SOUTH EAST SCANNING

Whitepaper

GROUND PENETRATING RADAR

A Practical Guide for Project Managers, Engineers, and Site Teams, by Aidan Waszaj, Zara Omidi, and Daniel Beech.

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Purpose of this Guide

Ground Penetrating Radar (GPR) is a non-destructive method widely used in construction, infrastructure, and subsurface investigations to support decision-making. However, its capabilities and limitations are often misunderstood. This guide provides practical advice on what GPR can and cannot do, factors affecting results, how to interpret outputs, and how to use findings safely and realistically.

What GPR Is and How It Works

GPR sends a short electromagnetic pulse into the ground or a structure, recording reflections from changes in material properties (dielectric constant), such as concrete-to-air, soil-to-pipe, or rebar-to-concrete. It does not “see” objects like a camera does, but detects signal responses that require interpretation with experience and context. What you get is an interpretation of subsurface conditions, supported by site knowledge, drawings, and verification.

Common Applications of GPR

Concrete scanning

Locating reinforcement, post-tension cables/ ducts, conduits, slab thickness checks, and congested areas.

Utility locating and mapping

Identifying possible buried services and alignments, often best combined with EM locating and records.

Void/ground loss checks

Detecting areas that may indicate voiding, loss of support, or disturbed ground.

Roads and civil infrastructure

Measuring pavement layer thickness, subgrade changes, moisture-related anomalies, and subsurface condition mapping.

Geophysical/environmental/ archaeological investigations

Mapping stratigraphy changes, buried features, targets of interest, and anomalies.

Factors Controlling GPR Performance

Material conditions: Wet, clay-rich, or salty materials absorb radar energy quickly, reducing depth and clarity. Dry, resistive materials allow deeper penetration.

Congestion: congested top layers in reinforced slabs can mask deeper features.

Contrast: GPR detects boundaries; if the target's dielectric properties are similar to the surroundings, the reflection may be weak.

Frequency trade-off: Higher-frequency antennas provide more detail at shallower depths; lower-frequency antennas reach deeper but with less detail. The targets being located also need to be bigger with lower frequencies.

Key Limitations and Expectations

GPR is a risk-reduction tool, not a guaranteed locator. It improves understanding but has limits.

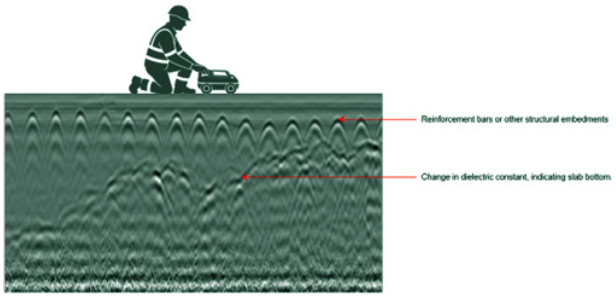
Depth estimates are approximate, as they depend on material properties that vary across a site.

Detection does not equal identification: GPR highlights responses that may represent objects or boundaries, but cannot confirm what the object is without supporting evidence.

Typical Deliverables

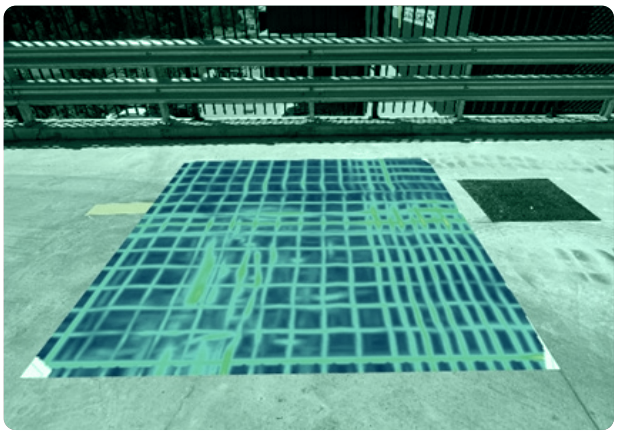
B-scan

A vertical profile along a line showing reflections versus distance and travel time, often converted to depth. Hyperbolic shapes indicate discrete reflectors like rebar.



C-scan / depth slice

A plan-view interpretation from multiple lines, visualising patterns and zones of response. It is not a literal photo of what's below.



Colour scales: Colours are a visualisation choice and may vary by software and settings; colour alone does not have a universal meaning.

Depths: Shown outputs are based on assumed or calibrated velocity and should be treated as best estimates, not exact measurements.

Recommendations and Cautions for Using GPR Results

Before the survey: Share drawings, records, and known constraints. Clarify objectives (e.g., locating PT ducts vs. confirming slab thickness).

During the survey: Expect reduced confidence in wet/clay soils, highly congested slabs, and near edges/walls (no-scan zones).

After the survey (decision-making):

Use GPR as a risk-reduction input, not a guarantee.

If the consequences of hitting something are high, plan for verification (potholing, scanning from multiple directions, complementary methods).

Treat “no response” as “not detected,” not “nothing exists.”

Frequently Asked Questions (FAQ)

How deep can GPR see?

Depth depends on material properties, moisture, and frequency. Wet, clay-rich, or salty materials reduce depth; dry materials allow deeper penetration. High-frequency antennas provide more detail but at shallower depths, while low-frequency antennas reach deeper but with less detail.

Why does it see deeper in some slabs than others?

The properties of the surrounding material affect radar penetration. For example, dense reinforcement or high moisture can limit depth and clarity.

Can GPR detect water and gas lines?

Sometimes. Water and gas utilities are often housed in polyethylene pipes. Depending on their diameter and depth, these can be very difficult to locate, especially if buried under compacted soil or reinforced concrete.

Why can't you scan on metal surfaces like Q-deck/Bondek?

Metal surfaces block radar signals, preventing effective scanning.

Does it say on the screen that it's a conduit?

GPR shows signal responses, not object identification. Interpretation relies on experience and context; supporting evidence is needed to confirm the asset type.

Why is there a no-scan zone close to walls, and what does it mean?

It's a physical access limitation of the scanner geometry since the radar antenna is housed within the scanner chassis and is set back from the unit's front edge. It means no data was collected there, not that it's clear.

Can GPR tell rebar size (diameter)?

Not reliably. It can usually show presence and location, but not an accurate diameter.

Can GPR locate utilities under reinforced concrete?

GPR can sometimes detect utilities under reinforced concrete, but performance depends on slab congestion and contrast between the target and the surrounding material. Verification is recommended for critical assets.

Final Note

GPR is a powerful tool when used with realistic expectations and good survey practice. The best outcomes occur when GPR results are interpreted within the context of site conditions and when high-risk decisions are supported by appropriate verification steps. GPR should therefore be regarded as a complementary technology that forms part of a broader investigative approach, which may also include review of available plans and records, conventional electromagnetic locating methods, and, where necessary, physical verification such as potholing or vacuum excavation.