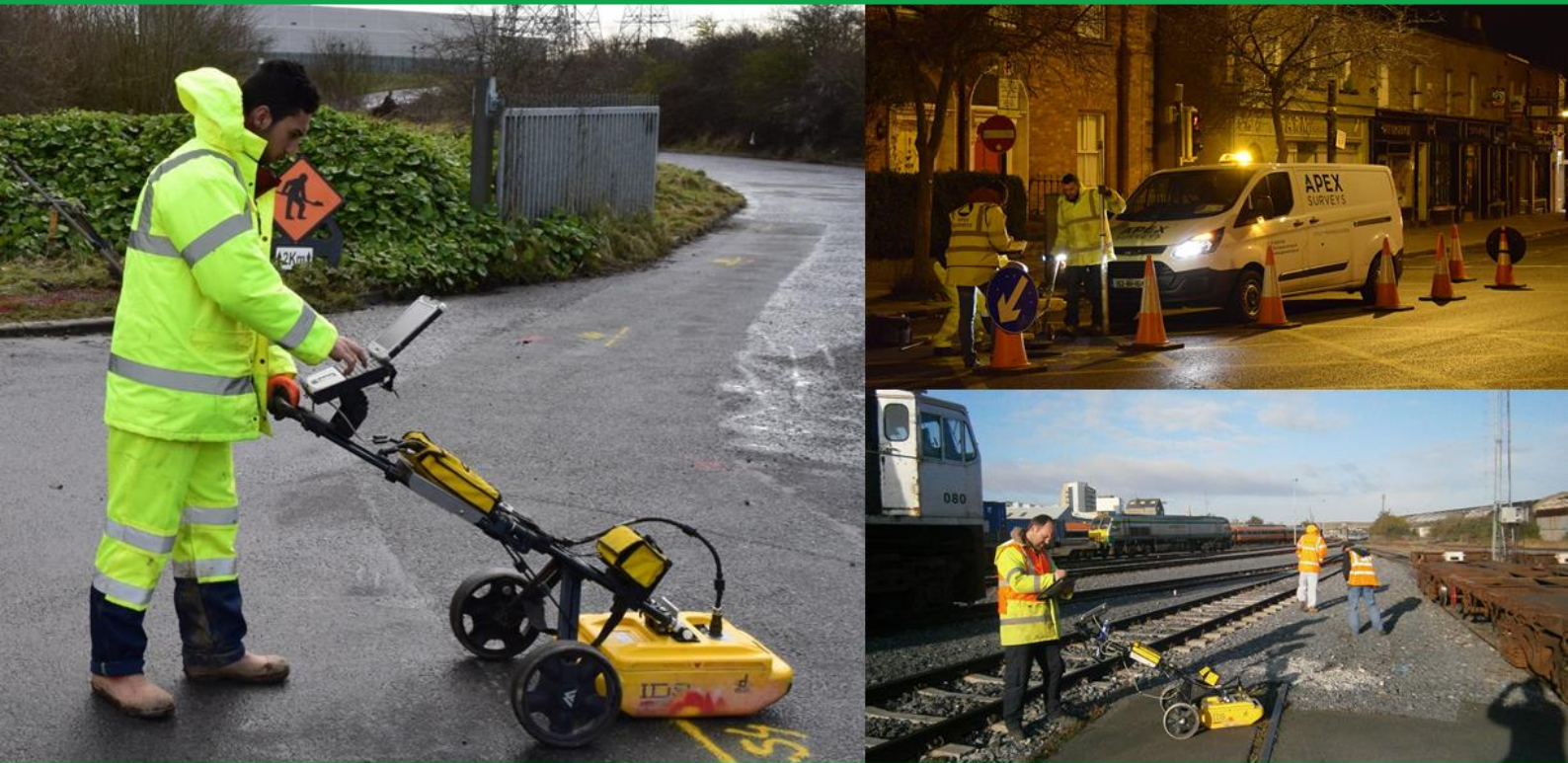


APEX SURVEYS

Ballincollig Fire Station

Underground Utility Mapping Report



Project: 7286

Client: Cork City Council

Date: 28/07/2025

Revision: 1

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Introduction

This report will provide a summary of the findings for an Underground Utility Survey carried out at Ballincollig Fire Station on behalf of Cork City Council along with the techniques and methodologies used and the constraints of these methodologies.

General Information

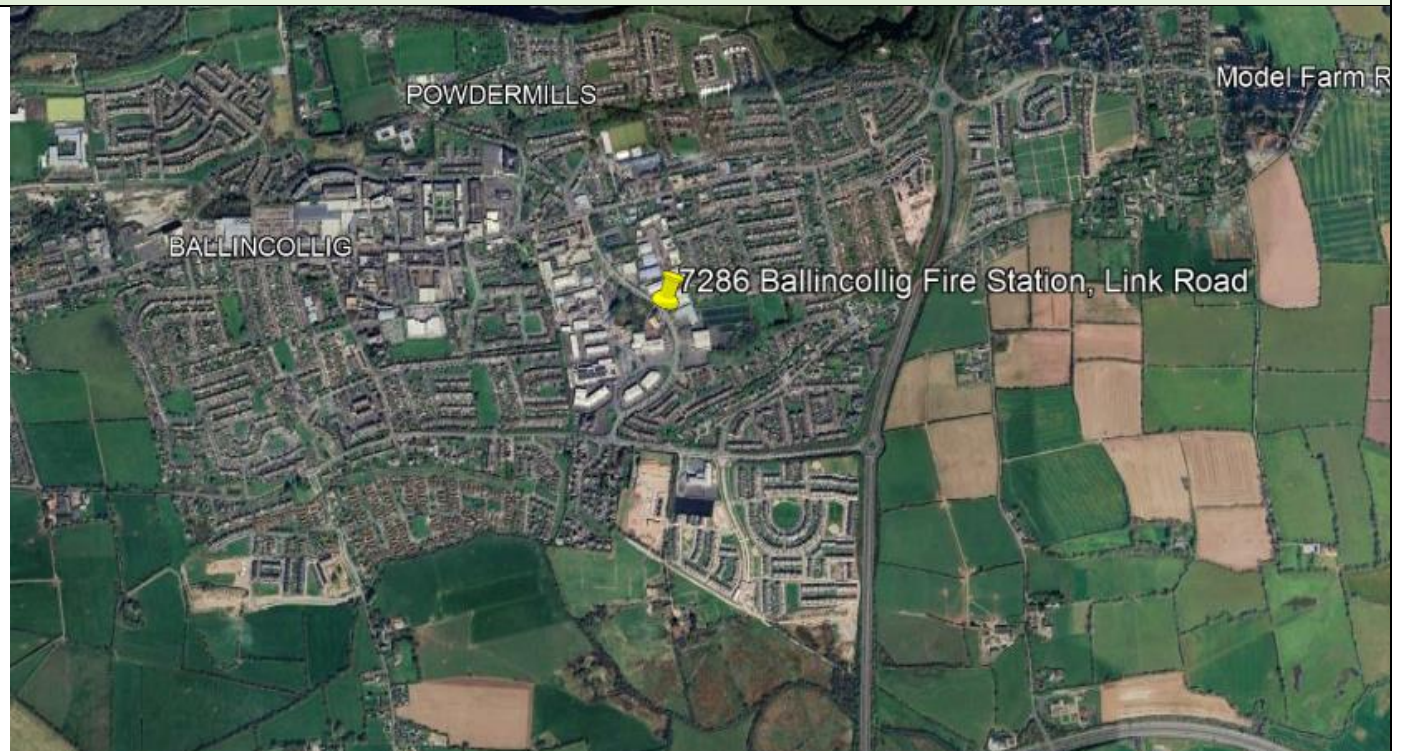
This report should be reviewed with the following drawing(s)

- 7286 Ballincollig Fire Station Link Road - UG - 200 ITM15 2D.dwg
- 7286 Ballincollig Fire Station Link Road - UG - 200 ITM15 3D.dwg
- 7286 Ballincollig Fire Station Link Road - UG - 200 ITM15 2D.pdf
- Manhole Log sheets
- Report

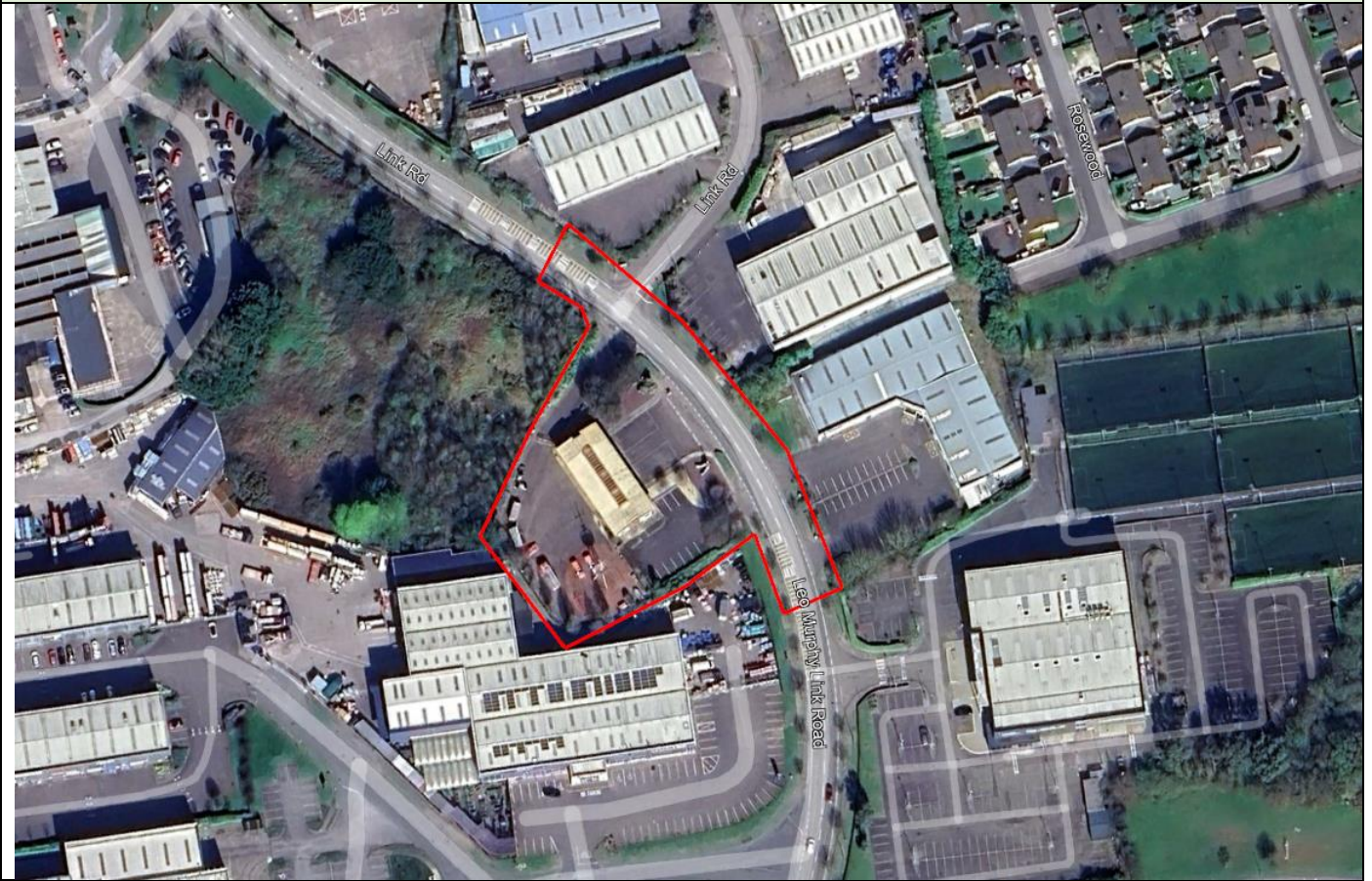
Works have been completed to the following guidelines and standards:

- PAS 128: Specification for underground utility detection verification and location
- Royal Institute of Chartered Surveyors: Measured Surveys of Land, Buildings and Utilities
- Society of Chartered Surveyors: Measured Survey of Utilities

Survey Location:



Survey Extents:



Approach and Methodology

Approach Overview

The purpose of the Underground Utility Survey aspect is to produce a three-dimensional drawing of underground utilities within the survey area. The Underground Utility Surveys shall detect drainage, foul sewer, water main, oil and gas lines, power cables, fiber optic cables, telecom cables, ducting and other services. This shall be achieved by utilising a combination of non-intrusive techniques to provide a comprehensive drawing of the sub-surface as per PAS:128 Standard for Underground Utility Mapping.

Chamber Inspections

Chamber Inspections involve opening all manhole covers within the survey area or within the survey area vicinity which may be of interest. These manholes are individually numbered on the ground, on manhole log sheets and in the topographical survey for identification and clarity.

All depths of the chambers are measured using a levelling staff/ measuring tape and logged on a manhole description sheet along with any other relevant information such as:

- Invert or Top of Duct Level
- Service type (i.e. drainage, cables, empty, etc)
- Pipe/duct diameter

- Pipe/duct make (i.e. iron, PVC, concrete, etc)
- Connecting manhole chambers

Biodegradable spray paint will be used to mark location of services on the ground. All measurements shall be taken from the surface.

Radio-detection

General Principals

Radio-detection uses the principle of electromagnetism to detect underground services. Electromagnetics work under the principle that a current which flows along a conductor emits a magnetic field, which will extend around the conductor in concentric circles. A receiver coil is then utilised to detect the amplitude of the magnetic field, with amplitude varying dependant on the orientation and position of the receiver within the field. By moving the receiver from side to side it is possible to follow the maximum signal response and therefore, the line of the buried service. This method can be used to locate electrical cables by traversing the object area in a grid pattern. Telecom and communication cables can also be traced from chamber to chamber by inducing a current of known frequency onto a conductor with a current generator and then scanning the ground with a receiver set at the same frequency to locate position and depth.

Direct Connection

Where possible the direct connection technique is used to induct a signal into the utility. The signal is then traced on the surface using Radio Detection techniques. The signal is traced along the line of the service and marked on the surface at set intervals, change of direction and change of depth.

Flexi and Sonde

Flexi cable with responder will be fed through the pipe/duct and traced on the surface using a receiver.

Signal Sweeping

Passive power, radio and active sweep techniques are carried out using CAT. The grid involves a diagonal sweep along an orthogonal bi-directional grid. Depth of utilities can either be obtained through induction or through GPR methodologies.

GPR (Ground Penetrating Radar)

General Principals

GPR works by directing pulses of electromagnetic energy into the ground from a transmitting antenna. The energy travels through the ground where buried objects reflect the energy back to the surface which is received by the GPR's receiving antenna. These returning signals are converted to a GPR section which can be displayed on laptop computer for on-site interpretation or exported for post-processing.

Grid Searching

Orthogonal grid pattern at set intervals to identify potential areas of interest. These AOIs are then targeted for intensive orthogonal follow-up. Grid lines are saved on the field computer for further interpretation and processing.

Pipes, if crossed at or near a right angle, give a response in the radar in the form of a hyperbola (known as diffraction). If, when marked out on the ground or processed in the office, the detected diffractions form a line then the user is able to interpret this as a linear feature such as a pipe, cable or ducting.

PAS: 128 – Quality Level Chart

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.						

PAS: 128 – Detection Method Chart

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.						

Findings Summary

Drainage and Sewer

Summary	PAS:128 Quality Level(s)	PAS 128: Method(s)
Drainage lines were detected running south along Leo Murphy Link Road. Lines were detected coming from the west and the buildings travelling east connecting to the main line. Sewer lines were detected coming from the building and running east where we were unable to detect the outfall.	QL-B2	M2

Electric

Summary	PAS:128 Quality Level(s)	PAS 128: Method(s)
Electric lines were detected coming into the survey area from the north and south and travelling throughout the survey area.	QL-B2	M2

Comms

Summary	PAS:128 Quality Level(s)	PAS 128: Method(s)
Comms lines were detected coming into the survey area from the south of Leo Murphy Link Road and running north towards the building and offsite to the north.	QL-B2	M2

Watermain

Summary	PAS:128 Quality Level(s)	PAS 128: Method(s)
Watermain lines were detected running along Leo Murphy Link Road.	QL-B2	M2

Gas

Summary	PAS:128 Quality Level(s)	PAS 128: Method(s)
Gas lines were detected running along Leo Murphy Link Road and running along the main access road to the north of the fire station.	QL-B2	M2

Unknown Services

Summary	PAS:128 Quality Level(s)	PAS 128: Method(s)
No unknown services were detected.	N/A	N/A

Anomalies

Summary	PAS:128 Quality Level(s)	PAS 128: Method(s)
There are Anomaly lines found from around the site. As they do not align with either traced services or records, it's not possible to determine what they might be.	QL-B2	M2

Limitations of the Approach

The interpretative nature and the non-intrusive, indirect and non-destructive survey methods must be taken into account when considering the results of the surveys. Therefore, Apex Surveys, while using appropriate practice to execute, interpret and present the data, gives no guarantees that all underground utilities and underground structures will be located and mapped. Furthermore, Apex Surveys cannot guarantee the accuracy of the depth or position of utility information annotated on the survey drawings.

Apex Survey shall not be liable for any omissions or inaccuracies in the survey which arise due to the limitations of the service. No liability shall attach to Apex Surveys, in any circumstances, howsoever arising, in respect of any loss or damages suffered by the Client.

Common GPR limitations

Limitations

- **Depth of Utility:** The depth and size of a utility affect the signal response and the degree with which a utility can be located. Due to attenuation of the radar signal with depth, resolution is restricted, hence making identification of utilities more difficult with increasing depth.
- **Size of Utility:** The smaller the diameter of a utility the more difficult it is to locate. This difficulty increases with depth.
- **Ground Conditions:** The depth penetration and quality of the data depends on the ground conditions of the site. GPR Surveying works best within high resistivity material. Clay overburden can impair GPR Surveying. Poor data may be a result of areas with high conductivity.
- **Utility Congestion:** Where different utilities converge together into a service corridor or cross paths it becomes difficult to isolate a specific utility and to map its route. The reflected signal will display a single response to multiple utilities. Therefore multiple utilities may appear to be a single utility. Where similar services run on close proximity, separation may be impossible.
- **Signal Jumping:** Signal from surrounding services may 'jump' to a highly conductive line masking its true identity.
- **Shadowing:** (of deeper utilities by shallower objects) Shallow utilities will mask the existence of deeper utilities where they are in close proximity. Also, high reflective materials close to the surface i.e rebar may hide deeper anomalies.
- **Surface Obstructions:** The GPR system relies on a relatively flat and even surface on which to perform radar passes. If ground obstructions such as vehicles, organic material (long grass, scrub) or undulating ground surface are present then the acquired data will be of lower resolution and in some cases not viable.
- **Loss of signal:** It is not always possible to trace the entire length of each underground service.
- **Connections between manholes:** Connections between manhole chambers are assumed to be straight.
- **Non-metallic objects:** Non-metallic objects are amongst the most difficult to trace therefore successful tracing of non-metallic pipes/ utilities may be limited.
- **Fiber Optic Cables:** Fiber optic cables may not be possible to locate except where laid with a built in tracer wire or similar conductor system.
- **Defective/ flooded manholes or pipework:** It may not be possible to establish connections between flooded or defective manholes or pipework.
- **Acute bends in pipework:** It may not be possible to trace a pipe past an acute bend.

Approach to Reduce Limitations

- **Combined Approach:** GPR investigation is combined with other techniques such as Radiodetection, traditional projection of sound through chambers, sonde and others to maximise the probability of detection.
- **Multi-Frequency Radars:** Multi-frequency radars allow for maximum probability of detection of services within the depth range.
- **Calibration:** GPR is calibrated as required.

Record Drawing Information

- Services which have been untraceable are shown from records where possible or available. These lines are annotated as "Taken From Records" or "From Records".
- Existing record information showing underground services is often incomplete and with unknown accuracies therefore it should be regarded as indicative only.
- Where Apex Surveys issue a utility drawing, this should be read in conjunction with all available public or private utility records.
- Apex Surveys endeavour to add relevant Public Utility record information onto the final drawing. However, we would recommend that direct contact is made with the asset owner or statutory undertaker.

- Apex Surveys shall not be held responsible for the accuracy, or otherwise, of the location of a service, as issued by the utility provider and therefore shown as “Taken for Records” on the drawing.

Exclusions

- Confined space entry (all measurements taken from the surface).
- Connections under buildings.
- Location of individual service feeds to properties or buildings.
- Internal building services.
- Any utilities which are not detected due to limitations of the approach.
- Pot ended or disconnected cables or terminated short lengths of pipe.
- Small diameter cables less than 20mm diameter or pipes less than 40mm diameter.
- Lifting manholes which require longer than 10 minutes effort using standard heavy-duty apparatus.