

The Developers Handbook





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<https://www.networkrail.co.uk/running-the-railway/looking-after-the-railway/asset-protection-and-optimisation/>

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Introduction

1.1 Purpose

This document provides guidance to developers carrying out work on, under or adjacent to High Speed 1, to enable them to successfully deliver the project by eliminating or reducing risks to the safety and performance of High Speed 1. It also aims to minimise, so far as is reasonably practicable, the impact of developers' works on future operation and maintenance costs and liabilities.

1.2 Scope

This document applies to the High Speed 1 line from the Channel Tunnel at Cheriton to St Pancras station including the links to Temple Mills depot from Stratford station and Fawkham junction from Southfleet junction, as well as other links at St Pancras, Ebbsfleet, Ashford and Dollands Moor freight yard.

The guidance covers all work by developers that can influence the railway, including stations and other lands. For example, general construction, excavations, demolition, installation of public utilities and other services including underground and overhead pipes and cables, surveys, ground investigation works and general access.

The primary concerns of Network Rail High Speed (NRHS) with regards to third party development are:

- > safety of passengers, railway staff and the public when using High Speed 1 premises or designated land
- > safety and stability of the track, running tunnels, overhead electrified lines, embankments, cuttings and structures
- > maintenance of dimensional clearances
- > protection of railway equipment
- > risks from plant such as cranes and piling rigs within a collapse radius of the High Speed 1 infrastructure
- > lines of sight to signals and avoidance of glare affecting train drivers
- > risks from flood, windblown debris and unexploded ordnance
- > avoiding additional maintenance or other liabilities/obligations
- > any covenants or safeguarded zones in favour of High Speed 1
- > heritage considerations at St Pancras station and surrounding assets.

This document does not cover in-house NRHS maintenance work or NRHS led projects, but it does cover some construction work instructed by High Speed 1 or NRHS of an outside party nature.

A companion document (C/05/OP/32/2001) gives guidance to the Asset Protection Engineer at planning application stage. Other requirements can be found in statutory instruments, regulations, codes of practice, Railway Group Standards and NRHS standards and guidance.

Further information can be obtained by contacting NRHS Asset Protection – we are here to help. In the first instance email: AssetProtectionHighspeed1@networkrail.co.uk

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1.3 Responsibilities

The High Speed 1 railway, formerly known as the Channel Tunnel Rail Link (CTRL), is owned by the Secretary of State for Transport who has signed a long-term concession with High Speed 1. High Speed 1 has contracted with NRHS to operate and maintain the railway, which includes management of work by developers. Where a PPA exists between High Speed 1 and the developer, NRHS acts as the Engineer under that agreement.

This document is prepared by the Asset Protection Project Manager and is applied by the Asset Protection Engineer and team members along with developers.

1.4 Asset Protection team charter

We are committed to managing the impact on High Speed 1 from the works of developers. We are concerned that this work goes ahead to the satisfaction of both parties and of our client, High Speed 1. This involves a pact between you – the developer – and us:

What are our imperatives:

- > safeguard the railway against accidents, incidents or near misses caused by developers
- > recognise any changes in long term costs and risks to High Speed 1 resulting from developers' schemes
- > comply with statute law, and standards where appropriate.

What we need from you:

- > to be professional and straightforward
- > understand our imperatives
- > comprehend our guidance notes and other communications, and act on them
- > plan your submissions and submit them in good time
- > consult with us on any possessions and isolations at a very early stage
- > know who to communicate with in our team and to use the OP number in any correspondence.

What to expect from us:

- > act in a professional, knowledgeable and competent way
- > try to understand your needs
- > communicate effectively with you by being approachable, responsive and giving straight answers
- > deliver to deadlines
- > exhibit safe behaviour.

Feedback:

- > we have a feedback process which we ask developers of significant schemes to be involved in. Please take the time to do this
- > we like to feedback to you, the developer, on how your work and attitude is affecting the risk to the railway, whether positively or negatively. If negatively, we need you to take note of this and put corrective actions in place.

Complaints:

- > if you have any complaints about Asset Protection you can raise them with the Asset Protection Project Manager.

This document is prepared by the Asset Protection Project Manager and is applied by the Asset Protection Engineer and team members along with developers.

1.5 Disclaimer

We have taken care to ensure that the content of this document is accurate, complete and suitable for its stated purpose. We make no warranties, express or implied, that compliance with the contents of this document shall be enough to ensure safe systems of work or operation. NRHS will not be liable to pay compensation in respect of the content or subsequent use of this document for any purpose other than its stated purpose or for any purpose other than that for which it was prepared except where NRHS can be shown to have acted in bad faith or where there has been wilful default.

Participation, opinion, permission or approval by NRHS does not extend to or imply any warranty or representation concerning the suitability or adequacy of the works. Nor does it displace the responsibility of the developer in relation to such matters.

1.6 Legal requirements

Responsibilities under the CDM Regulations 2015 are to be defined at the outset. Where the scheme is notifiable the developer is to forward a copy of the F10 to the Asset Protection Engineer.

Working on the railway is subject to a drugs and alcohol policy as described in Level 1 Standard: NR/L1/OHS/051.

The High Speed 1 route has been safeguarded, protecting the route from conflicting development.

1.7 Vested works

Although the works carried out by the developer would normally vest in the developer there are some exceptions, for example fences and gates providing security for, and access to, the railway. Works to be vested in High Speed 1 will be identified and agreed during design and construction. This ownership will be reflected in the maintenance agreement.

1.8 Elective works

In some cases, the developer will wish NRHS to carry out some of his works, or NRHS will insist on carrying out these works for safety reasons. These elective works are normally on the operational railway such as:

- > provision of possession and isolation staff
- > pre- and post-works condition surveys in tunnels
- > providing railway power supplies, such as for monitoring equipment.

1.9 Level playing field in tender situations

We are aware that in many cases our advice at tender stage can have a significant effect on the risk perceived by the tenderer and therefore on the construction methodology and price. Where the employer advises that work is being put out to tender we will therefore take care to ensure that the employer's wishes are met with regard to providing consistent information and a level playing field for all tenderers. This is normally best achieved by channelling the tender clarification questions and our responses through the employer. Although we are prepared to meet with individual tenderers the employer will be asked to approve this in advance. In our experience the answers to many of the questions are already covered in this handbook.

We would expect the employer to:

- > advise us that tendering is about to start
- > include this handbook in the tender documents as it will answer many of the tenderers' questions
- > advise whether tenderers' questions for us, and our responses, are to be channelled through the employer
- > if not channelled through the employer, state whether he is happy for individual meetings to go ahead.

1.10 Definitions

AIP	Approval in Principle: confirmation that a professionally competent person or body is satisfied that the design concept meets the principles for safety and performance of High Speed 1, and minimises – so far as is reasonably practicable – the impact of developer's works on future operation and maintenance, costs and liabilities
ancillary plant	Any plant involved in the piling process except for the piling rig itself
Asset Protection	The department within NRHS tasked with managing the risk from the work of any developer
Asset Protection Plan (APP)	A document produced by the developer of larger schemes to demonstrate how the High Speed 1 railway assets will be safeguarded during and after construction.
Asset Protection Engineer	A person appointed by NRHS to liaise with a developer concerning asset protection of High Speed 1 infrastructure
CAC	Contractor Assurance Case – formal certification by NRHS that a contractor has an acceptable safety management system to allow working on High Speed 1 infrastructure
CBR	California Bearing Ratio
CDM Regulations	Construction (Design and Management) Regulations 2015
collapse radius	In a lifting operation, the maximum extent of collapse of a crane jib plus the length of the load if hoisted vertically or half the length if hoisted horizontally. In the case of a mobile crane collapse the point of rotation can be either the boom about its pivot or else the whole crane about its most heavily loaded outriggers. In some cases, for example with the full counterweights in place and a light load combined with high jib angle, the most heavily loaded outriggers can be those furthest from the boom
Contractor's Engineering Manager	The person within a design and/or construction organisation with overall responsibility for engineering activities in a contract, including interdisciplinary checks
Contractor's Responsible Engineer	The person in a construction organisation responsible for the day-to-day management and coordination of the technical and engineering activities in a contract
CRA	Cost Reimbursement Agreement
CTRL	Channel Tunnel Rail Link, the former name of High Speed 1
Danger Zone	The area within 2.75m of any running rail (1,25m for platform edges and where line speed is less than 160km/h)
developer	An individual or organisation, not being High Speed 1 or Network Rail High Speed, promoting or carrying out work in the vicinity of High Speed 1
development questionnaire	Templated outline details of the development with contact details prepared by the developer at the earliest stage

DfT	Department for Transport
DZEP	Danger Zone Entry Permit
E&P	Electrification and plant
elective works	Works or activities forming part of the developer's scheme which are undertaken by NRHS
EMC	Electromagnetic compatibility
employer	In tendering situations, the body issuing tenders
F10	Notification to the Health and Safety Executive of a construction project, required for notifiable schemes under the CDM Regulations
FPS	Federation of Piling Specialists
goniophoto-metric	The angular distribution of light scattered from a surface
GSMR	Global System for Mobile Communications – Railway
Hazid	A formal hazard identification process
High Speed 1	The High Speed 1 railway (formerly CTRL)
HS1	In the context of this document, the company with the concession from government to operate, manage and maintain High Speed 1
isolation	Planned arrangements for a predetermined period for the interruption of traction electricity between defined locations
Line Standard	A Network Rail standard applicable to NRHS
LOLER	Lifting Operations and Lifting Equipment Regulations 1998
maintenance plan	A development of the maintenance strategy at detailed design stage, for review and acceptance by NRHS, which lists any maintenance tasks which give rise to railway risks as well as detailing their frequency and the equipment to be used
maintenance strategy	A document produced by the developer at approval in principal (Form A) stage, for review and acceptance by NRHS, which demonstrates that the railway risks from maintenance of the development are as low as reasonably practicable. This strategy should pay particular attention to maintenance activities that need to be taken into account in the design such as window cleaning access and glazing replacement on a railway facade
method statement	A document detailing a comprehensive step-by-step account for activities, which identifies responsibilities, resources, method of working and controls for risk from the work activity to the persons, property and operations. Equivalent to a work package plan (WPP)
monitoring	Checking of construction work by observation, measurement, testing or audit to verify that the execution is compliant with the specified technical requirements
Network Rail High Speed	A wholly-owned subsidiary of Network Rail Infrastructure Ltd contracted to operate and maintain the High Speed 1 line

Network Rail Infrastructure Ltd	That part of Network Rail responsible for ownership, operation and maintenance of the mainline railway excluding the High Speed 1 line. Sometimes known as the 'classic railway' or 'Network Rail classic' or NRIL
NoNO	Notice of No Objection
NPOS	Nominated Person on Site: the person charged with implementing OCS isolations
OCS	Overhead catenary system, known elsewhere as OHLE (overhead line equipment)
operational railway	The area between the innermost boundary fences of High Speed 1 covering both the Danger Zone and Safe Zone
ORR	Office of Road and Rail: the independent economic and safety regulator for Britain's railways
piling	The installation of bearing or lateral-restraint piles (continuous flight auger, rotary bored, driven cast-in-situ, driven pre-cast concrete, driven steel sections, auger displacement), retaining wall techniques (diaphragm walling, secant and contiguous pile walling, sheet piling), mini-piling or soil nailing/soil anchors
piling platform	The designed surface on which the piling rig and ancillary plant is operated
possession	Planned safety arrangements which control or prevent the normal movement of rail traffic between defined locations for a predetermined period
possession overrun risk assessment	An assessment of the risks to possession overrun and their mitigations, and the break points and times at which the work will be curtailed
PPA	Protective Provisions Agreement: a legal agreement between High Speed 1 and the developer covering safeguards, processes, responsibilities and cost recovery
protective works	Permanent works forming part of the developer's scheme which are provided to mitigate risks to the railway
Railway Group Standard	A standard applicable to the whole UK railway industry
RFI	Request for information
RIDDOR	The Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 2013 http://www.legislation.gov.uk/ukxi/2013/1471/contents/made
risk hierarchy	Five ways of controlling risk. These are, from most to least favoured: avoid > transfer > reduce > insure > accept
RISQS	Railway Industry Supplier Qualification Scheme
RLE	Rail Link Engineering: the body charged with the design of CTRL
RPOS	Responsible Person on Site: the person charged with taking and handing back High Speed 1 possessions
RSL	Rail Safety Leader
S&T	Signalling and telecoms
Safe Zone	The area between the innermost boundary fence and the Danger Zone
slew restricted zone	The working orbit of a crane (not the no-go area)

SOED	Submission of Engineering Documents: a form used to provide a remit to an external engineering advisor
specular	Reflection from shiny surfaces
sprag	To steer a crawler machine by applying the brake to one track whilst driving with the other
SRP	System Review Panel: A NRHS body typically meeting once per four week period charged with reviewing and approving significant changes to the High Speed 1 infrastructure to ensure any risk to the safety, operation or maintenance is managed
SZEP	Safety Zone Entry Permit
TOC	Train operating company
TS	Task Supervisor: the person charged with controlling work in a worksite
TW	Timetable week (starting Friday 21:00). See TW-1 etc
TW-1	Possession planning meeting held one week in advance of the possession
TW-6	Possession planning meeting held 6 weeks in advance of the possession. The possession data freeze applies from this time
TW-14	Possession planning meeting held 14 weeks in advance of the possession
TW-30	1. Deadline for submission of the Draft Period Possession Plan to the TOCs, 30 weeks in advance of the possession 2. The four-weekly possession planning meeting to discuss the Draft Period Possession Plan which typically takes place between 31 and 35 weeks in advance of the possession
UAS	Unmanned aerial system: entire UAV operating equipment including aircraft, the control station and the wireless data link
UAV	Small unmanned aircraft other than a balloon or kite up to 20kg in weight including any attachments
veiling luminance	Decreased visibility caused by bright lights in the visual field
vested works	Works forming part of the developer's scheme which pass to High Speed 1 to own and maintain
work package plan	See method statement
work site	An area on, above or below the operational railway where work is planned or taking place



Risk management

2.1 General

Risks are to be controlled using the risk hierarchy:

- > eliminate
- > transfer
- > reduce
- > insure
- > accept.

CDM Regulations 2015 refer to Principles of Prevention (see appendix A of the HSE guidance <http://www.hse.gov.uk/pubns/books/1153.htm>) which duty holders should use in their approach to identifying the measures they should take to control the risks to health and safety in a particular project. In summary, these are:

- > avoid risks where possible
- > evaluate those risks that cannot be avoided
- > put in place proportionate measures that control them at source.

The effort involved in managing a risk should be commensurate with the magnitude of that risk.

The developer is expected to demonstrate to NRHS that the risks associated with the scheme have been identified and controlled.

Risks arise where there is inadequate time to properly plan and execute the works. NRHS will expect an initial programme to be developed at an early stage

2.2 Risk tools

Nearly all schemes will have a risk register. In addition, risk assessments are expected at the task level, normally as part of the method statement/work package plan. The Asset Protection Engineer will always require sight of this and will often wish to comment.

If the work is subject to changing circumstances such as the weather, a suitably recorded dynamic risk assessment may be appropriate.

2.3 Programme development

Risks arise where there is inadequate time to properly plan and execute the works. NRHS will expect an initial programme to be developed at an early stage taking account of comments from the Asset Protection Engineer and this must be further reviewed as the development progresses. Section 5.6 gives typical timescales to allow in the programme for approvals and section 6.6 indicates notice required for booking possessions.

2.4 Safe working practices

Systems, procedures and working practices that identify and minimise risk to the safety, operation or maintenance of the railway, and that protect persons involved, must be developed and implemented. This is a key risk control measure and the Asset Protection Engineer will pay particular attention to it.

For some works affecting the safety or operation of the railway (or on High Speed 1 land) a contractor accredited by NRHS through our contractor assurance process may be required. The Asset Protection Engineer can advise whether this is likely to be the case and which contractors hold a Contractor Assurance Case (CAC).

2.5 Buried services

Historically, buried services strikes are a common incident type caused by developers. Accordingly, attention must be focussed on avoidance for example by following the HSE guidance note 47 "Avoiding Danger from Underground Services". Developers can greatly reduce the risk using vacuum excavation.

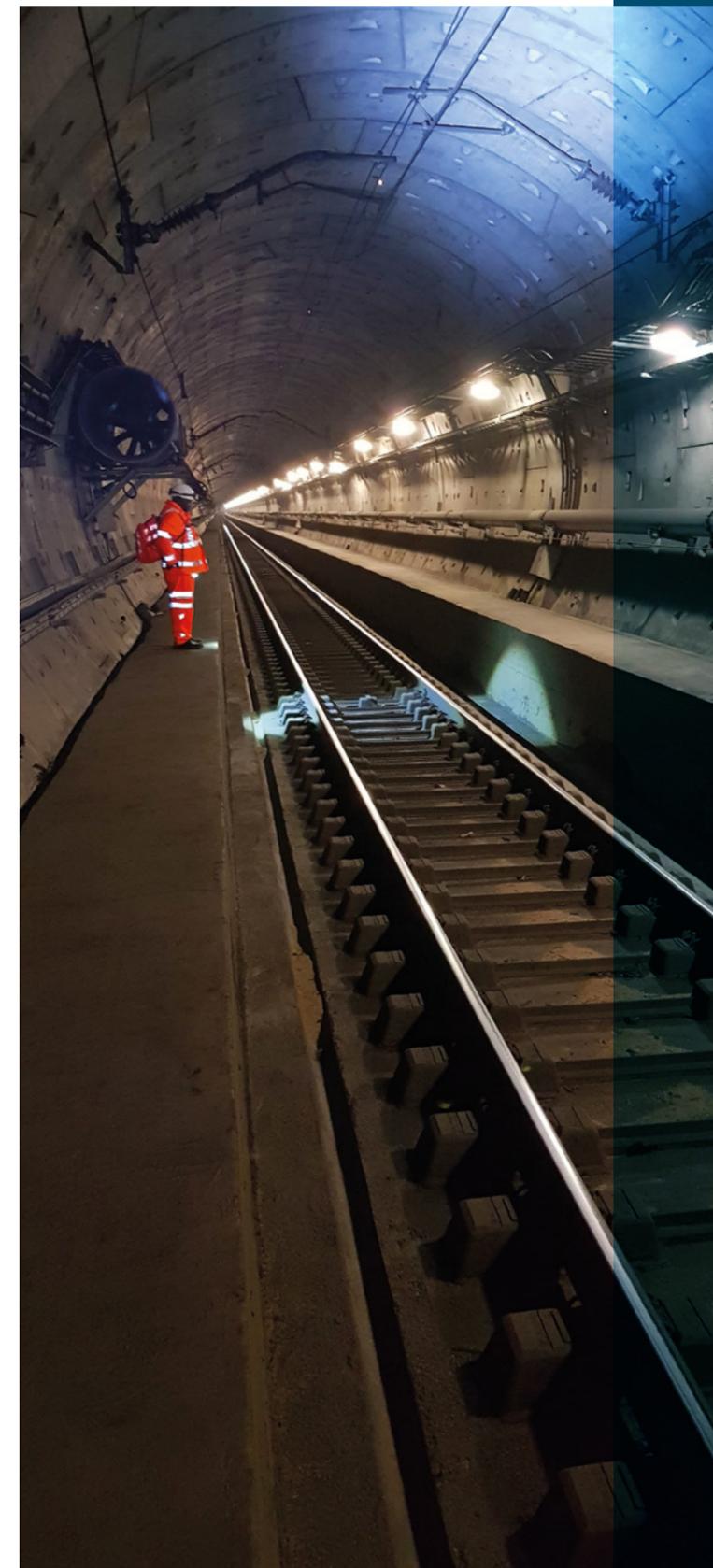
Information on some High Speed 1 services is available from NRHS upon request (see section 2.14) but developers will also need to contact the statutory undertakers. The Asset Protection Engineer will not issue a notice of no objection to the method statement allowing excavation work to go ahead until he is confident that the developer is controlling the risk of a buried service strike.

A full survey must be undertaken to ascertain the existence, location and nature of services. A permit to dig must be issued before excavating or driving objects into the ground. Note that such a survey may also be required before surcharging the ground.

Should any unknown or unexpected service be discovered or uncovered, work in the vicinity of the service must stop, ownership established, and both NRHS and the owner of the service informed. Appropriate precautions for protection must be taken prior to restarting work.

The degree of existing protection provided to services can vary. Therefore, High Speed 1 services must not be interfered with or moved unless authorised by the Asset Protection Engineer.

Services shall not be interrupted unless otherwise agreed. Any service not diverted must be supported, maintained, protected as necessary and kept in working order in its existing location. Where temporary or permanent service diversions are necessary a method statement and specification must be agreed with the Asset Protection Engineer.



2.6 Windblown debris

Windblown debris causes more lineside neighbour incidents than anything else. All could and should be avoided with good housekeeping.

More guidance – aimed at lineside neighbours – on the risks from windblown debris (as well as buried services, fires and fences) can be found at <http://www.networkrail.co.uk/High Speed 1 TracksideSafety>. See also section 7.13.

The developer shall minimise the risk of debris being blown onto the OCS or the track by making sure materials are properly stored and secured. Failure to do this could cause a very serious incident such as a flashover or train pantograph damage. Hoardings and similar temporary structures shall be designed and built to withstand the effects of wind, and may require a temporary works design.

2.7 Asset protection plan (APP)

The APP is a live document produced by the developer of larger schemes to show how the High Speed 1 railway assets will be safeguarded during and after construction. It is to be reviewed and agreed by NRHS and will include:

- > description of scheme and plan of footprint/layout
- > OP number
- > content of the development questionnaire including emergency and non-emergency contact list
- > responsibilities for the railway interface with contact details including CEM, CRE, CDM duty holders and emergency contacts
- > register of railway risks and risk treatments
- > list of vested works
- > list of elective works
- > overall programme
- > schedule of submissions.

The client has a major influence over the way a project is procured and managed through contractual control, appointing designers and contractors, and determining the money, time and other resources available.

2.8 Emergency preparedness

The developer will have in place emergency plans where appropriate, for example where identified in the APP, Hazid or possession overrun risk assessment.

Where there might be a need to stop trains during a possession in an emergency and/or arrange an isolation this will be done by NRHS. Onsite, a railway emergency contacts protocol poster should be displayed at agreed locations around the site. The Asset Protection Engineer can provide the latest version of this notice. Site staff shall be made fully conversant with this procedure as part of site induction.

The developer will provide and keep updated a list of emergency phone contacts (and email where appropriate). Where out-of-hours contact is provided or required, details of the cover will be advised.

2.10 Standards

Safe operation of the railway is governed by Group and Company standards that it is incumbent upon any developer to abide by. The developer is expected to appoint designers and project managers who know and understand what is required to comply with these.

NRHS has its own business standards, and these are separate from those of Network Rail Infrastructure Ltd. This is because High Speed 1 is governed under a completely independent ORR licence.

When working on the operational railway or High Speed 1 land the developer shall comply with the NRHS drugs and alcohol policy. Developers and others involved in work on the Railway should be familiar with the NRHS Environmental Policy Statement.

2.11 CDM Regulations 2015

The developer is subject to many legislative requirements of which the duties of the client and principal designer under CDM 2015 are new and worth highlighting:

The client has a major influence over the way a project is procured and managed through contractual control, appointing designers and contractors, and determining the money, time and other resources available. The client is required to assemble the project team and make suitable arrangements for managing the project safely

The principal designer should address health and safety issues from the very start. The designer is also responsible for coordinating design efforts to foresee and manage risks throughout the design process.

See <http://www.hse.gov.uk/pubns/books/l153.htm> for further info.

2.9 Maintenance strategy, plan and agreement

The maintenance of a lineside development often presents risks to the railway particularly if high-rise. Because these risks extend throughout the life of the building, the risk controls need to be scrutinised even more carefully than those for the transient construction phase. Such risks might arise from window cleaning, façade maintenance and glazing replacement, rooftop equipment maintenance, waste storage and disposal. These risks and the controls should be documented.

If relevant, a maintenance strategy is expected from the developer for review and acceptance at approval in principle stage. This will demonstrate that the railway risks from maintenance of the development are as low as reasonably practicable.

A maintenance agreement, if needed, is a legal agreement between the developer and High Speed 1 defining access rights and maintenance responsibilities for each party.



2.12 Health and safety file

Where High Speed 1 assets are created or changed the developer is required to prepare a health and safety file to a format and standard agreed with the Asset Protection Engineer, in liaison with the NRHS asset head.

2.13 System Review Panel (SRP)

For schemes modifying High Speed 1 assets or having a significant multi-disciplinary impact on the railway, it may be necessary to submit the scheme to SRP. In this case SRP may deal with scheme approval or they may delegate some parts of the approval to the Asset Protection team. Whichever is the case, Asset Protection will have the role of overseeing the construction

2.14 Request for information (RFI)

Any request for High Speed 1 asset information such as health and safety files, buried services or structural information should be made to the Asset Protection Coordinator (and copied to the Asset Protection Engineer), who will interrogate the records database and supply an index of the data found, together with the terms for acquiring it. Once there is a signed agreement and payment in place, the requested data will be released by email or via file sharing software.

Note that information is:

- > confidential
- > not for disclosure
- > solely for the purposes of the scheme
- > not warranted to be fit for this, or any, purpose
- > subject to limited liability
- > provided without a premium charge.

Requests from developers or utility owners concerning High Speed 1 land ownership should be made to the Asset Protection team, who will refer to the current lease boundary drawings to confirm.

2.15 As-built information

Where the scheme makes changes to High Speed 1 infrastructure, AS Built information may be required. This will normally be in conjunction with a formal handover. Where works are carried out on or near High Speed 1 land, as-built information to allow update of High Speed 1 records will be required. In both cases the Asset Protection Engineer will advise what is needed.

RFI Process

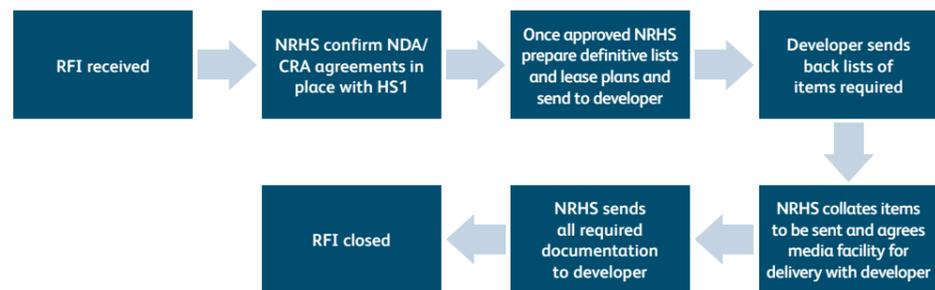


Figure 1 – RFI process flowchart



Design

3.1 General

It is advised that the developer consults the Asset Protection Engineer at the inception of the design to review relevant information.

As part of the scheme planning process, the developer shall agree with NRHS a schedule of submissions.

Working on the railway involves onerous and often expensive protective measures which the developer will wish to minimise through smart design and planning. This can be done by:

- > avoiding any work within the boundaries of the operational railway except as a last resort. This will require a possession, special supervision, possibly an isolation, and a notice of no objection from NRHS Asset Protection
- > avoiding any intrusion in to the zone of subsoil acquisition (see section 4.2)
- > eliminating any need to modify any High Speed 1 asset, including services
- > avoiding any work outside the operational railway but nevertheless on High Speed 1 land
- > adopting a construction methodology which avoids the need for an isolation
- > designing so that construction will not impart risks to the railway
- > avoiding the need for diversion of High Speed 1 services
- > designing the structure or building with long term maintenance in mind: remember that access to the exterior of a building close to the railway for maintenance of the fabric or cleaning the glass may require a method statement and approval by NRHS each time it is carried out
- > making sure that protective zones adjacent to the railway are preserved: this is the typically 5m wide safety zone providing protection against vehicle ingress. There is also often a 1m maintenance zone adjacent to fences and other boundaries
- > for a possession, carrying out an assessment of the risks of possession overrun (or other operational delay) and implementing the appropriate mitigation measures.

The minimisation of interruption to railway services during construction is a prime consideration in design.

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3.2 Clearances

Clearances are crucial to safe operation of the railway. The minimum clearances, outside which the whole development must be kept, are quoted here for convenience to avoid the need to extract this information from other documents. The dimensions quoted in the following may need to be increased where required by the railway infrastructure.

The Asset Protection Engineer must approve dimensioned plans, elevations and cross sections showing the exact relationship of the construction to the railway. Each dimensional ground point must be capable of identification on site.

Structures must meet the following clearances:

- > 1.00m clear of OCS (this means any OCS asset, live or earthed) unless agreed otherwise by the NRHS E&P team. See Figure 2 dimension "b"
- > at least 5.88m vertically above the highest rail. See Figure 2 dimension "a"
- > preferably 7m horizontally from the nearest rail. See Figure 3 dimension "c"
- > within 7m of the nearest rail permanent supports to structures spanning over the railway must be designed to withstand derailment collision loads. See Figure 3 dimension "c" and section 3.7
- > for equipment or personnel at least 2.75 metres from any part of the live OCS or the airspace at all heights above live OCS. This criterion can be temporarily removed with an isolation or permanently managed with shielding
- > for vehicles or plant, the clearances and barrier specification shall be risk assessed such that the Asset Protection Engineer agrees that the risk of vehicle incursion is as low as reasonably practicable
- > plant or temporary works that encroach, or can fall, within 4m of the operational boundary (even by accident, mishandling or as a result of system failure) should be avoided if it is reasonably practicable to do so. For cranes and piling rigs see sections 8 and 9
- > allowable proximity of tunnelling/thrust boring to the High Speed 1 infrastructure is governed by the risk to deformation affecting structures, track and OCS.

The Asset Protection Engineer must approve dimensioned plans, elevations and cross sections showing the exact relationship of the construction to the railway.

Screens and barriers can sometimes be used where clearances would otherwise be compromised.

Any encroachments on the agreed clearances must be corrected immediately.

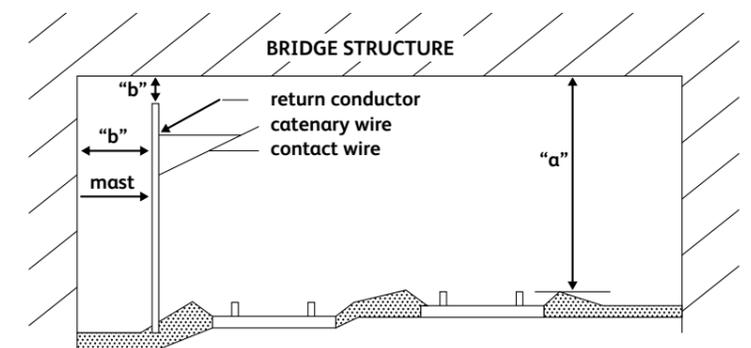


Figure 2 – Measurement of vertical clearances

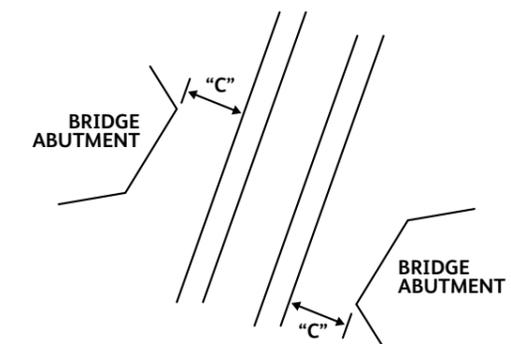


Figure 3 – Measurement of horizontal clearances



3.3 For High Speed 1 maintenance

In many places the High Speed 1 has been designed to have a maintenance zone between 1m and 5m wide outside the railway fenceline. This is provided to permit maintenance of the fence, access alongside the line, provision of future services or protection against errant vehicles. Developments in this zone are discouraged and, if permitted at all, will require the developer to provide additional safeguards.

3.4 Gauging

Gauging is the process by which the various swept envelopes of a vehicle (principally Class 373 and 374 (Eurostar) and Class 395 (Hitachi) but also freight and engineering trains for High Speed 1) are assessed to ensure they can maintain a safe clearance to lineside structures or vehicles on adjacent tracks. Lineside structures could also include temporary works.

3.5 Track and structure stability

Any proposal to excavate or construct foundations near High Speed 1 track or structure must ensure:

- > stability of the track and structures
- > stability of cables and cable trough, walkways and fences
- > safety of passing rail traffic.

Note that structure includes earthworks and, in this context, any foundations including fencepost footings.

Railway track and equipment is sensitive to ground disturbance. Foundations and changes in ground or water table level near the railway track or structure may affect the support to the track and drainage or the stability of the structure. Where this possibility exists, NRHS will require a soil survey, foundation loads and a design assessment. Often, monitoring of the track, OCS and structures will also be required.

3.6 Bridge parapets

Vehicle parapets over the railway have an inner face which is smooth, non-perforated over their full height, and without hand or footholds. Steeple copings, or similar anti-climbing feature are to be used. High Speed 1 is electrified throughout with OCS hence:

- > height of parapets including coping is at least 1800mm
- > in some areas additional protective screening may be needed against direct contact with live OCS.

Parapets are designed to resist vehicle impact to minimum H4a very high containment standard under the Design Manual for Roads and Bridges <http://www.bridgedesign.org.uk/parts/parapet.html>

3.7 Accidental loading

To avoid the risk of accidental loading arising from collisions from railway traffic, supports carrying any structure over or alongside railway tracks must be placed, where practicable, outside the hazard zone. The hazard zone extends for a width of 7m from the edge of the outside rails. All supports located between railway tracks are inside the hazard zone.

Where the railway is on an embankment and there is a risk of derailed vehicles rolling down the embankment, columns and piers beside the line may require an extended hazard zone.

If the risk cannot be avoided it shall be reduced by a design which:

- > defines the hazard zone where there is the greatest risk of impact
- > addresses the need for columns and piers to withstand the effect of light impacts that might occur from rail vehicles without sustaining irreparable damage
- > prevents a progressive collapse of the superstructure in the event of a major accident that results in the loss of a support.

The structure and supports of any buildings over railway lines shall be so designed and protected that they will withstand the effects of a fire on the track for such time as specified by the appropriate building control authority and the Asset Protection Engineer.

The derailment load requirements set out in the RLE standard Loading and Particular Criteria for CTRL Railway Bridges (000-GDS-LCEES-00087-06) and the document on which it is based, UIC code 777-2 must also be met.

3.8 Glare

Where the development includes a highly reflective facade the designer is to consider the extent to which specular surfaces, such as glass or polished metal, could adversely affect the vision of train drivers. Developments which give rise to spectral reflection will require a study of reflected sunlight as experienced by the train driver's perspective, even where they are some distance from the railway. The assessment should:

- > identify the relevant parts of the proposed facades which may reflect light
- > define the occurrence of such reflections throughout the year and the day
- > quantify the equivalent veiling luminance generated by the reflection at the driver's eye, undertaking goniophotometric studies if needed to accurately characterise materials which exhibit combined specular and diffuse reflection properties
- > illustrate the above for a relevant stretch of the train tracks in both directions of travel
- > consider the location and type of signals on the same stretch
- > measure the angular distance of the reflection from the driver's line of sight.

Animations are best suited to illustrate the assessment.

Note that lineside signalling is present on the approach to and exit from St Pancras station but is in-cab signalling elsewhere. NRHS may require the screening of any light (including vehicle, street lights, aviation warning beacons and external advertising screens) that may interfere with sighting of signalling apparatus or affect the train driver's vision. Flicker or moving images should be avoided.

Where the railway is on embankment and there is a risk of derailed vehicles rolling down the embankment, columns and piers beside the line may require an extended hazard zone.

3.9 Unexploded ordnance

High Speed 1 passes through areas, particularly the marshes to the north and south of the Thames, where unexploded second World War ordnance remains. This risk is to be assessed by a competent organisation by way of a desktop study. Where risk result is medium or high, on site exploration and probing measures are to be proposed and agreed with NRHS to control that risk. Please discuss with your designated Asset Protection Engineer.

3.10 Utilities

High Speed 1 buried service locations and depths must be known before detailed design and, unless unavoidable, the new infrastructure sited to avoid both the risk of a buried service strike during construction and a limitation on access to the service post-construction. Where such siting cannot be arranged NRHS will advise whether the developer is to divert the service before the start of construction. Diversion will be subject to NRHS approval.

3.11 Drainage

Drainage must be directed away from the railway and positively into an existing drainage system unless this is impractical, in which case soakaways may be considered in suitable locations and where slope stability is maintained. Connection to High Speed 1 drainage will not normally be permitted. The developer will be responsible for obtaining drainage consent.

Stratford Box is subject to de-watering at its ends. Neither the operation of the de-watering boreholes nor the outflow pipework should be prejudiced. Contamination of the lower aquifer must be avoided

Connection to High Speed 1 drainage will not normally be permitted. The developer will be responsible for obtaining drainage consent.

3.12 Security

Security of High Speed 1 is paramount: railway fences shall be maintained throughout the work and permanently reinstated to the satisfaction of the Asset Protection Engineer on completion. The level of security provided by the railway fence shall not be diminished, even temporarily.

Where a development introduces a change of use or increased risk of trespass or vandalism on the railway, the developer may be asked to provide mitigation measures such as higher specification fencing. Where palisade fencing is used the rivet-less type is preferred.

The international stations are enclosed in a security zone, generally provided by high containment bollards tested to resist impact of a 7.5 tonne vehicle at 80 km/h. The containment level must be maintained.

Provision of barriers against vehicle incursion from overbridges onto the railway is the subject of risk assessment and guidance, normally using the DFT Requirement for Road Restraint Systems, TD 19/06.

3.13 EVP

Where there are changes to road layout near overbridges (or elsewhere adjacent to the line), or changes to the road traffic nature, speed or density these vehicle incursion measures will need to be checked and agreed. As vehicle incursion could cause a catastrophic fatal accident on a high-speed railway, NRHS always require an appropriately high level of containment



3.14 Light

Where a development will shade any solar-powered railway equipment such as track lubricators, this risk will be assessed in advance and alternative measures – such as a permanent power supply – may be needed.

3.15 Wind

Wind turbines present risks of constructability, structural integrity and maintainability that will require a hazard identification exercise and risk assessment to be carried out. It is NRHS's position that all wind turbines should be placed a minimum of maximum blade height plus 10 % from the nearest railway owned asset.

3.16 Landscaping

The design must take account of the effects of works on existing trees and their roots, whether on the development site or High Speed 1 land adjoining the site. A choice of tree species is subject to guidance produced in consultation with the Tree Council (See Appendix C).

3.17 Noise

In some cases, a developer will be expected to provide mitigation for effects on the development arising from High Speed 1, such as noise barriers for a new residential development or containment for a nearby oil-filled transformer. The developer is reminded of his obligation to ensure appropriate mitigations are adopted to protect their development from noise from High Speed 1. The developer is responsible for ensuring that the development meets statutory requirements in accordance with Planning and Noise PPG 24 September 1994 – Annex 4 and provisions of the Safeguarding Direction.

The key to confidence that the track support zone has not been compromised is comparing the observed and anticipated volume of arisings.

3.18 Electromagnetic compatibility

Compatibility of electromagnetic emissions from developers' schemes with High Speed 1 systems is to be dealt with by risk assessment of potential coupling mechanisms. The rigour of the assessment will need to be proportionate to the level of risk: more rigour where there is a higher likelihood or where safety critical systems may be affected.

Where EMC effects cannot be ruled out developers may be required to submit an EMC strategy defining the process and any further design or acceptance requirements. In some cases, the developer may need to validate assumptions by testing.

High Speed 1 has been designed and built to be compliant with BS EN 50121. Nevertheless, developers are responsible for ensuring that their equipment can operate as intended in or around the railway environment.

3.19 Public mobile operators

Installation of a radio host site for a public operator near to the railway line must be submitted in advance for our acceptance, so that consequences for the railway can be considered and mitigated.

Large buildings near the railway can affect GSMR coverage and, if requested by NRHS, this risk may need to be studied or the effects measured. The developer will be responsible for the costs of this and any remedial measures.

3.20 Under track crossing (UTX)

UTXs shallower than 4.8m are not permitted so they are normally undertaken using horizontal directional drilling or other micro tunnelling techniques, NRHS will need assurance that their use beneath the railway will not adversely affect the railway infrastructure or safe running of trains.

The designer will need to demonstrate that the choice of tunnelling technique is appropriate. The design is then to be undertaken and checked by competent persons, and installation is by a competent and experienced contractor. Recognising that the safe and efficient delivery of UTX schemes is highly dependent upon a close and effective interface between designer and installer, NRHS requires evidence of this working relationship.

The key to confidence that the track support zone has not been compromised is comparing the observed and anticipated volume of arisings. Although this is not always straightforward it should always be attempted. The following records are also valuable:

- > monitoring of the nature of material forming the arisings and comparison with expected outcomes
- > observations of any lost ground or other ground movement
- > any unusual conditions or events
- > checks on line and grade
- > pipe jacking forces
- > pressure readings
- > groundwater control operations and groundwater levels
- > reasons for operational shutdown in the event a drive is halted.

Track and infrastructure settlement monitoring regimes are to be prepared, agreed and implemented prior to works commencing, along with appropriate mitigation measures which can be seamlessly employed during UTX installation should unforeseen events occur, or unexpected conditions be encountered.

Discussion on easements, wayleaves and clearances may be needed.



Developments above tunnels

4.1 Construction

High Speed 1 includes 42km of running tunnel. This is mostly under London in two sections to the west and east of Stratford, known as London Tunnel 1 and London Tunnel 2 respectively. They are twin tunnels generally between 20 and 35 metres below ground level lined with 350mm thick fibre-reinforced precast concrete segments. Access is possible at the portals and at five other locations where there are headhouses. The twin tunnels are parallel and, including linings, each have an outside diameter of 7.85 metres.

The Thames Tunnel is of similar construction though the North Downs tunnel under Blue Bell Hill is a single bore with in-situ lining.

Tunnels in Kent are cut and cover.

4.2 High Speed 1 subsoil acquisition

Where the line is in tunnel, developers should be aware of the extent of High Speed 1 subsoil acquisition. This is a rectangle in cross section covering both tunnel bores and the space between them. The rectangle extends to 3m above, below and to the side of the tunnel linings. Intrusion into this zone is considered trespass and is to be avoided except as a last resort. If the Asset Protection Engineer agrees that it cannot be avoided a licence from High Speed 1 will be required.

4.3 Safeguarded zone

A strip of land wider than the railway (including above tunnels) is designated a safeguarded zone. This prevents developments without consultation and requires planning authorities to heed certain conditions High Speed 1 may seek to impose. The safeguarding boundaries were modified in 2016 to shrink the safeguarded zone.

Network Rail High Speed will want to discuss loading or unloading from any development that could potentially load or deform the tunnel linings.

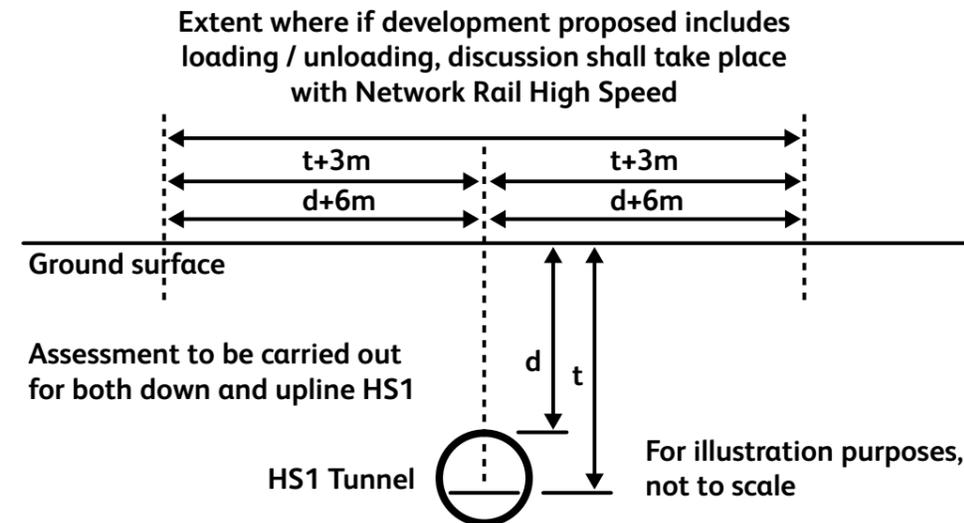


Figure 4 – Zone where there is requirement for interface of developer with Network Rail High Speed, where loading / unloading is proposed

4.4 Surcharge loadings

NRHS will want to discuss loading or unloading from any development that could potentially load or deform the tunnel linings. This is a strip within $d+6$ metres of either tunnel centreline where d is the depth of the tunnel centreline in metres, see Figure 4. Alternatively, $t+3$ metres can be used where t is the depth of track in metres.

The design of the London Tunnels allows for surcharge loadings from existing buildings or, where there were no existing buildings assumes a uniformly distributed load of 50kN/m^2 at ground level, based on the ground level at the time the design was undertaken. For the Thames Tunnel and Temple Mills Chord Tunnel the allowable surcharge is 20kN/m^2 (maximum 10kN/m^2 for live loads above TMC Tunnel). For Stratford Box this surcharge is 20kN/m^2 within 40m of the Box walls based on a ground level of +6.5m above Ordnance Datum.

High Speed 1 tunnels have not been designed to take point loads.

4.5 Exceeding surcharge loadings

The surcharge allowances in Section 4.4 can only be exceeded if an engineering assessment of the tunnel load and deformation is produced and is acceptable to NRHS. For developments less than the allowances in Section 4.4 developers should still seek clarification from NRHS that loads are acceptable. As-built drawings showing compliance will also be required. Speak to the Asset Protection team in all instances.

Please note the surcharges considered as part of the High Speed 1 design calculations noted in Section 4.4 are uniformly distributed vertical loads. An engineering assessment is required where the applied loading does not adhere to this scenario. Examples of this may include scenarios such as:

- > where changes to the horizontal loading around the tunnels arise, for example where basements are proposed or where piling is proposed nearby to the High Speed 1 tunnels
- > where non-uniform or vertical point loads are proposed.

As part of the engineering assessment, the developer shall:

- > calculate predicted soil movements and therefore tunnel lining movement at stages of construction, loading and consolidation, including unloading for example during demolition or basement construction
- > tunnel lining hoop stress, joint stress and bending moment changes, allowing for any segment joint lips and steps and tunnel ovalisation in that location
- > combination of hoop stress and bending moment with respect to the M-N interaction diagram, accounting for the current tunnel ovalisation
- > verification where appropriate using semi-empirical methods

- > longitudinal deformation at track level both vertical and horizontal, and comparing with serviceability limits of 4mm over 35m and 9mm over 70m. Note some of this deformation may have already occurred and will need to be factored into any future allowances. These tolerances are for managing the asset and not limits or the effects of developments on the tunnels
- > movement of OCS contact wire with respect to the track as a result of both tunnel squat and rotation of the segment that the OCS support bracket is fixed to, and comparing with a limit of 10mm
- > if cross passages are nearby the load and deformation of the linings, collar (where the cross passage joins the running tunnel) and potential for leakage.

The developer shall also consider issues with pile construction such as:

- > stress relief and deformation of High Speed 1 tunnels from the boring/installation process
- > potential for outflow of soil into pile bore, reducing support to tunnel lining
- > potential for concrete or support fluid flow from pile bore to High Speed 1 tunnels.

4.6 Foundation options

Above tunnels strip and raft foundations will, subject to enough clearance to the tunnel soffit, normally be acceptable forms of building foundation and are preferable to piled foundations.

Where piled foundations are required, rotary bored or CFA piles are preferred (see section 7.11 and 9).

The precise location, depth and loading of piled foundations should be carefully specified. As part of the consultation process NRHS may request advance notification of scheduled piling, and that the pile logs and test pile results be made available.

4.7 Boreholes

Those proposing boreholes should have regard to the extent of subsoil acquisition (see section 4.2). As a minimum the drilling method, diameter, proposed depth, inclination and OS coordinates of the borehole will be required before approval is given. The Asset Protection Engineer may wish to attend site to verify site controls on location and depth.

Where drilling support fluid is proposed, the fluid shall be selected to avoid any potential ingress of fluid into the nearby High Speed 1 tunnels, for instance from transmission of the fluid through fissures in the ground.

4.8 CTRL project grid

High Speed 1 documents use the CTRL project grid though national datum is used for levels. Defined as a plane true to scale grid which is related to Ordnance Survey coordinates, the essence of the grid is that measured distances on the ground are the same as distances calculated from grid coordinates within a specific area. Any projection from the surface of the earth on to a plane will be a compromise in retaining true geometrical properties and, therefore, any grid system will have limitations in terms of accuracy over large areas. The CTRL project grid has been developed specifically for the project to minimise any inaccuracies within the High Speed 1 trace.

On application to NRHS we can provide a conversion tool to convert between OS and CTRL project grid coordinates and vice versa.

4.9 Settlement above tunnels

Minor settlement occurred during the tunnelling operation of High Speed 1 but this has long since ceased. High Speed 1 has detailed monitoring records of settlement throughout the route and can prove that settlement is no longer happening. High Speed 1 will not accept any claim with regard to settlement.

High Speed 1 does not offer the right of support nor does it accept liability for any settlement, damage, noise or vibration emanating from the normal operation or maintenance of the railway.

4.10 Monitoring

For developments above, below or near to tunnels the developer will agree with the Asset Protection Engineer whether tunnel monitoring is required and, if so, to agree a monitoring regime. Measures will depend upon the predicted load and deformation at the tunnel extrados.

There will likely be a requirement for pre-works and post-works tunnel condition survey. Additional visual surveys may also be necessary when significant stages of construction works are carried out resulting in potential change in load/movement around the High Speed 1 tunnels.

A review of the track recording coach measurements of track vertical and horizontal alignment may be utilised.

There may be a requirement for Pre-works and post-works three-dimensional survey using laser or fixed targets (also during the works if for an extended period) to identify the radial and longitudinal deformation profile changes of the High Speed 1 tunnels during the work. This can be achieved by installing monitoring equipment to record movement of tunnel lining and track bed in real time. This will need to be in place well before loading (to allow a stable set of readings to be taken) and continue until soil movement is largely complete or until the settlement has matched the predictions

Monitoring of adjacent structures could be required. These are structures such as retaining walls forming basements close to the High Speed 1 tunnels so that displacements of the wall are monitored at source and may be able to be correlated with displacements of the nearby High Speed 1 tunnels.



Formal approvals

5.1 Principle

Where it may affect the railway, construction will not be allowed to proceed without the prior approval of NRHS. To enable this, the developer shall demonstrate acceptability of their proposals using the means set out below.

5.2 Planning consent

Planning authorities are required to consult with High Speed 1 for any developments within the Safeguarded Zone (see section 4.3) and High Speed 1/NRHS would normally propose conditions and informatives if within the zone of influence (see section 4.4 for tunnels and sections 7.20/7.21 where above ground).

Only the planning authority can discharge conditions. However, where the condition is one that High Speed 1 has proposed, NRHS suggest that developers submit the proposed wording of the discharge application to High Speed 1 for review prior to sending to the planning authority. Once NRHS/High Speed 1 are happy that the railway risks have been addressed, NRHS can provide a confirmation email which the developer may find useful in his discharge application.

5.3 Initial consultation

Although this section deals mainly with formal approvals there is informal, initial consultation which precedes this, and which is equally important in making sure the developer's scheme proceeds smoothly. The principal stages are:

- > planning application
- > initial fact finding
- > statement of programme
- > description of the design concept
- > discussion of construction methodology
- > identification of risks
- > agreement of a schedule of submissions.

The scheme checklist in Appendix A can be used as a guide on the main issues of concern. If in doubt consult the Asset Protection Engineer – we are here to help.

5.4 Formal approvals

The formal approvals regime in Figure 4 is like that used elsewhere on the national railway network as detailed in NR/L2/CIV/003 Technical Approval of Design, Construction and Maintenance of Civil Engineering Infrastructure. Note that this standard is aimed at changes to railway infrastructure and some adjustments to the submissions may be needed where developments are outside the railway boundary.

Components of this approval's regime are:

- > approval in principle (with sign off form F001)
- > statement of design intent (F002)
- > certificate of design and check (F003)
- > temporary works design
- > architectural and layout acceptance (F004)
- > certificate of fitness to be taken into use (F005)
- > monitoring proposal (if applicable)
- > method statement/work package plan/lifting plan
- > approval of CRE and CEM
- > maintenance strategy.

Formal approvals are required for works, permanent or temporary, whose failure or presence could possibly affect or otherwise transfer risk to a High Speed 1 asset. If there is a later substantive change to the scheme the Asset Protection Engineer may require a further submission, or parts of a submission.

With agreement of the Asset Protection Engineer, approval may be given in stages – for example separate submissions for substructure and superstructure – though this is not preferred as it can blur boundaries and responsibilities.

At scheme inception the developer will present the scheme and, following discussion, the Asset Protection Engineer will agree what submissions are necessary and this will enable the developer to forward a schedule of submissions.

If the works affect both NRHS and Network Rail Infrastructure Ltd each party will have their own requirements and carry out their own review and approvals. However, we would normally advise the developer to discuss with both parties at the outset and to prepare a single submission covering both interfaces.

The process set out in Highways Agency Standard BD2, Technical Approval of Highway Structures, is considered equivalent. F006 relates to highways authority agreement to bridgeworks. For gas installations a compliance check against the Institution of Gas Engineers and Managers (IGEM) standards may be acceptable.

This section does not apply to consents or approvals from outside bodies:

- > regulatory and statutory authorities
- > Environment Agency
- > planning, listed building and conservation area authorities
- > land and property owners or leaseholders
- > statutory undertakers and other public services and utilities owners
- > approvals under the New Roads and Street Works Act 1991.

At scheme inception the developer will present the scheme and, following discussion, the Asset Protection Engineer will agree what submissions are necessary and this will enable the developer to forward a schedule of submissions.

Submission Process

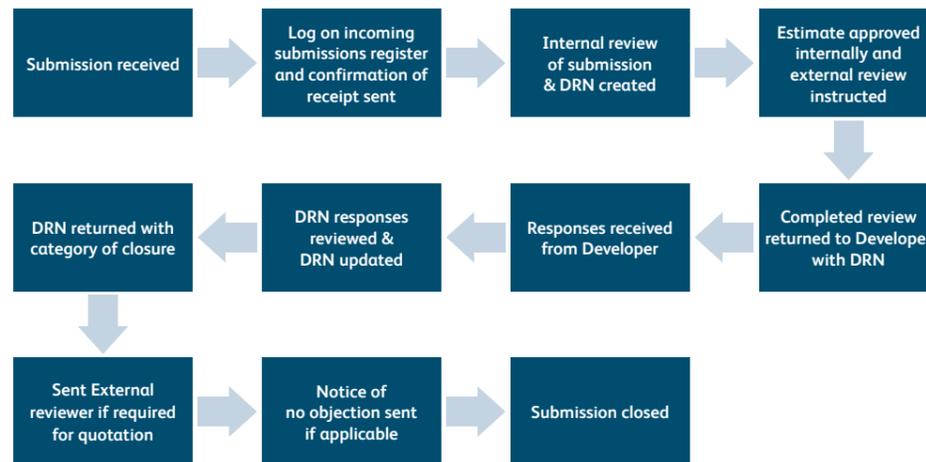


Figure 5 – Approvals process flowchart

5.5 Sending submissions

Submissions are to be made to the NRHS Asset Protection Coordinator at Singlewell in electronic format for logging and tracking. Note that any submissions are not considered to have been received until this is done, and acknowledgement of receipt has been received. For files above 10Mb use of a file sharing facility is advised – make contact if you wish us to send a link.

5.6 Timescales

Developers are advised to allow in their programme 40 working days for review of each of F001 and F002/F003. For other acceptances the duration will depend upon the size and scope of the document being approved, and whether the Asset Protection Engineer will need to submit for outside engineering review. We would normally expect the developer to allow 20 working days for a temporary works acceptance, and 15 working days for method statements/work package plans and lifting plans.

A poor-quality submission, significant rework or multiple iterations are likely to lengthen the approval timescale.

5.7 Approval in Principle (F001)

5.7.1 Approval of CRE and CEM

Appointment of the Contractor's Responsible Engineer and Contractor's Engineering Manager are subject to approval by NRHS. An application for approval should be made on the relevant form.

5.7.2 General Requirements

Approval in Principle (AIP) shall be obtained once the design concepts have been established but well before the start of detailed design, to allow NRHS to sign it off before start of detailed design.

To avoid delays, misunderstandings and abortive work, early communication should be established between the various parties involved in the AIP process as discussed in section 5.3.

AIP is granted when NRHS lead discipline head (track, civils, S&T E&P, Stations) has signed it and lapses three years after being granted.

5.7.3 Information to be submitted

The submission for AIP shall demonstrate that:

- > adequate geotechnical and other relevant investigations and surveys have been or will be undertaken
- > the proposed design loadings (including accidental loadings) are acceptable
- > the proposed design standards and methods of design are suitable
- > the requirements/recommendations of ORR, Railway Group standards and NRHS company standards are adequately addressed, with any proposed departures justified
- > any significant design matters not covered by standards are adequately addressed
- > the scheme will not result in unsatisfactory clearances, platform stepping distances or other constraints on the operational railway
- > arrangements for the interface between the civil engineering elements of the scheme and any signalling, telecommunications, electrification, lighting or other operational electrical or mechanical equipment are satisfactory
- > the effects of the scheme on existing infrastructure have been adequately considered
- > the likely effects of the scheme on the environment and on organisations external to NRHS have been adequately considered
- > arrangements for liaison and consultation with bodies external to NRHS (e.g. local authorities, statutory undertakers, Environment Agency, adjacent landowners) are satisfactory
- > provisions for examination, maintenance and eventual renewal/removal are satisfactory
- > risks to health and safety during construction, maintenance, operation and demolition are controlled so far as is reasonably practicable
- > any NRHS or other stakeholder comments from the initial meeting (or an earlier AIP submission) have been considered
- > potential liabilities for High Speed 1 have been recognised and mitigated
- > potential synergies with High Speed 1 have been recognised and, if appropriate, taken advantage of.

5.8 Design intent (F002) and Certificate of design and checking (F003)

5.8.1 General

Design submissions should cover detailed design to the extent needed to understand elements of the scheme affecting the safety, operation, maintenance or liabilities of High Speed 1. Developers will have established this extent with NRHS at AIP stage. For example:

- > for a development above tunnels the design submission would normally include: architectural details for the superstructure, design loads, foundation layout, and calculated load and deformation of the tunnels
- > where High Speed 1 is above ground but outside the influence zone we will want to see selected superstructure details such as window opening and cleaning arrangements, and maintenance proposals on the railway façade
- > The Asset Protection Engineer will advise what is required when agreeing the schedule of submissions (see section 5.3)
- > Non-objection to the design is granted when the Designated Project Engineer has signed the Form F002 and lapses three years after being granted.

In addition to demonstrating that the development is compatible with – and presents acceptable risk to – the railway, the submission of detailed design shall demonstrate that:

- > any issues not fully resolved at AIP stage are addressed
- > NRHS or other stakeholder comments from earlier stages have been considered
- > the design check category is not lower than specified in the F001.

5.8.2 Schemes with multiple designers

In cases where different designers are responsible for different parts of a single structure, a principle designer shall be identified and agreed by the Designated Project Engineer and one of the following arrangements shall apply:

- > a single design submission shall be prepared and signed by the lead designer taking design responsibility for the whole submission
- > a single design submission shall be submitted with a signature for each design contribution and signed by the lead designer as taking responsibility for the interfaces
- > each of the designers shall submit and sign a separate design submission, one of which shall be signed by the lead designer as taking responsibility for the interfaces. This is not preferred and should be avoided unless previously justified and agreed with NRHS.

5.8.3 Design check

The designer is responsible for arranging a check of his design. To demonstrate this has been done a certificate of design and checking shall accompany F001 and F002 submissions. In the case of a straightforward temporary works design, a F001 or F002 is not required.

5.8.4 Design check category

The level of independence of this design check shall reflect the risk to the safety, operation and maintenance of High Speed 1. The Designated Project Engineer will decide and state on the F001 what design check category is applicable in accordance with the principles in table 6 below. Note that the DPE may decide that a higher check level is appropriate if:

- > The design is carried out in-house by the construction organisation or in house by a sub-contractor to the construction organisation
- > The design is novel or complex
- > The design check shall be carried out without reference to the design calculations or assumptions.

Cat.	Type of scheme	Method of checking
0	Designs which can be adequately checked by inspection, and where failure could not conceivably affect safety or operation of the railway and would also be financially small	No formal design check is required
I	Designs where failure could not conceivably affect safety or operation of the railway but which could have an adverse impact on short or long term liabilities such as additional maintenance	The design may be checked in the same group or team as that which prepared the design, but by people other than the designers. Those carrying out the design check may refer to the design calculations and the assumptions on which the calculations are based, but shall critically consider the assumptions in order to be satisfied that the assumptions are valid
II	Designs where failure could not conceivably affect safety or operation of the railway but could adversely affect the safety or operation of other High Speed 1 assets	The design shall be checked by the same organisation as that which prepared the design, but in a separate group of team which has not been concerned with the development of the design
III	Designs where failure could prejudice the safety or operation of the railway	The design shall be checked by an organisation independent of the design organisation. Normally this means an organisation which is a separate legal entity

Figure 6 – Table of design check categories



5.8.5 Scope and method of design check

A design check shall include:

- > compliance with the signed AIP submission
- > structural adequacy of the design
- > any effects on surrounding infrastructure
- > non-structural safety-related aspects of the design
- > site conditions to the extent that could affect the safety and practicability of construction or operation
- > clearances.

When the Designated Project Engineer identifies that the method of design employed by the designer is novel, the method of checking shall not use the same method as for the design. In such cases, where practicable, recognised methods shall be used for the design check.

The computerised method used for a category III design check shall not be the same computerised method as used for the design or else a reasonable sample check of the output shall be carried out.

For more complex designs the Designated Project Engineer may then require a design check statement to show the design check methodology to be used. This statement shall:

- > specify the method of analysis to be used, including any computerised methods
- > detail the programme for the design check
- > state interfaces with the designer
- > state how compliance with the requirements of this section 5.8.3 will be achieved.

5.8.6 Liaison between designers and checkers

A design check may start before the design is complete provided the independence specified in Figure 3 is maintained. Those carrying out the design shall liaise with those carrying out the design check as necessary to ensure that their results are comparable and to resolve any points of disagreement that may arise. Design and design check calculations and assumptions may be exchanged if necessary, to reach agreement.

Differences which cannot be resolved shall be referred to the Asset Protection Engineer for resolution by the Designated Project Engineer.

The method statement checklist in Appendix B sets the minimum requirement, including mandatory review and sign off by manager prior to submission.

5.8.7 Sign off

The signature of the Designated Project Engineer indicates acceptance that the procedures followed for the design are in accordance with this Development Handbook and that any comments raised by the Asset Protection Engineer on the Submission of Engineering Documents form have been satisfactorily addressed.

5.8.8 Changes to the design

Changes to the scheme may require redesign and checking. Developers are advised to consult the Asset Protection Engineer in the first instance.

5.9 Temporary works (F003)

A F003 is required for temporary works where failure could adversely affect a High Speed 1 asset, such as excavations and crane bases or piling mats.

5.10 Architectural and layout acceptance (F004)

This is rarely required for schemes affecting High Speed 1 except at St Pancras.

5.11 Certificate of fitness to be taken into use (F005)

A F005 will be required by the Asset Protection Engineer or the Designated Project Engineer when either determines that it is necessary to verify that construction work is compliant with the design. This may include material certificates and results of commissioning tests.

The F005 shall be completed by the construction organisation and signed by the Contractor's Responsible Engineer, or other person nominated in advance, and shall be provided before the works are taken into use.

5.12 Method statement/work package plan or lifting plan

These will be required to be submitted to the Asset Protection Coordinator and Asset Protection Engineer for work which could affect the safety, operation or maintenance of the railway even if of a minor nature. They are expected to include a task risk assessment or, if the work is subject to changing circumstances such as the weather, a dynamic risk assessment. The method statement checklist in Appendix B sets the minimum requirement, including mandatory review and sign off by manager prior to submission.

A lifting plan is to be submitted where the collapse radius is within 4m of a High Speed 1 asset.

The Asset Protection Engineer will respond with a notice of no objection once he is satisfied with the content.

5.13 NHBC approval

Where a housing development above High Speed 1 tunnels is provided with an NHBC warranty, NHBC may wish to see confirmation that the development has been accepted by NRHS. We will provide this once we have:

- > approved the foundation design
- > reviewed the as-built foundation records together with a statement from the developer listing any deviations from the design.



Access

6.1 General

High Speed 1 is unique in Britain with its line speed of 300km/h. This introduces risks to those around the railway and for this reason the access regime is different from, and more onerous than, that on other parts of the railway network. For example, it is a people-less railway: no persons are allowed in the Danger Zone while trains are running.

NRHS has a separate rule book from Network Rail Infrastructure Ltd and the access requirements are different.

Booking possessions and isolations has a long lead time (see sections 6.6 and 6.8). Booking on-track access plant, if needed, is even longer. This is often a significant risk in a development and should be considered at an early stage. Before booking possessions, isolations or on-track plant this work will need to be planned in detail: we will support your request for track access but only when we are convinced you are clear what access is needed.

6.2 Access competency

Access to the operational railway (comprising Danger Zone and Safe Zone) or non-operational railway land must be arranged through your Asset Protection Engineer.

Persons accessing the High Speed 1 operational railway must hold either a NRHS competency or else a dispensation. In either case there must be a competent person in charge, depending upon zone, see figure 7.

DZEP and SZEP training will be sponsored by your Asset Protection Engineer if they are convinced of the necessity. A form will need to be filled in to get a login for the relevant online test. You must also have passed a drugs and alcohol screen and be certified to be medically fit as defined in Network Rail standard NR/L2/OHS/00124. If you hold a current Sentinel card for Network Rail Infrastructure Ltd or London Underground the medical is normally acceptable (this will be checked by NRHS online). Otherwise the developer will need to arrange this screen and medical and provide a certificate.

NRHS or their framework contractor will normally provide the RSL or TS, at the cost of the developer.

Zone	Description	Competency	
		Individual	Person in charge
Danger Zone	within 2.75m of any running rail (1,25m for platform edges and where linespeed is less than 160km/h)	Danger Zone Entry Permit (DZEP) or dispensation	Task Supervisor (TS)
Safe Zone	between the Danger Zone and the innermost boundary fence	Safe Zone Entry Permit (SZEP) or dispensation	Rail Safety Leader (RSL) or Task Supervisor (TS)
Non-operational	on High Speed 1 land outside the operational railway (outside Safe Zone and Danger Zone)	None	Asset Protection will advise

Figure 7 – Arrangements for accessing the operational and non-operational railway

6.3 Dispensation

Dispensations can be issued in certain circumstances:

- > for 3 days or less per calendar year
- > survey or specialist inspection
- > specialist short term work
- > a visitor not carrying out work.

A dispensation is like the Network Rail Infrastructure Ltd visitor permit but can only be issued by certain NRHS managers covering defined activities with defined supervision on defined dates. The manager will need to satisfy himself that the person covered by the dispensation is:

- > physically fit
- > adequately supervised
- > satisfactorily briefed
- > unable to take the DZEP or SZEP training.

Where track access is required developers should not underestimate the advance notice required. For many schemes this is on the critical path. Developers should submit plans in enough detail to allow discussion with the NRHS Planning Department to identify possible track access conflicts or issues.

6.4 Work on High Speed 1 land

Written authority is required before working on High Speed 1 land. This can be obtained through the Asset Protection Engineer and may include conditions. It is common for developer to be required to enter into a license agreement for works on High Speed 1 property.

The developer must establish and maintain robust procedures and actions to prevent unauthorised access.

Except for small schemes of low risk to the railway, High Speed 1 will normally require a protective provision agreement (PPA) to be in place. This is a legal agreement between High Speed 1 and the developer covering safeguards, processes, responsibilities and cost recovery. Where there is a need to access railway land not under our control, terms will need to be agreed with the landowner. Adequate time should be allowed for access in programming the works.

6.5 Disruptive possessions

The current possessions regime is agreed up to two years in advance and does not provide any disruptive possessions.

Any interruptions to rail services that the railway industry is prepared to accept will have to be arranged well in advance via the industry Engineering Access Statement (formally Rules of the Route), typically by August for the calendar year commencing 17 months later.



6.6 Possessions

Track possessions are available at night only and will allow a working period of about 3 to 4 hours (longer on Saturday nights). Possessions will be necessary for work:

- > within the operational railway
- > above the railway
- > where, in the opinion of the Asset Protection Engineer, work would actually or potentially interfere with the normal running of the railway.

Possessions must be planned well in advance (at the latest 36 weeks in advance of the timetable week (TW) to ensure visibility in the Draft Period Possession Plan which must be shared with the Train Operating Companies. The agreed plan is then submitted at TW-30. Early notice will also increase the likelihood that possession personnel resources can be allocated.

Only in exceptional circumstances is it possible to vary the possession or provide additional possessions or isolations. The developer may need to send a representative (who is intimately aware of the work planned) to accompany the Asset Protection possession coordinator to the TW-14/ TW-6/TW-1 possession planning meeting.

Operational constraints mean that possessions are sometimes cancelled or curtailed at short notice. NRHS cannot guarantee that possessions will take place or that they will be of the expected duration. Nor will NRHS be responsible for any of the developer's costs in this event.

There will be a Responsible Person on Site (RPOS) for each possession who will be the only person that may say that it is safe for work to commence. The developer must ensure that the person in charge of the works knows the identity of the RPOS and enforces compliance with his instructions. The RPOS will give up a possession when satisfied that:

- > the works requiring the possession are complete
- > personnel are clear of the line
- > the railway is safe and clear for traffic.

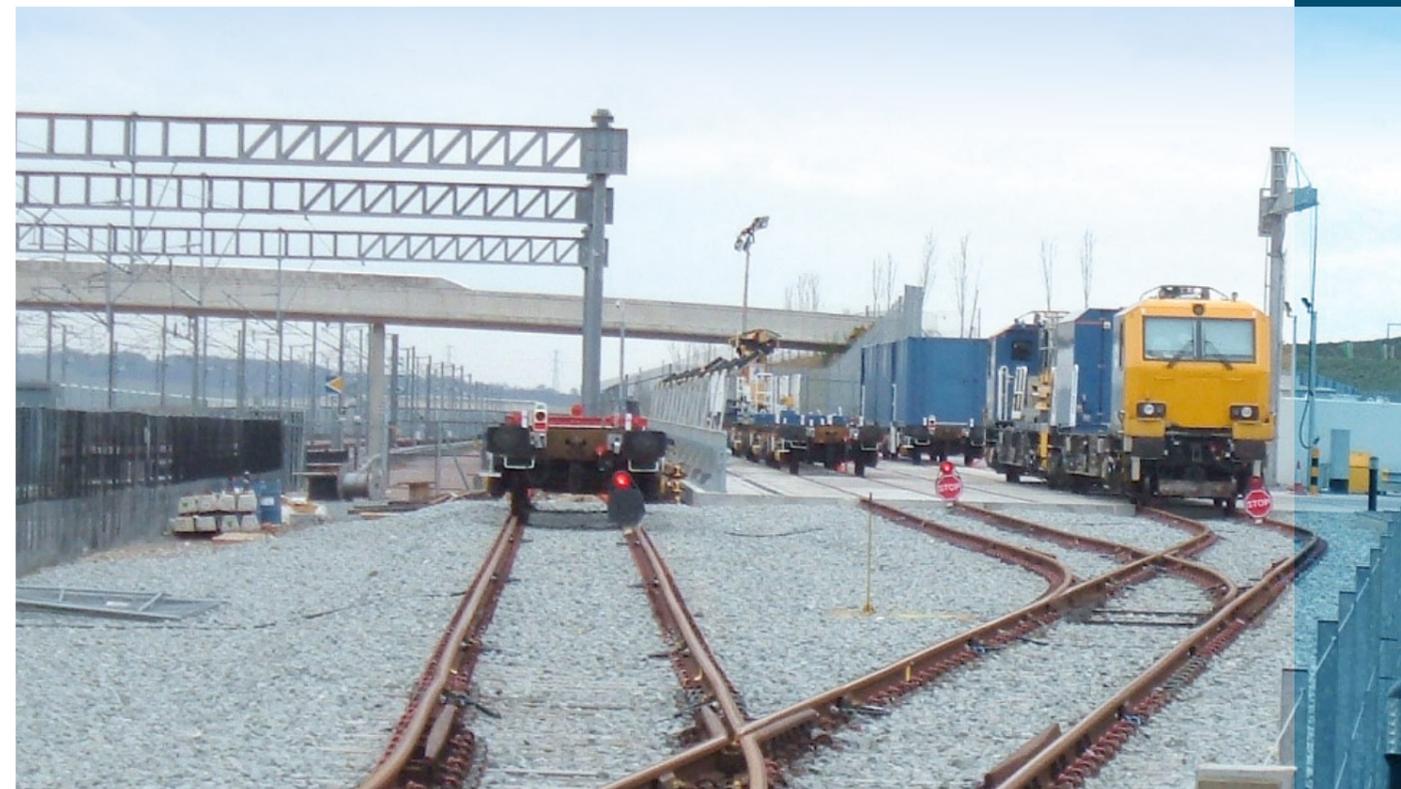
The developer must allow adequate time for taking and giving up a possession/isolation when planning the possession work scope.

6.7 Between trains working

Section 7 of Module T7 of the rule book allows the line to be temporarily blocked for certain purposes provided that normal passage of trains is not affected. These purposes are typically short duration lifting operations or piling rig works where the collapse radius would otherwise require a possession. Danger Zone access is prohibited.

On the main High Speed 1 route the frequency of trains is such that between trains working is generally only available at night or late and early in the day. A NRHS local manager will need to be arranged and be present on site to communicate with the signaller.

Between trains working must be planned, agreed and resourced in enough time to meet the TW-6 data freeze deadline.



6.8 Isolations

Where the work is near to or over the OCS an isolation will be required. This must be booked well in advance and will curtail the duration of working time in the possession. It can involve several persons setting up and removing the isolation in complex areas like the Ebbsfleet station throat. These resources are only available through NRHS and are scarce. The further in advance they are booked the more likely it is that the isolation personnel resources will be available (these resources are typically allocated one year in advance). However, NRHS cannot guarantee their availability and will not be held responsible for the consequences of any non-availability.

There are some areas of High Speed 1 which have third rail: Ebbsfleet High Level including the junction with North Kent Line, Ripple Lane, Fawkham Junction, Ashford and Dollands Moor to Eurotunnel.

6.9 Possessions across rail interfaces

On some parts of High Speed 1, interfaces exist with the rest of the railway network. If works are required which span the interface areas, there are additional factors to be considered. High Speed 1 operates under a different rule book to those other routes and the Sectional Appendix outlines how work is carried out there. Access planning in these areas is more complex and the early advice of the NRHS possessions planning team should be sought.

6.10 Rail traffic during a possession

During a possession it may be necessary for engineering trains or on-track plant to pass through the work site by prior arrangement. This will need temporary clearance of the track and cessation of those activities that could affect their passage or the safety of personnel.

There are some areas of High Speed 1 which have third rail: Ebbsfleet High Level including the junction with North Kent Line, Ripple Lane, Fawkham Junction, Ashford and Dollands Moor to Eurotunnel.

6.11 Possession overrun contingency planning

The costs of train delay in the event of a possession overrun are punitive. The developer must therefore assure himself and the Asset Protection Engineer that the work can be completed within the possession. For more complex works or those where early curtailment is not possible the Asset Protection Engineer will require the developer to undertake a quantified scheduled risk assessment (QSRA). This will detail the risks of overrun and their mitigations, as well as the break points and times at which the work will be curtailed. It is conducted jointly between the developer and NRHS and will involve any parties who can impact possession hand back.

6.12 Possession costs

The developer will be responsible for the costs of a possession and isolation including:

- > possession staff such as RPOS and TS where not provided by the developer
- > isolation staff such as the NPOS
- > support from Asset Protection Engineers
- > use of rail plant if needed
- > use of specialist NRHS contractors, such as those used for pre-works and post-works inspections
- > Costs of any developer related possession overrun.

Costs may still be incurred where the booked possession or isolation is cancelled or is not available on the night.

6.13 Personal protective equipment (PPE)

Persons on the operational railway must wear protective clothing of an approved colour, type and design. Note that yellow is not permitted on the railway. PPE includes hi-vis jacket and trousers, hard hat, safety boots, gloves (cut 5) and safety glasses. Other task specific PPE will be required as identified. The jacket and hard hat should be branded with the contractor's name so that an individual's employer can be identified. The PPE must be worn correctly and kept in a clean condition.

6.14 Removal of developers' employees

NRHS reserves the right to require the immediate removal from the operational railway of any person who in the opinion of NRHS is not in a fit condition to carry out their duties or is liable to endanger their own health and safety or that of others. Such persons will not be permitted further access to the work site without the agreement of NRHS.

6.15 Safety inspections

NRHS will carry out pre-arranged or unannounced safety inspections from time to time. These may cover lifting operations, piling, excavation, scaffolding or general site issues. Where appropriate, registers and certificates relevant to the works are to be made available for inspection by NRHS.

6.16 Notification of accidents and incidents

Any accident or incident causing:

- > injury to a railway worker, passenger or anyone on the operational railway
- > damage to railway property
- > a hazard to the railway (including any RIDDOR-reportable event)

must be reported at the earliest opportunity to the Asset Protection Engineer and should be followed up with the incident report without delay.

The location where the accident book is kept should be included in the method statement or work package plan.



Construction

7.1 Work methodology

The developer should present his methodology to the Asset Protection Engineer for input at an early stage as described in section 5.3. In most cases this will have happened during the feasibility or design stage and have been accompanied by an assessment of risks. The construction risks to the railway, both safety and operational, must be recognised and mitigated so far as is reasonably practicable.

Any later changes in location, design or programme will normally need discussion with the Asset Protection Engineer and may require further acceptance.

7.2 Supervision

Although the developer retains responsibility for safe execution of their works and for providing adequate supervision, where the safety or operation of the railway could be prejudiced NRHS may require an extra level of supervision. This could include:

- > for any works: site inspections of general safety, scaffolding, lifting operations, excavations near buried services
- > for works with a high risk to the safety of train operations: a NRHS safety representative full time
- > where possessions are provided: the provision of an RPOS and Task Supervisor
- > where isolations are provided: the provision of an NPOS and earthing teams
- > during between trains working: a local manager to liaise with the signaller
- > for work on NRHS property, especially near to railway services: full time or part time site representation on behalf of NRHS.

7.3 Induction and training

A good induction is an important element of site safety and a requirement under CDM regulations. The developer shall include applicable railway risks in his site inductions and site briefings. The Asset Protection Engineer can help with identifying these. Records of training and briefings shall be retained at the developer's site offices for inspection.

7.4 Communications

Communications between NRHS and the developer should be through established channels. However, the developer agrees that in an emergency during construction the Asset Protection Engineer (or other NRHS person) may give instructions directly to the contractor in the interests of railway safety.

Where appropriate the developer is expected to have emergency plans in place prior to the work. These will include emergency NRHS contact details. The Asset Protection Engineer will often require a notice showing contact details in the event of a railway emergency to be part of the work briefing and to be posted on site. Where the Asset Protection Engineer requires this, it will be included in his method statement comments.

Before start of work on the site the Asset Protection Engineer shall be provided with a list of names and telephone numbers for personnel responsible for organising remedial action in the event of an emergency on the work site when it is unattended.

7.5 Marking of hazards

Known hazards are to be indicated by the developer on site such as:

- > OCS
- > third rail
- > buried services
- > Japanese Knotweed
- > the presence of protected species.

7.6 Storage of plant, equipment and materials

All plant, equipment and materials shall be kept safe and secure when not in use and shall be located to avoid opportunity for trespass or vandalism on, or directed against, the railway or High Speed 1 land.

Storage of flammable gasses within 200m of High Speed 1 presents a risk of closure of the railway by the emergency services in the event of fire and should be avoided if practical. Acetylene can explode up to 24 hours after the fire has been extinguished and its use within 200m is to be avoided unless agreed with NRHS following a risk assessment by the developer. Where agreed it must only be on site when needed for that specific activity. Follow the published guidance on liquid petroleum gas (LPG) and acetylene.





7.7 Use of plant and equipment near to the railway.

Use of construction plant, equipment or materials that, in the event of mishandling or failure, could come within 4m of the railway boundary should be avoided. Where this could come within 4m of the nearest rail or 2.75m of any live OCS equipment this presents a safety risk and is only permitted with a possession and isolation.

Such work, or any work involving plant, equipment or materials on railway land, may only be undertaken with the prior written agreement of NRHS. This is normally granted as a letter of no objection to a method statement.

High Speed 1-owned bridges are not to be used for construction purposes without the approval of NRHS except in conformity with the rights afforded to the public, if any.

Specific guidance for cranes and piling rigs is given in sections 8 and 9.

7.8 Mast climbers

Mast climbers will require a temporary works design for the base and ties. In addition, we would expect:

- > data sheet, certificate of thorough examination and periodic inspection records for the mast climber
- > a temporary works design which considers all failure modes including asymmetric and unstable loads
- > temporary works design to include ground conditions, assumptions, loads from masts and proposed temporary mat if required
- > an explanation of the level of redundancy in ties (if one tie fails can the others resist the loads)
- > temporary loading conditions when raising and removing the masts
- > where the collapse radius is within 4m of the railway fenceline, the mast climber to be rated to work within 75% of the SWL
- > RAMS to prescribe an exclusion zone for vehicles and plant with physical barriers to prevent collision with masts.

Network Rail has framework contractors that can come within this 50m boundary. UAV operators can seek accreditation through RISQS.

7.9 Vehicle containment

The risk of vehicle incursion during the temporary construction phase must be recognised by the developer and mitigated. Normally this means keeping construction traffic away from the railway boundary or, if this cannot be arranged, erecting concrete interlocked vehicle containment barriers (VCBs).

The approaches to permanent structures must comply with, as a minimum, the Network Rail standard NR/GN/CIV/00012 and the RLE document titled Risk to the CTRL from Errant Vehicles/Vessels 000-GDG-LC-EEG-00002-06. Any development which changes the risk assessment score will require reassessment by the developer and may require additional measures. Over and above this the developer will need to ensure this is adequate.

The high containment bollards around the three international stations are designed to PAS68. Importance is attached to achieving a bollard layout which maximises the distance between containment and target.

7.10 Unmanned aerial systems (UAS)

Prior to use of UASs close to High Speed 1 we will want to see evidence that risks to the railway are addressed. For small unmanned aircraft (UAVs up to 20kg) Civil Aviation Authority articles 94 and 95 of the Air Navigation Order and Regulations 2016 are to be adhered to. A submission for small unmanned aircraft will include:

- > purpose of the flight and data to be acquired
- > flight boundaries in plan and height (with CAA permission if above 400 feet)
- > location of operator and a demonstration that the visual line of sight can be maintained
- > arrangements for take-off and landing including automatic return to base
- > weight of UAV and CAA permission if over 7kg (if greater than 7kg the operator is to remain at least 75 metres away from nearest rail)
- > how the UAV is to be kept at least 50 metres from the nearest rail unless a possession is in place (section 6.6) and the operator has an Operational Safety Case which exempts the operator from relevant aspects of CAP 722 50m rule. Note that Network Rail has framework contractors that can come within this 50m boundary. UAV operators can seek accreditation through RISQS
- > evidence of competency acceptable to CAA in theoretical knowledge, airmanship and recent flying experience/assessment (known as Permission for Aerial Work if on a commercial basis)
- > any restrictions placed by CAA, the hiring company or other landowners
- > demonstration of adequate insurance, normally £5m minimum.

7.11 Vibration

Vibration can present a risk to operation through disruption of equipment or through movement of ground or structures (ground displacement, settlement or heave).

Excessive vibration near to High Speed 1 structures, particularly tunnels, is unlikely to be acceptable, normally ruling out driven piling as well as vibro-compaction and stone columns. If these methods are used and the developer cannot demonstrate that the vibration does not exceed a peak particle velocity of 5mm/s at any structure, then a settlement and vibration monitoring regime will be required.

If NRHS believes that continuing piling will or is reasonably likely to have an adverse impact on High Speed 1 property and/or on High Speed 1 then we must have the right to suspend the piling works.

7.12 Confined spaces

A significant number of confined spaces exist on or about the High Speed 1 infrastructure, not all of which are shown on the CTRL hazard log. In carrying out the scheme, developers must demonstrate that they comply fully with the requirements of the Confined Spaces Regulations 1997 and the associated Approved Code of Practice.

7.13 Windblown debris

Windblown debris causes more lineside neighbours' incidents than anything else, by far. All could and should be avoided with good housekeeping. Plastic wrapping and aggregate sacks are too commonly blown onto the OCS, affecting the train service and incurring train delay costs which are punitive.

The developer shall minimise the risk of debris being blown onto the OCS or the track by making sure materials are properly stored and secured. Failure to do this could cause a very serious incident such as a flashover or train pantograph damage. Hoardings and similar temporary structures shall be designed and built to withstand the effects of wind and may require a temporary works design.

7.14 Dust, smoke and vapour

Excessive dust, smoke and vapour from works may adversely affect safe operation of the railway and create a nuisance and must be avoided.

The developer shall minimise the risk of debris being blown onto the OCS or the track by making sure materials are properly stored and secured. Failure to do this could cause a very serious incident such as a flashover or train pantograph damage.



7.15 Water

Full details of any proposed drainage systems will be required. Drainage channelling is to be directed away from High Speed 1 into local authority sewers and should be installed a minimum distance of two metres from the High Speed 1 boundary. Surface water discharge into a High Speed 1 drain or culvert, if permitted, requires prior written consent.

The use of soakaway drainage is not favoured as it could have a detrimental effect on High Speed 1 land. The drainage system should be designed to take this into account.

The construction and maintenance of ponds or swimming pools may pose risks to the railway and leakage or failure could lead to severe financial cost and possible prosecution. Prior consultation on any proposals is strongly urged.

Where altered drainage, flooding risk or significant discharges of water may be anticipated as a result of proposed development, due regard should be given to the potentially adverse impacts on foundations and ground structures including existing High Speed 1 structures.

Parts of the High Speed 1 route are provided with permanent, continuous, groundwater pumping to modulate ground water and water table levels. In the Stratford area such a scheme is in operation to mitigate the floatation pressures on the Stratford Box from the otherwise high groundwater levels. 22 wells penetrate the chalk strata down as deep as 30m and under-drain the Thanet Sands. Dewatering maintains the lower aquifer at not less than 10m below the underside of the base slab of the Stratford Box. In this locality those considering development, interventions below the surface or abstractions should have regard for of the dewatering regime and infrastructure.

7.16 Vegetation clearance

Clearance of lineside vegetation is often contentious with the public, and developers are advised to consult with neighbours where appropriate. Vegetation clearance is not to take place on High Speed 1 land without the approval of NRHS. No trees to be cut outside of High Speed 1 boundary which could fall within 4m of High Speed 1 boundary without consultation and approval of RAMS.

7.17 Overhead line equipment

This shall always be assumed to be live and dangerous except when in possession of a valid OCS permit.

Work shall not be carried out, cranes or other plant erected, operated and/or dismantled or materials stored within the prohibited space which is that space within a radius of 2.75 metres of the live overhead equipment together with anywhere vertically above this space.

The figure of 2.75 metres used in determining the prohibited space shall be increased by the length of any tool, equipment and/or material being handled. However, work on the track, platforms, walkways and the like below the overhead equipment is permitted without special precautions if tools, equipment and/or materials are not at any time raised above waist height.

Long objects, such as pipes, scaffold poles, ladders, long handled tools or any object of such length that if carried vertically could infringe on the prohibited space, shall be carried horizontally by two persons below head height.

Electrically conductive tools or surveying equipment shall not be used within (nor when used in a foreseeable way, capable of coming within) 2.75 metres of any overhead line equipment or third rail.

In certain cases, it may be permissible to use protective screens adjacent to overhead line equipment or third rail electrification to enable certain work to continue without isolations being required. Similarly, it may be permissible to use crash decks to enable certain work to continue without possessions or isolations being required.

Given the fatal nature of contact with live overhead equipment the 2.75 metres should be treated as a prohibited zone not as a safe working limit. The developer is responsible for providing a safe system of work which would normally provide greater clearance.

7.18 Third rail electrification

Work in the vicinity of third rail electrification will involve the provision of special protection or isolations to the equipment.

7.19 Earthing and temporary earthing

Where a metal structure such as scaffolding is erected there may be a requirement for temporary earthing due to induction or touch potential. NRHS Asset Protection Engineer can advise. No structure should be earthed to the track, OCS, fencing or other High Speed 1 equipment without consulting NRHS.

7.20 Excavations, foundations and embankments – support zones

Excavations or piling near High Speed 1 infrastructure are subject to agreement of design and method statements. They shall not commence until measures required to monitor and maintain the stability of the track and/or structure have been implemented, and the Asset Protection Engineer has confirmed there is no objection. To do this the engineer will need to assess:

- > location, extent and depth of excavation
- > temporary support within the excavation, its installation and removal
- > method of excavation
- > specification of backfilling.

Note that structure includes earthworks and, in this context, any foundations including fencepost footings.

Foundations (including piles) near to track or structures will be reviewed for:

- > imposed load affecting the stability of the line or adjacent land
- > penetration of the support zone or an existing structure (see Figure 8, 9 & 10)
- > increased loading on an existing foundation.

The track and structure support zones are defined in Figure 8 and Figure 9.

7.21 Retaining walls – imposed loads

For retaining walls there are requirements, as shown in Figure 10, for both:

- > excavation in front of the wall
- > imposed loads behind the wall.

In addition, the Asset Protection Engineer is to be advised of schemes that could cause instability or settlement by other means:

- > excavation below the toe of an embankment
- > proposals for a foundation to intersect a watercourse or drain, even if the latter can be diverted or protected
- > ground improvement schemes of any kind
- > dewatering schemes.

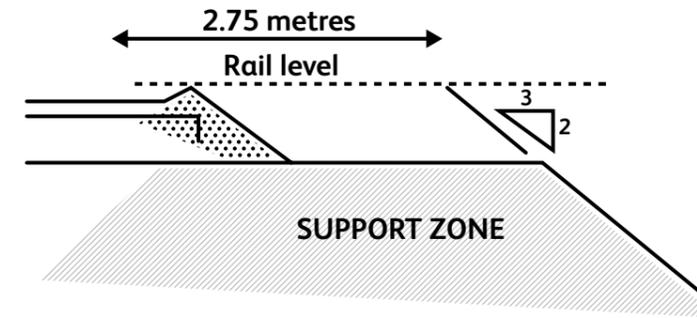


Figure 8 – Track support zone

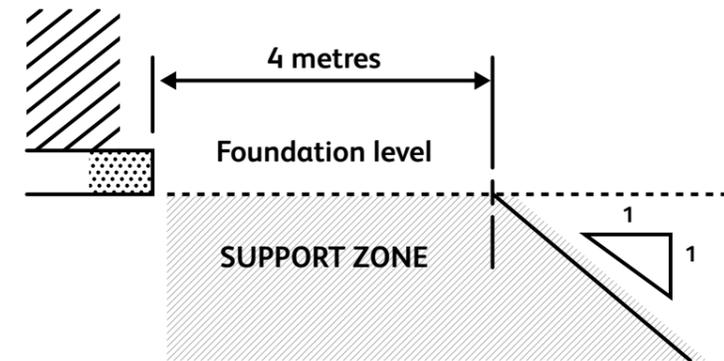


Figure 9 – Structure support zone

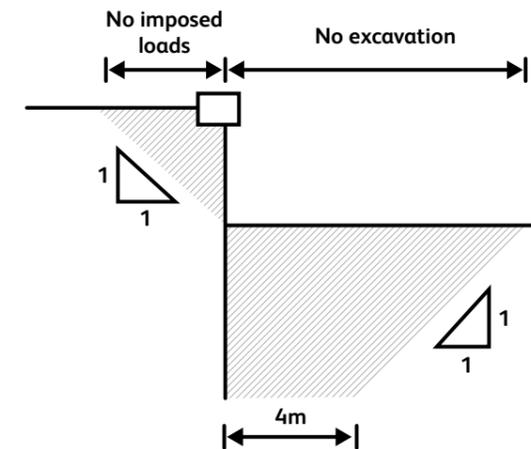


Figure 10 – Loading and excavation close to retaining walls

Lifting

8.1 Types of plant

This section deals with:

- > tower cranes (fixed or luffing jib)
- > mobile cranes
- > hoists, lifts and mobile elevated work platforms (MEWPs)
- > 360-degree excavators used as cranes
- > telehandlers
- > helicopter lifts.

It provides some general guidance appropriate to other types of cranes such as rail-mounted cranes and gantry cranes. Concrete pumps are also considered.

Piling rigs are dealt with in section 9.

The CPA guidance for tower cranes referred to in section 8.4 provides control measures which may be applicable to other types of crane.

8.2 Risk control

Use of lifting plant near to the railway presents a risk of catastrophic accident. BS 7121 Code of Practice for Safe Use of Cranes shall be adhered to.

The developer is expected to demonstrate that the craneage regime reduces the risk to the railway to as low as reasonably practicable. A hierarchy of measures should be implemented which, for mobile cranes, is:

- > risk reduction by position such that the collapse radius is more than 4m from the railway asset or boundary
- > slew restriction such that the collapse direction is away from the railway
- > slew restriction such that the collapse direction may be towards the railway but the collapse radius in that direction is more than 4m from the railway asset or property boundary
- > de-rating of crane and lifting equipment to 75% of duty and up-rating of crane base to 133% of duty.

The CPA guidance for tower cranes referred to in section 8.4 provides control measures which may be applicable to other types of crane.

Oversailing of High Speed 1 land constitutes trespass and is never permitted without NRHS permission. It normally requires a possession and isolation.

8.3 Crane mat

The criteria for piling platforms also apply. See section 9.6.

8.4 Tower cranes

Accidents involving tower cranes are becoming less frequent in the UK but still account for several accidents each year on average.

Tower cranes are to comply with BS EN 14439:2006. Many accidents arise from oversights in erection, dismantling or inspection all of which are covered by BS 7121. Requirements for Tower Cranes Alongside Railways Controlled by Network Rail was developed by NRHS, the HSE and the Construction Plant Association. Published June 2014, this is considered to constitute best practice: <http://www.cpa.uk.net/tower-crane-interest-group-tcig-publications>

For all tower cranes with the capacity to fall within 4m of the High Speed 1 boundary please contact the asset protection team for consultation and approvals.

8.5 Aerial lifting

Aerial lifting by helicopter must comply with the Lifting Operations and Lifting Equipment Regulations. This requires that lifting operations are risk assessed. LOLER regulation 8 (organising lifting operations) and regulation 9 (thorough examination and inspection) are key and the developer must demonstrate that the requirements are met.

In addition to the normal requirements from ground-based lift, an aerial lifting plan will need:

- > downdraft control strategy detailing clearance between load and height of helicopter when lifting and placing loads
- > exclusion zones to be managed so there is no risk of loose material or debris blowing onto High Speed 1
- > flight plan
- > CAA certificate of airworthiness.



The CPA guidance for tower cranes referred to in section 8.4 provides control measures which may be applicable to other types of crane.

A comprehensive submission comprising method statement together with lift plan, operating procedures, test certification and CAA certificate of airworthiness, risk assessment/risk control measures and emergency plan is to be submitted. When working adjacent to High Speed 1 downrating to 75% of allowable load is to be imposed.

Generally, no part of the helicopter is to fly above an exclusion zone extending 10 metres from the railway boundary fence in the event of any conceivable failure modes. Working is to be restricted in the 180-degree arc away from the operational railway.

8.6 Concrete pumps

The pump siting is to be planned and executed so that its boom will not need to slew to a position towards the track. No part of the pump or its boom should be capable of being within 4m of the operational railway boundary even in collapse conditions.

If there is no form of physical restraint, locking or zoning device to ensure this, the Asset Protection Engineer may require that a banksman be in attendance during pump operation.

Cleaning of concrete pumps or equipment should be well away from the railway and always away from any watercourses or High Speed 1 drainage assets.

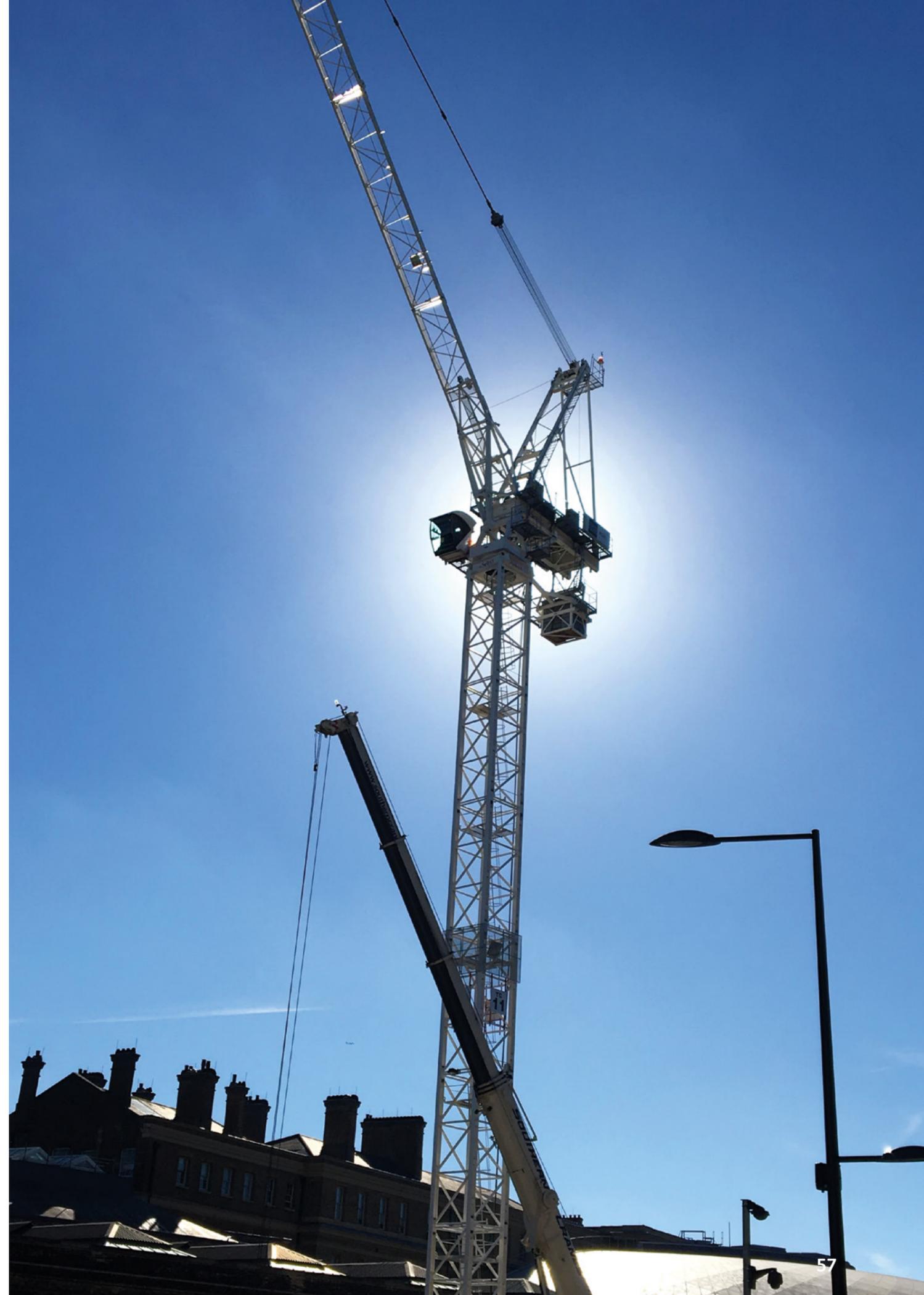
8.7 360 degree slew excavators and telehandlers

In normal operation at maximum boom outreach, allowing for power slide if fitted, no part of the machine or load should be capable of falling within 4m of the operational railway boundary. Additional errant vehicle protection may be required where mobile plant is to be used or a haul road is to be constructed adjacent to any railway boundary fence. This will be assessed on an individual basis at the initial planning consultation stage.

8.8 Mobile Cranes

For all mobile cranes working on adjacent sites to High Speed 1 (HS1) or with the potential to collapse within 4m of the High Speed 1 boundary fence please contact the asset protection teams.

The CPA document Requirements for Mobile Cranes Alongside Railways Controlled by Network Rail is a CPA good practice guide and is considered the starting point for discussing and planning lifts adjacent to High Speed 1 railway with any type of mobile crane. It can be found at <https://www.cpa.uk.net/crane-interest-group-publications-guidance>



Piling operations

9.1 General

This section provides advice on systems of work for piling that ensure the safety of High Speed 1.

Piling work shall be planned to be without risk to the railway so far as is reasonably practicable. To demonstrate this, piling methodology is to be carefully considered and is subject to NRHS acceptance. Piling platforms shall be designed, certificated, constructed and maintained. Piling shall not introduce an unacceptable level of vibration at High Speed 1 structures, particularly tunnels.

The developer shall consider where piling works may prejudice the safety of the railway because of:

- > plant operator or workforce error
- > failure of the ground supporting the piling equipment
- > piling outside the line of the piling rig tracks
- > equipment or accessory failure
- > the piling system and its interaction with the existing ground (such as vibration, displacement and loosening affects)
- > collapse radius of the piling rig or attendant crane.

9.2 Selection of the piling method

To identify the most practicable piling solution prior to finalising the structure design it is recommended that the developer seeks advice from a piling specialist. The method selected must not only be safe but also be appropriate for the geotechnical/soil conditions at the site and the existing High Speed 1 infrastructure in the vicinity. Hence the developer must consider:

- > working space and access to the site
- > proximity of High Speed 1 infrastructure, particularly if it may be sensitive to the works to be undertaken
- > limitations to ground or structure movement (lateral, heave or settlement whether caused by vibration or not)
- > noise and/or vibration limits (see also section 7.11)
- > effects of ground displacement and/or soil loosening
- > frequency and speed of trains.

9.3 Proximity to the line

Piling should be planned so that, in the event of mishandling or failure of piling equipment, no part of the equipment can fall within 4m of the operational railway boundary.

Where this cannot be achieved and a fall could be within 4m of the nearest line open to traffic or 2.75m of the live overhead catenary system the movement of the piling rig to, from or between pile positions will only be permitted during a blockade of the lines in question or, exceptionally, under a special operating procedure for between trains working.

A similar condition applies for crane movements or slinging loads: where the jib length/height of the crane plus half of the length of the longest load being lifted, in any orientation, could be within 4m of the nearest line open to traffic (or 2.75m of the live overhead catenary system), the crane should be downrated by 25%. That is, the heaviest load lifted should not exceed 75% of the safe working load.

9.4 Lineside protection

In some cases, protection between the piling and the railway tracks will be required. This may take the form of:

- > interlocked vehicle containment barriers (VCBs) to prevent vehicles approaching the railway
- > a screen to provide a physical barrier to prevent personnel, materials, lifting tackle or ancillary equipment accidentally falling or straying
- > a visible marker delineating plant movement boundary for example at the edge of the piling mat.

9.5 Operational considerations

The site area shall be planned and managed to avoid risks to the railway as far as reasonably practicable, including off-loading of materials, rebar fabrication areas, pile storage areas, mud plant and accommodation units.

The general position of the piling rig and movement of the piling rig when undertaking pile installation and the sequencing of the works must be planned to reduce the need for repeated significant changes in the orientation of the tracks of the piling rig and crane (the elimination of frequent spragging).

Any lifting operations such as for pile rebar frequently present a significant risk and are to be reviewed in detail. Control measures could include:

- > a secondary restraint e.g. back-up sling
- > pile cages being spliced to reduce the lifted length
- > tag lines shall be used to control loads.

See also section 8 which deals with lifting operations.

Where movement, noise or vibration monitoring is required before, during or after the piling works, the monitoring regime will be agreed with NRHS in advance.

At the end of each shift, plant is to be left in a safe and secure manner.

The general position of the piling rig and movement of the piling rig when undertaking pile installation and the sequencing of the works must be planned to reduce the need for repeated significant changes in the orientation of the tracks of the piling rig and crane (the elimination of frequent spragging).

9.6 Piling platform

In analysing accidents reported by its members to the Federation of Piling Specialists, it has been noted that the most serious accidents involving the failure of a piling rig, or a crane whilst on piling duties, have been caused by a failure of the platform supporting that rig/crane or by a failure in the maintenance of that platform rather than by mechanical failure of the machine itself.

In recognition of this the FPS, with the support of the HSE, has introduced a procedure outlining the responsibilities for the design, construction and maintenance of piling platforms. This procedure, which is detailed in Building Research Establishment Document Working Platforms for Tracked Plant and has become a standard construction industry requirement.

Installation of the platform shall be in accordance with the design and shall be undertaken by a competent contractor. The performance of the piling platform shall be verified by CBR tests or equivalent before use.

Once the installation of the piling platform has been completed, the Piling Platform Certificate will be completed, and a copy shall be held on site. Further ongoing inspection of the piling platform will be required.

The piling company shall provide all relevant rig and equipment loadings and bearing pressure calculations in advance of the piling platform being designed. If the rig and equipment which is delivered to site is not the same as that for which the loadings have been supplied, then the piling platform shall be redesigned for the loads appropriate to that rig and equipment.

The design of the piling platform shall be subject to a category 3 design check and a F003.

Good practice dictates that:

- > piling platforms shall exceed the working area by 2m all round
- > physical demarcation (timber baulks or similar) shall be placed to effectively demarcate the edge of the working area
- > platforms are to be designed for the full capacity of piling rigs, cranes and other equipment proposed
- > consideration may be given to the use of lean mix/reinforced concrete platforms as these may provide additional safety margins
- > the capacity of installed piling platforms shall be proven by CBR tests or similar prior to first use, and on any subsequent changes to the platform
- > consideration shall be given to the drainage of the piling platform
- > a regular piling platform inspection, testing and maintenance regime shall be proposed by the piling platform designer and approved by the piling contractor and principal contractor. The results of each inspection shall be recorded
- > access to the piling site, in particular if sloping, is to be planned to allow safe passage of the rig onto the designated piling platform
- > the project shall be planned to avoid excavation of the piling platform until piling operations have been completed
- > any unsupported pile shafts or trenches must be correctly backfilled to ensure that there is no localised reduction in the bearing capacity of the piling platform.



Once the installation of the piling platform has been completed, the Piling Platform Certificate will be completed, and a copy shall be held on site. Further ongoing inspection of the piling platform will be required.

Cost recovery

The developer is responsible for costs incurred by NRHS and High Speed 1 in connection with their development. Costs are recorded each four-week period by NRHS and invoiced by High Speed 1.

Developers will normally be expected to sign up to a Cost Reimbursement Agreement (CRA). This allows High Speed 1 to reclaim the costs incurred by themselves and NRHS. It also defines conditions on use of any records supplied. NRHS will provide an estimate of these costs on an emerging cost basis.

For schemes of significant size, complexity or risk to the railway a Protective Provisions Agreement (PPA) may also be required to safeguard High Speed 1 interests. This is a legal agreement between High Speed 1 and the developer covering safeguards, processes, responsibilities, indemnity and cost recovery. The ORR sets a standard of £155m for the indemnity.

It is in the interests of NRHS to know about developments either proposed or taking place near to the railway. Accordingly, initial fact finding should take place at the appropriate time whether there is an agreement in place or not.

Costs include:

- > requests for information, including borehole information
- > manpower costs for NRHS personnel
- > necessary engineering advice commissioned by NRHS to review submissions and sign off as DPE
- > provision of staff for possessions, isolations (see sections 6.6 to 6.8) or security where applicable
- > additional equipment provided by NRHS and required for the development such as spark gap equipment for a new overbridge
- > relocation of equipment, fencing, or High Speed 1-owned materials, to facilitate the scheme
- > High Speed 1 costs, such as legal fees and management fee
- > for borehole logs a sum reflecting use of intellectual property
- > additional future operation or maintenance costs (which we would normally seek to avoid but, if accepted, could be allowed for with a negotiated commuted sum)
- > emergency works carried out by NRHS or High Speed 1 to safeguard the infrastructure as a result of an act or omission of the developer.

Train delay or train cancellation costs resulting from the developer's work. Note that these are punitive, and higher than on the rest of the railway network.

This is a legal agreement between High Speed 1 and the developer covering safeguards, processes, responsibilities, indemnity and cost recovery.



Appendix A

Scheme Checklist

See Network Rail High Speed asset protection for a printable document.

Legal

- > are High Speed 1 assets to be changed? Are vested and elective works defined?
- > will High Speed 1 liabilities be affected?
- > is a drainage or other consent affected?
- > is a PPA or CRA required?
- > is planning consent required and if so has it been obtained?

Documentation and drawings

- > are method statements in place?
- > have they been accepted by Network Rail High Speed?
- > is the emergency procedure available and understood?

Access to site

- > will access to High Speed 1 land be needed?
- > what access routes are being used during construction?
- > is maintenance or emergency access being impaired?
- > what security is in place during works?

Activity

- > what is being built?
- > what type of foundations will be used?
- > what depth are the foundations?
- > will there be any changes to railway or public utilities?
- > will there be any change to public access?
- > will there be any impact on existing structures?
- > are there any temporary works involved?
- > is evidence available of design and checking?

Excavation

- > is there excavation adjacent to the railway?
- > how far is it from the rail?
- > does it impinge on the track support zone?
- > what depth is the excavation?
- > what methods of earth retention are used?
- > any High Speed 1 buried services?
- > any risk of unexploded ordnance?

Crossing High Speed 1 infrastructure

- > is the construction going over the railway?
- > at what height?
- > is the construction going under the railway?
- > at what depth?

Development above tunnels

- > what is the position in relation to the tunnels?
- > how is the location and depth controlled on site?
- > at what depth are they above the tunnel?
- > what is the displacement of the loading?
- > is there evidence that they have been designed, and the design checked?
- > has this been accepted?

Plant

- > is there any piling involved?
- > what controls have been put in place?
- > is there any craneage involved?
- > what other plant will be used?
- > will there be any vibration caused by the plant?
- > what controls have been put in place?
- > what consideration has been given to errant vehicles?

Cranes

- > what site position are the cranes?
- > what is the slew radius?
- > what is the load exclusion area?
- > are slew locks in place?

Storage of materials

- > proposed site location of stored materials
- > risk of windblown debris removed?
- > will any flammable products be stored?
- > what distance from High Speed 1?
- > any fire precautions to be put in place?
- > will any additional loading be placed on High Speed 1 structures?
- > could materials fall on High Speed 1 assets?

Possessions

- > will rail possessions be required?
- > planned timescale of works?
- > will any OCS isolations be required?
- > will third rail isolations be needed?

Residual risks

- > any additional residual risks?

Appendix B

Method Statement

See Network Rail High Speed asset protection for a printable document.

Project OP:		Contractor:	
Work:		WPP/MS Ref/Rev:	
WPP/MS Date:		WPP/MS Title:	
		Reviewed By:	
Items checked, enter N/A for those that are not applicable	OK? Y/N/ N/A		OK? Y/N/ N/A
Administration		Risks and hazards	
<ul style="list-style-type: none"> > cover page completed and signed off > pages numbered > document number and revision correct > review sign off by manager > referenced documentation provided/available > conformance to H&S legislation demonstrated 		<ul style="list-style-type: none"> > risks identified > controls and safeguards to be effected > buried and other services checked > any risk of unexploded ordnance? > planning permission > traffic management 	
Scope of work		Briefing arrangements	
<ul style="list-style-type: none"> > work to be undertaken > location of work > work limits, site boundaries, time limits, access to site > completion criteria 		<ul style="list-style-type: none"> > who briefs the method statement? > who is briefed? > how is briefing recorded? > how is understanding confirmed? > emergency numbers 	

Railway and public interface arrangements

- > DZEP/SZEP/non-operational zone
- > possession arrangements
- > protected/safe areas/ worksite/RPOS
- > movement of engineering trains
- > OHLE permit/isolation arrangements/ NPOS
- > disconnection/alteration of High Speed 1 operational services
- > restricted clearances especially at stations
- > passenger interfaces at stations
- > temporary speed restrictions
- > signal sighting implications
- > temporary fencing adjacent to railway
- > work adjacent to control rooms
- > temporary lighting blinding train drivers
- > road traffic management
- > road/rail machines near operational lines
- > handover/handback arrangements
- > security of material from vandalism

Protection of and from railway infrastructure

- > housekeeping to avoid windblown debris
- > buried and other services considered and checked
- > use of approved cable locating tools
- > identify infrastructure susceptible to damage
- > sketch showing location of services
- > protection of track
- > plant movement
- > demolition
- > hot work
- > additional fire precautions required
- > failsafe reconnection of fire precaution systems
- > disturbance of track support, structures, cuttings etc
- > disconnection and reconnection of services

Environmental protection arrangements

- > waste and pollution
- > noise, dust, smoke, vapour
- > dewatering arrangements and disposal of water
- > fuels, oils etc. storage and containment
- > hazardous substances, spill procedure

Plant and equipment

- > plant and equipment specified
- > inspection and examination certificates
- > temporary lighting
- > detail cranes, lifting machines etc including access
- > plant collapse within 4m of boundary?
- > arrangements for standby plant
- > loading and marshalling of rail mounted equipment

Personnel

- > number of contractors and subcontractors
- > supervision arrangements, names of person in charge
- > competence and training requirements outlined and met
- > site access arrangements e.g. permits
- > working hours
- > shift handover arrangements
- > welfare and first aid provision
- > health hazards assessed and controlled
- > track and other access requirements
- > dispensations required

Safety of contractor's personnel

- > control measures for specific health hazards
- > COSHH
- > manual handling
- > permit to work systems
- > PPE requirements
- > site emergency plan

Methodology

- > state order of work
- > hold points
- > bar chart showing sequence of separate tasks
- > standards & procedures (Network Rail and contractor's)
- > drawings and sketches
- > access and egress arrangements, including ladders/scaffolds
- > delivery and disposal of materials
- > temporary structures
- > method of authorising start of work
- > method of confirming each stage has been complied with

Emergency plans

- > contact phone numbers outside normal working hours
- > contractor including contact hours for project manager
- > Network Rail Operations
- > accident reporting and investigation
- > contingency plans
- > sub-standard conditions reporting

Contractor monitoring arrangements

- > how is compliance with the method monitored?

Communication and liaison

- > specific persons who must be contacted
- > effects on High Speed 1 property, Eurostar, LSER
- > other contractors working nearby
- > highway authorities
- > local authorities
- > occupiers of adjacent properties

Handback Arrangements

- > arrangements additional to handback strategy
- > liaison with maintenance contractor
- > handback contingency arrangements
- > sign off for taking back into use

Possession Overrun Contingency Plan

- > Required and complete

Comments

Method Statement OK?

Date Reviewed

Appendix C

Possible species for planting

The following charts are to be read across the pages from left to right.

>5m from the outside rail

Scientific name	Common name	Vegetation type				Safety considerations					Vegetation type	Conservation factor			Visual impact			Security		Comments	
		Ground cover	Shrub	Hedge	Small tree (<10m)	Stable root systems	Slow growing	Evergreen	Light leaf-fall	Non-brittle branches		High bird value	High insect value	High mammal value	Attractive foliage	Attractive blossom	Attractive fruit	Dense	Thorny		
<i>Cornus sanguinea</i>	Dogwood		X	X	X				X	X			X	X	X		X		X		Suckering shrub which prefers chalky soil but can grow on many soil types. Stem pleasing red colour in winter.
<i>Corylus avellana</i>	Hazel		X	X	X								X	X	X			X			Potential habitat for Dormice. Regenerates well after coppicing.
<i>Crataegus laevigata</i>	Midland thorn			X	X					X			X	X	X		X	X	X	X	Grows best in groups or as part of woodland planting. Don't use widely for hedging as prefers shaded conditions.
<i>Crataegus monogyna</i>	Common hawthorn		X	X	X					X	X		X	X	X		X	X	X	X	Ideal barrier hedge. Can be managed into a hedge or allowed to become large shrub or small tree.
<i>Cytisus scoparius</i>	Broom	X	X			X		X	X	X				X			X				Good shrub for mixed planting schemes but prefers sandy and acid soils.
<i>Erica/Calluna</i>	Heather	X	X			X	X	X	X	X			X	X			X				Good, easy maintenance ground cover but needs acid soil conditions below pH 6.5 to thrive.
<i>Frangula alnus</i>	Alder buckthorn		X	X				X		X	X		X	X	X			X	X		Native throughout Britain preferring moist, often acid soils.
<i>Hippophaë rhamnoides</i>	Sea buckthorn		X	X		X			X	X			X			X		X		X	Resistant to salt growing well in maritime conditions. Only use in coastal situations or on sandy area. Suckers freely.
<i>Juniperus communis</i>	Juniper		X			X	X	X	X	X			X					X			Grows on chalk or acid mountainous soils. Not for widespread planting but useful in limited circumstances.
<i>Ligustrum vulgare</i>	Wild privet	X	X			X	X		X	X				X					X		Good hedging but partially deciduous so loses leaves during winter, reducing value of cover. Prefers chalky soil.
<i>Malus sylvestris</i>	Crab Apple				X					X	X		X	X	X		X	X			Grows well, planted in hedges or scrub. Produces flowers and fruit suitable for bees and birds.
<i>Prunus padus</i>	Bird cherry				X								X	X			X	X			A suckering shrub growing well on wet acid soils. Very hardy but not tolerant of strong winds. Does not grow well in shade, so use as part of hedgerow or scrub planting.
<i>Prunus spinosa</i>	Blackthorn		X	X		X			X	X			X	X	X		X	X	X	X	Ideal barrier hedge. Suckers profusely. Can stand exposure to wind and coastal conditions.
<i>Pyrus communis</i>	Wild pear				X		X			X				X			X	X			Grows well in open conditions such as hedge planting, but doesn't thrive if planted in woodland conditions.

Scientific name	Common name	Vegetation type				Safety considerations					Conservation factor	Visual impact			Security		Comments	
		Ground cover	Shrub	Hedge	Small tree (<10m)	Stable root systems	Slow growing	Evergreen	Light leaf-fall	Non-brittle branches		High bird value	High insect value	High mammal value	Attractive foliage	Attractive blossom		Attractive fruit
<i>Rhamnus catharticus</i>	Buckthorn		X	X			X		X	X		X				X	X	Ideal barrier hedge. Prefers chalky soils and grows best in England, only occurring occasionally as a native in Wales and not recorded in Scotland.
<i>Rosa arvensis</i>	Field rose	X	X	X		X			X	X		X	X	X		X		Thorny and grows well as part of hedge/shrub mix.
<i>Rosa canina</i>	Dog rose	X	X	X		X			X	X		X	X	X		X		Thorny and grows well as part of hedge/shrub mix.
<i>Rubus fruticosus</i>	Bramble	X	X						X	X		X	X	X		X		Thorny and grows well as part of hedge/shrub mix.
<i>Ruscus aculeatus</i>	Butchers Broom	X	X			X		X	X	X		X	X		X	X		A small evergreen shrub – usually less than 1m. Spiny and tough so good as part of.
<i>Sambucus nigra</i>	Elder		X	X						X		X	X	X		X		Vigorous growing large shrub which grows well as part of hedge/ shrub mix.
<i>Sorbus aria</i>	Whitebeam				X	X				X		X		X	X	X		Large shrub or small tree, which prefers lime rich soils. Good in open sunny positions so ideal for hedges or as free standing trees.
<i>Ulex europea</i>	Gorse	X	X					X	X	X		X	X	X		X	X	Extremely spiny so good hedging. However gorse is extremely combustible, so large areas present serious fire hazards.
<i>Viburnum lantana</i>	Wayfaring tree		X	X		X				X		X		X	X			Good hedging plant on lime rich soils.
<i>Viburnum opulus</i>	Guelder Rose		X	X		X			X	X		X	X	X				Good hedging plant on moist, rich soils.

>10m from the outside rail

Scientific name	Common name	Vegetation type					Safety considerations					Conservation factor	Visual impact			Comments		
		Ground cover	Shrub	Hedge	Small tree (<10m)	Large tree (>10m)	Stable root systems	Slow growing	Evergreen	Light leaf-fall	Non-brittle branches		High bird value	High insect value	High mammal value		Attractive foliage	Attractive blossom
<i>Acer campestre</i>	Field maple					X	X			X		X	X	X	X			Native replacement for sycamore, slower growing and smaller. Usually reached 15m but can make 20m.
<i>Alnus glutinosa</i>	Alder					X				X		X	X					High conservation value, nitrogen fixing, good for reclamation work. Can make 30m in ideal conditions but usually reaches 15m. Grows well where water table is high eg streamsides and marshy land. Can stand long periods of roots being submerged.
<i>Betula pendula</i>	Silver birch					X				X		X	X		X			Can reach 25m tall in ideal conditions and can be unstable when older, prolific regeneration.
<i>Betula pubescens</i>	Downy birch					X				X		X	X					Can reach 25m tall in ideal conditions and can be unstable when older. Prolific regeneration.
<i>Carpinus betulus</i>	Hornbeam			X		X	X			X								Slow growing large tree with grey fluted bark. Prefers damp clay soils but can grow on many soil types. Coppices and pollards well. If cut as hedging will retain leaves throughout the winter.
<i>Fagus sylvatica</i>	Beech			X		X							X					Shallow rooted and susceptible to storm damage, potential hedging species if managed through regular cutting.
<i>Ilex aquifolium</i>	Holly			X		X	X	X	X	X		X	X	X	X		X	Ideal barrier hedge but can be slow growing. Can make 23m in ideal conditions, so should be managed as hedgerow.

Scientific name	Common name	Vegetation type					Safety considerations					Conservation factor	Visual impact			Comments		
		Ground cover	Shrub	Hedge	Small tree (<10m)	Large tree (>10m)	Stable root systems	Slow growing	Evergreen	Light leaf-fall	Non-brittle branches		High bird value	High insect value	High mammal value		Attractive foliage	Attractive blossom
<i>Pinus sylvestris</i>	Scots pine					X			X	X								Grows well on acid soils. Can make 35m tall in ideal conditions.
<i>Populus tremula</i>	Aspen					X	X					X						Can make 20m in height in ideal conditions. Grows well from root suckers, producing small thickets. Not long lived (30 to 50 years).
<i>Prunus avium</i>	Wild cherry					X						X	X		X	X	X	Can make 25m in ideal conditions. Doesn't grow well in shade so best used in hedges or as individual trees.
<i>Quercus petraea</i>	Sessile oak					X	X	X				X	X	X			X	Can make large tree – up to 40m in ideal conditions. Long lived, slowgrowing and tolerant of strong winds.
<i>Quercus robur</i>	Common oak					X	X	X				X	X	X			X	Can make large tree – up to 40m in ideal conditions. Long lived, slow.
<i>Sorbus aucuparia</i>	Rowan					X	X					X	X	X	X	X	X	Generally small deciduous tree but can on occasions reach 15m. Grows well on a range of soils and copes well with acid conditions. Quite fast growing and can be coppiced.
<i>Sorbus torminalis</i>	Wild service tree					X					X	X	X	X	X	X	X	Generally small tree but can reach 15m. Grows best on clay soils and prefers open situations. Regenerates well after coppicing.
<i>Taxus baccata</i>	Yew			X		X		X				X	X	X			X	Slow growing but can become mature tree which reaches heights of 20m.
<i>Ulmus glabra</i>	Wych elm			X		X							X					Can make large tree – up to 40m in ideal conditions. Prefers deep or heavy moist soils.

Species that should NOT be planted

Scientific name	Common name	Vegetation type					Safety considerations					Conservation factor	Visual impact			Comments		
		Ground cover	Shrub	Hedge	Small tree (<10m)	Large tree (>10m)	Stable root systems	Slow growing	Evergreen	Light leaf-fall	Non-brittle branches		High bird value	High insect value	High mammal value		Attractive foliage	Attractive blossom
<i>Acer pseudoplatanus</i>	Sycamore					X												Leaf-fall problem species, invasive, vigorous growth, prolific regeneration.
<i>Aesculus hippocastanum</i>	Horse chestnut					X						X	X		X	X		Leaf-fall problem species, potential trespass issues to obtain conkers.
<i>Castanea sativa</i>	Sweet chestnut					X	X						X			X		Leaf-fall problem species, profitable timber crop – especially coppice.
<i>Fraxinus excelsior</i>	Ash					X												Leaf-fall problem species, vigorous growth, prolific regeneration. Suffering from Ash Dieback which will cause tree death and result in tree failures.
<i>Populus nigra</i> var. <i>betulifolia</i>	Black poplar					X												Leaf-fall problem species, can be unstable.
<i>Populus nigra</i> var. <i>italica</i>	Lombardy poplar					X												Leaf-fall problem species, can be unstable.
<i>Tilia cordata</i>	Small-leaved lime					X						X						Leaf-fall problem species.
<i>Tilia platyphyllos</i>	Large-leaved lime					X						X						Leaf-fall problem species.
<i>Tilia x europea</i>	Common lime					X						X						Leaf-fall problem species.

