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PAS128 Underground Utility Mapping

Survey Report

Primary School

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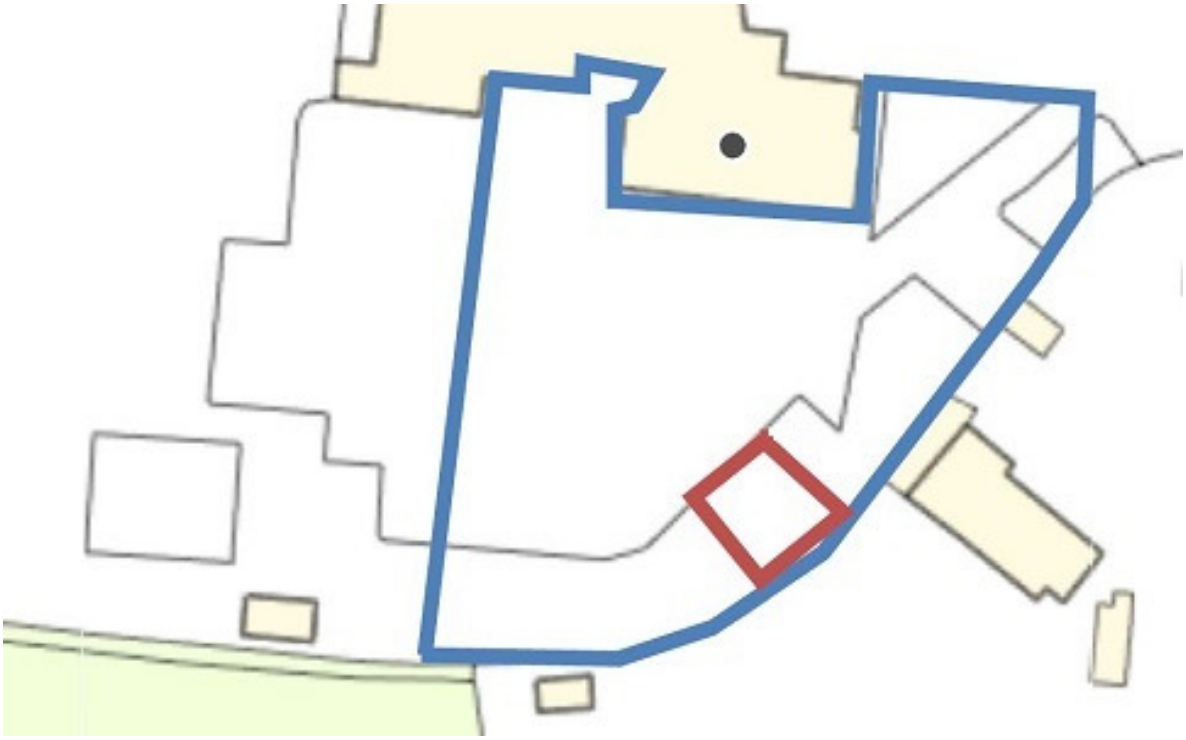
1.0 Introduction

The works are to undertake a Ground Penetrating Radar (GPR) and Radio Frequency underground utility survey within a predefined survey area. The utility survey has been undertaken to BSI PAS128:2014 specification and has been issued in 2D format for information purposes to further the client's understanding of the existing sub-surface utility and drainage layout across site and to aid in avoiding utility strikes in accordance with HSG47.

2.0 Scope of Works

The technical requirements of the utility location survey brief are to locate all traceable underground services within specified survey limits as shown on the image below. The area bound by the blue line was surveyed in line with PAS128 M1 Methodology and the area within the red line boundary was surveyed in line with PAS128 M4P Methodology



2.1 Site Photos

3.0 Problems Encountered / Site Limitations

No major problems or site limitations were encountered during the field work.

4.0 Control and Data Processing

Existing topographic control stations were used to survey the marked traced located underground services using a Leica total station. The surveyed data was processed using N4ce software and the final product edited and completed using BricsCAD software. Radar data was also post-processed within a small area of the site using GRED HD software.

5.0 Modes of Detection Used

We have used all reasonable efforts expected of experienced and qualified staff to detect and map underground utilities using non-intrusive techniques including electromagnetic, ground penetrating radar and visual inspection. Factors outside our control (for example seized covers, vegetation and adverse ground conditions) may limit the effectiveness of these techniques and we cannot guarantee 100% detection.

We undertake to survey only for declared utilities i.e. utilities that appear on statutory record data. Provision of up to date utility record data that covers the entire survey area is considered best practice by HSG47 and essential for PAS 128. Failure to detect or fully track any declared utility has been recorded in detail and annotated as taken from records. Where possible, depth estimations have been supplied. These depths are for guidance only and cannot be guaranteed. We have endeavoured to detect and trace any utilities not featured on record drawings but for technical reasons cannot guarantee to do so. Failure to detect or fully track any declared services has been recorded in detail.

Please note that end of trace on the survey drawing does not necessarily signify the termination of the service but rather the last reliable point of detection which can be guaranteed. Caution is advised thereafter. 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 Utility Location Survey Summary

6.1 Electricity

The main electric supply to the school enters the building within the survey boundary. This was successfully located to Quality Level B2 (QL-B2) and upgraded to QL-B1 where depths and location could be verified by GPR. No further electricity services are shown on the Scottish & Southern plans provided by the asset owner.

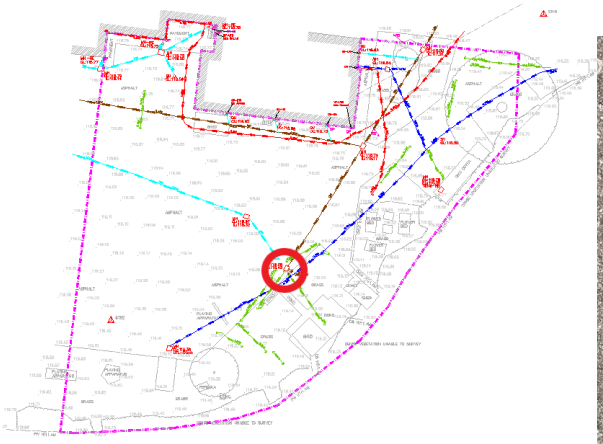
6.2 Water

We successfully located water services within the survey boundary to QL-B2. A small section was upgraded to QL-B1P as we were able to verify the depth by post-processing the GPR data. The mains water stop tap is also shown in

the cupboard on Figure 3 (above). This service is non-conductive and is laid in a duct, but we were unsuccessful in threading the duct.

6.3 Drainage

Most of the drainage on site was traced and located successfully to Quality Level B2 (QL-B2) within the survey boundary. One manhole was heavily silted and we were unable to survey this manhole. The location is shown in red on below. This drainage appears to be disused and would have likely taken the foul water drainage from the previous buildings. There is no drainage shown within the survey boundary on the Thames Water asset plans.



6.4 Electricity

The main electric supply to the school enters the building within the survey boundary. This was successfully located to Quality Level B2 (QL-B2) and upgraded to QL-B1 where depths and location could be verified by GPR. No further electricity services are shown on the Scottish & Southern plans provided by the asset owner.

6.5 Gas

No gas pipes are shown on the asset plans acquired form ESP Utilities & Southern Gas Networks. The gas meter house is located within the survey boundary and we were unable to locate the incoming gas pipework by EML and GPR.

6.6 Water

We successfully located water services within the survey boundary to QL-B2. A small section was upgraded to QL-B1P as we were able to verify the depth by post-processing the GPR data. The mains water stop tap is also shown in the cupboard on Figure 3 (above). This service is non-conductive and is laid in a duct, but we were unsuccessful in threading the duct.

6.7 Telecommunications

No underground telecoms were found to be present within the survey boundary or are shown on the asset plans. There are some overhead BT cables crossing the survey boundary to supply the school.

6.8 Unidentified Signals

Several unidentified signals were located within the survey boundary by GPR.

6.9 Miscellaneous

One manhole within the survey boundary was found to be stuck and has been annotated as UTL (Unable to Lift) on the drawing. No services were found to be running through this manhole and we were unable to identify its use. There is a water pipe travelling in the general direction and as all the drainage is accounted for, the water pipe has been continued as QL-B4 (assumed route).

7.0 Utility Records Obtained

Utility	Available at Time of Survey
Drainage – Thames Water	YES
Water – Thames Water	YES
Gas – ESP Utilities	YES
Electricity – Scottish & Southern	YES
Telecommunications - British Telecom	YES
Other Telecommunications - Gigaclear	YES
Fuel Lines	N/A
High Pressure Lines	N/A
Other	N/A

The utility record information was ordered by Warner Surveys prior to attending site. The utility records are dated and can be found in a separate report.

8.0 Ground Penetrating Radar

The GPR data is visible on site as data is collected and is also electronically stored until so it can be ‘post processed’ away from site. Post processing is a desktop exercise by which an analysist can take considerably more time to analyse and assess the obtained data as well as building up a bigger picture of the area by making comparison and joining together the hyperbolas generated by the radar data to create strings in CAD that represent a likely utility service or underground feature.

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

- Location of possible sub surface anomalies believed to be buried services.

The use of GPR throughout the general site was in conjunction with PAS128 M1 Methodology (detailed in 9.1 below). Due to us not being able to locate the incoming gas supply and water supply to the building we made the decision to increase the search transects around the building in the hope of locating these services. The GPR was connected to a Global Positioning System (GPS) and search transects can be seen in Figure 4. All point numbers shown were extracted from the GPR in DXF format and overlaid onto the utility mapping survey. We manged to locate several additional targets and these have been shown on the drawing as a Radar Trace as we have been unable to identify the lines.

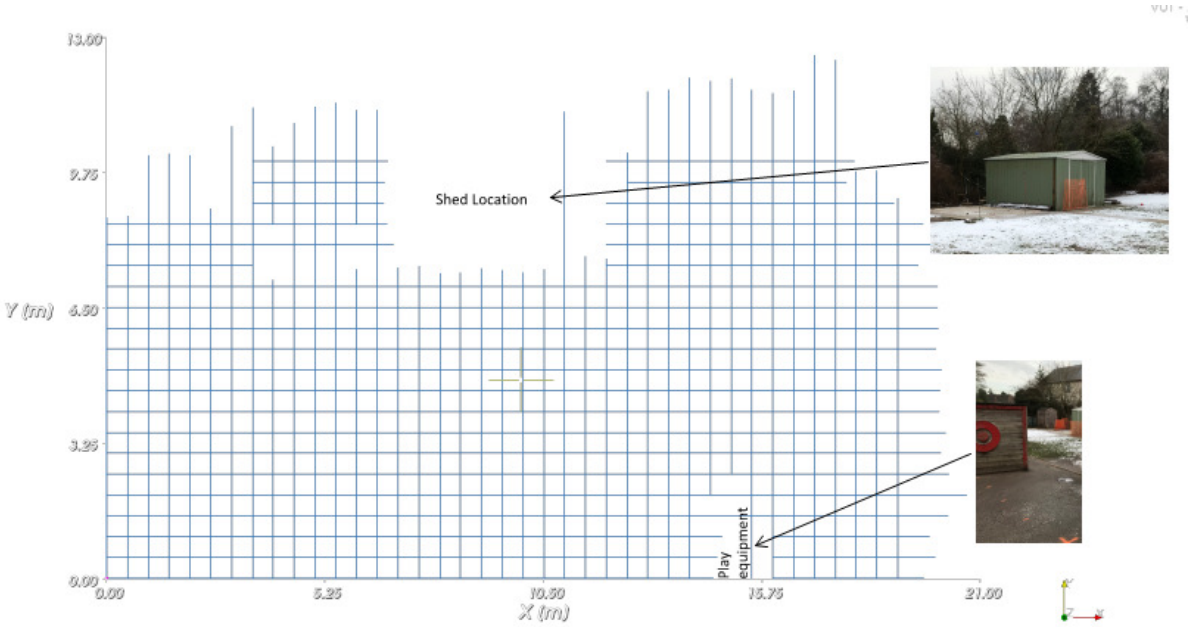
8.1 Limitations of GPR

- 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).
- GPR was unable to detect beneath the location of the shed or any other fixed furniture.

8.2 Post Processing of GPR Data

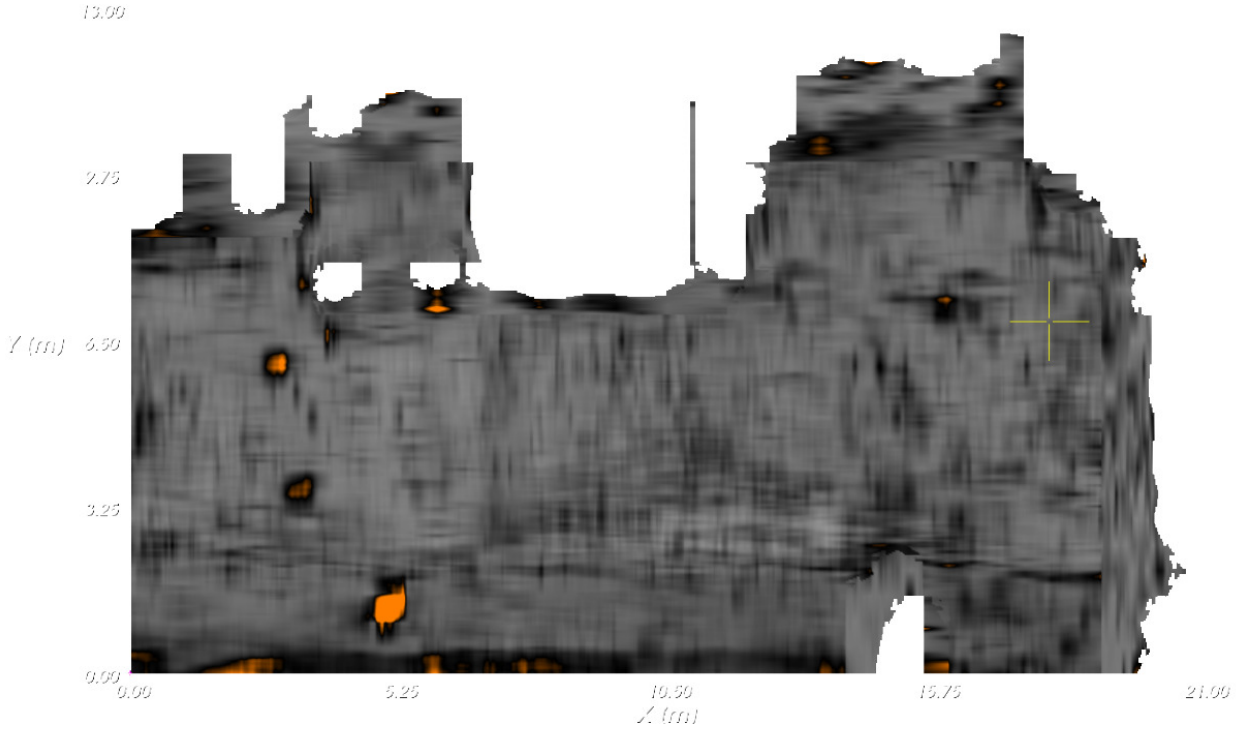
The project specification was by using Ground Penetrating Radar scan an area of the playground where the location of a previous building was believed to exist. The device to be used was a Leica DS2000 Ground Penetrating Radar consisting of a single channel emitting dual central frequencies of 250mhz and 700mhz in order to detect shallow and deep anomalies, the DS2000 GPR device would be pushed across the accessible area in a grid formation to obtain sub surface data for post processing and data interpretation. A 0.5m Grid was measured and marked out over what was accessible of the area due to the location of a shed and playground

equipment within the scan area. All grid scans were successfully collected, and data obtained around the fixed objects.

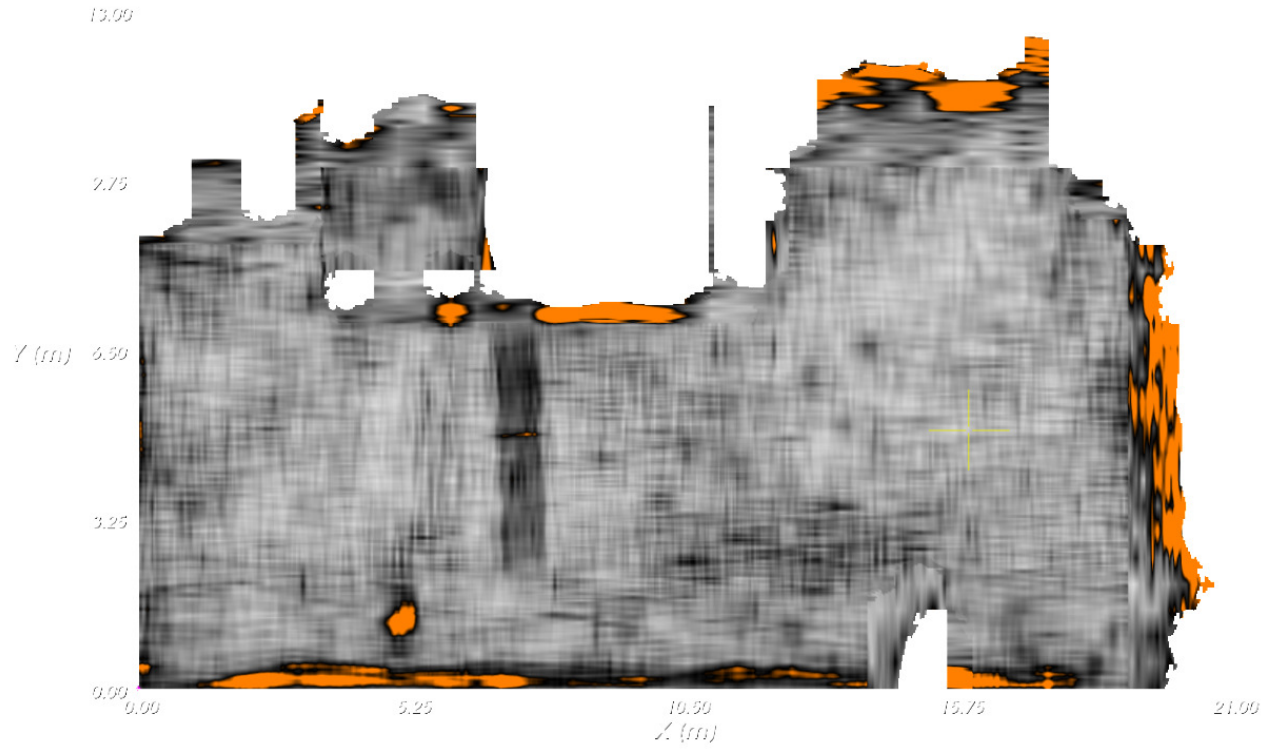


The GPR data obtained and post processed enabled the identification and detection of multiple buried services some of which were not discovered during the utility search phase during the site works. No structural elements such as foundations could be identified within the data that would suggest the location of a previous building. The following images show the processed GPR data that has been migrated in order to generate 3D radar tomography that can be viewed at depth slice intervals, the tomography heat maps generated clearly show the location and route of buried services within the site

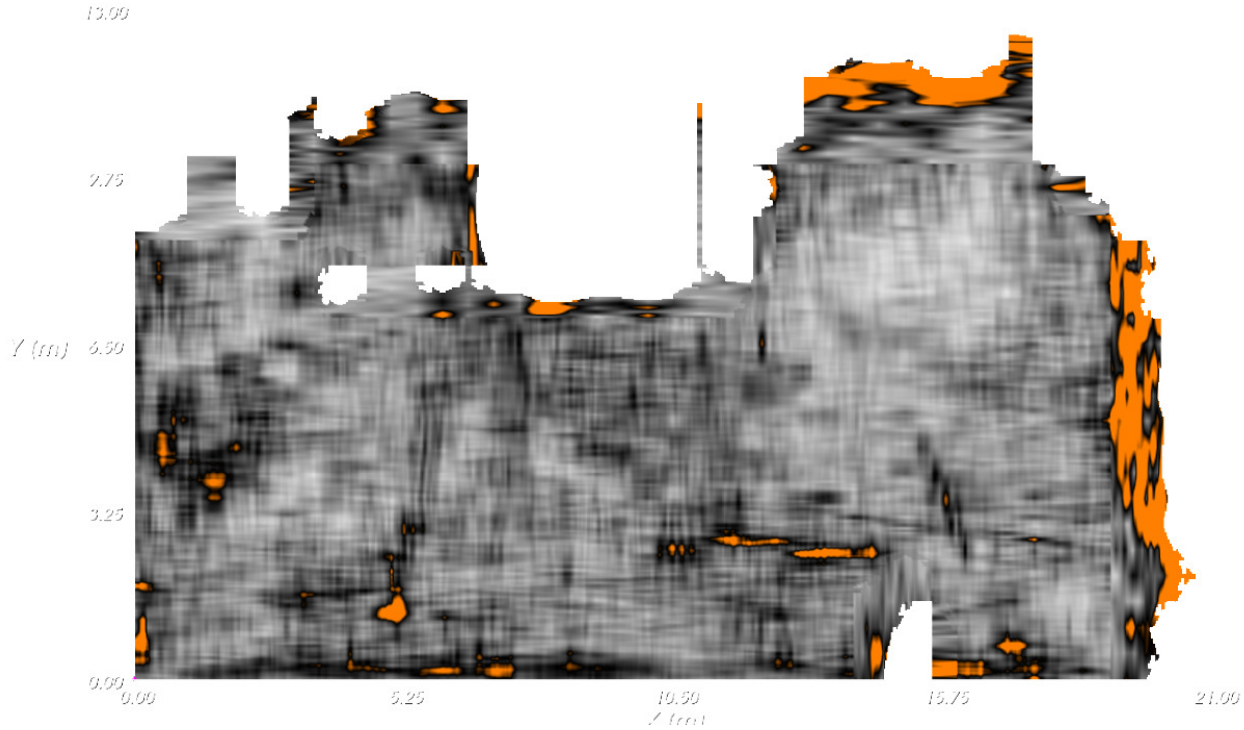
Depth 0.00m (Surface)
Large heat spot at southern base line end is drainage cover



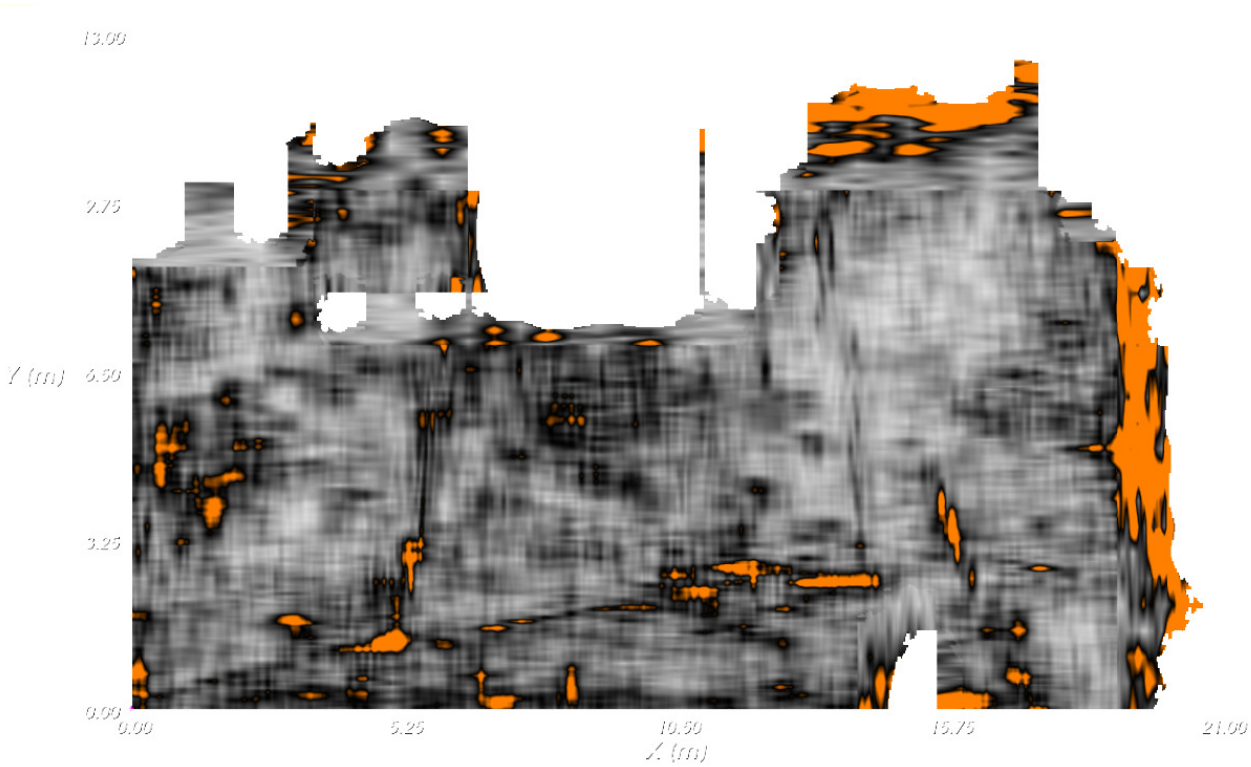
Depth 0.10m
Dark spot running north south is the footpath



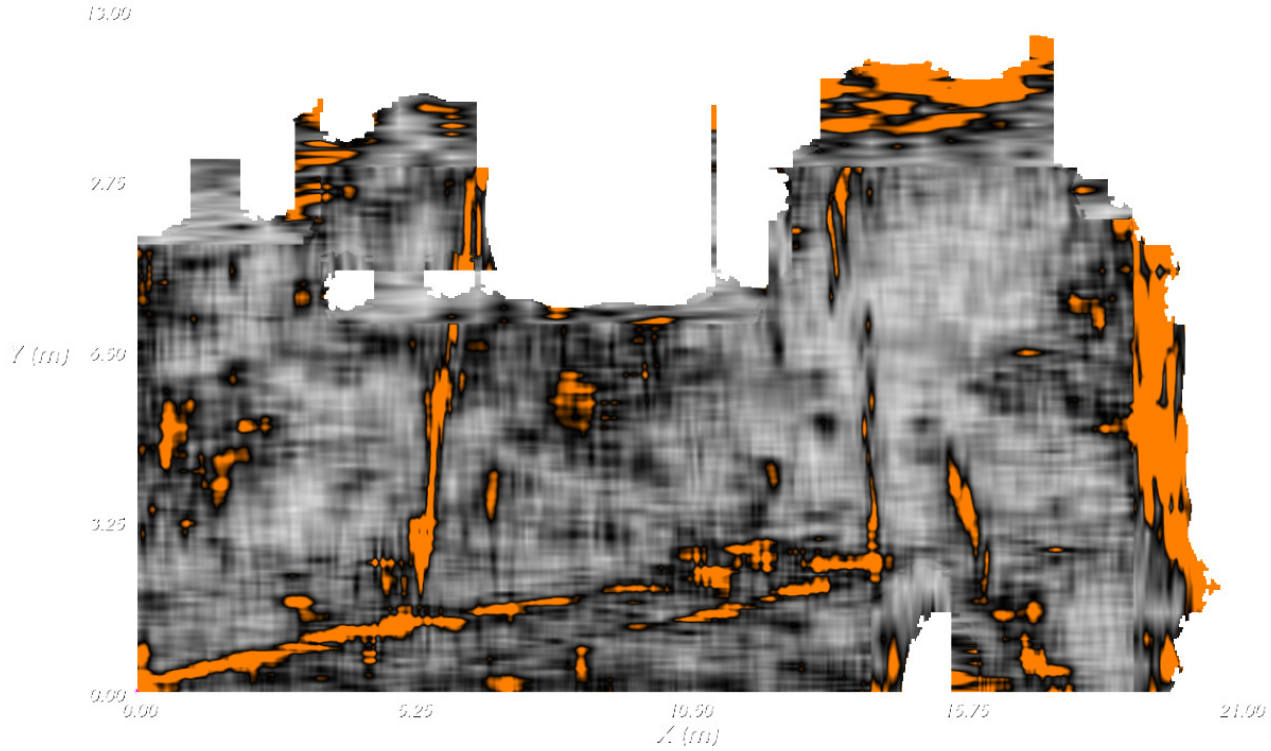
Depth 0.30m
Possible service routes starting to appear.



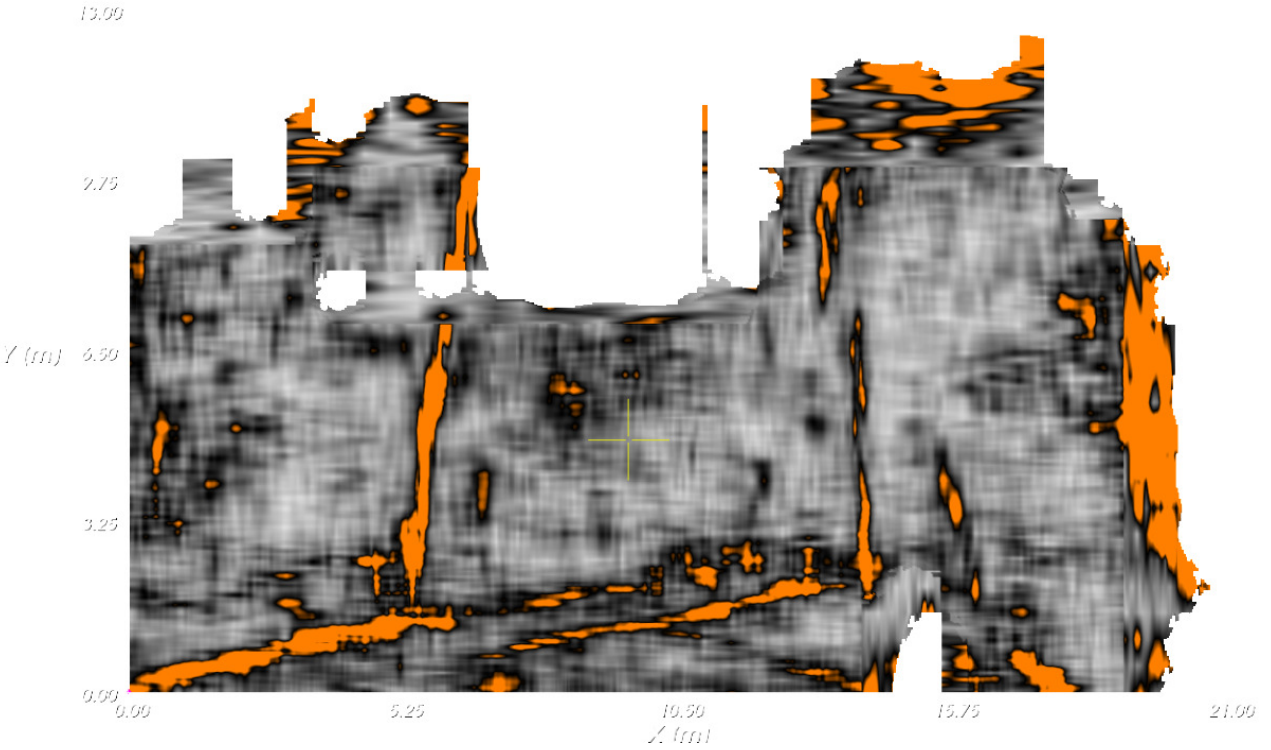
Depth 0.40m
Drainage service routes starting to appear leading to and from drainage cover location.



Depth 0.50m
Further drainage service routes starting to appear leading to and from IC location.

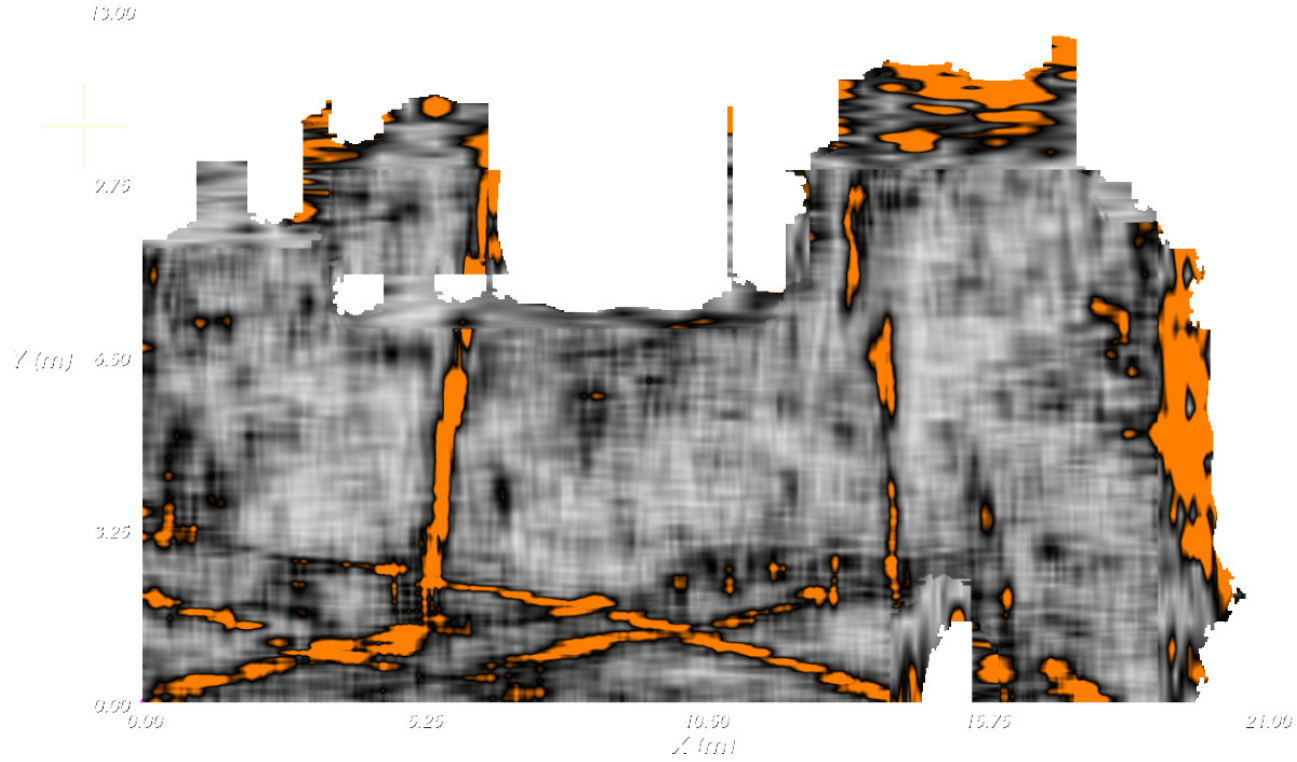


Depth 0.60m
More complex service routes are now starting to become apparent.

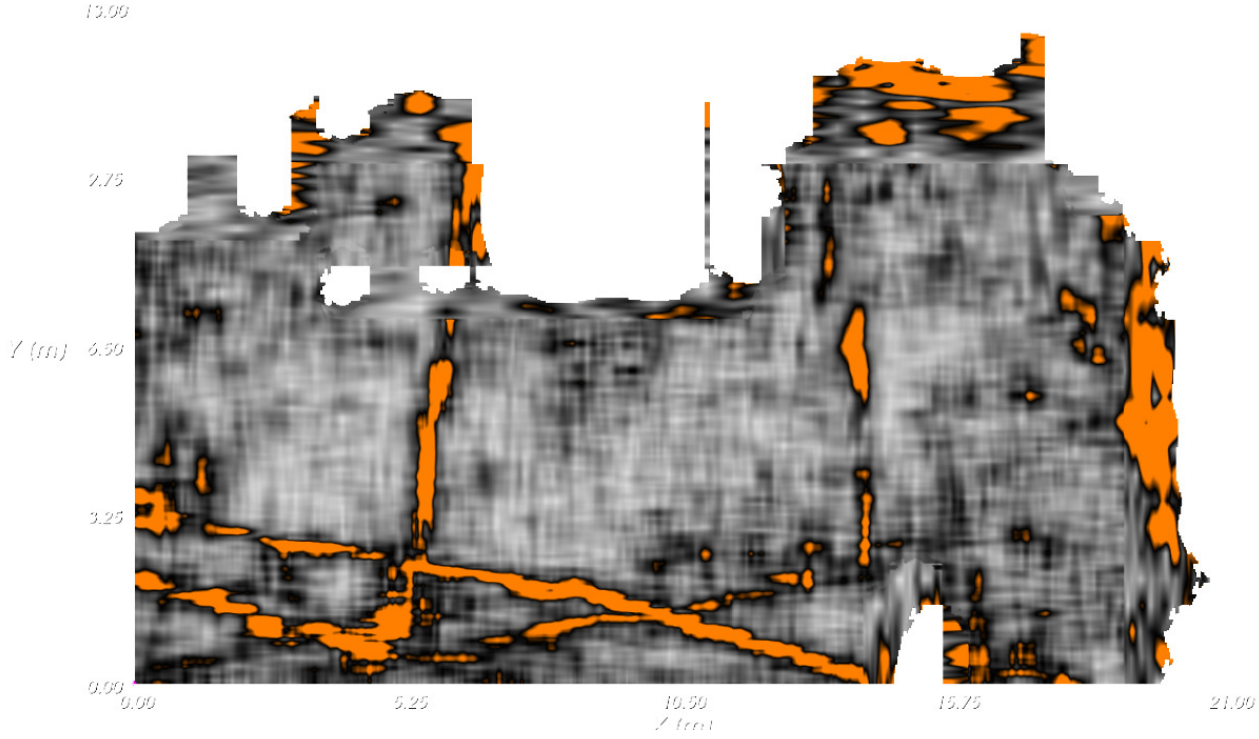


Depth 0.70m

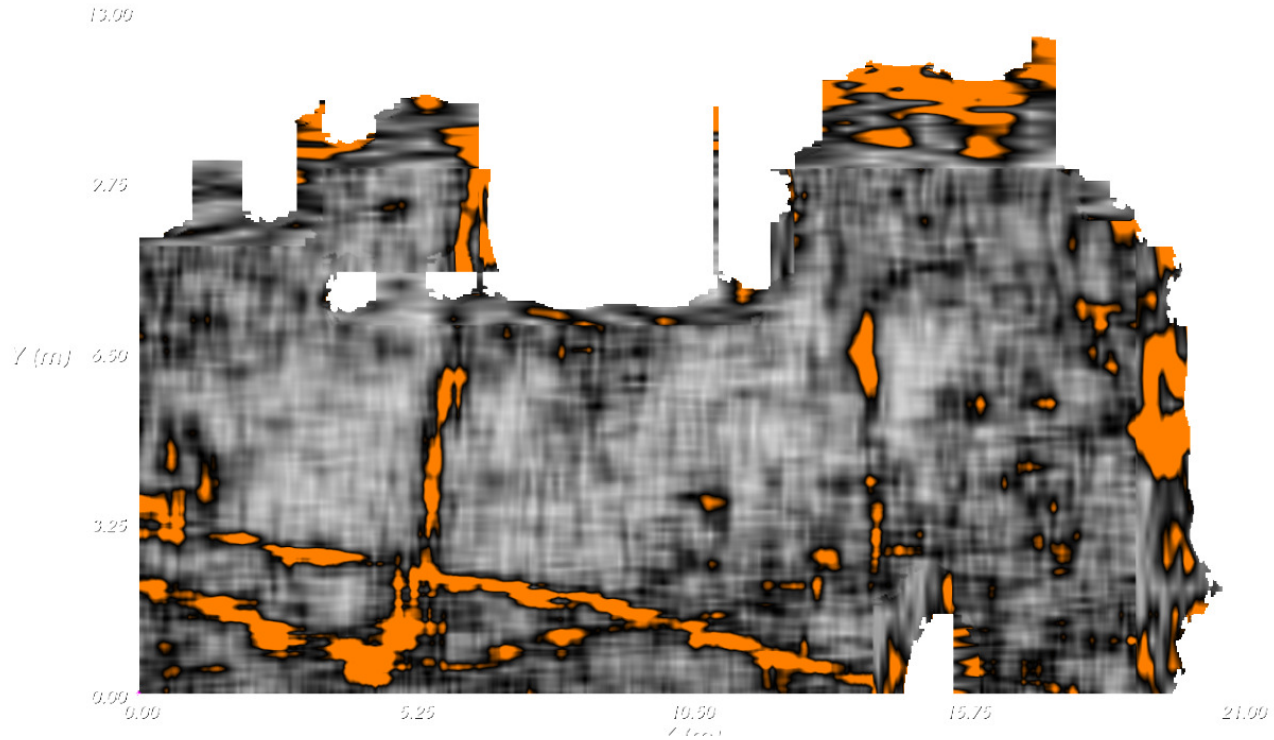
In addition to drainage routes a possible water service and unknown service have appeared.



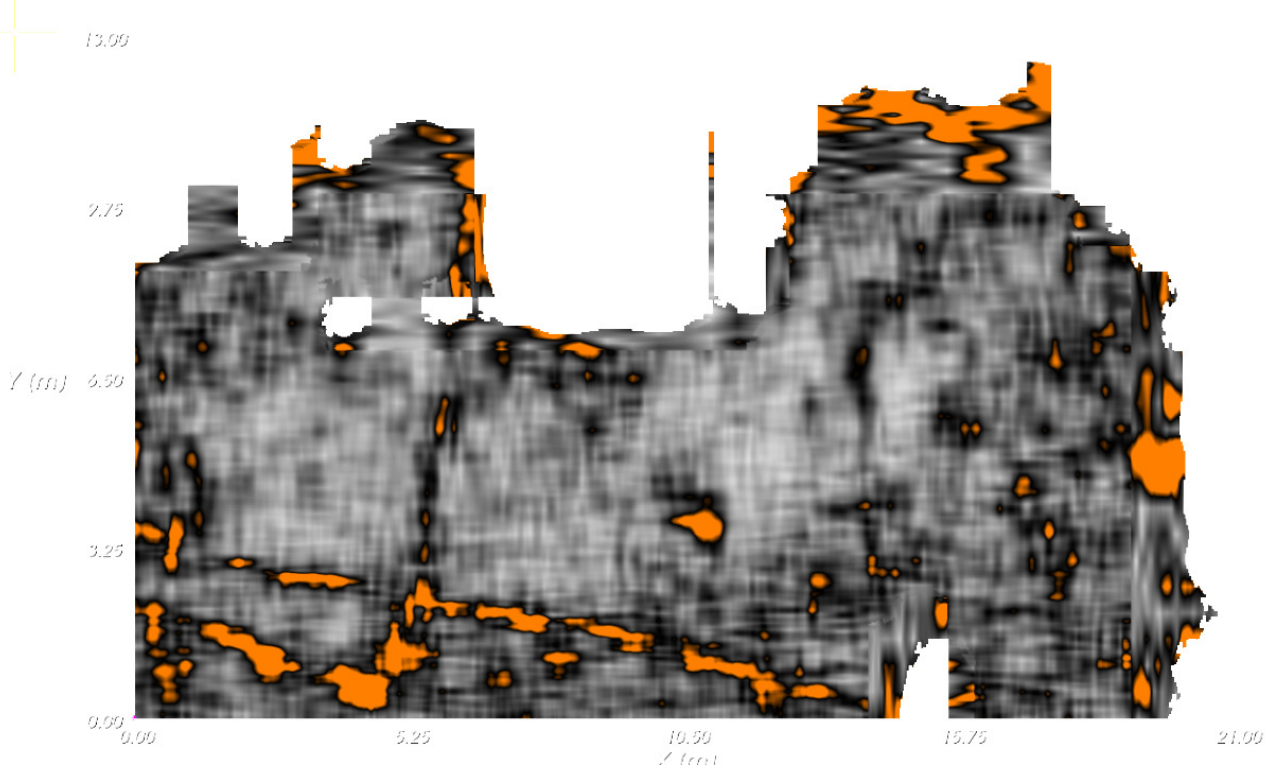
Depth 0.80m



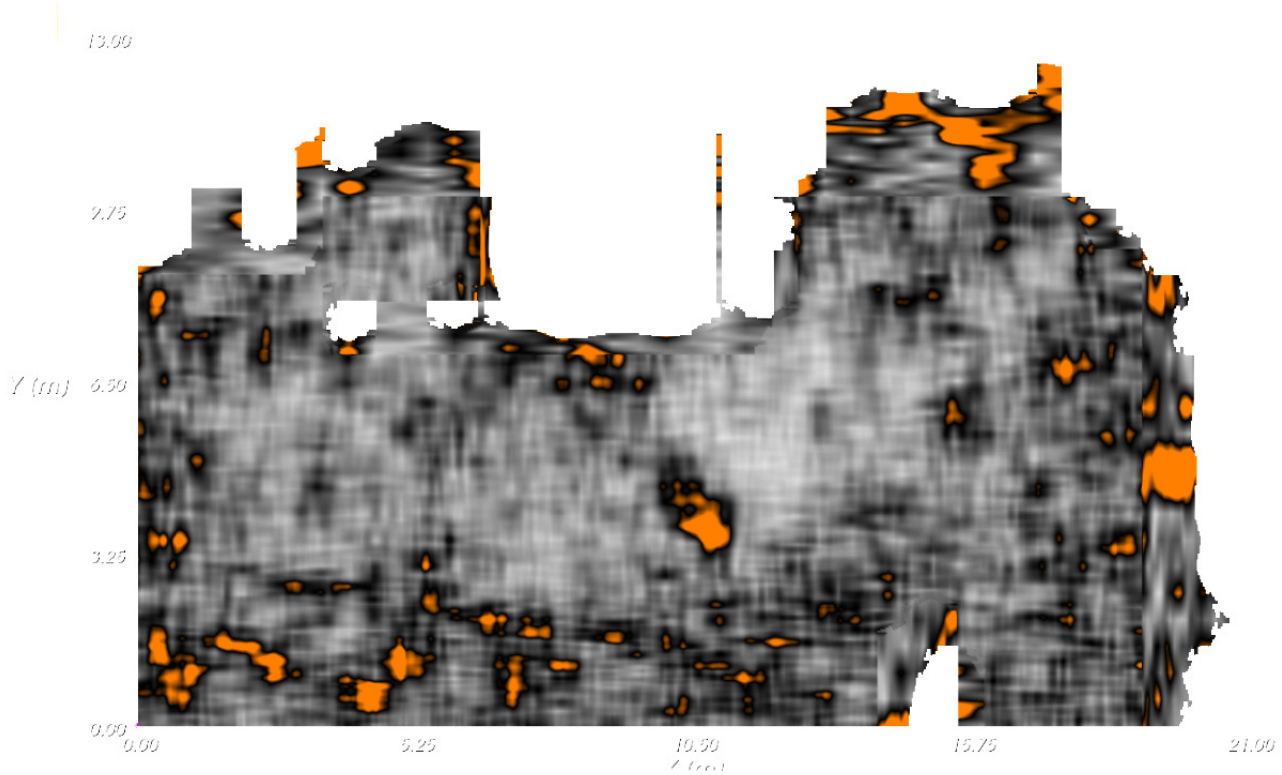
Depth 0.90m
Drainage routes are fading out yet more prominent unknown and water service routes really stand out.



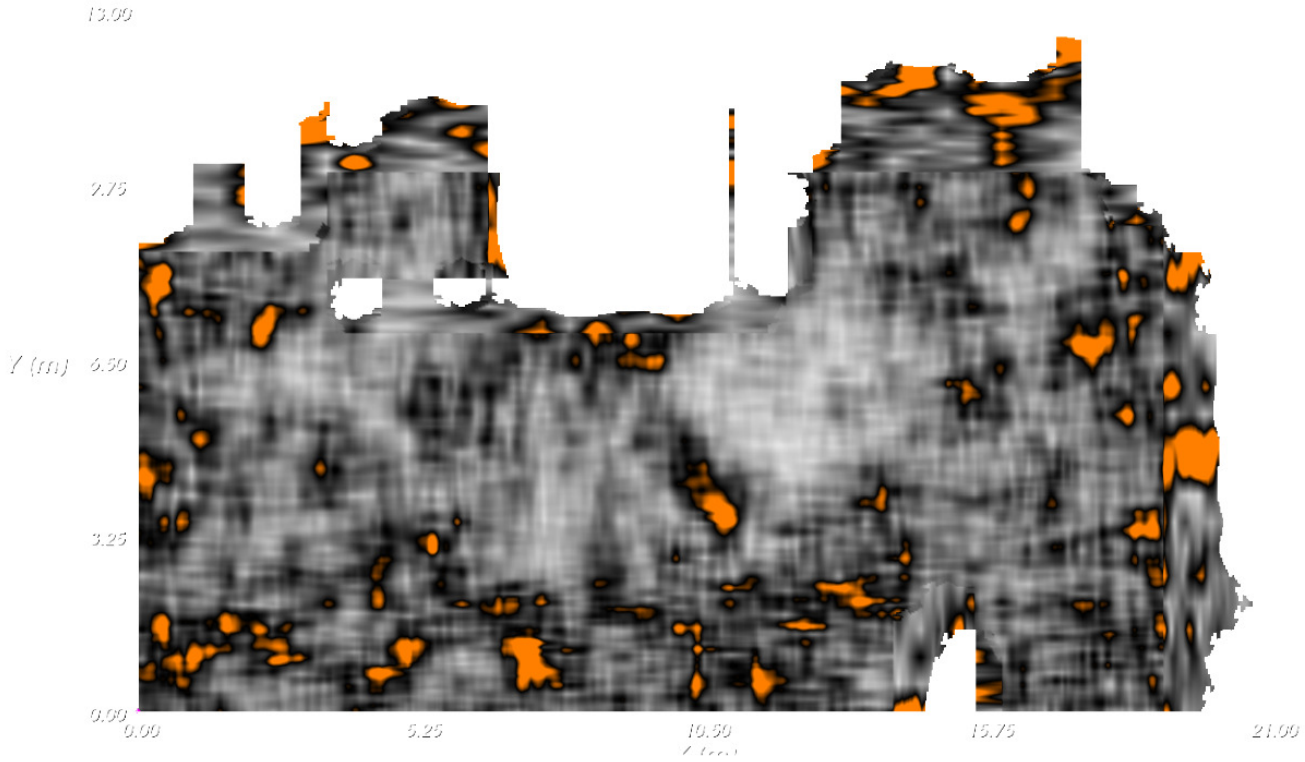
Depth 1.00m
All service locations are now starting to fade out



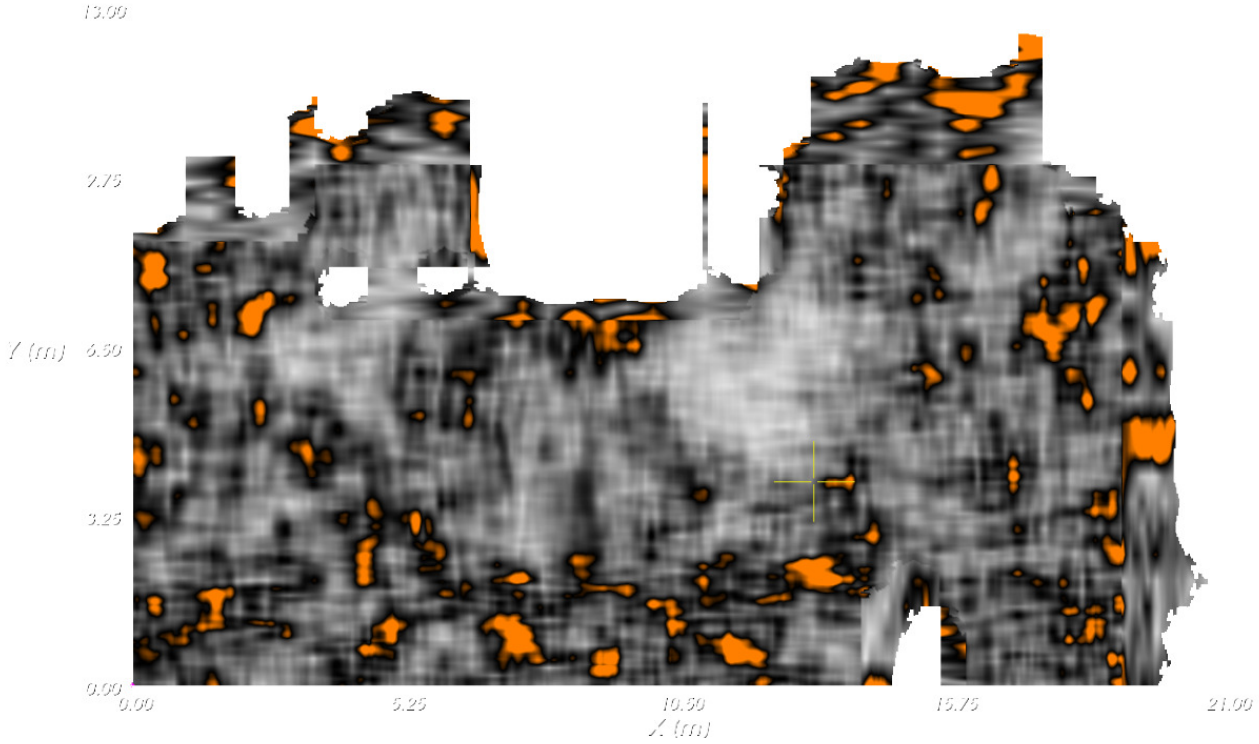
Depth 1.10m
All service locations have now disappeared.



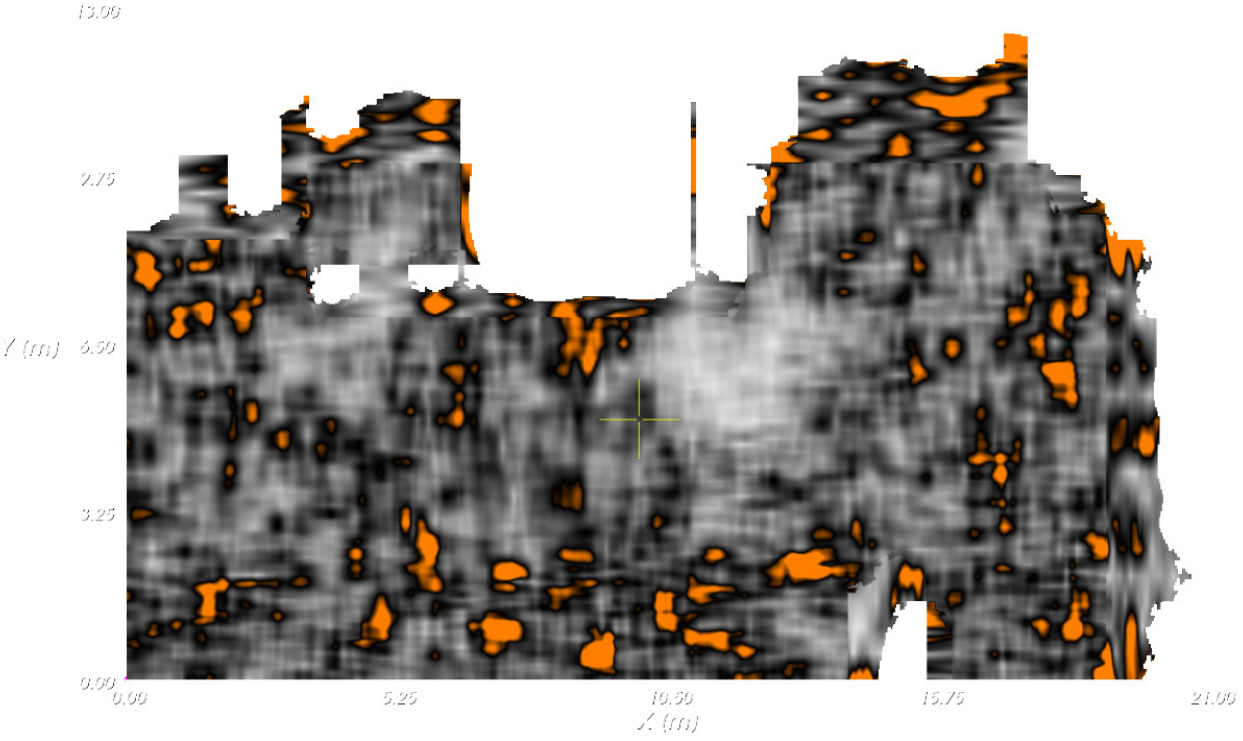
Depth 1.20m



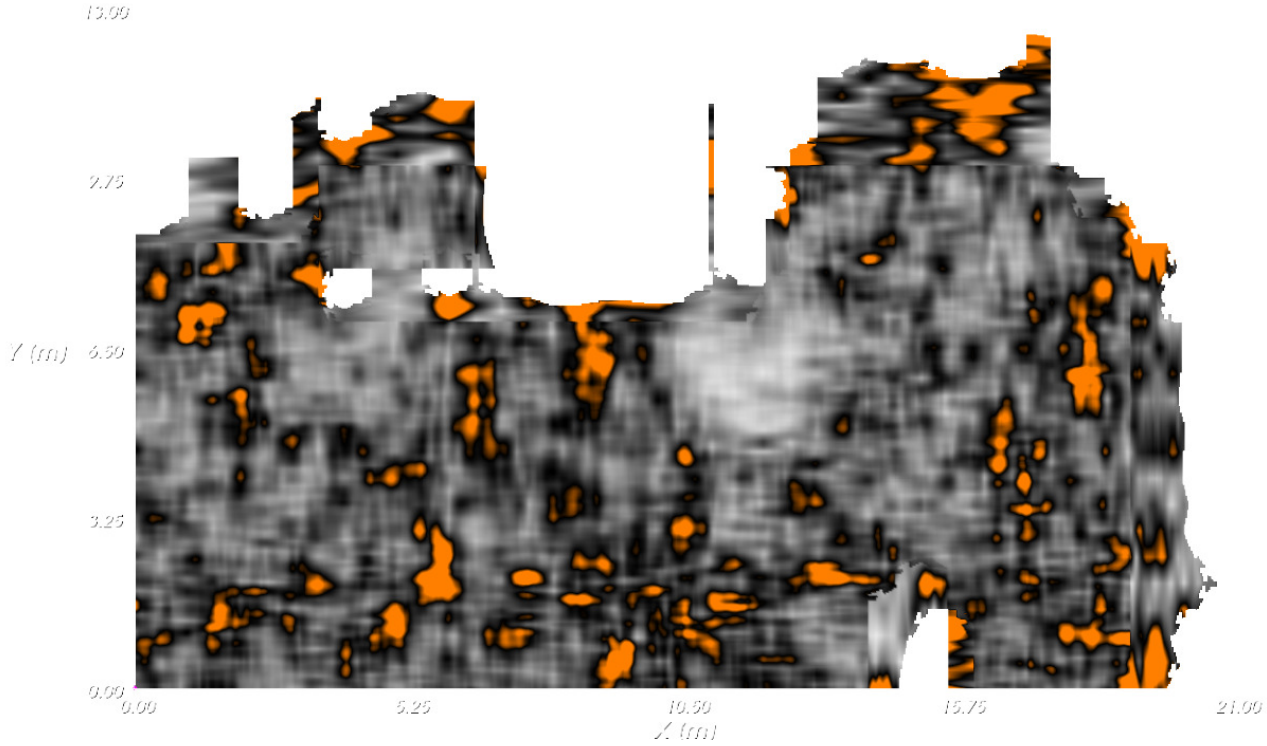
Depth 1.30m



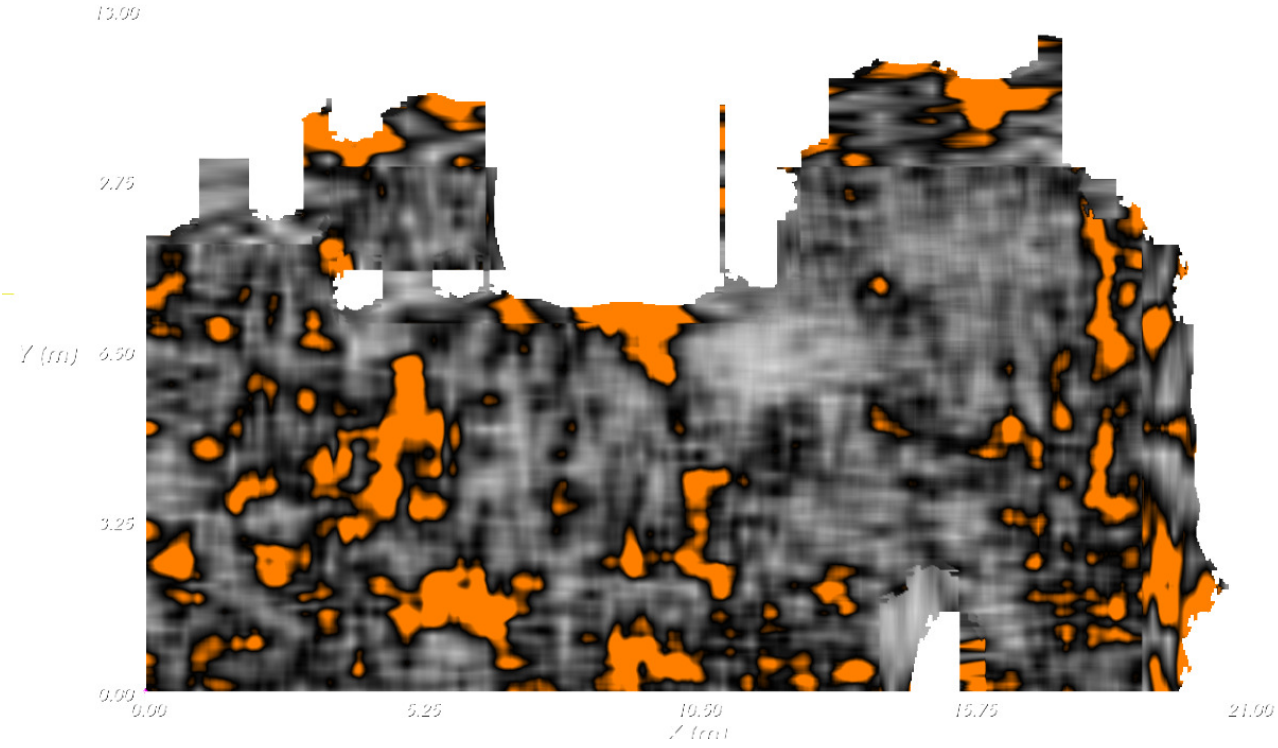
Depth 1.40m



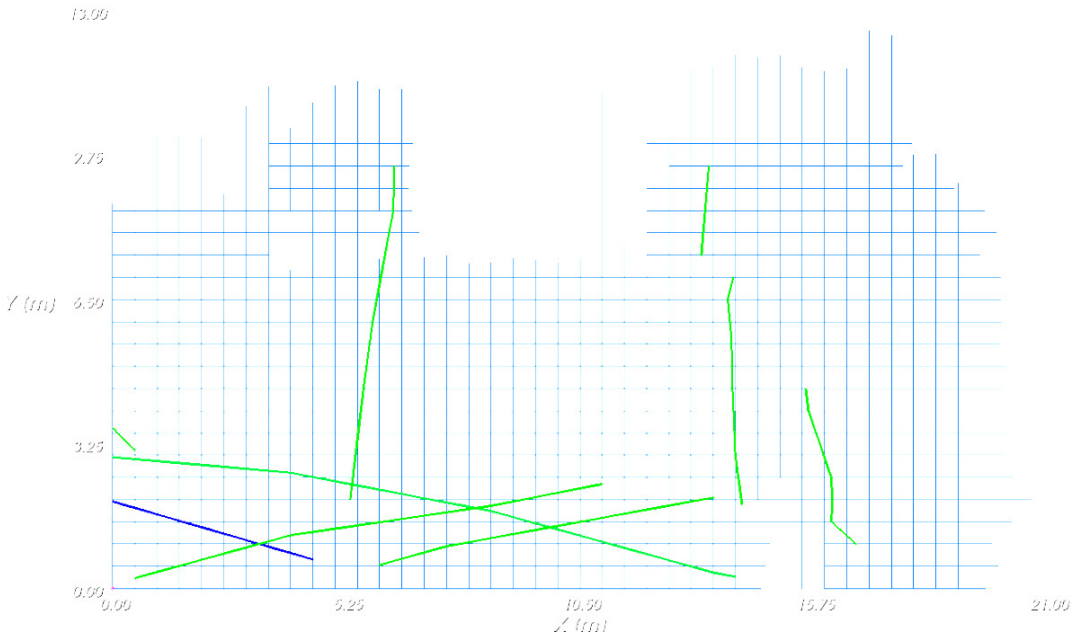
Depth 1.50m



Depth 2.00m



Picked objects from GPR data.
All identified service routes have been picked and plotted as per the below.



9.0 Final Presentation / Deliverables

The utility survey results have been overlaid onto our 2D topographical survey conducted during the same visit by a separate survey team.

This report should be read in conjunction with drawings 001 & 002.

9.1 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.

10.0 Conclusion

All utility information shown on final drawing and model is digitised from GPR data and EML 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.

The area deemed to have foundations present was surveyed using a 0.50m transect GPR grid and information post-processed using GRED HD. No evidence of foundations was found within the data we collected on site.

11.0 Disclaimer

This drawing, model and information contained within is issued in confidence and is the copyright of Warner Surveys.

Electromagnetic and Ground Penetrating Radar techniques combined with visual inspection have been used to locate and map the underground services shown on this plan. Warner Surveys 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. Services shown as QL(C), QL(D) or TFR (taken from records) and QL(B4) or AR (assumed route) have not been proven on site and are not guaranteed.

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.

Warner Surveys cannot be held responsible for any inaccuracies beyond those that could be reasonably expected of a competent company. No utility mapping survey can be considered a 100% accurate depiction of the sub-surface environment and the use of these drawings does not remove the requirement for the use of safe digging techniques at all times in line with HSG47.

Michael Wood
Utility Survey Manager
Warner Surveys

12.0 Appendices

12.1 Radar Data Sheet

Leica DS2000
Utility Detection Radar

DUAL-FREQUENCY ANTENNA		
Antenna footprint	40 x 50 cm	
Hardware channels	2	
Antenna central frequencies	250 MHz and 700 MHz	
Antenna orientation	Perpendicular, broadside	
Sampling frequency	400 kHz	
DATA ACQUISITION		
Acquisition speed	More than 10 km/h	
Scan rate per channel for 512 samples per scan	381 scans per second	
Scan interval	42 scan per metre	
Positioning	2 integrated encoders - GPS and/or TPS	
CONTROL UNIT		
Power consumption / supply	13.3 W / Rechargeable SLAB (Sealed Lead Acid Battery) 12 V DC, 12 Ah	
Operating temperature range	−10° C to +40° C	
Weight	24 kg	27 kg
Protection	IP65	