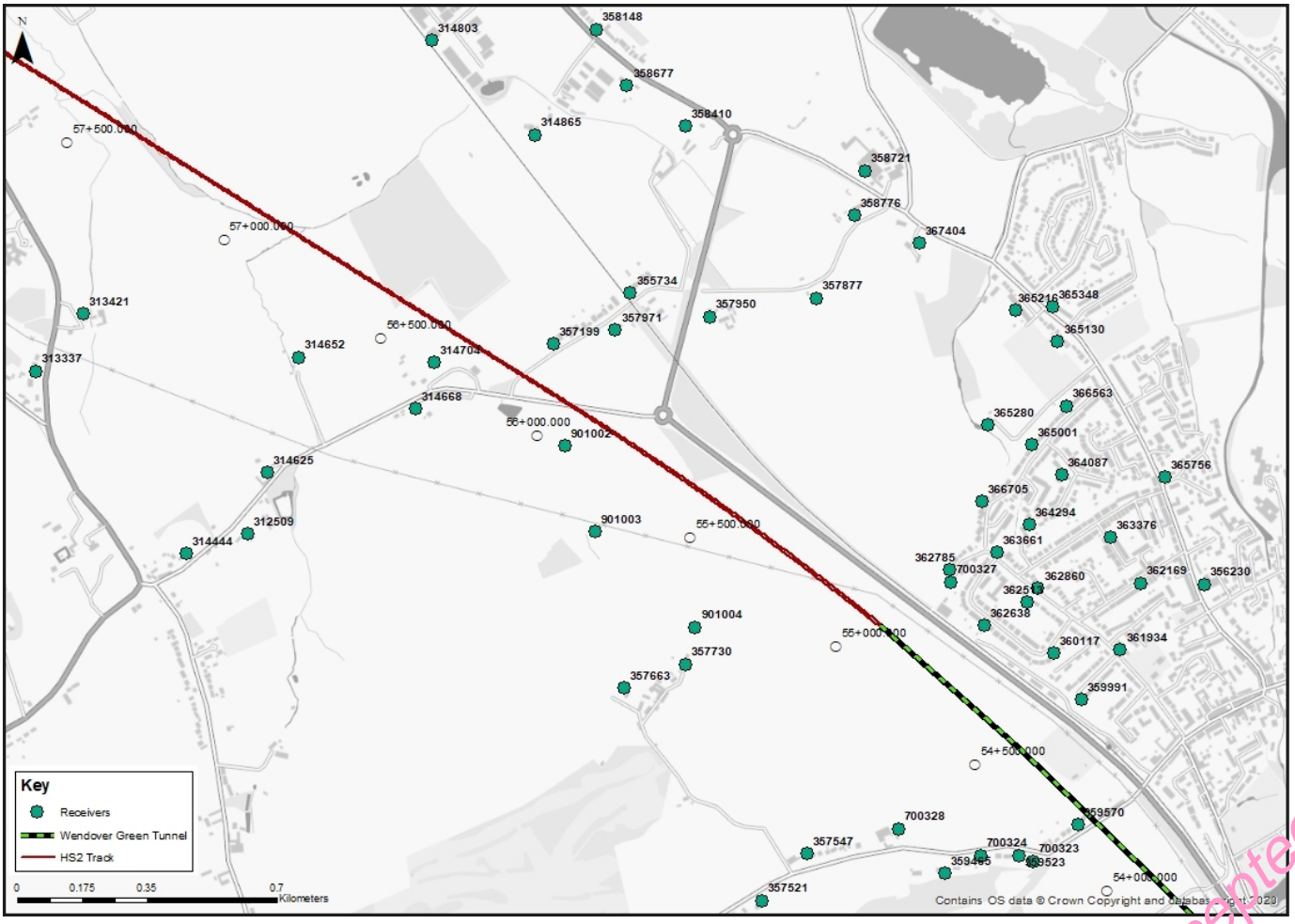


Image 5 Noise Receptor Locations for Wendover Cutting (Full Nash Lee Application Area – AVDC P4)

1.2.2 Wendover North Cutting to Stoke Mandeville (AVDC Package 5)

This Acoustic Mitigation Design Assessment supports the Schedule 17 submission under AVDC Package 5 for the approval of the Plans and Specifications submission for Wendover North Cutting to Stoke Mandeville between Ch 57+100 and Ch 59+500. The asset area forms part of the Stoke Mandeville Schedule 17 Application to be submitted to Buckinghamshire Council (BC), formerly Aylesbury Vale District Council (AVDC) for approval.

The assessment area as presented in 'The "*London-West Midlands Environmental Statement, Volume 5 Map books Sound, noise and vibration (Part 2 of 4) November 2013*' (CFA10) is shown on Image 6.

Image 6 indicates mitigation in the form of acoustic fencing to the east and west of the HS2 alignment. The ES assessment indicates that the vast proportion of Stoke Mandeville lies outside of the LOAEL contour; however, properties to the western extent of the village lie within the contour.

As part of the ES the mitigation was shown in the form of parallel noise barriers ranging in height from 3m above ToR to 4m above ToR along the eastern "Up-Track"; and 3m above ToR to 4m above ToR along the western "Down-Track" (indicated by the blue lines on Image 6 below)

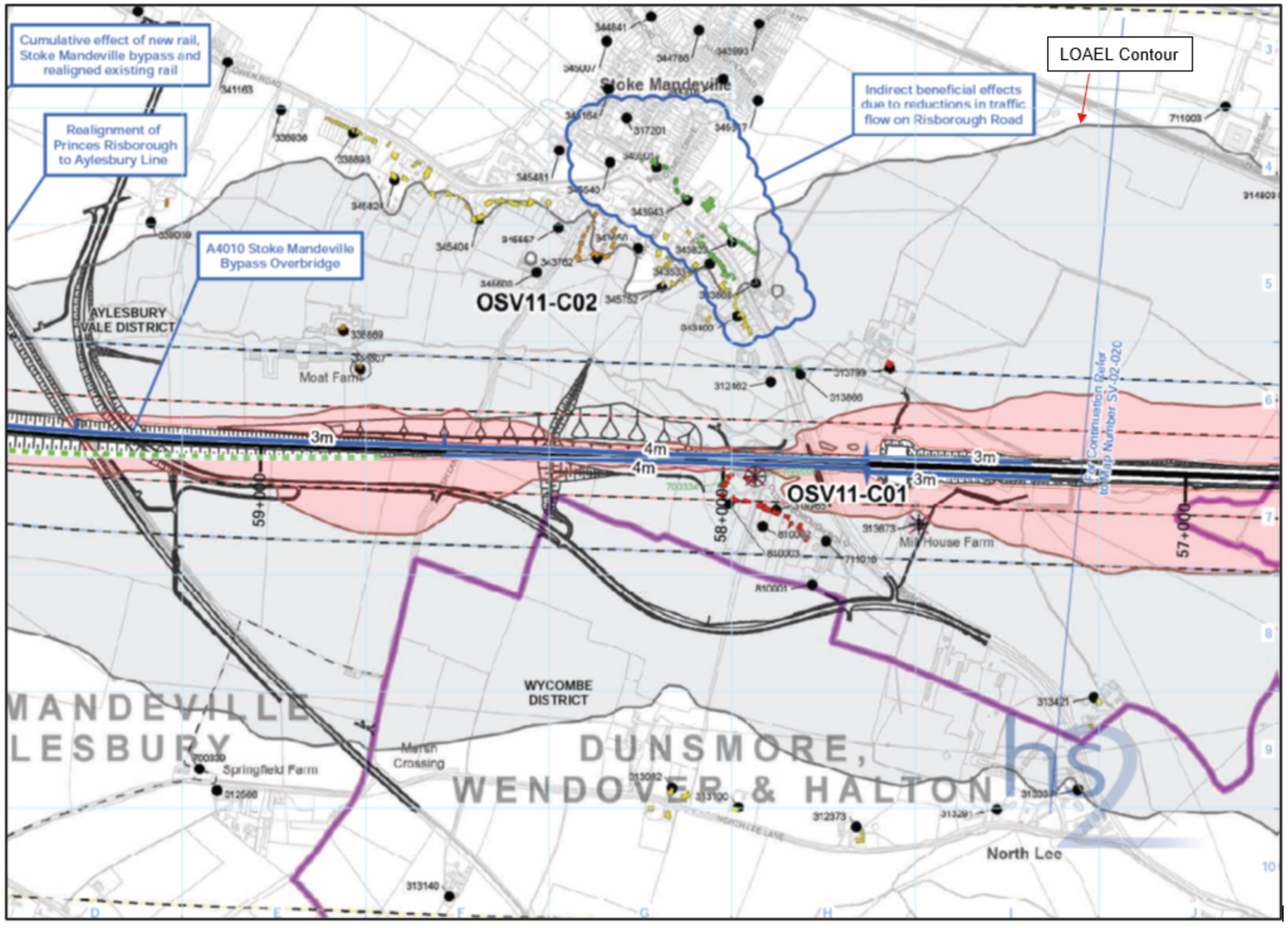


Image 6 ES Assessment Area for Stoke Mandeville presenting LOAEL Rail Noise Contour

The information on Image 6 indicates a significant effect occurs at community OSV11-CO1 to the west of the HS2 trace, and also a significant effect at community OSV11-CO1 to the east of the HS2 trace.

The significant effect for OSV11-C01 (as reported in *CFA11 Stoke Mandeville and Aylesbury Operational assessment (SV-004-011) Sound, noise and vibration*) covers the southern edge of Stoke Mandeville. This community consists of approximately 30 dwellings located along Risborough Road in the vicinity of Old Risborough Road and Whitethorn Close, including shared open areas. Forecast increases in sound from the railway are likely to cause a **major adverse effect** on the acoustic character of the area around the closest properties, reducing with distance away from the Proposed Scheme. The effect on the acoustic character of residential areas that are located further from the railway would be a minor effect.

The significant effect for OSV11-C01 (as reported in *CFA11 Stoke Mandeville and Aylesbury Operational assessment (SV-004-011) Sound, noise and vibration*) covers the western edge of Stoke Mandeville. Approximately 70 dwellings in the vicinity of Marsh Lane, Lower Road, Yew Tree Close, Chestnut Way and Chapel Lane, including shared open areas. Forecast increases in sound from the railway are likely to cause **minor adverse effects** on the acoustic character of the area around the closest properties, with **moderate effects at properties on Chestnut Way**.

For clarity the receptor locations considered for the mitigation design for Wendover North Cutting to Stoke Mandeville are presented alone on Image 7 below.

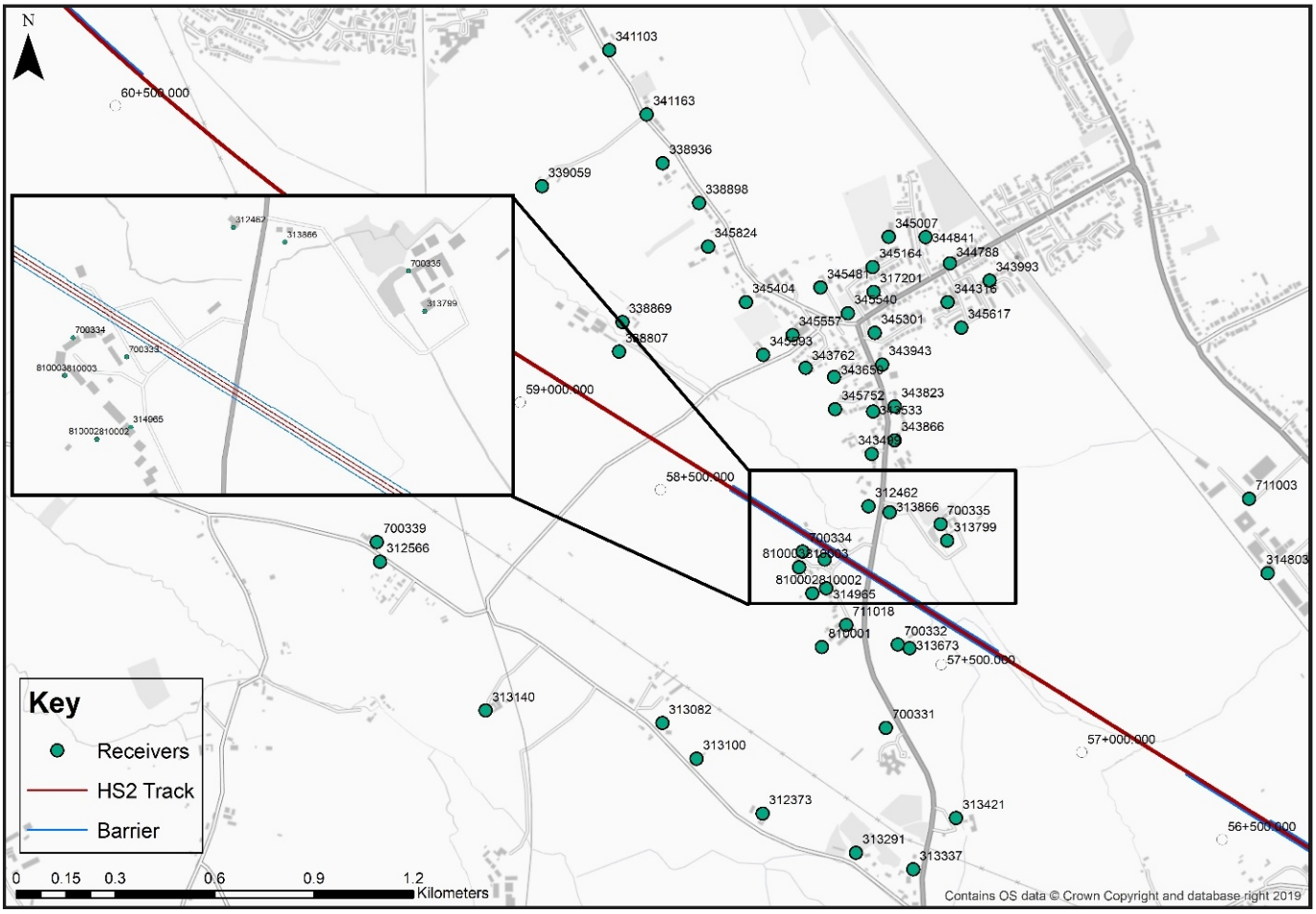


Image 7 ES Assessment Area for Stoke Mandeville

The assessments informing this report have identified residential buildings close to the Proposed Scheme where the daytime forecast noise level does not exceed the threshold set in the Regulations, but the forecast night-time noise level would exceed the World Health Organization's Interim Target of 55dB, or the maximum noise level (dependent on the number of train passes) as a train pass, exceeds the criterion.

These buildings will also be offered noise insulation as described in the Avoidance and mitigation measures section of Volume 2: Report 11. The buildings are shown on Map series SV-02 (Volume 5, Sound, Noise and Vibration Map Book). Receptor reference ID 338807 Old Moat Farmhouse, Marsh Lane, Stoke Mandeville was identified as qualifying for noise insulation (marked as OSV11-D03 in Table 3) based on the L_{max} noise level.

Taking account of the avoidance and mitigation measures incorporated into the Proposed Scheme, the assessment has identified a residential building, closest to the Proposed Scheme at Mill House Farm, Risborough Road receptor reference ID 313673 (marked as OSV11-D02 in Table 3) where noise would exceed the daytime trigger threshold set in the Regulations. It is therefore estimated that this building is likely

to qualify for noise insulation under the Regulations. These buildings are indicated on Map Series SV-02 (Volume 5, Sound, Noise and Vibration Map Book).

Changes in road traffic due to the Proposed Scheme are likely to cause beneficial noise effects on residential receptors along the A4010 Risborough Road, benefiting dwellings facing the road from just south of the junction with Chapel Lane to the junction with Lower Road, represented by receptor references 343823, 343943 and 345301. The changes in noise levels in this local area result from a reduction in road traffic presented within he traffic data supporting the Scheme, and are likely to benefit the acoustic character of the area such that there is a perceived improvement in the quality of life. These effects are considered significant when assessed on a community basis taking account of the local context.

Supplementary Environmental Statement and Additional Provision 2 Environmental Statement (SES and AP2 ES 3.2.1.11) July 2015 Volume 2 | Community forum area report CFA11 | Stoke Mandeville and Aylesbury

The Supplementary Environmental Statement (SES) reported the following corrections, which have been taken into consideration in this report.

- Old Moat Farmhouse, Marsh Lane, Stoke Mandeville was described as a single property however it should have been described as two properties.
- Sound, noise and vibration Table 15, Section 11 in Volume 2, CFA11 of the main ES Operational vibration assessment locations 700333 and 700334 were omitted from the assessment. In the main ES, the properties represented by these assessment locations were reported as subject to an adverse operational airborne noise effect. When these are assessed alongside other local adverse noise effects, the overall effect is considered significant.
- Operational vibration assessment locations ID 700333 and ID 700334 were omitted from the vibration assessment. The SES reported that operational vibration assessment locations ID 700333 and ID 700334 are likely to experience a combined noise and vibration effect (as part of the overall significant effect). The SES however reported that no additional mitigation measures, other than those proposed in the main ES are required.

The SES also provides for noise mitigation on the A4010 Stoke Mandeville Bypass (AP2-011-002). The original scheme makes no provision for mitigation of traffic noise from the bypass contributing to the likely operational noise significant effect on local residents and the Booker Park School. As a result a permanent provision of three earth bunds for a total length of 1km and two noise fence barriers along the side of the A4010 Stoke Mandeville Bypass were identified. The bunds and noise fence barriers will extend to 2m in height above the road pavement level of the bypass. Land outside the original limits of the Bill is permanently required to construct the bunds and noise fence barriers.

- two bunds, one approximately 300m long and the other approximately 340m long, along the east side of the bypass near properties on Old Risborough Road (refer to maps CT-05-041, CT-06-041, CT-05-041-L1 and CT-06-041-L1 in the SES and AP2 ES Volume 2, CFA11 Map Book). The gap between the bunds allows for the passage of Footpath ELL/2;

- a noise fence barrier, approximately 70m long, along the east side of the bypass and extending from the southern end of the bunds described above (refer to maps CT-05-041 and CT-06-041 in the SES and AP2 ES Volume 2, CFA11 Map Book);
- a noise fence barrier, approximately 335m long, along the north-west side of the bypass (refer to maps CT-05-042 and CT-06-042 in the SES and AP2 ES Volume 2, CFA11 Map Book); and
- a bund, approximately 400m long, along the north-west side of the bypass, from the northern extent of the noise fence barrier to the junction of the bypass and B4443 Lower Road (refer to maps CT-05-042 and CT-06-042 in the SES and AP2 ES Volume 2, CFA11 Map Book).

The mitigation measures set out above along the Stoke Mandeville bypass have been incorporated into the design. The assessment of road traffic noise for the Stoke Mandeville Bypass indicates that road traffic noise effects do not change from those reported in the ES.

- Wendover North Cutting to Stoke Mandeville (AVDC Packages 6 and 7)

This Acoustic Mitigation Design Assessment supports the Schedule 17 submission for the approval of the Plans and Specifications submission for Wendover North Cutting to Oxford Road Overbridge (Ch 59+500 to Ch 62+400). The asset area forms part of the Schedule 17 Application to be submitted to Buckinghamshire Council (BC), formerly Aylesbury Vale District Council (AVDC) for approval for package AVDC P06 South West Aylesbury, and AVDC P07 Hartwell.

The assessment area as presented in the "*London-West Midlands Environmental Statement, Volume 5 Map books Sound, noise and vibration (Part 2 of 4) November 2013*" and as revised in the *Supplementary Environmental Statement 4* and *Additional Provision 5 ES Volume 5 Technical Appendices Map Book (December 2015)* is shown in Image 8, Image 9 and Image 10 below (CFA11).

Image 8 indicates mitigation in the form of a 5m acoustic fencing provision adjacent to the eastern "Up-Track" . The ES assessment indicates that the majority of the receptors within Aylesbury lay outside of the LOAEL contour; however, properties to the western extent of Aylesbury fall within the contour and are therefore demonstrated to be subject to rail noise above LOAEL.

Image 9 indicates mitigation in the form of a 4m to 5m acoustic fencing/earth works bunding provision adjacent to the eastern "Up-Track"; along with a 3m to 4m acoustic fencing/earth works bunding provision adjacent to the western "Down-Track". The ES assessment indicates that the majority of the receptors within Aylesbury and Hartwell lay outside of the LOAEL contour; however, properties to the western extent of Aylesbury and the eastern extent of Hartwell fall within the contour and are therefore demonstrated to be subject to rail noise above LOAEL.

Image 10 indicates mitigation in the form of a 1.4m acoustic fence stepping to a 5m earthwork provision adjacent to the eastern "Up-Track". The ES assessment indicates that the majority of the receptors within Aylesbury lay outside of the LOAEL contour; however, properties to the western most extent of Aylesbury fall within the contour and are therefore demonstrated to be subject to rail noise above LOAEL.

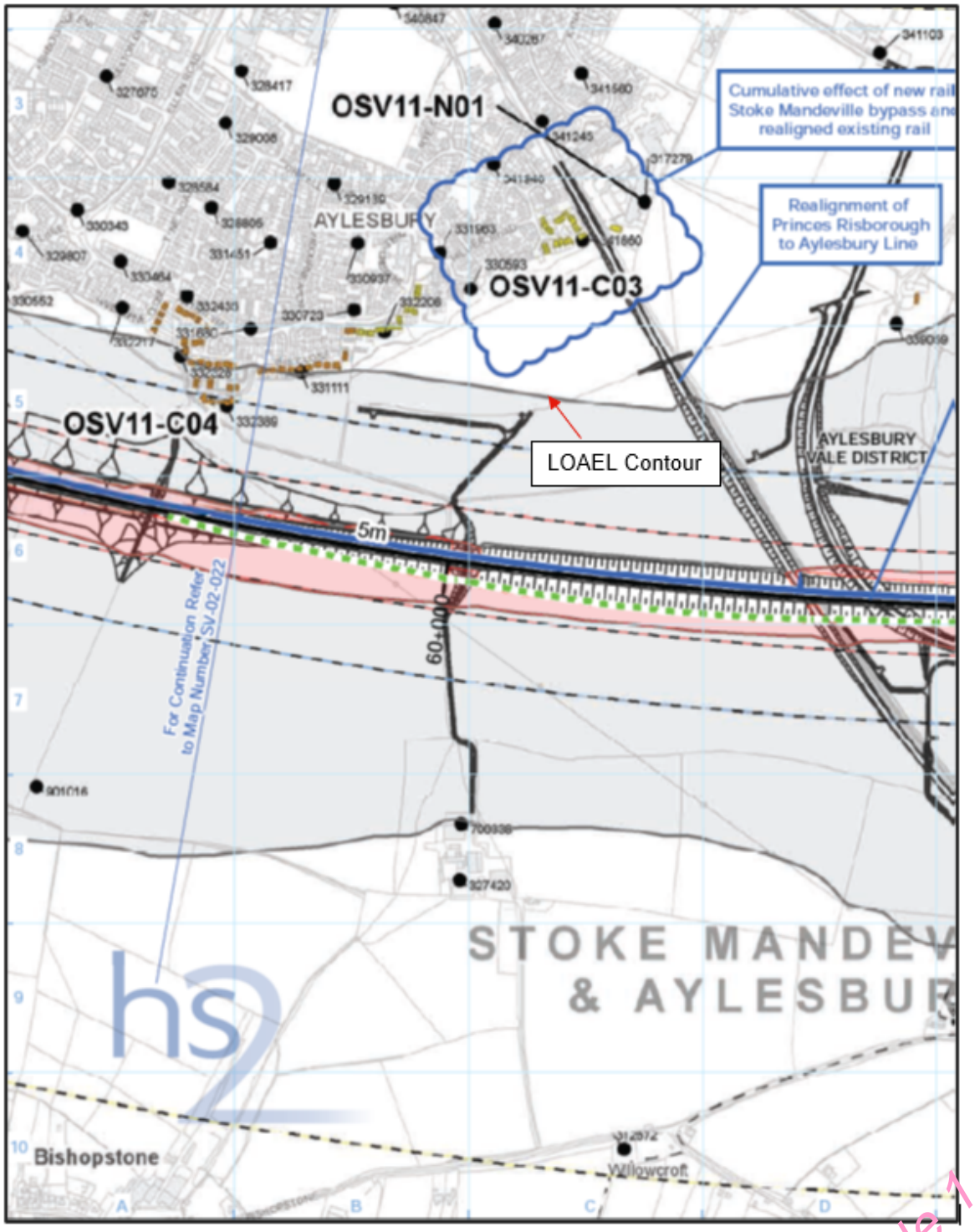


Image 8 ES Assessment Area for Stoke Mandeville Bypass to Aylesbury Embankment presenting the LOAEL Contour

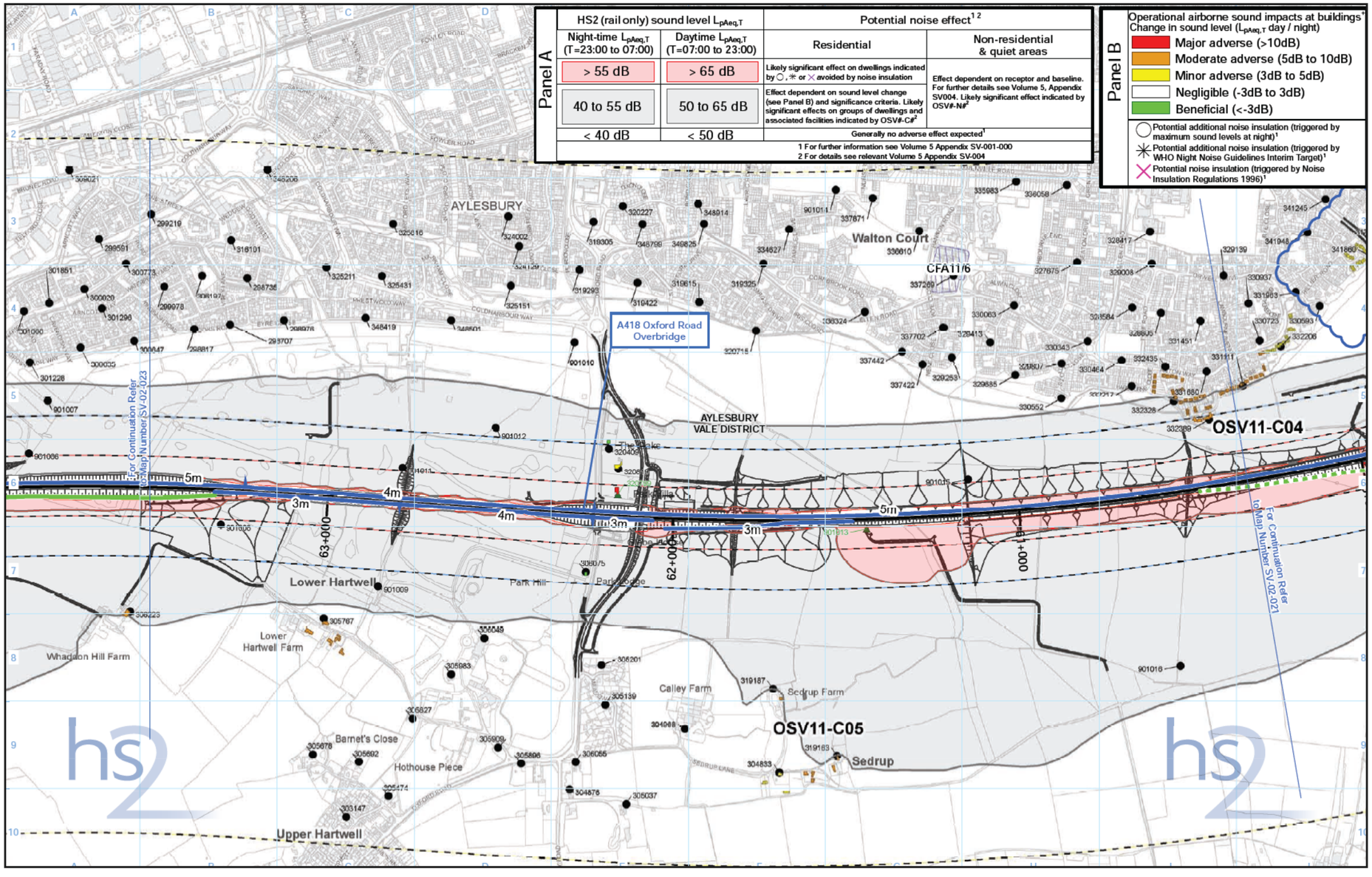


Image 9 ES Assessment Area for Aylesbury Embankment to north of Oxford Road Overbridge

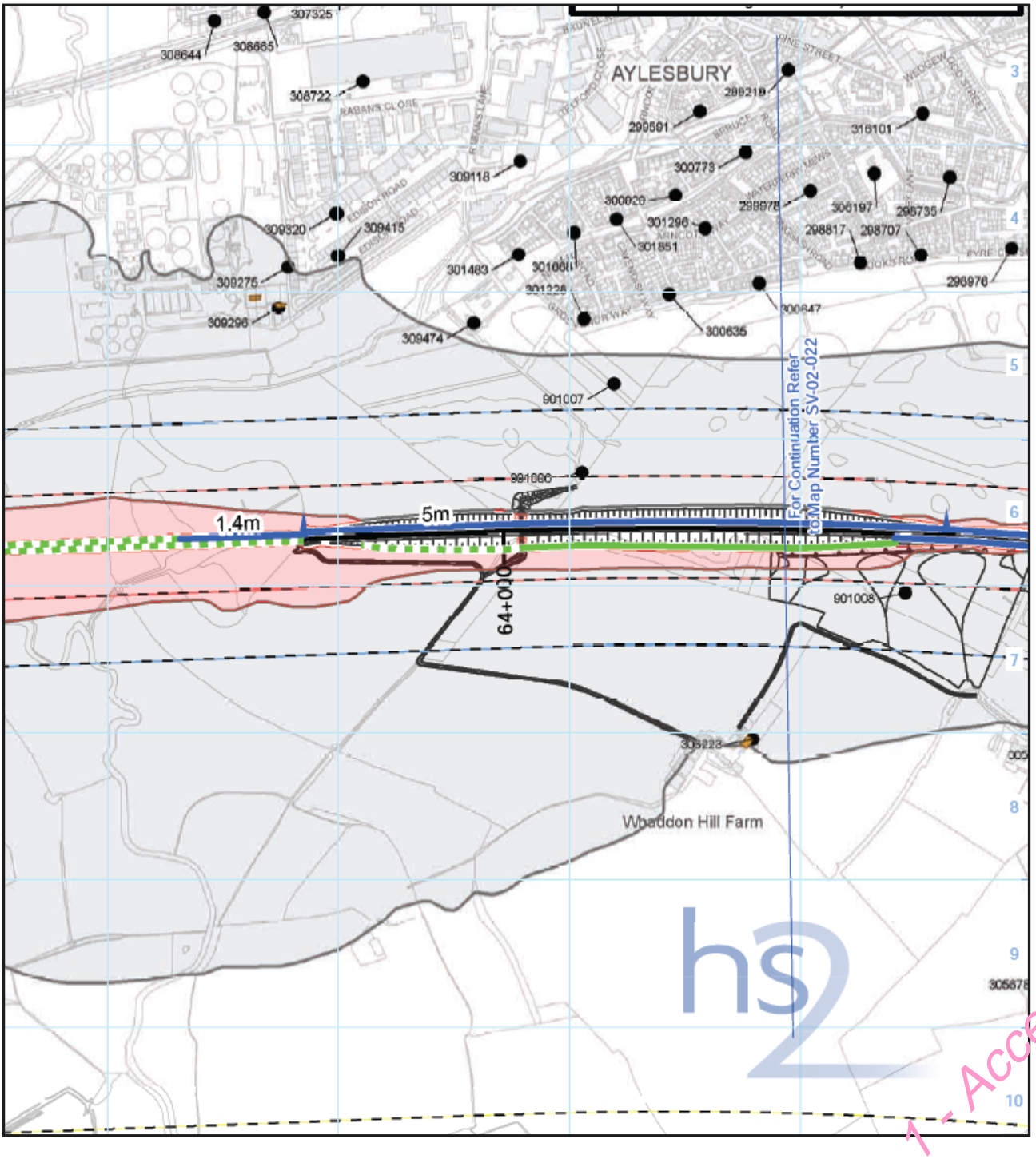


Image 10 ES Assessment Area for Aylesbury South to Thame Valley Viaduct

Image 8 shows a significant effect (OSV 11-C03) related to the Stoke Mandeville Bypass and the Princes Risborough to Aylesbury line. This significant effect is discussed and assessed in the Wendover North Cutting to Stoke Mandeville sections.

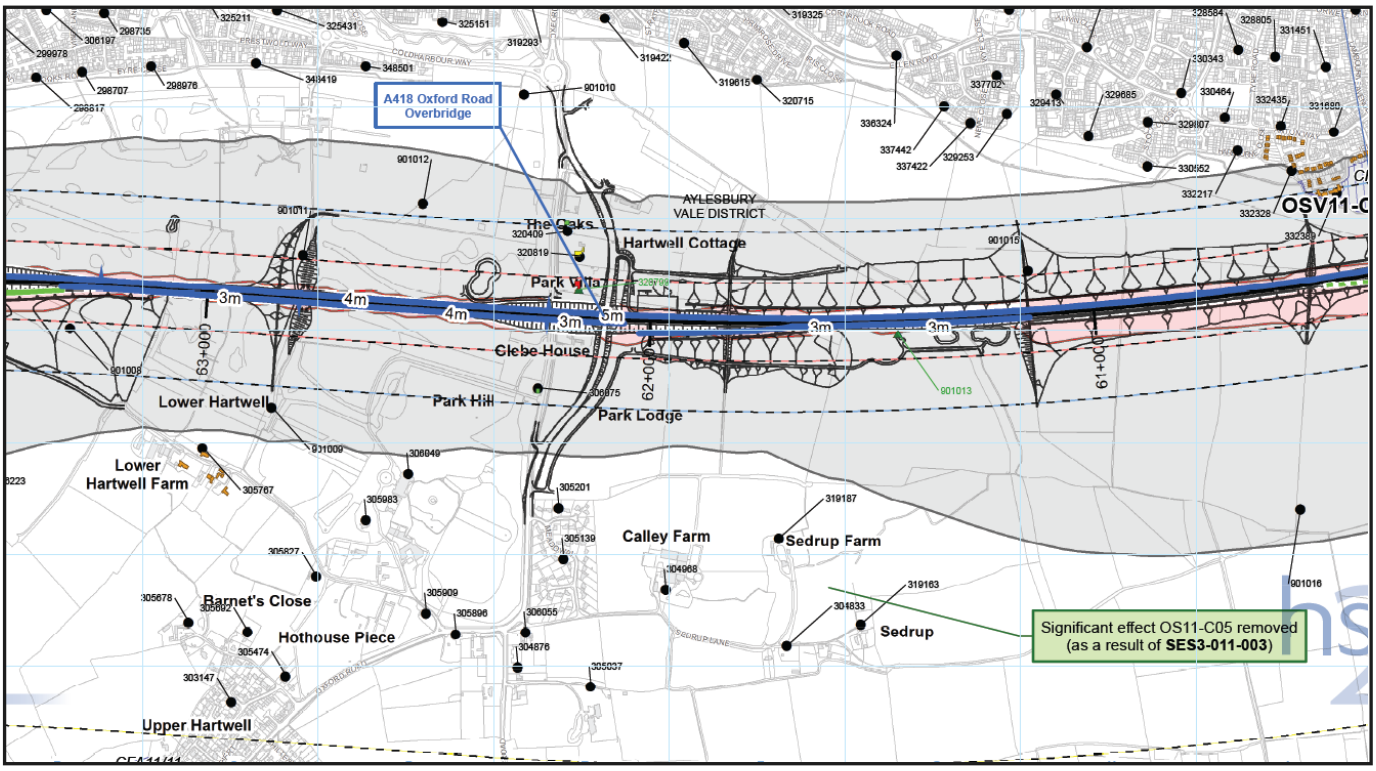


Image 11 SES 3 AP4 Assessment Area for Aylesbury Embankment to north of Oxford Road Overbridge (Sedrup)

Image 11 shows a significant effect at Sedrup to the west of the HS2 alignment (OSV11-C05). The significant effect relates to an airborne noise increase from the new train services that affects approximately 10 dwellings in the vicinity of Sedrup Lane. Forecast increases in sound from the railway are likely to cause a moderate adverse effect on the acoustic character of the area around the closest properties, reducing with distance away from the Proposed Scheme.

The Bill does not provide for noise mitigation on the west side of the HS2 route in the vicinity of Sedrup, Stone (refer to maps CT-05-043 (grid references E7, F7) and CT-06- 043 (E7, F7) in the main ES Volume 2, CFA11 Map Book). Further assessment work was carried out that identified the need to provide operational noise mitigation for Sedrup.

SES 3 AP4 provides for a noise barrier at Sedrup ditch (SES3-011-003). The provision of a 3m high noise fence barrier along the west side of the HS2 route, to the east of Sedrup Lane, for a length of approximately 350m to reduce operational noise effects in Sedrup. As shown on Image 11, significant effect OS11-C05 is removed by SES3-0110003.

The receptor locations considered for the mitigation design for Stoke Mandeville Overbridge to Oxford Road Overbridge are presented on Image 12 and Image 13 below.

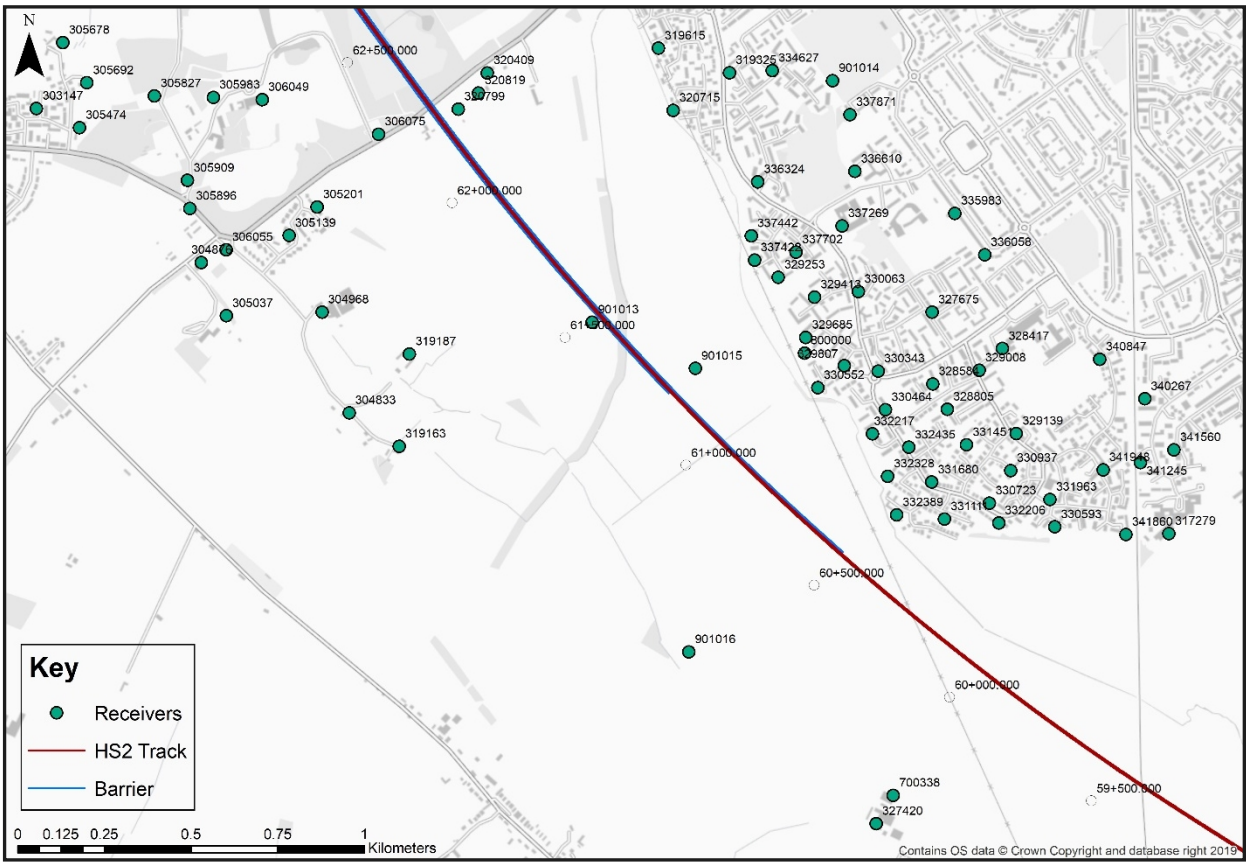


Image 12 SES 3 AP4 Assessment Area for Aylesbury Embankment to north of Oxford Road Overbridge (Sedrup)

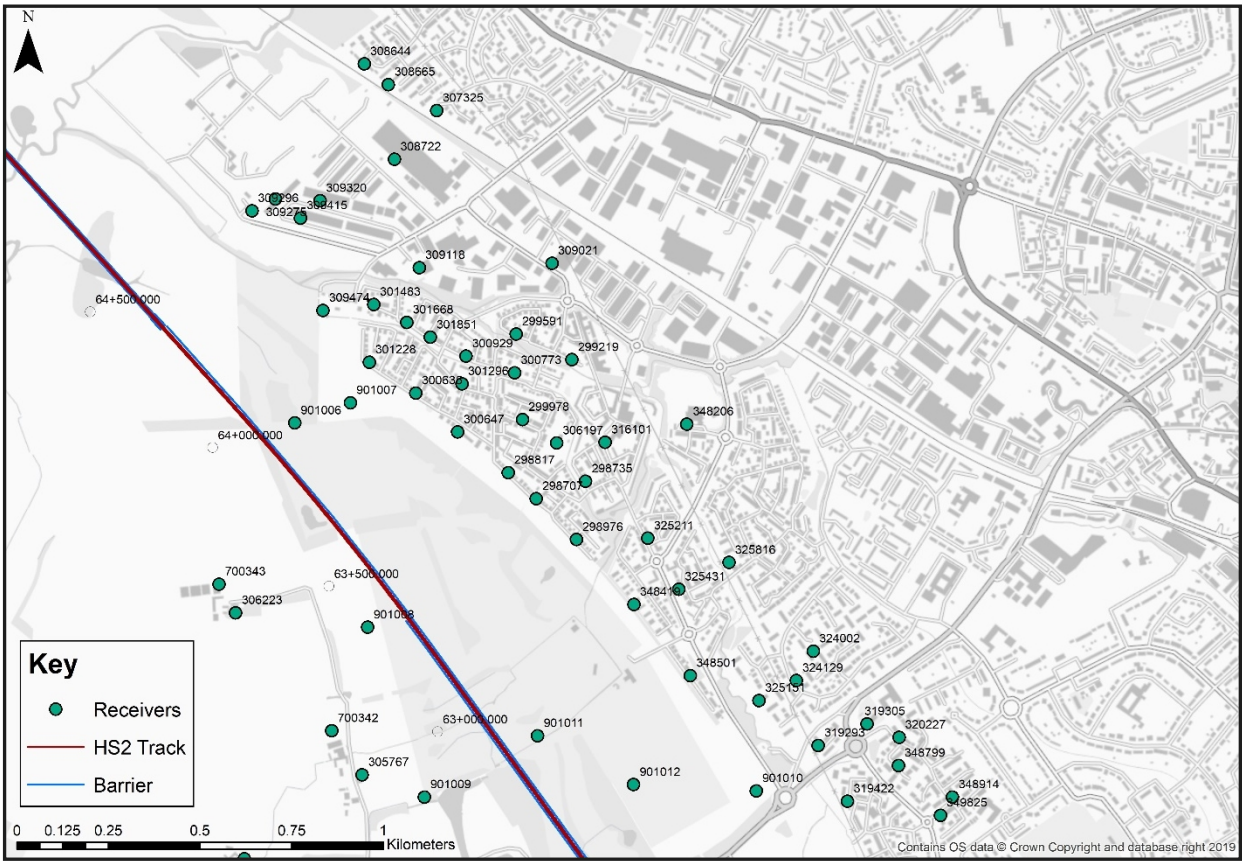


Image 13 SES 3 AP4 Assessment Area for Aylesbury Embankment to north of Oxford Road Overbridge (Sedrup)

1.3 Undertakings and Assurances

This section provides a summary of the Undertakings and Assurances (U&As) given by the Secretary of State relevant to the Stoke Mandeville area.

The controls contained in the EMRs, along with powers contained in *the Act* and the *Undertakings and Assurances (U&As)* given by the Secretary of State ensure that impacts which have been assessed in the ES will not be exceeded, unless any new impact or impacts in excess of those assessed in the ES:

- results from a change in circumstances which was not likely at the time of the ES; or
- would not be likely to be environmentally significant; or
- results from a change or extension to the project, where that change or extension does not itself require environmental impact assessment (EIA) under either (i) article 4(1) of and paragraph 24 of Annex 1 to the EIA Directive; or (ii) article 4(2) of and paragraph 13 of Annex 2 to the EIA Directive; or
- would be considered as part of a separate consent process (and therefore further EIA if required).

In the circumstances described in the first bullet point above, if the significant adverse impacts identified in the ES are likely to be exceeded, HS2 and their contractors will take all reasonable steps to minimise or eliminate those additional impacts. If despite these reasonable steps, significant adverse impacts remain HS2 and their contractors will report them.

All of the route-wide and area specific (relative to this area) U&As given by the Secretary of State in relation to operational noise, ground-borne noise and vibration are presented in Table 2 below.

U&A ref ID	Type	Beneficiary	U&A text	Subject	Start Chainage	End Chainage
2077	Assurance	Aylesbury Vale District Council	The Promoter will review proposals for screening and noise mitigation for the Stoke Mandeville maintenance loops in line with the Environmental Minimum Requirement commitments, liaising as appropriate with Aylesbury Vale District Council.	Screening and noise mitigation	57+500	60+500
2434	Assurance	Aylesbury Town Council	The Secretary of State will require the nominated undertaker to, in so far as it is reasonably practicable: ○ provide noise barriers on both the east and west side of the railway, of 4m height or equivalent, between the sections of the railway marked A1 and A2 and shown by a red line on the plan in the Annex to the Assurance; and, ○ provide noise barriers to a uniform height, between the sections of the railway marked A1 to B1 and A2 to B2 and shown by the red line on the plan. Please note that the above assurance has been drafted on the following assumptions: ○ the reference to 4 m height or equivalent means to provide equivalent performance of a noise fence barrier of 4 metres in height; and ○ the provision of noise barriers in A1 & A2 and B1 & B2 are both subject to a test of whether this would be reasonably practicable.	Noise barriers	57+500	58+500
2483	Assurance	Stoke Mandeville Parish Council	The Secretary of State will require the nominated undertaker to, in so far as it is reasonably practicable, provide noise barriers on the east side of the railway, of 4m height or equivalent, between the sections of the railway marked A and B shown on the plan in the Assurance. Please note that the above assurance has been drafted and is offered on the basis that the reference to 4m height or equivalent means to provide equivalent performance of a noise fence barrier of 4m in height.	Noise barriers	58+800	59+000

Table 2 Summary of Undertakings and assurances for Stoke Mandeville

1.4 The Green Banks Scheme (Hartwell Agreement)

Subject to planning consent (if required) and any approvals necessary under Schedule 16 to the Bill, the Promoter will require the Nominated Undertaker to construct the Green Banks Scheme as part of the Authorised Works in accordance with this Agreement. The Hartwell Agreement states as follows:

"In constructing the Authorised Works and subject to planning consent, the Promoter shall secure that the Green Banks Scheme earthworks function as a noise barrier on both sides of the Proposed Railway.

In constructing the Authorised Works and subject to planning consent, the Promoter is required to secure that the Green Banks Scheme earthworks function as a noise barrier on both sides of the Proposed Railway.

In constructing the Authorised Works, the Promoter shall secure that the Green Banks Scheme earthworks so far as reasonably practicable shall perform at least as well as all other noise barriers of similar height to be used by the Promoter elsewhere on Phase One of HS2.

The Promoter shall comply with the consultation and engagement provisions under clause 14 below in designing and constructing the Green Banks Scheme as a noise barrier.

In constructing the Authorised Works, the Promoter shall secure that the two structures are installed in parallel adjacent to Rifle Spinney between points A and B on Plan 2. The two structures are:

1. *a noise barrier ("the Noise Barrier"); and*
2. *on the side of the Noise Barrier that does not face the railway; a visual screen with planting on the side of the screen that does not face the railway ("the Planted Visual Screen").*

So far as reasonably practicable, the Promoter shall secure that:

- *the Noise Barrier will perform at least as well, at all distances from the track, as noise barriers of similar height to be used by the Promoter elsewhere on Phase One of HS2;*
- *both the Noise Barrier and the Planted Visual Screen will occupy the smallest possible area of land as is reasonably practicable;*
- *the Noise Barrier will be no higher than the Planted Visual Screen;*
- *the Planted Visual Screen runs continuously with the banks at an equal height to the banks from north to south;*
- *the Planted Visual Screen is planted with a mixture of evergreen and deciduous species compatible with the structure, so as to maintain a planted and natural aspect from the west throughout the whole year; and*
- *the Planted Visual Screen is designed so that the planted and natural aspect is achieved and maintained from top to bottom of the Planted Visual Screen along the whole of its length, including the top edge."*

The Green Banks Scheme refers to the scheme of landscaping works indicatively edged with blue dotted line on Image 14 below.

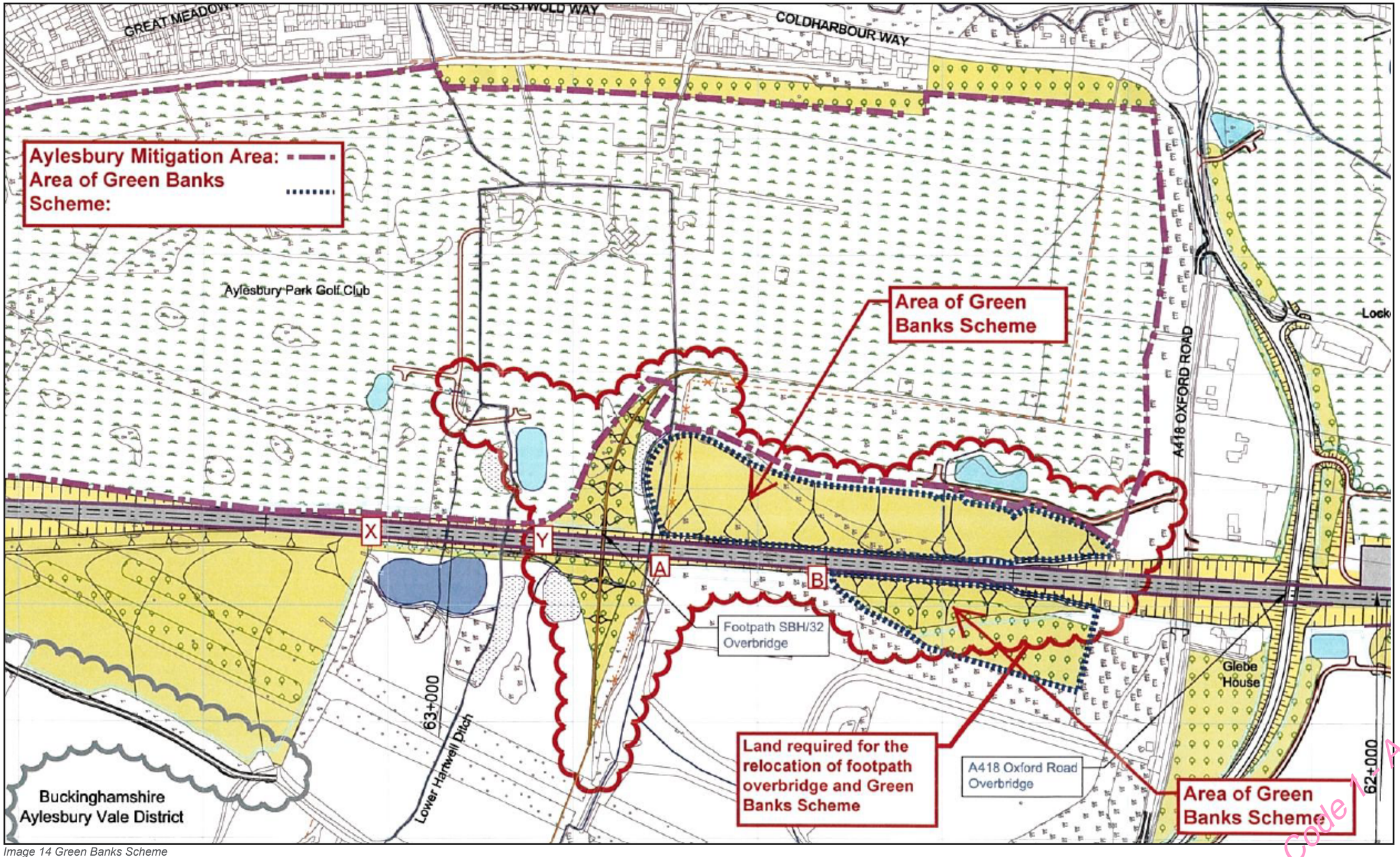


Image 14 Green Banks Scheme

1.5 Key Design Changes since ES

The following section outlines the key changes to the Scheme since the ES and the SES phases.

i. Wendover Green Tunnel North Portal to Wendover North Cutting

New earthworks have been locally added between Chainages 55+000 to 56+200 on the eastern side of the route to provide screening; as a result land drainage ditches have been provided to provide a cut-off drain so water cannot encroach on the cutting slopes.

Track spacing at the tunnel portal has been reduced slightly from 7,290mm in the ES to 6,990mm in the design, bringing the earthworks at the portal slightly closer to the rail lines and source of the noise.

Wendover North Cutting (055-L1) has changed from 1V:4H at ERD to 1V:2H (Ch 55+098 to Ch 55+636) and 1V:3.5H (Ch 55+636 to Ch 56+730) at Scheme Design, representing a steepening of the cutting slopes. This has the potential to reduce the width of the cutting and reduce the volume of material excavated.

The earthworks cross sections for Wendover Green Tunnel North Portal are shown on Drawing 1MC06-CEK-TP-DSE-CS03_CL06-000004, and Image 15 below shows the cross section at Ch 55+400 with the cutting 10m deep to the east (slope 1:2) and additional landscaping earthworks at the top of the cutting with a 1:4 slope.

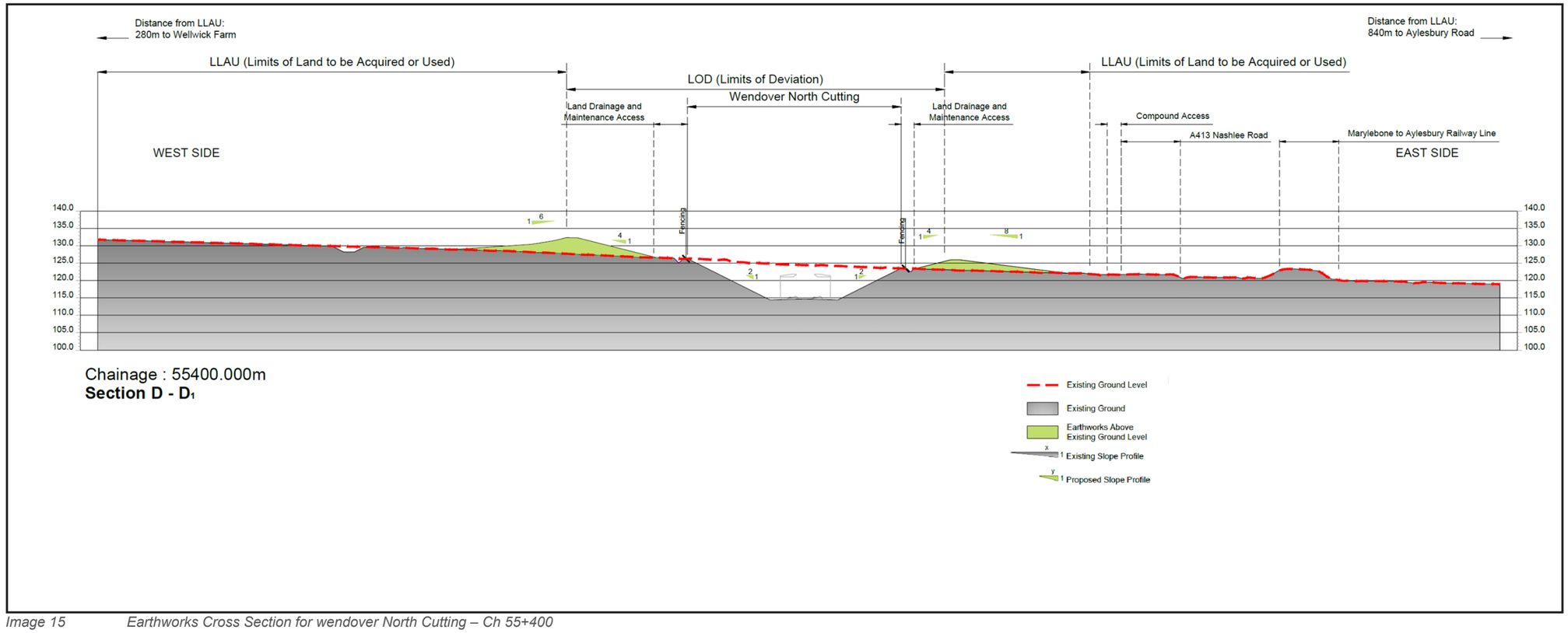


Image 15 Earthworks Cross Section for wendover North Cutting – Ch 55+400

The height and location of the 6m lineside barrier is illustrated on Image 16 below (cross section at Ch 55+400), indicating height of the earthworks and landscaping in relation to the noise barrier.

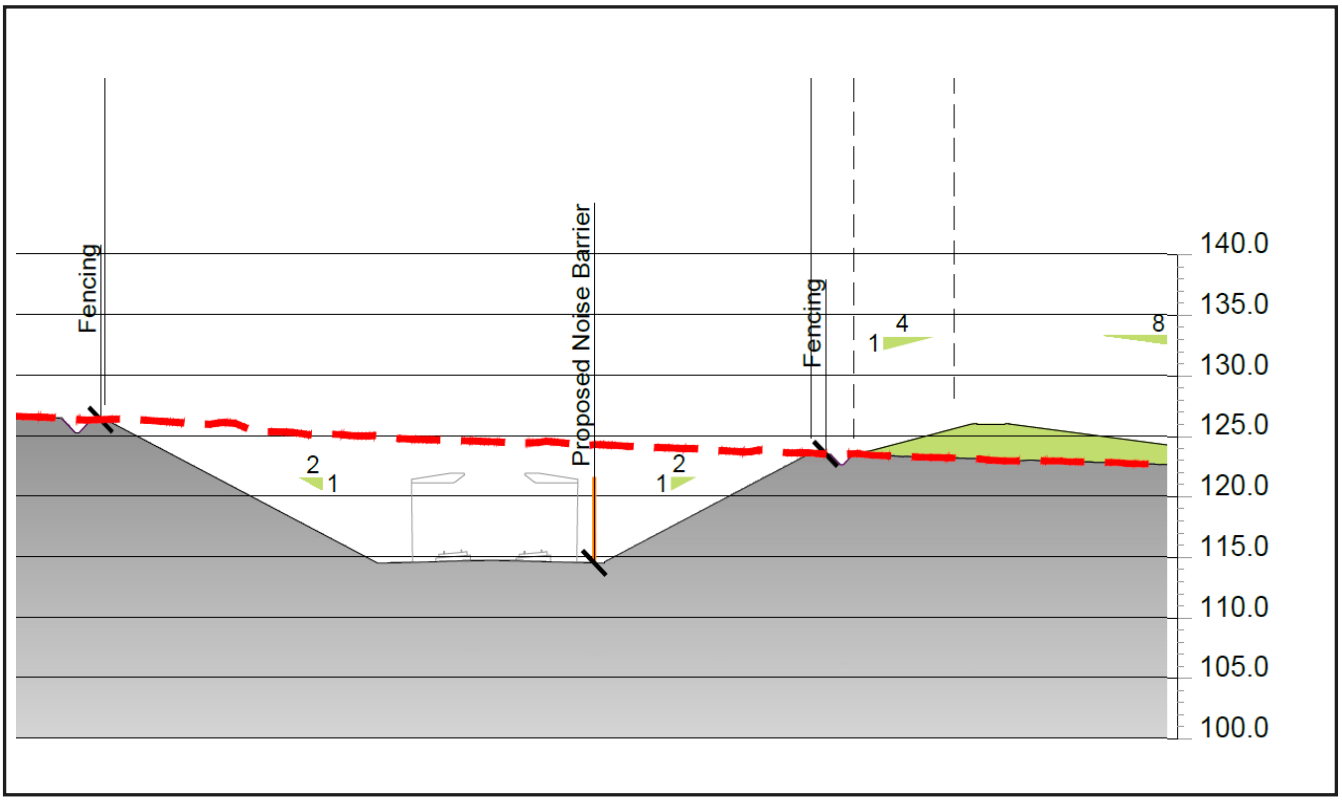


Image 16 Location of 6m barrier in relation to earthworks and landscaping – Ch 55+400

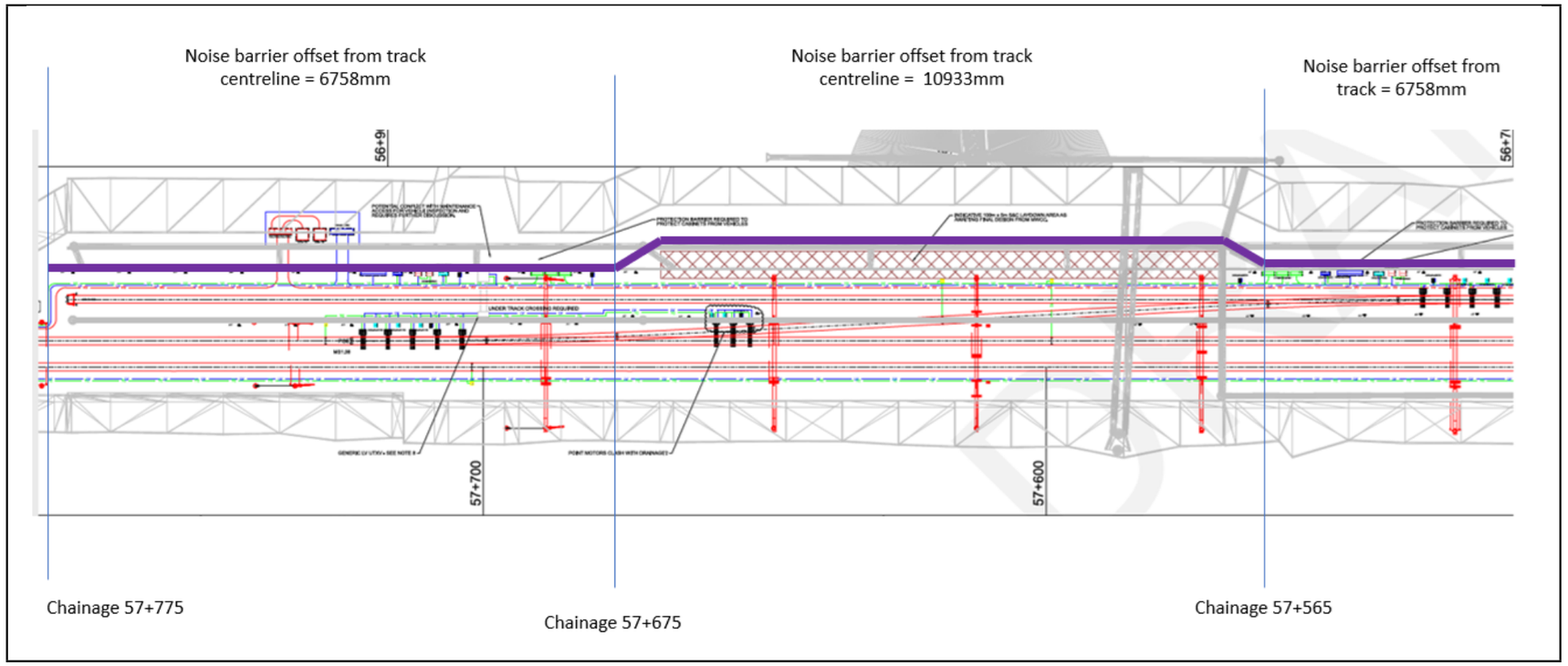
ii. Wendover North Cutting to Stoke Mandeville Bypass Overbridge

Value Engineering (VE-104) and optimisation has proposed the removal of one maintenance loop line from the Stoke Mandeville area. The optimisation allows the reduction of the width of the scheme and thus shortening of assets such as culverts in this area.

Deletion of one side of the loop would allow to shorten the over-bridges and the under-bridges crossing both HS2 and the maintenance loops.

The VE also reduces the surface of the civil platform, reduces the volume of embankments and cuttings, reduce the scope of the drainage and reduces the scope of the maintenance vehicle access.

Consultation with The Design Team, HS2 Rail Operations and HS2 Rail Maintenance has established the offset distances for the noise barrier at the Stoke Mandeville maintenance loop. The offsets are shown on Image 17 below.



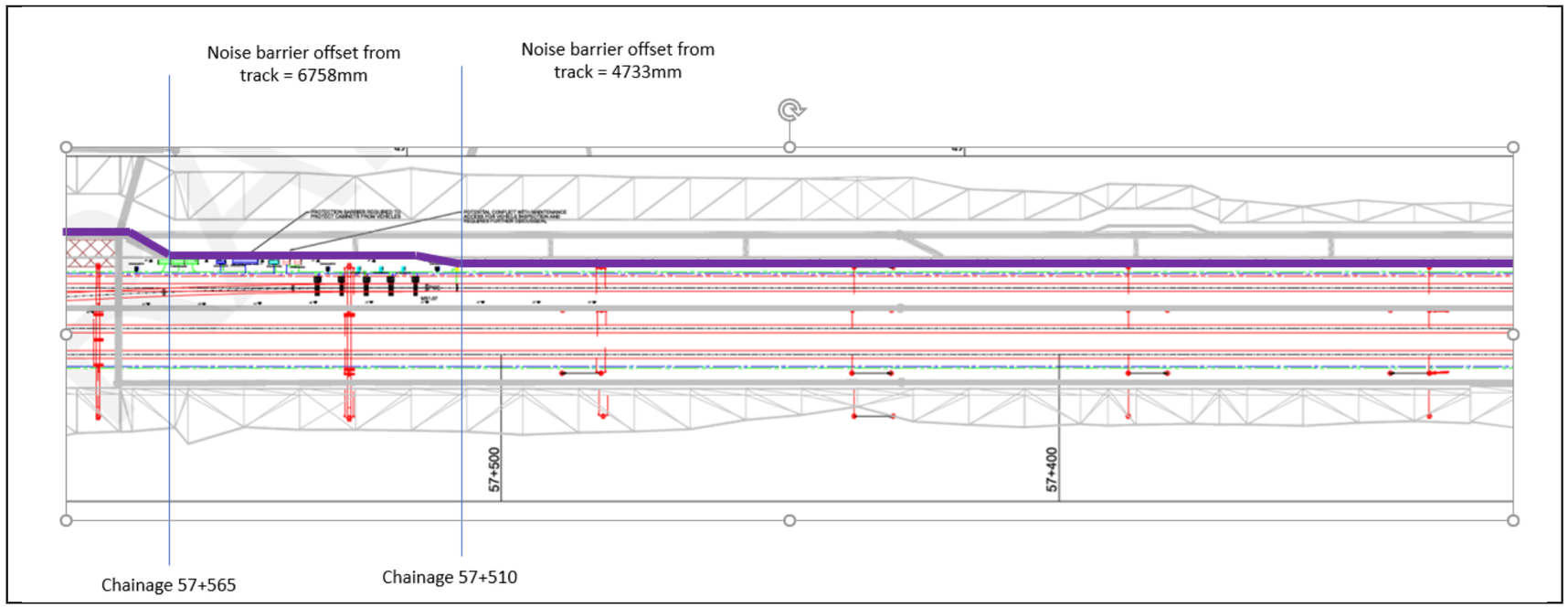


Image 17 Stoke Mandeville Maintenance Loop barrier Offset

In addition, within this area the Stoke Mandeville South Embankment (056-L1) has changed from 1V:2.5H at ERD to 1V:2H at Scheme Design, representing a steepening of the embankment slopes. Additional planting areas have been incorporated along the existing railway line and the outward slopes will be returned to agriculture.

iii. Stoke Mandeville Bypass Overbridge to Oxford Road Overbridge

A value engineering and optimisation exercise was carried out to eliminate the need for a pumping station at the current low spot in the track alignment in Aylesbury South Cutting (VE-30). VE-30 has been implemented so that the track will be raised approximately 1,470mm at chainage Ch 60+000, and approximately 1,000mm at chainage Ch 61+400 to enable the suppression of the proposed pumping station.

Aylesbury Embankment (060-L1) slopes have been slightly steepened from a gradient of 1 in 2.5 at ERD to 1 in 2 at Scheme Design, with a slight elevation in embankment height in line with VE-30.

Amendments have been made to the landscape earthworks in this area to reflect the change to the track vertical alignment under VE-30. This includes increasing the height of the landscape earthworks false cuttings on both sides to maintain a crest height above track similar to the original false cutting in the FPD design.

The Thame Valley South Embankment (064-L1) is designed with 1 in 2 slopes (from 1 in 2.5 slopes at ERD) and has been reduced by 16m in length, in line with the changes to the length of the Thame Valley viaduct.

The There are no other changes from ERD in this section.

▪ Scheme Wide Design Changes

Scheme wide design updates that have been considered in the noise modelling are set out below and are based on a track alignment which incorporates the reduction of track centres from 5,000mm in the ES design to 4,700mm in this design, quoted centre to centre distance.

- Where drainage requirements allow, the noise barrier has been offset 4,600mm from the HS2 trace (outside rail), which is 5,300mm from track centreline. This is closer than the standard 5,700mm (track centreline) offset used by HS2 at the time of the HS2 Phase 1 ES. By positioning the barriers closer to the tracks, their effectiveness has been improved.
- The locations along the trace where barrier offsets are varied from this standard 4,600mm, to accommodate drainage, and have been included in the modelling and are listed below. The offset in the list below is noted to be from outside rail:

Up Side	Ch 60.400	Ch 60.666	6,300mm
Up Side	Ch 60.666	Ch 60.816	6,100mm
Up Side	Ch 60.816	Ch 61.134	6,000mm
Up Side	Ch 61.134	Ch 61.618	6,100mm
Up Side	Ch 61.618	Ch 61.763	6,000mm
Up Side	Ch 63.292	Ch 63.874	5,700mm
Up Side	Ch 63.874	Ch 64.200	5,700mm

Up Side	Ch 64.200	Ch 64.259	6,300mm
Up Side	Ch 64.259	Ch 64.300	6,300mm
Up Side	Ch 64.300	Ch 64.334	6,300mm
Up Side	Ch 64.334	Ch 64.350	5,900mm
Up Side	Ch 64.350	Ch 64.340	5,900mm
Up Side	Ch 64.340	Ch 64.371	5,900mm
Up Side	Ch 64.371	Ch 64.382	5,900mm
Down Side	Ch 61.200	Ch 61.763	6,100mm

- The track support system has been revised to track slab for the HS2 main lines compared to a ballasted system adopted at the time of the ES preparation.
- The changes in noise source level are presented in Section 3.
- The revised noise source terms include the removal of TSI compliant trains.

2 Methodology

The assessment has been carried out with due consideration of the following documentation:

- Environmental Statement and associated documentation, for the definition of LOAEL/SOAEL and corresponding numerical values, for the definition of impact classifications and identification of significant effects both for individual receptors and for a group of receptors on a community basis;
- HS2 Phase 1 Information Papers E20 on HS2 Ltd.'s overall noise objectives on HS2 Phase 1;
- HS2 Phase 1 Operational Noise and Vibration EMRs – Material Difference (1TS01-ARP-CN-NOT-000-000001) to identify whether changes in noise constitute new or materially different significant effects;
- Technical Standard – Acoustic design of civil engineering assets, Document no.: HS2-HS2-EN-STD-000-000003-P05 for design guidance and design process to demonstrate compliance with HS2 requirements;
- WebTAG Application for the Assessment of Operational Airborne Noise Control (1TS01-ARP-CN-NOT-000-000002) for application of WebTAG for the assessment of airborne noise control, definition of Net Present Value (NPV);
- Excel spreadsheet "tag-workbook-noise-1dB-Aug-18-Template.xlsx" to support the application of WebTAG for local HS2 noise mitigation assessments based on 1dB noise changes;
- HS2 guidance on how to perform CBA in line with guidance contained in Defra NANR 201 is also contained in 1D202-EDP-EV-NOT-000-000001|C01 |Example Application of Technical Standard on Acoustic Design of Civil Engineering Assets, and
- Planning Forum Note 14 - Operational Noise from the Railway and Altered Roads for approach to demonstrating that noise from the operational railway and altered roads has been reduced 'as far as reasonably practicable' in parallel with seeking Schedule 17 approvals.

The ES sets the impact criteria according to the nature of the noise source, the sensitivity of the receptor and the local context; to reflect the effect that the noise or vibration of the Proposed Scheme exerts on any given receptor.

The assessment methodology for this appraisal has followed the methodology set out in the ES Volume 5 Technical Appendices 'Scope and methodology report CT-001-000/1 as amended by addendum (CT-001-000/2)' to allow for a meaningful comparison with the ES results.

2.1 Acoustic performance of Noise Barriers

An assessment has been carried out to determine the in-situ insertion loss for the noise barriers in the NoiseMap™ model at Receptor IDs considered in this assessment.

The highest insertion loss achieved in situ at any the Receptor IDs under consideration is presented in Table 3 below.

Scenario	First Floor Insertion Loss
Nash Lee – East (Up Side)	
Noise Barrier Mitigation Option 1: 4m absorptive barrier	1dB
Noise Barrier Mitigation Option 2: 5m absorptive barrier	2 dB
Noise Barrier Mitigation Option 3: 6m absorptive barrier	3dB
Noise Barrier Mitigation Option 3: 10m absorptive barrier/ retaining wall	7dB
Stoke Mandeville – East (Up Side)	
Noise Barrier Mitigation Option 1: 3m absorptive barrier	6dB
Noise Barrier Mitigation Option 2: 4m absorptive barrier	8dB
Noise Barrier Mitigation Option 2: 5m absorptive barrier	10dB
Stoke Mandeville – West (Down Side)	
Noise Barrier Mitigation Option 2: 3m absorptive barrier	10dB
Noise Barrier Mitigation Option 2: 4m absorptive barrier	12dB
Stoke Mandeville to Oxford Road Overbridge (Up Side)	
Noise Barrier Mitigation Option 1: 4m absorptive barrier	10dB
Noise Barrier Mitigation Option 2: 5m absorptive barrier	12dB
Stoke Mandeville to Oxford Road Overbridge (Down Side)	
Noise Barrier Mitigation Option 1: 4m absorptive barrier	10dB
Noise Barrier Mitigation Option 2: 5m absorptive barrier	11dB

Table 3 Noise Barrier Insertion Loss

2.2 Noise Modelling Methodology

This appraisal relates to the modelling and consideration of airborne noise in accordance with HS2 Technical Standard – Prediction of ground-borne sound, vibration and airborne sound from operation Document no.: HS2-HS2-EN-STD-000-000002 (PO5).

The modelling does not consider noise from stationary systems or fixed plant. The modelling and assessment of fixed plant in accordance with Technical Standard – Acoustic design of stationary systems Document no.: HS2-HS2-EN-STD-000-000004 will be carried out at detailed design and in accordance with the assessment methodology and prediction methods set out in said standard.

Noise modelling of rail noise has been carried out in accordance with Document no.: HS2-HS2-EN-STD-000-000002 (PO5) and the Train Noise Prediction Method (TNPM) incorporated in the NoiseMap™ noise modelling software. TNPM was originally validated against a large number of high-speed train noise measurements covering a broad range of scenarios, including propagation over flat ground up to distances of 800m from the railway, effects of screening (including reflective and absorptive barriers) and varying angles of view. The overall regression analyses gave a standard error, for the goodness of fit between predicated and measured levels, of approximately 3dB(A) for SEL and LpAFmax. This means that the difference between predicted and measured sound levels is typically within ±3dB(A). Consistent with the Hybrid Bill Scheme the mean values levels are presented in this report.

The noise model source terms and model assumptions are in accordance with Technical Note: Assumption for Phase 1 operational ground-borne sound, vibration and airborne sound assessment Document no.: PH1-HS2-EN-NOT-000-000002.

The noise modelling is based on the procedures as described below.

- The source heights used in the prediction of airborne sound from HS2 trains are modelled as follows:
  - rolling sound, at a height of 0m above rail head, which includes sound emitted by the wheels and the track;
  - body aerodynamic sound, at a height of 0.5m above rail head, which includes sound generated by flow in the lower regions of the train;
  - starting sound, at a height of 2.0m above rail head, which includes sound generated by power, traction and auxiliary systems;
  - pantograph recess aerodynamic sound at a height of 4.0m above rail head; and
  - raised pantograph aerodynamic sound at a height of 5.0m above rail head.
- In the prediction of airborne noise from HS2 trains, the speed dependence relationships for each of these sources, in terms of SEL shall be:
  - R_{SEL} + 20log10V for rolling sound;
  - B_{SEL} + 60log10V for body aerodynamic sound;
  - S_{SEL} - 10log10V for starting sound (V < 250 kph); and

- P_{SEL} + 60log10V for pantograph and pantograph recess sound.

where R_{SEL} is the source term for rolling sound, B_{SEL} is the source term for body aerodynamic sound, S_{SEL} is the source term for starting sound and P_{SEL} is the source term for pantograph and pantograph recess sound and V is the train speed in kph. S_{SEL} shall not be included for predictions of airborne noise when train speeds are 250 kph or above.

- The corresponding speed dependence relationships for each of these sources, in terms of LpAFmax, which shall be assumed in the prediction of airborne noise for each of these sources are:
  - $R_{LpAF,max}$ + 30log10V for rolling sound;
  - $B_{LpAF,max}$ + 70log10V for body aerodynamic sound;
  - $S_{LpAF,max}$ for starting sound; and
  - $P_{LpAF,max}$ + 70log10V for pantograph and pantograph recess sound.
- Where $R_{LpAF,max}$ is the source term for rolling maximum sound, $B_{LpAF,max}$ is the source term for body aerodynamic maximum sound, $S_{LpAF,max}$ is the source term for starting sound and $P_{LpAF,max}$ is the source term for pantograph and pantograph recess maximum sound and V is the train speed in kph.
- The method to predict airborne sound from operation shall model the propagation in order to consider, but not limited to, the following effects: topography, ground type, reflections, shielding by barriers and buildings, air absorption and meteorology.
- The total pass-by L_{pAFmax} is computed using the following equation:

$$L_{pAFmax} = MAX\ [\ (R_{LpAF,max} \oplus B_{LpAF,max} \oplus S_{LpAF,max})\ ,\ (R_{LpAF,max} \oplus P_{LpAF,max} \oplus S_{LpAF,max})]$$

- To account for the differing source heights resulting in different distance attenuation, ground absorption and shielding etc. the calculations for propagation from source to receptors will be undertaken for each source individually for both $L_{pAeq,T}$ and $L_{pAF,max}$ calculations.
  - *$L_{pAeq,T}$ will be logarithmically summed at the receptor location to provide a single figure value; and,*
  - *$L_{pAF,max}$ will be summed in accordance with equation above at the receptor location to provide a single figure value.*

The noise modelling presents predictions 15 years from the opening of the HS2 line in accordance with the HS2 ES, and maintains the same assumptions made in the ES with regard to modelling variables such as meteorological conditions and wind speeds.

In November 2018 HS2 Ltd Instructed the Main Works Construction Contractors (MWCCs) (EDC 052- Update of noise and vibration source terms for MWCC & SDSC acoustic design) to use a revised train service pattern together with the revised noise source terms for the purposes of assessment. This is presented within Table 4 (taken from PH1-HS2-EN-PPR-000-000052 Phase 1 Flow Information for Acoustics Modelling). The updated flow pattern and noise source data has been presented to the Phase 1 Planning Forum Environmental Health sub-group and is implemented across all noise modelling and prediction.

SEL Source	Captive (CP) train same as ES mitigated train, Conventional Compatible (CC) train with 1dB total increase at 360 km/h due to body aerodynamic noise. No Just TSI train (TSI trains excluded).	
	CP on Slab	**CC on Slab**
R (rolling noise)	42.1 dB	42.1 dB
B (body aerodynamic)	-59.9 dB	-57.9 dB
S (starting/traction noise)	98.7 dB	98.7 dB
P (recess) (pantograph recess)	N/A	N/A
P (pantograph)	-74.3 dB	-74.3 dB
Total $L_{Aeq,Tp}$ at 320 km/h	90.0 dB	90.9 dB
Total $L_{Aeq,Tp}$ at 350 km/h	91.9 dB	93.0 dB
Total $L_{Aeq,Tp}$ at 360 km/h	92.5 dB	93.6 dB

Table 4 Noise Source Terms – November 2018

The train flow pattern information as provided in "*PH1-HS2-EV-MOD-000-000002 P01 Phase 1 Flow Information for Acoustics Modelling*" is presented in Table 5.

Fleet Composition	Section	Speed km/h	Total 16hr Day	Total 8hr Night
Conventional Compatible (Catch-Up)	3A	360	22	1
Conventional Compatible (330)	3B	330	191	12
Captive (Catch-Up)	3C	360	22	1
Captive (330)	3D	330	222	13
Total (One-way flows)			**460 (Rounded)**	**30 (Rounded)**

Table 5 Train Flows to inform sound assessment (November 2018)

2.3 Appraisal Process

The WebTAG Application for the Assessment of Operational Airborne Noise Control (1TS01-ARP-CN-NOT-000-000002) document relating to airborne noise control provides a definition of Net Present Value (NPV).

The monetised Net Present Value of the noise levels is calculated using the excel-template "*tag-workbook-noise-1dB-Aug-18-Template.xlsx*" issued by HS2; within which the noise source is set to 'rail'. In this case it is assumed that the opening year is 2028, the forecast year is 2043 and the current year is 2018.

"Technical Standard – Acoustic design of civil engineering assets" requires each mitigation scenario to be compared to a reference scheme (unmitigated or with embedded mitigation only), which would represent a 'Do Minimum' scenario. The 'Do Nothing' scenario becomes relevant only when assessing the NPV.

In order to undertake a noise valuation of the mitigation scenarios, the NPV of each mitigation option needs to be compared to the reference case. With regard to the cost of the noise control measure the HS2 guidance listed in Table 6 applies. Calculations are carried out to determine the Whole-life economic costs of the mitigation measure and each option and are considered per linear meter to include installation, footings and foundations. Costs were compiled by EKFB in May 2019 and are the most up to date at the time of writing.

The cost estimates (construction costs) are based on a cost estimate per metre plus a cost per metre for estimated total life cycle operational cost, calculated using the HS2 Unit Rates Calculator: Bridging Structures – HS2 URC-BR P13 May 2018. This includes for:

- maintenance & replacement costs of relevant bridge elements
- operational costs for routine maintenance and General/Principal Inspections.

The estimate calculated however, does not include for remote condition monitoring costs or any other non-listed activities. Remote condition monitoring costs are to be determined from the Instrumentation & Monitoring Plan, which will be developed at detailed design. These costs will be updated once the Noise Barrier Approval in Principal document is accepted by HS2. Whole Life Costs (WLC) are based on a 60-year period in line with the costs used in the AFARP assessments in the ES and through the parliamentary process.

Description	ES costs		EK – May 2019	
	Base + Prelims	Base + Prelims + WLC	Base + Prelims	Base + Prelims + WLC
2m high (1m above rail)	-	-	£670	£736
3m high (2m above rail)	£495	£743	£1,005	£1,071
3.5m high (2.5m above rail)	-	-	£1,173	£1,239
4m high (3m above rail)	£627	£941	£1,340	£1,406
4.5m high (3.5m above rail)	-	-	£1,508	£1,574
5m high (4m above rail)	£957	£1436	£1,675	£1,741
5.5m high (4.5m above rail)	-	-	£1,843	£1,909
6m high (5m above rail)	£930	£1841	£2,010	£2,076
6.5m high (5.5m above rail)	-	-	£2,178	£2,244
7m high (6m above rail)	-	-	£2,345	£2,411
7.5m high (6.5m above rail)	-	-	£2,513	£2,579
11m high (10m above rail)	-	-		£7,500 *

Note *: This appraisal considers a 10m noise barrier/ retained cutting as a mitigation option. No official cost estimates for a 10m noise barrier have been provided. For the purposes of progressing the assessment the cost of a 10m barrier has been estimated based on design changes to pile depth, pile width and pile caps. With the structure being heavily dynamically loaded, it might be required to design a structure with a different static system though that would require considerable design consideration.

The cost for a 10m barrier has been estimated at £7,500 per linear metre (Base +Prelims + WLC).

Table 6 Whole-life barrier costs per linear meter

The end requirement and conclusion as to whether a barrier presents value for money is based upon the following Cost Benefit Ratio (CBR) defined through consideration of the WebTAG NPV and the Whole Life Cost as defined by HS2; as presented within Table 7.

Ratio of WebTAG NPV / long-life cost	Guidance
>1.0	Clear indication that noise control should be included in the design.
>0.2 and <1.0	1. Further consider other mitigation design objectives and weight that should be given to them with reference to any precedence for such weighting such as that used by HS2 for an Environmental Impact Assessment or petition management. 2. Whether there is any 'material difference' between the noise effects forecast for the proposed scheme design compares to any previous published results such as the ES and SES reports. 3. Engage as early as possible with HS2 Ltd to seek further guidance
< 0.2	Clear indication that noise control should NOT typically be included in the design. 1. Further consider other mitigation design objectives and weight that should be given to them with reference to any precedence for such weighting such as that used by HS2 for an Environmental Impact Assessment or petition management 2. Whether there is any 'material difference' between noise effects forecast for the proposed scheme design compared to any previous published results such as the ES and SES reports. 3. Engage as early as possible with HS2 Ltd to seek further guidance

Table 7 HS2 Guidance on ratio of WebTAG Net Present Value to life cost of noise mitigation measures

3 Acoustic Design of Civil Engineering Assets

Modelling within the scope of this report has been carried out for the area defined as C2 IDR E – Wendover Green Tunnel North Portal to Oxford Road Embankment (Ch 55+084 to Ch 62+435); covering AVDC Packages AVDC P4, AVDC P5, AVDC P6 and AVDC P7.

The noise modelling for IDR E has considered the design changes proposed to date and incorporates ground models as issued through the design team. These are listed below and incorporate the changes to earthworks and landscaping to that revision:

- C3D Surface Model - Snake Grid - IDR E: 1MC06-CEK-EV-MOD-C002-000007
- Non C3D Surface Model - Snake Grid - IDR E :1MC06-CEK-EV-MOD-C002-000008

The noise modelling has identified locations where it is indicated mitigation in the form acoustic barriers would be required above the mitigation inherent within the ground profiles. The locations identified as requiring mitigation in the form of acoustic barriers conform with those locations identified as requiring acoustic barriers in the London-West Midlands Environmental Statement (2013) (ES).

The mitigation options have been assessed against the findings of the London-West Midlands Environmental Statement, Volume 5, Technical Appendices, CFA11 Operational assessment (SV-004-010) and CFA10 Operational Noise Assessment (SV-004-011) and considered against material change criteria.

3.1 Wendover Green Tunnel North Portal to Wendover North Cutting (AVDC P4)

The mitigation options have been assessed against the findings of the London-West Midlands Environmental Statement, Volume 5, Technical Appendices, CFA11 Operational assessment (SV-004-010) and CFA10 Operational Noise Assessment (SV-004-011).

The assessment area as presented in ‘The “London-West Midlands Environmental Statement, Volume 5 Map books Sound, noise and vibration (Part 2 of 4) November 2013’ is shown on Image 1 (CFA11).

- **Wendover Green Tunnel North Portal:** Nash Lee (AVDC P4)

The ES assessment indicated that the identified communities would benefit from the noise mitigation scheme as presented in Table 8 (Noise mitigation –Nash Lee Bypass Overbridge). Through the Scheme design other Options were tested and considered, as also presented within Table 8.

Location	Start Chainage	End Chainage	Up/Down Line	Length (m)	Height above ToR (m)	Comments
ES mitigation (AP5) – performance presented in 'Do Something'	055+000	055+800	Up	800		Mitigation ID 055-IN1E Wendover North Cutting provides mitigation for a significant noise effect on the right side (east) of the alignment between Ch 055+000 and 055+800.
	055+000	056+000	Down	1000		Mitigation ID 055-IN2W Wendover North Cutting provides mitigation for a significant noise effect on the left side (west) of the alignment between Ch 055+000 and 056+000.
	055+000	055+340	Up	340	6	Mitigation ID AP5-NB2E Provision of a 6m high noise fence barrier within the cutting at the northern portal of the Wendover green tunnel on the right side (east) of the alignment. This will run along the eastern edge of the access track and around the area where the portal buildings are situated, for a total distance of approximately 340m.
Scheme design bund provision	55+100	55+300	Up	200	-	Wendover North Cutting provides mitigation for a significant noise effect on the right side (east) of the alignment.
Noise Barrier Design Option 1	055+000	055+340	Up	340	4	Absorptive barrier trackside 4.6m from outside rail on the right side (east) of the alignment.
Noise Barrier Design Option 2	055+000	055+340	Up	340	5	Absorptive barrier trackside 4.6m from outside rail on the right side (east) of the alignment.
Noise Barrier Design Option 3	055+000	055+340	Up	340	6	Absorptive barrier trackside 4.6m from outside rail on the right side (east) of the alignment.
Noise Barrier Design Option 4	055+000	055+500	Up	500	10	Representative 10m barrier (220m noise barrier and 280m retaining wall) to consider retained cutting. Barrier trackside 4.6m from outside rail on the right side (east) of the alignment.

Table 8 Summary or noise mitigation options – Wendover Green Tunnel North Portal (Nash Lee)

As summarised in Table 8, detailed 3-dimensional noise modelling has been undertaken to individually test each of the following Noise Barrier Design Options within the AVDC P4 Nash Lea Area:

- **No Noise Barrier** case as a baseline including the scheme design earthworks noise bund designs.
- **Noise Barrier Design Option 1:** 4m absorptive noise barrier with offset of 4.6m from outside rail and including the scheme design earthworks noise bund designs,
- **Noise Barrier Design Option 2:** 5m absorptive noise barrier with offset of 4.6m from outside rail and including the scheme design earthworks noise bund designs,
- **Noise Barrier Design Option 3:** 6m absorptive noise barrier with offset of 4.6m from outside rail and including the scheme design earthworks noise bund designs,
- **Noise Barrier Design Option 4:** 10m absorptive noise barrier with offset of 4.6m from outside rail to represent 220m of noise barrier and a 10m retained cutting 280m in length; and including the scheme design earthworks noise bund designs.

Option 4 is being considered as a mitigation option for the Nash Lea area (AVDC P4) following stakeholder engagement with Wendover HS2 and the local planning authority (BC).

It is further noted that the noise barrier design has considered a line side barrier as opposed to the SES 4 AP5 design, which considered a noise barrier around the portal building and along the access track to the portal building as shown on Image 2.

The noise predictions at each receptor for the ES design and each of the Noise Barrier Design Options 1 to 4 are presented and discussed in the Section below based upon.

- The ES (as amended) prediction Tables include noise predictions for the proposed Scheme (Year 15 flows), the future baseline without Scheme (in the opening year) and the overall Do Something noise level (the Opening baseline + the year 15 flows).
- The Scheme Design Tables include the predictions for the Do Something Scheme Design (the Opening baseline + the year 15 flows) without noise barriers as mitigation and then with the noise barrier options being considered as compared against the ES/ SES Do Something noise level.

A cost benefit analysis has been carried out for each option for the daytime and night-time L_{eq} levels and the results are presented in Table 9. The cost benefit analysis score of 0.01 for the No Barrier Option (earthworks design) Noise Barrier Design Option 1, Noise Barrier Design Option 2, Noise Barrier Design Option 3 and 0.00 for Noise Barrier Design Option 4 indicates that mitigation in the form of noise barriers should not typically be included in the design.

- The No Barrier Option (mitigation in the form of earthworks only) shows no impacts above LOAEL which matches the predictions in the ES.
- Noise Barrier Design Option 1 (4m noise barrier), Noise Barrier Design Option 2 (5m barrier), Noise Barrier Design Option 3 (6m barrier) and Noise Barrier Design Option 4 (10m barrier/ retained cutting) would therefore not show any material benefit over the No Barrier Option (earthworks design option).

Design Option	Noise impact and benefit						Estimated additional cost over unmitigated design	Noise to Benefit Cost Ratio
	Impacts above LOAEL			TOTAL IMPACTS (sum of minor - major)		WebTAG Change		
		Day	Night	Day	Night			
ES Levels	Beneficial	0	0	0	0	N/A	N/A	N/A
	Negligible	0	0					
	Minor	0	0					
	Moderate	0	0					
	Major	0	0					
	Total above LOAEL	0	0					
No Noise Barrier (mitigation in form of earthworks)	Beneficial	0	0	0	0	N/A	N/A	N/A
	Negligible	0	0					
	Minor	0	0					
	Moderate	0	0					
	Major	0	0					
		0	0					
Noise Barrier Design Option 1 (4m line side barrier with offset of 4.6m from outside rail)	Beneficial	0	0	0	0	£7,427	£591,940	0.01
	Negligible	0	0					
	Minor	0	0					
	Moderate	0	0					
	Major	0	0					
	Total above LOAEL	0	0					
	Engineering and operational compatibility			Barrier height lower than ES Scheme, no particular challenges to buildability				
	Visual Impacts/ compatibility with HS2 Design Vision			Barrier height lower than ES scheme, therefore accepted visual effects are reduced. Barrier screened by earthworks 9 to 12m above ToR.				
Noise Barrier Design Option 2 (5m line side barrier with offset of 4.6m from outside rail)	Beneficial	0	0	0	0	£10,698	£705,840	0.01
	Negligible	0	0					
	Minor	0	0					
	Moderate	0	0					
	Major	0	0					
	Total above LOAEL	0	0					
	Engineering and operational compatibility			Barrier height lower than ES Scheme in sections where the AP indicated a 6m barrier. No particular challenges to buildability				
	Visual Impacts/ compatibility with HS2 Design Vision			Barrier height generally lower than ES scheme, therefore visual effects neutral. Barrier screened by earthworks 9 to 12m above ToR.				
Noise Barrier Design Option 3 (6m line side barrier with offset of 4.6m from outside rail)	Beneficial	0	0	0	0	£10,698	£819,740	0.01
	Negligible	0	0					
	Minor	0	0					
	Moderate	0	0					
	Major	0	0					
	Total above LOAEL	0	0					
	Engineering and operational compatibility			Barrier height in line with ES Scheme, in sections where the AP indicated a 6m barrier. No particular challenges to buildability				
	Visual Impacts/ compatibility with HS2 Design Vision			Barrier higher than ES scheme with consistent height of 6m above ToR. Lineside location means barrier is visible from elevated locations and impacts are considered unacceptable within AONB.				
Noise Barrier Design Option 4 (10m line side barrier with offset of 4.6m from outside rail). Barrier is representative of a retained cutting	Beneficial	0	0	0	0	£10,698	£3,750,000	0.00
	Negligible	0	0					
	Minor	0	0					
	Moderate	0	0					
	Major	0	0					
	Total above LOAEL	0	0					
	Engineering and operational compatibility			Barrier height higher than ES Scheme, no particular challenges to buildability but further work is required to confirm impacts on pile diameters				
	Visual Impacts/ compatibility with HS2 Design Vision			Barrier higher than ES scheme with consistent height of 10m above ToR. Lineside location means barrier is visible from elevated locations and impacts are considered unacceptable within AONB.				

Table 9 Cost Benefit Analysis L_{eq} Daytime and Night-time) – Wendover North Portal (Nash Lee)

The predicted noise levels for the ES and each of the Noise Barrier Design Options at receptors adjacent to the up side track (east) at the Wendover Green Tunnel North Portal (Nash Lea Area) are presented in Table 10 below.

Locations where rail noise levels are predicted to exceed the daytime LOAEL of 50dB and night-time LOAEL of 40dB are highlighted in red. **Table 10 indicates that for HS2 rail operation noise levels, all Design Options, including earthworks alone, show no receptor locations above LOAEL, as was the case in the ES.**

ID	Area Represented	No of Impacts	Do Nothing (Opening Year baseline)		ES Design Scheme Noise Only		ES Design Opening Year Baseline +Year 15 Traffic LAeq dB		Proposed Scheme Only No Barrier		No Barrier Opening Year Baseline +Year 15 Traffic LAeq dB		Option 1 Scheme only: -4m barrier;		Option 1 +Opening Year Baseline +Year 15 Traffic LAeq dB		Option 2 Scheme only: -5m barrier;		Option 2 +Opening Year Baseline +Year 15 Traffic LAeq dB		Option 3 Scheme only: -6m barrier		Option 3+Opening Year Baseline +Year 15 Traffic LAeq dB		Option 3 Scheme only: -10m barrier		Option 3+Opening Year Baseline +Year 15 Traffic LAeq dB	
			Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night
365001	Lionel Avenue, Wendover	24	46	45	39	30	47	45	38	28	47	45	37	28	47	45	37	27	46	45	36	27	46	45	34	24	46	45
365130	Aylesbury Road, Wendover	15	50	43	36	28	50	43	35	25	50	43	34	25	50	43	34	25	50	43	34	24	50	43	32	23	50	43
365216	Aylesbury Road, Wendover	10	50	43	37	28	50	43	36	26	50	43	35	26	50	43	35	26	50	43	35	25	50	43	34	24	50	43
365280	Aylesbury Road, Wendover	1	46	45	40	31	47	45	39	30	47	45	39	29	47	45	38	29	47	45	38	28	47	45	36	26	46	45
365348	Aylesbury Road, Wendover	37	66	59	35	26	66	59	34	25	66	59	34	24	66	59	33	24	66	59	33	24	66	59	32	22	66	59
366563	Lionel Avenue, Wendover	38	46	45	37	28	47	45	36	26	46	45	35	26	46	45	34	25	46	45	34	25	46	45	32	23	46	45
362513	Dobbins Lane, Wendover	22	53	44	39	30	53	44	38	28	53	44	37	27	53	44	36	27	53	44	35	26	53	44	32	22	53	44
362638	Thornton Crescent, Wendover	49	59	53	39	30	59	53	39	30	59	53	39	29	59	53	37	28	59	53	37	27	59	53	33	24	59	53
362785	Bridleways, Wendover	22	50	45	45	36	52	45	45	35	51	45	43	34	51	45	42	33	51	45	42	32	51	45	38	29	50	45
362860	Dobbins Lane, Wendover	83	53	44	38	29	53	44	37	28	53	44	37	27	53	44	36	26	53	44	35	25	53	44	31	22	53	44
363661	Dobbins Lane, Wendover	19	50	41	42	33	50	41	41	31	51	41	40	30	50	41	39	29	50	41	38	29	50	41	35	25	50	41
364087	Orchard Close, Wendover	37	50	41	37	28	50	41	36	27	50	41	36	26	50	41	35	26	50	41	35	25	50	41	32	23	50	41
364294	The Cedars, Wendover	53	50	41	39	30	50	41	38	29	50	41	37	28	50	41	37	27	50	41	36	27	50	41	33	24	50	41
366705	Lionel Avenue, Wendover	32	46	45	42	33	48	45	41	32	47	45	41	31	47	45	40	30	47	45	39	30	47	45	36	27	46	45
700327	Bridleways, Wendover	1	50	45	45	36	52	45	45	35	51	45	43	34	51	45	42	33	51	45	41	32	51	45	38	29	50	45

Table 10 Comparison of Receptors above LOAEL at the most affected receptor grouping – Wendover North Portal (Nash Lee)

Table 11 below summarises the changes in noise levels due to each of the Noise Barrier Design Options, comparing them with the Do Nothing scenario.

The No Noise Barrier Option, Noise Barrier Design Option 1, Noise Barrier Design Option 2, Noise Barrier Design Option 3 and Noise Barrier Design Option 4 do not present any additional effects over what was reported in the HS2 Phase 1 ES, with all rail noise levels predicted to be below LOAEL and no significant effect reported.

ID	Area Represented	No of Impacts Represented	Significant Effect	ES Design		Change in Noise Levels in dB Compared with Do-Nothing Scenario									
				DM - ES Design		DM - No Noise Barrier		DM – Noise Barrier Design Option 1		DM - Noise Barrier Design Option 2		DM - Noise Barrier Design Option 3		DM - Noise Barrier Design Option 4	
				Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night
365001	Lionel Avenue, Wendover	24		+1	0	+1	0	+1	0	0	0	0	0	0	0
365130	Aylesbury Road, Wendover	15		0	0	0	0	0	0	0	0	0	0	0	0
365216	Aylesbury Road, Wendover	10		0	0	0	0	0	0	0	0	0	0	0	0
365280	Aylesbury Road, Wendover	1		+1	0	+1	0	+1	0	+1	0	+1	0	0	0
365348	Aylesbury Road, Wendover	37		0	0	0	0	0	0	0	0	0	0	0	0
366563	Lionel Avenue, Wendover	38		+1	0	0	0	0	0	0	0	0	0	0	0
362513	Dobbins Lane, Wendover	22		0	0	0	0	0	0	0	0	0	0	0	0
362638	Thornton Crescent, Wendover	49		0	0	0	0	0	0	0	0	0	0	0	0
362785	Bridleways, Wendover	22		+2	0	+1	0	+1	0	+1	0	+1	0	0	0
362860	Dobbins Lane, Wendover	83		0	0	0	0	0	0	0	0	0	0	0	0
363661	Dobbins Lane, Wendover	19		0	0	+1	0	0	0	0	0	0	0	0	0
364087	Orchard Close, Wendover	37		0	0	0	0	0	0	0	0	0	0	0	0
364294	The Cedars, Wendover	53		0	0	0	0	0	0	0	0	0	0	0	0
366705	Lionel Avenue, Wendover	32		+2	0	+1	0	+1	0	+1	0	+1	0	0	0
700327	Bridleways, Wendover	1		+2	0	+1	0	+1	0	+1	0	+1	0	0	0

Table 11 Consideration of Receptors above LOAEL at most affected receptor grouping – Wendover Green Tunnel North Portal (Nash Lea)

The predicted L_{max} levels for the No Noise Barrier Option, Noise Barrier Design Option 1, Noise Barrier Design Option 2, Noise Barrier Design Option 3 and Noise Barrier Design Option 4 are presented in Table 12 below.

Locations where operational rail noise levels are predicted to exceed the daytime LOAEL of 57.5dB (free-field) are highlighted in red for ease of reference, including those occurring in the ES case scenario for comparison; with locations where the SOAEL is exceeded (77.5dB Free field) in a darker red where they occur.

ID	Area Represented	No of Impacts Represented	Lmax No Noise Barrier (earthworks only)	Lmax Noise Barrier Design **Option 1** (4m)	Lmax Noise Barrier Design **Option 2** (5m)	Lmax Noise Barrier Design **Option 3** (6m)	Lmax Noise Barrier Design **Option 4** (10m)	Lmax **ES Design**
365001	Lionel Avenue, Wendover	24	55	54	53	51	51	55/58
365130	Aylesbury Road, Wendover	15	51	50	49	48	48	51/54
365216	Aylesbury Road, Wendover	10	52	50	49	49	49	51/54
365280	Aylesbury Road, Wendover	1	56	55	53	52	52	56/59
365348	Aylesbury Road, Wendover	37	50	49	48	48	48	50/52
366563	Lionel Avenue, Wendover	38	53	52	50	49	49	53/56
362513	Dobbins Lane, Wendover	22	58	58	57	56	52	58/61
362638	Thornton Crescent, Wendover	49	62	62	60	59	56	61/64
362785	Bridleways, Wendover	22	63	63	61	60	56	64/66
362860	Dobbins Lane, Wendover	83	58	57	56	55	51	58/61
363661	Dobbins Lane, Wendover	19	59	59	58	56	52	60/63
364087	Orchard Close, Wendover	37	54	54	52	51	50	55/57
364294	The Cedars, Wendover	53	57	56	55	54	51	57/60
366705	Lionel Avenue, Wendover	32	59	58	57	55	53	59/62
700327	Bridleways, Wendover	1	64	63	62	60	56	64/67
	Exceedance of LOAEL							
	Exceedance of SOAEL							

Table 12 LAmax levels for the Mitigation Design Options considered compared to ES -Nash Lee

Table 12 above shows that the No Noise Barrier Option (earthworks only) presents fewer L_{Amax} impacts above LOAEL than the ES case. Noise Barrier Design Options 1 to 3 show an improvement in reducing the number of impacts above LOAEL both over the earthworks design (No Noise Barrier Option) and the ES. Noise Barrier Design Option 4 with a 10m barrier/ retained cutting reduces all L_{max} levels to below LOAEL.

The cost benefit analysis for the L_{max} prediction is presented in Table 13 below. The cost benefit analysis score of 0.01 for Noise Barrier Design Options 1, 2, 3 and 0.00 for Option 4 indicates that the mitigation would not typically be included in the design.

Design Option	Number of Noise Impacts				Estimated additional cost over unmitigated design	Noise to Benefit Cost Ratio
	Above LOAEL (57.5dB(A))	Above SOAEL (77.5LAmax) and more than 20 events per night	Significant Effect above SOAEL	WebTAG Change		
ES Levels	306	N/A	0	N/A	N/A	N/A
No Noise Barrier (earthworks with no noise barrier)	228	0	0	N/A	N/A	N/A
Noise Barrier Design Option 1 (4m)	145	0	0	£7,779	£591,940	0.01
Noise Barrier Design Option 2 (5m)	91	0	0	£11,050	£705,840	0.01
Noise Barrier Design Option 3 (6m)	72	0	0	£11,050	£819,740	0.01
Noise Barrier Design Option 4 (10m)	0	0	0	£11,050	£3,750,000	0.00

Table 13 Cost Benefit Analysis L_{max} Levels – Wendover Green Tunnel North Portal (Nash Lea)

The following section considers each of the Noise Barrier Design Options presented above individually, considering against both L_{Aeq} and L_{Amax} levels.

No Noise Barrier (earthworks design and no additional noise barrier)

The No Noise Barrier Option (earthworks design with no additional acoustic barriers) shows an improvement over the ES with regard to predicted L_{eq} levels, with fewer exceedances of LOAEL than reported in the ES and a general reduction in railway generated noise. **In this Option all reported Leq levels are below LOAEL at all receptor locations**, which accords with the case reported in the ES, and as such the actual acoustic benefit is minimal. The L_{max} impacts above LOAEL for the earthworks design option are fewer than those reported in the ES (228 impacts above LOAEL compared to 306 in the ES case).

The No Noise Barrier earthworks only design has been optimised through the design process to ensure that it provided acoustic mitigation which improved on the acoustic performance offered by the noise screen, of between 1.0m and 6.0m above ToR, specified in the SES.

The No Noise Barrier design option does not include any form of acoustic fencing/barrier and therefore any potential visual impacts within the AONB are removed through design.

Costs associated with a noise fencing/barrier are also removed through removal of the feature in the design.

Noise Barrier Design Option 1 (4m noise barrier)

Noise Barrier Design Option 1 (4m barrier above ToR) shows an improvement over the ES with regard to predicted L_{eq} levels, with a general reduction in railway generated noise. **In this Option all reported Leq levels are below LOAEL at all receptor locations**, which accords with the case reported in the ES, and as such the actual acoustic benefit is minimal. The L_{max} impacts above LOAEL with Noise Barrier Design Option 1 are fewer than those reported in the ES (145 impacts above LOAEL compared to 306 in the ES case).

The low cost to benefit ratio indicates that Noise Barrier Design Option 1 would not typically be considered further as part of the design. The 4m lineside noise barrier will be largely screened by the significant earthwork structures designed into the scheme and therefore the potential visual impacts in the AONB are low.

Given the very slight acoustic benefits as compared to the low cost to benefit ratio, Noise Barrier Design Option 1 is not considered a feasible mitigation option.

Noise Barrier Design Option 2 (5m noise barrier)

Noise Barrier Design Option 2 (5m barrier above ToR) shows a general reduction in railway generated noise. **In this Option all reported Leq levels are below LOAEL at all receptor locations**, which accords with the case reported in the ES, and as such the actual acoustic benefit is minimal. The L_{max} impacts above LOAEL with Noise Barrier Design Option 2 are fewer than those reported in the ES (91 impacts above LOAEL compared to 306 in the ES case).

The low cost to benefit ratio indicates that Noise Barrier Design Option 2 would not typically be part of the design. The 5m noise lineside noise barrier will be partially screened by the significant earthworks design and therefore visual impacts in the AONB are potentially likely from elevated viewpoints.

Given the slight acoustic benefits as compared to the low cost to benefit ratio and the potential for adverse visual impacts, Noise Barrier Design Option 2 is not considered a feasible mitigation option.

Noise Barrier Design Option 3 (6m noise barrier)

Noise Barrier Design Option 3 (6m barrier above ToR) shows a general reduction in railway generated noise. **In this Option all reported Leq levels are below LOAEL at all receptor locations**, which accords with the case reported in the ES, and as such the actual acoustic benefit is minimal. The L_{max} impacts above LOAEL with Noise Barrier Design Option 3 are fewer than those reported in the ES (72 impacts above LOAEL compared to 306 in the ES case).

The low cost to benefit ratio indicates that Noise Barrier Design Option 3 would not typically be part of the design. As a result of the scale of the 6m acoustic fence/barrier the mass, scale and appearance of the fence will lead to materially significant visual effects within the AONB.

Given the slight acoustic benefits, the low cost to benefit ratio with regard to noise, and the potential for significant visual effects, Design Option 3 is not considered a feasible mitigation option.

Noise Barrier Design Option 4 (10m noise barrier)

Noise Barrier Design Option 4 (10m barrier above ToR) shows a general reduction in railway generated noise. **In this Option all reported Leq levels are below LOAEL at all receptor locations**, which accords with the case reported in the ES, and as such the actual acoustic benefit is minimal. The L_{max} impacts above LOAEL with Noise Barrier Design Option 4 are fewer than those reported in the ES, with he option removing all impacts above a LOAEL (0 impacts above LOAEL compared to 306 in the ES case).

The low cost to benefit ratio indicates that Noise Barrier Design Option 4 would not typically be part of the design. With regard to visual effects, the mass, scale and appearance of the 10m noise barrier will lead to significant and unacceptable visual effects within the AONB.

Given the slight acoustic benefits, the low cost to benefit ratio with regard to noise and the unacceptable visual effects, Design Option 4 is not considered a feasible mitigation option.

Recommended Design Option: Wendover Green Tunnel North Portal: Nash Lee (AVDC P4)

In summary, based on the appraisals in Tables 9 and 10 for L_{eq} daytime and night-time, the analysis in Table 11, and the appraisals for L_{max} values presented in Tables 12 and 13; along with consideration of acoustic cost benefits and potential visual effects associated with the noise barrier options, the recommendation is as follows within the Wendover Green Tunnel North Portal: Nash Lee package AVDC P4:

- Acoustic mitigation in the form of noise barriers would **not** be required to the east of the HS2 alignment at the Wendover Green Tunnel north portal.
- The earthworks design option is therefore presented as the recommended option in this area to balance all potential impacts; presented and discussed within this report as the **No Noise Barrier Option.**

- Wendover North Cutting - East (AVDC P4)

The ES assessment indicated that the identified communities would benefit from the noise mitigation arrangement for the Wendover Cutting area as shown in Table 14 (Noise mitigation – Wendover North Cutting to Nash Lee Bypass Overbridge).

Location	Start Chainage	End Chainage	Up/Down Line	Length (m)	Height above ToR (m)	Comments
ES mitigation (AP5) – performance presented in 'Do Something'	055+000	055+800	Up	800		Mitigation ID 055-IN1E Wendover North Cutting provides mitigation for a significant noise effect on the right side (east) of the alignment between Ch 055+000 and 055+800.
	055+000	056+000	Down	1000		Mitigation ID 055-IN2W Wendover North Cutting provides mitigation for a significant noise effect on the left side (west) of the alignment between Ch 055+000 and 056+000.
	055+800	58+950	Up	3150		Mitigation ID 056-NB1E A standard height noise barrier (3m above rail) at the top of the cutting from Ch 55+800 to the realigned Nash Lee Lane overbridge embankment at Ch 58+950 on the right side (east) of the alignment.
	058+570	060+470	Down	1900		Mitigation ID 059-IN1W Aylesbury South Cutting provides noise benefit on the left side (west) of the alignment.
	56+000	56+150	Up	150	3	Mitigation ID 056-NB1E A standard height barrier (3m above rail) at the base of the cutting to a point just short of Stoke Grove AT station on the right side (east) of the alignment.
	56+100	56+370	Up	270	3	Mitigation ID 056-NB1E A 3m high barrier at the top of the cutting adjacent to the access road to the AT station on the right side (east) of the alignment.
	056+000	056+650	Down	650	3	Mitigation ID 056-NB2W A Noise barrier (3m above rail) on the left side (west) of the alignment
No Noise Barrier Option Earthworks only	55+700	56+950	Up	250	10	Wendover North Cutting provides mitigation for a significant noise effect on the east side of the alignment in works in association with the landscape bund.

Location	Start Chainage	End Chainage	Up/Down Line	Length (m)	Height above ToR (m)	Comments
	56+950	56+500	Up	550	-	Wendover North Cutting provides mitigation for a significant noise effect on the east side of the alignment.
	055+100	056+000	Down	900	17.5m crest height	Earthworks bund at Wendover North Cutting. Bund slope 1:8.
	056+000	056+600	Down	600	-	Wendover North Cutting provides mitigation for a significant noise effect on the west side of the alignment.
Noise Barrier Design Option 1	55+840	56+400	Up	560	2	Absorptive barriers 2m above ToR to both the eastern and western sides of the Track.
	55+190	56+400	Down	1210	2	
Noise Barrier Design Option 2	55+840	56+400	Up	560	3	Absorptive barriers 3m above ToR to both the eastern and western sides of the Track.
	55+190	56+400	Down	1210	3	
Noise Barrier Design Option 3	55+840	56+400	Up	560	4	Absorptive barriers 4m above ToR to both the eastern and western sides of the Track.
	55+190	56+400	Down	1210	4	

Table 14 Summary or noise mitigation options – Wendover Embankment

As summarised in Table 14, detailed 3-dimensional noise modelling has been undertaken to individually test each of the following Noise Barrier Design Options within the AVDC P4 Nash Lea Area covering by the Wendover North Cutting work package:

- **No Noise Barrier** case as a baseline including the scheme design earthworks noise bund designs
- **Noise Barrier Design Option 1:** 2m from Ch 55+840 to Ch 56+400 on east side. Line side noise barrier offset at 4.6m from outside rail on both sides of the Track and including the scheme design earthworks noise bund designs
- **Noise Barrier Design Option 2:** 3m barrier from Ch 55+840 to Ch 56+400 on east side. Line side noise barrier offset at 4.6m from outside rail on both sides of the Track and including the scheme design earthworks noise bund designs

- **Noise Barrier Design Option 3:** 4m barrier from Ch 55+840 to Ch 56+400 on east side. Line side noise barrier offset at 4.6m from outside rail on both sides of the Track and including the scheme design earthworks noise bund designs

The noise predictions at each receptor for the ES design and each of the Noise Barrier Design Options 1 to 3 are presented and discussed in the Section below based upon.

- The ES (as amended) prediction Tables include noise predictions for the proposed Scheme (Year 15 flows), the future baseline without Scheme (in the opening year) and the overall Do Something noise level (the Opening baseline + the year 15 flows).
- The Scheme Design Tables include the predictions for the Do Something Scheme Design (the Opening baseline + the year 15 flows) without noise barriers as mitigation and then with the noise barrier options being considered as compared against the ES/ SES Do Something noise level.

A cost benefit analysis has been carried out for the daytime and night-time L_{eq} levels and the results are presented in Table 15. The cost benefit analysis score of 0.01 for Noise Barrier Design Options 1 and 2; and the score of 0.2 for Noise Barrier Design Option 3 indicates that mitigation in the form of noise barriers should not typically be included in the design.

The ES Design, the No Noise Barrier Option (earthworks mitigation only) and Noise Barrier Design Options 1 to 3 all show the same 7 moderate impacts above LOAEL for daytime and night-time.

Design Option	Noise impact and benefit						Estimated additional cost over unmitigated design	Noise to Benefit Cost Ratio
	Impacts above LOAEL			TOTAL IMPACTS (sum of minor - major)		WebTAG Change		
		Day	Night	Day	Night			
ES Levels	Beneficial	0	0	7	7	N/A	N/A	N/A
	Negligible	13	14					
	Minor	0	0					
	Moderate	7	7					
	Major	0	0					
	Total above LOAEL	20	21					
No Noise Barrier (mitigation in form of earthworks)	Beneficial	0	0	7	7	N/A	N/A	N/A
	Negligible	6	13					
	Minor	0	0					
	Moderate	7	7					
	Major	0	0					
		0	0					
Noise Barrier Design Option 1 (2m line side barrier with offset of 4.6m from outside rail)	Beneficial	0	0	7	7	£4,113	£599,760	0.01
	Negligible	6	13					
	Minor	0	0					
	Moderate	7	7					
	Major	0	0					
	Total above LOAEL	0	0					
	Engineering and operational compatibility			Barrier height lower than ES Scheme, no particular challenges to buildability				
	Visual Impacts/ compatibility with HS2 Design Vision			Barrier height lower than ES scheme, therefore accepted visual effects are reduced.				
Noise Barrier Design Option 2 (3m line side barrier with offset of 4.6m from outside rail)	Beneficial	0	0	7	7	£7.908	£787,360	0.01
	Negligible	6	6					
	Minor	0	0					
	Moderate	7	7					
	Major	0	0					
	Total above LOAEL	0	0					
	Engineering and operational compatibility			Barrier height same ES Scheme. No particular challenges to buildability				
	Visual Impacts/ compatibility with HS2 Design Vision			Barrier height same as ES scheme, therefore visual effects neutral.				
Noise Barrier Design Option 3 (4m line side barrier with offset of 4.6m from outside rail)	Beneficial	0	0	7	7	£17,866	£974.960	0.02
	Negligible	6	6					
	Minor	0	0					
	Moderate	7	7					
	Major	0	0					
	Total above LOAEL	0	0					
	Engineering and operational compatibility			Barrier height higher than ES Scheme. No particular challenges to buildability				
	Visual Impacts/ compatibility with HS2 Design Vision			Barrier higher than ES scheme therefore potential for increased visual effects.				

Table 15 Cost Benefit Analysis L_{eq} Daytime and Night-time) – Wendover Cutting Up Side

The predicted noise levels for the ES and the presented Noise Barrier Design Options for the eastern (of the track alignment) receptor locations at the Wendover Cutting are presented in Table 16 below.

Locations where rail noise levels are predicted to exceed the daytime LOAEL of 50dB and night-time LOAEL of 40dB would be highlighted in red. Table 16 indicates that for HS2 rail operational noise levels:

- No Barrier Design Option (earthworks design) and Noise Barrier Design Option 1 (2m barrier) conclude similar impacts relating to rail noise above LOAEL as presented in the ES, with no receptor locations above LOAEL in all cases.
- Noise Barrier Design Options 2 (3m barrier) and Option 3 (4m barrier) present fewer impacts relating to rail noise above LOAEL than either the No Barrier Design Option or Noise Barrier Design Option 1, removing the impacts above LOAEL at night at Receptor ID 355734. However, it is noted that the impacts reported in the ES at Receptor ID 355734 were negligible (noise change less than 3dB) and therefore the removal of these night-time impacts above LOAEL do not represent a material benefit.

ID	Area Represented	No of Impacts Represented	Do Nothing (Opening Year baseline)		ES Design Scheme Noise Only		ES Design Opening Year Baseline +Year 15 Traffic LAeq dB		Proposed Scheme Only No Barrier		No Barrier Opening Year Baseline +Year 15 Traffic LAeq dB		Option 1 Scheme only: - 2m barrier;		Option 1 +Opening Year Baseline +Year 15 Traffic LAeq dB		Option 2 Scheme only: - 3m barrier;		Option 2 +Opening Year Baseline +Year 15 Traffic LAeq dB		Option 3 Scheme only: - 4m barrier;		Option 3 +Opening Year Baseline +Year 15 Traffic LAeq dB	
			Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night
314803	Triangle Business Park, Rabans Lane Industrial (office)	19	54	47	52	43	56	49	50	41	56	48	50	40	55	48	50	40	55	48	50	40	55	48
358148	Wendover Road, Weston Turville	18	54	47	46	37	54	48	44	34	54	47	44	34	54	47	43	34	54	47	43	34	54	47
358410	Wendover Road Stoke Mandeville	2	54	47	45	36	54	48	43	33	54	47	43	33	54	47	43	33	54	47	42	33	54	47
358677	Wendover Road Stoke Mandeville	3	54	47	46	37	54	48	44	34	54	47	44	34	54	47	44	34	54	47	43	34	54	47
358721	Aylesbury Road Wendover	7	73	66	40	32	73	66	38	29	73	66	38	29	73	66	38	28	73	66	38	28	73	66
358776	Nash Lee End, Wendover	1	54	47	41	33	54	47	39	30	54	47	39	30	54	47	39	30	54	47	39	29	54	47
367404	Aylesbury Road Wendover	2	51	43	39	30	51	43	38	28	51	43	38	28	51	43	38	28	51	43	37	28	51	43
314865	Wendover Road, Stoke Mandeville	1	54	47	49	41	55	48	48	39	55	48	48	39	55	48	48	38	55	48	48	38	55	48
355734	Nash Lee Road Wendover	7	54	46	50	41	55	47	50	40	55	47	50	40	55	47	49	40	55	47	48	39	55	47
357199	Nash Lee Lane, Wendover	7	51	46	60	51	60	52	60	51	60	52	58	50	59	52	58	49	59	51	57	48	58	51
357950	Nash Lee End, Wendover (shopping)	1	56	51	49	40	57	51	47	38	57	51	47	38	57	51	47	38	57	51	47	37	57	51
357971	Nash Lee Lane Wendover	6	56	51	55	47	58	51	53	44	58	52	53	44	58	52	53	43	58	52	52	42	57	52
357877	Nash Lee End, Wendover	1	54	46	43	35	55	46	42	33	54	46	42	33	54	46	42	32	54	46	42	32	54	46

Table 16 Comparison of Receptors above LOAEL at the most affected receptor grouping- Wendover Cutting East side

Table 17 below summarises the changes in noise levels due to each of the Noise Barrier Design Options, comparing them with the Do Nothing scenario.

The No Noise Barrier Option, Noise Barrier Design Option 1, Option 2 and Option 3 do not result in the removal of the moderate impacts at Receptor ID 357199, and therefore would not result in the removal of significant effect OSV10-C04 reported in the ES.

ID	Area Represented	No of Impacts Represented	Significant Effect	ES Design		Change in Noise Levels Compared with Do-Nothing Scenario							
				DM - ES Design		DM - No Noise Barrier		DM – Noise Barrier Design Option 1		DM - Noise Barrier Design Option 2		DM - Noise Barrier Design Option 3	
				Day	Night	Day	Night	Day	Night	Day	Night	Day	Night
314803	Triangle Business Park, Rabans Lane Industrial (office)*	19		2	2	2	1	1	1	1	1	1	1
358148	Wendover Road, Weston Turville	18		0	1	0	0	0	0	0	0	0	0
358410	Wendover Road Stoke Mandeville	2		0	1	0	0	0	0	0	0	0	0
358677	Wendover Road Stoke Mandeville	3		0	1	0	0	0	0	0	0	0	0
358721	Aylesbury Road Wendover	7		0	0	0	0	0	0	0	0	0	0
358776	Nash Lee End, Wendover	1		0	0	0	0	0	0	0	0	0	0
367404	Aylesbury Road Wendover	2		0	0	0	0	0	0	0	0	0	0
314865	Wendover Road, Stoke Mandeville	1		1	1	1	1	1	1	1	1	1	1
355734	Nash Lee Road Wendover	7		1	1	1	1	1	1	1	1	1	1
357199	Nash Lee Lane, Wendover	7	OSV10-C04	9	6	9	6	8	6	8	5	7	5
357950	Nash Lee End, Wendover (shopping)*	1		1	0	1	0	1	0	1	0	1	0
357971	Nash Lee Lane Wendover	6		2	0	2	1	2	1	2	1	1	1
357877	Nash Lee End, Wendover	1		1	0	0	0	0	0	0	0	0	0
*	Non-residential												

Table 17 Consideration of Receptors above LOAEL at most affected receptor grouping – Wendover Cutting East side

The predicted L_{max} levels for the No Noise Barrier Option (earthworks only, no additional fencing/barrier provision), Noise Barrier Design Option 1, Option 2 and Option 3 are shown in Table 18 below.

Locations where operational rail noise levels are predicted to exceed the daytime LOAEL of 57.5dB (free-field) are highlighted in red for ease of reference, including those occurring in the ES case scenario for comparison; with locations where the SOAEL is exceeded (77.5dB Free field) in a darker red

ID	Area Represented	No of Impacts Represented	Lmax No Barrier Option	Lmax Design Option 1 (2m)	Lmax Design Option 2 (3m)	Lmax Design Option 3 (4m)	Lmax ES Design
314803	Triangle Business Park, Rabans Lane Industrial (office)*	19	64	64	64	64	64/67
358148	Wendover Road, Weston Turville	18	58	58	58	58	59/62
358410	Wendover Road Stoke Mandeville	2	56	56	56	56	59/62
358677	Wendover Road Stoke Mandeville	3	58	58	58	58	58/61
358721	Aylesbury Road Wendover	7	50	50	50	50	51/54
358776	Nash Lee End, Wendover	1	52	52	52	52	53/56
367404	Aylesbury Road Wendover	2	52	52	52	52	53/56
314865	Wendover Road, Stoke Mandeville	1	62	62	62	62	61/64
355734	Nash Lee Road Wendover	7	62	62	62	62	63/65
357199	Nash Lee Lane, Wendover	7	74	74	74	74	73/76
357950	Nash Lee End, Wendover (shopping)*	1	60	60	60	60	60/62
357971	Nash Lee Lane Wendover	6	67	67	67	67	67/69
357877	Nash Lee End, Wendover	1	55	55	55	55	57/60
*	Non-residential						
	Exceedance of LOAEL						
	Exceedance of SOAEL						

Table 18 LAmax levels for the Mitigation Design Options considered compared to ES - Wendover Cutting Up Side

Table 18 shows that the No Noise Barrier Option, Noise Barrier Design Option 1, Option 2 and Option 3 all present with fewer L_{Amax} impacts above LOAEL than the ES. However, it is demonstrated that Noise Barrier Design Option 1, Option 2 and Option 3 do not show any improvement over the No Noise Barrier Option, or the ES, in the reducing of impacts above LOAEL.

The cost benefit analysis for the L_{max} prediction is presented in Table 19 below. The cost benefit analysis score of 0.02 for Noise Barrier Design Option 1, Design Options 2 and Design Option 3 indicate that the mitigation would not typically be included in the design.

Design Option	Number of Noise Impacts				Estimated additional cost over unmitigated design	Noise to Benefit Cost Ratio
	Above LOAEL (57.5dB(A))	Above SOAEL (77.5LAmax) and more than 20 events per night	Significant Effect above SOAEL	WebTAG Change		
ES Levels	45	N/A	0	N/A	N/A	N/A
Design Option (earthworks with no noise barrier)	42	0	0	N/A	N/A	N/A
Noise Barrier Design Option 1 (2m)	42	0	0	£12,113	£599,760	0.02
Noise Barrier Design Option 2 (3m)	42	0	0	£14,911	£787,360	0.02
Noise Barrier Design Option 3 (4m)	42	0	0	£19,886	£974,960	0.02

Table 19 Cost Benefit Analysis L_{max} Levels – Wendover Cutting (east)

The following section considers each of the Noise Barrier Design Options presented above individually, considering against both L_{Aeq} and L_{Amax} levels.

No Noise Barrier (earthworks design and no additional noise barrier)

The No Noise Barrier Option (earthworks design with no additional acoustic barriers). Table 16 shows a reduction in the Leq noise levels over the levels reported in the ES. **The Design Option shows the same number of moderate impacts above LOAEL as the ES and does not therefore show a material benefit.**

The L_{max} impacts above LOAEL for the earthworks design option are fewer than those reported in the ES (42 impacts above LOAEL compared to 45 in the ES case).

The No Noise Barrier design option does not include any form of acoustic fencing/barrier and therefore any potential visual impacts within the AONB are removed through design.

Costs associated with a noise fencing/barrier are also removed through removal of the feature in the design.

Noise Barrier Design Option 1 (2m noise barrier)

Noise Barrier Design Option 1 (2m barrier above ToR) shows an improvement over the ES with regard to predicted L_{eq} levels, with a general reduction in railway generated noise. **The Design Option does however show the same number of moderate impacts above LOAEL as the ES and does not therefore show a material benefit**.

The L_{max} impacts above LOAEL with Noise Barrier Design Option 1 are fewer than those reported in the ES (42 impacts above LOAEL compared to 45 in the ES case).

Noise Barrier Design Option 1 includes a noise barrier lower than the 3m barrier in the ES and therefore visual effects will also be concluded to be lower.

The Cost to benefit ratio is low indicating that barriers would typically not be part of the design.

Noise Barrier Design Option 2 (3m noise barrier)

Noise Barrier Design Option 2 (3m barrier above ToR) shows an improvement over the ES with regard to predicted L_{eq} levels, with a general reduction in railway generated noise. **The Design Option does however show the same number of moderate impacts above LOAEL as the ES and does not therefore show a material benefit**.

The L_{max} impacts above LOAEL with Noise Barrier Design Option 1 are fewer than those reported in the ES (42 impacts above LOAEL compared to 45 in the ES case).

Noise Barrier Design Option 2 includes a noise barrier the same height as the 3m barrier in the ES and therefore visual effects will be neutral when considered in light of the ES conclusions.

The Cost to benefit ratio is low indicating that barriers would typically not be part of the design.

Noise Barrier Design Option 3 (4m noise barrier)

Noise Barrier Design Option 3 (4m barrier above ToR) shows an improvement over the ES with regard to predicted L_{eq} levels, with a general reduction in railway generated noise. **The Design Option does however show the same number of moderate impacts above LOAEL as the ES and does not therefore show a material benefit**.

The L_{max} impacts above LOAEL with Noise Barrier Design Option 1 are fewer than those reported in the ES (42 impacts above LOAEL compared to 45 in the ES case).

Noise Barrier Design Option 3 includes a noise barrier higher than the 3m barrier in the ES and therefore visual effects will potentially be concluded to be worse than those presented in the ES.

The Cost to benefit ratio is low indicating that barriers would typically not be part of the design.

Recommended Design Option: Wendover North Cutting - East (AVDC P4)

In summary, based on the appraisals in Tables 13 and 14 for L_{eq} daytime and night-time, the analysis in Table 15, and the appraisals for L_{max} values presented in Tables 16 and 17; along with consideration of acoustic cost benefits and potential visual effects associated with the noise barrier options, the recommendation is as follows within the Wendover North Cutting (East); package AVDC P4.

The acoustic performance provided by the earthworks design is due to the design changes to Wendover North Cutting (055-L1), which has changed from 1V:4H at ERD to 1V:2H (55+098–55+636) and 1V:3.5H (55+636–56+730) at Scheme Design, representing a steepening of the cutting slopes. This has the potential to reduce the width of the cutting and reduce the volume of material excavated.

In conclusion for the Wendover North Cutting – East, the following mitigation option is recommended:

- Acoustic mitigation in the form of noise barriers would **not** be required through this section.
- The earthworks design option is therefore presented as the recommended option in this area to balance all potential impacts; presented and discussed within this report as the **No Noise Barrier Option.**

▪ Wendover North Cutting – West (AVDC P4)

The ES assessment indicated that the identified communities would benefit from the noise mitigation arrangement for the Wendover Cutting area as shown in Table 14 (Noise mitigation – Wendover North Cutting to Nash Lee Bypass Overbridge).

As summarised in Table 14, detailed 3-dimensional noise modelling has been undertaken to individually test each of the following Noise Barrier Design Options within the AVDC P4 Nash Lea Area covering by the Wendover North Cutting work package:

- **No Noise Barrier** case as a baseline including the scheme design earthworks noise bund designs
- **Noise Barrier Design Option 1:** 2m from Ch 55+190 to Ch 56+400 on west side. Line side noise barrier offset at 4.6m from outside rail on both sides of the Track and including the scheme design earthworks noise bund designs
- **Noise Barrier Design Option 2:** 3m barrier from Ch 55+190 to Ch 56+400 on west side. Line side noise barrier offset at 4.6m from outside rail on both sides of the Track and including the scheme design earthworks noise bund designs
- **Noise Barrier Design Option 3:** 4m barrier from Ch 55+190 to Ch 56+400 on west side. Line side noise barrier offset at 4.6m from outside rail on both sides of the Track and including the scheme design earthworks noise bund designs

The noise predictions at each receptor for the ES design and each of the Noise Barrier Design Options 1 to 3 are presented and discussed in the Section below based upon.

- The ES (as amended) prediction Tables include noise predictions for the proposed Scheme (Year 15 flows), the future baseline without Scheme (in the opening year) and the overall Do Something noise level (the Opening baseline + the year 15 flows).
- The Scheme Design Tables include the predictions for the Do Something Scheme Design (the Opening baseline + the year 15 flows) without noise barriers as mitigation and then with the noise barrier options being considered as compared against the ES/ SES Do Something noise level.

A cost benefit analysis has been carried out for the daytime and night-time L_{eq} levels and the results are presented in Table 20. The cost benefit analysis score of 0.00 for Noise Barrier Design Options 1, 2 and 3 indicates that mitigation in the form of noise barriers should not typically be included in the design.

The No Noise Barrier Option (earthworks mitigation only) and Noise Barrier Design Options 1 to 3 all show 5 fewer moderate impacts above LOAEL for night-time than the ES, which is concluded to be a material benefit.

Design Option	Noise impact and benefit						Estimated additional cost over unmitigated design	Noise to Benefit Cost Ratio
	Impacts above LOAEL			TOTAL IMPACTS (sum of minor - major)		WebTAG Change		
		Day	Night	Day	Night			
ES Levels	Beneficial	0	0	7	8	N/A	N/A	N/A
	Negligible	15	14					
	Minor	7	3					
	Moderate	0	5					
	Major	0	0					
	Total above LOAEL	22	22					
No Noise Barrier (mitigation in form of earthworks)	Beneficial	0	0	7	7	N/A	N/A	N/A
	Negligible	1	7					
	Minor	7	7					
	Moderate	0	0					
	Major	0	0					
		8	14					
Noise Barrier Design Option 1 (2m line side barrier with offset of 4.6m from outside rail)	Beneficial	0	0	5	5	£7.886	£1,295,910	0.00
	Negligible	3	3					
	Minor	5	5					
	Moderate	0	0					
	Major	0	0					
	Total above LOAEL	8	8					
	Engineering and operational compatibility			No particular challenges to buildability				
	Visual Impacts/ compatibility with HS2 Design Vision			Barrier height lower than ES scheme, therefore visual effects are lower.				
Noise Barrier Design Option 2 (3m line side barrier with offset of 4.6m from outside rail)	Beneficial	0	0	5	5	£8,160	£1,701,260	0.00
	Negligible	3	3					
	Minor	5	5					
	Moderate	0	0					
	Major	0	0					
	Total above LOAEL	8	8					
	Engineering and operational compatibility			No particular challenges to buildability				
	Visual Impacts/ compatibility with HS2 Design Vision			Barrier height in line with ES scheme, therefore visual effects neutral				
Noise Barrier Design Option 3 (4m line side barrier with offset of 4.6m from outside rail)	Beneficial	0	0	5	5	£8,743	£2,106,.610	0.00
	Negligible	3	3					
	Minor	5	5					
	Moderate	0	0					
	Major	0	0					
	Total above LOAEL	8	8					
	Engineering and operational compatibility			No particular challenges to buildability				
	Visual Impacts/ compatibility with HS2 Design Vision			Barrier height higher than ES scheme, therefore visual effects are increased.				

Table 20 Cost Benefit Analysis L_{eq} Daytime and Night-time) – Wendover Cutting Down Side

The predicted noise levels for the ES and the Noise Barrier Design Options for the western (of the track alignment) receptor locations at the Wendover Cutting are presented in Table 21 below.

Locations where rail noise levels are predicted to exceed the daytime LOAEL of 50dB and night-time LOAEL of 40dB would be highlighted in red. Table 21 indicates that for HS2 rail operational noise levels,

- No Barrier Design Option (earthworks design) shows similar impacts above LOAEL than presented in the ES, with both situations presenting no receptor locations above LOAEL. As shown in Table 20 and Table 22, the exceedance of LOAEL at ID 314652 and ID 314704 results in a minor noise change as opposed to a moderate change in the ES. This results in the removal of 5 moderate impacts above LOAEL and is a material benefit.
- Noise Barrier Design Option 1 (2m barrier), Option 2 (3m barrier) and Option 3 (4m barrier) all present fewer impacts above LOAEL than the No Barrier Design Option, but as shown in Table 20, the reduced impacts above LOAEL do not represent a material benefit.

ID	Area Represented	No of Impacts Represented	Do Nothing (Opening Year baseline)		ES Design Scheme Noise Only		ES Design Opening Year Baseline +Year 15 Traffic LAeq dB		Proposed Scheme Only No Barrier		No Barrier Opening Year Baseline +Year 15 Traffic LAeq dB		Option 1 Scheme only: - 2m barrier;		Option 1 +Opening Year Baseline +Year 15 Traffic LAeq dB		Option 2 Scheme only: - 3m barrier;		Option 2 +Opening Year Baseline +Year 15 Traffic LAeq dB		Option 3 Scheme only: - 4m barrier;		Option 3 +Opening Year Baseline +Year 15 Traffic LAeq dB	
			Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night
314444	Nash Lee Road, Terrick	13	56	45	48	39	56	46	45	35	56	46	44	35	56	45	44	35	56	45	44	34	56	45
312509	Nash Lee Road, Terrick	5	56	45	48	39	56	46	45	36	56	46	45	35	56	46	45	35	56	45	45	35	56	45
314652	Nash Lee Road, Terrick	1	57	46	59	50	61	51	57	48	60	50	57	47	60	50	57	47	60	50	56	47	60	50
314668	Nash Lee Road, Terrick	1	57	46	58	50	58	50	58	45	58	48	58	45	58	48	58	45	58	48	57	45	58	47
314704	Nash Lee Road, Terrick	4	57	46	60	51	61	51	59	50	60	50	59	50	60	50	59	49	60	50	58	49	60	49
357730	Ellesborough Road, Wendover	4	49	43	45	36	50	44	43	34	50	43	43	34	50	44	43	34	50	44	43	34	50	44
357663	Ellesborough Road, Wendover	1	49	43	45	36	50	43	41	32	50	43	41	32	50	43	41	32	50	43	41	32	50	43
314625	Nash Lee Farm, Nash Lee	6	56	45	52	43	57	47	49	40	57	46	49	40	57	46	49	39	57	46	49	39	57	46
312509	Nash Lee Road, Terrick	5	56	45	48	39	56	46	45	36	56	46	45	35	56	46	45	35	56	45	45	35	56	45
313421	Risborough Road, Stoke Mandeville	2	54	45	56	47	58	49	54	47	57	48	53	43	56	47	53	43	56	47	52	43	56	47
313337	Risborough Road, Stoke Mandeville	8	54	45	51	42	55	47	49	39	55	46	48	38	55	46	47	38	55	46	47	38	55	46

Table 21 Comparison of Receptors above LOAEL at the most affected receptor grouping- Wendover Cutting Down Side

Table 22 below summarises the changes in noise levels due to each of the Noise Barrier Design Options, comparing them with the Do Nothing scenario.

The No Noise Barrier Option, Noise Barrier Design Option 1, Option 2 and Option 3 all reduce the significant effect OSV10-C04 reported in the ES by removing the minor night-time effect at Receptor ID 314668; and also reduces the moderate effects reported in the ES at receptor ID 314652 and ID 314704 to minor impacts. The reduction in 5 moderate impacts represents a material benefit.

ID	Area Represented	No of Impacts Represented	Significant Effect	ES Design		Change in Noise Levels Compared with Do-Nothing Scenario							
				DM - ES Design		DM - No Barrier		DM - 2m Barrier		DM - 3m Barrier		DM - 4m Barrier	
				Day	Night	Day	Night	Day	Night	Day	Night	Day	Night
314444	Nash Lee Road, Terrick	13		1	1	0	1	0	0	0	0	0	0
312509	Nash Lee Road, Terrick	5		1	1	0	1	0	1	0	0	0	0
314652	Nash Lee Road, Terrick	1	OSV10-C04	4	5	3	4	3	4	3	4	3	4
314668	Nash Lee Road, Terrick	1	OSV10-C04	1	3	1	2	1	2	1	2	1	1
314704	Nash Lee Road, Terrick	4	OSV10-C04	4	5	3	4	3	4	3	4	3	3
357730	Ellesborough Road, Wendover	4		1	1	1	0	1	1	1	1	1	1
357663	Ellesborough Road, Wendover	1		1	0	1	0	1	0	1	0	1	0
314625	Nash Lee Farm, Nash Lee	6		2	2	1	1	1	1	1	1	1	1
312509	Nash Lee Road, Terrick	5		1	1	0	1	0	1	0	0	0	0
313421	Risborough Road, Stoke Mandeville	2	OSV11-C01	4	4	3	3	2	2	2	2	2	2
313337	Risborough Road, Stoke Mandeville	8		2	2	1	1	1	1	1	1	1	1

Table 22 Consideration of Receptors above LOAEL at most affected receptor grouping – Wendover Cutting west

The predicted L_{max} levels for the No Noise Barrier Option (earthworks only, no additional fencing/barrier provision), Noise Barrier Design Option 1, Option 2 and Option 3 are shown in Table 23 below.

Locations where operational rail noise levels are predicted to exceed the daytime LOAEL of 57.5dB (free-field) are highlighted in red for ease of reference, including those occurring in the ES case scenario for comparison; with locations where the SOAEL is exceeded (77.5dB Free field) in a darker red

ID	Area Represented	No of Impacts Represented	Lmax No Barrier Option	Lmax Design Option 1 (2m)	Lmax Design Option 2 (3m)	Lmax Design Option 3 (4m)	Lmax ES Design
314444	Nash Lee Road, Terrick	13	60	59	59	59	61/64
312509	Nash Lee Road, Terrick	5	60	60	60	60	63/66
314652	Nash Lee Road, Terrick	1	71	71	71	71	65/70
314668	Nash Lee Road, Terrick	1	66	65	65	65	65/68
314704	Nash Lee Road, Terrick	4	70	70	70	70	70/73
357730	Ellesborough Road, Wendover	4	56	56	56	56	55/58
357663	Ellesborough Road, Wendover	1	54	54	54	54	55/58
314625	Nash Lee Farm, Nash Lee	6	65	65	65	65	65/68
312509	Nash Lee Road, Terrick	5	60	60	60	60	63/66
313421	Risborough Road, Stoke Mandeville	2	68	67	67	67	70/73
313337	Risborough Road, Stoke Mandeville	8	63	62	62	62	61/64
	Exceedance of LOAEL						
	Exceedance of SOAEL						

Table 23 LAmax levels for the Mitigation Design Options considered compared to ES -Wendover Cutting East

Table 23 shows that the No Noise Barrier Option, Noise Barrier Design Option 1, Option 2 and Option 3 all present with fewer L_{Amax} impacts above LOAEL than the ES. However, it is demonstrated that Noise Barrier Design Option 1, Option 2 and Option 3 do not show any improvement over the No Noise Barrier Option in the reducing of impacts above LOAEL.

The cost benefit analysis for the L_{max} prediction is presented in Table 24 below. The cost benefit analysis score of 0.00 for all presented Options, including the No Noise Barrier Option indicates that the mitigation would not typically be included in the design.

Design Option	Number of Noise Impacts				Estimated additional cost over unmitigated design	Noise to Benefit Cost Ratio
	Above LOAEL (57.5dB(A))	Above SOAEL (77.5 LAmax) and more than 20 events per night	Significant Effect above SOAEL	WebTAG Change		
ES Levels	50	N/A	0	N/A	N/A	N/A
Design Option (earthworks with no noise barrier)	45	0	0	N/A	N/A	N/A
Noise Barrier Design Option 1 (2m)	45	0	0	£8,741	£1,295,910	0.00
Noise Barrier Design Option 2 (3m)	45	0	0	£9,160	£1,701,260	0.00
Noise Barrier Design Option 3 (4m)	45	0	0	£9,374	£2,106,610	0.00

Table 24 Cost Benefit Analysis L_{max} Levels – Wendover Green Tunnel North Portal (Up Side)

The following section considers each of the Noise Barrier Design Options presented above individually, considering against both L_{Aeq} and L_{Amax} levels.

No Noise Barrier (earthworks design and no additional noise barrier)

The No Noise Barrier Option (earthworks design with no additional acoustic barriers) shows an improvement over the ES with regard to predicted L_{eq} levels, with fewer exceedances of LOAEL than reported in the ES and a general reduction in railway generated noise. **The Design Option removes 5 moderate impacts above LOAEL reported in the ES and therefore shows a material benefit.**

The L_{max} impacts above LOAEL for the earthworks design option are fewer than those reported in the ES (45 impacts above LOAEL compared to 50 in the ES case).

The No Noise Barrier design option does not include any form of acoustic fencing/barrier and therefore any potential visual impacts within the AONB are removed through design.

Costs associated with a noise fencing/barrier are also removed through removal of the feature in the design.

Noise Barrier Design Option 1 (2m noise barrier)

The Noise Barrier Design Option 1 (including earthworks design) shows an improvement over the ES with regard to predicted L_{eq} levels, with fewer exceedances of LOAEL than reported in the ES and a general reduction in railway generated noise. **Noise Barrier Design Option 1 removes 5 moderate impacts above LOAEL reported in the ES and therefore shows a material benefit.** However, Noise Barrier Design Option 1 does not show any material acoustic benefit over the No Noise Barrier Option (earthworks design).

The L_{max} impacts above LOAEL for the earthworks design option are fewer than those reported in the ES (45 impacts above LOAEL compared to 50 in the ES case).

Noise Barrier Design Option 1 includes a noise barrier which was not included as part of the design presented in the ES, and therefore there is a potential for new visual effects within the area.

The cost to benefit ratio is low indicating that barriers would typically not be part of the design.

Noise Barrier Design Option 2 (3m noise barrier)

The Noise Barrier Design Option 2 (including earthworks design) shows an improvement over the ES with regard to predicted L_{eq} levels, with fewer exceedances of LOAEL than reported in the ES and a general reduction in railway generated noise. **Noise Barrier Design Option 2 removes 5 moderate impacts above LOAEL reported in the ES and therefore shows a material benefit.** However, Noise Barrier Design Option 2 does not show any material acoustic benefit over the No Noise Barrier Option (earthworks design).

The L_{max} impacts above LOAEL for the earthworks design option are fewer than those reported in the ES (45 impacts above LOAEL compared to 50 in the ES case).

Noise Barrier Design Option 2 includes a noise barrier which was not included as part of the design presented in the ES, and therefore there is a potential for new visual effects within the area.

The cost to benefit ratio is low indicating that barriers would typically not be part of the design.

Noise Barrier Design Option 3 (4m noise barrier)

The Noise Barrier Design Option 3 (including earthworks design) shows an improvement over the ES with regard to predicted L_{eq} levels, with fewer exceedances of LOAEL than reported in the ES and a general reduction in railway generated noise. **Noise Barrier Design Option 3 removes 5 moderate impacts above LOAEL reported in the ES and therefore shows a material benefit.** However, Noise Barrier Design Option 3 does not show any material acoustic benefit over the No Noise Barrier Option (earthworks design).

The L_{max} impacts above LOAEL for the earthworks design option are fewer than those reported in the ES (45 impacts above LOAEL compared to 50 in the ES case).

Noise Barrier Design Option 3 includes a noise barrier which was not included as part of the design presented in the ES, and therefore there is a potential for new visual effects within the area.

The cost to benefit ratio is low indicating that barriers would typically not be part of the design.

Recommended Design Option: Wendover North Cutting - West (AVDC P4)

In summary, based on the appraisals in Tables 18 and 19 for L_{eq} daytime and night-time, the analysis in Table 20, and the appraisals for L_{max} values presented in Tables 21 and 22; along with consideration of acoustic cost benefits and potential visual effects associated with the noise barrier options, the recommendation is as follows within the Wendover North Cutting (West); package AVDC P4.

The acoustic performance provided by the earthworks design is due to the design changes to Wendover North Cutting (055-L1), which has changed from 1V:4H at ERD to 1V:2H (55+098–55+636) and 1V:3.5H (55+636–56+730) at Scheme Design, representing a steepening of the cutting slopes. This has the potential to reduce the width of the cutting and reduce the volume of material excavated.

In conclusion for the Wendover North Cutting – West, the following mitigation option is recommended:

- Acoustic mitigation in the form of noise barriers would **not** be required through this section.
- The earthworks design option is therefore presented as the recommended option in this area to balance all potential impacts; presented and discussed within this report as the **No Noise Barrier Option.**

3.2 Wendover North Cutting to Stoke Mandeville Bypass Overbridge (AVDC P5)

The mitigation options have been assessed against the findings of the “London-West Midlands Environmental Statement, Volume 5 Map books Sound, noise and vibration (Part 2 of 4) November 2013” is shown on Image 1 (CFA11).

The assessment area is as presented in Table 25 and in Section 4.2.1 (Wendover North Cutting to Stoke Mandeville Bypass Overbridge Up Side) and Section 4.2.2. (Wendover North Cutting to Stoke Mandeville Bypass Overbridge Down Side).

3.2.1 Wendover North Cutting to Stoke Mandeville – East of HS2 Trace (East)

The ES assessment indicated that the identified communities would benefit from the noise mitigation scheme as presented in Table 25 (Noise mitigation – Wendover north Cutting to Stoke Mandeville Bypass Overbridge).

The mitigation options set out in Table 25 and as assessed in the sections below include the Undertakings and Assurances described in Table 2.

Scenario	Start Chainage	End Chainage	Up/Down Line	Length (m)	Height above ToR (m)	Comments
ES mitigation (AP5) – performance presented in 'Do Something'	058+570	060+470	Down	1900		Mitigation ID 059-IN1W Aylesbury South Cutting provides noise benefit on the left side (west) of the alignment
	057+340	057+690	Up	350	3	Mitigation ID 057-NB2E Noise barrier (3m above rail) on the right side (east) of the alignment
	057+690	058+650	Down	960	4	Mitigation ID 058-NB1W Noise barrier (4m above rail) on the left side (west) of the alignment
	057+690	058+650	Up	960	4	Mitigation ID 058-NB2E Noise barrier (4m above rail) on the right side (east) of the alignment
	58+000		Down	600	2	Mitigation ID AP2 -M1W earth bund for a length of 600m tying into noise fence barrier ref.: AP2-NB1W. The bunds will extend to 2m in height above the road level of the bypass on the right side (east) of the alignment.
	58+000		Down	70	2	Mitigation ID AP2-NB1W The permanent provision of a noise fence barrier for a length of 70m tying into noise bund ref.: AP2-M2W. The noise barrier will extend to 2m in height above the road level of the bypass on the left side (west) of the alignment.
Scheme design bund provision	58+100	58+400	Up	300	3	Landscape bund on the Up side with 1:4 slopes on the right side (east) of the alignment.
Undertakings and assurances	57+500	58+500	Up and Down	1000	4	U&A ID 2434 (see Table 2) on the right side (east) and left side (west) of the alignment.
	57+800	59+100	Up	1300	4	U&A ID 2483 (see Table 2) on the right side (east) of the alignment.
Noise Barrier	57+400	59+100	Up	950	3	Absorptive barrier 3m above ToR

Scenario	Start Chainage	End Chainage	Up/Down Line	Length (m)	Height above ToR (m)	Comments
Design Option 1	57+380	58+500	Down	970	3	on the right side (east) of the alignment.
Noise Barrier Design Option 2	57+400	59+100	Up	950	4	Absorptive barrier 4m above ToR on the right side (east) and left side (west) of the alignment.
	57+380	58+500	Down	970	4	
Noise Barrier Option 3	57+400	59+100	Up	950	5	Absorptive barrier 5m above ToR on the right side (east) and left side (west) of the alignment.
	57+380	58+500	Down	970	5	

Table 25 Summary or noise mitigation options – Wendover North Cutting to Stoke Mandeville Bypass Overbridge

As summarised in Table 25, detailed 3-dimensional noise modelling has been undertaken to individually test each of the following Noise Barrier Design Options within the Wendover North Cutting to Stoke Mandeville Bypass Overbridge (AVDC P5 Area):

- **No Noise Barrier** case as a baseline including the scheme design earthworks noise bund designs.
- **Noise Barrier Design Option 1:** 3m absorptive noise barrier with offset of 4.6m from outside rail, except at Stoke Mandeville maintenance loop (see Image 3)
- **Noise Barrier Design Option 2:** 4m absorptive noise barrier with offset of 4.6m from outside rail, except at Stoke Mandeville maintenance loop (see Image 3)
- **Noise Barrier Design Option 3:** 5m absorptive noise barrier with offset of 4.6m from outside rail, except at Stoke Mandeville maintenance loop (see Image 3)

The noise predictions at each receptor for the ES design and each of the Noise Barrier Design Options 1 to 4 are presented and discussed in the Section below based upon.

- The ES (as amended) prediction Tables include noise predictions for the proposed Scheme (Year 15 flows), the future baseline without Scheme (in the opening year) and the overall Do Something noise level (the Opening baseline + the year 15 flows).
- The Scheme Design Tables include the predictions for the Do Something Scheme Design (the Opening baseline + the year 15 flows) without noise barriers as mitigation and then with the noise barrier options being considered as compared against the ES/ SES Do Something noise level.

A cost benefit analysis has been carried out for each option for the daytime and night-time L_{eq} levels and the results are presented in Table 26. The cost benefit analysis score of 0.04 for Noise Barrier Design Option 1 and 0.05 for Noise Barrier Design Options 2 and 3 indicates that mitigation in the form of noise barriers should not typically be included in the design.

The No Noise Barrier Option (mitigation in the form of earthworks only) shows significantly more moderate impacts for daytime and night-time as compared to the ES, presenting an adverse material change. This indicates that mitigation in the form of noise barriers is required.

- Mitigation Option 1 (3m noise barrier) shows 1 less major impact than the ES and more moderate e impact than the ES. Option 1 shows a worsening of the significant effect reported in the ES.
- Mitigation Design Option 2 (4m barrier) provides for a material benefit over the ES Design, removing the major impact for daytime reported in the ES, and reduces the 17 moderate daytime impacts reported in the ES to 3 moderate impact and the 72 moderate impacts at night to 1 moderate impact.
- Mitigation Design Option 3 (5m barrier) provides for a material benefit over the ES Design, removing the major impact for daytime reported in the ES, and reduces the 17 moderate daytime impacts reported in the ES to 3 moderate impact and the 72 moderate impacts at night to 1 moderate impact. Option 3 reduces the 97 minor daytime impacts shown for Option 2 to 88 impacts, but this is considered to be of slight acoustic benefit over Option 2; Option 2 still shows a material benefit over the ES.

Design Option	Noise impact and benefit					Estimated additional cost over unmitigated design	Noise to Benefit Cost Ratio
	Impacts above LOAEL			TOTAL IMPACTS (sum of minor - major)		WebTAG Change		
		Day	Night	Day	Night			
ES Levels	Beneficial	17	33	83	127	N/A	N/A	N/A
	Negligible	75	94					
	Minor	65	55					
	Moderate	17	72					
	Major	1	0					
	Total above LOAEL	175	254					
No Noise Barrier (mitigation in form of earthworks)	Beneficial	22	22	184	172	N/A	N/A	N/A
	Negligible	68	96					
	Minor	60	142					
	Moderate	123	29					
	Major	1	1					
		274	290					
Noise Barrier Design Option 1 (3m barrier)	Beneficial	24	24	181	161	£144,545	£3,360,900	0.04
	Negligible	57	114					
	Minor	76	160					
	Moderate	104	1					
	Major	1	0					
	Total above LOAEL	262	299					
	Engineering and operational compatibility			Barrier height lower than ES Scheme, no particular challenges to buildability				
	Visual Impacts/ compatibility with HS2 Design Vision			Barrier height lower than ES scheme, therefore visual effects are reduced.				
Noise Barrier Design Option 2 (4m barrier). Meets U&A requirement for 4m barrier (see Table 2)	Beneficial	24	33	100	72	£200,508	£4,173,500	0.05
	Negligible	67	193					
	Minor	97	71					
	Moderate	3	1					
	Major	0	0					
	Total above LOAEL	191	298					
	Engineering and operational compatibility			Barrier height generally aligned with ES Scheme, more panels and larger foundations required but does not present any particular engineering challenges				
	Visual Impacts/ compatibility with HS2 Design Vision			Barrier height generally aligned or higher than ES scheme, therefore visual effects neutral. Barrier height in line with requirement of U&A.				
Noise Barrier Design Option 3 (5m barrier)	Beneficial	24	33	91	72	£237,755	£4,986,100	0.05
	Negligible	67	123					
	Minor	88	71					
	Moderate	3	1					
	Major	0	0					
	Total above LOAEL	182	228					
	Engineering and operational compatibility			Barrier height higher than ES Scheme, more panels and larger foundations required but does not present any particular engineering challenges				
	Visual Impacts/ compatibility with HS2 Design Vision			Barrier higher than ES scheme, therefore visual effects are greater.				

Table 26 Cost Benefit Analysis L_{eq} Daytime and Night-time) – Wendover North Cutting to Stoke Mandeville Bypass Overbridge

The predicted noise levels for the ES and each of the Noise Barrier Design Options at the eastern receptor locations in Stoke Mandeville are presented in Table 27 below. Table 27 includes HS2 operational rail noise and noise from the altered Princes Risborough to Aylesbury line, along with noise associated with the Stoke Mandeville Bypass. Airborne noise from altered roads has been assessed in accordance with the methodology set out in the Calculation of Road Traffic Noise (CRTN) and the updated procedure in the Design Manual for Roads and Bridges (DMRB) HD213-11 Rev1.

Locations where operational noise levels are predicted to exceed the daytime LOAEL of 50dB and night-time LOAEL of 40dB would be highlighted in red. **Table 27 indicates that for HS2 rail operation noise levels, all Design Options show fewer receptor locations above LOAEL than was the case in the ES.**

ID	Area Represented	No of Impacts Represented	Do Nothing (Opening Year baseline)		ES Design Scheme Noise Only		ES Design Opening Year Baseline +Year 15 Traffic LAeq dB		Baseline Design Proposed Scheme HS2 + PRA Rail Only No Barrier		Baseline Design Proposed Scheme Total Noise No Barrier		No Barrier Opening Year Baseline +Year 15 Traffic LAeq dB		Option 1 Scheme HS2 + PRA only: - 3m barrier;		Option 1 - Proposed Scheme Total Noise 3m Barrier		Option 1 - 3m Barrier Opening Year Baseline +Year 15 Traffic LAeq dB		Option 2 Scheme HS2 + PRA only: - 4m barrier;		Option 2 - Proposed Scheme Total Noise 4m Barrier		Option 2 - 4m Barrier Opening Year Baseline +Year 15 Traffic LAeq dB		Option 3 Scheme HS2 + PRA only: - 5m barrier;		Option 3 - Proposed Scheme Total Noise 5m Barrier		Option 3 - 5m Barrier Opening Year Baseline +Year 15 Traffic LAeq dB	
			Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night
314803	Triangle Business Park,	19	54	47	52	43	56	49	50	41	50	41	56	48	50	41	50	41	56	48	50	40	50	41	56	48	50	40	50	41	55	48
317201	Station Road, Stoke Mandeville, (Office)	24	50	44	49	41	50	44	45	36	49	41	52	46	44	35	48	41	52	46	44	34	48	40	52	46	43	34	48	40	52	46
338898	Lower Road, Stoke Mandeville	14	50	41	52	44	54	45	46	37	51	43	54	45	46	37	51	43	54	45	46	37	51	43	54	45	46	36	51	43	54	45
338936	Lower Road, Stoke Mandeville	2	50	41	50	41	50	41	45	36	52	42	52	42	45	36	52	42	52	42	45	36	52	42	52	42	45	36	52	42	52	42
339059	Lower Road, Stoke Mandeville	1	54	50	58	50	59	53	50	41	57	49	59	53	50	41	57	49	59	53	50	41	57	49	59	53	50	41	57	49	59	53
341103	Lower Road, Aylesbury	1	50	41	50	41	50	41	42	32	51	42	53	43	42	32	51	42	52	42	42	32	51	42	51	41	42	32	51	42	51	41
341163	Lower Road, Stoke Mandeville	12	50	41	49	40	49	40	44	34	50	42	51	43	44	34	50	42	51	42	44	34	50	42	50	42	44	34	50	42	50	42
343499	Risborough Road, Stoke Mandeville	9	53	47	54	45	56	49	59	49	59	50	60	52	54	45	55	46	57	49	52	43	53	44	56	49	51	41	52	43	55	48
343533	Risborough Road, Stoke Mandeville	9	53	47	51	42	51	42	55	45	55	46	55	46	51	42	52	43	52	44	50	40	51	42	51	43	48	39	50	41	51	43
343823	Risborough Road, Stoke Mandeville	7	63	55	49	41	49	41	52	43	54	45	54	46	50	40	53	44	53	45	48	39	52	44	52	45	47	38	52	43	52	44
343866	Risborough Road, Stoke Mandeville	6	69	61	52	43	67	59	52	43	54	45	67	59	51	41	53	44	67	59	50	40	52	44	67	59	49	39	52	43	67	59
343943	Risborough Road, Stoke	5	66	59	49	40	62	55	50	40	52	44	62	55	48	39	51	43	62	55	47	37	50	43	62	55	46	36	50	42	62	55
343993	Chalgrove End, Stoke Mandeville	37	50	44	42	34	50	45	42	33	43	34	51	44	41	32	42	34	51	44	40	31	41	33	51	44	39	30	41	33	50	44
344788	Station Road, Stoke Mandeville	16	50	44	43	35	50	44	43	33	44	36	51	45	42	32	44	35	51	45	41	31	43	35	51	45	40	31	43	35	51	44
344841	Eskdale Road, Stoke Mandeville	19	50	44	44	36	51	45	42	33	44	36	51	45	41	32	43	36	51	45	40	31	43	35	51	45	39	30	43	35	51	45
345007	Eskdale Road, Stoke Mandeville	14	50	44	47	39	50	44	43	34	47	39	52	45	42	33	47	39	52	45	42	32	47	39	52	45	41	32	47	39	52	45
345164	Irvine Drive, Stoke Mandeville	18	50	44	47	39	51	44	44	35	47	39	52	45	43	34	47	39	52	45	42	33	46	39	52	45	42	33	46	39	51	45
345301	Risborough Road, Stoke Mandeville	10	59	50	51	43	51	43	48	39	53	45	53	45	47	37	53	44	53	44	46	36	53	44	53	44	45	35	52	44	52	44
345481	Lower Road Stoke Mandeville	15	61	54	57	50	58	51	47	38	58	50	59	52	46	37	58	50	59	52	45	36	58	50	59	52	45	35	58	50	59	52
345824	Lower Road, Stoke Mandeville	7	51	42	52	43	54	45	48	39	51	43	54	46	47	38	51	43	54	45	47	38	51	43	54	45	47	38	51	43	54	45
313799	Risborough Road, Stoke Mandeville	1	50	44	60	51	60	51	64	55	64	55	64	55	59	50	59	50	60	51	57	48	58	48	58	50	56	46	56	47	57	49
313866	Risborough Road, Stoke Mandeville	2	64	55	60	51	60	51	64	55	64	55	64	55	58	49	59	50	61	52	56	47	57	48	61	51	54	45	56	47	61	51
312462	Risborough Road, Stoke Mandeville	2	58	49	59	50	59	50	65	55	65	56	65	56	59	49	59	50	59	50	57	47	57	48	58	49	55	45	56	47	57	48
338807	Marsh Lane, Stoke Mandeville	1	55	51	62	53	63	55	57	48	58	49	60	53	57	48	58	49	60	53	57	48	58	49	60	53	57	48	58	49	60	53
338869	Marsh Lane, Stoke Mandeville	2	55	51	59	50	60	54	54	45	55	46	58	52	54	45	55	46	58	52	54	45	55	46	58	52	54	45	55	46	58	52
343650	Yew Tree Close, Stoke Mandeville	8	49	44	51	43	51	43	54	44	54	45	54	45	51	41	52	43	52	43	49	40	51	43	51	43	49	39	50	42	51	42
343762	Chestnut Way, Stoke Mandeville	13	49	44	55	46	55	47	54	45	55	46	56	48	51	42	52	44	54	47	50	41	52	43	53	47	49	40	51	42	53	47

ID	Area Represented	No of Impacts Represented	Do Nothing (Opening Year baseline)		ES Design Scheme Noise Only		ES Design Opening Year Baseline +Year 15 Traffic LAeq dB		Baseline Design Proposed Scheme HS2 + PRA Rail Only No Barrier		Baseline Design Proposed Scheme Total Noise No Barrier		No Barrier Opening Year Baseline +Year 15 Traffic LAeq dB		Option 1 Scheme HS2 + PRA only: - 3m barrier;		Option 1 - Proposed Scheme Total Noise 3m Barrier		Option 1 - 3m Barrier Opening Year Baseline +Year 15 Traffic LAeq dB		Option 2 Scheme HS2 + PRA only: - 4m barrier;		Option 2 - Proposed Scheme Total Noise 4m Barrier		Option 2 - 4m Barrier Opening Year Baseline +Year 15 Traffic LAeq dB		Option 3 Scheme HS2 + PRA only: - 5m barrier;		Option 3 - Proposed Scheme Total Noise 5m Barrier		Option 3 - 5m Barrier Opening Year Baseline +Year 15 Traffic LAeq dB	
			Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night
345404	Lower Road, Stoke Mandeville	17	51	42	53	44	55	46	50	41	52	43	54	46	49	40	51	43	54	45	49	39	51	42	54	45	49	39	51	42	54	45
345540	St. Mary's Church, Lower Road (Church)	1	66	59	61	53	62	56	47	38	62	54	64	56	46	37	62	54	63	56	46	36	62	54	63	56	45	36	62	54	63	56
345557	Stoke Mandeville Combined School (School)	1	53	48	51	42	56	49	50	41	52	43	55	49	49	40	51	43	55	49	49	39	51	43	55	49	48	39	51	42	55	49
345593	Marsh Lane, Stoke Mandeville	1	55	50	53	45	57	51	53	43	54	45	58	51	51	42	53	44	57	51	51	41	52	44	57	51	50	41	52	44	57	51
345752	Chapel Lane, Stoke Mandeville	18	49	44	52	43	53	46	57	48	57	48	58	50	53	43	54	45	54	47	51	41	52	43	53	46	50	41	51	43	53	46
317279	Booker Park School, Stoke Leys Close	1	52	43	50	43	55	46	45	36	50	42	54	46	46	36	50	42	54	46	45	36	50	42	54	45	45	35	49	42	54	45
340847	Bowler Road, Aylesbury	77	52	43	39	31	52	43	42	32	42	34	52	43	41	31	41	33	52	43	40	30	41	32	52	43	39	29	40	32	52	43
341245	Mentmore Green, Aylesbury	17	52	43	52	33	52	43	53	44	53	44	56	46	53	44	53	44	56	46	53	44	53	44	56	46	53	44	53	44	56	46
341560	Kynaston Avenue, Aylesbury	108	52	43	45	35	53	43	43	34	44	36	53	44	42	34	44	36	53	44	42	33	44	35	53	44	41	32	43	35	53	44
341860	Westfield, Aylesbury	2	52	43	49	41	54	46	51	42	52	44	55	47	51	42	52	44	55	46	50	42	52	44	55	46	50	42	52	44	55	46
341948	Rake Way, Aylesbury	127	52	43	43	34	52	43	45	35	45	36	53	44	44	38	45	39	53	44	43	34	44	36	53	44	42	33	43	35	53	44
331963	Hillier Road, Aylesbury	99	45	42	46	37	48	43	48	39	49	40	50	44	48	38	48	39	50	44	46	37	47	38	49	43	45	36	46	37	49	43
330593	Parslow Close, Aylesbury	71	45	42	49	41	50	44	50	41	51	42	52	45	49	40	50	41	51	45	48	39	49	41	51	44	47	38	48	40	50	44

Table 27 Comparison of Receptors above LOAEL at the most affected receptor grouping

Table 28 below summarises the changes in noise levels due to each of the Noise Barrier Design Options, comparing them with the Do Nothing scenario. The ES predicted a significant effect in Stoke Mandeville to the east of the HS2 alignment as indicated by the significant effect OSV11-C02.

The No Noise Barrier Option and Noise Barrier Design Options 1 and 2 do not present with any additional effects over what was reported in the HS2 Phase 1 ES, with all rail noise levels predicted to be below LOAEL.

Table 28 shows that Noise Barrier Design Option 2 (4m barrier Option) removes the major impact at Receptor ID 313799 (Risborough Road, Stoke Mandeville) and reduces the 13 moderate impacts at Receptor ID 343762 (Chestnut Way, Stoke Mandeville) reported in the ES, providing a material benefit.

Receptor ID	Area Represented	No of Impacts Represented	Significant Effect	ES Design		Change in Noise Levels Compared with Do-Nothing Scenario							
				DM - ES Design		DM - No Noise Barrier		DM – Noise Barrier Design Option 1		DM - Noise Barrier Design Option 2		DM - Noise Barrier Design Option 3	
				Day	Night	Day	Night	Day	Night	Day	Night	Day	Night
314803	Triangle Business Park, *	19		2	1	1	1	1	1	1	1	1	1
317201	Station Road, Stoke Mandeville, (Office) *	24		0	0	3	2	3	2	3	2	3	2
338898	Lower Road, Stoke Mandeville	14	OSV11-C02	4	4	4	5	4	5	4	5	4	5
338936	Lower Road, Stoke Mandeville	2		0	0	9	10	9	10	9	10	8	10
339059	Lower Road, Stoke Mandeville	1	OSV11-C02	6	3	5	3	5	3	5	3	5	3
341103	Lower Road, Aylesbury	1		0	0	12	14	12	14	12	14	12	14
341163	Lower Road, Stoke Mandeville	12		-1	-1	17	18	17	18	17	18	17	18
343499	Risborough Road, Stoke Mandeville	9		3	1	7	5	4	2	3	2	2	1
343533	Risborough Road, Stoke Mandeville	9		-2	-5	2	-1	-1	-3	-2	-4	-2	-4
343823	Risborough Road, Stoke Mandeville	7		-14	-14	-9	-9	-10	-10	-11	-10	-11	-11
343866	Risborough Road, Stoke Mandeville	6		-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
343943	Risborough Road, Stoke	5		-4	-3	-4	-4	-4	-4	-4	-4	-4	-4
343993	Chalgrove End, Stoke Mandeville	37		1	0	1	0	1	0	1	0	0	0
344788	Station Road, Stoke Mandeville	16		0	0	1	1	1	1	1	1	1	0
344841	Eskdale Road, Stoke Mandeville	19		1	0	1	1	1	1	1	1	1	1
345007	Eskdale Road, Stoke Mandeville	14		0	0	2	1	2	1	2	1	2	1
345164	Irvine Drive, Stoke Mandeville	18		1	0	2	1	2	1	2	1	2	1
345301	Risborough Road, Stoke Mandeville	10		-8	-8	-2	-1	1	1	1	1	1	1
345481	Lower Road Stoke mandeville	15		-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
345824	Lower Road, Stoke Mandeville	7	OSV11-C02	3	3	3	4	3	3	3	3	3	3
313799	Risborough Road, Stoke Mandeville	1	OSV11-C02	10	7	14	11	10	7	8	6	7	5
313866	Risborough Road, Stoke Mandeville	2		-4	-4	0	0	-3	-3	-3	-4	-3	-4
312462	Risborough Road, Stoke Mandeville	2		1	0	7	7	1	1	0	0	-1	-1
338807	Marsh Lane, Stoke Mandeville	1	OSV11-C02 OSV11-D03	8	4	5	2	5	2	5	2	5	2
338869	Marsh Lane, Stoke Mandeville	2	OSV11-C02	6	2	3	1	3	1	3	1	3	1
343650	Yew Tree Close, Stoke Mandeville	8		2	-1	5	1	3	-1	2	-1	2	-2
343762	Chestnut Way, Stoke Mandeville	13	OSV11-C02	6	4	7	4	5	3	5	3	5	3
345404	Lower Road, Stoke Mandeville	17	OSV11-C02	4	4	3	4	3	3	3	3	3	3
345540	St. Mary's Church, Lower Road (Church) *	1		-4	-3	-2	-3	-3	-3	-3	-3	-3	-3
345557	Stoke Mandeville Combined School (School) *	1		2	1	2	1	2	1	2	1	2	1
345593	Marsh Lane, Stoke Mandeville	1		2	1	3	1	2	1	2	1	2	1
345752	Chapel Lane, Stoke Mandeville	18	OSV11-C02	4	2	9	6	5	4	4	3	4	3
317279	Booker Park School, Stoke Leys Close *	1		3	3	3	3	3	3	3	3	3	3
340847	Bowler Road, Aylesbury	77		0	0	0	0	0	0	0	0	0	0
341245	Mentmore Green, Aylesbury	17		0	0	4	4	4	4	4	3	4	3
341560	Kynaston Avenue, Aylesbury	108		1	0	1	1	1	1	1	1	1	1
341860	Westfield, Aylesbury	2		2	3	3	4	3	4	3	4	3	4
341948	Rake Way, Aylesbury	127		0	1	1	1	1	2	1	1	1	1
331963	Hillier Road, Aylesbury	99	#	3	1	5	2	5	2	4	2	4	2
330593	Parslow Close, Aylesbury	71	#	5	2	7	3	7	3	6	2	5	2
*	Non-Residential receptor												

Table 28 Consideration of Receptors above LOAEL at most affected receptor grouping – Stoke Mandeville – East

The predicted L_{max} levels for the No Noise Barrier Option and Noise Barrier Design Option 1, Option 2 and Option 3 are presented in Table 29 below.

Locations where operational rail noise levels are predicted to exceed the night-time LOAEL of 57.5dB (free-field) would be highlighted in light red; with locations where the SOAEL is exceeded (77.5dB Free field) in a darker red.

ID	Area Represented	No of Impacts	Lmax No Barrier Option	Lmax Design Option 1 (3m)	Lmax Design Option 2 (4m)	Lmax Design Option 3 (5m)	Lmax ES Design
314803	Triangle Business Park *	19	64	64	64	64	64/67
317201	Station Road, Stoke Mandeville, (Office) *	24	58	57	57	57	61/64
338898	Lower Road, Stoke Mandeville	14	59	59	59	59	65/68
338936	Lower Road, Stoke Mandeville	2	58	58	58	58	64/67
339059	Lower Road, Stoke Mandeville	1	63	63	63	63	68/71
341103	Lower Road, Aylesbury	1	54	54	54	54	59/62
341163	Lower Road, Stoke Mandeville	12	56	56	56	56	62/65
343499	Risborough Road, Stoke Mandeville	9	75	70	70	70	68/71
343533	Risborough Road, Stoke Mandeville	9	72	64	64	64	61/65
343823	Risborough Road, Stoke Mandeville	7	71	70	70	70	60/65
343866	Risborough Road, Stoke Mandeville	6	69	66	66	66	65/68
343943	Risborough Road, Stoke	5	66	61	61	61	60/63
343993	Chalgrove End, Stoke Mandeville	37	55	55	55	55	52/55
344788	Station Road, Stoke Mandeville	16	55	55	55	55	58/61
344841	Eskdale Road, Stoke Mandeville	19	56	55	55	55	54/57
345007	Eskdale Road, Stoke Mandeville	14	55	55	55	55	59/62
345164	Irvine Drive, Stoke Mandeville	18	57	56	56	56	62/65
345301	Risborough Road, Stoke Mandeville	10	64	60	60	60	61/64
345481	Lower Road Stoke Mandeville	15	64	61	61	61	65/68
345824	Lower Road, Stoke Mandeville	7	63	62	62	62	66/69
313799	Risborough Road, Stoke Mandeville	1	75	73	73	73	71/74

ID	Area Represented	No of Impacts	Lmax No Barrier Option	Lmax Design Option 1 (3m)	Lmax Design Option 2 (4m)	Lmax Design Option 3 (5m)	Lmax ES Design
313866	Risborough Road, Stoke Mandeville	2	79	79	79	79	77/80
312462	Risborough Road, Stoke Mandeville	2	80	79	78	79	75/78
338807	Marsh Lane, Stoke Mandeville	2	71	71	71	71	79/82
338869	Marsh Lane, Stoke Mandeville	2	67	67	67	67	73/76
343650	Yew Tree Close, Stoke Mandeville	8	71	64	64	64	62/66
343762	Chestnut Way, Stoke Mandeville	13	71	67	67	67	68/71
345404	Lower Road, Stoke Mandeville	17	64	63	63	63	67/70
345540	St. Mary's Church, Lower Road (Church) *	1	61	59	59	59	65/68
345557	Stoke Mandeville Combined School (School) *	1	68	63	63	63	68/71
345593	Marsh Lane, Stoke Mandeville	1	69	65	65	65	68/71
345752	Chapel Lane, Stoke Mandeville	18	73	70	70	70	61/65
	Exceedance of LOAEL						
	Exceedance of SOAEL						
*	Non-residential.						

Table 29 L_{Amax} levels for the Mitigation Design Options considered compared to ES -Stoke Mandeville East side

Table 29 shows that all of the Noise Barrier Design Options (1 to 3) and the No Noise Barrier Option show improvements on L_{Amax} impacts above LOAEL when compared to the ES.

The ES indicated that Receptor ID 313866 and ID 312462, both on Risborough Road qualified for noise insulation as a result of the L_{max} impacts, and this remains the case with all of the mitigation options proposed. However, at Receptor ID 338807, on Marsh Lane in Stoke Mandeville, the requirement for noise insulation is removed as a result of all of the barrier design Options.

The No Noise Barrier Option and all of the Noise Barrier Design Options;1 to 3, show the same number of impacts above LOAEL, but all options present fewer L_{Amax} impacts above LOAEL than the ES mitigation design (145 in each Noise Barrier Design Option and the No Barrier Design Option, compared to 206 in the ES). The cost benefit analysis for the L_{max} prediction is presented in Table 30. The cost benefit analysis for the L_{max} analysis score of 0.06 for Noise Barrier Design Option 1, Option 2 and Option 3 indicates that the mitigation would not typically be included in the design.

Design Option	Number of Noise Impacts				Estimated additional cost over unmitigated design	Noise to Benefit Cost Ratio
	Above LOAEL (57.5dB(A))	Above SOAEL (77.5LAmax) and more than 20 events per night	Significant Effect above SOAEL	WebTAG Change		
ES Levels	206	N/A	6	N/A	N/A	N/A
Design Option (earthworks with no noise barrier)	145	0	4	N/A	N/A	N/A
Noise Barrier Design Option 1	145	0	4	£206,149	£3,360,900	0.06
Noise Barrier Design Option 2	145	0	4	£263,299	£4,173,500	0.06
Noise Barrier Design Option 3	145	0	4	£294,799	£4,986,100	0.06

Table 30 Cost Benefit Analysis L_{max} Levels – Stoke Mandeville (east)

The following section considers each of the Noise Barrier Design Options presented above individually, considering against both L_{Aeq} and L_{Amax} levels.

No Noise Barrier (earthworks design and no additional noise barrier)

The No Noise Barrier Option (earthworks design with no additional acoustic barriers) shows significantly more moderate and minor impacts above LOAEL for daytime and night-time as compared to the ES, presenting an adverse material change. This option also introduces 1 additional major night-time impact that was not reported in the ES. **Therefore, this Option represents a material worsening from the ES case.**

The L_{max} impacts above LOAEL for the earthworks design option are fewer than those reported in the ES (145 impacts above LOAEL compared to 206 in the ES case).

The No Noise Barrier design option does not include any form of acoustic fencing/barrier and therefore any potential visual impacts within the AONB are removed through design. Removal of the noise barrier would be seen as having a local benefit in terms of their reduced mass, particularly where they are on embankment. The beneficial landscape and visual effects would be outweighed by the concerns regarding train noise and compliance with the U&As.

Costs associated with a noise fencing/barrier are also removed through removal of the feature in the design.

Noise Barrier Design Option 1 (3m noise barrier)

Noise Barrier Design Option 1 (including earthworks design) shows an increase in the number of moderate impacts above LOAEL for daytime and night-time as compared to the ES, presenting an adverse material change. **Therefore, this Option represents a material worsening from the ES case; and does not meet the requirement of the U&As for a 4m barrier.**

The L_{max} impacts above LOAEL for the earthworks design option are fewer than those reported in the ES (145 impacts above LOAEL compared to 206 in the ES case).

Visual effects associated with the 3m barrier as opposed to a 3/4m barrier as proposed in the ES are reduced with the lower height barrier. A lower barrier of 3m height would be seen as having a local benefit in terms of their reduced mass, particularly where they are on embankment. Therefore, the lower the barrier the quicker and more effectively it would be integrated into the environment. On this basis a 3m barrier height would likely result in a minor visual benefit when compared with the ES, although this would not result in a reduction in the overall significant effects reported in the ES. The minor beneficial landscape and visual effects may therefore be outweighed by the environmental concerns regarding train noise. This option is an improvement over the ES in visual terms because of the slightly lower barrier.

Given the acoustic disbenefits and the low cost to benefit ratio, Noise Barrier Design Option 1 is not considered a feasible mitigation option.

Noise Barrier Design Option 2 (4m noise barrier)

Noise Barrier Design Option 2 (including earthworks design) shows a reduction in the number of moderate and major impacts above LOAEL for daytime and night-time as compared to the ES, presenting a beneficial material change. The Option removes the major impact for daytime reported in the ES and reduces the 17 moderate daytime impacts and 72 moderate night-time impacts reported in the ES to 3 moderate daytime and 1 moderate night-time impact. **Therefore, this Option represents a material benefit from the ES case; and also meets the requirement of the U&As (U&A 2434 and U&A 2483) for a 4m barrier or equivalent.**

The L_{max} impacts above LOAEL for the earthworks design option are fewer than those reported in the ES (145 impacts above LOAEL compared to 206 in the ES case).

The proposed barrier 4m above ToR is generally in line with the 960m section of barrier in the ES at 4m above ToR. The section in the ES at 3m above ToR is however increased in height to 4m, slightly increasing visual effects. The barriers are most visible on the Stoke Mandeville South embankment in the vicinity of the A4010 Risborough Road and within the low-lying vale landscape to the south. The barriers are 1m taller than reported in the ES in two sections. On that basis the proposed barriers will potentially be a more visible linear

feature in the landscape compared to that reported in the ES. However, as part of the design development of new woodland belts have been introduced throughout this vale landscape on both sides of HS2. Over time this enhanced landscape mitigation will create significant new woodland belts within locations that the ES assessment considered hedgerow mitigation. It is considered that the enhanced planting throughout the area will help to further integrate the HS2 infrastructures, including the noise barriers. It is therefore not anticipated that the taller barrier will result in worsening of the landscape and visual effects reported in the ES.

Given the acoustic benefits and despite the low cost to benefit ratio, as a result of the requirements of the U&As Noise Barrier Design Option 2 is considered a feasible mitigation option.

Noise Barrier Design Option 3 (5m noise barrier)

Noise Barrier Design Option 3 (including earthworks design) shows a reduction in the number of moderate and major impacts above LOAEL for daytime and night-time as compared to the ES, presenting a beneficial material change. The Option removes all major impacts for daytime and night-time reported in the ES and reduces the 17 moderate daytime impacts and 72 moderate night-time impacts reported in the ES to 3 moderate daytime and 1 moderate night-time impact. **Therefore, this Option represents a material benefit from the ES case; and exceeds the requirement of the U&As (U&A 2434 and U&A 2483) for a 4m barrier or equivalent.**

The L_{max} impacts above LOAEL for the earthworks design option are fewer than those reported in the ES (145 impacts above LOAEL compared to 206 in the ES case).

The proposed barrier 5m above ToR represents an increase in height over the 4m barrier in the ES that transitions to a 350m section at 3m above ToR, thereby increasing visual effects. It is considered that the enhanced planting throughout the area will help to further integrate the HS2 infrastructure, including the noise barriers, where they are visible on embankment. It is not anticipated that the taller barrier will result in worsening of the landscape and visual effects reported in the ES.

Given the acoustic benefits and despite the low cost to benefit ratio, as a result of the requirements of the U&As Noise Barrier Design Option 3 is considered a feasible mitigation option; however, it does not provide a material improvement over Noise Barrier Design Option 2.

Recommended Design Option: Wendover North Cutting to Stoke Mandeville – East of HS2 Trace (East) (AVDC P5)

In summary, based on the appraisals in Tables 26 and 27 for L_{eq} daytime and night-time, the analysis in Table 28, and the appraisals for L_{max} values presented in Tables 29 and 30; along with consideration of acoustic cost benefits and potential visual effects associated with the noise barrier options, the recommendation is as follows within the Wendover North Cutting to Stoke Mandeville – East package AVDC P5.

It is further noted that in this area under the requirements of U&A 2434 and U&A 2483, a 4m barrier or equivalent is required within the design. As such the proposed mitigation below has been selected to incorporate the mitigation proposed under the U&As.

- Noise Barrier Design Option 2: a 4m above ToR absorptive acoustic fence between Ch 57+400 to Ch 59+100 on the east side of the track.

3.2.2 Wendover North Cutting to Stoke Mandeville – West of HS2 Trace (West)

The ES assessment indicated that the identified communities would benefit from the noise mitigation arrangement for the Wendover Cutting area as shown in Table 25 (Summary or noise mitigation options – Wendover North Cutting to Stoke Mandeville Bypass Overbridge)

As summarised in Table 25, detailed 3-dimensional noise modelling has been undertaken to individually test each of the following Noise Barrier Design Options within the AVDC P5 Area covering by the Wendover North Cutting to Stoke Mandeville (west) work package:

- **No Noise Barrier** case as a baseline including the scheme design earthworks noise bund designs,
- **Noise Barrier Design Option 1:** 3m absorptive noise barrier with offset of 4,600mm from outside rail and including the scheme design earthworks noise bund designs
- **Noise Barrier Design Option 2:** 4m absorptive noise barrier with offset of 4,600mm from outside rail and including the scheme design earthworks noise bund designs

The noise predictions at each receptor for the ES design and Noise Barrier Design Option 1 and Option 2 are presented in the Section below. The Tables below present the ES reported operational noise levels reported in the ES as amended.

- The ES (as amended) prediction Tables include noise predictions for the proposed Scheme (Year 15 flows), the future baseline without Scheme (in the opening year) and the overall Do Something noise level (the Opening baseline + the year 15 flows).
- The Scheme Design Tables include the predictions for the Do Something Scheme Design (the Opening baseline + the year 15 flows) without noise barriers as mitigation and then with the noise barrier options being considered as compared against the ES/ SES Do Something noise level.

A cost benefit analysis has been carried out for the daytime and night-time L_{eq} levels and the results are presented in Table 31. The cost benefit analysis score of 0.2 for Option 1 indicates that mitigation in the form of noise barriers would be subject to consideration of alternate mitigation options and whether the mitigation results in a beneficial material change. The cost benefit analysis of 0.13 for Option 2 indicates that the mitigation would not typically be included in the design.

Design Option	Noise impact and benefit						Estimated additional cost over unmitigated design	Noise to Benefit Cost Ratio
	Impacts above LOAEL			TOTAL IMPACTS (sum of minor - major)		WebTAG Change		
		Day	Night	Day	Night			
ES Levels	Beneficial	0	0	37	30	N/A	N/A	N/A
	Negligible	11	21					
	Minor	9	9					
	Moderate	8	20					
	Major	20	1					
	Total above LOAEL	48	51					
No Noise Barrier (mitigation in form of earthworks)	Beneficial	0	0	36	30	N/A	N/A	N/A
	Negligible	1	10					
	Minor	8	2					
	Moderate	2	1					
	Major	27	27					
		37	40					
Noise Barrier Design Option 1 (3m barrier)	Beneficial	0	0	36	30	£307,660	£2,214,240	0.14
	Negligible	1	10					
	Minor	8	9					
	Moderate	16	19					
	Major	12	2					
	Total above LOAEL	38	40					
	Engineering and operational compatibility			Barrier height lower than ES Scheme, no particular challenges to buildability				
	Visual Impacts/ compatibility with HS2 Design Vision			Barrier height lower than ES scheme, therefore visual effects are likely to be reduced from those presented in the ES.				
Noise Barrier Design Option 2 (4m barrier)	Beneficial	0	0	28	29	£344,313	£2,749,600	0.13
	Negligible	1	17					
	Minor	8	0					
	Moderate	22	21					
	Major	6	0					
	Total above LOAEL	31	31					
	Engineering and operational compatibility			Barrier height generally aligned with ES Scheme, does not present any particular engineering challenges				
	Visual Impacts/ compatibility with HS2 Design Vision			Barrier height generally aligned or higher than ES scheme, therefore visual effects neutral change from those presented in the ES. Barrier height in line with requirements of U&A				

Table 31 Cost Benefit Analysis L_{eq} Daytime and Night-time) – Wendover North Cutting to Stoke Mandeville Bypass Overbridge-West

The No Noise Barrier Option (mitigation in the form of earthworks) shows significantly more major impacts for daytime and night-time as compared to the ES, which indicates that mitigation in the form of noise barriers is a requirement in this area.

- **Noise Barrier Design Option 1 (3m noise barrier)** provides for a benefit over the ES Design showing 8 fewer major impacts than the ES (20 in the ES and 12 under Option 1); however, as a result there are 8 more moderate impacts (reduced from major). For night-time Option 1 reduces the 20 moderate impacts at night reported in the ES to 11 moderate impacts.
- **Mitigation Design Option 2 (4m barrier)** provides for a material benefit over the ES Design, reducing the 20 major impact for daytime reported in the ES to 6 under Option 2. The 20 moderate impacts for night-time in the ES are reduced to 12.

The predicted noise levels for the ES and the design mitigation options at the western receptor locations in Stoke Mandeville are presented in Table 32 below. Locations where operational rail noise levels are predicted to exceed the daytime LOAEL of 50dB and night-time LOAEL of 40dB are highlighted in red.

ID	Area Represented	No of Impacts Represented	Do Nothing (Opening Year baseline)		ES Design Scheme Noise Only		ES Design Opening Year Baseline +Year 15 Traffic LAeq dB		Proposed Scheme HS2 + PRA Rail Only No Barrier		Proposed Scheme Total Noise No Barrier		No Barrier Opening Year Baseline +Year 15 Traffic LAeq dB		Option 1 Scheme HS2 + PRA only: - 3m barrier;		Proposed Scheme Total Noise 3m Barrier		3m Barrier Opening Year Baseline +Year 15 Traffic LAeq dB		Option 2 Scheme HS2 + PRA only: - 4m barrier;		Proposed Scheme Total Noise 4m Barrier		4m Barrier Opening Year Baseline +Year 15 Traffic LAeq dB	
			Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night
313337	Risborough Road, Stoke Mandeville	8	54	45	51	42	55	47	49	39	49	40	55	46	48	38	48	39	55	46	48	38	48	39	55	46
313421	Risborough Road, Stoke Mandeville	2	54	45	56	47	58	49	54	45	55	45	57	48	53	43	53	44	57	48	53	43	53	44	56	47
312373	Risborough Road, Stoke Mandeville	1	49	48	51	43	52	49	48	38	51	43	53	49	44	35	49	42	52	49	44	34	49	42	52	49
312566	Bishopstone, Aylesbury	2	54	53	50	42	55	53	46	36	49	40	55	53	46	36	49	40	55	53	46	36	49	40	55	53
313082	North Lee Lane, Terrick	5	49	48	50	43	52	49	48	38	51	43	53	49	44	35	50	43	53	49	44	34	50	43	53	49
313100	North Lee Lane, Terrick	1	49	48	50	43	52	49	48	38	52	44	54	49	44	35	51	43	53	49	43	34	51	43	53	49
313140	North Lee Lane, Terrick	1	46	39	49	39	51	42	43	33	46	38	49	41	42	33	45	38	49	41	42	33	45	38	49	41
313291	North Lee Lane, Terrick	4	49	48	49	40	52	48	47	37	48	39	52	49	45	36	47	39	51	48	45	35	47	38	51	48
700339	Upper Hartwell, Stone *	1	54	53	51	43	56	53	46	37	49	41	55	53	46	37	49	41	55	53	46	37	49	41	55	53
711018	Bucks Goat Centre, Old Risborough Road – North façade (General Commercial) *	1	58	49	60	51	60	51	66	57	66	57	66	57	56	47	58	49	58	49	54	45	57	48	58	49
313673	Risborough Road, Stoke Mandeville	1	54	45	66	56	66	56	67	58	67	58	67	58	59	49	59	50	60	51	57	48	57	48	59	50
314965	Old Risborough Road, Stoke Mandeville	7	52	50	59	50	60	52	69	59	69	59	69	60	58	49	59	49	59	53	57	47	57	47	58	52
700331	AP007: Fremantle Court care home, Risborough Road, Stoke Mandeville	1	54	45	58	50	59	51	58	49	61	53	62	54	53	44	60	52	60	52	53	43	60	52	60	52
700333	Old Risborough Road, Stoke Mandeville	2	49	44	62	53	62	53	75	66	75	66	75	66	63	54	63	54	63	54	61	51	61	51	61	52
700334	Old Risborough Road, Stoke Mandeville	4	49	44	61	52	61	52	72	62	72	62	72	62	62	52	62	52	62	53	59	50	60	50	60	51
810001	Bucks Goat Centre, Old Risborough Road – South façade (General Commercial) *	1	49	44	59	50	60	52	60	50	62	53	62	54	53	44	59	51	59	52	52	42	59	51	59	51
810002	Old Risborough Road Rear Facades 1	7	49	44	60	51	60	52	63	53	63	54	63	54	56	47	58	49	58	50	55	45	56	48	57	49
810003	Old Risborough Road Rear Facades 2	6	49	44	59	50	60	52	64	55	65	55	65	56	58	49	59	50	59	51	56	47	57	48	58	50
	Indicated noise insulation required for exceedance of WHO interim night-time noise target of 55dB																									
*	Non-residential																									

Table 32 Comparison of Receptors above LOAEL at the most affected receptor grouping-Stoke Mandeville - West

Table 32 indicates that for operational rail noise levels, the Design Options show fewer receptor locations above LOAEL than was the case in the ES.

In the ES, Receptor ID 313673 is reported to qualify for noise insulation as the night-time operational rail noise levels exceeds the WHO night-time limit of 55dB. Option 1 (3m barrier) and Option 2 (4m barrier) reduce the night-time rail noise levels to below 55dB, removing the qualification for noise insulation.

Table 33 below summarises the changes in noise levels due to each scenario, compared with Do Nothing scenario. The ES predicted a significant effect in Stoke Mandeville to the east of the HS2 alignment as indicated by the significant effect OSV11-C01.

The Design (mitigation in the form of earthworks) and Noise Barrier Design Options 1 and 2 do not present with any additional effects over what was reported in the HS2 Phase 1 ES. Table 33 shows that Option 2 (4m barrier Option) removes the major impact at Receptor ID 313673, ID 810002 and ID 810003, removing 13 major daytime impacts and providing a material benefit.

ID	Area Represented	No of Impacts Represented	Significant Effect	ES Design		Change in Noise Levels Compared with Do-Nothing Scenario					
				DM - ES Design		DM - No Barrier		DM - 3m Barrier		DM - 4m Barrier	
				Day	Night	Day	Night	Day	Night	Day	Night
313337	Risborough Road, Stoke Mandeville	8		2	2	1	1	1	1	1	1
313421	Risborough Road, Stoke Mandeville	2	OSV11-C01	4	4	3	3	3	3	2	2
312373	Risborough Road, Stoke Mandeville	1	~	3	1	4	1	3	1	3	1
312566	Bishopstone, Aylesbury	2		1	0	1	0	1	0	1	0
313082	North Lee Lane, Terrick	5	~	3	1	4	1	4	1	4	1
313100	North Lee Lane, Terrick	1	~	3	1	5	1	4	1	4	1
313140	North Lee Lane, Terrick	1	#	5	3	3	2	3	2	3	2
313291	North Lee Lane, Terrick	4	#	3	0	3	1	2	0	2	0
700339	Upper Hartwell, Stone I	1		2	0	1	0	1	0	1	0
711018	Bucks Goat Centre, Old Risborough Road – North façade (General Commercial)	1		2	2	8	8	0	0	0	0
313673	Risborough Road, Stoke Mandeville	1	OSV11-C01 OSV11-D02	12	11	13	13	6	6	5	5
314965	Old Risborough Road, Stoke Mandeville	7	OSV11-C01	7	3	17	10	7	3	6	2
700331	AP007: Fremantle Court Care Home, Risborough Road, Stoke Mandeville	1		5	6	8	9	6	7	6	7
700333	Old Risborough Road, Stoke Mandeville	2	OSV11-C01 OSV11-D02	13	9	26	22	14	10	12	8
700334	Old Risborough Road, Stoke Mandeville	4	OSV11-C01	12	9	23	18	13	9	11	7
810001	Bucks Goat Centre, Old Risborough Road – South façade (General Commercial)	1	^	11	8	13	10	10	8	10	7
810002	Old Risborough Road Rear Facades 1	7	OSV11-C01	12	9	14	10	9	6	8	5
810003	Old Risborough Road Rear Facades 2	6	OSV11-C01	12	8	16	12	10	7	9	6

Table 33 Consideration of Receptors above LOAEL at most affected receptor grouping – Stoke Mandeville – West

The predicted L_{max} levels for the No Noise Barrier Option and Noise Barrier Design Option 1 and Option 2 are shown in Table 34 below. Locations where noise level rail noise levels are predicted to exceed the daytime LOAEL of 57.5dB (free-field) would be highlighted in red.

Table 34 shows that all of the Noise Barrier Design Options (including the No Noise Barrier Option) report one receptor fewer above LOAEL than was reported in the ES (namely Receptor ID 313140; North Lee Lane, Terrick).

Locations where operational rail noise levels are predicted to exceed the night-time LOAEL of 57.5dB (free-field) would be highlighted in light red; with locations where the SOAEL is exceeded (77.5dB Free field) in a darker red. The ES indicated that Receptor ID 700333 would experience L_{max} levels above the free-field SOAEL of 77.5dB; none of the Design Options remove this exceedance of SOAEL.

ID	Area Represented	No of Impacts	Lmax No Barrier Option	Lmax Design Option 1 (3m)	Lmax Design Option 2 (4m)	Lmax ES Design
313337	Risborough Road, Stoke Mandeville	8	63	62	62	61/64
313421	Risborough Road, Stoke Mandeville	2	68	67	67	70/73
312373	Risborough Road, Stoke Mandeville	1	61	60	60	59/62
312566	Bishopstone, Aylesbury	2	59	59	59	61/64
313082	North Lee Lane, Terrick	5	61	59	59	58/61
313100	North Lee Lane, Terrick	1	61	60	60	56/60
313140	North Lee Lane, Terrick	1	57	57	57	60/63
313291	North Lee Lane, Terrick	4	59	59	59	59/62
700339	Upper Hartwell, Stone I *	G5	59	59	59	62/65
711018	Bucks Goat Centre, Old Risborough Road – North façade (General Commercial) *	1	80	80	80	69/73
313673	Risborough Road, Stoke Mandeville	1	82	75	75	72/76
314965	Old Risborough Road, Stoke Mandeville	7	74	72	72	69/72
700331	AP007: Fremantle Court care home, Risborough Road, Stoke Mandeville	1	71	69	69	70
700333	Old Risborough Road, Stoke Mandeville	2	92	81	81	77/83
700334	Old Risborough Road, Stoke Mandeville	4	89	79	76	75/78
810001	Bucks Goat Centre, Old Risborough Road – South façade (General Commercial) *	1	76	73	73	66/69
810002	Old Risborough Road Rear Facades 1	7	81	76	76	71/74
810003	Old Risborough Road Rear Facades 2	6	85	74	73	72/75
*	Non-residential					
	Exceedance of LOAEL					
	Exceedance of SOAEL					

Table 34 L_{Amax} levels for the Mitigation Design Options considered compared to ES -Stoke Mandeville Down Side

The cost benefit analysis for the L_{max} prediction is presented in Table 35. The cost benefit analysis score of 0.16/0.14 for Barrier Mitigation Options 1 and 2 indicates that the mitigation would not typically be included in the design.

The No Barrier Mitigation Option, Barrier Mitigation Options 1 and 2 show the same number of impacts above LOAEL, but all options present fewer L_{Amax} impacts above LOAEL than the ES mitigation design (49 vs. 52).

Design Option	Number of Noise Impacts				Estimated additional cost over unmitigated design	Noise to Benefit Cost Ratio
	Above LOAEL (57.5dB(A))	Above SOAEL (77.5LAmax) and more than 20 events per night	Significant Effect above SOAEL	WebTAG Change		
ES Levels	52	N/A	2	N/A	N/A	N/A
No Noise Barrier (mitigation in form of earthworks)	49	0	2	N/A	N/A	N/A
Noise Barrier Design Option 1	49	0	2	£353,769	£2,214,240	0.16
Noise Barrier Design Option 2	49	0	2	£391,370	£2,749,600	0.14

Table 35 Cost Benefit Analysis L_{max} Levels – Stoke Mandeville (West)

The following section considers each of the Noise Barrier Design Options presented above individually, considering against both L_{Aeq} and L_{Amax} levels.

No Noise Barrier (earthworks design and no additional noise barrier)

The No Noise Barrier Option (earthworks design with no additional acoustic barriers) shows significantly more major impacts above LOAEL for daytime and night-time as compared to the ES, presenting an adverse material change. **Therefore, this Option represents a material worsening from the ES case.**

There is no change relating to receptors above a SOAEL, which remains comparable with those reported in the ES.

The L_{max} impacts above LOAEL for the earthworks design option are fewer than those reported in the ES (49 impacts above LOAEL compared to 52 in the ES case).

The earthworks mitigation option would remove visual impacts associated with a 4m noise barrier as presented in the ES design. Removal of the noise barrier would be seen as having a local benefit in terms of the reduced mass, particularly where they are on embankment. However, the beneficial landscape and visual effects would be outweighed by the concerns regarding train noise.

Costs associated with a noise fencing/barrier are also removed through removal of the feature in the design.

Noise Barrier Design Option 1 (3m noise barrier)

Noise Barrier Design Option 1 (including earthworks design) shows 8 fewer major impacts above LOAEL than the ES; however, as a result presents 8 more moderate impacts than the ES for the daytime period; thus presenting a beneficial material change. **Therefore, this Option represents a material improvement over the ES case.**

There is no change relating to receptors above a SOAEL, which remains comparable with those reported in the ES.

The L_{max} impacts above LOAEL for the earthworks design option are fewer than those reported in the ES (49 impacts above LOAEL compared to 52 in the ES case).

The 3m noise barrier mitigation option would reduce visual impacts associated with the 4m noise barrier presented in the ES design. A lower barrier of 3m height would be seen as having a local benefit in terms of their reduced mass, particularly where they are on embankment. Therefore, the lower the barrier the quicker and more effective it would be integrated and screened within the first 15 years of operation. On this basis a 3m barrier height would likely result in a minor visual benefit when compared with the ES, although this would not result in a reduction in the overall significant effects reported in the ES. The minor beneficial landscape and visual effects may therefore be outweighed by the environmental concerns regarding train noise.

Given the acoustic benefits and accounting for the low cost to benefit ratio, Noise Barrier Design Option 1 is considered a feasible mitigation option.

Noise Barrier Design Option 2 (4m noise barrier)

Noise Barrier Design Option 2 (including earthworks design) shows 14 fewer major impacts above LOAEL than the ES; thus, presenting a beneficial material change. **Therefore, this Option represents a material improvement over the ES case.**

There is no change relating to receptors above a SOAEL, which remains comparable with those reported in the ES.

The L_{max} impacts above LOAEL for the earthworks design option are fewer than those reported in the ES (49 impacts above LOAEL compared to 52 in the ES case).

The 4m noise barrier mitigation option would match the 960m long 4m high noise barrier presented in the ES design. Although a 400m section of barrier in the ES is at 3m above ToR. The barriers are most visible on

the Stoke Mandeville South embankment in the vicinity of the A4010 Risborough Road and within the low-lying vale landscape to the south. Where the barrier is 1m taller than reported in the ES, the proposed barrier will potentially be a more visible linear feature in the landscape compared to that reported in the ES. However, as part of the design development new woodland belts have been introduced throughout this vale landscape on both sides of HS2. This enhanced landscape mitigation overtime will create significant new woodland belts within locations that the ES assessment considered as hedgerow mitigation. It is considered that the enhanced planting throughout the area will help to further integrate the HS2 infrastructure, including the noise barriers. It is therefore not anticipated that the taller barrier will result in worsening of the landscape and visual effects reported in the ES.

Given the acoustic benefits and accounting for the low cost to benefit ratio, Noise Barrier Design Option 2 is considered a feasible mitigation option.

Recommended Design Option: Wendover North Cutting to Stoke Mandeville – West of HS2 Trace (West) (AVDC P5)

In summary, based on the appraisals in Tables 31 and 32 for L_{eq} daytime and night-time, the analysis in Table 33, and the appraisals for L_{max} values presented in Tables 34 and 35; along with consideration of acoustic cost benefits and potential visual effects associated with the noise barrier options, the recommendation is as follows within the Wendover North Cutting to Stoke Mandeville – West package AVDC P5.

It is further noted that in this area under the requirements of U&A 2434, a 4m barrier or equivalent is required within the design. As such the proposed mitigation below has been selected to incorporate the mitigation proposed under the U&As.

- **Noise Barrier Design Option 2:** a 4m above ToR absorptive acoustic fence between Ch 57+380 to Ch 58+500 on the west side of the track.

3.3 Stoke Mandeville Bypass Overbridge to Oxford Road Overbridge (AVDC P6/P7)

The mitigation options have been assessed against the findings of the "London-West Midlands Environmental Statement, Volume 5 Map books Sound, noise and vibration (Part 2 of 4) November 2013" is shown on Image 8 and Image 9 (CFA11).

The assessment area is as presented in Table 36 and in Section 4.3.1 (Stoke Mandeville Bypass Overbridge to Oxford Road Overbridge – East) and Section 4.3.2. (Stoke Mandeville Bypass Overbridge to Oxford Road Overbridge – West).

- Stoke Mandeville Bypass Overbridge to Oxford Road Overbridge – East

The ES assessment indicated that the identified communities would benefit from the noise mitigation scheme as presented in Table 36 (Summary or noise mitigation options – Stoke Mandeville Bypass Overbridge to Oxford Road Embankment).

The mitigation options set out in Table 36 and as assessed in the sections below include any relevant Undertakings and Assurances described in Table 2. Along with "The Green Banks Scheme" as discussed in Section 2.4.

Location	Start Chainage	End Chainage	Up/Down Line	Length (m)	Height above ToR (m)	Comments
ES (as amended) mitigation – performance presented in 'Do Something' in Appendix C	055+800	58+950	Up	3150	3	Mitigation ID 056-NB1E standard height noise barrier (3m above rail) at the top of the cutting from Ch 55+800 to the realigned Nash Lee Lane overbridge embankment at Ch 58+950
	058+570	060+470	Down	1900	-	Mitigation ID 059-IN1W Aylesbury South Cutting provides noise benefit on the left (west) side of the alignment
	057+690	058+650	Down	960	4	Mitigation ID 058-NB1W Noise barrier (4m above rail)
	057+690	058+650	Up	960	4	Mitigation ID 058-NB2E Noise barrier (4m above rail)
	058+650	059+400	Up	750	3	Mitigation ID 059-M1E Noise barrier (3m above rail)

Location	Start Chainage	End Chainage	Up/Down Line	Length (m)	Height above ToR (m)	Comments
	061+490	62+230	Down	740	3	Mitigation ID 062-NB1W Noise barrier (3m above rail)
	62+230	62+790	Down	560	4	Mitigation ID 062-NB1W For the short section of route between Ch62+230 and Ch62+790, the barrier height was increased to 4m above rail
	62+790	63+300	Down	510	3	Mitigation ID 062-NB1W Noise barrier (3m above rail)
	059+400	062+230	Up	2830	5	Noise Mitigation ID 062-NB2E Noise barrier (5m above rail)
	062+230	063+240	Up	110	4	Noise Mitigation ID 062-NB2E section between Ch 062+230 and 063+240 which was reduced to 4m above rail on the up (east) side in the Hartwell area
	063+240	064+200	Up	960	5	Mitigation ID 062-NB2E Noise barrier (5m above rail)
	061+150	061+500	Down	350	3	Mitigation ID AP4-NB2(W) Noise barrier (3m above rail) at Sedrup Ditch
No Noise Barrier Option Scheme design bund provision	58+400	60+400	Down	2000	-	Aylesbury South Cutting provides noise benefit on the left (west) side of the alignment
	58+400	60+400	Up	2000	6	Aylesbury South Cutting provides noise benefit on the east side of the alignment with additional landscape bund
	60+024	61+950	Up	1926	5	Earthworks bund on top of cutting/embankment. Bund slope 1:4

Location	Start Chainage	End Chainage	Up/Down Line	Length (m)	Height above ToR (m)	Comments
	61+950	62+400	Up	450	-	Aylesbury North Cutting provides noise benefit on the east side of the alignment
	62+400	62+835	Up	435	5	Oxford Road Embankment Noise benefit on east. Slope 1:4
	62+386	62+600	Down	214	5	Oxford Road Embankment Noise benefit on east. Slope 1:4
Noise Barrier Design Option 1 Noise barrier offsets at varying offset from outside rail. Green Banks Scheme – Scheme agreed with National Trust to enhance earthworks design and possibly remove need for barriers (Ch 62+250 to Ch62 +880).	59+800	62+250	Up	2450	4	Absorptive barrier
	62+250	62+880	Up	630	-	Earthwork design as part of Green Banks Scheme; no noise barrier
	62+880	64+200	Up	1320	4	Absorptive Barrier
	64+200	64+382	Up	182	1.25	Absorptive barrier to tie into standard parapet on viaduct
	61+200	62+250	Down	2100	4	Absorptive barrier
	62+250	62+700	Down	450	-	Earthwork design as part of Green Banks Scheme, no noise barrier
	62+700	63+300	Down	600	4	Absorptive barrier
Noise Barrier Design Option 2 Noise barrier offsets at varying offset from outside rail. Noise Barrier in Green Banks Scheme	59+800	62+250	Up	2450	4	Absorptive barrier
	62+250	62+880	Up	630	3	Barrier in Green Banks Scheme
	62+880	64+200	Up	1320	4	Absorptive Barrier
	64+200	64+382	Up	182	1.25	Absorptive barrier to tie into standard parapet on viaduct
	61+200	62+250	Down	2100	4	Absorptive barrier
	62+250	62+700	Down	450	3	3m Barrier in Green Banks Scheme
	62+700	63+300	Down	600	4	Absorptive barrier
Noise Barrier Design Option 3 Noise barrier	59+800	62+250	Up	2450	4	Absorptive barrier
	62+250	62+880	Up	630	4	Barrier in Green Banks Scheme

Location	Start Chainage	End Chainage	Up/Down Line	Length (m)	Height above ToR (m)	Comments
offsets at varying offset from outside rail	62+880	64+200	Up	1320	4	Absorptive Barrier
	64+200	64+382	Up	182	1.25	Absorptive barrier to tie into standard parapet on viaduct
	61+200	62+250	Down	2100	4	Absorptive barrier
	62+250	62+700	Down	450	4	4m Barrier in Green Banks Scheme
	62+700	63+300	Down	600	4	Absorptive barrier
Noise Barrier Design Option 4 Noise barrier offsets at varying offset from outside rail. Green Banks Scheme – Scheme agreed with National Trust to enhance earthworks design and possibly remove need for barriers (Ch 62+250 to Ch62 +880).	59+800	62+250	Up	2450	5	Absorptive barrier
	62+250	62+880	Up	630	-	Earthwork design as part of Green Banks Scheme; no noise barrier
	62+880	64+200	Up	1320	5	Absorptive Barrier
	64+200	64+382	Up	182	1.25	Absorptive barrier to tie into standard parapet on viaduct
	61+200	62+250	Down	2100	4	Absorptive barrier
	62+250	62+700	Down	450	-	Earthwork design as part of Green Banks Scheme; no noise barrier
	62+700	63+300	Down	600	4	Absorptive barrier
Noise Barrier Design Option 5 Noise barrier offsets at varying offset from outside rail	59+800	62+250	Up	2450	5	
	62+250	62+880	Up	630	4	Barrier in Green Banks Scheme
	62+880	64+200	Up	1320	5	Absorptive Barrier
	64+200	64+382	Up	182	1.25	Absorptive barrier to tie into standard parapet on viaduct
	61+200	62+250	Down	2100	5	Absorptive barrier
	62+250	62+700	Down	450	4	4mBarrier in Green Banks Scheme
	62+700	63+300	Down	600	4	Absorptive barrier

Table 36 Summary or noise mitigation options – Stoke Mandeville Bypass Overbridge to Oxford Road Embankment

As summarised in Table 36, detailed 3-dimensional noise modelling has been undertaken to individually test each of the following Noise Barrier Design Options within the Stoke Mandeville Bypass Overbridge to Oxford Road Embankment (AVDC P6/P7 Area):

- **No Barrier Option** - Mitigation provided by the scheme design earthworks only.
- **Mitigation Design Option 1:**
    - Absorptive lineside noise barrier 4m above ToR at offsets varying 4.600 - 6.268m from outside rail (Ch. 59+500 to 62+250) to accommodate drainage.
    - Green Banks Scheme - No barrier (Ch. 62+250 to 62+880).
    - Absorptive lineside noise barrier 4m above ToR at offsets varying 4.600 - 5.968m from outside rail (Ch. 62+880 to 64+200) to accommodate drainage.
    - Absorptive lineside noise barrier 1.25m above ToR at offsets varying 4.600 – 6.268m from outside rail (Ch. 64+200 to tie in with the Thame Valley Viaduct) to accommodate drainage.
- **Mitigation Design Option 2:**
    - Absorptive lineside noise barrier 4m above ToR at offsets varying 4.600 - 6.268m from outside rail (Ch. 59+500 to 62+250) to accommodate drainage.
    - Green Banks Scheme - Absorptive lineside noise barrier 3m above ToR (Ch. 62+250 to 62+880).
    - Absorptive lineside noise barrier 4m above ToR at offsets varying 4.600 - 5.968m from outside rail (Ch. 62+880 to 64+200) to accommodate drainage.
    - Absorptive lineside noise barrier 1.25m above ToR at offsets varying 4.600 – 6.268m from outside rail (Ch. 64+200 to tie in with the Thame Valley Viaduct) to accommodate drainage.
- **Mitigation Design Option 3:**
    - Absorptive lineside noise barrier 4m above ToR at offsets varying 4.600 - 6.268m from outside rail (Ch. 59+500 to 62+250) to accommodate drainage.
    - Green Banks Scheme - Absorptive lineside noise barrier 4m above ToR (Ch. 62+250 to 62+880).
    - Absorptive lineside noise barrier 4m above ToR at offsets varying 4.600 - 5.968m from outside rail (Ch. 62+880 to 64+200) to accommodate drainage.
    - Absorptive lineside noise barrier 1.25m above ToR at offsets varying 4.600 – 6.268m from outside rail (Ch. 64+200 to tie in with the Thame Valley Viaduct) to accommodate drainage.
- **Mitigation Design Option 4:**
    - Absorptive lineside noise barrier 5m above ToR at offsets varying 4.600 - 6.268m from outside rail (Ch. 59+500 to 62+250) to accommodate drainage.
    - Green Banks Scheme - No barrier (Ch. 62+250 to 62+880).

- Absorptive lineside noise barrier 5m above ToR at offset varying 4.600 - 5.968m from outside rail (Ch. 62+880 to 64+200) to accommodate drainage.
- Absorptive lineside noise barrier 1.25m above ToR at offsets varying 4.600 – 6.268m from outside rail (Ch. 64+200 to tie in with the Thame Valley Viaduct) to accommodate drainage.

- **Mitigation Design Option 5:**
  - Absorptive lineside noise barrier 5m above ToR at offsets varying 4.600 - 6.268m from outside rail (Ch. 59+500 to 62+250) to accommodate drainage.
  - Green Banks Scheme - Absorptive lineside noise barrier 2m above ToR (Ch. 62+250 to 62+880).
  - Absorptive lineside noise barrier 5m above ToR at offsets varying 4.600 - 5.968m from outside rail (Ch. 62+880 to 64+200) to accommodate drainage.
  - Absorptive lineside noise barrier 1.25m above ToR at offsets varying 4.600 – 6.268m from outside rail (Ch. 64+200 to tie in with the Thame Valley Viaduct) to accommodate drainage.

The Tables in the sections below present the ES reported operational noise levels as amended through the SES and AP amendments.

- The ES (as amended) prediction Tables include noise predictions for the proposed Scheme (Year 15 flows), the future baseline without Scheme (in the opening year) and the overall Do Something noise level (the Opening baseline + the year 15 flows).
- The Scheme Design Tables include the predictions for the Do Something Scheme Design (the Opening baseline + the year 15 flows) without noise barriers as mitigation and then with the noise barrier options being considered as compared against the ES/ SES Do Something noise level.

A cost benefit analysis has been carried out for the daytime and night-time L_{eq} levels and the results are presented in Table 37. The cost benefit analysis score of 0.03 for Option 1 and Option 2 and 0.4 for all Design Option 3, Option 4 and Option 5 indicates that further consideration should be given to other design objectives and whether there is any 'material difference' between the noise effects forecast for the proposed scheme design and those published within the ES and SES reports.

- **The No Noise Barrier Option (mitigation in the form of earthworks)** shows significantly more moderate and major impacts for daytime and night-time as compared to the ES, presenting an adverse material change**. This indicates that mitigation in the form of noise barriers is required.**

  From a visual perspective, the No Barrier Option when compared to the HS2 Phase 1 ES (which considered a 4m barrier (990m) and 5m (660m) barrier above TOR), the No Barrier Option presented herein would result in a positive change from that reported in the HS2 Phase 1 ES. It is noted that there has been a very slight track uplift at this location making the Oxford Road embankment marginally higher. The no barrier section is contained by the proposed Green Banks earthworks south of the SBH/32 footbridge and by extensive existing vegetation which is part of the Hartwell House Pleasure Grounds. North of SBH/32 footbridge the no barrier section within the

Green Banks area will be glimpsed from the PRoW on the approach to the SBH/32 footbridge. It is considered that the Earthworks Design taking account of the no barrier section and the very minor track uplift will have a **positive effect on the local landscape** character of Hartwell House and former golf course to the West of Aylesbury and its visual amenity, when compared to that reported in the HS2 Phase 1 ES (as amended).

- **Mitigation Option 1** (4m noise barrier, no barrier in Green Banks) shows significantly more moderate and major impacts than the ES with daytime moderate impacts increasing from 100 to 163, night-time moderate impacts increasing from 46 to 101 and major impacts for daytime increase from 1 impact above LOAEL to 42 impacts above LOAEL. **This represents a material worsening over the ES.**

  From a visual perspective, Option 1, with no barrier within the Green Banks and a 4m (1.02Km) barrier above ToR compared to the HS2 Phase 1 ES (which considered a 4m barrier (990m) and 5m (660m) barrier) would have classified as a positive change. It is noted that there has been a very slight track uplift at this location making the Oxford Road embankment marginally higher. The no barrier section is contained by the proposed Green Banks earthworks south of the SBH/32 footbridge and by extensive existing vegetation which is part of the Hartwell House Pleasure Grounds. North of SBH/32 footbridge the proposed 4m barrier will then run along a 400m long exposed section of the Oxford Road embankment before disappearing again into the Whaddon Hill cutting, with the final 400m section contained by the cutting. The no barrier section within the Green Banks area will be glimpsed from the PRoW on the approach to the SBH/32 footbridge. The section of 4m barrier will be visible, albeit positioned on a marginally higher embankment, coincides with the same height barrier in the HS2 Phase 1 ES (as amended). It is considered that option 1 taking account of the no barrier section and the very minor track uplift will have a **negligible positive effect** on the local landscape character of Hartwell House and former golf course to the West of Aylesbury and its visual amenity to that reported in the ES (as amended).

- **Mitigation Design Option 2** (4m barrier with 3m barrier in the Green Banks Scheme) shows significantly more moderate and major impacts than the ES with daytime moderate impacts increasing from 100 to 163, night-time moderate impacts increasing from 46 to 100 and major impacts for daytime increase from 1 impact above LOAEL to 42 impacts above LOAEL. This represents a material worsening over the ES.

  From a visual perspective, a 3m barrier within the Green Banks and a 4m (1.02Km) barrier above TOR compared to the ES (which considered a 4m barrier (990m) and 5m (660m) barrier) will be neutral when compared to the conclusions of the HS2 Phase 1 ES. It is noted that there has been a very slight track uplift at this location making the Oxford Road embankment marginally higher. The 3m barrier section is contained by the proposed Green Banks earthworks south of the SBH/32 footbridge and by extensive existing vegetation which is part of the Hartwell House Pleasure Grounds. North of SBH/32 footbridge the 4m barrier will then run along a 400m long exposed section of the Oxford Road embankment before disappearing again into the Whaddon Hill cutting, with the final 400m section contained by the cutting. The section of 4m barrier will be visible, albeit positioned on a marginally higher embankment, coincides with the same height barrier in the HS2

Phase 1 ES (as amended). It is considered that option 2 taking account of the very minor track uplift will have a **neutral effect on the local landscape character** of Hartwell House and former golf course to the West of Aylesbury and its visual amenity to that reported in the ES (as amended).

- **Mitigation Option 3** (4m barrier with 4m barrier in the Green Banks Scheme) shows significantly more moderate and major impacts than the ES with daytime moderate impacts increasing from 100 to 162, night-time moderate impacts increasing from 46 to 100 and major impacts for daytime increase from 1 impact above LOAEL to 42 impacts above LOAEL. This represents a material worsening over the ES.

  From a visual perspective, a 4m barrier within the Green Banks and a 4m (1.02Km) barrier above TOR compared to the HS2 Phase 1 ES (which considered a 4m barrier (990m) and 5m (660m) barrier) will be neutral when compared to the conclusions of the HS2 Phase 1 ES. It is noted that there has been a very slight track uplift at this location making the Oxford Road embankment marginally higher. The 3m barrier section is contained by the proposed Green Banks earthworks south of the SBH/32 footbridge and by extensive existing vegetation which is part of the Hartwell House Pleasure Grounds. North of SBH/32 footbridge the 4m barrier will then run along a 400m long exposed section of the Oxford Road embankment before disappearing again into the Whaddon Hill cutting, with the final 400m section contained by the cutting. The section of 4m barrier will be visible, albeit positioned on a marginally higher embankment, coincides with the same height barrier in the HS2 Phase 1 ES (as amended). It is considered that option 2 taking account of the very minor track uplift will have a **neutral effect on the local landscape** character of Hartwell House and former golf course to the W of Aylesbury and its visual amenity to that reported in the ES (as amended).

- **Mitigation Option 4** (5m barrier with no barrier in the Green Banks Scheme) shows the same number of major impacts above LOAEL (1) as the ES for daytime (1) and 1 additional major impact for night-time over the ES (zero). The moderate impacts for night-time for Option 4 (46) are the same as the ES (46), while there is one additional moderate impact for daytime (101) compared to the ES (100).

  From a visual perspective, no barrier within the Green Banks and a 5m (1.02Km) barrier above TOR compared to the HS2 Phase 1 ES (which considered a 4m barrier (990m) and 5m (660m) barrier) will have a negative change when compared to the conclusions of the HS2 Phase 1 ES. It is noted that there has been a very slight track uplift at this location making the Oxford Road embankment marginally higher. The no barrier section is contained by the proposed green banks earthworks south of the SBH/32 footbridge and by extensive existing vegetation which is part of the Hartwell House Pleasure Grounds. North of SBH/32 footbridge the proposed 5m barrier will then run along a 400m long exposed section of the Oxford Road embankment before disappearing again into the Whaddon Hill cutting, with the final 400m section contained by the cutting. The no barrier section within the Green Banks section will be glimpsed from the PRoW on the approach to the SBH/32 footbridge. The section of 5m barrier will be visible, albeit positioned on a marginally higher embankment, coincides with the 4m barrier in the HS2 Phase 1 ES (as amended). It is considered that option 4 taking account of the no barrier section and the very minor track uplift will have a

negligible negative effect on the local landscape character of Hartwell House and former golf course to the West of Aylesbury and its visual amenity to that reported in the ES (as amended).

- **Mitigation Option 5** (5m barrier with 2m barrier in the Green Banks Scheme) shows the same number of major impacts above LOAEL (1) as the ES for daytime (1) and 1 additional major impact for night-time over the ES (zero). The moderate impacts for night-time for Option 4 (46) are the same as the ES (46), while there is one additional moderate impact for daytime (101) compared to the ES (100).

  From a visual perspective, a 2m barrier within the Green Banks and a 5m (1.02Km) barrier above TOR compared to the ES (as amended) assessed 4m barrier (990m) and 5m (660m) barrier will have a negative change. It is noted that there has been a very slight track uplift at this location making the Oxford Road embankment marginally higher. The no barrier section south of SBH/32 footbridge is contained by the proposed green banks earthworks south of the SBH/32 footbridge and by extensive existing vegetation which is part of the Hartwell House Pleasure Grounds. North of SBH/32 footbridge the 5m barrier will then run along a 400m long exposed section of the Oxford Road embankment before disappearing again into the Whaddon Hill cutting, with the final 400m section contained by the cutting. The section of 5m barrier will be visible, albeit positioned on a marginally higher embankment, coincides with the 4m barrier in the HS2 Phase 1 ES (as amended). It is considered that option 5 taking account of very minor track uplift will have a **negligible negative effect** on the local landscape character of Hartwell House and former golf course to the West of Aylesbury and its visual amenity to that reported in the ES (as amended).

Design Option	Noise impact and benefit						Estimated additional cost over unmitigated design	Noise to Benefit Cost Ratio
	Impacts above LOAEL			TOTAL IMPACTS (sum of minor - major)		WebTAG Change		
		Day	Night	Day	Night			
ES Levels	Beneficial	1	1	102	137			
	Negligible	311	812					
	Minor	1	91					
	Moderate	100	46					
	Major	1	0					
	Total above LOAEL	414	950					
Design Option (mitigation in form of earthworks)	Beneficial	0	0	1581	1612			
	Negligible	334	1072					
	Minor	338	825					
	Moderate	1142	782					
	Major	101	5					
		1915	2684					
Noise Barrier Design Option 1 (4m barrier with no barrier in Green Banks)	Beneficial	0	0	240	584	£2,094,066	£7,185,002	0.3
	Negligible	205	712					
	Minor	35	482					
	Moderate	163	101					
	Major	42	1					
	Total above LOAEL	445	1296					
	Engineering and operational compatibility			No particular engineering constraints				
	Visual Impacts/ compatibility with HS2 Design Vision			ES provides for 5m barrier transitioning to 4m barrier. Design provides lower barrier, therefore visual effects are reduced				
Noise Barrier Design Option 2 (4m barrier with 3m barrier in Green Banks).	Beneficial	0	0	240	584	£2,210,084	£7,817,702	0.3
	Negligible	187	599					
	Minor	35	483					
	Moderate	163	100					
	Major	42	1					
	Total above LOAEL	427	1183					
	Engineering and operational compatibility			No particular engineering constraints				
	Visual Impacts/ compatibility with HS2 Design Vision			ES provides for 5m barrier transitioning to 4m barrier. Design provides higher barrier in part, therefore visual effects are slightly increased				
Noise Barrier Design Option 3 (4m barrier with 4m barrier in Green Banks)	Beneficial	0	0	240	584	£2,276,060	£5,356,952	0.4
	Negligible	187	581					
	Minor	36	483					
	Moderate	162	100					
	Major	42	1					
	Total above LOAEL	427	1165					
	Engineering and operational compatibility			No particular engineering constraints				
	Visual Impacts/ compatibility with HS2 Design Vision			ES provides for 5m barrier transitioning to 4m barrier. Design matches ES, therefore visual effects are neutral				
Noise Barrier Design Option 4 (5m barrier, with no barrier in Green Banks Scheme	Beneficial	0	0	104	102	£2,368,295	£5,472,752	0.4
	Negligible	185	790					
	Minor	2	55					
	Moderate	101	46					
	Major	1	1					
	Total above LOAEL	289	892					
	Engineering and operational compatibility			No particular engineering constraints				
	Visual Impacts/ compatibility with HS2 Design Vision			Design incorporates Green Banks scheme, therefore meeting the requirements of the Hartwell Agreement				

Design Option	Noise impact and benefit						Estimated additional cost over unmitigated design	Noise to Benefit Cost Ratio
	Impacts above LOAEL			TOTAL IMPACTS (sum of minor - major)		WebTAG Change		
		Day	Night	Day	Night			
Noise Barrier Design Option 5 with 2m barrier in Green Banks Scheme	Beneficial	0	0	104	102	£2,578,701	£5,909,702	0.4
	Negligible	185	677					
	Minor	2	55					
	Moderate	101	46					
	Major	1	1					
	Total above LOAEL	289	779					
	Engineering and operational compatibility			No particular engineering constraints				
	Visual Impacts/ compatibility with HS2 Design Vision			Design incorporates Green Banks scheme, therefore meeting the requirements of the Hartwell Agreement				

Table 37 Cost Benefit Analysis L_{eq} Daytime and Night-time) – Wendover North Cutting to Stoke Mandeville Bypass Overbridge

The predicted noise levels for the ES and each of the Noise Barrier Design Options at the eastern receptor locations in the Stoke Mandeville Overbridge to Oxford Road Overbridge section are presented in Table 38 below. Table 38 includes HS2 operational noise and noise from the new Stoke Mandeville Bypass, along with the altered Oxford Road alignment.

Locations where noise level rail noise levels are predicted to exceed the daytime LOAEL of 50dB and night-time LOAEL of 40dB would be highlighted in red.

Table 38 indicates that for operational noise (rail and altered roads), the No Noise Barrier Option (earthworks design) shows more receptor locations above LOAEL than was the case presented in the ES. Whereas Table 38 details that Noise Barrier Design Option 5 shows fewer impacts above LOAEL than reported in the ES.

ID	Area Represented	No of Impacts Represented	Do Nothing (Opening Year baseline) L_{Aeq} dB		ES Design L_{Aeq} dB		ES Design Opening Year Baseline +Year 15 Traffic L_{Aeq} dB		Earthworks Design L_{Aeq} dB		Earthworks Design Year Baseline +Year 15 Traffic L_{Aeq} dB		Option 1 4m lineside barrier / 0m Green Banks / 4m lineside barrier L_{Aeq} dB		Option 1 4m lineside barrier / 0m Green Banks / 4m lineside barrier Opening Year Baseline +Year 15 Traffic L_{Aeq} dB		Option 2 4m lineside barrier / 3m Green Banks / 4m lineside barrier L_{Aeq} dB		Option 2 4m lineside barrier / 3m Green Banks / 4m lineside barrier Opening Year Baseline +Year 15 Traffic L_{Aeq} dB	
			Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night
298707	Cooks Road, Aylesbury	78	51	41	47	38	52	42	54	45	56	47	46	37	52	42	46	36	52	42
298735	Hickman Street, Aylesbury	85	47	42	43	35	48	42	49	40	51	44	44	34	49	43	43	33	48	43
298817	Cooks Road, Aylesbury	78	46	36	47	38	49	39	53	44	54	44	46	37	49	39	46	36	49	39
298976	Eyre Close, Aylesbury	59	51	41	47	39	52	42	55	46	57	47	47	37	52	42	45	36	52	42
299219	Brimmers Way, Aylesbury	121	49	46	41	32	50	46	45	36	51	46	41	32	50	46	41	31	50	46
299591	Brimmers Way, Aylesbury	75	49	46	42	32	50	46	46	37	51	47	42	33	50	46	42	33	50	46
299978	Great Meadow Way, Aylesbury	65	47	42	43	34	49	42	48	39	51	44	44	34	49	43	43	34	49	43
300635	Napier Road, Aylesbury	61	46	35	47	38	50	40	52	43	53	43	48	38	50	40	48	38	50	40
300647	Warbler Close, Aylesbury	69	44	39	47	38	48	41	52	43	52	44	47	37	49	41	47	37	49	41
300773	Wren Path, Aylesbury	32	49	46	42	33	50	46	47	38	51	47	43	33	50	46	43	33	50	46
300929	Spruce Road, Aylesbury	43	49	46	44	35	50	46	48	39	52	47	45	35	50	46	45	35	50	46
301228	Grosvenor Way, Aylesbury	68	48	38	48	39	51	41	53	44	54	45	49	40	52	42	49	40	52	42
301296	Arncott Way, Aylesbury	36	49	46	44	35	50	46	49	40	52	47	45	36	50	46	45	35	50	46
301483	Chelsea Road, Aylesbury	14	49	46	46	37	51	47	51	41	53	47	48	39	52	47	48	39	52	47
301668	Chelsea Road, Aylesbury	21	49	46	45	36	51	46	50	40	52	47	47	37	51	47	47	37	51	47
301851	Hampstead Close, Aylesbury	35	49	46	45	35	50	46	49	39	52	47	46	36	51	46	46	36	51	46
306197	Swallow Lane, Aylesbury	24	47	42	43	34	48	42	48	39	51	44	43	34	48	43	43	33	48	43
307325	Meredith Drive, Aylesbury	48	49	46	41	31	50	46	43	34	50	46	42	32	50	46	42	32	50	46
308644	Gogh Road, Aylesbury	40	49	46	43	34	50	46	45	36	51	46	44	35	50	46	44	35	50	46
308665	Picasso Place, Aylesbury	40	49	46	43	33	50	46	45	35	50	46	44	34	50	46	44	34	50	46
308722	Rabans Lane, Aylesbury *, (General Commercial)	1	49	46	43	34	50	46	47	37	51	47	45	35	50	46	45	35	50	46
309021	Telford Close, Aylesbury	1	49	46	39	30	50	46	44	35	50	46	40	31	50	46	40	31	50	46
309118	Tompion Road, Aylesbury	1	47	42	44	35	49	43	49	39	51	44	46	37	49	43	46	37	49	43
309275	Edison Road, Rabans Lane Industrial Area *, (General Commercial)	10	47	36	50	41	52	42	54	44	55	45	52	43	53	44	52	43	53	44
309296	Rabans Lane, Aylesbury	4	47	36	52	43	53	43	57	47	57	48	53	44	54	45	53	44	54	45
309320	Woodley House, Rabans Close Industrial Area *, (Office)	1	47	36	47	38	50	40	52	42	53	43	50	40	52	42	50	40	52	42
309415	Edison Road, Rabans Lane Industrial Area *, (Office)	8	47	36	50	40	52	42	54	44	55	45	52	42	53	43	52	42	53	43
309474	Rabans Lane, Aylesbury	2	50	46	49	39	52	47	53	44	55	48	51	41	53	47	51	41	53	47
316101	Hampden Square, Aylesbury	189	47	42	41	33	48	42	47	37	50	43	42	33	48	42	42	32	48	42
317279	Booker Park School, Stoke Leys Close, Aylesbury *, (School)	1	52	43	50	43	55	46	50	42	54	46	50	42	54	46	50	42	54	46

ID	Area Represented	No of Impacts Represented	Do Nothing (Opening Year baseline) L_{Aeq} dB		ES Design L_{Aeq} dB		ES Design Opening Year Baseline +Year 15 Traffic L_{Aeq} dB		Earthworks Design L_{Aeq} dB		Earthworks Design Year Baseline +Year 15 Traffic L_{Aeq} dB		Option 1 4m lineside barrier / 0m Green Banks / 4m lineside barrier L_{Aeq} dB		Option 1 4m lineside barrier / 0m Green Banks / 4m lineside barrier Opening Year Baseline +Year 15 Traffic L_{Aeq} dB		Option 2 4m lineside barrier / 3m Green Banks / 4m lineside barrier L_{Aeq} dB		Option 2 4m lineside barrier / 3m Green Banks / 4m lineside barrier Opening Year Baseline +Year 15 Traffic L_{Aeq} dB	
319293	Pearson Close, Aylesbury	35	57	48	49	42	56	46	51	43	58	49	50	42	58	49	49	42	58	49
319305	Church of Jesus Christ of Latter day Saints, Aylesbury *, (Church)	1	57	48	44	36	57	48	47	38	57	48	45	37	57	48	45	36	57	48
319325	Alham Road, Aylesbury	93	47	41	43	35	48	42	46	37	49	43	44	36	49	42	44	36	49	42
319422	Dormer Close, Aylesbury	118	49	44	49	44	49	44	50	42	52	46	48	41	52	46	47	40	51	46
319615	Bonham Close, Aylesbury	178	49	44	49	44	49	44	50	42	53	46	49	41	52	46	49	41	52	46
320227	Briskman Way, Aylesbury	28	57	48	40	31	57	48	44	35	57	48	42	33	57	48	40	31	57	48
320409	Oxford Road, Hartwell	1	59	50	55	46	55	46	61	53	61	53	60	52	60	52	59	50	59	50
320715	Lupin Walk, Aylesbury	127	49	44	50	42	50	45	51	43	53	47	50	42	52	46	50	42	52	46
320799	Oxford Road, Hartwell	1	52	43	61	52	61	52	66	57	67	57	64	55	64	55	63	54	63	54
320819	Oxford Road, Hartwell	1	56	48	60	51	60	51	63	54	64	55	61	52	62	53	59	50	61	52
324002	Slattenham Close, Aylesbury	208	47	41	39	31	47	41	45	36	49	42	43	35	48	42	42	34	48	42
324129	Rowland Way, Aylesbury	112	47	41	42	34	47	41	47	39	50	43	45	37	49	42	44	36	49	42
325151	Upper Abbotts Hill, Aylesbury	118	57	48	50	42	57	47	52	44	58	50	52	44	58	49	51	43	58	49
325211	Great Meadow Way, Aylesbury	72	57	48	44	35	57	48	50	41	58	49	45	37	57	48	44	36	57	48
325431	Horton Close, Aylesbury	130	57	48	44	36	57	48	50	41	58	49	46	38	57	48	45	37	57	48
325816	Pitcher Walk, Aylesbury	347	47	42	42	34	48	42	47	39	50	44	44	36	49	43	43	35	48	43
327675	Torridge Road, Aylesbury	176	47	41	42	33	48	41	46	37	50	43	44	35	49	42	44	35	49	42
328417	Ellen Road, Aylesbury	1	45	41	41	32	46	41	45	36	48	42	43	34	47	42	43	34	47	42
328584	Brent Path, Aylesbury	41	45	41	44	35	47	41	49	39	50	43	46	37	48	42	46	37	48	42
328805	Lowmon Way, Aylesbury	53	45	41	45	36	48	42	50	40	51	44	47	38	49	43	47	38	49	43
329008	Orwell Close, Aylesbury	84	45	41	42	33	47	41	46	37	49	43	44	36	48	42	44	36	48	42
329139	Enborne Close, Aylesbury	64	45	41	44	35	47	42	48	39	50	43	46	37	49	43	46	37	49	43
329253	Welland Road, Aylesbury	30	45	46	46	37	48	46	50	41	51	47	47	38	49	47	47	38	49	47
329413	Blackwater Drive, Aylesbury	61	47	41	45	36	49	42	49	40	51	44	46	38	50	43	46	38	50	43
329685	Witham Way, Aylesbury	57	45	41	48	39	49	43	52	42	53	45	48	40	50	43	48	40	50	43
329807	Witham Way, Aylesbury	44	45	41	46	37	49	42	51	42	52	44	48	39	50	43	48	39	50	43
330063	Alwin Close, Aylesbury	84	47	41	43	34	48	42	48	39	50	43	45	36	49	42	45	36	49	42
330343	Ebble Close, Aylesbury	78	45	41	46	37	48	42	50	41	51	44	47	38	49	43	47	38	49	43
330464	Anton Way, Aylesbury	13	45	41	47	38	49	42	52	42	52	45	48	39	50	43	48	39	50	43
330552	Stour Close, Aylesbury	49	45	41	49	39	50	43	53	44	54	46	50	41	51	44	50	41	51	44
330593	Parslow Close, Aylesbury	78	45	42	49	41	50	44	51	43	52	45	50	41	51	45	50	41	51	45
330723	Anton Way, Aylesbury	56	48	39	48	39	51	42	52	43	53	44	49	40	52	43	49	40	52	43
330937	Garron Close, Aylesbury	71	48	39	45	36	50	41	49	40	52	43	47	39	51	42	47	39	51	42
331111	Isis Close, Aylesbury	27	45	39	50	41	51	43	55	46	55	47	52	43	53	44	52	43	53	44

ID	Area Represented	No of Impacts Represented	Do Nothing (Opening Year baseline) L_{Aeq} dB		ES Design L_{Aeq} dB		ES Design Opening Year Baseline +Year 15 Traffic L_{Aeq} dB		Earthworks Design L_{Aeq} dB		Earthworks Design Year Baseline +Year 15 Traffic L_{Aeq} dB		Option 1 4m lineside barrier / 0m Green Banks / 4m lineside barrier L_{Aeq} dB		Option 1 4m lineside barrier / 0m Green Banks / 4m lineside barrier Opening Year Baseline +Year 15 Traffic L_{Aeq} dB		Option 2 4m lineside barrier / 3m Green Banks / 4m lineside barrier L_{Aeq} dB		Option 2 4m lineside barrier / 3m Green Banks / 4m lineside barrier Opening Year Baseline +Year 15 Traffic L_{Aeq} dB	
331451	Bowmont Drive, Aylesbury	63	45	41	45	37	48	42	50	41	51	44	48	39	49	43	48	39	49	43
331680	Anton Way, Aylesbury	103	45	39	48	39	50	42	53	44	54	45	50	41	51	43	50	41	51	43
331963	Hillier Road, Aylesbury	99	45	42	46	37	48	43	50	41	51	44	48	39	50	44	48	39	50	44
332206	Anton Way, Aylesbury	33		39	49	40	48	43	53	43	54	45	50	41	52	43	50	41	52	43
332217	Harbourne Close, Aylesbury	31	45	39	49	39	50	42	53	44	54	45	50	41	51	43	50	41	51	43
332328	Deverill Road, Aylesbury	28	45	39	50	41	51	43	55	45	55	46	52	42	53	44	52	42	53	44
332389	Oat Close, Aylesbury	41	45	39	52	43	53	45	57	48	57	48	54	45	55	46	54	45	55	46
332435	Anton Way, Aylesbury	64	45	41	48	38	49	43	52	43	53	45	49	40	51	44	49	40	51	44
334627	Hamble Drive, Aylesbury	146	47	41	41	33	47	41	45	37	49	42	43	36	49	42	43	35	48	42
335983	Grenville Road, Aylesbury	42	47	41	37	28	47	41	43	34	48	42	41	33	48	42	41	33	48	42
336058	Grenville Road, Aylesbury	125	47	41	38	28	47	41	43	34	48	42	41	33	48	42	41	33	48	42
336324	Cornbrook Road, Aylesbury	124	47	41	46	39	49	42	48	40	51	43	46	38	50	43	46	38	50	43
336610	Plym Close, Aylesbury	108	47	41	42	34	48	41	45	36	49	42	43	35	48	42	43	35	48	42
337269	Hannon Road, Aylesbury	65	47	41	43	35	48	42	47	38	50	43	44	36	49	42	44	36	49	42
337422	Nene Close, Aylesbury	27	45	46	48	40	49	46	51	42	52	47	48	40	50	47	48	40	50	47
337442	Frome Close, Aylesbury	45	45	46	42	33	47	46	47	38	49	47	45	36	48	46	45	36	48	46
337702	Tees Road, Aylesbury	44	47	41	44	36	48	42	48	39	51	43	46	37	49	42	46	37	49	42
337871	Nursery Close, Aylesbury	21	47	41	36	27	47	41	40	31	48	41	38	30	48	41	38	30	48	41
340267	Hughenden Green, Aylesbury	49	52	43	52	33	52	43	51	38	54	44	50	38	54	44	50	38	54	44
340847	Bowler Road, Aylesbury	77	52	43	39	31	52	43	43	35	53	44	42	34	52	43	42	34	52	43
341245	Lower Road, Aylesbury	17	52	43	52	33	52	43	52	40	55	45	51	39	54	45	51	39	54	45
341560	Mentmore Green, Aylesbury	108	52	43	45	35	53	43	48	40	53	45	47	40	53	45	47	40	53	45
341860	Kynaston Avenue, Aylesbury	2	52	43	49	41	54	46	51	42	55	46	50	42	54	45	50	42	54	45
341948	Rake Way, Aylesbury	127	52	43	43	34	52	43	47	38	53	44	45	37	53	44	45	37	53	44
348206	Keen Close, Aylesbury	75	47	42	39	30	48	42	44	35	49	43	40	32	48	42	40	31	48	42
348419	Prestwold Way, Aylesbury	113	56	46	48	40	56	46	55	46	58	49	49	41	57	47	48	40	57	47
348501	Andrews Way, Aylesbury	18	56	46	49	42	56	46	53	44	58	48	50	42	57	47	48	40	57	47
348799	Jakeman Way, Aylesbury	36	47	41	41	33	48	41	46	37	49	43	44	36	49	42	43	36	49	42
348914	Briskman Way, Aylesbury	88	47	41	40	31	47	41	44	36	49	42	43	35	48	42	42	34	48	42
349825	Wendover Road, Weston Turville	58	47	41	42	34	48	41	46	38	50	43	45	37	49	42	44	37	49	42
*	Non-residential																			

ID	Area Represented	No of Impacts Represented	Do Nothing (Opening Year baseline) L_{Aeq} dB		ES Design L_{Aeq} dB		ES Design Opening Year Baseline +Year 15 Traffic L_{Aeq} dB		Option 3 4m lineside barrier / 4m Green Banks / 4m lineside barrier L_{Aeq} dB		Option 3 4m lineside barrier /4m Green banks / 4m lineside barrier Opening Year Baseline +Year 15 Traffic L_{Aeq} dB		Option 4 5m lineside barrier / 0m Green banks / 5m lineside barrier L_{Aeq} dB		Option 4 5m lineside barrier / 0m Green banks / 5m lineside barrier Opening Year Baseline +Year 15 Traffic L_{Aeq} dB		Option 5 5m lineside barrier / 2m Green Banks / 5m lineside barrier L_{Aeq} dB		Option 5 5m lineside barrier / 2m Green Banks / 5m lineside barrier Opening Year Baseline +Year 15 Traffic L_{Aeq} dB	
			Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night
298707	Cooks Road, Aylesbury	78	51	41	47	38	52	42	45	36	52	42	46	37	52	42	45	35	52	42
298735	Hickman Street, Aylesbury	85	47	42	43	35	48	42	42	33	48	43	44	34	49	43	42	33	48	42
298817	Cooks Road, Aylesbury	78	46	36	47	38	49	39	46	36	49	39	46	37	49	39	45	35	48	39
298976	Eyre Close, Aylesbury	59	51	41	47	39	52	42	45	36	52	42	47	37	52	42	45	35	52	42
299219	Brimmers Way, Aylesbury	121	49	46	41	32	50	46	41	31	50	46	41	32	50	46	40	31	50	46
299591	Brimmers Way, Aylesbury	75	49	46	42	32	50	46	42	33	50	46	42	33	50	46	42	32	50	46
299978	Great Meadow Way, Aylesbury	65	47	42	43	34	49	42	43	34	49	43	44	34	49	43	42	33	48	43
300635	Napier Road, Aylesbury	61	46	35	47	38	50	40	48	38	50	40	48	38	50	40	47	37	49	39
300647	Warbler Close, Aylesbury	69	44	39	47	38	48	41	47	37	49	41	47	37	49	41	45	36	48	41
300773	Wren Path, Aylesbury	32	49	46	42	33	50	46	43	33	50	46	43	33	50	46	42	32	50	46
300929	Spruce Road, Aylesbury	43	49	46	44	35	50	46	45	35	50	46	45	35	50	46	44	34	50	46
301228	Grosvenor Way, Aylesbury	68	48	38	48	39	51	41	49	40	52	42	49	40	52	42	48	39	51	42
301296	Arncott Way, Aylesbury	36	49	46	44	35	50	46	45	35	50	46	45	36	50	46	44	34	50	46
301483	Chelsea Road, Aylesbury	14	49	46	46	37	51	47	48	39	52	47	48	39	52	47	48	38	51	47
301668	Chelsea Road, Aylesbury	21	49	46	45	36	51	46	47	37	51	47	47	37	51	47	46	37	51	46
301851	Hampstead Close, Aylesbury	35	49	46	45	35	50	46	46	36	51	46	46	36	51	46	45	36	50	46
306197	Swallow Lane, Aylesbury	24	47	42	43	34	48	42	43	33	48	43	43	34	48	43	42	32	48	42
307325	Meredith Drive, Aylesbury	48	49	46	41	31	50	46	42	32	50	46	42	32	50	46	41	32	50	46
308644	Gogh Road, Aylesbury	40	49	46	43	34	50	46	44	35	50	46	44	35	50	46	44	35	50	46
308665	Picasso Place, Aylesbury	40	49	46	43	33	50	46	44	34	50	46	44	34	50	46	44	34	50	46
308722	Rabans Lane, Aylesbury *, (General Commercial)	1	49	46	43	34	50	46	45	35	50	46	45	35	50	46	45	35	50	46
309021	Telford Close, Aylesbury	1	49	46	39	30	50	46	40	31	50	46	40	31	50	46	39	30	49	46
309118	Tompion Road, Aylesbury	1	47	42	44	35	49	43	46	37	49	43	46	37	49	43	46	36	49	43
309275	Edison Road, Rabans Lane Industrial Area *, (General Commercial)	10	47	36	50	41	52	42	52	43	53	44	52	43	53	44	52	43	53	44
309296	Rabans Lane, Aylesbury	4	47	36	52	43	53	43	53	44	54	45	53	44	54	45	53	44	54	45
309320	Woodley House, Rabans Close Industrial Area *, (Office)	1	47	36	47	38	50	40	50	40	52	42	50	40	52	42	50	40	52	42
309415	Edison Road, Rabans Lane Industrial Area *, (Office)	8	47	36	50	40	52	42	52	42	53	43	52	42	53	43	52	42	53	43
309474	Rabans Lane, Aylesbury	2	50	46	49	39	52	47	51	41	53	47	51	41	53	47	50	41	53	47
316101	Hampden Square, Aylesbury	189	47	42	41	33	48	42	41	32	48	42	42	33	48	42	41	31	48	42
317279	Booker Park School, Stoke Leys Close, Aylesbury *, (School)	1	52	43	50	43	55	46	50	42	54	46	50	42	54	46	50	42	54	46
319293	Pearson Close, Aylesbury	35	57	48	49	42	56	46	49	42	58	49	49	42	58	49	49	42	58	49

ID	Area Represented	No of Impacts Represented	Do Nothing (Opening Year baseline) L_{Aeq} dB		ES Design L_{Aeq} dB		ES Design Opening Year Baseline +Year 15 Traffic L_{Aeq} dB		Option 3 4m lineside barrier / 4m Green Banks / 4m lineside barrier L_{Aeq} dB		Option 3 4m lineside barrier /4m Green banks / 4m lineside barrier Opening Year Baseline +Year 15 Traffic L_{Aeq} dB		Option 4 5m lineside barrier / 0m Green banks / 5m lineside barrier L_{Aeq} dB		Option 4 5m lineside barrier / 0m Green banks / 5m lineside barrier Opening Year Baseline +Year 15 Traffic L_{Aeq} dB		Option 5 5m lineside barrier / 2m Green Banks / 5m lineside barrier L_{Aeq} dB		Option 5 5m lineside barrier / 2m Green Banks / 5m lineside barrier Opening Year Baseline +Year 15 Traffic L_{Aeq} dB	
319305	Church of Jesus Christ of Latter day Saints, Aylesbury *, (Church)	1	57	48	44	36	57	48	44	36	57	48	45	37	57	48	45	36	57	48
319325	Alham Road, Aylesbury	93	47	41	43	35	48	42	43	35	49	42	43	35	49	42	43	35	49	42
319422	Dormer Close, Aylesbury	118	49	44	49	44	49	44	47	40	51	46	48	41	52	46	47	41	51	46
319615	Bonham Close, Aylesbury	178	49	44	49	44	49	44	49	41	52	46	49	41	52	46	49	41	52	46
320227	Briskman Way, Aylesbury	28	57	48	40	31	57	48	39	31	57	48	41	33	57	48	40	32	57	48
320409	Oxford Road, Hartwell	1	59	50	55	46	55	46	58	50	58	50	60	52	60	52	59	51	59	51
320715	Lupin Walk, Aylesbury	127	49	44	50	42	50	45	49	42	52	46	49	42	52	46	49	42	52	46
320799	Oxford Road, Hartwell	1	52	43	61	52	61	52	62	53	62	54	64	55	64	55	63	54	63	54
320819	Oxford Road, Hartwell	1	56	48	60	51	60	51	58	50	60	52	61	52	62	53	60	51	61	53
324002	Slattenham Close, Aylesbury	208	47	41	39	31	47	41	41	33	48	42	43	35	48	42	42	34	48	42
324129	Rowland Way, Aylesbury	112	47	41	42	34	47	41	43	36	49	42	45	37	49	42	44	36	49	42
325151	Upper Abbotts Hill, Aylesbury	118	57	48	50	42	57	47	51	43	58	49	52	44	58	49	51	43	58	49
325211	Great Meadow Way, Aylesbury	72	57	48	44	35	57	48	44	36	57	48	45	37	57	48	44	36	57	48
325431	Horton Close, Aylesbury	130	57	48	44	36	57	48	44	36	57	48	46	38	57	48	45	37	57	48
325816	Pitcher Walk, Aylesbury	347	47	42	42	34	48	42	43	35	48	43	44	36	49	43	43	35	49	43
327675	Torridge Road, Aylesbury	176	47	41	42	33	48	41	44	35	49	42	43	34	48	42	43	34	48	42
328417	Ellen Road, Aylesbury	1	45	41	41	32	46	41	43	34	47	42	42	34	47	42	42	34	47	42
328584	Brent Path, Aylesbury	41	45	41	44	35	47	41	46	37	48	42	44	35	48	42	44	35	48	42
328805	Lowmon Way, Aylesbury	53	45	41	45	36	48	42	47	38	49	43	45	37	48	42	45	37	48	42
329008	Orwell Close, Aylesbury	84	45	41	42	33	47	41	44	36	48	42	43	35	47	42	43	35	47	42
329139	Enborne Close, Aylesbury	64	45	41	44	35	47	42	46	37	49	43	45	37	48	42	45	37	48	42
329253	Welland Road, Aylesbury	30	45	46	46	37	48	46	47	38	49	47	46	37	48	47	46	37	48	47
329413	Blackwater Drive, Aylesbury	61	47	41	45	36	49	42	46	38	50	43	45	37	49	42	45	37	49	42
329685	Witham Way, Aylesbury	57	45	41	48	39	49	43	48	40	50	43	47	39	49	43	47	39	49	43
329807	Witham Way, Aylesbury	44	45	41	46	37	49	42	48	39	50	43	46	37	49	42	46	37	49	42
330063	Alwin Close, Aylesbury	84	47	41	43	34	48	42	45	36	49	42	44	35	49	42	44	35	49	42
330343	Ebble Close, Aylesbury	78	45	41	46	37	48	42	47	38	49	43	46	37	48	43	46	37	48	43
330464	Anton Way, Aylesbury	13	45	41	47	38	49	42	48	39	50	43	47	38	49	43	47	38	49	43
330552	Stour Close, Aylesbury	49	45	41	49	39	50	43	50	41	51	44	48	39	50	43	48	39	50	43
330593	Parslow Close, Aylesbury	78	45	42	49	41	50	44	50	41	51	45	49	40	50	44	49	40	50	44
330723	Anton Way, Aylesbury	56	48	39	48	39	51	42	49	40	52	43	48	39	51	42	48	39	51	42
330937	Garron Close, Aylesbury	71	48	39	45	36	50	41	47	39	51	42	46	38	50	41	46	38	50	41
331111	Isis Close, Aylesbury	27	45	39	50	41	51	43	52	43	53	44	51	42	52	43	51	42	52	43
331451	Bowmont Drive, Aylesbury	63	45	41	45	37	48	42	48	39	49	43	46	37	49	43	46	37	49	43

ID	Area Represented	No of Impacts Represented	Do Nothing (Opening Year baseline) L_{Aeq} dB		ES Design L_{Aeq} dB		ES Design Opening Year Baseline +Year 15 Traffic L_{Aeq} dB		Option 3 4m lineside barrier / 4m Green Banks / 4m lineside barrier L_{Aeq} dB		Option 3 4m lineside barrier /4m Green banks / 4m lineside barrier Opening Year Baseline +Year 15 Traffic L_{Aeq} dB		Option 4 5m lineside barrier / 0m Green banks / 5m lineside barrier L_{Aeq} dB		Option 4 5m lineside barrier / 0m Green banks / 5m lineside barrier Opening Year Baseline +Year 15 Traffic L_{Aeq} dB		Option 5 5m lineside barrier / 2m Green Banks / 5m lineside barrier L_{Aeq} dB		Option 5 5m lineside barrier / 2m Green Banks / 5m lineside barrier Opening Year Baseline +Year 15 Traffic L_{Aeq} dB	
331680	Anton Way, Aylesbury	103	45	39	48	39	50	42	50	41	51	43	49	39	50	42	49	39	50	42
331963	Hillier Road, Aylesbury	99	45	42	46	37	48	43	48	39	50	44	47	38	49	44	47	38	49	44
332206	Anton Way, Aylesbury	33	48	39	49	40	52	43	50	41	52	43	49	40	51	42	49	40	51	42
332217	Harbourne Close, Aylesbury	31	45	39	49	39	50	42	50	41	51	43	48	39	50	42	48	39	50	42
332328	Deverill Road, Aylesbury	28	45	39	50	41	51	43	52	42	53	44	50	41	51	43	50	41	51	43
332389	Oat Close, Aylesbury	41	45	39	52	43	53	45	54	45	55	46	52	43	53	45	52	43	53	45
332435	Anton Way, Aylesbury	64	45	41	48	38	49	43	49	40	51	44	48	39	50	43	48	39	50	43
334627	Hamble Drive, Aylesbury	146	47	41	41	33	47	41	43	35	48	42	43	35	48	42	43	35	48	42
335983	Grenville Road, Aylesbury	42	47	41	37	28	47	41	41	33	48	42	40	32	48	42	40	32	48	42
336058	Grenville Road, Aylesbury	125	47	41	38	28	47	41	41	33	48	42	40	32	48	42	40	32	48	42
336324	Cornbrook Road, Aylesbury	124	47	41	46	39	49	42	46	38	50	43	46	38	49	43	46	38	49	43
336610	Plym Close, Aylesbury	108	47	41	42	34	48	41	43	35	48	42	42	35	48	42	42	34	48	42
337269	Hannon Road, Aylesbury	65	47	41	43	35	48	42	44	36	49	42	44	36	49	42	44	36	49	42
337422	Nene Close, Aylesbury	27	45	46	48	40	49	46	48	40	50	47	47	39	49	47	47	39	49	47
337442	Frome Close, Aylesbury	45	45	46	42	33	47	46	45	36	48	46	44	35	47	46	44	35	47	46
337702	Tees Road, Aylesbury	44	47	41	44	36	48	42	46	37	49	42	45	36	49	42	45	36	49	42
337871	Nursery Close, Aylesbury	21	47	41	36	27	47	41	38	30	48	41	37	29	47	41	37	29	47	41
340267	Hughenden Green, Aylesbury	49	52	43	52	33	52	43	50	38	54	44	50	38	54	44	50	38	54	44
340847	Bowler Road, Aylesbury	77	52	43	39	31	52	43	42	34	52	43	41	33	52	43	41	33	52	43
341245	Lower Road, Aylesbury	17	52	43	52	33	52	43	51	39	54	45	51	39	54	45	51	39	54	45
341560	Mentmore Green, Aylesbury	108	52	43	45	35	53	43	47	40	53	45	47	40	53	45	47	40	53	45
341860	Kynaston Avenue, Aylesbury	2	52	43	49	41	54	46	50	42	54	45	50	42	54	45	50	42	54	45
341948	Rake Way, Aylesbury	127	52	43	43	34	52	43	45	37	53	44	45	36	53	44	45	36	53	44
348206	Keen Close, Aylesbury	75	47	42	39	30	48	42	39	31	48	42	40	32	48	42	39	31	48	42
348419	Prestwold Way, Aylesbury	113	56	46	48	40	56	46	48	39	57	47	49	41	57	47	48	40	57	47
348501	Andrews Way, Aylesbury	18	56	46	49	42	56	46	48	40	57	47	50	42	57	47	49	41	57	47
348799	Jakeman Way, Aylesbury	36	47	41	41	33	48	41	43	36	49	42	44	36	49	42	44	36	49	42
348914	Briskman Way, Aylesbury	88	47	41	40	31	47	41	42	34	48	42	42	34	48	42	42	34	48	42
349825	Wendover Road, Weston Turville	58	47	41	42	34	48	41	44	37	49	42	44	37	49	42	44	37	49	42
*	Non-residential																			

Table 38 Comparison of Receptors above LOAEL at the most affected receptor grouping

Table 39 below summarises the changes in noise levels due to each of the Noise Barrier Design Options, comparing them with the Do Nothing scenario. The ES predicted a significant effect in Stoke Mandeville to the east of the HS2 alignment as indicated by the significant effect OSV11-C02.

The No Noise Barrier Option (mitigation in the form of earthworks) shows additional effects over what was reported in the ES.

Noise Barrier Design Option Option1, Option 2, Option 3 and Option 4 show fewer effects above LOAEL than reported in the ES.

ID	Significant Effect	No of Impacts Represented	Significant Effect	ES Design		Change in Noise Levels Compared with Do-Nothing Scenario											
				DM - ES Design		DM - No Barrier		Option 1 - 4m Barrier / 0m Green Banks/ 1.25m viaduct		Option 2 - 4m Barrier / 3m Green Banks/ 1.25m viaduct		Option 3 - 4m Barrier / 4m Green Banks/ 1.25m viaduct		Option 4 - 5m Barrier / 0m Green Banks/ 1.25m viaduct		Option 5 - 5m Barrier / 2m Green Banks/ 1.25m viaduct	
				Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night
298707	Cooks Road, Aylesbury	78		1	1	5	6	1	1	1	1	1	1	1	1	1	1
298735	Hickman Street, Aylesbury	85		1	0	4	2	2	1	1	1	1	1	2	1	1	0
298817	Cooks Road, Aylesbury	78	#	3	3	8	8	3	3	3	3	3	3	3	3	2	3
298976	Eyre Close, Aylesbury	59		1	1	6	6	1	1	1	1	1	1	1	1	1	1
299219	Brimmers Way, Aylesbury	121		1	0	2	0	1	0	1	0	1	0	1	0	1	0
299591	Brimmers Way, Aylesbury	75		1	0	2	1	1	0	1	0	1	0	1	0	1	0
299978	Great Meadow Way, Aylesbury	65		2	0	4	2	2	1	2	1	2	1	2	1	1	1
300635	Napier Road, Aylesbury	61	#	4	5	7	8	4	5	4	5	4	5	4	5	3	4
300647	Warbler Close, Aylesbury	69	#	5	2	8	5	5	2	5	2	5	2	5	2	4	2
300773	Wren Path, Aylesbury	32		1	0	2	1	1	0	1	0	1	0	1	0	1	0
300929	Spruce Road, Aylesbury	43		1	0	3	1	1	0	1	0	1	0	1	0	1	0
301228	Grosvenor Way, Aylesbury	68	#	3	3	6	7	4	4	4	4	4	4	4	4	3	4
301296	Arncott Way, Aylesbury	36		1	0	3	1	1	0	1	0	1	0	1	0	1	0
301483	Chelsea Road, Aylesbury	14		2	1	4	1	3	1	3	1	3	1	3	1	2	1
301668	Chelsea Road, Aylesbury	21		2	0	3	1	2	1	2	1	2	1	2	1	2	0
301851	Hampstead Close, Aylesbury	35		1	0	3	1	2	0	2	0	2	0	2	0	1	0
306197	Swallow Lane, Aylesbury	24		1	0	4	2	1	1	1	1	1	1	1	1	1	0
307325	Meredith Drive, Aylesbury	48		1	0	1	0	1	0	1	0	1	0	1	0	1	0
308644	Gogh Road, Aylesbury	40		1	0	2	0	1	0	1	0	1	0	1	0	1	0
308665	Picasso Place, Aylesbury	40		1	0	1	0	1	0	1	0	1	0	1	0	1	0
308722	Rabans Lane, Aylesbury, (General Commercial)	1		1	0	2	1	1	0	1	0	1	0	1	0	1	0
309021	Telford Close, Aylesbury	1		1	0	1	0	1	0	1	0	1	0	1	0	0	0
309118	Tompion Road, Aylesbury	1		2	1	4	2	2	1	2	1	2	1	2	1	2	1
309275	Edison Road, Rabans Lane Industrial Area, (General Commercial)	10		5	6	8	9	6	8	6	8	6	8	6	8	6	8
309296	Rabans Lane, Aylesbury	4	~	6	8	10	12	7	9	7	9	7	9	7	9	7	9
309320	Woodley House, Rabans Close Industrial Area (Office)	1		3	4	6	7	5	6	5	6	5	6	5	6	5	6
309415	Edison Road, Rabans Lane Industrial Area, (office)	8		4	6	8	9	6	7	6	7	6	7	6	7	6	7
309474	Rabans Lane, Aylesbury	2	#	3	1	5	2	3	1	3	1	3	1	3	1	3	1
316101	Hampden Square, Aylesbury	189		1	0	3	1	1	0	1	0	1	0	1	0	1	0
317279	Booker Park School, Stoke Leys Close, Aylesbury (School)	1	OSV11-N01	3	3	2	3	2	3	2	3	2	3	2	3	2	3
319293	Pearson Close, Aylesbury	35		-1	-2	1	1	1	1	1	1	1	1	1	1	1	1
319305	Church of Jesus Christ of Latter day Saints, Aylesbury (Church)	1		0	0	0	0	0	0	0	0	0	0	0	0	0	0

ID	Significant Effect	No of Impacts Represented	Significant Effect	ES Design		Change in Noise Levels Compared with Do-Nothing Scenario											
				DM - ES Design		DM - No Barrier		Option 1 - 4m Barrier / 0m Green Banks/ 1.25m viaduct		Option 2 - 4m Barrier / 3m Green Banks/ 1.25m viaduct		Option 3 - 4m Barrier / 4m Green Banks/ 1.25m viaduct		Option 4 - 5m Barrier / 0m Green Banks/ 1.25m viaduct		Option 5 - 5m Barrier / 2m Green Banks/ 1.25m viaduct	
				Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night
319325	Alham Road, Aylesbury	93		1	1	2	2	2	1	2	1	2	1	2	1	2	1
319422	Dormer Close, Aylesbury	118		0	0	3	2	3	2	2	2	2	2	3	2	2	2
319615	Bonham Close, Aylesbury	178		0	0	4	2	3	2	3	2	3	2	3	2	3	2
320227	Briskman Way, Aylesbury	28		0	0	0	0	0	0	0	0	0	0	0	0	0	0
320409	Oxford Road, Hartwell	1		-4	-4	2	3	1	2	0	0	-1	0	1	2	0	1
320715	Lupin Walk, Aylesbury	127		2	1	4	3	3	2	3	2	3	2	3	2	3	2
320799	Oxford Road, Hartwell	1	~	10	9	15	14	12	12	11	11	10	11	12	12	11	11
320819	Oxford Road, Hartwell	1	~	4	3	8	7	6	5	5	4	4	4	6	5	5	5
324002	Slattenham Close, Aylesbury	208		0	0	2	1	1	1	1	1	1	1	1	1	1	1
324129	Rowland Way, Aylesbury	112		0	0	3	2	2	1	2	1	2	1	2	1	2	1
325151	Upper Abbotts Hill, Aylesbury	118		0	-1	1	2	1	1	1	1	1	1	1	1	1	1
325211	Great Meadow Way, Aylesbury	72		0	0	1	1	0	0	0	0	0	0	0	0	0	0
325431	Horton Close, Aylesbury	130		0	0	1	1	0	0	0	0	0	0	0	0	0	0
325816	Pitcher Walk, Aylesbury	347		1	0	3	2	2	1	1	1	1	1	2	1	2	1
327675	Torridge Road, Aylesbury	176		1	1	3	2	2	1	2	1	2	1	1	1	1	1
328417	Ellen Road, Aylesbury	1		1	0	3	1	2	1	2	1	2	1	2	1	2	1
328584	Brent Path, Aylesbury	41		2	1	5	2	3	1	3	1	3	1	3	1	3	1
328805	Lowmon Way, Aylesbury	53		3	1	6	3	4	2	4	2	4	2	3	1	3	1
329008	Orwell Close, Aylesbury	84		2	1	4	2	3	1	3	1	3	1	2	1	2	1
329139	Enborne Close, Aylesbury	64		2	1	5	2	4	2	4	2	4	2	3	1	3	1
329253	Welland Road, Aylesbury	30	#	3	0	6	1	4	1	4	1	4	1	3	1	3	1
329413	Blackwater Drive, Aylesbury	61		2	1	4	3	3	2	3	2	3	2	2	1	2	1
329685	Witham Way, Aylesbury	57	#	4	2	8	4	5	2	5	2	5	2	4	2	4	2
329807	Witham Way, Aylesbury	44	#	4	2	7	3	5	2	5	2	5	2	4	1	4	1
330063	Alwin Close, Aylesbury	84		1	1	3	2	2	1	2	1	2	1	2	1	2	1
330343	Ebble Close, Aylesbury	78	#	3	1	6	3	4	2	4	2	4	2	3	2	3	2
330464	Anton Way, Aylesbury	13	#	4	2	7	4	5	2	5	2	5	2	4	2	4	2
330552	Stour Close, Aylesbury	49	#	5	3	9	5	6	3	6	3	6	3	5	2	5	2
330593	Parslow Close, Aylesbury	78	#	5	2	7	3	6	3	6	3	6	3	5	2	5	2
330723	Anton Way, Aylesbury	56	#	3	3	5	5	4	4	4	4	4	4	3	3	3	3
330937	Garron Close, Aylesbury	71		2	2	4	4	3	3	3	3	3	3	2	2	2	2
331111	Isis Close, Aylesbury	27	OSV11-C04	6	4	10	8	8	5	8	5	8	5	7	4	7	4
331451	Bowmont Drive, Aylesbury	63	#	3	1	6	3	4	2	4	2	4	2	4	2	4	2

ID	Significant Effect	No of Impacts Represented	Significant Effect	ES Design		Change in Noise Levels Compared with Do-Nothing Scenario											
				DM - ES Design		DM - No Barrier		Option 1 - 4m Barrier / 0m Green Banks/ 1.25m viaduct		Option 2 - 4m Barrier / 3m Green Banks/ 1.25m viaduct		Option 3 - 4m Barrier / 4m Green Banks/ 1.25m viaduct		Option 4 - 5m Barrier / 0m Green Banks/ 1.25m viaduct		Option 5 - 5m Barrier / 2m Green Banks/ 1.25m viaduct	
				Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night
331680	Anton Way, Aylesbury	103	#	5	3	9	6	6	4	6	4	6	4	5	3	5	3
331963	Hillier Road, Aylesbury	99	#	3	1	6	2	5	2	5	2	5	2	4	2	4	2
332206	Anton Way, Aylesbury	33	OSV11-C04	3	4	6	6	4	4	4	4	4	4	3	3	3	3
332217	Harbourne Close, Aylesbury	31	#	5	3	9	6	6	4	6	4	6	4	5	3	5	3
332328	Deverill Road, Aylesbury	28	OSV11-C04	6	4	10	7	8	5	8	5	8	5	6	4	6	4
332389	Oat Close, Aylesbury	41	OSV11-C04	8	5	12	9	10	7	10	7	10	7	8	6	8	6
332435	Anton Way, Aylesbury	64	#	4	2	8	4	6	3	6	3	6	3	5	2	5	2
334627	Hamble Drive, Aylesbury	146		1	0	2	1	2	1	1	1	1	1	1	1	1	1
335983	Grenville Road, Aylesbury	42		1	0	1	1	1	1	1	1	1	1	1	1	1	1
336058	Grenville Road, Aylesbury	125		1	0	1	1	1	1	1	1	1	1	1	1	1	1
336324	Cornbrook Road, Aylesbury	124	#	2	1	4	2	3	2	3	2	3	2	2	2	2	2
336610	Plym Close, Aylesbury	108		1	1	2	1	1	1	1	1	1	1	1	1	1	1
337269	Hannon Road, Aylesbury	65		1	1	3	2	2	1	2	1	2	1	2	1	2	1
337422	Nene Close, Aylesbury	27	#	4	1	7	1	5	1	5	1	5	1	4	1	4	1
337442	Frome Close, Aylesbury	45		2	0	4	1	3	0	3	0	3	0	2	0	2	0
337702	Tees Road, Aylesbury	44		2	1	4	2	2	1	2	1	2	1	2	1	2	1
337871	Nursery Close, Aylesbury	21		0	0	1	0	1	0	1	0	1	0	0	0	0	0
340267	Hughenden Green, Aylesbury	49		1	0	2	1	2	1	2	1	2	1	2	1	2	1
340847	Bowler Road, Aylesbury	77		0	0	1	1	0	0	0	0	0	0	0	0	0	0
341245	Lower Road, Aylesbury	17		0	0	3	2	2	2	2	2	2	2	2	2	2	2
341560	Mentmore Green, Aylesbury	108		1	0	1	2	1	2	1	2	1	2	1	2	1	2
341860	Kynaston Avenue, Aylesbury	2	OSV11-C03	2	3	3	3	2	2	2	2	2	2	2	2	2	2
341948	Rake Way, Aylesbury	127		0	1	1	1	1	1	1	1	1	1	1	1	1	1
348206	Keen Close, Aylesbury	75		1	0	2	1	1	0	1	0	1	0	1	0	1	0
348419	Prestwold Way, Aylesbury	113		0	0	2	3	1	1	1	1	1	1	1	1	1	1
348501	Andrews Way, Aylesbury	18		0	0	2	2	1	1	1	1	1	1	1	1	1	1
348799	Jakeman Way, Aylesbury	36		1	0	2	2	2	1	2	1	2	1	2	1	2	1
348914	Briskman Way, Aylesbury	88		0	0	2	1	1	1	1	1	1	1	1	1	1	1
349825	Wendover Road, Weston Turville	58		1	0	3	2	2	1	2	1	2	1	2	1	2	1

Table 39 Consideration of Receptors above LOAEL at most affected receptor grouping – Stoke Mandeville Overbridge to POxford Road Overbridge – Up Side

The predicted L_{max} levels for the No Noise Barrier Option (mitigation in the form of earthworks), Noise Barrier Design Option 1, Option 2, Option 3 Option 4 and Option 5 are shown in Table 40 below. Locations where operational rail noise levels are predicted to exceed the daytime LOAEL of 57.5dB (free-field) are highlighted in red.

Table 40 shows that the Noise Barrier Design Options show more L_{Amax} impacts above LOAEL than the ES. The increase in L_{max} impacts above LOAEL is attributed to the essential track lift to allow the removal of the Aylesbury pump station and the associated loss of screening.

Table 40 also shows that Option1 (4m barrier with no barrier in the Green Banks Scheme) and Option 4 (5m barrier with no barrier in the Green Banks Scheme, show more L_{max} impacts above LOAEL than the ES, indicating that barriers would be required in the Green Banks Scheme to reduce the number of L_{max} exceedances of LOAEL.

Barrier Option 1, Barrier Option 2, Option 3, Option 4 and Option 5 also show an exceedance of SOAEL at ID 320799, which was not the case in the ES. The exceedance of SOAEL is attributed to the track lift in the area, resulting in reduced screening at the receptor.

Locations where operational rail noise levels are predicted to exceed the night-time LOAEL of 57.5dB (free-field) would be highlighted in light red; with locations where the SOAEL is exceeded (77.5dB Free field) in a darker red

ID	Area Represented	No of Impacts Represented	No barrier	Option 1 4m 0m Green Banks	Option 24m 3m Green Banks	Option 3 4m 4m Green Banks	Option 4 5m 0m Green Banks	Option 5 5m 2m Green Banks	ES
298707	Cooks Road, Aylesbury	78	67	63	60	60	63	58	59/63
298735	Hickman Street, Aylesbury	85	62	60	55	54	60	54	55/59
298817	Cooks Road, Aylesbury	78	66	62	60	60	62	57	58/62
298976	Eyre Close, Aylesbury	59	69	65	59	59	65	59	58/63
299219	Brimmers Way, Aylesbury	121	57	55	54	54	55	54	53/56
299591	Brimmers Way, Aylesbury	75	57	57	57	57	57	57	54/57
299978	Great Meadow Way, Aylesbury	65	61	57	55	55	57	55	54/57
300635	Napier Road, Aylesbury	61	64	62	62	62	62	61	59/62
300647	Warbler Close, Aylesbury	69	63	61	61	61	61	58	57/61
300773	Wren Path, Aylesbury	32	59	56	56	56	56	56	54/57
300929	Spruce Road, Aylesbury	43	59	59	59	59	59	59	56/59
301228	Grosvenor Way, Aylesbury	68	64	64	64	64	64	64	62/65
301296	Arncott Way, Aylesbury	36	61	58	58	58	58	58	55/58
301483	Chelsea Road, Aylesbury	14	64	64	64	64	64	64	61/64
301668	Chelsea Road, Aylesbury	21	62	62	62	62	62	62	60/63
301851	Hampstead Close, Aylesbury	35	60	60	60	60	60	60	58/61
306197	Swallow Lane, Aylesbury	24	60	58	54	54	58	54	54/57
307325	Meredith Drive, Aylesbury	48	56	56	56	56	56	56	54/57
308644	Gogh Road, Aylesbury	40	59	59	59	59	59	59	57/60
308665	Picasso Place, Aylesbury	40	59	59	59	59	59	59	57/60
308722	Rabans Lane, Aylesbury, (General Commercial)	1	60	60	60	60	60	60	56/59
309021	Telford Close, Aylesbury	1	55	55	55	55	55	55	51/54
309118	Tompion Road, Aylesbury	1	61	61	61	61	61	61	58/61

ID	Area Represented	No of Impacts Represented	No barrier	Option 1 4m 0m Green Banks	Option 24m 3m Green Banks	Option 3 4m 4m Green Banks	Option 4 5m 0m Green Banks	Option 5 5m 2m Green Banks	ES
309275	Edison Road, Rabans Lane Industrial Area, (General Commercial)	10	71	68	68	68	68	68	64/67
309296	Rabans Lane, Aylesbury	4	73	69	69	69	69	69	66/69
309320	Woodley House, Rabans Close Industrial Area (Office)	1	65	65	65	65	65	65	61/64
309415	Edison Road, Rabans Lane Industrial Area, (office)	8	69	67	67	67	67	67	64/67
309474	Rabans Lane, Aylesbury	2	66	67	67	67	67	67	64/67
316101	Hampden Square, Aylesbury	189	59	58	53	53	58	53	52/55
317279	Booker Park School, Stoke Leys Close, Aylesbury (School)	1	57	57	57	57	57	57	59/62
319293	Pearson Close, Aylesbury	35	66	63	57	55	63	57	55/60
319305	Church of Jesus Christ of Latter Day Saints, Aylesbury (Church)	1	61	59	53	51	59	51	51/54
319325	Alham Road, Aylesbury	93	57	56	54	54	56	53	51/54
319422	Dormer Close, Aylesbury	118	66	63	56	55	63	55	55/59
319615	Bonham Close, Aylesbury	178	63	61	57	56	61	56	54/58
320227	Briskman Way, Aylesbury	28	63	60	53	52	60	52	52/56
320409	Oxford Road, Hartwell	1	76	74	70	69	74	70	69/71
320715	Lupin Walk, Aylesbury	127	59	59	58	58	59	56	54/58
320799	Oxford Road, Hartwell	1	80.5	80.5	77.6	78	80.5	80	74/77
320819	Oxford Road, Hartwell	1	75	75	72	71	75	71	68/72
324002	Slattenham Close, Aylesbury	208	58	57	52	50	57	50	50/53
324129	Rowland Way, Aylesbury	112	64	61	54	52	61	52	52/55
325151	Upper Abbotts Hill, Aylesbury	118	67	64	57	56	64	56	56/61
325211	Great Meadow Way, Aylesbury	72	61	61	56	56	61	55	55/60
325431	Horton Close, Aylesbury	130	67	62	57	56	62	56	55/60

ID	Area Represented	No of Impacts Represented	No barrier	Option 1 4m 0m Green Banks	Option 24m 3m Green Banks	Option 3 4m 4m Green Banks	Option 4 5m 0m Green Banks	Option 5 5m 2m Green Banks	ES
325816	Pitcher Walk, Aylesbury	347	64	60	54	52	60	52	52/55
327675	Torridge Road, Aylesbury	176	54	54	54	54	52	52	51/54
328417	Ellen Road, Aylesbury	1	54	54	54	54	52	52	50/53
328584	Brent Path, Aylesbury	41	57	57	57	57	55	55	54/58
328805	Lowmon Way, Aylesbury	53	59	59	59	59	56	56	55/59
329008	Orwell Close, Aylesbury	84	55	55	55	55	53	53	52/55
329139	Enborne Close, Aylesbury	64	58	57	57	57	56	56	53/57
329253	Welland Road, Aylesbury	30	58	58	58	58	57	57	56/60
329413	Blackwater Drive, Aylesbury	61	58	58	58	58	56	56	55/58
329685	Witham Way, Aylesbury	57	63	60	60	60	58	58	57/62
329807	Witham Way, Aylesbury	44	59	59	59	59	58	58	57/61
330063	Alwin Close, Aylesbury	84	56	56	56	56	54	54	53/56
330343	Ebble Close, Aylesbury	78	60	60	60	60	57	57	56/60
330464	Anton Way, Aylesbury	13	61	61	61	61	59	59	57/62
330552	Stour Close, Aylesbury	49	65	62	62	62	60	60	59/64
330593	Parslow Close, Aylesbury	78	62	61	61	61	60	60	59/61
330723	Anton Way, Aylesbury	56	63	62	62	62	60	60	58/62
330937	Garron Close, Aylesbury	71	60	59	59	59	57	57	55/58
331111	Isis Close, Aylesbury	27	67	66	66	66	65	65	61/65
331451	Bowmont Drive, Aylesbury	63	60	60	60	60	58	58	56/60
331680	Anton Way, Aylesbury	103	65	64	64	64	61	61	59/63
331963	Hillier Road, Aylesbury	99	60	59	59	59	58	58	55/59
332206	Anton Way, Aylesbury	33	64	64	64	64	62	62	59/63

ID	Area Represented	No of Impacts Represented	No barrier	Option 1 4m 0m Green Banks	Option 24m 3m Green Banks	Option 3 4m 4m Green Banks	Option 4 5m 0m Green Banks	Option 5 5m 2m Green Banks	ES
332217	Harbourne Close, Aylesbury	31	62	62	62	62	60	60	60/64
332328	Deverill Road, Aylesbury	28	65	65	65	65	62	62	62/66
332389	Oat Close, Aylesbury	41	69	68	68	68	65	65	63/68
332435	Anton Way, Aylesbury	64	62	61	61	61	59	59	58/63
334627	Hamble Drive, Aylesbury	146	55	55	52	52	55	51	49/52
335983	Grenville Road, Aylesbury	42	50	50	50	50	48	48	47/51
336058	Grenville Road, Aylesbury	125	50	50	50	50	49	49	47/51
336324	Cornbrook Road, Aylesbury	124	56	56	56	56	54	54	53/57
336610	Plym Close, Aylesbury	108	52	52	52	52	51	50	49/53
337269	Hannon Road, Aylesbury	65	54	54	54	54	52	52	51/55
337422	Nene Close, Aylesbury	27	58	58	58	58	57	57	56/61
337442	Frome Close, Aylesbury	45	56	56	56	56	55	55	52/55
337702	Tees Road, Aylesbury	44	56	56	56	56	55	55	54/57
337871	Nursery Close, Aylesbury	21	48	48	48	48	47	47	45/48
340267	Hughenden Green, Aylesbury	49	52	52	52	52	52	52	48/51
340847	Bowler Road, Aylesbury	77	52	52	52	52	51	51	49/52
341245	Lower Road, Aylesbury	17	54	54	54	54	54	54	51/54
341560	Mentmore Green, Aylesbury	108	53	53	53	53	53	53	53/56
341860	Kynaston Avenue, Aylesbury	2	59	59	59	59	59	59	59/62
341948	Rake Way, Aylesbury	127	56	56	56	56	55	55	52/55
348206	Keen Close, Aylesbury	75	57	56	51	50	56	51	49/52
348419	Prestwold Way, Aylesbury	113	69	66	60	59	66	60	58/63
348501	Andrews Way, Aylesbury	18	69	66	60	58	66	60	58/62

ID	Area Represented	No of Impacts Represented	No barrier	Option 1 4m 0m Green Banks	Option 24m 3m Green Banks	Option 3 4m 4m Green Banks	Option 4 5m 0m Green Banks	Option 5 5m 2m Green Banks	ES
348799	Jakeman Way, Aylesbury	36	59	57	53	51	57	51	50/53
348914	Briskman Way, Aylesbury	88	56	55	51	51	55	51	48/52
349825	Wendover Road, Weston Turville	58	58	57	52	52	57	52	50/53
	Exceedance of LOAEL								
	Exceedance of SOAEL								

Table 40L_{Amax} levels for the Mitigation Design Options considered compared to ES -Stoke Mandeville Up Side

Table 40 shows that all of the Noise Barrier Design Options show improvements on L_{Amax} impacts above LOAEL when compared to the HS2 Phase 1 ES.

The cost benefit analysis for the L_{max} prediction is presented in Table 30. The cost benefit analysis score of 0.5 for Option 1 and Option 2 and 0.8 for Option 3, Option 4 and Option 5 indicate that further consideration needs to be given to the design objectives and that there is a need there is a need to determine whether there is any material difference between the noise effects for the proposed design compared to the ES and SES reports.

Design Option	Number of Noise Impacts				Estimated additional cost over unmitigated design	Noise to Benefit Cost Ratio
	Above LOAEL (57.5dB(A))	Above SOAEL (77.5LAmax) and more than 20 events per night	Significant Effect above SOAEL	WebTAG Change		
ES Levels	2975	N/A	0	N/A	N/A	N/A
No Noise Barrier Design (earthworks with no noise barrier)	3917	0	1	N/A	N/A	N/A
Noise Barrier Design Option 1 (4m with no barrier in Green Banks	3454	0	1	£3,769,933	£7,185,002	0.5
Noise Barrier Design Option 2 Noise Barrier Design Option 1 (4m with 3m barrier in Green Banks	2018	0	1	£4,041,713	£7,817,702	0.5
Noise Barrier Design Option 3 Noise Barrier Design Option 1 (4m with 4m barrier in Green Banks	2018	0	0	£4,110,883	£5,356,952	0.8
Noise Barrier Design Option 4 Noise Barrier Design Option 1 (5m with no barrier in Green Banks	3134	0	1	£4,181,052	£4,925,252	0.8
Noise Barrier Design Option 5 Noise Barrier Design Option 1 (5m with 2m barrier in Green Banks	2150	0	1	£4,544,492	£5,909,702	0.8

Table 41 Cost Benefit Analysis L_{max} Levels – Stoke Mandeville Overbridge to Oxford Rod Overbridge (Up Side)

The following section considers each of the Noise Barrier Design Options presented above individually, considering against both L_{Aeq} and L_{Amax} levels.

No Noise Barrier (earthworks design and no additional noise barrier)

The No Noise Barrier Option (earthworks design with no additional acoustic barriers) shows significantly more moderate and major impacts above LOAEL for daytime and night-time as compared to the ES, presenting an adverse material change. **Therefore, this Option represents a material worsening from the ES case.**

The L_{max} impacts above LOAEL for the earthworks design option are more than those reported in the ES (3917 impacts above LOAEL compared to 2975 in the ES case).

Visual effects associated with the noise barrier proposed in the ES are avoided by removing the noise barrier in this option. This option is better in visual terms due to the barrier being avoided. Removal of the noise barrier would be seen as having a local benefit in terms of their reduced mass, particularly where they are on embankment. The beneficial landscape and visual effects would be outweighed by the concerns regarding train noise impacts.

Costs associated with a noise fencing/barrier are also removed through removal of the feature in the design.

Noise Barrier Design Option 1 (4m noise barrier with no barrier in the Green Banks)

Noise Barrier Design Option 1 (including earthworks design) shows significantly more moderate and major impacts above LOAEL for daytime and night-time as compared to the ES, presenting an adverse material change. **Therefore, this Option represents a material worsening from the ES case.**

The L_{max} impacts above LOAEL for Noise Barrier Design Option 1 are more than those reported in the ES (3454 impacts above LOAEL compared to 2975 in the ES case).

Visual effects associated with the 4m will present with reduced visual effects when compared with the conclusions of the ES where a 5m barrier transitioning to a 4m barrier was reported.

Given the acoustic disbenefits, and the low cost to benefit ratio, Noise Barrier Design Option 1 should not t be considered a feasible mitigation option.

Noise Barrier Design Option 2 (4m noise barrier with 3m barrier in the Green Banks)

Noise Barrier Design Option 2 (including earthworks design) shows significantly more moderate and major impacts above LOAEL for daytime and night-time as compared to the ES, presenting an adverse material change. **Therefore, this Option represents a material worsening from the ES case.**

The L_{max} impacts above LOAEL for Noise Barrier Design Option 2 are less than those reported in the ES (2018 impacts above LOAEL compared to 2976 in the ES case). This indicates that a noise barrier in the Green Banks is effective at reducing Lmax exceedances of LOAEL.

From a visual perspective, a 3m barrier within the Green Banks and a 4m (1.02Km) barrier above TOR compared to the ES (as amended) assessed 4m barrier (990m) and 5m (660m) barrier will be neutral. It is noted that there has been a very slight track uplift at this location making the Oxford Road embankment marginally higher. The 3m barrier section is contained by the proposed Green Banks earthworks south of

the SBH/32 footbridge and by extensive existing vegetation which is part of the Hartwell House Pleasure GroundsThe section of 4m barrier will be visible, albeit positioned on a marginally higher embankment, coincides with the same height barrier in the HS2 Phase 1 ES (as amended). It is considered that option 2 taking account of the very minor track uplift will have a neutral effect on the local landscape character of Hartwell House and former golf course to the W of Aylesbury and its visual amenity to that reported in the ES (as amended).

Given the acoustic disbenefits, and the low cost to benefit ratio, Noise Barrier Design Option 2 should not be considered a feasible mitigation option.

Noise Barrier Design Option 3 (4m noise barrier with 4m barrier through Green bank Scheme)

Noise Barrier Design Option 3 (including earthworks design) shows significantly more moderate and major impacts above LOAEL for daytime and night-time as compared to the ES, presenting an adverse material change. **Therefore, this Option represents a material worsening from the ES case.**

The L_{max} impacts above LOAEL for Noise Barrier Design Option 3 are less than those reported in the ES (2018 impacts above LOAEL compared to 2976 in the ES case). This indicates that a noise barrier in the Green Banks is effective at reducing L_{max} exceedances of LOAEL.

From a visual perspective, a 4m barrier within the Green Banks and a 4m (1.02Km) barrier above TOR compared to the ES (as amended) assessed 4m barrier (990m) and 5m (660m) barrier will be neutral. It is noted that there has been a very slight track uplift at this location making the Oxford Road embankment marginally higher. The 3m barrier section is contained by the proposed Green Banks earthworks south of the SBH/32 footbridge and by extensive existing vegetation which is part of the Hartwell House Pleasure Grounds. The section of 4m barrier will be visible, albeit positioned on a marginally higher embankment, coincides with the same height barrier in the HS2 Phase 1 ES (as amended). It is considered that option 2 taking account of the very minor track uplift will have a neutral effect on the local landscape character of Hartwell.

Given the acoustic disbenefits, but accounting for the low cost to benefit ratio, Noise Barrier Design Option 3 should not typically be considered a feasible mitigation option.

Noise Barrier Design Option 4 (5m barrier with no barrier in the Green Banks Scheme)

Noise Barrier Design Option 4 (including earthworks design) shows the same number of major impacts above LOAEL (1) as the ES for daytime (1) and 1 additional major impact for night-time over the ES (zero). The moderate impacts for night-time for Option 4 (46) are the same as the ES (46), while there is one additional moderate impact for daytime (101) compared to the ES (100).

The L_{max} impacts above LOAEL for Noise Barrier Design Option 2 are less than those reported in the ES (2018 impacts above LOAEL compared to 2976 in the ES case). This indicates that a noise barrier in the Green Banks is effective at reducing L_{max} exceedances of LOAEL.

From a visual perspective, no barrier within the Green Banks and a 5m (1.02Km) barrier above TOR compared to the ES (as amended) assessed 4m barrier (990m) and 5m (660m) barrier will have a negative

change. The section of 5m barrier will be visible, albeit positioned on a marginally higher embankment, coincides with the 4m barrier in the HS2 Phase 1 ES (as amended). It is considered that option 4 taking account of the no barrier section and the very minor track uplift will have a negligible negative effect on the local landscape character of Hartwell House and former golf course to the W of Aylesbury and its visual amenity to that reported in the ES (as amended).

The low cost to benefit ratio indicates Noise Barrier Design Option 4 should not typically be considered a feasible mitigation option.

Noise Barrier Design Option 5 (5m barrier with 2m barrier in the Green Banks Scheme)

Noise Barrier Design Option 4 (including earthworks design) shows the same number of major impacts above LOAEL (1) as the ES for daytime (1) and 1 additional major impact for night-time over the ES (zero). The moderate impacts for night-time for Option 4 (46) are the same as the ES (46), while there is one additional moderate impact for daytime (101) compared to the ES (100).

The L_{max} impacts above LOAEL for Noise Barrier Design Option 2 are less than those reported in the ES (2018 impacts above LOAEL compared to 2976 in the ES case). This indicates that a noise barrier in the Green Banks is effective at reducing L_{max} exceedances of LOAEL.

From a visual perspective, a 2m barrier within the Green Banks and a 5m (1.02Km) barrier above TOR compared to the ES (as amended) assessed 4m barrier (990m) and 5m (660m) barrier will have a negative change. It is noted that there has been a very slight track uplift at this location making the Oxford Road embankment marginally higher. The section of 5m barrier will be visible, albeit positioned on a marginally higher embankment, coincides with the 4m barrier in the HS2 Phase 1 ES (as amended). It is considered that option 5 taking account of very minor track uplift will have a negligible negative effect on the local landscape character of Hartwell House and former golf course to the W of Aylesbury and its visual amenity to that reported in the ES (as amended).

Recommended Design (Option 5): Stoke Mandeville Bypass Overbridge to Oxford Road Overbridge - East (AVDC P6/P7)

Five different combinations of lineside barriers have been assessed within he scope of this study. **The Proposed Design (Option 5) with a combination of a 5m lineside barriers and a 2m barrier in the Green Banks scheme has been selected as the proposed mitigation design**.

Compared to the HS2 Phase 1 ES (as amended) Option 5 presents one more major impact during night-time and one more moderate during daytime, as well as 1 more minor impact during daytime but 36 less minor during night-time. Whilst Option 4 without a barrier in the Green Banks has been considered, Option 5 presents the best solution as it reduces the number of LAmax exceedances above LOAEL by 984 compared to Option 4 and 645 when compared to HS2 Phase 1 ES (as amended). On balance, this acoustic performance is considered beneficial.

From a visual perspective, the proposed design (Option 5) would have a negligible negative change from that reported in the HS2 Phase 1 ES. The Proposed Design has been selected on the basis that it reduces

noise as far as reasonably practicable and represents the optimum balance between maximising the acoustic benefits, whilst minimizing other impacts.

In summary, based on the appraisals in Tables 37 and 38 for L_{eq} daytime and night-time, the analysis in Table 39, and the appraisals for L_{max} values presented in Tables 40 and 41; along with consideration of acoustic cost benefits and potential visual effects associated with the noise barrier options, the recommendation is as follows within the Stoke Mandeville Bypass Overbridge to Oxford Road Overbridge package AVDC P6/P7.

Noise Barrier Design Option 5 (5m barrier with 2m through the Green Banks Scheme) presents the most balanced approach; consisting of:

- Ch 59+800 to Ch 62+250: 5m above top of rail absorptive acoustic fence on the east side of the Track;
- Ch 62+250 to Ch 62+880: proposed earthworks design as agreed under the Green Banks Scheme as part of the Hartwell Agreement;
- Ch 62+880 to Ch 64+200: 5m above top of rail absorptive acoustic fence on the east side of the Track
- Ch 64+200 to Ch 64+382: 1.25m above top of rail absorptive acoustic fence on the east side of the Track to tie in with the Thame Valley Viaduct parapet

- Stoke Mandeville Bypass Overbridge to Oxford Road Overbridge – West

The ES assessment indicated that the identified communities would benefit from the noise mitigation scheme as presented in Table 36 (Summary or noise mitigation options – Stoke Mandeville Bypass Overbridge to Oxford Road Embankment).

The mitigation options set out in Table 36 and as assessed in the sections below include any relevant Undertakings and Assurances described in Table 2. Along with “The Green Banks Scheme” as discussed in Section 2.4.

As summarised in Table 36, detailed 3-dimensional noise modelling has been undertaken to individually test each of the following Noise Barrier Design Options within the Stoke Mandeville Bypass Overbridge to Oxford Road Embankment (AVDC P6/P7 Area):

- **No Barrier Option** - Mitigation provided by the scheme design earthworks only.
- **Mitigation Design Option 1:**
  - Absorptive lineside noise barrier 4m above ToR on embankment at an offset 6.068m from outside rail (Ch. 61+200 to 61+618) to accommodate drainage and 4.6m from outside rail (Ch. 61+618 to 62+250).
  - Green Banks Scheme - No barrier (Ch. 62+250 to 62+700).
  - Absorptive lineside 4m noise barrier above ToR on embankment at an offset of 4.6m from outside rail (Ch. 62+700 to 63+300).
- **Mitigation Design Option 2:**
  - Absorptive lineside noise barrier 4m above ToR on embankment at an offset of 6.068m from outside rail (Ch. 61+200 to 61+618) to accommodate drainage and 4.6m from outside rail (Ch. 61+618 to 62+250).
  - Green Banks Scheme - Absorptive noise barrier 3m above ToR at an offset of 4.6m from outside rail (Ch. 62+250 to 62+700).
  - Absorptive lineside 4m noise barrier above ToR on embankment at an offset of 4.6m from outside rail (Ch. 62+700 to 63+300).
- **Mitigation Design Option 3:**
  - Absorptive lineside noise barrier 4m above ToR on embankment at an offset of .6.068m from outside rail (Ch. 61+200 to 62+250) to accommodate drainage and 4.6m from outside rail (Ch. 61+618 to 62+250).
  - Green Banks Scheme - Absorptive noise barrier 4m above ToR at an offset of 4.6m from outside rail (Ch. 62+250 to 62+700).
  - Absorptive lineside 4m noise barrier above ToR on embankment at an offset of 4.6m from outside rail (Ch. 62+700 to 63+300).

- **Mitigation Design Option 4:**
    - Absorptive lineside noise barrier 5m above ToR on embankment at an offset of 6.068m from outside rail (Ch. 61+200 to 62+250) to accommodate drainage and 4.6m from outside rail (Ch. 61+618 to 62+250).
    - Green Banks Scheme - No barrier (Ch. 62+250 to 62+700).
    - Absorptive lineside 4m noise barrier above ToR on embankment at an offset of 4.6m from outside rail (Ch. 62+700 to 63+300).
- **Mitigation Design Option 5:**
    - Absorptive lineside noise barrier 5m above ToR on embankment at an offset of 6.068m from outside rail (Ch. 61+200 to 62+250) to accommodate drainage and 4.6m from outside rail (Ch. 61+618 to 62+250).
    - Green Banks Scheme - Absorptive noise barrier 4m above ToR at an offset of 4.6m from outside rail (Ch. 62+250 to 62+700).
    - Absorptive lineside 4m noise barrier above ToR on embankment at an offset of 4.6m from outside rail (Ch. 62+700 to 63+300).

The Tables in the sections below present the ES reported operational noise levels as amended through the SES and AP amendments.

- The ES (as amended) prediction Tables include noise predictions for the proposed Scheme (Year 15 flows), the future baseline without Scheme (in the opening year) and the overall Do Something noise level (the Opening baseline + the year 15 flows).
- The Scheme Design Tables include the predictions for the Do Something Scheme Design (the Opening baseline + the year 15 flows) without noise barriers as mitigation and then with the noise barrier options being considered as compared against the ES/ SES Do Something noise level.

A cost benefit analysis has been carried out for the daytime and night-time L_{eq} levels and the results are presented in Table 42. The cost benefit analysis score of 0.0/0.02 for Noise Barrier Design Option 1, Option 2, Option 3, Option 4 and Option 5 indicates that mitigation should not typically be included in the design.

The No Barrier Option (mitigation in the form of earthworks) shows significantly more major impacts for daytime and night-time as compared to the ES, presenting an adverse material change. This indicates that mitigation in the form of noise barriers is required.

- **Mitigation Option 1** (4m noise barrier with no barrier in the Green Banks) shows 8 major impacts for daytime compared to zero in the ES and nine moderate impacts for night-time compared to 1 moderate night-time exceedance of LOAEL in the ES. **This represents a material disbenefit over the ES**.

  From a visual perspective, no barrier compared to the HS2 Phase 1 ES (which considered a 4m barrier (990m) and 5m (660m) barrier above TOR) would present a positive change from the

conclusions drawn in the ES. It is noted that there has been a very slight track uplift at this location making the Oxford Road embankment marginally higher. The no barrier section is contained by the proposed Green Banks earthworks south of the SBH/32 footbridge and by extensive existing vegetation which is part of the Hartwell House Pleasure Grounds. North of SBH/32 footbridgen the no barrier section within the Green Banks area will be glimpsed from the PRoW on the approach to the SBH/32 footbridge. It is considered that the Earthworks Design taking account of the no barrier section and the very minor track uplift will **have a positive effect on the local landscape** character of Hartwell House and former golf course to the West of Aylesbury and its visual amenity to that reported in the ES (as amended).

- **Mitigation Design Option 2** (4m barrier with 3m barrier in the Green Banks) shows the same number of moderate and major impacts for daytime as the ES; but shows 9 moderate night-time impacts compared to 1 moderate impact in the ES. **This represents a material disbenefit over the ES.**

  From a visual perspective, a 3m barrier within the Green Banks and a 4m (1.02Km) barrier above TOR compared to the ES (which considered a 4m barrier (990m) and 5m (660m) barrier) will be neutral when compared with the conclusions drawn in the ES. It is noted that there has been a very slight track uplift at this location making the Oxford Road embankment marginally higher. The 3m barrier section is contained by the proposed Green Banks earthworks south of the SBH/32 footbridge and by extensive existing vegetation which is part of the Hartwell House Pleasure Grounds. North of SBH/32 footbridge the 4m barrier will then run along a 400m long exposed section of the Oxford Road embankment before disappearing again into the Whaddon Hill cutting, with the final 400m section contained by the cutting. The section of 4m barrier will be visible, albeit positioned on a marginally higher embankment, coincides with the same height barrier in the HS2 Phase 1 ES (as amended). It is considered that option 2 taking account of the very minor track uplift will have a **neutral effect on the local landscape character** of Hartwell House and former golf course to the West of Aylesbury and its visual amenity to that reported in the ES (as amended).

- **Mitigation Design Option 3** (4m barrier with 4m barrier in the Green Banks) shows the shows the same number of moderate and major impacts for daytime as the ES; but shows 9 moderate night-time impacts compared to 1 moderate impact in the ES. **This represents a material disbenefit over the ES**.

  From a visual perspective, a 4m barrier within the Green Banks and a 4m (1.02Km) barrier above TOR compared to the ES (as amended) assessed 4m barrier (990m) and 5m (660m) barrier will be neutral. It is noted that there has been a very slight track uplift at this location making the Oxford Road embankment marginally higher. The 3m barrier section is contained by the proposed Green Banks earthworks south of the SBH/32 footbridge and by extensive existing vegetation which is part of the Hartwell House Pleasure Grounds. North of SBH/32 footbridge the 4m barrier will then run along a 400m long exposed section of the Oxford Road embankment before disappearing again into the Whaddon Hill cutting, with the final 400m section contained by the cutting. The section of 4m barrier will be visible, albeit positioned on a marginally higher embankment, coincides with the same height barrier in the HS2 Phase 1 ES (as amended). It is considered that option 2 taking account of

the very minor track uplift will have a **neutral effect on the local landscape** character of Hartwell House and former golf course to the West of Aylesbury and its visual amenity to that reported in the ES (as amended).

- **Mitigation Design Option 4** (4m barrier with no barrier in the Green Banks, 4m barrier north of Green Banks) shows 8 major impacts for daytime compared to zero in the ES and nine moderate impacts for night-time compared to 1 moderate night-time exceedance of LOAEL in the ES. **This represents a material disbenefit over the ES.**

  From a visual perspective, no barrier within the Green Banks and a 5m (1.02Km) barrier above TOR compared to the ES (as amended) assessed 4m barrier (990m) and 5m (660m) barrier will have a negative change. It is noted that there has been a very slight track uplift at this location making the Oxford Road embankment marginally higher. The no barrier section is contained by the proposed green banks earthworks south of the SBH/32 footbridge and by extensive existing vegetation which is part of the Hartwell House Pleasure Grounds. North of SBH/32 footbridge the proposed 5m barrier will then run along a 400m long exposed section of the Oxford Road embankment before disappearing again into the Whaddon Hill cutting, with the final 400m section contained by the cutting. The no barrier section within the Green Banks section will be glimpsed from the PRoW on the approach to the SBH/32 footbridge. The section of 5m barrier will be visible, albeit positioned on a marginally higher embankment, coincides with the 4m barrier in the HS2 Phase 1 ES (as amended). It is considered that option 4 taking account of the no barrier section and the very minor track uplift will have a negligible negative effect on the local landscape character of Hartwell House and former golf course to the W of Aylesbury and its visual amenity to that reported in the ES (as amended).

  Mitigation Design Option 5 (5m barrier with 4m barrier in the Green Banks; 4m barrier north of Green Banks) shows one moderate impact for daytime, which is 8 less than the 9 moderate impacts reported in the ES for daytime. Night-time moderate impacts are the same as the ES and Option 5 shows no major impacts (same as the ES). **The reduction of 8 moderate impacts presents a** material benefit.

  From a visual perspective, a 2m barrier within the Green Banks and a 5m (1.02Km) barrier above TOR compared to the ES (as amended) assessed 4m barrier (990m) and 5m (660m) barrier will have a negative change from the conclusions drawn in the ES. It is noted that there has been a very slight track uplift at this location making the Oxford Road embankment marginally higher. The no barrier section south of SBH/32 footbridge is contained by the proposed green banks earthworks south of the SBH/32 footbridge and by extensive existing vegetation which is part of the Hartwell House Pleasure Grounds. North of SBH/32 footbridge the 5m barrier will then run along a 400m long exposed section of the Oxford Road embankment before disappearing again into the Whaddon Hill cutting, with the final 400m section contained by the cutting. The section of 5m barrier will be visible, albeit positioned on a marginally higher embankment, coincides with the 4m barrier in the HS2 Phase 1 ES (as amended). It is considered that option 5 taking account of very minor track uplift will have **a negligible negative effect on the local landscape** character of Hartwell House

and former golf course to the W of Aylesbury and its visual amenity to that reported in the ES (as amended).

Option 5 provides an acoustic benefit comparable with the ES (as amended). It is considered that this acoustic benefit outweighs the visual impacts associated with the taller barrier and is considered to be the preferred design.

Design Option	Noise impact and benefit						Estimated additional cost over unmitigated design	Noise to Benefit Cost Ratio
	Impacts above LOAEL			TOTAL IMPACTS (sum of minor - major)		WebTAG Change		
		Day	Night	Day	Night			
ES Levels	Beneficial	0	0	9	9			
	Negligible	40	43					
	Minor	0	8					
	Moderate	9	1					
	Major	0	0					
	Total above LOAEL	49	52					
Design Option (mitigation in form of earthworks)	Beneficial	0	0	45	60			
	Negligible	40	28					
	Minor	1	20					
	Moderate	36	32					
	Major	8	8					
		85	88					
Noise Barrier Design Option 1 (4m barrier with no barrier in Green Banks)	Beneficial	0	0	9	9	£91,665	£2.872,650	0.03
	Negligible	17	42					
	Minor	0	0					
	Moderate	1	9					
	Major	8	0					
	Total above LOAEL	26	51					
	Engineering and operational compatibility			No particular engineering constraints				
	Visual Impacts/ compatibility with HS2 Design Vision			ES provides for 5m barrier transitioning to 4m barrier. Design provides lower barrier, therefore visual effects are reduced				
Noise Barrier Design Option 2 (4m barrier with 3m barrier in Green Banks).	Beneficial	0	0	9	9	£116,424	£3,505,350	0.03
	Negligible	16	40					
	Minor	0	0					
	Moderate	9	9					
	Major	0	0					
	Total above LOAEL	25	49					
	Engineering and operational compatibility			No particular engineering constraints				
	Visual Impacts/ compatibility with HS2 Design Vision			ES provides for 5m barrier transitioning to 4m barrier. Design provides higher barrier in part, therefore visual effects are slightly increased				
Noise Barrier Design Option 3 (4m barrier with 4m barrier in Green Banks. 4m barrier north of Green Banks)	Beneficial	0	0	9	9	£121,285	£3,656,100	0.03
	Negligible	16	40					
	Minor	0	0					
	Moderate	9	9					
	Major	0	0					
	Total above LOAEL	25	49					
	Engineering and operational compatibility			No particular engineering constraints				
	Visual Impacts/ compatibility with HS2 Design Vision			ES provides for 5m barrier transitioning to 4m barrier. Design matches ES, therefore visual effects are neutral				
Noise Barrier Design Option 4 (5m barrier, with no barrier in Green Banks Scheme; 4m barrier north of Green Banks)	Beneficial	0	0	9	9	£98,854	£3,425,400	0.03
	Negligible	17	42					
	Minor	0	0					
	Moderate	1	9					
	Major	8	0					
	Total above LOAEL	26	51					
	Engineering and operational compatibility			No particular engineering constraints				

Design Option	Noise impact and benefit						Estimated additional cost over unmitigated design	Noise to Benefit Cost Ratio
	Impacts above LOAEL			TOTAL IMPACTS (sum of minor - major)		WebTAG Change		
		Day	Night	Day	Night			
	Visual Impacts/ compatibility with HS2 Design Vision			Design incorporates Green Banks scheme, therefore meeting the requirements of the Hartwell Agreement				
Noise Barrier Design Option 5 (5m barrier, with 4m barrier in Green Banks Scheme; 4m barrier north of Green Banks)	Beneficial	0	0	1	9	£123,518	£3,907,350	0.03
	Negligible	16	16					
	Minor	0	8					
	Moderate	1	1					
	Major	0	0					
	Total above LOAEL	17	25					
	Engineering and operational compatibility			No particular engineering constraints				
	Visual Impacts/ compatibility with HS2 Design Vision			Design incorporates Green Banks scheme, therefore meeting the requirements of the Hartwell Agreement				

Table 42 Cost Benefit Analysis L_{eq} Daytime and Night-time) – Wendover North Cutting to Stoke Mandeville Bypass Overbridge

The predicted noise levels for the ES and each of the design mitigation options at the western receptor locations in the Stoke Mandeville Overbridge to Oxford Road Overbridge section are presented in Table 43 below. Table 43 includes HS2 operational noise and noise from the new Stoke Mandeville Bypass, along with the altered Oxford Road alignment.

Locations where operational rail noise levels are predicted to exceed the daytime LOAEL of 50dB and night-time LOAEL of 40dB would be highlighted in red. Table 43 indicates that for operational noise levels (rail and altered roads), the Noise Barrier Design Options 5 shows fewer receptor locations above LOAEL than was the case in the ES.

ID	Area Represented	No of Impacts Represented	Do Nothing (Opening Year baseline) L_{Aeq} dB		ES Design L_{Aeq} dB		ES Design Opening Year Baseline +Year 15 Traffic L_{Aeq} dB		Earthworks Design Year L_{Aeq} dB		Earthworks Design Year Baseline +Year 15 Traffic L_{Aeq} dB		Option 1 4m lineside barrier / 0m Green Banks / 4m lineside barrier L_{Aeq} dB		Option 1 4m lineside barrier / 0m Green Banks / 4m lineside barrier Opening Year Baseline +Year 15 Traffic L_{Aeq} dB		Option 2 4m lineside barrier / 3m Green Banks / 4m lineside barrier L_{Aeq} dB		Option 2 4m lineside barrier / 3m Green Banks / 4m lineside barrier Opening Year Baseline +Year 15 Traffic L_{Aeq} dB	
			Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night
303147	Cottage Grounds, Stone	25	53	45	40	31	53	45	46	37	54	46	43	34	53	45	41	32	53	45
304833	Sedrup, Hartwell	4	47	40	43	34	49	41	51	42	52	44	45	36	49	42	45	36	49	42
304876	Portway Road, Stone	3	58	49	42	33	58	49	47	39	58	49	45	36	58	49	43	34	58	49
304968	Sedrup, Hartwell	1	49	43	44	33	50	43	49	41	52	45	46	38	51	44	46	37	51	44
305037	Portway Road, Stone	1	49	43	41	31	50	43	47	39	51	44	44	36	50	44	43	35	50	44
305139	Meadoway, Hartwell	24	54	45	50	42	54	45	51	43	56	47	49	41	55	46	48	40	55	46
305201	Meadoway, Hartwell	15	60	51	59	50	59	50	58	50	62	54	55	48	61	53	55	47	61	53
305474	Upper Hartwell, Stone	45	46	37	42	34	47	38	48	39	50	41	45	36	48	40	43	34	48	39
305678	Upper Hartwell, Stone	6	46	37	43	35	47	38	50	41	52	43	47	38	49	40	45	36	48	40
305692	Upper Hartwell, Stone	19	46	37	44	35	47	38	51	42	52	43	47	38	50	41	44	36	48	40
305767	Lower Hartwell, Aylesbury	8	44	38	50	41	50	41	59	50	59	50	53	44	54	45	51	42	51	43
305827	Lower Hartwell, Aylesbury	1	53	45	46	38	53	45	54	45	56	48	50	41	55	47	47	39	54	46
305896	Oxford Road, Stone	2	70	62	48	41	70	62	51	43	70	62	48	40	70	62	46	39	70	62
305909	Lower Hartwell, Aylesbury	1	61	52	48	41	61	52	51	43	61	53	49	41	61	52	47	39	61	52
305983	Church of the Assumption *, Hartwell	1	45	37	49	40	49	40	56	47	56	47	53	44	54	45	49	40	50	42
306049	Hartwell House Hotel, Oxford Hartwell House Hotel *, Oxford	1	45	37	50	41	50	41	57	48	57	49	55	46	55	46	51	43	52	44
306055	Bugle Horn Hotel, Oxford Road, Lower Hartwell *, (Hotel)	1	63	55	44	36	63	55	49	41	63	55	47	38	63	55	45	37	63	55
306075	Oxford Road, Hartwell	1	71	63	61	53	67	58	64	56	72	64	63	54	72	64	61	52	71	63
306223	Lower Hartwell, Aylesbury	1	46	36	51	42	52	43	53	44	54	45	52	43	53	43	52	43	53	43
319163	Sedrup, Hartwell	5	46	39	45	35	49	40	52	43	53	45	46	37	49	41	46	37	49	41
319187	Sedrup, Hartwell	1	47	40	46	37	50	42	54	45	55	46	48	39	51	43	48	39	50	43

ID	Area Represented	No of Impacts Represented	Do Nothing (Opening Year baseline) L_{Aeq} dB		ES Design Scheme noise only L_{Aeq} dB		ES Design Opening Year Baseline +Year 15 Traffic L_{Aeq} dB		Option 3 4m lineside barrier / 4m Green Banks / 4m lineside barrier L_{Aeq} dB		Option 3 4m lineside barrier /4m Green banks / 4m lineside barrier Opening Year Baseline +Year 15 Traffic L_{Aeq} dB		Option 4 5m lineside barrier / 0m Green banks / 4m lineside barrier L_{Aeq} dB		Option 4 5m lineside barrier / 0m Green banks / 4m lineside barrier Opening Year Baseline +Year 15 Traffic LAeq dB		Option 5 5m lineside barrier / 4m Green Banks / 4m lineside barrier LAeq dB		Option 5 5m lineside barrier / 4m Green Banks / 4m lineside barrier Opening Year Baseline +Year 15 Traffic L_{Aeq} dB	
			Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night
303147	Cottage Grounds, Stone	25	53	45	40	31	53	45	41	32	53	45	43	34	53	45	40	32	53	45
304833	Sedrup, Hartwell	4	47	40	43	34	49	41	44	36	49	42	44	36	49	41	43	36	49	41
304876	Portway Road, Stone	3	58	49	42	33	58	49	42	34	58	49	45	36	58	49	41	33	58	49
304968	Sedrup, Hartwell	1	49	43	44	33	50	43	45	37	51	44	46	37	51	44	45	37	50	44
305037	Portway Road, Stone	1	49	43	41	31	50	43	43	35	50	44	44	36	50	44	42	34	50	44
305139	Meadoway, Hartwell	24	54	45	50	42	54	45	48	40	55	46	49	41	55	46	47	40	55	46

305201	Meadoway, Hartwell	15	60	51	59	50	59	50	55	47	61	53	55	48	61	53	55	47	61	53
305474	Upper Hartwell, Stone	45	46	37	42	34	47	38	42	34	48	39	45	36	48	40	42	34	47	39
305678	Upper Hartwell, Stone	6	46	37	43	35	47	38	44	36	48	39	47	38	49	40	44	35	48	39
305692	Upper Hartwell, Stone	19	46	37	44	35	47	38	44	36	48	39	47	38	50	41	44	35	48	39
305767	Lower Hartwell, Aylesbury	8	44	38	50	41	50	41	50	41	51	43	53	44	54	45	50	41	50	42
305827	Lower Hartwell, Aylesbury	1	53	45	46	38	53	45	46	38	54	46	50	41	55	47	46	38	54	46
305896	Oxford Road, Stone	2	70	62	48	41	70	62	46	38	70	62	48	40	70	62	46	38	70	62
305909	Lower Hartwell, Aylesbury	1	61	52	48	41	61	52	47	39	61	52	49	40	61	52	47	39	61	52
305983	Church of the Assumption *, Hartwell	1	45	37	49	40	49	40	48	40	50	41	53	44	53	45	48	39	50	41
306049	Hartwell House Hotel, Oxford Hartwell House Hotel *, Oxford	1	45	37	50	41	50	41	50	42	51	43	55	46	55	46	50	42	51	43
306055	Bugle Horn Hotel, Oxford Road, Lower Hartwell *, (Hotel)	1	63	55	44	36	63	55	44	37	63	55	47	38	63	55	44	36	63	55
306075	Oxford Road, Hartwell	1	71	63	61	53	67	58	60	52	71	63	62	54	72	63	60	52	71	63
306223	Lower Hartwell, Aylesbury	1	46	36	51	42	52	43	52	43	53	43	52	43	53	43	52	42	53	43
319163	Sedrup, Hartwell	5	46	39	45	35	49	40	46	37	49	41	45	36	48	41	44	36	48	41
319187	Sedrup, Hartwell	1	47	40	46	37	50	42	48	39	50	43	47	39	50	42	47	38	50	42
*	Non-residential																			

Table 43 Comparison of Receptors above LOAEL at the most affected receptor grouping

Table 44 below summarises the changes in noise levels due to each Noise Barrier Design scenarios, compared with Do Nothing scenario. The No Noise Barrier Option presents with more effects above LOAEL over what was reported in the HS2 Phase 1 ES.

Option 5 presents with fewer impacts above LOAEL than the ES.

ID	Area Represented	No of Impacts Represented	Significant Effect	ES Design		Change in Noise Levels Compared with Do-Nothing Scenario											
				DM - ES Design		DM - No Barrier		DM - 4m Barrier / 0m Green Banks/ 1.25m viaduct		DM - 4m Barrier / 3m Green Banks/ 1.25m viaduct		DM - 4m Barrier / 4m Green Banks/ 1.25m viaduct		DM - 5m Barrier / 0m Green Banks/ 1.25m viaduct		DM - 5m Barrier / 4m Green Banks/ 1.25m viaduct	
				Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night
303147	Cottage Grounds, Stone	25		0	0	1	1	0	0	0	0	0	0	0	0	0	0
304833	Sedrup, Hartwell	4		2	1	5	4	2	2	2	2	2	2	2	1	2	1
304876	Portway Road, Stone	3		0	0	0	0	0	0	0	0	0	0	0	0	0	0
304968	Sedrup, Hartwell	1		1	0	3	2	2	1	2	1	2	1	2	1	1	1
305037	Portway Road, Stone	1		1	0	2	1	1	1	1	1	1	1	1	1	1	1
305139	Meadoway, Hartwell	24		0	0	2	2	1	1	1	1	1	1	1	1	1	1
305201	Meadoway, Hartwell	15		-1	-1	2	3	1	2	1	2	1	2	1	2	1	2
305474	Upper Hartwell, Stone	45		1	1	4	4	2	3	2	2	2	2	2	3	1	2
305678	Upper Hartwell, Stone	6		1	1	6	6	3	3	2	3	2	2	3	3	2	2
305692	Upper Hartwell, Stone	19		1	1	6	6	4	4	2	3	2	2	4	4	2	2
305767	Lower Hartwell, Aylesbury	8	^	5	4	15	12	10	7	7	5	7	5	10	7	6	4
305827	Lower Hartwell, Aylesbury	1		0	0	3	3	2	2	1	1	1	1	2	2	1	1
305896	Oxford Road, Stone	2		0	0	0	0	0	0	0	0	0	0	0	0	0	0
305909	Lower Hartwell, Aylesbury	1		0	0	0	1	0	0	0	0	0	0	0	0	0	0
305983	Church of the Assumption, Hartwell	1		4	3	11	10	9	8	5	5	5	4	8	8	5	4
306049	Hartwell House Hotel, Oxford Hartwell House Hotel, Oxford	1		5	4	12	12	10	9	7	7	6	6	10	9	6	6
306055	Bugle Horn Hotel, Oxford Road, Lower Hartwell, (Hotel)	1		0	0	0	0	0	0	0	0	0	0	0	0	0	0
306075	Oxford Road, Hartwell	1		-4	-5	1	1	1	1	0	0	0	0	1	0	0	0
306223	Lower Hartwell, Aylesbury	1	~	6	6	8	9	7	7	7	7	7	7	7	7	7	7
319163	Sedrup, Hartwell	5		3	1	7	6	3	2	3	2	3	2	2	2	2	2
319187	Sedrup, Hartwell	1		3	2	8	6	4	3	3	3	3	3	3	2	3	2

Table 44 Consideration of Receptors above LOAEL at most affected receptor grouping – Stoke Mandeville Overbridge to Oxford Road Overbridge West

The predicted L_{max} levels for the No Noise Barrier Option and Noise Barrier Design Options 1, to 5 are shown in Table 45 below. Locations where operational rail noise levels are predicted to exceed the night-time LOAEL of 57.5dB (free-field) would be highlighted in light red; with locations where the SOAEL is exceeded (77.5dB Free field) in a darker red. None residential is identified in grey.

Noise Barrier Design Option 1 and Option 4 show more L_{max} impacts above LOAEL than the ES; while Options 2, 3 and 5 all show fewer L_{max} impacts above LOAEL than reported in the ES.

ID	Area Represented	No of Impacts Represented	No barrier	Option 1 4m 0m Green banks	Option 2 4m 3m Green banks	Option 3 4m 4m Green banks	Option 4 5m 0m Green banks	Option 5 5m 2m Green banks	ES
303147	Cottage Grounds, Stone	25	60	58	56	56	58	56	52/55
304833	Sedrup, Hartwell	4	66	63	63	63	63	63	63/ 66
304876	Portway Road, Stone	3	62	60	54	54	60	54	54/57
304968	Sedrup, Hartwell	1	60	58	57	57	58	56	55/57
305037	Portway Road, Stone	1	60	58	57	57	57	57	54/57
305139	Meadoway, Hartwell	24	62	61	58	57	61	56	57/60
305201	Meadoway, Hartwell	15	64	64	61	58	64	58	60/63
305474	Upper Hartwell, Stone	45	60	59	57	57	59	57	53/56
305678	Upper Hartwell, Stone	6	65	62	59	59	62	59	55/58
305692	Upper Hartwell, Stone	19	65	62	59	59	62	59	55/58
305767	Lower Hartwell, Aylesbury	8	73	69	66	66	69	66	61/64
305827	Lower Hartwell, Aylesbury	1	67	64	59	59	64	59	56/60
305896	Oxford Road, Stone	2	65	62	56	55	62	55	55/59
305909	Lower Hartwell, Aylesbury	1	63	63	57	56	63	56	55/60
305983	Church of the Assumption, Hartwell	1	70	67	61	60	67	60	59/64
306049	Hartwell House Hotel, Oxford Hartwell House Hotel, Oxford	1	72	69	63	62	69	62	62/67
306055	Bugle Horn Hotel, Oxford Road, Lower Hartwell, (Hotel)	1	63	61	55	55	61	54	55/58
306075	Oxford Road, Hartwell	1	76	76	71	70	76	70	67/71
306223	Lower Hartwell, Aylesbury	1	66	65	65	65	65	65	63/66
319163	Sedrup, Hartwell	5	67	63	63	63	61	61	65/ 68
319187	Sedrup, Hartwell	1	70	65	65	65	65	65	68/ 71
	Exceedance of LOAEL								
	Exceedance of SOAEL								

Table 45 L_{Amax} levels for the Mitigation Design Options considered compared to ES -Stoke Mandeville Overbridge to Oxford Road Down Side

The cost benefit analysis for the L_{max} prediction is presented in Table 46. The cost benefit analysis score of 0.05 for Noise Barrier Design Option 1, Option 2, Option 3 and Option 5 and 0.04 for Option 4 indicates that the mitigation would not typically be included in the design.

Noise Barrier Design Option 1 and Option 4 (both with no barrier in the Green Banks Scheme) show more impacts above LOAEL than the ES. Options 2, 3 and 5 all show fewer impacts above LOAEL than the ES.

Design Option	Number of Noise Impacts				Estimated additional cost over unmitigated design	Noise to Benefit Cost Ratio
	Above LOAEL (57.5dB(A))	Above SOAEL (77.5LAmax) and more than 20 events per night	Significant Effect above SOAEL	WebTAG Change		
ES Levels	88	0	0	N/A	N/A	N/A
Design Option (earthworks with no noise barrier)	163	0	0	N/A	N/A	N/A
Design Option 1	162	0	0	£137,773	£2,872,650	0.05
Design Option 2	85	0	0	£181.628	£3,505,350	0.05
Design Option 3	61	0	0	£189,102	£3,656,100	0.05
Design Option 4	162	0	0	£138,306	£3,425,400	0.04

Design Option	Number of Noise Impacts				Estimated additional cost over unmitigated design	Noise to Benefit Cost Ratio
	Above LOAEL (57.5dB(A))	Above SOAEL (77.5LAmax) and more than 20 events per night	Significant Effect above SOAEL	WebTAG Change		
Design Option 5	61	0	0	£190,289	£3,907,350	0.05

Table 46 Cost Benefit Analysis L_{max} Levels – Stoke Mandeville to Oxford Road Overbridge (Down Side)

The following section considers each of the Noise Barrier Design Options presented above individually, considering against both L_{Aeq} and L_{Amax} levels.

No Noise Barrier (earthworks design and no additional noise barrier)

The No Noise Barrier Option (earthworks design with no additional acoustic barriers) shows significantly more major impacts above LOAEL for daytime and night-time as compared to the ES, presenting an adverse material change. **Therefore, this Option represents a material worsening from the ES case.**

The Lmax impacts above LOAEL for the earthworks design option are more than those reported in the ES (166 impacts above LOAEL compared to 136 in the ES case).

As a result of this option presenting no acoustic fencing provision the visual effects associated with the 4m barrier as proposed in the HS2 Phase 1 ES are avoided. This option is potentially an improvement to that presented in the ES in visual terms because the visual effects associated with the barrier are avoided.

Removal of the noise barrier would be seen as having a local benefit but would be outweighed by the concerns regarding train noise and the associated material disbenefit.

Costs associated with a noise fencing/barrier are also removed through removal of the feature in the design.

Noise Barrier Design Option 1 (4m noise barrier)

The acoustic performance of this option is considered to be a **material worsening** due to the increase in major impacts during the day and moderate impacts at night.

Visually with no barrier within the Green Banks and a 4m (600m) barrier above TOR compared to the ES (as amended) assessed 4m (540m) and 3m (510m) barrier above TOR would have a negative change from the conclusions drawn in the ES. It is considered that Option 1 taking account of the no barrier section and the very minor track uplift will have a **negligible negative effect on the local landscape** character of Hartwell House and former golf course to the W of Aylesbury and its visual amenity to that reported in the ES (as amended).

Noise Barrier Design Option 2 (4m noise barrier with 3m barrier in the Green Banks Scheme)

The acoustic performance of this option is considered to be a **material worsening** due to the in-crease of 8 moderate impacts during the night.

Visually a 3m barrier within the Green Banks and a 4m (600m) barrier above TOR compared to the ES (as amended) assessed 4m (540m) and 3m (510m) barrier above TOR would have a negative change from the conclusions drawn in the ES. It is considered that Option 2 taking account of the very minor track uplift will have a **negligible negative effect on the local landscape** character of Hartwell House and former golf course to the West of Aylesbury and its visual amenity to that reported in the ES (as amended).

Noise Barrier Design Option 3 (4m barrier with 4m in the Green Banks Scheme)

The acoustic performance of this option is considered to be a **material worsening** due to the in-crease of 8 moderate impacts during the night.

Visually a 4m barrier within the Green Banks and a 4m (600m) barrier above TOR compared to the ES (as amended) assessed 4m (540m) and 3m (510m) barrier above TOR would have a negative change from the conclusions drawn in the ES. It is considered that Option 3 taking account of the very minor track uplift will have a **negligible negative effect on the local landscape** character of Hartwell House and former golf course to the West of Aylesbury and its visual amenity to that reported in the ES (as amended).

Noise Barrier Design Option 4 (5m barrier and no barrier in Green Banks Scheme)

The acoustic performance of this option is considered to be a **material worsening** due to the in-crease of 8 major impacts during the day and 8 moderate impacts during the night.

Visually with no barrier within the Green Banks and a 4m (600m) barrier above TOR compared to the ES assessed 4m (540m) and 3m (510m) barrier above TOR would have a negative change from the conclusions drawn in the ES. It is considered that taking account the no barrier section and the very minor track uplift will have a **negligible negative effect on the local landscape** character of Hartwell House and former golf course to the W of Aylesbury and its visual amenity to that reported in the ES (as amended).

Noise Barrier Design Option 5 (5m barrier and 4m barrier in Green Banks Scheme)

On balance, the acoustic performance is beneficial due to the decrease in moderate impacts during the day.

Visually a 4m barrier within the Green Banks and mostly a 4m (600m) barrier above TOR (with a very short section of 5m barrier – see image 10) compared to the ES (as amended) assessed 4m (540m) and 3m (510m) barrier above TOR would have a negative change from the conclusions drawn in the ES. It is considered that Option 5 taking account of the very minor track uplift will have a **negligible negative effect on the local landscape** character of Hartwell House and former golf course to the W of Aylesbury and its visual amenity to that reported in the ES (as amended).

Recommended Design Option: Stoke Mandeville Bypass Overbridge to Oxford Road Overbridge – West (AVDC P6/P7)

Five different combinations of lineside barriers have been assessed. **The Proposed Design (Option 5) with a combination of a 5m lineside barrier, 4m barrier in the Green Banks scheme, and 4m lineside barrier on the west side (downside) has been selected as the proposed mitigation design because it provides an acoustic benefit which outweighs the negative visual change**.

In summary, based on the appraisals in Tables 42 and 43 for L_{eq} daytime and night-time, the analysis in Table 44, and the appraisals for L_{max} values presented in Tables 45 and 46; along with consideration of acoustic cost benefits and potential visual effects associated with the noise barrier design options, the recommendation is as follows within the Stoke Mandeville Bypass Overbridge to Oxford Road Overbridge west package (AVDC P6/P7).

Despite the requirements of the Hartwell Agreement (section 2.4) through this section the acoustic disbenefits are considered to be significant and as such Noise Barrier Design Option 5 is the recommendation of the findings of this report, presenting the most balanced approach; consisting of.

- Ch 61+200 to Ch 62+250: 5m above top of rail absorptive acoustic fence on the west side of the Track
- Ch 62+250 to Ch 62+700: 4m above top of rail absorptive acoustic fence in the Green Banks Scheme on the west side of the Track
- Ch 62+700 to Ch 63+300: 4m above top of rail absorptive acoustic fence on the west side of the Track

4 Summary of Acoustic Barrier Requirements

Based upon the assessments and considerations informing this report the noise barrier requirements for IDR E are summarised below.

Location	Start Chainage	End Chainage	Up/Down Line	Length (m)	Height above ToR (m)
Wendover Embankment to Stoke Mandeville Bypass Overbridge Upside (East) – Option 2 Downside (West) – Option 2	57+400	59+100	Up	1700	4
	57+380	58+500	Down	1120	4
Stoke Mandeville Bypass Overbridge to Oxford Road Embankment Upside (East) – Option 5 Downside (West) – Option 5	59+800	62+250	Up	1400	5
	62+250	62+880	Up		2m Barrier in Green Banks Scheme
	61+880	64+200	Up	1320	5
	64+200	64+382	Up	182	1.25m (to tie in with Thame Valley Viaduct parapet
	61+200	62+250	Down	1050	5
	62+250	62+700	Down	450	4m Barrier in Green Banks Scheme
	62+700	63+300	Down	600	4

*The barrier between Oxford Road Embankment to Thame Valley Viaduct (IDR C) has been assessed as part of a composite barrier system to afford protection to the Aylesbury community and the appraisal of the composite barrier has been presented in this Acoustic Design Compliance Report for IDR E.

Table 47 Summary of Acoustic Barrier Requirements

The mitigation design includes the Undertaking and Assurance that indicated the need for noise barriers at 4m above ToR at the following locations:

- Ch 57+500 to Ch 58+500 Barrier 4m above ToR on East and West side
- Ch 57+800 to Ch 59+100 Barrier 4m above ToR on East Side