Minimum Standard for Utility Identification and Protection on Road Projects

Author: Martin McMullan | Manager, Zero Harm

February 2015

VERSION 1
Copyright information

This publication is copyright © NZ Transport Agency. Material in it may be reproduced for personal or in-house use without formal permission or charge, provided suitable acknowledgement is made to this publication and the NZ Transport Agency as the source. Requests and enquiries about the reproduction of material in this publication for any other purpose should be made to:

Manager, Information
NZ Transport Agency
Private Bag 6995
Wellington 6141

The permission to reproduce material in this publication does not extend to any material for which the copyright is identified as being held by a third party. Authorisation to reproduce material belonging to a third party must be obtained from the copyright holder(s) concerned.

Disclaimer

The NZ Transport Agency has endeavoured to ensure material in this document is technically accurate and reflects legal requirements. However, the document does not override governing legislation. The NZ Transport Agency does not accept liability for any consequences arising from the use of this document. If the user of this document is unsure whether the material is correct, they should refer directly to the relevant legislation and contact the NZ Transport Agency.

More information

NZ Transport Agency
Published March 2015

If you have further queries, call our contact centre on 0800 699 000 or write to us:

NZ Transport Agency
Private Bag 6995
Wellington 6141

This document is available on the NZ Transport Agency’s website at www.nzta.govt.nz
DOCUMENT MANAGEMENT PLAN

Purpose
This management plan outlines the updating procedures and contact points for the document.

Document information

<table>
<thead>
<tr>
<th>DOCUMENT NAME</th>
<th>Minimum Standard for Utility Identification and Protection on Road Projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>DOCUMENT NUMBER</td>
<td>ZHMS - 03</td>
</tr>
<tr>
<td>DOCUMENT AVAILABILITY</td>
<td>This document is located in electronic form on the NZ Transport Agency’s</td>
</tr>
<tr>
<td></td>
<td>website at <a href="http://www.nzta.govt.nz">www.nzta.govt.nz</a>.</td>
</tr>
<tr>
<td>DOCUMENT OWNER</td>
<td>Martin McMullan</td>
</tr>
<tr>
<td>DOCUMENT SPONSOR</td>
<td>Martin McMullan</td>
</tr>
</tbody>
</table>

Amendments and review strategy
All corrective action/improvement requests (CAIRs) suggesting changes will be acknowledged by the document owner.

<table>
<thead>
<tr>
<th>COMMENTS</th>
<th>FREQUENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amendments (minor revisions)</td>
<td>As required</td>
</tr>
<tr>
<td>Updates incorporated immediately they occur.</td>
<td></td>
</tr>
<tr>
<td>Review (major revisions)</td>
<td>Two yearly</td>
</tr>
<tr>
<td>Amendments fundamentally changing the content or structure of the</td>
<td></td>
</tr>
<tr>
<td>document will be incorporated as soon as practicable. They may require</td>
<td></td>
</tr>
<tr>
<td>coordinating with the review team timetable.</td>
<td></td>
</tr>
<tr>
<td>Notification</td>
<td>Immediately</td>
</tr>
<tr>
<td>All users that have registered their interest by email to <a href="mailto:zeroharm@nzta.govt.nz">zeroharm@nzta.govt.nz</a> will be advised by email of amendments and updates.</td>
<td></td>
</tr>
</tbody>
</table>

Other information (at document owner’s discretion)
There will be occasions, depending on the subject matter, when amendments will need to be worked through by the review team before the amendment is actioned. This may cause some variations to the above noted time frames.
# RECORD OF AMENDMENT

<table>
<thead>
<tr>
<th>AMENDMENT NUMBER</th>
<th>DESCRIPTION OF CHANGE</th>
<th>EFFECTIVE DATE</th>
<th>UPDATED BY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NZ TRANSPORT AGENCY
ACKNOWLEDGEMENTS

Key contributors include:

- James Mear | State Highway H&S Programme Manager – NZ Transport Agency
- Martin McMullan | Manager, Zero Harm – NZ Transport Agency
- Dave Bain | McConnell Dowell
- Ian Cox | New Zealand Utilities Advisory Group (NZUAG)
- ILM Forum | Powerco, Chorus, Water NZ, Civil Contractors, Enable, Rotorua Council
- Trevor Lord | Lord Civil
- Nick Gluvas | MWH
- Paula Lock | Opus

This document has been compiled with the support of:

- NZ Transport Agency Zero Harm Industry Group
- TR Lord and Associates Ltd t/a LORD Civil

Contact us

Zero Harm – NZ Transport Agency
E: zeroharm@nzta.govt.nz
CONTENTS

1. Introduction .................................................................................................................................................. 1
2. Background ..................................................................................................................................................... 1
3. Scope ............................................................................................................................................................. 1
4. Benefits of using a minimum standard for underground utility identification .............................................. 2
   4.1 Improve safety for workers and others .................................................................................................... 2
   4.2 Avoid unexpected utility conflicts ......................................................................................................... 2
   4.3 Avoid damage to your brand and reputation .......................................................................................... 2
5. Coordinated approach to planning and applying minimum standards ............................................................ 3
   5.1 Responsibilities ........................................................................................................................................ 3
   5.2 Training and education ............................................................................................................................ 3
   5.3 Potential utility conflicts ......................................................................................................................... 3
   5.4 Strikes and consequences ....................................................................................................................... 4
6. Methods and processes for locating underground utilities ............................................................................ 4
   6.1 Preferred methods for excavation ........................................................................................................... 4
   6.2 Processes for locating utilities ................................................................................................................ 5
   6.3 Planning for a site mark-out .................................................................................................................... 6
   6.4 Marking out a site ..................................................................................................................................... 7
   6.5 Use GPR to confirm target size ............................................................................................................... 8
Appendix A: Responsibilities for identifying underground utilities ................................................................. 9
Appendix B: References .................................................................................................................................... 11
Appendix C: Definition of Terms .................................................................................................................... 12
Appendix D: Utility survey quality levels ....................................................................................................... 14
Appendix E: Utility mark-out standards ......................................................................................................... 16
Appendix F: Utility location briefing form ..................................................................................................... 18
Appendix G: Permit to excavate (example) ...................................................................................................... 21
Appendix H: Cable and pipe tracer features and specifications ....................................................................... 24
Appendix I: Ground penetrating radar (GPR) features and specifications ....................................................... 25
1. INTRODUCTION

This document provides a minimum standard for utility identification and protection on road projects in New Zealand. It has been produced by an industry working group representing utilities, contractors and designers as part of the Transport Agency Zero Harm programme.

In this document, you will read about:

- the benefits of using a minimum standard for utility identification
- a coordinated approach to application and planning
- methods and processes for locating underground utilities
- relevant measures for health, safety and the environment.

2. BACKGROUND

Recent investigations into utility strikes and a Transport Agency workshop with key stakeholders found that the civil construction industry has significant gaps in its approach to identifying and protecting utilities on road projects.

The current industry-wide approach to providing utility information and avoiding utility strikes is an issue for designers, construction teams and utility network owners. This has a subsequent impact on safety, reputational and financial risk to individual organisations and the community.

3. SCOPE

It is intended that this document complement rather than compete with existing utility procedures already in use in New Zealand. Examples include New Zealand Utilities Advisory Group (NZUAG) National Code of Practice for Utility Operators' Access to Transport Corridors, and WorkSafe NZ guidelines.

While the NZUAG Code of Practice, WorkSafe NZ guidelines and other New Zealand utility-specific regulations provide a solid legislative framework, they do not provide detailed information on how best practice can be achieved.

The minimum standard for utility identification and protection applies to all those involved in the design process, and to all phases of the design. It provides a focused approach that must be integrated into the Transport Agency's investigation, design and construction processes. These minimum standards also apply to Transport Agency maintenance contracts.

This minimum standard document will:

- ensure every person working within a Transport Agency roading corridor and/or project area understands their role and responsibilities in relation to health and safety and utilities
- provide processes to allow effective communication and coordination of utility related activities between asset owners, designers and contractors
- define the process for ensuring the accurate mapping, location and depiction of utilities in three dimensions
- ensure all technical issues, timing and costs associated with utility design and construction are fully incorporated into Transport Agency project scope and budget.

The Transport Agency, along with the NZUAG and other New Zealand business partners, has the qualified personnel and technology required to initiate this minimum standard without additional investment or the need to 'reinvent the wheel'.

As part of the design process, consideration must be given to health and safety throughout the life cycle of the asset. This includes reviewing how the asset can be constructed, operated, maintained, decommissioned or demolished safely.
4. BENEFITS OF A MINIMUM STANDARD FOR UTILITY IDENTIFICATION AND PROTECTION

A minimum standard allows for the proactive and safe identification and protection of utilities that are located within existing or proposed Transport Agency road corridors. An informed engineering design can then be carried out before commencing project works.

The benefits include better safety, fewer utility conflicts, and protection of your brand and reputation.

4.1 Improve safety for workers and others

Accurate information about the location of utilities lets you keep excavation or grading work away from known utilities. This minimises potential damage to the utility and reduces serious health and safety risks that may result in death, personal injury, property damage, or releases of product into the environment.

4.2 Avoid unexpected utility conflicts

Conflicts and unsafe excavation can be avoided when construction plans accurately show the exact location of utilities. This also reduces:

- project delays caused by redesign when construction can’t follow the original design due to utility conflicts
- construction delays caused by cutting, damaging, or discovering unidentified utility lines
- contractor claims for delays resulting from unexpected encounters with utilities.

Sometimes utilities are sited close to each other, or interact with each other. This knowledge helps you highlight cost-effective opportunities to make improvements.

4.3 Avoid damage to your brand and reputation

The repercussion of utility strikes can be significant when reported in media. When there are no utility strikes, the risk to corporate, professional, or individual reputation can be avoided.
5. COORDINATED APPROACH TO PLANNING AND APPLYING MINIMUM STANDARDS

A coordinated and systematic approach to minimum standards during the application and planning stages gives you confidence in the location and depth of underground utilities before exposing or working around them. This reduces potential strikes on utility networks.

This section describes:
- who is responsible for each part of the project
- what training and education to arrange before the project
- how to deal with potential utility conflicts you identify
- what to do if there is a utility strike.

5.1 Responsibilities

Everyone involved in the project has responsibilities throughout the project lifecycle:

- Programme business case and indicative business case – Transport Planners, Utility Operator and Design Lead
- Detailed business case – Transport Planners, Project Manager, Designers and Utility Operator
- Pre-implementation – Project Manager, Designers, Corridor Access Manager and Utility Operator
- Implementation – Principal Contractor, Utility Operator, Engineer to Contract, Client Agent Manager and Corridor Access Manager.

The table found in Appendix A sets out the responsibilities at each stage of the lifecycle.

5.2 Training and education

Before starting work on the site, project managers, site engineers, supervisors, operators, spotters, and all other staff engaged on the project must be adequately trained and competent in:

- reading utility plans
- locating utilities
- health and safety matters relevant to the utilities they will be working around.

Training should be provided by a recognised industry professional. Daily site toolbox meetings must include the procedures for locating, exposing and working around all utilities within the area covered by the permit to excavate.

5.3 Potential utility conflicts

If you identify a potential conflict during assessment or detailed design stages, confirm the utility locations with the utility location providers. This will allow you to positively identify the utility and provide locations that are accurate to at least Quality Level B as detailed in Appendix D.

Provide details of the protection, relocation or upgrade of affected utilities in the design report and construction methodology as part of the project documentation.

All principal contractors, their subcontractors and all personnel employed or engaged by those parties must apply the following procedures set out in this minimum standard.
5.5 Strikes and consequences

The person responsible (see Appendix A) must raise an incident report where a strike occurs on any utility. If any processes or procedures have not been followed, the person responsible must also raise a non-compliance report. The Transport Agency must be promptly notified in writing following any utility strike (however it occurs).

Each principal contractor and its sub-contractors must undertake their own internal investigation following a utility strike. They must keep the Transport Agency updated on the progress of any such investigation. If requested, they must provide copies of any reports to the Transport Agency.

Each party is expected to have its own disciplinary procedures in place and to follow them in the event that conduct is established that warrants disciplinary action.

If a utility is hit or compromised, or a notifiable event occurs, the delivery team and sub-contractor staff involved in the event must undergo compulsory drug and alcohol testing.

A formal return-to-work process must follow any recordable utility strike, reportable utility incident, or notifiable event. The project manager or their representative authorising the return to work must be satisfied that remedial action has been taken and an investigation has been initiated.

6. METHODS AND PROCESSES FOR LOCATING UTILITIES

This document, together with the Transport Agency’s minimum standard for hydro excavation, outlines the key considerations required for efficient and cost effective hydro excavation and location by ground penetrating radar (GPR). This section describes the:

- preferred methods for excavation
- processes for locating utilities
- planning for a site mark-out
- marking out a site.

6.1 Preferred methods for excavation

The work crew, led by the principal contractor’s project engineer, are responsible for making sure the appropriate tools and methods for locating and working around underground utilities are used on their project.

Hydro or vacuum excavation is the preferred method for positively identifying utilities and working around utilities on Transport Agency sites.

The project engineer should carry out a formal risk analysis when hydro or vacuum excavation is not practical. Reasons not to hydro or vacuum excavate should be recorded in the Job Safety and Environmental Analysis (JSEA). Permits should not generally allow machinery or hand digging within 1.5 metres of a utility that is indicated on a drawing. If digging within 1.5 metres of a utility is necessary, the permit should require a formal risk analysis.

Use network-approved measures (such as ‘goalposts’ or ‘tiger tails’) to physically stop machines coming into contact with any overhead lines.

Use engineered standard support and protection solutions for utilities that are exposed or fragile, particularly those that span across or along trenches. This includes AC pipes and oil-filled electrical or telecommunication cables.
6.2 Processes for locating utilities

Use GPR or radio-frequency cable and pipe tracers to locate the utility indicated on a drawing. Hydro or air excavation is the preferred methods to visually identify the utility. The project engineer should choose which method is most appropriate.

Positively identify the utility and record its attributes before excavation begins within 1.5 metres of that utility - as specified in the pre-dig documentation.

Locating underground utilities includes collating information from a range of sources. Check for information from all of the following sources:

- surface observations such as marks, covers, trenches, depressions, or outlets
- building features relevant to termination of utilities
- visible utilities (such as drains in sumps), bollards of all types, lamp-posts, and hydrants
- anecdotal history of area (e.g. previous site uses, road widening evidence)
- Dial Before You Dig records for the site
- plans and records provided by the utility owners known to have underground utilities on the site
- detail provided by surface-based geophysical technologies including GPR, cable and pipe tracers, sondes, pipe cameras, water hammer devices, ferrous-metal locators (for buried hatch covers), and hydraulic/vacuum excavation.

The amount of information obtained from the above sources may vary depending on local site conditions and the Quality Level required.
6.3 Planning for a site mark-out

**Identify**
- Ensure the site requiring mark-out is clearly identified and that the required Quality Level is defined before beginning work (refer Appendix D)

**Plan**
- Organise traffic management if required
- Plan for weather conditions - work is best carried out when there is no rain

**Review**
- Obtain all plans and records before arriving on site (Dial Before You Dig)
- Review plans for completeness and confirm any details not clearly described (e.g. plan scale or clutter at any given point) before arriving on site

**Evaluate**
- Consider appropriate survey pattern/strategy
- Plan for an optimum outcome by taking into account influencing local site conditions (e.g. hilly terrain, uneven ground, known site issues)

**Assess**
- Assess all physical attributes and conduct a risk assessment
- Reconcile these with the details previously obtained to ensure completeness on site arrival
6.4 Marking out a site

**Confirm positions**
- Confirm horizontal positions of (1) metallic assets using pipe and cable tracer, and (2) non-metallic assets by laying tracer wires concurrently.
- Correlate positions with plans supplied.

**Confirm depth**
- Confirm depths with GPR that delivers a clear location to a typical depth of two metres and provides level of accuracy specified in utilities briefing form.
- Do not call depths with cable and pipe tracer unless cross-correlated with equipment manufacturer’s recommended nulling technique.
- Enhance target clarity by ensuring survey depth window is nominally twice the penetration depth.
- Signal strength of targets should be used to confirm or correlate target material (e.g. metal vs non-metal).
- GPR survey pattern should cross all targets perpendicularly to ensure no errors in depth readings.
- Ensure a cross-correlation with surface markers and identifying features for each given utility type.

**Identify targets**
- If unknown targets are observed on a given trace, confirm by running parallel sweeps at least one metre to each side to assess correlation of target line.
- Record relevant unusual underground features observed in the course of the survey - with site report. These may include buried man-made targets such as flat-topped surface features, covered tram tracks, slumpage, voids, or earthquake damage.
- Mark all identified targets on site to descriptors and colours as specified in Appendix E, noting the Quality Level of any identifications not made to Quality Level B.
- Be aware of the risk of false targets when working with GPR near large trees.

**Review work**
- Review work against risk assessment and consider whether any changes to the planned work or to the risk assessment are required.
6.5 Use GPR to confirm target size

Use the GPR to confirm the actual target size conforms the target size expected. Remember to use the GPR in a 'contextual' fashion, observing signs of isolated trenches or disturbances with expected target location.

6.5.1 Record data obtained during a site mark out

Permanently mark all identified targets as described in Appendix E. Unless otherwise instructed, record them using survey GPS to a resolution of +/- 100 mm (or better) in the horizontal plane. Record at a resolution of +/- 50mm (or better) in the vertical and horizontal plane for utilities exposed in the location process.

The location contractor is responsible for ensuring the satellite coverage at the site is appropriate for the GPS survey technique and that the data is recorded correctly.

Transfer saved GPS data to the Transport Agency database within three working days of the mark-out.

6.5.2 Brief excavation crews before excavation

If excavation work will follow the location and mark out process, the location contractor must brief the project engineer and site supervisor formally and fully on:

- the nature of the underground utilities
- the depths and positions of utilities (with accuracy statements on all points taken)
- special features of the site noted in the survey
- any unknown targets observed
- any other matters identified in the risk assessment.

The briefing must also include any control measures put in place to eliminate or minimise risks.

6.5.3 Operator requirements

A single operator is generally sufficient for a mark-out. Larger sites may require a second operator for improved efficiency.

The project commissioner must be satisfied that the locate provider(s) is suitably qualified. All operators must provide evidence of training in underground utility location by a recognised industry professional. If the locate is carried out for design purposes, evidence must be provided to the project design lead. Alternatively if the locate is carried out as part of construction, then evidence must be provided to the principal contractor’s project engineer.

In cases where more than one operator is required, the operators must consult and cooperate on assessing and recording any risks and developing any relevant control measures.
## Appendix A: Responsibilities for identifying utilities

<table>
<thead>
<tr>
<th>Programme stage</th>
<th>Who is responsible</th>
<th>Responsibility</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Programme business case (project definition)</td>
<td>• Transport Planners</td>
<td>• Programme Awareness.</td>
<td>High-level understanding of utility networks and their programmes, including:</td>
</tr>
<tr>
<td></td>
<td>• Utility Operator</td>
<td></td>
<td>• Electricity - overhead and underground</td>
</tr>
<tr>
<td></td>
<td>• Design Lead</td>
<td></td>
<td>• Power poles, electrical substations, transformers and distribution boxes</td>
</tr>
<tr>
<td>(indicative business case)</td>
<td></td>
<td></td>
<td>• Gas and landfill gas pipelines</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Gas values and metres</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Fibre optic and copper telecommunication, overhead and underground</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Telecommunication cabinets and demarcation points</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Traffic signalling</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• High pressure oil</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Pump stations, lift stations</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Cell phone towers.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Detailed business case (assessment stage)</td>
<td>• Transport Planners</td>
<td>• Gain site specific knowledge of utilities and complete non-destructive</td>
<td>Utilities investigations completed in accordance with the best practice</td>
</tr>
<tr>
<td></td>
<td>• Project Manager</td>
<td>investigations.</td>
<td>underground utility location.</td>
</tr>
<tr>
<td></td>
<td>• Designers</td>
<td>• TP or PM assesses likely impact on project using Safety in design principles</td>
<td>Impact project will have on all utilities has been documented.</td>
</tr>
<tr>
<td></td>
<td>• Utility Operator</td>
<td>• to mitigate the risk of conflict with utilities.</td>
<td>Likely impact of project and timing of project phases communicated to</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• TP or PM gains accurate and up to date</td>
<td>utility owner.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• as-built information from Utilities</td>
<td>Project requirements coordinated with utility owner.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Operator.</td>
<td>Rough order costs associated with utilities have been quantified.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Utility owner has provided initial technical assistance and price estimates in</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>design and construction of utility related works.</td>
</tr>
<tr>
<td>Programme stage</td>
<td>Who is responsible</td>
<td>Responsibility</td>
<td>Outcome</td>
</tr>
<tr>
<td>-----------------</td>
<td>-------------------</td>
<td>----------------</td>
<td>---------</td>
</tr>
</tbody>
</table>
| Pre-implementation (specimen/detailed design or maintenance planning) | • Project Manager  
• Designers  
• Corridor Access Manager  
• Utility Operator | • Positive identification of all utilities. Coordinates shared trenching where practical.  
• Incorporate protection or relocation of utilities in design by following Safety in Design principles.  
• Provide corridor access for site investigation.  
• Utility owner to provide design, detailed cost, time period and relevant industry standards/controls required for construction of utility related works. | • Site Investigation Contractor has completed utilities investigations to a minimum of Quality Level B in accordance with the in accordance with the best practice underground utility location.  
• Specimen/physical work design includes requirements for protection or relocation of utilities (above and below ground).  
• Specimen/physical work design includes firm cost and time period for utility-related work and confirms the extent of work to be completed by main contractor and utility operator.  
• Risk register and risk management plan updated.  
• Works Access Permit issued for investigations.  
• Specimen/physical work design includes requirements and firm cost for protection or relocation of utilities (above and below ground). |
| Implementation (construction or planned maintenance activity) | • Principal Contractor  
• Utility Operator  
• Engineer to Contract  
• Client agent Manager  
• Corridor Access Manager | • Positive identification and adequate protection of all utilities.  
• Contractor communicates directly with affected utilities to confirm timing, scope of work and any H&S issues.  
• Ensures utility related risks are mitigated in accordance with Health and Safety and Quality plan.  
• Road opening licence issued by CAR manager. | • Physical works program (construction methodology) incorporates utilities.  
• Contractor does not use utility as-built plans where the date of issue is more than 30 days ago.  
• Utility location provider completes location and mark out of utilities in accordance with the in accordance with the best practice underground utility location.  
• Protection/relocation works are executed in accordance with the best practice underground utility location and best practice for hydro excavation.  
• All utility strikes, damage or notifiable events reported to project manager.  
• Risk register and risk management plan update.  
• All notifiable events recorded and reported to WorkSafe NZ in accordance with health and safety legislation.  
• Works Access Permit kept as part of project documentation. |
Appendix B: References

The list of industry codes of practice and guides listed below are not comprehensive.

- TR Lord and Associates Ltd t/a LORD Civil
  - LOCATE-SAFE® Buried utility location and identification method - brochure
  - LORD Civil Products

- NZ Transport Agency Survey specification Z-16: Z Series - State highway professional services contract proforma manual
Appendix C: Definition of Terms

For the purpose of this document the following definitions apply:

- **Utility location**: The coordinated application of information on a given site from as many sources as possible, and the marking out (to a range of prescribed tolerances) on the ground surface. The location process includes the identification of the utility types expected at the site, and noting any other items that might also be of a utility nature. The process provides for a range of confidences (Quality Levels) to be allocated to each item or cluster of underground utilities, depending upon the nature of the information sources.

- **Quality Levels**: A series of four prescribed descriptions derived from Australian Standard AS5488: 2013 that have been interpreted by the Transport Agency to tighter tolerances of depth and positional accuracy from the various sources of information for determining the final marked out location of underground utilities to a given confidence level (refer Appendix D). The Quality Levels range from D to A, with the latter having the highest confidence levels in the certainty of the depth, nature, and position of any underground infrastructure identified.

- **Plans**: The paper or electronic records of underground utilities for a given site. These plans are usually provided by the owner/s of utilities at that site. The plans:
  - may contain records of depth, route run, cross-sectional details, measurements off identified datum, and depths
  - are to be regarded only as guides to the location of the underground utilities to which they pertain
  - must have been sourced from the asset owner within the past 30 days
  - are generally obtained from the Dial Before You Dig service (0800 248 344).

- **Ground penetrating radar (GPR)**: Is a device that is mounted on a wheeled cart structure in close proximity to the surface of the ground. It contains at least a transmit antenna, a receive antenna, associated radar electronics, an odometer to trigger the transmitting function at regular intervals, and a suitable display/controller device. Typically the GPR uses frequencies between 250MHz (megahertz) to 1000 MHz. It can also be calibrated to consider ground conditions and prove accurate depth information.
  The GPR should be operated by a trained person who understands how to interpret the results from the survey in the context of local conditions they observe, and by correlating the output with anticipated target shapes and outlines.

- **Pipe and cable tracer**: A device to trace and determine the horizontal position of underground utilities of a metallic nature. The device consists of two separate devices, a transmitter, and a receiver. Each device will:
  - Allow the use of at least two frequencies (1) a low frequency approx. 512 Hz or 815Hz to allow for physical coupling to metallic items that are de-energised, and (2) a high frequency approx. 82 kHz (kilohertz) that is used to induce signal into a metallic utility when placed above and parallel to it.
  - Have transmitter powers in the range of 1-10 watts. The transmitter may also be equipped with a clamp-type antenna as an option, allowing a nominal 82kHz signal to be induced into a specific utility, which the clamp is placed around.
  - A sonde, operating at 512 or 815 Hz, connected to a camera or drain rod and pushed up a pipe, may also be used as the transmitting source.
- **Mark-out:** The recording on the ground surface at the nominated survey site of horizontal positions of all centre lines corresponding to the horizontal position of each underground utility, along with a brief descriptor of each utility type. Depth to the top of each utility can also be recorded.
  - Marks on the ground are laid up in various colours of spray paint according to the guideline in Appendix E. Indications of the extent of contiguous targets such as ducts laid by one asset owner can also be recorded in the mark-out detail.
  - If the final mark-out is being done for planning purposes significantly ahead of construction work, or if specifically sought by the Transport Agency, it can be recorded by manual use of a GPS unit having horizontal spatial accuracy of +/-100 mm or better (or +/- 50 mm in depth and position if working on Transport Agency Q/L B accuracy mark out).

- **Potholing:** Digging one or more small-scale test holes to locate underground utilities to Quality Level A. Can be completed using hydro or vacuum excavation, as opposed to careful hand digging.
Appendix D: Utility survey quality levels

This guideline is consistent with New Zealand regulation (NZUAG Code of Practice Oct 2011 and Utilities Access Act 2010), Australia Standard AS5488 (Draft) for Sub Surface Utility Information, and the USA’s ASCE 38-02 Standard Guideline for the Collection and Depiction of Subsurface Utility Data. Section 2.8 of the NZUAG Code of Practice contains the framework and New Zealand context for these requirements.

Quality Level D

Utility attribute information from the Transport Agency’s GIS spatial viewer shall include:

a) utility owner,
b) an indication of the utility type, and
c) an indicative location of the visible and subsurface features of the utility. Tolerance does not apply to an indicative location that is attributed to quality level D.

Quality Level C

Quality Level C is described as a surface feature correlation or an interpretation of the approximate location and attributes of a subsurface utility asset using a combination of existing records (and/or anecdotal evidence) and a site survey of visible evidence. The minimum requirement for Quality Level C is geospatial position in the local coordinate system**.

Attribute information

Quality Level C attribute information shall include:

a) utility owner;
b) an indication of the utility type;
c) an interpolation of the location and direction of the subsurface utility using visible features or SURVEY ACCURATE coordinates if available, as points of reference;
d) feature codes of visible features including but not limited to pits, access chambers, poles, valves and hydrants, and
e) the location of visible features measured in terms of spatial positioning with a maximum horizontal tolerance of ±200 mm.

Quality Level B

Quality Level B provides relative subsurface feature location in three dimensions. The minimum requirement for Quality Level B is geospatial position in the local coordinate system and datum**.

Attribute information

Quality level B attribute information shall include:

a) utility owner;
b) an indication of the utility type;
c) the location of visible features measured geospatially with a maximum horizontal tolerance of ±100 mm; and
d) the location of subsurface features measured geospatially with a maximum horizontal tolerance of ±100 mm and maximum vertical tolerance of ±100 mm. Where there are contiguous utilities (e.g. a cluster of Chorus ducts) an indication of the horizontal extent of these shall be recorded to a minimum of Quality Level C.
**Quality Level A**

Quality Level A is the highest quality level and consists of the positive identification of the attribute and location of a subsurface utility at a point to absolute geospatial accuracy in three dimensions. It is the only quality level that defines a subsurface utility as ‘validated’.

Where the whole line segment cannot be verified by line of sight, Quality Level A shall not be attributed to the line segment between validated points.

**Attribute information**

Quality Level A attribute information shall include:

a) utility owner;
b) the utility
   - Type
   - Status (in service or unknown)
   - Material
   - Size, and
   - configuration
c) feature codes of visible and subsurface features including but not limited to pits, access chambers, poles, valves, hydrants; and
d) the location of points surveyed on visible surface and subsurface features measured in terms of absolute spatial positioning with a maximum horizontal and vertical tolerance of ±50 mm

Local Coordinate System NZ Transport Agency: New Zealand Geodetic Datum 2000 – Local projection (as relevant to each project area)

Local Vertical Datum NZ Transport Agency: Local Datum
## Appendix E: Utility mark-out standards

<table>
<thead>
<tr>
<th>Service</th>
<th>COLOUR</th>
<th>Network Operator</th>
<th>Marking Convention (Examples)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical, lighting, traffic signals</td>
<td>ORANGE</td>
<td>Electricity</td>
<td>✂️ ✂️ ✂️ ORN ✂️ ✂️ ✂️ ✂️ ✂️ ✂️</td>
</tr>
<tr>
<td>Lines, cables and ducting</td>
<td></td>
<td>Street lights and Traffic Signals</td>
<td>✂️ ✂️ ✂️ CCC ✂️ ✂️ ✂️ ✂️ ✂️</td>
</tr>
<tr>
<td>Telecommunications</td>
<td>PURPLE</td>
<td>Telecom/Chorus (CHOR)</td>
<td>✂️ ✂️ ✂️ CHOR ✂️ ✂️ ✂️ ✂️ ✂️</td>
</tr>
<tr>
<td>Lines, cables and ducting</td>
<td></td>
<td>Vodafone VOD</td>
<td>✂️ ✂️ ✂️ VOD ✂️ ✂️ ✂️ ✂️ ✂️</td>
</tr>
<tr>
<td>Ultra-fast broadband</td>
<td>PURPLE</td>
<td>UFB Operator</td>
<td>✂️ ✂️ ✂️ UFB ✂️ ✂️ ✂️ ✂️ ✂️</td>
</tr>
<tr>
<td>Fibre optic cables</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gas</td>
<td>YELLOW</td>
<td>GAS</td>
<td>✂️ ✂️ ✂️ ✂️ ✂️ ✂️ ✂️ ✂️ ✂️ ✂️</td>
</tr>
<tr>
<td>Potable water</td>
<td>BLUE</td>
<td>Water Authority</td>
<td>✂️ ✂️ ✂️ ✂️ ✂️ ✂️ ✂️ ✂️ ✂️ ✂️</td>
</tr>
<tr>
<td>Wastewater</td>
<td>RED</td>
<td>Wastewater Authority</td>
<td>✂️ ✂️ ✂️ ✂️ ✂️ ✂️ ✂️ ✂️ ✂️ ✂️</td>
</tr>
<tr>
<td>Stormwater</td>
<td>GREEN</td>
<td>Stormwater Authority</td>
<td>✂️ ✂️ ✂️ ✂️ ✂️ ✂️ ✂️ ✂️ ✂️ ✂️</td>
</tr>
<tr>
<td>Preliminary mark out</td>
<td>White</td>
<td>All services for preliminary design</td>
<td>Must use colour codes for construction mark out – No exceptions</td>
</tr>
<tr>
<td>(Not for construction)</td>
<td></td>
<td>investigation only</td>
<td></td>
</tr>
</tbody>
</table>
### MATERIAL TYPE and SIZE

When known, the size, material type and owner of the service shall be indicated at the beginning and end of the locate request area and site specific in between.

- **100mm PE ENN**
  - 100mm Polyethylene owned by Enable

### OFFSETS

Where possible offset marks should be used in conjunction with colour coding. Offset marks shall include an arrow pointing in the direction of the utility line with the distance in millimetres to the location of the utility line shown on the right hand side of the arrow. Material type and other information on the lefthand side of the arrow.

- **100mm PE FO**
  - 900mm offset to a 100mm PE encased fibre optic cable

### Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PE</td>
<td>Polyethylene</td>
</tr>
<tr>
<td>PVC</td>
<td>Polyvinyl Chloride</td>
</tr>
<tr>
<td>HPVC</td>
<td>High density Polyvinyl Chloride</td>
</tr>
<tr>
<td>CI</td>
<td>Cast Iron</td>
</tr>
<tr>
<td>GS</td>
<td>Galvanised Steel</td>
</tr>
<tr>
<td>FG</td>
<td>Fibreglass</td>
</tr>
<tr>
<td>CPR</td>
<td>Copper</td>
</tr>
</tbody>
</table>

### Electrical and Telecommunication Labels

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multi</td>
<td>Multi Strand Cable FO</td>
</tr>
<tr>
<td>Single</td>
<td>Single Strand Cable CPR</td>
</tr>
<tr>
<td>Solid</td>
<td>Solid Cable</td>
</tr>
</tbody>
</table>
Appendix F: Utility location briefing form

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Project ID</td>
<td>Your project ID here 10XXX</td>
</tr>
<tr>
<td>Project Name</td>
<td>Your project name/description here</td>
</tr>
<tr>
<td>From</td>
<td>Type your name here</td>
</tr>
<tr>
<td>Contact Details</td>
<td>Type your desk and mobile phone numbers here</td>
</tr>
<tr>
<td>Date</td>
<td>Type date here</td>
</tr>
<tr>
<td>Requested Due Date</td>
<td>Type date information is required by. Be realistic!</td>
</tr>
<tr>
<td>Project Purpose</td>
<td>Expand</td>
</tr>
<tr>
<td>Deliverables</td>
<td>Clarify format data is returned in; eg 12d file, excel sheet with xyz, CAD file hand drawn sketch, photographs, etc</td>
</tr>
<tr>
<td>Known issues?</td>
<td>eg fuel pipeline, level 2 road, NZ Transport Agency road, private access required, known site contact (provide contact details), etc</td>
</tr>
<tr>
<td>References</td>
<td></td>
</tr>
</tbody>
</table>
Utility attribute information shall include:

<table>
<thead>
<tr>
<th></th>
<th>Quality level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td>1. utility owner</td>
<td>✓</td>
</tr>
<tr>
<td>2. indication of the utility type</td>
<td>✓</td>
</tr>
<tr>
<td>3. indication of the utility status (in service or unknown)</td>
<td>✓</td>
</tr>
<tr>
<td>4. indication of the utility material</td>
<td>✓</td>
</tr>
<tr>
<td>5. indication of the utility size</td>
<td>✓</td>
</tr>
<tr>
<td>6. indication of the utility configuration</td>
<td>✓</td>
</tr>
<tr>
<td>7. indicative location of the visible and subsurface features of the utility</td>
<td>✓</td>
</tr>
<tr>
<td>8. interpolation of the location and direction of the subsurface utility using visible features or GPS coordinates if available, as points of reference</td>
<td>x</td>
</tr>
<tr>
<td>9. feature codes of visible features including but not limited to pits, access chambers, poles, valves and hydrants</td>
<td>✓</td>
</tr>
<tr>
<td>10. the location of visible features measured in terms of spatial positioning with a maximum horizontal tolerance of</td>
<td>50mm</td>
</tr>
<tr>
<td>11. feature codes of visible and subsurface features including but not limited to pits, access chambers, poles, valves, hydrants</td>
<td>✓</td>
</tr>
<tr>
<td>12. subsurface feature vertical tolerance</td>
<td>50mm</td>
</tr>
<tr>
<td>13. subsurface feature horizontal tolerance</td>
<td>50mm</td>
</tr>
</tbody>
</table>

**Note:** Quality Level A is the highest quality level and consists of the positive identification of the attribute and location of a subsurface utility at a point to an absolute accuracy in three dimensions. It is the only quality level that defines a subsurface utility as ‘validated’. Where the whole line segment cannot be verified by line of sight, Quality Level A shall not be attributed to the line segment between validated points.
<table>
<thead>
<tr>
<th>Location ID #¹</th>
<th>Street</th>
<th>House #</th>
<th>Type of utility targeted: e.g. pressure main, laterals, all, etc</th>
<th>Original or make safe pavement O/M</th>
<th>Quality Level A/B/C</th>
<th>Notify Engineer when digging Y/N</th>
<th>Other i.e. different level of accuracy (state) etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>10999-PH-001</td>
<td>Magdala Place</td>
<td>1</td>
<td>lateral</td>
<td>O</td>
<td>A</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>10XXX-PH-001</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10XXX-PH-002</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10XXX-PH-003</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10XXX-PH-004</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10XXX-PH-005</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10XXX-PH-006</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10XXX-PH-007</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10XXX-PH-008</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10XXX-PH-009</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10XXX-PH-010</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10XXX-PH-011</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10XXX-PH-012</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10XXX-PH-013</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10XXX-PH-014</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In addition, a clearly annotated proposed plan must also be attached and contain the following information:

- project name and project number
- street addresses and house numbers
- all known utilities shown
- clearly marked location of the proposed pothole and/or scan areas
- the type of the proposed investigation works (laterals, mains, etc).

¹ Note: Typical pothole ID# format: 10XXX-PH-YYY, where 10XXX is the project number (Transport Agency assigned) and YYY is the sequential counter, starting at 001.
# Appendix G: Permit to excavate (example)

<table>
<thead>
<tr>
<th>NZ Transport Agency Project No</th>
<th>__________________________</th>
</tr>
</thead>
<tbody>
<tr>
<td>NZ Transport Agency Project Name</td>
<td>__________________________</td>
</tr>
<tr>
<td>SITE COPY / OFFICE COPY (circle one)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Construction Contractor:</th>
<th>PERMIT No:</th>
</tr>
</thead>
</table>

## Permit request

- **Location of excavation (clearly identify boundary of excavation area):**

- **Description/purpose of excavation:**

- **Name of contractor/subcontractor:**

- **Start date of work:**

- **Permit expiry date:**

- **Is the work notifiable?**
  - Yes
  - No
  - *(If yes send notification to healthsafety.notification@worksafe.govt.nz)*

- **Will work be within 1.5 metres of any underground utility?**
  - Yes
  - No

- **Will work be within 4 metres of overhead lines?**
  - Yes
  - No

- **Within minimum safe distances for excavation near poles or stay wires (5 metres)?**
  - Yes
  - No

*(New Zealand Electrical Code of Practice for Electrical Safe Distances (NZECP 34:2001))*

- **Are there gas mains within 5 metres of the works?**
  - Yes
  - No

- **Is there fibre optic cable within 5 metres of the works?**
  - Yes
  - No

- **Are there traffic signals within 50 metres of the works?**
  - Yes
  - No

## Underground utilities

- Approval to work attached and stand over by electrical network arranged for 66Kv, 33Kv or 11Kv on site?  
  - Yes  
  - N/A

  **Any requirements/safeguards to be observed:**

- Telecommunication approval issued in regards to within 5 metres of fibre optic cable and attached?  
  - Yes  
  - N/A

  **Any requirements/safeguards to be observed:**

- Gas provider contacted in regards to work within 5 metres of gas mains  
  - Yes  
  - N/A

  **Any requirements/safeguards to be observed:**

- Traffic Signals team contacted in regards to work within 50m of traffic signals  
  - Yes  
  - N/A
## Overhead utilities

Approval to work within 4 metres of overhead lines or 5 metres of poles and stay wires issued by electricity network and attached?

- Yes
- N/A

Any requirements/safeguards to be observed:

New Zealand Electrical Code of Practice for Electrical Safe Distances (NZECP 34:2001)

## WorkSafe NZ


- Yes
- N/A

## Service plans / utility as built

Service plan expiry date (30 days from date of issue):

<table>
<thead>
<tr>
<th>Service plans obtained by:</th>
<th>Signature:</th>
<th>Date:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permit issued to:</td>
<td>Signature:</td>
<td>Date:</td>
</tr>
<tr>
<td>Permit authorised by:</td>
<td>Signature:</td>
<td>Date:</td>
</tr>
<tr>
<td>Handover person:</td>
<td>Signature:</td>
<td>Date:</td>
</tr>
</tbody>
</table>

## Utility location

<table>
<thead>
<tr>
<th>Traced and marked by:</th>
<th>Signature:</th>
<th>Date:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Comments:

---

## Excavation pre-start

As the person responsible for the above mentioned work, I will inform all associated personnel bound by this Permit of their duties and ensure compliance with the site specific excavation requirements as stated in the JSEA.

Site Engineer:  

| Signature: | Date: |

I will undertake non-destructive pot-holing to visually identify all utilities shown in this permit prior to works commencing. (refer Excavation procedure agreement)

Subcontractor Foreman:  

| Signature: | Date: |

Excavator Operator:  

| Signature: | Date: |
Permit extension (if required)

Works still within boundaries of the existing permit: ☐ Yes ☐ No (If no request a new permit)
Service plans still valid (no other contractors have moved or added utilities within site)? ☐ Yes ☐ No

Permit extended to: Authorised by: Signature:

Permit close out

Job complete and site left secure and safe ☐ Yes ☐ No
Service plans withdrawn from site and discarded or archived ☐ Yes ☐ No
Closed out by: Site Engineer Signature: Date:

Excavation Procedure Agreement

The below procedure must be followed when working around utilities on NZ Transport Agency sites.

1. Where a utility locate provider has been used, site engineer must walk over site with the locate provider to review their findings.
2. Site engineer and subcontractor’s supervisor/foreman to confirm that utility plan and that any utilities marked onsite are in agreement.
3. Contractor is responsible for contacting site engineer at least two hours prior to excavation works commencing.
4. All underground utilities must be potholed by hydro or air excavation, hand excavation, or a combination of both. Pick axes and crow bars must not be used except for breaking up surface seal.
5. All utilities found by potholing must be visually identified as the utility that is on the drawing.
6. No mechanical excavator is allowed to work within 2 metres of a utility if it has not been potholed and positively identified by an engineer and subcontractor foreman/spotter.
7. An engineer must be present when any excavation work takes place around electrical cables, gas lines or fibre optic cables.
8. When excavating close to any underground utility, a competent spotter must be present to guide the excavator operator, after it has been potholed.
9. When working close to overhead lines a competent spotter must be present to guide the excavator operator. If the spotter needs to step away, the excavator must stop work until the spotter returns.
10. Where appropriate, ‘tiger tails’ will be fixed to overhead lines. The electricity network will make an assessment on whether ‘tiger tails’ are appropriate.
11. Where possible, overhead lines may be relocated temporarily.

NZ Transport Agency, Principal Contractor:
Failure to follow these procedures may result in disciplinary action being taken against the individual/s responsible.

Subcontractors:
Failure to follow these procedures will result in excavator operator and spotter being re-inducted. Repeat offenders will be removed from site.

Subcontractor’s representatives (Foreman and Operator):
Signed: Signed:  
Date: Date:

Principal Contractor representative
Signed:  
Date:
Appendix H: Cable and pipe tracer features and specifications

There is a range of technology available in an extensive variety of packages. The professional location contractor should include the following minimum requirements in the package:

- Transmitter with a power of at least 5 watts, preferably 10 watts, capable of maintaining this into a direct connection impedance of 10 kilohms. The transmitter power setting should be adjustable.
- Transmitter frequencies of at least 815Hz and 82 kHz, but possibly including other frequencies such as 8 kHz and 33 kHz.
- 100 mm clamp-style antenna accessory and direct-connect leads, and earth stake accessory.
- Ample supply of transmitter batteries for the day or a rechargeable transmitter.
- Receiver with the frequency capability to match the above transmitter, and additional modes of 50Hz and RF.
- Push-button depth modes on receivers are an option but should not be used to determine depths formally.
Appendix I: Ground penetrating radar (GPR) features and specifications

To allow the best combination of penetration depth and identification of weaker reflecting targets (e.g. air-filled ducts), all surveys carried out must be at a frequency that provides the levels of accuracy specified in Appendix D.

Ideally the GPR antenna should be shielded to minimise the effects of surrounding surface features. As different frequencies offer an advantage in data clarity, the operating frequency of the equipment should be optimised according to the locate requirements.

GPR units must have practical, quick, and simple to use onscreen means to confirm the propagation speed of the GPR signal in ground at every point at which a depth reading is taken.

Ideally the operator should be able to set depth ranges and gain on the GPR display. This should be adjustable in real time without having to re-trace the surveyed data once a change has been made.

A filter to remove horizontal stratigraphy on the display is a useful feature.

While trace recording is not required for Transport Agency locations, the facility to save and later download a given underground feature noted by the operator is encouraged. Associated fiducial marks on the display are an advantage.