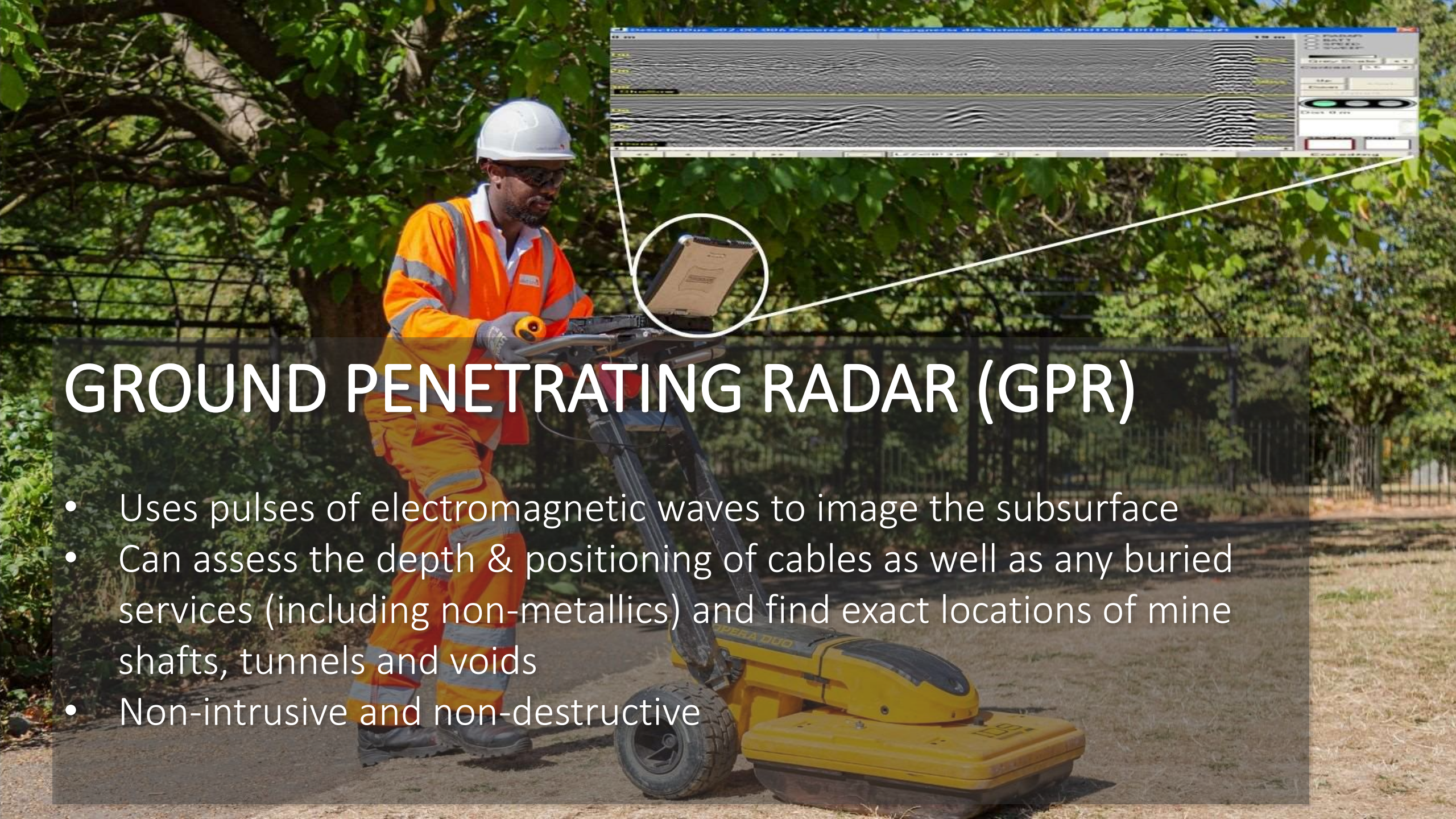
select surveys

UTILITY AND LAND SURVEYORS
AND BIM MANAGEMENT SPECIALISTS

GPR: CAPABILITIES AND LIMITATIONS FOR UNDERGROUND SURVEYING



GROUND PENETRATING RADAR (GPR)

- Uses pulses of electromagnetic waves to image the subsurface
- Can assess the depth & positioning of cables as well as any buried services (including non-metallics) and find exact locations of mine shafts, tunnels and voids
- Non-intrusive and non-destructive

CAPABILITIES & LIMITATIONS OF GPR

- GPR alone ≠ a utility survey
- While there have been advances in GPR technology over the years, GPR alone will not provide accurate results
- Other techniques alongside GPR are vital to ensure accuracy and completeness
- To achieve the highest quality of survey we will always use multiple detection methods

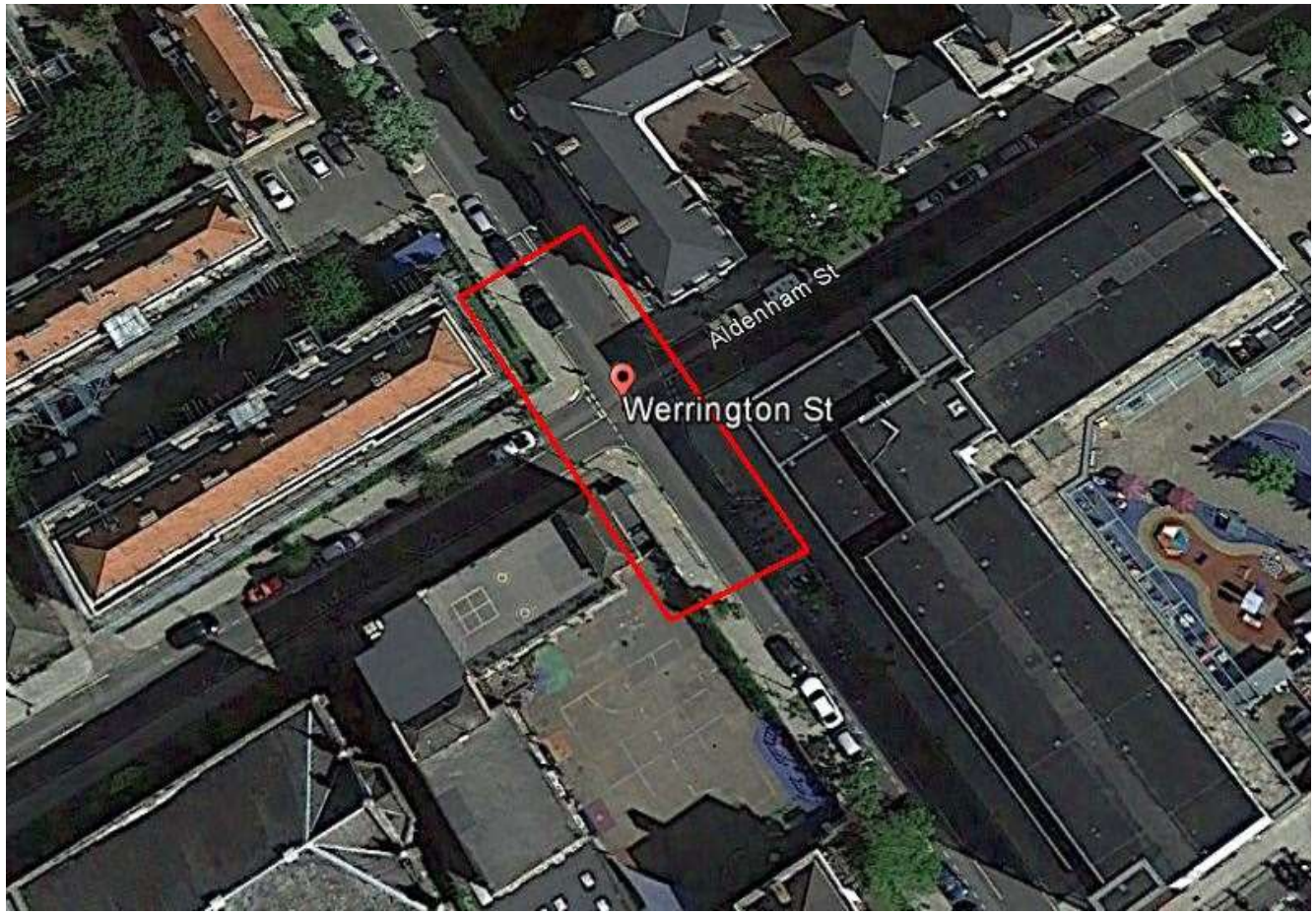
GPR: MYTHS AND LEGENDS

GPR cannot:

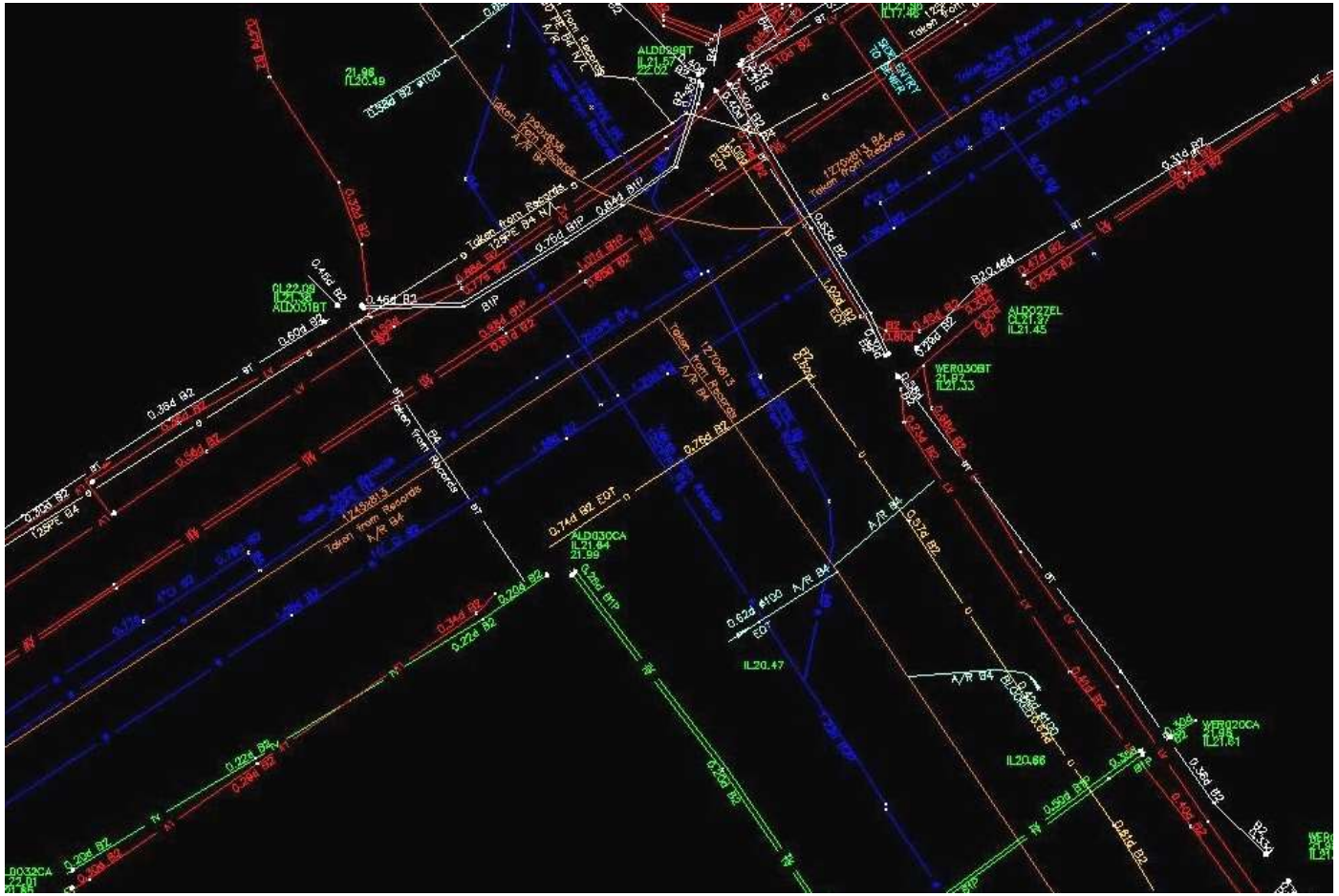
- Look sideways, you can’t see under obstructions
- See through wet ground or standing water
- Pick up all utilities
- See clearly through rebar
- Identify Utilities or their size

VEHICLE TOWED GPR VS HI-MOD

A comparison of Select Surveys' GPR methods vs a Vehicle-towed GPR survey employed on the Euston Throat survey demonstrates the difference in data collected from different techniques.



SURVEY RESULTS

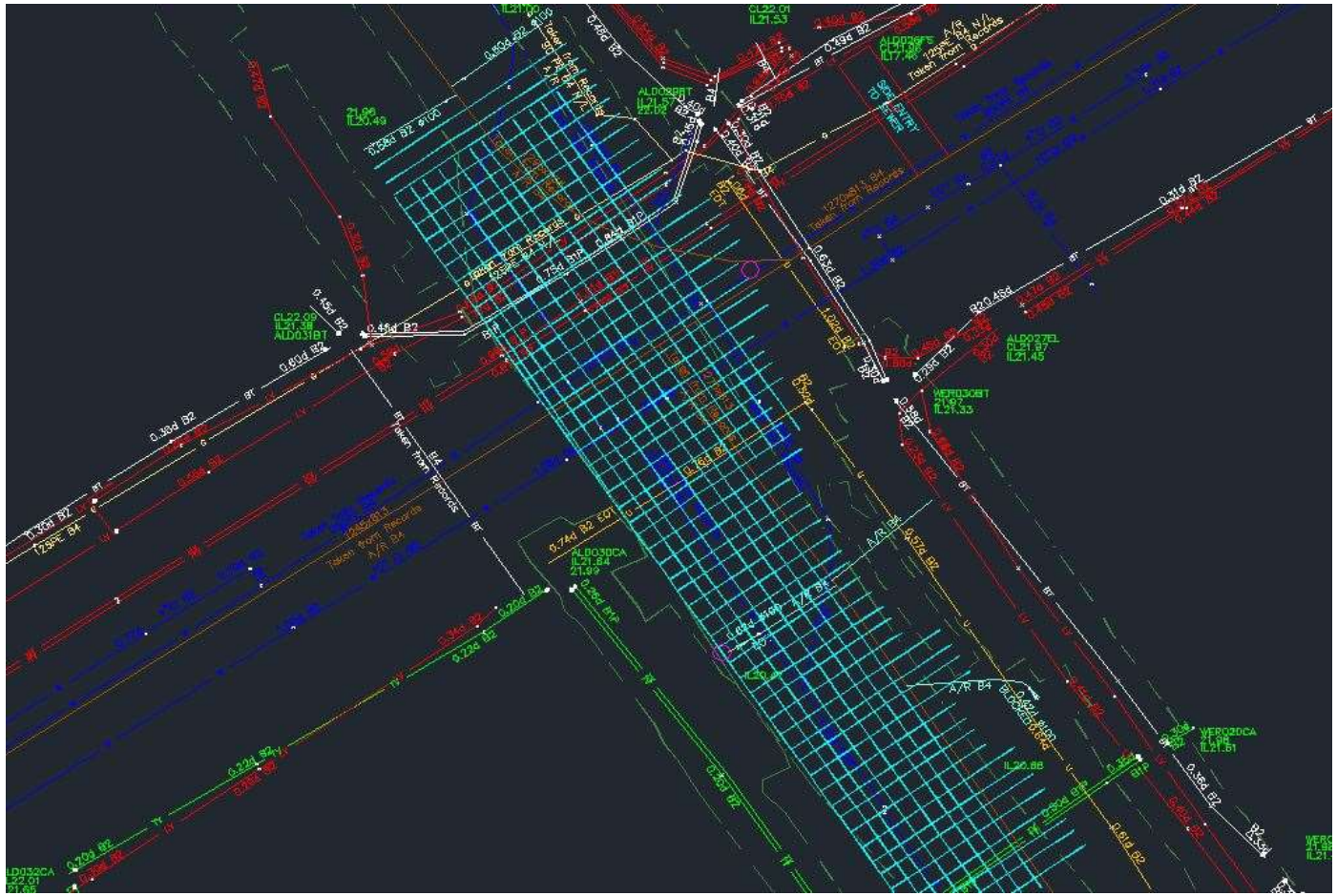


- Electromagnetic Survey Data

SURVEY RESULTS

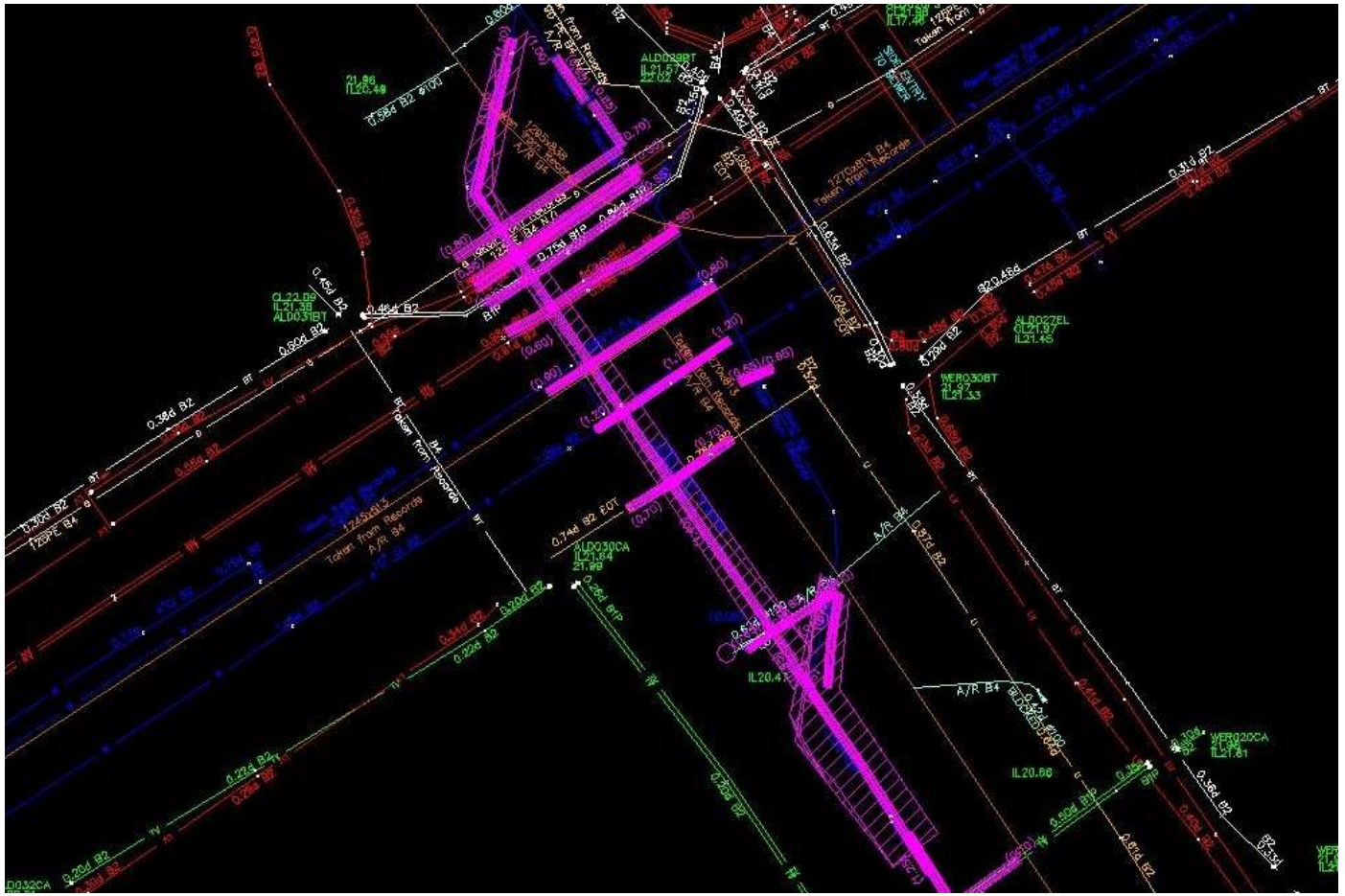
- Electromagnetic Survey Data
- High Speed Vehicle-towed GPR Data Added

SURVEY RESULTS



- Electromagnetic Survey Data
- High Speed Vehicle-towed GPR Data Added
- Select Surveys Scan Area

SURVEY RESULTS



- Electromagnetic Survey Data
- High Speed Vehicle-towed GPR Data Added
- Select Surveys Scan Area
- Select Surveys Hi-Mod GPR Data

PAS128: 2014 vs 2022

- PAS128: 2014 represented a huge step forward in the standardisation of surveying
- PAS128 was updated in 2022
- Some positive changes were introduced in the 2022 version:
  - The need for surveyors to have a recognised qualification
  - Codification of the requirements for permits to break ground and the mandated methodology requirements
- Unfortunately other changes have watered down the level of accuracy needed to deliver results with the highest confidence rating
- In our opinion this ultimately lessens the safety of digging teams

PAS128 LEVELS OF ACCURACY

Table 1 – Quality level of survey outputs (normative)

Survey type (Establish with client prior to survey)		Quality level (Practitioner to determine post survey)	Post-processing	Location accuracy		Supporting data
				Horizontal [1]	Vertical [2]	
D	Desktop utility records search	QL-D	—	Undefined	Undefined	—
C	Site reconnaissance	QL-C	—	Undefined	Undefined	A segment of utility whose location is demonstrated by visual reference to street furniture, topographical features or evidence of previous street works (reinstatement scar).
B	Detection [3]	QL–B4	No	Undefined	Undefined	A utility segment which is suspected to exist but has not been detected and is therefore shown as an assumed route.
		QL-B3	No	±500 mm	Undefined (No reliable depth measurement possible)	Horizontal location only of the utility detected by one of the geophysical techniques used.
		QL-B3P	Yes			
		QL-B2	No	±250 mm or ±40% of detected depth whichever is greater	±40% of detected depth	Horizontal and vertical location of the utility detected by one of the geophysical techniques used. [4]
		QL–B2P	Yes			
		QL-B1	No	±150 mm or ±15% of detected depth whichever is greater	±15% of detected depth	Horizontal and vertical location of the utility detected by multiple [5] geophysical techniques used.
		QL–B1P	Yes			
A	Verification	QL-A	—	±50 mm	±25 mm	Horizontal and vertical location of the top and/or bottom of the utility. Additional attribution is recorded as specified in 9.2.5.

[1] Horizontal location is to the centreline of the utility.
[2] Vertical location is to the top of the utility.
[3] For detection, it is a requirement that a minimum of GPR and EML techniques are used (see 8.2.1.1.2).
[4] Electronic depth readings using EML equipment are not normally sufficient to achieve a QL-B2 or higher.
[5] Some utilities can only be detected by one of the existing detection techniques. As a consequence, such utilities cannot be classified as a QL-B1.

PAS128 DETECTION METHODS

Table 2 – Detection methods (normative)

Method [1] (to be determined in consultation with the client)	Survey grid/search resolution [2]				Quality levels achievable	Typical application (informative)
	EML [3]	GPR		Other techniques [4]		
		General	Post-processing			
M1	Orthogonal search transect at ≤10 m intervals and when following a utility trace, search transects at ≤5 m intervals	Use as applicable	No	≤5 m survey grid	B1, B2, B3, B4	Used where the density of services is typical of an undeveloped area
M1P			Yes		B1P, B2P, B3P	
M2	Orthogonal search transect at ≤5 m intervals and when following a utility trace, search transects at ≤2 m intervals	Either: a) ≤2 m orthogonal; or b) high density array [5]	No	≤2 m survey grid	B1, B2, B3, B4	Used where the density of services is typical of a suburban area or where the utility services cross a boundary of a survey area
M2P			Yes		B1P, B2P, B3P	
M3	Orthogonal search transect at ≤2 m intervals and when following a utility trace, search transects at ≤1 m intervals	Either: a) ≤1 m orthogonal; or b) high density array [5]	No	≤1 m survey grid	B1, B2, B3, B4	Used where the density of services is typical of a busy urban area or for clearance surveys prior to operations such as borehole/drilling/ fencing/tree planting
M3P			Yes		B1P, B2P, B3P	
M4	Orthogonal search transect at ≤2 m intervals and when following a utility trace, search transects at ≤0.5 m intervals	Either: a) ≤0.5 m orthogonal; or b) high density array [5]	No	≤0.5 m survey grid	B1, B2, B3, B4	Used where the density of services is typical of a congested city area
M4P			Yes		B1P, B2P, B3P	

NOTE 1 In general the effort increases from M1 to M4 and the addition of post-processing. For areas with a greater density of utilities or areas considered high risk by the client, a detection method that has a higher level of effort should be selected.

NOTE 2 "P" indicates off-site post-processing has been included.

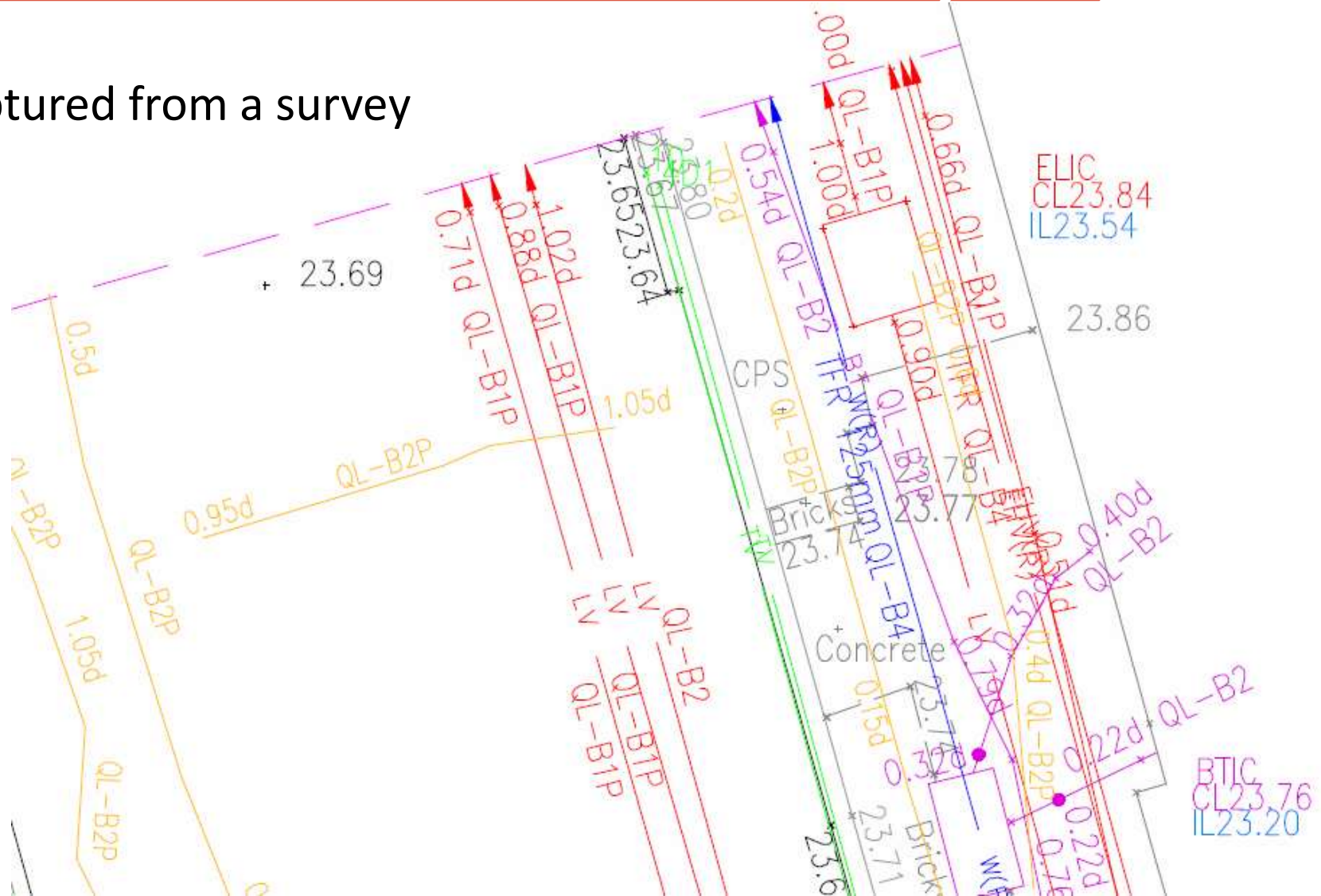
[1] It is a requirement that a minimum of GPR and EML techniques are used (see 8.2.1.1.2).
[2] The tolerance for orthogonal transect centres and survey grids shall be ±0.1 m.
[3] It is a requirement that passive EML is deployed over the whole survey area and that where an active EML method can be used, it is used (see 8.2.1.3.2).
[4] The transect centre depends on technique used.
[5] A high density array comprises 100 mm or closer antenna separation.

PROCURING A SURVEY

- Desktop surveys give an estimate of how many underground services are present
- These should always be followed up with an underground utility survey before breaking ground
- Which survey is right for me?
  - Where is my survey?
  - What am I doing on site?
  - What known utilities are in the area?
- Who is best placed to help procure a survey?

UNDERSTANDING SURVEY DATA

- Example data captured from a survey

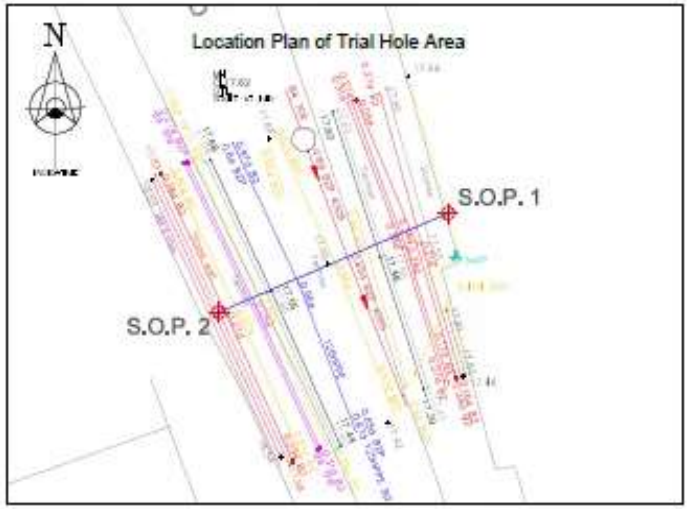


CONCLUSION

- A GPR survey ≠ a utility survey
- For the most accurate results an underground survey needs to go above and beyond PAS128:2022 specifications
- Multiple detection methods are required to ensure the highest quality of data is collected

VIRTUAL TRIAL HOLES

- Non-intrusive
- Mobile works / Less Traffic management
- No-dig - access areas where breaking ground is not possible
- Cost effective
- More sites/ better coverage
- Modify location without replanning
- Lower environmental impact



PAYE

Bell Yard
Law Society

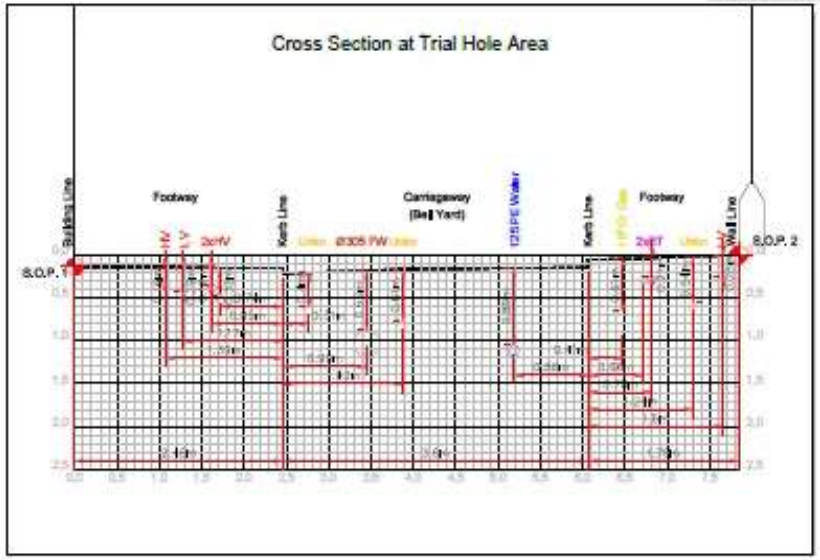
Trial Hole Report

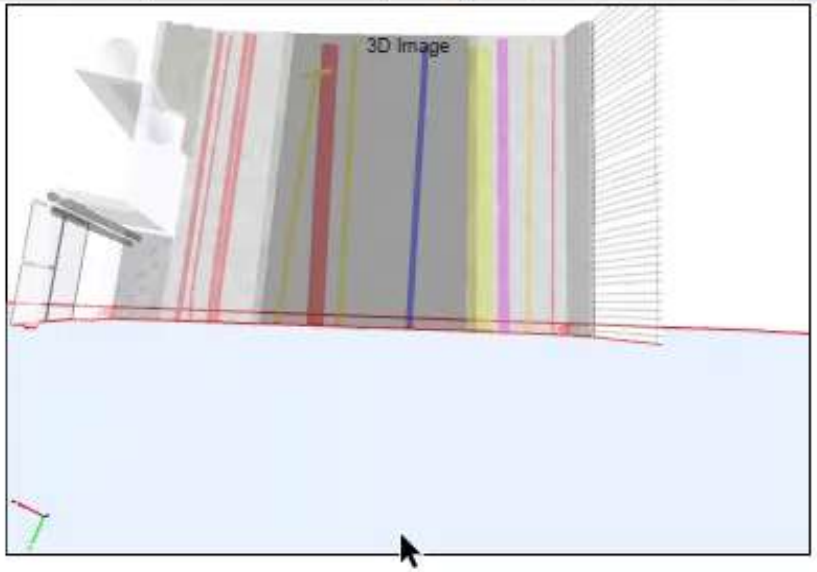
15-PAE-1540

select surveys

The Old Coach House
London Road
Wrotham
Kent
TN15 7RR
TEL: 0844 4 787839 FAX: 01732 783680

DATE Sep 2016





select surveys

The Old Coach House, Kent

08444 787 839

select.surveys@selectsurveys.com

www.selectsurveys.com

ISO 45001 HEALTH & SAFETY MANAGEMENT

ISO 14001 ENVIRONMENTAL MANAGEMENT

ISO 9001 QUALITY MANAGEMENT