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FULL CIRCLE CO LLC
SITE OPERATIONS

GPR SURVEY REPORT: SWIMMING POOL AREA

CONCRETE STRUCTURAL & WATER LEAKAGE INSPECTION AT PROPOSED - BY GROUND PENETRATING RADAR AT GROUND FLOOR : PROJECT DATE 01.05.2023

CLIENT	GPR SURVEY COMPANY
FULL CIRCLE CO LLC	MHS PROJECT MANAGEMENT SERVICES
N-A	N-A

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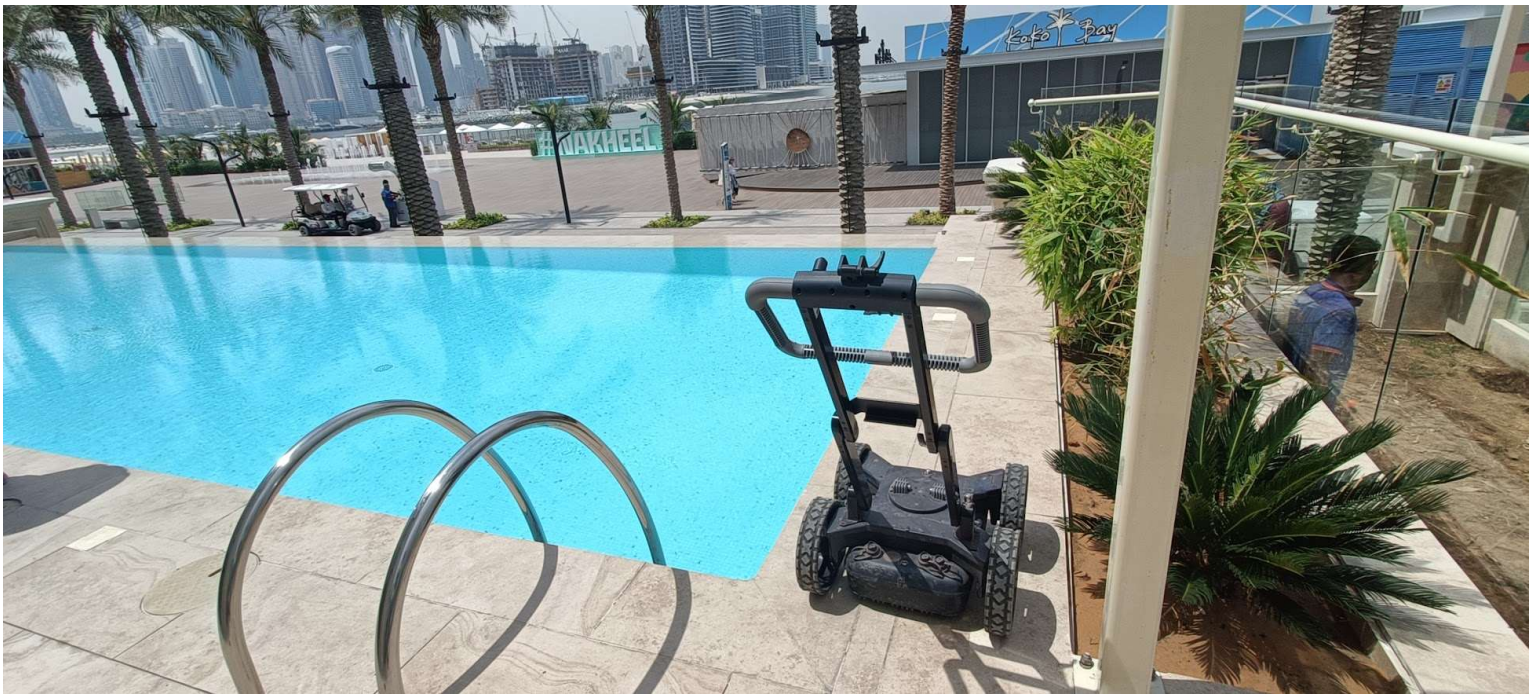
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GPR SURVEY REPORT: SWIMMING POOL

SEA BIRD RESIDENCE THE PALM JUMEIRAH – DUBAI – UAE






Kafo Bay













WATER LEAKAGE LOCATION AT SWIMMING POOL AREA

This Geophysical Survey was carried out by MHS according to the request of the FULL CIRCLE. The objective was to inspect the concrete slab swimming pool area water leakages means of Ground Penetrating Radar todetect areas with water content that could lead to the water source location.

1. Objective

DUBAI, UAE. (*Figure 1*). The required area is exhibited in *Figure 2*.

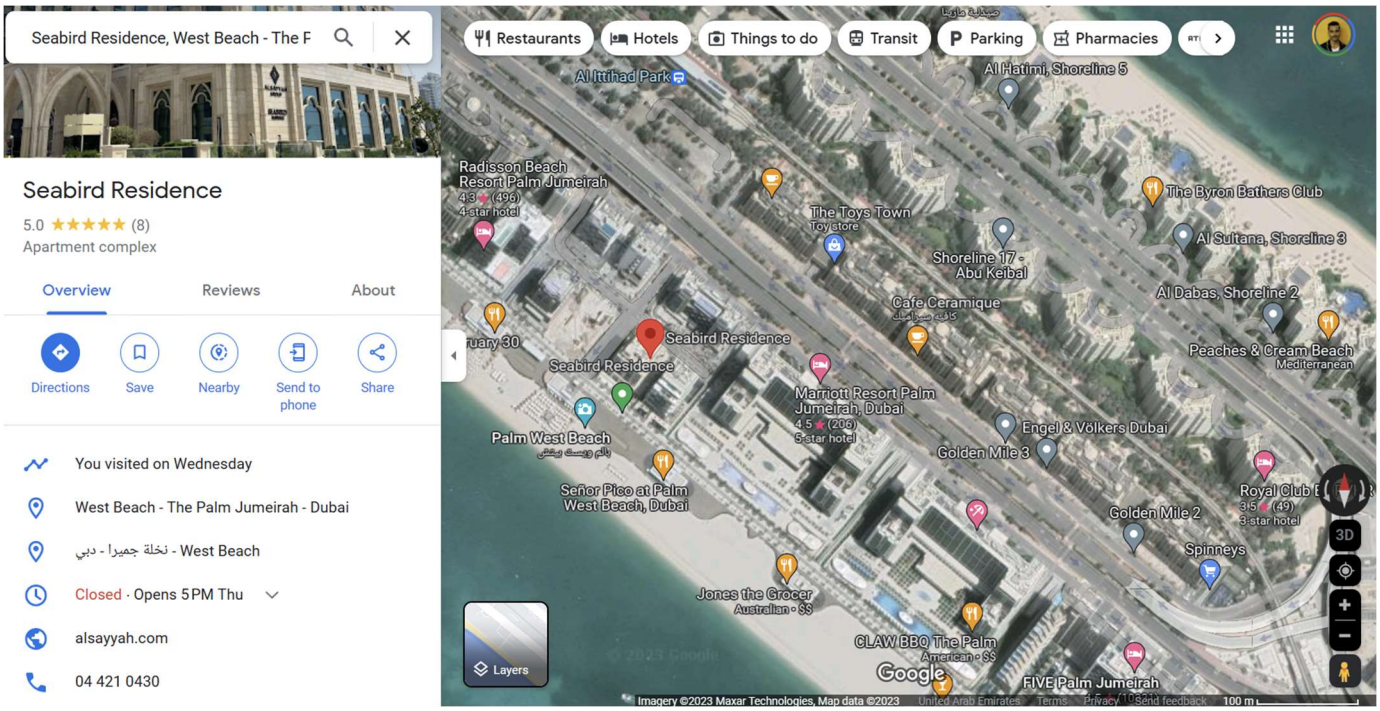


Figure 1 – Satellite view of the case study.

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2. Basic Principles

Ground Penetrating Radar is a geophysical technique that produces continuous high-resolution profile of the subsurface by measuring the travel time of an electromagnetic Pulse between a transmitter, a reflective boundary, and a receiver. The used GPR consists of a common off-set, I e, constant distance between the transmitter and receiver (*Figure 3*). The velocity of an electromagnetic pulse varies with the dielectric property of the Penetrated material.

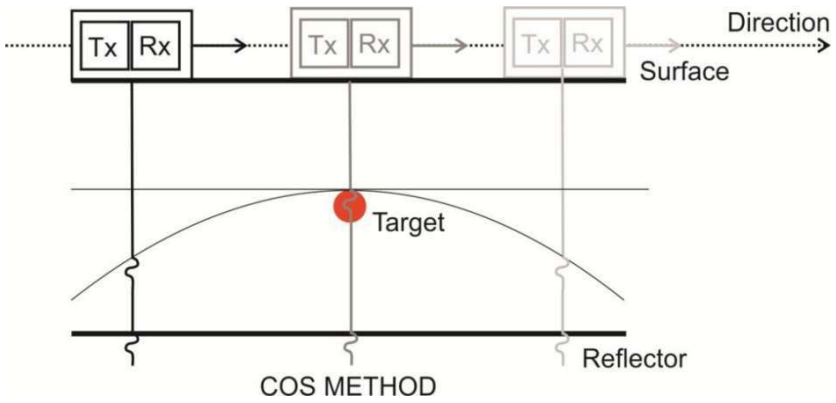


Figure 3 – Principle of GPR based on a Common Off-set (COS) method with a fixed distance between the transmitter (Tx) and the receiver (Rx).

The transmitter generates a very short Pulse (few nanoseconds) and this is emitted by a ground-coupled antenna. Energy backscattered by any target such as a pipe, rebar or wall is then captured by the receiving antenna, which is fixed to the transmitting antenna so that

they move along the surface together. The whole antenna needs to be closed to the ground surface during acquisition, so it impedes any over ground obstacles like trees, bushes, etc. The receiver processes the data collected by the equipment and displays the results on a color monitor. Position and Depth of the target are obtained by reading coordinates of the shape (hyperbolic for a rebar) within the radar map.

It is necessary either to calibrate signal travel time to a known distance travelled in order to infer distance from the recorded travel time, or to use a known velocity through a material to calibrate accurately the instrument. If this cannot be achieved, the operator will use a specific calibration Program incorporated in the data acquisition software of the GPR.

Depth readings from GPR rely on multiplying the measured two-way travel time by the velocity of the radio signals passing through the materials under investigation. As the surface and subsurface of the site changes, frequent recalibration of the subsurface velocities results in an accurate calculation of Depths and thicknesses of located features relative to the surface.

Post-site Processing then took Place using specialized software, GPR Slice. Several Processing stages were involved, including start time correction, amplitude gain adjustments, Gaussian filtering, dynamic correction, and noise removal. Once the raw data is Processed (Figure 3), individual targets were identified on each survey line and linear features mapped out over the survey areas. These GPR results are then pointed into AutoCAD.

WATER CONTENT

In suma, the high water content can be identified when:

- the velocity decreases,

- the amplitude diminished,

- the frequency spectrum is highly attenuated.

However, it is well known that damaged concrete including cracks, fractures or voids can increase the overall amplitude.

3. Equipment

Depending on the required depth for inspection, it was used GS8000 Proceq step-frequency continuous wave GPR antenna (SFCW) operating from 40 – 3440 MHz with an effective bandwidth of 3200 MHz (*Figure 4*). The second antenna output two radargrams, one higher

resolution and another with lower resolution, allows identifying visual up 2m depth* and the second until the 9m depth*. A high frequency antenna (SFCW) Proceq GP8000 from the same manufacturer was applied to verify the results obtained by the GS8000. This GPR device operate with a centre frequency of 2.4 GHz and allows analyzing high resolution images up to 50 cm depth*(*Figure 6*).



*Figure 6 – GP8000 Proceq antenna. *depending on ground conditions.*

4. Survey

The survey consisted of examining in detail the required structural elements by means of GPR. A mesh of parallel and transversal profiles with the GP8000 (*Figure 6*) is carried out to fully cover the surface of interest (*Figure 8*).

5. Data processing and results

The conditions were suitable to apply GPR. However, several filters were applied to the radargrams: time-zero correction, AGC gain and background removal.

In this section are shown the most significant GPR profiles results: one longitudinal, one transversal section and one section in the smaller area, *Figure 9*, *Figure 10* and *Figure 11*, respectively. The rest of the most representative profiles can be found in Annex. It is visible top and bottom reinforcement, the soil and possible pipe trench at depth 1m approx. (*Figure 12).*

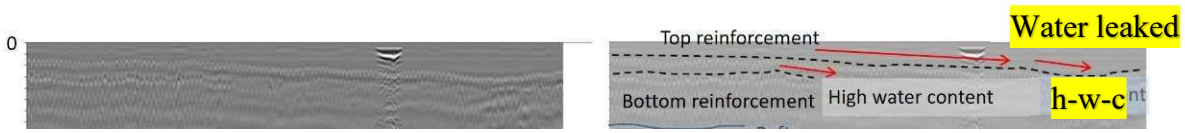
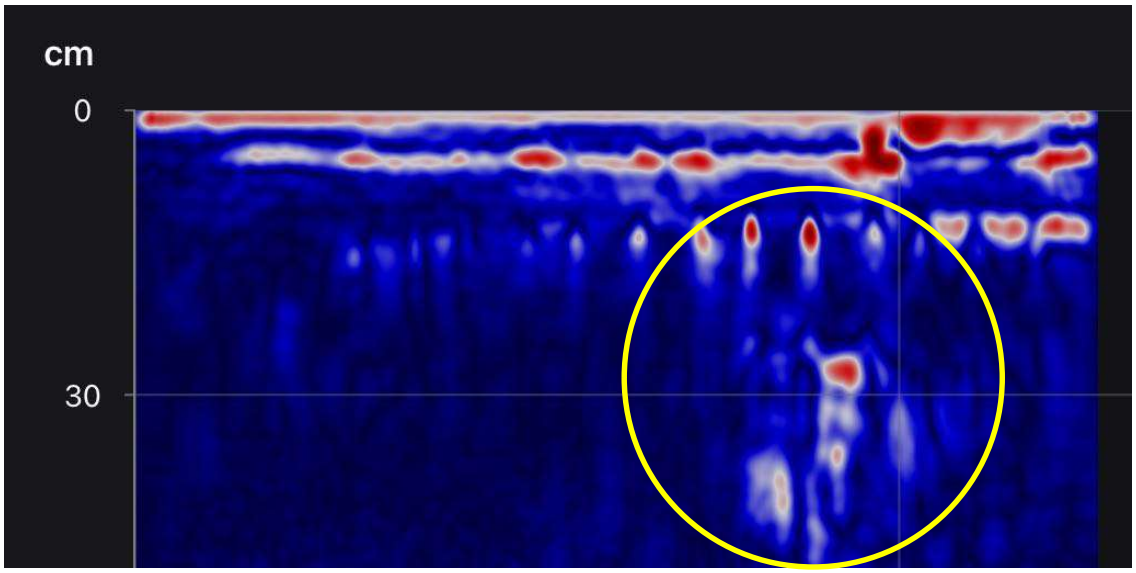


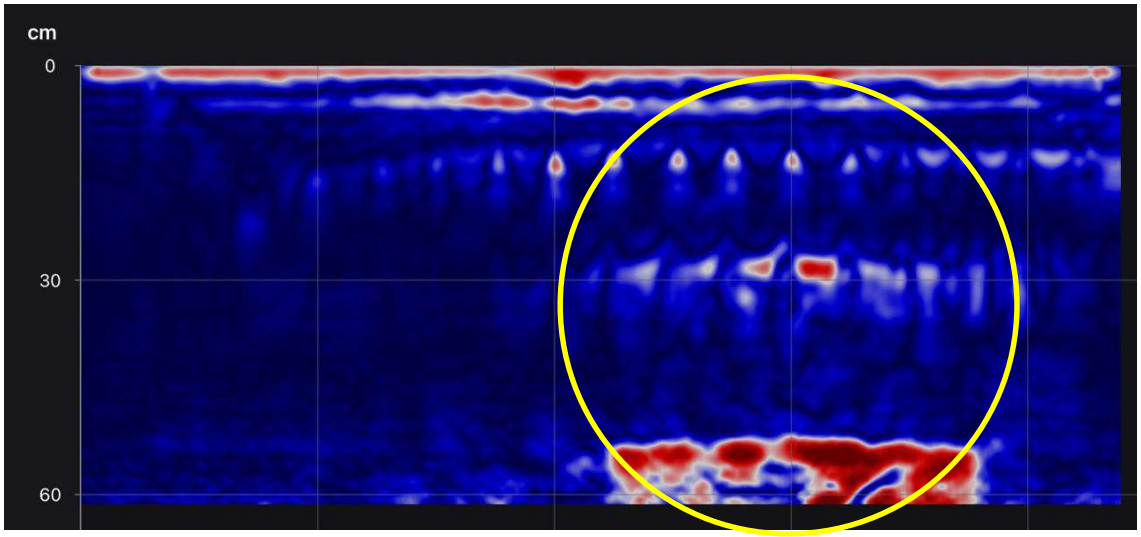
Figure 9 – GPR Profile: Y15, left - processed, right - interpreted.

AREA 1 : MAJOR LEAKAGE AREA : MULTIPLE 8 PIPES CROSSING POINT



AREA 1 : SCANNED LEAK POINTS POSSIBLE PIPE DEPTH 200mm to 300mm





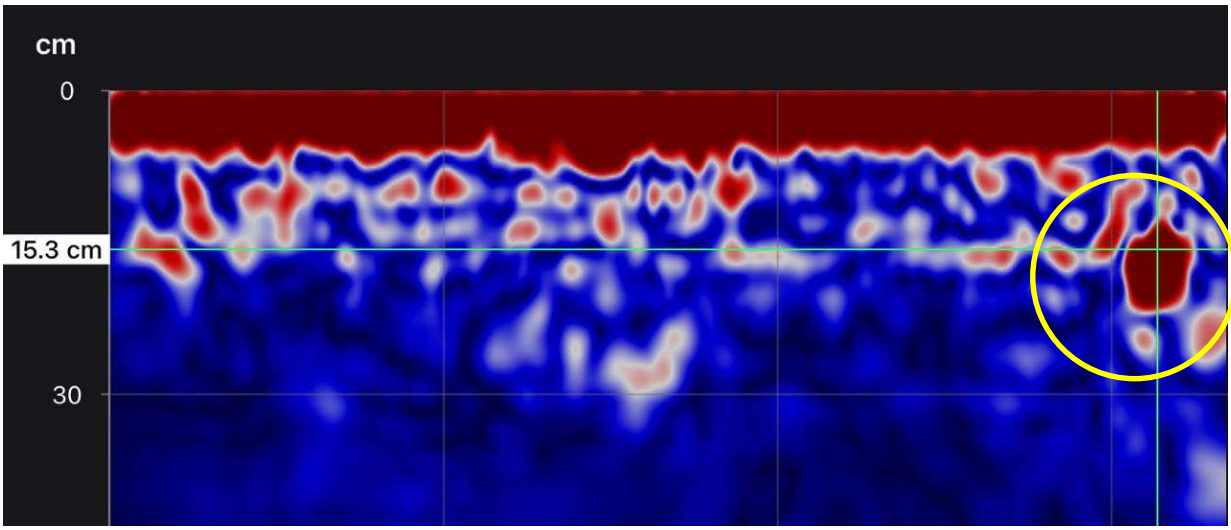
MAIN OUTCOMES : AREA 1

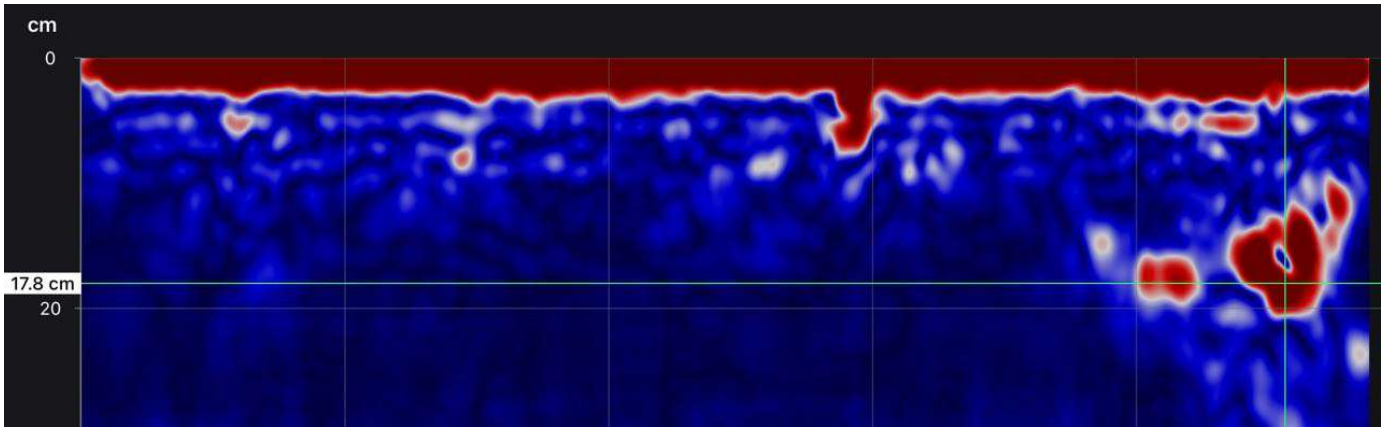
- 5-9 pipes crossing at this point has a possible major leakage,
- Excavation needs to done based on this result and new re-routing of pipes are recommended.
- The method is completely non-destructive.
- The analysis is based on scientific principles and experience based on previous similar projects.
- All the efforts were carried out to provide the most accurate and reliable information.
- Semi-destructive testing is advised to be performed to verify the GPR results.

AREA 2 : SCANNED MINOR LEAKAGE AREA : MULTIPLE 3-5 PIPES CROSSING POINT



AREA 2 : SCANNED RESULT GPR : WATER LEAKAGE SOURCE POSSIBLE PIPE DEPTH 150mm to 200mm





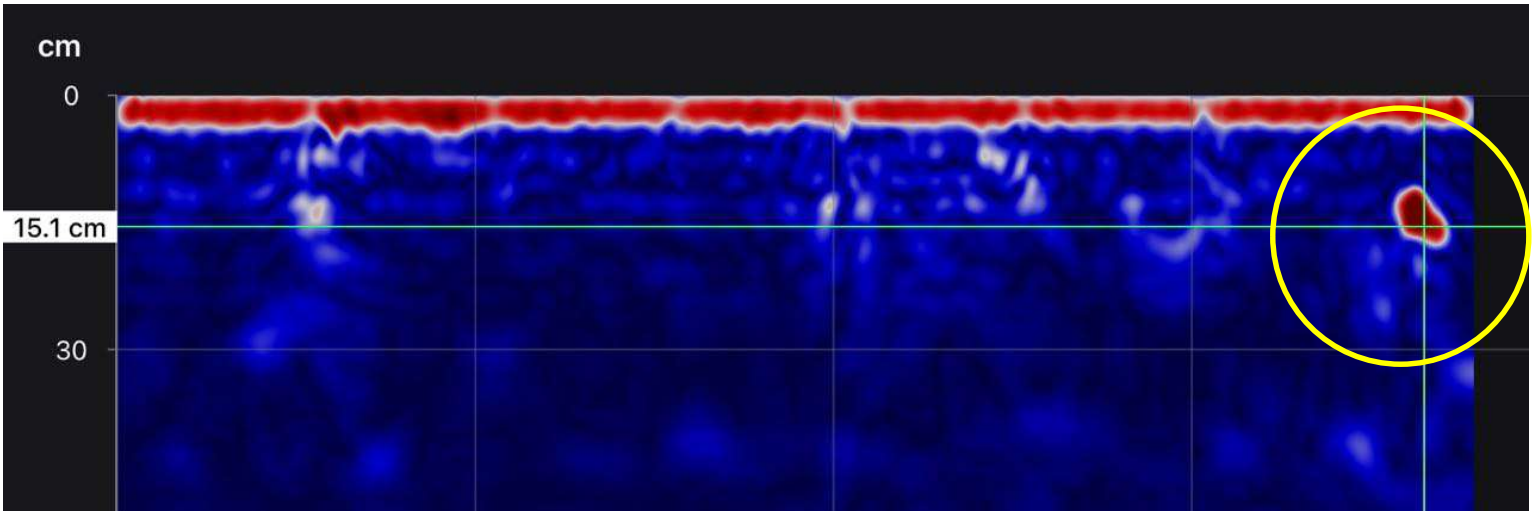
MAIN OUTCOMES : AREA 2

- 3-5 pipes crossing at this point has a possible minor leakage not to be neglected.
- Please follow the images where the equipment is stationed to identify the exact location of leakage since no survey was involved in the process.
- Excavation needs to done based on this result and new re-routing of pipes are recommended.
- The method is completely non-destructive.
- The analysis is based on scientific principles and experience based on previous similar projects.
- All the efforts were carried out to provide the most accurate and reliable information.
- Semi-destructive testing is advised to be performed to verify the GPR results.

AREA 3 : SCANNED MINOR LEAKAGE AREA : MULTIPLE 3-5 PIPES CROSSING POINT



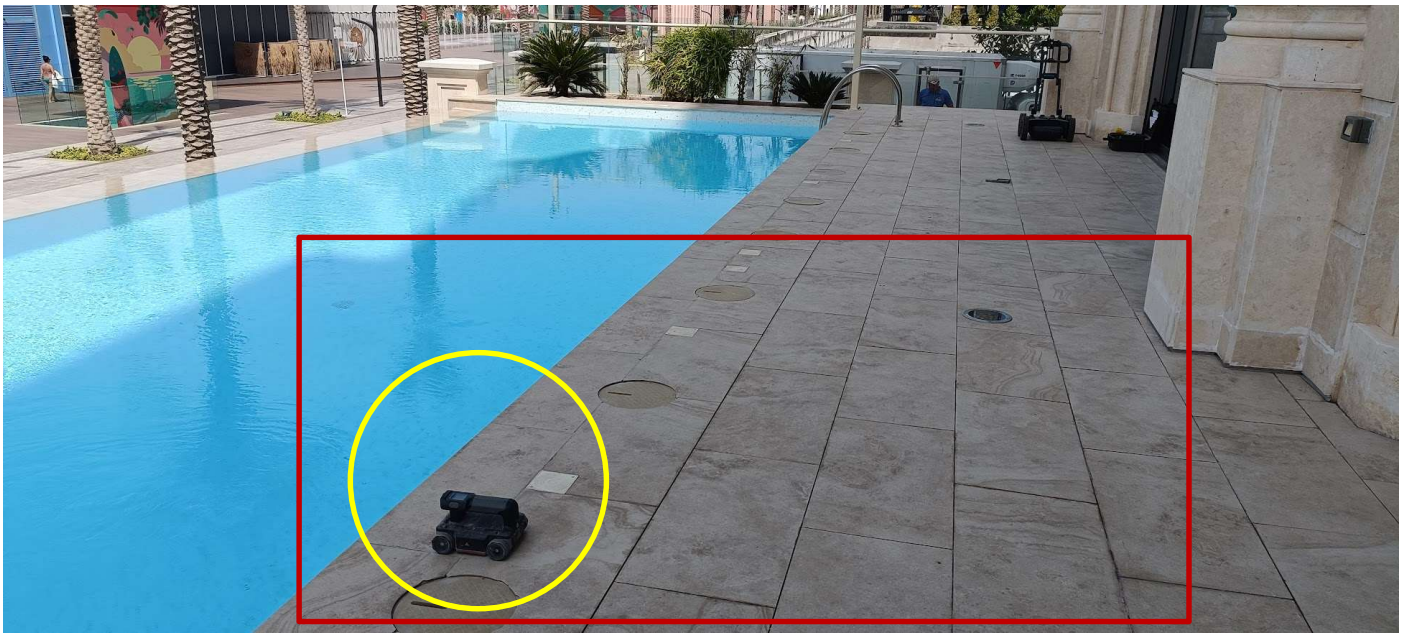
AREA 3 : SCANNED RESULT GPR : WATER LEAKAGE SOURCE POSSIBLE PIPE DEPTH 150mm to 200mm



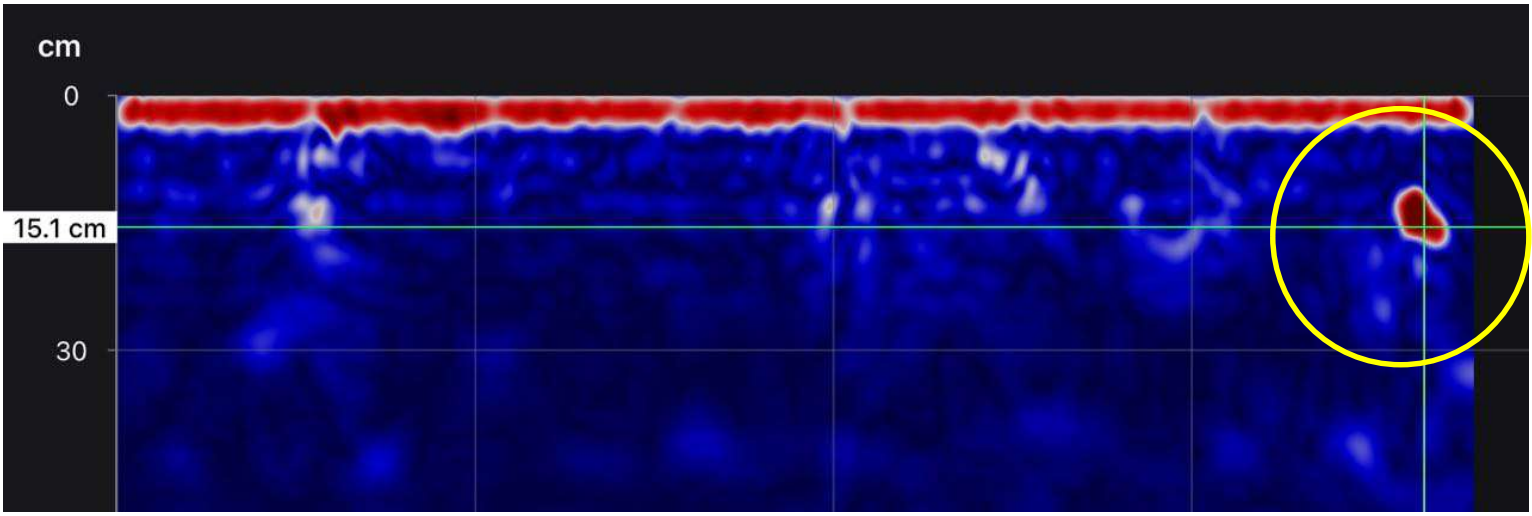
MAIN OUTCOMES : AREA 3

- 3-5 pipes crossing at this point has a possible minor leakage not to be neglected.
- Please follow the images where the equipment is stationed to identify the exact location of leakage since no survey was involved in the process.
- Excavation needs to done based on this result and new re-routing of pipes are recommended.
- The method is completely non-destructive.
- The analysis is based on scientific principles and experience based on previous similar projects.
- All the efforts were carried out to provide the most accurate and reliable information.
- Semi-destructive testing is advised to be performed to verify the GPR results.

AREA 4 : SCANNED MINOR LEAKAGE AREA : MULTIPLE 3-5 PIPES CROSSING POINT



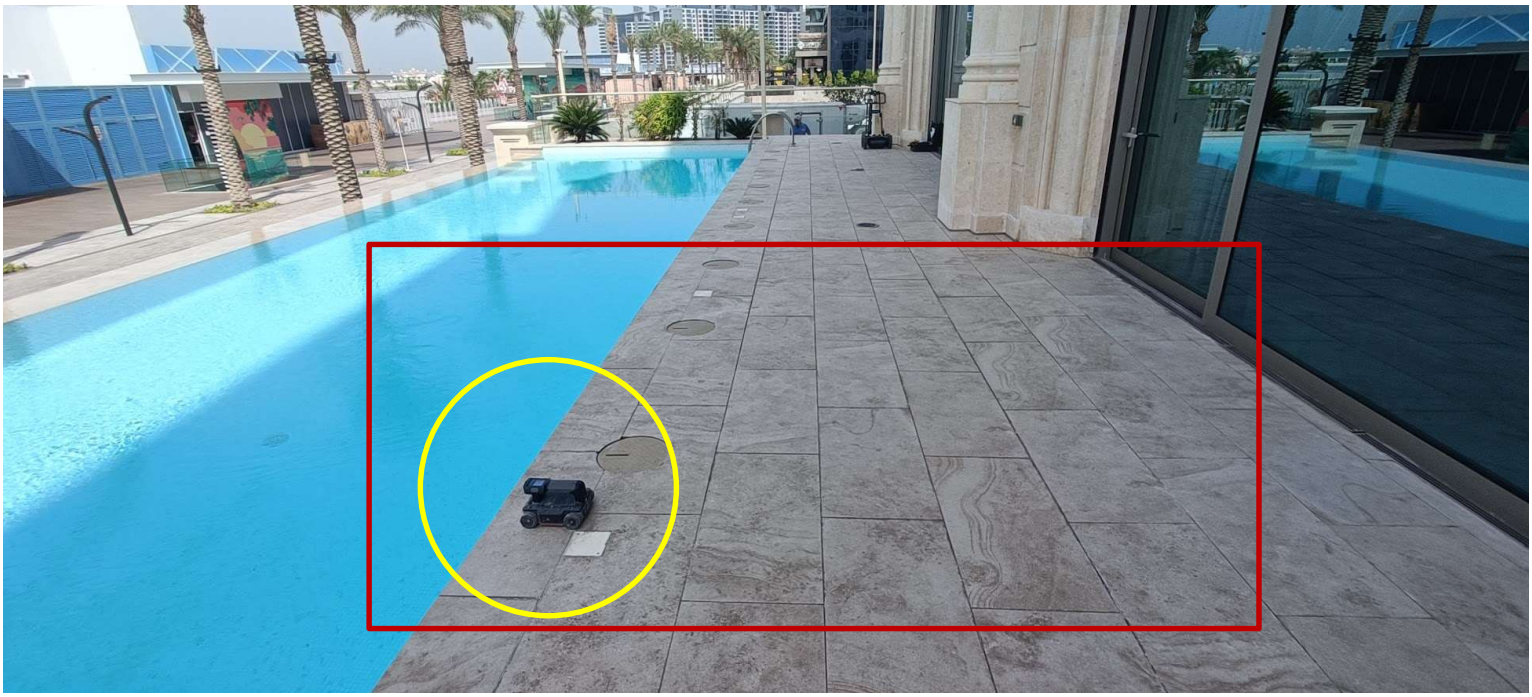
AREA 4 : SCANNED RESULT GPR : WATER LEAKAGE SOURCE POSSIBLE PIPE DEPTH 150mm to 200mm



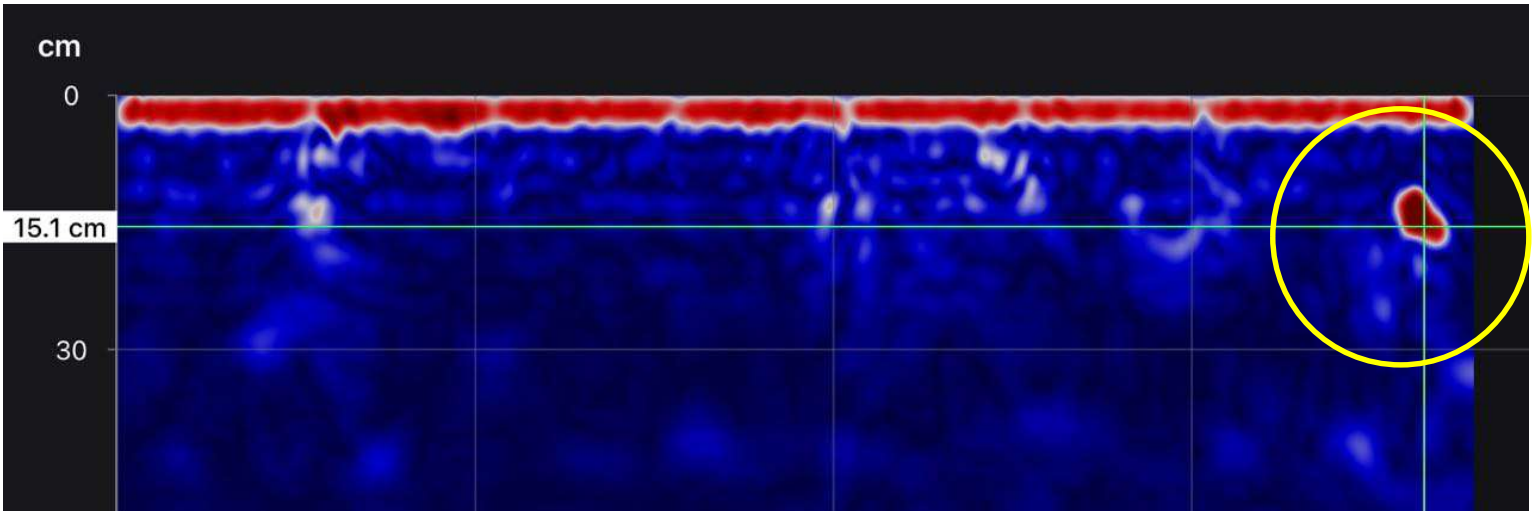
MAIN OUTCOMES : AREA 4

- 3-5 pipes crossing at this point has a possible minor leakage not to be neglected.
- Please follow the images where the equipment is stationed to identify the exact location of leakage since no survey was involved in the process.
- Excavation needs to done based on this result and new re-routing of pipes are recommended.
- The method is completely non-destructive.
- The analysis is based on scientific principles and experience based on previous similar projects.
- All the efforts were carried out to provide the most accurate and reliable information.
- Semi-destructive testing is advised to be performed to verify the GPR results.

AREA 5: SCANNED MINOR LEAKAGE AREA : MULTIPLE 3-5 PIPES CROSSING POINT



AREA 5 : SCANNED RESULT GPR : WATER LEAKAGE SOURCE POSSIBLE PIPE DEPTH 150mm to 200mm



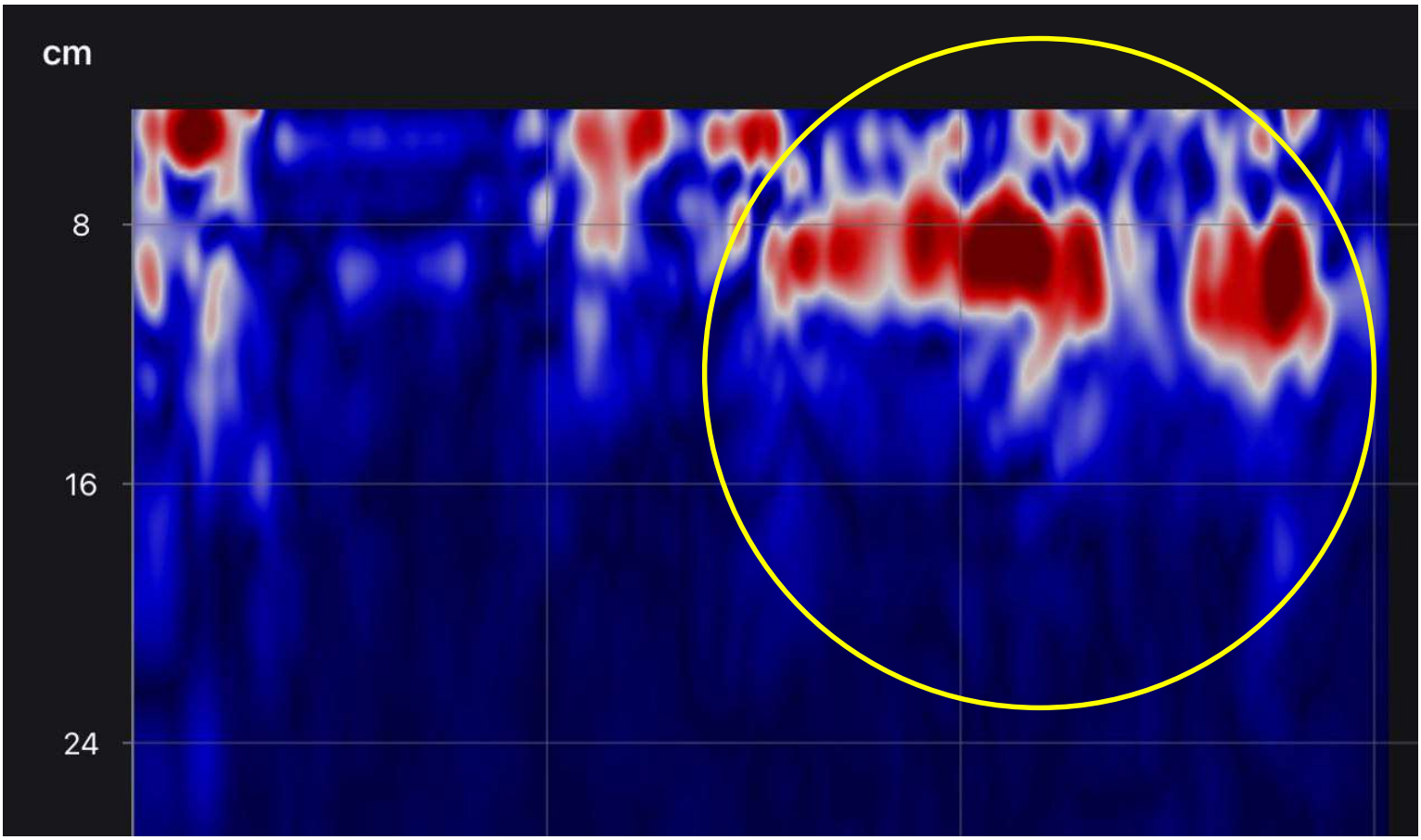
MAIN OUTCOMES : AREA 5

- 3-5 pipes crossing at this point has a possible minor leakage not to be neglected.
- Please follow the images where the equipment is stationed to identify the exact location of leakage since no survey was involved in the process.
- Excavation needs to done based on this result and new re-routing of pipes are recommended.
- The method is completely non-destructive.
- The analysis is based on scientific principles and experience based on previous similar projects.
- All the efforts were carried out to provide the most accurate and reliable information.
- Semi-destructive testing is advised to be performed to verify the GPR results.

AREA 6: SCANNED MAJOR LEAKAGE AREA : PIPES UNKNOWN



AREA 6 : SCANNED RESULT GPR : WATER LEAKAGE SOURCE



MAIN OUTCOMES : AREA 6

- 2-3 pipes crossing at this point has a major leakage immediate action is recommended.
- Please follow the images where the equipment is stationed to identify the exact location of leakage since no survey was involved in the process.
- Excavation needs to done based on this result and new re-routing of pipes are recommended.
- The method is completely non-destructive.
- The analysis is based on scientific principles and experience based on previous similar projects.
- All the efforts were carried out to provide the most accurate and reliable information.
- Semi-destructive testing is advised to be performed to verify the GPR results.

Recommendations

Excavate and test the destructive process to confirm the locations scanned. New rerouting of all the pipes leading to the swimming pool area as mentioned above needs to be done.

All the efforts were carried out to provide the most accurate and reliable results (please refer to drawings to more precise graphical and numerical information).



Disclaimer:

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