Traverses were conducted with a SIR-3000 ground-penetrating radar (GPR) on three terraces to the Susquehanna River near Maytown in Lancaster County, Pennsylvania. A 200 MHz antenna was used in this study. Figure 1 is a Google Earth image of the area showing the locations of four GPR traverse lines. Traverse lines 1 and 2 are on the lower terrace, which, in this image is flooded by flood waters from the Susquehanna River. Traverse line 3 in on the middle terrace and traverse line 4 is on the upper terrace along Vinegar Ferry Road. The red and green colored dots at the ends of the traverse lines correspond to red and green colored dots on the accompanying radar records.

Figure 1. A Google Earth Image of the Terrace Sites in Lancaster County.

Lower Terrace

Two traverses were made with the GPR in an area mapped as Newark silt loam (Nc). The very deep, somewhat poorly drained Newark soils formed in mixed alluvium on nearly level flood plains. Newark is a member of the fine-silty, mixed, active, nonacid, mesic Fluventic Endoaquepts family. Soil cores extracted from this site revealed a coarse loamy soil with an underlying sand layer. Because of the soil's low clay content, attenuation rates were low and GPR provided satisfactory penetration depth (>2 m) and resolution of subsurface features. These soils are considered to have high potential for GPR soil applications.

In the following radar records all scales are expressed in meters. The depth scales are based on core observations made on the lower terrace. On higher-lying terraces, the depth scale should be considered an approximation.

Figure 2 is the radar record from traverse line 1, which was located on the lower terrace (see Fig. 1). The identified sand stratum is clearly evident on this radar record. This layer appears to be truncated in an area with shallower, segmented subsurface features. Though not confirmed by core observations, this area is believed to represent an area of soil disturbance.

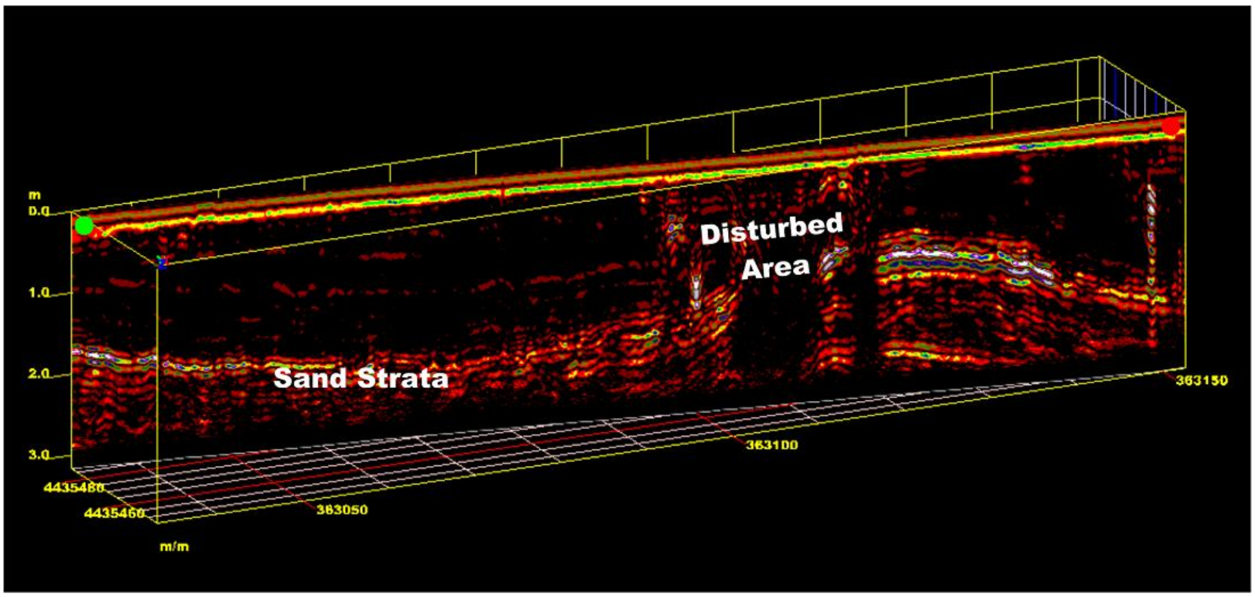

Figure 2. This radar record was obtained from the lower Terrace, which consists of a coarse loamy soil that is underlain by a sandy stratum at varying depths. This radar record is from a traverse (#1) which was conducted parallel with the Susquehanna River.

Figure 3 is the radar record from traverse line 2, which was also located on the lower terrace (see Fig. 1). This traverse line crosses an access road and continues eastward across two fields. The road is expressed by moderately high-amplitude (colored yellow) surface reflections. The sand stratum begins beneath the western embankment slope to the road and continues across the nearby field. Near the boundary to the second field, additional subsurface reflections occur. This suggests a change in soil materials and soil type. The sand stratum appears to continue across the second field, but is more weakly expressed (low amplitude signals that are colored red), segmented, and has a more irregular topography. In this field, the presence of buried drainage tiles is inferred by four, equally spaced point reflectors (with underlying reverberated reflections) that occur at relatively uniform soil depths. Ground-truth coring is needed to confirm these interpretations.

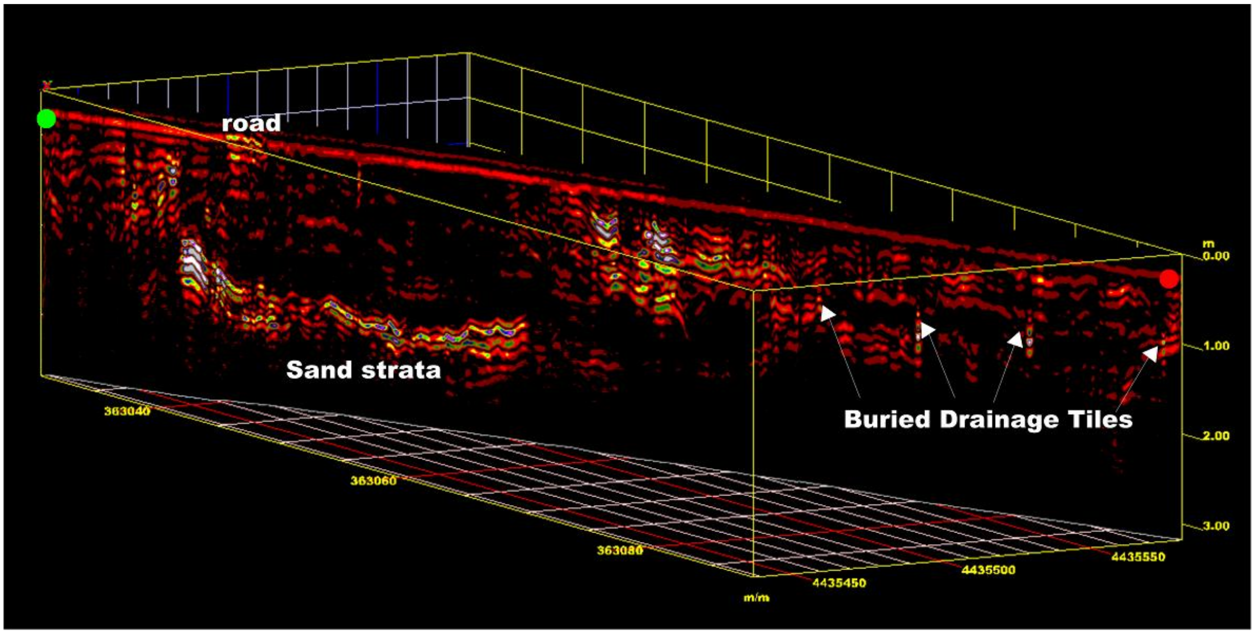

Figure 3. This radar record represents traverse line #2, which was conducted orthogonal to the Susquehanna River. A stratum of sand is well expressed beneath the north-south trending road and into the adjoining field (to east). Four buried drainage tiles have been identified in the lower-lying, eastern field.

Middle Terrace:

A traverse was made with the GPR in an area mapped as Elks silt loam (EcA). The very deep, well drained Elk soils formed in mixed alluvium. Elk is a member of the fine-silty, mixed, active, mesic Ultic Hapludalfs family. The argillic horizon is mainly silt loam or silty clay loam, but ranges to silty clay in the lower part. Because of the higher clay content of Elks soils, the penetration depth and effectiveness of GPR is restricted. Elks soil is considered to have moderate potential for GPR applications.

Figure 4 is the radar record from traverse line 3, which was located on the middle terrace (see Fig. 1). This traverse line crosses a cultivated field. The two weak, near surface planar reflections are assumed to represent the argillic horizon. Though highly interpretive and difficult to trace, a deeper subsurface interface has been identified on the radar record shown in Figure 4. The underlying materials consist of weak (colored red), moderate (colored yellow) and high (colored white, grey, and blue) amplitude reflectors. The irregular topography and form (short, inclined, segmented, planar reflectors and point reflectors) of this interface suggest bedrock. Ground-truth coring is needed to confirm these interpretations.

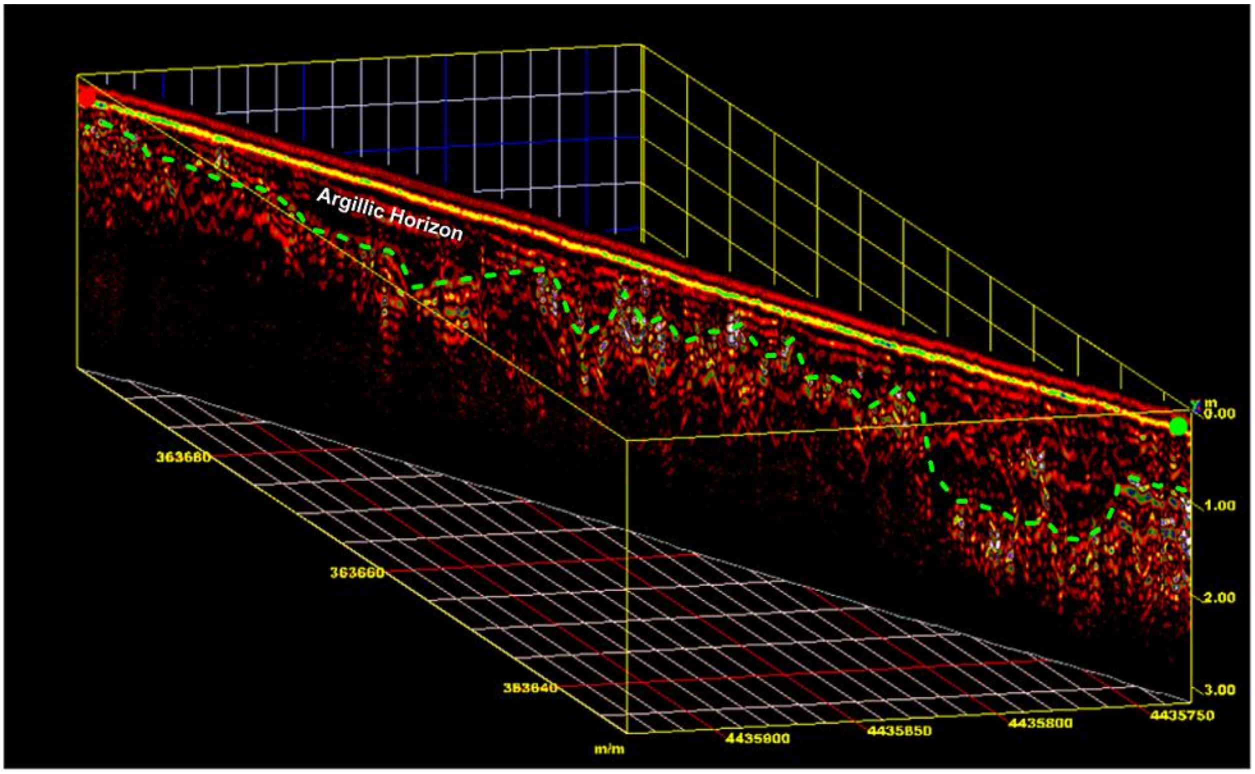

Figure 4. This radar record represents traverse line #3, which was conducted on the middle terrace. Though difficult to trace, a highly irregular subsurface interface can be identified. This interface varies in amplitude and form.

Upper Terrace:

The GPR traverse crossed areas mapped as Elks silt loam on 0 to 3 % slopes (EcA) and Duffield silt loam on 3 to 8 % slopes (DbB). The very deep, well drained Elk soils formed in mixed alluvium. Elk is a member of the fine-silty, mixed, active, mesic Ultic Hapludalfs family. The argillic horizon is mainly silt loam or silty clay loam, but ranges to silty clay in the lower part. The deep and very deep, well drained Duffield soils formed in residuum from limestone bedrock. Duffield is a member of the fine-loamy, mixed, active, mesic Ultic Hapludalfs family. These soils are considered to have moderate potential for GPR soil investigations.

Figure 5 is the radar record from traverse line 4, which was located on the upper terrace (see Fig. 1). This traverse line crosses two cultivated fields that are separated by a grassed drainageway. Attenuation rates are higher on this terrace. As a consequence, penetration depths are more restricted than on the other two terraces. Other than the argillic horizon, no additional subsurface interface can be identified. Clusters of high amplitude reflections could represent buried rock fragments or other features, but none can be identified with any degree of confidence from the radar record alone. Ground-truth coring is needed to confirm these interpretations.

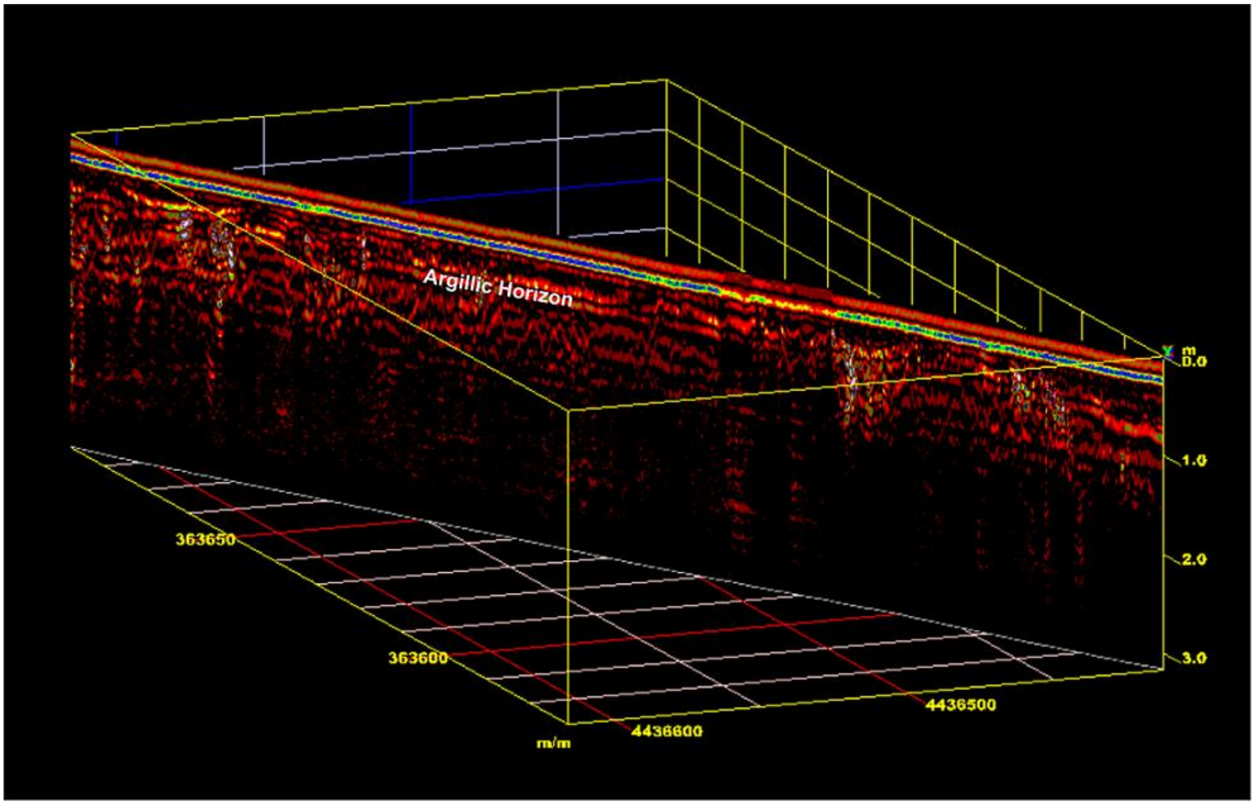

Figure 5. This radar record represents traverse line #4, which was conducted on the upper terrace. Other than the argillic horizon, no subsurface interface can be identified on this radar record.