May 26, 2011

Caryn Dejesus
AECOM
30 Knightsbridge Road, Suite 520
Piscataway New Jersey 08854

Project: Geophysical Survey –Garfield Ave and Caven Point Rd. – Jersey City, NJ.

Dear Eric;

The following is a brief letter report detailing the results of the geophysical survey performed at the above referenced site. Site maps and/or pertinent ground penetrating radar (GPR) transects are contained in the report. It would be helpful to review the site maps when reading this report. TPI's standard practice is to indicate the results of the geophysical survey by marking all identified utility lines, tanks, and GPR anomalies etc. with chalk, paint or flags. It should be noted that this report is a means of transferring data and results of data interpretation, which was performed during the time allotted for the fieldwork

Project Scope and Visual Site Inspection

TPI Environmental, Inc. (TPI) was contracted by AECOM (client) to conduct a geophysical survey with the goal of detecting the backfilled Morris Canal. The Morris canal was a coal-carrying canal operating from the 1820's until its closure in 1924. The study area consists of a vacant lot located at the above address and as indicated on Figure 1. Upon arrival to the site on May 10, 2011, TPI reviewed the site history with the client and performed a site walk to search for surficial evidence of the canal. Previous boring logs in the area revealed the local soil stratigraphy to include historic fill, fine silts and clays, and fine coastal sands and gravels at depth. During the site walk the following areas of interest were noted;

- No surficial evidence of the canal was observed. The client indicated the general area thought to contain the canal based upon historical aerial photography.

Methodology

Geophysical surveys are typically accomplished by employing the following techniques; GPR, Fisher TW6 electromagnetic metal detection (TW6 EM), a Geonics EM61-MK2 Time – Domain Electromagnetic Detector unit (EM61), radio frequency line locating (RF), AGI SuperSting R8 IP Earth Resistivity and IP Meter, and magnetics. Known utilities are typically traced with the RF unit, GPR, and the TW6 EM unit depending on the size, matrix and conductive properties of the line. The EM61 is a high power, high sensitivity metal detector capable of detecting both ferrous and non-ferrous metal. The TW6 EM unit sounds an audible alarm in the presence of a large mass of metal such as an UST. A description and discussion of these geophysical methods as well as TPI's standard procedures for performing geophysical surveys is found in Appendix A. In general, "blind surveys" are typically performed by initially scanning the site with a TW6

EM unit and/or an EM61 unit and noting areas of relatively high EM response. Then locations with high EM response are further investigated with GPR. EM units are typically not effective and practical in areas underlain with reinforced concrete and/or the presence of ubiquitous metallic objects.

The AGI SuperSting unit measures the voltage drop of an induced electrical current across numerous electrodes as it travels through the electrically heterogenous subsurface. Multiple survey profiles are completed in this manner based upon the specific conditions of the field area in order to assemble a complete characterization of the ground resistivity properties. The resistivity data is then processed and examined for evidence of significant subsurface features including bedrock surfaces, perched groundwater tables, cavities/sinkholes, or potential contaminant plumes.

Geophysical Survey Results

The geophysical survey at this site was accomplished with the AGI Super Sting Resistivity unit. Five resistivity lines were deployed as indicated in Figure 1. Electrodes were spaced at 5 feet for Lines 1-4, and 10 feet for Line 5. Resistivity data for all five lines were collected via Inverse Schlumberger, Wenner and Dipole-Dipole electrode arrays with the latter two yielding best results. Pseudosections of resistivity versus depth are presented in Figure 1 of this report. Results of the geophysical survey are as follows;

- Resistivity data for Lines 1-4 all reveal a circular high conductivity (low resistivity) anomaly near the eastern terminus of the profiles. These conductivity anomalies roughly correspond with the supposed location of the canal. TPI suspects the highly conductive signature may be related to channelized groundwater flow resulting from a combination of the low permeability of the former canal bottom and the loose material used to backfill the former canal. The increased organic component within the interstitial fluid of cores collected in the former canal would also explain the high conductivity values.
- On average, the depth to the top of the suspected canal anomaly is 11' below ground surface (b.g.s.) and the depth to the base of the anomaly is approximately 20'-25' b.g.s. Suspected top and bottom canal depths based upon multiple soil borings in the area correlate remarkably well with the resistivity data.
- Average width of the suspected canal anomaly is approximately 23'.
- Due to the resolution of the resistivity data, TPI was able to detect an undocumented westward bend in the course of the canal. Spatial resolution of this scale is most likely not possible with historic information and maps.
- TPI concludes that the resistivity profiling method successfully detected the backfilled canal with respect to both vertical and horizontal dimensions. Depending upon unforeseen environmental limitations, this technique along with a limited boring program should be effective in delineating the canal boundaries elsewhere within the client's work area. The resitivity profiles have proven to be a highly effective subjective tool for predicting and delineating the changes in subsurface conditions between borings.
- If the client desires to expand the resistivity survey based upon this highly successful pilot study, TPI recommends performing the survey prior to any boring activity. Following the survey, a limited boring program could be designed to ground truth the

resistivity data and document the environmental conditions of the former canal backfill sediments.

TPI completes non-intrusive geophysical surveys using equipment and techniques representing best available technology. TPI does not accept responsibility for survey limitations due to inherent technological limitations or unforeseen and varying site-specific conditions such as metal-reinforced concrete. In practical terms, TPI serves to reduce the risk of encountering subsurface features or greatly increase the chance of locating them depending on the goal of the project. The results of this investigation should only be used as a tool and should not be considered a guarantee regarding the presence or absence of subsurface features.

If you should require additional information or have any questions, please do not hesitate to contact me at the above phone number or email me at ffendler@tpienv.com.

Sincerely,

Frank Fendler

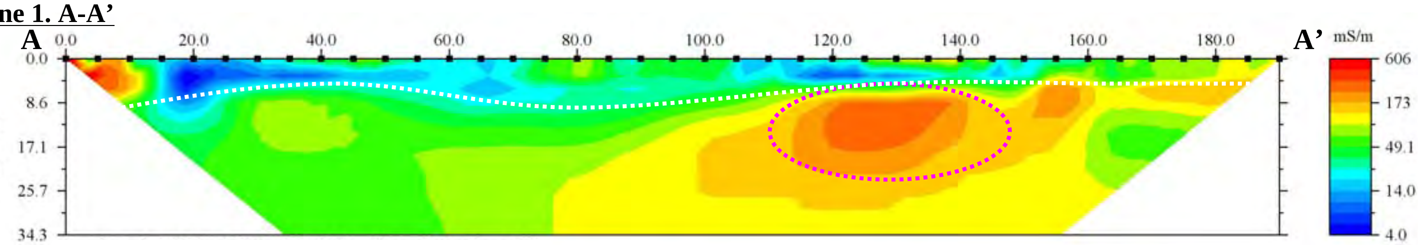
Frank Fendler, M.S, P.G.
President

Michael Robbins

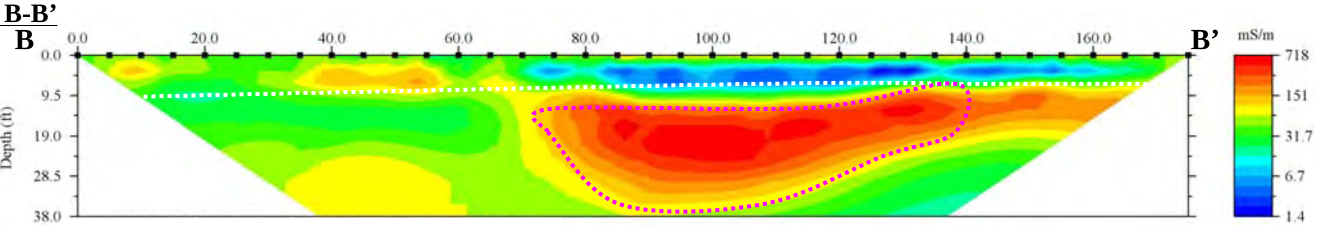
Michael Robbins, M.S.
Geologist

Ground Conductivity Pseudosections

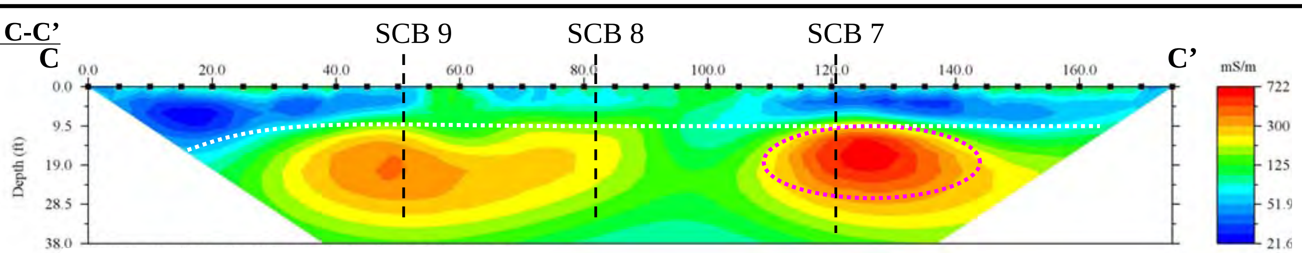
Line 1. A-A'



Line 2. B-B'



Line 3. C-C'

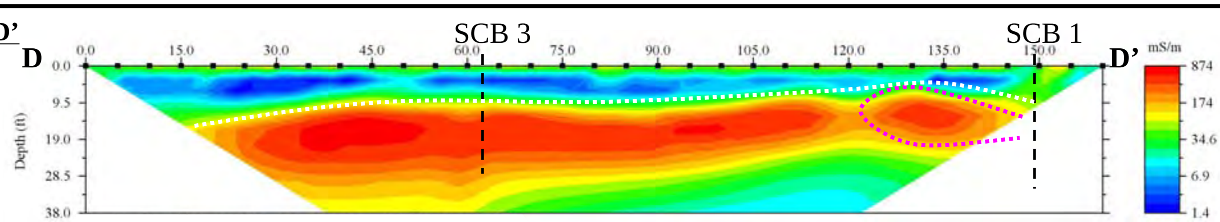


SCB 9 Interpreted Sedimentology	
0'-12'	Unconsolidated "cindery" fill
12'-25'	Conductive organic-rich sediments
25'-30'	Interbedded sands

SCB 8 Interpreted Sedimentology	
0'-12'	Unconsolidated "cindery" fill
12'-25'	Fine sands/silts. No canal fill.

SCB 7 Interpreted Sedimentology	
0'-12'	Unconsolidated "cindery" fill
12'-25'	Canal fill/organics
25'-30'	Interbedded sands

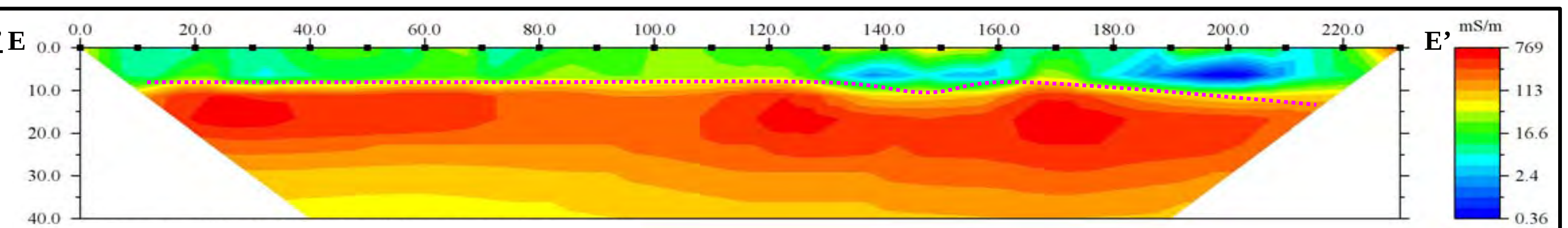
Line 4. D-D'



SCB 3 Interpreted Sedimentology	
0'-12'	Unconsolidated "cindery" fill
12'-30'	Organic rich silts/fine sands

SCB 1 Interpreted Sedimentology	
0'-15'	Unconsolidated "cindery" fill
15'-19'	Conductive canal fill
19'-35'	Interbedded sands and gravel

Line 5. E-E'



Legend of Generalized Sedimentology

- Base of surficial fill (Lines 1-4).
- Boundaries of canal anomaly.
- Unconsolidated "cindery" surficial fill (low conductivity).
- Fine sands/silts/clays with likely organic pore fluids (high conductivity).
- Moderately conductive interbedded sands.

*Data-based interpretations for known soil boring locations are given in Lines 3, 4.

Figure 1. North-facing oblique view of study area. Yellow lines indicate the orientation of Lines 1-5 (left)

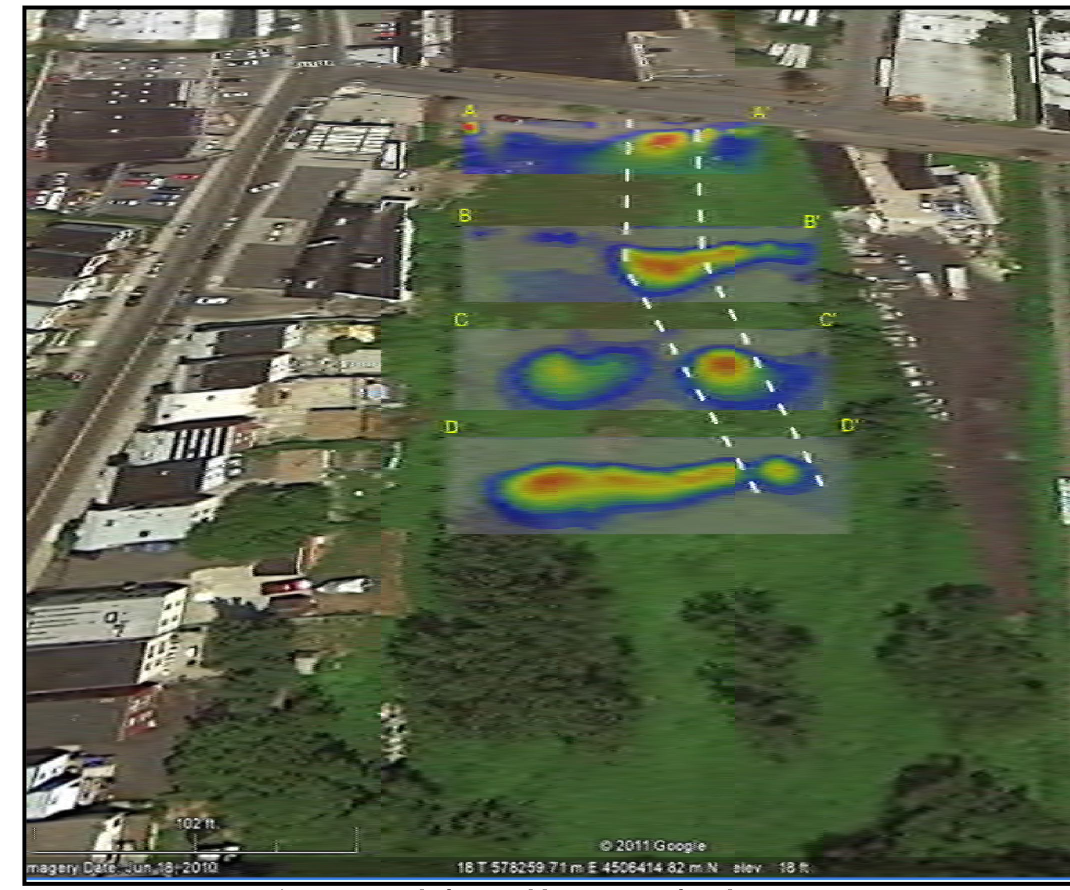


Figure 2. North-facing oblique view of study area. Conductivity (inverse of resisitivity) data is shown along the approximate line of data collection. Top of each data profile approximates 0' b.g.s as shown on left axes. TPI's interpretation of the canal boundaries are shown in dashed white lines.

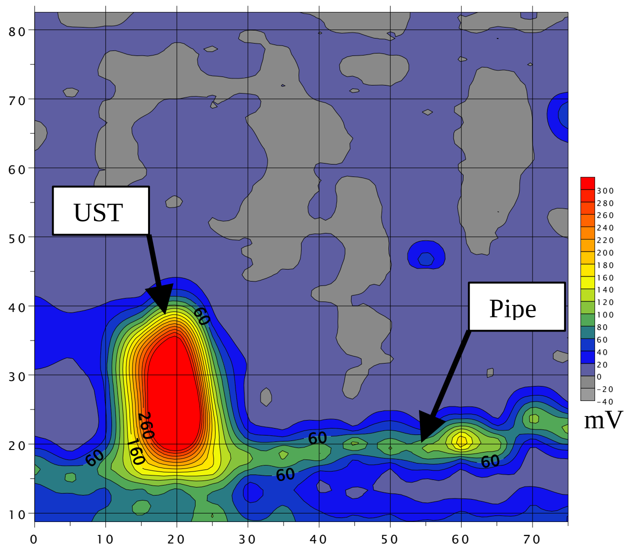
TPI environmental	Vacant Lot – Garfield Ave and Caven Point Rd., Jersey City, NJ.			Figure 1
	Client: AECOM	Date: 5/10/11	Morris Canal Investigation	Resistivity Profiling Results (Displayed as Conductivity)

Attachment A
TPI's Geophysical Survey Equipment & Methods

Geonics EM61-MK2

The EM61 is a high resolution time-domain metal detector which is used to detect ferrous and non-ferrous metallic objects. It consists of a powerful transmitter that generates a pulsed primary magnetic field, which induces eddy currents in nearby metallic objects. The decay of these currents is measured by two receiver coils mounted on the coil assembly. The responses are recorded and displayed by an integrated computer based digital data logger with real time numberical and graphic display. Two ports on the logger allows simultaneous collection of EM and GPS data. For further processing and interpretation data can be transferred to a laptop computer in the field and a color contoured map of the EM61 reponse is prepared (see below).

EM61 Color Contoured Map



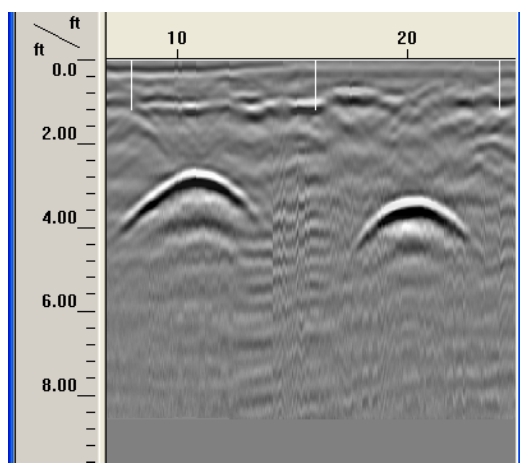
The EM61-MK2 detects a single 55 gallon drum at a depth of over 10-feet beneath the instrument, yet it is relatively insentsitive to interference from nearby surface metal such as fences, buildings, cars, etc. By making the measurement at a relatively long time after termination of the primary pulse, the response is practically independent of the electrical conductivity fo the ground.

Due to it unique coil arrangements, the response curve is a single well defined positive peak greatly facilitating quick and accurate location of the target, the depth of which can usually be estimated from the width of the response and/or from relative response from each of the two receiver coils.

GPR

This method is one of the most powerful and cost effective methods of locating man made objects and stratigraphic layers in the subsurface. It is an active method that transmits electromagnetic pulses into the ground, the radar pulses are reflected from materials or layers of differing dielectric and electrical conductive properties. The GPR computer measures the elapsed time in billionths of a second (nanoseconds) from when the pulses are sent and when they are received back at the surface that can then be converted to depth. Results of the radar scan are displayed as a continuous cross section of the subsurface on the computer screen in real time. Metallic materials such as tanks, pipes conduits, rebar etc. have vastly different dielectric properties then soils so there reflections are striking and relatively easy to identify. Pipes and tanks constructed of PVC, concrete, and terracotta also produce distinct reflections, however, these reflections are typically not as striking as metallic materials. A typical radar image of two metallic underground storage tanks is found below.

GPR Image Of Two Metallic USTs



GPR surveys are conducted with the most advanced GPR equipment currently available including a Geophysical Survey Systems (GSSI) SIR-3000 subsurface radar unit with a 400 MHz antenna. The 400 MHz antenna has a depth range of approximately 20-feet and other antennas may be employed with the system depending on specific site conditions and objectives of the survey. The GPR transect data may be saved on the internal hard drive and transferred to a PC for storage, printing, and post processing. GSSI is the world leader in the development of GPR systems and was the first company to commercialize GPR in 1970. GPR hardware and software has improved dramatically over the last several years allowing for relatively rapid and economical GPR surveys. With 3-dimensional capabilities, the latest GPR software takes data processing a step farther then the former 2-dimensional viewing method. Three-dimensional visualization helps you to see the whole picture, giving you a powerful tool to interpret complex utility layouts and identify subtle linear features that may have otherwise been missed.

GPR surveys are typically conducted by searching for GPR hyperbolas indicative of subsurface pipes or tanks signatures in the vicinity of known entities. Theses signatures are marked on the ground and areas progressively further from the known entity are scanned and marked. This process is continued until the GPR operator performed enough scans to determine and mark the subsurface pipe, tank or anomaly. During this process the GPR data is typically not saved due to the immense size of the data files. After this phase of the GPR survey is completed, representative GPR transects or grids are performed and saved for the report and post processing. Some of the factors that may negatively affect GPR results include clay soils, rebar in concrete, high moisture content, depth of the target, and the integrity, size, and material of the target.

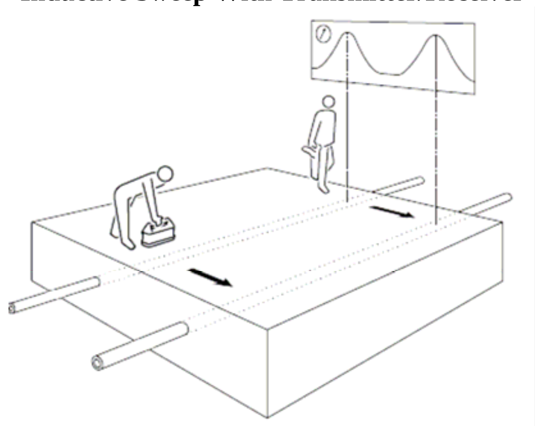
TW-6 EM Unit

TPI routinely employs a Fisher TW-6 electromagnetic metal detector when performing GPR surveys. The TW-6 creates an electromagnetic field with a transmitting coil and measures the strength of that field with a receiving coil. As the TW-6 passes over electrically conductive materials such as metal tanks or drums the field is distorted and the instrument produces an audible alarm based on the degree of the distortion. The TW-6 can detect conductive materials the size of drums or small tanks to depths of 10-feet. The instrument is actually a relatively poor metal detector which makes it ideal for locating large conductive materials such as metal drums, medium to large metal pipes, reinforced concrete pipes, and metal tanks. A more sensitive metal detector would produce "false positives" on small pieces of metal that are typically found in fill and throughout developed sites. If the survey area is underlain by reinforced concrete or cars and other large surficial metallic features are within 10-feet, the TW-6 will not be useful.

Line Locating

Line locating is performed with a Radiodetection RD400 PXL-2 line locator with a 433 HCTX-2 transmitter. The transmitter emits a specific radio or electromagnetic signal which is indirectly induced or directly conducted onto the metallic line. The transmitter is capable of producing frequencies of 512 Hz, 8 kHz, or 33 kHz and the receiver is configured for the specific transmitted frequency. The induced signal is coupled with the line by either using an induction clamp which surrounds an exposed line or placing the transmitter above a buried line and transmitting the signal to it. The receiver may also be used in a passive locate mode (power) to identify the presence of current carrying lines. Nonmetallic lines may also be located by snaking a sonde down accessible lines with push rods. A sonde is a small transmitter that emits a specific electromagnetic frequency which can be detected by the receiver at depths of 12 to 16-feet.

Inductive Sweep With Transmitter/Receiver



Attachment A
TPI's Geophysical Survey Equipment & Methods

Resistivity

TPI conducts subsurface resistivity surveys using the AGI SuperSting R8 IP Earth Resistivity and IP Meter. The SuperSting unit measures the voltage drop of an induced electrical current across numerous electrodes as it travels through the electrically heterogenous subsurface. Multiple survey profiles are completed in this manner based upon the specific conditions of the field area in order to assemble a complete characterization of the ground resistivity properties. The resistivity data is then processed and examined for evidence of significant subsurface features including bedrock surfaces, perched groundwater tables, cavities/sinkholes, or potential contaminant plumes.

AGI SuperSting R8 IP Earth Resistivity and IP Meter assembly

PO Box 518 ffendler@tpienv.com 888-204-3266-Phone
New Hope, PA 18938 www.tpienv.com 888-204-3266-Fax

Line 1 (A-A')

	Northing (UTM)	Easting (UTM)	
	14785141.7	1897238.9	Zero point (A)
	14785043.7	1897403.8	End point (A')
Transect Borings			
Boring #5	14785094.6	1897320.5	
Boring #4	14785084.6	1897339.5	
Boring #3	14785075.2	1897359.2	
Boring #2	14785056.5	1897380.5	
Boring#1	14785043.3	1897397.1	

Line 2 (B-B'')

	Northing (UTM)	Easting (UTM)	
	14785043.7	1897214.5	Zero point (B)
	14784981.4	1897371.5	End point (B')
	Transect Borings	Distance From Zero (ft)	

**No transect borings along Line 2*

Line 3 (C-C')

	Northing (UTM)	Easting (UTM)	
	14784971.7	1897185	Zero point (C)
	14784918.7	1897347.6	End point (C')
Transect Borings			
Boring #5	14784989.5	1897217.2	
Boring #4	14784976.2	1897258.1	
Boring #3	14784962.4	1897281	
Boring #2	14784947.7	1897317.6	
Boring#1	14784931.4	1897343.1	

Line 4 (D-D')

	Northing (UTM)	Easting (UTM)	
	14784885.3	1897142.9	Zero point (D)
	14784815.4	1897285.1	End point (D')
Transect Borings			
Boring #4	14784855.8	1897197.1	
Boring #3	14784846.1	1897224.2	
Boring #2	14784829.8	1897245.5	
Boring#1	14784817.3	1897274.5	