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PAS128 Utility Mapping – Survey Report

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Document History & Status

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1.0 Introduction

The works are to undertake a utility mapping survey within a predefined survey area. The utility mapping survey has been undertaken and has been issued in 2D format for information purposes to further the client's understanding of the existing sub-surface layout. The field work was carried out during November 2020.

2.0 Site Location Plan

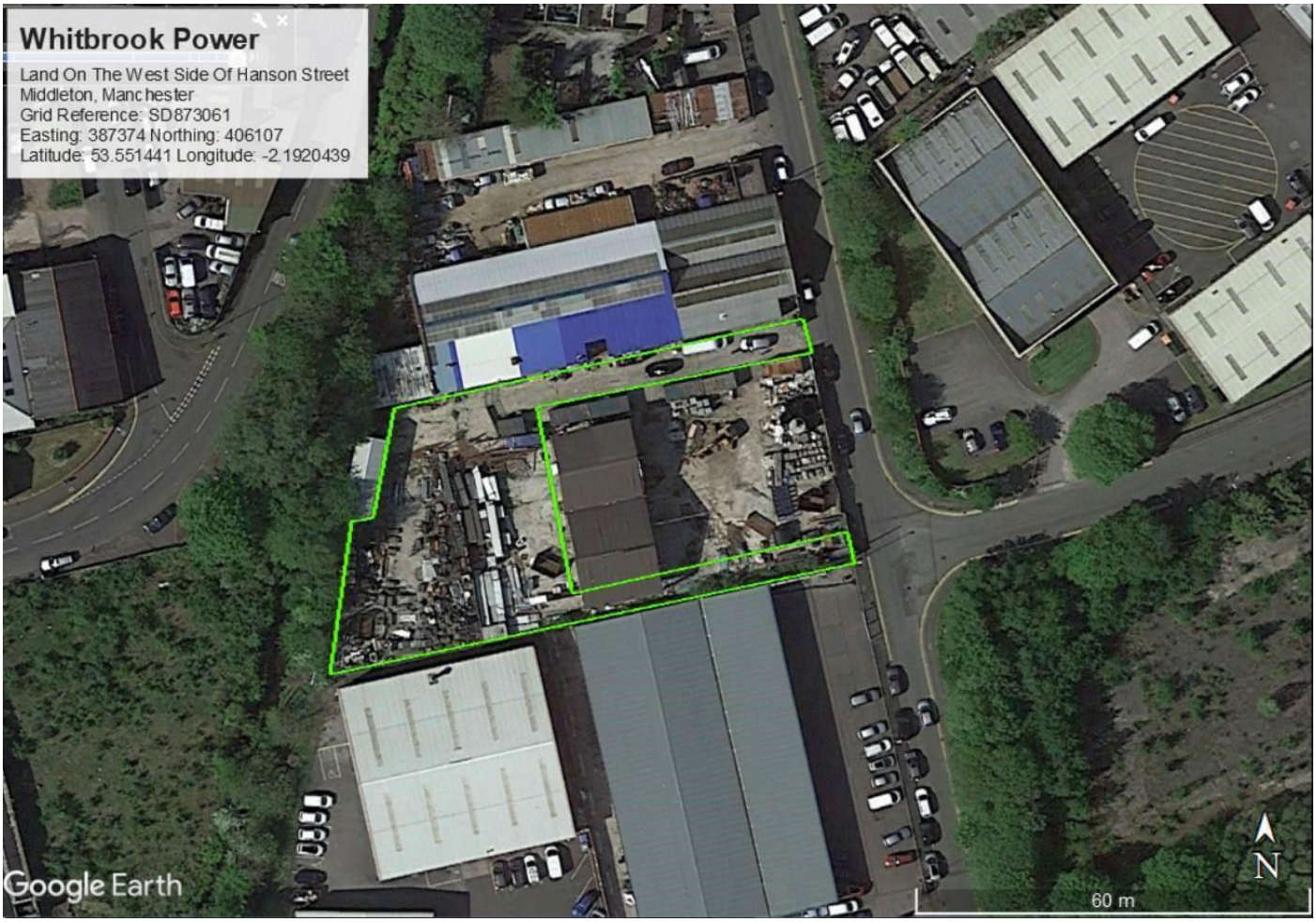


Fig1. Survey Boundary

3.0 Scope of Works

We work to ***PAS:128 2014 The Specification for Underground Utility Detection, Verification and Location***, with the list below identifying the four different survey types that can be adopted when undertaking utility mapping, Level A to Level D.

- **Level D survey** - Desktop Record Search (C2 search).
- **Level C survey** - A Level D survey but also visiting the site to ensure that there was visual evidence of the equipment expected by the Statutory Providers was in fact on site.
- **Level B Survey** – Detection. This involves surveyors taking the stats plans provided from the Level D survey and attempting to trace these items through the survey area accurately. The survey teams will use Electromagnetic Precision Locators, Genny's, and Ground Penetrating Radar, Flexi-trace systems, sondes and auxiliary utility survey equipment.
- **Level A** - Verification is undertaken on the Level B survey, typically in the form of Trial Pits. The location of trial pits can be decided from the Level B survey to maximise the information gathered.

The technical requirements of the ground scanning survey brief are to identify and locate all possible underground services within specified survey limits, as shown on the site location plan.

For this project we have adopted a level B survey with the buried utility location, tracing and depth determination undertaken using M1.

M1 methodology is generally used where the density of services is typical of an undeveloped area. EML orthogonal search transects will be at ≤10m intervals and when following a utility trace at ≤5m intervals. GPR search resolution will be at ≤10m orthogonal transects or targeted use only.

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.

Fig2. PAS128 Detection Methods

4.0 Problems Encountered / Site Limitations

The survey area was heavily congested by debris deposited on site. The South boundary has been recorded reflectorless, as the vegetation was dense and made the survey difficult. The GPR and EML transect have been undertaking around these obstacles as far as reasonably practicable.



Fig3. Obstructions



Fig4. Obstructions



Fig5. Obstructions

5.0 Modes of Detection Used

We have used all reasonable efforts expected of experienced and qualified staff to detect and map all possible utilities positioned below the surface. Factors outside our control (for example vegetation and adverse ground conditions) may have limited the effectiveness of these techniques and we cannot guarantee 100% detection.

Ground works should always be undertaken with caution in this regard and should be carried out with attention paid to HSE document HSG47 “Avoiding danger from underground services”.

6.0 Ground Penetrating Radar

A Leica DS2000 GPR antenna, emitting both 250MHz and 700MHz, is a trolley-based system which is pushed across the site on a 5 meter, overlapping grid, where terrain allowed, to ensure maximum coverage. It used to detect for areas where the subsurface environment has been disturbed and where possible buried utilities or subsurface features are present.

To do this the GPR emits microwave signals into the ground. When the emitted energy encounters a buried object or a boundary between the materials having differing Relative Dielectric Permittivities (RDP), the signals are returned to the receiver and it records a two-way travel time and the strength of the signal. For best results, a contrast in the RDP is needed between the target and host material.

Radar travels at different speeds through different mediums and the more conductive or saturated the medium, the signal will attenuate, which may limit the effective depth range of GPR investigation.

Metadata contained within the Report/ CAD drawing is as follows:

- Location of linear sub surface anomalies believed to be buried utilities
- AutoCAD and PDF drawing showing scan locations and findings

Detection Technique	Equipment Trade Name	Manufacturers Details
Ground Penetrating Radar	Leica DS2000	Appendix B

6.1 Limitations of GPR

- Reinforcement bars, high ground water and made up ground can limit penetration.
- The minimum size of asset that can be detected diminishes with depth (10% rule e.g. a 5-6cm diameter target might not be detectable using the GPR if buried deeper than 50-60cm).
- The ground conditions generally allowed depth penetration of 1.10-1.50m across the site

GPR works best with proximity between the antenna and the ground, excessive movement on uneven surfaces can lead to signals being lost, producing poor quality data. Uneven surfaces could also lead to a disparity between the GPRs odometer and actual distances the GPR has travelled when completing scans. This could lead to the position of anomalies not being accurately placed.

6.2 Calibration Procedures

Calibration is scheduled on an annual basis with the manufacturer.

Our GPR survey equipment has built in self-checking and calibrating systems which are activated when the device is turned on and during the software initialisation. The equipment cycles through a series of checks to ensure that all systems are correctly functioning. Should any of these systems fail, an error message is displayed, the equipment will not be used and returned to the dealer/supplier for servicing and calibration.

6.3 Horizontal & Vertical Accuracy

Accuracy of underground utilities can vary depending on the type / size of service, its depth (vertical) and local soil conditions. Whilst best practice is implemented, errors may occur in relation to the positions given for buried services and anomalies, and in certain cases, this error may be in excess of +/- 20% of the value stated.

Depths obtained by ground penetrating radar will usually be to the top of the service or anomaly.

For accurate position and depth measurements we would always recommend trial holes being dug to confirm the presence of buried services.

7.0 Utility Location Survey Summary

7.1 Drainage

No drainage network has been located and the 450 VC from records drawing has been shwon as Quality Level D (QL-D)

7.2 Telecommunications

No communication cable have been located on site. The cables located on the footpath hahave been shown as Quality Level B2 (QL-B2).

7.3 Unidentified Signals

The unidentified service shown on the drawing has been shown as Quality Level B2 (QL-B2) and it has been traced to End of Trace..

7.4 Gas

The gas pipe shown on the records has been located outside the site, on the road, and it has been shown as Quality Level B3 (QL-B3), as we were able to locate the trench were this has been burried but not the top of the service to determine the depth of it.

7.5 Electricity

The electric cable shown on the records has been located outside the site, on the footpath, and shown as Quality Level B2 (QL-B2)

7.6 Water

The water pipe shown on the has been located outside the site, on the foothpath, and it hs been shown as Quality Level B2 (QL-B2).

7.7 Ground Penetrating Radar

No extra targets have been located on site through using the GPR.

8.0 Utility Records Obtained

The utility record information was compiled by Cornerstone Projects prior to attending site. All utilities shown on the records within 5m of the survey boundary have been added for information purposes.

Utility	Utility Owner	Available at Time of Survey
Drainage	United Utilities	YES
Water	United Utilities	YES
Gas	Cadent	YES
Electricity	Electricity Noth West	YES
Telecommunications	BT Openreach	YES

9.0 Control and Data Processing

The survey has been oriented onto the topographical survey provided prior commencing site works. The surveyed data was processed using N4ce software, with the final product edited and completed using BricsCAD.

10.0 Final Presentation / Deliverables

The utility mapping survey results have been overlaid, in 2D format, onto the topographical survey undertaken by 128Mapping during the same visit. This report should be read in conjunction with drawing 128-20-5126-P001.

10.1 PAS128 Expected Accuracies

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.

Fig6. PAS128 Quality Level of Survey Outputs

11.0 Conclusion

All information shown on final drawing and model is digitised from EML and GPR data to produce an ‘overview’ of the network of buried utilities. Although the location accuracy, position and depth will be very high, it does not, in all cases, include utility information such as ownership, service type, pipe materials, duct formation, numbers, etc. Also, due to limitations of GPR and EML, some services may not be able to be detected such as un-ducted cables, small diameter pipes, deep services (beyond signal penetration range).

This survey adheres to PAS128:2014 Type B – M1 specification. Should there be any intrusive works planned, a Type-A (Verification) survey would be recommended to confirm the exact location of services, especially those assumed, or taken from records (QL-B4, QL-C & QL-D).

Due to the dangers of striking underground services, we would certainly suggest that this be undertaken following the HSE Avoiding danger from underground services (HSG47) best practice, along with safe digging practices whenever there is the requirement to break ground. Should there be any intrusive works planned, a Type-A (Verification) survey would be recommended to confirm the exact location of structures.

12.0 Disclaimer

Ground Penetrating Radar techniques combined with visual inspection have been used to map the underground features shown on this plan/report. We use all reasonable efforts expected of experienced and qualified staff combined with calibrated equipment to perform our surveys; however, the completeness of any underground survey cannot be guaranteed. Depths are provided as a guide only.

Please note that not all buried pipes, utilities and features can be detected and mapped due to conditions outside of our control, such as depth, location, material type, geology and proximity to other services. It is recommended that trial holes are undertaken to confirm identification, location and depth of services at critical locations.

13.0 General Site Photos



Fig7. Photo Location Plan



Fig8. General Photo



Fig9. General Photo



Fig10. General Photo



Fig11. General Photo



Fig12. General Photo



Fig13. General Photo



Fig14. General Photo



Fig15. General Photo

APPENDIX A

IC1 - Location	IC1 - Internal
	

IC2- Location	IC2 - Internal
	

APPENDIX B