SUPPLY CHAIN SAFETY
LEADERSHIP GROUP

Highways Safety Hub

Raising the Bar 9

Utility Avoidance

Issued July 2013 Revised April 2024

Contents

Objective

This Raising the Bar Guidance Document provides practical guidance on how to the comply with the Supply Chain Safety Leadership Council Common Intent Document on Utility Avoidance as well as providing guidance to Designers and Contractors as to the standardised method of compliance preferred by National Highways.

Scope

The expectation is that this Raising the Bar Guidance Document will apply to all elements of working around underground, above ground or overhead utilities. From planning and design through to location, verification, safe excavation and update of drawings and plans to be passed on to the client and maintainers. It also includes both permanent, existing utilities and to temporarily installed utilities, including temporary safety critical cables, on National Highways worksites and will be implemented by all supply chain partners working with National Highways.

It will be used by:

- National Highways/Principal Designers – when commissioning, designing and planning works
- Supply Chain Partners – when working for National Highways
- National Highways and Supply Chain Partners when assuring compliance.

Additionally - when following any risk control methodology, the Principal Designer or Contractor will often identify more than one compliant solution to a problem.

This guidance is relevant to ALL utilities including:

- Electrical, gas, water, sewerage and other drainage
- Telecommunications and other fibre optic cables
- NRTS road technology cables (inc. Bypass cables)
- Overhead utilities (See also RTB7)
- Above ground utilities e.g. CCTV cables
- Above ground gas installations

This standard does not replace Standards and Codes of Practice such as: GS6, HSG47, PAS128 or PAS256 but will identify expectations for implementing requirements contained within these documents and other Industry Guidance. It is expected that all designers and contractors will check their own adherence to legislative and Utility Asset Owner Requirements as well as compliance with their own company procedures. Guidance contained in this document is in line with recommendations from the Utility Strike Avoidance Group (USAG) and their toolkits.

Background

Utility Service strikes continue to be one of the biggest health and safety hazards in our industry. Across key suppliers to National Highways, there can be as many as one utility strike per day on average. The most significant incidents have tragically resulted in fatalities and life changing injuries.

Routinely, the root cause of these incidents includes poor quality or inaccurate information about buried utility locations, little or no consideration of diversion during design development, no re-design to avoid utilities, lack of consistency of safe working practices across the industry and inadequate or inconsistent control measures on site.

Governance Requirements

There is a clear expectation within the Supply Chain Safety Leadership Group Common Intent Document on Utility Strike Avoidance that where working around live utilities cannot be designed out then the Senior Representative for the Principal Designer and subsequently for the Principal Contractor needs to be satisfied that all mitigation measures have been considered and exhausted with respect to Elimination and Isolation prior to accepting proposals for Engineered Controls to be relied upon for working in the vicinity of live utilities.

Minimum Requirements

The following elements are mandatory requirements and suppliers shall ensure these elements are applied fully on National Highways sites.

Mandatory Elements

- Conductive metal setting out pins are prohibited on all National Highways sites
- Where designers identify a requirement for excavation GPR surveys must be undertaken prior to completion of detailed design
- Designers must undertake clash detection workshops during preliminary and detailed design phases
- Routes for temporary safety critical cables must be planned to reduce the risk of damage and have a whole life maintenance plan
- Interpretation of survey data must be undertaken by experienced qualified personnel in accordance with PAS128 and HSG47
- All persons involved in the planning, permitting, scanning and excavating around live utilities needs to be trained in an accredited HSG47 (Avoiding danger from underground utilities) course.
- Permits should always be briefed at the dig location
- Cable avoidance tools must have GPS and a data logging capability which is operated
- A CAT must always be used with a genny
- Vacuum excavators should be the default method when excavating around buried services wherever practical
- Insulated hand digging tools must be used
- GS6 must be in place to protect overhead utilities
- Investigations to follow the USAG Incident Investigation format

Guidance – Applying the Hierarchy of Controls

Overview

The following guidance is written with the expectation that it represents best practice and as such should normally be followed unless a better local solution has been devised to meet the overall objective.

The guidance follows the Hierarchy of Controls and assumes that we will first Eliminate the hazard posed by a utility by designing to avoid it. Where this is not possible, we will seek to isolate it – i.e. turn off the supply during our works and only when this is shown to not be possible will we rely on engineering controls.

1. Elimination

Accurate and robust capture of data

Hazards can only be eliminated if they are known and the capture and access to accurate and robust data relating to existing utilities is key to ensuring we are basing decisions on the best available information.

The hazard of excavation around utilities must be initially identified at the design stage and be included on the design risk register. Efforts must be made and works considered to eliminate or reduce this activity wherever practical. Early engagement with utility companies and the client to collate data and information on utilities must be undertaken, together with commissioning of relevant surveys.

By integrating verified locations of utilities and structures the designer can validate data available from National Highways and utility owners – and use that data to inform safer design choices.

All overhead utilities must be assessed prior to works and a suitable safe system of work must be established and documented to prevent mobile plant equipment and vehicles striking any overhead structures, utilities and other fixed hazards.

Where there is a potential during construction for an overhead utility to be struck then a hierarchy shall be adopted, with the avoidance of carrying out works or inspections under and adjacent to overhead utilities and other fixed hazards, being the first consideration.

Where work is required around overhead utilities then an opportunity to divert or isolate prior to the construction phase should be identified early in the design process.

Assess Provision of Statutory Drawings by a Competent Person

All Utility plans must be:

- In colour
- At a scale of 1 to 500 (minimum) when printed or viewed on a device
- When printed, at the scale indicated on the drawing (e.g. drawing is 1 to 500 if printed in A3)
- Current i.e. within the specified date range stated by the plan provider, which is within 28 days for gas (mandated) and 90 days for other utilities (advisory).

Development and Planning

Engagement with statutory undertakers and supply chain undertaking the work (if appointed) should be held as early in the design process as possible to set expectations with regards to competency and working standards.

Agreement must also be reached with the utility owner about what methods and techniques can be utilised within the proximity of their asset. The responsibility for works (who is principal contractor under the Construction (Design and Management) Regulations) should be clearly recorded for each element of the works as this may change depending on the location of the works.

All excavation tasks must be planned to ensure that current utility drawings are obtained and fully reviewed. Utility drawings may give an indication as to the location of a utility; however, the accuracy can vary.

The location must be confirmed via a filed study survey and positive verification in accordance with PAS 128 Survey Category Type C, B and A. A single trial hole cannot be relied upon to confirm the location of a utility as the depth / offset can vary significantly over very short distances, especially where there are physical constraints. Robust scanning and multiple trial holes should be carried out on each utility to confirm the location, as appropriate.

NB the methods applied to trial hole excavation should follow the guidance contained later in this document with respect to safe working practices for excavation.

Design Process

Eliminating hazards through design is a crucial aspect of the hierarchy of control and the design that avoids the need to work over/under/adjacent to live utilities should be the optimal solution. A sub-optimal solution is to seek to divert the utilities in advance of any works undertaken.

Designers must confirm the "legend" on plans received as these can vary.

Note: Plans will provide a specification e.g. 400Kv or 7 bar gas and a material but only give an indication of the location of utilities. They are rarely drawn accurately to scale and scales might have changed during copying. Utility Plans must be used only as a guide to help tracing using locating devices. Proven information should be entered into working drawings.

Minimum "air gaps" should also be identified on drawings when there is a need to travel beneath overhead cables. This includes travelling and tracking of mobile plant equipment, travelling of vehicles, and erection, use and dismantling of temporary works systems etc.

For existing overhead cables minimum "air gaps" can be obtained by contacting the cable owner (Statutory provider), who will provide a "GS6 Safe Clearance Assessment Report" for each overhead cable location

At request, Statutory providers will also provide guidance of the minimum "air gaps" when working and travelling beneath 11kV (11,000v), 33kV (33,000v), 66kV (66,000v) and 132kV (132,000v) overhead power lines

If plans and information are not available (e.g. for emergency work) the work must be planned on the assumption that there are buried/encased utilities in the area.

Established best practice in mapping existing utilities to combined plans

- Start with high quality, accurate CUDs (Combined Utility Drawings) so that design teams can be certain that their designs do not clash with utilities.
- Adopt best practice for the project, encouraging a minimum standard of CUDs and the use of GIS to map utilities across the route.
- The use of High-Density Array Ground Penetrating Radar is preferred over less advanced systems. Whilst more expensive initially the accuracy and time saved prove economical and the use of this, and ongoing improvements in such technology, is the preferred method of location and a Best Available Technique
- Map utility locations in GIS and incorporate key asset data – utility type, size, asset owner, feeder location. This could also include contact details of asset owner and brief outline of their protection requirements/processes within the asset data.
- Combining the work scopes for a whole site to reduce the need for partial surveys for individual tasks.
- Consider existing easements as may apply to utilities
- It is essential that combined plans are checked for completeness, accuracy of position and that the legends match the way that the utilities are marked on the original plans
- Dependent on the plan scale it is likely that marking multiple utilities on it will make those utilities appear as one line – the designer must consider how to present the correct information to the Principal Contractor

It is essential that the design of works has been allocated sufficient funding, time and resources to check that utilities have been identified, confirmed and risks eliminated - or that residual risk is clearly identified when work is handed to the Principal Contractor and a practicable mitigation is proposed.

As a general principle any utility that does NOT need to be within the works should be removed from the work either by re-planning the works – or by altering the utility outside the works where practicable. This will ensure safety during construction and for ongoing maintenance. Where a cost/benefit analysis shows this not to be practicable then identification, structural support and physical protection is required.

Note that the presence of that utility must be considered in the maintenance and repair statement.

Design for maintenance

By combining BIM and GIS the interface between existing and proposed assets can be seen and optimum locations for maintenance points can be established.

- All newly laid cables (cameras, traffic signs etc.) on the National Highways network should be within appropriately coloured ducting and provided with additional warning or protection. Accurate records of location are essential – particularly if the cable is isolated via a "pot end". Pot ends should ideally be removed from the works to facilitate works and ongoing maintenance. The use of resonance balls on pot ends that must remain will assist in ongoing location for maintenance.

- A maintenance and repair statement (MRS) shall be prepared during the design stage see GD 304 Section 2
- The design must also identify any utilities made redundant by the scheme or any legacy redundant utilities within the works so provision can be made to ensure their removal, so they are not left in situ

Preparatory works

As damage is frequently associated with preparatory work or ancillary work the designer should consider utilities during the investigation phase of the works and the possible location of compounds and storage facilities. This includes any situation where the ground will be broken/penetrated or may move – not just excavations. Typical situations include:

- Putting in posts for site hoardings
- Creating temporary fence lines or setting out
- Movement of heavy plant and equipment

Protection of utilities

- Consider temporary access routes as a permanent design with same rigorous utility searches and consideration.
- Consider technical interfaces when designing protection slabs and engage with National Highways throughout the process to avoid assumptions or future reconstruction.
- It is not acceptable to concrete around cables, gas or fuel pipes.

The flexibility to work around utilities

- If possible, allow for provision to be made for utilities to ensure they remain in their traditional locations (i.e. ensuring footpaths/verges are wide enough that all existing utilities will sit within them).

Consider;

- Movement of ground containing utilities adjacent to the actual works
- Ground loading during construction – from machinery or spoil
- Reduction in ground level that may affect the utility by decreasing the protection from damage
- Increases in ground level that may affect structural integrity or make future access difficult
- Utility condition – to be discussed with the owner as the concept of betterment may apply
- Liaison with utility owners or operators, and other interested parties such as landowners and other utility providers
- The stability of ground supporting structures and utilities

Diversions

Where diversions must take place the Client and Principal Designer should engage the Utility Owner and Principal Contractor (PC) to determine suitable work phasing as only limited work will be possible before diversions are complete and, typically, the utility owner is not working directly for or under the immediate control of the PC – all of which can seriously affect work phasing. As an example:

- Phase 1 – PC Sets up on site, grade ground to new levels, lay out new route
- Phase 2 – Stop work and hand site to Utility Owner to complete works
- Phase 3 – PC returns to complete works

Costs for diversion of utilities must be considered in the context of the scale/complexity of the project/activities and unless prohibitively expensive/disproportionate for the context, then this option must be thoroughly exhausted before a lesser control measure is accepted. Diversions must be captured in the as built information both in drawings and GIS formats.

2. Isolation

Where the hazard can't be eliminated, the Supply Chain safety Leadership Group Common Intent document on Utility Strike Avoidance requires delivery partners to always seek to isolate the utility during construction and maintenance activities by having the supply temporarily stopped.

Supply Chain Partners must check any requirement for the isolation of utilities as these are frequently difficult to schedule in a timely manner. If Isolation is delayed, the Supply Chain Partner must be prepared to delay other works to match, as not doing so is likely to increase risk.

If an isolation is identified early in the design the Designer needs to design works so that they can be efficiently delivered during an isolation, e.g. by consideration of additional catch pits/manholes in a drainage run, construction joints beyond the area where the isolated services lie, etc

Utilities encased in concrete

Where it is believed utilities are encased in concrete and cannot economically be moved/diverted, it may be necessary to isolate so as to be able to work around the utility safely. The Designer must confirm with the Utility Owner how this will happen, how long it will take and if supporting works (e.g. excavations within the National Highways working area) will be required. This is key information needed by the PC for planning as the concrete must not be broken up until such time as a solution is identified, and the cable is made dead / confirmed in writing by the cable owner.

3. Engineering Controls applied via safe working practices

If a utility cannot be eliminated or isolated then the senior leader of each project will need to sign off a safe system of work in order to work around live utilities that focuses heavily on robust engineering controls, that physically prevent any people, plant or equipment coming into contact with the utility, as part of the safe digging procedures.

Be aware that when working in close proximity to utilities it is possible that they may run through material that is to be removed, e.g. ducting that has been overlaid with concrete. If not appropriately managed this can lead to utilities being unintentionally removed with other items such as kerbs. Where possible utilities should be isolated, or items removed in small controlled quantities.

All excavation work must be carried out carefully, following recognised safe digging practices, and must only begin after a locating device has confirmed the position and route of the expected underground utilities and that no other utilities are detected.

The following hierarchy of methods of excavation should be formally considered, those which are discounted (with reasons) must be included in a works planning record.

- Remote excavation
- Directional drilling for underground works
- Vacuum excavation
- Air lance
- Hand dig using 'safety graft' with rounded blade edges and non-conductive shaft. Invasive tools such as bars or picks should not be used.
- Hand dig using standard shovel with non-conductive shaft

NB: Use of hand tools/digging is not considered to be an Engineering Control and vacuum excavation should be the default method when excavating around live utilities unless a risk assessment determines the location or substrate unsuitable. Therefore, the use of hand tools should be included in the approvals noted under governance below and signed off by someone who has overall senior responsibility.

All utilities must be considered live until they are disconnected and proven safe at the point of work. Documented proof to confirm must be available at the work site

The use of bars, forks and picks is prohibited. Handheld power tools and mechanical excavators must not be used close to buried utilities unless the utility has already been exposed by digging under the surface to be broken out and it is at a safe depth (at least 300mm) below the bottom of the hard surface material: or physical precautions have been taken to prevent the tool striking the surface.

Where practicable, do not use handheld power tools within 500mm of the indicated line of a utility buried in or below a hard surface.

The 500mm safety margin may be reduced:

- Where congestion of utilities renders it impracticable; or
- Where surface obstructions limit the space available.

But only if the line of the cable has been positively identified by plans, confirmed by a locator and additional precautions are used to prevent damage to the utilities.

Mechanical excavators and power tools can be used to break up hard surfaces where the survey has proved that there are no utilities, or the utilities are deep enough so as not to be damaged by such tools.

Equipment Requirements

- **Vacuum Excavation** - Vacuum extraction can be a useful method of extracting material without damaging utilities. Significant advances have been made in this field. Vacuum excavator's come in all shapes and sizes making them more accessible in areas previously thought impractical.
- **Air Picks** - The air pick (soil pick or air spade) is used when compacted ground conditions are encountered. It is connected to a mobile compressor via an air hose. High speed air is used to fracture and displace the hard material. Loose material is removed from the trial hole with an insulated hand shovel. Manufacturer's instructions should be followed as methods of use can vary with model. When using the air pick full PPE and impact resistant goggles must always be worn by all personnel within the vicinity of the operation. Consideration should be made to any additional risks introduced with use of this equipment, for example, noise, vibration or scattering of material.
- **Insulated Tools** - When hand-digging, insulated tools must be used to protect the user from current leakage or utility strikes.

Before starting any excavation ensure that edge protection is installed to protect operatives and/or the public from falls into the excavation (See Raising the Bar 13).

Cable Detection and Avoidance Equipment

Cable avoidance tools must be used in line with formal training and manufacturer's guidance. There are a variety of cable avoidance tools on the market each with slightly different features. The mandatory requirement for cable avoidance tools is that they have GPS and a data logging capability. This enables supervisors and others to interrogate which mode the tool has been used in and exactly which location the tool has been used in.

Trials of data logging CATs have resulted in a positive change in people's behaviour and a reduction in utility strikes.

Works Managers or Supervisors should actively monitor the data logged by the CAT to ensure they are being used appropriately.

Cable avoidance tools must always be used with a genny.

Cable avoidance tools must be calibrated by an authorised dealer. Personnel should be aware that this service is unlikely to be offered by tool hire companies.

Cable avoidance tools should also be tested before each use to ensure they are in good working order.

Any personnel using a CAT and genny must have training on the specific model they are using.

Be aware cable avoidance tools are not fool proof and are less likely to detect pot ends, utilities without a live current (e.g. street lighting that is off) and when there are multiple utilities one can mask another. Safety fencing and cables that are no longer live confuse the situation. This is a support tool, and in no way a definitive guarantee.

Locating Utilities on Site

As part of any safe digging procedure the location of utilities, accurately determined/confirmed on site prior to commencement of any work, at every location and the presence visibly identified using appropriate means.

For reactive/minor works the use of 'ground mapping' with radar should be considered but may not be practicable. In this case results of previous surveys from the H&S file may be used only if surveys are less than 90 days old. This data must be used with care and be supported by conventional Cable Detection Techniques – see Cable Avoidance Tools below.

Where no utilities are shown, conduct an onsite survey looking for:

- Items that may have a power supply e.g. streetlamps, signage or gantries
- Scarring or depressions in the road where there may have been a repair or new utility laid
- Manhole covers and frames including hydrants and valves.
- In addition, look for any above ground utilities which may be hidden in the verges by grass such as Trailing CCTV cables
- Above ground gas installations (illustrated here)

Checking Designs and Plans

All Supply Chain Partners must have in place competent people systems to check, review and, as appropriate, challenge designs and information supplied – this must include utilities

Supply Chain Partners must confirm that they have the ability, in terms of:

- Material availability to the design specification
- Having access to equipment and tools specified
- Employing enough competent people to construct the design as proposed – without creating a previously unrecognised risk to utilities.

Care must be taken in checking information provided in relation to utilities and confirming that the working method and residual risks are understood, including any requirement for support of that utility as work progresses.

Risks/controls

When writing risk assessments and method statements around safe excavations, significant risks / controls (risks verses controls) which should be considered include:

Striking buried utilities	Follow extraction and permit system. Isolation of electrical equipment. Cable removal / spiking and cutting of any redundant cables.
Falls into excavations	Before starting an excavation, ensure that there is edge protection available for protecting the work area.
Vehicle movements	Ensure stop blocks are adequate to prevent vehicles entering excavations.
Contaminated land	Soil testing to assess risk.
HAVs / noise from tools	Assessments to be in place including health surveillance where necessary.

4. Minimise

Excavations

During the design phase designers should challenge the need for excavation. The extent and depth of any excavations required should be minimised to reduce the overall footprint of the area affected.

Where excavations cannot be avoided, these should be located in areas least likely to be affected by utilities. It is critical that early design surveys are completed to confirm the location of utilities. Any decision to locate excavations adjacent to an existing service should be substantiated by a GG104 risk assessment demonstrating why the proposed option is the optimum from a health and safety point of view.

Marking Underground Utilities

Where utilities are known they must be marked on the ground to make them clear to anyone. They should be marked in the colour that relates to the service.

Table 1: Standard Service Colours:

Utility	Colour	Utility	Colour
Electricity	Red	BT	Grey
Gas	Yellow	Data cables	Purple
Water main	Blue	Cable TV	Green
Sewer/drainage	Brown	Road lighting	Orange

Do not mark utilities solely on the basis of the location shown on a drawing. Where works are not starting within 48 hours or there are utilities in difficult to mark areas like soft verges a more permanent system of marking should be considered.

Be aware that whilst the table above should be followed, any type of existing utility can be any colour. Black and clay ducts for example are frequently found.

Marking Overhead Utilities

Goal posts that span traffic routes and provide a physical barrier to vehicles that may impact with overhead structures and utilities must be used in accordance with Health and Safety Executive publication GS6

As an additional control, and where practicable, sets of goal posts, together with blue coloured road cones and combination safety signage, must be placed at the end of construction areas. Refer to Raising the bar 7 for further details relating to overhead protection measures.

This will serve to provide driver/operators with an addition visual message "reminder" of the need to ensure that boom/body/accessories are stowed correctly prior to leaving the construction area. However, height restrictors should be used on any plant that could come into contact with overhead utilities if unrestricted. Refer to Raising the bar 1 and 7 for further details relating to mobile plant and equipment.

Gates/barriers/exclusion zones/other measures (e.g. audible warnings and physical limiters in cabs for drivers as hazards are approached) to physically prevent uncontrolled access to areas where overhead cables are present.

Protection and Maintenance of Temporary Surface Laid Cables

Incidents involving damage to temporary surface laid cables can lead to the loss of safety critical services. Temporary cables, including NRTS bypass, CCTV, ANPR and Average Speed Camera cables have frequently been damaged during maintenance activities such as grass cutting and vegetation clearance. Damage to temporary cables also commonly occurs from rodent activity, vandalism, and theft. These cables carry **safety critical services,** and they must be protected to prevent the loss of these services and to avoid disruption to the network.

In accordance with the principles of prevention hierarchy set out by this Raising the Bar, the first consideration should always be elimination and during the design and planning stages of works, the use of wireless technologies must be considered and adopted unless there is a specific, significant reason why wireless is not suitable or reasonably practicable.

Where temporary safety critical cables are necessary, a maintenance plan is required to identify the responsibilities for the ongoing maintenance of the infrastructure and the associated cabling covering the whole life of the cable, i.e. a formal handover when the responsibility is transferred.

The maintenance plan should be developed by the Principal Contractor in collaboration with the Principal Designer and key stakeholders, including regional teams. Plans should be updated to reflect significant changes, HPNMs or cable damage incident investigation reviews.

The route for safety critical cables must be planned to reduce the risk of vandalism, damage or theft and to prevent access to rodents. As defined by the maintenance plan, the responsible organisation (the project) must give due consideration to minimising risks to the cables through their planning activities, including:

- Dedicated route, with consideration given to reducing the risk of damage, including work activities, vandalism or theft
- Minimise requirement for relocations or changes to the cable route
- Clear arrangements for access for maintenance/24hr service outages
- Identifying and protecting joints and connection points
- Location of National Highways/Private land boundaries, e.g. wayleaves
- Nature of the site – topography, ease of unauthorised public access, vegetation and habitats
- Duration of temporary cable and any planned changes to route
- Removal of cable and all associated infrastructure immediately on works completion.

Specific arrangements are identified in TSP0420 for the protection of NRTS bypass cables, including the responsibility on the project to:

- Install, maintain and remove upon completion temporary bypass cable ducting.
- Provide a safe means of access to and alongside the route of the temporary bypass cable.
- Clear the route of vegetation and other obstructions including those in the vicinity of the duct start and finish points.
- Install mechanical duct plugs or other proprietary duct sealing system that can easily be removed (excluding expanding foam) within each open end of the ducts, i.e. where there are joints and at the ends of the route and shall also seal the cable entry ports to the chambers where the bypass enters if applicable.
- Manage the route during its life, ensuring that it is not endangered by other works by other contractors or is at risk through theft or vandalism.
- Notify the Service Provider immediately in the event of any threat or actual damage to the bypass cable and provide whatever assistance is required by the Service Provider to repair or rectify such faults.

If the planning activity identifies the location for safety critical cables must be the central reserve, detailed arrangements will be required for safe and immediate access for maintenance activities and 24hr service outages.

All safety critical cables should be recorded within project BIM or GIS models or equivalent, as is the agreed practice for buried and overhead cables, and include the route(s) of the cable and key access points, such as the location of any joints or chambers. This information/drawing(s) should be accessible to/shared with key stakeholder organisations to aid safe planning of their activities.

Standard Practice

If safety critical cables must be routed on the roadside verge, to mitigate the risk all cables are to be sleeved in ducts and raised off the ground or placed on stakes.

Temporary safety critical cables should not be attached to the vehicle restraint barrier, or to an existing boundary fence unless it can be confirmed as National Highways property or permission from the landowner has been obtained.

Wherever possible, temporary safety critical cables should not be routed within 2m of the vehicle restraint barrier or edge of carriageway (e.g., to avoid damage through vegetation clearance or placed within VRS deflection zone). The Design Risk Assessment and planning activities must consider routing the cable away from the carriageway, along the rear boundary if access for installation and maintenance is possible.

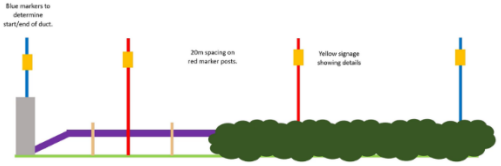
Further consideration for the protection of safety critical cables and infrastructure should include:

- Fenced or barrier area around cross-carriageway duct exit and entry points
- Suitably sealed ducting to prevent access by rodents at joints/ends
- Collared joints to prevent access at points along length of duct (secured with tie wraps to prevent joints separating)
- High visibility weed suppressant matting at cross-carriageway ducts
- Identification markers to show cable route above vegetation growth
- Vegetation management plan (i.e. swathe cutting / use of growth retardant herbicide along routes and at identified assets/locations)
- proactive communication of the bypass routes with stakeholders

All temporary cables, ducting and infrastructure must be removed when the temporary service is no longer required and should be agreed as part of the handover process.

Marking Temporary Safety Critical Cables

To aid identification throughout the life of the temporary cable, in addition to maintaining clear access to the cable, the installation of hazard markers is recommended. The hazard markers should be placed at the start and finish of the safety critical cable and at regular points along the route to provide an enhanced visual identifier.



To aid identification in the event of a service outage, hazard board may be used to include identification of cable/service and contact details.

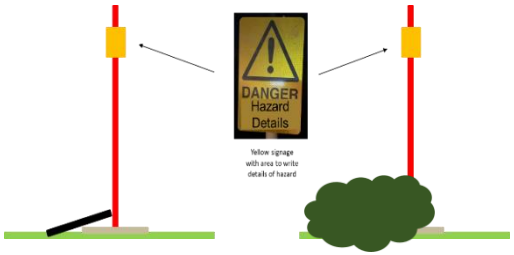
Dealing with Legacy Services

Visual inspections should be made prior to any vegetation clearance, grass cutting or other activities to identify any unmarked hidden services. Where areas are completely overgrown, follow a safe method for clearance by clearing 1m wide swathes at regular intervals throughout the proposed site clearance area. Cut swathed areas downwards in 300mm intervals with a visual check for services and difficult underfoot conditions such as rabbit holes etc. before progressing with works.

Where unanticipated surface laid cables are located, action will be required to identify the cable and whether it is live (and the service it carries), it is redudant but potentially live (e.g pot-ended electrical cable) or construction waste (not active).

Arrangements for temporary or permanent protection, i.e. ducting, raising, or removal should be agreed and recorded on drawings, GIS, registers etc. to ensure information is properly documented.

Where a hazard exists that cannot be removed, the use of hazard markers to provide a visual identification of the cable route should be considered; a board can be used to identify the hazard and provide information to any personnel attending the site.



Unexpected surface laid cables and identified hazards should be formally raised with National Highways, to agree permanent removal/rectification to eliminate the hazard for future works.

PERMITS

Before any activity is undertaken that breaks the surface of the ground a permit to break ground/ dig must be issued. The permit system is designed to ensure that only competent and authorised people conduct the task and that adequate consideration of risk has been taken. The issue of the permit cannot by itself make the task safe.

Any work outside the scope of the permit is not permitted. If anything changes during the task, or is not as anticipated from the briefing or method statement prior to work commencing, then work must be stopped and the situation re-assessed with a new permit issued if necessary.

In the raising of a permit a trained cable avoidance tool operator must scan the ground using a cable avoidance tool.

Authority for breaking ground

Breaking ground is defined as any work activity which involves breaking the surface of the ground including mechanical/hand/vacuum excavation, driving nonconductive pins or posts (including setting out), drilling/boring/cutting/planning.

Prior to any ground penetration/excavation a formal pre-start review/hold point - 'Authority to commence' record must be completed - this can be a Permit or a 'hold point' built into a recognised workflow. Hazards and safe working requirements are to be clearly communicated to those undertaking the work.

It is anticipated that the 'Authority to commence' record will be specific to each Supply Chain Partner.

Each Supply Chain Partner must define and implement processes/ procedure(s) that meet these basic requirements:

- A person(s) is responsible for authorising works is formally nominated by a senior person and that nomination is recorded
- That person(s) is required to review, confirm and record:
  - who is responsible for doing the work
  - who is responsible for supervising the work
  - the scope of the works
  - the method of working
  - the start time/date, the duration of the works and how the authority is removed/re-given each shift
  - the emergency action plan
  - the competency of those involved in the planning and implementation stages
  - all the required information is available
  - all pre-excavation activity has been completed
  - that the works may continue
  - when the works must stop
- Permits need to be briefed to site teams by the permit issuer, prior to work commencing and at the point of work. Where relevant they then need to be re-briefed on a shift/daily basis.
- Permits must be time bound (7 days maximum) and identify a clear process for managing changes within the working environment.

PPE Requirements

All persons involved with breaking ground where there is a risk of coming into contact with live utilities must wear suitable personal protective equipment offering protection from heat and flame e.g. to standard FR3 and Arc Class 1 as per risk assessment.

Monitoring

Regular assurance checks and audits should be undertaken to check controls are being met. This can include not only physical inspection of sites, equipment and adhoc checks on permits, but also the random downloading and sampling of data collected from CATs to ensure equipment is being used effectively.

People Requirements

Training and Competency Requirements

The minimum training requirement for all Permit Raises, Permit Authorises, Permit Coordinators, Permit Responsible Persons, Supervisors and Operatives required to locate underground utilities during planned excavations is an accredited HSG47 (Avoiding danger from underground services). Supply Chain Partners must ensure that persons assessing surveys and results are trained and competent. It is good practice after any training to undertake a two week follow up check to ensure the training is being applied effectively.

Communications and briefings

Supply Chain Partners must have robust procedures for ensuring that hazards and risks identified in the design and their risk assessments are briefed to all who are potentially at risk on site. Labourers and other individuals working in close proximity to utilities digging trial holes for example must be made aware of the standard types and coloured ducting used for each service. This may form part of induction or be delivered through service-related training on site. Personnel should also be aware of the dangers of poorly maintained utilities that could conduct in water or leak hazardous substances. Toolbox talks and regular refresher sessions should be delivered to workers.

Permits should always be briefed to the work gang at the dig location by the permit raiser. That way the permit raiser can clearly point out the utility markers and features as well as ensuring the work gang has the correct tools and equipment to undertake their task.

Stop Work, Hold and Review Points

Workers must be given the ability to challenge information and operations and temporarily stop work without fear of penalty through the inclusion of "hold" or "review" points as each stage of work is completed.

Responsibilities of Personnel

There are several people involved in creating a permit. The permit raiser will gather information and write the permit. The permit authoriser will verify the information in the permit and the responsible person will supervise the works ensuring adherence to the permit. Responsibilities are detailed below.

A copy of the permit must be held at the work site and a copy held at the site office.

Permit Raisers:

- Review utility drawings
- Check the location
- Ensure CAT scanning and marking of utilities on the ground has been undertaken
- Raise the permit and get it authorised
- Communicate the contents of the permit to the supervisor ensuring full understanding
- Close out the permit when work is completed
- Look for evidence of utilities
- Open chambers and manhole cover to verify utility routes
- Look for things which will require utilities – lighting columns, telecom boxes etc.

Permit authorisers:

- Check the utilities are clearly identified
- Check the control measures can be fully implemented
- Check the drawings are clear and concise
- Check the responsible person is clearly identified.

Permit responsible person:

- Ensure that all the details, control measures or restrictions contained in the permit are strictly met
- Supervise the operation throughout. If there is reason to leave the operation (even for a short duration) work must stop. The authorised person must be informed, who will approve a suitable replacement

- Stop works if anything is encountered which is not indicated on the permit and inform the authorised person
- Check where hand digging is a requirement, that all engaged in the task have received formal instructions on safe hand digging techniques
- Communicate the full contents of the permit to all necessary personnel ensuring they are clear about hazards and permit restrictions
- Ensure adequate inspections of existing excavations affected by the work have been undertaken before work starts
-

Emergency Arrangements

Site Emergency Plan

In the event of a utility strike work in the immediate area must stop. A Site Emergency Plan created by the Principal Contractor should detail contacts for utility providers in the event of a utility strike and the action that site personnel are expected to take. This should include consideration of strikes involving uncharted utilities.

Personnel should be made aware that in the event of an injury, not to place themselves in danger when assisting others and must be clear about site first aid procedures and reporting procedures.

Reporting and Recording

All strikes, incidents or near miss events involving any utility must be reported immediately to the National Highways Project Manager or Sponsor and investigated in accordance with their potential severity.

All utility strikes, regardless of whether the utility is live or not, must be logged onto National Highways HART incident reporting system in line with the individual organisation requirements and compliant with GG128.

Incident Investigation

It is mandatory for all utility strike incident investigations to follow the USAG Incident Investigation format.
http://www.highwayssafetyhub.com/uploads/5/1/2/9/51294565/usag_checklist.docx.

References

PAS 128: 2014: Specification for underground utility detection, verification and location
HSE Publications & Guidance:
HSG47 Avoiding danger from underground services
https://www.hse.gov.uk/pubns/books/hsg47.htm
GS6 Avoiding danger from overhead power lines
https://www.hse.gov.uk/pubns/gs6.htm
Overhead Power Lines
http://www.hse.gov.uk/electricity/information/overhead.htm

Utility Strike Avoidance Toolkit Link
http://www.utilitystrikeavoidancegroup.org/toolkit.html

Appendix 1 Minimum Exclusion zones for Underground Utilities

Type of utility	 Air Lance & Vacuum excavator	 Hand Dig	 Powered hand tool	 Mechanical Excavation	 Piling
High Voltage (132Kv) Electric Cables	0.0m if supervised by SU or 3m without SU supervision	0.0m if supervised by SU and safe digging techniques applied, or 3m without supervision	5m	5m	10m
High Voltage (11 & 25Kv) Electric Cables			3m	3m	5m
High Pressure Gas > 7 bar			3m	3m	15m
Intermediate Pressure Gas 2-7bar			3m	3m	15m
High Pressure clean/waste water			3m	3m	3m
Fuel pipelines			10m	10m	30m
Medium pressure gas 75mb - 2bar	0.0m	0.0m if safe digging techniques applied	1m	1m	15m
Low Pressure Gas 0–75mb			1m	1m	15m
Low Voltage Electric Cables			1m	1m	1m
Telecom cable			1m	1m	10m
Low pressure water			1m	1m	1m

Appendix 2: Definitions

Phrase	Description
Client	HE who commission the design, construction, installation and maintenance of works on the Highway
Design	A plan or proposal for the construction of a structure or system. It includes drawings, design details and specifications and bills of quantities
Designer	A person who prepares or modifies designs for example, people planning the routes of cables are designers and are responsible for applying the 'hierarchy of risk control' prior to designing or specifying the works
Authorised/ Nominated person	A competent person trained, appointed and responsible for managing and implementing all the requirements of this guidance including but not limited to the issuing and management of the 'Authority to commence' system on site. Specific job titles will vary dependent on who employs them
Team Leader	The competent person trained in underground utilities and responsible for the implementation of the requirements of the 'Authority to Commence'. This person must present during the works either carrying out or supervising the work. Specific job titles will vary dependent on who employs them
Risk assessment	A process of hazard identification, assessment of risk and determination of controls.
Competent	A person with sufficient skills, training and experience necessary to be able to execute the works safely
Underground utilities	All outdoor pipes, cables and equipment associated with electricity, gas, water (including sewerage), other fluid transporting pipelines and telecommunication utilities that may be in the ground, fixed to walls and/or lying on the surface
Overhead utilities	Utilities that are supported or suspended from metal towers / pylons or wooden poles that are often referred to as transmission or distribution lines. The utilities can be uninsulated or insulated and carry electricity and telecommunications.
Structures	Built engineering associated with underground or overhead utilities e.g. pylon bases and sewer access shafts
Practicable	Weighing a risk against the trouble, time and money needed to control it to the extent that if the controls are possible to do and the costs aren't disproportionate to the risk, the controls should be provided/implemented
Reasonably practicable	Weighing a risk against the trouble, time, and money needed to control it to the extent that the costs don't outweigh the risks
Safe system of work (SSoW)	A clear and concise mechanism that translates requirements – including those identified in the task (or other) risk assessment – into an easy to understand set of hazards, controls and emergency arrangements for the supervisor/operative to be briefed into and follow. The SSoW leads to a prescribed method of work that implements the control measures and minimises the risk of harm to people and property.
Authority to commence	Formalised approval by authorised person for work to commence. Authorisation is given following a satisfactory assessment of the intended safe system of work. Authorisation can be included as part of a defined workflow or managed via permitting.
Permit to Dig	A formal sector level management system used to control the risks associated with digging. This enables an assessment of the risks to be made and to specify detailed control measures which will be put in place in order to minimise the risk as low as is reasonably practicable

Appendix 3: Responsibility Definitions

Role category	example roles	Responsible and accountable for:	Accountable to
National Highways Board and Executive Committee	HE Board, CEO	• Providing HSEQ leadership in setting policy, business objectives and strategy aligned to, and informed by, HSEQ performance • HSEQ performance across HE • Reviewing significant HSEQ incidents, the outcomes of investigations into their causes and the lessons	
Supply Chain Business Leader	Managing Director, Business Unit Director,	• Implementing HSEQ strategy and objectives across their companies • Ensuring adequate resources are provided to deliver HE strategy and objectives. • Strategic decision maker to adopt work practices other than in accordance with HE common intent	HE Board & CEO
Operational Directors/ Managers	Account Director, Account Manager, Operations Manager, Depot Manager, Site Manager, Quality Manager	• Ensuring those under their management adhere to HE policies, processes, procedures as defined in the management system(s) • Ensuring adequate resources are provided to deliver HE strategy and objectives.	Operational or Functional Business Leader or Account Director/Manager
Nominated Person	Manager, Works Supervisor, Team Leader, Gang Supervisor	• Obtain all the necessary drawings/specification/information from the designer/specifier of the works relating to the residual risks that exist for the works being undertaken. • Undertake a 'risk assessment' of the works to be undertaken.	
Designer/ Specifier	Designer	• Obtain asset data and information from service owners • Design out risks as far as is reasonably practicable working with asset owners to understand hazards, measures and mitigation • Verify data provided using techniques such as 'ground penetrating radar' for planned scheme works; • Apply the 'hierarchy of risk control' to all designs; • Provide the Nominated person with the information relating to the residual risk	Operational or Functional Business Leader or Account Director/Manager as appropriate
Supervisor	Works Supervisor, Team Leader, Gang Supervisor	• Supervising staff and operatives as they perform day-to-day tasks based on managers' expectations.	Manager
CAT and Genny user	Works Supervisor, Gang Supervisor, Operative	• Understand the drawing s from the Utility Asset Owner • Before using the CAT and Genny check it has been serviced and calibrated within 12 months and calibration certificates are available on site;	Manager, Works Supervisor, Team Leader, Gangers Supervisor,
Operative	Any role carrying out an activity	• Carrying out the tasks as assigned by the supervisor • Following safe Systems • Challenging not right • Complying with hold and review points • Accepting their personal	Supervisor
Utility companies providing 3rd party support and services to HW		• Provide accurate asset data • Provide information on support and protection • Cost diversions in a timely manner • Complete diversions as planned and to schedule	

Appendix 4: Service Colour Coding

There are recognised colours for utility services. Whilst useful on modern plastic piping these can be wholly relied on as metallic gas and water pipes are often black or metallic grey.

Utility	Duct (Typically)	Pipe (Typically)	Cable (Typically)	Marker / Warning tape (if used)
Gas – low and medium pressure		Cast Iron or Yellow		Yellow with black legend
Gas – intermediate and high pressure		Yellow		
Water		Blue, in MDPE/MOPVC or blue-coated ductile iron Can be black in blue sheathing		Blue or blue/black
Water pipes for special purposes (contaminated ground)		Blue with brown stripes, in polyethylene or blue-coated ductile iron		
Sewerage		No distinguishing colour/material (eg: ductile Iron may be red; PVC may be brown	N/A	
'Grey' water		Black with green stripes		
Communications	Grey, white, green, black, purple	N/A	Black or light grey	Various
Electricity	Black or red duct or tile		Black (red for some high-voltage, orange for some traffic signal power cables)	Yellow with black legend
Government pipelines (MOD)				
Private oil and chemical pipelines				

Appendix 5: Responsibility Process Map

Action	Client	Designer / Principal Designer	Contractor	References
Clearly scope works	▼	▼	▼	BPAUS 04 – Client, Principal Designer, Designer and Contractor Opportunities, Responsibilities and Checklists
Ensure clarity of known areas of service interaction		▼		
Define requirement for management of work near underground utilities	▼		▼	
Define communication channels inc Principal Designers, Designers and supply chain		▼		
Ensure clear understanding of communication internally and with Clients, Principal Designer, Designer, Planners and Contractors	▼		▼	http://www.hse.gov.uk/pUbns/priced/l153.pdf
	▼	▼	▼	
Define change management process			▼	BPAUS 04 – Client, Principal Designer, Designer and Contractor Opportunities, Responsibilities and Checklists
Understand responsibilities for coordination and management of underground utilities information.				
Follow change management process				http://www.hse.gov.uk/

Location of utilities included in scope and price				construction/cdm/2015/designers.htm
Tender submissions include management of underground utilities				
Encourage supply chain to sign up to USAG charter				
Principal Designer and Designers demonstrably competent in underground utilities aspects.				BPAUS 05 –Training Framework for Principal Designers and Designers.