Botley West Solar Farm

Environmental Statement

Volume 3

Appendix 13.2: Construction Phase Noise and Vibration

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Glossary

Term	Meaning
Ambient sound level, $L_{Aeq,T}$	The steady sound level which, over a period of time T, contains the same amount of A-weighted sound energy as the time varying sound over the same period. Also known as the equivalent continuous sound pressure level.
Attenuation	The reduction in magnitude of sound energy.
Basic Noise Level	A measure of traffic source noise prior to development. It is calculated from traffic flows, road speed, and HGV percentage.
Code of Construction Practice	A document detailing the overarching principles of construction, contractor protocols, construction-related environmental management measures, pollution prevention measures, the selection of appropriate construction techniques and monitoring processes.
Decibel	A unit used to measure or compare the intensity of a sound by comparing it with a given reference level on a logarithmic scale.
Environmental Impact Assessment	The process of identifying and assessing the significant effects likely to arise from a project. This requires consideration of the likely changes to the environment, where these arise as a consequence of a project, through comparison with the existing and projected future baseline conditions.
Noise	An unwanted or unexpected sound.
Peak Particle Velocity	An indicator of the magnitude of ground vibration which refers to the movement of molecular particles within the ground.
Preliminary Environmental Information Report	A report that provides preliminary environmental information in accordance with the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017. This is information that enables consultees to understand the likely significant environmental effects of a project, and which helps to inform consultation responses.
Sound	Fluctuations of pressure within a medium (gas, solid or fluid) within the audible range of loudness and frequencies which excite the sensation of hearing.
Sound Power Level, L_w	The total sound energy emitted by a source per unit time.
Sound Pressure Level, L_p	The amount of force a sound wave exerts on a surface area perpendicular to the direction of travel. A measure of the variation of sound level over a distance.
The Applicant	SolarFive Ltd
The Project	The Botley West Solar Farm

Abbreviations

Abbreviation	Meaning
BNL	Basic Noise Level
BPM	Best Practicable Means
BS	British Standard
BWSF	Botley West Solar Farm Project
CoCP	Code of Construction Practice
CoPA	Control of Pollution Act
CRTN	Calculation of Road Traffic Noise
DMRB	Design Manual for Roads and Bridges
EIA	Environmental Impact Assessment
ES	Environmental Statement
HDD	Horizontal Directional Drilling
HGV	Heavy Goods Vehicle
ISO	International Organisation for Standardisation
LOAEL	Lowest Observed Adverse Effect Level
NOAEL	No Observed Adverse Effect Level
NOEL	No Observed Effect Level
NPSE	Noise Policy Statement for England
OS	Ordnance Survey
PPG	Planning Practice Guidance
PPV	Peak Particle Velocity
PEIR	Preliminary Environmental Information Report
SOAEL	Significant Observed Adverse Effect Level

Units

Unit	Description
dB	Decibels
hr	Hour
J	Joule
km	Kilometre
m	Metre
mm/s	Millimetres per second
mins	Minutes
ms	Millisecond

1 Construction Phase Noise & Vibration

1.1 Introduction

1.1.1 This document forms Appendix 13.2 of Volume 3 of the Environmental Statement (ES) prepared for the Botley West Solar Farm Project (BWSF), henceforth referred to as the Project. The ES presents the findings of the Environmental Impact Assessment (EIA) process.

1.1.2 This document provides the methodology and results of calculations undertaken to assess the noise and vibration impacts on nearby receptors due to the construction of the Project.

1.2 Legislation and guidance

Control of Pollution Act (CoPA) 1974

1.2.1 Section 60, Part III of the CoPA refers to the control of noise on construction sites. It outlines legislation by which Local Authorities can control noise from construction sites and prevent noise disturbance.

1.2.2 British Standards 5228-1:2009+A1:2014 and British Standard 5228 2:2009+A1:2014 were approved within The Control of Noise (Code of Practice for Construction and Open Sites) Order 2015 as suitable guidance on appropriate methods for the control of noise from construction and open sites in exercise of the powers conferred on the Secretary of State by sections 71(1)(b), (2) and (3) of the CoPA.

1.2.3 The CoPA provides a Local Authority with the power to serve a notice imposing requirements for the way in which construction works are to be carried out in their jurisdiction. This notice can specify:

- the plant or machinery permitted for use;
- the hours during which construction work may be undertaken;
- limits for the emission levels of noise and vibration due to the works at any time or spatial position on site; and
- any other change in circumstance.

1.2.4 Section 61, Part III of the CoPA refers to prior consent for work on construction sites. It provides a method by which a contractor can apply for consent to undertake construction works in advance. Providing consent is granted, and compliance is maintained with the stated method and hours of work, no action may be taken by the Local Authority under Section 60.

1.2.5 Section 71, Part III of the CoPA refers to the preparation and approval of codes of practice for minimising noise.

1.2.6 Section 72, Part III of the CoPA refers to Best Practicable Means (BPM), which is defined as:

‘In that expression, ‘practicable’ means reasonably practicable, having regards among other things to local conditions and circumstances, to the current state of technical knowledge and to the financial implications’. Whilst ‘Means’ includes ‘the design, installation, maintenance and manner and periods of operation of plant and machinery, and the design, construction and maintenance of buildings and acoustic structures.’

Environmental Protection Act (EPA) 1990

1.2.7 Section 79, Part III of the EPA contains a list of matters that amount to statutory nuisances and places a duty on Local Authorities to regularly inspect areas in their jurisdiction to determine where statutory nuisances may exist.

1.2.8 This section also considers and defines the concept of BPM which originates from Section 72, Part III of the CoPA.

1.2.9 The local authority must serve an abatement notice where it is satisfied that a statutory nuisance does exist or is likely to occur/recur. Section 80, Part III of the EPA provides local authorities with the power to serve an abatement to prohibit or restrict its occurrence or recurrence; and to carry out works or other actions necessary to abate the nuisance.

1.2.10 Section 82, Part III of the EPA allows a magistrates' court to act on a complaint made by any person on the grounds that they are aggrieved by a statutory nuisance, such as noise.

1.2.11 The procedures for appeals against abatement notices are detailed in the Statutory Nuisance (Appeals) Regulations 1995.

British Standard 5228:2009

1.2.12 This British Standard comprises the following two parts.

- British Standard 5228-1:2009+A1:2014 – 'Code of practice for noise and vibration control on construction and open sites' – Part 1: Noise.
- British Standard 5228-2:2009+A1:2014 – 'Code of practice for noise and vibration control on construction and open sites' – Part 2: Vibration.

1.2.13 The British Standard provides guidance, information, and procedures for the control of noise and vibration from demolition and construction sites. British Standard 5228- 1:2009+A1:2014 and British Standard 5228-2:2009+A1:2014 provides guidance on appropriate methods for minimising noise from construction and open sites under the relevant sections of the CoPA 1974.

1.2.14 There are no set standards for the definition of the significance of construction noise effects. However, noise example criteria are provided in British Standard 5228-1:2009+A1:2014 Annex E and vibration example criteria are provided in British Standard 5228-2:2009+A1:2014 Annex B.

1.2.15 British Standard 5228-1:2009+A1:2014 provides basic information and recommendations for methods of noise control relating to construction and open sites where work activities/operations generate significant noise levels. It includes sections on:

- community relations;
- noise and persons on site;
- neighbourhood nuisance;
- project supervision; and
- the control of noise.

1.2.16 The annexes include information on legislative background, noise sources, remedies and their effectiveness (mitigation options); current and historic sound level data for on-site equipment and site activities; significance of noise effects; calculation procedures estimating sound emissions from sites and sound level monitoring; types of piling; and air overpressure.

1.2.17 British Standard 5228-2:2009+A1:2014 contains information and recommendations for basic methods of vibration control arising from construction and open sites where work activities/operations generate significant levels of vibration. It includes sections on community relations; vibration and persons on site; neighbourhood nuisance; project supervision; control of vibration and measurement. British Standard 5228-2:2009+A1:2014 refers to British Standard ISO 4866:2010; British Standard 7385-2:1993; British Standard 6472-1:2008, and British Standard 6472-2:2008 for further advice on the significance of vibration.

Design Manual for Roads and Bridges (DMRB) – LA 111 – Noise and Vibration

1.2.18 The DMRB LA 111 (Highways England *et al.,* 2020), provides guidance on methods for assessing noise and vibration from construction traffic.

1.2.19 The magnitude of noise impacts is assessed using the predicted change in the Basic Noise Level (BNL) on the closest public roads to a receptor following the introduction of construction traffic.

1.2.20 The noise change is calculated using the methods outlined in the CRTN (Department for Transport, 1988) which considers:

- the change in traffic flow due to construction traffic;
- vehicle speed; and
- the percentage of Heavy Goods Vehicles (HGVs).

1.2.21 Paragraph 3.19 of DMRB LA 111 states the following:

‘Construction noise and construction traffic noise shall constitute a significant effect where it is determined that a major or moderate magnitude of impact will occur for a duration exceeding:

- *10 or more days or nights in any 15 consecutive days or nights;*
- *a total number of days exceeding 40 in any 6 consecutive months.’*

Planning Practice Guidance (PPG)

1.2.22 The Planning Practice Guidance (PPG) (Department for Levelling Up, Housing and Communities and Ministry of Housing, Communities and Local Government, 2019) supports the National Planning Policy Framework (NPPF) (Department for Levelling Up, Housing and Communities, 2023) and provides guidance across a range of topic areas.

1.2.23 The noise section of the PPG provides outline guidance and refers to general guidance on noise policy and assessment methodology detailed in the NPPF, the Noise Policy Statement for England (NPSE) (Department for Environment, Food & Rural Affairs, 2010) and British Standards. The NPSE sets out noise management policy in the form of the Government’s long-term vision to manage noise and improve health and quality of life.

1.2.24 The following guidance is presented within the PPG on how noise impacts may be determined:

“Plan-making and decision making need to take account of the acoustic environment and in doing so consider:

- *whether or not a significant adverse effect is occurring or likely to occur;*
- *whether or not an adverse effect is occurring or likely to occur; and*
- *whether or not a standard of amenity can be achieved."*

1.2.25 The construction noise and vibration impact magnitude criteria have been defined in the context of the Lowest Observed Adverse Effect Level (LOAEL) and the Significant Observed Adverse Effect Level (SOAEL). The observed effect levels are defined as the following:

- "Significant observed adverse effect level: This is the level of noise exposure above which significant adverse effects on health and quality of life occur;
- Lowest observed adverse effect level: this is the level of noise exposure above which adverse effects on health and quality of life can be detected; and
- No observed effect level: this is the level of noise exposure below which no effect at all on health or quality of life can be detected."

Criteria for the impacts of construction noise and vibration have been derived based on the guidance detailed in DMRB LA 111 in conjunction with British Standard 5228-1:2009+A1:2014 and British Standard 5228-2:2009+A1:2014. Full details are provided in **Section 1.3** of this Appendix.

1.3 Assessment criteria

1.3.1 Based on the guidance above, the following impact criteria have been adopted.

Construction noise

1.3.2 Impact criteria for construction noise have been determined in accordance with DMRB LA 111 and Annex E of British Standard 5228-1:2009+A1:2014. Table 3.12 of DMRB LA 111 provides guidance (as summarised in **Table 13.3**) for determining the LOAEL and SOAEL for construction noise and (in **Table 13.1**) for determining the magnitude of impacts.

Table 13.1: Summary of noise exposure hierarchy from NPSE and PPG

Response	Examples of outcomes	Increasing effect level	Action
No Observed Effect Level			
Not present	No effect.	No Observed Effect.	No specific measures required.
No Observed Adverse Effect Level			
Present and not intrusive	Noise can be heard but does not cause any change in behaviour, attitude, or other physiological response. Can slightly affect the acoustic character of the area but not such that there is a change in the quality of life.	No Observed Adverse Effect.	No specific measures required.
Lowest Observed Adverse Effect Level (LOAEL)			

Response	Examples of outcomes	Increasing effect level	Action
Present and intrusive	Noise can be heard and causes small changes in behaviour, attitude or other physiological response, e.g., turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a small actual or perceived change in the quality of life.	Observed Adverse Effect.	Mitigate and reduce to a minimum.
Significant Observed Adverse Effect Level (SOAEL)			
Present and disruptive	The noise causes a material change in behaviour, attitude or other physiological response, e.g., avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening, and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect.	Avoid.
Present and very disruptive	Extensive and regular changes in behaviour, attitude or other physiological response and/or an inability to mitigate effect of noise leading to psychological stress, e.g., regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g., auditory and non-auditory.	Unacceptable Adverse Effect.	Prevent.

Table 13.2: Construction time period – LOAEL and SOAEL

Time Period	LOAEL	SOAEL
Weekdays (0700-1900 hours) Saturdays (0700-1300 hours)	Baseline sound levels, $L_{Aeq,T}$	Lowest threshold values as presented Table E.1 British Standard 5228-1:2009+A1:2014.
Evenings (1900-2300 hours) Saturdays (1300-2300 hours) Sundays (0700-2300 hours)		
Night (2300-0700 hours)		

1.3.3 The criteria to determine the impact magnitude during the construction and decommissioning stage is presented in **Table 13.3**.

Table 13.3: Construction and decommissioning noise impact magnitude criteria

Magnitude of impact	Construction noise level
High	$L_{Aeq,T}$ ≥ SOAEL + 5 dB

Magnitude of impact	Construction noise level
Medium	SOAEL ≤ $L_{Aeq,T}$ < SOAEL +5 dB
Low	LOAEL ≤ $L_{Aeq,T}$ < SOAEL
Negligible	$L_{Aeq,T}$ < LOAEL

1.3.4 The measured ambient sound levels vary significantly at receptors along the Project site (see Volume 3, Appendix 13.1: Baseline sound survey of the ES).

1.3.5 However, following the construction noise criteria, which is detailed in BS5228: 5228- 1:2009+A1:2014, the lowest noise category is Category A, which stipulates a noise limit of 65 dB(A) $L_{eq,1h}$ for daytime construction works, which is applicable to the majority of the construction works of the Project. Lower construction phase limits of 55 dB(A) and 45 dB(A) are provided for construction works during the evening and night-time.

1.3.6 These construction noise criteria are defined based upon the existing ambient sound level. Where the existing daytime ambient sound level is below 65 dB, then the receptor is placed into Category A.

1.3.7 The majority of the receptors are located away from significant sources of sound, and therefore have an ambient sound level which is below 65 dB(A) during the daytime. Subsequently, it is not necessary to identify the existing ambient sound level at every receptor. Instead, every receptor can be placed into Category A to ensure a robust assessment.

1.3.8 Therefore, the impact criteria for the relevant locations are presented in **Table 13.4**.

Table 13.4: Construction noise criteria

Magnitude of Impact	Threshold Value (dB)		
	Weekdays (0700-1900) and Saturdays (0700-1300)	Evening (1900-2300) and Weekends (1300-2300 on Saturdays and 0700-2300 on Sundays)	Night (2300-0700)
Northern Site			
High	$L_{Aeq,T}$ ≥ 70	$L_{Aeq,T}$ ≥ 60	$L_{Aeq,T}$ ≥ 50
Medium	65 ≤ $L_{Aeq,T}$ < 70	55 ≤ $L_{Aeq,T}$ < 60	45 ≤ $L_{Aeq,T}$ < 50
Low	54 ≤ $L_{Aeq,T}$ < 65	48 ≤ $L_{Aeq,T}$ < 55	43 ≤ $L_{Aeq,T}$ < 45
Negligible	$L_{Aeq,T}$ < 54	$L_{Aeq,T}$ < 48	$L_{Aeq,T}$ < 43
Central Site			
High	$L_{Aeq,T}$ ≥ 70	$L_{Aeq,T}$ ≥ 60	$L_{Aeq,T}$ ≥ 50
Medium	65 ≤ $L_{Aeq,T}$ < 70	55 ≤ $L_{Aeq,T}$ < 60	45 ≤ $L_{Aeq,T}$ < 50
Low	49 ≤ $L_{Aeq,T}$ < 65	43 ≤ $L_{Aeq,T}$ < 55	42 ≤ $L_{Aeq,T}$ < 45
Negligible	$L_{Aeq,T}$ < 49	$L_{Aeq,T}$ < 43	$L_{Aeq,T}$ < 42

Magnitude of Impact	Threshold Value (dB)		
	Weekdays (0700-1900) and Saturdays (0700-1300)	Evening (1900-2300) and Weekends (1300-2300 on Saturdays and 0700-2300 on Sundays)	Night (2300-0700)
Southern Site			
High	$L_{Aeq,T} \geq 70$	$L_{Aeq,T} \geq 60$	$L_{Aeq,T} \geq 50$
Medium	$65 < L_{Aeq,T} < 70$	$55 < L_{Aeq,T} < 60$	$45 < L_{Aeq,T} < 50$
Low	$48 < L_{Aeq,T} < 65$	$46 < L_{Aeq,T} < 55$	$43 < L_{Aeq,T} < 45$
Negligible	$L_{Aeq,T} < 48$	$L_{Aeq,T} < 46$	$L_{Aeq,T} < 43$

1.3.9 This construction phase noise criteria has been used to identify the construction phase noise impact magnitude. To aid clarity in this assessment, the ‘Low’ impact magnitude has been taken as the lowest impact magnitude for construction phase noise at receptors. Therefore, where receptors are shown to experience a low impact magnitude from construction phase noise, the true impact could be either low or negligible. Both the medium, and High impact magnitude categories have been used where required.

Construction traffic noise

1.3.10 There may be a change in local noise levels due to contributions from construction traffic on local road networks and temporary diversion networks during the construction of the Project.

1.3.11 The impact assessment takes account of the absolute level of the road traffic noise and the existing sound levels at the nearest receptors.

1.3.12 Impact criteria for these changes have been obtained from the guidance in DMRB LA 111 and are presented in **Table 13.5** below.

Table 13.5: Construction Phase Traffic Noise

Magnitude of impact	Increase in BNL of closest public road used for construction traffic (dB)
High	BNL ≥ 5
Medium	3 ≤ BNL < 5
Low	1 ≤ BNL < 3
Negligible	BNL < 1

Construction vibration

1.3.13 Impact criteria for vibration from construction have been identified based on guidance provided in British Standard 5228-2:2009+A1:2014. The following outline criteria in Table 13.6 in terms of peak particle velocity (PPV) can be used to identify potential significant impacts on nearby receptors.

Table 13.6: Construction and decommissioning vibration impact magnitude criteria

Magnitude of impact	Vibration level, PPV, mm/s
High	PPV ≥ 10
Medium	3 ≤ PPV < 10
Low	0.3 ≤ PPV < 3
Negligible	PPV < 0.3

1.3.14 The magnitude of impact will also depend on the frequency and duration for which people are likely to be exposed to vibration.

1.4 Methodology

Study area

1.4.1 The study area for the noise and vibration assessment of the Project focuses on receptors where potential noise and vibration impacts are most likely to occur.

1.4.2 The study area relevant to the ES for construction noise and vibration is defined as:

- the area of land to be temporarily or permanently occupied during the construction, operation and decommissioning of the Project;
- noise sensitive receptors located within 300 meters (m) of construction activities; and
- vibration sensitive receptors located within 100 m of construction activities.

1.4.3 The noise and vibration study areas above are presented graphically in Figure 13.1 and 13.2 of Volume 2: Figures of the ES, respectively.

Construction noise

1.4.4 The construction scenarios considered include, each consider the maximum design scenario, and the cable route options:

- Noise impacts during the construction and use of the construction compounds.
- Trenchless techniques at junctions and crossings via Horizontal Directional Drilling (HDD) and Direct Pipe;
- Open-cut trenching along the cable corridor (including cable route options);
- Solar pile driving techniques for the installation of the mounts for the solar panels; and
- Construction of the main Project Substation and NGET substation.

1.4.5 An assessment of the potential noise and vibration impacts on noise sensitive receptors has been undertaken based on a list of construction plant proposed for each activity required for the Project, as well an estimated percentage of the construction period during which the plant would be in operation.

1.4.6 The data used within this assessment is presented in Appendix A in this appendix. Source noise data for the construction works have been obtained from manufacturers' datasheets for typical plant items and professional experience of similar projects. Typical noise levels for the types of plant proposed for open-cut trenching have been obtained from Annex C of British Standard 5228-1:2009+A1:2014 which contains current and historic noise data for various on-site construction activities.

1.4.7 The potential noise impact from the construction works have been assessed against the criteria in **Table 13.4** in this Appendix.

1.4.8 Only human receptors have been considered at this stage. An assessment of noise and vibration impacts on ecological receptors has been undertaken in Chapter 9 of the Environmental Statement (ES).

Construction vibration

1.4.9 Construction vibration impacts may occur where HDD, Direct Pipe or piling activities are required.

1.4.10 Prediction methods for the variation of vibratory piling levels with distance outlined in Annex E of British Standard 5228-2:2009+A1:2014 are valid for vibratory hammer energies of up to 10,500 J/cycle. Recent assessments of these techniques have involved vibro-hammers with energies greater than 10,500 J/cycle.

1.4.11 The vibration impacts due to solar pile driving will depend on the location, equipment and proximity to receptor. However, a typical specification for a solar pile driving hydraulic unit has been provided which has a maximum hammer energy of 1.1 kJ per blow. This is a relatively low hammer energy and is unlikely to give rise to adverse impacts, particularly since the works will not be undertaken in one location for the whole construction period.

1.4.12 The levels of vibration generated due to HDD exit pits have been calculated using library data from a historic project where similar techniques were adopted. A summary of the specification is provided in Table 13.7 below.

Table 13.7: Vibro-hammer specification

Hammer model	Hammer type	Maximum power energy, *E* (J/cycle)	Soil/hammer parameter[(1)], *C*
SPI MRZV 30VV (TM20)	Vibro	13,154	0.7

1.4.13 Vibration levels from the construction activities have been undertaken using the methodology detailed in BS5228-2.

Construction traffic

1.4.14 The change in the BNL due to the introduction of additional vehicles onto local highways as part of the construction of the Project has been calculated using the method outlined in CRTN, as detailed in paragraph 1.2.20.

1.4.15 The 18-hour BNL $L_{10,18h}$ is calculated using the linear equation for Chart 3 of CRTN reproduced in Equation 2 below. This equation is empirically derived and depends upon the traffic flow (Q) at a mean speed (V) of 75 km/h assuming no HGVs.

$$L_{10,18hr} = 29.1 + 10\log_{10} Q \qquad (2)$$

1.4.16 This BNL is adjusted by a correction (C) to account for variations in mean traffic speed (V) and the percentage of HGVs (p) using the empirically derived equation in Chart 4 of CRTN, as given by Equation 3 below.

$$C = 33\log_{10}\left(V + 40 + \frac{500}{V}\right) + 10\log_{10}\left(1 + \frac{5p}{V}\right) - 68.8 \quad (3)$$

1.4.17 The baseline traffic and predicted construction traffic flows are presented in Appendix B.

1.5 Results

Construction Compounds

1.5.1 The Project will require construction compounds to be formed. These are located in the Northern Site Area, Central Site Area, and, Southern Site Area. These construction compounds will need to be formed using heavy construction equipment, as is set out in Table A.1. The normal use of the construction compound may include a generator, site cabins, and some light construction works.

1.5.2 The construction compounds will be required for the solar piles, panel installation, storage of materials, and cable route installation. They will not be used for the HDD operations and so will only be operational during the core working hours.

1.5.3 The identified noise emissions from the set-up and normal use of the construction compound have been entered into the computer noise model to enable the assessment of construction noise at the receptors.

1.5.4 The results of the computer noise modelling are shown in Appendix C herein. The results are displayed as coloured contours maps and singular point receiver results where there is a residential receptor nearby.

1.5.5 The construction compounds are situated sufficiently far from receptors such that no high impacts are predicted due to vibration.

1.5.6 As shown in the results, noise from the construction compounds during the set-up and normal use is below 65 dB(A) at all residential receptors. This equates to low impact magnitude. Residential receptors have a medium sensitivity, therefore noise from construction compounds would cause a minor adverse impact significance, which is not significant.

Solar Pile Driving Noise and Vibration

1.5.7 The solar PV modules are expected to be mounted upon a metal frame. This would be supported by galvanised steel piles or screws driven into the ground by impact piling to a depth of approximately 1.5 – 2.0 m.

1.5.8 The exact depth of the piles will be determined during the early stages of the construction phase when testing can be undertaken.

1.5.9 The solar pile driver is similar to the type of equipment a farmer may use to install fence posts into the ground.

1.5.10 This pile driving procedure has the potential to cause some noise, which may be audible outside of the site boundary. The highest sound levels will occur during the pile installation and will typically take 1-2 minutes per pile, with time spent for the machine to relocated to the next pile location where the sound emitted from the process will be much lower. The pile driver will then move away from this receptor, which will effectively reduce the noise from the pile driving activity received at the receptor.

1.5.11 Subsequently, all receptors would not be affected simultaneously across all sections. Moreover, the solar pile driving works would be very transient in nature and would move across each of the PV installation areas, thus receptors may be exposed to high noise levels but this would occur only for a short period of time. Furthermore, this activity would only occur during the core working hours.

1.5.12 Sound emission data for the solar pile installation equipment is provided in Table A.3.

1.5.13 If required, noise screens could be installed around the solar pile driver where the installation occurs very close to residential receptors.

1.5.14 The vibration impacts due to solar pile driving will depend on the location, equipment, and proximity to receptor. However, a typical specification for a solar pile driving hydraulic unit has been provided which has a maximum hammer energy of 1.1 kJ per blow. This is a relatively low hammer energy and is unlikely to give rise to adverse impacts, particularly since the works would not be undertaken in one location for the whole construction period.

1.5.15 Calculations of the impact magnitudes at various distances have been undertaken using the methodology defined in BS5228-2 Table E.1. The Results of the assessment identify that the impact magnitude will be low at a distance of 15m or more from the solar pile driving.

1.5.16 Noise and vibration from the installation of the solar piles would cause a low impact magnitude. Residential receptors have a medium sensitivity, therefore, noise and vibration from solar piles would cause a minor adverse impact significance, which is not significant.

HDD & Direct Pipe Noise and Vibration

1.5.17 There are currently ten (HDD 6 has 2 options) locations where HDD is likely to be required. It would be possible to undertake HDD in additional locations, with appropriate noise controls to maintain an impact magnitude of 'low'.

1.5.18 The defined locations for HDD are listed below:

- HDD 1: Hedgerow - Location: 51°52'13.3"N 1°19'55.1"W)
- HDD 2: Road - Location: 51°50'16.0"N 1°20'11.1"W
- HDD 3: Road - Location: 51°49'12.9"N 1°21'08.6"W
- HDD 4: Railway crossing - Location: 51°48'39.6"N 1°20'51.2"W
- HDD 5: Evenlode River - Location: 51°47'52.4"N 1°21'49.8"W
- HDD 6a: Thames River - Location: 51°46'46.0"N 1°21'11.8"W
- HDD 6b: Thames River - Location 51°46'42.5"N 1°21'18.6"W
- HDD 7: Woodland (for 33kV cable) - Location: 51°51'49.6"N 1°20'39.7"W
- HDD 8: Railway crossing (for 33kV cable) - Location: 51°48'15.6"N 1°19'53.2"W
- HDD 9: Hedgerow (for 33kV cable) - Location: 51°48'30.6"N 1°20'32.3"W
- HDD 10: Landfill (for 275kV cable) - Location: 51°51'07.0"N 1°20'12.2"W

1.5.19 Each of the options for HDD 6a/b have been assessed and the maximum design scenario determined as the option which gives rise to high noise impacts at the greatest number of receptors.

1.5.20 The HDD entry points, where the majority of the noise producing equipment is located, are positioned over 500 m from one-another, and so cumulative noise effects from the HDD works are considered very unlikely to occur.

1.5.21 The identified noise emissions from the HDD works have been entered into the computer noise model using the details of the plant and equipment which is set-out in Table A.2.

1.5.22 The results of the computer noise modelling are shown in Appendix D herein. The results are displayed as coloured contours maps, and singular point receiver results where there is a residential receptor nearby.

1.5.23 As shown in the results, noise from HDD activities is below 55 dB(A) at all residential receptors, which allows for HDD works to be carried out during the daytime and evening, whilst avoiding a significant adverse impact.

1.5.24 Where it is necessary to undertake HDD works during the night-time, noise screens will be installed around the HDD compounds for HDD 2 and HDD 10.

1.5.25 These noise screens will be specified in the CoCP.

1.5.26 The locations for the HDD works are situated sufficiently far from receptors such that no high impacts are predicted due to vibration.

1.5.27 However, HDD 3 is located close to Burleigh Lodge. A low impact magnitude has been predicted where HDD works take place during the daytime and evening, however, noise screens will be required to be installed around the HDD compound where works need to take place during the night-time. Continuous vibration monitoring should be undertaken at Burleigh Lodge throughout the duration of the HDD activities for HDD 3.

1.5.28 Furthermore, there is concern from the Environment Agency (EA) that HDD works could adversely affect flood defences. This is likely to only relate to HDD 6 which runs below the River Thames.

1.5.29 In line with the comments from the EA, continuous vibration monitoring will be undertaken during HDD works nearby flood defences (HDD 6).

1.5.30 There are some areas across the site where Direct Pipe trenchless cross will be employed. This Direct Pipe methodology will be typically employed to enable cables to pass below hedgerows and other sensitive features, where open trench techniques are not desirable. Where possible the Direct Pipe method will be undertaken away from receptors, and any noisy works will be short duration, and during the daytime only.

1.5.31 Noise and vibration from HDD works would cause a low impact magnitude. Residential receptors have a medium sensitivity, therefore, noise and vibration from HDD works would cause a minor adverse impact significance, which is not significant.

Open Cut Trenching Noise

1.5.32 The majority of the cable route would be constructed via open trenching techniques. Although it would be possible to employ alternative cable laying techniques with appropriate noise control measures, to ensure that the impact magnitude of the works remained 'low'.

1.5.33 The impact magnitude assessment has considered the works required to backfill the trench since the data provided shows this to be the highest noise-generating activity associated with open trench techniques.

1.5.34 The route of the cable can be found in Figure 2.4a - Figure 2.4c of Volume 2: Figures. As shown, a significant proportion of the solar route occurs within the Project Site Boundary, and away from residential receptors.

1.5.35 There are cable route corridor options linking the Northern Site Area, Central Site Area, and, Southern Site Area. These options are also addressed in the assessment of HDD. Full details of these cable route corridor options are set-out in Volume 1, Chapter 6: Project Description [Doc ref: 7.3].

1.5.36 The highest likelihood of a potential adverse impact occurs where construction activities take place closest to noise sensitive receptors.

1.5.37 For each of the cable route options, the maximum design scenario has been considered (i.e. where construction activities are proposed closest to the noise sensitive receptors).

1.5.38 The cable corridor will require the digging of a narrow trench (approximately 0.6m wide, to a depth of around 1.4 m. The open-cut trench method is similar to any other utility being install in a road-way (e.g. gas/water etc). The methodology used is well understood. Furthermore, noise from the open-cut trenching will only occur during the daytime.

1.5.39 Details of the plant and equipment which is likely to be used for the open-cut trenching operation is shown in Table A.4 in this document.

1.5.40 As with the solar pile driving, the noise from open-cut trenching will be transient, and will only occur close to any one receptor for a short period of time, with works quickly moving along the cable route.

1.5.41 Therefore, it is possible that construction phase noise levels could exceed 65 dB(A) at any one receptor, however, any exceedance would only occur for a short period of time and would not cause a significant adverse effect.

1.5.42 The installation of the cable route will cause a similar level of disruption to the installation of any other underground service, which is an acknowledged and accepted noise source at any residential receptor.

1.5.43 Noise from open cut trenching works (including cable route options) would cause a low impact magnitude. Residential receptors have a medium sensitivity, therefore, noise open cut trenching works would cause a minor adverse impact significance, which is not significant.

NGET Substation Noise

1.5.44 The Project includes three substations defined as the Project Substation. These are located in the Southern Section of the site. Forming the bases for these substations and installation of the associated electrical equipment will require the use using heavy construction equipment, as is set-out in Table A.5.

1.5.45 The identified noise emissions from the construction of the substation bases have been entered into the computer noise model to enable the assessment of construction noise at the receptors.

1.5.46 The results of the computer noise modelling are shown in Appendix E herein. The results are displayed as coloured contours maps, and singular point receiver results where there is a residential receptor nearby.

1.5.47 As shown in the results, noise from the construction of the substations, even when undertaken concurrently, is below 65 dB(A) at all residential receptors, which avoids a significant adverse impact.

1.5.48 Noise from the construction of the substation bases would cause a low impact magnitude. Residential receptors have a medium sensitivity, therefore, noise from the construction of the substation bases would cause a minor adverse impact significance, which is not significant.

Construction Traffic

1.5.49 The introduction of additional construction vehicles on local highways may increase noise levels at receptors close to the road. The baseline traffic flows on the key highway links surrounding the Project Site, and thereby BNL, are relatively high. As such, the introduction of additional vehicular movements due to construction traffic does not significantly increase noise levels. The maximum increase predicted is +1 dB.

1.5.50 As a result the noise assessment shows that construction phase traffic will not adversely affect receptors, and the effect is not significant.

1.5.51 The full results of the construction traffic noise assessment are tabulated in Appendix B herein.

1.5.52 In summary, due to relatively high existing baseline traffic flows for some key highway links surrounding the Project Site, the change in BNL results in impacts of 'low' to 'negligible' overall.

1.6 References

Control of Pollution Act 1974, Chapter 40, Part III

Environmental Protection Act (1990), Chapter 43, Part III

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Heckman, W.S., Hagerty, D.J, (1978*), 'Vibrations associated with pile driving'*, Journal of the Construction Division, 104(4), 385-394

International Organisation for Standards (2010), *'ISO 4866:2010 – Mechanical vibration and shock – Vibration of fixed structures – Guidelines for the measurement of vibrations and evaluation of their effects on structures'*

International Organisation for Standards (1996) *'ISO 9613-2:1996 – Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation'.*

Appendix A: Construction Noise Source Spectra

Table A.1 Input data for Construction Compounds

Plant Item	Sound Pressure Level at 10 m at Octave Band Centre Frequency (Hz)								dB(A)
	63	125	250	500	1k	2k	4k	8k	
Set-Up									
Excavators	89	78	73	67	64	62	58	51	71
Vibratory Roller	88	83	69	68	67	65	62	59	89
Front Loader	78	72	68	66	66	62	58	55	79
Temporary Welfare Facilities (incl. diesel genies)	80	74	57	54	53	48	45	37	61
Use of Compounds									
Temporary Welfare Facilities (incl. diesel genies)	80	74	57	54	53	48	45	37	61
Light construction equipment	98	96	92	86	87	85	81	74	92

Table A.2 Input data for assessment of HDD noise

Plant Item	Sound Power Level at Octave Band Centre Frequency (Hz)								dB(A)
	63	125	250	500	1k	2k	4k	8k	
Drill rig	95	103	103	99	99	96	93	86	104
Rig hydraulic power unit	99	107	108	109	110	10	106	99	113
Mounting supports for HDD	77	83	73	68	73	80	84	77	87
Generator	67	80	74	72	72	72	68	61	78
Slurry pump	87	82	76	76	75	70	67	55	79
Water pump	87	82	76	76	75	70	67	55	79
Slurry mixing tank	73	74	80	73	70	68	64	61	77
Cuttings separation equipment	74	75	81	74	71	69	65	62	78
Excavator	74	75	81	74	71	69	65	62	78
Engine exhausts	74	75	81	74	71	69	65	62	78
Light construction equipment	98	96	92	86	87	85	81	74	92

Table A.3 Input data for Solar Pile Driving

Plant Item	Sound Power Level at Octave Band Centre Frequency (Hz)								dB(A)
	63	125	250	500	1k	2k	4k	8k	
Pauselli 500 (Idling)	98	92	88	83	79	75	67	61	86
Pauselli 500 (Piling)	110	117	118	114	113	108	104	95	117

Table A.4 Input data for assessment of open-cut trenching

Plant Item	Sound Pressure Level at 10 m at Octave Band Centre Frequency (Hz)								dB(A)
	63	125	250	500	1k	2k	4k	8k	
21T excavator	80	83	76	73	72	70	69	66	78
5T Forward Tipping Dumper	90	86	72	71	71	71	66	59	77
Loading shovel	85	83	76	75	75	72	72	61	80
Trench Roller	82	78	67	71	67	64	60	57	73
Telehandler	79	73	66	65	78	66	54	47	79
Mobile self-contained welfare unit	64	67	68	65	58	54	49	42	66
Mobile generator	75	72	76	70	69	65	56	47	74
Temporary lighting	78	71	66	62	59	55	56	49	66
Pump	83	76	70	73	74	72	65	58	78

Table A.5 Input data for assessment of substation construction

Plant Item	Sound Pressure Level at 10 m at Octave Band Centre Frequency (Hz)								dB(A)
	63	125	250	500	1k	2k	4k	8k	
Mobile Crane	80	79	73	74	73	73	64	55	78
Flat bed articulated truck	85	87	77	75	76	73	69	62	81
Rock Breakers/Concrete Munchers	79	82	81	82	86	86	86	85	93
CAT 320 Excavators	89	78	73	67	64	62	58	51	71
Compressors (Diesel) (Atlas Copco)	58	58	58	61	64	64	64	59	70
Piling Rigs	83	82	79	82	82	84	82	77	89
Lighting Towers (Diesel)	80	74	57	54	53	48	45	37	61
Concrete Pumps	83	77	75	75	74	75	67	63	80
Temporary Welfare Facilities (incl. diesel genies)	80	74	57	54	53	48	45	37	61

Appendix B: Construction Traffic Assessment

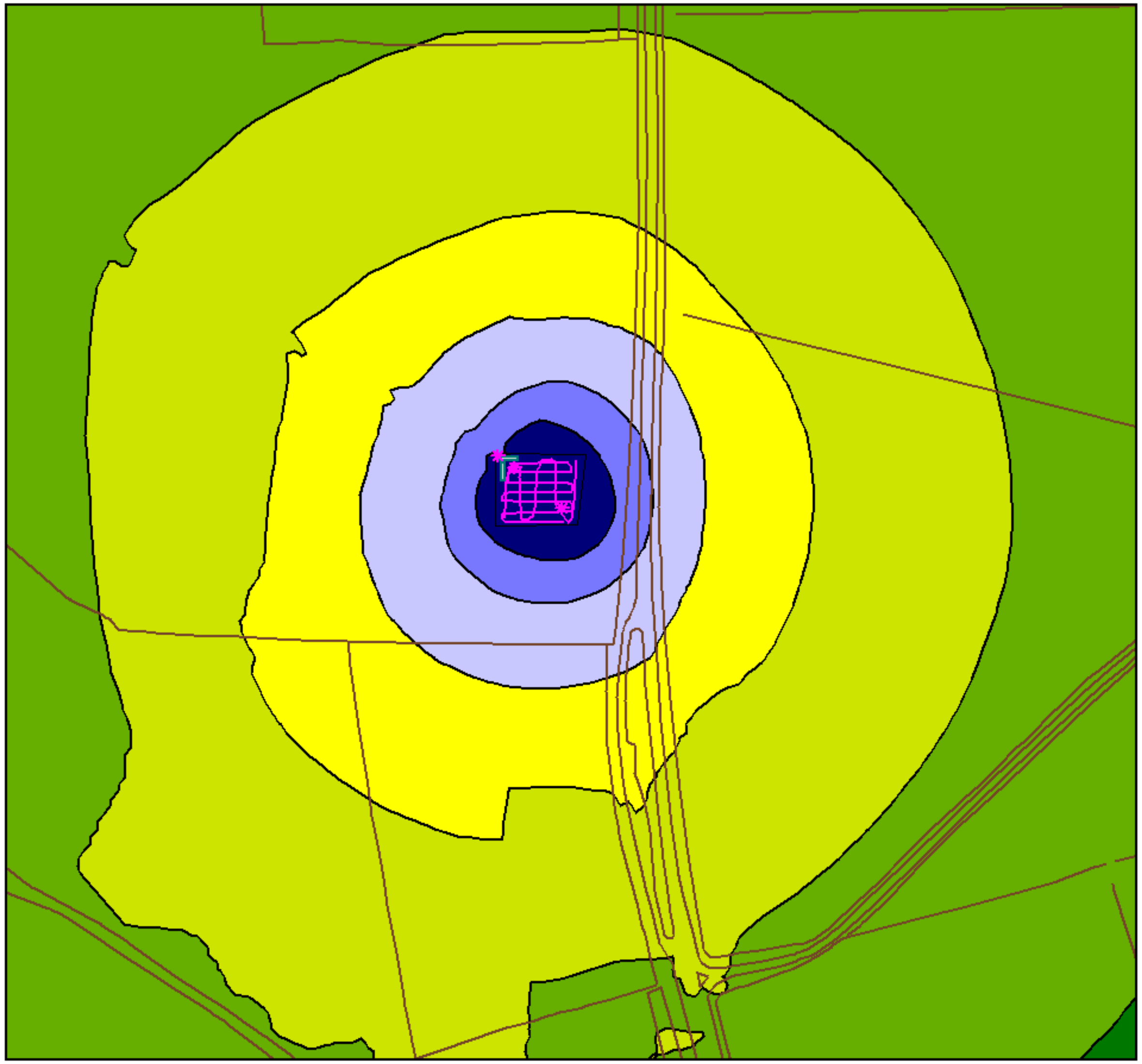
Table B.1 Construction traffic noise assessment results

Link	Baseline Traffic Flows				Construction Traffic Flows		Increase in BNL of closest public road used for construction traffic (dB)				
	Total Vehicles	HGVs	p (%)	BNL + C (dB)	Total Vehicles	HGVs	Total Vehicles	HGVs	p (%)	BNL + C (dB)	Impact
Link 1: A4260 between Access and B4027	11,566	476	4%	67	133	105	11699	581	5%	67	Negligible
Link 2: B4027 between Access and A4260	3,584	65	2%	62	10	2	3594	67	2%	62	Negligible
Link 3: A4260 between B4027 and A4095	12,239	504	4%	67	133	105	12372	609	5%	67	Negligible
Link 4: A4260 between A4095 (NE) and A4095 (SW)	22,033	907	4%	71	133	105	22166	1012	5%	71	Negligible
Link 5: A4095 between A4260 and A44	11,306	803	7%	68	133	105	11439	908	8%	68	Negligible
Link 6: A4095 between A44 and Cassington Road	14,775	1,049	7%	69	10	2	14785	1051	7%	69	Negligible
Link 7: Cassington Road between A4095 and Access	750	10	1%	56	10	2	760	12	2%	56	Negligible
Link 8: A44 between A4095 and Langford Lane	26,788	1,111	4%	71	133	105	26921	1216	5%	71	Negligible
Link 9: A44 between Langford Lane and Cassington Road	28,668	1,296	5%	72	133	105	28801	1401	5%	72	Negligible

Link	Baseline Traffic Flows				Construction Traffic Flows		Increase in BNL of closest public road used for construction traffic (dB)				
	Total Vehicles	HGVs	p (%)	BNL + C (dB)	Total Vehicles	HGVs	Total Vehicles	HGVs	p (%)	BNL + C (dB)	Impact
Link 10: A44 between Cassington Road and A4260	28,668	1,296	5%	73	133	105	28801	1401	5%	73	Negligible
Link 11: A44 between A4260 and A34	32,877	1,609	5%	73	133	105	33010	1714	5%	73	Negligible
Link 12: A34 northeast of Kidlington	78,317	8,710	11%	77	133	105	78450	8815	11%	77	Negligible
Link 13: A44 between A34 and A40	33,468	1,769	5%	73	133	105	33601	1874	6%	73	Negligible
Link 14: A40 between A44 and Eynsham Road	25,030	1,993	8%	72	133	105	25163	2098	8%	72	Negligible
Link 15: A40 between Eynsham Road and Lower Road	27,277	2,172	8%	73	133	105	27410	2277	8%	74	Low
Link 16: Lower Road between A40 and Access	7,248	355	5%	68	133	105	7381	460	6%	68	Negligible
Link 17: B4449 between A40 and Access	11,912	774	6%	70	10	2	11922	776	7%	70	Negligible
Link 18: B4449 between Access and Access on B4044 Oxford Road	11,912	774	6%	70	10	2	11922	776	7%	70	Negligible
Link 20: B4044 Oxford Road between Access and Cumnor Road	11,393	741	7%	70	10	2	11403	743	7%	70	Negligible

Link	Baseline Traffic Flows				Construction Traffic Flows		Increase in BNL of closest public road used for construction traffic (dB)				
	Total Vehicles	HGVs	p (%)	BNL + C (dB)	Total Vehicles	HGVs	Total Vehicles	HGVs	p (%)	BNL + C (dB)	Impact
Link 21: Cumnor Road between B4044 Eynsham Road and Access	3,360	91	3%	65	133	105	3493	196	6%	66	Low
Link 22: B4044 Eynsham Road between Cumnor Road and A420	10,975	713	6%	71	133	105	11108	818	7%	71	Negligible
Link 23: A420 between B4044 Eynsham Road and A34	32,417	2,399	7%	75	133	105	32550	2504	8%	75	Negligible
Link 24: A34 (SB) at junction with A420	76,909	7,276	9%	79	133	105	77042	7381	10%	79	Negligible
Link 25: A34 between A420 and Peartree Roundabout	88,119	8,307	9%	80	133	105	88252	8412	10%	80	Negligible

Appendix C: Construction Compounds - Modelling Results



Key

- Basemap
- Construction Equipment
- Construction Compound
- Construction Equipment

Noise Levels (dB $L_{Aeq, 1 hr}$)

	<= 45
45 <	<= 50
50 <	<= 55
55 <	<= 60
60 <	<= 65
65 <	<= 70
70 <	

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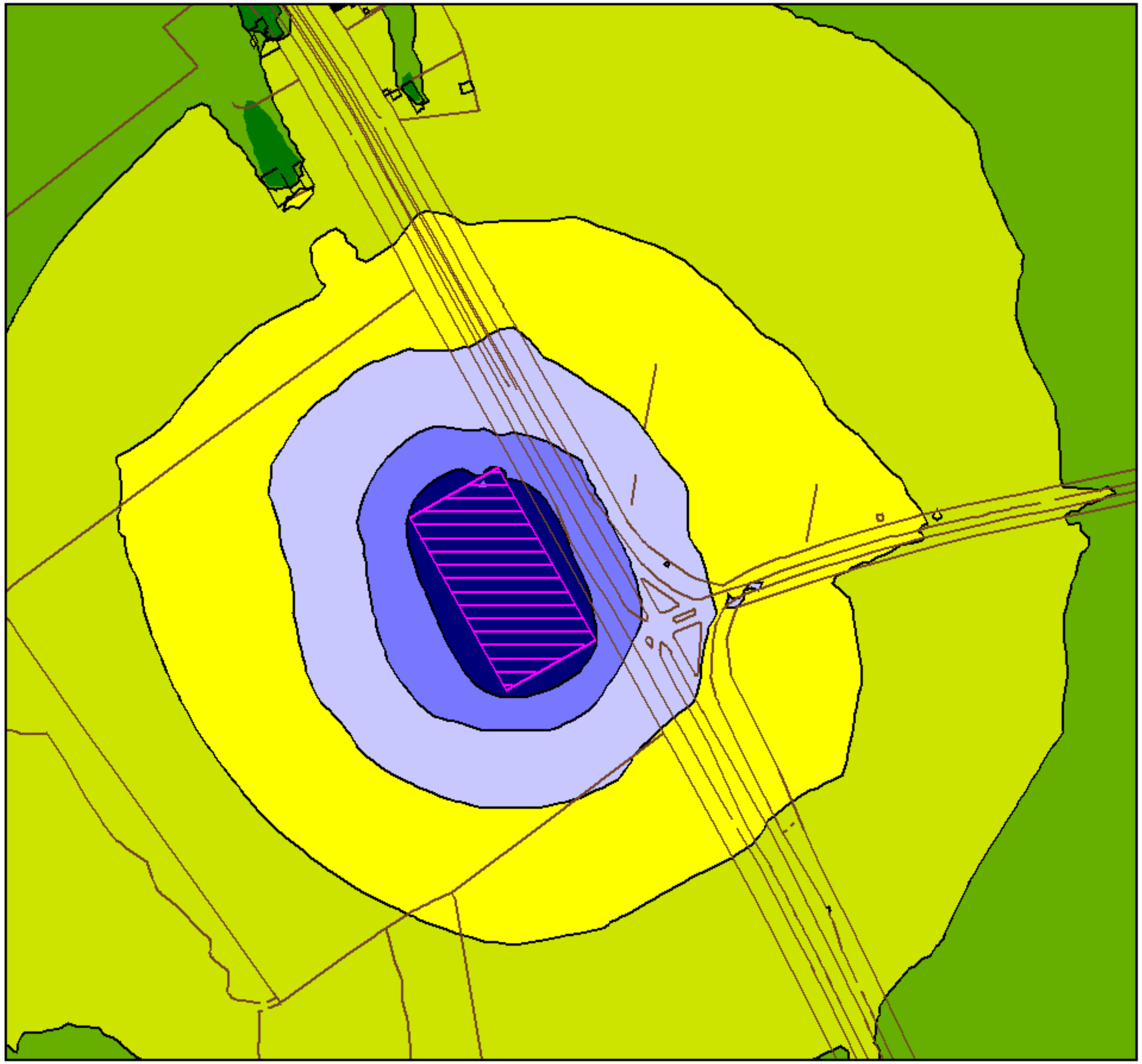
DRG Size	Scale	Date Drawn
A3	1:2500	17/07/2024

Project:
Botley West Solar Farm

DRG No:
Construction Compund #1 - Set-Up

Title:
Construction Compound



Key

- Basemap
- Point source
- HDD Compound
- Line

Noise Levels (dB $L_{Aeq, 1 hr}$)

	<= 45
45 <	<= 50
50 <	<= 55
55 <	<= 60
60 <	<= 65
65 <	<= 70
70 <	

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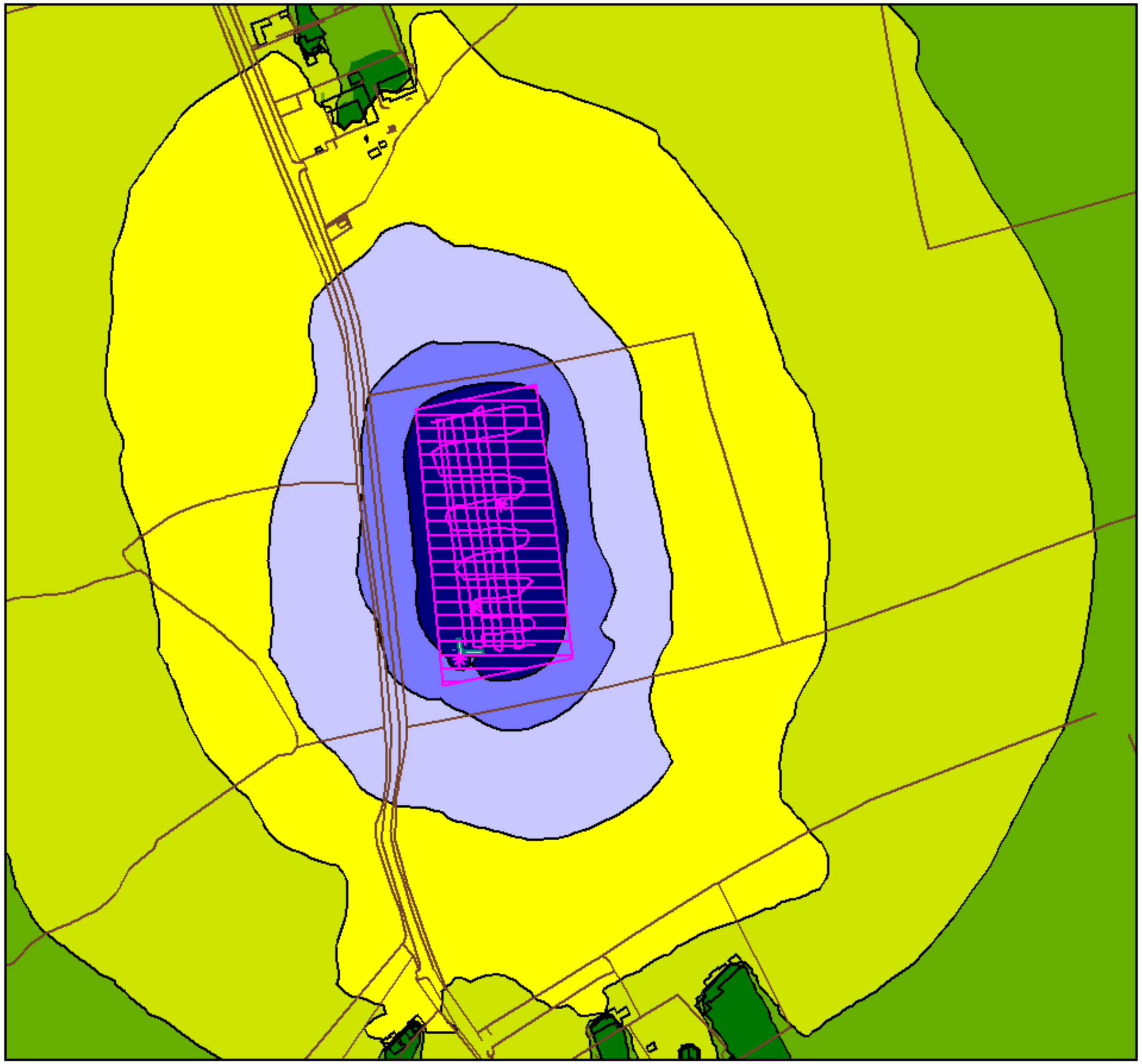
Client:
PVDP

Project:
Botley West Solar Farm

DRG No:
Construction Compund #2 - Set-Up

Title:
Construction Compound



Key

Black line	Basemap
Magenta asterisk	Construction Equipment
Brown line	Line
Magenta line	Construction Equipment

	<= 45
45 <	<= 50
50 <	<= 55
55 <	<= 60
60 <	<= 65
65 <	<= 70
70 <	

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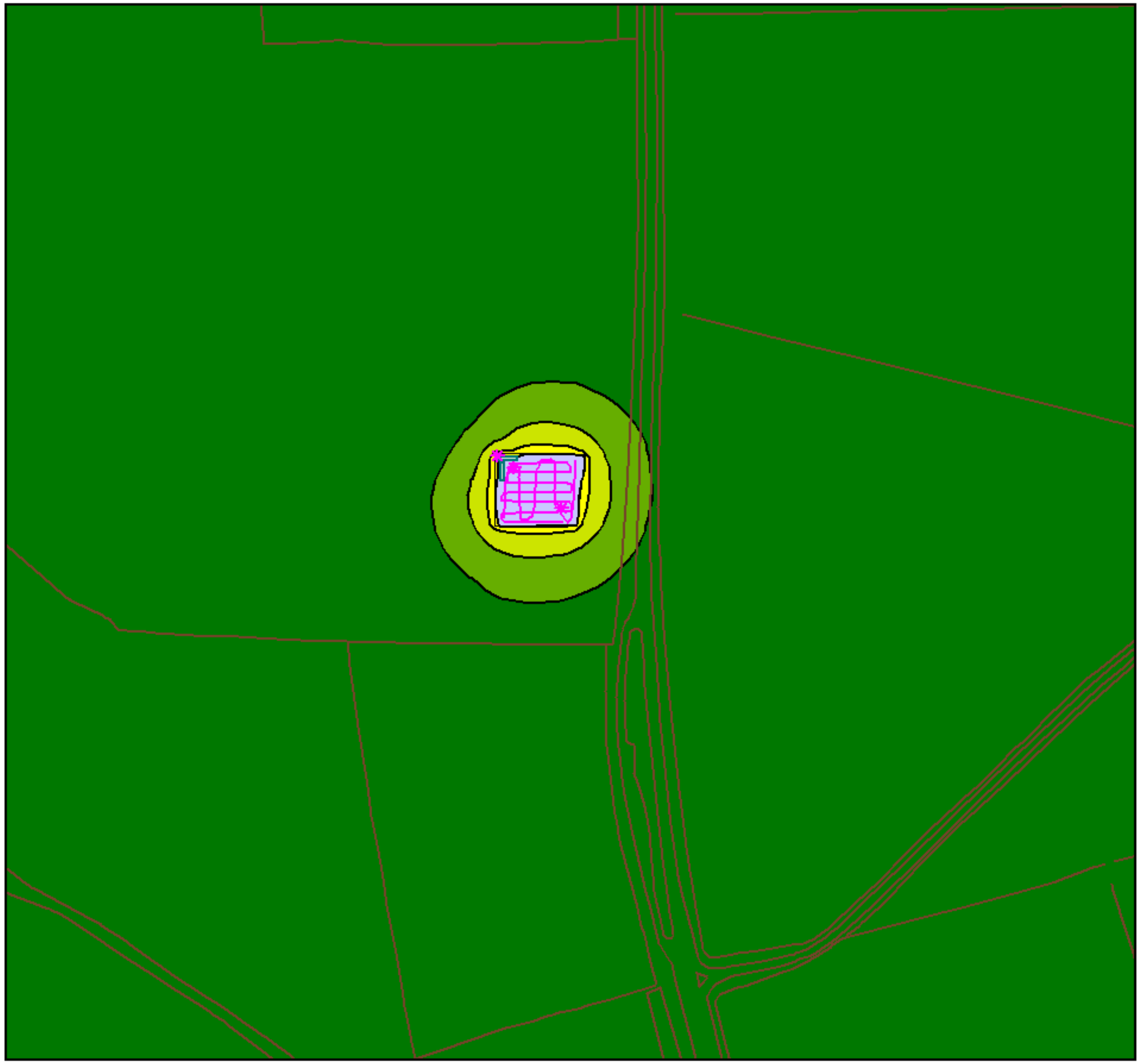
Project:
Botley West Solar Farm

DRG No:
Construction Compund #3 - Set-Up

Title:
Construction Compound



Key

- Basemap
- Construction Equipment
- Construction Compound
- Construction Equipment

Noise Levels (dB $L_{Aeq, 1 hr}$)

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45 <	<= 50
50 <	<= 55
55 <	<= 60
60 <	<= 65
65 <	<= 70
70 <	

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Project:
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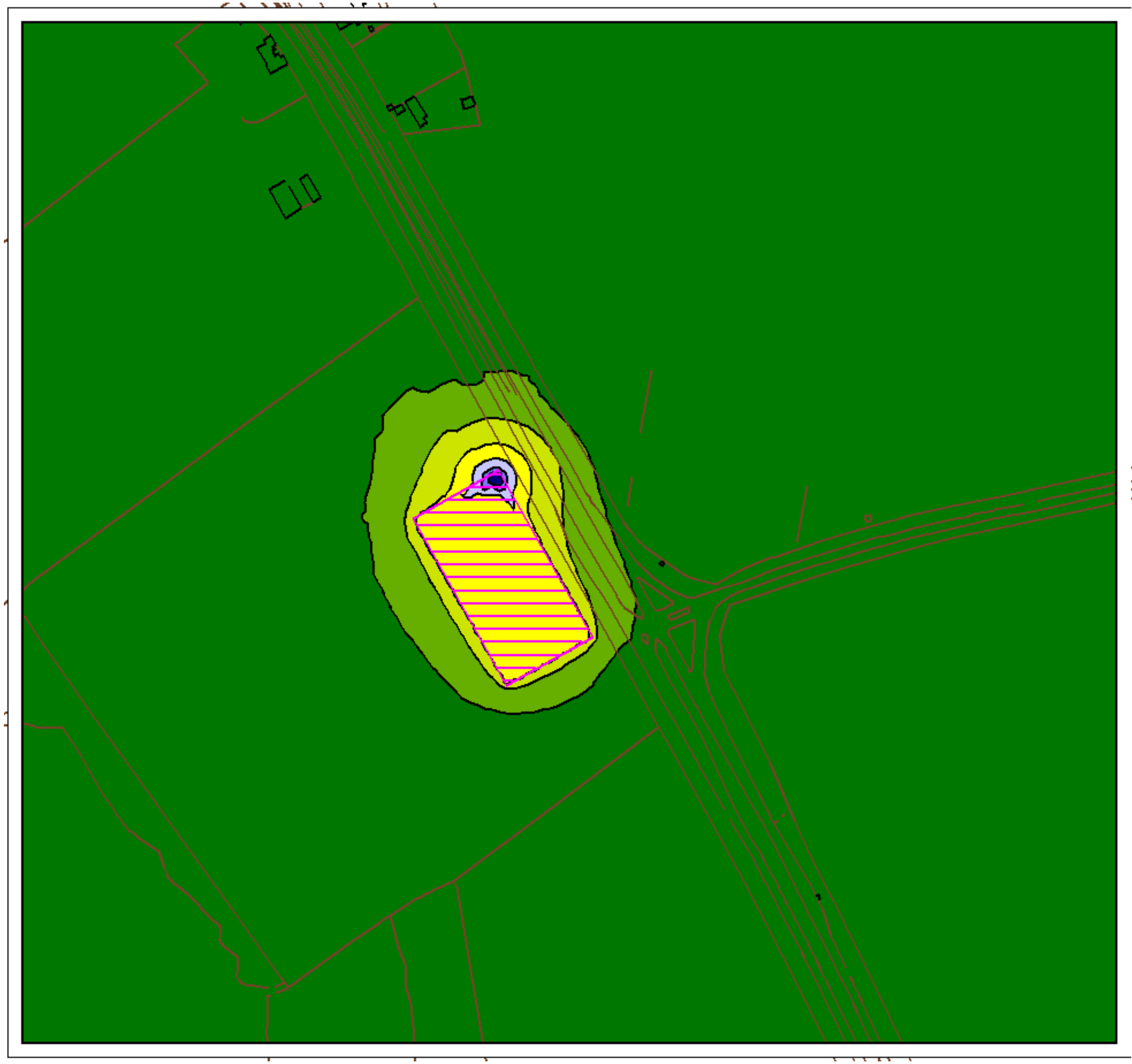
DRG No:
Construction Compund #1 - Normal Use

Title:
Construction Compound



Key

—	Basemap
*	Point source
▭	HDD Compound
—	Line

Noise Levels (dB $L_{Aeq, 1 hr}$)

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45 <	<= 50
50 <	<= 55
55 <	<= 60
60 <	<= 65
65 <	<= 70
70 <	

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Drawn by	Checked by	Approved by
R Calvert		

Client:
PVDP

Project:
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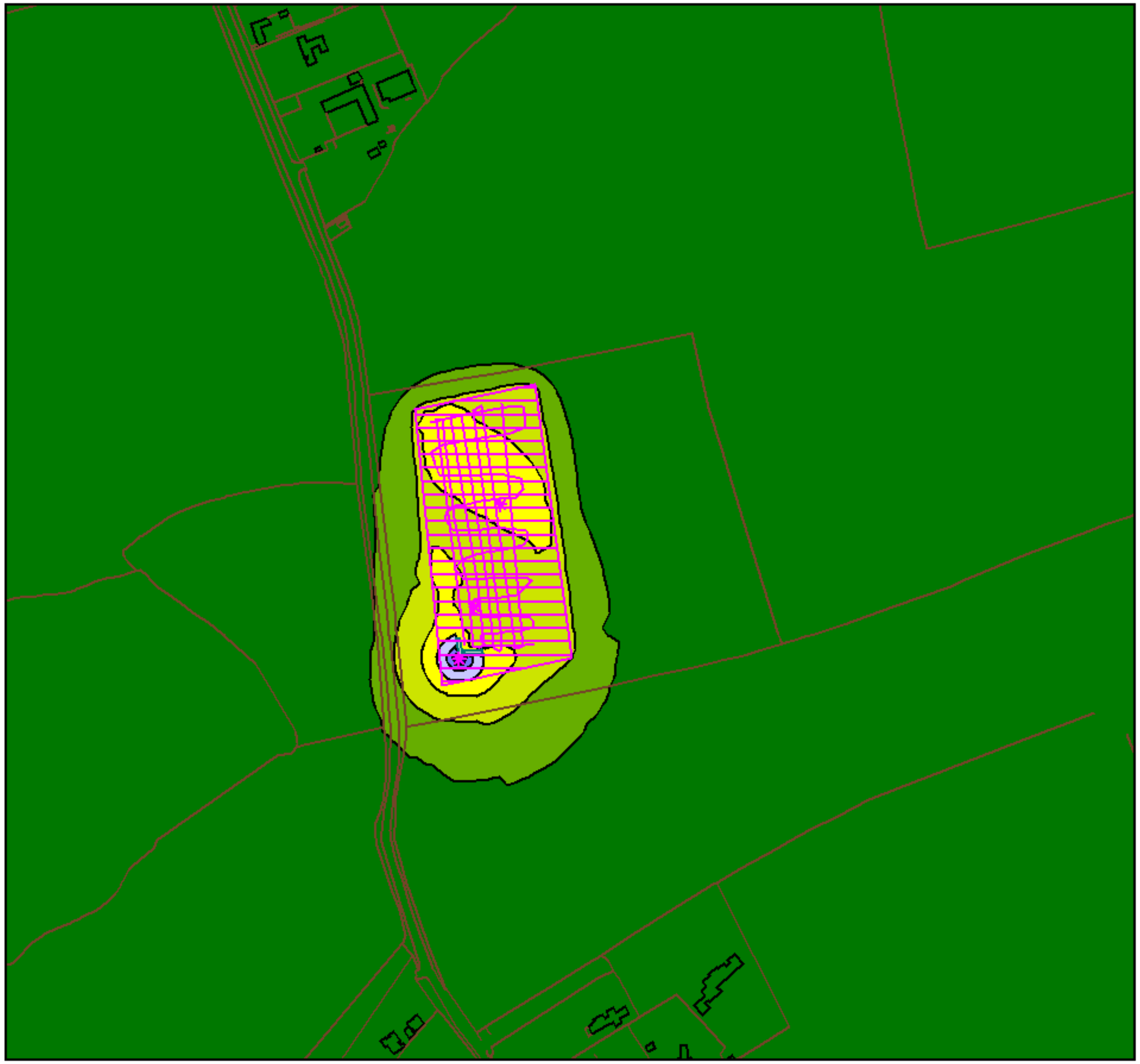
DRG No:
Construction Compund #2 - Normal Use

Title:
Construction Compound



Key
Basemap
Construction Equipment
Line
Construction Equipment

	<= 45
45 <	<= 50
50 <	<= 55
55 <	<= 60
60 <	<= 65
65 <	<= 70
70 <	

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Project:
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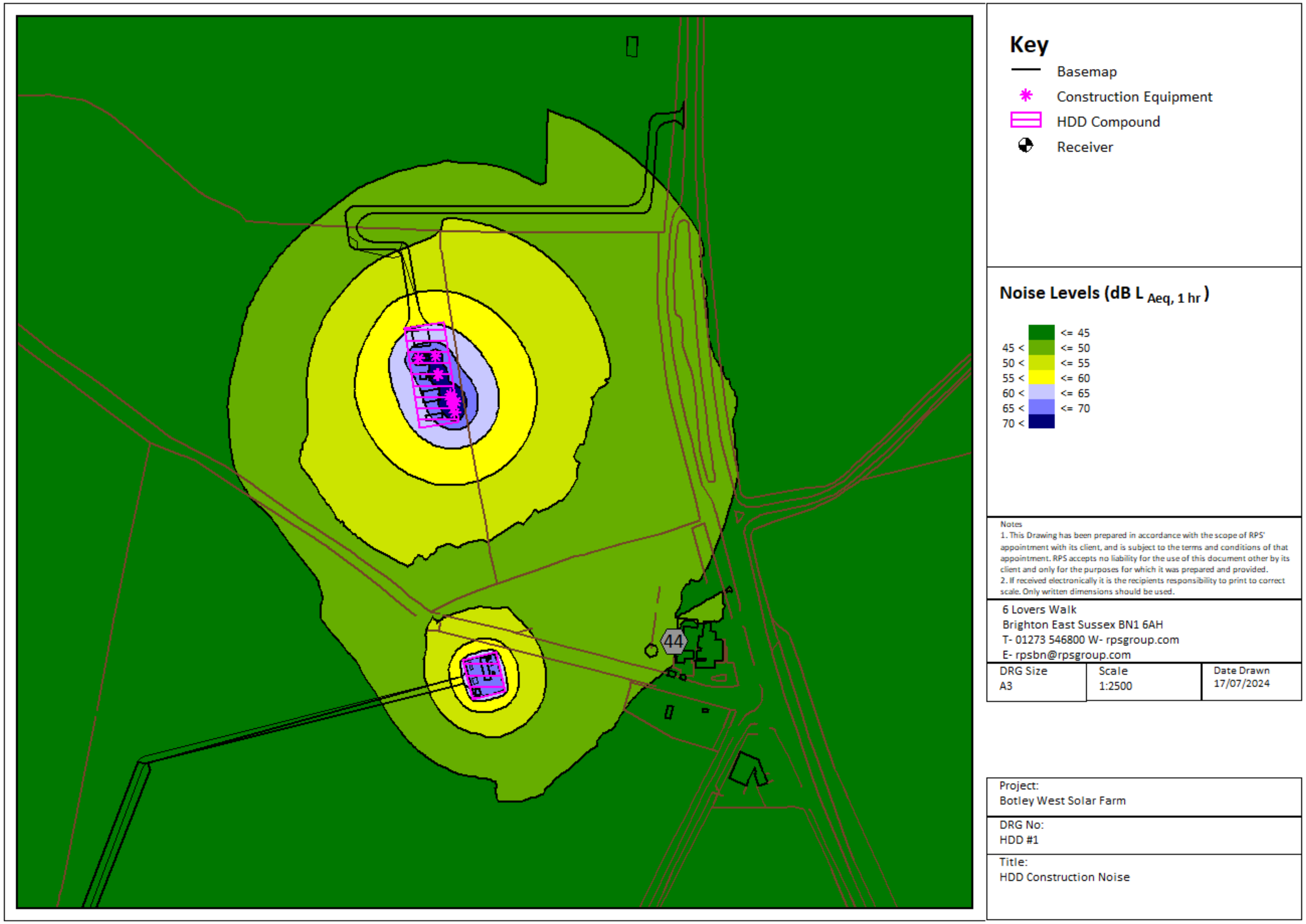
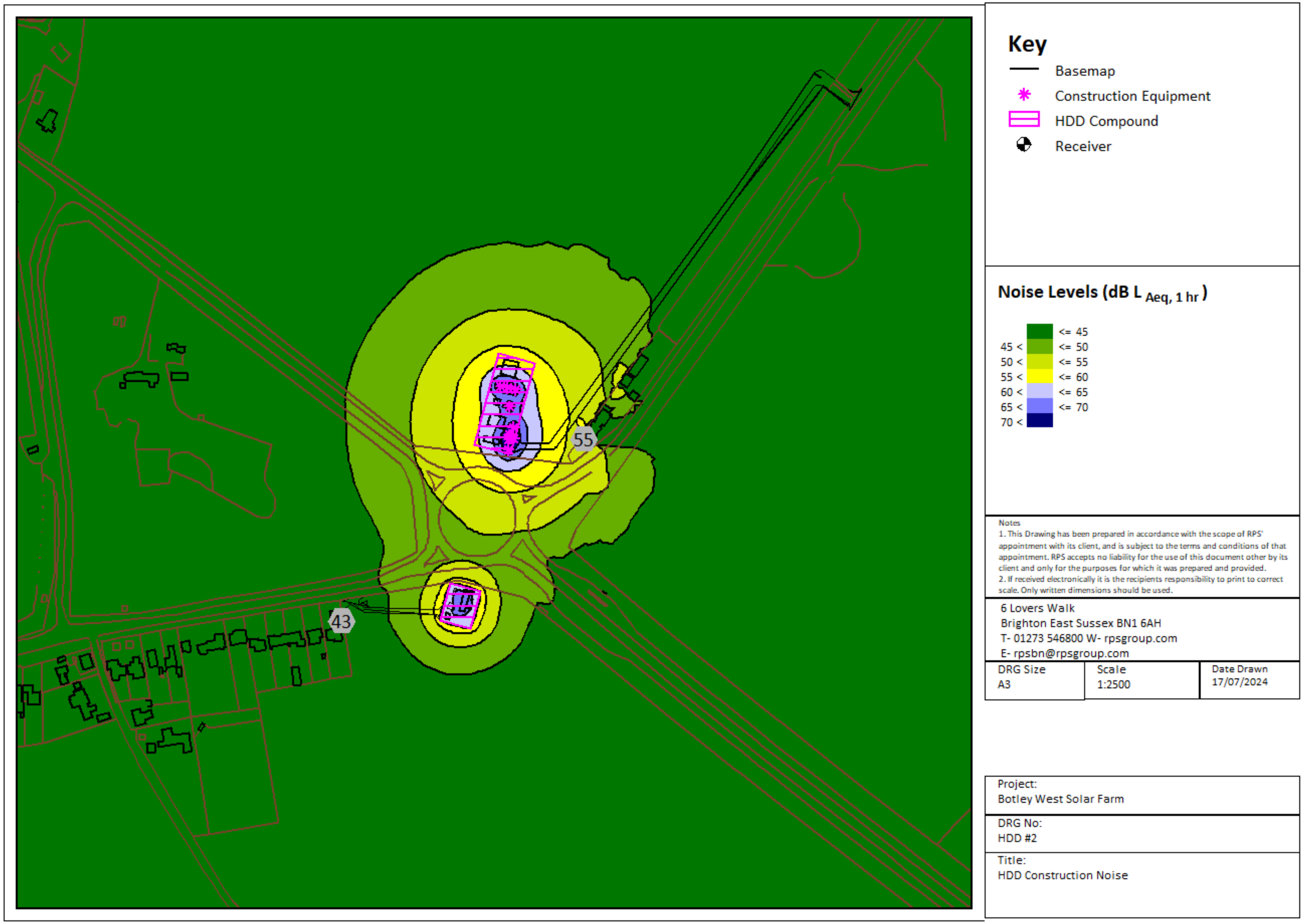
DRG No:
Construction Compund #3 - Normal Use

Title:
Construction Compound

Appendix D: HDD Modelling Results

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43
Key
Basemap
Construction Equipment
HDD Compound
Receiver
Noise Levels (dB L Aeq, 1 hr)
<= 45
45 < <= 50
50 < <= 55
55 < <= 60
60 < <= 65
65 < <= 70
70 <
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Project:
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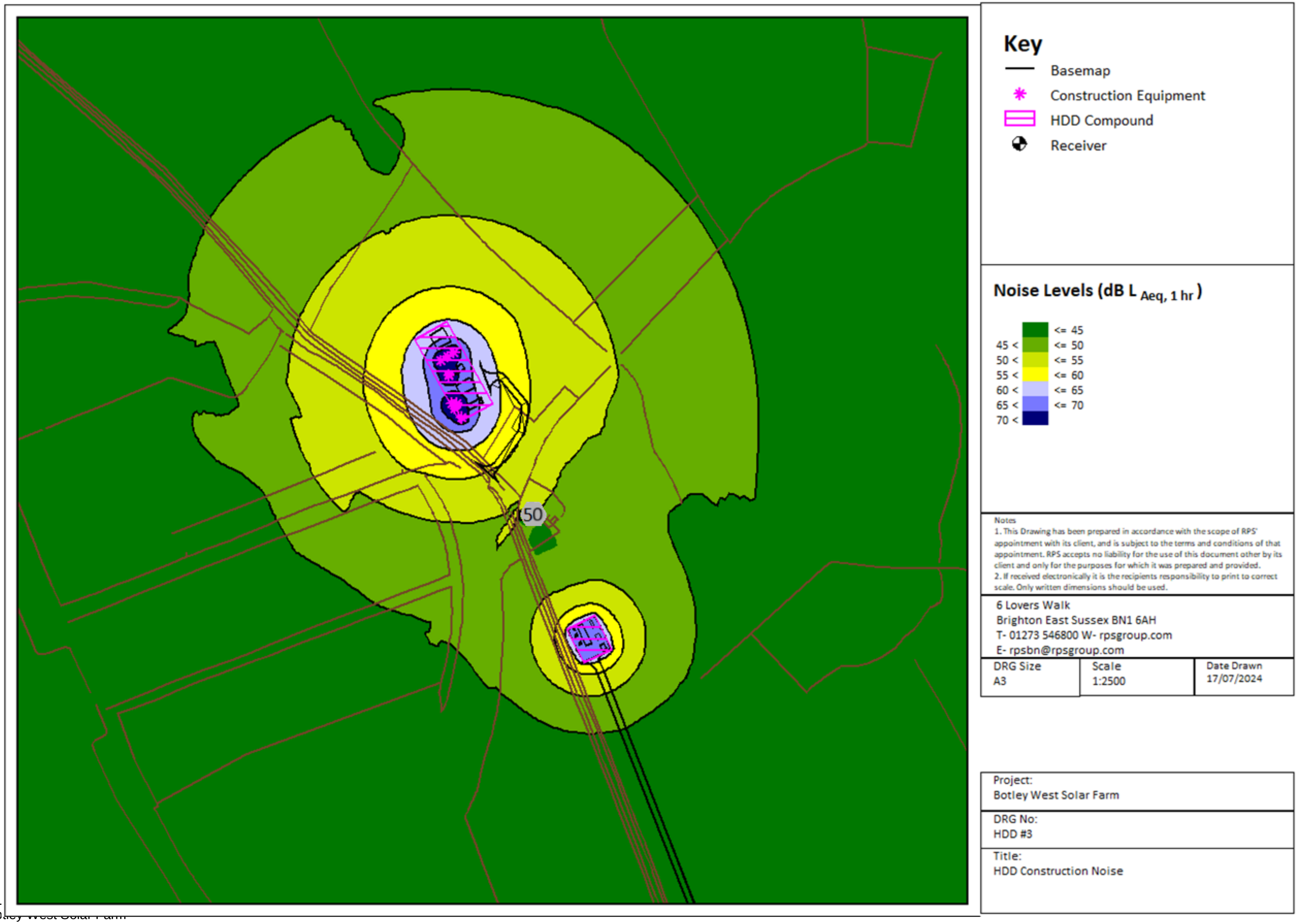
DRG No:
HDD #2
Title:
HDD Construction Noise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Key
Basemap
Construction Equipment
HDD Compound
Receiver
Noise Levels (dB L Aeq, 1 hr)
<= 45
45 < <= 50
50 < <= 55
55 < <= 60
60 < <= 65
65 < <= 70
70 <
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Scale
1:2500
Date Drawn
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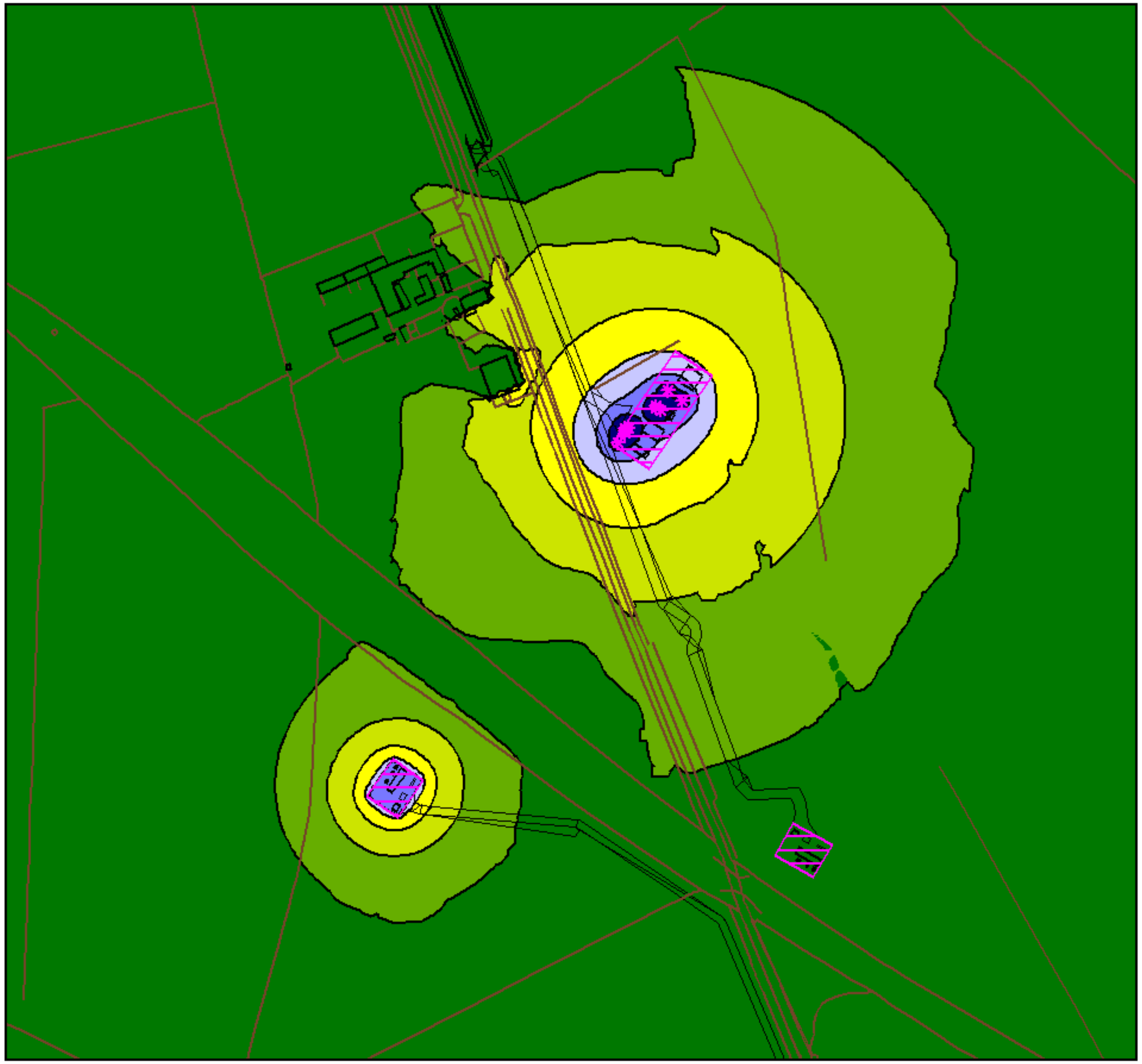
Project:
Botley West Solar Farm
DRG No:
HDD #3
Title:
HDD Construction Noise



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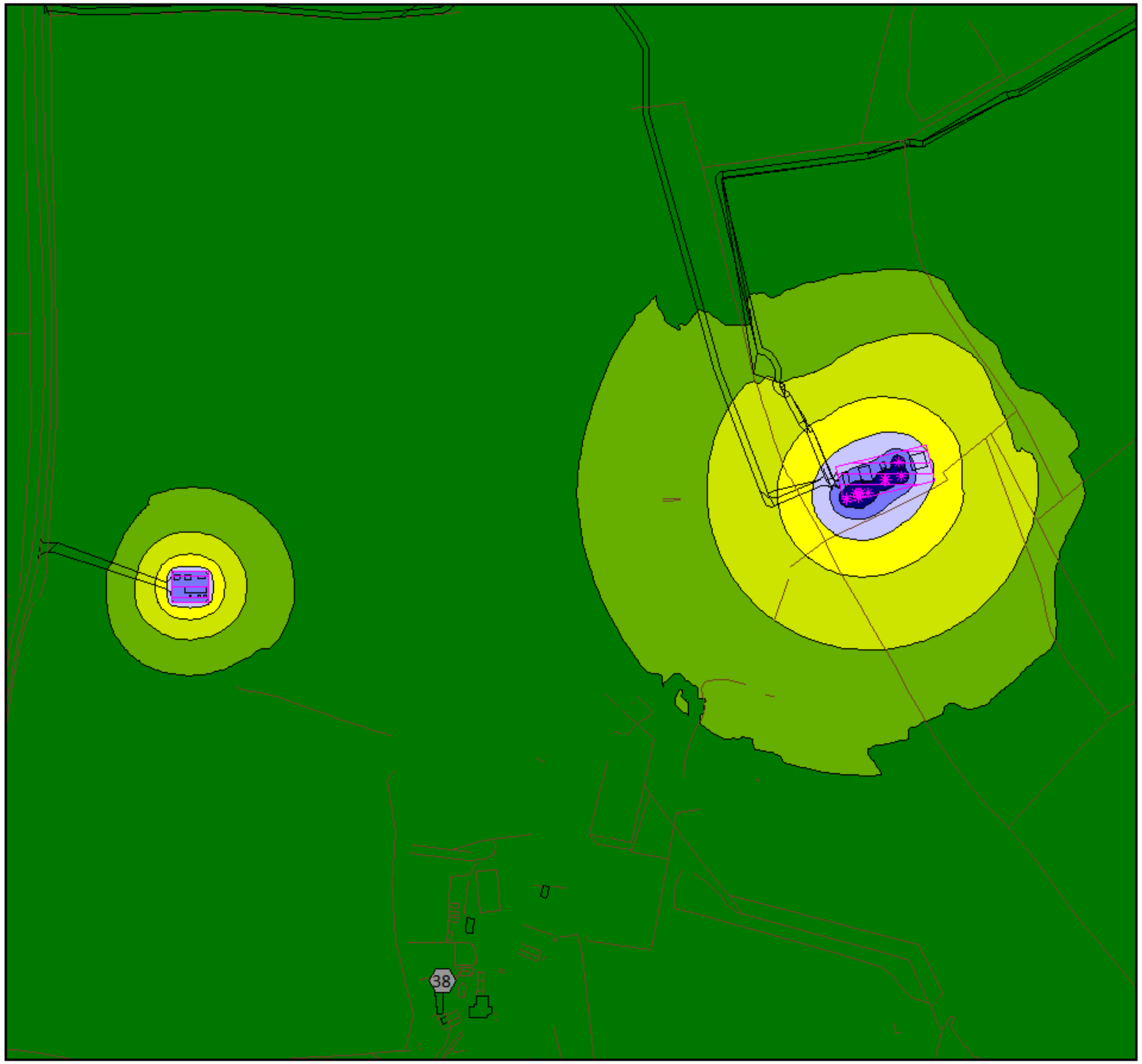
DRG Size	Scale	Date Drawn
A3	1:2500	17/07/2024

Project:
Botley West Solar Farm

DRG No:
HDD #4

Title:
HDD Construction Noise



Key

- Basemap
- Construction Equipment
- HDD Compound
- Receiver

Noise Levels (dB $L_{Aeq, 1 hr}$)

	<= 45
45 <	<= 50
50 <	<= 55
55 <	<= 60
60 <	<= 65
65 <	<= 70
70 <	

Notes
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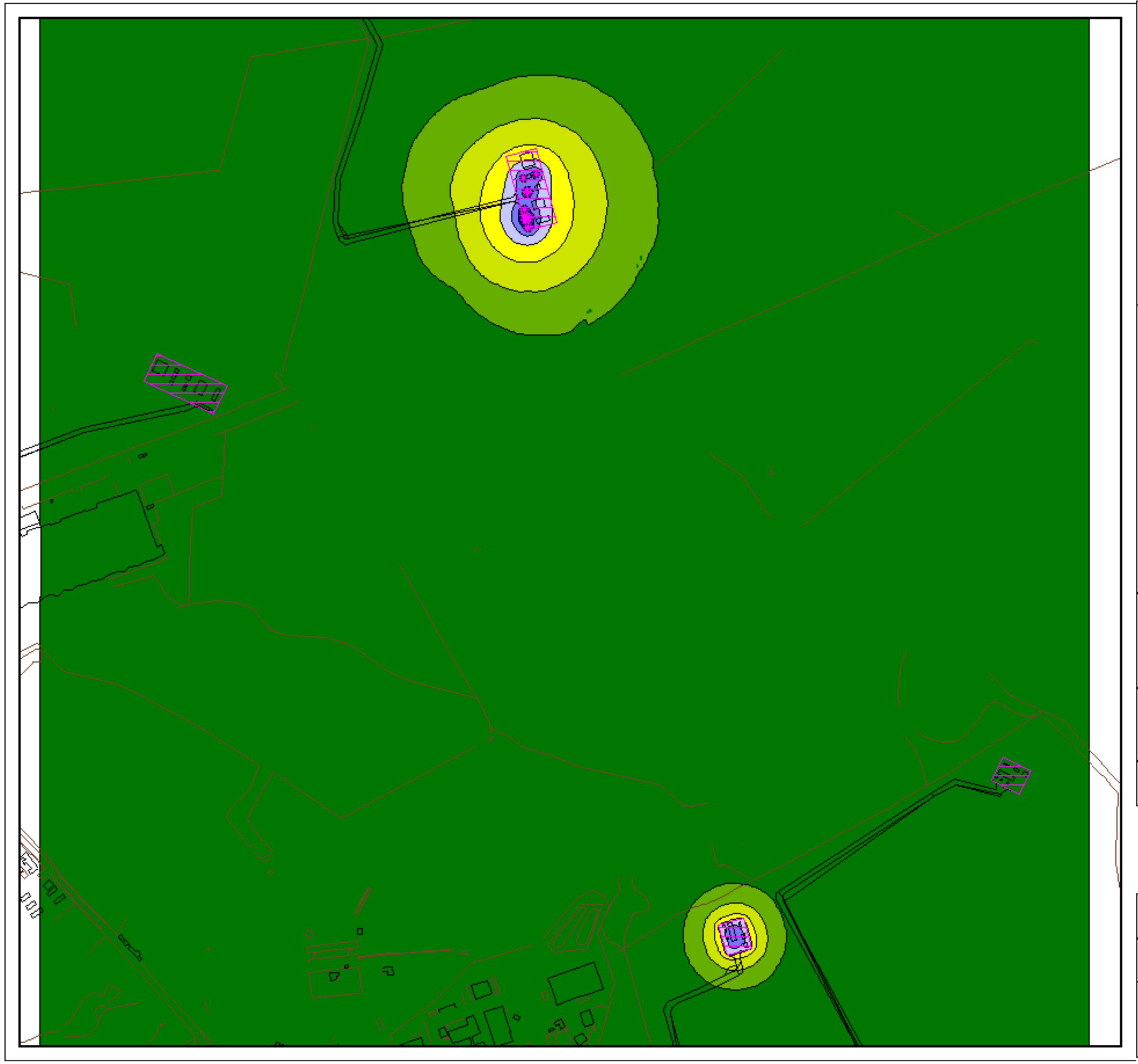
E- rpsbn@rpsgroup.com

DRG Size	Scale	Date Drawn
A3	1:3000	17/07/2024

Project:
Botley West Solar Farm

DRG No:
HDD #5

Title:
HDD Construction Noise



Key

- Basemap
- Construction Equipment
- HDD Compound
- Receiver

Noise Levels (dB $L_{Aeq,\ 1\ hr}$)

	<= 45
45 <	<= 50
50 <	<= 55
55 <	<= 60
60 <	<= 65
65 <	<= 70
70 <	

Notes
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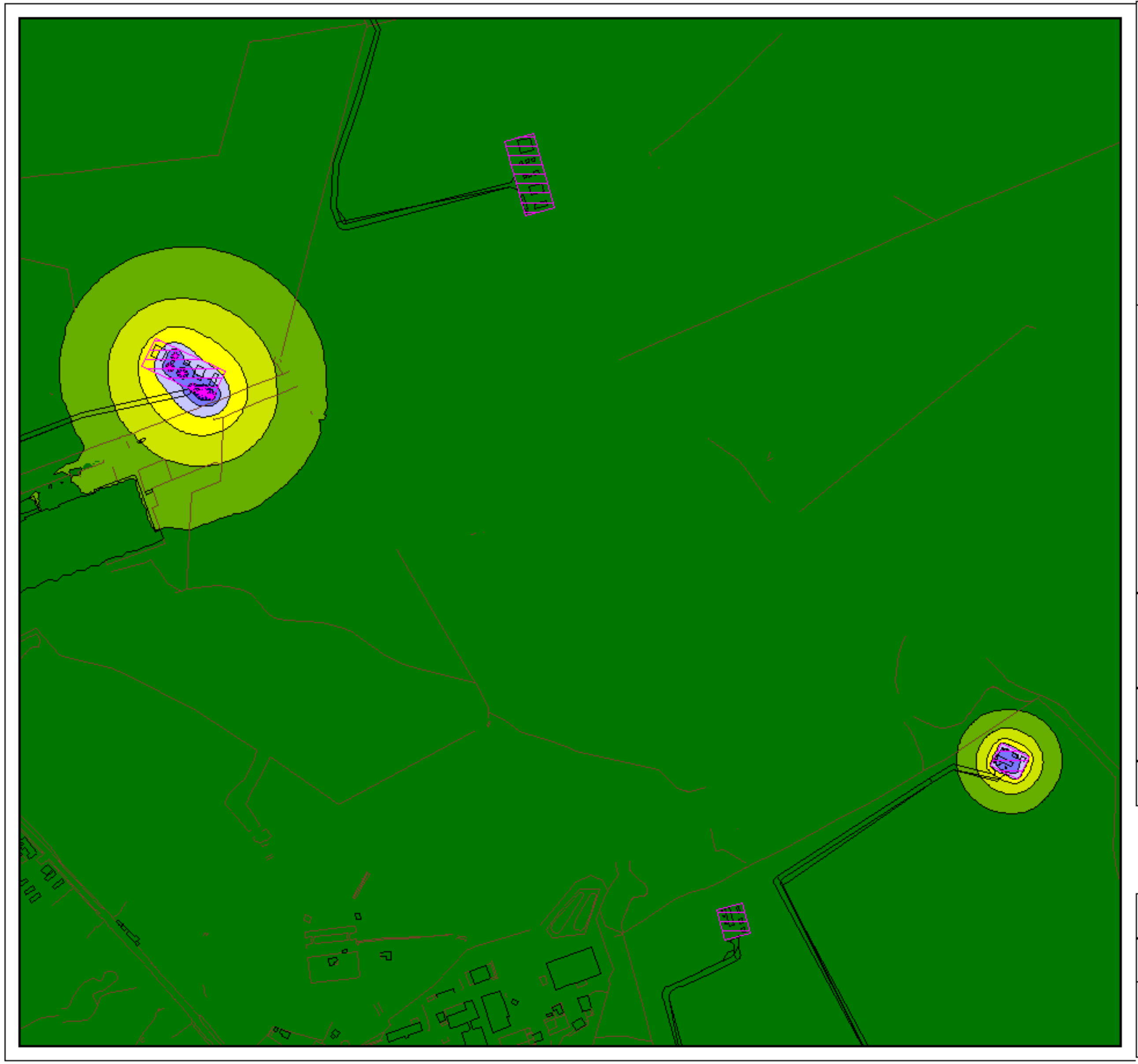
DRG Size	Scale	Date Drawn
A3	1:3500	17/07/2024

Project:
Botley West Solar Farm

DRG No:
HDD #6a

Title:
HDD Construction Noise



Key

Basemap

Construction Equipment

HDD Compound

Receiver

Noise Levels (dB $L_{Aeq, 1 hr}$)

	<= 45
45 <	<= 50
50 <	<= 55
55 <	<= 60
60 <	<= 65
65 <	<= 70
70 <	

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DRG Size	Scale	Date Drawn
A3	1:3500	17/07/2024

Project:
Botley West Solar Farm

DRG No:
HDD #6b

Title:
HDD Construction Noise

Key

- Basemap
- Construction Equipment
- HDD Compound
- Receiver

Noise Levels (dB $L_{Aeq, 1 hr}$)

	<= 45
45 <	<= 50
50 <	<= 55
55 <	<= 60
60 <	<= 65
65 <	<= 70
70 <	

Notes
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DRG Size	Scale	Date Drawn
A3	1:2500	17/07/2024

Project:
Botley West Solar Farm

DRG No:
HDD #7

Title:
HDD Construction Noise

Key

- Basemap
- Construction Equipment
- HDD Compound
- Receiver

Noise Levels (dB $L_{Aeq,\,1\,hr}$)

	<= 45
45 <	<= 50
50 <	<= 55
55 <	<= 60
60 <	<= 65
65 <	<= 70
70 <	

Notes
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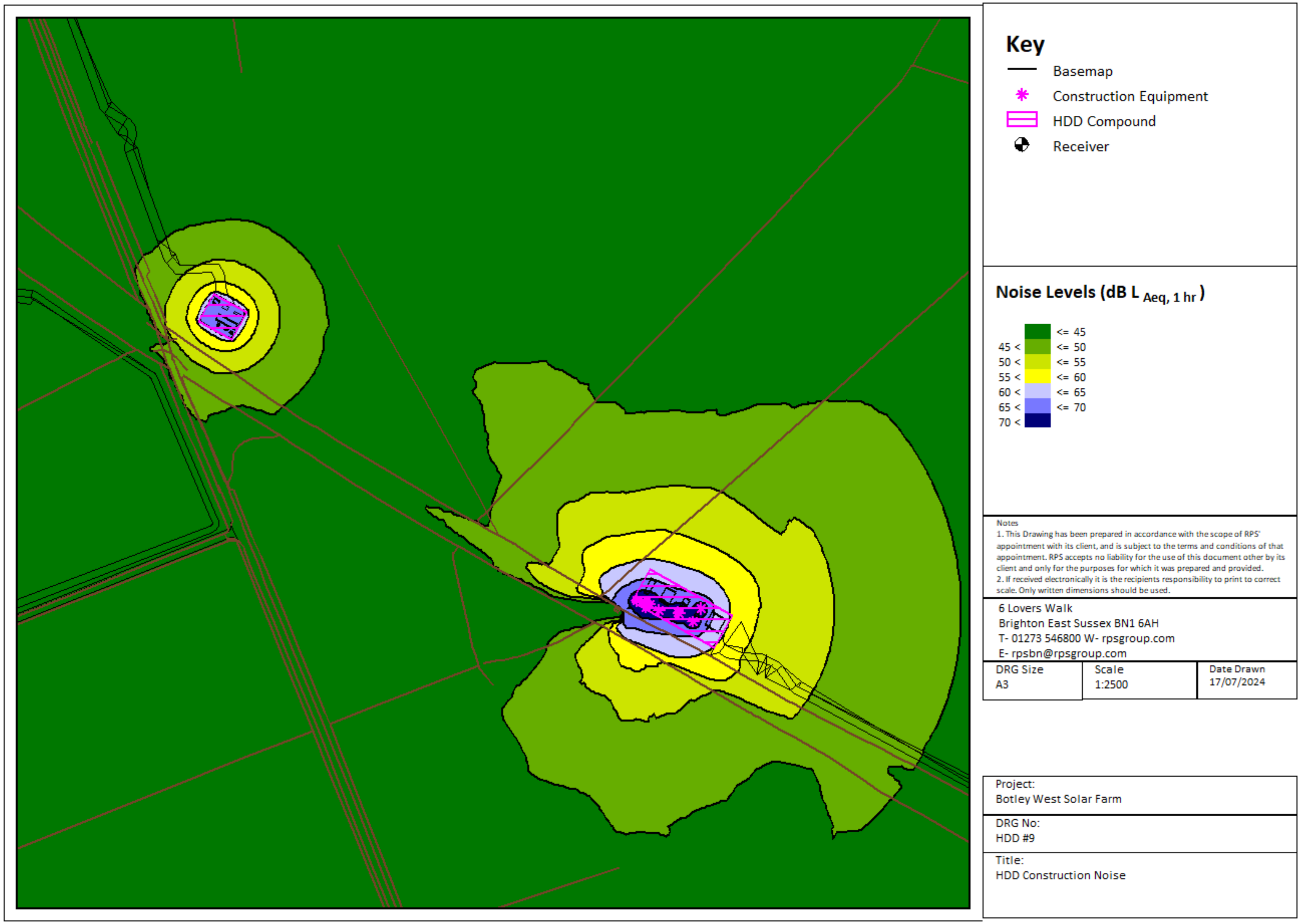
DRG Size	Scale	Date Drawn
A3	1:2500	17/07/2024

Project:
Botley West Solar Farm

DRG No:
HDD #8

Title:
HDD Construction Noise


Key
Basemap
Construction Equipment
HDD Compound
Receiver
Noise Levels (dB L Aeq, 1 hr)
<= 45
45 < <= 50
50 < <= 55
55 < <= 60
60 < <= 65
65 < <= 70
70 <
Notes
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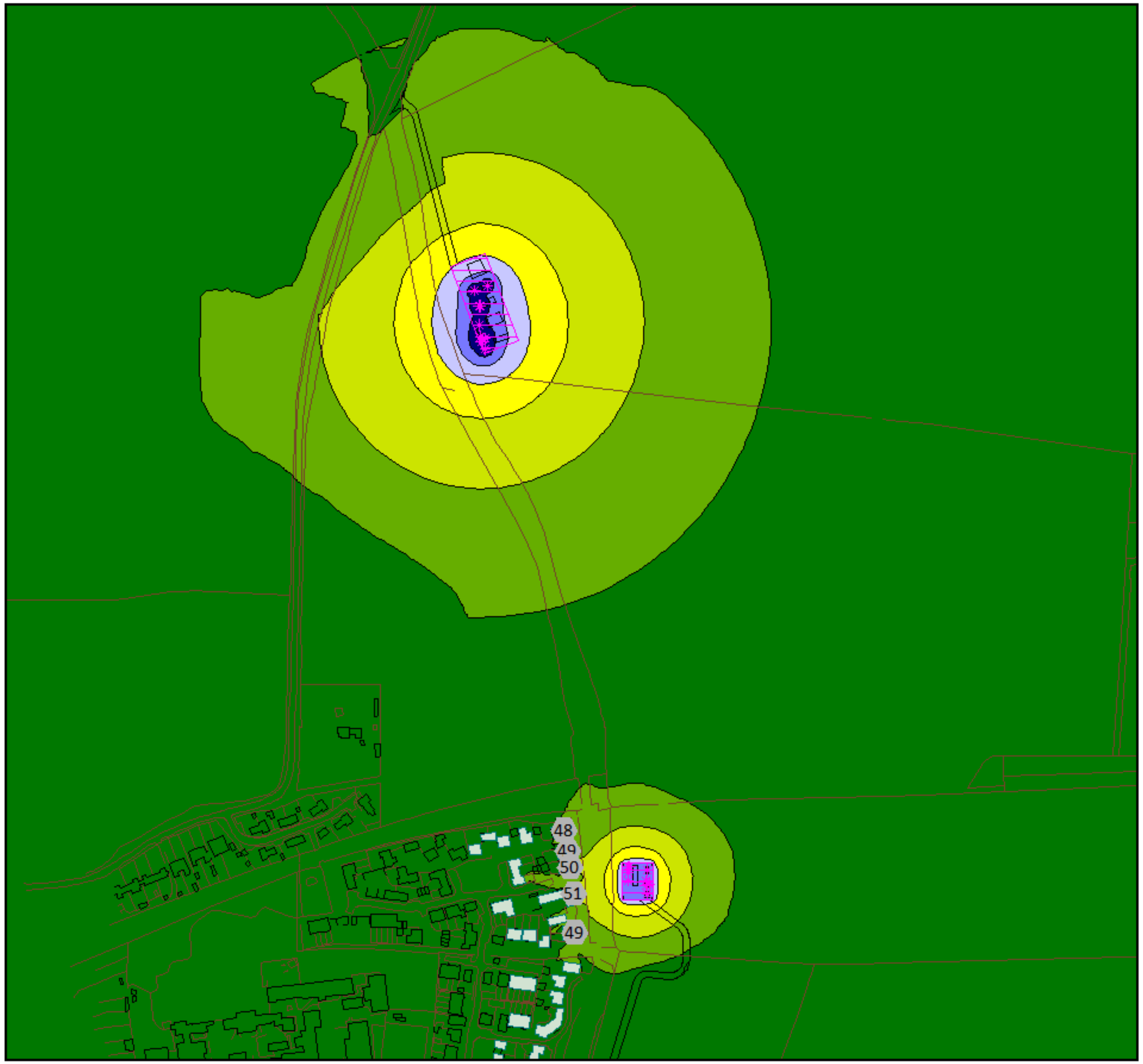
E- rpsbn@rpsgroup.com
DRG Size
A3
Scale
1:2500
Date Drawn
17/07/2024
Project:
Botley West Solar Farm
DRG No:
HDD #9
Title:
HDD Construction Noise



Key

Basemap
Construction Equipment
HDD Compound
Receiver

Noise Levels (dB $L_{Aeq, 1 hr}$)

	<= 45
45 <	<= 50
50 <	<= 55
55 <	<= 60
60 <	<= 65
65 <	<= 70
70 <	

Notes
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DRG Size	Scale	Date Drawn
A3	1:3000	17/07/2024

Project:
Botley West Solar Farm

DRG No:
HDD #10

Title:
HDD Construction Noise

Appendix E: Construction of Substation Bases - Modelling Results