

Golf Green Management

Greens at golf courses receive special attention from grounds maintenance personnel.

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Noggin 1000 SmartCart surveying a golf green.

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Greens keepers face challenges

GPR helps maintain a golf green

Overview

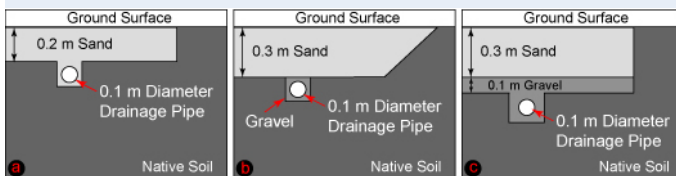
Golf greens are designed to have very good drainage so there is no standing water. Further, the surfaces can dry out quickly resulting in severe distress on the surface grasses. Greens keepers face a constant challenge of ensuring enough water is available for healthy grass growth but not too much water.

This site evaluation carried out at the Loxahatchee golf course, West Palm Beach, Florida shows GPR in action. The primary focus of the study was to assess GPR for defining the location of drainage pipes and channels under a green and to examine the engineered soil structures beneath a stressed green.

Problem

Greens at golf courses receive special attention from grounds maintenance personnel. Further, greens are carefully constructed; coarse grained soils and surface contouring plus drainage piping ensure good drainage and eliminate standing water. Damage to piping or development of impermeable soil horizons leads to drainage problems.

As shown below, both tees and greens are generally constructed with plastic drainage pipes in sand (a). Depending on the method, there may be gravel around the drainage pipe (b) or a gravel layer underlying the sand (c).



Golf green construction techniques: (a) plastic drainage pipes in sand, (b) gravel around the drainage pipe, (c) a gravel layer underlying the sand.

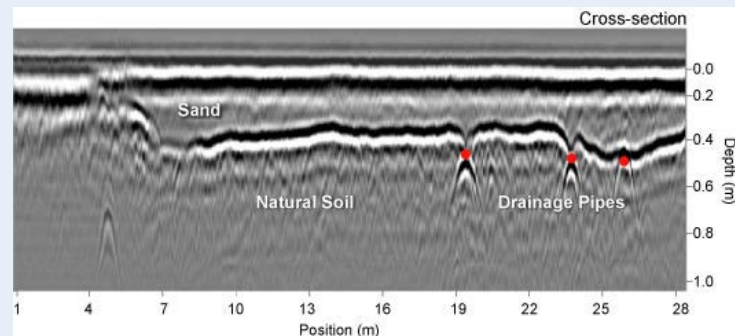
GPR Contribution to Solution

GPR is a non-invasive imaging tool with a track record of use in locating metallic and non-metallic pipes. Further, GPR can sense subtle changes in soil conditions and variations in soil water content.

The GPR investigation had two aspects. The first was simple reconnaissance profiling to locate buried drainage channels quickly using the profile and mark process. In the second, a regular survey grid was established and detailed surveying conducted resulting in the generation 3D depth slice images of the green's subsurface.

GPR can be used to survey golf greens to locate drainage pipes, determine pipe depth and define engineered soil layers. GPR, being a non-destructive imaging tool, plays a powerful role on golf courses. For locating metallic and non-metallic utilities around the course, GPR is a fast, proven technology. Where GPR truly excels is in the important maintenance and remodeling of the tees and greens.

Cross-sectional lines collected with GPR can pinpoint non-metallic drainage pipes and image the sand and gravel layers in real time.



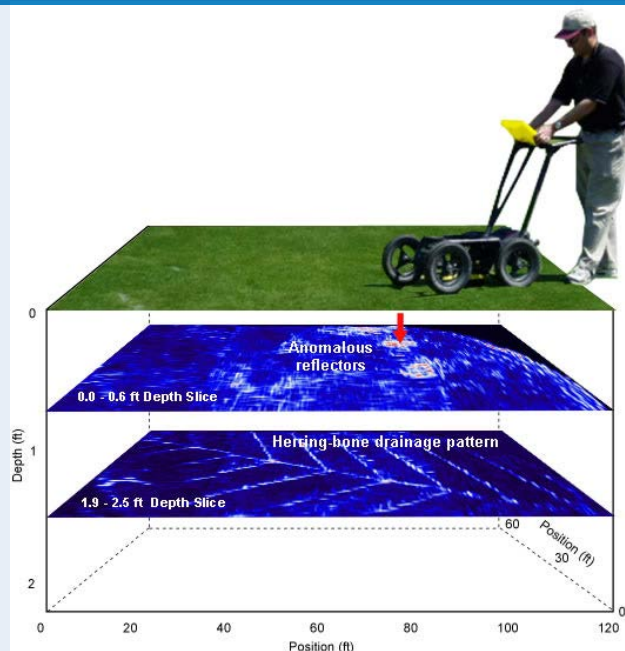
Typical cross-section of a green sand and gravel layers with drainage pipes underneath.

Data collected in grids can be displayed as depth slice images to map the geometry of drainage pipes.

Depth slice views can provide more than simply the pattern of the drainage pipes. The golf green in the example below had drainage problems due to an unknown cause.

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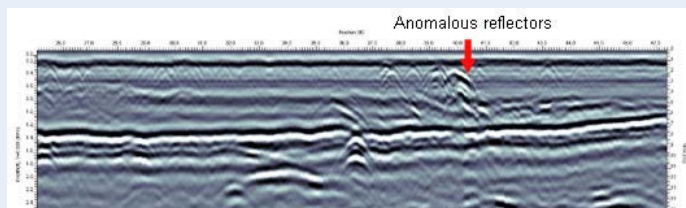
Map of the subsurface at a depth of 1.9 - 2.5 ft shows herring-bone pattern of the drainage system under the green. The shallower 0.0 - 0.6 ft depth map reveals a potential drainage problem area within the sand layer.



A look at the shallower depth slice map in the sand layer above the pipes reveals a potential drainage problem area. A GPR image through a homogeneous sand layer would normally have minimal reflectors but in this case three distinct areas of stronger GPR signals reveal anomalies within the sand layer.

Reviewing one of the cross-sections shows areas of strong signals and confirms the interpretation of the map image.

Both the shallow depth slice and the cross-section show anomalous reflectors within the sand layer that may be associated with drainage problems on the green.



Cross-section showing anomalous reflectors within the sand layer.

The precise construction and place of greens and, to a lesser degree, tees is not usually well documented. To carry out timely and efficient maintenance, locating the pipes and drainage paths is critical. Further, being able to define soil differences that affect the growth health of the surface grass is a challenge without invasive investigation, which can disrupt use of the golf course.

Results & Benefits

Maintaining the drainage and irrigation systems is a constant challenge. This case study illustrates how one golf course has used GPR to locate drainage pipes, determine pipe depth and define engineered soil layers in their golf greens. Some key benefits are:

- Noggin 1000 SmartCart is a compact portable and rugged GPR for golf course maintenance
- Operation is simple and intuitive
- Users can be effective with only a few hours of training
- Systematic search protocols are available as best practice guides
- Locate and mark provides rapid and immediate zone of interest identification
- Grid mapping simplify data analysis and reduces false alarms

GPR responses vary greatly depending on the target being sought and the host material. GPR response variability can be challenging to new GPR users. When learning about GPR, the best practice is to review several similar case studies to develop an understanding of variability. Check for other insightful information on the resources tab to learn more. Use Contact Us or Ask-the-Expert to reach our Application Specialists who can help you tap into Sensors & Software's vast array of technical information.

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