PAS 128:2022 Client Specification Guide

What to ask for when commissioning a PAS 128 utility survey

From the Utilities and Subsurface Mapping Panel
Chartered Institution of Civil Engineering Surveyors

Contents

Contact
Chief Executive Officer
Chartered Institution of Civil Engineering Surveyors
ceo@cices.org

Introduction

When you need to know the location and type, size, depth and number of underground utilities, it is important to ensure that when engaging a consultant or specialist surveyor, that the enquiry or instruction is clear and preferably uses a known, robust and respected specification. There are many ways of providing data to depict underground utilities. These include providing record drawings, historic data, site visits, detecting the underground utilities via various geophysical survey methods and excavating to confirm location.

The Chartered Institution of Civil Engineering Surveyors (CICES) suggests clients consider the **PAS 128:2022 Specification for the detection of underground utilities**. This has been developed with input and advice from professional bodies, survey practitioners, technology providers and academia and it is recommended that it is referenced in any specification document to ensure that tender returns are robust and technically sufficient. The PAS 128:2022 Specification for underground utility detection, verification and location can be purchased from the BSI website.

You will need to specify in detail the type of PAS 128 survey required when you enquire, as well as the level of detail that you need and expect from a surveyor. This will ensure that you receive the type of survey you are expecting, plus the level of detection, quality and type of data presentation that you need.

PAS 128:2022 provides example project workflow diagrams within Annex E (informative) on pages 55-59 inclusive, to assist with project planning.

PAS 128 is split into four different survey types which can be used to determine the quality level of survey data provided to the client by the surveyor:

- **Survey Type D: Desktop utility records search**
  This is where underground utilities are approximately identified through the collation and analysis of existing paper and digital utility records via a thorough search of potential asset owners.
- **Survey Type C: Site reconnaissance**
  This is where existing records are supported and validated by the visual inspection of above-ground physical evidence observed or recorded during a site visit.
- **Survey Type B: Detection**
  This is where underground utilities are detected by geophysical techniques, visual inspection, metadata collection and are geospatially located.
- **Survey Type A: Verification**
  This is where underground utilities are visually identified via a manhole or inspection chamber or are excavated and exposed.

About this guidance

The CICES specialist Utilities and Subsurface Mapping Panel (USMP) has produced this best practice guidance to assist clients when specifying verification, detection and location for PAS 128 survey types D, C, B and A.

When you see the symbol  this is where we suggest text clients could copy to help them in seeking robust, informative and clear tender returns.

This document should be read in conjunction with PAS 128:2022. This guidance is provided as an open and free-to-use document, information is provided in good faith. No survey accuracy is guaranteed, implied or given. Users should always refer to the full PAS 128 specification for clarification where necessary. While there is an extensive client guide (Annex B) within PAS 128, it is recognised that many clients may wish to incorporate elements of the PAS 128 specification within their own tender and specification documents.

It is recommended that clients familiarise themselves with the **Secure Data Management for Utility Surveys** best practice guidance and guidance notes from **The Survey Association** which will help when tendering.

Survey Types and Quality Levels explained

Survey Type D is a prerequisite to all other survey types C, B and A being undertaken. Survey Type D data can be provided by the client (if considered robust and up-to-date by the asset owner) or can form part of a tender for other survey work (including survey types C, B and/or A).

Survey Type C can be undertaken at the same time as Survey Type B on-site. Often a surveyor will include Survey Type C within the scope for Survey Type B. However, clients should always request that Survey Type C is specified within the scope of the survey.

Survey Type B consists of a full utility mapping survey. This must include a minimum of:

- Type D and C surveys.
- Electromagnetic locator (EML) and ground penetrating radar (GPR) survey techniques.
- Other survey techniques as appropriate to the project.
- Accurate survey of located services and related infrastructure.

Survey Type A is visual identification. This can either be at a verification test hole, slit trench or excavation, or from visual inspection within chambers.

What the client needs to specify

The client should identify the accuracy they need in different areas of their site (D, C or B1, B2, B3) and the surveyor should propose a methodology which provides the best opportunity to achieve this quality level, using a combination of the different survey types and methodologies. If you have doubts about PAS 128, survey types, methodology types, and quality levels achievable, request clarification from a specialist utility surveyor. Membership of CICES and/or the Royal Institution of Chartered Surveyors (RICS) are indications of professionalism. Membership of The Survey Association (TSA), European GPR Association (EuroGPR) or being regulated by RICS indicates that a company is committed to high standards and operating in an ethical manner. Early engagement of a trusted specialist utility surveyor is key to successful survey data.

We suggest that clients make themselves familiar with Annex B of PAS 128:2022, Client guide to using the PAS 128 and Utility Surveys. This will help explain how a survey is undertaken, the methodologies used and the possible levels of quality and accuracy. Guidance notes from TSA are also helpful in this regard.

Where possible, the client should provide information on survey areas and any existing topographical data as digital files (such as CAD or GIS formats). Ambiguity in quoting can often be caused by poor quality PDF files being issued which have come from a digital form in the first place.

Survey Type	Quality Level	Description
Survey Type D Desktop Utility Records Search	QL-D	Positional location has been provided by a utility record search only. This is the lowest quality level a survey can provide.
Survey Type C Site Reconnaissance	QL-C	Positional location has been confirmed by visual inspection and reference to street furniture, topographical features or evidence of previous street works, such as a reinstatement scar.
Survey Type B Detection	QL-B4	Positional location has been assumed. The utility, or segment of utility, is suspected to exist but was not detected by the geophysical techniques used.
	QL-B3	Positional location has been detected by one of the geophysical techniques but with no confidence in depth.
	QL-B2	Positional location and depth of the utility have been detected by one of the geophysical techniques and the surveyor has a reasonable confidence in the survey accuracy or quality level.
	QL-B1	Positional location and depth of the utility have been detected by one of the geophysical techniques and the surveyor has a high degree of confidence in the survey accuracy or quality level.
Survey Type A Verification	QL-A	Positional location and depth of the exposed utility at a manhole or inspection chamber, including the horizontal and vertical position of the top and/or bottom of the utility, have been detected and recorded with any additional attributes specified by the client. This is the highest quality level a PAS 128 survey can provide. Also attributable to a utiltity that has been exposed in a trail hole or slit trench/excavation and the exposed utility has been geophysically referenced.

1. Survey Type D: Desktop Utility Records Search

When requesting a Survey Type D desktop utility record search, clients could include the following text in the specification document:

Undertake a Survey Type D: Desktop Utility Records Search, as defined in Section 7 of PAS 128:2022, of the required site area (reference to the search boundary plan to be provided by the client). This shall comprise a thorough and complete search of all known utility asset owners within the specified area.

The search shall identify and include:

01. *A plan showing the boundary of the requested survey area.*
02. *A list of utility owners who were sent a request for data.*
03. *A list of owners of utility data on private sites* who were sent a request for data.*
04. *A list of utility owners who responded.*
05. *A list of actions taken to obtain a response from utility owners who did not respond to the request for data.*
06. *All data received from utility owners, together with any covering letter/s and asset guidance notes.*
07. *The date of issue of all data supplied by utility owners.*
08. *An advisory note in* bold type *explaining how this data was constructed, its limitations regarding accuracy and stating that no on-site survey or geophysical detecting techniques have been used in compiling the information.*
09. *A final deliverable may be provided as a compilation and consolidation of all record data into a digital representation within a CAD, GIS, PDF or BIM model file structured to the client's requirements.***

*Private sites could include for example hospitals, airports and nuclear power plants. When a project takes place on a private site, such as a hospital, industrial or military establishment, a utility owner might not have statutory records covering the survey area. Historical utility data should be obtained from the relevant estate's department, where available.

**This may be offered as an additional item. It is not a requirement of PAS 128.

2. Survey Type C: Site Reconnaissance

When requesting a Survey Type C site reconnaissance, the client should include the following text in the specification document:

Undertake a Survey Type C: Site Reconnaissance, as defined in Section 8 of PAS 128:2022, of the required site area (reference to the search boundary plan to be provided by the client). This shall comprise an on-site visual inspection of all accessible parts of the site and to identify physical features above ground that support the existence of utilities within the survey area in comparison to utility records. The survey data will be used to assess if there are any conflicts that need to be resolved.

Where the utility records can be matched to surface features, the quality level achieved shall be documented as QL-C.

Where the utility records cannot be matched to surface features, the quality level achieved shall be documented as QL-D.

The search shall identify and include:

01. *A plan showing the boundary, the presence, type and markings of utility-related surface features.*
02. *Measurements between known surface features on the ground compared with those depicted on any existing plans.*
03. *Differences between features on existing records supplied and those visible on the ground.*
04. *Surface features to be included in the on-site checks shall include as a minimum:*
    a) manhole and inspection chamber covers
    b) valve covers
    c) utility markers
    d) control and distribution pillars and columns, LV power, street lighting, traffic lights
    e) historic excavation scar lines.

Reporting should be conducted with reference to clauses 8.2.4, 8.2.5 and 8.2.6 of PAS 128:2022.

Survey Type C can be undertaken at the same time as Survey Type B, not necessarily as a separate site visit.

3. Survey Type B: Detection

Survey Type B needs careful consideration from both client and surveyor. Within Survey Type B, Methodology Types indicate the level of intensity of the survey. The Methodology Type can directly influence the level of accuracy or quality achievable in the deliverable data for each section of the surveyed utility.

PAS 128 calls for the client to indicate to the surveyor the level of accuracy or quality level that they require or would like to be achieved, if technically possible, in different areas of the project. The surveyor will then suggest the appropriate survey type(s) to potentially achieve this using a combination of appropriate geophysical survey methods. To aid this part of the commissioning process, we suggest that prior to a formal tender or quotation request being undertaken, dialogue takes place between the client and a specialist utility surveyor to discuss the different options and potential survey outcomes available.

When requesting a Survey Type B: Detection survey, the client should include the following text in the specification document:

> *Undertake a Survey Type B: Detection survey to a Methodology Type(s) appropriate to the project needs, as defined in Section 9 of PAS 128:2022, of the required site area (a survey boundary plan is provided in Section X/Appendix X*). The on-site survey shall use EML and GPR geophysical techniques as a minimum, plus other geophysical methods as appropriate.*
>
> *The survey will also comprise markings to the ground to depict the position and depth of underground apparatus. These markings shall be in permanent spray paint/semi-permanent spray paint/wax chalk/ flags/pegs*. Should any of the chosen marking types be impractical or not possible then the surveyor shall inform the client in writing and suggest an alternative marking system.*
>
> *GPR post-processing and off-site data analysis shall/shall not* be required.*
>
> *Visual inspection of all accessible manhole covers, inspection chambers and access points shall be undertaken as part of a Survey Type B survey. The data gathered from a visual inspection is categorised as Survey Type A and must adhere to Section 10.2.2 of PAS 128:2022. Data shall be presented in the form of photographs accompanied by chamber asset cards, reports or similar.*

**Delete as appropriate*

GPR Post-processing

GPR post-processing is a system where GPR transects are recorded on site and then post-processed via specialist software. This process endeavours to clean up the radar data, assist the surveyor to interrogate the data at varying depths and make informed choices via an office-based process. Non post-processed GPR data involves the site surveyor making decisions based on site readings from the GPR equipment. The client should consider what level of confidence it requires from the data:

- On-site GPR data analysis is quicker, however fine detail may be missed.
- Post-processed GPR data is potentially more accurate and better quality, however it takes longer.
- Density of services, size of site and ground conditions can impact on the effectiveness of on-site readings.
- Consider the competence of the person completing real-time GPR readings on-site or post-processing and what geophysical knowledge they possess to allow accurate interpretation of data.
- Other certain ground conditions may make other geophysical survey methods more appropriate.

Methodology Types

The higher the Methodology Type, the more intense the on-site survey and potentially more accurate final deliverable data. There are six different Methodology Types: M1 being the simplest to M4P being the most complex. M1 and M2 Methodology Types can include GPR post processing, while M3P and M4P always include GPR post processing. Broadly, the different types relate to:

- **M1/M1P**. Used where density of services is typical of an undeveloped area.
- **M2/M2P**. Used where the density of services is typical of a suburban area or where the utility services cross a boundary of a survey area.
- **M3P**. Used where density of services is typical of a busy urban area or for clearance surveys prior to operations like borehole, drilling, fencing or planting.
- **M4P**. Used where the density of services is typical of a congested city area.

4. Survey Type A: Verification

When requesting verification by excavation, the client should include the following text in the specification document:

Undertake a Survey Type A: Verification by Excavation survey, as defined in Section 10 of PAS 128:2022, of the required site area (reference to the search boundary plan to be provided by the client).

The survey shall identify and include:

01. *Trial pit/trial hole/slit trench [delete as appropriate] to be excavated to a width of XX metres and depth of XX metres or to a width and depth that is safe and practical to do so.**

02. *Information gathered from an exposed utility within an excavation shall as a minimum consist of:*
    a) nature of utility (such as pipe, cable or other)
    b) configuration of multiple utility layout
    c) diameter of utility (external diameter only)
    d) material type
    e) backfill materials used
    f) observation of the condition of utility
    g) prevailing ground conditions
    h) appropriate imagery to be captured of the exposed asset and environment – in line with the requirements of the client.

03. *When backfilling a hole or trench any material used shall be compressed and tamped down to avoid subsidence. Any wearing course will be replaced with a like-for-like material, unless otherwise instructed.*

04. *Fees should be included to cover any excavation permit, safe systems of work and supervisor under the New Roads and Street Works Act 1991 (NRSWA) as appropriate.*

Verification Types

Survey Type A: Verification can be by one of two different visual inspections, as defined in Section 10 of PAS 128:2022:

- Inspection via a manhole chamber, inspection chamber and/or access point; or
- Exposing the utility and subsequently measuring and recording its accurate location as well as other relevant attributes through excavation.

Survey Type A by excavation can be the ideal way of confirming the exact position and depth of a utility detected previously via Survey Type B techniques. Strategic positioning of verification trial holes can considerably aid design and build. Verification by excavation can be undertaken by either vacuum or suction excavation or by hand-dug or machine-dug trial pits.

If excavating on the public highway, which includes footpaths, it is mandatory to obtain an excavation permit from the local authority. Many providers of verification by excavation will be able to arrange this.

*The surveyor can advise on this if the client is unsure what to specify.

5. Deliverables

Deliverables provide the client with an understanding of the survey accuracy and confidence levels, methodologies used, together with any cautionary advice notes and limitations. When requesting deliverables, the client could include the following text in the specification document:

*Survey data shall be presented as file formats for use in CAD/GIS/BIM [delete as appropriate] and/or in other project or client specified deliverables.**

A report shall accompany any survey output. This shall contain the following as a minimum:

01. *Written description of the survey project requirements and defined survey area.*

02. *List of the detection methodologies used during the survey.*

03. *Survey outcomes including:*
    a) planimetric information
    b) metadata
    c) a description of how successful each detection methodology was and a plan showing any areas where the detection methodologies were not successful
    d) a list of any utilities expected to be present based on the desktop utility records search that were not detectable using the detection methodologies. These should be referenced to the plan in (c) above
    e) a list of buried features and obstructions other than utilities detected during the execution of the survey
    f) plans showing all areas of conflict between record information, site information and detected utilities
    g) photographs as specified or where taken to support understanding
    h) recommendations for any further survey work provided during the execution of the works
    i) information on how GPR was calibrated and how many calibrations have been conducted around the site
    j) what post-processing software has been used to post-process the GPR results
    k) the variations in depth of the GPR penetration achieved around the site
    l) the conditions on site at the time of the survey and any issues that might generically affect the survey outputs, for example rain.

04. *A post-survey debrief in person (at an office or location of the client's choosing) or virtual via video sharing software. This meeting shall be noted and the outcome recorded in writing for both client and practitioner.***

*The client should be clear as to the type of deliverable required. The term 'data' can include everything from historic paper records, plans, maps and photographs to digital geospatial and geophysical data, such as CAD drawings, EML and GPR data, point clouds and models for use in augmented reality applications.
**A post survey debrief can be requested by the client and is valuable in aiding familiarity with the data collected. Clients are strongly recommended to specify a post-survey debrief on major projects.

This guidance has been prepared by the Utilities and Subsurface Mapping Panel of the Chartered Institution of Civil Engineering Surveyors.
Lead authors: John Robinson FCInstCES, Janos Dobsi FCInstCES MBA and Abigail Tomkins CICES
Thanks to members of the Utilities and Subsurface Mapping Panel.