

DEADLINE 6 SUBMISSION

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Alternatives, recent Government reports

With new evidence from the Government, in two reports¹, we ask the Panel to look closely at the evidence that is, and is not, in front of them about the project and its alternatives.

There is still no breakdown of the project costs from the Applicant, despite requests for this from the outset, in 2022. Thus, we do not know if fair comparisons are being made between alternatives. We believe that our own Treasury Book costings provide a good starting point for discussions, but that the Applicant should be transparent. Below are our updated costs based on the new reports, and we set out our workings and analysis in Appendix A:

	Current HVAC Proposal (£ million)	Underground HVDC 6GW "Cut and Cover" (£ million)	Underground HVDC 4GW "Cut and Cover" (£ million)	Underground HVDC 4GW "Cable Ploughed" (£ million)
Lifetime power transfer cost	1,629	3,990	2,660	2,529
Community benefits	63	0	0	0
Community funds for transmission infrastructure	33	3	3	3
Impact on property values	1,017	89	89	89
Natural capital loss (total)	1,796	282	282	282
TOTAL:	4,537	4,364	3,034	2,903

The new reports back up the evidence that we have been submitting to the Applicant for several years, and, more recently to the ExA:

- HVDC is viable over long distances (+120km),
- HVDC undergrounding is cheaper and less damaging than AC undergrounding, and has many technical benefits.
- Cable ploughing offers many benefits over cut and cover, and also potentially over the installation of OHLs. The additional costs associated with cut and cover are simply passed on. This means that in the Dedham Vale, for example, National Grid has chosen cut and cover, even though the extra costs will be paid by bill payers. Benefits of cable ploughing set out in the reports:
 - **Lower labour costs:** A faster process, from planning through to construction, reduces labour costs.
 - **Faster planning and approval:** The method can reduce the time required for planning approvals and preparatory work.
 - **Reduced environmental impact:** Eliminates or minimises spoil removal and damage to the ground, leading to lower carbon impact from civil works.

¹ <https://assets.publishing.service.gov.uk/media/6a27e1592cdcfdb7436ac131/undergrounding-transmission-cables-report.pdf>; <https://assets.publishing.service.gov.uk/media/6a27d9c656960b0542c0b202/international-electricity-networks-research-best-practice.pdf>

- **Fuel efficiency:** Diesel consumption is significantly lower—claims of 58 L per km per slit, whereas open trench methods could use 10–15 times more.
- **Increased construction speed:** Faster installation (up to 1.5 km/day, with potential for 4.5 km/day using three ploughs) reduces labour costs.
- **Minimal ground damage:** Damage to the ground and reinstatement required is much less than with cut-and-cover.
- **Easement reduction:** Especially when no sand backfill is used, the easement can be limited to the width of the plough, reducing land disruption.
- **Potential cost parity with overhead lines:** It is claimed (Thomas 2024) that cable ploughing could be similar in cost to overhead lines (OHL).
- Underground cables have lower failure rates than overhead cables and are protected from extreme weather (and terrorist attacks).
- High Temperature Low Sag conductors offer huge capacity advantages. We ask again, therefore, why the Applicant is not looking to upgrade the existing grid using these high-capacity conductors, at a much lower cost and at far lower community and environmental harm than building new transmission lines. Alternatively, why is the Applicant not looking to use these conductors on the N2T project.

We note that neither Government report includes a Treasury Green Book analysis. This matters, because the externalities (natural capital impact and socio-economic impact) have not been quantified, and therefore the costs set out are for construction only and therefore the adverse impacts of OHLs and benefits of HVDC undergrounding have not been included in the cost comparisons provided.

What these reports show us is that there are better ways of doing things and, these should have been considered by the Applicant.

Need case

We agree with Mr Bedford, the KC for Suffolk County Council, who noted at the most recent hearings that the need case (timing and generation amount) of the project has not been updated.

Our position set out in submissions remains: that the absolute capacity required has been over-estimated by the Applicant and that the timings for required delivery of new generation capacity are far too optimistic given demonstrable delays in the industry.

There is not the great need for speed repeatedly pressed on the panel by the KC for the Applicant. This is simply bluster, and the NESO 2030 Clean Power report that sets out constraints costs contains clear inaccuracies/errors about constraint costs (as we have set out previously) and therefore cannot

be relied on. While there is a national need to upgrade the transmission grid in East Anglia (the CNP/public-benefit angle much repeated by the Applicant's KC) this need can be met in a number of ways, and with time to get it right. The panel has seen in person the landscapes and natural habitats at risk, heard and read the impassioned submissions of residents and business owners, and read the evidence submitted about the widespread harms caused by the project. We and others have submitted evidence which demonstrates that the CNP exemptions are engaged. It is therefore imperative that the need case is understood, so that a project which causes enormous public harm is not wrongly approved.

The Applicant now states, in response to the Dedham Vale Society/PEA Ltd submission, that there is a boundary need of 8GW² (an increased need case since the outset of the project). This is to justify their purported need for 6GW of DC cabling. However, if this is the case, it raises two issues:

- i. The project scope has therefore changed.
- ii. The proposed solution (AC OHL 6.93GW) will not be sufficient to meet the new presented need. In fact, a DC solution would be closer to meeting the new need presented (remembering that DC is controllable and can be used to the full, while AC is not, and requires headroom, so cannot be fully utilised). It would also be more beneficial to use higher capacity conductors (such as TS Conductor) on overhead lines.

Our understanding is therefore that the proposed solution cannot carry 6 GW or more continuously under normal operation, and requires spare capacity for contingency scenarios.

We quote directly from the Eastern Green Link 3 & 4 Strategic Optioneering Report 2024³:

"5.0.1 The largest capacity AC technology option that can be used on NGET's transmission system consists of two 3,465 MW transmission circuits that are supported on a single set of towers (6930 MW double circuit capacity). The largest HVDC capacity systems that can currently be accommodated on our transmission system are 2,000 MW HVDC cables.

5.0.2 Power flows on AC transmission system circuits cannot be controlled to the same extent as can be achieved using HVDC connections. This lower level of controllability can result in higher power flows particularly during transmission system fault conditions. Taking account of the potential for higher power flows that could be expected, therefore to provide the potential

² <https://nsip-documents.planninginspectorate.gov.uk/published-documents/EN020027-003567-8.4.12%20Applicants%20Comments%20on%20Post-Hearing%20Submissions%20and%20Interested%20Party%20Action%20Points.pdf>

³ <https://www.nationalgrid.com/document/151426/download>

equivalent capacity, the AC option would need to consist of a high capacity (6,930MW) double circuit route to meet any high loading during fault conditions.

5.0.3 The required capacity HVDC links over the proposed distance have comparable capital costs, but much lower lifetime costs than the alternative onshore AC option in this case. It is also recognised that delivery of an onshore solution with a long route length, carries much higher delivery risk than the HVDC reinforcement proposals (EGL3 and EGL4) that are currently being progressed. The use of overhead lines is not considered to be feasible because they cannot be delivered by the required 2030 timescale.”

We therefore contend that the project in front of the ExA (AC 6.93GW) can equally be delivered using 4GW HVDC cables, not 6GW. This, as we have previously stated, has cost and environmental benefits. If, as the Applicant now states, there is a greater need, then that would require an analysis of different solutions.

Written Questions, PEA Comment on Applicant Response [REP3-074]⁴

D6 Bird collisions BIO 1.12

Summary of position so far:

We note that at the Inception Meeting⁵ on 4th April 2022, the Inspectorate “queried whether surveys of birds and flight paths have been considered. The Applicant responded that these had not been conducted yet.” This means that the choice of technology and route had been decided by the Applicant before understanding the potential impact on birds. This is a clear indication of predetermination.

The Applicant finds no residual operational effect (in Table 8.24 of ES Chapter 8 [AS-026], saying: “...collision risk and potential mortality in the absence of mitigation is considered to be a negligible effect in the medium term which is not significant”.

We disagree.

The absence of specific surveys for wintering farmland birds by the Applicant because they “are not considered to be at risk of collision” (8.5.57 of ES Chapter 8 [AS-026]) is an unfounded decision. We have supplied copious evidence of large waterbirds, raptors, and waders (including IUCN globally

⁴ <https://nsip-documents.planninginspectorate.gov.uk/published-documents/EN020027-003575-8.4.13.1%20Applicant%E2%80%99s%20Response%20to%20Pylons%20East%20Anglia%E2%80%99s%20Comments%20on%20its%20ExQ1%20Responses.pdf>

⁵ <https://nsip-documents.planninginspectorate.gov.uk/published-documents/EN020027-M-49441685-East%20Anglia%20GREEN%20-%20Project%20Inception%20Meeting%20Note%2004.04.2022.pdf>

Near Threatened Eurasian curlew and northern lapwing) feeding on farmland/traversing across the farmland on the N2T route, submitted as direct observations in the form of photos, or other forms of record, at varied locations.

Further, we have supplied evidence, summarised in the Bird Collision Matrix, that birds of all species groups are at risk of mortality due to collision with overhead lines.

Our response to 8.4.13.1⁶

We note that the Applicant has not disputed the fact that although they claimed to follow CIEEM guidance, there is no overhead power line guidance in that document.

The Applicant should note that ScotNature says, “Once the preferred route has been chosen for a transmission power line, field surveys will be required to provide up-to-date information on bird distribution and activity, to assess the risk to birds and to inform any required mitigation.” The ‘comprehensive desk study’ referred to by the Applicant is not sufficient, and nor are the ‘vantage point’ surveys, particularly as they showed ‘no significant collision risk’, which seems an unlikely conclusion given the known geese, egrets (great and little), great cormorant, mute swan, and various birds of prey, waders, and farmland birds (several of which are nationally Red Listed), recorded in both river valleys.

Despite the Applicant noting that Natural England is in agreement on their approach to Functionally Linked Habitat, our observations along the route suggest that there *is* in fact a strong Functional Link to the coastal protected habitats and large waterbodies. Those waterfowl our supporters have observed along the project route are seasonal or temporary, and there is considerable potential that they return to the coast diurnally or seasonally.

It is widely known that there is a lack of data about coastal birds feeding inland. For this reason, the Applicant, when building a 50-metre high barrier stretching across East Anglia, should have taken extra care to carry out surveys that explicitly examine the movements of bird species between inland areas and coastal areas, but this daily shifts or seasonal/migratory movements. The absence of data does not automatically equate to an absence of birds (as indicated by our own observations). The

⁶ <https://nsip-documents.planninginspectorate.gov.uk/published-documents/EN020027-003575-8.4.13.1%20Applicant%E2%80%99s%20Response%20to%20Pylons%20East%20Anglia%E2%80%99s%20Comments%20on%20its%20ExQ1%20Responses.pdf>

precautionary principle is key in a project of such a huge scale and such a devastating potential impact.

In one of the few studies⁷ of pink-footed geese feeding inland (in north Norfolk), by the British Trust for Ornithology, it was acknowledged that there is not enough evidence of the feeding habitats and movement behaviour of coastal birds, and that even the study itself was restricted in its conclusions due to lack of data. However, the study discovered that pink-footed geese regularly move far inland (even beyond the 20 km line which contained the main study results). There are a great many points along the N2T route where the pylons fall well within a 20km distance from the coastal SPA's, SACs and RAMSAR sites.

The study concluded, "Further, there is a need for important agricultural feeding areas for geese and swans to be identified and protected or managed for the benefit of the internationally important concentrations of birds they support, complementing the protection provided to roosting birds through the existing suite of designated sites for this species."

With a UNESCO bid⁸ for the globally significant 'East Coast Flyway' under consideration, it is of paramount importance that an infrastructure project that could be designed to avoid harm to birds altogether, does not create a risk to the multitude of East Coast waterfowl, including the Arctic and continental European avian visitors, which may benefit from foraging habitats and resources in rural East Anglia's fields.

Below we respond to the Applicant's comments about Fordham / Aldham, although we note that this is a mere microcosm of a pattern that is repeated along the route, and it should be taken as a case study that is likely representative of other locations. We are a community group and do not have the capacity to carry out formal surveys of our own.

Applicant's comment	PEA Ltd Response
With regards to the topography at Fordham / Aldham, the landscape is considered to comprise rolling hills rather than steep hills with exposed ridges.	We agree.

⁷

https://www.bto.org/sites/default/files/brides_et_al_2013_mapping_distribution_of_feeding_pinkfooted_geese_in_england_wwt_natural_england_report.pdf?utm_source=chatgpt.com

⁸ <https://whc.unesco.org/en/tentativelists/6689/>

Added by Government to the UK Tentative List of Potential World Heritage Sites (April 2023) and UNESCO list (September 2023)

In addition, the landscape contains many woodlands, copses and lines of trees, and the overhead line in this area is not considered to be exposed.	As previously stated, the overhead line throughout the Fordham Valley, across the Colne, and up the towards Aldham, as well as across the Roman River nature corridor is in fact very exposed.
Vantage point surveys have been completed along the river corridor in this area and did not identify this as an area of collision concern.	This is not an adequate response. It conveys very little and is extremely ambiguous.
The wooded landscape is less suitable for the Target Bird Species that are of risk of collision such as geese, which prefer large, open, flat landscapes for feeding and roosting.	This is a landscape of water-meadows, hay fields and arable land. There are several waterbodies in the vicinity of the route: the Fordham reservoirs (two adjacent to the route and one on the airfield) and a very large lake off Vernon's Road, Chappel, which hosts hundreds of geese and swans in winter and smaller numbers in summer, only 2 km from the Ford Street pylons. Our previous submissions, including at registration have included numerous observations of waterfowl in the area or passing daily across the area to and from the direction of the coast in the winter. These did not include the egret now regularly spotted on the Colne at Ford Street, and we note again the great cormorants regularly seen at the Vernon's Road lake. We note again that birds of prey such as common kestrel, common buzzard, red kites and barn owl are abundant in the area (as they are along much of the route), which do not appear to have been observed by the Applicant. And we remind the Applicant that the Bird Collision Matrix shows that small farmland birds are also at risk from collisions with power lines.
NatureScot guidance also suggests birds react to obvious obstacles such as trees early, and therefore, although the trees are not of equal or greater height than the pylons, flight heights	NatureScot's precise words are: "Running power lines along <u>existing linear elements of equal or greater height</u> (e.g. cliffs or rows of trees) may reduce collision risk, as birds will react earlier to fly over the more obvious obstacle." It will be quite apparent that there are no elements of an equal or greater

will likely be above collision risk height or close to this, so flight adjustments to ensure avoidance are not extreme	height in the Fordham/Colne Valley/Aldham area, or along the rest of the route. A mature oak grows to a maximum of 30 m and Aldham Church spire is 30 m high. As the Applicant notes above, there are no cliffs in the Colne Valley, or along the route. Ironically, the Colne Valley is an area which will see particularly significant tree loss for the Project, with the result that the area will become more open, putting birds at arguably greater risk. Even if birds do adapt when there are trees, power lines are less visible than trees, and are particularly obscured and undetectable at dawn and dusk, during fog, and at night time. NatureScot also says, in the pre-survey conditions, “Known roosting and feeding areas, known flight paths between these areas or any known flight paths used by migrating birds. For example, placing a power line between fields used by grazing geese and a roost loch could cause mortality of commuting birds colliding with the wires, or potentially create a barrier effect leading to reduced use of the site. The problem is that the Applicant did not know about many of the roosting and feeding areas along the route because it did not carry out the relevant surveys, and was disinterested in residents’ submissions during the four years of consultations.
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There remains considerable and unacceptable risk that the Applicant has significantly understated the mortality and behavioural/distribution change risk to birds of multiple species groups from the Norwich to Tilbury overhead lines. Inland movements of SPA-associated birds have not been adequately assessed. Substantial uncertainty remains, and the precautionary principle requires further investigation before consent can be granted. Additional surveys are required the bird collision data should be reviewed by an independent. Post construction monitoring must be built into the DCO such that additional diverters can be fitted.

HW 1.1 and GEN 1.26 Health & Wellbeing

We disagree with the Applicant as follows:

- We believe that the project does present an unacceptable risk to human health
- We do not agree that there are no significant impacts identified in relation to mental health and well-being either during construction or operation. Those significant impacts already exist, as identified by our own survey, which itself is likely to significantly understate the impacts.
- The baseline data used by the Applicant is desktop-based, generic and high-level, and does not reflect the reality. If we, a community group with very limited resources, have been able to carry out regular surveys that identify and highlight real health and well-being issues on the ground, why has the Applicant not made the effort to do so?
- The applicant claims inclusive and transparent engagement. Quite apart from the fact that it has been shown through our submissions, a great many other submissions, and CAH and OFH statements that engagement has been neither inclusive nor transparent, it is clear that whatever the Applicant thinks it has done has not been successful. For example, the Applicant claims that it has responded to fears about health related to the project yet our most recent survey, more than four years after the first consultation in 2022 indicates that respondents remain concerned about EMF and implanted medical devices.
- The Applicant claims that its public information events were designed to capture information and feedback, yet one of the most common complaints that Pylons East Anglia received about these events was that it was very difficult to give feedback and that what residents told staff at the events was not captured in any way. The vast majority of conversations with the Applicant's representatives at these events went uncaptured. We also remind you of our 'Deficiencies' submission which highlighted numerous other issues with the consultation process.
- Furthermore, the panel should be aware that the Pylons East Anglia team receives countless messages, emails and calls of despair, with residents at their wits end, not knowing what to do, telling us about their own physical or mental health, or the health of a loved one, due to the N2T project. We are unable to share these, due to the private and personal nature, but, quite apart from the survey results we have submitted, we are acutely aware of the terrible impact this project is having on people in the region.

We remain of the view that the Applicant chooses not to understand the very significant, widespread physical and mental harms caused by the project, and the responses given do not persuade us that people with Protected Characteristics have been identified or, if they have, been taken into account.

LUS 1.2 Acid Sulphate Soils

We note that document 5.9.15, SOCG with the Environment Agency, has no mention of acid sulphate soils.

We reaffirm our concerns set out previously, including at Deadline 5, reminding the panel that acid sulphate soils are known as the world's nastiest soils because of the environmental risk and risk to human health that they pose.

Summary of the position so far:

- The Applicant has now given up its pretence that it has looked for acid sulphate soils, with the tests it claimed it used being unsuitable for the identification of acid sulphate soils. We therefore know that the Applicant does not know if there are any along the route (despite the likelihoods/possibilities highlighted by Dr Dent.
- The applicant will appoint an expert but has not provided qualifications of that expert.
- The Applicant says, "the outline Soil Resources Plan will be updated to include more detail on the approach to managing any potential occurrences of these soils."

The Secretary of State cannot properly make a decision on this basis. There is a risk to human health which is unknown and unmitigated. The CNP exception is therefore engaged.

SS 1.2 Security & Defence

National Policy Statement EN-1 is clear that the Secretary of State may only make a decision if he "is satisfied that the impacts of proposed energy developments do not present risks to national security and physical safety, and where they do, provided that the Secretary of State is satisfied that appropriate mitigation can be achieved, or appropriate requirements can be attached to any Development Consent Order to secure those mitigations, consent may be granted."

EN-1 also notes (4.16.2) that DESNZ works closely with government security agencies including the National Protective Security Authority (NPSA) and the National Cyber Security Centre (NCSC) to provide advice to the most critical infrastructure assets on terrorism and other national security threats, as well as on risk mitigation.

EN-1 states that (4.16.8) if NPSA, ONR (for civil nuclear) and/or DESNZ are satisfied that security issues have been adequately addressed in the project when the application is submitted to the Secretary of State, it will provide confirmation of this to the Secretary of State. The Secretary of State should not need to give any further consideration to the details of the security measures in its examination.

In this examination of the Norwich to Tilbury DCO, the Secretary of State cannot be satisfied that there are no national security risks, nor that any mitigation (let alone appropriate) can be achieved, and therefore cannot make a decision to recommend approval of the project.

This is because there is no evidence in front of the panel that the NPSA has addressed the security issues raised. There is no evidence that the Applicant has understood, let alone addressed, the security issues associated with overhead lines and Bramford Substation*. This is required under *“Applicant assessment 4.16.6 Where national security implications have been identified, the applicant should consult with relevant security experts from NPSA, ONR (for civil nuclear) and/or DESNZ to ensure security measures have been adequately considered in the design process and that adequate consideration has been given to the management of security risks.”*

4.16.4 of EN-1 notes that Government policy is to ensure that, where possible, proportionate protective security measures are designed into new infrastructure projects at an early stage in the project development. This has not been done.

If matters are sensitive, then 4.16.9 allows for closed hearing sessions.

[Pylons East Anglia submission to Deadline 4 on Defence & Security is below. The points raised remain unaddressed.]

<u>PEA Ltd Deadline 4 submission points</u>	<u>Our comment on the Applicant’s reponse at D5</u>
Evidence of worst-case risk assessment and scenario planning, resilience design alternatives, and the respective recovery capabilities	The Applicant states, <i>“As previously stated, the Applicant does not rely solely on compliance with the Security and Quality of Supply Standard in addressing resilience considerations. The Project has been developed taking account of broader engineering, operational and security requirements, including consideration of credible outage and disruption scenarios through established industry and regulatory processes.”</i> <u>Yet security</u>

	<u>of supply (SQSS) is not the same as defence security, so this does not address our points.</u>
The Applicant refers to embedded mitigation measures, as reported in 6.4 Environmental Statement Chapter 4 - Project Description [APP-130], yet this document says very little except that security fences and lighting will be installed at EACN.	No further evidence of defence measures.
There is no evidence that any of the following security considerations, which the Applicant states it has carried out, have been carried out: • Alignment with guidance issued by the National Protective Security Authority • Engagement with relevant Counter Terrorism Advisors and other relevant stakeholders • Application of established security design principles and approved technologies Independent assurance processes at key stages, including design and commissioning	The Applicant simply says, <i>“Security, resilience and operational continuity form part of the wider design, assessment and governance framework applied to critical national infrastructure projects and are considered throughout the development process.”</i>. <u>This is not evidence.</u> <i>“The Applicant also reiterates that security planning for critical national infrastructure is undertaken in line with established government guidance and with engagement, where appropriate, with relevant security and advisory bodies, including the National Protective Security Authority and associated stakeholders. By its nature, detailed security assessment material, operational arrangements and specific scenario planning are not appropriate for disclosure within the public domain.”</i> <u>We request that the panel asks for this information. The Secretary of State cannot make a decision in the absence of this information.</u>
We have not seen evidence that the Applicant can meet the Electricity System Restoration Standard (ESRS) for worst case scenarios, or	<i>“The Applicant does not agree with the characterisation that the absence of publicly available detailed security documentation</i>

consideration of the impact and increased risk both to this project and public safety of 'connected' projects	<i>indicates that such matters have not been considered."</i> <u>It is not a characterization. There is no evidence available. The panel must have sight of the evidence.</u> <i>"Equally, the Applicant does not agree with speculative assertions presented regarding potential impacts, outage scenarios or risk levels associated with the wider transmission network and surrounding infrastructure."</i> <u>These are not speculations. They are real risks and the panel should see evidence that these risks have been considered. Since our previous submission there has been further news coverage about drone incursions into UK and European airspace, launched by the Russian shadow fleet, and including energy infrastructure targets, and of further plans for war preparedness.</u> <i>"The Environmental Statement has been prepared in accordance with the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 and the agreed 6.20 Scoping Opinion [APP-297]. The Applicant remains satisfied that the information provided is appropriate and proportionate for the purposes of the Examination and that the application is in accordance with section 4.16 of NPS EN-1 on security considerations."</i> <u>[The application is not in accordance with 4.16 of NPS EN-1 until the panel is satisfied that defence and security has been full taken into account in the planning of N2T].</u>
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This continuing obfuscation remains unacceptable, and we remind the panel of the legal opinion by Lord Charles Banner KC submitted at deadline 3 which said, in paragraph 7, “This sustained obfuscation on such key questions should be deprecated by the Examining Authority and, if it is continued, adverse inferences should be made.”

The panel must seek answers to all of our points raised at Deadline 4, in order to be able to make a recommendation to the Secretary of State. Without this the Secretary of State cannot make a decision to approve the DCO. It may be that the answers need to be tested at an Issue Specific Hearing. EN-1 notes, in 4.1.7, that the CNP presumption does not apply to “residual impacts which present an unacceptable risk to, or interference with, human health and **public safety, defence...**”

SS 1.6 Aviation impact

Airfields and risk to life: is the CNP exemption triggered?

Policy

- Paragraph 4.2.15 of National Policy Statement EN-1 (2024) cites the potential creation of an exception to the critical national priority (CNP) presumption with regards to residual impacts presenting unacceptable risk to, or unacceptable interference with, human health or public safety.
- Paragraph 200 of the NPPF: “Planning policies and decisions should ensure that new development can be integrated effectively with existing businesses and community facilities (such as places of worship, pubs, music venues and sports clubs). Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established. Where the operation of an existing business or community facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or ‘agent of change’) should be required to provide suitable mitigation before the development has been completed.”

Q1. Is there a risk to human life caused by the project e.g. lack of manoeuvring space for an aircraft?

Yes, according to Norfolk Gliding Club. We see no distinction between licensed or unlicensed aerodromes or airfields. If there is a risk to aircraft, there is a risk to aircraft.

Q2. Is this a risk to, or unacceptable interference with, human health or public safety, as per 4.2.15?

Yes.

Q3. Can that risk to human life be mitigated through project design or project alternatives?

No, according to Norfolk Gliding Club.

Q4. Is there anything in 4.2.15 to suggest or infer or state that the risk can be removed by forcing a change of use on an existing business, club or receptor?

No. Taking this further, it seems entirely irrational and unreasonable to infer that this the intention of the policy.

Q5. Does NPS EN-1 override the agent of change principle?

No. There is nothing to suggest that this is the case.

Any mitigation must be safe: "5.5.44. Mitigation for infringement of OLS [Obstacle Limitation Surfaces] may include: agreed changes to operational procedures of the aerodromes in accordance with relevant guidance, provided that safety assurances can be provided by the operator that are acceptable to the CAA where the changes are proposed to a civilian aerodrome."

If this cannot be achieved, the risk to human life caused by the project remains.

The Agent of Change principle means that the party introducing a new use or source of harm is expected to manage its effects on existing lawful uses. The burden does not fall on the receptor.

Closure of the aerodrome is not mitigation of the development's effects. It is the removal of the receptor affected by those effects. The planning system normally assesses whether the development is acceptable in the presence of existing lawful uses, not whether those uses can be extinguished to accommodate the development.

It flies counter to planning policy, and is entirely circular (the chicken and egg situation mentioned by the panel), for the Applicant to suggest that the absence of aircraft after closure of an aerodrome due to its own proposal can retrospectively demonstrate the absence of the safety risk that necessitated the closure. Worse than this, it makes a mockery of the planning system and risks setting a precedent that undermines public trust in the system. It would mean that the public safety CNP exemption could always be avoided by suggesting that the public whose safety are at risk simply avoid the area.

It is clear that the CNP exception is brought into play.

Miscellaneous

Dark Skies

At Thorington, St, in the National Landscape, the village has succeeded in being designated a Dark Sky Village, with all residents working together to preserve the darkness. There is an observatory based there to benefit from these dark skies. This demonstrates the importance of dark skies.

Planning guidance on light pollution states that:

- when a development may increase levels of lighting, conditions should be set at the planning stage.
- that if a development is in or near a protected area **or an intrinsically dark landscape** then the issue of light pollution is more important

Lighting should not spill beyond the construction site.

There should be none beyond the site boundary.

Upward light should be minimised.

In Cambridge, the Waste Water Treatment Plant DCO included a requirement for a Lighting Design Strategy. This must be approved by the local planning authority before construction.

Given the extent of the project and its impact on rural East Anglia a Lighting Design Strategy is essential for the N2T DCO.

Bats

We have previously raised concerns about the level of uncertainty associated with reliance on bioacoustics recordings alone. Even for expert bat ecologists, solely relying on recordings can be misleading. If the Applicant only manually reviewed a subset of recordings, there is potential miscalculation error here, so we ask whether the data handling assumptions and sample size were sufficient to reduce the classification bias for rarer bats (for example, *Myotis* group remain particularly difficult to separate). We remain concerned about this approach.

Our analysis of the Applicant's submissions indicates that they primarily used static bat detection methods for their surveys. They deployed "Song Meter SM4BAT full spectrum static detectors" at identified locations. These detectors were set to record automatically from 30 minutes before sunset to 30 minutes after sunrise for a minimum of 5 consecutive nights. The collected recordings were then analysed using Kaleidoscope Pro software, followed by manual quality assurance checks by experienced ecologists.

However, there is no mention of roving transect walks. This could be considered a methodological constraint in determining bat commuting routes as site walks are the usual 'go to' in determining flight lines, crossing points over the proposed route, direction of flight, finding roosts etc. Bat survey guidelines are a good reference here. The author of document 6.8.A10 Environmental Statement Appendix 8.10 – Bat Activity Report - Clean Version openly admits that static recorders will under-record some species.

Further, survey activity which looks at isolated points along the route neglects the landscape use of bats, and their commuting patterns. Along the R. Brain for example, location 56 has high *Nyctalus* and serotine activity but there appears to be no wider assessment of landscape connectivity. Scant mention is made of the Colne, or its tributaries (e.g.: R. Roman). *Barbastelle* records are interesting and this species seems quite widespread across the surveys (subject to some radio tracking work. To inform an understanding of the harm caused by the project as a whole and/or mitigation approach, the wider landscape context must be understood.

For comparisons, the HS2 ecology technical standards are submitted as an Appendix. Here the focus with these standards was linked to landscape connectivity and the wider ecological network (Lawton Review principles). They set a precedent that we believe should be mirrored for this large scale, linear infrastructure scheme.

Nature Opportunities: Document: 8.4.12.2 Response to ISH2 Action Point 27 - Masterplans

The base layer map is so faint that it is very hard to distinguish the features, which makes these maps hard to analyse. As noted by the Applicant, they have not talked to landowners, Parish Councils or local people. Lack of discussions with landowners in particular makes these presented opportunities undeliverable.

In addition, many of the opportunities are undeliverable from a practical perspective, or meaningless, and obvious opportunities have been missed out.

For example, looking at the two Colne Valley maps alone, just some of the issues identified are as follow:

- NG proposes new scrub, woodland and grassland in the Woodland Trust area already managed for exactly that.
- Likewise, the Applicant proposes 'connective green infrastructure' on the Fordham Estate, which is already managed for meadowland and woodland by the Woodland Trust and is public access.

- The Colne Valley maps contain random arrows that point meaninglessly at areas and associate them with the Local Nature Recovery Strategy.
- Meanwhile, the map does not show that the Roman River Corridor is in Colchester's Draft Local Plan as both an Essex LNRS nature opportunity and as green/blue infrastructure.
- The map shows recommended tree planting in an area that has planning permission for 150+ houses.
- The map shows a stretch of Rectory Road, Aldham which could see 'connective green infrastructure enhancements' but it is a quiet country lane with hedgerows already.
- Likewise, it appears to show that New Road offers the same opportunity but it is a road with trees and hedges all along it.

An examination by Friends of Wortham Ling of National Grid's proposal to plant trees and hedges on Wortham Ling finds that:

- There has been no consultation locally about this draft plan as far as they are aware.
- They are baffled by NG's proposal to plant trees and hedges on the Ling and do not believe this "opportunity" can be achieved.
- Wortham Ling is a SSSI⁹ and its citation is based on its landscape as lowland dry heath and acid heathland which would preclude planting trees. In fact previous management schemes have focussed on removing trees. Natural England would have to approve tree planting but is unlikely to do that given the SSSI citation is for acid heathland.

The panel has also received representations from Roydon and Bressingham PC about this area.

Likewise, for the Walthams, in Essex, a resident tells us that 'the Draft Opportunities Plan has nothing constructive to add to the debate. What the suggested enhancements will be and how they compensate for the considerable detriment caused by the Project is a mystery. The watercourses are and have for many years been used for the planting and harvesting of bat willows by a long-established local industry and it's unclear how their interests would be protected by "connective blue infrastructure enhancements"'. Near Langleys, lanes already have hedgerows, so could not be enhanced as a nature corridor opportunity, and other areas ear-marked for nature opportunities are already in use for cricket willows.

9

<https://designatedsites.naturalengland.org.uk/SiteDetail.aspx?SiteCode=S1005979&SiteName=wortham%20ling&countyCode=&responsiblePerson=&SeaArea=&IFCAArea=>

Colne Valley – does it have the qualities required to be designatable?



Firstly, we attach as Appendix D a follow-up note by The Landscape Partnership post ISH4.

At ISH4 there was discussion about the qualities of a National Landscape¹⁰, and we stated that we would follow-up in writing with our thoughts.

The qualities are landscape quality, scenic quality relative wildness, relative tranquility, natural heritage features, cultural heritage e.g archaeological remains.

We address each of those in the table below in summary form, as the full evidence has been submitted to the Applicant in various forms by various parties over the past few years, and many submissions have been made to the Inspectorate:

Characteristic	Comment
Landscape quality, where natural or man-made landscape is good quality	The landscape has been well preserved conserved over centuries, with the same field boundaries (ancient hedgerows), woodlands and water meadows persisting, such that the ancient character of the deeply rural, agricultural landscape feels special and worth protecting. The landscape exhibits a high degree of integrity, with ancient hedgerow networks, woodland, water meadows and historic field

¹⁰ <https://www.gov.uk/guidance/areas-of-outstanding-natural-beauty-aonbs-designation-and-management#meet-the-natural-beauty-criterion>

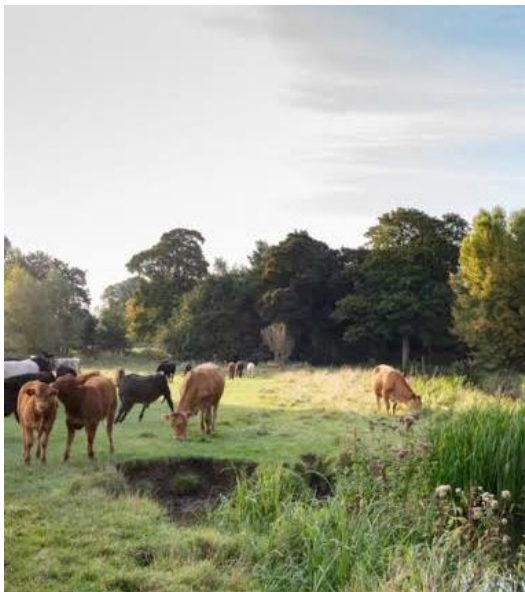
	patterns surviving largely intact. The continuity of these features over many centuries has conserved a deeply rural agricultural landscape with a strong sense of time-depth..
Scenic quality, such as striking coastal landforms	The scenic quality is unique to distinctive of north Essex (and south Suffolk???), and is due to its attractive scenery of wide valley and gently rolling hills, which are open to far-reaching views from both sides. Juxtaposition of broad pastoral valley floor with gently rolling valley sides, affording extensive views across a varied landscape of water meadows, arable fields, pasture, hedgerows and woodlands The landscape is very varied, from water meadows, to hillside hay meadows, paddocks and arable land, with a patchwork of fields separated by hedgerows and woodlands. This is a landscape that has not much changed for hundreds of years.
Relative wildness, such as distance from housing or having few roads	The only main road is the Colchester to Halstead Road which winds through the valley, affording spectacular views of the meadows and woodlands. Otherwise, the Colne Valley through to the Roman River consists of quiet, narrow country lanes (including some Protected Lanes), footpaths and tracks. The Essex Way passes through the area. Built form is limited to ... occasional scattered farmsteads and small villages... Beyond the valleys, the A12 and Colchester exert little or no influence. Limited presence of modern development, infrastructure and urbanising influences Landscape retains a distinctly rural character.
Relative tranquillity, where natural sounds, such as	The Colne and Roman River valleys are oases of tranquillity where the footpaths, bridleways and country lanes are undisturbed by modern life. A walker or cyclist will be deafened by bird song,

streams or birdsong are predominant	especially from late January onwards when the dawn chorus begins for the year, or later in the summer when the hedgerows are full of Yellowhammers singing their characteristic ‘Little bit of bread and no cheeeeeese’ song while the Skylarks sing overhead and the buzzards call. At night time it is so quiet that you can hear the bats fluttering overhead. During the evening and night the absence of significant light sources contributes to exceptionally dark skies for a landscape in close proximity to a major town. ASSUMING THIS TO BE CORRECT.
Natural heritage features, such as distinctive geology or species and habitat	On the Roman River, the Brickpit SSSI^[2] is significant for its record of pollen throughout the Hoxnian Interglacial around 400,000 years ago, and this is the best vegetational record for any British interglacial site. The Colne Valley is an unusually wide valley that was shaped over multiple glacial–interglacial cycles. The gravel, clay and alluvial soils produce a remarkable variety of habitats over short distances: • seasonally flooded wet grassland, • gravel terraces with dry calcareous grassland, • ancient woodland on heavier clays, • springs emerging where permeable gravels meet impermeable London Clay.
Cultural heritage, which can include the built environment that makes the area unique, such as archaeological remains or historic parkland	The River Colne was of great significance to the Romans, with Romano Temple ruins at Sheepen, a few miles downstream from Fordham, and the much discussed Roman Hunting Lodge on the route of the pylons at Fordham. A Roman Road crosses the area, there are Anglo Saxon burials, a possible Saxon mill site by the river, and evidence of prehistoric activity. We remind the panel of the submission by Fordham Parish Council^[3] which maps out these sites. WW2 pill boxes are dotted at regular intervals along the river, and airfields such as that at Wormingford...

	Parkland. Cricket willows. The intact ancient historic landscape itself
Associations	Finally, as per our submission at Deadline 5, we note the importance of the Colne Valley to writers/poets: John Nash, Ronald Blythe, Edward Smythe and James Withers, and of the association with Gainsborough, who took inspiration from the landscape??? through the so-called Gainsborough Line and Chappel Viaduct, a striking and dominant feature in the Colne Valley landscape. Demos a longstanding relationship between landscape, literature and art...

Spot the difference: Cows in the river

Dedham Vale



Colne Valley



(Image DVNLS)

Taken together, these characteristics create a landscape with a particularly strong sense of place. The combination of distinctive landform, extensive historic continuity, tranquillity, ecological richness, cultural associations and ability to appreciate it, gives the Colne and Roman River valleys a distinctive identity that is recognisable and which clearly distinguishes them from the surrounding farmed plateau landscapes.



Public access meadows & woodland, Fordham



WW2 Pill Box at edge of River Colne



Cricket Willows on River Colne floodplain

Curtilage / RVAA

At ISH 4, it was stated by the Applicant that the distance measured should be from the curtilage and not the property centre, as evidenced from the transcription:

“00:33:01:16 - 00:33:38:11 There would be or not. But what I would say is that in undertaking the work that we did, both desk based and field based. We took in consideration properties around the margin of that 200 meter zone. We also took into account guidance to the landscape Ministry guidance, which specifically said about overhead lines that 150m was the

the limit from which the threshold could be breached. Um, so my, uh, answer would be that it's very unlikely there would be other properties like that.

00:33:38:13 - 00:33:54:29 That's not to say, though, that there and again, written in our work, that there may be properties upon which there'd be a high magnitude of effect occurring in, in that zone, that the thing that is unlikely is that that would break, that those would break the threshold.

00:33:56:18 - 00:34:15:24 Understand? Thank you. Um, and the measurements for the 200m cut off, if you like. Is that taken from the curtilage of the affected properties, then Hilda for the applicant. Yes. **We're very acutely aware that it's gardens, driveways, suchlike which are equally important to receptors in this regard. So it's taken from the edge of the curtilage.** Okay. Thank you."

Curtilage

The RVAA¹¹ document (6.13.A4) states:

- LI TGN 2/19 defines Residential Visual Amenity as 'the overall quality, experience and nature of views and outlook available to occupants of residential properties, including views from gardens and domestic curtilage' (LI TGN 2/19, Page 3, Para. 1.2).
- That it is not just about visual impact on residents, "LI TGN 2/19 notes that 'Residential Amenity comprises a range of visual, aural, olfactory and other sensory components. Development can cause effects on one or more components of Residential Amenity, for example effects of noise, dust, access to daylight, vibration, shadow flicker, outlook and visual amenity. Sometimes this is referred to as 'living conditions'" Footnote 2
- "LI TGN 2/19 notes that 'For example, when assessing effects of overhead transmissions lines, generally only those properties within 100 – 150 metres of the finalised route are potentially considered for inclusion in a RVAA' (paragraph 4.7)" Footnote 6.

However, it appears that the distances quoted in the RVAA document are to the property centre, and not the property curtilage.

An analysis of the Works Plans indicates that several examples of this are as follows:

¹¹ https://nsip-documents.planninginspectorate.gov.uk/published-documents/EN020027-002958-6.13.A4%20Environmental%20Statement%20Appendix%2013.4%20-%20Residential%20Visual%20Amenity%20Assessment_Revision%20B_Clean%20Version_Part%201.pdf

- Range Cottage is listed in the RVAA document as being 152m from pylon TB169, and Halfway House 168m from TB171. However, using the property curtilage, this appears to be ~120m for Range Cottage and 115m for Halfway House. If the route were to move by the allowed 50m, this has a significant impact to those properties.
- Red House, near Great Waltham is shown on the NG document as being 133m from TB141, but is actually around 100m from curtilage.
- Windmill House in Great Waltham is listed as being 84m from TB141, but is actually about 43m from the curtilage, a significant difference and very close - particularly when this is to the pylon centre, not allowing for the arms of the potentially shorter pylons being used there.
- In Aldham, Amora and Willows are shown as being 153m from TB54 - but in reality, the property boundary is approximately 110m.

We therefore believe that the RVAA assessment for these properties is not valid. It changes the magnitude of effect significantly, and this is just a small sample population. It is of concern that there are many more properties that have been incorrectly appraised, if the Applicant has been using house centre and not curtilage for their measurements. A failure at Step 1 of the Methodology (13.2.1: Identification of properties to be considered (defining the Study Area and scope, including grouping of properties) means a failure at steps 2 to 4.

Appendix A: Cable Ploughing

Revision: 1

Date: 6 July 2026

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1. Summary

This submission outlines a review of DESNZ commissioned report “*RAF021/2425 Study of the Potential for Cost Reduction in Undergrounding Transmission Lines over Long Distances*”. The study was undertaken by Ramboll and the report issued on 12 June 2026.

In previous submissions to this Examination, PEA has highlighted the potential of cable ploughing to reduce cost, save time and reduce environmental harm. The Ramboll study provides an informative review and discusses the various pros and cons of cable ploughing when compared with other undergrounding methods. It highlights, for example, a preference for cable ploughing in the Netherlands due to the environmental benefits.

The Ramboll study uses baseline cost data from the report “*A comparison of electricity transmission technologies: Costs and characteristics*” published by the Institution of Engineering and Technology (IET) (Mott MacDonald, 2025). As the previously submitted PEA report “*Norwich to Tilbury Project Green Book Analysis*”, used the same data it was possible to tie the two analyses together to provide the costs for different scenarios. The high-level results are outlined in the main deadline 6 submission from PEA.

PEA has previously discussed how the need for haul roads has been eliminated on some underground HVDC projects due to material movements being significantly less than equivalent HVAC projects. This is an important consideration when assessing the impact of a project. By default, haul roads are not used with cable ploughing, although the Ramboll report does warn that these may be required. The use of HVDC technology in combination with cable ploughing would appear therefore to be the optimum solution to reduce the need for haul roads. In this report some key construction parameters relating to the proposed Norwich to Tilbury project haul roads are quantified to help illustrate the impact.

2. Introduction

This submission discusses Ramboll report “*RAF021/2425 Study of the Potential for Cost Reduction in Undergrounding Transmission Lines over Long Distances*”¹, which was issued on 12 June 2026.

As outlined in the report’s introduction Ramboll was appointed by DESNZ “*to undertake a high level study (UKSBS, 2025) to identify if there is potential for cost reduction in undergrounding transmission lines over long distances of 20km and 50km by using unconventional or innovative undergrounding methods*”.

Such a study is welcomed by PEA. The use of conventional open cut excavation, which is referred to as “*cut and cover*” in the Ramboll report, can be very slow, costly and harmful to the environment. This is particularly the case with underground HVAC due to the extensive amount of excavation required.

One of the alternative undergrounding methods assessed in the study was cable ploughing. Information on this method has previously been presented to the ExA by PEA. This demonstrated how cable ploughing can be a quicker, cheaper and lower impact method of laying underground cables. Included at Deadline 1 was an evidence report in Appendix B of “*EN020027-001370-Pylons-East-Anglia-Ltd-written-post-hearing-submissions.pdf*” [REP1-266].

The introduction to the Ramboll report goes on to state: “*Cost is a key consideration when making decisions on technology solutions, however such decisions are also informed by several wider considerations including environmental impact and operability. The report is intended to fill an evidence gap in respect of the build costs of non-traditional undergrounding methods, and the reader should refer to more detailed studies for costs of traditional methods. This report documents a literature review and qualitative assessment to identify emerging undergrounding technologies and assess their benefits and disbenefits against key criteria, taking three forwards for further investigation.*”

¹ <https://assets.publishing.service.gov.uk/media/6a27e1592cdcfd7436ac131/undergrounding-transmission-cables-report.pdf>

3. General points from the Ramboll report relating to cable ploughing

- 3.1. The Ramboll report reviewed the following methods for underground transmission cable installation: Cut & Cover (the Baseline), Cable Ploughing, Horizontal Directional Drilling (HDD), Microtunnelling (Pipe Jacking), Direct Pipe, E-Power Pipe, Auger bore and Pipe Express.
- 3.2. When discussing cable ploughing the report states: *“In summary cable ploughing can be a cost-effective way of laying distances of cable in soft soils as it is significantly faster than traditional trenching methods. This can reduce labour costs, and there is less surface disturbance, reducing the need for costly and time-consuming restoration work.”*
- 3.3. The report states that *“...large principal contractors tend to prefer cut-and-cover as a construction method they are familiar with, with any increase in costs passed to clients”*.
- 3.4. And: *“In the Netherlands, carbon footprints and dewatering issues led clients to instruct principal contractors to adopt cable ploughing as the installation method. Clients tend to recognise advantages in cable ploughing and consider it to be the preferred solution in subsequent projects.”*
- 3.5. The study carried out a qualitative assessment that uses *“selected criteria with a weighted scoring system to evaluate the undergrounding methodologies with the most potential of reducing costs for transmission lines over long distances of 20km and 50km”*.
- 3.6. From this the report states: *“Cable ploughing (2.4) and HDD (2.4) score the highest, comfortably ahead of the other methodologies, mostly due to cost but also technical feasibility and minimising impact”* [the figures in brackets are the individual scores].
- 3.7. In relation to this the report states: *“As part of the qualitative assessment carried out in the present study, cable ploughing was considered one of the installation solutions with the highest potential to reduce costs.”*
- 3.8. Under the Environment heading the report states: *“The damage to the ground and the reinstatement required for cable ploughing is much less than cut-and-cover. However, trenchless methods like HDD can minimise that even further with very little surface disruption in both the temporary and permanent cases”*.
- 3.9. Under the Energy Security heading the report states: *“For all of the technologies considered, the fact that the cables are buried underground means that they are more protected against extreme weather such as storms, high winds, trees falling, fire and lightning than overhead lines”*.
- 3.10. The summary of the cable ploughing assessment from the report follows:

Summary

Cable ploughing presents an efficient and cost-effective method for underground transmission cable installation, particularly in rural and arable land settings. While cost reductions can be achieved for larger-scale projects, limitations in ground conditions and regulatory requirements must be carefully managed. The method offers significant benefits in reducing disruption and installation time but may not be viable in more urbanised areas and becomes less cost effective where strict sand backfill requirements exist. Continued innovation in equipment and installation techniques will further enhance its feasibility for large-scale deployment.

Pros:

- Cost-effective over long distances compared to cut-and-cover.
- Fast installation speeds with minimal surface disruption.
- Environmentally preferable in certain contexts (some clients mandate ploughing due to carbon footprint considerations).
- Can potentially reduce the need for heavy civil works and temporary access roads.
- Flexible in handling a variety of ground conditions.
- Lower per-metre cost for large-scale projects.

Cons:

- Limited effectiveness in urban areas due to frequent obstacles.
- Pre-ripping may be required in certain terrains, adding cost.
- Strict client specifications (e.g. mandatory bedding) can negate cost advantages.
- Depth requirements may necessitate additional equipment or slower speeds.
- Some projects require trenchless crossings or excavation work, increasing complexity.

4. General recommendations from PEA

The Ramboll study is an important piece of work, with a lot of detailed information on the key methods used for underground transmission cable installation.

For any further work in this area, PEA would like to make the following general recommendations:

- The scope of the study was limited to project lengths of 20km and 50km. As HVDC underground cables can be significantly longer than this, it would be beneficial to extend the scope. For example, the onshore HVDC option included in the 2025 IET report is 700 km long. Including the same length in the study would also ease comparison.
- The Ramboll study did not include 525 kV HVDC, even though this has become the new standard. This could have implications on the costs. For example, when

compared with a 400 kV HVDC circuit of the same power transmission capacity, the heating effects would be substantially reduced due to the lower current. This could potentially reduce the need for imported backfill and hence alter the assessment.

5. Baseline Costs

- 5.1. For baseline costs the Ramboll study uses data from report “*A comparison of electricity transmission technologies: Costs and characteristics*” published by the Institution of Engineering and Technology (IET) (Mott MacDonald, 2025)². This is subsequently referred to here as the “2025 IET report”.
- 5.2. It is important to note for comparison purposes that the figures quoted in relation to the 2025 IET report are the typically the “*Lifetime Power Transfer Cost*”, whereas the Ramboll report uses the “*Total Build Cost*”, which is a component of the “*Lifetime Power Transfer Cost*”.
- 5.3. Comparison was made between the Total Build Costs extracted from the 2025 IET report and those from the Ramboll report, after converting into the “£/MWkm” format used in the Ramboll report. While there was very good agreement with the HVAC figures, there were discrepancies with the HVDC figures.
- 5.4. Consequently, for the HVDC cable ploughing cost calculations in this report, baseline costs directly obtained from the 2025 IET report were used. These are then applied in conjunction with factors derived from the Ramboll report for the relative cost of cable ploughing to “cut and cover” to establish the impact on cost.
- 5.5. PEA will provide DESNZ with feedback on the discrepancies noted in the Ramboll report, as the report was commissioned by DESNZ.

6. Qualitative assessment

Table 2 of the Ramboll report provides a “*Qualitative assessment of underground methods against key criteria*”.

The table shows that Cable Ploughing and HDD have the joint highest overall score of 2.4, compared with the Cut & Cover (Baseline) at 2.1. The results are very dependent on the weighting, and it is noted that “Minimising impact” only has a weighting of 10%. If an equal weighting of 25% was given to the four criteria, which is more in line with

² A comparison of electricity transmission technologies: Costs and characteristics (Mott MacDonald in conjunction with the IET, 2025) https://www.theiet.org/media/axwkktkb/100110238_001-rev-j-electricity-transmission-costs-and-characteristics_final-full.pdf

NESO HND methodology, the differences in the Overall score become even more distinct:

Cut & Cover (Baseline): 1.75

Cable Ploughing: 2.0

HDD: 2.5

7. Cable ploughing cost calculations

Underground HVDC circuits from Norwich to Tilbury

- 7.1. In August 2025, PEA issued a Green Book analysis for the Norwich to Tilbury project. The work was, in part, prompted by the publication of the 2025 IET report in April 2025, on the basis that this meant that much better build cost data had become available. The previous version of the IET report was issued in 2012, and there have been significant changes to both the cost and the technology landscape since then.
- 7.2. The accompanying report “*Norwich to Tilbury Project Green Book Analysis*”³ was issued to Ofgem immediately on completion of the work in August 2025. It was then made generally available and it was included as part of the representation by Pylons East Anglia Ltd submitted to the Norwich to Tilbury Examination on 26 November 2025.
- 7.3. As the infrastructure cost data used for the Green Book analysis was obtained from the 2025 IET report, this provided the baseline data for the cost comparison with cable ploughing.
- 7.4. This involved creating a cable ploughed variant of option “Onshore HVDC VSC – 181 km – Rating 2,000 MW” modelled in the Green Book analysis.
- 7.5. As was the case with the Ramboll study, the IET underground costs are assumed to be cut and cover. The use of cable ploughing for 400 kV (or above) was dismissed by the authors of the 2025 IET report.
- 7.6. To derive the cost of a cable ploughed version of the HVDC underground option the IET derived variable build cost was multiplied by the corresponding cost ratio from the Ramboll report. The fixed build cost and operating costs remained the same as those used for the original cut and cover variant.
- 7.7. The cost factor used was the Ramboll figure (in “£/MWkm”) for “Cable Ploughing” divided by the corresponding Ramboll figure for “Cut & Cover. For

³ https://nsip-documents.planninginspectorate.gov.uk/published-documents/EN020027-000805-Norwich%20to%20Tilbury_Green%20Book%20Analysis_1.pdf

both figures the “Med 400kV DC”, “Sand” backfill, “Flat” cable formation and “50km” length option was chosen.

7.8. The cost factor was calculated at 78.6%, corresponding to a 21.4% reduction in the variable build cost. The factor therefore falls within the band stated in the Ramboll report that cable ploughing can *“reduce the total build costs to 60% to 80% that of cut-and-cover, a reduction of up to 20% to 40%”*.

7.9. To provide a further reference, the corresponding factor for the HVAC underground option was calculated at 66.5% corresponding to a 33.5% reduction in the variable build cost.

7.10. The build cost totals calculated for the 181km onshore HVDC circuit investigated are presented in the following table. These include the associated converter costs.

Capacity (GW)	Build Cost Total (£ million)	
	“Cut & Cover”	“Cable Ploughing”
2	£990	£925
4	£1,980	£1,849
6	£2,970	£2,774

7.11. This therefore indicates, for example, that cable ploughing would reduce the Total Build Cost of a 181km 4 GW project (two 2 GW circuits) by £131 million (the same reduction would apply to the Lifetime Power Transfer Cost).

Alternative scenarios for underground HVDC circuits from Norwich to Tilbury

- 7.12. The Ramboll report states: *“there may be some scenarios in which the decision to underground DC rather than AC does not affect the number of converter stations needed, but only their location. This might for example arise if connecting a node which is already planned to be DC (such as an offshore windfarm with a HVDC export cable) to an AC node point to point. In such a scenario, it may be appropriate to exclude the cost of converter stations when considering undergrounding options”*.
- 7.13. An example of such a scenario has previously been highlighted in submissions from PEA, and this is outlined here.
- 7.14. Current plans entail the 2.9 GW HVDC output from Hornsea 3 being converted to HVAC at Norwich.
- 7.15. If the converters were located at Tilbury instead of Norwich, the additional cost would purely be the cost of additional cabling between Norwich and Tilbury. There is no need for additional converters, and it therefore avoids the substantial costs associated with these.
- 7.16. Costs were calculated for two 2 GW circuits using the 2025 IET data. The length of each circuit was assumed to be 181 km (2 circuits would be required to avoid exceeding the 2 GW limit for each circuit).
- 7.17. This resulted in a variable build cost of £612 million for conventional, cut and cover, cable laying.
- 7.18. By factoring the calculated build cost to adjust for cable ploughing, as outlined earlier in this section, the variable build cost becomes £481 million.
- 7.19. This therefore represents an extremely good value and low impact method of delivering 2.9 GW from Norwich to Tilbury.
- 7.20. The power would be delivered by 4 cables (2 pairs) in 2 trenches, instead of the current HVAC plans where, for the underground sections, the 6 GW capacity requires 18 cables in 6 trenches.
- 7.21. It could also be delivered very quickly. Hornsea 3 is expected to be completed around the end of 2027⁴.
- 7.22. As a comparison, again using figures from the 2025 IET report, the variable build cost of the currently proposed Norwich to Tilbury 6 GW HVAC underground section alone is £542 million, assuming a length of 22 km.
- 7.23. Appendix G of Pylons East Anglia submission [REP5-265] discusses how the 3.48 GW of total capacity from the North Falls and Five Estuaries Offshore

⁴ <https://orsted.co.uk/insights/from-the-front-line-of-climate-action/doubling-capacity-with-the-next-worlds-largest-wind-farm>

Windfarms plus the Tarchon Energy Limited Interconnector could be connected to the grid also using HVDC transmission to minimise the impact. The result when added to the Hornsea 3 output would therefore be a potential total HVDC capacity of 6.38 GW.

7.24. It is acknowledged that it is not for PEA to propose solutions. PEA also does not have the resources to consider the many permutations of options that are likely to be available. It is also accepted that the build of Hornsea 3 is already very well advanced.

7.25. However, this shows that locating the converters at Tilbury instead of Norwich would have saved very significant amounts of money, resulted in a solution that minimised harm and could have been delivered very quickly.

7.26. This exercise demonstrates that other potentially far less harmful and viable alternatives are available and have not been considered.

7.27. In this example, cable ploughing has the potential to further enhance the viability of an option, by offering a faster means of laying the cables and at the same time reducing the cost and the harm caused.

8. Haul roads

8.1. PEA submission “*Response to Section 3 of [REP4-300] 8.4.10.1...*”, which is Appendix G of [REP5-265], discusses how other developers have demonstrated that with underground HVDC the need for haul roads can be eliminated and how this would result in a very significant reduction to the impact.

8.2. By default, the construction of haul roads is not required for cable ploughing.

8.3. The Ramboll report for example discusses how with cable ploughing “*the amount of backfill material and disposal of spoil is eliminated or minimised*”.

8.4. The Ramboll report does warn though that: “*Bedding supply – depending on ground conditions, the provision of bedding to site may require the construction of haul roads, which significantly raises costs*”.

8.5. However, due to the considerably greater amount of bedding materials needed for HVAC when compared with HVDC (due the number of trenches and their larger widths), this is more likely to apply to HVAC than HVDC.

8.6. Calculations were carried out using the Applicant’s latest haul road drawing “*2.6.3 Design and Layout Plans - Traffic and Transport (Final Issue A)*” [APP-043].

8.7. The drawing shows an “*Illustrative haul road 6m (widening to 8m for passing places)*”. For the purposes of these calculations the passing places were assumed to relate to 25% of the length of the route, resulting in an average width of 6.5m.

- 8.8. This is therefore comparable with the width of two motorway lanes, which are typically 3.65 m wide⁵. This temporary road would essentially run from Norwich to Tilbury.
- 8.9. For the purposes of this assessment the total haul road length was assumed to be the route length of 181km. It is likely though to be longer than this as, for example, in some places the haul roads required for HVAC undergrounding run parallel to those required for the OHL construction.
- 8.10. The calculations show that this would result in a land take of 118 ha for the haul road surface alone. Even though this land take is temporary, the effects of soil compaction would result in permanent harm.
- 8.11. Using a calculated average depth of 0.3275 m from the data provided on the Applicant's drawing, the compacted volume of aggregates is 385,304 m³. A similar amount of material needs to be excavated to allow the haul roads to be built.
- 8.12. "HS2 Learning Legacy" document "*Temporary access road optioneering and cost analysis*"⁶, published on 17 September 2020, provides useful information on the merits of different types of temporary access roads, including the type specified for this project.
- 8.13. Applying the data from the HS2 report results in a material cost of £37 million for the haul road. It is to be noted that this assumes an average depth. The maximum depth can be more than twice the average, and as the HS2 report was published in September 2020, the costs are also likely to have increased significantly. Maintenance costs are additional.
- 8.14. In addition, as shown on the Applicant's drawing, also associated with the haul roads are drainage swales and boundary fence foundation excavation, as there is a fence on both sides of haul road.
- 8.15. One issue highlighted by the HS2 report is that this form of construction leads to greater dust pollution than the other options investigated.

⁵ <https://www.standardsforhighways.co.uk/tses/attachments/by-attachment-id/210ff1ed-4a73-466f-ad7c-45936d121fce?inline=true>

⁶ <https://learninglegacy.hs2.org.uk/document/temporary-access-road-optioneering-for-hs2/>

Appendix B

Rebuttal to the Applicant's Response — Doc 8.4.13.1

This Note is a rebuttal to Table 5.1 of 8.4.13.1 Applicant's Response to Pylons East Anglia's Comments on its ExQ1 Responses (June 2026), which responds to our Deadline 4 submission on Section 18 (Water Environment). It has regard to the updated Drainage Strategy [REP4-186] and its Appendix B [REP4-188] submitted at Deadline 4, and to the Deadline 5 submissions the Applicant's response promised or cross-refers to — Draft DCO Rev E [REP5-060], Outline CoCP Rev E [REP5-139], Outline FWEF Rev B [REP5-147], DASSI Rev C [REP5-166], and the updated Statements of Common Ground with Norfolk [REP5-081], Essex [REP5-085], Suffolk [REP5-083], Thurrock [REP5-087] and the Environment Agency [REP5-101].

1. Correction to our Deadline 4 quotation of NPS EN-1 paragraph 4.1.7

Our Deadline 4 submission quoted the December 2025 wording of paragraph 4.1.7. The Applicant's response at Table 5.1 Section 1 quotes the January 2024 wording. The Applicant is correct. Under the transitional provisions at paragraph 1.6.2 of the December 2025 EN-1, applications accepted for examination before final publication of the 2025 amendments are decided under the January 2024 version. Norwich to Tilbury falls in that category.

The correct wording of paragraph 4.1.7 (January 2024) includes "irreplaceable habitats or unacceptable risk to the achievement of net zero" in the list of impacts to which the CNP presumption does not apply. The onshore flood limb of the exception, on which we rely, is identical in both versions. Our substantive argument is unaffected. We accept the correction.

2. Response to the Applicant's CNP position (Table 5.1, Section 1)

The Applicant's position is that the paragraph 4.1.7 onshore flood exception is not engaged because "the Environment Agency and several of the other LLFAs have confirmed that, subject to implementation of these measures, there will not be a residual impact from flooding". However we question if this is the case in light of the latest information submitted at Deadline 4.

(a) The Applicant's Deadline 5 SoCGs don't demonstrate the progress the Applicant's response describes.

The Applicant's response at WE 1.8 said updated SoCGs would be submitted at Deadline 5 to "demonstrate progress towards agreeing Hydrology and Flood Risk matters". Deadline 5 was on 10th June 2026. On the substantive items, the position is unchanged:

- Norfolk CC SoCG [REP5-081, 5.9.1 Rev D]: 11 of 13 items in section 3.7 (Hydrology, Land Drainage and Flood Risk) still Under Discussion — the same 11 as at Deadline 4. The only items Agreed remain 3.7.2 (study area) and 3.7.4 (assessment methodology).
- Essex CC SoCG [REP5-085, 5.9.3 Rev E]: 11 of 13 items in section 3.8 still Under Discussion — the same 11 as at Deadline 4. Only 3.8.2 (study area) and 3.8.4 (assessment methodology) Agreed.
- Suffolk CC SoCG [REP5-083, 5.9.2 Rev D]: 6 of 13 UD (unchanged).
- Thurrock Council SoCG [REP5-087, 5.9.4 Rev D]: 7 of 13 UD (unchanged).

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Critically, the substantive items relating to the assessment of flood risk effects and the FRA itself — 3.7.10 / 3.8.10 (construction effects), 3.7.11 / 3.8.11 (operational effects), 3.7.12 / 3.8.12 (Outline CoCP including FWEP), and 3.7.13 / 3.8.13 (Flood Risk Assessment) — remain Under Discussion across all four LLFAs as of Deadline 5. Norfolk's stated position on the FRA at Deadline 5 is unchanged and identical to Deadline 4: it "lacks the site-specific modelling, detailed drainage design annexes and consistent application of stated methodologies", with resolution expected only by Deadline 7. Essex's stated position on the Tilbury North culvert (3.8.3) is also unchanged: "it is therefore impossible to assess whether the capacity of the proposed culvert is sufficient to manage the predicted peak flow".

The Environment Agency's SoCG [REP5-101, 5.9.15 Rev D] does record all Hydrology and Flood Risk (section 3.2, all 24 items) and Contaminated Land / Groundwater (section 3.4, all 9 items) as Agreed. That's consistent with the Applicant's reference to "the Environment Agency" confirming. But it doesn't extend to "several of the other LLFAs". No LLFA has confirmed "no residual impact from flooding" in the sense the Applicant's argument needs. The items Suffolk and Thurrock have Agreed are earlier procedural and mitigation items — not the effects assessment or the FRA. The Applicant's "several of the other LLFAs" framing conflates procedural agreement with substantive agreement.

(b) The Drainage Strategy Rev B [REP4-186] doesn't evidence the engagement it relies on.

Rev B was issued 8 May 2026. The LLFA engagement dates table (Rev B Table 2.1) records meetings only up to January 2025 — before the LIRs, before our 16 March 2026 review, and before the pre-Deadline-4 engagement period. Essex's SoCG position at 3.8.1 records a meeting between the Applicant and Essex on 27 April 2026. That meeting is not in Rev B's engagement table. The document the Applicant now points to as the answer to LLFA concerns doesn't itself record engagement with the LLFAs on those specific concerns.

Our position is therefore unchanged. Residual onshore flood risk has not been demonstrated to have been mitigated as far as possible. The paragraph 4.1.7 exception is engaged and the CNP presumption at paragraph 4.2.28 falls away for flood risk.

3. Row-by-row rebuttal

The table below sets out the Applicant's response to each of our sixteen Written Question reviews, followed by our rebuttal. Where a point is closed we say so.

WE ref	Applicant's response (from 8.4.13.1)	Our rebuttal
WE 1.1	Norfolk CC LIR. Points to the updated Drainage Strategy [REP4-186] issued at Deadline 4. Agrees GG22, B03 and AS05 are also relevant to preventing silt pollution (in addition to GG24).	The GG22/B03/AS05 confirmation for silt pollution is a fair concession — accepted . The wider concern remains. Rev B's LLFA engagement table (Table 2.1) stops at January 2025, before Norfolk's LIR was filed. Norfolk SoCG [REP5-081, 5.9.1 Rev D] still records 11 of 13 items in section 3.7 as Under Discussion — unchanged from Deadline 4 — and Norfolk's summary states resolution likely only by Deadline 7. NPS EN-1 paragraph 5.8.20 requires the applicant, where a flood risk management authority has reasonable concerns, to "take all reasonable steps to agree ways in which the proposal might be amended, or additional information provided, which would satisfy the authority's concerns". On the record, the Strategy said to embody the answer to Norfolk's concerns doesn't itself record engagement with Norfolk on those concerns.
WE 1.2	River Stour link pillars. Small number in FZ3, ~1 m ² ground footprint each. Exception Test satisfied via built-in flood resilience. Directs the ExA to section 5.6 of 7.16 DASSI [Revision C].	Confirmed footprint of ~1 m ² per link pillar and FZ3 placement — helpful. On the Exception Test reference: we've checked section 5.6 of DASSI Rev C [REP5-166]. It covers link pillar siting, technical requirements, boundary treatment, access, surface treatment and external appearance. It contains no flood resilience narrative, no Exception Test reasoning, and no discussion of FZ3 placement or residual risk. The Applicant's response tells us where to look for the Exception Test justification and the referenced section doesn't contain it. This point should not be closed. Recommendation: the next iteration of the FRA (or DASSI) to set out the Exception Test at link pillar locations in FZ3, covering the resilience measures said to be built in and confirming they satisfy the Exception Test criteria at NPPF paragraph 178 (wider sustainability benefits outweigh flood risk; safe for lifetime without increasing flood risk overall).
WE 1.3	Five sub-points: (1) scour — not a design consideration unless close to a watercourse; assessment via specialist input during design development; (2) blockage — ~10 permanent culverts; W14 secures sizing including CC; blockage modelling "not necessary"; (3) Tilbury	(1) Scour. Deferral to post-consent design. NPS EN-1 paragraph 5.8.7 requires new energy infrastructure in flood risk areas to be designed and constructed to remain operational in times of flood; paragraph 5.8.14 requires the FRA to identify and assess the risks of all forms of flooding to and from the project, taking climate change into account. WE 1.3(1) asked whether pylon foundations in FZ3 have been designed to withstand the 1% AEP+CC event. The response doesn't answer that.

WE ref	Applicant's response (from 8.4.13.1)	Our rebuttal
	North — approach reasonable in principle, continues to engage with Essex; (4) W07 — wording revised in CoCP Rev E at Deadline 5; (5) Tas/Wid — FWEP Rev B updates with NaFRA2 depth and frequency data.	(2) Blockage. The response addresses permanent culverts. WE 1.3(2) asked about temporary culverts on ordinary watercourses. W14 doesn't apply to temporary culverts. NPS EN-1 paragraph 5.8.14 requires the FRA to identify and assess the risks of all forms of flooding to and from the project — which includes construction-phase risks from temporary culverts on the watercourses the haul roads cross. 50% / 100% blockage modelling is the industry standard for construction-phase FRAs. (3) Tilbury North. WE 1.3(3) specifically asked for hydraulic calculations proving the box culvert would not accelerate flow conveyance. We've checked Rev B [REP4-186] and Appendix B [REP4-188]. Neither contains hydraulic calculations for the Tilbury North culvert. Essex SoCG 3.8.3 [REP5-085, 5.9.3 Rev E] still records Essex's explicit position — unchanged since Deadline 3: "it is therefore impossible to assess whether the capacity of the proposed culvert is sufficient to manage the predicted peak flow. In the absence of this detail, the LLFA is concerned that the situation could lead to unacceptable surface water run-off and flooding." Continued engagement is not the calculation the ExA asked for or the assessment Essex needs. (4) W07. Confirmed in CoCP Rev E [REP5-139]. The revised W07 now includes "ensuring the most vulnerable components are placed in the areas at lowest risk, and incorporate flood resilience measures as required", plus retained evidence of EA Flood Warning Service registration. Point closed on wording. (5) Tas/Wid. FWEP Rev B [REP5-147] has been submitted at Deadline 5 with NaFRA2 depth and frequency data for the River Tas (0.3–0.6 m, 3.3% AEP) and River Wid (0.3–0.9 m, 3.3% AEP across three locations). We welcome the data being populated. But FWEP Rev B's own footnote states: "Defined using the National Flood Risk Assessment 2 dataset as there is no available data from EA flood models for these watercourses at these locations." That footnote confirms the underlying position: there is no site-specific fluvial modelling for these watercourses where haul roads cross them. NPS EN-1 paragraph 5.8.15 requires the FRA to be proportionate to the risk and appropriate to the scale, nature and location of the project. NaFRA2 is a national-scale surface water dataset; it is not the site-specific hydraulic modelling appropriate to a linear NSIP with multiple haul-road watercourse crossings. The FWEP is improved; the FRA-level deficiency remains.
WE 1.4	Essex CC parameters. Points to paragraph 5.4.8 of Rev B [REP4-186] — Essex greenfield runoff at the 1 in 1 year rate, capped at 2 l/s/ha.	The 1-in-1-year Essex rate at 2 l/s/ha in Rev B is confirmed — accepted. Essex SoCG 3.8.1 (no detail on managing surface water when control limits are exceeded) and 3.8.10 remain Under Discussion. Essex's recorded position at 3.8.10 is that "surface water runoff from permanent and temporary built-up areas should be managed on site using infiltration or runoff and

WE ref	Applicant's response (from 8.4.13.1)	Our rebuttal
		should be restricted to 1-year greenfield rates. Additionally, network modelling should be done for 100 years plus climate change allowance.” Rev B for Essex uses FSR rainfall for the current strategy (Rev B paragraph 2.3.8), with FEH committed only for post-consent detailed design. The design in front of the ExA is FSR-based for two of the four LLFA areas.
WE 1.5	Individual RRs. Site-specific drainage “typical for a Project of this size and scale” not developed at DCO stage. RR-2169 (Billericay, Wid): Outline Soil Resource Plan Rev B. RR-1937 (Long Stratton Road, Tas tributary): confirms this refers to a small stream where RG40 sits at the head, not the main Tas channel; commits to pre-development discharge rates and preservation or re-provision of drainage features.	The RR-1937 response is a site-specific commitment we accept — pre-development discharge rates and preservation of drainage features for the RG40 head-of-stream tributary is a substantive answer. The RR-2169 response repeats generic mitigation (GG28, AS01) without engaging with the catchment-scale runoff change concern from a multi-kilometre haul road corridor. The wider point remains. Where third parties have raised specific residual flood risk at specific locations and the response is generic or a process commitment for a future contractor, that contributes cumulatively to the paragraph 4.1.7 picture.
WE 1.6	LLFA request to secure Drainage Strategy in the dDCO. Points to Rev B and GG22 secured by Requirement 4.	The substantive point wasn’t engaged with. The LLFAs asked for the Strategy itself (not the SWMP) to be secured as a DCO document under Schedule 3 of the Planning Act 2008, and cited precedent in other DCOs. GG22 commits to a future Plan substantially in accordance with the Strategy, but the Strategy is not itself in Schedule 18. That means the SoS’s satisfaction under NPS EN-1 paragraph 5.8.36 rests on a Strategy that isn’t itself controlled by the Order. See WE 1.10 on certification.
WE 1.7	Defra 2025 SuDS Standards. Rev B addresses the seven Standards and includes catchment areas, runoff calculations and exceedance flow routes; drainage plans in Appendix B [REP4-188]. EA SoCG 3.2.22 is Agreed.	Rev B has added new sections addressing Standards 2 (interception, section 5.5), 4 (water quality, chapter 6), 5 (amenity, chapter 7), 6 (biodiversity, chapter 8) and 7 (design for construction, operation and maintenance, chapter 9) of the Defra National Standards for Sustainable Drainage Systems (June 2025). We welcome this. Compliance at framework level is not compliance at site level. Standard 1 (runoff destination hierarchy): no per-site justification table for lower-priority discharge destinations over higher-priority. Standard 2 (interception): section 5.5 addresses interception in narrative terms but doesn’t present site-by-site first-5mm interception volume calcs against impermeable area. Standards 4–6 (water quality, amenity, biodiversity): framework described but the CIRIA C753 Simple Index Approach has not been applied for

WE ref	Applicant's response (from 8.4.13.1)	Our rebuttal
		each SuDS asset. Standard 7 (design for construction, operation and maintenance): Table 9.1 is a generic maintenance schedule, not asset-specific. Appendix B (66 pages) is drainage figures showing SuDS basin locations and per-pond discharge rates. It is not a site-by-site catchment-scale demonstration of the Standards. Essex still uses FSR rainfall in Rev B. Compliance with Standard 3 (extreme rainfall) on outdated rainfall methodology is not compliance in substance.
WE 1.8	LLFA residual concerns. Updated SoCGs to be submitted at Deadline 5 to demonstrate progress; continues to engage.	The Applicant's response promised the Deadline 5 SoCGs would "demonstrate progress towards agreeing Hydrology and Flood Risk matters". Norfolk (REP5-081, 5.9.1 Rev D): 2 Agreed, 11 Under Discussion — identical to Deadline 4, item-by-item. Essex (REP5-085, 5.9.3 Rev E): 2 Agreed, 11 UD — identical to Deadline 4, item-by-item. Suffolk (REP5-083, 5.9.2 Rev D): 7 Agreed, 6 UD — unchanged. Thurrock (REP5-087, 5.9.4 Rev D): 6 Agreed, 7 UD — unchanged. Not a single item across the four LLFAs' Hydrology, Land Drainage and Flood Risk sections has changed status between Deadline 4 and Deadline 5. Every LLFA still has construction effects, operational effects, Outline CoCP+FWEP, and the FRA itself recorded as Under Discussion at Deadline 5. NPS EN-1 paragraph 5.8.36 requires the SoS to be satisfied — among other things — that the application is supported by an appropriate FRA, that the sequential approach has been applied, and that the proposal is in line with any relevant local flood risk management strategy. Two of the four LLFAs still don't agree the FRA is appropriate at Deadline 5. Rev B (May 2026) Table 2.1 stops at January 2025 despite the Applicant's own SoCG entries (Essex 3.8.1, 3.8.3, 3.8.10) recording a meeting between the Applicant and Essex on 27 April 2026.
WE 1.9	WMA. SoCG (5.9.16 [REP4-087]) being progressed towards the noted target.	Confirmed. Point closed subject to WMA Protective Provisions being agreed in principle before close of examination.
WE 1.10	Certification of FRA and Drainage Strategy. Cites government guidance (Content of a DCO required for NSIPs, 30 April 2024, para 016) that certification should be limited to documents "secured under the DCO and particularly which may be different to the version submitted as part of the application". FRA being examined is still	On the Applicant's own reasoning, the Drainage Strategy meets the guidance's test for certification. Rev B (May 2026) is materially different from the version submitted with the application (Rev A, February 2026). It is secured indirectly through GG22 and Requirement 4. It meets both criteria the Applicant cites. It should be listed in Schedule 18. On the FRA, the argument that mitigation is "already captured" via the CoCP register understates what the FRA does. The FRA is the flood risk assessment for the Project — sequential test, exception test, residual risk conclusions, flood zone classifications, climate change methodology. None of that sits in the

WE ref	Applicant's response (from 8.4.13.1)	Our rebuttal
	Rev A. Argues FRA mitigation is secured through the CoCP (in turn secured by Requirement 4), so certification is not necessary.	CoCP register. The FRA needs to be certified so that the version relied on for the flood risk case is the version examined.
WE 1.11	CoCP W07 and Sequential Test. Revisions to W07 included in Deadline 5 CoCP Rev E. Flood risk was a factor in strategic routeing and siting. Avoidance of higher-flood-risk areas not practicable for a linear project of this scale. Vast majority of operational infrastructure, including all new and extended substations, sited on land at low flood risk. Progress being made with Norfolk through continued engagement.	W07: confirmed in CoCP Rev E [REP5-139] — the revised wording is in place. Closed on wording. On the wider Sequential Test point, the response addresses strategic routeing and operational infrastructure siting. That isn't the same point as our critique. FRA section 5.1 (Sequential Test) is three paragraphs (5.1.1–5.1.3) and doesn't engage with the Sequential Test approach set out in PPG Flood Risk paragraphs 027 and 027a — paragraph 027a in particular addresses “infrastructure proposals of regional or national importance”, i.e. a linear NSIP. Norfolk SoCG 3.7.13 [REP5-081, 5.9.1 Rev D] remains Under Discussion — unchanged from Deadline 4. Norfolk's recorded position is unchanged: the FRA “lacks the site-specific modelling, detailed drainage design annexes and consistent application of stated methodologies” . Resolution likely at Deadline 7.
WE 1.12	Private water supplies / EA consultee. W04 in the latest CoCP provides additional robust protection. Says the Applicant has “updated 3.1 Draft DCO (Revision D) [REP4-037] to include the Environment Agency as a named consultee in respect of the code of construction practice in Requirement 4”. EA SoCG items 3.4.6–3.4.9 all now Agreed.	W04 wording (additional robust protection for private water supplies) accepted. EA SoCG items 3.4.6–3.4.9 all Agreed — accepted. On the EA consultee point, we've checked DCO Rev D [REP4-037]. Requirement 4 in Rev D names Natural England (LEMP) and the highway authority (CTMP). The Environment Agency is not named as a consultee on Requirement 4 in Rev D, and doesn't appear anywhere in Schedule 3 (Requirements) or Schedule 4 (Discharge of Requirements). The Applicant's own 3.5 Schedule of Changes to the Draft DCO Rev D [REP5-064], Row 11, confirms this. It records: “Amendment to include the Environment Agency as a requirement consultee on the code of construction management plan following a request from the Environment Agency”, with the “Version of dDCO” as E. That is the Applicant's own document confirming the change is at Rev E, not Rev D as 8.4.13.1 stated. The substance the Applicant referred to is in place — but in DCO Rev E [REP5-060], not Rev D. DCO Rev E Requirement 4 has been amended to require consultation “with Natural England in the case of the landscape and ecological management plan, the Environment Agency in the case of the code of construction practice”. The Applicant's 8.4.13.1 statement was factually wrong about which revision contained the change, but the change is now in the current draft. We accept the point as closed on substance.

WE ref	Applicant's response (from 8.4.13.1)	Our rebuttal
WE 1.13	Holton St Mary / otter habitat. Section 6.2 of Rev B references CIRIA C753 (SuDS Manual) and C648 (control of water pollution from linear construction). SWMP secured by GG22 and Requirement 4 will comply.	Referring to CIRIA C753 in the framework isn't the same as testing the treatment train at this location against it. Rev B section 6.2 sets out the framework but doesn't perform the site-specific test. The receiving stream is a small ordinary watercourse in otter habitat. CIRIA C753 Simple Index Approach at this location would point to a treatment train (i.e. vegetated swale + sediment forebay + pond) rather than a settlement pond alone. Rev B doesn't demonstrate this at this location.
WE 1.14	Anglian Water WRA. Template completed and returned to Anglian Water.	Confirmed. To be tracked to Deadline 6.
WE 1.15	MCA / waterways. Notes our position.	No issue arising.
WE 1.16	Affinity Water. Tri-party discussions with Anglian Water and Affinity Water on Ardleigh Reservoir. Impacts "generally considered minimal"; formal sign-off from the joint-operational committee pending. Position reflected in the updated SoCG [REP4-197].	Tri-party engagement on Item 7.1 (Overhead Line Crossing at Ardleigh Reservoir) is a step forward, though joint sign-off from the joint-operational committee is still pending. All 10 items in section 7 of the Affinity SoCG (Matters Currently Under Discussion) remain Under Discussion. Section 6 (Matters Agreed) currently contains a single ID (6.1) with no content — no matter recorded as Agreed. Item 7.10 (Protective Provisions) is material — Affinity's recorded position is that even the bespoke draft "still do not include a number of matters which Affinity would expect to be covered for its benefit". A public water supply asset with a majority-Under-Discussion SoCG engages the paragraph 4.1.7 human health and public safety limb as well as the onshore flood limb.

4. What we ask the ExA to require

- Drainage Strategy [REP4-186] and its Appendix B [REP4-188] certified as DCO documents under Schedule 3. On the Applicant's own reasoning at WE 1.10 they meet the guidance's test for certification.
- Flood Risk Assessment [APP-331] certified as a DCO document. The FRA underpins the flood risk case and its sequential/exception test reasoning sits outside the CoCP register.
- Signed (not draft) SoCGs with all four LLFAs covering Section 18 by Deadline 6. At Deadline 5 the position on effects, CoCP+FWEP and the FRA remains Under Discussion for all four LLFAs, unchanged from Deadline 4.
- Hydraulic calculations for the Tilbury North box culvert in the next iteration of the Drainage Strategy or its Appendix B, as specifically requested by the ExA at WE 1.3(3) and consistent with the position Essex has held from Deadline 3 through Deadline 5.

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- Confirmation of the FEH version (FEH22 vs FEH13 or FEH99) in the next iteration of the Drainage Strategy. FEH22 is the current version of the Flood Estimation Handbook and the standard in current UK flood risk practice.
- FRA sections 5.1–5.2 Sequential and Exception Test reasoning expanded in the next iteration to engage with PPG Flood Risk paragraphs 027 and 027a (area of search for national infrastructure) and with the Exception Test in NPPF paragraph 178 and PPG paragraph 031.
- Exception Test reasoning for the River Stour link pillars in FZ3 to be set out in the next iteration of the FRA or DASSI (the reference at 8.4.13.1 to DASSI Rev C section 5.6 does not in fact contain that reasoning).
- Site-specific fluvial hydraulic modelling for the River Tas and River Wid where haul roads cross them. FWEP Rev B [REP5-147] now uses NaFRA2 data but its own footnote confirms there is no EA flood model for these locations — which is not the FRA-appropriate evidence base for a linear NSIP.

Points closed on the Applicant's response:

- W04 wording (WE 1.12).
- EA SoCG items 3.4.6–3.4.9 — all Agreed (WE 1.12).
- Environment Agency as named consultee on Requirement 4 — substance now in DCO Rev E [REP5-060], not Rev D as the Applicant's response claimed (WE 1.12).
- CoCP W07 wording revised in Rev E [REP5-139] (WE 1.3(4), WE 1.11).
- FWEP Rev B [REP5-147] populates NaFRA2 depth/frequency data for Tas and Wid — partial improvement, underlying FRA fluvial modelling deficiency still stands (WE 1.3(5)).
- WMA SoCG progression (WE 1.9), subject to Protective Provisions agreed in principle before close of examination.
- Anglian Water WRA (WE 1.14), subject to tracking through Deadline 6.
- MCA / waterways (WE 1.15).

Appendix Bi



Report to the Examining Authority Norwich to Tilbury Project – Chelmsford 6 Section Flood Risk Concerns Relating to Roxwell and the River Can Catchment

presented by Melanie Shipley
& the Roxwell Flood Prevention Group (RFPG)
23 June 2026

Executive summary

The Roxwell Flood Prevention Group (RFPG) submits this report to express its serious concerns regarding National Grid's proposals for the Chelmsford 6 section of the Norwich to Tilbury project.

Our concern is straightforward.

Major construction works and permanent electricity infrastructure are proposed within one of the most hydraulically sensitive parts of the River Can catchment, despite the existence of a viable offshore alternative.

This is not simply a question of engineering.

It is a question of public safety.

It is a question of whether unnecessary flood risk should be imposed upon communities that have already suffered devastating flooding when an alternative route exists that avoids much of this risk.

For over a decade, residents, local authorities, the Environment Agency, Essex County Council, Essex Wildlife Trust, the Rivers Trust and landowners have invested considerable time, expertise and public funding into reducing flood risk across the Roxwell catchment through Natural Flood Management.

It is therefore difficult to understand how one arm of Government can invest substantial public funds to restore the natural function of this floodplain while another supports proposals that will compromise the very processes those schemes are designed to protect.

Our evidence is not based upon theory.

It is based upon:

- **first-hand experience of repeated flooding**
- **extensive photographic and video evidence**
- **years of continued partnership working with statutory bodies**
- **direct involvement in Natural Flood Management projects**
- **detailed knowledge of how this catchment behaves during flood events**

We believe the current assessments materially underestimate flood risk because they rely heavily upon modelling that does not fully reflect observed conditions, do not adequately consider cumulative impacts, climate change, downstream consequences or the interaction between multiple major upstream and downstream infrastructure projects.

More importantly, they have failed to demonstrate that this development can proceed without increasing flood risk to people, property, businesses, agriculture, livestock and critical infrastructure.

Where uncertainty exists and the consequences involve risks to life, public safety and nationally funded flood mitigation projects, the burden must rest with the developer to demonstrate beyond reasonable doubt that additional risk will not arise.

The roxwell flood prevention group

The Roxwell Flood Prevention Group was established following repeated flooding within the village.

Since its formation the Group has worked alongside:

- **Environment Agency**
- **Essex County Council**
- **Chelmsford City Council**
- **Essex Rivers Hub**
- **Essex Wildlife Trust (previously)**
- **Rivers Trust**
- **local landowners**
- **parish representatives**

to understand the behaviour of the catchment and reduce future flood risk.

This work continues today.

Government itself has recognised the seriousness of flooding within the Roxwell catchment, with Teresa Coffey publicly supporting the project on BBC Look East.

More than £100,000 of public funding has already been invested in Natural Flood Management initiatives designed specifically to slow water, restore natural floodplain function and increase resilience.

That investment reflects official recognition that this catchment is already vulnerable.

It should therefore be afforded the highest possible level of protection.

Understanding the catchment

The location proposed for construction around Blackwall Bridge is not simply agricultural land. It occupies one of the most important hydraulic locations within the River Can catchment.

At this point:

- **Newlands Brook converges with**
- **Roxwell Brook**

before forming the River Can.

This creates a natural hydraulic bottleneck where floodwater accumulates before passing beneath Blackwall Bridge and sits just outside this area also.

Floodwater frequently overtops its banks and spreads naturally across the surrounding floodplain as shown below.

This floodplain performs an essential function. It temporarily stores water before releasing it downstream.

Without this natural storage, floodwater would travel more rapidly and at greater depth towards Writtle and Chelmsford.

The proposed pylon sits immediately in the middle of this critical area.

The temporary construction works, access routes, compounds and haul roads would also occupy land that currently forms part of this natural flood storage system, as shown in photos supplied below.

The reality of flooding

Flooding within Roxwell is not theoretical.

It is not based solely upon computer modelling.

It is a repeatedly observed reality.

During prolonged or intense rainfall:

- **roads become impassable**
- **farmland is inundated**
- **homes flood**
- **businesses are disrupted**
- **sewage contaminates floodwater**
- **emergency access becomes restricted**
- **livestock become vulnerable**

The 2016 flood was sufficiently severe to receive regional BBC television coverage.

Residents witnessed roads transformed into fast-flowing rivers.

Vehicles became stranded.

Homes suffered extensive damage.

Businesses were forced to close.

The Roxwell Flood Prevention Group possesses extensive photographic and video evidence documenting:

- **submerged roads**
- **deep and fast-flowing floodwater**
- **stranded vehicles**
- **flooded homes**
- **damage to businesses**
- **threats to public safety**
- **risks to livestock**

These events have happened repeatedly.

They cannot be dismissed as isolated incidents, with flooding of Vicarage Road happening every year, sometimes as much as twice a year.

Lessons from 2016

On 23 June 2016 approximately 46mm of rainfall fell over a relatively short period.

Although 46mm may appear modest when viewed purely as a daily rainfall total, the intensity of the rainfall and the rapid response of the catchment produced catastrophic consequences.

Our own Grade II listed home suffered approximately £140,000 of damage.

Many neighbouring properties flooded.

Roads became impassable.

Village facilities were inundated.

The floodwater was contaminated with sewage.

Preschool flooded.

Most importantly, official flood maps indicated that many affected properties, including our own, were not at significant flood risk.

Those maps were wrong.

Only after the disaster were they revised.

Even today, despite revisions made in 2024, significant areas known to have flooded remain absent from Environment Agency flood mapping.

We have supplied photographic evidence demonstrating these discrepancies.

This illustrates an important principle.

Flood modelling is only as reliable as the information upon which it is based.

Where baseline data is incomplete, historic or inaccurate, the resulting assessment may significantly underestimate real-world flood behaviour.

Observed evidence must therefore carry equal weight to computer modelling.

Climate change changes everything

The flood experienced in 2016 occurred following approximately 46mm of rainfall.

That alone should give pause for thought.

National planning policy, the Environment Agency and the scientific community all recognise that climate change is increasing the likelihood of:

- **more intense rainfall**
- **more frequent storms**

- **wetter winters**
- **successive storm events before catchments recover**
- **higher peak river flows**
- **more frequent overtopping**

The infrastructure proposed by National Grid is expected to remain operational for many decades.

It must therefore perform safely under tomorrow's climate, not yesterday's.

The critical issue is not whether today's model predicts acceptable flood behaviour.

It is whether those predictions remain valid under the climate conditions expected throughout the operational lifetime of the infrastructure.

The River Can catchment already operates close to hydraulic capacity during major rainfall events.

Future conditions are expected to place even greater pressure upon this already sensitive system.

Floodplains are critical infrastructure

Floodplains are often viewed as empty fields.

They are not.

They are natural infrastructure.

They store water.

They reduce downstream flooding.

They slow river flows.

They protect communities.

Their value only becomes visible when they are needed.

Activities such as:

- **soil compaction**
- **vegetation removal**
- **haul roads**
- **construction compounds**
- **permanent foundations**
- **altered drainage pathways**
- **modified ground levels**

all have the potential to alter how floodwater behaves.

Even relatively small reductions in flood storage or changes in flow direction may increase flood depth elsewhere or accelerate water downstream.

The consequences can extend well beyond the construction site itself.

Temporary construction does not mean temporary impact

National Grid has suggested that temporary works will be removed following construction.

Removal of infrastructure does not automatically restore the floodplain to its original condition.

Construction can permanently alter:

- **soil structure**
- **infiltration rates**
- **vegetation**
- **drainage pathways**
- **overland flow routes**

Some impacts may persist for many years after construction has finished.

Floodplain function depends upon natural processes that develop over decades.

They cannot simply be reinstated once disturbed.

Cumulative effects have not been adequately considered

Approximately two miles upstream lies the proposed 103-hectare extraction site.

If approved, that development has the potential to alter:

- **runoff**
- **groundwater interaction**
- **flood storage**
- **drainage pathways**
- **sediment transport**

National Grid's assessment appears to consider only partially its own infrastructure and woefully shy of this.

Floodwater does not.

Catchments function as interconnected systems.

The cumulative interaction between multiple major developments must therefore be assessed together rather than individually.

Failure to do so risks significantly underestimating the true flood consequences.

Emergency access and public safety

Flood risk is not simply about water entering buildings.

It is about consequence.

Roxwell has four principal access routes.

Each has experienced flooding.

When roads become impassable, emergency access becomes severely restricted.

During major events, Blackwall Bridge and the A1060 become critically important.

These are precisely the locations where National Grid proposes construction works, traffic management and associated infrastructure.

The consequences are obvious.

Construction traffic combined with flooding could:

- **delay emergency services**
- **isolate residents**
- **prevent evacuation**
- **disrupt businesses**
- **place livestock at risk**
- **increase danger to motorists**

To date we have seen no convincing evidence that National Grid have assessed this effectively, in fact photography below shows a total inadequacy in knowledge.

Natural Flood Management

The Government has already recognised that this catchment requires intervention.

Natural Flood Management projects are currently underway.

These include measures designed to:

- **slow water**
- **increase infiltration**
- **restore natural processes**
- **improve resilience**
- **reduce downstream flooding**

These schemes exist because the floodplain matters.

It is therefore difficult to reconcile continued public investment in restoring these natural systems with proposals introducing substantial construction activity directly into the same floodplain.

One public body should not be undermining the work of another.

Concerns regarding flood modelling

Flood models are indispensable engineering tools.

However, they are only as reliable as the evidence used to create them.

In Roxwell, official flood mapping failed to predict catastrophic flooding.

Even after revision, current Environment Agency mapping still omits areas that demonstrably flooded as proven by supplied photographic evidence, video evidence can also be supplied.

Our photographic evidence confirms this.

When observed evidence conflicts with computer models, the models must be questioned.

Not the evidence.

We also remain concerned regarding rainfall methodology.

National Grid relies heavily on desktop assessments, but models are only as good as their data. We know this because official records showed no risk for flooding for our own homes, and yet the flood still came.

Questions have also been raised about the continued use of older rainfall FSR methodologies in Essex while newer FEH22 methods are used elsewhere on the project. Residents deserve clarity on this inconsistency.

We are also concerned that modelling based on incomplete baseline data cannot reflect real conditions. Our evidence shows that even 2024 flood maps do not accurately represent significant events.

1 in 1, 1 in 30, 1 in 100

Flood return periods are often quoted throughout technical reports using terms such as a 1 in 1 year, 1 in 30 year or 1 in 100 year event. Whilst these are familiar to flood engineers, they can obscure the real-world consequences for the communities who live within these catchments.

Based on our lived experience, supported by years of observing how the catchment responds to rainfall, we believe the practical consequences are as follows:

1 in 1 Year Event (Annual Flooding)

Flooding affecting Roxwell is not an exceptional occurrence. Almost every year—and in some years more than once—the four principal roads providing access to the village experience flooding.

These include:

**Vicarage Road
Stonehill Road
Boyton Cross Lane
Skreens Park Road**

Flooding regularly affects the area proposed for the National Grid pylon and associated access routes, restricting movement and making parts of the village difficult or impossible to access. Even relatively frequent flood events therefore have significant consequences for residents, local businesses, agriculture and emergency access.

1 in 30 Year Event

Under current rainfall assumptions, and without taking account of future climate change, more severe flood events have already demonstrated the vulnerability of the Roxwell catchment.

Flooding at this level has resulted in:

**homes being inundated
roads becoming impassable
preschool facilities being affected
damage to Grade II listed and historic buildings
disruption to local businesses
risks to livestock and agriculture
sewage-contaminated floodwater
prolonged community disruption**

These are not hypothetical impacts. They have been experienced by our community and are supported by photographic, video and historical evidence.

1 in 100 Year Event

A flood event of this magnitude would place unprecedented pressure on an already highly constrained catchment.

Given the existing hydraulic bottlenecks, the repeated overtopping of watercourses and the known limitations of emergency access, it is reasonable to anticipate that such an event could:

**isolate the village for an extended period
severely restrict or prevent emergency service access
inundate additional homes and businesses
place vulnerable residents, road users and responders at significant risk
increase risks to livestock, agriculture and critical local infrastructure
create conditions where there could be a serious danger to life**

Importantly, these assessments are based on current understanding of flood behaviour. National planning policy and climate projections indicate that the frequency and intensity of extreme rainfall events are expected to increase over the lifetime of the proposed infrastructure. Consequently, what are currently described as rarer flood events may become more frequent, increasing both the probability and the consequences of flooding unless the natural function of the floodplain is fully protected.

Downstream consequences

Water does not stop at parish boundaries. Floodwater here flows directly through the River Can network, through neighbouring Writtle, and straight into the heart of Chelmsford city centre an urban area already under severe flood stress, with many new properties built within high risk flood plane areas, one such site on Roxwell Road coming up to Chignal Road (Roxwell Row) is a mere 10 to 20 feet from the local brook, and as far as we are aware, another flood plain.

The tragedy of this local destruction is that it is entirely unnecessary. There is a viable, strategic offshore grid solution available that completely removes the need for these destructive overland pylons. National Grid claims it is 'too expensive,' but we ask the Inspectors: what is the true cost of flooding our homes, destroying our active environmental partnerships, and putting a major city centre at risk?

Why this matters

This report is not an objection to infrastructure.

It is an objection to introducing avoidable flood risk into one of the most flood-sensitive parts of the River Can catchment when a viable offshore alternative exists.

Flooding differs from many other environmental impacts.

Once floodwater leaves its natural channel it becomes largely uncontrollable.

There is no emergency switch.

No engineering intervention can be installed during a storm.

Mistakes cannot be corrected once homes are underwater.

The consequences include:

- **danger to life**
- **isolation of vulnerable residents**
- **delayed emergency response**
- **destruction of homes**
- **damage to Grade II listed heritage**
- **business interruption**
- **agricultural losses**
- **livestock losses**
- **sewage contamination**
- **long-term mental health impacts**
- **increased insurance costs**
- **significant public expenditure**

When consequences are this severe, planning decisions must be based upon the highest possible level of confidence.

Where uncertainty remains, the precautionary principle should prevail.

The precautionary principle

Flood management is inherently uncertain.

No model can perfectly predict future weather.

No model can perfectly replicate the complexity of natural catchments and we know they are highly inaccurate.

Where uncertainty exists and the potential consequences involve risks to life, property, critical infrastructure and substantial public investment, planning decisions should adopt the precautionary principle.

The burden should not fall upon local communities to prove that flooding will become worse.

It should fall upon the developer to demonstrate that it will not.

We do not believe that this has yet been achieved.

Our request

The Roxwell Flood Prevention Group respectfully requests that the Examining Authority require National Grid to undertake:

- **a comprehensive site-specific Flood Risk Assessment for the Chelmsford 6 section based on accurate and up to date data**
- **assessment using the latest climate change allowances and rainfall datasets**
- **cumulative modelling including the proposed extraction site and other major developments**
- **detailed emergency access modelling during both construction and operation**
- **independent assessment of local photographic and video evidence**
- **detailed demonstration of how Natural Flood Management objectives will be protected**
- **clear evidence that neither temporary nor permanent works will reduce floodplain function**

Until National Grid can demonstrate, through transparent and independently verified evidence, that neither construction nor permanent infrastructure will increase flood risk, compromise emergency access, undermine Natural Flood Management or worsen flooding for downstream communities, we respectfully submit that consent should not be granted for this overland route while a viable offshore alternative remains available.

Conclusion

The Roxwell Flood Prevention Group is not asking the Examining Authority to speculate.

We are asking it to recognise the evidence already before it.

We know this catchment floods because we have, and continue to lived through it.

We know official flood mapping has been wrong because our own homes flooded despite being shown outside the floodplain, and because even the revised maps continue to omit areas that are demonstrably known to flood.

We know the floodplain around Blackwall Bridge performs a vital hydraulic function because it has done so throughout every major flood event experienced by the village.

We know Government has already invested substantial public funds in Natural Flood Management because the flood risk is recognised as nationally significant.

Against this background, it is difficult to justify introducing major construction activity and permanent infrastructure into the very floodplain that public authorities are simultaneously working to restore and protect.

National Grid has consistently stated that its proposals will not materially increase flood risk. Given the scale of the potential consequences, those assurances should be supported by the most rigorous, transparent and up-to-date evidence available. Where credible uncertainty and inaccurate data remains, the burden must rest with the developer to demonstrate that no additional risk will arise, not with local communities to prove that it will.

Floodwater does not recognise parish boundaries, planning red lines or construction compounds. Decisions taken at Roxwell have consequences throughout the River Can catchment, including Writtle and Chelmsford.

The Examining Authority is therefore respectfully requested to require a comprehensive reassessment based upon current climate projections, robust local evidence, accurate data, cumulative catchment impacts and independent review before consent is granted.

Once floodplain function has been compromised, the consequences cannot simply be undone.

The infrastructure will remain for decades.

The flood risk will remain for generations.

The opportunity to prevent it exists only now.

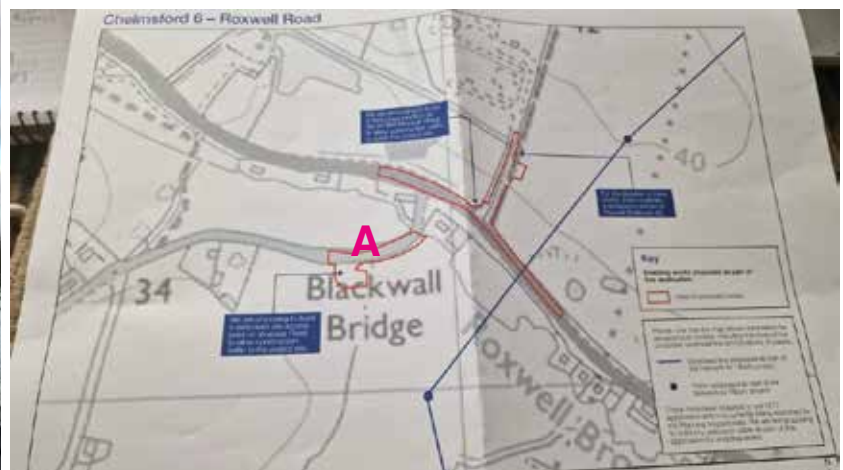
See further pages for photographic evidence.

Chelmsford 6 Roxwell Road



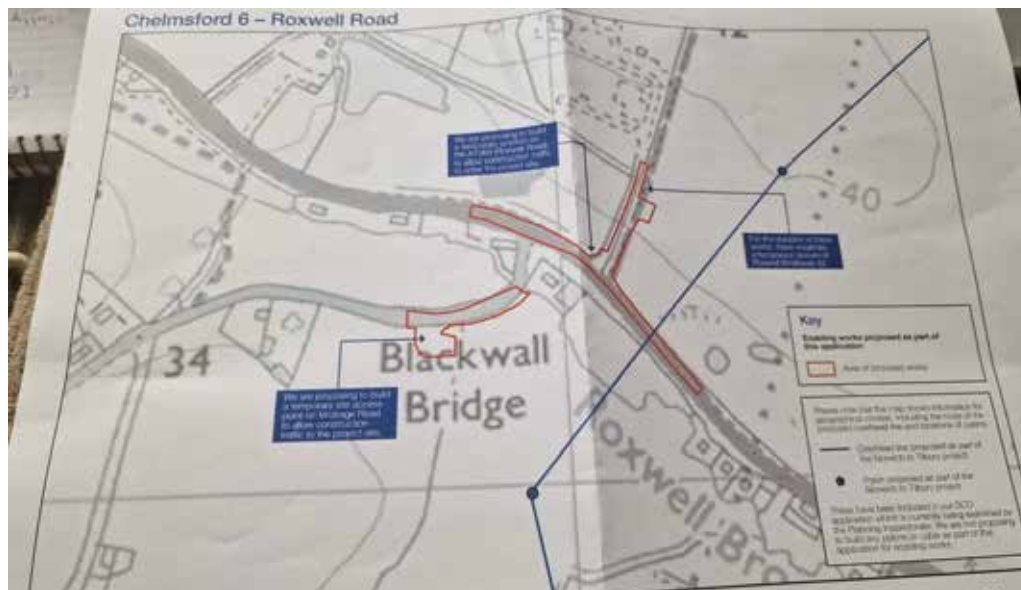
It is important to note that it is hard to get close to the flood areas when it is at its highest, photos supplied show when it has subsided enough to get a car through, these areas are not passable by cars or trucks when it is at its highest points.

These floods are not a 1 in 30, they are mostly yearly, sometimes more than 2 or 3 times a year, ask any parishioner, they will confirm this.



National Grid plan.

Pylon location within flood plain.



National Grid plan.



Flood plains that flood yearly, supporting video evidence can be provided.



An additional point to make is that the proposed position of the pylon is right in the middle of the flood plain that floods every year, sometimes twice or more a year.



Summary

- No emergency access at all to the village at peak flood times.
- NG pylon access routes planned in one of the largest flood plains in the whole catchment.
- Flood plain that floods more than yearly (video and photo evidence based).
- Weak planning built on inaccurate data (flood data held not accurate).
- Use of old FSR data, when National Grid have made adjustments in other parts of the planned route and are now using FEH22, why are they still using old data?
- Flooding happens with just 30mm of rain, major disaster for local residence at 45mm, some parts of the country see as much as 300mm+ of rain - what will happen if this happens in our catchment?
- Elderly have been removed from their homes in the past by rafts by emergency services.
- The EA are aware of the flood risks, although their own flood data does not reflect accurate flood areas, as shown in photos and video evidence. Why are the EA and NG suggesting they are satisfied with no flood risk, where we are providing clear evidence of major flood risk.
- How will NG and the EA guarantee no flood impact on such a highly volatile catchment, what happens if planning goes ahead, who will watch and repair the impact? who will be paying for increases in insurance premiums?

COMMUNITY

Locally taken

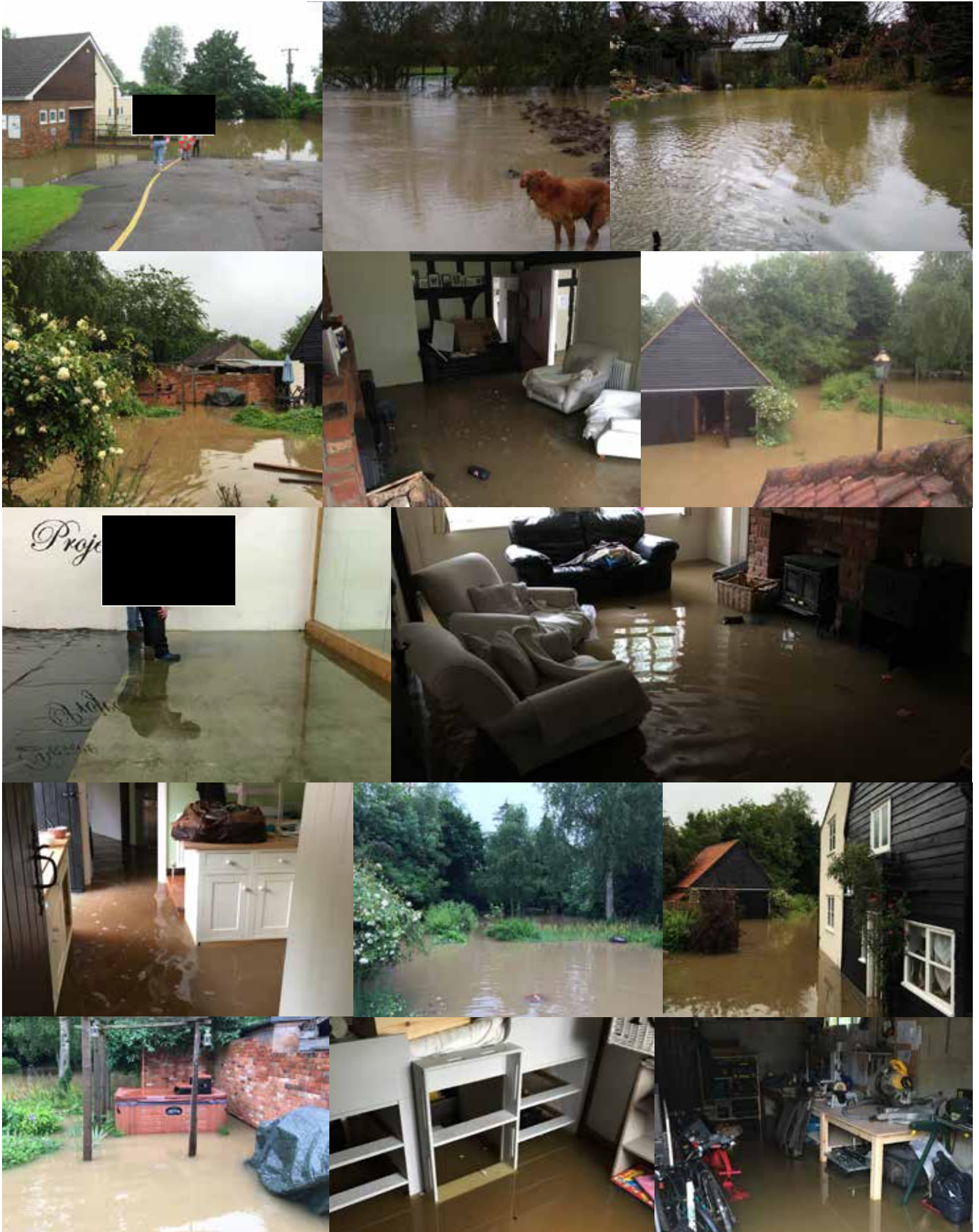
FAMILY

Locally taken

SUPPORT

Locally taken

Local homes, families and business



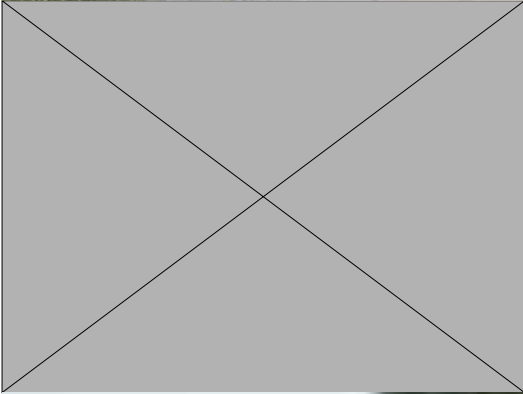
What happens to families with just 46mm of rain fall, some parts of the UK have had 400mm+ events.

Local roads & Infrastructure

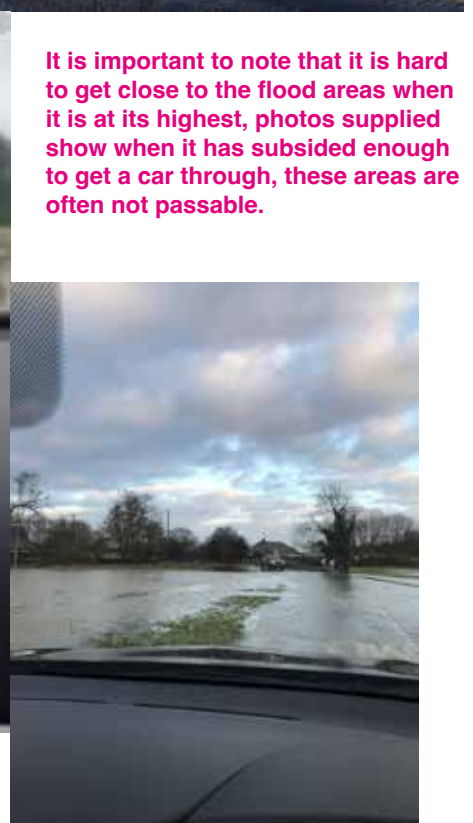


What happens to infrastructure with just 46mm of rainfall, making Roxwell completely isolated, and floods downstream in Writtle.

Roxwell access



This was taken when the road was still passable, an hour before and this was not passable or possible to get close enough to take a picture.



It is important to note that it is hard to get close to the flood areas when it is at its highest, photos supplied show when it has subsided enough to get a car through, these areas are often not passable.

This happens mostly yearly, sometimes more than two or three times a year, and when it does, the whole of Roxwell is not accessible from anywhere.



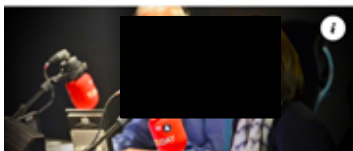
What happens in Roxwell and the surrounding areas and into the city centre with 46mm of rain fall, some parts of the UK have had 400mm+ events, what happens then?





⚠️ Take care if you're visiting some of our parks like Admirals, West Park, and Chelmer Valley Local Nature Reserve this weekend. 🌧️

"Flood risk being the biggest natural catastrophe risk that the UK faces, flood insurance was more than likely going to be more expensive so we sat down with the government, worked out a plan about how to deal with and in 2016 launched a scheme called @FloodRe." says James Dalton, Director of General Insurance Policy at the Association of British Insurers, on BBC Radio 4's Today. Flood Re is the governmental initiative to create an affordable market for flood insurance. Listen to the segment at 25:14 via



Chelmsford's Admirals Park flooded so badly it looks 'like a lake'

Heavy downpours of rain have hit the park badly



NEWS By Louise Lazell Senior Reporter

14:05, 21 Dec 2019



📷 The whole park is completely flooded following the heavy downpours

Essex floods: Eleven rescued from minibus in ford at Writtle

📅 6 October 2021



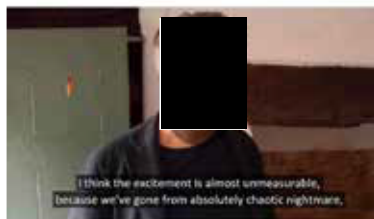
Essex Fire and Rescue Service said it was called to 26 incidents in three hours across the county

Eleven people were rescued from a minibus after it became trapped in "waist-high" flood water.

Essex Fire Service was called to a ford in Cow Watering Lane, Writtle at 17:15 BST on Tuesday to find the occupants trapped in four feet (1.2m) of water.

Inflatable boats were used to rescue the passengers, who were aged 16 to 25, and

Watch Melanie and Joseph Hedges renew their home insurance through the Flood Re scheme following their home being flooded in June 2016



(I think the excitement is almost unmeasurable, because we've gone from absolutely chaotic nightmares,



🌊 Flood Action Week 🌊 is all about making sure you're prepared in the event of a flood.

🏠 Check the flood risk in your area (search "prepare for flooding")
📋 Prepare an emergency grab bag, with important documents (such as insurances), toiletries, and a list of prescription medications

Chelmsford City Council 5 Jan 2024 · 🌐

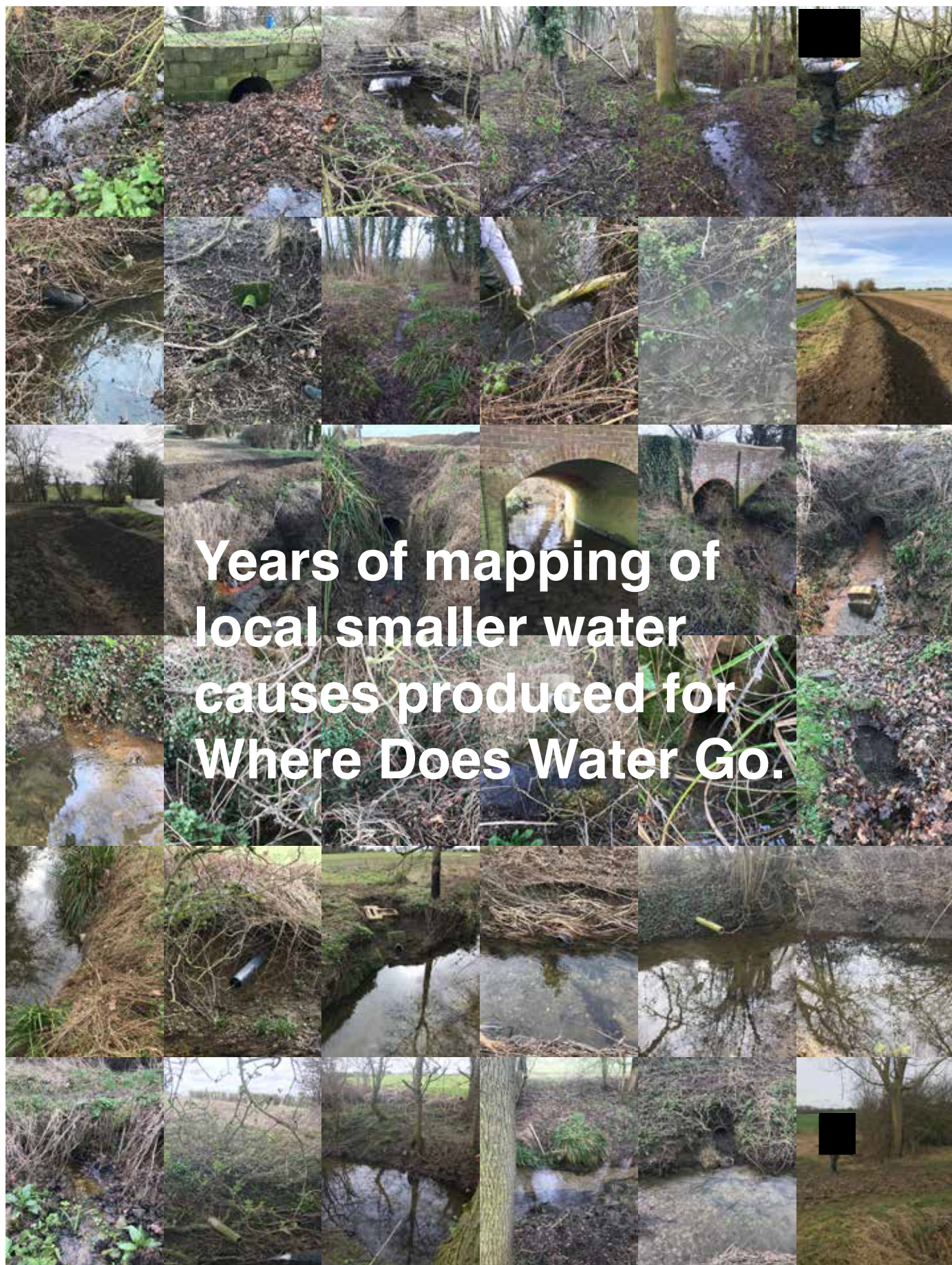
⚠️ Rivers are high in our city centre's parks, please take care ⚠️

The Rivers Chelmer, Can and Wid are all higher than usual, and some footpaths and cycle tracks close to the river banks will be impassable. This particularly applies to the river valley flood meadows in the Bunny Walks and Admirals Park.

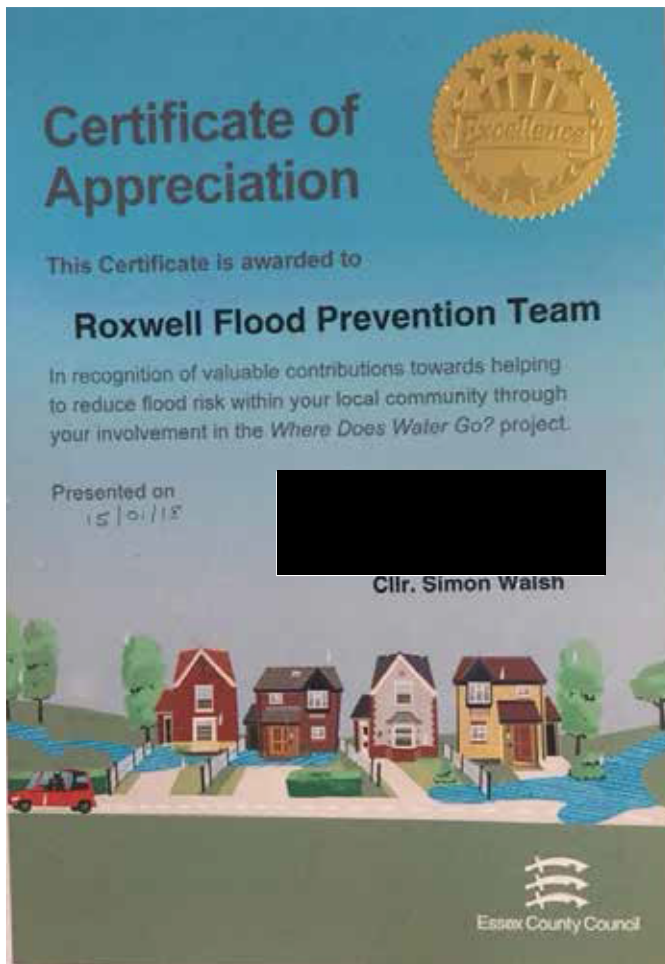
Please avoid areas of flood water and take extra care if walking your dog – we suggest keeping dogs on a lead in these locations.

#ChelmsfordEssex Public Health & Protection Services at Chelmsford City Council Love Your Chelmsford

When the floods come, people remember, and the people in and around Roxwell and flood risk areas take note of what is going on, including local council.



We have spent years plotting water, watching how the brooks work and understanding flood risks, even completing a ‘Where Does Water Go’ initiative. We have a large database of images and videos supporting evidence of major flood risks.



Teresa Coffey, local farmers, local council, the Environment Agency, Wildlife Trust and some of the Roxwell Flood Group after Teresa allocated funding to Roxwell.

Appendix C

Written Submission on Behalf of Pylons East Anglia

Note on the Applicant's Response to Pylons East Anglia's (PEA) Heritage Rebuttal [REP4-369]

Summary Position

The Applicant's reply (REP4-300/REP4-318 and associated cross-references) does not engage with the substance of Pylons East Anglia's (PEA's) rebuttals throughout the course of this DCO. Instead, it restates prior conclusions, repetitively re-asserts that the approach is "robust and proportionate," and points to other documents rather than answering the specific points raised. This pattern is repeated across every heading in the response: methodology, setting, cumulative harm, mitigation hierarchy and scoping, and it is most clearly exposed at Kenningham Hall (1373056), where the Applicant's own assessment is contradicted by the physical evidence that PEA has identified. The text emphasised in bold below summarises PEAs response to the latest document 8.4.13.1 provided by the Applicant.

In summary, the Applicant has failed to respond appropriately to the points presented by PEA, with the result that concerns raised have been left unaddressed rather than rebutted.

1. Repetition Rather Than Rebuttal

The Applicant's reply is structured almost entirely as a signposting exercise. Under each heading (Methodology, Assessment of Setting, Substantial Harm, Mitigation Hierarchy, Cumulative Effects, Scoping, Landscape and Scale, EN-1), the same formula recurs: a restatement that the methodology is "robust, proportionate" and "agreed with Historic England," followed by a list of paragraph references in other submissions. PEA's specific objections have always been and continue to be:

- that the matrix-based approach is inappropriate and obscures professional judgement,
- that the presence of screening (either by trees or other buildings' is wrongly equated with 'no harm',
and
- that "Low-Mid Less than Substantial" harm is being applied to changes that would in fact severely impact the setting of heritage assets as a result of infrastructure which would dominate the landscape.

The Applicant has not responded to these concerns adequately anywhere in the response.

Reasserting a conclusion is not the same as addressing why that conclusion was challenged.

2. Overuse of Cross-Reference in Place of Engagement

Across the extract, the Applicant cites at least a dozen separate documents (REP4-300, REP4-318, REP3-070, REP3-074, REP4-083, REP4-299, APP-209, APP-356, and the forthcoming Deadline 5 responses) rather than setting out the substantive reasoning in the document meant to respond directly to PEA's concerns. This has resulted in two outcomes: it makes the response very difficult to test against the specific rebuttal points made, and it allows the same unresolved assertions to be recycled from submission to submission without ever being tested against PEA's evidence.

A reply that mostly says “see elsewhere” is not a substantive answer to a methodological challenge; it is an index of where the same answer has previously been repeated.

3. Reliance on Historic England Agreement which has not been Confirmed.

The Applicant repeatedly relies on “agreement with Historic England” as the basis for confidence in the methodology. PEA's rebuttal specifically notes that the Statement of Common Ground with Historic England has not been finalised and that Historic England remains in dispute over multiple issues. The Applicant's response does not address this discrepancy; it continues to cite the draft Statement of Common Ground as though settled agreement exists.

This is a further instance of restating a conclusion rather than resolving the challenge to its basis.

4. Applicant's Methodology Tested Against the Evidence

As with all responses from PEA, it is impossible to cite every heritage asset that has been underassessed or wrongly identified due to a lack of resources. Nonetheless, PEA has produced countless examples of heritage assets which they believe have been wrongly or under assessed, and have been able to demonstrate that (despite the Applicants consistent statement to the fact that no listed buildings are located within the DOL) at least one listed building is located within the draft order limits (curtilage buildings associated with Kenningham Hall, NHLE 1373056).

PEA has identified, from the 1882 OS map, that buildings within the farmstead are curtilage-listed rather than non-designated, and that the Development Order Limits (DOL) for the project cut directly through that curtilage group, with the moated NDHA site to be directly lost. On this basis PEA has assessed a level of Substantial Harm; In contrast, the Applicant's assessment of Low Less than Substantial Harm. Despite the evidence introduced by PEA, the Applicant's reply does not engage with the curtilage-listing evidence at all. Kenningham Hall is simply included in a list of assets said to be “already addressed” in REP4-300, with no direct response to the identification of the grade II curtilage buildings or the physical loss of the NDHA. If curtilage-listed status is correct, the asset should have been assessed under the higher, designated-asset threshold from the outset, not screened through the non-designated route — which alone would justify revisiting the harm level.

Silence on a fact capable of overturning the Applicant's own harm rating illustrates that the wider claim of a “robust, case-by-case” assessment has not been tested against contrary evidence, only reasserted.

5. Same Pattern in Cumulative Harm and the Mitigation Hierarchy

On cumulative effects, the Applicant repeats that harms cannot simply be “counted or added together” a point PEA already conceded, without addressing PEA's actual argument, drawn from Historic England's GPA3, that cumulative harm can arise through shared setting, group value or intervisibility (e.g. Ardleigh, Rivenhall, the Waltham conservation areas). The response asserts that group value “has been assessed” but does not show how, for the specific groups PEA identified. On the mitigation hierarchy, the Applicant confirms harm was “identified prior to any balancing exercise,” which restates the policy test rather than answering PEA's point: that under-assessment at the identification stage (as at Kenningham Hall) means the subsequent balancing exercise is built on an unreliable base.

The Applicant has consistently failed to address PEA's key concerns about cumulative harm and under-assessment of harm, which has undermined the balancing exercise as required by section

104 of the Planning Act 2008, section 16 of the Planning (Listed Buildings and Conservation Areas) 1990, and paragraphs 4.1.3 – 4.1.7 of Policy EN-1 .

Conclusion

Taken as a whole, the Applicant's response fails to demonstrate that PEA's concerns have been rigorously examined and dismissed on their merits; rather, it shows they have simply been recorded and deferred to other parties. Where the record can be checked against physical evidence — as at Kenningham Hall (GII 13730560), or against the photomontages that have been produced, as at the Church of St Mary (GII) 1122253 (HE20), **The Examining Authority should treat the Applicant's repeated assurances of a “robust and proportionate” methodology with caution** based upon the flawed approach and errors that PEA has consistently raised throughout the entire DCO process.

Appendix D

Technical Standard - Ecology

Document no.: HS2-HS2-EV-STD-000-000017

Revision	Author	Checked by	Approved by	Date Approved	Issued for/Revision details
P15				12.04.19	

SECURITY CLASSIFICATION: OFFICIAL

Handling instructions: Sensitive

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1 Introduction

1.1 Scope and purpose

Background

- 1.1.1 This document is to inform detailed design and delivery of ecological works for HS2 and to provide a basis for the procurement of design and construction contracts.
- 1.1.2 Technical standards for ecology are required to define the requirements for both habitats and species. The specifications should be applied route-wide and are not site-specific except where a specification is applicable in only one location.
- 1.1.3 The over-arching aim of the Ecology Technical Standards (ETS) is to ensure a consistency of approach to design and construction across multiple contracts, realise cost efficiencies, and help to streamline the detailed consenting process for works associated with the Scheme by having stakeholder buy-in (i.e. acceptance of approach) to mitigation design (also incorporating compensation measures) from an early stage.
- 1.1.4 The Ecology Technical Standards document is a live document that is likely to be subject to further development following discussions with stakeholders and other consultees.

Purpose, intended use of standards and relevant additional documents

Background

- 1.1.5 This ecology technical standards document contains details of mitigation methods, where these are required to address impacts and effects that cannot be avoided.
- 1.1.6 The Ecological Principles of Mitigation (EPoM) (HS2 London to West Midlands Environmental Statement Volume 5 Technical Appendices, Scope and Methodology Report Addendum (CT-001-000/2)) and Code of Construction Practice (CoCP) (HS2 London to West Midlands Environmental Statement Volume 5 Technical Appendices, Code of Construction Practice (CT-003-000)) documents require Phase 1 designers at each design stage to seek to avoid or further reduce the impacts and effects before employing the measures described herein, and to demonstrate to HS2 Ltd that this has been an integral part of the design process.

Use of standards

- 1.1.7 The standards comprise a range of approaches to mitigation and a series of design specifications. They focus on setting minimum and maximum design parameters and target conditions, performances and/or functions for mitigation measures. Their scope does not extend to detailed design of these items and the standards allow for a level of control and flexibility to be handed to designers in further developing that detail.

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- 1.1.8 At the same time, some of the design requirements identified within each Chapter are mandatory. It is expected that detailed design will comply, in full, with those requirements. The following convention is used to indicate mandatory clauses:

Mandatory clauses are differentiated from the main text of this document by use of a 'black box'. They contain the word 'shall' to indicate their status as a requirement.

- 1.1.9 Any intention to not comply with a mandatory clause is considered to be a departure from this Technical Standard. Any departures are to be in accordance with the Departures Procedure (HS2-HS2-SA-PRO-000-000011). Innovative design is encouraged, and if any proposals are considered not to comply with this technical standard, then a departure application can be made provided robust justification is provided.
- 1.1.10 Each Chapter directs the reader to relevant industry best practice guidance/scientific study where this exists and is considered to be both current and fit for purpose. Chapter cross-references and reference to other relevant HS2 Technical Standards are also provided. All flow charts provided are for guidance purposes only.
- 1.1.11 The design specifications will enable site specific habitat and species mitigation to be designed through the inclusion of information such as dimensions, materials and necessary seasonal constraints and may be accompanied by, or cross-referenced to, a drawing that is intended to both specify and to illustrate the design. Where only an approach has been developed (and no additional specification is required), the information provided is an evolution of the EPoM, to include the latest and most relevant guidance and best practice on timings and seasonality of activities.
- 1.1.12 The achievement of multi-functional design solutions is a key objective of the standards. Where the primary driver for design is ecological, the designer should also consider means of addressing the possible secondary and/or tertiary aims (such as landscape integration, screening, productive forestry), as long as those aims do not compromise the primary ecological function. A number of related documents should be consulted in developing the multi-functional elements of the design, including the HS2 Information Paper E26: Indicative Periods for the Management and Monitoring of Habitats Created for HS2 Phase One and Information Paper E2: Ecology for Phase 2a (available online).
- 1.1.13 The designer is required to use this document in developing the design in advance of enabling and construction works. The designs shall be compliant with the approaches and specifications contained within this document. Any statements or guidance within this document which are not contained within a requirement will have no data deliverable attached.
- 1.1.14 The designer is to identify proposed deviations from the approaches and specifications, together with a clear rationale for such deviations and the identification of alternatives proposed to achieve the required mitigation performance. This would include where terms such as 'where possible' and 'ideally' have been used within this document, such that the designer is to demonstrate within the design that all reasonable effort has been made to achieve the mitigation aims and to provide reasons why it is not possible, along with alternatives to be

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implemented to achieve the aims. All deviations will require approval from HS2 Ltd before they can be incorporated in the design.

- 1.1.15 Designers are required to check for updates to external guidance and specifications cited within this document, to notify HS2 Ltd of such updates (including the nature of those updates), and to agree with HS2 Ltd whether and how to apply it to the Scheme's detailed design.
- 1.1.16 Designers will also need to take into account works in adjacent contract areas, such that detailed design objectives are consistent with those of adjoining areas in order to achieve continuity in the approach to design across the route. An example would be the installation of features to facilitate wildlife movement where these cross contract area boundaries.
- 1.1.17 Throughout this document, the terms 'dormant' and 'growing' are referred to in regards to plant growth periods. The general time frames that these periods are expected to cover is outlined below:
- Dormant season– October to February, inclusive; and
 - Growing season – March to September, inclusive.
- 1.1.18 It should be noted that external factors such as weather may influence these periods in any given year, and site-specific advice should always be sought from the suitably experienced ecologist.

Relevant additional documents

- 1.1.19 The following additional documents are relevant to the implementation of the required design specifications and monitoring/maintenance works carried out at each site in relation to the habitats and species covered within the Chapters of this Technical Standard.

Ecology Survey Data Capture

- 1.1.20 HS2 Ltd. currently have produced a set of ecology survey proformas to capture survey data digitally (HS2-HS2-EV-TEM-000-000005) in accordance with the HS2 Environmental Survey Specification document (HS2-HS2-EV-SPE-000-000002). It is expected that these will be superseded by a GIS schema.

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| 1.1.21 | All ecology surveys shall be undertaken using the ecology survey data capture approach as directed by HS2 Ltd. |
|--------|--|

Ecology Site Management Plans

- 1.1.22 The Environmental Memorandum establishes the requirement for an Ecology Site Management Plan (ESMP) to be developed for each habitat creation site. Drafts of these management plans will be discussed with relevant environmental bodies and Natural England.
- 1.1.23 A template for the production of Ecology Site Management Plans will be provided by HS2 Ltd (HS2-HS2-EV-TEM-000-000019).

- | | |
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| 1.1.24 | Each Ecology Site Management Plan shall be developed and produced with completion of all relevant sections of the ESMP template, for acceptance by HS2 Ltd, prior to commencement of habitat creation work. |
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Ecological Monitoring Strategy

- 1.1.25 A route-wide Ecological Monitoring Strategy (HS2-HS2-EV-STR-000-00029) will provide designers with the information to reliably inform changes in the condition of ecological mitigation areas created or managed by HS2 Ltd, as well as the populations of protected species they are supporting (and where relevant as per licence requirements).

- | | |
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| 1.1.26 | The Ecological Monitoring Strategy shall be used to inform each Ecology Site Management Plan and for relevant licencing requirements. |
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No net loss in biodiversity calculation

- 1.1.27 HS2 Ltd is seeking to achieve the goal of HS2 resulting in no net loss in biodiversity at a route-wide level.
- 1.1.28 Requirements for reporting against this goal shall follow the mechanisms set out in Chapter 23 of this standard: No Net Loss in Biodiversity.

1.2 Legislation and roles

- 1.2.1 All ecological mitigation activities endorsed by HS2 Ltd will be fully compliant with relevant domestic and international legislation. All practitioners (and contractors) involved in the design or implementation of mitigation measures should be fully conversant with the legislation relating to their field.
- 1.2.2 Throughout this document references are provided to 'suitably experienced ecologists' and 'Ecological Clerk of Works (ECoW)'. Whilst both of these roles are envisaged to be fulfilled by practicing ecological professionals, to be employed by or working for the Contractors, their roles and responsibilities differ. With regard to this Technical Standard, the definition of these roles is intended as follows:
- The 'suitably experienced ecologist' operates at a strategic design level rather than on-site. The individual is expected to have significant experience of making ecological decisions on variety of complex projects. They should also have a full working knowledge of wildlife legislation, policy and licensing procedures (where necessary), as well as detailed knowledge of relevant HS2 produced technical documents and appropriate ecological mitigation measures. Specialist knowledge of relevant species/habitats is expected where required.
 - The ECoW should work on-site alongside contractors, providing an inspection, monitoring and advisory role in line with the strategic / design level guidance provided by the 'suitably experienced ecologist'. They should be able to make clear ecological decisions on species and habitat issues, seeking best possible ecological outcomes, often on an *ad hoc* basis, drawing upon appropriate knowledge. Where required, they will need to hold the relevant protected

species survey licences.

1.3 Stakeholders and consultees

- 1.3.1 As the statutory advisor on nature conservation, Natural England has been consulted regularly throughout the development of the approaches and specifications set out in this document. Their input has been particularly valuable with respect to the approaches and specifications in obtaining the necessary licences and consents prior to construction and in ensuring that the latest developments in guidance, policy and legislation are accounted for.

1.4 Target Performance & Performance Requirements

- 1.4.1 Target Performance & Performance Requirements set out within this standard should be read in conjunction with the route-wide Ecological Monitoring Strategy (HS2-HS2-EV-STR-000-00029) and the HS2 Ecological Monitoring GIS Guidance (HS2-HS2-EV-GDE-000-000021), where relevant. These documents set out the details of the monitoring requirements for habitats and species, and define any data deliverables to be provided to HS2 Ltd.
- 1.4.2 Where certain ecological monitoring has been excluded from the EcMS scope (as set out in section 1.4.2 of the EcMS), the alternative documents referenced should be reviewed for monitoring requirements and data deliverables to be provided to HS2 Ltd.
- 1.4.3 Unless specified, it is assumed that no deliverable is required, although designers to ensure all requirements are met, and be in a position to demonstrate this if required.

2 Woodland creation and soil translocation

2.1 Approaches

2.1.1 The design of the Scheme includes provision for areas of woodland habitat creation through a combination of new planting and the salvage and translocation of soils from affected ancient woodlands. The following approaches are required:

- Salvage of ancient woodland soils (and associated seed bank), vegetation and dead wood in response to losses of ancient woodland habitat;
- Creation of woodland to compensate for loss of woodland habitat; and
- Creation of woodland to address impacts on specific species (for example bats), to provide and improve habitat connectivity, and to better integrate the Scheme into the surrounding landscape.

2.2 Design specifications - general

2.2.1 Woodland creation through planting - primarily for the purpose of nature conservation: the planting design and species selection shall be informed by the ecological and physical characteristics of the woodland that is being lost. The design shall identify 10, 25 and 50 year targets for the following:

- Species composition % (canopy/understorey/ground flora);
- Canopy cover/glades % (including need for sowing/seeding);
- Height (m) (canopy/understorey);
- Age structure (at 50 years only); and
- Woodland edge structure (including rides and glades).

2.2.2 Translocation of ancient woodland soils and vegetation: As a starting assumption the soils are to be translocated from each of the areas of ancient woodland, where loss will occur, to provisional locations identified in HS2's Ancient Woodland Strategy document (PH1-HS2-EV-STR-000-000003).

2.2.3 The Phase 1 contractor(s) should ensure works affecting ancient woodland sites are guided by the Ancient Woodland Strategy (PH1-HS2-EV-STR-000-000003).

2.2.4 The Phase 2a contractor(s) should ensure works affecting ancient woodland sites are guided by the Ancient Woodland Strategy (PH2-HS2-EV-STR-A000-000001).

2.2.5 In accordance with the EMRs, during detailed design and construction, the contractors should use reasonable endeavours to avoid or further reduce impacts on Ancient Woodland. As detailed design is undertaken, further information shall be gathered relating to both the areas of ancient woodland that should be affected, and the proposed receptor sites. Details on the further information requirement can be found in the Habitat Translocation Phase 1 Gap analysis Master Spreadsheet (1Doo8-EDP-EV-SUR-00-000001) and associated report (1Doo8-EDP-EV-REP-000-000007).

2.2.6 Design specification for translocation of ancient woodland soils and vegetation shall accord with best practice guidance, results of baseline and soil surveys.

2.2.7 Current best practice includes but is not limited to the following; CIRIA C6001 and recognised best practice based on experience at Cossington Fields (A2/M2)2.

2.2.8 Figure 2.1 sets out the decision-making process for re-use of ancient woodland soils.

2.3 Information required for detailed design

2.3.1 This section identifies the details that will be required to inform the development of the detailed design, including the decision on whether to translocate soils.

2.3.2 A National Vegetation Classification (NVC) survey and mapping of the woodland to be lost shall be undertaken, to sub-community level, according to published methods³.

2.3.3 All mapping should be in accordance with the Geographic Information System Standards (HS2-HS2-GI-STD-000-000002).

2.3.4 Geospatial data on woodland creation and receptor sites shall be recorded by the designer and passed to HS2 Ltd in accordance with the Geographic Information System Standards (HS2-HS2-GI-STD-000-000002).

Information to inform new woodland creation

2.3.5 The following information shall be required to inform new woodland creation:

- Species composition and soil and physical characteristics of the woodland to be lost, to comprise soil texture, total depth, horizon thickness, rooting depth, structure, available nutrient levels (N, P, K, Mg) and other variables that may subsequently be identified by HS2 Ltd as necessary;
- The characteristics of the soil to be planted into (as above) and the Natural England Character Area to inform the planting plan;
- Habitat creation site characteristics (drainage, soils, slope, aspect and microtopography) and their appropriateness for the desired habitat;
- Availability of dead wood habitat, coppice stools, saplings suitable for salvage from the habitat being impacted for re-use at the woodland creation site;
- Restrictions to undertaking the works (including access restrictions, presence of utilities or services, presence of protected or invasive species);
- Landscape design requirements;

¹ Penny Anderson, 2003, CIRIA C600, Habitat translocation – a best practice guide. CIRIA. London.

² Cresswell/Hyder 2012 A2/M2 Cobham to Junction 4 Widening Scheme: Ten-year Ecological Monitoring Strategy 2000-2009. Final Monitoring Report

³ Rodwell, J. S. (ed.) (1991) British Plant Communities. Volume 1. . Woodlands and Scrub Cambridge University Press

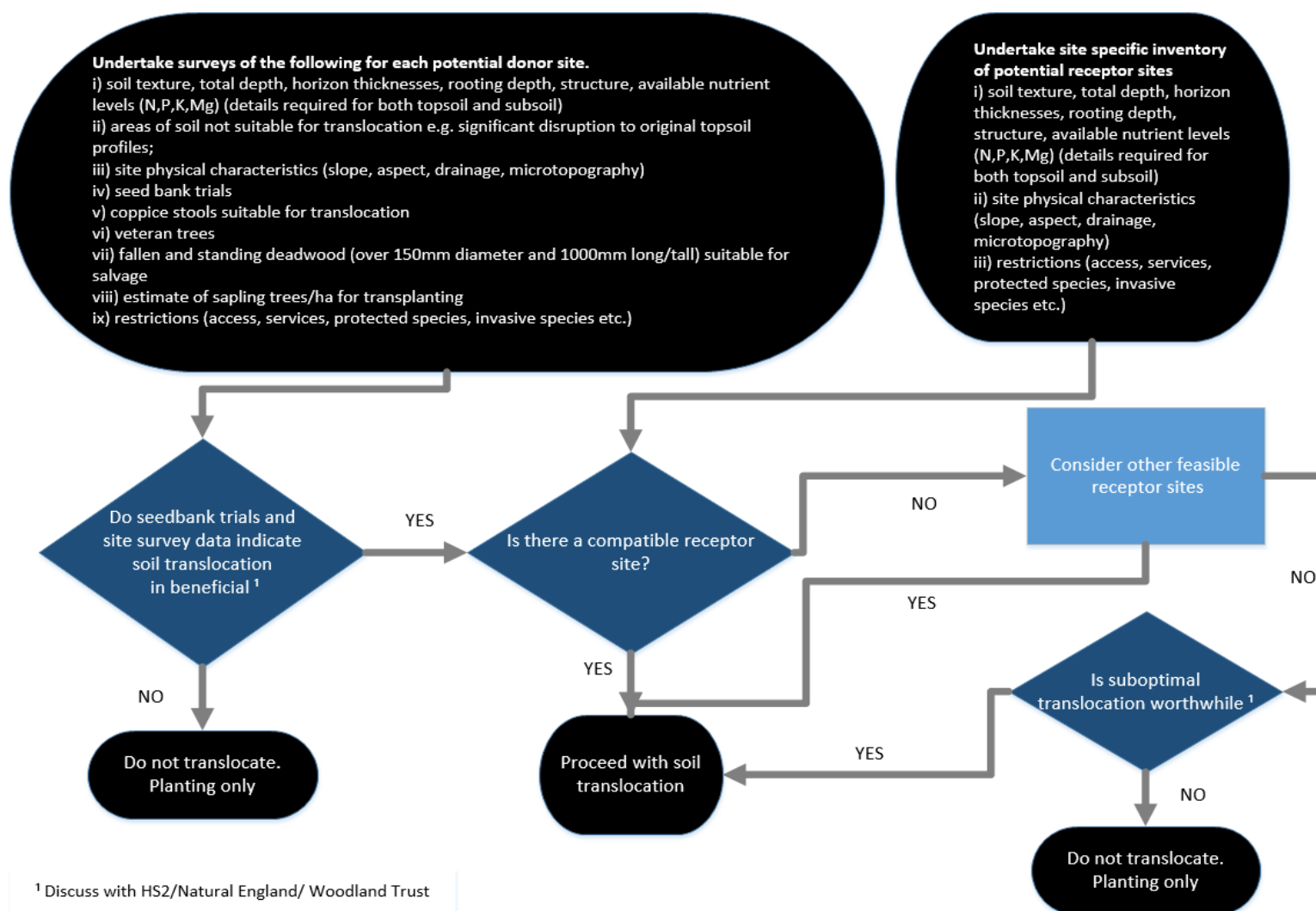
- Post-planting management; and
- The presence of protected species and associated constraints.

Information to inform soil translocation

2.3.6 The following information shall be required to inform soil translocation:

- Donor and receptor site characteristics, (physical and chemical characteristics as identified above), to ensure comparability.
- Data collected on number of coppice stools, veteran trees and standing and fallen dead wood present and suitable for transfer.
- Assessment of the potential for natural regeneration through seed bank trials using an approved method.
- Presence and abundance of species of woodland plant with bulbs and rhizomes to inform soil depths to be moved;
- Restrictions to undertaking the works;
- Presence of protected species and associated constraints;
- Uses for surplus topsoil (generated from receptor sites); and
- Post-translocation management or post-construction monitoring requirements.

Figure 2.1 W1 Decision Matrix: compensation for ancient woodland loss and soil translocation



2.4 Design specification - woodland planting

- 2.4.1 The habitat types to be created from the list in Section 41 of the NERC Act will be specified. They will normally also specify the particular target plant communities that are required.
- 2.4.2 Each woodland area should include for 10% to 20% open areas (at maturity) not planted with trees (as rides and glades). Where appropriate the creation of open-grown veteran tree candidates around the peripheries of newly created woodlands should also be considered. Design may vary from this where particular mitigation objectives (landscape, visual or ecological) at each location require variance.
- 2.4.3 The detailed planting plan for each site requiring woodland planting shall be determined by reference to the presence and abundance of key species in the woodlands being lost and/or the soil types being planted into and/or the relevant Natural England Character Area.

Site preparation

- 2.4.4 Any necessary cultivation/vegetation management and/or clearance to be undertaken prior to woodland planting shall be determined on a site by site basis and shall be informed by a soil survey and assessment of the ground vegetation and agreed with the Ecological Clerk of Works (ECow) and soil scientist.

Planting

- 2.4.5 Woodland planting shall occur in the dormant season.

Establishment phase management

- 2.4.6 The requirements for management of new planted woodlands for the establishment period to 50 years are detailed in the Technical Standard – Landscape Maintenance, Management and Monitoring Plan (HS2-HS2-EV-STD-000-000023).

Target performance

- 2.4.7 The overall target for woodland planting is the establishment of planted woodland that shall conform with the Lowland Mixed Deciduous Woodland or Lowland Beech and Yew Woodland priority habitat types listed on Section 41 of the NERC Act 2006.
- 2.4.8 Detailed targets shall be determined by the species composition used, the nature of woodlands lost, the soil type into which new woodland is to be planted and the Natural England Character Area. Interim targets shall also be defined, based around the timing of management operations.

Performance requirements

- 2.4.9 Performance requirements for woodland planting shall include:

- Development of open areas and edge habitat as appropriate to woodland size and mitigation objectives; and
- Development in the longer term of a varied age structure of trees and species composition and that preserve any existing transitions with other surrounding semi-natural habitats.

2.5 Design specification – translocation of soils and vegetation

2.5.1 Translocation should be undertaken in late autumn/early winter avoiding frost/snow and heavy rain. Suitable weather conditions are described below.

2.5.2 Low ground pressure vehicles should be used for these works.

Receptor site preparation

2.5.3 Vegetation shall be cleared and arisings removed from the woodland soil and vegetation receptor site, accounting for restrictions associated with other ecological objectives and mitigation (including nesting birds and other protected species).

2.5.4 The topsoil shall be stripped and removed (to the depth defined by soil surveys), using a non-toothed bucket.

2.5.5 Sequential stripping should be undertaken as material from the donor site becomes available, to limit the extent of bare ground present (and thus limit the risk of erosion and silt-laden runoff).

2.5.6 The topographical and micro-topographical features of the woodland soil and vegetation donor site (including the slopes, depressions and raised areas), shall be recreated in the exposed subsoil surface prior to placement of translocated soils and shall be overseen by the ECoW.

2.5.7 Haul and access routes shall not run on topsoil, but may run on exposed subsoil.

2.5.8 Prior to spreading the translocated soils, the subsoil shall be ripped to a depth of 450mm with tines set at 600mm centres (subject to site objectives). The surface shall then be cultivated to a depth of 150mm in strips immediately prior to the spreading of translocated topsoil. No vehicles shall traffic over the prepared surface.

Donor site preparation and soil/vegetation translocation

2.5.9 Vegetation clearance should be undertaken within one month prior to soil translocation.

2.5.10 Areas where the woodland soils are not suitable for translocation shall be identified and agreed with a suitably qualified and experienced soil scientist, with clear reasons detailed. These areas shall be clearly demarcated by the contractor, although HS2 Ltd. does not require data on these areas.

2.5.11 For any plantation ancient woodland sites (PAWS) planted with conifers that are subject to soil translocation, needle litter should be removed prior to topsoil stripping.

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2.5.12	Prior to vegetation clearance, coppice stools, saplings and dead wood (where present) for translocation shall be identified and clearly marked.
2.5.13	Dead wood (standing or fallen and over 150mm diameter and 1000mm long/tall), shall be removed and placed within the receptor area under direction / agreement of the ECoW.
2.5.14	Where felled trees are to be used to provide new dead wood habitat, mature trees can be used to provide standing dead wood by removing all branches and “planting” the main trunk at the receptor site to a depth so that the tree is stable once installed.
2.5.15	Any veteran tree hulks that are to be moved as standing dead wood, or are to be placed in the receptor area as fallen dead wood.
2.5.16	Any saplings that are identified for translocation shall be excavated by hand tools prior to woodland soil translocation.
2.5.17	Unless otherwise directed by the ECoW, they should be taken directly to the receptor site and re-planted into reinstated soils. If they need to be held for any period of time, this should be in a nursery environment. Proposals for nursery arrangements should be included within the detailed design for approval by HS2 Ltd.
2.5.18	Prior to all woodland soil handling operations, a soil scientist approval shall be required to ensure the soils are in an appropriate condition to be handled without risk of damage. Whilst there is no data deliverable to HS2 Ltd., the contractor shall record data and decision-making which would need to be made available as necessary.
2.5.19	Soil-handling operations shall be carried out in accordance with Technical Standard – Soil Handling for Land Restoration (HS2-HS2-EV-STD-000-000008).
2.5.20	Topsoil (to a depth defined through soil surveys but can be between 100mm and 300mm) shall be stripped using a non-toothed excavator bucket to avoid mixing of topsoil and subsoil. The soil survey undertaken shall inform whether the topsoil shall be stripped as a single layer or as two layers. This topsoil shall be taken directly to the receptor site. There shall be no storage of topsoil beyond the day of stripping (i.e. stripping, transport and restoration operations shall occur within one day).
2.5.21	Haul and access routes shall not run on topsoil, but may run on exposed subsoil.
2.5.22	Haul routes shall be mulched and maintained in a serviceable condition for the traffic movements required.
2.5.23	All machines shall work from the haul route or exposed subsoil. There shall be no tracking over topsoil.
2.5.24	Where there is also a requirement for subsoil to be translocated, this shall be stripped and transported separately from the topsoil.
2.5.25	Where coppice stools are to be translocated, they shall be lifted with as large a root ball as possible; using an appropriate bucket excavator or tree spade capable of a root ball up to three metres diameter.

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- 2.5.26 Stools should be lifted sequentially, moved to the receptor site and re-planted the same day. If this is not possible coppice stools can be stored during the dormant season for up to 3 days (as long as appropriately protected from drying).

- 2.5.27 Once all salvageable material has been removed, the woodland soil and vegetation donor site shall be inspected and a completion certificate signed by the ECoW before the commencement of any other construction works.

Receptor site - reinstatement of soils and vegetation and planting

- 2.5.28 The following shall be completed prior to reinstatement of topsoil at the woodland soil and vegetation receptor site:

- Placement of subsoil (where relevant); and
- 'Planting' of coppice stools (backfilled with subsoil) and hulks for dead wood.

- 2.5.29 The woodland soil and vegetation donor site topsoil shall be loose tipped onto the prepared surface and shall be spread using a non-toothed bucket. The topsoil shall be spread to a depth as defined by the soil survey, with any additional depth included to allow for settlement of the soil (based on volume calculations).

- 2.5.30 Planting shall be undertaken in the next available planting period following translocation. An exception to this is where seed bank trials show greater than 75% weed flora present, in which case weed treatment shall be required and trees planted following treatment.

Establishment phase management

- 2.5.31 For areas receiving ancient woodland soils, management shall be undertaken in accordance within the ancient woodland section of the Technical Standard – Landscape Maintenance, Management and Monitoring Plan, unless there is a requirement for specific management practice in connection with the presence of a protected species.

Target performance

- 2.5.32 Targets should be identified based upon the donor community and in accordance with the target performance identified for woodland planting.

Performance requirements

- 2.5.33 Soil translocation should be undertaken by specialist contractor.

3 Grassland habitat creation, enhancement and translocation

3.1 Approaches

- 3.1.1 Potential mitigation proposals are identified for the provision of translocation, re-creation or enhancement of vegetation types that accord with the grassland habitat types identified as being priority for conservation in England within Section 41 of the NERC Act 2006; these include Lowland meadow, Lowland dry acid grassland, Lowland calcareous grassland, coastal and floodplain grazing marsh and purple moor grass and rush pastures. Upland hay meadows and Calaminarian grassland are not included here as are unlikely to be impacted upon.

3.2 Selection of design specifications

- 3.2.1 Figure 3.1 (G1: Selection of design specification for grassland creation and translocation for unimproved grasslands) should be used to identify the appropriate specification where unimproved grassland is to be lost. Figure 3.2 (G2: Grassland creation and enhancement decision matrix) should be used to identify the appropriate method where turf translocation and/or soil translocation are not appropriate.
- 3.2.2 Depending on the quality and scale of existing grasslands and the new grasslands to be established, a combination of more than one specification may be required for a single parcel of land.

3.3 Design specifications - general

3.3.1 Design specification for grassland translocation shall:

- be in accordance with CIRIA C600 (Habitat translocation, a best practice guide)⁴;
- be based upon baseline surveys; and
- be informed by a detailed soil survey.

- 3.3.2 If identified as appropriate, nursery grown plug plants should be used to enhance the grassland creation.

3.3.3 Geospatial data on grassland creation and receptor sites shall be recorded by the designer and passed to HS2 Ltd in accordance with the Geographic Information System Standards (HS2-HS2-GI-STD-000-000002) Information required for detailed design

⁴ Anderson, P. 2003, Habitat Translocation – a best practice guide. CIRIA C600, London

3.3.4 A National Vegetation Classification (NVC) survey⁵ and mapping of donor vegetation shall be undertaken, to sub-community level, according to recognised best practice.

3.3.5 All mapping should be in accordance with the Geographic Information System Standards (HS2-HS2-GI-STD-000-000002).

Information to inform new grassland creation

3.3.6 Soil-handling operations shall be carried out in accordance with what is outlined in Technical Standard – Soil Handling for Land Restoration.

3.3.7 The following information shall be required for grassland receptor and donor sites:

- Physical characteristics to comprise soil type, texture, total depth, horizon thickness, structure, pH, available nutrient levels (N, P, K, Mg) and other variables that may subsequently be identified by HS2 Ltd as necessary;
- A suitably experienced ecologist shall review the soil analysis prior to works and advise on any soil remedial measures required;
- Habitat creation site characteristics (drainage, soils, slope, aspect and microtopography) and their appropriateness for the desired habitat;
- The Natural England Character Area to inform the planting plan;
- Restrictions to undertaking the works (including access restrictions, presence of utilities or services, presence of protected or invasive species);
- Landscape design requirements;
- Post-creation management; and
- The presence of protected species and associated constraints.

Information to inform translocation

3.3.8 The following information shall be required for grassland creation:

- Donor and receptor site characteristics, to ensure comparability: to comprise soil type, texture, total depth, horizon thickness, rooting depth, structure, pH, available nutrient levels (N, P, K, Mg) and other variables that may subsequently be identified by HS2 Ltd as necessary. If the donor and proposed receptor site soils are not comparable (to be determined by an appropriately experienced ecologist) then remedial measures shall be identified (where appropriate), or an alternative receptor site identified;
- Restrictions to undertaking the works; and

⁵ Rodwell, J.S. 2006, National Vegetation Classification User's Handbook. Joint Nature Conservation Committee, Peterborough

- Presence of protected species and associated constraints.

- 3.3.9 Turf translocation is likely to have the highest success rate in maintaining the main features of interest in the grassland. Considerations as to whether turf translocation is likely to be practical and successful are provided in Figure 3.1. Turves are not to be stored.
- 3.3.10 Where monitoring confirms that germination from turf translocation is patchy remedial actions should be decided by a suitably experienced ecologist.

3.3.11 The requirement to introduce certain plants by small scale grassland turf transfer shall be identified for each site.

3.3.12 Seeding shall be used to provide species-rich habitats where 1) it is not feasible to use turf or soil transfer, 2) much larger areas are being created than lost, 3) there are established species poor grasslands that can be enhanced.

3.3.13 Seed can be sourced from suitable donor sites using 1) green hay 2) seed collected by brush harvesting a hay meadow, or 3) seed can be purchased. This should be specified and based on the availability of local donor sites, the timing of the works and availability of seed (see Figure 3.2).

3.3.14 During the establishment period enhancement of existing grasslands may be identified as required. This should be used to promote an improvement in vegetation structure and/or increase in plant species diversity. It is appropriate only where the target species are (i) already present but suppressed by current management; (ii) present within a residual seed bank or, (iii) able to readily re-colonise from adjacent sites.

3.3.15 Natural colonisation for grasslands shall only be used in the following circumstances:

- Steep slopes on thin soils, such as cuttings and some rocky embankments; and

- Adjacent to an unimproved or semi-improved grassland habitat to provide a source of plant propagules.

3.3.16 In some cases the need for a nurse crop to achieve a rapid 'greening' of the site (for landscape or stability reasons) may be identified. Alternatively, oversowing at a low rate to allow 'greening' and natural colonisation to occur in combination may be appropriate.

Figure 3.1 G1: Selection of design specification for grassland creation and translocation for unimproved grassland

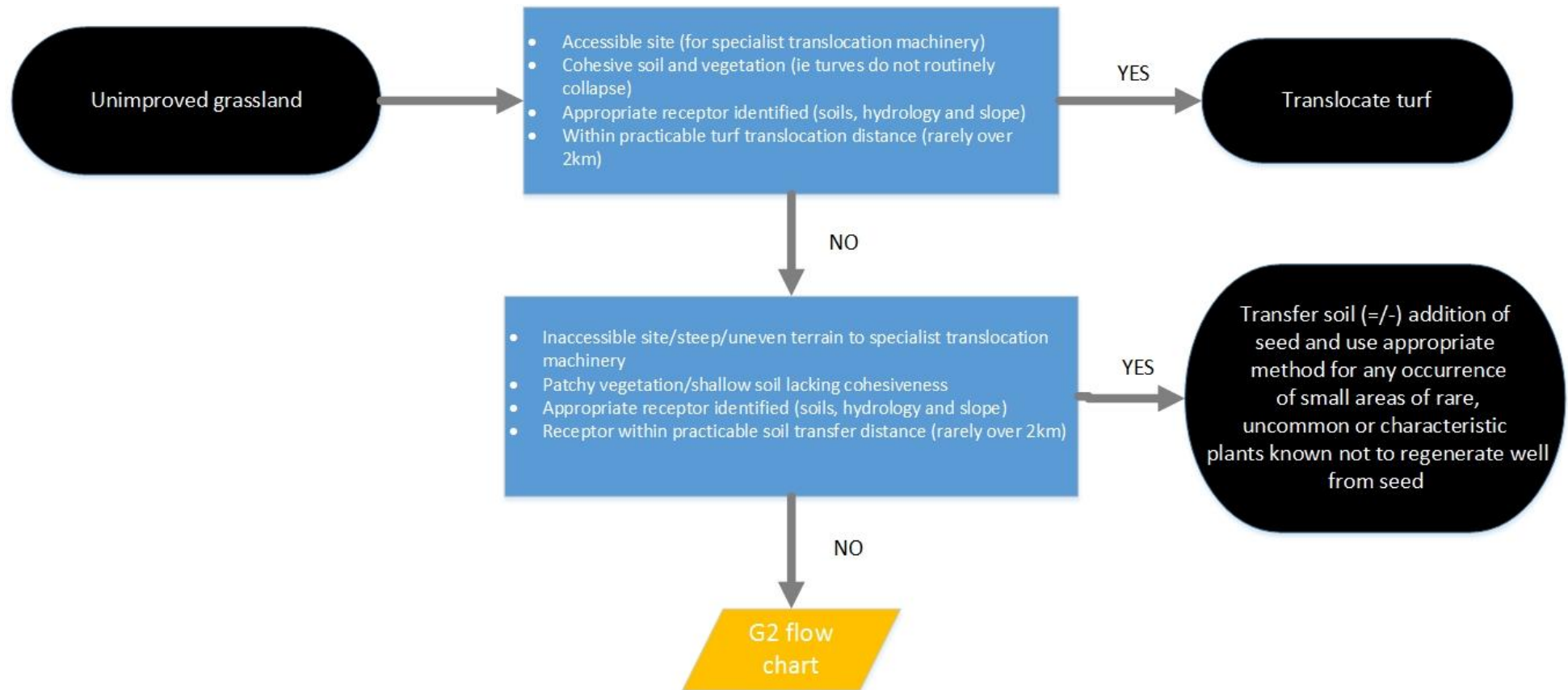
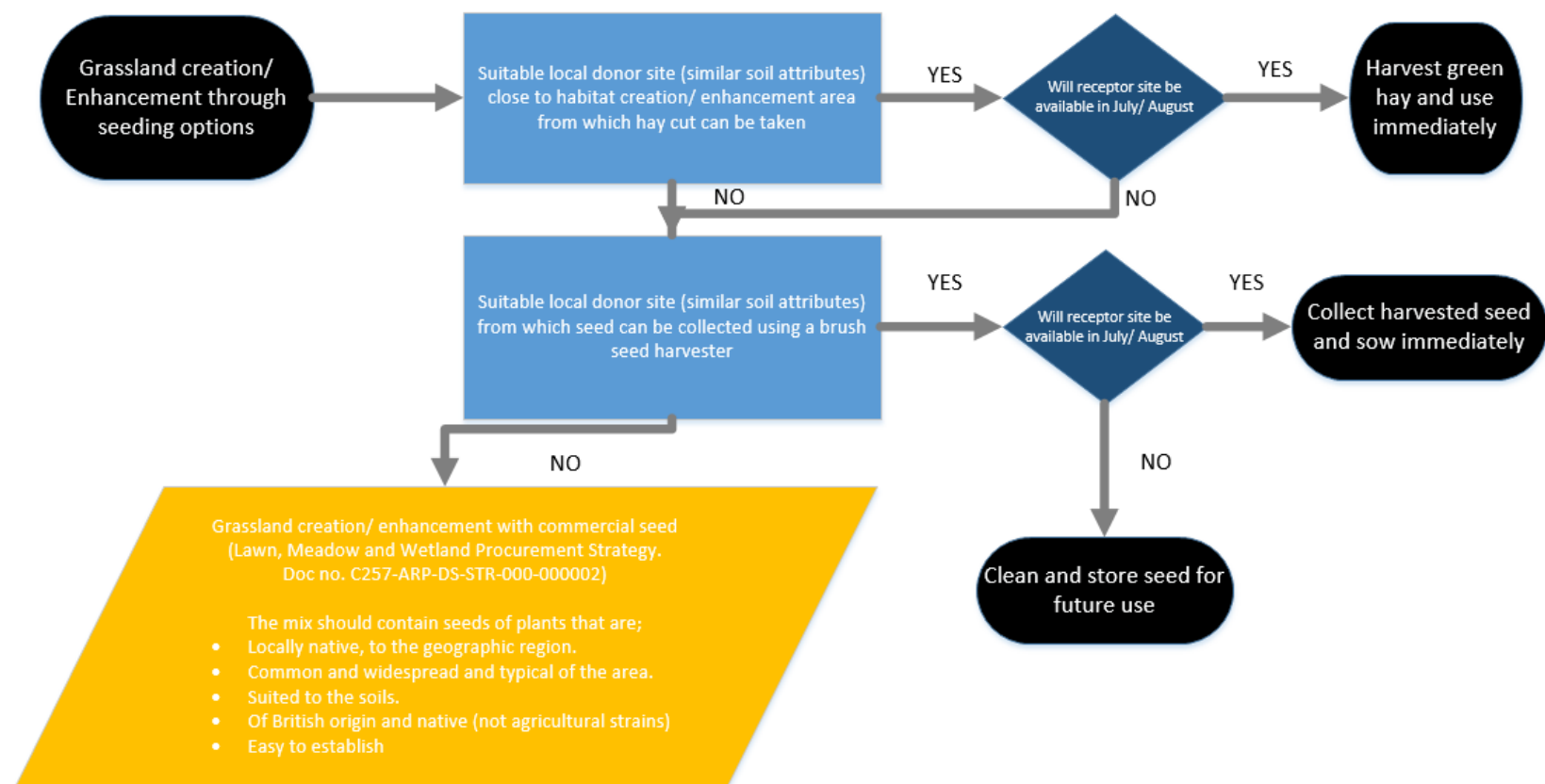


Figure 3.2 G2: Grassland creation and enhancement decision matrix



If certain plant species are required within the sward and have poor germination from seed, plug plants may be required. This would be decided in conjunction with reference to Chapter 19; terrestrial invertebrates, and the requirement for specific food plants.

3.3.17	The grassland shall be cut or grazed short to between 100mm – 150mm immediately prior to translocation.
3.3.18	Translocation of turf shall occur in the dormant season (unless otherwise agreed by the suitably experienced ecologist), subject to ground conditions.
3.3.19	Turf shall be cut with a vertical blade to create a clean cut edge to the turf. This may be a smooth blade, guillotine or other equipment approved for use by ECoW.
3.3.20	Turf to be as large as reasonably practicable (2m x 1m or more) unless otherwise agreed with the ECoW. Turf depth shall be agreed with a suitably experienced ecologist (likely to be 200-400mm).
3.3.21	The turf shall be cut and lifted in one operation.

- 3.3.22 If the receptor site is within approximately 100m of the donor site, the turf may be moved there by the machine that cuts it. If over a greater distance, a flat-bed trailer with central bar may be used.

Receptor site

Preparation

- 3.3.23 If subsoil needs to be removed from the grassland receptor site, based on soil properties determined from soil surveys, this should be identified.
- 3.3.24 If subsoil removal is not required and there are no works required to change slope, hydrology and other physical characteristics, then the topsoil should be removed progressively in workable widths with an excavator and dump truck. The dump trucks/turf trailers should run on topsoil only.
- 3.3.25 Where subsoil removal is required, dump trucks and turf trailers should run on basal layer.
- 3.3.26 Where there is no subsoil removal but ground level re-modelling is required to replicate slope and hydrology, de-compaction of the subsoil by the excavator should be required as progress is made across the receptor area.

3.3.27	Works shall not be undertaken when ground conditions are water logged, frozen or snow covered (to be agreed with the ECoW).
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Laying of Turves

3.3.28	The turves shall abut as closely together as possible without gaps and with an even surface. Any gaps between turves shall be filled with subsoil.
3.3.29	Turves shall be re-laid in the same order as taken from the donor site to preserve the community patterns present in the donor site at the new receptor site (unless otherwise agreed with the ECoW).

Establishment phase management

- 3.3.30 Grazing management should be implemented on the site as soon as is reasonably practicable or alternatives explored i.e. if grazing not possible the grassland should be cut and arisings collected after the first growing season following translocation.
- 3.3.31 The need for additional grazing/cutting to remove initial vigorous growth should be determined by a suitably experienced ecologist.

Target performance

- 3.3.32 The overall target for grassland translocation is the establishment of grassland that shall conform with the targeted priority habitat type listed on Section 41 of the NERC Act 2006.
- 3.3.33 Detailed targets shall be determined by the species composition used, the nature of grassland lost, the soil type into which new grassland is to be planted and the Natural England Character Area. Interim targets shall also be defined, based around the timing of management operations.

Performance requirements

- 3.3.34 Performance requirements for grasslands shall include:

- Re-creation of donor site ground features at receptor site;
- Works to be undertaken in the dormant season (unless otherwise agreed with the suitably experienced ecologist);
- Maximum distance between turves on receptor site to be no more than 50mm;
- No tracking or driving over the re-laid turf; and
- There shall be less than 5% cover in total of invasive plants or other weedy species (to be defined on a site by site basis).

3.4 Design specification – grassland soil transfer (littering)

Donor site

- 3.4.1 The grassland shall be cut or grazed short (100mm – 150mm) immediately prior to translocation.
- 3.4.2 The surface should be rotavated/power harrowed to a depth specified by a suitably experienced ecologist.
- 3.4.3 Grassland soil translocation shall occur in the vegetation dormant season (unless otherwise agreed by the suitably experienced ecologist), subject to ground conditions.
- 3.4.4 Soil transfer should be excavated, transferred and spread on the same day. Where subsoil is also to be translocated the top soil should be temporarily set aside to enable the subsoil to be translocated first.

3.4.5	Unless otherwise instructed and agreed with the ECoW, the grassland soil shall be transported to, and spread on, the receptor site without storage.
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Receptor site

Preparation

3.4.6	If subsoil removal from the grassland receptor site is not required and there are no works required to change slope, hydrology or other physical features, then the topsoil shall be removed progressively in workable widths with an excavator and dump truck. The dump trucks/turf trailers shall run on topsoil only.
3.4.7	Where subsoil removal is required, dump trucks and turf trailers to run on basal layer; subsoil to be laid in strips on which turves are then placed.
3.4.8	Where there is no subsoil removal but ground level re-modelling is required to replicate slope and hydrology, de-compaction of the subsoil by the excavator shall be required as progress is made across the receptor area.
3.4.9	Works shall not be undertaken when ground conditions are water logged, frozen or snow covered (ground conditions to be agreed with the ECoW).

Laying of soil/litter

3.4.10	The topsoil shall be re-laid at a depth and in a pattern to replicate that at the donor site as closely as possible.
3.4.11	If the vegetation was not rotavated then effort shall be made to turn any turf sections the correct way up.
3.4.12	The re-laid soil shall be rolled provided the ground conditions are considered suitable by the ECoW, to create a suitable seedbed for the seed bank to germinate.
3.4.13	No truck or excavator shall track or drive over the re-laid topsoil.

Establishment phase management

3.4.14	Establishing grassland by soil transfer shall be treated as a newly sown grassland habitat.
3.4.15	Management shall be required to prevent weeds or early grasses from suppressing the flowers.
3.4.16	An appropriate cutting regime should be implemented in accordance with the recommendations of the suitably experienced ecologist.
3.4.17	If cutting is not possible due to slope or other hazards a requirement for grazing to maintain the open sward and restrict the vigour of the grasses in the establishment period may be identified.

Target performance

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| 3.4.18 | The overall target for grassland soil translocation (littering) is the establishment of grassland that shall conform with the targeted priority habitat type listed on Section 41 of the NERC Act 2006. |
| 3.4.19 | Detailed targets shall be determined by the nature of grassland lost, the soil type into which new grassland is to be planted and the Natural England Character Area. Interim targets shall also be defined, based around the timing of management operations. |

Performance requirements

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| 3.4.20 | Performance requirements for grassland soil transfer (littering) shall include: |
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| <ul style="list-style-type: none">• Re-creation of donor site ground features at receptor site.• Works to be undertaken in the dormant season.• There shall be less than 5% cover in total of invasive plants or other weedy species (to be defined on a site basis). |
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3.5 Design specification – grassland: translocation of individual plants

Donor site

- 3.5.1 To aid translocation the individual grassland plants to be translocated should be accurately marked when they are in flower and easy to find.

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| 3.5.2 | Translocation shall occur when the vegetation is dormant (unless otherwise agreed by the suitably experienced ecologist). |
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| 3.5.3 | Turf shall be cut with a vertical blade to create a clean cut edge. |
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- 3.5.4 Turf transportation should be designed to reduce multiple handling of the turf and avoid breaking the turf.

- 3.5.5 Individual plants may be dug-up and temporarily stored, as advised by the ECoW, in a holding area for later transplanting into an appropriate site.

Receptor site

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| 3.5.6 | The suitability of the receptor site for the target community of grassland plants shall be established. Whilst there is no data deliverable to HS2 Ltd., the contractor shall record data and decision-making which would need to be made available as necessary. |
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- 3.5.7 The plants should either be replaced randomly in the existing vegetation or clustered in one area of the receptor site as specified.

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| 3.5.8 | The translocated individual grassland plants shall be placed flush with the existing ground surface. |
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Establishment phase management

- 3.5.9 Control undesirable species by hand (pulling, digging or cutting) or with herbicides depending on the species and the level of the problem.

Target performance

- 3.5.10 The overall target for grassland translocation (of individual plants) is the establishment of grassland (and populations of named species) that shall conform with the targeted priority habitat type listed on Section 41 of the NERC Act 2006.
- 3.5.11 Detailed targets shall be determined by the nature of grassland lost, the nature of grassland lost, the soil type into which new grassland is to be planted and the Natural England Character Area. Interim targets shall also be defined, based around the timing of management operations.

Performance requirements

- 3.5.12 Failure of any translocated grassland plants shall be assessed on a site specific basis and remedial measures advised upon by the suitably experienced ecologist.

3.6 Design specification – grassland habitat creation from seed

Site preparation

- 3.6.1 The need for engineering of site physical conditions shall be considered and implemented to ensure correct conditions for the target grassland community type created from seed.
- 3.6.2 Soil nutrient level management may be appropriate to achieve the target condition.
- 3.6.3 The seed bed shall be prepared immediately prior to sowing the grassland.

Sowing seed

- 3.6.4 Use Figure 3.2 in Section 3.2 to guide when to use the various seed sources.

Using local seed source

- 3.6.5 Where a suitable donor site is identified the collection of local seed should follow the guidance provided below:

Green hay

- Cut the donor meadow mid-July - early August unless otherwise advised by the suitably experienced ecologist (for example, if early flowering species are known to be present). Do not use a mower conditioner as this encourages seed to drop.
- Bale hay, transport to receptor site or alternatively collect as chopped forage.
- Bales must be unrolled and spread as soon as reasonably practicable.
- Spread hay with a tractor mounted fork or bucket or load each bale into a

straw chopper or similar, chop and spread using agricultural machines.

- Each ha of cut material to be spread evenly across 2-3 ha of prepared site, to be determined by the ECoW.
- Roll spread material if necessary.
- All operations must be completed in one day.
- Remove hay after 2-3 weeks if hindering seed germination. The ECoW to advise if this is necessary.
- The addition of green hay may have to be repeated the following year based on monitoring of establishment success.

Sowing collected seed

- Harvest seed from donor meadow using a brush/vacuum collector; at the appropriate times to obtain a sufficient range of species.
- Sow the seed immediately after collection but if any delay that might affect seed viability, seed must be cleaned, dried and stored in suitable conditions to maximise viability.
- Broadcast fresh unprocessed brush-harvested seed by hand where practicable.
- Where seed has been cleaned, dried and stored, sow using fertiliser spinner.
- Seeding rates will vary depending on the site and will be advised in advance by a suitably experienced ecologist on a site by site basis.
- Roll site after spreading seed using a ribbed 'crinkle' or Cambridge roller.
- The above seed harvesting and sowing may have to be repeated the following year based on monitoring of establishment success.

Commercial seed

3.6.6	The design and sowing of all grassland seed mixes shall follow recognised best practice guidance documents.
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Establishment phase management – all sown grasslands

- 3.6.7 Depending on the soil fertility the site may require cutting and removal of the cuttings up to four times in the first year to be determined by a suitably experienced ecologist.
- 3.6.8 In subsequent years cutting once a year in early/mid-July (similar to traditional hay cutting date in the lowlands) should be sufficient followed by late summer/autumn grazing or if not possible a second cut in spring with cuttings removed (before the bird breeding season) to reduce the grasses vigour.
- 3.6.9 If cutting is not possible due to slope or other hazards a requirement for grazing to maintain the open sward and restrict the vigour of the grasses in the establishment period may be required. Grazing periods/densities should be informed by a suitably experienced ecologist.

Target performance – all sown grasslands

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| 3.6.10 | The overall target for sown grasslands is the establishment of grassland that shall conform with the targeted priority habitat type listed on Section 41 of the NERC Act 2006. |
| 3.6.11 | Detailed targets shall be determined by the nature of grassland lost, the soil type into which new grassland is to be planted and the Natural England Character Area. Interim targets shall also be defined, based around the timing of management operations. |

Performance requirements

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| 3.6.12 | Performance requirements for sown grasslands shall include |
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| <ul style="list-style-type: none">• Creation of a species-rich grassland sward composed of native grasses, herbaceous species and wildflowers;• There shall be less than 5% cover in total of invasive plants or other weedy species (to be defined on a site basis); and• Implementing agreed management. |
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3.7 Design Specification – grassland habitat enhancement

- 3.7.1 Enhancement of existing species-poor, agriculturally improved grasslands can be achieved using translocation of individual plants and/or seeding (see details provided within this Chapter). Where the current management regime is likely to be limiting species diversity, this can be addressed by changes to management practices.

Site preparation

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| 3.7.2 | It shall be determined on a site by site basis whether grassland enhancement is to be achieved through management alone or by seeding/oversowing, introduction of plug plants, small-scale turf translocation or a combination of these. |
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- 3.7.3 Specification for management to be agreed on a site by site basis with an appropriately experienced ecologist.

Target performance

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| 3.7.4 | The overall target for grassland habitat enhancement is the establishment of grassland that shall conform with the targeted priority habitat type listed on Section 41 of the NERC Act 2006. |
| 3.7.5 | Detailed targets shall be determined by the soil type into which grassland is to be planted and the Natural England Character Area. Interim targets shall also be defined, based around the timing of management operations. |

Performance requirements

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| 3.7.6 | Performance requirements for grassland habitat enhancement shall be no significant establishment (less than 5% cover in total) of non-target species such as invasive plants or other weedy species (to be defined on a site by site basis). |
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3.8 Design specification – grassland habitat creation from natural colonisation

- 3.8.1 Grassland creation from natural colonisation may be an appropriate method for establishing ecologically valuable grasslands on cutting slopes where bare substrate is created.

Site preparation

- 3.8.2 Depending on the current state site preparation may involve reducing the weed burden.
- 3.8.3 A suitably experienced ecologist should make the decision as to the need for a nurse-crop to 'green' or stabilise the site once the site soil conditions are known. Sow at low rates (site dependant) to retain gaps in the vegetation for natural regeneration.

Establishment phase management

- 3.8.4 The grassland may require management to prevent weeds or early grasses from suppressing the flowers (see Technical Standard – Landscape Maintenance, Management and Monitoring Plan).
- 3.8.5 Control of undesirable or invasive species should be undertaken by hand or with herbicides depending on the species and the level of the problem if practicable.
- 3.8.6 The grassland should be monitored to record changes in the sward and changes to management requirements implemented if necessary.

Target performance

- 3.8.7 Creation of a species-rich grassland sward composed of native grasses, herbaceous species and suitable wildflowers.

Performance requirements

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| 3.8.8 | There shall be less than 10% cover in total of invasive plants or other weedy species (to be defined on a site basis) in grassland habitats created from natural colonisation. |
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4 Heathland creation and translocation

4.1 Approaches

4.1.1 The identified approaches for heathland are:

- Turf transfer; and
- Soil transfer (incorporating seed or bud bank).

4.1.2 The creation of heathland habitat by brash or seed spreading alone (i.e. without incorporating at least one of the above approaches) is considered unsuitable for this project as heathland creation sites with suitable soils are unlikely to be present within the local area. However, there could be localised situations on steep or rocky slopes where this may be the only option.

4.1.3 The option of natural regeneration is considered unsuitable for this project as timeframes for this are extremely long and likely to result in a grass-dominated community rather than a heathland type.

4.2 Selection of design specifications

4.2.1 For any type of high value heathland habitat (National/County/District value) or areas where the vegetation community has a significant proportion of characteristic plant species that are unlikely to successfully re-establish from seed/bud fragments, such as bilberry or sphagnum mosses, then turf translocation is the primary means of mitigation. Turf translocation is likely to have the highest success rate in maintaining the main features of interest in the heathland, including the range of plant species in a mix characteristic of that vegetation community. The key guidance document for habitat translocation is Anderson 2003⁶.

4.2.2 Soil transfer (littering) can, if carefully undertaken using the right approach, produce a good approximation of the original heathland community. For heather dominated sites where there are no plant species vulnerable to loss through this approach this is often the most practical way of retaining key elements of the characteristic vegetation. The regenerating vegetative fragments ('buds bank') and seed bank maintain the local genetic diversity of the plant species present. In addition, existing soil bacterial and fungal communities (which are important in the successful re-establishment of some higher plants, including dwarf shrub species) are transferred and there is the potential to transfer invertebrates.

4.2.3 Small scale turf transfer, targeted at individual plant species/species mixes within an otherwise overwhelmingly heather dominated heathland habitat, should also be considered alongside soil transfer. Some plants do not germinate well from seed or bud banks and if these are rare, uncommon or locally distinctive species and/or required as food plants by invertebrates they can be translocated from small areas within lower quality heathlands into suitable receptor areas.

4.2.4 Turf transfer should be used when there are:

⁶ Anderson, P. 2003, Habitat Translocation – a best practice guide. CIRIA C600, London

- Areas of high value heathland vegetation communities within selected sites to be lost/impacted, as identified through site survey;
- Areas of heathland where the vegetation has a significant proportion of characteristic plant species that are unlikely to successfully re-establish from seed/bud fragments, such as bilberry or mosses;
- Areas where sub-soil translocation is not required (i.e. where receptor site subsoil is already suitable), as identified through soil assessments; and
- Areas where the material only needs to be moved over shorter distances and immediately.

4.2.5 Soil transfer (incorporating seed and/or bud bank) should be used when there are:

- Areas of heathland containing at least 25% cover of heather, as identified through survey;
- Areas where the key species are known to regenerate successfully from seed; and
- Areas where receptor site may not be immediately available as soils can be stored for limited period (no longer than six months).

4.2.6 The use of heather seed or brash is useful in localised areas where other methods are less suitable or where the seed bank is reduced. This should be undertaken under guidance from a suitably experienced ecologist.

4.2.7 The final decision on the most appropriate method heathland turf and / or soil transfer shall be made when environmental data on the donor and receptor sites (as described in 4.2 above) are available and taking into account the nature and value of the habitats involved.

4.2.8 Geospatial data on heathland creation and receptor sites shall be recorded by the designer and passed to HS2 Ltd in accordance with the Geographic Information System Standards (HS2-HS2-GI-STD-000-000002).

4.3 Information required for detailed design

4.3.1 The critical factor in heathland translocation and heathland creation projects is the suitability of the receptor site in terms of soils, hydrology, slope and aspect.

4.3.2 Soil-handling operations and soil survey methodologies shall be carried out in accordance with what is outlined in Technical Standard – Soil Handling for Land Restoration.

4.3.3 Heathland soil survey and soil analysis for pH and levels of P, K and N shall be required from both the donor and receptor sites, to ensure that their soils are of similar character. Whilst there is no data deliverable to HS2 Ltd., the contractor shall record data and decision-making which would need to be made available as necessary.

- 4.3.4 Soil coring and or small soil pits should be undertaken to determine donor topsoil depths, and rooting zones of the vegetation to establish the depth of turves to be taken.

- 4.3.5 The hydrology, slope and aspect of the heathland donor and receptor sites shall be established prior to translocation and this information used in the detailed design of the receptor site.
- 4.3.6 Baseline information on species composition/community type of donor vegetation against which the target for the receptor can be judged shall be required.
- 4.3.7 Seed bank trials shall be required before a final decision is made as to whether soil transfer will be appropriate in creating the target community.
- 4.3.8 Whilst there is no data deliverable to HS2 Ltd. on the points above, the contractor shall record data and decision-making which would need to be made available as necessary.

- 4.3.9 Additional brash/seed may be required if representative species from the target community are low.

4.4 Design specification – heathland turf transfer

Donor site

- 4.4.1 The heathland to be translocated shall be cut or grazed short prior to translocation to around 100mm – 150mm.
- 4.4.2 Translocation shall occur in the vegetation dormant season (subject to ground conditions).

- 4.4.3 Tracking over the donor site prior to translocation should be avoided.

- 4.4.4 Heathland turf shall be cut with a vertical blade to create clean cut edge to the turf.
- 4.4.5 Turf shall be as large as reasonably practicable – a minimum of at least 2m x 1m and 200 mm deep depending on topsoil depth at the site. The depth must be agreed prior to translocation with a suitably experienced ecologist, or on site with the ECoW.

- 4.4.6 The turf should be cut and lifted in one operation.

Receptor site

Preparation

- 4.4.7 The receptor site shall be suitably prepared in advance to receive cut heathland turves immediately.
- 4.4.8 The receptor site shall be engineered to ensure required ground conditions, elevations and aspect are equivalent to the donor site.
- 4.4.9 Ground conditions shall be suitable for works to proceed, as confirmed by the ECoW (i.e. not water logged, frozen or snow covered).

Laying of Turves

4.4.10	If heathland subsoil removal is not required and there are no works required to change slope, hydrology or other physical features, then the topsoil shall be removed progressively in workable widths with an excavator and dump truck. The dump trucks/turf trailers shall run on topsoil only.
4.4.11	Where sub-soil removal is required dump trucks and turf trailers shall run on basal / non-soil layer.
4.4.12	Sub-soil shall be laid in strips on which turves are then placed.
4.4.13	Where no sub-soil removal but ground level re-modelling is required to replicate slope and hydrology or other physical features, there shall be careful de-compaction of the sub-soil by the excavator as progress is made across the receptor area. The necessity of this shall be advised upon by the soil scientist.
4.4.14	Turves shall be abutted as close together as possible to reduce gaps and create an even surface.

4.4.15 Turves should be re-laid in the same order as taken from the donor site.

Establishment phase management

- 4.4.16 Control undesirable or invasive plant species by hand-pulling or with herbicides, depending on the species and the level of the problem.
- 4.4.17 It should be considered whether there is the need to 'top up' with heather seed or brash if establishment is poor.

Target performance

4.4.18	The overall target of heathland turf transfer is the establishment of heathland that shall conform with the Lowland Heathland priority habitat type listed on Section 41 of the NERC Act 2006.
4.4.19	Detailed targets shall be determined by the species composition used, the soil type into which new heathland is to be planted and the Natural England Character Area. Interim targets shall also be defined, based around the timing of management operations.

Performance requirements

4.4.20	Performance requirements for heathland turf transfer shall include:
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- Receptor site shall be ready to receive turves before turf translocation begins;
- A suitably experienced ECoW shall oversee all works carried out on site;
- Area for turf transfer shall be identified and demarcated;
- Maximum gap between re-laid turves shall be no more than 300mm apart; and
- At least 95% of all gaps between translocated turves shall be filled with subsoil.

- 4.4.21 Less than 5% of re-laid turves should have soil on the surface vegetation.
- 4.4.22 There should be no significant establishment (less than 10% cover in total) of non-target species such as invasive plants or other weedy species (to be defined on a site basis).

4.5 Design specification – heathland soil transfer (littering)

Donor site

4.5.1 Heathland soil transfer (littering) shall occur in the vegetation dormant season (unless otherwise agreed by the suitably experienced ecologist).

4.5.2 If vegetation regeneration is dependent on the seed bank only, then the surface should be "sod cut" to a depth of up to 100mm (once loose litter is removed). Rotovation should be avoided unless necessary.

4.5.3 If regeneration is dependent on the bud bank (in addition to the seed bank) then the soil should not be rotovated/power harrowed.

4.5.4 The total depth of heathland topsoil to be taken for soil transfer shall be agreed on a site by site basis and will depend on the soil structure and the vegetation on the site.

4.5.5 The rotovated top litter/soil layer or upper turf layer (if not rotovated) shall be removed to an agreed depth.

4.5.6 The remaining topsoil shall be removed to an agreed depth and transfer to receptor site.

4.5.7 If required the sub-soil should be removed and transferred to the receptor site.

4.5.8 Unless otherwise instructed and agreed with the ECoW, the heathland soil shall be transported to, and spread on, the receptor site without storage.

4.5.9 If soil storage is necessary this shall not be for more than six months (maximum) with clear demarcation of upper topsoil layer, lower topsoil layer and sub-soil storage areas.

4.5.10 Soils from areas of rush dominated vegetation should be stored separately from non-rush areas to ensure that the rush seed is not spread across the whole receptor site, separated into upper and lower layers as necessary.

Receptor site

Preparation

4.5.11 If sub-soil removal is not required and there are no works required to change slope, hydrology or other physical features, then the topsoil should be progressively removed in workable widths with an excavator and dump truck (see Technical Standard - Route Wide Soil Resources Plan); dump trucks/turf trailers should run on topsoil only.

4.5.12 Where sub-soil removal from the heathland soil receptor site is required, dump trucks and turf trailers shall run on basal layer.

4.5.13	Sub-soil shall be laid in strips on which topsoil is then placed.
4.5.14	Where no sub-soil removal but ground level re-modelling is required to replicate slope, hydrology and other physical features, there shall be de-compaction of the sub-soil by the excavator as progress is made across the receptor area.
4.5.15	The receptor site shall be engineered to ensure required ground conditions, elevations and aspect are equivalent to the donor site. Whilst there is no data deliverable to HS2 Ltd., the contractor shall record data and decision-making which would need to be made available as necessary.
4.5.16	The ground conditions shall be suitable for the works to proceed.

Laying of Soil/Litter

4.5.17	If the heathland vegetation was not rotovated then effort shall be made to turn any turf sections the correct way up.
4.5.18	Topsoil shall be managed to produce a suitable seedbed for the seed bank to germinate.

4.5.19 Soils from rush-dominated donor site areas should be laid in areas of the receptor site specifically selected by the ECoW.

Establishment phase management

4.5.20 Control undesirable or invasive plant species by hand-pulling or with herbicides, depending on the species and the level of the problem.

4.5.21 It should be considered whether there is the need to 'top up' with heather seed or brash if establishment is poor.

Target performance

4.5.22	The overall target of heathland soil transfer (littering) is the establishment of heathland that shall conform with the Lowland Heathland priority habitat type listed on Section 41 of the NERC Act 2006.
4.5.23	Detailed targets shall be determined by the species composition used, the soil type into which new heathland is to be planted and the Natural England Character Area. Interim targets shall also be defined, based around the timing of management operations.

Performance requirements

4.5.24	Performance requirements for heathland soil transfer shall include:
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- Ensure soil nutrients and pH status or receptor site match donor site and do not exceed known values required for heathland vegetation;
- Requirement for a suitably experienced ECoW on site during operations with the ability to stop the works if the results are not satisfactory; and
- There shall be no tracking or driving over the re-laid soils.

- 4.5.25 There should be no significant establishment (less than 10% cover in total) of non-target species such as invasive plants or other weedy species (to be defined on a site basis).

5 Hedgerow creation and translocation

5.1 Approaches

- 5.1.1 The approach taken for hedgerows closely follows the key principles set out in Chapter 14 of the Ecological Principles of Mitigation, which includes translocation as an option. A number of examples of hedgerow translocation are given by Stanhope and Box (2011)⁷ and Box and Stanhope (2010)⁸. Guidance on hedgerow creation is given in Gilbert, O.L. and Anderson, P. (1998)⁹ and Brooks and Agate (2000)¹⁰.
- 5.1.2 New hedgerows will normally be created by planting, but in certain circumstances translocation is undertaken.

5.1.3	Geospatial data on hedgerow creation and receptor sites shall be recorded by the designer and passed to HS2 Ltd in accordance with the Geographic Information System Standards (HS2-HS2-GI-STD-000-000002).
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5.2 Information required for detailed design

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| 5.2.1 | Surveys shall be completed for all potentially 'important hedgerows' (as defined under the Hedgerow Regulations 1997). |
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5.3 Design specifications - general

5.3.1	Hedgerow translocation shall be undertaken where an 'important hedgerow' forms a significant ecological feature within a statutory or a non-statutory designated site of nature conservation importance (as defined in the designated sites citation).
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- 5.3.2 Translocation may be required where there is a need to rapidly establish flightline connectivity for bats.
- 5.3.3 Where hedgerows are translocated there may be a requirement to move hedgerow trees (as informed by the suitably experienced ecologist and / or an arboriculturist). A root ball bucket, tree spade or other specialist machinery should be used.
- 5.3.4 For hedgerows provided through new planting, the design and species composition should reflect the regional distinctiveness of hedgerows and should use local provenance stock.

5.4 Design specification - hedgerow translocation

Donor site

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| 5.4.1 | During the growing season preceding the hedgerow translocation, the extent and composition of woodland ground flora associated with the hedgerow shall be recorded accurately and marked for translocation with the hedgerow. Whilst there is |
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⁷ Stanhope, K. and Box, J. 2011. IEEM Conference Proceedings, Autumn. Draft paper Salvage Translocation

⁸ Box, J. and Stanhope, K. 2010. Translocating wildlife habitats: A guide for civil engineers. Atkins Technical Journal no. 6 - p. 143-150.

⁹ Gilbert, O.L. and Anderson, P. (1998) Habitat Creation and Repair. Oxford University Press.

¹⁰ Brooks A. & Agate E. 2000. Hedging a practical handbook. BTCV.

no data deliverable to HS2 Ltd., the contractor shall record data and decision-making which would need to be made available as necessary.

5.4.2 Root pruning should be carried out up to two seasons prior to translocation if appropriate.

5.4.3 Shrubs shall be coppiced in the autumn immediately prior to translocation to a height of 300 mm-500mm.

5.4.4 Hedgerows shall be translocated in as large sections as possible to reduce damage to the roots; minimum two metres long and one metre deep, and less than 5m wide, unless otherwise agreed with the ECoW. Whilst there is no data deliverable to HS2 Ltd., the contractor shall record data and decision-making which would need to be made available as necessary.

5.4.5 All hedgerow translocations shall be undertaken in the dormant season.

Receptor site

5.4.6 Receptor sites shall be selected to match donor sites to ensure compatibility.

5.4.7 Ground conditions should be created at the hedgerow receptor site to replicate those from the donor site.

5.4.8 The trench shall be prepared as close to the time that the hedgerow is translocated as possible.

5.4.9 Ground conditions shall be suitable for the works to proceed (as informed by the suitably experienced ecologist).

5.4.10 The hedgerow should be excavated and immediately transferred to the prepared trench without double handling. This trench should be back filled with suitable topsoil from the donor site.

Establishment phase management

5.4.11 Where the hedgerow is adjacent to land with livestock present, then appropriate fencing should be used to allow successful establishment.

Target performance

5.4.12 The overall target for hedgerow translocation is establishment of hedgerow that shall conform with the hedgerow priority habitat type listed on Section 41 of the NERC Act 2006.

5.4.13 Detailed targets shall be determined (by the suitably experienced ecologist) by the species composition used, the nature of the hedgerow translocated, the soil type into which new hedgerow is to be planted and the Natural England Character Area. Interim targets shall also be defined, based around the timing of management operations.

Performance requirements

5.4.14 There shall be no gaps between hedgerow sections.

5.4.15	There shall be no tracking or driving over the translocated hedgerow sections.
5.4.16	The established hedgerow (post-five years) should have no more than 5% weed cover.
5.4.17	An appropriate management regime for the translocated hedgerow(s) shall be agreed and implemented in advance of works commencing.
5.4.18	An ECoW shall be on site during hedgerow translocation.

5.5 Design specification – hedgerow: translocation of individual plants

Donor site

- 5.5.1 Translocation shall occur during the dormant season.
- 5.5.2 Hedgerow plant transportation should be designed to reduce multiple handling of the turf and avoid breaking the turf.

Receptor site

- 5.5.3 The hedgerow plants should be replaced along the new hedgerow line in accordance with the manner stated by the suitably experienced ecologist.

5.5.4	Hedgerow sections shall be placed at the receptor site so that they are flush with the existing ground surface.
5.5.5	Any gaps at ground level shall be filled with subsoil excavated during translocation.

Establishment phase management

- 5.5.6 Weed species should be controlled by hand within one metre of the translocation and it should be ensured the translocated plants are not treated with herbicides.

Target performance

5.5.7	The overall target for hedgerow translocation (individual plants) is establishment of hedgerow that shall conform with the hedgerow priority habitat type listed on Section 41 of the NERC Act 2006.
5.5.8	Detailed targets shall be determined by the species composition used, the nature of the hedgerow translocated, the soil type into which new hedgerow is to be planted and the Natural England Character Area. Interim targets shall also be defined, based around the timing of management operations.

Performance requirements

5.5.9	An ECoW shall be on site during translocation of individual hedgerow plants.
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5.6 Design specification - hedgerow planting

Planting

- 5.6.1 All hedgerow plant material should ideally be locally sourced native stock.

5.6.2	Species mix shall be based on local hedgerow characteristics.
5.6.3	Unless otherwise advised by the ECoW, all hedgerows shall be planted as two staggered rows (300mm apart) of transplants with five plants per metre along each row. Whilst there is no data deliverable to HS2 Ltd., the contractor shall record data and decision-making which would need to be made available as necessary.
5.6.4	Hedgerow planting shall occur during the dormant season.

Establishment phase management

5.6.5	Rabbit fences or guards should be provided and managed / maintained in line with the manufacturer's specification. Where plant damage by deer grazing is known to be a local issue then appropriate measures should be taken to protect establishing plants (as defined by the suitably experienced ecologist).
5.6.6	Weed species should be controlled with herbicides as identified in the Technical Standard – Landscape Maintenance, Management and Monitoring Plan.

Target performance

5.6.7	The overall target for hedgerow planting is establishment of hedgerow that shall conform with the hedgerow priority habitat type listed on Section 41 of the NERC Act 2006.
5.6.8	Detailed targets shall be determined by the species composition used, the nature of the hedgerow translocated, the soil type into which new hedgerow is to be planted and the Natural England Character Area. Interim targets shall also be defined, based around the timing of management operations.

Performance requirements

5.6.9	The established hedgerow should have no more than 5% weed cover.
5.6.10	An ECoW shall be on site during all hedgerow planting.

6 Open mosaic habitats

6.1 Approaches

- 6.1.1 Open Mosaic Habitats on Previously Developed Ground is recognised as a priority habitat for conservation in England on Section 41 of the NERC Act 2006.
- 6.1.2 The approach taken for open mosaic habitats closely follows the key principles set out in Chapter 14 of the Ecological Principles of Mitigation. This document sets out the hierarchy of mitigation to be applied. In order of preference this involves consideration of the following mitigation options

6.2 Design specifications - general

Translocation and natural regeneration

- 6.2.1 This requires that existing substrates (incorporating seed bank propagules) be salvaged and translocated, so that they can be used to create a new area of similar habitat off-site. Suitable receptor sites should be identified as close as possible to the area to be lost.

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| 6.2.2 | Geospatial data on open mosaic habitat creation and receptor sites shall be recorded by the designer and passed to HS2 in accordance with the Geographic Information System Standards (HS2-HS2-GI-STD-000-000002). |
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- 6.2.3 Flora should be allowed to regenerate from the seed bank and propagules associated with the salvaged substrates, and to colonise naturally from adjacent seed sources, with no additional supplementation or seeding.
- 6.2.4 Where grassland, heathland, scrub and wetland forms part of the open mosaic habitat then consideration should be given to options for the salvage and re-use of turves, soil transfer/littering and individual plants from the area to be lost.

Habitat creation at ground level

- 6.2.5 Suitable receptor sites should be identified as close as possible to the area to be lost.
- 6.2.6 Flora should be allowed to regenerate from any seed bank and propagules associated with the imported substrates, and to colonise naturally from adjacent seed sources, with no additional supplementation or seeding.
- 6.2.7 Where there is a risk of an invasive coloniser of open ground dominating the newly created habitat, the suitably experienced ecologist should decide the most appropriate seeding method.
- 6.2.8 When formulating detailed design specifications for terrestrial habitats there are a number of relevant documents that should be consulted, including:
- Open Mosaic Habitats on Previously Developed Land 2010¹¹, for a definition and examples of relevant plant communities associated with this habitat type;

¹¹ UK Biodiversity Action Plan; Priority Habitat Descriptions. BRIG (ed. Ant Maddock) 2008 (Updated 2010).

- Ecomimicry for Barking Riverside: Achieving locally contextualised biodiversity-led multifunctional urban green infrastructure 2016¹², for research on establishing a multifunctional terrestrial habitats; and
- Buglife Case Study: Beetle Bump, London 2012¹³, for a case study demonstrating the benefits open mosaic habitats can provide to rare invertebrate species.

Habitat creation at height (brown roofs)

- 6.2.9 Where ground level mitigation is not feasible, mitigation should take the form of a brown roof (or 'extensive green roof'). The objective for the design of brown roofs should be to provide habitat comparable to the area of open mosaic habitat to be lost at a site as close as possible to the area lost.
- 6.2.10 Where feasible the construction of brown roofs should include the use of substrates derived from the area to be lost, as these will include seeds and propagules of the flora associated with the area to be lost.
- 6.2.11 The use of brown roofs as a mitigation technique should only be considered once all other mitigation options have been explored and exhausted.
- 6.2.12 When formulating detailed design specifications for brown roofs there are a number of relevant documents that should be referred to:
- Green Roof Code of Best Practice for the UK 2014¹⁴, should be referred to for industry best practice and design specifications/standards for brown roofs
 - Building Green: A guide to using plants on roofs, walls and pavements¹⁵, should be referred to for practical advice on the construction and maintenance of brown roofs
 - Design principles for black redstart habitat creation¹⁶, should be referred to for situations where this protected bird species is a specific design consideration
 - Creating green roofs for invertebrates: a best practice guide¹⁷, should be referred to for situations where invertebrates are a specific design consideration

6.3 Selection of design specifications

- 6.3.1 Where open mosaic habitats cannot be reinstated then consideration should be given to the identification of suitable land where off-site open mosaic habitat mitigation can be provided.

¹² Connop, Stuart and Nash, C. (2016) Ecomimicry for Barking Riverside: Achieving locally contextualised biodiversity-led multifunctional urban green infrastructure. Project Report. University of East London, London.

¹³ <https://www.buglife.org.uk/sites/default/files/Uel%20beetle%20bump,%20London.pdf>

¹⁴ <http://www.nfrc.co.uk/docs/default-source/green-roofing/grocode2014.pdf?sfvrsn=2>

¹⁵ http://static.london.gov.uk/mayor/strategies/biodiversity/docs/Building_Green_main_text.pdf

¹⁶ <http://www.blackredstarts.org.uk/pages/greenroof.html>

¹⁷ https://www.buglife.org.uk/sites/default/files/Creating%20Green%20Roofs%20for%20Invertebrates_Best%20practice%20guidance.pdf

- 6.3.2 Detailed site-specific design specifications for open mosaic habitats should consider the specific characteristics of the open mosaic habitats to be lost.
- 6.3.3 Where substrate transfer is not feasible, then substrates will need to be imported. These should replicate as closely as possible the characteristics of the substrates to be lost.
- 6.3.4 Target objectives should be defined in consultation with a suitably experienced ecologist before commencing detailed design. Target objectives should be based on the baseline characteristics of the site to be lost, any requirements for ecological enhancement to secure net biodiversity gains, and interfaces with other design specifications.

6.4 Information required for detailed design

- 6.4.1 The following information and/or data shall be required to inform the detailed design for ground level open mosaic habitats (Whilst there is no data deliverable to HS2 Ltd., the contractor shall record data and decision-making which would need to be made available as necessary):

- Detailed baseline data on the structure and composition of open mosaic habitat and substrate; and
- Ground water levels.

- 6.4.2 Where available, relevant species records for the site and local should also be used to inform the detailed design. Whilst there is no data deliverable to HS2 Ltd., the contractor shall record data and decision-making which would need to be made available as necessary.

- 6.4.3 The following information and/or data shall be required to inform the detailed design for habitat creation at height (brown roofs) (Whilst there is no data deliverable to HS2 Ltd., the contractor shall record data and decision-making which would need to be made available as necessary):

- Detailed baseline data of the open mosaic habitat and substrate is required on the structure and composition of the open mosaic habitat associated with the area to be lost, to determine if and how this can be replicated when designing the brown roof;
- The load bearing capacity of potential host roofs shall be known; and
- Drainage requirements shall be identified and considered at design.

6.5 Design specification – ground level open mosaic habitats

Donor site

6.5.1 Any substrates and vegetation requiring re-instatement or off-site translocation shall be identified and protected until the ground level open mosaic receptor site(s) is ready.

6.5.2 Different substrate types should be handled and managed separately to reduce reconfiguration as much as possible.

Receptor site

6.5.3 Ground level open mosaic habitat receptor sites shall be suitably prepared, including the creation of relevant physical characteristics.

6.5.4 Import and contour substrates (translocated and/or new substrates) to reinstate/create a variety of depths, aspects, and particle sizes (sands to large rocks/rubble). Substrates should be distributed to replicate, as far as is practicable, the niches present in association with the site to be lost.

6.5.5 Scrub, grassland and wetland vegetation should be saved from the donor site where practicable and reinstated/translocated as appropriate.

6.5.6 Substantial new plantings should not be undertaken unless this is required to meet pre-defined site-specific target objectives.

6.5.7 A wildflower seed mixture can be sown, if necessary to achieve target objectives. Where feasible, seed should be harvested from a suitable donor site.

6.5.8 Seed beds shall be prepared in advance of seed sowing on ground level open mosaic habitats.

6.5.9 No fertilisers shall be applied as the goal is establishment of a nutrient-poor habitat.

Establishment Phase Management

6.5.10 The intention is to create conditions that are self-sustaining and subject to natural processes.

6.5.11 Scrub, grassland and wetland habitats that form part of the open mosaic habitat may need management during the establishment phase in accordance with the relevant specifications.

6.5.12 Weed control requirements should be assessed on a case by case basis on the advice of the suitably experienced ecologist.

Target performance

6.5.13 Ecological objectives for the ground level open mosaic habitat (including target habitat types to be created) shall be identified.

6.5.14 Where practicable, the mitigation habitats should have resemblance to comparable habitats associated with the area to be lost.

Performance requirements

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| 6.5.15 | Open mosaic habitat features shall replicate the physical and biological characteristics of the donor site / area lost. |
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6.6 Design specification – brown roofs

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| 6.6.1 | Any substrates requiring translocation and re-use on brown roofs shall be identified and protected until required. |
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- 6.6.2 Different substrate types should be handled and managed separately to reduce as much as possible reconfiguration.

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| 6.6.3 | The design and installation of brown roofs shall be carried out in accordance with the specification in the Green Roof Code of Best Practice for the UK 2014. |
|-------|---|

- 6.6.4 A variety of depths, aspects and particle sizes of substrates should be used.

- 6.6.5 A wildflower seed mixture should be sown, if necessary to achieve target objectives, otherwise, flora should be left to colonise naturally.

- 6.6.6 Seed sowing should be carried out during the growing season.

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| 6.6.7 | No fertilisers shall be applied to the brown roof as the objective is nutrient-poor habitat. |
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Establishment Phase Management

- 6.6.8 General maintenance should be undertaken in accordance with the specification for 'Biodiverse Roof Maintenance' in the Green Roof Code of Best Practice for the UK 2014. No fertilisers should be applied as the objective is nutrient-poor habitat. The intention is to create a self-sustaining system subject to natural processes.

- 6.6.9 Undesirable invasive plant species should be controlled as and when identified during routine maintenance inspections.

Target performance

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| 6.6.10 | The target shall be to create an ecologically functional brown roof. |
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Performance requirements

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| 6.6.11 | Creation of a brown roof that based on space available and consideration of the needs of target species, shall replace the physical and biological characteristics of the area lost. |
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7 Wetland

7.1 Approaches

The design of the Scheme includes provision for the creation of a range of wetland types that accord with habitats identified in S41 of the NERC Act 2006 as being of priority for conservation in England. The following approaches are required; soil transfer, translocation of individual plants, sown seed, plug plants, tree planting and natural regeneration.

- 7.1.1 The creation of ponds for particular aquatic species can be found in the relevant species chapter in this document. For general principals of design for wildlife ponds with no specific target requirement other than as part of general biodiversity enhancement see Pond Conservation 2010¹⁸ and Pond Conservation 2011¹⁹.
- 7.1.2 Guidance for creating fen and marginal communities (including reedbed) is given in Gilbert and Anderson 1998²⁰ and McBride et al. 2011²¹, with additional information in Falsham et al 2000²² which also covers wet woodland establishment and management.

7.2 Selection of design specifications

- 7.2.1 Suitable hydrological conditions are specific to each wetland type and choices about wetland type should be influenced by existing conditions on the proposed site. New sites should have underlying suitability but may also need ground preparation to aid successful wetland establishment.
- 7.2.2 Table 7.1 Suitability of wetland creation methods aids selection of the habitat creation scenario to be used.

¹⁸ Williams, P.J., Biggs, J., Whitfield, M., Thorne, A., Bryant, S., Fox, G., Nicolet, P., Williams, P. & Julian, A.M. 2010. The Pond Book: A guide to the management and creation of ponds. Pond Conservation

¹⁹ Pond Conservation (2011) *Million Ponds Project: Pond Design Toolkit Sheets 1 -8* http://www.freshwaterhabitats.org.uk/wordpress/wp-content/uploads/2013/09/MPP-Toolkit-core-sheets-1-8_June2011.pdf

²⁰ Gilbert, O.L. and Anderson, P. 1998. Habitat Creation and Repair. Oxford university press.

²¹ Andrew McBride, Iain Diack, Nick Droy, Bobby Hamill, Peter Jones, Johan Schutten, Ann Skinner and Margaret Street (eds), 2011. The Fen Management Handbook. Scottish Natural Heritage.

²² Fasham, M. (ed.) 2000. *Wildlife Management and Habitat Creation on Landfill Sites - a manual of best practice*. Ecoscope Applied Ecologists

Table 7.1 Suitability of wetland creation methods

APPROACH	Obtain suitable site conditions:	Turf/soil translocation:			Habitat creation:				Natural regeneration:
WETLAND TYPE	Site suitability	Whole turf translocation	Soil transfer	Translocation of individual Plants	Sown seed - commercial/harvested	Plug plants	Tree planting	Scrape creation	
RIVERS									
In channel		Not suitable	Not suitable	Not suitable	Not suitable	Not suitable	Not suitable	Not suitable	Only really suitable option
Riverbanks		Refer to Chapter 3		Suitable if: either 'nationally scarce' species or plants of local interest present	Refer to Chapter 3		Suitable - but to be agreed on a site by site basis	Not suitable	Suitable and most often preferred option
TERRESTRIAL WETLANDS									
Wet Grassland	Water quality & quantity is important for all wetlands and scrape creation (wet grassland), as is soil type. Refer to Figure 7.1	Refer to Chapter 3		Suitable if: either 'nationally scarce' species or plants of local interest present	Refer to Chapter 3		Not suitable	Suitable - increases biodiversity value on low diversity sites	Not suitable - high risk of undesired species establishment
Fen		Only cost-effective for high value sites - not present on scheme	Not suitable - high risk of undesired sp. becoming dominant	Suitable if: either 'nationally scarce' species or plants of local interest present	Suitable if: a local nearby donor site available	Suitable - best & most likely option for most sites	Not suitable	Not suitable	Not suitable - high risk of undesired species establishment
Reedbed		Not suitable - other methods optimal	Suitable if: donor site with reed available. Otherwise not suitable.	Suitable if: either 'nationally scarce' species or plants of local interest present	Suitable - especially if local source available	Suitable - best option	Not suitable	Not suitable	Suitable if: contiguous with existing stand of reed to colonise
Wet Woodland		Not suitable - other methods optimal	Not suitable - other methods optimal	Suitable if: either 'nationally scarce' species or plants of local interest present	Not suitable - other methods optimal	Not suitable - other methods optimal	Suitable - best option	Not suitable	Suitable - best option for ground flora

7.3 Information required for detailed design

7.3.1 The suitability of the receptor site for the proposed wetland habitat should be investigated. Water quantity and quality as well as seasonality, depending upon the specific requirements of the habitat to be created, with reference to replicating conditions in areas to be lost, if relevant.

7.3.2 Geospatial data on wetland creation and receptor sites shall be recorded by the designer and passed to HS2 Ltd in accordance with the Geographic Information System Standards (HS2-HS2-GI-STD-000-000002).

7.3.3 Water quality (surface and/or groundwater) supply to aid selection of most appropriate wetland type should be assessed. Jeffries 1988²³ cites water chemistry ranges for several key aquatic macrophytes. Whether ground or surface, water quality should ideally be of 'Good' Chemical (and Ecological) Status under the Water Framework Directive, see also Technical Standard – Water Framework Directive (WFD) Compliance Approach (HS2-HS2-EV-STD-000-000012).

7.3.4 The soil chemistry, especially pH and nutrient status (especially nitrate and phosphorous), should be investigated. The appropriate chemical parameters for wetlands can vary widely dependent upon the habitat type. More detail for specific identifiable wetland communities can be found in Rodwell 1991²⁴, Rodwell 1995²⁵ and Wheeler et al. 2004²⁶, with UK Priority wet woodland defined as NVC communities W1 to W7 inclusive²⁷. Grime 2007²⁸ sets out soil pH ranges for common British plants, and the Biological Flora of the British Isles²⁹ series provides indicative nitrogen and phosphorous levels.

7.4 Design specification – soil transfer/littering

7.4.1 This design specification is mainly for creation of reedbeds but may also be suitable for other types of swamp.

7.4.2 This should be undertaken during the dormant season when ground conditions are not waterlogged or frozen.

Donor site preparation

7.4.3 The reed stems should not be cut, because aerial stems, seed and litter can aid establishment.

²³ Jeffries, M., 1988. *Water Quality and Wildlife, A review of Published Data. Volume 1 Main Text*. Nature Conservancy Council.

²⁴ Rodwell, J.S. (ed.), 1991. *British Plant Communities – Volume 1: Woodlands and Scrub*. Cambridge University Press.

²⁵ Rodwell, J.S. (ed.), 1995. *British Plant Communities Volume 4: Aquatic Communities, Swamps and Tall-Herb Fens*. Cambridge University Press.

²⁶ Wheeler, B.D, Gowing, D.J.G., Shaw, S.C., Mountford, J.O., and Money, R.P., 2004. *Ecohydrological Guidelines for Lowland Wetland Plant Communities*. Environment Agency, Peterborough.

²⁷ http://jncc.defra.gov.uk/PDF/UKBAP_PriorityHabitatDesc-Rev2011.pdf

²⁸ Grime, J.P., Hodgson, J.G. and Hunt, R. 2007. *Comparative Plant Ecology - a functional approach to common British species*. Castlepoint Press.

²⁹ <http://www.britishecologicalsociety.org/publications/journals/journal-of-ecology/biological-flora-of-the-british-isles/>

7.4.4 The substrate should not be rotavated as this damages rhizomes.

7.4.5 Only the top section of wetland soil containing rhizomes shall be transferred. This shall be identified by the ECoW on a site by site basis.

7.4.6 Soil should be harvested by mechanical bucket, avoiding tracking over areas to be harvested.

Receptor site preparation

7.4.7 The wetland soil receptor site shall be excavated as required to provide appropriate hydrological conditions.

7.4.8 For further information on reedbed management see Hawke & Jose (1996)³⁰ and White, Self & Blyth (2014)³¹.

7.4.9 Topsoil should be removed from the wetland creation area especially where open water forms part of new habitat creation area.

7.4.10 Wetland soil rhizomes shall be spread at a minimum of 250mm deep and inundated to the appropriate depth as specified as soon as practicable.

7.4.11 Soil compaction across the receptor site should be reduced where practicable.

Establishment phase management

7.4.12 Avoid disturbance and drying of the translocated material in the first two years and protect from grazing by water fowl (especially geese) where this is considered likely to be an issue by the suitably experienced ecologist.

7.5 Design specification – translocation of individual plants

7.5.1 Species should be translocated within the same river, or within one of its tributaries if this is not possible.

7.5.2 Haslam 2006³² and RSPB 2001³³ should be used as the key sources of information on the choice of species for suitable river plants.

7.5.3 Translocation of marginal or emergent vegetation should occur in the dormant season.

7.5.4 Translocation of floating vegetation should take place during the growing season.

³⁰ Hawke, C.J. and José, P.V. 1996 Reedbed management for wildlife and commercial interests. The RSPB, Sandy.

³¹ White, G., Self, M. & Blyth, S. (2014) Bringing Reedbeds to Life: Creating and Managing Reedbeds for Wildlife. RSPB, Sandy.

³² Haslam, S. M. (2006) River Plants: The Macrophytic Vegetation of Watercourses 2nd Revised edition. University of Cambridge.

³³ Royal Society for the Protection of Birds, National Rivers Authority and Royal Society for Nature Conservation (1994, reprinted 2001). The New Rivers and Wildlife Handbook. RSPB.

Donor site preparation

7.5.5	The location of the individual wetland plants to be translocated shall be accurately marked.
7.5.6	Translocation of individual species from wet sites by mechanical means shall use a bucket or a grab mechanism. Species can also be dug up or collected by hand.
7.5.7	There shall be no storage of collected plant material unless advised otherwise by the ECoW.

Receptor site

7.5.8	The wetland plant receptor site must have similar hydrological and other physical conditions to the donor site, unless otherwise agreed with the suitably experienced ecologist.
7.5.9	All planting of translocated material shall be done by hand.
7.5.10	<i>Riparian Vegetation Management</i> good practice guide (SEPA 2009a) ³⁴ (pp8-10 and pp18-20) and <i>The New Rivers and Wildlife Handbook</i> (RSPB 2001) ³⁵ (pp246-249) should be used as the key sources of information on planting river margins.
7.5.11	Translocated plants should be replaced randomly in existing vegetation or clustered in one area of the receptor site. Suitability should be determined on a site by site basis by the ECoW.
7.5.12	Any gaps around the translocated plants should be packed with the soil excavated to accommodate the plants.
7.5.13	Where the only practical wetland plant translocation method is turf stripping, turves shall be cut to a depth as specified by the ECoW.
7.5.14	Turf shall be cut with a vertical blade to create clean cut edge to the turf.
7.5.15	Turf transportation should be designed to reduce multiple handling of the turf and to avoid breaking the turf.
7.5.16	Other species / plant communities of value should not be disturbed during the translocation.

Establishment phase management

7.5.17	Individual plants should be protected from grazing by water fowl (especially geese) or livestock where necessary.
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³⁴ SEPA (2009a) *Engineering in the Water Environment Good Practice Guide: Riparian Vegetation Management* 2nd edition (WAT-SG-44).
http://www.sepa.org.uk/media/151010/wat_sg_44.pdf

³⁵ Holmes, N., Ward, D. & Jose, P. (2001) *The New Rivers and Wildlife Handbook*. RSPB

- 7.5.18 Undesirable or invasive non-native species should be controlled by hand or with herbicides where appropriate.

7.6 Design specification – establishment from sown seed

- 7.6.1 Locally appropriate native species should be used. For details see the Technical Standard - Meadow and Wetland Procurement Strategy (HS2-HS2-EV-STR-000-000006).
- 7.6.2 Seeds should be sown during late May or June ensuring that day time temperatures range from 10-25 °C and nights are frost free.

General site preparation

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| 7.6.3 | The wetland receptor site shall have hydrological and physical conditions that are suitable for the establishment and persistence of the sown seed species. |
| 7.6.4 | The receptor site shall include a reliable water supply and for common reeds up to 300mm of water depth in spring. |
- 7.6.5 For herbaceous fens, the conditions should be based on those of the fen that will be lost during construction of the Scheme or modelled on a nearby good example of the target habitat.

Seed collection and storage

Reedbed

- 7.6.6 Common reed seeds should be collected during the dormant season when the panicles are dry and the seeds mature.
- 7.6.7 Seed should be stored in a cool, dry place until it is needed.

Fen

- 7.6.8 Spreading of hay containing herbaceous fen species (where common reed is not the target species) should take place directly after harvesting i.e. July - August, depending on the growing season.

River bank

- 7.6.9 Seeds from required species to be harvested from a donor site (preferably on the same river system) should be identified by a suitably experienced ecologist.
- 7.6.10 Where there is no suitable donor site a standard river bank seed mixture with grasses available from commercial seed suppliers should be used, consistent with Technical Standard - Lawn, Meadow and Wetland Procurement Strategy.

Reedbed site preparation

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| 7.6.11 | Competing reedbed vegetation shall be controlled by stripping turf and litter to create a flat bed. |
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| 7.6.12 | Water levels shall be controlled to create saturated soil conditions during the establishment phase. |
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Fen site preparation

- 7.6.13 On wet fen sites, where creation of a fine seedbed is not possible, existing vegetation should be removed.
- 7.6.14 If hay is added to enhance an existing wet fen site, then some ground disturbance (through scarification or light cattle poaching), to create colonisation gaps, prior to hay strewing, should be carried out.

River bank site preparation

- 7.6.15 The New Rivers and Wildlife Handbook³⁶ should be used as the key source of information on seeding of riverbanks.

Reedbed seeding

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| 7.6.16 | Common reed seed shall be hand sown. |
| 7.6.17 | A seed rate of 10-125 viable seeds / m ² shall be adopted for common reed. |

- 7.6.18 Sowing should take place during appropriate weather conditions, as advised by the suitably experienced ecologist.
- 7.6.19 Panicle branches where used should be pressed into the substrate to ensure good contact.

Fen seeding

- 7.6.20 Appropriate machinery should be used for hay strewing to avoid damaging the soil structure.
- 7.6.21 On very small sites hand spreading of hay may be used.

River bank seeding

- 7.6.22 Sowing should include a quick growing 'nurse crop' in conjunction with low maintenance seed mixes containing wildflowers (see Technical Standard - Lawn, Meadow and Wetland Procurement Strategy).

Establishment phase management

- 7.6.23 Sown seeds should be protected from grazing by water fowl (especially geese) or livestock where necessary.
- 7.6.24 Rush, birch and willow should be no more than 1% coverage.

³⁶ Royal Society for the Protection of Birds, National Rivers Authority and Royal Society for Nature Conservation (1994, reprinted 2001). The New Rivers and Wildlife Handbook. RSPB.

- 7.6.25 Undesirable or invasive species should be controlled by hand or with herbicides where appropriate.
- 7.6.26 Water levels should be raised after the reed has started producing new shoots.

7.7 Design specification – plug planting

- 7.7.1 Plug planting on rivers should be carried out in growing season.
- 7.7.2 Plug planting of fen species should take place in the dormant season.
- 7.7.3 Planting of reed should be carried out in June, or as soon as possible after overnight frosts have ceased.

Site preparation

- 7.7.4 The wetland plug plant receptor site shall have hydrological and physical conditions that are suitable for the establishment and persistence of the species to be planted.
- 7.7.5 Areas for plug planting shall be accurately marked.

Planting

General

- 7.7.6 Plug planting should be done by hand.

Rivers

- 7.7.7 Plants should be prevented from being washed out by the use of geotextiles or similar engineered products.
- 7.7.8 Vegetated coir rolls and pallets should be sown in March for installation in July.

Establishment phase management

- 7.7.9 Plugs should be protected from grazing by water fowl (especially geese) or livestock where necessary.
- 7.7.10 Rush, birch and willow should be no more than 1% coverage.
- 7.7.11 Undesirable or invasive species should be controlled by hand or with herbicides where appropriate.

7.8 Design specification –wet woodland

- 7.8.1 Wet woodland shall be created during the dormant season.

Site Preparation

- 7.8.2 Appropriate hydrological and physical conditions shall be created on site for wet woodland and river bank trees.

Planting

- 7.8.3 The following should be considered:
- Species used should be appropriate to the conditions. A ratio of 40:60 trees to shrubs is optimal.
 - Trees shrubs planted into 650 mm-750mm deep soil, root stock protected during planting to prevent desiccation.
 - Plant at variable densities of 2 - 3.6m spacing (trees) and 0.5 - 1m spacing (shrubs), not in rows but in irregular clumps leaving some open areas.
 - Avoid soil compaction.
 - Willow cuttings can also be used. One-year old branches should be used.

Establishment phase management

- 7.8.4 Appropriate water levels should be maintained in areas of wet woodland planting.

Target performance

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| 7.8.5 | The overall target is establishment of wet woodland that shall conform with the wet woodland priority habitat type listed on Section 41 of the NERC Act 2006. |
| 7.8.6 | Detailed targets shall be determined by the species composition used, the nature of woodlands lost, the soil type into which new woodland is to be planted and the Natural England Character Area. Interim targets shall also be defined, based around the timing of management operations. |

Performance requirements

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| 7.8.7 | Performance requirements for wet woodland shall include development of a varied age structure of trees and species composition and that preserve any existing transitions with other surrounding semi-natural habitats. |
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7.9 Design specification – wetland using natural regeneration

- 7.9.1 The preferred method for in-channel re-vegetation of rivers and river banks should be natural regeneration.
- 7.9.2 The creation site should be adjacent to, and contiguous with, an existing established wetland of appropriate vegetation.
- 7.9.3 Natural regeneration of wet woodland is only to be adopted where specifically identified and justified.

Site preparation

- 7.9.4 Wetland creation sites shall have appropriate hydrological conditions for target habitat.

Establishment phase management

- 7.9.5 The site should be protected from cutting and grazing management in early years to allow aquatic plants, marginal plants, reed or woodland species to establish.

Reedbed

- 7.9.6 Existing vegetation, litter and topsoil should be stripped during landforming.
- 7.9.7 Appropriate water levels should be maintained in reedbeds.
- 7.9.8 Disturbance or drying should be avoided.
- 7.9.9 Natural regeneration should be protected from grazing by water fowl (especially geese) or livestock where necessary.
- 7.9.10 Rush, birch and willow should be no more than 1% coverage.
- 7.9.11 Undesirable or invasive species should be controlled by hand or with herbicides where appropriate.

Wet woodland

- 7.9.12 Existing vegetation should be removed in patches (scarify) to facilitate establishment of trees.
- 7.9.13 Appropriate water levels should be maintained in wet woodlands.
- 7.9.14 A mosaic of habitats and structural diversity including more open, un-shaded areas and poached or bare ground should be maintained.

7.10 Design specification – river enhancements

- 7.10.1 A detailed assessment should be undertaken and target objectives defined in consultation with an aquatic ecologist and river geomorphologist before commencing detailed design.
- 7.10.2 The Manual of river restoration techniques (online-only resource available on the River Restoration Centre (RRC) website)³⁷ should be used as a source of information in relation to suitability of design specifications for river enhancement and management.
- 7.10.3 Timing and phasing of river works should be determined on a site specific basis and agreed with the Environment Agency or lead local flood authority.

Site preparation

- 7.10.4 River enhancement sites should have appropriate hydrological and physical conditions suitable for the establishment and persistence of target riparian species.

³⁷ River Restoration Centre (online): Manual of river restoration techniques. <http://www.therrc.co.uk/manual-river-restoration-techniques>

Establishment phase management

- 7.10.5 Guidance on the installation of large wood can be found in SEPA's Good Practice Guide on Riparian Vegetation Management (SEPA 2009)³⁸.
- 7.10.6 SEPA (2010)³⁹ river crossing good practice guide (WAT-SG-25) general design principles should be used to reduce as much as possible construction impacts.
- 7.10.7 The purpose of in-channel and river bank vegetation management should be clearly established to identify whether any intervention is required.

Performance requirements

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| 7.10.8 | The required river community shall be created with key indicator habitat features and species for the relevant river type. |
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- 7.10.9 As many river habitat features of conservation value should be retained in situ.
 - 7.10.10 Removal of coarse sediments should be avoided.
 - 7.10.11 There should be no greater than 5% of non-target species, to be defined on a site by site basis.

³⁸ SEPA (2009) Engineering in the Water Environment Good Practice Guide: Riparian Vegetation Management;
<http://www.sepa.org.uk/regulations/water/engineering/engineering-guidance/>

³⁹ <http://www.sepa.org.uk/regulations/water/engineering/engineering-guidance/>

8 Green bridges

8.1 Approaches

8.1.1 The various designs for green bridges are categorised into the following types based on their principal purpose:

- Type 1 – Green bridges for Bechstein’s bats.
- Type 2 – Green bridges for important populations of scarce bat species (other than Bechstein’s bats) and high value assemblages of bats.
- Type 3 – Green bridges for landscape and habitat connectivity and/or the dispersal and passage of wildlife.

8.1.2 Where the primary function is ecological, the green bridge design will depend upon the target species requirements. Where possible, green bridges should provide other multi-functional benefits such as providing access routes for pedestrians, cyclists and equestrians. The design should also respect the area’s sense of place and local character, and should be in accordance with Landscape Design Approach (HS2-HS2-EV-STR-000-000010 Revision: Po2) and Bridge Design Requirements (HS2-HS2-BR-STD-000-000004).

8.1.3 A key source of information on green bridges, their design, function and uses is the Landscape Institute’s Green Bridges Technical Guidance note⁴⁰. Other sources of information do exist however and site-specific guidance should be sought from the suitably experienced ecologist, a landscape architect, and relevant engineers during design and construction.

8.2 Selection of design specifications

8.2.1 The stepped process below outlines the considerations that should be taken.

- **Step 1:** Review highway and access commitments and/or functional requirements and identify multi-functional needs and opportunities for wider environmental benefits from design.
- **Step 2:** Where not solely identified for bats, the ecological design of each bridge needs to accommodate habitat types and features to facilitate use by any other target species, where relevant.
- **Step 3:** Where the design is for avoiding significant impacts to the FCS of rare and/or scarce bat species or high value assemblages of bats, the location of the bridge should be based upon the existing flight paths and commuting/foraging routes.
- **Step 4:** Once detailed species requirements have been identified, the detail of the habitats and vegetation required can be incorporated into the design. This

⁴⁰ Landscape Institute (2015). Green Bridges – Technical Guidance Note 09/2015

will then allow decisions to be made regarding the specific growing medium requirements.

- **Step 5:** Consideration of a water supply sufficient to provide for the vegetation types to be developed. There should be a preference for optimising passive water retention or supply opportunities, water recycling technology, and taking account of climate change and extreme weather such as drought, high rainfall, high winds and snow. This will depend on soil type and depth, rain shadow, and gradient of the bridge and will have to be designed for each bridge following detailed assessment of the requirements.
- **Step 6:** Review potential design formations and layouts of habitat types, planting mixes and highways/accesses.
- **Step 7:** Issue designs to HS2 Ltd.
- **Step 8:** Agree a management regime and, where necessary, identify where monitoring is required. For green bridge monitoring requirements please refer to Ecological Monitoring Strategy (HS2-HS2-EV-STR-000-000029).

8.3 Design specification - All green bridges

8.3.1 The designs should incorporate a mix or mosaic of habitat types including tree planting, hedgerow and/or grassland habitats as appropriate to use of the bridge.

8.3.2 The green bridge design shall ensure the long-term (i.e. design lifetime of the green bridge) viability of the habitats created through the use of appropriate volumes of soil material and incorporation of appropriate drainage and water management.

8.3.3 Minimum soil depth requirements should be as follows:

- Grass and herbs - 0.3 m
- Shrubs (including hedgerows) - 0.6m
- Standard trees (A tree that has a single, upright, clear stem up to c.1.8m from the ground before the canopy starts) - 1.5 m

8.3.4 Unless essential for safety purposes, there shall be no artificial lighting provision on the green bridge, and also no artificial lighting provision where light could spill onto the flight path of bats, either on the bridge or on the approaches to the bridge.

8.3.5 Where some lighting is considered to be essential for safety purposes, this need should be demonstrated with regard to relevant safety standards and all alternatives properly considered. If there is no alternative, any lighting should be designed to avoid light spill (above 0.5 lux) onto the flight path (including proposed structure at Sheephouse Wood, roosts and temporary navigation features) and a separate lighting impact assessment provided prior to implementation, to confirm that lighting will not compromise the ecological function of the green bridge.

Ecology Technical Standards

8.3.6 Bridges should be wider at the 'entrances' than the minimum required green width, to encourage guidance and 'funnelling' of species across the structure, or it may be possible to provide funnelling through planting leading up to the bridge.

8.3.7 It may be possible to achieve deeper soil depths at the edges of the bridge with shallower depths in the centre. Whilst the overall structure of vegetation should reflect habitats adjacent to the bridge, where the vegetated zone along the bridge is wide enough, variation in soil depths should be used to create a mosaic of vegetation, including maintaining areas of bare ground, and creating a varied topography.

8.3.8 Where the provision on the green bridge is specifically for bats, the hedgerows and/or trees shall provide a continuous cover over the bridge and connect directly into the adjacent vegetation at either end of the bridge (except for gated access points for maintenance, the size and number of which should be kept as low as reasonably practicable).

8.3.9 Fencing may be required at either end of the green bridge, adjacent to the railway line, to dissuade bats from crossing over the line at these locations.

8.3.10 The closest proximity of vegetation to the bridge edge/parapet will be defined by the maintained height of that vegetation. For example, a hedgerow to be maintained at a height of 4m would be planted no closer than 4m to the bridge edge.

8.3.11 Where the provision of the green bridge is specifically for bats, the design shall be in accordance with the design specification for permanent bat flight path within section 10 of the Ecology Technical Standards.

Design specification - Type 1

8.3.12 The key objective of these bridges is to avoid significant adverse impacts to the FCS of the Bechstein bat populations concerned.

8.3.13 As a minimum, a vegetated width of 30m shall be required for type 1 green bridges. This shall comprise a 12m double hedgerow and grassland core vegetated zone, with an additional 9m of vegetated surface on either side.

8.3.14 The core vegetated zone of type 1 green bridges shall be maintained as a wide double hedgerow (with each hedgerow individually measuring at least 3m wide, plus a gap of at least 3m between the two hedgerows). On the outside of both hedgerows, a minimum provision of 1.5m of meadow grassland shall be made as a further habitat buffer for the hedgerows. The base of the hedgerows and gap area in between shall be sown with an appropriate grassland mix, locally sourced where possible.

8.3.15 The additional vegetated surface (on either side of the core vegetated zone) should comprise short-sward species-rich grassland, or open mosaic habitat (or a mixture of both).

8.3.16 The vegetated areas outside of the core vegetated zone on type 1 green bridges could support a farm access track, bridleway and/or footpath, but these shall not be hard-surfaced or artificially lit.

- 8.3.17 Footpaths and/or bridleways could also be accommodated within the gap between the hedgerows of the core vegetated zone, but these shall not be hard-surfaced, artificially lit, or more than 4m in width.
- 8.3.18 Where the type 1 green bridge also provides for a road, the carriageway and any footways or verges associated with it shall be located outside of the 30m vegetated width (i.e. with no 'shared' areas). Similarly, any accesses or public rights of way with a paved surface shall be located outside of the 30m vegetated width.
- 8.3.19 The separation of these features may also necessitate the use of close-boarded fencing (or an appropriate green barrier) between the road or vehicular access and the green component of the bridge to reduce light spill and other disturbances from passing traffic. The need or otherwise for such fencing will be advised by a suitably experienced ecologist.
- 8.3.20 A suitably experienced ecologist's view shall be sought on the maturity and height of stock required for hedgerows on type 1 green bridges to ensure that it is fit for purpose at the time that impacts are incurred.
- 8.3.21 Consideration will need to be given to conditions to foster successful vegetation establishment, including plant specification, soil depth, drainage and aftercare.
- 8.3.22 Hedgerows on type 1 green bridges shall be maintained in the long-term at an appropriate height to be suitable to achieve the ecological objectives for the green bridge.
- 8.3.23 It is expected that hedgerows on type 1 green bridges should be at least 1.5m in height on the bridge decks and two metres on the approaches to those bridges at the time of impact.
- 8.3.24 Standard trees may be required at particular points, most likely on the approaches to and/or at either end of the bridge, to act as 'sign posts' for bats, but the need for these should be determined by a suitably experienced ecologist at the detailed design stage.
- 8.3.25 The hedgerows of the core vegetated zone of type 1 green bridges shall be extended at either end of the bridge structure to tie-in with the surrounding landscape, to maximise the likelihood of bats finding and using this corridor when arriving from surrounding areas.
- 8.3.26 Beyond this tie-in point, new woodland planting may be required to infill landscaped areas on either side of the bridge, depending upon the ecological and landscape character requirements identified during detailed design.
- Design specification - Type 2**
- 8.3.27 A number of such bridges have been identified where the bridges need to provide for the potential impacts of habitat severance and barrier effects upon particular species, or groups of species, of bat.

Ecology Technical Standards

8.3.28 The key objective of these bridges is to avoid significant adverse impacts to the FCS of the populations of the bat species concerned.

8.3.29 These green bridge types require the provision of a range of habitat types and structures within the vegetated zones, including elements of hedgerow and grassland as minimum. The bridges are likely to require the provision of continuous vegetated cover across the route.

8.3.30 As a minimum, the design shall accommodate a core vegetated zone of at least 12m, across the centre of each type 2 green bridge or away from the edges of the bridge as far as possible.

8.3.31 The core vegetated zone of each type 2 green bridge shall be maintained as a wide double hedgerow (with each hedgerow individually measuring at least 3m wide, plus a gap of at least 3m between the two hedgerows). On the outside of both hedgerows, a minimum provision of 1.5m of meadow grassland shall be made as a further habitat buffer for the hedgerows. The base of the hedgerows and gap area in between shall be sown with an appropriate species-rich grassland mix, locally sourced where possible.

8.3.32 Any additional bridge deck width required for the purposes of integration with the local landscape and topographical form, for example, should comprise short-sward species-rich grassland or open mosaic habitat (or a mixture of both) wherever possible. In combination with the core vegetated zone, an overall vegetated width of 20m or more is recommended.

8.3.33 Areas outside of the core vegetated zone on each type 2 green bridge could support a farm access track, bridleway and/or footpath, but these shall not be hard-surfaced or artificially lit. Footpaths and/or bridleways could also be accommodated within the gap between the hedgerows of the core vegetated zone, but these shall not be hard-surfaced (e.g. asphalt or concrete), artificially lit, or more than 4m in width.

8.3.34 Where the type 2 green bridge also provides for a road, the carriageway and any footways or verges shall be located outside of the 12m core vegetated zone (i.e. with no 'shared' areas). Similarly, any accesses or public rights of way with a paved surface shall be located outside of the 12m vegetated width.

8.3.35 The separation of these features may also necessitate the use of close-boarded fencing (or an appropriate green barrier) between the road or vehicular access and the green component of the bridge to reduce light spill and other disturbances from passing traffic. The need or otherwise for such fencing will be advised by a suitably experienced ecologist.

8.3.36 The suitably experienced ecologist's view shall be sought on the maturity and height of stock required for hedgerows on type 2 green bridges to ensure that it is fit for purpose at the time that impacts are incurred. Consideration will need to be given to conditions to foster successful vegetation establishment, including plant specification, soil depth, drainage and aftercare. Hedgerows shall be maintained in the long-term at

an appropriate height to be suitable to achieve the ecological objectives for the green bridge.

- 8.3.37 Standard trees may be required at particular points, most likely on the approaches to and/or at either end of the bridge, to act as 'sign posts' for bats, but the need for these should be determined by a suitably experienced ecologist at the detailed design stage.

- 8.3.38 The hedgerows of the core vegetated zone of type 2 green bridges shall be extended at either end of the bridge structure to tie-in with the surrounding landscape, to maximise the likelihood of bats finding and using this corridor when arriving from surrounding areas.

- 8.3.39 Beyond this tie-in point, new woodland planting may be required to infill landscaped areas on either side of the bridge, depending upon the ecological and landscape character requirements identified during detailed design.

Design specification - Type 3

- 8.3.40 A number of green bridges have been identified where the opportunity has been sought to green a component of an otherwise conventional overbridge. These form part of a wider network of replacement habitats and other features (such as underpasses and culverts), where the key objective is to achieve connectivity between habitats on either side of the railway, and to provide the opportunity for a broad range of wildlife types to cross the bridge, where such species are present.

- 8.3.41 Design of type 3 green bridges shall be dependent on target species requirements and shall be decided by the suitably experienced ecologist with guidance from relevant engineers and other disciplines as required, such as landscape architects.

- 8.3.42 The overall width of the bridge structure will largely be determined by its landscape and/or highway/access functions.

- 8.3.43 Vegetated zones (including hedgerow and grassland habitats) should run along either side of this type of green bridge (where shading and/or wind speed/turbulence do not become a significant limitation).

- 8.3.44 Bridges may have single or double vegetated zones, where divided, for example, by a highway or access. However, each zone should ideally accommodate a hedgerow and grassland buffer.

- 8.3.45 The need for single or double vegetated zones should be defined by the other functional requirements of the bridge and will depend in part upon the species groups utilising the bridge (other than bats), the location of habitat and/or landscape features on either side of the green bridge and the need to link and tie-in to these features. Such requirements should be determined by a suitably experienced ecologist.

- 8.3.46 Where a type 3 green bridge provides for a road, farm access track, bridleway and/or footpath, the whole of these (including footways and verges) shall be located outside of the vegetated zone(s) (i.e. with no 'shared' areas).

- 8.3.47 The separation of these features may also necessitate the use of close-boarded fencing between the road or vehicular access and the green component of the bridge to reduce light spill and other disturbances from passing traffic. The need or otherwise for such fencing will be advised by a suitably experienced ecologist.
- 8.3.48 Hedgerows on type 3 green bridges should be maintained in an appropriate condition in the long-term.
- 8.3.49 Tree planting may not be necessary for the intended function of this bridge type, unless there are other drivers to do so, such as landscape character and integration. Where possible the connection of planting from the green bridge should extend into the surrounding habitats.

Specification details - grassland for green bridges

- 8.3.50 The approach to grassland creation is dependent upon the desired habitat required. Unless a quick cover is required for a particular species need, this can be by sowing of an appropriate native wildflower meadow mix, locally sourced where possible.
- 8.3.51 Soil (physical and chemical) characteristics, and drainage requirements shall be determined by the desired grassland type to be created on each green bridge.
- 8.3.52 Consideration should be given to the location of grassland areas in proximity to bridge parapets to avoid heavy shading and to also ensure that sufficient rainfall is received.

Specification details - hedgerows for green bridges

- 8.3.53 Soil (physical and chemical) characteristics, and drainage requirements for the hedgerows on each green bridge shall be identified. Drainage is required to be sufficient to prevent waterlogging of the soils but should avoid rapid drying out of the soil.
- 8.3.54 As set out in Section 8.2, water recycling technology should be considered when designing drainage requirements.
- 8.3.55 Hedgerows should tie in with adjacent vegetation (particularly other linear features) to lead bats (and other wildlife) to the bridge crossing points and to ensure physical connectivity, and designs should include any measures required to encourage species to find and use these structures.
- 8.3.56 Positioning of hedgerow vegetation on the bridges should avoid areas of heavy shading which may occur in close proximity to the parapets. In addition, the parapets may also restrict the levels of rainfall received by these areas.

Specification details – standard tree planting for green bridges

- 8.3.57 Soil (physical and chemical) characteristics and drainage requirements for standard tree planting on each green bridge shall be identified. Where drought stress is assessed as being a potential issue, the design should focus surface run-off and subsurface drainage from adjacent areas in to these habitat areas. This could require provision of a bespoke system.

- 8.3.58 Shallow rooted tree species shall be used only where restricted soil depths are available.
- 8.3.59 If following design, drought is still considered to be a potential issue, drought resistant species should be used where appropriate.
- 8.3.60 Native trees should be used for planting and should be in keeping with the local landscape character. Relevant technical standards should be followed such as the Landscape Design Approach (HS2-HS2-EV-STR-000-000010 Revision: Po2).
- 8.3.61 Consideration should be given to the risk of wind-blow/ throw, to minimise potential health and safety implications where close to the operational rail line. Details of the rooting depth of a range of native trees for a range of soil types can be found in the Forestry Commission Note 'Influence of Soils and Species on Tree Root Depth'⁴¹.
- 8.3.62 Standard trees for each type of green bridge shall be a minimum of 5m tall (when planted) or of a height that meets the functional requirements as advised by a suitably experienced ecologist.

Target performance – All types

- 8.3.63 The overall target of the green bridge (all types) shall be:

- To maintain safe movement and dispersal of animals and plants from one side of the railway to the other.
- To avoid significant adverse impacts to the FCS of species for which they have been designed.
- To provide clear connectivity across the route for the target species.
- To achieve healthy plants and vegetation communities that are not unduly water-stressed or nutrient deprived.

Performance requirements – All types

- 8.3.64 The establishment of viable vegetation communities and provision of long-term habitat connectivity.

⁴¹ Forestry Commission (2005); The Influence of Soils and Species on Tree Root Depth. Information Note, Forestry Commission, Edinburgh
[http://www.forestry.gov.uk/pdf/fcino78.pdf/\\$FILE/fcino78.pdf](http://www.forestry.gov.uk/pdf/fcino78.pdf/$FILE/fcino78.pdf)

9 Culverts, underpasses and fencing

9.1 Approach

- 9.1.1 Although species specific requirements for mitigation are covered within other Chapters, this Chapter brings together the design requirements for protected and notable species, including fish, as they relate to culverts, underpasses and fencing.
- 9.1.2 Due to the legislative protection afforded to several target species, the implementation of some of the measures within this Chapter may require a licence under the Wildlife and Countryside Act 1981 (as amended) and/or the Conservation of Habitats and Species Regulations 2017. Their implementation may also be required in support of a licence.

Approach to route permeability

- 9.1.3 Broadly, the railway (and the route-wide fencing) is expected to provide permeability for fauna species. As such, fencing should be permeable to some species groups and concrete sills (where used) should be positioned at grade with the fence line/surrounding landscape to ensure a level of permeability for smaller animals. In general, fencing should not be permeable to rabbit or larger animals.
- 9.1.4 In many cases, amphibians and reptiles may be expected to pass freely beneath the tracks without risk of significant mortality effects and, as such, no specific measures to address connectivity are proposed for these groups.
- 9.1.5 However, where the risks of amphibian colonisation/ entrapment cannot be designed out, consideration should be given by designers to the use of amphibian exclusion fencing around features in which the operational maintenance of HS2 infrastructure may be compromised by amphibian (specifically great crested newt) presence.
- 9.1.6 Water vole and hazel dormouse are not expected to cross the railway track, except in exceptional circumstances.
- 9.1.7 Where a high risk of mortality of otter and badger has been identified, otter and badger fencing and safe crossing points in the form of culverts, underpasses and underbridges should be provided to reduce the risk.
- 9.1.8 By utilising methods such as landscape design it is expected that the use of fencing can be minimised. Innovation is encouraged, especially where sustainable solutions can be provided, and if any innovative design proposals are considered not to comply with this standard, then a departure application can be made.
- 9.1.9 Where required as part of the mitigation design, bat flight paths (particularly key commuting routes which need to be maintained to avoid significant effect) should be protected using close-boarded fencing (to minimise light spill) in addition to landscaping. High bat fencing (mesh) should be used to guide bats to safe crossing points under or over the Scheme in key areas where this is required to address the risk of bat mortality (also see Chapter 8: Green bridges). At Sheephouse Wood (Phase 1), a dedicated structure will be constructed to avoid Bechstein's bats accessing the HS2

route (also see Chapter 10: Bats (including proposed structure at Sheephouse Wood, roosts and temporary navigation features)).

- 9.1.10 Deer may be expected to cross the HS2 route at underbridges and overbridges, and at green bridges (see Chapter 8: Green bridges). Fencing requirements for deer should follow that set out in the Fencing Technical Standard. Where the presence of deer has been identified as requiring an underbridge these should be sized accordingly.

9.2 Design specification – ecological culvert design

Target performance

- 9.2.1 To provide and maintain a suitable route for passage of the target species along a watercourse crossed by the HS2 route.

Performance requirements

- 9.2.2 The length of culverts shall be reduced to the shortest reasonably practicable length and located as close to the existing watercourse alignment as reasonably practicable.

- 9.2.3 Box (rectangular) culverts should be the preferred option.

- 9.2.4 Culvert width should be set to that of the natural low-flow channel (use of multiple culverts of smaller dimensions is unacceptable where passage of mammals is a requirement).

- 9.2.5 Culverts should allow as much daylight in as reasonably practicable.

- 9.2.6 Minimum culvert size and other minimum dimensions and specifications are contained in Technical Standard – Cross Drainage (HS2-HS2-DR-STD-000-000001), except where specified in the ecological requirements provided below.

- 9.2.7 For water vole, otter and badger, where provision of passage through a culvert is required the following points shall be followed / implemented:

- Where provision of passage is required, the culvert design shall provide a minimum 500 mm wide dry passage during 1 in 5 year flood conditions.
- Where this cannot be achieved, a mammal ledge(s) shall be provided at least along one side and must be a minimum 500 mm wide. The mammal ledge width can be reduced to 150 mm where passage for water vole only is required.
- It must be located 150 mm above the 1 in 5 year flood level and provide at least 600 mm headroom (measured from the centre of the ledge).
- Access ramps to any ledges shall be provided from the river bank, and ledges linked and landscaped appropriately so that otter, badger and other mammals will use them. The surface of ramps must be sufficiently roughened as to provide grip.
- Where it is not possible to design a culvert to meet these requirements for

badger and/or otter, a separate underpass shall be provided.

9.2.8 Where the culvert is intended to maintain a bat commuting route the following shall apply:

- It shall provide at least 2.5 m height above 'normal' water level (QMED), and be at least 2.5 m wide. The HS2 Technical Standard – Hydraulic Modelling (HS2-HS2-EV-STD-000-000013) provides information on QMED and how it should be calculated.
- An exclusion zone devoid of suitable bat habitat shall be created above the culvert, to dissuade bats from using areas where they are at risk of collision with (or vulnerable to the turbulence from) passing trains. This shall include the area up to 6 m above and to either side of the entrance, at and above the level of the top (ceiling or obvert level) of the culvert.
- Bat fencing shall be installed above the culvert entrance. Where there is a risk of light spillage from the railway onto the culvert entrance of flight approaches, close-boarded fencing shall be used. Where both bat fencing and close-boarded fencing are required, the designer must design a single barrier, which achieves the Performance requirements of both Design Specifications.
- Close-boarded fencing must be used to guide bats to culvert entrances where vegetation cannot be established, or as a temporary measure until vegetation has established.
- Prior to operation of the Scheme, connecting hedgerows shall be in place to guide bats directly to the culvert, with no gap in cover between the hedgerow and the start of the culvert. A suitably experienced ecologist's view shall be sought on the maturity and height of stock required for the culvert to ensure that it is fit for purpose at the time that impacts are incurred.
- Hedgerows shall be maintained in the long-term at an appropriate height to be suitable to achieve the ecological objectives for the culvert..

9.2.9 Consideration will need to be given to conditions to foster successful vegetation establishment, including plant specification, soil depth, drainage and aftercare.

9.2.10 Care should be taken to avoid causing bats to potentially fly directly across the railway rather than use the culvert. As such, vegetation planting within 20m of the culvert should not create a canopy height (at maturity) of more than 1 m below the top of the culvert.

9.2.11 Where the culvert is identified on a Bechstein's bat commuting route, it shall provide at least 4 m height above 'normal' water level (QMED), and be at least 4 m wide. The HS2 Technical Standard – Hydraulic Modelling (HS2-HS2-EV-STD-000-000013) provides information on QMED and how it should be calculated.

9.2.12 For fish, the following should apply:

- The required design criteria for culverts for salmonids are those recommended by the Scottish Executive (Anon, 2000⁴²), with some modifications, notably to include coarse fish, presented in the Fish Pass Manual (Environment Agency 2010⁴³) and for eel and elver in the Provision of Upstream Migration Facilities for Eel and Elver (Environment Agency 2004⁴⁴).
- Key considerations are local topography, river characteristics, flow and species to be accommodated. Successful fish passage through a culvert requires conditions that must include adequate swimming space, adequate depth of water, appropriate water velocity and no physical or behavioural barriers.
- To achieve this, align culverts with the direction and gradient of the existing watercourse to provide a stable hydraulic regime upstream and downstream and ensure approach conditions are within the sustainable swimming speeds of the target fish species. Use culverts with a high roughness coefficient to encourage boundary layer effects or install baffles, cementing rocks to the bed of the bore, or use of a metal framework to create flow conditions within a culvert suitable for fish passage.

Other considerations

9.2.13 The culvert shall be unlit and there shall be a designated dark area (maximum 0.5 lux) within 50 m of the entrance to the culverts.

9.2.14 If artificial lighting is required for health and safety reasons, this shall only operate on a motion-triggered basis. The motion triggers shall be designed to ensure they are not triggered by the species utilising the culvert.

9.2.15 Pools should be provided at each end of culverts where required to provide rest areas for fish.

9.2.16 Any grille shall have an aperture no smaller than width 250 mm and height 250 mm at the mammal ledge to allow the passage of otter and badger. Where the culvert is to be located on a bat commuting route and a grille must be fitted, the horizontal spacing between bars shall be between 130 mm-150 mm and the vertical spacing shall be between 450 mm-500 mm to allow the passage of bats.

⁴² Anon, (2000) River Crossings and Migratory Fish: Design Guidance.

⁴³ Environment Agency (2010) Fish Pass Manual.

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/298053/geho0910btbp-e-e.pdf.

⁴⁴ Environment Agency (2004) Provision of Upstream Migration Facilities for Eel and

Elver. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/291066/scho1204bime-e-e.pdf.

9.3 Design specification – mammal underpasses

Target performance

- 9.3.1 To provide and maintain a suitable route for passage of badgers and otters across the HS2 route.

Performance requirements

- 9.3.2 Mammal underpasses for badger shall be located where the suitably experienced ecologist confirms the territory of a social group will be severed to a significant extent.
- 9.3.3 In addition, at watercourses where passage for badger and otter is required, but where the design of the culvert(s) does not allow sufficient width and/or headroom then separate mammal underpasses (suitable for both otter and badger) shall be provided in alternative locations, as follows:

- As close to the culvert as reasonably practicable possible, and no more than 50m from the watercourse; and
- Above possible flood levels (at least, above 1 in 5 year level).

- 9.3.4 Mammal underpasses shall be used away from watercourses where otter would otherwise be likely to cross the Scheme and be at risk of mortality.

- 9.3.5 Minimum mammal underpass size shall be: 600 mm height x 500 mm width.

- 9.3.6 Underpasses should be widened at the entrance to form a funnel shape where reasonably practicable to do so.

- 9.3.7 Appropriate otter and badger fencing shall be installed around the tunnel entrance to prevent badger or otter accessing the HS2 route.

- 9.3.8 A suitably experienced ecologist's view shall be sought on the design of fencing to ensure that it is fit for purpose in the context of existing use by otter and badger, and the Scheme design in the local area.

- 9.3.9 Planting design should be checked for compliance with requirements for other species (such as bats) and any conflicts which could cause reduction in performance should be recorded and a solution and/deviation from the specification agreed with HS2 Ltd before completion of the design.

- 9.3.10 There shall be suitable drainage throughout the mammal underpass. The entrances shall be well-drained.

- 9.3.11 Any grille shall be designed to have a minimum aperture of 250 mm x 250 mm at ground level to allow the passage of otter and/or badger.

9.4 Design specification – ecological underbridge design

- 9.4.1 This specification relates to all pedestrian or farm/ private access underbridges where the need to provide passage for wildlife has been identified. This includes those structures that are required specifically for wildlife passage, and those for which the passage of wildlife is incidental to their primary function. This specification is not intended for use on underbridges for public roads or other railways.

Target performance

- 9.4.2 The overall targets for ecological underbridges shall be:

- To enable wildlife to cross under the railway line safely.
- To reduce fragmentation between habitats and reduce significant loss of territory due to severance.
- To avoid or reduce the risk of wildlife mortality on the railway.

Performance requirements

- 9.4.3 Ecological underbridges shall be used to provide dedicated crossing points along key commuting routes for bats. The alignment of the underbridge shall be determined in consultation with a suitably experienced ecologist, and in most instances will be within 10m of a known flight path.

- 9.4.4 Species rich hedgerows with trees should be used to encourage bats to divert their flight paths to reach the underbridge. The hedgerows which lead to the underbridge should be dense and at least 2 m high, and contain trees.

- 9.4.5 The underbridge shall be designed with dimensions appropriate for the target species.

- 9.4.6 The structure should have a rectangular cross section, and should normally be 2.5m high and 2.5m wide.

- 9.4.7 Where the underbridge is intended to maintain a bat key commuting route the following shall apply:

- An exclusion zone devoid of suitable bat habitat shall be created above the underbridge, to dissuade bats from using areas where they are at risk of collision with (or vulnerable to the turbulence from) passing trains. This shall include the area up to 6 m above and to either side of the entrance, at and above the level of the top (ceiling or overtop level) of the underbridge.
- Bat fencing shall be installed above the underbridge entrance. Where there is a risk of light spillage from the railway onto the underbridge entrance of flight approaches, close-boarded fencing shall be used. Where both bat fencing and close-boarded fencing are required, the designer must design a single barrier, which achieves the performance requirements of both Design Specifications.

Ecology Technical Standards

- Close-boarded fencing must be used to guide bats to underbridge entrances where vegetation cannot be established, or as a temporary measure until vegetation has established.
- Prior to operation of the Scheme, connecting hedgerows shall be in place to guide bats directly to the underbridge, with no gap in cover between the hedgerow and the start of the underbridge. An ecologist's view shall be sought on the maturity and height of stock required for the underbridge to ensure that it is fit for purpose at the time that impacts are incurred.
- Hedgerows shall be maintained in the long-term at an appropriate height to be suitable to achieve the ecological objectives for the underbridge..

9.4.8 Consideration will need to be given to conditions to foster successful vegetation establishment, including plant specification, soil depth, drainage and aftercare.

9.4.9 Care should be taken to avoid causing bats to potentially fly directly across the railway rather than use the underbridge. As such, vegetation planting within 20m of the underbridge should not create a canopy height (at maturity) of more than 1m below the top of the underbridge.

9.4.10 Where the underbridge is located to maintain a Bechstein's bat commuting route, it shall be at least 4m high and 4 m wide.

9.4.11 Where the underbridge is intended for use by badgers and / or otters appropriate fencing should be installed on both sides of the railway and a minimum of 50 m each way from the underbridge. It should be positioned such that it may guide badgers / otters towards the underbridge.

9.4.12 Prior to operation, habitat connectivity between the underbridge and existing landscape features such as hedgerows shall be provided. Shrubs or other vegetation shall be provided on either side of the entrance and approach.

9.4.13 Where the underbridge is intended to be used by deer, the following shall apply:

- Be at least 4 m high;
- Its cross-sectional area shall increase with increases in length; and
- Its substrate must include earth or grass along the whole length of the underbridge.

9.4.14 Fencing should be installed on both sides of the railway and up to 50 m each way from the underbridge. It should be positioned such that it may guide deer towards the underbridge.

9.4.15 For all mammal underpasses an appropriate 'openness index' of the underbridge shall be devised by the suitably experienced ecologist based upon the target deerspecies.

- 9.4.16 The 'openness index' is based on the underpasses height x width / length as set out in Langbein (2010)⁴⁵.

9.4.17 The underbridge shall not normally be lit artificially, however if artificial lighting is required for health and safety reasons, this shall operate on a motion-triggered basis.

- 9.4.18 Lighting levels in the vicinity of the underbridge should be strictly controlled through screening with close boarded fencing or vegetation.

- 9.4.19 There should be suitable drainage throughout the underbridge.

9.5 Design specification – bat fencing

Target performance

- 9.5.1 The overall targets for bat fencing shall be:

- To prevent / deter bats from accessing the line at locations where potential significant adverse effects have been identified during ecological assessment.
- To encourage the bats to cross at safe locations.

Performance requirements

- 9.5.2 At locations where required, bat fencing shall be integrated with the HS2 route-wide fencing.
- 9.5.3 The bat fencing will be designed in consultation with a suitably experienced ecologist. The height of the fencing will be the minimum required to encourage bats to safely cross the Scheme at the given location. Fencing will extend up to 50m either side of the existing or proposed flight corridors (refined on a case-by-case basis by a suitably experienced ecologist at detailed design).
- 9.5.4 Mesh size (maximum aperture) shall be 12.5 mm.
- 9.5.5 In applicable situations, to further minimise the risk of bats accessing the Scheme, the suitably experienced ecologist may deem it necessary to create a bat exclusion zone adjacent to the fence on its outer side. This should extend at least 3 m from the fence, and vegetation within this area should be removed and recolonisation by plants prevented and/or regrowth controlled and managed.
- 9.5.6 Alternatives to mesh fencing such as planting of new vegetation, the use of a line of potted shrubs/trees, or willow woven fencing could be used in situations where it can be demonstrated that these would be effective.

⁴⁵ Langbein, J. (2010) Pilot study to assess the potential of selected existing structures on the A30 and A38 trunk roads to provide safer crossing places for deer. Langbein Wildlife Associates.

9.6 Design specification – close-boarded fencing (bats)

Target performance

9.6.1 The overall target for close-boarded fencing (bats) shall be:

- To prevent light spill on to bat flight corridors.
- To guide bats towards suitable crossing points or along flight paths parallel and close to the line.
- To guide bats where connecting habitat cannot be established or where there is a temporary breach of connectivity.

Performance requirements

9.6.2 Where it is required, the close-boarded fence shall be integrated with the HS2 route-wide fencing.

9.6.3 It shall prevent the passage of light (for example, it is envisaged that it could be made from timber boards, with no gaps.). Light levels in areas where close-boarded fencing has been used to provide mitigation for bats, post construction must not exceed 0.5 lux compared to pre-construction levels.

9.6.4 It shall connect directly with established vegetation where filling gaps in flight paths.

9.6.5 Minimum height of close-boarded fencing shall be 3 m above ground level.

9.6.6 Where identified by the suitably experienced ecologist, to further minimise the risk of bats accessing the Scheme, it may be necessary to create a bat exclusion zone adjacent to the fence on its outer side. This should extend at least 3 m from the fence (except on green bridges), and vegetation within this area should be removed and recolonisation by plants prevented and/or regrowth controlled and managed.

9.6.7 Where no sources of artificial lighting other than from passing trains would be likely to impact bats, an alternative to close-boarded fencing such as mesh fencing.

9.6.8 Alternatives to close-boarded fencing such as planting of new vegetation, the use of a line of potted shrubs/trees, or willow woven fencing could be used in situations where it can be demonstrated that these would be effective.

9.7 Design specification – otter and badger fencing

Target performance

9.7.1 The overall target for otter and badger fencing shall be to:

- To avoid mortality of badger and otter on the railway in locations where significant risk has been identified by the suitably experienced ecologist.
- To direct badger and otter to safe crossing points.

Performance requirements

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| 9.7.2 | The otter and badger fence shall be integrated with HS2 route-wide fencing. |
| 9.7.3 | Where used solely by badger, mesh shall extend at least 1000 mm above ground. |
| 9.7.4 | The mesh shall be firmly attached to, or incorporated into, a concrete sill, or extended below ground for a minimum of 300 mm and with a return of at least 300 mm. |

Where the risk of badgers digging beneath the fence is highest, or where manufacturers' recommendations dictate it, consideration should be given to extending the fence to a depth of 600 mm.

- 9.7.5 Where covered by an organisational licence (also known as a route-wide licence), any variation to required badger fencing would need to be approved by HS2 Ltd.

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| 9.7.6 | Where otter are present, mesh shall extend at least 1500 mm above ground, with an additional 300 mm at the top, aligned outward at 45 degrees in the direction from which otters will approach. |
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| 9.7.7 | The fence shall comprise galvanised weld mesh, with a maximum aperture of 50 mm |
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- 9.7.8 Any feature along the line of fencing which may create a 'weak spot', such as ditch crossings and drain outfalls, should be designed to prevent access by badger/otter.

- | | |
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| 9.7.9 | Vehicle / pedestrian access gates in the otter and / or badger fencing shall have the correct size mesh fitted to the inside and a concrete slab underneath. The gate shall close to leave a gap of no more than 10 mm between the slab and the bottom rail, and shall be sprung so they close automatically. |
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9.8 Design specification – water vole fencing

Target performance

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| 9.8.1 | The overall target for water vole fencing shall be: |
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| <ul style="list-style-type: none">• To prevent the movement of water voles into construction areas in locations where significant risk has been identified by the suitably experienced ecologist.• To facilitate water vole translocation operations. |
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Performance requirements

- 9.8.1 Water vole exclusion should be carried out in accordance with Dean et al (2016)⁴⁶.

⁴⁶ Dean, M., Strachan, R., Gow, D. And Andrews, R. (2016) *The Water vole Mitigation Handbook*. The Mammal Society Eds. F Mathews and P Chanin.

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| 9.8.2 | Water vole fencing shall be set greater than 5 m back from the edge of the watercourse. |
| 9.8.3 | The minimum height (above ground) of water vole fencing installed shall be 1.2 m. |
| 9.8.4 | Water vole fencing shall be buried below ground to a depth of 700 mm, and should include a below ground return turned out towards the direction of approach. |
- 9.8.5 The fence should be constructed from rigid plastic panels, or plywood. Strong wire mesh (with an aperture diameter of 15 mm or less) could be used, but only in association with a baffle to prevent access over the top (were water voles to attempt climbing the mesh).
- 9.8.6 The fencing materials should be attached to the flat face of supporting posts to ensure a level join, with posts always on the opposite side to that on which the water voles are expected to remain.

9.8.7	Water vole fencing shall be installed under the supervision of an ECoW.
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- 9.8.8 Any feature along the line of fencing likely to create a 'weak spot', such as ditch crossings and drain outfalls, should be designed to prevent access by water voles.

Monitoring and maintenance

- 9.8.9 Monitoring of water vole fence lines should be carried out for the duration of their required use. This should be daily during trapping and translocation operations, but may be less frequent at other times when not in use (as advised by the suitably experienced ecologist).
- 9.8.10 Maintenance measures should include keeping any fence barrier intact and free of debris or vegetation that may cause breaches of integrity.

9.9 Design specification – amphibian and reptile fencing (temporary and permanent)

Target performance

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| 9.9.1 | The overall target for amphibian and reptile fencing (temporary and permanent) shall be: |
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| <ul style="list-style-type: none">• To prevent the movement of amphibians and / or reptiles into construction areas in locations where significant risk has been identified by the suitably experienced ecologist.• To facilitate amphibian and / or reptile translocation operations. |
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Performance requirements

9.9.2	The design, installation and use of all amphibian exclusion fencing shall follow the principles of exclusion as set out within the Great Crested Newt Mitigation Guidelines (Natural England, 2001).
9.9.3	Table 9.1 gives options for consideration as to the fence/barrier type required and their potential for successful use as exclusion measures for great crested newts and reptiles.
9.9.4	Where both GCN and reptile fencing is required, appropriately designed fencing should be employed which is suitable for both GCN and reptiles.
9.9.5	By utilising methods such as landscape design it is expected that the use of fencing can be minimised.
9.9.6	Any variation to amphibian and reptile fencing required under a licence shall need to be approved by HS2 Ltd under the terms of the organisational licences.

Monitoring and maintenance

9.9.7	Monitoring of amphibian and / or reptile fence lines shall be carried out for the duration of their required use. This shall be daily during the period when the traps are open, but a monthly check shall be implemented for the duration of their use during the hibernation period of the target species.
9.9.8	Maintenance measures should include keeping any fence barrier intact and free of debris or vegetation that may cause breaches of integrity.

Table 9.1 Amphibian and reptile fence decision table

Fence/Barrier Type	Recommended use	Design Source	Purpose			Cost	Susceptibility to Damage	Sustainability	Maintenance requirements	Other notes
			Drift	Temp	Perm					
1. Plastic fence grade 1000 gauge, with wooden post fence.	Best used for drift fencing. Due to this having a lightweight gauge it can become damaged easily. If used for temporary fencing, avoidance of clear (uncoloured transparent or translucent) plastic is advised. Only to be used for short duration – six months to three years.	English Nature. 2001. Great crested newt mitigation guidelines, English Nature, Peterborough. Section 8, Figure 4, Page 50	Yes	Yes	No	Low	High	Can be used once only, plastic and wood waste.	High	Can entrap invertebrates in flap like folds at top, which if using clear plastic can result in bird damage through predation of insects. Can be subject to damage from other animals and through human anti-social behaviour.
2. Geotextile and wooden post fence.	Best used for temporary fencing and likely lasts around five years.	English Nature. 2001. Great crested newt mitigation guidelines, English Nature, Peterborough. Section 8, Figure 4, Page 50	No	Yes	No	Low	Moderate	Can be used once only, geotextile sheet and wood waste.	Moderate	Great crested newt can occasionally climb this material, but this is outweighed by its robustness over plastic 1000 gauge fencing. Can be subject to damage from human anti-social activities.
3. Partially flexible plastic modular fencing, bolted together	Best used for temporary fencing where risk of damage is more likely and where duration is required for 5-30* years (*subject to product statement).	Several commercially available brands	No	Yes	Yes	Moderate	Low (some brands can be driven over and remain free of damage which may be useful for site access routes)	Can be re-used either within same project elsewhere or re-sold if undamaged; or re-cycled.	Moderate	Rapid installation if ploughed in from tractor mounted plough – flat ground more feasible for this method.

Fence/Barrier Type	Recommended use	Design Source	Purpose			Cost	Susceptibility to Damage	Sustainability	Maintenance requirements	Other notes
			Drift	Temp	Perm					
4. Rigid modular plastic fencing, with steel staple supports.	Best used for temporary fencing where more robust fencing measures are required and for a period of 5 – 15 years. Potential for metal staples to get stolen – avoid its use on high risk sites.	HA. 2001. Volume 10 Section 4 Part 6 HA 98/01 Nature Conservation Management Advice in Relation to Reptiles. HA website. Volume 10, Section 4, Part 7, Annex B, page B/4	No	Yes	Yes	Moderate	Low	Can be re-used or re-cycled.	Moderate	Steel staples may get stolen.
5. HDPE sheeting panel, with wooden supports that can be free-standing or attached to boundary fences.	Best used for temporary fencing that needs to be attached to other boundary or security fencing. This method can be used where both amphibian and reptile exclusion is required.	HA. 2001. Volume 10 Section 4 Part 6 HA 98/01 Nature Conservation Management Advice in Relation to Reptiles. HA website. Volume 10, Section 4, Part 7, Annex B, page B/3	No	Yes	Yes ⁴⁷	Moderate	Moderate	Can be re-used or re-cycled.	Moderate	For free-standing use: rapid installation if ploughed in from tractor mounted plough – flat ground more feasible for this method. Note for amphibian use these fence panels require the return flaps at the base which are sunken underground.
6. One-way fence, using longitudinal section of 600mm diameter twin-walled plastic	Best used where requirement for semi-permanent to permanent one way fence and/or where visual intrusion may be an issue.	HA. 2001. Volume 10 Section 4 Part 6 HA 98/01 Nature Conservation Management Advice in Relation	No	Yes	Yes	Moderate	Low	Can be re-used or re-cycled.	Moderate	In DMRB this refers to its use for reptiles, but can also be used for amphibian exclusion or may be used where both species groups require exclusion.

⁴⁷ (unknown, but likely five years)

Fence/Barrier Type	Recommended use	Design Source	Purpose			Cost	Susceptibility to Damage	Sustainability	Maintenance requirements	Other notes
			Drift	Temp	Perm					
pipe, partially sunken and backfilled behind	Likely duration of this fence is 5-15 years.	to Reptiles. HA website. Volume 10, Section 4, Part 7, Annex B, page B/4								Can be awkward to install. One-way fence only. Can be less visually intrusive.
Concrete fencing sections	Best used where a permanent fence is required for 10-50 years.	Several commercially available brands	No	No	Yes	High	Low	Aimed for long term use, but can be re-used to some extent.	Moderate	Some brands are for one-way use, some upright. Costs can be prohibitive.
7. Ha-ha – Creation of a tick shaped channel with plastic projecting lip, as an alternative exclusion measure.	Potential to be used where fencing is non-desirable due to visual impacts and for mid-to long term period (structural elements may need re-design dependant on longevity). Has restrictions for its use in certain soils types (free- draining soils only).	None, alternative proposal to fencing.	No	Yes	Yes	Moderate to high ⁴⁸	Moderate	Lower use of plastic and other materials.	Moderate to high	Subject to NE review and acceptance. Several associated pros and cons including: - Slumping/cracking of soils a potential issue. - Can only be used on free draining soils where infiltration rate unlikely to exceed drainage rate.

⁴⁸ (taking construction and maintenance costs together)

10 Bats

10.1 Approaches

10.1.1 To address impacts on bats that cannot be avoided, the various mitigation measures during construction and operational phases for bats fall under four main categories:

1. Mortality avoidance mitigation measures;
2. Habitat connectivity and fragmentation mitigation measures;
3. Foraging habitat mitigation measures; and
4. Roost impacts (loss and disturbance) mitigation measures.

10.2 Licencing of activities

10.2.1 Due to the high level of legislative protection afforded to bats, some of the mitigation measures described within this Chapter can only be implemented under a European Protected Species (EPS) licence, obtained from Natural England.

10.2.2 All licensable works affecting bats shall be undertaken in accordance with the relevant EPS licence.

10.2.3 HS2 Ltd shall be informed of all licence applications and will need to approve licence applications where monitoring requirements extend beyond the period of the Contractors involvement in the Scheme.

Use of non-standard methods – Natural England’s Licencing Policies

10.2.4 In implementing mitigation and compensation measures for bats, a combination of traditional, standard, ‘best practice’ shall be used, but also drawing upon Department for Environment, Food and Rural Affairs (Defra) Licensing Policies.

10.2.5 Where the application of the licencing policies is being considered, contractors should discuss this with Natural England and take account of any relevant guidance from HS2 Ltd and Natural England.

10.3 Information required for detailed design

Additional Survey Information

10.3.1 The following information is required to allow the selection of design specifications to be made:

- Survey and re-survey requirements should be carried out in accordance with the requirements of the relevant licence and recognised best practice.
- The requirement to re-survey will depend upon:
 - Whether the initial survey has been completed in accordance with the requirements of the relevant licence and /or recognised best practice ; and
 - The application of professional ecological judgement, on a case by case basis, to

determine whether surveys are sufficiently up-to date to provide the required level of information relating to a site, the roost type(s) and its complexity.

10.4 Mitigation - Detailed Design

10.4.1 The survey information and project programme will inform the development of the detailed design of the mitigation measures required for roosting bats. This should take account of the following:

- The number, type and location of roosts affected;
- The extent of impacts at a species level within each bat population;
- Appropriate measures for working near retained roosts;
- Which roosts require measures to mitigate harm or removal;
- Appropriate locations for any compensation, taking into account current and potential connectivity; and
- Safe crossing points and habitat connectivity.

10.5 Selection of design specifications

10.5.1 The mitigation design for replacement roosts should follow Figure 10.1 (Roost flowchart).

10.5.2 The design of temporary and permanent mitigation for habitat connectivity and severance issues of commuting and foraging routes should follow Figure 10.2 (Flight path flowchart).

10.5.3 It should be noted that what is described in Figure 10.1 and 10.2 is guidance only and there may be instances where an alternative design is required. Guidance should be taken from a suitably experienced ecologist.

Figure 10.1 Roost flowchart

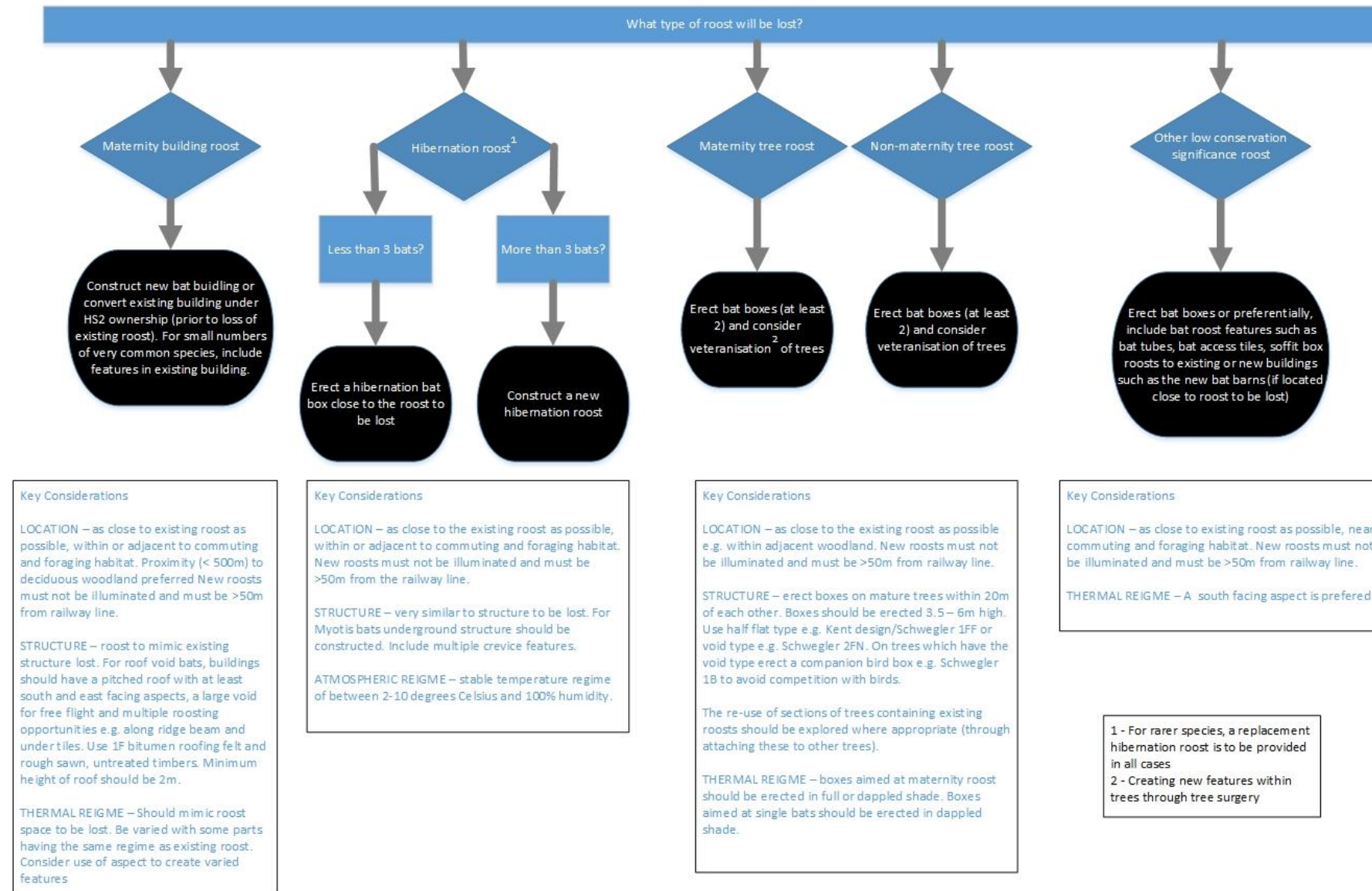
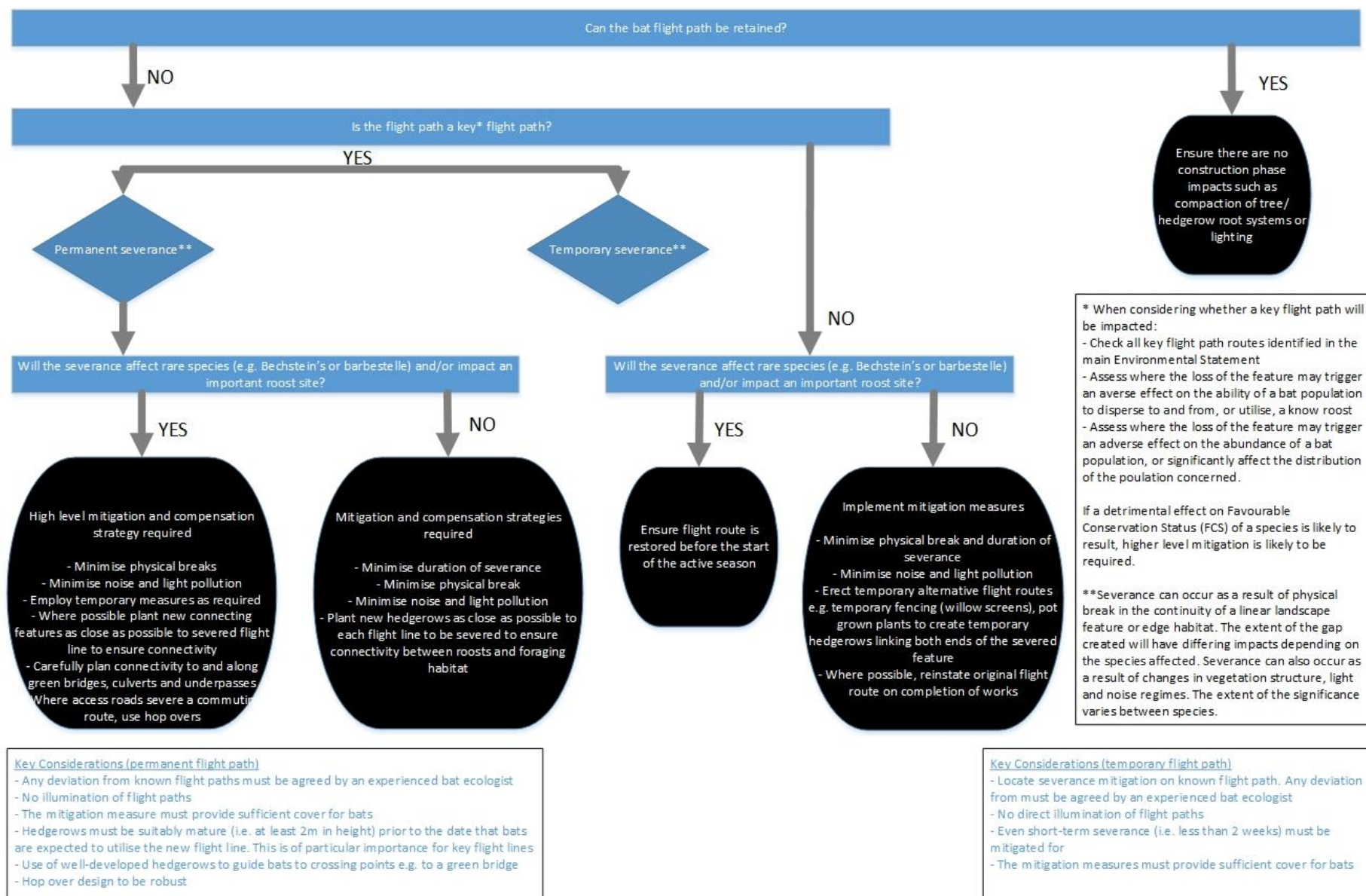


Figure 10.2 Flight path flowchart



Existing guidance

10.5.4 The following references should be referred to during the development of detailed design:

- Bat Surveys for Professional Ecologists: Good Practice Guidelines (The Bat Conservation Trust, 2016).
- Bats and artificial lighting in the UK – Guidance Note 08/18 (The Bat Conservation Trust, 2018).
- The Bat Mitigation Guidelines (English Nature, 2004).
- The Designing for Biodiversity Technical Guide (RIBA Publishing, 2013).
- Landscape and Urban Design for Bats and Biodiversity (The Bat Conservation Trust, 2012).
- The Bats and Road Construction guidance document (Limpens, Twisk & Veenbaas, 2005).
- The Highways Agency Interim Advice Note for bats (2008).
- The Highways Agency Review of Bat Mitigation in Relation to Highways Severance (2011).
- DEFRA's WC1060 Report 'Development of a cost-effective method for monitoring the effectiveness of mitigation for bats crossing linear transport infrastructure'.

10.6 Design specification – bat structure at Sheephouse Wood

- | | |
|--------|---|
| 10.6.1 | The Sheephouse Wood bat mitigation structure, which forms part of the High Speed Rail (London - West Midlands) Act 2017, shall be installed prior to operation of the route. |
| 10.6.2 | The response of bats to the mitigation structure shall be monitored to assess if it is effective and corrective actions are to be implemented in advance of operation if necessary. |

Target performance

- | | |
|--------|---|
| 10.6.3 | The overall target of the bat structure at Sheephouse Wood shall be to prevent the killing and/or injury of bats through operation of the railway, and to mitigate for the resultant fragmentation. |
|--------|---|

Performance requirements

- | | |
|--------|---|
| 10.6.4 | The Sheephouse Wood bat mitigation structure shall run the length of Sheephouse Wood. Its minimum extent will be from chainage 76+650 to chainage 77+500. |
| 10.6.5 | The design will incorporate measures to prevent bats from accessing the line, or any area with wind turbulence exceeding five m/s during the passage of trains alongside Sheephouse Wood. |
| 10.6.6 | It shall be designed such that bats are discouraged from using the structure as a roost. |
| 10.6.7 | The gauge of the mesh on the structure shall be a maximum of 25mm x 43mm. |
| 10.6.8 | The roof of the structure shall be composed of a solid material. |

- | | |
|---------|---|
| 10.6.9 | Bats shall be actively discouraged from crossing the line for at least 20m from both ends of the structure. |
| 10.6.10 | Deterrents shall be used to reduce the risk of bats accessing the structure or crossing the line within 20m of the ends of the structure, unless otherwise agreed with HS2 Ltd. |

Monitoring and maintenance

Monitoring

- | | |
|---------|--|
| 10.6.11 | To measure the success of the structure, an appropriate bat monitoring and maintenance plan shall be produced and agreed with HS2 Ltd. |
|---------|--|
- 10.6.12 If the pre-operation surveys record bats within the structure, appropriate remedial measures should be implemented prior to operation to dissuade bats from entering the structure.

10.7 Design specification – hop overs (for roads only)

Target performance

- | | |
|--------|---|
| 10.7.1 | The overall target performance for hop overs (roads only) shall be to provide suitable route for bats to cross roads and tracks that are no wider than 10m. |
|--------|---|

Performance requirements

- | | |
|--------|--|
| 10.7.2 | Hop overs shall be located on new roads which could fragment key foraging or commuting routes. |
|--------|--|
- 10.7.3 A hop over should comprise at least two large trees (existing or newly planted) set amongst existing or planted vegetation, on either side of the road or track where the canopy almost meets in the middle (providing an unbroken vegetated link).
- | | |
|--------|---|
| 10.7.4 | The trees for hop overs shall be located directly opposite each other on either side of the new road. |
|--------|---|
- 10.7.5 Existing trees may be used if they are deemed (by a suitably experienced ecologist) to be close enough to the new road to provide the function of a hop over.
- 10.7.6 Trees intended to function as part of the hop over should be at least 15m high, with at least two metre canopy spread, within three years of operation. Newly planted trees, where required, should be sufficiently mature at the time of planting to meet these dimensions.
- 10.7.7 The hop over points along the roads should not be lit. A dark zone of less than 0.5 lux should be maintained at all times within the bat active season within 10m either side of the hop over.

10.8 Design specification – flight paths (temporary and permanent)

Target performance

- | | |
|--------|--|
| 10.8.1 | The overall target of bat flight paths (temporary and permanent) shall be: |
|--------|--|

- | |
|--|
| <ul style="list-style-type: none">To provide connectivity for bats between the wider landscape, mitigation/compensation features and roosts. |
|--|

- To provide replacement bat commuting habitat.
- To provide temporary flight paths for bats during the construction phase.

Performance requirements

Permanent flight paths

- | | |
|--------|--|
| 10.8.2 | New permanent bat flight paths shall be created at selected locations where significant adverse effects to commuting habitat have been identified , or where it is required to help guide bats to cross the train line safely. |
|--------|--|
- 10.8.3 Permanent new flight paths should be created in locations away from existing commuting routes only where it is not reasonably practicable to install or reinstate them at the existing location and/or in an appropriate timescale. These locations should be selected based on known bat activity within the local area.
- 10.8.4 Permanent flight paths should comprise species rich hedgerows with trees.
- | | |
|--------|---|
| 10.8.5 | Permanent bat flight paths shall be designed to be ecologically functional for the species and impact level at that location and at the time of impact to the bat population. |
| 10.8.6 | Planting heights and widths shall be based upon recognised best practice and site specific evidence. |
- 10.8.7 It is expected that permanent bat flight paths should be at least 2m high and 1.5m wide at time of impact.
- 10.8.8 The hedgerows should be unmanaged (at least until target dimensions and structure are achieved) and have tall/rank grassland strips of at least one metre wide either side which will be managed as meadow.
- 10.8.9 Hedgerows should be ideally planted or translocated at least three years before bats are expected to use the hedgerow.
- 10.8.10 Permanent and temporary bat flight paths should not be artificially lit or be impacted by light spill of more than 0.5 lux.
- 10.8.11 Where possible, all bat flight paths (temporary and permanent) should not be lit.

Temporary flight paths

- | | |
|---------|---|
| 10.8.12 | Temporary bat flight paths, such as artificial hedgerows, shall be installed where known flight paths will be removed and where this could result in significant adverse effects. |
|---------|---|
- 10.8.13 The existing flight path should remain in existence for as long as reasonably practicable and only removed when it is essential to facilitate construction.
- 10.8.14 The function of the flight path is to help bats navigate through the landscape, provide foraging opportunities, to provide shelter from strong winds and protection from predation.
- | | |
|---------|---|
| 10.8.15 | The temporary bat flight paths shall connect up to existing/retained flight paths without gaps, and be installed at a height appropriate to the impacted flight path (as advised upon by the suitably experienced ecologist). |
|---------|---|

- 10.8.16 Temporary flight paths should comprise either a line of potted shrubs/trees, willow woven fencing, or wooden or close-boarded fencing (or a combination of these).
- 10.8.17 The features should be left *in situ* for as long as is reasonably practicable, and until such time that other mitigation has been implemented, where required.

10.9 Design specification – foraging habitat creation

Target performance

- | | |
|--------|---|
| 10.9.1 | The overall target of bat foraging habitat creation shall be to provide compensatory foraging habitat for woodland bat species (in particular). |
|--------|---|

Performance requirements

- 10.9.2 Applies to woodland creation areas in close proximity (within 500m) of where woodland will be removed, where this does not compromise primary functions of the woodland creation as outlined within the relevant chapter of this document.

- | | |
|--------|---|
| 10.9.3 | Locations for bat foraging habitat shall be identified by a suitably experienced ecologist. |
|--------|---|

- 10.9.4 Bat foraging habitat creation should, as a minimum, include all woodland habitat creation areas over 1ha where requirements for bats do not conflict with the primary reasons for woodland creation. It should ideally be located within 500m of existing key foraging and commuting routes.

- | | |
|--------|--|
| 10.9.5 | Woodland rides shall be created through areas of new woodland planting where these areas are large enough to accommodate such features and these are deemed to provide bat foraging habitat. |
|--------|--|

- 10.9.6 Woodland edges should also be established, employing scalloped edges where reasonably practicable. Care will need to be taken that woodland interior conditions are maintained.
- 10.9.7 The selected woodlands should contain a diverse range of at least seven native woody species. Ideally, this will include a dominance of oak (with a mixture of other faster growing species), with an understorey including hazel.

10.10 Design specification – bat roosts

Target performance

- 10.10.1 The overall target of bat roost creation should be:
- To provide bat barns/bat buildings to replace maternity roosts lost in buildings.
 - To replace hibernation roosts lost and to enhance the hibernation habitat for bats.
 - Bat boxes to replace roosts of lower conservation significant in buildings or to replace roosts in trees.
 - Features added to existing buildings to allow access for bats (where this can be achieved).

Performance requirements

10.10.2 The bat roost specifications have been divided into:

- Bat barns for maternity roost replacement in buildings for brown long eared bats and Natterer's bats;
- Bat building/wall for common pipistrelle;
- Hibernation roost – replacement and enhancement;
- Tree roost; and
- Bat boxes.

10.10.3 See Figure 10.1 for further information on bat roost replacement specification.

Bat barn

10.10.4 The bat barn should be located away from existing external artificial light sources with less than 0.5 lux within at least 50m in all directions from the bat barn.

10.10.5 The bat barn should be located within 50m of known fly-ways or hedgerow and tree lines used by the colony affected by the loss of an existing roost.

10.10.6 The bat barn shall be more than 50m from the high speed rail line, except where the line is in tunnel or other area with no collision risk.

10.10.7 The bat barn shall be located within 500m and no further than 1 kilometre of established woodland.

10.10.8 Consideration should be given to the long-term use and management of the land surrounding the bat barn location to ensure that there is no conflict with considerations such as lighting and connectivity to foraging habitat.

10.10.9 The bat barn shall be constructed prior to the demolition of the existing roost, ideally at least one active season in advance.

10.10.10 The new bat barn shall emulate the roof structure of the building to be lost, in terms of dimensions, materials and temperature regime.

10.10.11 The appearance of the bat barn must be considered in terms of a number of factors, including the threat of vandalism and blending in with the local landscape and other buildings.

10.10.12 Roost access via the bat barn shall mimic that to be lost, as far as reasonably practicable.

10.10.13 Materials should be replicated or recycled from those in the existing roost.

10.10.14 Breathable membranes shall not be used in the bat roosts.

10.10.15 Wooden timbers shall be used within the roof space of any bat barn.

10.10.16 The timbers, including the ridge board, should be constructed with rough sawn timber.

10.10.17 Dark coloured roof coverings should be used to help produce high roost temperatures.

Ecology Technical Standards

10.10.18 All timbers within the bat barn shall either be untreated or only treated with chemicals on Natural England's approved timber treatment list.

10.10.19 The bat barn should be designed to have at least two ridges at right angles, orientated to capture sunlight throughout the day.

10.10.20 New hedgerow/tree planting shall be undertaken to ensure that there is adequate connectivity between the bat barn and foraging habitat.

10.10.21 The bat barn should include an accessible loft hatch (locked) for monitoring and maintenance.

10.10.22 Features should be installed or designed within the roof space of the bat barn to ensure that there are a range of roosting locations.

Common pipistrelle bat building/wall

10.10.23 The new common pipistrelle building / wall should be located away from existing external artificial light sources with less than 0.5 lux within at least 50m in all directions.

10.10.24 The roost shall be 50m from the high speed rail line, unless the line is in tunnel or other area with no collision risk.

10.10.25 The bat building/wall shall be located close to suitable foraging habitat.

10.10.26 Consideration should be given to the long-term use and management of the land surrounding the bat building/wall location.

10.10.27 The bat building/wall shall be constructed prior to the demolition of the existing roost, ideally at least one active season in advance.

10.10.28 The common pipistrelle building / wall shall include at least two different types of crevices in which the bats could roost within. The crevice features shall be located on at least two elevations, one of which must be the southern elevation.

Hibernation roosts

10.10.29 The new hibernation roost should be located as close to the existing hibernation roost as reasonably practicable.

10.10.30 The new hibernation roost shall be more than 50m from the high speed rail line, except where the line is in a tunnel or other area with no collision risk.

10.10.31 The new hibernation roost should be located away from existing external artificial light sources with less than 0.5 lux within at least 50m in all directions.

10.10.32 The new hibernation roost shall be located within 15m of existing woodland.

10.10.33 The hibernation site should be sited with a north-facing aspect.

10.10.34 Ideally, replicate dimensions, materials and temperature and humidity regime of existing roost. Void size would also need to be appropriate for the species in question.

10.10.35 The hibernation roost shall have cold and stable temperatures and high humidity.

Ecology Technical Standards

- 10.10.36 Where possible, the hibernation site should be between 2-10°C, with 100% humidity.
- 10.10.37 The hibernation site should have crevices at differing heights.
- 10.10.38 Siting of the hibernation roost should consider its long-term protection.

Tree roosts - section attachment

- 10.10.39 Where known roosts within trees will be lost, the use of section felling should be an adopted mitigation practice.

10.10.40 The section of timber containing the original roost or roosting feature shall:

- be more than 50m from the high speed rail line, except where the line is in a tunnel or other area with no collision risk;
- be strapped to another mature tree, replicating the donor location as closely as possible in terms of height, aspect and in a tree with as similar orientation to adjacent trees at the donor site; and
- be positioned as close as practicable to where the existing roost was located.

- 10.10.41 The section of timber containing the original roost or roosting feature should be located away from existing external artificial light sources with less than 0.5 lux within at least 50m in all directions.
- 10.10.42 The habitat should be the same as where the existing roost was located.

Bat boxes – trees and buildings

10.10.43 Bat boxes installed on buildings and trees shall be at least 50m from the high speed rail line, except where the line is in a tunnel or other area with no collision risk.

- 10.10.44 Boxes used as compensation for roost loss should be located within 100m of where the existing roost was located.

10.10.45 Bat boxes shall be located on mature trees in woodland or suitably mature trees along hedgerows. The boxes shall be located in the same habitat in which the bats were previously recorded roosting.

- 10.10.46 Bat boxes for pipistrelle and noctule bats should be located so they receive direct sunlight or dappled shade for most of the day.
- 10.10.47 Bat boxes for *Myotis* species and brown long eared bats should be located so they are in dappled shade or deep shade for most of the day.
- 10.10.48 Bat boxes should be installed in groups of two to three, with boxes at different orientations on the same tree to provide varying thermal conditions.
- 10.10.49 Bat boxes on trees and buildings should be positioned 3.5-6m above the ground level.
- 10.10.50 There should be a clear flight path to the entrance point of the box.
- 10.10.51 The type of bat box selected should take into consideration the species being targeted and the type of roost being compensated for.

Ecology Technical Standards

10.10.52 The bat boxes used on buildings and trees shall have a lifespan of at least 20 years.

10.10.53 There should be no artificial light sources in close proximity to the bat boxes.

11 Badger

11.1 Approaches

11.1.1 The key mitigation measures for badger fall under four main categories, as described in the Ecological Principles of Mitigation. These are:

- Sett creation
- Habitat creation/improvement Including maintaining safe passage across the route to prevent fragmentation
- Mitigating disturbance impacts during construction works
- Management, maintenance and monitoring

11.2 Licensing of activities

11.2.1 Due to the legislative protection afforded to badger under the Protection of Badgers Act, 1992, certain mitigation measures described within this Chapter may only be implemented under a Natural England licence.

11.2.2 HS2 has been issued with an organisational licence (also known as a route-wide licence) for Phase 1 from Natural England enabling a range of otherwise unlawful activities (such as disturbance, sett interference and sett closure) to take place and enable construction, including enabling, works. The licence permits the activities set out in this Chapter, across Phase 1.

11.2.3 All works affecting badgers shall be undertaken in accordance with the requirements of the applicable licence.

11.2.4 Where it is necessary to undertake works affecting badgers that are different to those described in any organisational licence then it shall be necessary to ensure that a separate individual licence application is prepared in sufficient time (i.e. prior to works commencing at that site) for approval by Natural England. HS2 Ltd. shall be informed of all licence applications and will need to approve licence applications where monitoring requirements extend beyond the period of the Contractors involvement in the Scheme.

11.2.5 All works carried out under licence shall be overseen by a suitably experienced ecologist. All ecologists working under the organisational licence will need to be approved in advance by HS2 Ltd.

11.2.6 The requirements for ecologists to work under the organisational licence are provided in Appendix 1.

11.2.7 The Ecology Licence Tracker template (HS2-HS2-EV-TEM-000-000035) shall be completed for all method statement approvals relating to badgers (and other relevant protected species).

11.3 Information required for detailed design

Additional Survey Information

- 11.3.1 Detailed design of mitigation for badger must be based on contemporary survey information which will ordinarily be obtained in the 12 months prior to the detailed design works.
- 11.3.2 Review existing survey information and re-survey as necessary. Determine current classification and status of setts within 50m of the proposed works and the regular badger paths crossed by the route. Setts beyond this distance may also need identifying if an artificial sett is to be created, to avoid territory conflicts.
- 11.3.3 Bait-marking is the preferred method of identifying the territories of social groups where detailed information is required, otherwise territory extent will be estimated based on the location of the neighbouring main setts, latrines, paths and other relevant signs.

Project Programme

- 11.3.4 The works design comprising the extent of works areas, and the nature of works (temporary and permanent), including works for diversion of services, needs to be known before the following likely impacts upon badgers can be determined and suitable detailed mitigation designed.
- 11.3.5 The phasing of the works needs to be known in order to programme the following works activities affecting badgers:
- Closure of occupied or used setts (only permitted by Natural England licence between 1 July and 30 November). Closure takes a minimum of 21 days and this period may be longer if badgers are very territorial to their sett;
 - Construction of artificial setts; and
 - Installation of crossing points and badger resistant fencing.

Mitigation Design

- 11.3.6 The survey information and project program will then inform the detailed design of the mitigation measures required. Consideration will need to be given to the following:
- The number, type and location of setts to be impacted;
 - The extent of impacts in each badger territory;
 - Which setts require closure or measures to mitigate harm;
 - Appropriate locations for any artificial setts;
 - Appropriate measures for working near setts;
 - Safe crossing points and habitat connectivity; and
 - Requirements for temporary (during construction) and permanent (operational) badger resistant fencing.
- 11.3.7 Whilst there is no data deliverable to HS2 Ltd., the contractor shall record data and decision-making which would need to be made available as necessary.

11.4 Selection of design specifications

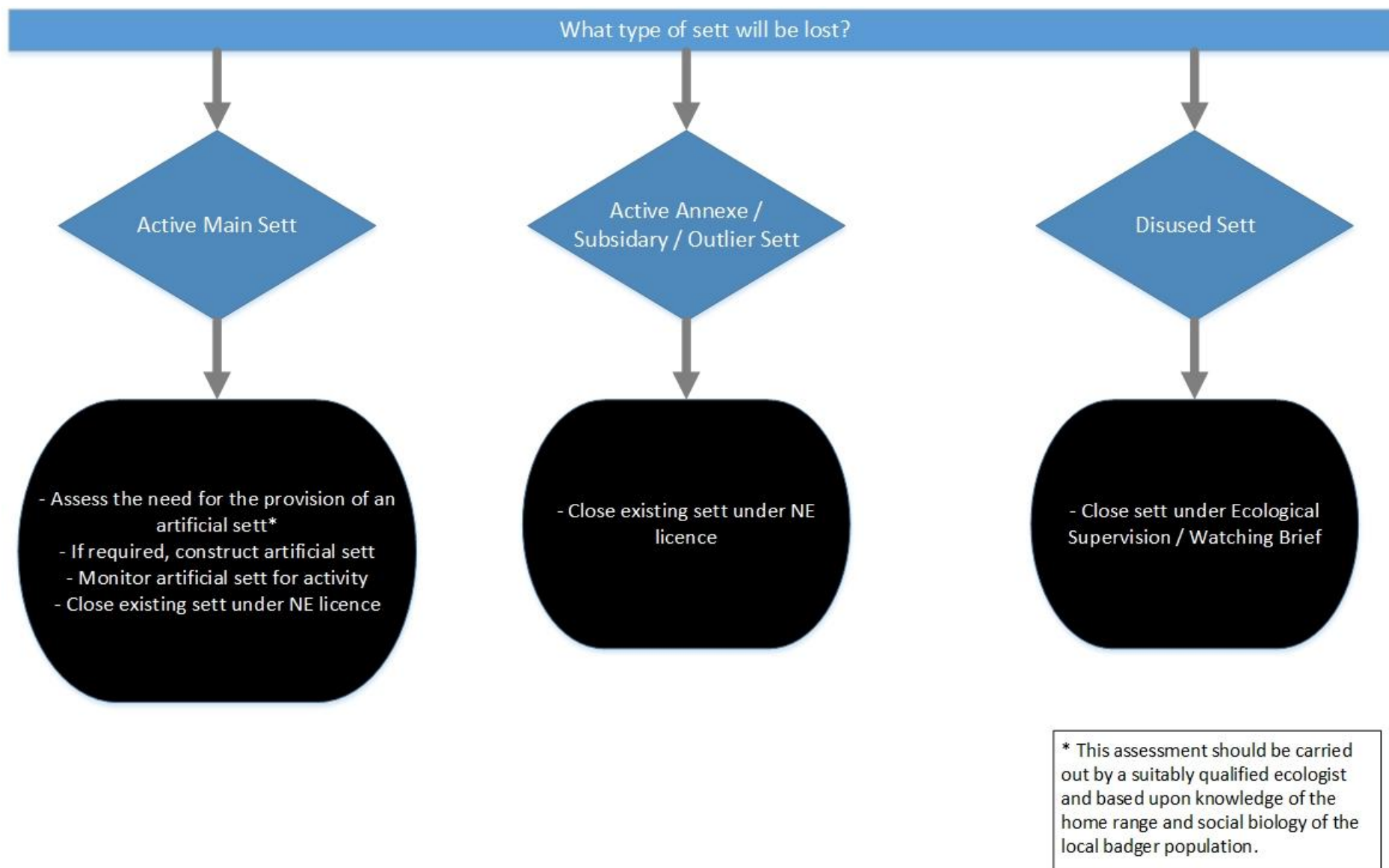
- 11.4.1 All setts that will be disturbed, damaged, isolated or destroyed by temporary or permanent works should be identified for detailed design of mitigation and their status should be updated by re-survey undertaken at the correct time. The most recent guidance from Natural England should be followed to determine whether licensable activity will be required.

11.5 Sett closures and artificial sett creation

- 11.5.1 All works affecting badgers should be undertaken in accordance with the licencing requirements set out in Section 11.2.
- 11.5.2 Sett closures, especially of main setts, should only be undertaken where there are no other suitable alternatives. Setts may be closed and destroyed (permanent closure) or closed temporarily where this is preferable to avoid harm to the social group at that location. Temporarily closed setts may be re-opened when no further impacts are likely to occur.
- 11.5.3 Where a main sett is to be lost or severely impacted by the works required at that location then consideration should be given to provision of an artificial sett.
- 11.5.4 An artificial sett should normally only be provided if a main sett is being lost and there are no known suitable alternative setts within the home range of the social group of badgers occupying that main sett. A suitable sett may be an annex, outlier or even disused sett of suitable size and location, with signs that the social group have recently visited that area or sett.
- 11.5.5 Figure 11.1 should be used to determine whether an artificial badger sett is required.
- 11.5.6 Definitions of setts are given in Scottish Natural Heritage (2003)⁴⁹.
- 11.5.7 Where a subsidiary or outlier badger sett is to be closed there should be one or more known suitable alternative setts available to accommodate the displaced animals. If this is not the case, an artificial sett should be provided.
- 11.5.8 Sett closure should be required where a sett will be isolated by the development and safe passage for badgers to suitable habitat or an alternative sett cannot be provided.

⁴⁹ Scottish Natural Heritage (2003) *Best Practice Guidance - Badger Surveys*. Inverness Badger Survey 2003. Commissioned Report No. 096

Figure 11.1 Badger sett flowchart



Mitigating disturbance during construction works around, or vegetation clearance over, an active sett

- 11.5.9 An ECoW should oversee works within 30m of an active badger sett.
- 11.5.10 General construction mitigation measures should be implemented to prevent unlicensed or avoid/limit disturbance of any active badger sett. Such measures include avoiding disturbance by using or undertaking the following within 30m of a sett (unless otherwise advised by a suitably experienced ecologist):
- Using demarcation fencing around setts;
 - Restricted use of machinery near setts;
 - Restricted use of lighting;
 - Restricted working hours to avoid key badger activity periods;
 - Avoiding any storage of material; and
 - Open trenches or other earthworks with the potential to trap badgers (or other mammals) must be fenced to exclude them and/or ramps or other suitable means of egress must be provided.

Operations likely to cause interference and disturbance

- 11.5.11 Prior to the start of works, an 'exclusion zone' with a minimum distance of 10m of any active badger sett entrances should be clearly marked using coloured tape, string, paint, or other markers. Any further setts which are discovered during the operation should be similarly marked as soon as their presence becomes known.
- 11.5.12 Within the marked 'exclusion zone' no heavy machinery should be used and no chipping or burning is to be carried out. Fuel, oil, and chemicals shall not be stored or applied within the marked area (the only exception is where conifer stumps must be treated against attack by the fungus *Heterobasidion annosum* (Fomes)).
- 11.5.13 Vehicles should not drive directly over badger sett entrances.
- 11.5.14 Trees should be felled to fall away from, or be lifted away from, badger sett entrances.
- 11.5.15 Trees/stumps/shrubs/hedgerows within 20m of an active sett should not be uprooted.
- 11.5.16 Trees may be felled or vegetation cleared within the exclusion zone using hand-held tools and hand held machinery such as chainsaws or brush-cutters or using a purpose-built machine, where the boom or arm and cutting head can safely reach into the exclusion zone, provided the body of the machine remains parked outside the exclusion zone.
- 11.5.17 Timber or brash may be extracted or removed from inside the exclusion zone using appropriate machinery, provided the body of the machine remains parked outside the exclusion zone.

- 11.5.18 Any badger sett entrances which become blocked should be unblocked and left unobstructed at the end of each day's work.
- 11.5.19 Timber stacks or chipping / brash piles should not be created within the exclusion zone.
- 11.5.20 Where works involve pile driving, rock boring, dynamic compaction or a similar activity with the potential to cause ground vibration that could disturb badgers occupying a sett or damage a sett by causing tunnel collapse, the impact on that sett should be evaluated.
- 11.5.21 If disturbance is likely to result in a long term impact on the badgers occupying that sett or cause tunnel collapse, in accordance with Licence conditions, badgers should be excluded from the sett and the sett closed and proofed against re-entry by badgers before that operation begins and for its duration. Activities with the potential to cause such a level of disturbance should therefore not be carried out between 1 December and 30 June.
- 11.5.22 It will be necessary to consider the impact using engineering impact reports and the knowledge of a suitably experienced ecologist. Likely impacts should be considered according to the circumstances of the site. Where suitable barriers exist between the sett and the works (e.g. a water body) or the topography of the land between the sett and works is such that vibration will not cause an issue, then sett closure should not be necessary.
- 11.5.23 As a general guide, impacts are likely to be negligible >100m from the sett, but very likely to occur for these activities within 30m of a sett. Between these guide distances expert engineering opinion in conjunction with guidance from a suitably experienced ecologist will be required to determine likely impacts.

11.6 Exclusion of badgers by means of one-way gates (Sett closures)

- 11.6.1 All works affecting badgers should be undertaken in accordance with the licencing requirements set out in Section 11.2.
- 11.6.2 The exclusion of badgers from their setts by means of one-way gates and destruction of the sett should only be carried out between 1st July and 30th November (inclusive).
- 11.6.3 At the start of the badger sett closure, vegetation around the sett should be removed down to ground level only.
- 11.6.4 One-way badger gates, opening outwards, should be securely installed in all sett entrances displaying signs of possible occupation by badgers to allow badgers to exit from but not enter the sett.
- 11.6.5 In order to prevent badgers from digging into the ground surrounding the sett, material capable of preventing access by badgers, such as heavy gauge chain-link netting, should be pegged down over the surface of the ground surrounding the gated entrances. Chain-link netting (if used) should be galvanised wire of 2.5mm gauge.

Ecology Technical Standards

- 11.6.6 Un-gated entrances to tunnels which have been shown not to be occupied by badgers should be blocked or proofed against re-entry by badgers.
- 11.6.7 Where for safety or other practical reasons it is not possible to install a one-way gate in every sett entrance, the sett should be enclosed by a badger-proof electric or wire mesh fence incorporating at least 1 one-way badger gate(s), opening outwards, to allow badgers to exit from but not enter the fenced area.
- 11.6.8 Badger activity at the one-way badger gates should be monitored; for example, by placing small sticks in front of and/or behind the gate, tying a fine thread across the front of the gate, and/or smoothing the soil or sand in front of the gate in order to detect badger footprints. If sticks are used, care must be taken that they do not obstruct access to the sett or prevent closure of the gate if disturbed. Whilst there is no data deliverable to HS2 Ltd., the contractor should record data and decision-making which would need to be made available as necessary.
- 11.6.9 The sett should be visited at intervals of no more than 3 days to inspect the gate(s) to ensure that they open and close freely, and to check for signs of badgers having regained access to the sett.
- 11.6.10 A written record (including photographic evidence) of monitoring of badger activity at all sett entrances should be maintained and made available to Natural England and HS2 Ltd upon request.
- 11.6.11 The badger gate(s) should remain continuously in position for a minimum period of 21 days following the last sign indicating possible access by badgers into the sett and until immediately before action is taken to close or destroy the sett.
- 11.6.12 Measures to exclude badgers should remain in place until immediately before sett destruction or proofing is carried out.

Sett Destruction

- 11.6.13 Setts should only be destroyed when it is known there are no badgers occupying the sett, either following closure with 1 way gates or monitoring (for example, by means of soft blocking) for 21 consecutive days.
- 11.6.14 The sett should be destroyed by digging back all tunnels as far as possible and backfilling with materials appropriate for the particular site.
- 11.6.15 After the sett has been destroyed or tunnels have been blocked, the area should be proofed against re-entry by badgers using material capable of preventing access by badgers, for example chain-link netting or similar material laid on the surface of the ground and/or as a vertical barrier (buried to a depth of at least 1.5 metres below ground) and secured to prevent further access by badgers.

Emergency Action – Excavating a badger sett or part thereof without prior exclusion of badgers.

- 11.6.16 It is extremely unlikely that badger setts will need to be excavated prior to exclusion of badgers (live digging) from that sett. However, in some circumstances it may be

beneficial to partly excavate a tunnel of an active sett where this action will avoid the need for full sett closure. Examples include, where it is necessary to install a fence line or utility trench, or similar.

- 11.6.17 The live digging of badger setts is only be permitted under specific circumstances as detailed in the HS2 organisational licence to cover unforeseeable emergency situations where badgers face immediate threat due to failure of part of the sett, e.g. for the excavation of an obvious tunnel.
- 11.6.18 It does not cover closures required because of programming changes or difficulties.
- 11.6.19 If the emergency live digging of a sett, or part of a sett, is required both the HS2 Area Ecology Manager and Natural England Licensing officer should be contacted as soon as it is known the action is required. The person proposing the action should explain why the action is required and what events have transpired to require the action. This should then be confirmed in writing, via email, at the soonest available opportunity. The verbal agreement of both HS2 and NE licensing is required before any action is undertaken. This confirmation will also be made in writing via email.
- 11.6.20 Where partial sett closure for a trenching or fencing is proposed this should be included in detailed design for the site and authorised via the normal process.
- 11.6.21 Any live digging of setts should be undertaken as follows:
- Digging into the sett must be by means of hand tools or light machinery under close supervision.
 - Tunnels must be dug back, starting from their entrance, only as far as necessary to complete the operation. All tunnels discovered during the excavation must be either dug back to their ends or have access holes left open so as to avoid trapping badgers.
 - If tunnels are re-instated following excavation then the specification for pipes connecting the original tunnel to the surface is as for the construction of an artificial sett.
 - A suitable cage or similar equipment must be available at the site of work to retain any injured badgers found during the excavation for veterinary attention.
 - Any uninjured badger found must be allowed to escape unless it is a dependent cub and there is good reason to believe that it will not survive. Provision must be made to ensure the welfare of any such cub.
 - Provision must be made for prompt veterinary assistance to deal with any injured badger.

Habitat loss and severance – Maintaining safe passage across the route

- 11.6.22 Where possible, safe passage for badgers across the HS2 route should be provided where:

- Over 30% of the habitat of the social group territory will be lost/severed and the distance to a suitable crossing point is over 250 m; and a main or annexe sett is less than 50m from the route and over 30% of territory will be lost/severed; and
- It is felt that the actions will result in an increased risk of badger mortality on the adjacent roads. In order to assess this the following relevant factors should be taken into account: territory extent, well used paths, and the location of foraging areas in relation to the sett. (NB tunnels may only be provided by HS2 Ltd on land that is required for the Scheme except by agreement with affected landowners).

- 11.6.23 Locations for mammal underpasses should be included in the detailed design where the locations of green bridges, culverts and underbridges do not provide sufficient connectivity based on the criteria above; or where there are fewer than three safe crossing points per kilometre of badger territory crossed by the HS2 route.
- 11.6.24 Where the standards of provision of safe passage above cannot be met, for example due to the route being in a deep cutting, the reason for departure from standard should be recorded and justified.
- 11.6.25 Mammal underpasses should normally be located on an existing well-used badger path, except where locating the tunnel on the line of the path will increase loss of existing habitat where there is some overriding design reason, or where a mammal underpass is required, but the badger paths are not clear. Suitable fencing should be used to guide badgers to safe crossing points (where this is reasonably practicable within the land required for the Scheme).
- 11.6.26 The length of badger fencing required should be determined in detailed design. It should extend 50m in both directions from the entrance of a mammal underpass, but this should be extended further where:
- a main sett is within 50m of the route but not adjacent to the mammal underpass tunnel; or
 - there are two or more badger paths crossing in close proximity to a single mammal underpass tunnel.
- 11.6.27 The length may be extended or reduced to allow the fencing to be tied-in at a structure such as a bridge where the structure becomes part of the barrier to prevent badger access.
- 11.6.28 Whilst there is no data deliverable to HS2 Ltd., the contractor shall record data and decision-making which would need to be made available as necessary.

11.7 Design specification – artificial sett creation

Target performance

- 11.7.1 To compensate for the loss of certain main setts, where a natural alternative refuge for badgers does not exist within the territory, an artificial sett should be provided,

and should be located within the same social territory as that from which the sett will be lost.

11.7.2	Geospatial data on artificial badger sett creation shall be recorded by the designer and passed to HS2 in accordance with the Geographic Information System Standards (HS2-HS2-GI-STD-000-000002).
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Location of artificial setts

11.7.3 Locations for artificial badger setts should:

- Be adjacent to existing areas of scrub or woodland and/or grassland habitats that provide foraging areas;
- should normally be provided close to the original location as possible, within 100m of the original sett. Where this is not possible an alternative location can be selected in the range 100-500m from the original sett but within the existing territory.
- Be in areas to be created as woodland or scrub, or close to them;
- not be close to busy roads, preferably more than 100m away;
- not be in areas with high levels of public access, or else if there is access nearby the artificial sett must be screened and made less accessible using planted scrub plus brushwood;
- not be in wet areas or areas prone to flooding; and
- not be where it is likely to cause territorial issues between social groups of badgers.

11.7.4 Artificial setts should be sited within the land required for construction and operation (but outside the route-wide security fence), except where no suitable alternatives are available within the territory of the social group affected.

11.7.5 No active sett should be closed until the artificial sett constructed to replace it has been completed for at least six months prior to sett closure and/or there is clear evidence of the artificial sett having been found by the same social group.

Design of artificial setts

11.7.6 The exact design (shape, profile and number of chambers) will depend on the size of the sett to be lost, the space available for the artificial sett and the local ground conditions and topography.

11.7.7 The artificial sett should be designed and constructed to be well-drained with no standing water within the sett or sett entrances and be free draining throughout.

11.7.8 Setts should be created above or below existing ground level.

11.7.9 A larger artificial sett design (i.e. more than 2-3 chambers) should be required to compensate for loss of a main sett.

- 11.7.10 Materials chosen to construct the artificial sett (e.g. wood or concrete) should be used depending on site conditions. Exterior grade timber chamber walls and roof are preferred due to condensation issues associated with concrete but other material can be used.
- 11.7.11 Network Rail (2011)⁵⁰ badger sett creation design, in conjunction with the guidance of relevant engineers, should be used if an artificial sett is to be created within an embankment, where concrete chambers are required for load-bearing.

Tunnel and entrance specifications

- 11.7.12 Tunnel and entrance design for artificial badger setts should include:
- Multiple entrances, a minimum of four entrances to be provided for each artificial sett;
 - Entrances must be at different heights to aid ventilation, angled to avoid excessive draughts;
 - Pipes used to construct tunnels should have an internal surface that allow the animals grip (ridges or rough surfaces preferred); alternatively the base of the pipe can be cut to provide a bare earth surface subject to load-bearing requirements
 - Cross-connections between tunnels to provide at least one alternative exit;
 - A minimum of four dead-end tunnels to allow badger to extend the sett internally;
 - Tunnel length from the entrance to the start of the chambers must be a minimum of one metre;
 - Constructed in material that can be excavated by badger, preferably loam-rich topsoil, or other light soil, not clay; and
 - Tunnels within artificial setts must have an internal diameter of 300mm.

Chamber design within artificial setts

- 11.7.13 Chamber design within artificial badger setts should include:
- Provision of multiple chambers (comprising both through chambers and end chambers) at least half of which will be off-set from the route through the sett, a minimum of six chambers to be provided;
 - Maximum internal height 500 mm, Length and width of the chambers will be in the range approximately 450-750 mm.
 - Chambers must be roofed with panels capable of bearing the weight of at least

⁵⁰ Network Rail (2011) *Ecological Works: Artificial Badger Sett Creation* - NR NR/CIV/SD/246 ISSUE A.

one metre depth of overlying soil;

- The floor of each chamber must be earth and must be slightly mounded in the centre to ensure that any damp seeps toward the tunnels or free-draining edges. Chambers must be above the lowest point of the artificial sett;
- Before the chambers are covered by the roof, they must be half-filled with clean, dry straw or hay for bedding;
- The chamber roofs or a wider area above them must be covered with galvanised weldmesh to deter illegal digging for badgers.

11.7.14 Weld-mesh frames with geotextile can be used over the junctions of pipe to prevent soil falling into the tunnels when soil is mounded over the sett.

11.7.15 Materials used in landscaping an artificial sett can vary. Turf fragments, brush wood, salvaged coppice and other salvaged vegetation should be used to provide cover in preference, supplemented by planting of scrub and seeding with grass if required.

11.7.16 Badgers should be encouraged to use the artificial setts by laying food baits and transporting materials from the existing sett.

11.7.17 Landscaping and planting required as part of the design of the artificial sett should be carried out immediately after construction of the artificial sett or as soon as reasonably practicable thereafter, but before badgers have occupied the sett.

Monitoring and maintenance

11.7.18 Monitoring and maintenance of mitigation and habitat compensation measures should be undertaken in accordance with the organisational badger licence and the site objectives.

11.7.19 Monitoring should be carried out to determine whether the social group that has lost a sett and been provided a replacement artificial sett are visiting, using or occupying that sett –within six months of creation.

11.7.20 Monitoring should be carried out to determine whether the affected social group visiting, using or occupying the artificial sett continues. Monitoring should be undertaken at least six monthly intervals starting three months after completion of sett closure, for 2 years, or until the badgers have created a new main sett elsewhere within the territory, whichever is the soonest.

11.8 Design specification – habitat creation

11.8.1 In order to encourage use by badgers, vegetation should be planted to provide cover at:

- entrances of mammal underpasses;
- the approaches to a green bridge;
- artificial setts; and

- to re-connect routes to setts.

11.8.2 Any native shrub species are suitable for planting for habitat connectivity for badger. Those producing fruits or nuts are preferred as food sources, those with spines are preferred to discourage human disturbance.

Target performance

11.8.3 The overall target of badger habitat creation should be:

- To provide connectivity of habitat suitable for foraging by badgers.
- To provide connectivity between artificial and retained setts.
- To provide screening and protection of tunnels and artificial setts to reduce the risk of badgers being persecuted illegally.

12 Hazel dormouse

12.1 Approaches

- 12.1.1 The aim should be to safeguard dormice from killing and harm (both in the short and long term) and, wherever possible, to retain populations/communities within their current distribution.
- 12.1.2 A suitably experienced ecologist should be engaged at the earliest opportunity to guide the selection of appropriate mitigation measures and reference should be made to Bright et al. (2006) *The Dormouse Conservation Handbook 2nd Edition* (English Nature) and the NE/Defra survey and mitigation guidance⁵¹.

12.2 Licencing of activities

- 12.2.1 Due to the high level of legislative protection afforded to hazel dormice, some of the mitigation measures described within this Chapter can only be implemented under a European Protected Species (EPS) licence, obtained from Natural England.

- 12.2.2 All licensable works affecting hazel dormice shall be undertaken in accordance with the relevant EPS licence.
- 12.2.3 HS2 Ltd shall be informed of all licence applications, and will need to approve licence applications where monitoring requirements extend beyond the period of the Contractors involvement in the Scheme.

12.3 Design specification: short-term temporary disturbance

Target performance

- 12.3.1 The overall target for short-term (temporary) hazel dormouse disturbance shall be:

- To avoid causing the killing, injuring or disturbance to hazel dormouse.
- To retain the population within local area at a favourable level.

Performance requirements – non-licensable works

- 12.3.2 Short term, temporary works should be undertaken using a Working Method Statement approach. This would guide activities to avoid and/or mitigate low impact works. Examples of non-licensable works include:
- The realignment of short sections of hedgerow;
 - Limited hand-clearing of scrub clearance during the dormant season;
 - Small breaches (less than five metres) in hedgerows during the dormant

⁵¹ <https://www.gov.uk/guidance/hazel-or-common-dormice-surveys-and-mitigation-for-development-projects>

season (assuming that hibernation potential is limited); and

- The erection of dormouse nest boxes within a woodland.

12.3.3 In all such cases, a suitably experienced ecologist should be consulted with to ensure compliance with UK legislation.

Monitoring

12.3.4 Monitoring will not be necessary if the area is restored to a condition comparable to that which existed prior to clearance works.

12.4 Design specification: habitat creation

Target performance

12.4.1	The overall target for hazel dormouse habitat creation shall be the creation of new habitat using appropriate species, designed to be well-connected to existing local habitat.
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Performance requirements

12.4.2	Hazel dormouse habitat loss shall be compensated for either directly through the replacement of habitat on a minimum of a 1:1 scale, or through habitat enhancement of what is retained.
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12.4.3	Newly created dormouse habitat shall include the range of plant species necessary to support dormice throughout the year. Planting shall commence as soon as possible.
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12.4.4 If agreed with the suitably experienced ecologist, smaller areas that have been substantially enhanced for dormice can be utilised.

12.5 Design specification: dormouse persuasion

Target performance

12.5.1	The overall target of dormouse persuasion shall be to avoid the killing and injuring of dormice during the reduction of vegetation within the area they occur.
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12.5.2 Persuasion should be used if either of the following apply:

- less than 100 metres of hedgerow will be removed - as long as the remaining habitat is linked to a larger dormouse habitat; or
- less than a 50 metre wide strip of woodland will be removed - as long as the remaining habitat is linked to a larger dormouse habitat.

12.5.3 If the land to be lost is part of a large, continuous area of habitat, the dormice should be persuaded to leave the area by progressively clearing narrow strips of habitat. Each strip removed should be narrower than the radius of the dormice's typical home range (an average of 50 metres).

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| 12.5.4 | Vegetation shall only be cleared during dormouse persuasion works between May to September. |
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Performance requirements

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| 12.5.5 | A licence from Natural England shall be required for dormouse persuasion works. |
| 12.5.6 | The suitability of adjacent habitat where the dormice are to be moved into, shall be confirmed in advance of persuasion works taking place. |

12.6 Design specification: dormouse translocation

Target performance

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| 12.6.1 | The overall target of dormouse translocation shall be to avoid the killing and injuring of dormice during their collection and removal. |
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- 12.6.2 Dormice should ideally be relocated to a non-adjacent, purpose built receptor site and this site managed for the species to provide for their long term security. This site should be within the home range of the dormice in question and should not already support a population.

Performance requirements

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| 12.6.3 | A licence from Natural England shall be required for dormouse translocation works ⁵² . |
| 12.6.4 | Prior to the movement of hazel dormice, a purpose built receptor site shall be selected, surveyed and enhanced. Plans for the receptor site would be drawn up by an appropriately experienced ecologist. |
- 12.6.5 Long term site safeguards for the receptor site should be included to ensure the future survival of the translocated animals. The receptor site should be prepared well in advance of receiving hazel dormice.

Use of non-standard methods – Natural England's Licencing Policies

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| 12.6.6 | In implementing mitigation and compensation measures for dormice, a combination of traditional, standard, 'best practice' shall be used, but also drawing upon Natural England's (NE) licensing policies. |
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- 12.6.7 Where the application of the licencing policies is being considered contractors should discuss this with Natural England, and take account of any relevant guidance from HS2 Ltd and Natural England.

⁵² It should be noted that dormouse translocation is considered a last resort during mitigation. Natural England require an extremely strong justification for any licence application for this and granting of licences is exceptional. Advice should always be sought in advance from a suitably experienced ecologist.

12.7 Further information required for detailed design

- 12.7.1 Detailed design should be informed by all available data sources. Where necessary existing survey information should be updated to inform the selection of appropriate mitigation measures. Whilst there is no data deliverable to HS2 Ltd., the contractor should record data and decision-making which would need to be made available as necessary.

13 Water vole

13.1 Approaches

13.1.1 Due to the legislative protection afforded to water vole under the Wildlife and Countryside Act 1981 (as amended), certain mitigation measures described in this chapter can only be implemented under a Natural England licence.

13.1.2 All licensable works affecting bats shall be undertaken in accordance with the relevant licence from Natural England.

13.1.3 HS2 Ltd shall be informed of all licence applications and will need to approve licence applications where monitoring requirements extend beyond the period of the Contractors involvement in the Scheme.

13.1.4 This chapter sets out the key mitigation principles to be implemented notably through applying the hierarchy described in the *Water Vole Mitigation Handbook* (Dean *et al* 2016)⁵³. This handbook should be used as the key source of information in relation to the design of water vole mitigation.

13.2 Selection of design specifications

13.2.1 Dean *et al* (2016) should be followed in relation to mitigation against disturbing water vole and water vole habitat.

13.2.2 Engineering works such as bank protection to watercourses should follow guidance in Highways Agency (2001)⁵⁴, SEPA (2010)⁵⁵, Strachan *et al* (2011)⁵⁶ and Dean *et al* (2016). Key requirements include:

- Retain as many features of water vole conservation value.
- Retain one bank intact for as long as reasonably practicable.
- Minimise length affected at any one time.
- Where banks are reformed new profiles to include steep bank (bank angle greater than 35°) with a gradual transition at the toe to allow for marginal habitat to develop.
- Seek to reduce the use of hard revetment or surfaces.
- Preferentially use bio-engineering techniques.
- Carrying out works at the correct time of year.

⁵³ Dean, M., Strachan, R., Gow, D. And Andrews, R. (2016) *The Water vole Mitigation Handbook*. The Mammal Society Eds. F Mathews and P Chanin.

⁵⁴ Highways Agency (2001) *Design Manual for Roads and Bridges*, Vol. 10, section 4, Part 4. Department for Transport, UK.
<http://www.standardsforhighways.co.uk/dmr/b/vol10/section4/ha8199.pdf>

⁵⁵ SEPA (2010) *Engineering in the water environment: good practice guide – river crossings*. <https://www.sepa.org.uk/media/151036/wat-sg-25.pdf>

⁵⁶ Strachan, R., Moorhouse, T., Geeling, M. *Water Vole Conservation Handbook* (3rd Ed.). WildCru, Oxford.

13.2.3	Where water vole exclusion, trapping, translocation and displacement is required then a licence shall be obtained from Natural England.
13.2.4	Where reasonably practicable to do so, habitat manipulation should be used to encourage the displacement of individuals to areas of suitable retained or enhanced habitat in adjoining sections of the same watercourse through progressive removal of bankside vegetation.
13.2.5	Displacement is considered appropriate when: • Lengths of habitat are of no more than 50m (where affected area is less than 20% of the total length of habitat occupied by the water vole colony). • There is suitable habitat directly adjacent, and the affected area is more than 500m from other works on the same watercourse. • Numbers of water vole are low or they are seasonally absent. • It is undertaken between 15th February and 15th April (subject to weather conditions).
13.2.6	Capture and translocation of water voles shall ensure the following: • Receptor sites have been appropriately selected; • The absence of existing water vole population in the receptor site; • Release of substantial numbers of healthy, equal sex ratio sub-adult water vole which are genetically diverse; • Release at the right time of year; • Security of site tenure; and • Sustainable (and verified) absence of North American mink, or appropriate active mink control and preferential landscape management for water vole.
13.2.7	Only as a last resort should a captive breeding programme be considered if these requirements are not met.
13.2.8	All water vole trapping and translocation to be carried out by suitably experienced ecologists.
13.2.9	Disease screening shall be carried out during water vole translocation activities prior to release.

Habitat replacement

13.2.10	The design shall compensate for the loss and/or disturbance of existing water vole habitat through the creation of replacement habitat of at least similar quantity and quality.
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13.2.11 Where restoring existing/creating new water vole habitat the following shall be applied:

- Replacement habitat to be as close as reasonably practicable to the habitat to be lost;
- New receptor sites to be created at least 12 months in advance to allow sufficient habitat to become established;
- Restoration or creation habitat to include deep water and a berm/shelf along one or both banks in order to stimulate marginal vegetation growth;
- Provision of plants of local provenance suitable to local environmental conditions; and
- Habitat restoration of impacted sites to occur as soon as reasonably practicable after construction.

13.2.12 Natural England and Defra (2015)⁵⁷ provide high level environmental management guidance in relation to water vole mitigation. Scottish Natural Heritage (2014)⁵⁸ provides more detailed guidance on the provision/enhancement of habitats for water vole.

13.2.13 Pond Conservation (2010)⁵⁹ should be followed on design of ponds for water vole.

13.3 Information required for detailed design

13.3.1 Detailed design should be informed by all available data sources. Where necessary, existing survey information should be updated to inform the selection of appropriate mitigation measures. It may be also be necessary to update surveys prior to site clearance.

13.3.2 The capture, translocation, release (with or without captive breeding) and post release site maintenance and monitoring will all be subject to securing a Natural England Licence. Natural England will normally only accept licence applications where survey data is no more than two years old.

13.3.3 The construction site layout, including both the temporary and permanent works areas, will need to be known before the design of temporary exclusion fencing in relation to water vole can be finalised.

⁵⁷ Natural England and Defra (2015) *Environmental management guidance; Water voles: surveys and mitigation for development projects*. <https://www.gov.uk/water-voles-protection-surveys-and-licences>

⁵⁸ Scottish Natural Heritage (2014) *Conserving water voles – best practice*. <http://www.snh.gov.uk/about-scotlands-nature/wildlife-and-you/water-voles/best-practice/>

⁵⁹ Pond Conservation (2010) *Million Ponds Project: Creating ponds for water voles*. <http://www.freshwaterhabitats.org.uk/wordpress/wp-content/uploads/2013/09/watervole-dossier.pdf>

14 Otter

14.1 Approaches

14.1.1 Due to the high level of legislative protection afforded to otter (at both a national and European level), some of the mitigation measures described within this chapter can only be implemented under a European Protected Species (EPS) mitigation licence, obtained from Natural England, including more intrusive surveys.

14.1.2 All licensable works affecting otter shall be undertaken in accordance with the relevant EPS licence.

14.1.3 HS2 Ltd. shall be informed of all licence applications and will need to approve licence applications where monitoring requirements extend beyond the period of the Contractors involvement in the Scheme.

14.2 Selection of design specifications

Mitigating Disturbance

14.2.1 Mitigating disturbance of breeding activity should be determined on a site by site basis.

14.2.2 Mitigating effects of disturbance on otter holts shall include:

- No works within 150m of any holts at which breeding females or cubs are present (unless otherwise agreed with the relevant authority);
- No use of wheeled or tracked vehicles within 20m of an active, but non-breeding holt, and no light work, such as digging by hand or scrub clearance within 15m of such holts except under licence; and
- Prohibited working area associated with otter holts to have temporary fencing to prevent accidental infringement.

14.2.3 To reduce the risk of impact to active holts (and the otters that use them), previously identified holts to be directly impacted should be dismantled, under licence, in advance of works.

14.2.4 The option to temporarily block holts to be indirectly impacted by must be agreed on a site-specific basis with Natural England.

Use of non-standard methods – Natural England’s Licencing Policies

14.2.5 In implementing mitigation and compensation measures for otters, an appropriate combination of traditional, standard, ‘best practice’ shall be used.

14.2.6 Where the application of the licencing policies is being considered contractors should discuss this with Natural England, and take account of any relevant guidance from HS2 Ltd and Natural England.

Replacing otter holts

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| 14.2.7 | Where the loss of holts cannot be avoided, mitigation shall be developed and implemented to ensure favourable conservation status of the populations concerned. |
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- 14.2.8 Liles (2003)⁶⁰ should be followed in relation to otter breeding sites, including enhancing sub-optimal habitats and creating new natal dens.
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| 14.2.9 | Two artificial holts shall be provided where an otter holt within 150m of the works is being lost. |
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- 14.2.10 Where reasonably practicable to do so, one of the replacement holts should be provided in close proximity to the original holt that was lost when construction in the vicinity is complete. The other should be provided in a nearby area of suitable habitat that will not be subject to disturbance during the period of construction.
- 14.2.11 Where otter holts within 150m are made less habitable for otters, additional artificial otter holts may be required. This will need to be determined on a case-by-case basis.
- 14.2.12 Highways Agency (2001)⁶¹ advice in relation to road schemes should be followed that, unless the safety of otter can be assured, artificial holts must not be placed in close proximity (within 150m) to any part of the scheme during construction or once operational.
- | | |
|---------|--|
| 14.2.13 | Artificial otter holts shall be located on the same watercourse as the holt to be lost. |
| 14.2.14 | A suitably experienced ecologist shall advise on suitable locations and which designs of holts can be best adapted to suit local conditions. |
- 14.2.15 Artificial holts should be created at least 12 months in advance of scheduled holt loss in order to give otter time to investigate and become acclimatised to the artificial holts.
- ### 14.3 Information required for detailed design
- 14.3.1 Detailed design should be informed by all available data sources. Where necessary, existing survey information should be updated to inform the selection of appropriate mitigation measures.
- 14.3.2 These should be supplemented by a further inspection of the development area immediately prior to site clearance to ensure that there is no new otter activity.
- 14.3.3 Due to the mobility of otters Natural England will normally only accept licence applications where survey data is no more than two years old.

⁶⁰ Liles, G (2003) *Otter Breeding Sites Conservation and Management* Conserving Natura 2000 Rivers Conservation Techniques Series No. 5. <http://publications.naturalengland.org.uk/publication/70047>

⁶¹ Highways Agency (2001) *Design Manual for Roads and Bridges*, Vol. 10, Section 4, Part 4. Department for Transport, UK. <http://www.standardsforhighways.co.uk/dmr/vol10/section4/ha8199.pdf>

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- 14.3.4 The construction site layout, including both the temporary and permanent works areas, will need to be known before the design of exclusion fencing in relation to otter holts can be finalised.
- 14.3.5 The location and design of the fencing which will be required to exclude otter should be finalised once the detailed design of each crossing is made available.

15 White-clawed crayfish

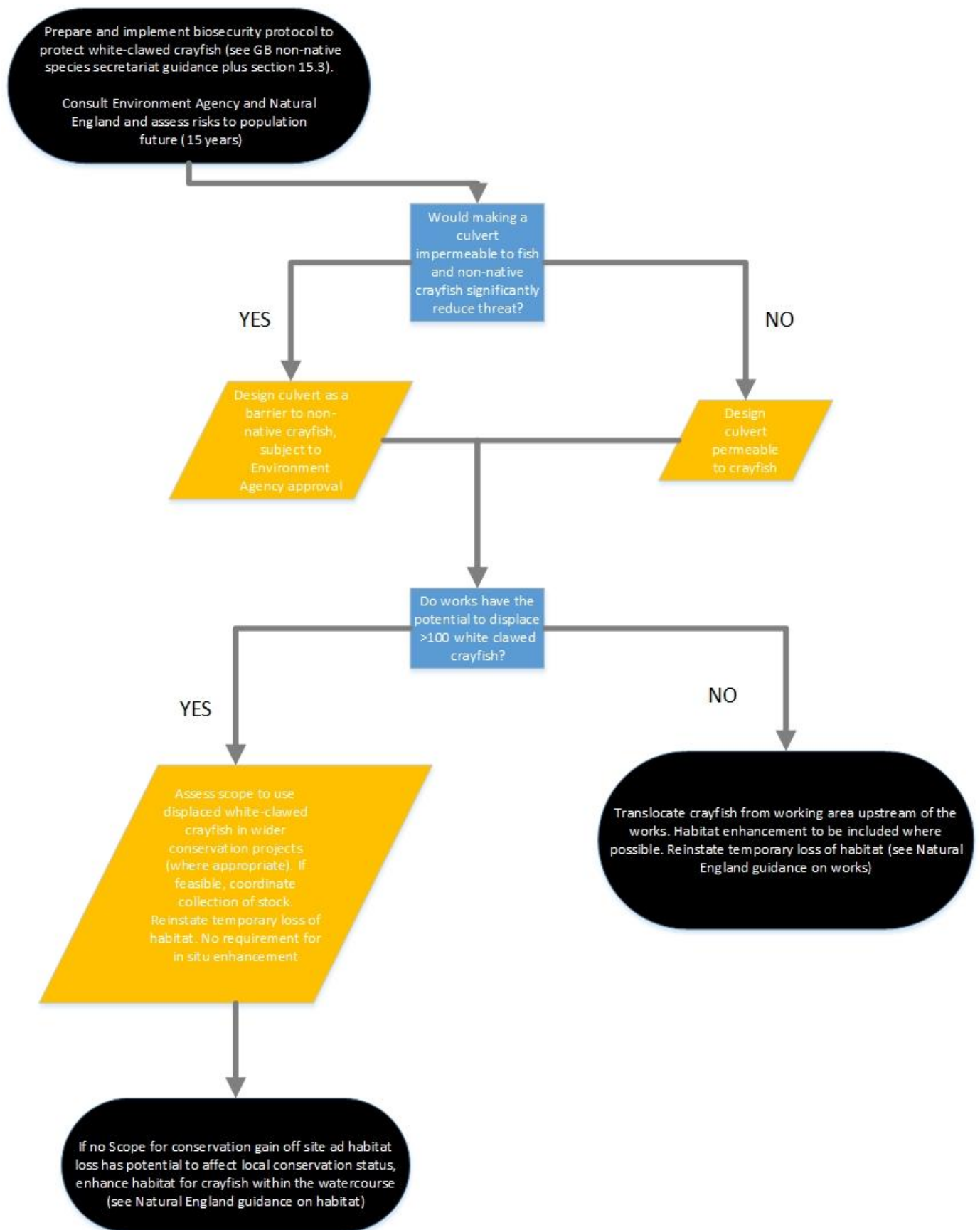
15.1 Approaches

- 15.1.1 This document sets out key mitigation principles to be implemented and is based on Peay (2000)⁶², with some updating.
- 15.1.2 In addition to the detail outlined in this chapter, the following documents (and any revisions) should be consulted in regards to design, mitigation and survey of white-clawed crayfish:
- English Nature and the Environment Agency (2000) Guidance on works affecting white-clawed crayfish.
 - English Nature and the Environment Agency (2003) Guidance on habitat for white-clawed crayfish.
 - Buglife (2011) A toolkit for developing catchment-scale conservation strategy for White-clawed crayfish.
 - English Nature (2003) Reintroducing the white-clawed crayfish.
 - English Nature (2003) Guidance on monitoring the white-clawed crayfish.
 - JNCC (2015) Common standards guidance for freshwater fauna.
 - JNCC (2015) Common standards guidance for freshwater lakes.
 - JNCC (2014) Common standards monitoring guidance for rivers.
- 15.1.3 Given the particular susceptibility of white-clawed crayfish to disease, including crayfish plague, an appropriate Biosecurity Management Plan (as outlined in Chapter 22), should be produced and implemented in advance of works taking place in any waterbody that has, or is likely to have, white-clawed crayfish present.
- 15.1.4 Figure 15.1 summarises the approach to selecting specification, based on the status of crayfish and should be followed.

⁶² PEAY, S. (2000) Guidance on works affecting white-clawed crayfish. *English Nature & Environment Agency*. [Online] Available from: <http://www.devon.gov.uk/guidancewccrayfish.pdf> [Accessed: 31st March 2015]

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Figure 15.1 White-clawed crayfish flowchart



15.2 Licencing of activities

- 15.2.1 Due to the legislative protection afforded to white-clawed crayfish, a Natural England conservation licence shall be required for surveys and for any works that may result in an adverse impact on this species. A licence shall also be required to move / translocate white-clawed crayfish from areas impacted by works.
- 15.2.2 HS2 Ltd shall be informed of all licence applications and will need to approve licence applications where monitoring requirements extend beyond the period of the Contractors involvement in the Scheme.
- 15.2.3 Use of crayfish traps shall require a crayfish trapping consent from the Environment Agency.

15.3 Selection of design specifications

Capture and exclusion

- 15.3.1 De-watering combined with manual search/ destructive search is the preferred and most effective method for exclusion and removal of white-clawed crayfish. Trapping, as a method of removing white-clawed crayfish from an area to be affected by works, will generally only be used if the crayfish are to be used for stocking another site.
- 15.3.2 White-clawed crayfish removed from an area of works should be immediately relocated in the same waterbody in suitable habitat upstream of the proposed works. Morphometrics should be recorded where possible.
- 15.3.3 If surveys and habitat appraisal indicate the number of white-clawed crayfish likely to be removed during works is more than 100 individuals, the scope to integrate work with wider conservation projects for the species will be determined in consultation with the Environment Agency.
- 15.3.4 The mitigation for white-clawed crayfish should be coordinated with any mitigation measures for removal of fish.

Aquatic habitat creation and restoration

- 15.3.5 To allow passage of white-clawed crayfish there shall be no vertical steps in any culvert on a watercourse with a white-clawed crayfish population except where a submerged passable route is provided.
- 15.3.6 To maintain passage for white-clawed crayfish along a watercourse, each culvert should be designed to provide submerged areas where passage by white-clawed crayfish can be made in flow with velocity less than 0.3m s^{-1} during normal (QMED) flow. The HS2 Technical Standard – Hydraulic Modelling (HS2-HS2-EV-STD-000-000013) provides information on QMED and how it should be calculated.
- 15.3.7 Submerged refuges should be included at less than 2m spacing and preferably less than one metre spacing.

- 15.3.8 A semi-natural channel bed with cobble and boulders is preferred, but any durable natural or artificial material can be used for refuges.

15.3.9 Where enhancement of existing habitat is undertaken for white-clawed crayfish this shall seek to achieve one or more the following:

- Prevention of incursion by non-native species (in particular signal crayfish);
- improved water quality;
- reduced siltation;
- increased refuge availability; and
- improved type, structure and management of bankside vegetation as appropriate.

15.3.10 Where additional white-clawed crayfish refuges are provided in the channel these shall be of size, type and location to provide shelter for both adults and juveniles.

- 15.3.11 As part of works on a watercourse with white-clawed crayfish, banks and channel temporarily affected by works should be reinstated with habitat suitable for white-clawed crayfish.

Avoiding and mitigating effects during construction phase

15.3.12 Recognised best practice measures shall be implemented during construction to mitigate for impacts to white-clawed crayfish:

- avoid (where practicable) changes in water level or water flow beyond areas directly affected by works on a watercourse;
- reduce the risk of disturbance and damage;
- prevent siltation, which smothers refuges used by white-clawed crayfish and causes damage to their gills; and
- prevent contamination of water by pollutants.

15.4 Further information required for detailed design

- 15.4.1 The status of crayfish in the waterbody and connected watercourses should be determined. Where presence of white-clawed crayfish has been recorded or is possible, update status (presence/absence) should be undertaken by survey not more than 12 months prior to detailed design.
- 15.4.2 Site-scale appraisal of features of the habitat for white-clawed-crayfish to inform mitigation during works, including location, type and abundance of refuges in the channel and submerged banks.

- 15.4.3 Culvert design: size, type, gradient, level(s) and scope for shelter/passage for white-clawed crayfish through culvert.

16 Great crested newt

16.1 Approaches

16.1.1 The key mitigation measures for GCN fall under the following main categories:

1. *In situ* mitigation and compensation: New aquatic and terrestrial habitat for great crested newt primarily within locations that have connectivity with retained habitat that is already utilised by the populations affected.
2. *Ex situ* mitigation and compensation: Where it is not reasonably practicable to address the possible impact of the local population *in situ* then opportunities will be taken to consolidate compensation provision as part of larger scale habitat creation areas.
3. Trapping, relocation and exclusion, where necessary to maintain the FCS of the affected population.
4. Where severance is identified as having the potential to result in an adverse effect on conservation status, then habitat creation/restoration (or if relevant amphibian tunnels) is required to increase connectivity with other known areas of suitable habitat in the landscape, and maintain the viability of these severed elements.

16.1.2 The approach draws on the principles of Defra's Licensing Policies – LP's⁶³. These result in a reduction in the requirements for fencing-off construction boundaries and reduce the time of capture, relocation and translocation exercises, in favour of strategically protecting or creating high quality GCN habitats which are of high value to populations. In collaboration with NE, this approach will be implemented route-wide (where applicable), providing a rigorous test of the approach.

16.1.3 Due to the protection afforded to great crested newt under domestic legislation, certain mitigation measures described within this Chapter may only be implemented under a NE licence.

16.2 Licensing of activities

16.2.1 HS2 Ltd has been issued with an organisational licence (also known as a route-wide licence) for Phase 1 from NE, permitting a range of otherwise unlawful activities (such as disturbance, capture and damaging breeding or resting places) to take place, including enabling and construction works. The licence permits the activities set out in this chapter, across Phase 1. Works affecting great crested newts within Phase 2a and 2b are not covered by this licence.

16.2.2 All works affecting great crested newt shall be undertaken in accordance with the requirements of the applicable licence.

⁶³ <https://www.gov.uk/government/news/new-licensing-policies-great-for-wildlife-great-for-business>

- 16.2.3 Where it is necessary to undertake works affecting great crested newts that are different to those described in any organisational licence, a separate individual licence application shall be prepared and submitted for approval to Natural England (in advance of site works being undertaken).
- 16.2.4 Where it is necessary to undertake works affecting great crested newts within Phase 2a or 2b, then it shall be necessary to ensure a separate individual licence application is prepared and submitted for approval to Natural England (in advance of site works being undertaken), or that an organisational licence covering the relevant phase has been issued.
- 16.2.5 HS2 Ltd shall be informed of all licence applications and will need to approve licence applications where monitoring requirements extend beyond the period of the Contractors involvement in the Scheme.
- 16.2.6 All works carried out under an organisational licence shall be overseen by a suitably experienced ecologist. All ecologists will need to be authorised to operate under the organisational licence by HS2 Ltd, who will ensure that such authorised persons possess suitable levels of experience for undertaking works on site, in order to comply with terms and conditions of the licence and to understand the consequences should these not be met.

- 16.2.7 Surveys and translocation should be undertaken in accordance with the statement in ARG-UK Advice Note 4 (version 2): Amphibian disease precautions: a guide for UK field workers.

16.3 Information required for detailed design

- 16.3.1 The following information is required to allow the selection of design specifications to be made:

Additional Survey Information

- 16.3.2 In advance of detailed design and construction works, a re-survey of ponds which have previously been confirmed as supporting GCN may be required, as detailed below.
- 16.3.3 Great crested newt survey data should be sufficient to accurately reflect the status of site prior to work commencing on site. For the purposes of re-survey, a complete assessment of the conditions present on site to identify significant increases or decreases in habitat quality which could affect the metapopulation size and therefore the level of mitigation proposed shall be carried out.
- 16.3.4 For all levels of impacts on metapopulations, provided that full population size class surveys have been completed following acceptable methodology, within the four years prior to detailed design, results are considered sufficiently up to date to reliably inform the impacts of works. This is based on the assumption that populations are highly unlikely to have fluctuated significantly within this time period without external influences such as habitat creation or destruction.

16.3.5 Where full great crested newt population size class assessment surveys have not been undertaken in the four years prior to detailed design, the following approach should be adopted for great crested newt (GCN) metapopulations:

- A Habitat Suitability Index (HSI) assessment should be undertaken to compare the condition of the pond at the time of survey with that of the initial survey. Where habitat and pond condition has remained broadly unchanged since the time of the last survey, metapopulation sizes should be assumed to have remained stable and pond surveys (e.g. eDNA, bottle trapping) shall not be undertaken.
- Where the aquatic habitat has improved in quality to give an increase of >20% in HSI score, the pond may have improved in condition enough to potentially support a higher class of newt population. In this situation, unless the population had already been recorded as large, a population class size assessment should be undertaken on all ponds within the metapopulation to reassess the population size, and to recalculate mitigation requirements based on this result where necessary.
- Where the aquatic habitat has decreased in quality to give a decrease of >20% in HSI score, and only where the updated score falls below 0.4 (a "poor" pond score according to HSI methodology), the pond may have decreased in condition sufficiently to support a lower population size, or no longer support GCN. Where this is the case, an eDNA survey should be undertaken in the first instance to inform local GCN persistence. Where GCN are confirmed as present, a population class size assessment shall be undertaken to determine the existing population class size. Where the rapid turnaround time for eDNA results required to facilitate this methodology is unlikely to be attained, eDNA and/or presence absence surveys and population size class assessments should be undertaken at the same time as eDNA, with pond surveys ceasing if eDNA demonstrates GCN absence.

16.3.6 The extent of the resurvey required should be determined using experienced professional ecological judgement taking into account the overall size of the metapopulation, the location of the pond(s) within the metapopulation and any individual pond clusters as well as the habitat connectivity between these.

16.3.7 Where GCN are thought to be likely absent (through application of professional judgement), no further survey should be undertaken.

Project Programme

16.3.8 The works design comprising the extent of works areas, and the nature of works - temporary and permanent, including works for diversion of services, needs to be known before the likely impacts upon GCN can be fully determined and suitable detailed mitigation designed.

16.3.9 The phasing of the works needs to be known in order to programme the following works activities:

- Exclusion, capture and translocation of GCN from the site of impact; and
- Creation of aquatic and terrestrial habitat in compensation areas.

Mitigation design

16.3.10 The survey information and project program will then inform the development of the detailed design of the mitigation measures required. Consideration should be given to the following:

- The number, type and location of ponds, and terrestrial habitat to be impacted;
- The extent of impacts in each GCN population;
- Which locations or populations require measures to mitigate impacts;
- Appropriate locations for any mitigation/compensation, taking into account current and potential connectivity;
- Appropriate measures for working near populations;
- Safe crossing points and habitat connectivity; and
- Requirements for temporary (during construction) and permanent (operation) GCN exclusion fencing.

16.4 Mitigation - Detailed Design

- 16.4.1 Prior to the design of any great crested newt mitigation where metapopulations are located within 500m or across a Contract Area border, designers from the two contractors should develop a protocol for establishing mitigation and habitat creation in accordance with their contract requirements.
- 16.4.2 The detailed design of mitigation should identify and consider potential opportunities where habitat creation and enhancement can be delivered at sufficient scale and in a suitable timescale to reduce the effort and cost of capture and both permanent and temporary exclusion measures, whilst still adequately addressing adverse effects on conservation status.
- 16.4.3 The rationale for choosing the selected mitigation design should be outlined in the detailed design document.

Use of non-standard methods – Natural England’s Licencing Policies

- 16.4.4 In implementing mitigation and compensation measures for great crested newts, a combination of traditional, standard, ‘best practice’ should be used, but also drawing upon Defra’s licensing policies.
- 16.4.5 Where the application of the licencing policies is being considered contractors should discuss this with Natural England, and take account of any relevant guidance from HS2 Ltd and Natural England.

Maintenance of connectivity

- 16.4.6 Where severance has potential to have an adverse effect on great crested newt populations, this should be addressed through implementing habitat creation/restoration to increase connectivity with other known areas of suitable habitat in the landscape, and maintain the viability of these severed elements.
- 16.4.7 Where severance cannot be addressed on site, great crested newts should be translocated to a receptor site.
- 16.4.8 Culverts allowing amphibian passage beneath roads may be considered on a case by case basis to mitigate for this potential severance and meet licensing requirements where necessary. In these situations, compensatory habitat should still be provided to account for the possibility that the culvert remains unused.

Managing risk of entrapment and harm to GCN

- 16.4.9 At detailed design stage, drainage or other engineering features should be designed to avoid the potential entrapment of newts or other amphibians/small mammals. Where this is not reasonably practicable, preventative measures should be included to reduce the likelihood of entrapment.
- 16.4.10 Best practice measures should be followed for gullies, catch pit covers and other highway and track drainage related orifices to be appropriately screened to prevent accidental ingress by great crested newts and other amphibians/small mammals.

Aquatic habitat creation

- 16.4.11 Where ponds supporting great crested newt are lost, they should be compensated for through pond replacement at a minimum ratio of 2:1 (created: lost), with two ponds created for each pond lost. Where this requirement can't be delivered at the local level, it should be demonstrated how this ratio will be achieved at the contract level.
- 16.4.12 Ponds should be created at a size range of minimum size of 100m², maximum size 300m².
- 16.4.13 Water bodies > 1000 m² which are unsuitable for breeding, (and do not otherwise contribute to the maintenance of the affected population), should be discounted in calculating the ratio of areas lost and gained. Where it is proposed to provide less than a 2:1 ratio for this reason, the design should be supported by baseline data for habitat suitability.
- 16.4.14 If pond replacement at a ratio of 2:1 (created: lost) is not possible, provision of approximately double the surface area of suitable aquatic habitat through the creation of larger ponds than those lost should be carried out (as agreed in advance with HS2).
- 16.4.15 In circumstances where ponds supporting great crested newts are not lost, but the level of terrestrial habitat loss or change do not allow for sufficient replacement habitats to be installed in situ to retain pond viability, these ponds should be treated as lost and replaced, and the need for translocation determined.

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- 16.4.16 Pond design (including size, depth, area, bank profile, immediately adjacent habitat and planting program for vegetation cover) should be based on the guidance set out in Section 8.3.1 of English Nature, (2001), Great crested newt mitigation guidelines, and the Freshwater Habitats Trust: Pond Creation Toolkit Factsheets 2 to 8; Supplementary Advice Factsheets, Designing wildlife ponds in areas with public access and Designing wildlife ponds to minimise the risk of birdstrike; and Species Dossier, Creating ponds for amphibians and reptiles.
- 16.4.17 Pond creation locations should be chosen based upon their hydrological suitability taking into account future climate change, in particular the likelihood of increased frequency and severity of drought conditions.
- 16.4.18 A hierarchy of preference should be used when considering the lining of created ponds: unlined > puddled clay > bentonite clay > plastic/butyl liner. Ponds should be unlined wherever practicable. Where this is not possible, the detailed design should provide a clear justification and rationale for the use of lining. Plastic or butyl liners should only be considered for use (in agreement with the suitably experienced ecologist) as a last resort where other lining options are not possible due to substrate and / or hydrological constraints.
- 16.4.19 Water bodies should be created to allow as much time as possible to permit sufficient establishment prior to translocation of great crested newts and accord with the conditions of the licence.
- 16.4.20 Ideally new ponds should be located in areas away from public and livestock disturbance, and in locations where suitable terrestrial habitat is present.
- 16.4.21 Existing plants of value for GCN should be translocated, to be advised by a suitably experienced ecologist. Use of native stock in planting and seeding proposals, where supplementary/intervention planting is required.

Terrestrial habitat creation

- 16.4.22 Where there is an adverse effect on great crested newts as a result of terrestrial habitat loss, compensatory terrestrial habitat should be provided.
- 16.4.23 Terrestrial habitat creation should connect habitats alongside and across the route, so that the permanent works at least maintain (and ideally improve) permeability for great crested newt and other amphibians. This may not be possible where there are extensive areas of engineered built infrastructure. Amphibian tunnels should not be considered unless specifically requested or approved by HS2 Ltd.
- 16.4.24 The route wide habitat balance should demonstrate that the value to great crested newts of the habitat provided is equal to or higher than the value of habitats lost.
- 16.4.25 Terrestrial habitat should be created to allow for sufficient establishment time prior to use by great crested newts and accord with the conditions of the licence.
- 16.4.26 Designs for terrestrial habitats should follow principles within Section 8.3.2 pg. 42 of The Great Crested Newt Mitigation Guidelines, Section 8 pg. 39 / 40 and Section 9 pg.

43 of the Amphibian Habitat Management Handbook⁶⁴ and pages 10 and 41 of the Great Crested Newt Conservation Handbook⁶⁵.

- 16.4.27 The terrestrial habitat creation should be planned in detail to be in accordance with the Landscape Maintenance, Management and Monitoring Technical Standard and with pond specifications.
- 16.4.28 Hibernacula design should follow the dimensions stated in the Amphibian Habitat Management Handbook and the cross section design set out in Section 8.3.2 of the Great Crested Newt Mitigation Guidelines.

Capture and exclusion

- 16.4.29 Where standard methodology applies, capture and exclusion works should be undertaken in accordance with the latest NE licencing guidelines and the Great Crested Newt Mitigation Guidelines,
- 16.4.30 Where the LP approach is taken, this should be agreed with HS2 Ltd in advance.
- 16.4.31 Fencing and other exclusion measures should be selected on a case by case basis depending on the requirements within each location.

Pitfall traps and carpet tiles

- 16.4.32 The types, required densities and advice for appropriate use of both pitfall traps and carpet tiles (artificial refuges) is specified within Sections 5.6.5 pg. 25, 8.6.2 pg. 57, 8.4.2.2 pg. 49 and Figure 4 pg. 50 of the Great Crested Newt Mitigation Guidelines.
- 16.4.33 Pitfall traps should be inspected in accordance with the Great Crested Newt Mitigation Guidelines.

Fencing

- 16.4.34 Design specifications have been developed for the selection of the different types of fencing to be used within each area. A series of design options are presented in Chapter 9: Culverts, underpasses and fencing, in the Design Specification – Amphibian and Reptile Fencing, to guide appropriate design for licensing, or at detailed design stage.
- 16.4.35 All locations where fencing for great crested newt is proposed should be recorded, showing the fencing used and a programme for its installation, monitoring checks and maintenance.
- 16.4.36 Design should ensure that the correct fence type has been chosen for the location, and that minimum length required is utilised.
- 16.4.37 The designer should liaise with other contractors to identify opportunities for the re-use of fencing materials across the route where reasonably practicable.

⁶⁴ John Baker, Trevor Beebee, John Buckley, Tony Gent and David Orchard (2011). *Amphibian Habitat Management Handbook*, Amphibian and Reptile Conservation, Bournemouth:

⁶⁵ Langton, T.E.S., Beckett, C.L., and Foster J.P. (2001), *Great Crested Newt Conservation Handbook*, Froglife, Halesworth:

- 16.4.38 Temporary exclusion fencing for great crested newts should remain in-situ, until such a time that the risk to amphibian populations is considered, by the suitably experienced ecologist, to be minimal.

Gates

- 16.4.39 Where pedestrian and vehicle access points are required to allow passage across the fencing, they should be designed to exclude the target species as far as reasonably practicable.
- 16.4.40 Gates installed as part of the great crested newt fencing should be monitored at least weekly for the duration of their use under licence. Maintenance measures will include keeping any such barrier intact and free of debris or vegetation that may cause breaches of integrity.

Monitoring and maintenance

- 16.4.41 Monitoring of the created aquatic and terrestrial habitat will follow the principles outlined in the Great Crested Newt Habitat Management, Maintenance & Population Monitoring Plan (HS2-HS2-EV-PLN-000-000010). The habitats will be managed to ensure that conservation status within the metapopulations is at least maintained.
- 16.4.42 Ongoing management, maintenance and monitoring of mitigation and compensation measures, should to be undertaken in accordance with the great crested newt Habitat Management, Maintenance & Population Monitoring Plan (HS2-HS2-EV-PLN-000-000010).

Relocated populations

- 16.4.43 Monitoring of translocated populations to ascertain the successful maintenance of FCS is a requirement of the NE licence and should be carried out in accordance with section 6 of the GCN Habitat Management, Maintenance & Population Monitoring Plan.

Terrestrial habitat management (including amphibian culverts and hibernacula)

- 16.4.44 Terrestrial habitat management should follow the prescriptions in the great crested newt Habitat Management, Maintenance and Population Monitoring Plan.

Aquatic habitat management

- 16.4.45 Ponds should be managed in accordance with the objectives in the great crested newt Habitat Management, Maintenance and Population Monitoring Plan and the HS2 Landscape Management, Monitoring and Maintenance Plan.
- 16.4.46 Water bodies created for great crested newt mitigation purposes should be monitored for the required duration and frequency, as specified in the great crested newt Habitat Management, Maintenance and Population Monitoring Plan.

17 Reptiles

17.1 Approaches

- 17.1.1 The hierarchy of mitigation, as outlined in the Ecological Principles of Mitigation should be used to inform the selection of the most appropriate approach with regards to reptiles: Avoid, Mitigate, Compensate.
- 17.1.2 The aim of all works should be to safeguard the reptiles from killing and harm (both in the short and long term) and, to retain populations within their current distribution. A suitably experienced ecologist should be engaged at the earliest opportunity to guide the selection of appropriate mitigation measures.

17.2 Selection of design specifications

- 17.2.1 Where works have the potential to kill or injure reptiles, but there is suitable habitat immediately adjacent to the work site that could support a viable population with enhancements, mitigation measures should follow Design Specification – Habitat Manipulation and Displacement.
- 17.2.2 Where there is no suitable habitat immediately adjacent to the work site, mitigation measures should follow the gov.uk guidance 'Reptiles: surveys and mitigation for development projects'⁶⁶.
- 17.2.3 Habitat creation works should follow Design Specification – Habitat Creation, and be carried out in accordance with Edgar, Foster & Baker (2010).

17.3 Information required for detailed design

- 17.3.1 Survey data no more than two years old should be used to inform the selection of appropriate reptile mitigation measures (to be advised by the suitably experienced ecologist).

17.4 Design specification: habitat manipulation and displacement

Target performance

17.4.1 The overall target during reptile habitat manipulation shall be:

- To avoid the killing and injuring of reptiles (by displacing them to adjacent suitable habitats).
- To retain populations or communities of reptiles, ensuring no long-term adverse effects on the conservation status of widespread reptile species.

⁶⁶ Reptiles: Surveys and mitigation for development projects: <https://www.gov.uk/guidance/reptiles-protection-surveys-and-licences#moving-reptiles-translocation-as-mitigation>

Performance requirements

17.4.2	Where no permanent habitat loss is to occur (i.e. habitat will be reinstated within two years), reptile habitat manipulation works shall be undertaken during the winter (November to February, or when daytime temperatures average less than 5°C during a single 24hr period).
17.4.3	Where permanent infrastructure or land use changes that are detrimental to reptiles is required, areas of up to 200 m ² (assuming that this represents less than 10 % of suitable habitat available) shall be manipulated to encourage reptiles to move towards adjacent habitat during the reptile active period (March to October). The manipulation shall involve a staged vegetation clearance using hand tools only carried out in the presence of an ECoW.
17.4.4	All vegetation to be removed should be cut down to 0.3m and removed from site – the site should then be left undisturbed for two warm and dry days; this would then be repeated taking the vegetation down to 0.1m. Finally, the vegetation should be taken down as close to the ground as possible and maintained in this condition for the duration of the works.
17.4.5	Where areas of greater than 200 m ² are to be cleared or where between 10 % and 50% of the habitat available is to be lost, habitat displacement techniques alone are unlikely to be effective. Typical reptile behaviour would be to 'go to ground' and remain inactive, possibly resulting in their isolation within the cleared area. Under such circumstances, it is likely that a reptile translocation would be required (see below).
17.4.6	A Working Method Statement should be produced and implemented (by a suitably experienced ecologist) to ensure that reptiles are retained and safeguarded throughout the construction and operational phases.
17.4.7	Existing features such as log piles or hibernacula should ideally be avoided. If this is not possible they should carefully dismantled by hand during the reptile active period (overseen by an ECoW). Any breeding sites should be dismantled by hand outside the breeding season. Where possible, habitat features such as hibernacula or egg-laying sites which are to be lost should be reconstructed (or replaced) within the replacement habitats.

17.5 Design specification: reptile translocation

Target performance

17.5.1	The overall target during reptile translocation shall be to avoid the killing and injuring of individuals.
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Performance requirements

17.5.2	Reptile translocations shall adhere to recognised best practice guidelines.
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- 17.5.3 A Working Method Statement should be produced and implemented to ensure that reptiles are safeguarded throughout the construction and operational phases.

17.5.4 Prior to the translocation of reptiles, a suitable receptor site shall be identified by the suitably experienced ecologist. The receptor site shall be prepared at a minimum of six months (during the growing season) prior to translocation of reptiles commencing. Whilst there is no data deliverable to HS2 Ltd., the contractor shall record data and decision-making which would need to be made available as necessary.

- 17.5.5 Where used, exclusion fences should follow the specification as set out within Chapter 9: Culverts, underpasses and fencing, see Design Specification – Amphibian and Reptile Fencing.

- 17.5.6 Artificial refuges should be deployed throughout the capture in line with recognised best practice.

17.5.7 Reptiles shall be captured by hand over the course of a translocation and moved to the receptor site.

- 17.5.8 Key habitat features within the site should be searched by hand and/or dismantled using an excavator during a destructive search overseen by the ECoW.

17.6 Design specification: habitat creation for reptiles

Target performance

17.6.1 The overall target for reptile habitat creation shall be to create habitat conditions that are suitable for the appropriate reptile species.

Performance requirements

- 17.6.2 Habitat loss should be compensated for either directly through the replacement of habitat or through habitat enhancement of what is retained (where appropriate and feasible).

- 17.6.3 Terrestrial habitat shall be created to allow as much time as possible to permit sufficient establishment to ensure it is suitable prior to the translocation of reptiles.

17.6.4 The suitably experienced ecologist shall demonstrate that the habitat is sufficiently established to support the translocated reptile population.

- 17.6.5 The minimum period should be least six months establishment covering a growing season, (March – September inclusive), in advance of its intended use by reptiles. In all instances (i.e. whether the habitat maturation period has been significantly more than six months or potentially a reduced period) the suitably experienced ecologist must demonstrate that the habitat is sufficiently established to support the translocated reptile population.

17.6.6 The establishment period for reptile hibernacula shall be decided upon by the suitably experienced ecologist.

- 17.6.7 Guidance on terrestrial habitat creation is provided in the Reptile Management Handbook (Edgar, Foster & Baker, 2010).

18 Breeding birds

18.1 Approaches

- 18.1.1 All wild birds are subject to the provisions of the Wildlife and Countryside Act 1981 (as amended) and afforded protection while a nest is being built or in use. Birds are also covered by The Conservation of Habitats and Species Regulations 2017 and Section 40/41 of the NERC Act 2006.
- 18.1.2 Species listed on Schedule 1 of the Wildlife and Countryside Act, such as barn owl, are subject to additional protection from disturbance during nesting and the rearing of their dependent young.
- 18.1.3 The creation of habitats should seek to replicate the structure and type of habitats lost.

18.2 Selection of design specifications

General

- 18.2.1 Habitat clearance should be conducted outside of the bird nesting season (March to August inclusive) where practicable.

- 18.2.2 If habitat clearance is carried out during the bird nesting season (March to August inclusive) then an appropriate Working Method Statement shall be completed in advance of clearance works commencing, and appropriate supervision provided by the ECoW.
- 18.2.3 The use of netting to prevent birds nesting in trees, hedgerows and shrubs shall not to be used, other than in exceptional circumstances, as advised by a suitably experienced ecologist. Where netting is used, entrapment/entanglement risks to birds and other wildlife shall be appropriately negated. HS2 Ltd shall be notified in advance of any proposed use of netting of vegetation.

- 18.2.4 The following sections outline the design and installation of bird boxes / structures relating to a variety of species known to occur within the HS2 route. This list should not be taken as definitive (except where requirements are provided) and species-specific guidance should be sought from a suitably experienced ecologist when mitigating for impacts to birds providing enhancements.

Barn owl

- 18.2.5 The Phase One HS2 Barn Owl Mitigation Plan (HS2-HS2-EV-REP-000-000041) and advice note (HS2-HS2-EV-NOT-000-000031) should be used as key sources of information in relation to undertaking mitigation and compensation measures for barn owl, including the design and positioning of nest boxes. The Barn Owl Conservation Handbook in conjunction with the Barn Owl Trust website may also be used as key sources of information. GIS data associated with the HS2 Barn Owl Mitigation Plan can be requested using the HS2 GIS Data Request Procedure HS2-HS2-GI-PRO-000-000028.

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| 18.2.6 | Mitigation and compensation actions for barn owl shall accord with the actions identified in the HS2 Barn Owl Mitigation Plan, where reasonably practicable. In the instance that action is not practicable, the rationale shall be recorded and provided to HS2 Ltd. Information relating to the actions undertaken for barn owl shall be provided in accordance with AIMS AD4 (HS2-HS2-IM-ADD-000-000230). |
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Black redstart

- 18.2.7 Feu (2005)⁶⁷ should be used as the key source of information in relation to the design and positioning of artificial black redstart boxes.
- 18.2.8 Nest sites can be created by adapting retained or proposed built structures.

Hobby

- 18.2.9 Freeman (1998)⁶⁸ should be used as the key source of information in relation to the design and positioning of artificial Hobby nest boxes.

Kingfisher and sand martin

- 18.2.10 RSPB guidance relating to the Management and Creation of Sand Martin Nest Sites⁶⁹ and Environment Agency guidance relating to the Artificial Bank Creation for Sand Martins and Kingfishers⁷⁰ should be used as the key source of information in relation to the design and creation of artificial nesting banks.

Lesser spotted woodpecker and willow tit

- 18.2.11 Guidance on lesser spotted woodpecker⁷¹ and willow tit⁷² nest sites should be used as the key sources for the creation of artificial nesting sites.

Oystercatcher and common tern

- 18.2.12 Feu (2005) and the RSPB Design of Management Rafts⁷³ should be used as the key sources for the creation of gravel islands and rafts.

Tree sparrow

- 18.2.13 Feu (2005) should be used as the key source of information in relation to the design and positioning of artificial tree sparrow nest boxes.

⁶⁷ Du Feu, C. (2005) *Nestboxes – Extracts from the British trust for Ornithology Field guide Number 23 with some additions and amendments*. BTO

⁶⁸ Freeman, A. (1998). Artificial Nests for the Hobby (*Falco subbuteo*). *The Raptor*, **25**, 22-27. Hawk and Owl Trust.

⁶⁹ RSPB. *Management and Creation of Sand Martin Nest Sites*. Royal Society for the Protection of Birds, Sandy. <https://www.rspb.org.uk/ourwork/conservation/advice/sandmartins/index.aspx>.

⁷⁰ Hopkins, L. (2001). *Artificial Bank Creation for Sand Martins and Kingfishers*. Environment Agency.

⁷¹ Smith, K.W. & Charman, E.C. (2012). The ecology and conservation of the lesser Spotted Woodpecker. *British Birds*, **105**, 294-307.

⁷² Last, J. & Burgess, M. (2015). Nestboxes and fieldcraft for monitoring Willow Tits. *British Birds*, **108**, 30-36.

⁷³ RSPB. *Design of Management of Rafts*. Royal Society for the Protection of Birds, Sandy. http://www.rspb.org.uk/Images/Designofrafts_tcm9-212589.pdf

19 Terrestrial invertebrates

19.1 Approaches

19.1.1 The main principle is that habitat creation should be informed by an understanding of the importance of plant, habitat and structural diversity in creating niches for a variety of invertebrate species.

19.1.2 A range of key guidance documents should be referred to during the detailed design phase where specific terrestrial invertebrate mitigation is required. These included, but are not limited to, the following:

- The Butterfly Conservation Handbook⁷⁴(2005).
- RSPB's Farming & Crofting for Wildlife Guidance Note⁷⁵.
- Habitat Management for Invertebrates – A Practical Handbook (2013)⁷⁶.
- Butterfly Conservation factsheets (moths and butterflies)⁷⁷.

19.2 Selection of design specifications

19.2.1 The selection of the design specification will be dependent upon whether targeted species mitigation is required or whether a more general approach to terrestrial invertebrates is appropriate.

19.2.2 Where blackthorn is to be planted on structures and in areas to mitigate habitat losses for black hairstreaks, the following methods should be implemented:

- The laying of cut blackthorn or re-using of blackthorn from the donor site, will reduce impacts on black hairstreak eggs, which may be present on the branches and stems. This method will allow eggs to be moved to receptor sites which will encourage the establishment of a viable population
- Using locations with a southern aspect for planting/habitat creation, as this can increase the rate of establishment;
- Protecting and retaining existing areas of blackthorn adjacent to the Scheme; and
- Suitable management of all areas of blackthorn – laying of the bushes if possible (to reduce the impact on the eggs) and if areas need to be cut in autumn/ winter when eggs are on the branches no more than 25% of the blackthorn in any one area should be cut at one time

⁷⁴ English Nature & the Highways Agency (2005). *The Butterfly Conservation Handbook. General advice note on mitigating the impacts of roads on butterfly populations*. Peterborough. ISBN: 1 903798 25 6.

⁷⁵ RSPB. Farming & Crofting for Wildlife. Beetle Banks.

⁷⁶ Kirby P. (2013). *Habitat Management for Invertebrates: A Practical Handbook*. National Power, Joint Nature Conservation Committee & RSPB. Bedfordshire.

⁷⁷ <https://butterfly-conservation.org/3514/downloads-resources--reports.html>

19.2.3 The following is a list of measures that should be included within the specification for habitat creation areas in order to enhance their value for terrestrial invertebrates:

- Planting areas should include a wide variety of native flowering tree and shrub species (preferably of local provenance) to provide sources of nectar, pollen and fruit throughout the growing season;
- The design of habitat creation areas should maximise structural diversity, through the provision of a wide variety of features, from bare ground and areas of short grass, to longer tussocky grassland, scrubby scalloped edges to planting areas, and more dense planting;
- Wherever reasonably practicable, topographical variation should also be provided, through the creation of mounds, banks and ditches, ideally creating a number of south-facing slopes;
- Scrapes and ponds should be installed, wherever reasonably practicable, as wetland habitats are important for a wide variety of invertebrates that are terrestrial at other stages of their development;
- Where sand is the predominant geology, low sandy south or south west facing cliffs should be created using a digger bucket, as these are particularly important for burrowing bees and wasps; and
- Log piles of varying shapes and sizes, and in various conditions (from half-buried to fully exposed), should be created using material felled during site clearance.

19.3 Information required for detailed design

19.3.1 Suitable features of value for terrestrial invertebrates should be identified, and potential receptor sites reviewed for suitability, and preparation carried out where necessary, particularly in relation to dead wood features and specific rare / scarce invertebrates that may be present on sites.

20 Aquatic invertebrates

20.1 Approaches

20.1.1 As there are a wide range of aquatic invertebrate species and habitats specific mitigation measures are not provided for each species potentially present. Therefore a broad set of principles that will protect and/or enhance the populations of aquatic invertebrates present are provided.

20.1.2 The mitigation measures should follow the principles outlined below:

- Retain aquatic habitats (or elements of) where reasonably practicable;
- Where aquatic invertebrate habitats are lost or otherwise affected there needs to be the provision of compensatory habitat and/or enhancement of existing habitats;
- Where water bodies (ponds and slow flowing ditches) will be impacted, approaches such as the transfer of plant material into compensatory ponds could be considered to increase the likelihood that target species will occupy new habitats. Any crossings, notably culverts, will be appropriately designed and installed in order to avoid the creation of barriers to invertebrate migration;
- Where there are notable species that are potentially affected, measures (notably habitat designs seasonal limitations) will be taken in to consideration; and
- Pollution control measures.

20.2 Selection of design specifications

General

20.2.1 The following existing guidance should be followed:

- River Restoration Centre (2013) Manual of river restoration techniques⁷⁸
- SEPA - Managing River Habitats for Fisheries⁷⁹
- Fisher, K. and Ramsbottom, D. (2001), River Diversions: A Design Guide ⁸⁰
- RSPB (2001). The New Rivers and Wildlife Handbook. RSPB.

⁷⁸ River Restoration Centre (2013) *Manual of river restoration techniques* http://www.therrc.co.uk/MOT/Low-res/2013_Update_2.pdf?bcsi_scan_AB11CAA0E2721250=0&bcsi_scan_filename=2013_Update_2.pdf

⁷⁹ SEPA Managing River Habitats for Fisheries http://www.sepa.org.uk/water/regulations/guidance/ldoc.ashx?docid=36bca21f-9bdb-4914-92fb-84f91d606ea3&version=-1&bcsi_scan_E956BCBE8ADBC89F=g3lpS5FNh2Tn8VmE3+sJPSJNzqitAAAaVBSX8w==:1

⁸⁰ Fisher, K. and Ramsbottom, D. (2001). *River Diversions: A Design Guide*. Thomas Telford Ltd.

- JNCC (2014). Common standards monitoring guidance for rivers.
- JNCC (2015). Common standards monitoring for freshwater lakes.
- Natural England Research Report NERRo64: A narrative for conserving freshwater and wetland habitats in England.

20.2.2 For wetland habitat creation and enhancements the following guidance should be followed:

- SEPA - Ponds, pools and lochans guidance on good practice in the management and creation of small water bodies in Scotland June 2000⁸¹;
- Pond Conservation (2011) Million Ponds Project: Pond Design Toolkit Sheets 1 - 8⁸²;
- Williams et al. (1997) Designing new ponds for wildlife. British Wildlife, Vol. 8, No. 3⁸³;
- Buglife (2011). Managing farmland habitats for invertebrates: Ponds & Ditches⁸⁴;
- RSPB Sustainable Drainage Systems guidance⁸⁵; and
- Buglife. Grazing Marsh Ditches. Sheets 1 - 4⁸⁶.

20.2.3 With regards to mitigation measures for aquatic invertebrates associated with watercourse crossings, the following guidance should be followed.

- Vaughan (2002) Potential impact of road-stream crossing (culverts) on the upstream passage of aquatic macroinvertebrates⁸⁷
- SEPA (2010) Engineering in the water environment good practice guide - River crossings⁸⁸
- HS2-HS2-DR-STD-000-000003 – Technical Standard – Railway drainage.

Habitat creation & enhancements

20.2.4 New or replacement habitats created should be designed to address significant effects on aquatic invertebrates and recreate similar structure and form of existing habitats that support the population in question. This should include:

- Use of appropriate and similar water supply regimes, where practicable; and
- Other key considerations include the depth profiles, proximity to other water

⁸¹ SEPA (2000) *Ponds, pools and lochans - Guidance on good practice in the management and creation of small waterbodies in Scotland*

⁸² Pond Conservation (2011) *Million Ponds Project: Pond Design Toolkit Sheets 1 - 8*

⁸³ Williams P, Biggs J, Corfield A, Fox G, Walker D, Whitfield M. Designing new ponds for wildlife. British Wildlife, Vol. 8, No. 3

⁸⁴ Buglife (2011) *Managing farmland habitats for invertebrates: Ponds & Ditches*

⁸⁵ RSPB Sustainable Drainage Systems guidance

⁸⁶ Buglife (2011) *Grazing Marsh Ditches Sheet 1 - 5*

⁸⁷ Vaughan (2002) Potential impact of road-stream crossing (culverts) on the upstream passage of aquatic macroinvertebrates

⁸⁸ <http://www.sepa.org.uk/media/151036/wat-sg-25.pdf>

bodies, choice of vegetation, shape, underwater topography and substrate.

20.2.5 Waterbody creation and enhancement designs should follow appropriate guidance for the target habitat, notably:

- River Restoration Centre (2013) *Manual of river restoration techniques*⁸⁹
Fisher, K. and Ramsbottom, D. (2001), *River Diversions: A Design Guide*⁹⁰ and
SEPA - *Managing River Habitats for Fisheries*⁹¹ for rivers;
- Pond Conservation (2011) *Million Ponds Project: Pond Design Toolkit Sheets 1 -8*⁹², Williams et al. 1997. *Designing new ponds for wildlife*. British Wildlife, Vol. 8, No. 3⁹³ SEPA - *Ponds, pools and lochans guidance on good practice in the management and creation of small water bodies in Scotland* June 2000⁹⁴ and Buglife. 2011. *Managing farmland habitats for invertebrates: Ponds & Ditches*⁹⁵ for ponds; and
- Buglife. *Grazing Marsh Ditches*. Sheets 1 - 4⁹⁶ for ditches.

20.2.6 The following applies to pond and ditch habitat creation and enhancement measures:

- Ponds and ditches should be allowed to develop for no less than six months (during the growing season);
- Pond creation and enhancement measures should consider future climate change, in particular the likelihood of increased frequency and severity of drought conditions;
- Aquatic plant material should be transferred to the area of mitigation / compensatory provision; and
- If deemed appropriate by a suitably experienced ecologist, aquatic invertebrate habitat creation measures should be included in Sustainable Drainage Systems (SuDS) designs following existing guidance.

20.2.7 If the transfer of aquatic material between sites is required as part of habitat enhancement measures, strict biosecurity practices should be adhered to (following the detail provided in Chapter 22).

20.2.8 Enhancements should be appropriate to the watercourse and need to be considered on a case by case basis.

20.2.9 Culverts and other crossings shall be designed and installed so not to create a barrier to aquatic invertebrates.

⁸⁹ River Restoration Centre (2013) *Manual of river restoration techniques*

⁹⁰ Fisher, K. and Ramsbottom, D. (2001). *River Diversions: A Design Guide*. Thomas Telford Ltd.

⁹¹ SEPA *Managing River Habitats for Fisheries*

⁹² Pond Conservation (2011) *Million Ponds Project: Pond Design Toolkit Sheets 1 -8*

⁹³ Williams P, Biggs J, Corfield A, Fox G, Walker D, Whitfield M. *Designing new ponds for wildlife*. British Wildlife, Vol. 8, No. 3

⁹⁴ SEPA (2000) *Ponds, pools and lochans - Guidance on good practice in the management and creation of small waterbodies in Scotland*

⁹⁵ Buglife (2011) *Managing farmland habitats for invertebrates: Ponds & Ditches*

⁹⁶ Buglife (2011) *Grazing Marsh Ditches Sheet 1 - 5*

21 Fish

21.1 Approaches

- 21.1.1 All native species of fish found in freshwaters are afforded protection under the Salmon and Freshwater Fisheries Act 1975 (as amended). Those species listed on Schedule 5 of the Wildlife and Countryside Act 1981 (as amended) are subject to further protection.
- 21.1.2 Due to the legislative protection afforded to fish, certain mitigation measures described within this Chapter may only be implemented under licence or an Environment Agency permit.

21.2 Selection of design specifications

- 21.2.1 Where significant effects on fish populations are identified as a consequence of possible restrictions to fish movement then the requirement to provide fish passage should be considered.
- 21.2.2 Selection of design specification for works to watercourses to reduce fragmentation of fish habitat will be site specific and should be informed by a fisheries scientist on a case by case basis.
- 21.2.3 Key sources of guidance include CIRIA (2010), as supported by SEPA (2010)⁹⁷ guide on river crossings (WAT-SG-25) and Scottish Executive (2000)⁹⁸ design guidance on river crossings and migratory fish.
- 21.2.4 Where reasonably practicable to do so, temporary diversions which replicate the existing channel as closely as possible should be utilised to maintain the safe passage of fish during construction.
- 21.2.5 Environment Agency (2010)⁹⁹ should be followed where removal of substrate is justified to maintain hydrology or would be of demonstrable benefit to in-channel ecology and geomorphology.
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| 21.2.6 | All culverts shall be designed to allow safe passage of fish where fish habitat is provided. |
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- 21.2.7 CIRIA (2010)¹⁰⁰ *Culvert Design and Operation Guide* (C68g) and online Environment Agency (2009)¹⁰¹ fluvial design guide should be used as the key sources of information on culvert design in order to seek to reduce fragmentation of fish habitat.
- 21.2.8 General principles to be followed in selecting baffle designs include:
- Weir baffles usually between 150m and 450m in height to create roughness.

⁹⁷ SEPA (2010) *Engineering in the Water Environment Good Practice Guide: River Crossings 2nd edition* (WAT-SG-24).

⁹⁸ Scottish Executive (2000) *River Crossings and Migratory Fish: Design Guidance*.

⁹⁹ Environment Agency (2010) *Good Practice Sediment Management: Good Practice Management of In-channel Sediments Design Guidance*.

¹⁰⁰ CIRIA (2010) *The Culvert Design and Operation Guide* (C68g).

¹⁰¹ Environment Agency (2009) *Fluvial Design Guide*.

They are not recommended for slopes over 1%;

- Corner baffles to be used in culverts with slopes of 1-2.5%; and
- Notch baffles to be used in wide culverts where the slope is 2.5-5%. The central length of notch can be zero, thus giving two corner baffles.

21.2.9 Highways Agency (2001)¹⁰² should be followed in relation to the main time periods to avoid when undertaking works which may affect fish.

21.2.10 Timing, phasing and methodology of works shall be determined on a site specific basis and agreed with the Environment Agency for works which may affect fish.

21.2.11 CIRIA (2010), as supported by SEPA (2010) and Scottish Executive (2000), provides general design principles to minimise construction impacts to fish, which should be followed.

21.2.12 An ECoW shall supervise all works likely to involve disturbance, capture, handling or translocation of fish.

21.2.13 All works involving capture of fish using equipment shall be carried out in accordance with the issued Environment Agency permit under section 27A of the Salmon and Freshwater Fisheries Act 1975.

21.2.14 All works involving translocation of fish shall be carried out in accordance with the issued Environment Agency permit under the Keeping and Introduction of Fish Regulations 2015.

21.2.15 Embedded mitigation for the provision of replacement fish habitat shall be undertaken in consultation with the lead local flood authority.

21.2.16 Diversions and realignments should be designed to provide appropriate habitat conditions for target fish species and life-stages.

21.2.17 SEPA (2002)¹⁰³ handbook on managing river habitats for fisheries produced in collaboration with the Scottish Executive, the Fisheries Research Services and Scottish Natural Heritage should be followed in the designing fish habitat enhancement schemes.

21.2.18 Environment Agency (2006)¹⁰⁴ and Institute of Fisheries Management (2012)¹⁰⁵ guidance on managing river habitats for fish, in conjunction with the River Restoration Centre website¹⁰⁶ and the IFM Fish Pass Manual¹⁰⁷ should be used as the key sources of information in relation to best practice for fisheries habitat creation, enhancement and management in still and running water.

¹⁰² Highways Agency (2001) Design Manual for Roads and Bridges, (DMRB) Vol. 10, Section 4, Part 1.(HA 84/01). Department for Transport, UK.

¹⁰³ SEPA (2002) Managing River Habitats for Fisheries Handbook: A guide to best practice.

¹⁰⁴ Environment Agency (2006) Better habitats mean better fishing: fisheries habitat improvement.

¹⁰⁵ Institute of Fisheries Management (2012) Code of Good Practice for Freshwater Fisheries Management Part 1 Salmon and Brown Trout.

¹⁰⁶ River Restoration Centre: Manual of river restoration techniques.

¹⁰⁷ <https://ifm.org.uk/wp-content/uploads/2016/01/Fish-Pass-Manual.-minimum-size.pdf>

Management, maintenance and monitoring

- 21.2.19 Environment Agency (2006) and SEPA (2002) should be used as the key source of information where fish habitat management, maintenance and monitoring are required.
- 21.2.20 Further monitoring requirements are set out in the WFD compliance assessment and will be developed further during the detailed design.
- 21.2.21 Once reinstatement of habitat suitable for fish has been completed, no specific on-going management for fish is likely to be required (provided no structures to aid fish movements have been created).
- 21.2.22 The requirements for monitoring any fish populations will be agreed with the Environment Agency on a case by case basis, including as part of securing a permit for any translocations.

21.3 Information required for detailed design

- 21.3.1 The capture, translocation and release of fish will be subject to securing an Environment Agency Permit. Prior to submission of an application for a permit, surveys will be required to confirm the species and numbers of fish present. Survey methods set out in Hinckley (1996)¹⁰⁸ and Beaumont et al (2002)¹⁰⁹ should be followed to ensure fish are safely removed and relocated where required by construction activities.
- 21.3.2 Habitat types provide a useful guide when selecting fisheries monitoring methodologies, as appropriate survey methods are affected by the physical characteristics of a water body. Key considerations when selecting a survey methodology include timing of surveys in regard to both the behaviour and life stage of fish species being targeted. Specific aims and objectives of surveys will dictate what factors take priority.

¹⁰⁸ Hickley, P. (1996). Fish population survey methods: a synthesis. In: I.G. Cowx (ed.) Stock Assessment in Inland Fisheries, pp. 3-10. Fishing News Books, Blackwell, Oxford.

¹⁰⁹ Beaumont, W., R., C., Taylor, A., A., L., Lee, M., J., Welton, J., S., 2002. Guidelines for Electric Fishing Best Practice, Environment Agency, R&D Technical Report W2-054/TR.

22 Biosecurity and invasive non-native species

22.1 Approach

- 22.1.1 Invasive non-native species (INNS) of particular concern are those listed under Schedule 9 of the Wildlife and Countryside Act 1981 (as amended).
- 22.1.2 The GB Invasive Non-native Species Strategy¹¹⁰ (Defra 2015) and EU Regulation 1143/2014 on Invasive Alien Species (entered into force on 1 January 2015) direct landowners and managers to adopt a proactive biosecurity driven approach to INNS management. The Environment Agency, Natural England and the Forestry Commission advocate this proactive approach.
- 22.1.3 In addition to the GB NNSS website¹¹¹, key generic multispecies guidance documents associated with the control of INNS are listed below.
- Defra (2015)¹¹² - The GB Invasive Non-native Species Strategy.
 - Defra (2013)¹¹³ - Prevent harmful weeds and invasive non-native plants spreading.
 - Forestry Commission (2016)¹¹⁴ - Keep it Clean.
 - National Roads Authority Republic of Ireland (2010)¹¹⁵ - Guidelines on the Management of Noxious Weeds and Non-Native Invasive Plant Species on National Roads.
 - SEPA guidance: Biosecurity and management of invasive non-native species for construction sites and Controlled Activities¹¹⁶.
- 22.1.4 The risk of introducing plant diseases as a result of planting, seeding and remedial works carried out during contractor led works is covered within Technical Standard - Meadow and Wetland Procurement Strategy.
- 22.1.5 It should be noted that the above list is not exhaustive and the relevant recognised best practice should be used to for each species (plant and animal) to be covered under the relevant Biosecurity Plan.

¹¹⁰ DEFRA (2015) The GB Invasive Non-native Species Strategy. HMSO. Crown Copyright

¹¹¹ <http://www.nonnativespecies.org/home/index.cfm>

¹¹² The Great Britain Invasive Non-native Species Strategy.

¹¹³ DEFRA (2013) Prevent harmful weeds and invasive non-native plants spreading (website access)

¹¹⁴ Forestry Commission (2016) Biosecurity - Keep it Clean

¹¹⁵ National Roads Authority Republic of Ireland (2010) Guidelines on the Management of Noxious Weeds and Non-Native Invasive Plant Species on National Roads.

¹¹⁶ <https://www.sepa.org.uk/media/163480/biosecurity-and-management-of-invasive-non-native-species-construction-sites.pdf>

22.2 Biosecurity Management Plan

Specification

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| 22.2.1 | A Biosecurity Management Plan shall be produced in advance of works commencing, where required due to the potential spread or impact to areas containing invasive non-native species (plant and/or animal). The necessity to produce one shall be advised upon by the suitably experienced ecologist. Whilst there is no data deliverable to HS2 Ltd, the Biosecurity Management Plan would need to be made available as necessary. |
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- 22.2.2 The following general factors should be considered with regards to the production of a Biosecurity Management Plan:
- The timeframe in which the work needs to be completed;
 - Structural or environmental features that might affect control action, such as proximity to watercourses, desired vegetation and built structures;
 - Future plans for the area, such as development or landscaping plans; and
 - Hazards or risks identified during the site inspection, such as underground services and chemical contamination.
- 22.2.3 Based on consideration of these overview factors, a Biosecurity Management Plan should contain:
- The objectives of management;
 - An evaluation of control/containment/eradication options;
 - A detailed description of the action to be taken;
 - An assessment of the risks associated with action;
 - How the success of the action will be evaluated;
 - An assessment of potential INNS pathways (and associated development activities) along with recommendations for preventing spread on-site and off-site during control action;
 - How to prevent re-colonisation;
 - A monitoring schedule;
 - A treatment schedule (if required);
 - A re-vegetation plan (if required); and
 - A site-specific distribution map (at an appropriate resolution).

Pre-control action

22.2.4 Disruptive works (those that will break ground or involve heavy machinery) shall not take place in areas with confirmed Schedule 9 invasive plant species presence without a site-specific Biosecurity Management Plan being in place.

22.2.5 The location of INNS should be clearly demarcated and, where necessary, fenced off to create a buffer zone of the recommended width. Signs must be erected indicating what species are present, with protection/avoidance requirements clearly stated.

General biosecurity precautions

22.2.6 Any soil/sediment used in works shall only be used where known to be free of invasive non-native species. If the soil/sediment originated from off-site, it shall be obtained from a source confirmed as uncontaminated with invasive non-native plant species and/or their propagules.

22.2.7 Precautions should be taken to reduce the transfer/spread of plant and animal species including:

- Avoiding the need to create a risk situation in the first place;
- Planning your activity/works to reduce the risk of picking up and spreading INNS;
- Checking equipment, clothing and footwear for soil, seeds and live organisms;
- Cleaning, washing and drying all equipment, footwear and clothing thoroughly;
- Disinfect all equipment and clothing where the spread of microorganisms is possible; and
- Before and after being used for works vehicles should be thoroughly cleaned.

General precautions for carrying out excavations in areas with INNS

22.2.8 An ECoW shall oversee any excavations that take place in soils containing Schedule 9 invasive plants.

22.2.9 The amount of waste generated that contains invasive plants, or their propagules, should be minimized and guidance is provided in Defra (2013)¹¹⁷.

22.2.10 Any waste containing INNS should be treated on site where possible.

22.2.11 Prior to the on-site burial of any invasive plant waste, the Environment Agency shall be contacted in order to check if burial is permitted at the location.

¹¹⁷ DEFRA (2013) Japanese knotweed, giant hogweed and other invasive plants (website)

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| 22.2.12 | Any waste containing Schedule 9 invasive plant material that is taken off site shall be taken by a licensed waste carrier to an authorised waste disposal facility. |
| 22.2.13 | INNS contaminated soil shall not be stockpiled within 10m of a watercourse or stored within 7m of a construction area. |
- 22.2.14 If contaminated soils are being moved around a site as part of mitigation works), then a haulage route should be set out in advance (clearly marked on site maps and on the ground) and an ECoW must oversee haulage along such routes. Vehicles not involved in INNS remediation should not enter the haulage route until an ECoW has stated that it is permissible to do so.
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| 22.2.15 | If aquatic INNS are present within an on-site water body that is connected to an off-site water body, then strict biosecurity precautions shall be taken to prevent spread from the site by water flow (as advised the suitably experienced ecologist). |
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Disease and health screening

- 22.2.16 Where required, a review of biosecurity issues relating to protected and/or notable species should be carried out in advance of or at the time of works, to determine whether further survey, biosecurity and/or monitoring protocols should be implemented. This includes, but is not limited to:
- Species related diseases, for example fungal infections in bats and amphibians and crayfish plague in white-clawed crayfish;
 - Taking specific precautions when carrying out works in known bovine TB high risk areas; and
 - Virulent tree pathogens, including *Phytophthora ramorum* (affecting oak and other species) and *Hymenoscyphus fraxineus* (affecting ash).

23 No Net Loss in Biodiversity

23.1 Objective

23.1.1 HS2 Ltd is seeking to achieve the goal of Phase One of HS2 resulting in no net loss in biodiversity for replaceable habitats¹¹⁸ at a route-wide level.

23.1.2 The Contractor shall seek to achieve No Net Loss in biodiversity where reasonably practicable.

23.1.3 This may require collaborative working as per Works Information 830: Collaboration (1MCo1-HS2-PR-ITT-000-001162), to understand losses and gains of biodiversity across contract areas, in order that the route-wide objective be achieved.

23.1.4 To demonstrate how it will seek to achieve this goal HS2 Ltd has developed a modified version of the Defra pilot biodiversity offsetting metric ('the HS2 metric'). The HS2 metric has been used as an 'accounting tool' and applied to the habitats present pre- and post-construction of the scheme to compare the losses and gains in biodiversity units as a consequence of the scheme. This accounting process is referred to as the 'no net loss calculation for replaceable habitats'.

23.1.5 Ancient woodland is considered irreplaceable by HS2 Ltd. To demonstrate this, all areas of ancient woodland and any compensation attributed to its loss are not included in the No Net Loss calculation. Reducing losses of ancient woodland should be prioritised over losses of other habitat.

23.1.6 The latest iteration of the methodology and calculation was published in 2016¹¹⁹. The HS2 metric has been revised in 2017 following consultation with Natural England and other stakeholders. This has provided a baseline position against which all subsequent changes can be measured, hereafter referred to as 'the 2017 no net loss baseline dataset for replaceable habitats'. HS2 Ltd. will provide each Contractor with a baseline dataset. As detailed design progresses, further iterations of the calculation will be carried out to measure progress against HS2 Ltd's objective.

23.2 Reporting

23.2.1 In order to demonstrate progress towards meeting this target it will be necessary for Contractors to provide information on biodiversity losses and gains relative to the 2017 no net loss baseline dataset within their contract boundary, as part of their environmental reporting requirement.

23.2.2 This shall require recording, as a minimum, consideration of changes to the Scheme brought forward during construction and operation that:

¹¹⁸ Certain habitats, notably ancient woodlands, are considered irreplaceable, and have been removed from the scope of the metric

¹¹⁹ HS2 (2016) https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/490928/No_net_loss_in_biodiversity_calculation_-_methodology_and_results_v2.pdf

- Alter the overall extent of habitat required for the construction and/or operation of the scheme, or to be created or enhanced;
- Alter the type of habitat (i.e. distinctiveness);
- Alter the condition of habitat;
- Alter the location of habitat creation/enhancement; and/or
- Alter the time to target condition or difficulty of restoration multipliers used.

- 23.2.3 The contractor shall record in their File Geodatabase (ESRI ArcGIS version 10.x) (2DE02-ACI-GI-GDD-L000-000003) format any such change outlined in 23.2.2 that may impact the 2017 no net loss baseline dataset. The Esri Arc GIS NNL Toolbox (2DE02-ACI-GI-GDD-L000-000004) contains scripts to allow the contractor to auto-populate the majority of the attribute fields based on habitat type according to the biodiversity metric developed by HS2 in consultation with Defra and Natural England. The use of this toolbox is not compulsory and the contractor is free to implement the management of their NNL data as they see fit providing it is in accordance with the HS2 methodology. The HS2 document: 'Guidance to inform future iterations of no net loss in biodiversity calculation (2DE02-ACI-EV-REP-L000-000004), has been prepared to guide the contractor through the process of updating NNL data.
- 23.2.4 The contractor shall use the Esri ArcToolbox to extract data from the contractor NNL database to populate the NNL summary Excel spreadsheet which will provide a summary of changes from the 2017 NNL baseline.
- 23.2.5 Completed no net loss datasets shall be provided to HS2 Ltd. on a quarterly basis which will detail the effect of design changes from the 2017 no net loss baseline dataset.

Appendix 1 – Requirements for ecologists working under route-wide protected species licences

HS2 Phase One: Requirements for ecologists working under route-wide protected species licences

Document no.: PH1-HS2-EV-NOT-000-000023

Revision	Author	Checked by	Approved by	Date approved	Reason for revision
P01	David Whitehorne	David Prys-Jones	C. Bonard	5/12/16	First Issue
P02	David Whitehorne	David Prys-Jones	C. Bonard	18/07/16	Amendment 4.2
P03	David Whitehorne	David Prys-Jones	C. Bonard		

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1 Introduction

1.1 Background

1.1.1 In accordance with the Phase 1 Protected Species Licence Strategy (PH1-HS2-EV-STR-000-000002) section 2.2.1, HS2 Ltd are likely to have the following responsibilities and accountabilities for route-wide licences:

- the preparation of the licence application (guidance, advice and overview) and provide approval for and submission;
- to be the 'licensee' responsible for ensuring the correct and appropriate implementation of the licence and its conditions;
- to have an senior member of the ecology team as the 'appointed person' who is nominated to act as a single point of contact for Natural England with regard to the licence, with responsibility to oversee use of the licence;
- to determine the skills, experience and qualifications required by the contractors (the 'accredited agent' (see below)) to implement the licence requirements, and approval of all 'accredited agents'; and
- to authorise contractors to act under the licence, ensure that there is adequate and comprehensive record keeping and compliance with the licence.

1.1.2 The route-wide licence processes, which have both HS2 and Contractor responsibilities, include the following:

- Licensee appointing Appointed Person;
- Appointed Person appointing Authorised Persons;
- Appointed Person and/or Authorised Persons authorising Accredited Agents; and
- Accredited Agents undertaking mitigation works and appointing Assistants.

1.2 Aims

1.2.3 The aim of this technical note is to outline the framework for different roles and responsibilities under the proposed route-wide licensing approach for great crested newts and badgers. It provides details of the skills and experience requirements for those roles and provides criteria relevant to both HS2 and Contractor ecology staff to satisfactorily undertake their responsibilities under the route-wide licence.

2 General requirements

2.1.4 All ecologists working under the route-wide licences are expected to be members of the Chartered Institute of Ecology and Environmental Management (or other similar professional body) and shall have the following competencies:

- to appropriately scope fieldwork requirements and methodologies;
- plan and implement sound scientific surveys;
- interpret and analyse survey data;
- take appropriate biosecurity precautions and procedures; and
- take appropriate health and safety precautions.

2.1.5 It is expected that, in accordance with HS2 core values, every aspect of protected species mitigation health and safety issues and planning are given the relevant priority. Personnel at all levels shall be able demonstrate sufficient training and application of health and safety measures and the undertaking of risk assessments.

3 HS2 Ecology

3.1.6 The route-wide licensing approach requires the licensee to assume additional responsibilities when ensuring compliance with the terms of the licence. It is proposed that HS2 Ltd will fulfil the roles of licensee, appointed person and authorised person(s).

3.1.7 The role of HS2 ecologists will include reviewing, and agreeing detailed mitigation plans for delivery and, therefore, require skills and experience consistent with their responsibility.

3.2 Licensee

3.2.8 There are no specific skills or experience requirements for the licensee. The licence will be an organisational licence with the signatory being a relevant senior member of staff (e.g. relevant director or company secretary).

3.3 Appointed person

3.3.9 The requirements of the appointed person are that they need not have qualifications or experience of implementing the licensed works, but ideally will have some previous experience. They should be a person with a suitable level of seniority and responsibility within the organisation and be effective managers/organisers. They should have knowledge of wildlife legislation, policy and also licensing procedures (including amendments/ reporting/ compliance monitoring).

- 3.3.10 The appointed person will be the Construction Directorate Ecology Lead. The Ecology Lead is, (based upon job description), an ecologist with a high level of ecological knowledge, experience, understanding and application, with a detailed knowledge of protected species licensing issues and a proven track record of developing appropriate reporting on all ecology matters to a high standard.

3.4 Authorised person

- 3.4.11 The requirements of the Authorised person are that they need not have qualifications or experience of implementing the licensed works, but ideally will have some previous experience, by being either a named accredited agent or licence holder for one or more species. They should have knowledge of wildlife legislation, policy and also licensing procedures (including amendments/reporting/compliance monitoring) as well as detailed knowledge of HS2 documents.
- 3.4.12 The Authorised person/s will be the Construction Directorate Area Ecology Managers (Area South, Area Central and Area North). An Area Ecology Manager is, (based upon job description), an ecologist with good level of ecological knowledge, experience, understanding and application (generally at a senior consultant level), with a minimum of 5 years' experience of delivering successful ecology programmes and detailed knowledge and experience of protected species licensing issues and licence applications.

4 Contractors

- 4.1.13 The Contractor shall provide personnel with the relevant skills and experience to implement the required mitigation and compensation measures for great crested newts and badgers, in accordance with the High Speed Rail (London to West Midlands) Act (2017), the HS2 Ecological Principles of Mitigation (C250-ARP-EV-NOT-000-001010), HS2 Ecology Technical Standards (HS2-HS2-EV-STD-000-000017) and in accordance with the route-wide licence conditions.
- 4.1.14 It is essential that Contractors drawing up detail plans for these species are experienced in mitigation and development licensing. It is important that the mitigation and compensation detailed design team are ecologists with significant levels of experience with the relevant species. The lead designer requirements will as a minimum need to be equivalent to those of the accredited agent (great crested newts) and additional authorised person (badgers) as detailed below.
- 4.1.15 Such level of experience will enable them to be satisfied that plans drawn up are compliant with the Ecology Technical Standard, the terms and conditions of the licence and also workable on the ground (taking into account site conditions, site constraints and programme for the works).

4.2 Accredited Agent (great crested newt)

- 4.2.16 An accredited agent must hold a current Natural England great crested newt survey licence.
- 4.2.17 For those leading or supervising works, the ecologist should have been a named ecologist on a 'mitigation' licence for that species within the last 3 years.
- 4.2.18 It is recognised that some ecologists with high levels of skills and experience in great crested newt mitigation may not qualify under this criteria and, therefore, in these instances such ecologists can be considered as an accredited agent where evidence of such experience is provided. It is expected that the ecologist should have been a named ecologist on a 'mitigation' licence for that species within the last 5 years.
- 4.2.19 An accredited agent may also be authorised where the ecologist has been an accredited agent on a great crested newt 'mitigation' licence within the last 2 years and covering activities and mitigation measures of a similar nature to those required.
- 4.2.20 For those undertaking more limited activities on the ground (e.g. checking and emptying pitfall traps) then the experience level should be suitable for the activity being undertaken and authorised.

4.3 Additional Authorised Person (badgers)

- 4.3.21 Those leading or supervising the implementation of detailed works should have been a licence holder on more than one badger development licence that has involved the closure of a main sett within the last 3 years. As a minimum they must have been a named additional authorised person on more than one badger development licence that has involved the closure of a main sett within the last 3 years.
- 4.3.22 The ecologist should ideally have an average of 1 main sett closure licence per year, (e.g. 3 licences within a 3 year period, or 5 within 5 years).
- 4.3.23 For those undertaking more limited activities on the ground then experience should be suitable for the work being undertaken and authorised.

4.4 Assistants

- 4.4.24 An "Assistant" is a person assisting the accredited agent (or additional authorised person in relation to badgers). They are only authorised to act under licence whilst they are under the direct supervision of that person. It is therefore, the responsibility of the accredited agent (or additional authorised person) to ensure that any assistants are suitably experienced and/or qualified for the tasks/works they are to be authorised to undertake.
- 4.4.25 Assistants normally undertake low risk activities and help the accredited agent (or additional authorised person) with tasks.

- 4.4.26 Assistants must ensure they themselves comply with the licence terms and conditions and instructions given to them by the accredited agent (or additional authorised person). They are responsible for their own actions taken under licence.

5 Provision of information

- 5.1.27 The Contractor will submit to HS2 Ltd. the name and details of all personnel to be included as accredited agents for the route-wide great crested newt licence and/or additional authorised persons on the route-wide badger licence.
- 5.1.28 The names and details shall be provided to HS2 Ltd by the Contractor as soon as reasonably possible following appointment. Ideally these should be provided immediately upon instruction to allow time for HS2 Ltd to undertake approvals and, where necessary, for the Contractor to identify additional ecologists should some names not get approved.
- 5.1.29 Failure to provide details for approval by HS2 Ltd in a timely manner and significantly in advance of the required works, could result in project delays.
- 5.1.30 The details required for each ecologist submitted for authorisation as an accredited agent (or additional authorised person) are provided in Appendix A. HS2 Ltd will maintain a record of all accredited agents acting under these licences to be available for review by Natural England as required.

6 References

Title	Reference

Appendix A

Great crested newt accredited agent details - exampleError! Not a valid link.

Badger additional authorised person details – exampleError! Not a valid link.

Appendix E

E24820: Norwich to Tilbury

R04: Summary of the Landscape Sensitivity Appraisal – Colne Valley

7th July 2026 | Simon Neesam

Summary of the findings

1. At the recent Issue Specific Hearing 4: Environmental Matters, held 25th June 2026, we welcomed the opportunity to explain our assessment of the value, susceptibility to change and sensitivity of the landscape of the Colne River Valley.
2. For the purposes of understanding the likely landscape and visual effects of the Norwich to Tilbury Project, this landscape has been studied by three independent and professionally qualified Chartered Landscape Architects: Land Use Consultants (on behalf of National Grid); Planscape Consultants Ltd (on behalf of Villages against Pylons), and The Landscape Partnership (on behalf of Essex Suffolk Norfolk Pylons).
3. All three professionals had considered the likely effects of the development on landscape receptors and visual receptors (people) separately as required by the Guidelines for Landscape and Visual Impact Assessment (GLVIA3). It was apparent that all three reached broadly similar conclusions regarding the sensitivity of this landscape and the views they afford, and the levels of effects that the proposed pylons and their associated infrastructure would impose on landscape character and visual amenity. National Grid's own Landscape and Visual Impact Assessment (LVIA) concluded that many of these landscape and visual impacts would be Significant in EIA terms.
4. Furthermore, the assessments found that these adverse effects would not be confined to isolated locations or small discrete areas but would extend across an extensive tract of rural countryside and be experienced from numerous publicly accessible viewpoints.
5. In summary, the three independent assessments are aligned in indicating the potential for widespread and significant adverse landscape and/or visual impacts along certain sections of the route.
6. The National Policy Statement for Electricity Networks Infrastructure (EN-5) recognises that, where there is a high potential for widespread and significant adverse landscape and/or visual impacts, feasible alternatives, including undergrounding, may warrant consideration on a case-by-case basis. The policy also requires the decision-maker to be satisfied that sufficient evidence has been provided to support a decision on whether undergrounding is or is not appropriate.

Appendix F

The Green Book and its relevance to the Norwich to Tilbury project

Date: 7 July 2026

Revision: 1

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1. Introduction

PEA strongly believes in the importance of applying HM Treasury Green Book (“Green Book”) methodologies to the appraisal and evaluation of alternative options for the Norwich to Tilbury project, and indeed other electricity infrastructure projects. This view, together with supporting information such as a Green Book analysis of the project, has been articulated throughout the Examination process.

The growing significance of natural capital and socio-economic impacts is widely recognised and is very relevant to the duties on ministers and policy makers. For example, in relation to electricity infrastructure projects such as Norwich to Tilbury, the Energy National Policy Statements reference Green Book methodologies.

As information on the relationships between duties, the relevant policies and the Green Book is dispersed, the aim of this document is to consolidate in one place the most relevant references that PEA is currently aware of.

2. Overview

On 4 July 2023, Lord Charles Banner KC produced an Opinion¹ for Pylons East Anglia on the applicability of the HM Treasury Green Book to the Norwich to Tilbury project. The concluding section from the Opinion is copied below:

10. It follows that, in the context of the future examination and determination of an application for a DCO for the Project:

a. to the extent that any applicable national policy statements to the Project require consideration of matters to which the Green Book relates, the use of Green Book and its supplementary business case guidance is “*mandatory*”;

b. in the context of the statutory test under s.104(7) of the 2008 Act, namely that an application for a DCO must be made in accordance with a NPS unless (amongst other things), the Secretary of State “is satisfied that the adverse impact of the proposed development would *outweigh its benefits*”, the Green Book is a material consideration to which regard must be had; and

c. a failure by the Examining Authority, and thereafter the Secretary of State, to have regard to the Green Book in either of these contexts would amount to an error of law.

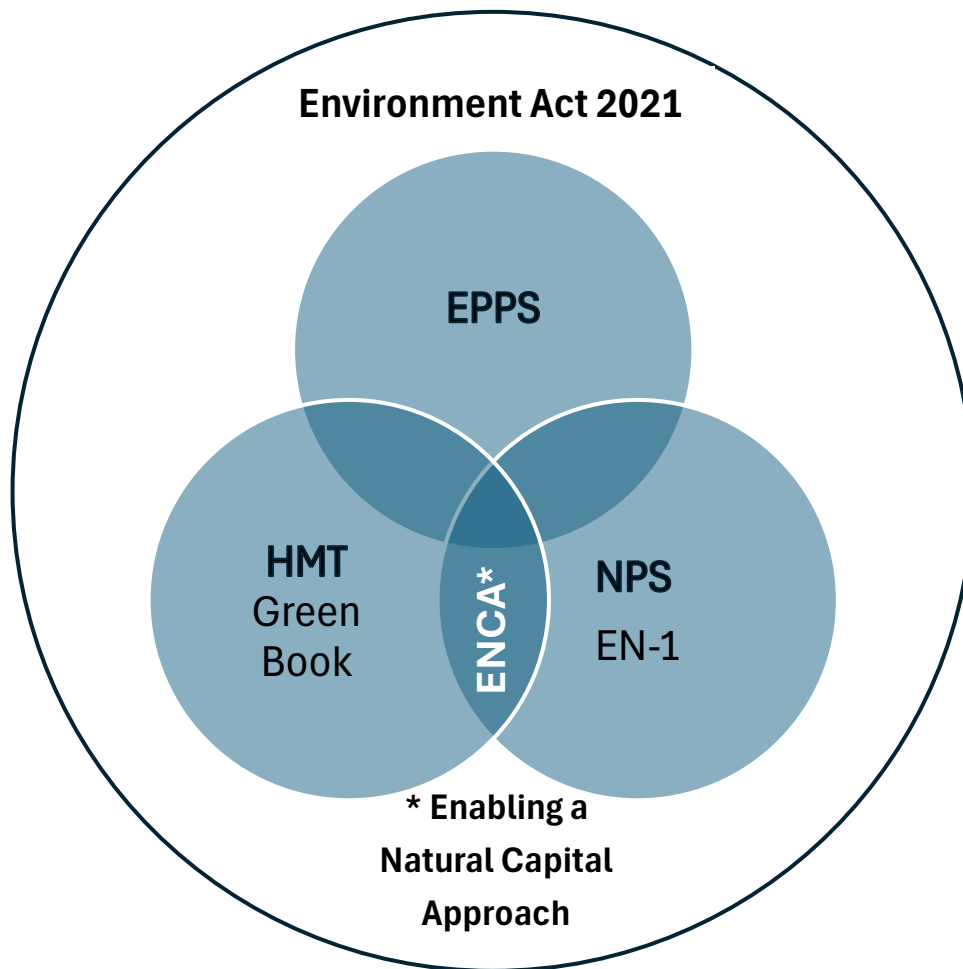
Since the Opinion was written, there have been several very relevant developments which have added further weight:

- On 1 November 2023 the environmental principles policy statement (EPPS) came into force, as part of the Environment Act 2021. This sets out “*how policymakers should apply environmental principles to support environmental protection and enhancement.*”
- From November 2023 the Overarching National Policy Statement for Energy (EN-1) has referred to the duties of the Secretary of State under the Environment Act 2021 (this was carried forward into the October 2025 version of EN-1).
- Both the November 2023 and October 2025 versions of EN-1 reference the Natural Capital Committee’s ‘How to Do it: natural capital workbook’, the government’s guidance on Enabling a Natural Capital Approach (ENCA) as a tool for measuring natural capital assets and ecosystem services. **This is a key HM Treasury Green Book tool.**
- The 2023 version of the “*Appraisal of Sustainability*” for the National Policy Statements for Energy refers to “*Alignment with HM Treasury Green Book principles*” when “*conducting strategic options appraisal*”. This is to “*help ensure that development proposals are approached in a holistic way that optimises the social / public value and will help ensure a joined-up approach to development*”. **The most compelling use of the Green Book on this project is for the balanced analysis of alternatives for best outcomes.**

¹ East Anglia Pylons 4July2023.pdf: <https://nsip-documents.planninginspectorate.gov.uk/published-documents/EN020027-000158-5.1%20Consultation%20Report%20-%20Appendix%20N%20Legal%20Opinions.pdf>

- The updated Green Book released on 5 February 2026, specifically references the EPPS, which therefore explicitly ties it to the duties on policy makers that commenced on 1 November 2023.
- As public bodies it is mandatory for DESNZ, NESO and Ofgem to fully adopt Green Book methodology.

The following diagram illustrates how the various elements discussed are intrinsically linked:



- The EPPS binds the making and revising of policy.
- NPS EN-1 and EN-5 are the relevant policies to this project.
- Those policies contain the appropriate natural-capital/ENCA/Environment Act references.
- Therefore, the project decision must properly apply those NPS requirements.

Unless the Examining Authority and subsequently the Secretary of State are provided with an appropriate Green Book appraisal, they are not equipped with information critical to making the correct decisions on proposals.

The following sections in this document provide supporting information.

3. The environmental principles policy statement (EPPS)

The duty in the Environment Act 2021 to have due regard to the Environmental Principles Policy Statement (EPPS) commenced on 1 November 2023. Ministers and policy makers must now consider the environmental impact of new policies. HM Government information on the act describes this duty as “a measure to ensure the environment is at the heart of governmental policy”².

*“The Environment Act 2021 places a duty on Ministers of the Crown to have due regard to the environmental principles policy statement. The policy statement sets out how policymakers should apply environmental principles to support environmental protection and enhancement. The final version of the strategic policy statement was laid in Parliament on 31 January 2023. The duty will commence on 1 November 2023”*³.

Application of the duty has subsequently been tested in Court. This is outlined by the Office for Environmental Protection (OEP), in its role as a “public body that protects and improves the environment by holding government and other public authorities to account”⁴:

“The Court handed down its judgment in R (Rights: Community: Action Ltd) v Secretary of State for Housing, Communities and Local Government, which concerned the duty in the Environment Act 2021 to have due regard to the EPPS.

*The judgment brings further clarity to the application of the duty, confirming that an EPPS assessment undertaken at a later stage of the process cannot rectify a failure to comply with the duty at an earlier stage. The Court also confirmed that the duty to have due regard to the EPPS applies throughout the policy-making process, when a policy is being formulated and different policy options are being considered.”*⁵

Link to the judgment - [Rights Community: Action Limited, R \(on the application of\) v The Secretary of State for Housing, Communities and Local Government \[2025\] EWCA Civ 990](#)

² <https://www.gov.uk/government/news/environmental-principles-duty-comes-into-force>

³ <https://www.gov.uk/government/publications/environmental-principles-policy-statement>

⁴ <https://www.theoep.org.uk/office-environmental-protection>

⁵ <https://www.theoep.org.uk/news/oep-notes-court-appeal-decision-application-epps>

4. Relationship between the EPPS, the Environment Act 2021 and the Green Book

The Green Book is very relevant to the duty in the Environment Act 2021 to have due regard to the Environmental Principles Policy Statement (EPPS). There is reference to the Green Book in the original environmental principles policy statement on the Government website (updated 31 January 2023):

“Policymakers should take a proportionate approach in the application of the policy statement. They should balance social, economic, and environmental considerations in making policy. They should consider the potential environmental effects of a policy and any mitigating actions. They should consider this in the context of the associated costs and benefits to society of the policy’s primary objectives, as well as the financial and economic costs and benefits. The Green Book provides further guidance on appraising the wider impacts of policy options, including natural capital and related ecosystem services, which could be used to support this analysis. [footnote 4] Environmental, social and economic factors are interlinked. Nature, and the biodiversity that underpins it, ultimately sustains our economies, livelihoods and well-being, and so our decisions must take into account the true value of the goods and services we derive from it. [footnote 5] After consideration of these factors, ministers may decide that the public interest is best served by taking forward a policy option that includes associated negative environmental effects. In these cases, the issues should be recorded, and policy teams should consider the issues in the round”⁶.

The Green Book is a key tool for ensuring compliance with the EPPS.

In its “Review of implementation of the duty to have due regard to the Environmental Principles Policy Statement in England⁷” published on 27 February 2025 the OEP places great importance on the Green Book, with many references to it. This included reporting that the:

“Government committed to embedding environmental principles into existing policymaking guidance, including HMT Green Book guidance on how to appraise policies, programmes and projects. This commitment was repeated in the explanatory memorandum to the EPPS. The National Audit Office (NAO) reported in October 2024 that HMT told it that the Green Book is an important tool to help departments consider environmental and climate change issues in their project appraisals and funding bids.”⁸

⁶ <https://www.gov.uk/government/publications/environmental-principles-policy-statement/environmental-principles-policy-statement>

⁷ https://www.theoep.org.uk/sites/default/files/reports-files/E03277018_OEP_EPPS%20in%20England_v05_Web%20Accessible%20%281%29.pdf

⁸ https://www.theoep.org.uk/sites/default/files/reports-files/E03277018_OEP_EPPS%20in%20England_v05_Web%20Accessible%20%281%29.pdf

The NAO report referred to by the OEP is: “*Achieving environmental improvement and responding to climate change: enablers for success (16 October 2024)*”. The full quotation is provided below:

Embed environment and climate change in the government’s business planning

1.12 Embedding environment and climate change considerations into the government’s business planning, such as funding decisions, policy appraisal and organisational strategies, is an important part of creating the conditions for a strong culture of shared commitment to these ambitions across government. In 2020, we recommended that HM Treasury should ensure that its guidance informing public spending decisions (including the Green Book and guidance for accounting officers) requires departments to evaluate how policies impact the net zero target and that this is consistently applied. During fieldwork for this report, HM Treasury told us that the Green Book is an important tool to help departments consider environmental and climate change issues in their project appraisals and funding bids, but it recognised that skills and capability within departments were an issue in its effective use.⁹

The Government response to the Office for Environmental Protection review of implementation of the duty to have due regard to the Environmental Principles Policy Statement in England, May 2025 states:

“The principal guidance on policy development and appraisal is the Green Book. This, together with supplementary guidance, sets out how policy options should be informed by analysis of economic, social and environmental factors. Economic analysis should include assessments of natural capital, which aims to measure the economic value of natural assets and processes. The supplementary guidance on Enabling a Natural Capital Approach includes references to the EPPS. The Green Book will be updated to include the EPPS at its next iteration, and HMT will update the Business Case guidance to include the EPPS at its next iteration”¹⁰.

⁹<https://www.nao.org.uk/wp-content/uploads/2024/10/achieving-environmental-improvement-and-responding-to-climate-change.pdf>

¹⁰

https://assets.publishing.service.gov.uk/media/68270a71010c5c28d1c7e706/Government_response_to_OEP_s_review_of_EPPS_duty_implementation.pdf

Reference to the EPPS in the Green Book (2026)

When the latest update to the Green Book¹¹ was released on 5 February 2026, specific reference to the EPPS was included.

The EPPS is, for example, referenced in the section copied below:

Natural environment

The Environment Act 2021 sets legally binding targets for the government to improve the environment. Practitioners should take these targets into account when developing proposals. There is Green Book supplementary guidance on enabling a natural capital approach (ENCA). This provides a framework to integrate nature into policymaking, including appraising policy impacts on nature, and using nature investment to meet broader policy goals.

Practitioners should note the statutory duties around the environmental principles policy statement (EPPS) and biodiversity, described fully in Chapter 3. These duties ensure that the consideration of the natural environment is embedded in proposals from the outset.

Natural capital includes the living and non-living aspects of nature that provide value to people. These include forests, fisheries, rivers, biodiversity, land, minerals, and the atmosphere, amongst other natural assets. Natural assets provide services, called ecosystem services, according to their quantity, quality and location. These services deliver benefits to society and the economy. A proposal that directly or indirectly affects natural assets will have an effect on social value. It is thus important to include nature in appraisal.

¹¹ Updated 5 February 2026: <https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-government/the-green-book-2026>

5. Duties under the Environment Act 2021 in “Overarching National Policy Statement for Energy (EN-1)”

Reference to duties under the Environment Act 2021 in “Overarching National Policy Statement for Energy (EN-1)” include the following:

EN1 (2023) 4.16.10: *“The Secretary of State must also consider duties under other legislation including duties under the Environment Act 2021 in relation to environmental targets and the government’s Environmental Improvement Plan”.*

EN1 (2025) 4.16.10: *“The Secretary of State must also consider duties under other legislation including duties under the Environment Act 2021 in relation to environmental targets and the Government’s Environmental Improvement Plan 2023”.*

6. References in the Energy National Policy Statements

References to the HM Treasury Green Book and ENCA

The 2023 National Policy Statements for Energy came into force on 17 January 2024.

The government’s *“Enabling a Natural Capital Approach (ENCA)”* guidance, which is a key tool within the Green Book, is referenced in National Policy Statement *“Overarching National Policy Statement for Energy (EN-1)”*.

Paragraph 4.6.16 in both the 2023 and 2025 versions of EN-1 states: *“Applicants should make use of available guidance and tools for measuring natural capital assets and ecosystem services, such as the Natural Capital Committee’s ‘How to Do it: natural capital workbook’, the government’s guidance on Enabling a Natural Capital Approach (ENCA), and other tools that aim to enable wider benefits for people and nature”*^{12, 13}.

The Natural Capital Committee (NCC) was instrumental in embodying natural capital within the Green Book. *“Between 2016-18 the Natural Capital Committee (NCC) worked with H.M. Treasury to advise and co-author the Green Book guidance regarding the incorporation of natural capital, ecosystem services and the value of associated goods and services into government appraisals. The guidance was incorporated into the revised Green Book published in March 2018”*¹⁴. The NCC *“End of Term Report”*¹⁵ was

¹² <https://assets.publishing.service.gov.uk/media/695e4a71e83db7562d671929/overarching-nps-for-energy-en1-withdrawn.pdf>

¹³ <https://assets.publishing.service.gov.uk/media/6915ba42bc34c86ce4e6e726/overarching-national-policy-statement-for-energy-en-1-web-accessible.pdf>

¹⁴ <https://assets.publishing.service.gov.uk/media/5fbcd3ec8fa8f559e21539a8/ncc-green-book-advice.pdf>

¹⁵ <https://assets.publishing.service.gov.uk/media/5f9c3befe90e070428701525/ncc-end-of-term-report.pdf>

The above NCC reports also available at: <https://www.theoep.org.uk/our-reports-and-publications>

very clear on the need to take full account of natural capital on such projects: “*The NCC recommends that all infrastructure projects should take full account of natural capital by including it in the project appraisal process as per the Green Book guidelines.*” The Government’s Guidance on Enabling a Natural Capital Approach (ENCA)¹⁶ shows how wide the scope should be.

The National Policy Statements for Energy are reinforced by the corresponding “*Appraisal of Sustainability*” (AoS) reports^{17,18}.

The 2023 version of the “*Appraisal of Sustainability*” for the National Policy Statements for Energy refers to “*Alignment with HM Treasury Green Book principles*” when “*conducting strategic options appraisal*”. This is to “*help ensure that development proposals are approached in a holistic way that optimises the social / public value and will help ensure a joined-up approach to development*”. **The most compelling use of the Green Book on this project is for the balanced analysis of alternatives for best outcomes.**

As copied below, the 2023 version of the AoS also outlines the five principles of the Environmental Principles Policy Statement as set out within section 17(5) of the Environment Act (2021):

“Note that the AoS follows closely the five principles of the Environmental Principles Policy Statement that is set out within section 17(5) of the Environment Act (2021) and it is considered that the NPS has been developed in line with these as the UK government has already committed to these principles through international instruments and processes. The five principles are:

- Integration: look at opportunities to embed environmental protection and/or enhancement
- Prevention: prevent environmental harm before it occurs or contain existing damage
- Rectification at source: environmental damage should be addressed at its origin to avoid the need to remedy its effects later
- Polluter pays: the costs of pollution should be borne by those causing it
- Precautionary: where there are threats of serious or irreversible environmental damage, a lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation”

¹⁶ <https://www.gov.uk/guidance/enabling-a-natural-capital-approach-enca>

¹⁷ <https://assets.publishing.service.gov.uk/media/655dff3d544aea000dfb3287/appraisal-sustainability-main-report.pdf>

¹⁸ <https://assets.publishing.service.gov.uk/media/695ccc7053866d6cdff21b44/appraisal-of-sustainability.pdf>

In both the 2023 and 2025 versions of the “Appraisal of Sustainability” the Green Book is listed as a reference document.

The “Appraisal of Sustainability – Main Report”¹⁹ relating to the “National Policy Statement for Energy – Update 2025” makes some very pertinent points, such as those in relation to “Communities: Physical Health and mental wellbeing”. The Green Book “Enabling a Natural Capital Approach” integrates the value of nature into decision making to improve physical and mental health. Some examples are copied below:

“Indirectly, health and wellbeing levels could be improved through secondary effects of policies that help to create healthy environments. This involves the protection of existing and creation of new open spaces...”

“Good design principles can combine with broader green infrastructure as key factors in fostering active travel, recreation and healthy lifestyles”.

“The NPS should seek to ensure continued access to and provision of quality greenspace along with improvement of the physical environment in general. Ensuring continued or enhanced access to employment, educational, recreational / leisure and health services and facilities, along with adequate provision, should also be a priority.”

“Improved walking and cycling facilities, along with open spaces and outdoor recreational facilities are vital to ensuring people have opportunities to undertake informal and formal physical activity outdoors in a safe manner. This will help to increase physical activity levels and improve general health and wellbeing”.

Considerations such as these are seen to be increasingly important. Overhead lines can be very detrimental to the benefits the physical environment provides. The Green Book provides best practice for making the necessary assessments. Report “Norwich to Tilbury Project Green Book Analysis”²⁰ which was included as part of the representation by Pylons East Anglia Ltd submitted on 26 November 2025 references data from “Enabling a Natural Capital Approach” (ENCA) case studies published by the Government and data on “ecosystem service” asset value from the ONS UK Natural Capital Accounts 2024 including “Recreation (health benefits)”.

References to socio-economic impacts

Various references to socio-economic impacts from EN1 follow:

¹⁹ <https://assets.publishing.service.gov.uk/media/695ccc7053866d6cdff21b44/appraisal-of-sustainability.pdf>

²⁰ https://nsip-documents.planninginspectorate.gov.uk/published-documents/EN020027-000805-Norwich%20to%20Tilbury_Green%20Book%20Analysis_1.pdf

EN1 (2023) 5.13.4: *“The applicant’s assessment should consider all relevant socio-economic impacts...”*

This includes: *“...effects (positive and negative) on tourism and other users of the area impacted”*

EN1 (2023) 5.13.5: *“Applicants should describe the existing socio-economic conditions in the areas surrounding the proposed development and should also refer to how the development’s socio-economic impacts correlate with local planning policies.”*

EN1 (2023) 5.13.9: *“The Secretary of State should have regard to the potential socio-economic impacts of new energy infrastructure identified by the applicant and from any other sources that the Secretary of State considers to be both relevant and important to its decision.”*

The socio-economic impact of the currently proposed Norwich to Tilbury project is very significant. Illustrative figures from the PEA “Norwich to Tilbury Project Green Book Analysis”²¹ are listed below:

- £1 bn impact on property values
- £1.5 bn impact on amenity, health, exercise and recreation benefits
- £0.3 bn impact on recreation and tourism (expenditure)
- £9 million impact on agricultural biomass provisioning *

On top of this it was estimated that the current HVAC proposal would result in an additional £1.6 bn impact on businesses, due to disruption, relative to an underground HVDC solution.

The Green Book is the only mechanism available to assess these impacts.

* This analysis was based on ONS data. The values appeared surprisingly low when the work was carried and it has been noted that the Government has recently announced it is to be reassessed: *“Farmers produce around 65% of the nation’s food, manage 70% of England’s land, and underpin the £153 billion agri-food sector recognised as Critical National Infrastructure...”*

...The government will also review how the economic value of agriculture is measured, ensuring farming receives the recognition it deserves. A single figure of 0.6% of Gross Value Added is misleading because it captures only primary agricultural activities. Working with the Office for National Statistics, the government will look to develop new supplementary statistics to include the wider food supply chain, from processing and manufacturing to distribution and retail.”²²

²¹ https://nsip-documents.planninginspectorate.gov.uk/published-documents/EN020027-000805-Norwich%20to%20Tilbury_Green%20Book%20Analysis_1.pdf

²² <https://www.gov.uk/government/news/new-plan-to-make-english-farming-profitable-productive-sustainable-and-resilient>

The Green Book is therefore very relevant to the National Policy Statements for Energy.

7. The Green Book and “Societal impact”

It should be noted that Green Book guidance would apply even if only considering the societal impact. HM Treasury document *“Valuing infrastructure spend: Supplementary guidance to the Green Book”* states that it is applicable to *“infrastructure spending and interventions that involve the use of public money or have a societal impact”*²³ (emphasis added). Electricity networks and other forms of energy infrastructure are referenced in the guidance. The proposed infrastructure clearly has *“societal impact”* and therefore Green Book guidance applies based on this aspect alone. The full paragraph is below:

“To ensure that the UK’s economic infrastructure is able to fulfil its purpose, in facilitating the operation of our society and economy, this document supports effective decision-making in relation to infrastructure spending and interventions that involve the use of public money or have a societal impact”.

8. Use of the Green Book in planning decisions

The use of the Green Book also has precedent in planning decisions. Some examples are provided below:

- In the examination of the North Essex Authorities Local Plan²⁴ in 2020, the Inspector, Roger Clews, included references to the need to adhere to contingencies set out in guidance accompanying the Green Book.
- Hinkley Point C: Value for Money Assessment²⁵ (in relation to net social benefits).
- Lower Thames Crossing - Summary Business Case²⁶.

²³

https://assets.publishing.service.gov.uk/media/5a75bdc3e5274a545822dde0/PU1798_Valuing_Infrastructure_Spend_-_latest_draft.pdf

²⁴ <https://www.braintree.gov.uk/downloads/file/2940/examiners-report-on-the-examination-of-ne-a-s1-10th-dec-2020>

²⁵ https://assets.publishing.service.gov.uk/media/5a8226f8ed915d74e6236106/Detailed_value_for_money_assessment.pdf

²⁶ https://nationalhighways.citizenspace.com/ltc/lower-thames-crossing-consultation/user_uploads/lower-thames-crossing-consultation-summary-business-case.pdf

- The Department for Transport “Wider Economic Impacts Appraisal”^{27, 28}.
- The East West Rail Business Case Process²⁹
- Airports Commission, Gatwick Airport Second Runway: Business Case and Sustainability Assessment³⁰
- It is referenced in the Northern Housing Consortium (NHC) Renew inquiry interim report³¹
- Department for Transport – Heathrow Expansion Appraisal Report, published June 2026³².

To highlight the last example on the above list:

If the Green Book is needed for the Heathrow Expansion project, it is also needed for the Norwich to Tilbury project. The expansion of Heathrow will ultimately be paid for by passengers in the same way that the Norwich to Tilbury project would ultimately be paid for by electricity consumers, via the infrastructure element of bills.

²⁷ <https://www.gov.uk/guidance/transport-analysis-guidance-tag>

²⁸ <https://assets.publishing.service.gov.uk/media/6899ec58586f9c9360656a93/tag-unit-a2-1-wider-economic-impacts-appraisal-may-25.pdf>

²⁹ <https://eastwestrail.co.uk/planning/our-business-case>

³⁰ <https://assets.publishing.service.gov.uk/media/5a7dbc0a40f0b65d88634163/evidence-base-gatwick-airport-second-runway.pdf>

³¹ <https://renew.northern-consortium.org.uk/interim-report/#top>

³² <https://assets.publishing.service.gov.uk/media/6a33ce0b0bea238415c9a21f/hear.pdf>

9. The importance of the Green Book and the associated Natural Capital methodologies

There are no legitimate reasons for not fully adopting the HMT Green Book and the associated Natural Capital methodologies. There are instead many reasons why the Green Book should be fully adopted:

The risks to England's natural environment

The State of Natural Capital Report for England 2024 states: *"It is widely acknowledged that England's natural environment has been heavily modified by human activity and continues to be degraded. England is ranked as one of the most nature depleted countries in the world in terms of how well it has retained natural animals and plants"*.³³

Natural Capital: "the world's most important asset"

The OECD report: "Biodiversity, Natural Capital and the Economy: A Policy Guide for Finance, Economic and Environment Ministers" states: *"Natural capital underpins all economic activities and human well-being; it is the world's most important asset"*.³⁴

HM Government response to an Environmental Audit Committee report (22 July 2025)

In the report: "The role of natural capital in the green economy: Government Response"³⁵ the Government refers to *"...the critical role natural capital plays in delivering the Government's mission to secure sustained economic growth"*.

It states: *"Our economy and businesses depend on a healthy natural environment to operate, grow and innovate. The decline of nature poses a material risk to the economy, and the benefits of nature's recovery must be secured by businesses and taxpayers' money pulling in the same direction. The natural capital approach builds upon traditional economic models to help demonstrate how nature's assets deliver tangible benefits for society and the economy. Making the value of nature more visible, and treating investment in it like any other economic asset, helps businesses and investors understand their reliance on natural systems and take informed action to support sustainable economic growth. The natural capital approach highlights the need for collaboration between the public and private sectors to reach our nature recovery goals and secure long-term economic growth..."*.

The report endorses use of HMT Green Book and Enabling a Natural Capital Approach (ENCA).

"Natural capital has become a standard analytical approach to thinking about nature"

³³ <https://publications.naturalengland.org.uk/publication/6683489974616064>

³⁴ https://www.oecd.org/content/dam/oecd/en/publications/reports/2021/05/biodiversity-natural-capital-and-the-economy_940af1d4/1a1ae114-en.pdf

³⁵ <https://committees.parliament.uk/publications/48960/documents/257100/default/>

From HM Government “Enabling a Natural Capital Approach guidance”, updated 10 February 2026:

*“Understanding nature as a set of assets that benefit people and society in all kinds of ways can support better decision-making. This helps us to give the best public value given that there are scarce resources and trade-offs between objectives. It reduces the risk of the value of the natural environment being ignored in decision making. Natural capital has become a standard analytical approach to thinking about nature, following the seminal UK National Ecosystem Assessment (2011 and 2014) and the work of the Natural Capital Committee. It offers a balanced focus on natural assets in ecological terms (their quantity, condition and sustainability) and the social and economic benefits that derive from those assets”.*³⁶

³⁶ <https://www.gov.uk/government/publications/enabling-a-natural-capital-approach-enca-guidance/enabling-a-natural-capital-approach-guidance>