CAAP Quarterly Report

Date of Report: *October 5, 2016*

Contract Number: *DTPH5615HCAP09*

Prepared for: *U.S. Department of Transportation/Pipeline and Hazardous Materials Safety Administration (USDOT-PHMSA)*

Project Title: *Advancement in the Area of Intrinsically Locatable Plastic Materials*

Prepared by: *West Virginia University, Constructed Facilities Center (WVU-CFC)*

Contact Information: *Dr. Udaya B. Halabe, Professor, CEE Department, WVU*
Email: Udaya.Halabe@mail.wvu.edu
Phone: 304-293-9934

For quarterly period ending: *September 30, 2016*

Business and Activity Section

1. Generated Commitments

1.1 *Agreement Changes*

There has been no change in project participants or other contracts details during the last quarter.

1.2 *Purchases*

Some supplies have been purchased during this reporting period. The purchased supply items are listed in Table 1.

Table 1: Supplies purchased

No.	Item Description	Quantity
1	Top soil (40 lb bags)	15
2	Grass seed (3 lb bag)	1
3	Tape Measure (25')	1
4	Miscellaneous items (spray foam, silicone lubricant etc.)	Varies

2. Graduate Students Working on the Project

Ph.D. Students – 1

M.S.C.E. Student – 2

B.S.Ch.E. Student – 1

Note: All students have part-time appointments on research project.

3. Status Update of Past Quarter Activities

The following project planning and research activities have been completed during the last quarter (July 1 – September 30, 2016).

3.1 *Procurement of Materials*

Backfill of the trenches in which the pipe samples were buried had settled over the course of last quarter because of the rain. WVU facilities management brought soil to fill areas with major settlements, and the remaining areas were filled with bags of top soil procured in this quarter. The filled trench areas were then reseeded with a bag of grass seed purchased in this quarter.

3.2 *GPR Testing of Buried Pipes*

Ground Penetrating Radar (GPR) tesing of the burried pipe samples has commenced. As mentioned in the previous quarterly report, 33 pipes were buried in 3 trenches with 12ft. spacing between the trenches.

We first waited for the grass to start growing over the trenches (after refilling and reseeding the the settled ditches) before taking GPR data. The refilling of ditches to achieve a level field was needed to avoid introducing unwanted noise in the GPR signals due to shaking of the radar antenna. Figure 1 shows the GPR equipment and radar antennas used in the testing. The GPR equipment setup in the field is shown in Figure 2.

(a) *(b)* *(c)*

Figure 1: (a) GPR equipment, (b) 400 MHz GPR antenna, (c) 900 MHz GPR antenna

Figure 2: GPR equipment setup in the field

A sample of the GPR data collected from a pipe buried at 2 ft depth is shown in Figure 3. The hyperbolic feature in the GPR cross-sectional scan (B-scan) and the corresponding signal at this location (A-scan), marked by RED ellipse, shows radar signal reflection from a pipe burried at 2 ft depth. These types of signals can be enhanced by processing steps such as background noise removal and "zero correction." The next quarter will focus on acquiring GPR data from the different buried pipes, and processing and analyzing them using radar data processing software.

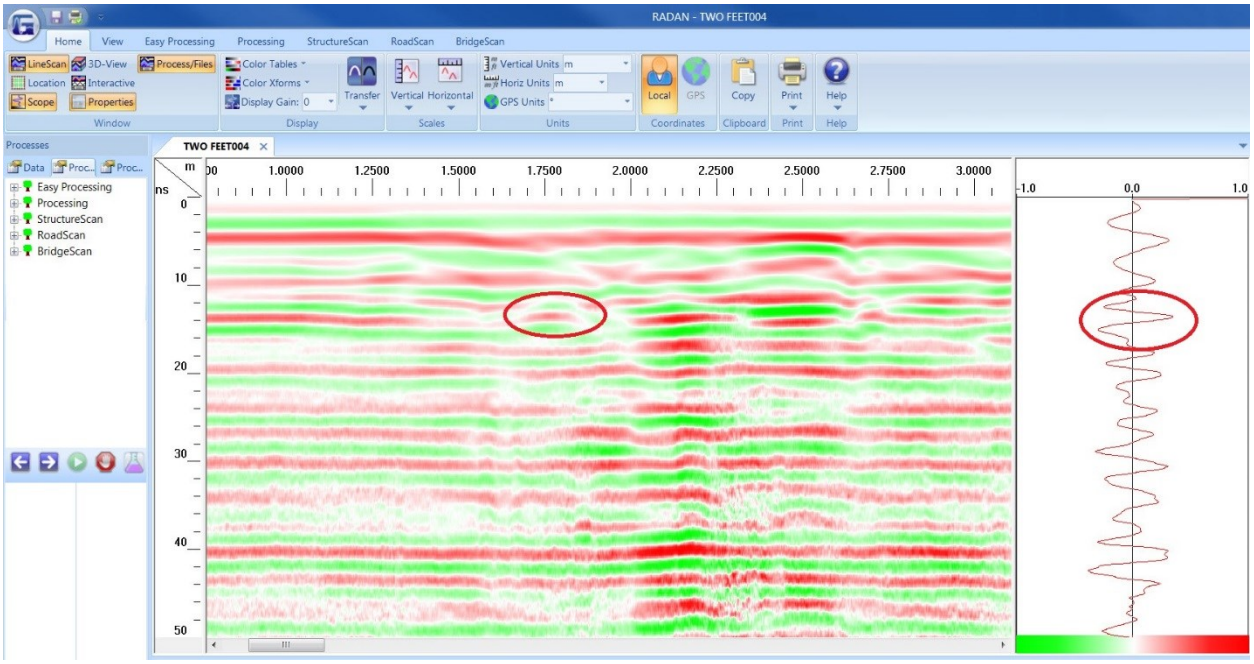

Figure 3: Sample GPR cross-sectional scan (left) and A-scan signal (right)

In addition to the GPR data, buried soil sensors along the pipes were used to record soil properties such as volumetric water content, electrical conductivity, and temperature. These measurements can also be used to estimate the dielectric permittivity of the soil which affects GPR velocity and depth estimations. The GPR data shown in Figure 3 was collected on a sunny day with soil temperature around 22 C and soil volumetric moisture content of less than 0.5. Acquiring GPR signals under different soil moisture conditions will enable the determination of optimal soil condition for GPR detection of the various buried pipe samples. Figures 4a and 4b show one of the soil sensors and the data logger for the sensors respectively.

(a) *(b)*

Figure 4: (a) Soil moisture and resistivity sensor, (b) Data logger

4. Description of any Problems/Challenges

No challenges were encountered in the past quarter.

5. Planned Activities for the Next Quarter

The following activities are planned for the next quarter:

1. The detectability of the buried PVC, GFRP, and CFRP pipes will be evaluated using GPR over the next several quarters under various soil moisture conditions.

2. Various signal processing steps will be utilized using radar software to enhance the GPR data acquired from the buried pipes, so that their detectability could be improved.

3. Also, leak detection from a pipe buried in a box filled with soil and carrying compressed gas is in progress.