

**Root Cause Analysis of  
TVA Kingston Dredge Pond Failure from  
December 22, 2008**

**Volume III – Laboratory Testing and Results**

**Kingston Fossil Plant, Harriman, Tennessee**

Project No. 60095742  
June 25, 2009

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### **3.1 Laboratory Testing and Results**

#### **3.1.1 Geotechnical Index Tests, Gradations and Classification**

Geotechnical index testing was performed on representative samples of the material collected during the exploration phase. The index testing was used to classify the soil in general accordance with the Unified Soils Classification System and to identify consistent geologic units across the project site. Index testing included: moisture content, grain size distribution, liquid limit, plastic limit, plasticity index, carbon content, specific gravity, pH and density determinations. The results of these tests are summarized in the Table 3.1\_T1 through T4 at the end of this Chapter and the individual lab sheets for some of the tests are included in the Appendix of this volume.

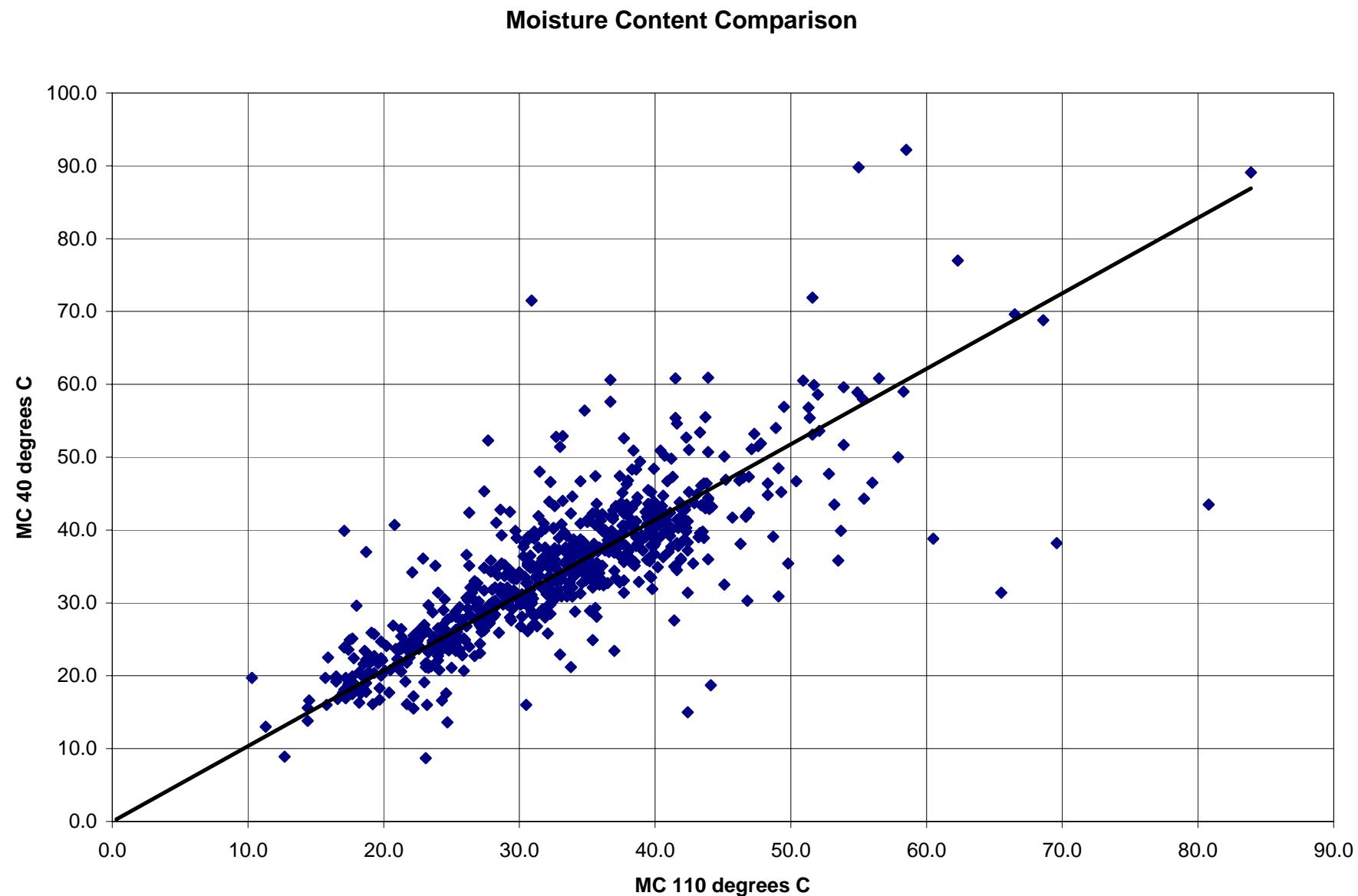
The moisture content of all natural soil samples was determined in general accordance with ASTM Standard D 2216. The moisture content of the ash was determined by two methods. In some cases, the ash moisture content was determined in general accordance with D 2216. However, there was some concern that at a drying temperature of 110°C a chemical reaction would be triggered in the ash causing the formation of cemented ash. To prevent this reaction from occurring, the ash samples were dried to a constant weight at 40°C. Figure 3.1.1\_1 presents the relationship of the moisture content determined using the 40°C oven versus the 110°C oven is included at the end of this chapter.

The grain size distribution of the materials was determined in general accordance with ASTM Standard D 422 to determine the distribution of fine grained and coarse grained particles. The individual reports for each of these tests are included in Appendix 3A.

The liquid limit, plastic limit and plasticity index of selected fine grained materials were determined in general accordance with ASTM Standard D 4318 using the multi-point procedures. The individual test reports for each of the completed tests are included in Appendix 3A.

The specific gravity of natural and fill materials were determined using the procedures described in ASTM Standard D854. The pH was determined in accordance with ASTM D 4972. The carbon content was determined in accordance with ASTM D 2974 Method C. The results of these tests are summarized in the tables at the end of this chapter.

Figure 3.1.1\_1



The density and void ratio of selected undisturbed tube samples was measured on selected samples of the fly ash. The density was determined in general accordance with ASTM Standard D 7263 Method B for tube samples. The void ratio of the samples was determined using the total density determined as previously described along with the specific gravity and moisture content. The void ratio was calculated using two methods. First, the void ratio was calculated based solely on the moisture content assuming 100 percent saturation since sample jars were collected immediately after the sampler was opened at the drill rig. The second method utilized the densities measured as described above. The results of the density testing and void ratio calculations are presented in Table 3.1\_T1.

### 3.1.2 Proctor Tests

Standard and Modified Proctor tests were completed on selected bulk samples of fly ash obtained from sand cone density test locations (SC-XX) within Test Trench No. 3 (southwest crest of Dredge Cell No. 1) at the Kingston Fossil Plant. Standard Proctor samples were compacted in three lifts using a 5.5-lb mechanical compaction hammer over a 12-inch drop at 25 blows per lift in general accordance with ASTM D 698-07 Method A. Modified Proctor samples were compacted in five (5) lifts using a 10-lb mechanical compaction hammer over an 18-inch drop at 25 blows per lift in general accordance with ASTM D 1557-07 Method A. A summary of the Standard and Modified Proctor test results is presented in the following Tables 3.1.2\_T1 and 3.1.2\_T2. The individual Standard and Modified Proctor test results are included in Appendix 3B.

**Table 3.1.2\_T1  
Standard Proctor Results**

| Sample No. | Test Specification | Material Description / Elevation (USGS) | Specific Gravity <sup>1</sup> | Natural Water Content (%) | Optimum Water Content (%) | Maximum Dry Density (pcf) |
|------------|--------------------|---|-------------------------------|---------------------------|---------------------------|---------------------------|
| 1,2,3,4,5  | Standard           | Fly Ash – Dark Gray Composite Sample    | 2.33                          | ---                       | 28.4                      | 79.9                      |
| SC-10      | Standard           | Fly Ash – Dark Gray Elevation 815       | 2.33                          | 24.3                      | 24.4                      | 84.2                      |
| SC-18      | Standard           | Fly Ash - Dark Gray Elevation 812       | 2.33                          | 16.3                      | 23.0                      | 79.4                      |
| SC-26      | Standard           | Fly Ash - Dark Gray Elevation 802       | 2.33                          | 24.6                      | 26.6                      | 81.5                      |
| SC-34      | Standard           | Fly Ash - Dark Gray Elevation 798       | 2.33                          | 21.2                      | 24.3                      | 86.0                      |
| SC-40      | Standard           | Fly Ash - Dark Gray Elevation 794       | 2.33                          | 20.5                      | 19.4                      | 88.9                      |
| Average    |                    |   | 2.33                          | 20.7                      | 23.3                      | 84.0                      |

<sup>1</sup>Estimated

| <b>Table 3.1.2_T2</b><br><b>Modified Proctor Results</b> |                    |  |                               |                           |                           |                           |
|--|--------------------|--|-------------------------------|---------------------------|---------------------------|---------------------------|
| Sample No.   | Test Specification | Material Description / Elevation (USGS)                                    | Specific Gravity <sup>1</sup> | Natural Water Content (%) | Optimum Water Content (%) | Maximum Dry Density (pcf) |
| SC-1   | Modified           | Fly Ash - Dark Gray<br>Elevation 848                                       | 2.33                          | 21.5                      | 19.2                      | 90.6                      |
| SC-25  |                    | Fly Ash - Dark Gray<br>Elevation 802                                       | 2.33                          | 35.2                      | 17.6                      | 80.7                      |
| SC-26  | Modified           | Fly Ash - Dark Gray<br>Elevation 802                                       | 2.33                          | 18.0                      | 17.9                      | 88.0                      |
| SC-27  | Modified           | Fly Ash, Little Sand,<br>Trace Fine Gravel -<br>Dark Gray<br>Elevation 802 | 2.33                          | 21.9                      | 17.6                      | 88.4                      |
| Average  |                    |  | 2.33                          | 25.0                      | 17.7                      | 85.7                      |

<sup>1</sup>Estimated

The average optimum moisture content of the Standard Proctor tests on the fly ash was 23.3%, and the average maximum dry density was 84 pounds per cubic (pcf). The average optimum moisture content of the Modified Proctor tests was 17.7% and the average maximum dry density was 85.7 pcf. The higher compactive energy used in the Modified Proctor test, as compared to the Standard Proctor test, typically results in a higher maximum dry density and lower optimum water content, as is seen in the Proctor results for the Kingston fly ash. However, the increase in average maximum dry density between the Modified and Standard tests is relatively small given the corresponding significant increase in average optimum water content.

### 3.1.3 Hydraulic Conductivity Testing

Vertical and horizontal hydraulic conductivity tests were completed on 3-inch diameter Shelby tube samples of undisturbed fly ash obtained from Test Trench No. 3 (southwest crest of Dredge Cell No. 1). The tests were completed using the rising tail water method in general accordance with ASTM D 5084 Method C. The fly ash was non-cohesive; thus, the hydraulic conductivity tests were conducted in-tube (i.e., the ash samples were not extruded from the Shelby tubes prior to testing) to preserve the ash fabric. As a result, any aggregate within the sample that was larger than the No. 4 sieve was retained in the tube during the test. If found, intermittent aggregate-sized pieces encountered at the end of samples were removed and the resulting void filled with loose ash and lightly tamped. The latex membrane used to separate the sample from the confining fluid was stretched over the outside of the Shelby tube and was not in direct contact with the ash sample. De-aired tap water was used as the liquid permeate.

In addition to the undisturbed Shelby tube samples, hydraulic conductivity tests were completed on reconstituted bulk samples of ash obtained from Sand Cone location SC-60 (also from Test Trench No. 3). The ash samples were reconstituted by compacting material passing the No. 4 sieve and hydrated to approximately 19% initial water content into a cylindrical mold in three (3) lifts. A total of three reconstituted specimens were prepared at initial dry unit weights of 85 pcf, 90 pcf and 95 pcf, respectively. The compacted surface of each lift was scarified prior to the placement of the next lift. After compaction, the specimen was extracted from the cylinder, trimmed, weighed and measured to determine the specimen volume and percent compaction. Hydraulic conductivity tests were then completed using the rising tail water method in general accordance with ASTM D 5084 Method C. De-aired tap water was using as the liquid permeate.

The results of the vertical and horizontal hydraulic conductivity tests on undisturbed Shelby tube samples are summarized in Tables 3.1.1\_T1 and 3.1.1\_T2. The results of the hydraulic conductivity tests on reconstituted fly ash samples are summarized in Table 3.1.3\_T3. The individual test results are included in the Appendix 3C.

The vertical hydraulic conductivity of the undisturbed Shelby tube samples ranged from 8.0E-04 centimeters per second (cm/sec) to 4.8E-06 cm/sec, with an average of 1.3E-04 cm/sec. The horizontal hydraulic conductivity of the undisturbed Shelby tube samples ranged from 1.3E-03 cm/sec to 1.9E-05 cm/sec, with an average of 1.3E-04 cm/sec. Thus, from the test trench samples, the ratio of average  $K_h/K_v$  os about 1.0.

The hydraulic conductivity of the reconstituted fly ash samples ranged from 7.9E-05 cm/sec to 6.4E-05 cm/sec, with an average of 7.3E-05 cm/sec. In general, the hydraulic conductivity of the reconstituted fly ash samples decreased slightly with increasing initial dry unit weight.

**Table 3.1.3\_T1**  
**Vertical Hydraulic Conductivity Test Results**

| Boring No.           | Sample No. | Elevation<br>(feet NGVD) | Initial Dry Unit<br>Weight<br>(pcf) | Maximum<br>Hydraulic<br>Gradient | Hydraulic<br>Conductivity<br>(cm/sec) |
|----------------------|------------|--------------------------|-------------------------------------|----------------------------------|---------------------------------------|
| Test Trench<br>No. 3 | ST-1       | 848.0                    | 70.0                                | 1.77                             | 7.5E-05                               |
|                      | ST-3       | 816.9                    | 59.0                                | 1.59                             | 5.0E-05                               |
|                      | ST-4       | 818.3                    | 83.4                                | 2.30                             | 8.0E-04                               |
|                      | ST-5       | 817.3                    | 73.6                                | 1.93                             | 1.5E-05                               |
|                      | ST-7       | 814.7                    | 83.1                                | 1.91                             | 1.9E-05                               |
|                      | ST-9       | 813.9                    | 73.3                                | 1.89                             | 7.2E-04                               |
|                      | ST-11      | 814.7                    | 77.9                                | 1.93                             | 4.8E-05                               |
|                      | ST-13      | 812.0                    | 86.3                                | 1.97                             | 1.3E-04                               |
|                      | ST-15      | 812.1                    | 71.9                                | 1.92                             | 7.8E-05                               |
|                      | ST-17      | 812.0                    | 70.5                                | 1.98                             | 3.4E-05                               |
|                      | ST-19      | 810.3                    | 83.9                                | 1.99                             | 9.1E-05                               |
|                      | ST-21      | 810.4                    | 70.6                                | 1.92                             | 5.4E-05                               |
|                      | ST-29      | 804.5                    | 90.0                                | 1.90                             | 1.8E-04                               |
|                      | ST-31      | 801.9                    | 62.9                                | 2.02                             | 3.1E-05                               |
|                      | ST-33      | 802.5                    | 86.9                                | 1.90                             | 2.8E-05                               |
|                      | ST-63      | 815.5                    | 88.2                                | 1.89                             | 5.4E-05                               |
|                      | ST-73      | 807.9                    | 75.0                                | 2.08                             | 1.6E-05                               |
|                      | ST-81      | 799.9                    | 78.8                                | 2.32                             | 1.8E-05                               |
|                      | ST-89      | 792.0                    | 85.0                                | 2.85                             | 4.8E-06                               |
| Average              |            |                          | 77.4                                | 2.00                             | 1.3E-04                               |

**Table 3.1.3\_T2**  
**Horizontal Hydraulic Conductivity Test Results**

| Boring No.           | Sample No. | Elevation<br>(feet NGVD) | Initial Dry Unit<br>Weight<br>(pcf) | Maximum<br>Hydraulic<br>Gradient | Hydraulic<br>Conductivity<br>(cm/sec) |
|----------------------|------------|--------------------------|-------------------------------------|----------------------------------|---------------------------------------|
| Test Trench<br>No. 3 | ST-2       | 817.7                    | 65.8                                | 1.97                             | 7.9E-05                               |
|                      | ST-6       | 816.5                    | 69.4                                | 1.94                             | 7.5E-05                               |
|                      | ST-8       | 815.3                    | 72.7                                | 1.97                             | 1.6E-04                               |
|                      | ST-10      | 814.8                    | 75.1                                | 1.94                             | 1.1E-04                               |
|                      | ST-12      | 815.7                    | 70.8                                | 1.97                             | 6.2E-05                               |
|                      | ST-14      | 812.6                    | 86.7                                | 1.96                             | 1.2E-04                               |
|                      | ST-16      | 812.5                    | 77.3                                | 2.00                             | 4.6E-05                               |
|                      | ST-18      | 812.8                    | 75.3                                | 1.97                             | 4.9E-05                               |
|                      | ST-20      | 810.9                    | 87.1                                | 1.95                             | 4.4E-05                               |
|                      | ST-22      | 810.7                    | 72.1                                | 1.93                             | 6.5E-05                               |
|                      | ST-24      | 808.4                    | 72.9                                | 2.01                             | 1.3E-03                               |
|                      | ST-26      | 808.7                    | 71.6                                | 2.07                             | 8.6E-05                               |
|                      | ST-30      | 805.2                    | 78.8                                | 1.97                             | 4.1E-05                               |
|                      | ST-32      | 802.7                    | 82.0                                | 1.97                             | 1.9E-05                               |
|                      | ST-34      | 802.9                    | 88.2                                | 1.87                             | 3.3E-05                               |
|                      | ST-64      | 816.4                    | 72.3                                | 2.20                             | 5.3E-05                               |
|                      | ST-74      | 808.8                    | 71.4                                | 2.29                             | 2.5E-05                               |
|                      | ST-82      | 800.6                    | 75.0                                | 2.27                             | 4.6E-05                               |
|                      | ST-90      | 792.6                    | 81.0                                | 2.14                             | 1.8E-05                               |
| Average              |            |                          | 76.1                                | 2.00                             | 1.3E-04                               |

**Table 3.1.3\_T3**  
**Hydraulic Conductivity Test Results - Reconstituted Fly Ash Samples**

| Boring No. | Sample No. | Elevation<br>(feet NGVD) | Remolding<br>Method | Initial Dry<br>Unit Weight<br>(pcf) | Maximum<br>Hydraulic<br>Gradient | Hydraulic<br>Conductivity<br>(cm/sec) |
|------------|------------|--------------------------|---------------------|-------------------------------------|----------------------------------|---------------------------------------|
| SC-60      | MT-85PCF   | 804.0                    | Moist Tamp          | 84.5                                | 2.18                             | 7.9E-05                               |
| SC-60      | MT-90PCF   | 804.0                    | Moist Tamp          | 89.3                                | 2.18                             | 7.6E-05                               |
| SC-60      | MT-95PCF   | 804.0                    | Moist Tamp          | 94.8                                | 2.18                             | 6.4E-05                               |
| Average    |            |                          |                     |                                     | 7.3E-05                          |                                       |

### 3.1.4 Direct Shear Testing

A program of consolidated drained direct shear testing was performed in general accordance with ASTM Standard D 3080. In total, nineteen (19) tests were performed. Five (5) tests were performed on reconstituted ash samples. The remaining fourteen tests were performed on samples of natural silty clay. The reconstituted samples were consolidated to vertical effective stresses ranging from 8 to 128 pounds per square inch (psi). The clay alluvium samples were consolidated to a vertical effective stress equivalent to the overburden stress in the field at the time of drilling. The overburden stress was calculated based on the depth of the sample within the soil boring it was collected from. The groundwater table was assumed to be at the ground surface for the calculation.

Based on the results of the testing, the reconstituted ash exhibited a friction angle between 42.5 degrees at a confining stress of 8 psi and 27 degrees at a confining stress of 128 psi. The drained friction angle determined from the testing decreased with an increase in confining stress. The test results are summarized in Table 3.1\_T1. The individual test plots are included within Appendix 3D at the end of this volume.

The clay samples which were tested were located just below the interface of the clay and fly ash fill. The drained friction angle of this material varied from 23 to 36 degrees. The average drained friction angle was 31.7 degrees. The test results are summarized in Table 3.1\_T1. The individual test plots are included within Appendix 3D at the end of this volume.

### 3.1.5 Consolidation Testing

Consolidation tests were conducted on undisturbed 3-inch diameter Osterberg and Shelby tube samples obtained from the 09-100, 09-200, 09-300, 09-400, 09-500, and 09-600 boring series at the Kingston Fossil Plant. Consolidation testing was not performed on tube samples obtained in the 09-700, 09-800, or 09-900 boring series. In general, the samples selected for testing consisted of the native cohesive soils which were encountered beneath the upper fly ash and fill soils. Tube samples obtained at or very near the interface of the upper fly ash and native cohesive soils were reserved for direct shear testing and were typically not tested for consolidation properties.

Consolidation tests were completed on selected Osterberg and Shelby tube samples in general accordance with ASTM D 2435-04 Method B. Consolidation test specimens were prepared in the following manner: An approximately 6 to 8-inch length of tube and sample was cut from the selected Osterberg or Shelby tube. In general, the consolidation test sample was obtained nearer to the bottom of the tube sample to avoid potential disturbance effects near the top of the tube. The cut sample was then extruded and a consolidation ring was advanced into the sample. The consolidation ring was advanced by first positioning the sample on a soil lathe and then slowly advancing the ring into the sample by hand trimming tools. The sample was slowly rotated on the lathe and slight side cuts were made into the sample to allow for the consolidation ring to move smoothly through the sample with minimal disturbance. Excess cuttings were collected for water content measurements. The test

specimen and ring were then cut from the remaining tube sample, trimmed and weighed for determination of water content. Index tests, including Atterberg limits and specific gravity, were conducted on the remaining unused sample. Filter papers were placed on opposite ends of the specimen, and the specimen was secured in the consolidometer. A porous stone and loading platen were mounted on top of the specimen and the specimen was placed in the loading frame.

The test sample was loaded and unloaded incrementally using a set of calibrated weights in conjunction with the loading arm attached to the load frame. The consolidometer was inundated with water above the top of the test specimen after placement of the initial load increment (0.25 tsf). The specimen deformation was measured via an external LVDT mounted on the load frame, and the time increment, load, and specimen deformation were recorded via a Geolog acquisition system. The test sample was allowed to consolidate until 100% of primary consolidation ( $T_{100}$ ) had been reached.  $T_{100}$  was determined from the square-root of time versus deformation graph, using the square-root of time method as outlined in ASTM D 2435-04. After  $T_{100}$  was reached, the next load increment was applied. The test was finished after all loading and unloading steps in a given loading cycle were completed.

After completion of the consolidation test, the test specimen was patted dry with a towel and the after-test weight of the ring and specimen was obtained. The specimen was then extruded from the consolidation ring and the final water content of the specimen was determined.

Initial void ratio ( $e_0$ ), initial and final unit weights, incremental void ratios ( $e_i$ ) and coefficients of consolidation for each loading step ( $c_v$ ) were calculated in accordance with ASTM D 2435-04. The specific gravity ( $G_s$ ) used in the computations was measured from specific gravity tests on remaining unused sample, or where sufficient sample was unavailable, estimated based on the soil type. Graphs of void ratio versus pressure, deformation versus time, and deformation versus the square-root of time were produced using the Geolog acquisition system.

The compression index ( $C_c$ ) was determined as the average slope of the virgin compression curve; i.e., the steepest portion of the void ratio versus [log] pressure graph. The recompression index ( $C_{cr}$ ) was determined as the average slope of the recompression portion of the void ratio versus [log] pressure graph.

The preconsolidation pressure ( $P_c$ ) was determined using the Method of Work given by Becker et al. (1987). In the Method of Work,  $P_c$  is determined by first plotting the cumulative work ( $\Sigma(\Delta W_i)$ ) versus pressure on an arithmetic scale. Work ( $\Delta W_i$ ) is computed using Equation 3.1.5\_E1.

$$\Delta W_i = \left[ \frac{\sigma'_i + \sigma_{i+1}}{2} \right] (\varepsilon_{i+1} - \varepsilon_i) \quad (\text{Eq. 3.1.5_E1})$$

Where:

$\sigma'_i$  is the pressure at load increment  $i$ ,

$\sigma_{i+1}$  is the pressure at load increment  $i + 1$ ,

$\varepsilon_i$  is the cumulative strain at the end of load increment  $i$ ,

$\varepsilon_{i+1}$  is the cumulative strain at the end of load increment  $i + 1$ .

Two distinct straight lines are then drawn through the estimated pre-yield and post-yield sections of the cumulative work versus pressure graph. The intersection of the pre-yield line and the post-yield line is taken as  $P_c$ . In general, the scale of the cumulative work versus pressure graph can be expanded near the pre-yield portion of the curve to provide a more accurate estimation of  $P_c$ .

The results of the consolidation tests for samples obtained from 09-100, 09-200, 09-300, 09-400, 09-500, and 09-600 boring series are summarized in the following Tables 3.1.5\_T1 through 3.1.5\_T6. In general,  $P_c$  increased with decreasing void ratio for all boring series except for series 09-500. The average  $P_c$  for the boring series ranged from 2.51 tsf (for the 09-500 series) to 3.60 tsf (for the 09-300 series). The average  $C_c$  for the boring series ranged from 0.14 (for the 09-300 series) to 0.20 (for the 09-600 series), the average  $C_{cr}$  ranged from 0.015 (for the 09-100 series) to 0.026 (for the 09-500 series), and the average  $e_o$  ranged from 0.56 (for the 09-300 series) to 0.69 for the (09-600 series).

**Table 3.1.5\_T1**  
**Consolidation Testing Results - 100 Series – Dike A Cell 2**

| Boring No.           | Sample No. | Initial Void Ratio, $e_0$ | Compression Index, $C_c$ | Recompression Index, $C_{cr}$ | Preconsolidation Pressure, $P_c$ (tsf) |
|----------------------|------------|---------------------------|--------------------------|-------------------------------|--|
| 09-102B              | S-2        | 0.72                      | 0.170                    | 0.007                         | 2.50                                   |
|                      | S-4        | 0.68                      | 0.187                    | 0.017                         | 2.20                                   |
| 09-103B              | S-4        | 0.72                      | 0.213                    | 0.023                         | 2.70                                   |
|                      | S-5        | 0.70                      | 0.166                    | 0.023                         | 2.95                                   |
| 09-104B              | S-5        | 0.99                      | 0.335                    | 0.015                         | 3.40                                   |
|                      | S-6        | 1.69                      | 0.701                    | 0.037                         | 4.65                                   |
| 09-105B              | S-1        | 0.63                      | 0.173                    | 0.014                         | 2.05                                   |
|                      | S-2        | 0.62                      | 0.189                    | 0.012                         | 2.60                                   |
| 09-108B              | S-3        | 0.64                      | 0.169                    | 0.012                         | 2.75                                   |
| 09-109B              | S-4        | 0.50                      | 0.098                    | 0.016                         | 3.00                                   |
|                      | S-5        | 0.56                      | 0.128                    | 0.011                         | 2.85                                   |
|                      | S-6        | 0.51                      | 0.115                    | 0.010                         | 3.60                                   |
| Average <sup>1</sup> |            | 0.63                      | 0.161                    | 0.015                         | 2.72                                   |

<sup>1</sup>Boring 09-104B was cross-contaminated with a secant shaped bentonite plug from an adjacent borehole. The initial void ratio, and  $C_c$  are inconsistent with observed values for similar soils and are considered erroneous due to bentonite cross-contamination and thus, values from Boring 09-104B were not used to compute the series averages.

**Table 3.1.5\_T2**  
**Consolidation Testing Results - 200 Series Dike C Perimeter**

| Boring No. | Sample No. | Initial Void Ratio, $e_0$ | Compression Index, $C_c$ | Recompression Index, $C_{cr}$ | Preconsolidation Pressure, $P_c$ (tsf) |
|------------|------------|---------------------------|--------------------------|-------------------------------|--|
| 09-200B    | S-5        | 0.62                      | 0.136                    | 0.020                         | 2.25                                   |
| 09-201B    | S-3        | 0.75                      | 0.187                    | 0.014                         | 2.75                                   |
| 09-202B    | S-3        | 0.55                      | 0.118                    | 0.013                         | 3.60                                   |
| 09-203B    | S-5        | 0.48                      | 0.133                    | 0.020                         | 3.50                                   |
|            | S-6        | 0.49                      | 0.156                    | 0.020                         | 4.20                                   |
| 09-203B2   | S-3        | 0.49                      | 0.113                    | 0.011                         | 2.65                                   |
| 09-204B    | S-5        | 0.61                      | 0.186                    | 0.023                         | 3.50                                   |
|            | S-6        | 0.51                      | 0.182                    | 0.020                         | 4.10                                   |
| 09-205B    | S-2        | 0.62                      | 0.183                    | 0.023                         | 3.80                                   |
|            | S-3        | 0.61                      | 0.183                    | 0.023                         | 3.70                                   |
| 09-206B    | S-3        | 0.74                      | 0.270                    | 0.037                         | 3.05                                   |
|            | S-4        | 0.54                      | 0.143                    | 0.020                         | 3.05                                   |
| 09-207B    | S-4        | 0.65                      | 0.168                    | 0.023                         | 3.25                                   |
|            | S-5        | 0.60                      | 0.163                    | 0.013                         | 4.55                                   |
|            | S-6        | 0.65                      | 0.186                    | 0.020                         | 4.25                                   |
|            | S-7        | 0.52                      | 0.120                    | 0.023                         | 3.80                                   |
| 09-209B    | S-2        | 0.59                      | 0.153                    | 0.020                         | 2.50                                   |
|            | S-3        | 0.65                      | 0.166                    | 0.023                         | 3.00                                   |
| 09-210B    | S-3        | 0.57                      | 0.136                    | 0.023                         | 3.25                                   |
| 09-211B    | S-4        | 0.62                      | 0.156                    | 0.023                         | 2.30                                   |
|            | S-5        | 0.65                      | 0.186                    | 0.023                         | 2.90                                   |
| Average    |            | 0.59                      | 0.163                    | 0.022                         | 3.33                                   |

**Table 3.1.5\_T3****Consolidation Testing Results - 300 Series – Unfailed Cell 1**

| Boring No. | Sample No. | Initial Void Ratio, $e_o$ | Compression Index, $C_c$ | Recompression Index, $C_{cr}$ | Preconsolidation Pressure, $P_c$ (tsf) |
|------------|------------|---------------------------|--------------------------|-------------------------------|--|
| 09-301B    | S-7        | 0.57                      | 0.183                    | 0.023                         | 3.25                                   |
|            | S-8        | 0.48                      | 0.128                    | 0.023                         | 3.50                                   |
| 09-303B    | S-10       | 0.63                      | 0.134                    | 0.013                         | 3.30                                   |
|            | S-11       | 0.59                      | 0.136                    | 0.020                         | 3.70                                   |
|            | S-12       | 0.54                      | 0.128                    | 0.009                         | 4.25                                   |
| Average    |            | 0.56                      | 0.142                    | 0.018                         | 3.60                                   |

**Table 3.1.5\_T4****Consolidation Testing Results - 400 Series – West toe of Cells 1 and 2**

| Boring No. | Sample No. | Initial Void Ratio, $e_o$ | Compression Index, $C_c$ | Recompression Index, $C_{cr}$ | Preconsolidation Pressure, $P_c$ (tsf) |
|------------|------------|---------------------------|--------------------------|-------------------------------|--|
| 09-402B    | S-3        | 0.72                      | 0.210                    | 0.025                         | 2.00                                   |
|            | S-4        | 0.76                      | 0.268                    | 0.040                         | 2.00                                   |
|            | S-5        | 0.56                      | 0.160                    | 0.016                         | 2.60                                   |
|            | S-6        | 0.55                      | 0.120                    | 0.020                         | 3.30                                   |
|            | S-7        | 0.55                      | 0.105                    | 0.013                         | 3.15                                   |
|            | S-8        | 0.65                      | 0.094                    | 0.012                         | 4.00                                   |
| 09-404B    | S-4        | 0.80                      | 0.219                    | 0.027                         | 2.45                                   |
|            | S-5        | 0.54                      | 0.123                    | 0.020                         | 3.00                                   |
| 09-408B    | S-10       | 0.49                      | 0.136                    | 0.020                         | 3.65                                   |
|            | S-8        | 0.64                      | 0.152                    | 0.020                         | 2.50                                   |
|            | S-9        | 0.57                      | 0.130                    | 0.023                         | 2.90                                   |
| Average    |            | 0.62                      | 0.156                    | 0.021                         | 2.87                                   |

**Table 3.1.5\_T5**  
**Consolidation Testing Results - 500 Series – Under Cell 2**

| Boring No. | Sample No. | Initial Void Ratio, $e_o$ | Compression Index, $C_c$ | Recompression Index, $C_{cr}$ | Preconsolidation Pressure, $P_c$ (tsf) |
|------------|------------|---------------------------|--------------------------|-------------------------------|--|
| 09-500B    | S-7        | 0.57                      | 0.143                    | 0.027                         | 2.20                                   |
|            | S-8        | 0.59                      | 0.143                    | 0.023                         | 2.15                                   |
| 09-503B    | S-3        | 0.82                      | 0.112                    | 0.027                         | 3.50                                   |
|            | S-4        | 0.64                      | 0.196                    | 0.027                         | 2.20                                   |
| Average    |            | 0.66                      | 0.149                    | 0.026                         | 2.51                                   |

**Table 3.1.5\_T6**  
**Consolidation Testing Results - 600 Series - Under Dike D**

| Boring No. | Sample No. | Initial Void Ratio, $e_o$ | Compression Index, $C_c$ | Recompression Index, $C_{cr}$ | Preconsolidation Pressure, $P_c$ (tsf) |
|------------|------------|---------------------------|--------------------------|-------------------------------|--|
| 09-600B    | S-4        | 0.74                      | 0.189                    | 0.023                         | 2.80                                   |
| 09-602B    | S-5        | 0.58                      | 0.128                    | 0.023                         | 3.75                                   |
| 09-604B    | S-6        | 0.62                      | 0.173                    | 0.027                         | 3.70                                   |
|            | S-7        | 0.70                      | 0.206                    | 0.027                         | 4.15                                   |
|            | S-8        | 0.75                      | 0.239                    | 0.027                         | 3.00                                   |
|            | S-9        | 0.89                      | 0.284                    | 0.030                         | 2.50                                   |
| 09-605B    | S-9        | 0.64                      | 0.179                    | 0.023                         | 2.85                                   |
| Average    |            | 0.70                      | 0.200                    | 0.026                         | 3.25                                   |

References: Becker, D. E. et al. (1987), "Work as a Criterion for Determining in Situ and Yield Stresses in Clays," CGJ, vol. 24, no. 4, Nov, pp. 549-564.

### 3.1.6 Triaxial Testing

#### 3.1.6.1 Equipment and General Procedure

In a triaxial test, a cylindrical soil sample is placed in a latex membrane and inserted in a sealed chamber, whereupon the sample is subjected to radial pressure (to recreate its in-place condition) and a subsequent axial load (to recreate shearing effects). The radial (cell) pressure is applied by the fluid in the chamber (i.e., water) and a corresponding but lower fluid pressure is maintained in the sample (sample pressure), both of which are controlled and recorded by pressure control and measuring devices. The pressure lines are instrumented with volume measuring devices, so that changes in volume of fluid in the sample or in the cell are recorded. The axial force is applied by a vertical piston, instrumented to measure its vertical displacement and the actual vertical load applied to the sample.

Two different types of equipment were utilized to perform the triaxial testing program in our laboratory:

- 1) LoadTrac-II/FlowTrac-II system. a fully automated triaxial system manufactured by Geocomp. All the triaxial measuring and controlling devices are connected to a computer with a network card for data acquisition and control. The triaxial tests are fully controlled from the computer interface.
- 2) Triaxial chamber (Model S-510) and pressure control panel (Model S-500 and S-502) manufactured by Durham Geoslope Indicator. The axial loader (Model 70021) was manufactured by Wykeham Farrance. In this triaxial setup only the measuring devices (manufactured by Geocomp) are connected to a computer for data acquisition. This computerized data acquisition system records axial loading, axial displacement and sample pressure. Sample volume and cell pressure are recorded independently (manually) through a system of burettes and pressure gauges. The pressure control system and axial loaders are also controlled manually.

After sample preparation and setup, three main stages are performed in most triaxial tests. These include:

- Back Pressure Saturation
- Consolidation
- Shear

#### Back Pressure Saturation

The purpose of the backpressure saturation is to eliminate the air bubbles in the system and to saturate the soil sample. Both the cell and sample pressures are increased in cycles, with the cell pressure larger but keeping this difference constant, on the order of 4.0 psi. The initial effective stress applied to the sample is equal to this difference. As the pressure of the fluid, both in the sample and cell, increases, the trapped bubbles tend to collapse. When negligible changes in fluid volume are observed and the Pore Pressure Parameter B reaches a value close to 0.9 to 1.0, this is indicative of complete saturation and an air free system.

The sample pressure at the end of the back pressure saturation phase is referred to as back pressure.

### Consolidation

After backpressure saturation, the small confining effective stress is increased to the selected levels. Different criteria were utilized depending upon the type of soil. Two types of consolidation stages were utilized:

- Isotropic Consolidation
- $K_o$  Consolidation

The difference between the pressure of the fluid in the cell and in the sample is resisted by the soil skeleton. This difference is equal to the stress resisted or applied to the soil grains and is referred to as the effective stress.

The effective stress in the sample is increased by increasing the cell pressure and keeping the sample pressure (back pressure) constant. The effective stress is increased in small increments allowing time for the sample pressures to equalize with the back pressure after each increment. The process of consolidating the sample by using only the cell pressure, is called isotropic or equi-directional consolidation. The consolidation is isotropic because the effective stress is equal in the vertical and radial directions.

Alternatively, samples can be consolidated anisotropically; in other words, consolidated with a vertical effective stress different than the radial effective stress. This is accomplished by engaging the axial loading device to apply a vertical stress in addition to the pressure applied by the cell fluid. A particular type of anisotropic consolidation procedure is the  $K_o$  consolidation procedure. In the  $K_o$  consolidation procedure the vertical and radial stress increments are measured and adjusted several times per second using an automatic control system not to allow any radial deformation.  $K_o$  consolidation mimics natural deposition of soil by sedimentation, where the soil can deform vertically but not horizontally.

After the consolidation stresses are reached, the soil is allowed the creep under constant stress. The creep cycle is extended for a period of approximately 12 hours and reduces the effect of secondary compression on the shearing phase.

### Shear

Two main modes of shear have been utilized in our laboratory testing procedures. These shearing modes include:

- Triaxial Compression
- Reduced Triaxial Extension

In a triaxial compression test, the vertical load is increased at a constant strain rate. The cell pressure remains constant during the test. In a reduced triaxial extension test, the cell pressure is held at a constant rate and the vertical load is lifted of the sample during the test.

The triaxial compression and reduced extension tests were performed under different drainage conditions. The tests are further classified depending upon whether drainage is allowed as the sample is sheared. During undrained shearing the lines connected to the sample are closed, not allowing any water to flow out of the sample. Consequently, water pressure builds within the sample upon the application of an external stresses. Such a build-up of water pressure is measured and referred to as excess pore water pressure. During drained shearing, the lines could be left opened allowing water to flow out of the sample, thus keeping the sample pressure constant (equal to the back pressure).

The rate of loading during a drained test should be slow enough not to allow any excess pore water pressure build-up during shearing. The rate of loading during an undrained test should be slow enough to allow equalization of the excess pore water pressure across the sample and prevent areas of stress concentration. The actual rate of shearing depends on the type of material, and more important on the permeability. The rate of loading for the different soil samples were selected based on guidelines provided by the corresponding ASTM standards.

### Tests Conducted

The different triaxial tests are referred to by an acronym composed by six characters such as CID-TXC or CKU-TXE. The first character “C”, stands for consolidated, meaning that a consolidation phase was conducted. The second character “I” or “K” represents the type of consolidation: “A” for Anisotropic, “I” for Isotropic and “K” for  $K_o$  consolidation. The third character “D” or “U” stands for the drainage condition selected during the shearing phase. “D” stands for Drained and “U” for Undrained. The last three characters indicate the stress path during the shearing phase. “TXC” stands for Triaxial Compression and “RTXE” stands for Reduced Triaxial Extension.

The primary tests conducted in this project included:

- Isotropically Consolidated, Undrained Triaxial Compression Tests (CIU-TXC)
- Anisotropically Consolidated, Undrained Reduced Triaxial Extension Tests (CAU-RTXE)
- $K_o$  Consolidated, Undrained Triaxial Compression Tests (CK<sub>o</sub>U-TXC)
- Isotropically Consolidated, Drained Triaxial Compression Tests (CID-TXC)

In addition, one Unconsolidated Undrained Triaxial Compression Tests (UU-TXC) was performed. The UU-TXC tests are performed following a similar procedure to the one described above; with the difference that no saturation or consolidation phases are performed. Since these two phases are omitted, the state of effective stress and degree of saturation of the sample at the time of shear is uncertain. Therefore, the results from these tests are not considered as reliable as the ones from consolidated triaxial tests.

The tests were performed in general accordance with the ASTM standards ASTM D 2850-03a and ASTM D 4767-02. Drained Triaxial Tests have not been standardized by ASTM; therefore, the drained tests were performed in general agreement with the procedures described in:

- US Army Corps of Engineers (USACE), EM-1110-2-1906.

### **3.1.6.2 Tests on Undisturbed Cohesive Soils**

#### Objective

The objective of the triaxial testing program on cohesive samples was to measure the stress-strain-strength relationship of the cohesive materials primarily under undrained conditions (constant volume).

#### Sample Selection and Preparation

The samples were collected using three-inch-diameter Osterberg tubes. In the laboratory, the samples were setup following the wet mounting method described in the ASTM procedures. Only cohesive samples can withstand the sample preparation described in this section with limited disturbance.

#### Selection of Tests

The two test types listed below were performed on cohesive samples:

- Unconsolidated Undrained, Triaxial Compression Test (UU-TXC)
- Isotropically Consolidated, Triaxial Compression Tests (CIU-TXC)

UU tests are often used by geotechnical engineering practitioners, primarily because these tests are a relatively economic, simple and fast. CIU-TXC tests are more complex and costly, but they provide more reliable soil information. Therefore, only one UU test was performed and the testing program was primarily focused on CIU-TXC tests.

During the consolidation phase in the CIU-TXC tests, the samples were reconsolidated to the in-situ horizontal effective stresses. The in-situ horizontal effective stress was estimated to be equal to one half of the post-failure vertical effective stress ( $K_0=0.5$  was assumed).

#### Data Reduction and Corrections

After completion of the tests, the final mass of the sample was recorded and a representative portion of the sample was tested for Water Content and Specific Gravity and Atterberg Limit determination.

The void ratio for each of the stages was computed based on the final mass measurement and water content of the sample at the end of the test, in conjunction of the recorded volume changes for each of the steps. The height of the sample after consolidation was measured using the instrumented piston. The diameter of the sample after consolidation were estimated based on the final sample volume, accounting for the volume loss during shear and the height of the consolidated sample as described by ASTM.

Area corrections were applied to the deviator stress during the shearing phase as recommended by ASTM; however, no rubber membrane or filter paper corrections were applied.

#### Test Results

The most important parameter obtained from the CIU-TXC tests are the undrained shear strength and the mobilized drained friction angle. A summary table including the undrained shear strength and mobilized friction angles are included in Table 3.1\_T1 in the attachments to this Section.

The results from the individual tests depicting plots of the deviator stress versus axial strain, volumetric strain versus axial strain (for drained tests) or excess pore water pressure versus axial strain (for undrained test) and q-p diagrams, as recommended by ASTM, are included in Appendix 3F.

#### **3.1.6.3 Tests on Reconstituted Granular Samples**

##### Objective

Reconstituted fly ash samples were tested under triaxial loading to characterize the drained and undrained behavior of this material utilizing critical-state soil mechanics.

##### Sample Selection and Preparation

Fly Ash obtained from Osterberg tube samples from the 200 series borings were utilized in the testing program, as noted below in Table 3.1.6\_T1.

| <b>Table 3.1.6._T1</b>   |               |
|--|---------------|
| <b>Fly Ash Soil Samples Utilized in the Triaxial Testing Program</b> |               |
| <b>Soil Boring</b>   | <b>Sample</b> |
| 09-203B  | OST-1         |
| 09-205B  | OST-1         |
| 09-207B  | OST-1         |
| 09-207B  | OST-2         |

These tubes were selected since they contained very low blowout fly ash that had been clearly distorted during the failure at a location downstream of the Cell 2 Dike A. Therefore we are assured the liquefied fly ash came from within failed Cell 2.

The soil retrieved from the four tubes was mixed, and the soil mix was utilized to prepare the specimens. Full grain size distribution curves were obtained from each of the tubes and from the mixture. These gradation curves show that each tube contained a similar particle size distribution. The actual gradation tests for the four tubes and for the mixture have been included in Appendix 3A. Gradation analysis was also completed midway through the Triaxial testing program. The results of these analyses are also included in Appendix 3A. The composite specific gravity of the combined sample was measured to be 2.33.

Two methods of sample reconstitution were utilized. These methods included:

- Pluviation
- Moist Tamp

In the pluviation method, the fly ash was mixed with sufficient water to prepare a mixture with the consistency of a liquid. Suction was applied to a split mold installed on the bottom of the test chamber, to keep the rubber membrane in contact with the mold. The mixture was poured inside the mold and the ash particles allowed to sediment out under its own weight for some few minutes, until clear water was observed over the solids.

Immediately after, the line connected to the bottom of the sample was opened allowing water flow. This line was connected to a vacuum applying a suction pressure of approximately 5.0 psi. This suction speeded up the downward flow and discharge of excess water from the mixture. The drainage was stopped when the free water reached the surface of the solids. The top porous stones, platens and O-rings were attached to the top of the rubber membrane. A line was connected to the top platen and both lines connected to the sample (top and bottom) were connected to the suction pump. Since the fluid pressure at the top and bottom of the sample were equal, no water flow occurred at this time. The vacuum was left in place for a few minutes allowing for the pressures within the sample to stabilize. Shortly after, the valves in the samples were closed, locking in the negative water pressure. The vacuum was removed but the negative water pressures locked in the sample artificially strengthened the sample while the remainder of the triaxial equipment was assembled.

After the chamber was assembled, the cell was inundated and a nominal net confining pressure of approximately 8.0 and 4.0 psi, were applied in the cell and in the lines connected to the samples, respectively. Then, the lines connected to the sample were opened allowing for the fluid pressure within the sample to equate the pressure applied in the lines (i.e., 4.0 psi). The back pressure saturation process was then completed.

For moist tamp sample preparation methods, a moist fly ash mixture was prepared with a controlled moisture content (approximately 9 to 19%). Similarly to the pluviation process, the sample mold was attached to the bottom of the chamber. The mold was filled with a known weight of a water and fly ash mixture in five lifts applying a nominal compaction effort after each lift with a smooth rod. After the mold was filled, the top platen was connected and a vacuum pressure of approximately 5.0 psi was applied to the top and bottom of the sample. The vacuum was left in place for a few minutes allowing for the air pressures within the sample to stabilize. Shortly after, the valves in the samples were closed locking in the negative air pressure. The vacuum was removed but the negative air pressures locked in the sample artificially strengthened the sample while the remainder of the triaxial equipment was assembled.

After the chamber was assembled, the cell was inundated and a nominal pressure of approximately 5.0 psi was applied in the cell. The lines connected to the sample were opened allowing the pressure within the sample to equate the atmospheric pressure. The lines connected to the top and bottom of the sample we utilized to run water through the sample. The line connected to the bottom of the sample was connected to a reservoir of de-aired water placed 4 to 5 feet above the level of the sample. The line connected to the top of the sample was left opened allowing free flow of water. This setup caused a vertical flow of water through the sample. A continuous flow was allowed for at least one hour or until the sample appeared to be fully inundated.

After the sample was saturated with water the lines connected to the sample were connected to the pressure controlling device for the back pressure saturation stage.

#### Selection of Tests

Five test types, listed below, were performed on the fly ash samples:

- Isotropically Consolidated, Undrained Triaxial Compression Tests (CIU-TXC)
- Anisotropically Consolidated, Undrained Reduced Triaxial Extension Tests (CAU-RTXE)
- $K_o$  Consolidated, Undrained Triaxial Compression Tests (CK<sub>o</sub>U-TXC)
- Isotropically Consolidated, Drained Triaxial Compression Tests (CID-TXC)

The triaxial tests were performed over a large range of consolidation stresses and reconstituted at different densities (or void ratios). The void ratio of the consolidated samples (before shear) ranged from 0.6 to 1.2 and the consolidation stresses ranged from 8 to 128 psi. These ranges were selected so that an accurate model of the soil behavior could be determined. Many of the pertinent correlations which were created were based on the log of the confining stress, therefore, a large range of pressures was utilized in the testing.

### Data Reduction and Corrections

After each test, care was exercised not to allow the sample to absorb or give up water to the pressurization lines. The final mass of the sample was recorded and the full sample was used to determine the final water content and dry mass of the sample.

The void ratio for each of the stages was computed based on the final mass measurement and the mass of the dry solids at the end of the test, in conjunction with recorded volume changes for each of the stages. The height of the sample after consolidation was measured directly using the instrumented piston. The diameter of the sample after consolidation was estimated based on the final sample volume, the volume loss during shear and the height of the consolidated sample as described by ASTM.

Area corrections were applied to the deviator stress during the shearing phase; however, no rubber membrane corrections were applied.

### Test Results

Summary tables including the index properties, sample dimensions, void ratio and effective stresses after each stage are included at the beginning of each test in Appendix 3F. The summary of the state of stresses at failure and at the end of the tests have also been identified for each test and are listed in this summary. Plots of the deviator stress versus axial strain, volumetric strain versus axial strain (for drained tests) or excess pore water pressure versus axial strain (for undrained test) and q-p diagrams, as recommended by ASTM, are included.

Triaxial testing references:

- Standard Method for Unconsolidated Undrained Test on Cohesive Soils. ASTM D 2850-03A.
- Standard Method for Consolidated Undrained Triaxial Compression Test on Cohesive Soils, ASTM D 4767-02.
- Army Corps of Engineers (1970). Laboratory Soils Testing EM 1110-2-1906

### 3.1.7 Tube Photographs

A selection of Osterberg samples were extruded and photographed. These samples were primarily of the fly ash. In some cases the ash/clay interface was encountered and photographed or the clay layer immediately underlying the ash was photographed. The photographs are presented in Appendix 3G of this Volume. The photograph log includes the boring and sample number along with a brief description of the subject of the photograph. Table 3.1.7\_T1 summarizes the samples which were photographed.

| 3.1.7_T1                         |               |
|----------------------------------|---------------|
| Summary of<br>Photographed Tubes |               |
| Boring<br>No.                    | Sample<br>No. |
| 09-100B                          | OST-1         |
| 09-100B                          | OST-2         |
| 09-100B                          | OST-3         |
| 09-101B                          | OST-1         |
| 09-101B                          | OST-2         |
| 09-101B                          | OST-3         |
| 09-103B                          | OST-2         |
| 09-104B                          | OST-1         |
| 09-105B                          | OST-3         |
| 09-210B                          | OST-2         |
| 09-408B                          | OST-3         |
| 09-408B                          | OST-4         |
| 09-502B                          | OST-1         |
| 09-502B                          | OST-2         |
| 09-503B                          | OST-1         |
| 09-503B                          | OST-4         |
| 09-604B                          | OST-5         |

TABLE 3.1\_T1 SUMMARY OF LABORATORY TESTING

| Boring No. | Sample No. | Surface Elevation | Depth  |      | Elevation |       | Atterbergs |    |    | ASTM D422 Size Analysis |          | Grain ASTM D1140 |        | Organic Content |  |
|------------|------------|-------------------|--------|------|-----------|-------|------------|----|----|-------------------------|----------|------------------|--------|-----------------|--|
|            |            |                   | ft.    | ft.  | ft.       | ft.   | LL         | PL | PI | G <sub>s</sub>          | % Gravel | % Sand           | % Silt | % Clay          |  |
| 09-100     | 5          | SS                | 767.11 | 8.0  | - 10.0    | 759.1 | - 757.1    |    |    |                         |          |                  |        | 51.2            |  |
| 09-100     | 10         | SS                | 767.11 | 18.0 | - 20.0    | 749.1 | - 747.1    |    |    |                         | 8.3      | 73.1             | 13.8   | 4.8             |  |
| 09-100     | 24         | SS                | 767.11 | 47.5 | - 49.5    | 719.6 | - 717.6    |    | NP |                         | 18.7     | 57.0             | 15.1   | 9.2             |  |
| 09-100     | 25         | SS                | 767.11 | 49.5 | - 51.5    | 717.6 | - 715.6    |    |    |                         |          |                  |        | 13.2            |  |
| 09-100     | 29         | SS                | 767.11 | 57.5 | - 59.5    | 709.6 | - 707.6    |    |    |                         | 0.0      | 57.3             | 29.8   | 12.9            |  |
| 09-101     | S-18       | SS                | 768.31 | 35.5 | - 37.5    | 732.8 | - 730.8    |    |    |                         | 0.0      | 4.3              | 73.1   | 22.6            |  |
| 09-102     | S-14A      |                   | 761.91 | 30.5 | - 31.5    | 731.4 | - 730.4    |    |    |                         |          |                  |        | 3.37            |  |
| 09-102     | S-15A      | SS                | 761.91 | 32.0 | - 34.0    | 729.9 | - 727.9    |    |    |                         | 3.8      | 34.8             | 41.7   | 19.7            |  |
| 09-102     | S-21       | SS                | 761.91 | 46.0 | - 48.0    | 715.9 | - 713.9    |    |    |                         | 0.0      | 53.2             | 36.0   | 10.8            |  |
| 09-102     | S-17       | SS                | 761.91 | 36.0 | - 38.0    | 725.9 | - 723.9    |    |    |                         |          |                  |        | 19.8            |  |
| 09-103     | S-22       | SS                | 766.31 | 46.5 | - 48.5    | 719.8 | - 717.8    |    |    |                         | 0.0      | 64.0             | 23.3   | 12.7            |  |
| 09-104     | S-14       | SS                | 761.29 | 29.5 | - 31.5    | 731.8 | - 729.8    |    |    |                         | 0.0      | 60.1             | 18.4   | 21.5            |  |
| 09-104     | S-20       | SS                | 761.29 | 43.5 | - 45.5    | 717.8 | - 715.8    |    |    |                         |          |                  |        | 58.1            |  |
| 09-104     | S-21       | SS                | 761.29 | 45.5 | - 47.5    | 715.8 | - 713.8    |    |    |                         | 0.0      | 45.7             | 33.7   | 20.6            |  |
| 09-105     | 7A         | SS                | 748.35 | 13.0 | - 14.0    | 735.4 | - 734.4    | 27 | 17 | 10                      |          |                  |        |                 |  |
| 09-106     | S-9        | SS                | 755.05 | 16.0 | - 18.0    | 739.1 | - 737.1    |    |    |                         |          |                  |        | 64.0            |  |
| 09-106     | 13A        |                   | 755.05 | 24.3 | - 26.0    | 730.8 | - 729.1    | 19 | 15 | 4                       |          |                  |        | 1.50            |  |
| 09-106     | S-19       | SS                | 755.05 | 36.0 | - 38.0    | 719.1 | - 717.1    |    |    |                         | 0.0      | 59.1             | 28.7   | 12.2            |  |
| 09-106     | S-23       | SS                | 755.05 | 44.0 | - 46.0    | 711.1 | - 709.1    |    |    |                         | 0.0      | 43.3             | 37.6   | 19.1            |  |
| 09-107     | S-6A       | SS                | 762.44 | 11.0 | - 12.0    | 751.4 | - 750.4    |    |    |                         |          |                  |        | 59.4            |  |
| 09-107     | S-9        | SS                | 762.44 | 16.0 | - 18.0    | 746.4 | - 744.4    |    |    |                         |          |                  |        | 54.2            |  |
| 09-107     | S-12       | SS                | 762.44 | 22.0 | - 24.0    | 740.4 | - 738.4    |    |    |                         |          |                  |        | 61.3            |  |
| 09-107     | S-14       | SS                | 762.44 | 26.0 | - 28.0    | 736.4 | - 734.4    |    |    |                         |          |                  |        | 20.2            |  |
| 09-107     | S-15A      | SS                | 762.44 | 28.5 | - 30.0    | 733.9 | - 732.4    |    |    |                         |          |                  |        | 2.61            |  |
| 09-108     | S-3        | SS                | 759.77 | 4.0  | - 6.0     | 755.8 | - 753.8    |    |    |                         |          |                  |        | 94.1            |  |
| 09-108     | S-6        | SS                | 759.77 | 10.0 | - 12.0    | 749.8 | - 747.8    |    |    |                         |          |                  |        | 84.4            |  |
| 09-108     | S-8        | SS                | 759.77 | 14.0 | - 16.0    | 745.8 | - 743.8    |    |    |                         | 0.0      | 4.3              | 76.0   | 19.7            |  |
| 09-108     | S-9        | SS                | 759.77 | 16.0 | - 18.0    | 743.8 | - 741.8    |    |    |                         |          |                  |        | 98.5            |  |
| 09-108     | S-12A      | SS                | 759.77 | 22.0 | - 25.0    | 737.8 | - 734.8    |    |    |                         |          |                  |        | 95.0            |  |
| 09-108     | 13         | SS                | 759.77 | 25.0 | - 27.0    | 734.8 | - 732.8    | 23 | 14 | 9                       |          |                  |        |                 |  |
| 09-108     | S-14       | SS                | 759.77 | 27.0 | - 29.0    | 732.8 | - 730.8    |    |    |                         |          |                  |        | 65.7            |  |
| 09-108     | S-20       | SS                | 759.77 | 39.0 | - 41.0    | 720.8 | - 718.8    |    | NP |                         | 0.0      | 68.6             | 21.4   | 10.0            |  |
| 09-108     | S-24       | SS                | 759.77 | 47.0 | - 49.0    | 712.8 | - 710.8    |    |    |                         | 0.0      | 54.5             | 28.7   | 16.8            |  |
| 09-109     | S-3        | SS                | 763.59 | 4.0  | - 6.0     | 759.6 | - 757.6    |    |    |                         |          |                  |        | 57.8            |  |
| 09-109     | S-6        | SS                | 763.59 | 10.0 | - 12.0    | 753.6 | - 751.6    |    |    |                         |          |                  |        | 63.5            |  |
| 09-109     | S-9        | SS                | 763.59 | 16.0 | - 18.0    | 747.6 | - 745.6    |    |    |                         |          |                  |        | 99.0            |  |
| 09-109     | S-12       | SS                | 763.59 | 22.0 | - 24.0    | 741.6 | - 739.6    |    |    |                         |          |                  |        | 95.7            |  |
| 09-109     | S-13       | SS                | 763.59 | 24.0 | - 26.0    | 739.6 | - 737.6    |    |    |                         |          |                  |        | 95.9            |  |
| 09-109     | 14A        | SS                | 763.59 | 26.5 | - 28.0    | 737.1 | - 735.6    | 20 | 14 | 6                       |          |                  |        |                 |  |
| 09-110     | S-3        | SS                | 774.57 | 4.0  | - 6.0     | 770.6 | - 768.6    |    |    |                         |          |                  |        | 43.5            |  |
| 09-110     | S-6        | SS                | 774.57 | 10.0 | - 12.0    | 764.6 | - 762.6    |    |    |                         |          |                  |        | 53.9            |  |
| 09-110     | S-9        | SS                | 774.57 | 16.0 | - 18.0    | 758.6 | - 756.6    |    |    |                         |          |                  |        | 34.6            |  |
| 09-110     | S-12       | SS                | 774.57 | 22.0 | - 24.0    | 752.6 | - 750.6    |    |    |                         |          |                  |        | 42.1            |  |
| 09-110     | S-15       | SS                | 774.57 | 28.0 | - 30.0    | 746.6 | - 744.6    |    |    |                         |          |                  |        | 65.5            |  |
| 09-110     | S-16       | SS                | 774.57 | 30.0 | - 32.0    | 744.6 | - 742.6    |    |    |                         |          |                  |        | 93.6            |  |
| 09-110     | S-18       | SS                | 774.57 | 34.0 | - 36.0    | 740.6 | - 738.6    |    |    |                         |          |                  |        | 84.1            |  |
| 09-110     | S-21       | SS                | 774.57 | 40.0 | - 42.0    | 734.6 | - 732.6    |    |    |                         |          |                  |        | 46.0            |  |
| 09-110     | S-24       | SS                | 774.57 | 46.0 | - 48.0    | 728.6 | - 726.6    |    |    |                         |          |                  |        | 15.4            |  |
| 09-110     | S-25       | SS                | 774.57 | 48.0 | - 50.0    | 726.6 | - 724.6    |    |    |                         | 0.0      | 68.2             | 17.6   | 14.2            |  |
| 09-110     | S-26       | SS                | 774.57 | 50.0 | - 52.0    | 724.6 | - 722.6    |    |    |                         | 0.0      |                  |        | 23.4            |  |
| 09-110     | S-30       | SS                | 774.57 | 58.0 | - 60.0    | 716.6 | - 714.6    |    |    |                         | 0.0      | 72.9             | 15.9   | 11.2            |  |
| 09-110     | S-35       | SS                | 774.57 | 68.0 | - 70.0    | 706.6 | - 704.6    |    |    |                         | 0.0      | 67.1             | 19.5   | 13.4            |  |
| 09-200     | S-16       | SS                | 764.91 | 34.0 | - 36.0    | 730.9 | - 728.9    | 19 | 16 | 3                       |          |                  |        | 66.5            |  |
| 09-200     | S-18       | SS                | 764.91 | 38.0 | - 40.0    | 726.9 | - 724.9    |    |    |                         |          |                  |        | 21.7            |  |
| 09-200     | S-20       | SS                | 764.91 | 42.0 | - 42.5    | 722.9 | - 722.4    |    |    |                         |          |                  |        | 21.7            |  |
| 09-200     | S-20A      | SS                | 764.91 | 42.5 | - 44.0    | 722.4 | - 720.9    |    |    |                         |          |                  |        | 88.6            |  |
| 09-200     | S-22       | SS                | 764.91 | 46.0 | - 46.5    | 718.9 | - 718.4    |    |    | </td                    |          |                  |        |                 |  |

TABLE 3.1\_T1 SUMMARY OF LABORATORY TESTING

| Boring No. | Sample No. | Sample Type | Surface Elevation ft. | Depth ft. |      | Elevation ft. |       | Atterbergs |    |    | G <sub>s</sub> | ASTM D422 Size Analysis |        | Grain  |        | ASTM D1140 P200 | Organic Content |
|------------|------------|-------------|-----------------------|-----------|------|---------------|-------|------------|----|----|----------------|-------------------------|--------|--------|--------|-----------------|-----------------|
|            |            |             |                       | ft.       | ft.  | ft.           | ft.   | LL         | PL | PI |                | % Gravel                | % Sand | % Silt | % Clay |                 |                 |
| 09-202     | S-3        | SS          | 761.47                | 4.0       | 6.0  | 757.5         | 755.5 |            |    |    |                |                         |        |        |        | 95.1            |                 |
| 09-202     | S-6        | SS          | 761.47                | 10.0      | 12.0 | 751.5         | 749.5 |            |    |    |                |                         |        |        |        | 94.2            |                 |
| 09-202     | S-9        | SS          | 761.47                | 16.0      | 18.0 | 745.5         | 743.5 |            |    |    |                |                         |        |        |        | 98.8            |                 |
| 09-202     | S-12       | SS          | 761.47                | 22.0      | 24.0 | 739.5         | 737.5 |            |    |    |                |                         |        |        |        | 87.6            |                 |
| 09-202     | S-15       | SS          | 761.47                | 28.0      | 29.8 | 733.5         | 731.7 |            |    |    |                |                         |        |        |        | 97.2            |                 |
| 09-202     | S-17       | SS          | 761.47                | 32.0      | 34.0 | 729.5         | 727.5 |            |    |    |                |                         |        |        |        | 60.5            |                 |
| 09-202     | S-19       | SS          | 761.47                | 36.0      | 37.0 | 725.5         | 724.5 |            |    |    |                |                         |        |        |        | 62.7            |                 |
| 09-202     | S-20       | SS          | 761.47                | 38.0      | 40.0 | 723.5         | 721.5 |            |    |    | 0.0            | 71.9                    | 19.2   | 8.9    |        |                 |                 |
| 09-202     | S-21       | SS          | 761.47                | 40.0      | 41.0 | 721.5         | 720.5 |            |    |    |                |                         |        |        |        | 16.5            |                 |
| 09-202     | S-21A      | SS          | 761.47                | 41.0      | 42.0 | 720.5         | 719.5 |            |    |    |                |                         |        |        |        | 22.1            |                 |
| 09-202     | S-23       | SS          | 761.47                | 43.0      | 44.0 | 718.5         | 717.5 |            | NP |    | 2.9            | 52.6                    | 34.2   | 10.3   | 52.4   |                 |                 |
| 09-202     | S-25       | SS          | 761.47                | 46.0      | 47.5 | 715.5         | 714   |            |    |    |                |                         |        |        |        | 20.8            |                 |
| 09-203     | S-3        | SS          | 759.59                | 4.0       | 6.0  | 755.6         | 753.6 |            |    |    |                |                         |        |        |        | 98.5            |                 |
| 09-203     | S-6        | SS          | 759.59                | 10.0      | 12.0 | 749.6         | 747.6 |            |    |    |                |                         |        |        |        | 97.7            |                 |
| 09-203     | S-9        | SS          | 759.59                | 16.0      | 18.0 | 743.6         | 741.6 |            |    |    |                |                         |        |        |        | 94.4            |                 |
| 09-203     | S-12       | SS          | 759.59                | 24.0      | 24.5 | 735.6         | 735.1 |            |    |    |                |                         |        |        |        | 84.0            |                 |
| 09-203     | S-15       | SS          | 759.59                | 30.0      | 32.0 | 729.6         | 727.6 |            |    |    |                |                         |        |        |        | 80.5            |                 |
| 09-203     | S-18       | SS          | 759.59                | 36.0      | 38.0 | 723.6         | 721.6 |            |    |    |                |                         |        |        |        | 38.5            |                 |
| 09-203     | S-20       | SS          | 759.59                | 40.0      | 40.4 | 719.6         | 719.2 |            |    |    |                |                         |        |        |        | 55.8            |                 |
| 09-204     | S-8        | SS          | 750.14                | 14.0      | 16.0 | 736.1         | 734.1 |            |    |    |                |                         |        |        |        | 58.7            |                 |
| 09-204     | S-10       | SS          | 750.14                | 18.0      | 20.0 | 732.1         | 730.1 |            |    |    |                |                         |        |        |        | 61.4            |                 |
| 09-204     | S-12       | SS          | 750.14                | 22.0      | 23.0 | 728.1         | 727.1 |            | NP |    | 0.0            | 37.9                    | 41.2   | 20.9   | 60.7   |                 |                 |
| 09-204     | S-14       | SS          | 750.14                | 26.0      | 28.0 | 724.1         | 722.1 |            | NP |    | 0.2            | 60.3                    | 24.8   | 14.7   | 42.7   |                 |                 |
| 09-204     | S-15       | SS          | 750.14                | 28.0      | 30.0 | 722.1         | 720.1 |            |    |    |                |                         |        |        |        | 42.5            |                 |
| 09-204     | S-16       | SS          | 750.14                | 30.0      | 30.5 | 720.1         | 719.6 |            |    |    |                |                         |        |        |        | 33.8            |                 |
| 09-205     | S-5        | SS          | 754.57                | 8.0       | 10.0 |               |       |            |    |    | 0.0            | 3.2                     | 71.5   | 25.3   |        |                 |                 |
| 09-205     | S-9        | SS          | 754.57                | 16.0      | 18.0 | 738.6         | 736.6 |            |    |    |                |                         |        |        |        | 82.1            |                 |
| 09-205     | S-11       | SS          | 754.57                | 20.0      | 22.0 | 734.6         | 732.6 |            |    |    |                |                         |        |        |        | 66.4            |                 |
| 09-205     | S-14       | SS          | 754.57                | 26.0      | 26.5 | 728.6         | 728.1 |            |    |    |                |                         |        |        |        | 52.9            |                 |
| 09-205     | S-15       | SS          | 754.57                | 28.0      | 30.0 | 726.6         | 724.6 |            |    |    |                |                         |        |        |        | 55.6            |                 |
| 09-205     | S-17       | SS          | 754.57                | 32.0      | 34.0 | 722.6         | 720.6 |            |    |    |                |                         |        |        |        | 37.8            |                 |
| 09-205     | S-18A      | SS          | 754.57                | 34.5      | 35.8 | 720.1         | 718.8 |            |    |    |                |                         |        |        |        | 14.9            |                 |
| 09-206     | S-13       | SS          | 754.56                | 24.0      | 26.0 | 730.6         | 728.6 |            |    |    |                |                         |        |        |        | 45.9            |                 |
| 09-206     | S-14       | SS          | 754.56                | 26.0      | 28.0 | 728.6         | 726.6 |            |    |    | 0.0            | 58.2                    | 23.1   | 18.7   |        |                 |                 |
| 09-206     | S-15       | SS          | 754.56                | 28.0      | 30.0 | 726.6         | 724.6 |            |    |    |                |                         |        |        |        | 41.5            |                 |
| 09-206     | S-17       | SS          | 754.56                | 32.0      | 33.0 | 722.6         | 721.6 |            |    |    |                |                         |        |        |        | 47.0            |                 |
| 09-206     | S-18       | SS          | 754.56                | 34.0      | 36.0 | 720.6         | 718.6 |            |    |    | 16.5           | 61.2                    | 14.9   | 7.4    |        |                 |                 |
| 09-206     | S-19       | SS          | 754.56                | 36.0      | 37.0 | 718.6         | 717.6 |            |    |    |                |                         |        |        |        | 13.7            |                 |
| 09-207     | S-8        | SS          | 747.11                | 14.0      | 16.0 | 733.1         | 731.1 |            |    |    |                |                         |        |        |        | 83.9            |                 |
| 09-207     | S-10       | SS          | 747.11                | 18.0      | 20.0 | 729.1         | 727.1 |            |    |    |                |                         |        |        |        | 83.1            |                 |
| 09-207     | S-12       | SS          | 747.11                | 22.0      | 24.0 | 725.1         | 723.1 |            |    |    |                |                         |        |        |        | 90.5            |                 |
| 09-207     | S-14       | SS          | 747.11                | 26.0      | 28.0 | 721.1         | 719.1 |            |    |    |                |                         |        |        |        | 59.7            |                 |
| 09-207     | S-16       | SS          | 747.11                | 30.0      | 32.0 | 717.1         | 715.1 |            |    |    |                |                         |        |        |        | 13.5            |                 |
| 09-208     | S-3        | SS          | 744.78                | 4.0       | 6.0  | 740.8         | 738.8 |            |    |    |                |                         |        |        |        | 93.2            |                 |
| 09-208     | S-5        | SS          | 744.78                | 8.0       | 10.0 | 736.8         | 734.8 |            |    |    |                |                         |        |        |        | 86.0            |                 |
| 09-208     | S-7        | SS          | 744.78                | 12.0      | 14.0 | 732.8         | 730.8 |            |    |    |                |                         |        |        |        | 45.0            |                 |
| 09-208     | S-9        | SS          | 744.78                | 16.0      | 18.0 | 728.8         | 726.8 |            |    |    |                |                         |        |        |        | 38.9            |                 |
| 09-208     | S-11       | SS          | 744.78                | 20.0      | 22.0 | 724.8         | 722.8 |            |    |    |                |                         |        |        |        | 32.6            |                 |
| 09-208     | S-13       | SS          | 744.78                | 24.0      | 26.0 | 720.8         | 718.8 |            |    |    |                |                         |        |        |        | 36.5            |                 |
| 09-208     | S-15       | SS          | 744.78                | 28.0      | 29.0 | 716.8         | 715.8 |            |    |    |                |                         |        |        |        | 14.9            |                 |
| 09-209     | S-3        | SS          | 746.19                | 4.0       | 6.0  | 742.2         | 740.2 |            |    |    |                |                         |        |        |        | 92.4            |                 |
| 09-209     | S-4        | SS          | 746.19                | 6.0       | 8.0  | 740.2         | 738.2 |            |    |    |                |                         |        |        |        | 93.9            |                 |
| 09-209     | S-5        | SS          | 746.19                | 8.0       | 10.0 | 738.2         | 736.2 |            |    |    |                |                         |        |        |        | 81.3            |                 |
| 09-209     | S-6        | SS          | 746.19                | 10.0      | 12.0 | 736.2         | 734.2 |            |    |    |                |                         |        |        |        | 55.5            |                 |
| 09-209     | S-8        | SS          | 746.19                | 14.0      | 16.0 | 732.2         | 730   |            |    |    |                |                         |        |        |        |                 |                 |

TABLE 3.1\_T1 SUMMARY OF LABORATORY TESTING

| Boring No. | Sample No. | Surface Elevation | Depth  |          | Elevation |       | Atterbergs |    |    | G <sub>s</sub> | ASTM D422 Size Analysis |        | Grain  |        | ASTM D1140 | Organic Content |
|------------|------------|-------------------|--------|----------|-----------|-------|------------|----|----|----------------|-------------------------|--------|--------|--------|------------|-----------------|
|            |            |                   | ft.    | ft.      | ft.       | ft.   | LL         | PL | PI |                | % Gravel                | % Sand | % Silt | % Clay | P200       |                 |
| 09-211     | S-8A       | SS                | 765.55 | 15.3     | 16.0      | 750.3 | 749.6      |    |    |                |                         |        |        |        |            | 30.7            |
| 09-211     | S-10       | SS                | 765.55 | 18.0     | 20.0      | 747.6 | 745.6      |    |    |                |                         |        |        |        |            | 28.2            |
| 09-211     | S-12       | SS                | 765.55 | 22.0     | 24.0      | 743.6 | 741.6      |    |    |                |                         |        |        |        |            | 42.5            |
| 09-211     | S-13       | SS                | 765.55 | 24.0     | 26.0      | 741.6 | 739.6      |    |    |                |                         |        |        |        |            | 20.2            |
| 09-211     | S-15       | SS                | 765.55 | 28.0     | 30.0      | 737.6 | 735.6      |    |    |                |                         |        |        |        |            | 50.5            |
| 09-211     | S-17       | SS                | 765.55 | 32.0     | 34.0      | 733.6 | 731.6      |    |    |                |                         |        |        |        |            | 38.5            |
| 09-211     | S-19       | SS                | 765.55 | 37.5     | 40.5      | 728.1 | 725.1      |    |    |                |                         |        |        |        |            | 34.1            |
| 09-211     | S-21       | SS                | 765.55 | 42.5     | 44.5      | 723.1 | 721.1      |    |    |                |                         |        |        |        |            | 29.2            |
| 09-211     | S-22       | SS                | 765.55 | 44.5     | 46.5      | 721.1 | 719.1      |    |    |                |                         |        |        |        |            | 47.8            |
| 09-211     | S-24       | SS                | 765.55 | 48.5     | 50.5      | 717.1 | 715.1      |    |    |                |                         |        |        |        |            | 47.8            |
|            |            |                   |        |          |           |       |            |    |    |                |                         |        |        |        |            |                 |
| 09-301     | S-3        | SS                | 815.95 | 4.0      | 6.0       | 812   | 810        |    |    |                |                         |        |        |        |            | 96.2            |
| 09-301     | S-6        | SS                | 815.95 | 10.0     | 12.0      | 806   | 804        |    |    |                |                         |        |        |        |            | 91.3            |
| 09-301     | S-9        | SS                | 815.95 | 16.0     | 18.0      | 800   | 798        |    |    |                |                         |        |        |        |            | 98.4            |
| 09-301     | S-12       | SS                | 815.95 | 22.0     | 24.0      | 794   | 792        |    |    |                |                         |        |        |        |            | 99.3            |
| 09-301     | S-15       | SS                | 815.95 | 28.0     | 30.0      | 788   | 786        |    |    |                |                         |        |        |        |            | 99.3            |
| 09-301     | S-18       | SS                | 815.95 | 34.0     | 36.0      | 782   | 780        |    |    |                |                         |        |        |        |            | 95.0            |
| 09-301     | S-21       | SS                | 815.95 | 40.0     | 42.0      | 776   | 774        |    |    |                |                         |        |        |        |            | 98.3            |
| 09-301     | S-24       | SS                | 815.95 | 46.0     | 48.0      | 770   | 768        |    |    |                |                         |        |        |        |            | 99.4            |
| 09-301     | S-27       | SS                | 815.95 | 52.0     | 54.0      | 764   | 762        |    |    |                |                         |        |        |        |            | 99.9            |
| 09-301     | S-30       | SS                | 815.95 | 56.0     | 58.0      | 760   | 758        |    |    |                |                         |        |        |        |            | 89.2            |
| 09-301     | S-33       | SS                | 815.95 | 62.0     | 64.0      | 754   | 752        |    |    |                |                         |        |        |        |            | 16.8            |
| 09-301     | S-36       | SS                | 815.95 | 68.0     | 70.0      | 748   | 746        |    |    |                |                         |        |        |        |            | 99.5            |
| 09-301     | S-39       | SS                | 815.95 | 74.0     | 76.0      | 742   | 740        |    |    |                |                         |        |        |        |            | 96.2            |
| 09-301     | S-42       | SS                | 815.95 | 80.0     | 82.0      | 736   | 734        |    |    |                |                         |        |        |        |            | 82.1            |
| 09-301     | S-45       | SS                | 815.95 | 86.0     | 88.0      | 730   | 728        |    |    |                |                         |        |        |        |            | 98.7            |
| 09-301     | S-48       | SS                | 815.95 | 92.0     | 94.0      | 724   | 722        |    |    |                |                         |        |        |        |            | 50.3            |
|            |            |                   |        |          |           |       |            |    |    |                |                         |        |        |        |            |                 |
| 09-302     | S-2        | SS                | 817.38 | 5.0      | 7.0       | 812.4 | 810.4      |    |    |                |                         |        |        |        |            | 99.3            |
| 09-302     | S-5        | SS                | 817.38 | 20.0     | 22.0      | 797.4 | 795.4      |    |    |                |                         |        |        |        |            | 91.2            |
| 09-302     | S-8        | SS                | 817.38 | 35.0     | 37.0      | 782.4 | 780.4      |    |    |                |                         |        |        |        |            | 96.8            |
| 09-302     | S-11       | SS                | 817.38 | 50.0     | 52.0      | 767.4 | 765.4      |    |    |                |                         |        |        |        |            | 82.7            |
| 09-302     | S-12       | SS                | 817.38 | 52.0     | 54.0      | 765.4 | 763.4      |    |    |                |                         |        |        |        |            | 88.5            |
| 09-302     | S-14       | SS                | 817.38 | 56.0     | 58.0      | 761.4 | 759.4      |    |    |                |                         |        |        |        |            | 99.3            |
| 09-302     | S-16       | SS                | 817.38 | 60.0     | 62.0      | 757.4 | 755.4      |    |    |                |                         |        |        |        |            | 96.7            |
| 09-302     | S-17       | SS                | 817.38 | 62.0     | 64.0      | 755.4 | 753.4      |    |    |                |                         |        |        |        |            | 59.2            |
| 09-302     | S-18       | SS                | 817.38 | 64.0     | 66.0      | 753.4 | 751.4      |    |    |                |                         |        |        |        |            | 96.2            |
| 09-302     | S-20       | SS                | 817.38 | 68.0     | 70.0      | 749.4 | 747.4      |    |    |                |                         |        |        |        |            | 96.9            |
| 09-302     | S-23       | SS                | 817.38 | 74.0     | 76.0      | 743.4 | 741.4      |    |    |                |                         |        |        |        |            | 86.7            |
| 09-302     | S-26       | SS                | 817.38 | 80.0     | 82.0      | 737.4 | 735.4      |    |    |                |                         |        |        |        |            | 96.0            |
| 09-302     | S-27       | SS                | 817.38 | 82.0     | 87.0      | 735.4 | 730.4      |    |    |                |                         |        |        |        |            | 89.9            |
| 09-302     | S-30       | SS                | 817.38 | 82.0     | 87.0      | 735.4 | 730.4      |    |    |                |                         |        |        |        |            | 82.5            |
| 09-302     | S-29       | SS                | 817.38 | 89.0     | 91.0      | 728.4 | 726.4      |    |    |                |                         |        |        |        |            | 72.1            |
| 09-302     | S-32       | SS                | 817.38 | 95.0     | 97.0      | 722.4 | 720.4      |    |    |                |                         |        |        |        |            | 75.2            |
|            |            |                   |        |          |           |       |            |    |    |                |                         |        |        |        |            |                 |
| 09-303     | 1          | SS                | 817.43 | 0.0      | 2.0       | 817.4 | 815.4      |    |    |                |                         |        |        |        |            | 93.2            |
| 09-303     | 3          | SS                | 817.43 | 4.0      | 6.0       | 813.4 | 811.4      |    |    |                |                         |        |        |        |            | 88.2            |
| 09-303     | 5          | SS                | 817.43 | 8.0      | 10.0      | 809.4 | 807.4      |    |    |                |                         |        |        |        |            | 70.1            |
| 09-303     | 7          | SS                | 817.43 | 12.0     | 14.0      | 805.4 | 803.4      |    |    |                |                         |        |        |        |            | 95.0            |
| 09-303     | 9          | SS                | 817.43 | 16.0     | 18.0      | 801.4 | 799.4      |    |    |                |                         |        |        |        |            | 96.3            |
| 09-303     | 11         | SS                | 817.43 | 20.0     | 22.0      | 797.4 | 795.4      |    |    |                |                         |        |        |        |            | 88.9            |
| 09-303     | 13         | SS                | 817.43 | 24.0     | 26.0      | 793.4 | 791.4      |    |    |                |                         |        |        |        |            | 96.6            |
| 09-303     | 15         | SS                | 817.43 | 28.0     | 30.0      | 789.4 | 787.4      |    |    |                |                         |        |        |        |            | 82.5            |
| 09-303     | 17         | SS                | 817.43 | 32.0     | 34.0      | 785.4 | 783.4      |    |    |                |                         |        |        |        |            | 80.6            |
| 09-303     | 19         | SS                | 817.43 | 36.0     | 38.0      | 781.4 | 779.4      |    |    |                |                         |        |        |        |            | 96.8            |
| 09-303     | 21         | SS                | 817.43 | 40.0     | 42.0      | 777.4 | 775.4      |    |    |                |                         |        |        |        |            | 77.9            |
| 09-303     | 22         | SS                | 817.43 | 42.0     | 44.0      | 775.4 | 773.4      |    |    |                |                         |        |        |        |            | 91.7            |
| 09-303     | 24         | SS                | 817.43 | 46.0     | 48.0      | 771.4 | 769.4      |    |    |                |                         |        |        |        |            | 80.0            |
| 09-303     | 25         | SS                | 817.43 | 48.0     | 50.0      | 769.4 | 767.4      |    |    |                |                         |        |        |        |            | 87.9            |
| 09-303     | 27         | SS                | 817.43 | 51.5</td |           |       |            |    |    |                |                         |        |        |        |            |                 |



TABLE 3.1\_T1 SUMMARY OF LABORATORY TESTING

| Boring No. | Sample No. | Sample Type | Surface Elevation ft. | Depth ft. |      | Elevation ft. |       | Atterbergs |    |    | G <sub>s</sub> | ASTM D422 Size Analysis |        |        | Grain ASTM D1140 | Organic Content |
|------------|------------|-------------|-----------------------|-----------|------|---------------|-------|------------|----|----|----------------|-------------------------|--------|--------|------------------|-----------------|
|            |            |             |                       | ft.       | ft.  | ft.           | ft.   | LL         | PL | PI |                | % Gravel                | % Sand | % Silt | % Clay           |                 |
| 09-503     | 3          | SS          | 764.65                | 4.0       | 6.0  | 760.7         | 758.7 |            |    |    |                |                         |        |        |                  | 77.0            |
| 09-503     | 6          | SS          | 764.65                | 10.0      | 12.0 | 754.7         | 752.7 |            |    |    |                |                         |        |        |                  | 81.0            |
| 09-503     | 9          | SS          | 764.65                | 16.0      | 18.0 | 748.7         | 746.7 |            |    |    |                |                         |        |        |                  | 78.5            |
| 09-503     | 12         | SS          | 764.65                | 22.0      | 24.0 | 742.7         | 740.7 |            |    |    |                |                         |        |        |                  | 94.0            |
| 09-503     | 15         | SS          | 764.65                | 28.0      | 30.0 | 736.7         | 734.7 |            |    |    |                |                         |        |        |                  | 93.3            |
| 09-503     | 17         | SS          | 764.65                | 32.0      | 34.0 | 732.7         | 730.7 |            |    |    |                |                         |        |        |                  | 96.0            |
| 09-601     | S-24       | SS          | 773.44                | 47.5      | 50.0 | 725.9         | 723.4 |            |    |    |                |                         |        |        |                  | 18.2            |
| 09-601     | S-29       | SS          | 773.44                | 60.0      | 62.5 | 713.4         | 710.9 |            |    |    | 0.0            | 43.3                    | 43.4   | 13.3   |                  |                 |
| 09-602     | 3          | SS          | 781.50                | 4.0       | 6.0  | 777.5         | 775.5 |            |    |    |                |                         |        |        |                  | 67.9            |
| 09-602     | 6          | SS          | 781.50                | 10.0      | 12.0 | 771.5         | 769.5 |            |    |    |                |                         |        |        |                  | 75.8            |
| 09-602     | 9          | SS          | 781.50                | 16.0      | 18.0 | 765.5         | 763.5 |            |    |    |                |                         |        |        |                  | 65.8            |
| 09-602     | 18         | SS          | 781.50                | 34.0      | 36.0 | 747.5         | 745.5 |            |    |    |                |                         |        |        |                  | 97.7            |
| 09-602     | 21         | SS          | 781.50                | 40.0      | 43.0 | 741.5         | 738.5 |            |    |    |                |                         |        |        |                  | 99.7            |
| 09-602     | 22         | SS          | 781.50                | 43.0      | 44.5 | 738.5         | 737   |            |    |    |                |                         |        |        |                  | 77.9            |
| 09-602     | 25         | SS          | 781.50                | 53.0      | 55.0 | 728.5         | 726.5 |            |    |    |                |                         |        |        |                  | 96.3            |
| 09-603     | 3          | SS          | 780.61                | 4.0       | 6.0  | 776.6         | 774.6 |            |    |    |                |                         |        |        |                  | 87.9            |
| 09-603     | 6          | SS          | 780.61                | 10.0      | 12.0 | 770.6         | 768.6 |            |    |    |                |                         |        |        |                  | 73.3            |
| 09-603     | 9          | SS          | 780.61                | 16.0      | 18.0 | 764.6         | 762.6 |            |    |    |                |                         |        |        |                  | 30.3            |
| 09-603     | 12         | SS          | 780.61                | 22.0      | 24.0 | 758.6         | 756.6 |            |    |    |                |                         |        |        |                  | 96.6            |
| 09-603     | 15         | SS          | 780.61                | 29.5      | 32.0 | 751.1         | 748.6 |            |    |    |                |                         |        |        |                  | 95.0            |
| 09-603     | 18         | SS          | 780.61                | 36.0      | 38.0 | 744.6         | 742.6 |            |    |    |                |                         |        |        |                  | 60.5            |
| 09-603     | 21         | SS          | 780.61                | 42.5      | 44.5 | 738.1         | 736.1 |            |    |    |                |                         |        |        |                  | 96.8            |
| 09-603     | 24         | SS          | 780.61                | 48.5      | 50.5 | 732.1         | 730.1 |            |    |    |                |                         |        |        |                  | 77.4            |
| 09-604     | S-3        | SS          | 782.48                | 4.0       | 6.0  | 778.5         | 776.5 |            |    |    |                |                         |        |        |                  | 71.4            |
| 09-604     | S-6        | SS          | 782.48                | 10.0      | 12.0 | 772.5         | 770.5 |            |    |    |                |                         |        |        |                  | 52.8            |
| 09-604     | S-9        | SS          | 782.48                | 16.0      | 18.0 | 766.5         | 764.5 |            |    |    |                |                         |        |        |                  | 45.4            |
| 09-604     | S-12       | SS          | 782.48                | 22.0      | 24.0 | 760.5         | 758.5 |            |    |    |                |                         |        |        |                  | 91.7            |
| 09-604     | S-15       | SS          | 782.48                | 28.0      | 30.0 | 754.5         | 752.5 |            |    |    |                |                         |        |        |                  | 7.6             |
| 09-604     | S-18       | SS          | 782.48                | 34.0      | 36.0 | 748.5         | 746.5 |            |    |    |                |                         |        |        |                  | 59.9            |
| 09-604     | S-21       | SS          | 782.48                | 40.0      | 42.0 | 742.5         | 740.5 |            |    |    |                |                         |        |        |                  | 17.6            |
| 09-604     | S-24       | SS          | 782.48                | 46.0      | 48.0 | 736.5         | 734.5 |            |    |    |                |                         |        |        |                  | 81.7            |
| 09-604     | S-27       | SS          | 782.48                | 52.0      | 55.5 | 730.5         | 727   |            |    |    |                |                         |        |        |                  | 88.9            |
| 09-604     | S-29       | SS          | 782.48                | 59.0      | 62.0 | 723.5         | 720.5 |            |    |    |                |                         |        |        |                  | 82.5            |
| 09-605     | S-3        | SS          | 781.74                | 4.0       | 6.0  | 777.7         | 775.7 |            |    |    |                |                         |        |        |                  | 50.2            |
| 09-605     | S-6        | SS          | 781.74                | 10.0      | 12.0 | 771.7         | 769.7 |            |    |    |                |                         |        |        |                  | 38.6            |
| 09-605     | S-9        | SS          | 781.74                | 16.0      | 18.0 | 765.7         | 763.7 |            |    |    |                |                         |        |        |                  | 42.9            |
| 09-605     | S-12       | SS          | 781.74                | 22.0      | 23.5 | 759.7         | 758.2 |            |    |    |                |                         |        |        |                  | 40.7            |
| 09-605     | S-15       | SS          | 781.74                | 28.0      | 30.0 | 753.7         | 751.7 |            |    |    |                |                         |        |        |                  | 83.9            |
| 09-605     | S-18       | SS          | 781.74                | 34.0      | 35.0 | 747.7         | 746.7 |            |    |    |                |                         |        |        |                  | 55.1            |
| 09-605     | S-21       | SS          | 781.74                | 40.0      | 42.0 | 741.7         | 739.7 |            |    |    |                |                         |        |        |                  | 94.9            |
| 09-605     | S-24       | SS          | 781.74                | 46.0      | 48.0 | 735.7         | 733.7 |            |    |    |                |                         |        |        |                  | 96.4            |
| 09-700     | S-3        | SS          | 764.55                | 4.0       | 6.0  | 760.6         | 758.6 |            |    |    |                |                         |        |        |                  | 13.2            |
| 09-700     | S-6        | SS          | 764.55                | 10.0      | 12.0 | 754.6         | 752.6 |            |    |    |                |                         |        |        |                  | 99.2            |
| 09-700     | S-9        | SS          | 764.55                | 16.0      | 18.0 | 748.6         | 746.6 |            |    |    |                |                         |        |        |                  | 98.7            |
| 09-700     | S-12       | SS          | 764.55                | 22.0      | 24.0 | 742.6         | 740.6 |            |    |    |                |                         |        |        |                  | 99.4            |
| 09-700     | S-13       | SS          | 764.55                | 24.0      | 26.0 | 740.6         | 738.6 |            |    |    |                |                         |        |        |                  | 59.1            |
| 09-700     | S-14       | SS          | 764.55                | 32.0      | 34.0 | 732.6         | 730.6 |            |    |    |                |                         |        |        |                  | 21.6            |
| 09-700     | S-16       | SS          | 764.55                | 36.0      | 38.0 | 728.6         | 726.6 |            |    |    |                |                         |        |        |                  | 10.4            |
| 09-700     | S-18       | SS          | 764.55                | 40.0      | 42.0 | 724.6         | 722.6 |            |    |    |                |                         |        |        |                  | 10.7            |
| 09-700     | S-20       | SS          | 764.55                | 44.0      | 46.0 | 720.6         | 718.6 |            |    |    |                |                         |        |        |                  | 20.6            |
| 09-700     | S-22       | SS          | 764.55                | 48.0      | 50.0 | 716.6         | 714.6 |            |    |    |                |                         |        |        |                  | 36.3            |
| 09-700     | S-25       | SS          | 764.55                | 54.0      | 56.0 | 710.6         | 708.6 |            |    |    |                |                         |        |        |                  | 7.7             |
| 09-700     | S-27       | SS          | 764.55                | 58.0      | 60.0 | 706.6         | 704.6 |            |    |    |                |                         |        |        |                  | 16.9            |
| 09-702     | S-3        | SS          | 764.40                | 4.0       | 6.0  | 760.4         | 758.4 |            |    |    |                |                         |        |        |                  | 95.1            |
| 09-702     | S-6        | SS          | 764.40                | 10.0      | 12.0 | 754.4         | 752.4 |            |    |    |                |                         |        |        |                  | 97.8            |
| 09-702     | S-9        | SS          | 764.40                | 16.0      | 18.0 | 748.4         | 746.4 |            |    |    |                |                         |        |        |                  | 98.7            |
| 09-702     | S-12       | SS          | 764.40                | 22.0      | 24.0 | 742.4         | 740.4 |            |    |    |                |                         |        |        |                  | 71.8            |
| 09-702     | S-14       | SS          | 764.40                | 26.0      | 26.5 | 738.4         | 737.9 |            |    |    |                |                         |        |        |                  |                 |

### TABLE 3.1\_T1 SUMMARY OF LABORATORY TESTING

TABLE 3.1\_T1 SUMMARY OF LABORATORY TESTING

| Boring No. | Sample No. | Sample Type | Surface Elevation ft. | Depth ft. |      | Elevation ft. |       | Atterbergs |    |    | G <sub>s</sub> | ASTM D422 Size Analysis |        |        | ASTM D1140 P200 | Organic Content |  |
|------------|------------|-------------|-----------------------|-----------|------|---------------|-------|------------|----|----|----------------|-------------------------|--------|--------|-----------------|-----------------|--|
|            |            |             |                       | ft.       | ft.  | ft.           | ft.   | LL         | PL | PI |                | % Gravel                | % Sand | % Silt | % Clay          |                 |  |
| 09-714     | S-3        | SS          | 764.16                | 4.0       | 6.0  | 760.2         | 758.2 |            |    |    |                |                         |        |        |                 | 32.8            |  |
| 09-714     | S-6        | SS          | 764.16                | 10.0      | 12.0 | 754.2         | 752.2 |            |    |    |                |                         |        |        |                 | 99.2            |  |
| 09-714     | S-9        | SS          | 764.16                | 16.0      | 18.0 | 748.2         | 746.2 |            |    |    |                |                         |        |        |                 | 97.2            |  |
| 09-714     | S-12       | SS          | 764.16                | 22.0      | 24.0 | 742.2         | 740.2 |            |    |    |                |                         |        |        |                 | 99.6            |  |
| 09-714     | S-15       | SS          | 764.16                | 28.0      | 30.0 | 736.2         | 734.2 |            |    |    |                |                         |        |        |                 | 69.6            |  |
| 09-714     | S-18       | SS          | 764.16                | 34.0      | 34.5 | 730.2         | 729.7 |            |    |    |                |                         |        |        |                 | 96.0            |  |
| 09-714     | S-18A      | SS          | 764.16                | 34.5      | 36.0 | 729.7         | 728.2 |            |    |    |                |                         |        |        |                 | 72.5            |  |
| 09-714     | S-20A      | SS          | 764.16                | 39.0      | 40.0 | 725.2         | 724.2 |            |    |    |                |                         |        |        |                 | 63.8            |  |
| 09-714     | S-22       | SS          | 764.16                | 42.0      | 44.0 | 722.2         | 720.2 |            |    |    |                |                         |        |        |                 | 51.7            |  |
| 09-714     | S-24       | SS          | 764.16                | 46.0      | 48.0 | 718.2         | 716.2 |            |    |    |                |                         |        |        |                 | 43.9            |  |
| 09-714     | S-26       | SS          | 764.16                | 50.0      | 52.0 | 714.2         | 712.2 |            |    |    |                |                         |        |        |                 | 35.6            |  |
| 09-714     | S-28       | SS          | 764.16                | 54.0      | 56.0 | 710.2         | 708.2 |            |    |    |                |                         |        |        |                 | 32.7            |  |
| 09-714     | S-30       | SS          | 764.16                | 58.0      | 60.0 | 706.2         | 704.2 |            |    |    |                |                         |        |        |                 | 10.3            |  |
| 09-800     | S-3        | SS          | 763.09                | 4.0       | 6.0  | 759.1         | 757.1 |            |    |    |                |                         |        |        |                 | 16.5            |  |
| 09-800     | S-6        | SS          | 763.09                | 10.0      | 12.0 | 753.1         | 751.1 |            |    |    |                |                         |        |        |                 | 96.1            |  |
| 09-800     | S-9        | SS          | 763.09                | 16.0      | 18.0 | 747.1         | 745.1 |            |    |    |                |                         |        |        |                 | 90.0            |  |
| 09-800     | S-12       | SS          | 763.09                | 22.0      | 14.0 | 741.1         | 749.1 |            |    |    |                |                         |        |        |                 | 12.7            |  |
| 09-800     | S-15       | SS          | 763.09                | 28.0      | 30.0 | 735.1         | 733.1 |            |    |    |                |                         |        |        |                 | 53.7            |  |
| 09-801     | 3          | SS          | 765.26                | 4.0       | 6.0  | 761.3         | 759.3 |            |    |    |                |                         |        |        |                 | 29.4            |  |
| 09-801     | 5          | SS          | 765.26                | 8.0       | 10.0 | 757.3         | 755.3 |            |    |    |                |                         |        |        |                 | 27.8            |  |
| 09-801     | 9          | SS          | 765.26                | 16.0      | 18.0 | 749.3         | 747.3 |            |    |    |                |                         |        |        |                 | 47.6            |  |
| 09-801     | 12         | SS          | 765.26                | 22.0      | 24.0 | 743.3         | 741.3 |            |    |    |                |                         |        |        |                 | 90.2            |  |
| 09-801     | 15         | SS          | 765.26                | 28.0      | 30.0 | 737.3         | 735.3 |            |    |    |                |                         |        |        |                 | 87.7            |  |
| 09-801     | 18         | SS          | 765.26                | 34.0      | 36.0 | 731.3         | 729.3 |            |    |    |                |                         |        |        |                 | 91.1            |  |
| 09-801     | 21         | SS          | 765.26                | 40.0      | 42.0 | 725.3         | 723.3 |            |    |    |                |                         |        |        |                 | 74.6            |  |
| 09-801     | 24         | SS          | 765.26                | 46.0      | 48.0 | 719.3         | 717.3 |            |    |    |                |                         |        |        |                 | 35.2            |  |
| 09-801     | 27         | SS          | 765.26                | 52.0      | 54.0 | 713.3         | 711.3 |            |    |    |                |                         |        |        |                 | 25.8            |  |
| 09-801     | 30         | SS          | 765.26                | 58.0      | 60.0 | 707.3         | 705.3 |            |    |    |                |                         |        |        |                 | 27.8            |  |
| 09-801     | 31         | SS          | 765.26                | 60.0      | 61.0 | 705.3         | 704.3 |            |    |    |                |                         |        |        |                 | 12.5            |  |

TABLE 3.1\_T1 SUMMARY OF LABORATORY TESTING

| Boring No. | Sample No. | Surface Elevation | Tube Depth |      | Tube Elevation |       | USCS (computed) | Atterbergs |       |    | ASTM D422 Size Analysis |          |        |        | Grain ASTM D1140 |      |          |
|------------|------------|-------------------|------------|------|----------------|-------|-----------------|------------|-------|----|-------------------------|----------|--------|--------|------------------|------|----------|
|            |            |                   | ft.        | ft.  | ft.            | ft.   |                 | LL         | PL    | PI | G <sub>s</sub>          | % Gravel | % Sand | % Silt | % Clay           | P200 | QP (tsf) |
| 09-100A    | S-1        | 2ST               | 767.27     | 15.0 | 17.5           | 752.3 | 749.8           |            |       |    |                         |          |        |        |                  |      |          |
| 09-100A    | S-2        | 2ST               | 767.27     | 20.0 | 22.5           | 747.3 | 744.8           |            |       |    |                         |          |        |        |                  |      |          |
| 09-100A    | S-3        | 2ST               | 767.27     | 25.0 | 27.5           | 742.3 | 739.8           |            |       |    |                         |          |        |        |                  |      |          |
| 09-100A    | S-4        | 2ST               | 767.27     | 30.5 | 33.0           | 736.8 | 734.3           |            |       |    |                         |          |        |        |                  |      |          |
| 09-100A    | S-5        | 2ST               | 767.27     | 33.0 | 35.5           | 734.3 | 731.8           |            |       |    |                         |          |        |        |                  |      |          |
| 09-100A    | S-6        | 2ST               | 767.27     | 35.5 | 38.0           | 731.8 | 729.3           |            |       |    |                         |          |        |        |                  |      |          |
|            |            |                   |            |      |                |       |                 |            |       |    |                         |          |        |        |                  |      |          |
| 09-102A    | S-1        | 2ST               | 761.68     | 42.0 | -              | 43.5  | 719.7           | 718.2      | CL-ML | 21 | 15                      | 6        | 0.4    | 41.8   | 36.1             | 21.7 |          |
| 09-102A    | S-2        | 2ST               | 761.68     | 43.5 | -              | 45.5  | 718.2           | 716.2      | SM    | 19 | 19                      | NP       | 5.3    | 50.6   | 28.5             | 15.6 |          |
|            |            |                   |            |      |                |       |                 |            |       |    |                         |          |        |        |                  |      |          |
| 09-103A    | S-1        | 2ST               | 766.11     | 36.0 | -              | 37.5  | 730.1           | 728.6      | ML    | 34 | 30                      | 4        | 2.676  | 0.0    | 27.5             | 49.4 | 23.1     |
| 09-103A    | S-1A       | 2ST               | 766.11     |      |                | 766.1 | 766.1           | CL-ML      | 22    | 17 | 5                       | 2.662    | 0.0    | 33.4   | 44.5             | 22.1 |          |
| 09-103A    | S-2        | 2ST               | 766.11     | 37.5 | -              | 39.0  | 728.6           | 727.1      | ML    | 16 | 18                      | NP       | 2.699  | 0.0    | 42.2             | 39.7 | 18.1     |
| 09-103A    | S-3        | 2ST               | 766.11     | 39.0 | -              | 40.5  | 727.1           | 725.6      | ML    | 16 | 14                      | 2        | 2.754  | 1.0    | 38.8             | 44.2 | 16.0     |
| 09-103A    | S-4        | 2ST               | 766.11     | 42.0 | -              | 44.0  | 724.1           | 722.1      | CL-ML | 21 | 14                      | 7        | 0.0    | 46.3   | 35.9             | 17.8 |          |
|            |            |                   |            |      |                |       |                 |            |       |    |                         |          |        |        |                  |      |          |
| 09-104B    | S-9        | 2ST               | 761.29     | 35.0 |                | 37.0  | 726.3           | 724.3      |       |    |                         |          |        |        |                  |      |          |
|            |            |                   |            |      |                |       |                 |            |       |    |                         |          |        |        |                  |      |          |
| 09-105A    | S-1        | 2ST               | 748.73     | 13.0 |                | 15.0  | 735.7           | 733.7      | CL    | 27 | 17                      | 10       | 0.0    | 17.0   | 42.6             | 40.4 | 0.25     |
| 09-105A    | S-2A       | 2ST               | 748.73     | 15.0 |                | 17.0  | 733.7           | 731.7      | CL    | 27 | 19                      | 8        | 2.678  | 0.0    | 47.1             | 30.0 | 22.9     |
| 09-105A    | S-3A       | 2ST               | 748.73     | 17.0 |                | 19.0  | 731.7           | 729.7      | SM    | 19 | 22                      | NP       | 0.0    | 61.8   | 19.5             | 18.7 |          |
|            |            |                   |            |      |                |       |                 |            |       |    |                         |          |        |        |                  |      |          |
| 09-107A    | S-1        |                   | 762.42     |      |                | 732.4 | 732.0           |            |       | 24 | 16                      | 8        |        |        |                  |      |          |
| 09-107A    | S-2        | 2ST               | 762.42     | 30.0 |                | 31.5  | 732.4           | 730.9      | CL    | 24 | 16                      | 8        | 0.0    | 34.8   | 39.9             | 25.3 |          |
|            |            |                   |            |      |                |       |                 |            |       |    |                         |          |        |        |                  |      |          |
| 09-108A    | S-1        | 2ST               | 759.27     | 25.5 | -              | 27.5  | 733.8           | 731.8      | CL-ML | 22 | 16                      | 6        | 2.686  | 0.0    | 33.2             | 44.7 | 22.1     |
| 09-108A    | S-2        |                   | 759.27     |      |                | 759.3 | 759.3           | CL         | 23    | 14 | 9                       | 0.0      | 33.1   | 41.3   | 25.6             | 66.9 |          |
|            |            |                   |            |      |                |       |                 |            |       |    |                         |          |        |        |                  |      |          |
| 09-109A    | S-1        | 2ST               | 763.27     | 30.0 |                | 32.0  | 733.3           | 731.3      |       |    |                         |          |        |        |                  |      |          |
| 09-109A    | S-3        | 2ST               | 763.27     |      |                | 763.3 | 763.3           | CL-ML      | 19    | 16 | 3                       |          |        |        |                  |      |          |
| 09-109A    | S-3A       | 2ST               | 763.27     |      |                | 763.3 | 763.3           | CL-ML      | 21    | 14 | 7                       |          |        |        |                  |      |          |
|            |            |                   |            |      |                |       |                 |            |       |    |                         |          |        |        |                  |      |          |
| 09-110A    | S-1        |                   | 774.77     |      |                | 774.8 | 774.8           | CL         | 26    | 16 | 10                      | 0.0      | 32.5   | 37.7   | 29.8             | 67.5 |          |
| 09-110A    | ST-2       | 2ST               | 774.77     | 40.0 |                | 42.0  | 734.8           | 732.8      | CL    | 24 | 16                      | 8        |        |        |                  |      |          |
|            |            |                   |            |      |                |       |                 |            |       |    |                         |          |        |        |                  |      |          |
| 09-200A    | S-1        | 2ST               | 765.15     | 35.0 |                | 37.0  | 730.2           | 728.2      | ML    | 19 | 17                      | 2        | 2.664  | 2.1    | 32.3             | 47.5 | 18.1     |
| 09-200A    | S-1        | 2ST               | 765.15     | 13.5 |                | 16.0  | 751.7           | 749.2      |       |    |                         |          |        |        |                  |      | 0.5      |
| 09-200A    | S-2        | 2ST               | 765.15     | 42.0 |                | 44.0  | 723.2           | 721.2      | CL    | 26 | 15                      | 11       | 2.3    | 25.5   | 43.0             | 29.2 | 0.5      |
| 09-200A    | S-3        | 2ST               | 765.15     | 30.0 |                | 32.5  | 735.2           | 732.7      |       |    |                         |          |        |        |                  |      |          |
| 09-200A    | S-4        | 2ST               | 765.15     | 32.5 |                | 35.0  | 732.7           | 730.2      |       |    |                         |          |        |        |                  |      |          |
| 09-200A    | S-5        | 2ST               | 765.15     | 35.0 |                | 37.5  | 730.2           | 727.7      |       |    |                         |          |        |        |                  |      |          |
|            |            |                   |            |      |                |       |                 |            |       |    |                         |          |        |        |                  |      |          |
| 09-201A    | S-1        | 2ST               | 760.51     | 26.0 | -              | 28.0  | 734.5           | 732.5      | CL-ML |    |                         |          | 2.701  | 0.0    | 41.5             | 31.6 | 26.9     |
| 09-201A    | S-2        | 2ST               | 760.51     | 28.0 | -              | 29.5  | 732.5           | 731.0      | CL    | 27 | 16                      | 11       | 0.7    | 38.6   | 33.0             | 27.7 | 0.5      |
| 09-201A    | S-3        | 2ST               | 760.51     | 29.5 | -              | 31.5  | 731.0           | 729.0      | CL    | 28 | 19                      | 9        | 2.692  | 0.0    | 29.4             | 42.9 | 27.7     |
|            |            |                   |            |      |                |       |                 |            |       |    |                         |          |        |        |                  |      | 1.5      |
| 09-202A    | S-1        |                   | 761.31     | 30.0 |                | 32.0  | 731.3           | 729.3      | CL-ML | 19 | 16                      | 3        | 2.72   | 0.0    | 35.0             | 55.2 | 9.8      |
| 09-202A    | S-3        | 2ST               | 761.31     |      |                | ##### | #####           | ML         | 20    | 17 | 3                       |          |        |        |                  |      |          |
|            |            |                   |            |      |                |       |                 |            |       |    |                         |          |        |        |                  |      |          |

TABLE 3.1\_T1 SUMMARY OF LABORATORY TESTING

| Boring No. | Sample No. | Surface Elevation | Tube Depth |      | Tube Elevation |       | USCS (computed) | Atterbergs |       |    | ASTM D422 Size Analysis |          |        |        | ASTM D1140 |      |      |      |
|------------|------------|-------------------|------------|------|----------------|-------|-----------------|------------|-------|----|-------------------------|----------|--------|--------|------------|------|------|------|
|            |            |                   | ft.        | ft.  | ft.            | ft.   |                 | LL         | PL    | PI | G <sub>s</sub>          | % Gravel | % Sand | % Silt | % Clay     |      |      |      |
| 09-203A    | S-2        | 759.36            | 26.5       | 28.5 | 732.9          | 730.9 | CL              | 25         | 16    | 9  | 2.72                    | 0.0      | 33.9   | 37.9   | 28.2       |      |      |      |
| 09-203A    | S-3        | 759.36            | 28.5       | 30.5 | 730.9          | 728.9 | CL              | 25         | 16    | 9  | 2.72                    | 0.0      | 45.7   | 29.5   | 24.8       |      |      |      |
| 09-204A    | S-1        | 2ST               | 749.55     | 14.0 | -              | 15.5  | 735.6           | 734.1      | CL    | 25 | 16                      | 9        | 0.0    | 27.8   | 49.5       | 22.7 |      |      |
| 09-204A    | S-2        | 2ST               | 749.55     | 15.5 | -              | 17.0  | 734.1           | 732.6      | CL-ML | 21 | 15                      | 6        | 0.0    | 40.4   | 39.4       | 20.2 |      |      |
| 09-204A    | S-3        | 2ST               | 749.55     | 17.0 | -              | 18.5  | 732.6           | 731.1      | CL-ML | 24 | 17                      | 7        | 0.0    | 33.4   | 43.2       | 23.4 |      |      |
| 09-204A    | S-4        | 2ST               | 749.55     | 18.5 | -              | 20.0  | 731.1           | 729.6      | CL-ML | 20 | 15                      | 5        | 0.0    | 35.8   | 43.4       | 20.8 |      |      |
| 09-204A    | S-5        | 2ST               | 749.55     | 20.0 | -              | 21.5  | 729.6           | 728.1      | CL    | 25 | 17                      | 8        | 2.708  | 1.5    | 23.5       | 47.8 | 27.2 |      |
| 09-204A    | S-6        | 2ST               | 749.55     | 21.5 | -              | 23.0  | 728.1           | 726.6      | CL-ML | 21 | 16                      | 5        | 0.0    | 35.3   | 46.7       | 18.0 |      |      |
| 09-205A    | S-1        | 2ST               | 754.33     | 13.5 | -              | 15.5  | 740.8           | 738.8      | ML    | NV | NP                      | NP       |        | 5.8    | 32.8       | 47.5 | 13.9 |      |
| 09-205A    | S-4        |                   | 754.33     |      |                |       | 754.3           | 754.3      | CL    | 28 | 17                      | 11       | 2.244  | 0.0    | 13.4       | 48.5 | 38.1 |      |
| 09-205A    | S-5        |                   | 754.33     |      |                |       | 754.3           | 754.3      | CL    | 32 | 18                      | 14       |        | 0.3    | 18.1       | 45.5 | 36.1 |      |
| 09-205A    | S-6        |                   | 754.33     |      |                |       | 754.3           | 754.3      | SM    |    |                         |          |        | 0.0    | 50.0       | 29.6 | 20.4 |      |
| 09-206A    | S-1        | 2ST               | 754.98     | 14.0 | -              | 15.5  | 741.0           | 739.5      | CL    | 29 | 16                      | 13       |        | 0.0    | 26.6       | 37.9 | 35.5 |      |
| 09-206A    | S-2        | 2ST               | 754.98     | 15.5 | -              | 17.0  | 739.5           | 738.0      | CL    | 31 | 18                      | 13       | 2.701  | 0.0    | 10.7       | 48.0 | 41.3 |      |
| 09-206A    | S-3        | 2ST               | 754.98     | 17.0 | -              | 18.5  | 738.0           | 736.5      | CL    | 32 | 18                      | 14       |        | 0.0    | 10.7       | 45.4 | 43.9 |      |
| 09-206A    | S-4        | 2ST               | 754.98     | 18.5 | -              | 20.0  | 736.5           | 735.0      | CL    | 33 | 18                      | 15       | 2.706  | 0.0    | 16.8       | 44.9 | 38.3 |      |
| 09-206A    | S-5        | 2ST               | 754.98     | 20.0 | -              | 21.5  | 735.0           | 733.5      | ML    | 20 | 19                      | 1        |        | 0.0    | 42.8       | 38.4 | 18.8 |      |
| 09-206A    | S-6        |                   | 754.98     | 21.5 | 23.0           | 733.5 | 732.0           | CL-ML      | 23    | 17 | 6                       |          |        | 0.0    | 41.1       | 35.1 | 23.8 | 58.9 |
| 09-206A    | S-7        |                   | 754.98     | 23.0 | 24.5           | 732.0 | 730.5           | CL         | 25    | 17 | 8                       |          |        | 0.0    | 40.6       | 35.9 | 23.5 | 59.4 |
| 09-207A    | S-3A       |                   | 747.31     | 17.5 | 19.5           | 729.8 | 727.8           | CL         | 30    | 17 | 13                      |          | 0.0    | 19.2   | 44.8       | 36.0 | 80.8 |      |
| 09-207A    | S-4A       |                   | 747.31     | 19.5 | 21.0           | 727.8 | 726.3           | CL         | 37    | 19 | 18                      |          | 0.0    | 12.3   | 52.1       | 35.6 | 87.7 |      |
| 09-207A    | S-5A       |                   | 747.31     | 21.0 | 22.5           | 726.3 | 724.8           | CL         | 31    | 15 | 16                      |          | 0.0    | 19.8   | 48.0       | 32.2 | 80.2 |      |
| 09-208A    | 2          |                   | 744.85     |      |                | 736.9 | 735.9           | CL         | 47    | 21 | 26                      |          | 0.0    | 5.9    | 43.5       | 50.6 |      |      |
| 09-208A    | 3          |                   | 744.85     | 10.0 | 12.0           | 734.9 | 732.9           | CL         | 29    | 18 | 11                      | 2.72     | 0.0    | 32.8   | 37.9       | 29.3 |      |      |
| 09-208A    | 4          |                   | 744.85     | 12.0 | 14.0           | 732.9 | 730.9           | CL         | 29    | 18 | 11                      | 2.72     | 0.0    | 31.2   | 38.2       | 30.6 |      |      |
| 09-209A    | S-1        | 2ST               | 746.42     | 6.0  | 8.5            | 740.4 | 737.9           |            |       |    |                         |          |        |        |            |      |      |      |
| 09-209A    | S-2        | 2ST               | 746.42     | 8.5  | 11.0           | 737.9 | 735.4           |            |       |    |                         |          |        |        |            |      |      |      |
| 09-209A    | S-2        | 2ST               | 746.42     | 8.5  | 10.5           | 737.9 | 735.9           | CL         | 38    | 19 | 19                      |          |        |        |            |      |      |      |
| 09-209A    | S-3        | 2ST               | 746.42     | 11.0 | 13.0           | 735.4 | 733.4           |            |       |    |                         |          |        |        |            |      |      |      |
| 09-209A    | S-3        | 2ST               | 746.42     | 10.5 | 12.5           | 735.9 | 733.9           | CL         | 26    | 17 | 9                       |          | 0.0    | 41.6   | 34.1       | 24.3 |      |      |
| 09-209A    | S-4        | 2ST               | 746.42     | 12.5 | 14.0           | 733.9 | 732.4           | ML         | 21    | 19 | 2                       |          |        |        |            |      |      |      |
| 09-210A    | S-1        |                   | 749.94     | 10.0 | 12.0           | 739.9 | 737.9           |            | 24    | 28 | NP                      | 2.33     | 7.6    | 20.3   | 53.3       | 18.8 |      |      |
| 09-210A    | S-2        |                   | 749.94     | 12.0 | 14.0           | 737.9 | 735.9           |            | 37    | 19 | 18                      | 2.72     | 0.0    | 17.0   | 37.1       | 45.9 |      |      |

TABLE 3.1\_T1 SUMMARY OF LABORATORY TESTING

| Boring No. | Sample No. | Surface Elevation | Tube Depth |       | Tube Elevation |       | USCS (computed) | Atterbergs |       |    | ASTM D422 Size Analysis |          |        |        | Grain ASTM D1140 |      |          |      |      |
|------------|------------|-------------------|------------|-------|----------------|-------|-----------------|------------|-------|----|-------------------------|----------|--------|--------|------------------|------|----------|------|------|
|            |            |                   | ft.        | ft.   | ft.            | ft.   |                 | LL         | PL    | PI | G <sub>s</sub>          | % Gravel | % Sand | % Silt | % Clay           | P200 | QP (tsf) |      |      |
| 09-211A    | S-1        | 2ST               | 765.43     | 24.0  | 26.0           | 741.4 | 739.4           | SM         | 16    | 17 | NP                      |          | 0.5    | 69.1   | 16.2             | 14.2 |          |      |      |
| 09-211A    | S-1A       | 2ST               | 765.43     |       |                | 765.4 | 765.4           | CL         | 27    | 15 | 12                      |          | 0.0    | 29.5   | 37.0             | 33.5 |          |      |      |
| 09-211A    | S-2        | 2ST               | 765.43     | 26.0  | 28.0           | 739.4 | 737.4           | CL         | 24    | 12 | 12                      |          |        |        |                  |      |          |      |      |
|            |            |                   |            |       |                |       |                 |            |       |    |                         |          |        |        |                  |      |          |      |      |
| 09-303A    | S-2        |                   | 817.49     | 26.0  | 28.0           | 791.5 | 789.5           | CL         | 30    | 17 | 13                      |          |        |        |                  |      |          |      |      |
| 09-303A    | S-3        | 2ST               | 817.49     | 90.5  | 92.0           | 727.0 | 725.5           | CL         | 33    | 20 | 13                      | 2.702    | 0.3    | 20.8   | 45.4             | 33.5 |          | 0.5  |      |
| 09-303A    | S-4        | 2ST               | 817.49     | 92.0  | 93.5           | 725.5 | 724.0           | CL         | 29    | 18 | 11                      | 2.764    | 0.0    | 35.5   | 32.6             | 31.9 |          | 1.25 |      |
| 09-303A    | S-5        |                   | 817.49     | 93.5  | 95.0           | 724.0 | 722.5           | CL         | 25    | 16 | 9                       |          |        |        |                  |      |          |      |      |
| 09-303A    | S-6        |                   | 817.49     | 100.0 | 100.5          | 717.5 | 717.0           | CL-ML      | 21    | 15 | 6                       |          | 0.0    | 45.1   | 34.1             | 20.8 | 54.9     |      |      |
| 09-303A    | S-7        |                   | 817.49     | 102.0 | 104.0          | 715.5 | 713.5           | SM         | 14    | 12 | 2                       |          | 0.0    | 51.6   | 31.0             | 17.4 | 48.4     |      |      |
| 09-303A    | S-8        |                   | 817.49     | 104.0 | 106.0          | 713.5 | 711.5           | SM-SC      | 17    | 13 | 4                       |          | 0.0    | 62.8   | 23.1             | 14.1 | 37.2     |      |      |
|            |            |                   |            |       |                |       |                 |            |       |    |                         |          |        |        |                  |      |          |      |      |
| 09-402A    | S-1        | 2ST               | 765.03     | 36.5  | 38.5           | 728.5 | 726.5           | CL         | 35    | 18 | 17                      |          |        |        |                  |      |          |      |      |
| 09-402A    | S-2        | 2ST               | 765.03     | 38.5  | 40.5           | 726.5 | 724.5           | CL         | 44    | 20 | 24                      |          | 0.0    | 20.7   | 24.4             | 54.9 |          |      |      |
| 09-402A    | S-3        | 2ST               | 765.03     | 40.5  | 42.5           | 724.5 | 722.5           | CL         | 41    | 24 | 17                      |          |        |        |                  |      |          |      |      |
| 09-402A    | S-4        | 2ST               | 765.03     | 42.5  | 44.5           | 722.5 | 720.5           | CL         | 33    | 17 | 16                      |          |        |        |                  |      |          |      |      |
| 09-402A    | S-5        | 2ST               | 765.03     | 44.5  | 46.5           | 720.5 | 718.5           | ML         | 18    | 15 | 3                       |          |        |        |                  |      |          |      |      |
| 09-402A    | S-6        | 2ST               | 765.03     | 46.5  | 48.5           | 718.5 | 716.5           | ML         | 19    | 16 | 3                       |          | 0.0    | 33.5   | 41.3             | 25.2 |          |      |      |
|            |            |                   |            |       |                |       |                 |            |       |    |                         |          |        |        |                  |      |          |      |      |
| 09-404A    | S-1        | 2ST               | 763.62     | 39.0  | 41.0           | 724.6 | 722.6           | CL         | 26    | 16 | 10                      |          |        |        |                  |      |          |      |      |
| 09-404A    | S-2        | 2ST               | 763.62     | 41.0  | 43.0           | 722.6 | 720.6           | ML         | 7     | 19 | NP                      |          |        |        |                  |      |          |      |      |
| 09-404A    | S-2A       | 2ST               | 763.62     | 41.0  | 43.0           | 722.6 | 720.6           | CL         | 24    | 16 | 8                       |          |        |        |                  |      |          |      |      |
| 09-404A    | S-3        | 2ST               | 763.62     | 43.0  | 45.0           | 720.6 | 718.6           | ML         | 18    | 23 | NP                      |          | 0.0    | 4.1    | 78.0             | 17.9 |          |      |      |
| 09-404A    | S-3A       | 2ST               | 763.62     | 43.0  | 45.0           | 720.6 | 718.6           | CL-ML      | 25    | 18 | 7                       |          |        |        |                  |      |          |      |      |
|            |            |                   |            |       |                |       |                 |            |       |    |                         |          |        |        |                  |      |          |      |      |
| 09-406A    | ST-1       |                   | 764.42     | 35.0  | 37.0           | 729.4 | 727.4           | CL         | 39    | 29 | 10                      |          | 0.0    | 37.8   | 23.5             | 38.7 |          | 0.5  |      |
| 09-406A    | S-2        | 2ST               | 764.42     | 36.0  | -              | 38.0  | 728.4           | 726.4      | CL    | 32 | 18                      | 14       |        | 0.0    | 34.5             | 35.1 | 30.4     |      | 0.5  |
| 09-406A    | S-3        | 2ST               | 764.42     | 38.0  | -              | 40.0  | 726.4           | 724.4      | CL-ML | 25 | 18                      | 7        | 2.706  | 0.0    | 36.1             | 36.7 | 27.2     |      | 0.25 |
| 09-406A    | S-4        | 2ST               | 764.42     | 40.0  | -              | 42.0  | 724.4           | 722.4      | SM    |    |                         |          | 1.1    | 64.8   | 22.4             | 11.7 |          |      |      |
| 09-406A    | S-4A       | 2ST               | 764.42     |       |                | 764.4 | 764.4           | SM         | 23    | 21 | 2                       |          | 0.6    | 50.7   | 30.1             | 18.6 |          | 0.5  |      |
| 09-406A    | S-5        | 2ST               | 764.42     | 42.0  | -              | 44.0  | 722.4           | 720.4      | CL    | 27 | 17                      | 10       | 2.699  | 0.0    | 18.4             | 51.0 | 30.6     |      | 0.25 |
| 09-406A    | S-6        | 2ST               | 764.42     | 44.0  | -              | 46.0  | 720.4           | 718.4      | CL    | 26 | 18                      | 8        |        | 0.0    | 26.9             | 46.9 | 26.2     |      | 0.25 |
| 09-406A    | S-7        | 2ST               | 764.42     | 46.0  | -              | 48.0  | 718.4           | 716.4      | CL-ML | 23 | 18                      | 5        | 2.718  | 0.0    | 21.4             | 52.2 | 26.4     |      | 0.25 |
| 09-406A    | S-8        | 2ST               | 764.42     | 48.0  | -              | 50.0  | 716.4           | 714.4      | ML    | 18 | 17                      | 1        |        | 0.0    | 37.5             | 43.4 | 19.1     |      | 0.25 |
|            |            |                   |            |       |                |       |                 |            |       |    |                         |          |        |        |                  |      |          |      |      |
| 09-408A    | S-9        | 2ST               | 764.35     | 4.5   | 43.0           | 759.9 | 721.4           |            |       |    |                         |          |        |        |                  |      |          |      |      |
| 09-408A    | S-1        | 2ST               | 764.35     | 15.0  | 17.5           | 749.4 | 746.9           | ML         | 13    | 26 | NP                      |          |        |        |                  |      |          |      |      |
| 09-408A    | S-2        | 2ST               | 764.35     | 17.5  | 20.0           | 746.9 | 744.4           | CL-ML      | 29    | 22 | 7                       |          | 0.0    | 47.8   | 31.3             | 20.9 | 52.2     |      |      |
| 09-408A    | S-3        | 2ST               | 764.35     | 20.0  | 22.5           | 744.4 | 741.9           |            |       |    |                         |          |        |        |                  |      |          |      |      |
| 09-408A    | S-4        | 2ST               | 764.35     | 22.5  | 25.0           | 741.9 | 739.4           | CL         | 24    | 14 | 10                      |          | 0.0    | 45.9   | 25.3             | 28.8 | 54.1     |      |      |
| 09-408A    | S-5        | 2ST               | 764.35     | 30.0  | 32.5           | 734.4 | 731.9           | ML         | 18    | 15 | 3                       |          | 0.0    | 48.7   | 29.5             | 21.8 | 51.3     |      |      |
| 09-408A    | S-6        | 2ST               | 764.35     | 33.0  | 35.5           | 731.4 | 728.9           |            |       |    |                         |          |        |        |                  |      |          |      |      |
| 09-408A    | S-7        | 2ST               | 764.35     | 35.5  | 38.0           | 728.9 | 726.4           |            |       |    |                         |          |        |        |                  |      |          |      |      |
| 09-408A    | S-1A       | 2ST               | 764.35     | 36.0  | 37.0           | 728.4 | 727.4           | OH         | 52    | 29 | 23                      |          |        |        |                  |      |          |      |      |
| 09-408A    | S-8        | 2ST               | 764.35     | 38.0  | 40.0           | 726.4 | 724.4           |            |       |    |                         |          |        |        |                  |      |          |      |      |
| 09-408A    | S-10       | 2ST               | 764.35     | 43.0  | 45.5           | 721.4 | 718.9           |            |       |    |                         |          |        |        |                  |      |          |      |      |
| 09-408A    | S-11       | 2ST               | 764.35     | 45.5  | 48.0           | 718.9 | 716.4           |            |       |    |                         |          |        |        |                  |      |          |      |      |
| 09-408A    | S-12       | 2ST               | 764.35     | 48.0  | 50.5           | 716.4 | 713.9           |            |       |    |                         |          |        |        |                  |      |          |      |      |
|            |            |                   |            |       |                |       |                 |            |       |    |                         |          |        |        |                  |      |          |      |      |

TABLE 3.1\_T1 SUMMARY OF LABORATORY TESTING

| Boring No. | Sample No. | Surface Elevation | Tube Depth |      | Tube Elevation |       | USCS (computed) | Atterbergs |    |    | ASTM D422 Size Analysis |          |        |        | ASTM D1140 |      |          |
|------------|------------|-------------------|------------|------|----------------|-------|-----------------|------------|----|----|-------------------------|----------|--------|--------|------------|------|----------|
|            |            |                   | ft.        | ft.  | ft.            | ft.   |                 | LL         | PL | PI | G <sub>s</sub>          | % Gravel | % Sand | % Silt | % Clay     | P200 | QP (tsf) |
| 09-410A    | S-1        | 762.08            | 14.0       | 16.0 | 748.1          | 746.1 | CH              | 57         | 20 | 37 |                         |          |        |        |            |      |          |
| 09-410A    | S-2A       | 762.08            | 18.5       | 19.5 | 743.6          | 742.6 | CL              | 43         | 17 | 26 |                         |          |        |        |            |      |          |
| 09-410A    | S-4        | 762.08            | 22.5       | 24.5 | 739.6          | 737.6 | CL-ML           | 22         | 18 | 4  |                         | 7.8      | 35.3   | 37.8   | 19.1       | 56.9 |          |
| 09-410A    | S-6        | 762.08            | 32.0       | 34.0 | 730.1          | 728.1 | CL              | 33         | 17 | 16 |                         | 0.0      | 36.2   | 31.4   | 32.4       |      |          |
|            |            |                   |            |      |                |       |                 |            |    |    |                         |          |        |        |            |      |          |
| 09-413A    | S-1        | 2ST               | 764.49     | 6.0  | 8.0            | 758.5 | 756.5           | CL         | 40 | 18 | 22                      | 2.709    | 30.0   | 25.7   | 15.4       | 28.9 |          |
| 09-413A    | S-2        | 2ST               | 764.49     | 8.0  | 10.0           | 756.5 | 754.5           | CL         | 48 | 19 | 29                      |          | 1.0    | 24.6   | 18.4       | 56.0 |          |
| 09-413A    | S-3        | 2ST               | 764.49     | 10.0 | 12.0           | 754.5 | 752.5           | CL         | 44 | 20 | 24                      | 2.723    | 17.5   | 25.0   | 17.7       | 39.8 |          |
| 09-413A    | S-4        | 2ST               | 764.49     | 12.0 | 14.0           | 752.5 | 750.5           | CL         | 49 | 22 | 27                      |          | 2.9    | 24.5   | 21.9       | 50.7 |          |
| 09-413A    | S-5        | 2ST               | 764.49     | 14.0 | 16.0           | 750.5 | 748.5           | CL         | 43 | 21 | 22                      | 2.729    | 1.5    | 26.5   | 24.2       | 47.8 |          |
| 09-413A    | S-6        | 2ST               | 764.49     | 27.5 | 29.5           | 737.0 | 735.0           | ML         | 21 | 27 | NP                      |          | 0.6    | 49.0   | 35.6       | 14.8 |          |
| 09-413A    | S-7        |                   | 764.49     | 31.5 | 33.5           | 733.0 | 731.0           | ML         | 15 | 15 | NP                      |          | 1.5    | 38.5   | 42.9       | 17.1 | 60       |
| 09-413A    | S-8        |                   | 764.49     | 33.5 | 35.5           | 731.0 | 729.0           | ML         |    |    |                         |          | 4.9    | 37.0   | 40.6       | 17.5 |          |
|            |            |                   |            |      |                |       |                 |            |    |    |                         |          |        |        |            |      |          |
| 09-500A    | S-1        | 2ST               | 757.01     | 30.0 | 32.0           | 727.0 | 725.0           | CL         | 34 | 20 | 14                      |          |        |        |            |      |          |
| 09-500A    | S-1A       | 2ST               | 757.01     | 30.0 | 32.0           | 727.0 | 725.0           | ML         | 19 | 16 | 3                       |          |        |        |            |      |          |
| 09-500A    | S-2        | 2ST               | 757.01     | 32.0 | 34.0           | 725.0 | 723.0           | CL         | 23 | 15 | 8                       |          | 1.2    | 26.2   | 47.0       | 25.6 |          |
| 09-500A    | S-3        | 2ST               | 757.01     | 34.0 | 36.0           | 723.0 | 721.0           | CL         | 28 | 14 | 14                      |          |        |        |            |      |          |
|            |            |                   |            |      |                |       |                 |            |    |    |                         |          |        |        |            |      |          |
| 09-502A    | S-1        | 2ST               | 753.16     | 5.0  | 7.5            | 748.2 | 745.7           | CL         | 30 | 16 | 14                      |          | 0.0    | 32.6   | 34.9       | 32.5 | 67.4     |
| 09-502A    | S-2        | 2ST               | 753.16     | 10.0 | 12.5           | 743.2 | 740.7           | ML         |    |    |                         |          | 0.0    | 54.6   | 24.4       | 21.0 |          |
|            |            |                   |            |      |                |       |                 |            |    |    |                         |          |        |        |            |      |          |
| 09-503A    | S-1        | 2ST               | 768.25     | 23.0 | 25.5           | 745.3 | 742.8           | CL-ML      | 27 | 21 | 6                       |          |        |        |            |      |          |
| 09-503A    | S-2        | 2ST               | 768.25     | 31.0 | 33.5           | 737.3 | 734.8           | CL-ML      | 21 | 16 | 5                       |          | 0.0    | 19.4   | 60.5       | 20.1 |          |
| 09-503A    | S-2A       | 2ST               | 768.25     | 37.5 | 39.5           | 730.8 | 728.8           | CL         | 32 | 16 | 16                      |          |        |        |            |      |          |
| 09-503A    | S-3        | 2ST               | 768.25     | 35.5 | 38.0           | 732.8 | 730.3           | CL         | 30 | 16 | 14                      |          |        |        |            |      |          |
| 09-503A    | S-4        | 2ST               | 768.25     | 38.0 | 4.5            | 730.3 | 763.8           | CL-ML      | 23 | 16 | 7                       |          |        |        |            |      |          |
|            |            |                   |            |      |                |       |                 |            |    |    |                         |          |        |        |            |      |          |
| 09-600A    | S-2        | 2ST               | 777.3      | 47.5 | 49.5           | 729.8 | 727.8           | CL         | 31 | 18 | 13                      |          | 0.0    | 38.2   | 32.0       | 29.8 |          |
| 09-600A    | S-3        | 2ST               | 777.3      | 49.5 | 50.5           | 727.8 | 726.8           | CL         | 28 | 19 | 9                       |          |        |        |            |      |          |
|            |            |                   |            |      |                |       |                 |            |    |    |                         |          |        |        |            |      |          |
| 09-601A    | S-1        | 2ST               | 775.08     | 40.0 | 42.0           | 735.1 | 733.1           | CL         | 23 | 14 | 9                       |          |        |        |            |      |          |
| 09-601A    | S-2        | 2ST               | 775.08     | 42.0 | 44.0           | 733.1 | 731.1           | CL         | 27 | 16 | 11                      |          | 0.0    | 46.2   | 26.1       | 27.7 |          |
| 09-601A    | S-3        | 2ST               | 775.08     | 44.0 | 46.0           | 731.1 | 729.1           | CL-ML      | 17 | 11 | 6                       |          |        |        |            |      |          |
| 09-601A    | S-4        | 2ST               | 775.08     | 46.0 | 48.0           | 729.1 | 727.1           | ML         | 13 | 11 | 2                       |          |        |        |            |      |          |
|            |            |                   |            |      |                |       |                 |            |    |    |                         |          |        |        |            |      |          |
| 09-602A    | S-1        |                   | 781.1      | 55.0 | 57.0           | 726.1 | 724.1           | CL         | 26 | 18 | 8                       |          |        |        |            |      |          |
| 09-602A    | S-2        |                   | 781.1      | 61.5 | 63.0           | 719.6 | 718.1           | CL-ML      | 22 | 16 | 6                       |          |        |        |            |      |          |
| 09-602A    | S-3        | 2ST               | 781.1      | 63.0 | 63.5           | 718.1 | 717.6           | CL-ML      | 16 | 11 | 5                       |          | 0.0    | 48.5   | 35.1       | 16.4 |          |
|            |            |                   |            |      |                |       |                 |            |    |    |                         |          |        |        |            |      |          |
| 09-604A    | S-1        | 2ST               | 782.39     | 64.0 | 66.0           | 718.4 | 716.4           | CL         | 35 | 18 | 17                      |          |        |        |            |      |          |
| 09-604A    | S-2        | 2ST               | 782.39     | 66.0 | 68.0           | 716.4 | 714.4           | CL         | 28 | 16 | 12                      |          | 0.0    | 26.4   | 41.5       | 32.1 |          |
| 09-604A    | S-3        |                   | 782.39     |      |                | 782.4 | 782.4           | SM         |    |    |                         |          | 0.0    | 53.0   | 28.6       | 18.4 |          |
| 09-604A    | S-4        | 2ST               | 782.39     | 72.0 | 74.0           | 710.4 | 708.4           | CL-ML      | 19 | 15 | 4                       |          |        |        |            |      |          |
|            |            |                   |            |      |                |       |                 |            |    |    |                         |          |        |        |            |      |          |
| 09-605A    | ST-1       | 2ST               | 781.81     | 49.5 | 51.5           | 732.3 | 730.3           | CL         | 23 | 13 | 10                      |          |        |        |            |      |          |
| 09-605A    | ST-2       | 2ST               | 781.81     | 51.5 | 53.5           | 730.3 | 728.3           | CL-ML      | 24 | 17 | 7                       |          |        |        |            |      |          |
| 09-605A    | ST-3       | 2ST               | 781.81     | 53.5 | 55.5           | 728.3 | 726.3           | CL         | 38 | 23 | 15                      |          |        |        |            |      |          |
| 09-605A    | ST-4       |                   | 781.81     | 55.5 | 57.0           | 726.3 | 724.8           | CL         | 37 | 20 | 17                      |          | 0.0    | 41.2   | 25.6       | 33.2 | 58.8     |

TABLE 3.1\_T1 SUMMARY OF LABORATORY TESTING

| Boring No. | Sample No. | Surface Elevation | Tube Depth |      | Tube Elevation |       | USCS (computed) | Atterbergs |    |    | ASTM D422 Size Analysis |          |        |        | Grain ASTM D1140 |      |          |
|------------|------------|-------------------|------------|------|----------------|-------|-----------------|------------|----|----|-------------------------|----------|--------|--------|------------------|------|----------|
|            |            |                   | ft.        | ft.  | ft.            | ft.   |                 | LL         | PL | PI | G <sub>s</sub>          | % Gravel | % Sand | % Silt | % Clay           | P200 | QP (tsf) |
| 09-700A    | S-1        | 764.48            | 23.0       | 25.0 | 741.5          | 739.5 | ML              | 21         | 25 | NP |                         |          |        |        |                  |      |          |
| 09-700A    | S-2        | 764.48            | 25.0       | 27.0 | 739.5          | 737.5 | CL              | 25         | 15 | 10 |                         |          |        |        |                  |      |          |
| 09-700A    | ST-3       | 2ST               | 764.48     | 27.0 | 29.0           | 737.5 | 735.5           | CL         | 31 | 16 | 15                      | 0.0      | 29.9   | 37.1   | 33.0             |      |          |
| 09-700A    | ST-4       |                   | 764.48     | 29.0 | 31.0           | 735.5 | 733.5           | SM         | 18 | 17 | 1                       | 0.0      | 54.3   | 26.0   | 19.7             |      |          |
| 09-700A    | ST-5       |                   | 764.48     | 31.0 | 33.0           | 733.5 | 731.5           | SM         | NV | NP | NP                      | 0.0      | 57.0   | 22.3   | 20.7             |      |          |
|            |            |                   |            |      |                |       |                 |            |    |    |                         |          |        |        |                  |      |          |
| 09-708A1   | S-1        | 763.71            |            |      | 735.7          | 735.2 | ML              | 18         | 24 | NP |                         |          |        |        |                  |      |          |
| 09-708A1   | S-2        | 763.71            | 30.0       | 32.0 | 733.7          | 731.7 | CL              | 21         | 13 | 8  | 0.0                     | 38.1     | 41.0   | 20.9   |                  |      |          |
| 09-708A1   | S-3        | 763.71            | 32.0       | 34.0 | 731.7          | 729.7 | ML              | 16         | 13 | 3  | 0.0                     | 44.6     | 34.8   | 20.6   |                  |      |          |
| 09-708A1   | S-4        | 763.71            | 34.0       | 36.0 | 729.7          | 727.7 | CL              | 31         | 17 | 14 |                         |          |        |        |                  |      |          |
|            |            |                   |            |      |                |       |                 |            |    |    |                         |          |        |        |                  |      |          |
| 09-712A1   | S-2        | 763.77            | 45.8       | 46.0 | 718.0          | 717.8 | ML              | 22         | 19 | 3  |                         |          |        |        |                  |      |          |
| 09-712A1   | S-3        | 763.77            | 44.5       | 46.0 | 719.3          | 717.8 | SM              | 16         | 15 | 1  | 0.0                     | 55.9     | 29.8   | 14.3   |                  |      |          |
| 09-712A1   | S-4        | 763.77            | 46.0       | 47.5 | 717.8          | 716.3 | ML              | 20         | 18 | 2  |                         |          |        |        |                  |      |          |
|            |            |                   |            |      |                |       |                 |            |    |    |                         |          |        |        |                  |      |          |
| 09-712A2   | S-1        | 763.67            | 42.0       | 44.0 | 721.7          | 719.7 | CL-ML           | 23         | 17 | 6  |                         |          |        |        |                  |      |          |
| 09-712A2   | S-2        | 763.67            | 44.0       | 46.0 | 719.7          | 717.7 | CL              | 25         | 15 | 10 | 0.0                     | 45.5     | 30.7   | 23.8   |                  |      |          |
| 09-712A2   | S-3        | 2ST               | 763.67     | 46.0 | 47.0           | 717.7 | 716.7           | CL         | 25 | 15 | 8                       | 0.0      | 47.1   | 32.4   | 20.5             |      |          |
|            |            |                   |            |      |                |       |                 |            |    |    |                         |          |        |        |                  |      |          |
| 09-800A    | ST-1       | 762.9             | 29.0       | 30.5 | 733.9          | 732.4 | CL-ML           | 23         | 18 | 5  |                         |          |        |        |                  |      |          |
| 09-800A    | ST-2       | 2ST               | 762.9      | 30.5 | 32.0           | 732.4 | 730.9           | SM-SC      | 21 | 17 | 4                       | 0.0      | 50.8   | 30.7   | 18.5             |      |          |
| 09-800A    | ST-3       |                   | 762.9      | 33.5 | 35.5           | 729.4 | 727.4           | SM         | 18 | 17 | 1                       | 0.0      | 51.7   | 27.2   | 21.1             | 48.3 |          |
|            |            |                   |            |      |                |       |                 |            |    |    |                         |          |        |        |                  |      |          |
| 09-801A    | ST-1       | 765.13            | 37.5       | 39.5 | 727.6          | 725.6 | CL              | 27         | 19 | 8  |                         |          |        |        |                  |      |          |
| 09-801A    | ST-2       | 2ST               | 765.13     | 39.5 | 41.5           | 725.6 | 723.6           | CL-ML      | 20 | 15 | 5                       | 1.4      | 27.2   | 50.3   | 21.1             |      |          |
| 09-801A    | ST-3       |                   | 765.13     | 41.5 | 43.5           | 723.6 | 721.6           | CL         | 26 | 18 | 8                       |          |        |        |                  |      |          |
| 09-801A    | ST-4       |                   | 765.13     | 43.5 | 45.5           | 721.6 | 719.6           | CL         | 35 | 20 | 15                      |          |        |        |                  |      |          |
| 09-801A    | ST-5       |                   | 765.13     | 45.5 | 47.5           | 719.6 | 717.6           | CL         | 29 | 21 | 8                       |          |        |        |                  |      |          |
| 09-801A    | ST-6       | 2ST               | 765.13     | 47.5 | 49.5           | 717.6 | 715.6           | CL         | 26 | 17 | 9                       | 0.0      | 47.3   | 32.8   | 19.9             |      |          |
| 09-801A    | ST-6A      | 2ST               | 765.13     | 47.5 | 49.5           | 717.6 | 715.6           | CL         | 24 | 16 | 8                       | 0.0      | 42.1   | 37.4   | 20.5             |      |          |
| 09-801A    | ST-7       |                   | 765.13     | 49.5 | 51.5           | 715.6 | 713.6           | CL         | 25 | 16 | 9                       | 0.0      | 44.1   | 33.2   | 22.7             | 55.9 |          |
| 09-801A    | ST-8       |                   | 765.13     | 51.5 | 53.5           | 713.6 | 711.6           | CL         | 23 | 15 | 8                       | 0.0      | 42.8   | 35.6   | 21.6             | 57.2 |          |
| 09-801A    | ST-9       |                   | 765.13     | 53.5 | 55.5           | 711.6 | 709.6           | SM         | 16 | 13 | 3                       | 1.2      | 58.5   | 23.2   | 17.1             | 40.3 |          |
|            |            |                   |            |      |                |       |                 |            |    |    |                         | 0.0      | 54.6   | 24.4   | 21.0             |      |          |
| 09-902A    | S-2        |                   | 766.27     | 24.0 | 26.0           | 742.3 | 740.3           |            |    |    |                         |          |        |        |                  |      |          |

TABLE 3.1\_T1 SUMMARY OF LABORATORY TESTING

| Boring No. | Sample No. | Sample Type | Surface Elevation | Tube Depth |     | Tube Elevation |       | USCS (computed) | Atterbergs |       |    | G <sub>s</sub> | ASTM D422 Size Analysis |        |        |        | Grain | ASTM D1140                 | Consolidation    |                |                 |                |                      |      | Triaxial |                       |          |     |                      | Direct Shear           |                            |                  |                      |          |        |      |      |      |
|------------|------------|-------------|-------------------|------------|-----|----------------|-------|-----------------|------------|-------|----|----------------|-------------------------|--------|--------|--------|-------|----------------------------|------------------|----------------|-----------------|----------------|----------------------|------|----------|-----------------------|----------|-----|----------------------|------------------------|----------------------------|------------------|----------------------|----------|--------|------|------|------|
|            |            |             | ft.               | ft.        | ft. | ft.            | ft.   |                 | LL         | PL    | PI |                | % Gravel                | % Sand | % Silt | % Clay | P200  | Density (yd <sub>3</sub> ) | W/C <sub>0</sub> | C <sub>c</sub> | C <sub>cr</sub> | e <sub>0</sub> | P <sub>c</sub> (tsf) | W/C  | Test     | S <sub>3'</sub> (tsf) | c' (tsf) | ϕ'  | S <sub>u</sub> (tsf) | ε <sub>1</sub> at Peak | Density (yd <sub>3</sub> ) | W/C <sub>0</sub> | S <sub>n</sub> (tsf) | c' (tsf) | ϕ'     |      |      |      |
| 09-100B    | 1-TIP      | OST         | 767.02            | 15.0       | -   | 17.5           | 752.0 | -               | 749.5      |       |    |                |                         |        |        |        |       | 71.8                       |                  |                |                 |                |                      |      |          |                       |          |     |                      |                        |                            |                  |                      |          |        |      |      |      |
| 09-100B    | 2-TIP      | OST         | 767.02            | 20.0       | -   | 22.5           | 747.0 | -               | 744.5      |       |    |                |                         |        |        |        |       | 96.9                       |                  |                |                 |                |                      |      |          |                       |          |     |                      |                        |                            |                  |                      |          |        |      |      |      |
| 09-100B    | 3-TIP      | OST         | 767.02            | 25.0       | -   | 27.5           | 742.0 | -               | 739.5      |       |    |                |                         |        |        |        |       | 86.0                       |                  |                |                 |                |                      |      |          |                       |          |     |                      |                        |                            |                  |                      |          |        |      |      |      |
| 09-100B    | 4-TIP      | OST         | 767.02            | 30.5       | -   | 33.0           | 736.5 | -               | 734.0      |       |    |                |                         |        |        |        |       | 88.8                       |                  |                |                 |                |                      |      |          |                       |          |     |                      |                        |                            |                  |                      |          |        |      |      |      |
| 09-100B    | 5-TIP      | OST         | 767.02            | 33.0       | -   | 35.5           | 734.0 | -               | 731.5      |       |    |                |                         |        |        |        |       | 97.1                       |                  |                |                 |                |                      |      |          |                       |          |     |                      |                        |                            |                  |                      |          |        |      |      |      |
| 09-100B    | 6-TIP      | OST         | 767.02            | 35.5       | -   | 38.0           | 731.5 | -               | 729.0      |       |    |                |                         |        |        |        |       | 65.6                       |                  |                |                 |                |                      |      |          |                       |          |     |                      |                        |                            |                  |                      |          |        |      |      |      |
| 09-101B    | S-1        | OST         | 766.86            | 10.0       | -   | 12.5           | 756.9 | -               | 754.4      |       |    |                |                         |        |        |        |       |                            |                  |                |                 |                |                      |      |          |                       |          |     |                      |                        |                            |                  |                      |          |        |      |      |      |
| 09-101B    | S-2        | OST         | 766.86            | 15.0       | -   | 17.5           | 751.9 | -               | 749.4      |       |    |                |                         |        |        |        |       |                            |                  |                |                 |                |                      |      |          |                       |          |     |                      |                        |                            |                  |                      |          |        |      |      |      |
| 09-101B    | S-3        | OST         | 766.86            | 20.0       | -   | 22.5           | 746.9 | -               | 744.4      |       |    |                |                         |        |        |        |       |                            |                  |                |                 |                |                      |      |          |                       |          |     |                      |                        |                            |                  |                      |          |        |      |      |      |
| 09-101B    | S-4        | OST         | 766.86            | 35.5       | -   | 38.0           | 731.4 | -               | 728.9      |       |    |                |                         |        |        |        |       |                            |                  |                |                 |                |                      |      |          |                       |          |     |                      |                        |                            |                  |                      |          |        |      |      |      |
| 09-101B    | S-5        | OST         | 766.86            | 38.0       | -   | 40.5           | 728.9 | -               | 726.4      |       |    |                |                         |        |        |        |       |                            |                  |                |                 |                |                      |      |          |                       |          |     |                      |                        |                            |                  |                      |          |        |      |      |      |
| 09-101B    | S-6        | OST         | 766.86            | 46.0       | -   | 48.5           | 720.9 | -               | 718.4      |       |    |                |                         |        |        |        |       |                            |                  |                |                 |                |                      |      |          |                       |          |     |                      |                        |                            |                  |                      |          |        |      |      |      |
| 09-102B    | S-1        | OST         | 761.42            | 20.0       | -   | 22.5           | 741.4 | -               | 738.9      |       |    |                |                         |        |        |        |       |                            |                  |                |                 |                |                      |      |          |                       |          |     |                      |                        |                            |                  |                      |          |        |      |      |      |
| 09-102B    | S-2        | OST         | 761.42            | 29.5       | -   | 32.0           | 731.9 | -               | 729.4      |       |    |                |                         | 2.31   |        |        |       |                            |                  |                |                 |                |                      |      |          |                       |          |     |                      |                        |                            | 85.102           | 30.21                | 0.8644   | 0      | 27.6 |      |      |
| 09-102B    | S-2        | OST         | 761.42            | 29.5       | -   | 32.0           | 731.9 | -               | 729.4      | CL    | 30 | 21             | 9                       | 2.64   |        |        |       |                            | 61.439           | 27.62          | 0.170           | 0.007          | 0.72                 | 2.50 |          |                       |          |     |                      |                        |                            |                  |                      | 66.54    | 50.79  | 0.9  | 0    | 34.9 |
| 09-102B    | S-2        | OST         | 761.42            | 29.5       | -   | 32.0           | 731.9 | -               | 729.4      |       |    |                |                         |        |        |        |       |                            |                  |                |                 |                |                      |      |          |                       |          |     |                      |                        |                            |                  | 85.374               | 30.39    | 0.8043 | 0    | 35.4 |      |
| 09-102B    | S-2        | OST         | 761.42            | 29.5       | -   | 32.0           | 731.9 | -               | 729.4      |       |    |                |                         |        |        |        |       |                            |                  |                |                 |                |                      |      |          |                       |          |     |                      |                        |                            |                  | 77.54                | 30.89    | 0.9    | 0    | 23.4 |      |
| 09-102B    | S-3        | OST         | 761.42            | 32.0       | -   | 34.5           | 729.4 | -               | 726.9      |       |    |                |                         |        |        |        |       |                            |                  |                |                 |                |                      |      |          |                       |          |     |                      |                        |                            |                  |                      |          |        |      |      |      |
| 09-102B    | S-4        | OST         | 761.42            | 43.7       | -   | 46.2           | 717.7 | -               | 715.2      | CL    | 27 | 17             | 10                      | 2.70   |        |        |       |                            | 99.98            | 22.42          | 0.187           | 0.017          | 0.68                 | 2.20 | 24.70    | CIU                   | 0.540    | 0.0 | 29.5                 | 0.90                   | 27.9                       |                  |                      |          |        |      |      |      |
| 09-103B    | S-1        | OST         | 766.37            | 20.0       | -   | 22.5           | 746.4 | -               | 743.9      |       |    |                |                         |        |        |        |       |                            | 71.4             |                |                 |                |                      |      |          |                       |          |     |                      |                        |                            |                  |                      |          |        |      |      |      |
| 09-103B    | S-2        | OST         | 766.37            | 32.5       | -   | 36.0           | 733.9 | -               | 730.4      | ML    |    |                |                         |        | 0      | 43.3   | 40.2  | 16.5                       | 59.5             |                |                 |                |                      |      |          |                       |          |     |                      |                        |                            |                  |                      |          |        |      |      |      |
| 09-103B    | S-3        | OST         | 766.37            | 36.0       | -   | 38.5           | 730.4 | -               | 727.9      |       |    |                |                         |        |        |        |       | 78.6                       |                  |                |                 |                |                      |      |          |                       |          |     |                      |                        |                            |                  |                      |          |        |      |      |      |
| 09-103B    | S-4        | OST         | 766.37            | 39.5       | -   | 40.0           | 726.9 | -               | 726.4      | CL-ML | 23 | 17             | 6                       | 2.72   |        |        |       |                            | 98.771           | 24.91          | 0.213           | 0.023          | 0.72                 | 2.70 | 21.90    | CIU                   | 0.480    | 0.0 | 12.1                 | 0.14                   | 26.1                       |                  |                      |          |        |      |      |      |
| 09-103B    | S-5        | OST         | 766.37            | 41.0       | -   | 43.0           | 725.4 | -               | 723.4      | CL-ML | 29 | 22             | 7                       | 2.72   |        |        |       |                            | 99.691           | 24.03          | 0.166           | 0.023          | 0.70                 | 2.95 | 23.40    | CIU                   | 0.500    | 0.0 | 33.5                 | 0.96                   | 26.2                       |                  |                      |          |        |      |      |      |
| 09-104B    | S-1        | OST         | 761.29            | 10.0       | -   | 12.5           | 751.3 | -               | 748.8      |       |    |                |                         |        |        |        |       |                            |                  |                |                 |                |                      |      |          |                       |          |     |                      |                        |                            |                  |                      |          |        |      |      |      |
| 09-104B    | S-3        | OST         | 761.29            | 23.0       | -   | 22.5           | 738.3 | -               | 738.8      |       |    |                |                         |        |        |        |       |                            |                  |                |                 |                |                      |      |          |                       |          |     |                      |                        |                            |                  |                      |          |        |      |      |      |
| 09-104B    | S-4        | OST         | 761.29            | 22.5       | -   | 25.5           | 738.8 | -               | 735.8      |       |    |                |                         |        |        |        |       |                            |                  |                |                 |                |                      |      |          |                       |          |     |                      |                        |                            |                  |                      |          |        |      |      |      |
| 09-104B    | S-5        | OST         | 761.29            | 25.0       | -   | 27.5           | 736.3 | -               | 733.8      | CL    | 29 | 18             | 11                      | 2.69   |        |        |       |                            | 84.46            | 34.25          | 0.335           | 0.015          | 0.99                 | 3.40 |          |                       |          |     |                      |                        |                            |                  |                      |          |        |      |      |      |
| 09-104B    | S-5B       | OST         | 761.29            | 25.0       | -   | 27.5           | 736.3 | -               | 733.8      |       |    |                |                         |        |        |        |       |                            |                  |                |                 |                |                      |      |          |                       |          |     |                      |                        |                            |                  |                      |          |        |      |      |      |
| 09-104B    | S-6        | OST         | 761.29            | 27.5       | -   | 30.0           | 733.8 | -               | 731.3      | CL    | 29 | 19</           |                         |        |        |        |       |                            |                  |                |                 |                |                      |      |          |                       |          |     |                      |                        |                            |                  |                      |          |        |      |      |      |

TABLE 3.1\_T1 SUMMARY OF LABORATORY TESTING

| Boring No. | Sample No. | Sample Type | Surface Elevation | Tube Depth |      | Tube Elevation |       | USCS (computed) | Atterbergs |       |    | G <sub>s</sub> | ASTM D422 Size Analysis |        |        |        | Grain | ASTM D1140 | Consolidation              |                  |                |                 |                | Triaxial             |      |       |                       |          | Direct Shear |                      |                        |                            |                  |                      |          |    |      |
|------------|------------|-------------|-------------------|------------|------|----------------|-------|-----------------|------------|-------|----|----------------|-------------------------|--------|--------|--------|-------|------------|----------------------------|------------------|----------------|-----------------|----------------|----------------------|------|-------|-----------------------|----------|--------------|----------------------|------------------------|----------------------------|------------------|----------------------|----------|----|------|
|            |            |             | ft.               | ft.        | ft.  | ft.            | ft.   |                 | LL         | PL    | PI |                | % Gravel                | % Sand | % Silt | % Clay |       | P200       | Density (yd <sub>3</sub> ) | W/C <sub>0</sub> | C <sub>c</sub> | C <sub>cr</sub> | e <sub>0</sub> | P <sub>c</sub> (tsf) | W/C  | Test  | S <sub>3'</sub> (tsf) | c' (tsf) | ϕ'           | S <sub>u</sub> (tsf) | ε <sub>1</sub> at Peak | Density (yd <sub>3</sub> ) | W/C <sub>0</sub> | S <sub>n</sub> (tsf) | c' (tsf) | ϕ' |      |
| 09-201B    | S-1        | OST         | 760.65            | 16.0       | 18.5 | 744.7          | -     | 742.2           | ML         |       |    |                | 0                       | 20.4   | 74.5   | 5.1    |       | 46.6       |                            |                  |                |                 |                |                      |      |       |                       |          |              |                      |                        |                            |                  |                      |          |    |      |
| 09-201B    | S-1        | OST         | 760.65            | 16.0       | -    | 18.5           | 744.7 | -               | 742.2      |       |    |                |                         |        |        |        |       |            | 97.233                     | 26.07            | 0.187          | 0.014           | 0.75           | 1.10                 |      |       |                       |          |              |                      |                        |                            |                  |                      |          |    |      |
| 09-201B    | S-2        | OST         | 760.65            | 25.5       | -    | 28.0           | 735.2 | -               | 732.7      |       |    |                |                         |        |        |        |       |            |                            |                  |                |                 |                |                      |      |       |                       |          |              |                      |                        |                            |                  |                      |          |    |      |
| 09-201B    | S-3        | OST         | 760.65            | 28.0       | -    | 30.5           | 732.7 | -               | 730.2      | CL    | 28 | 18             | 10                      | 2.72   |        |        |       |            | 74.3                       | 97.233           |                | 0.187           | 0.014          | 0.75                 | 2.75 | 25.10 | CIU                   | 0.380    | 0.0          | 28.5                 | 0.59                   | 23.9                       |                  |                      |          |    |      |
| 09-202B    | S-1        | OST         | 761.26            | 26.0       | -    | 28.5           | 735.3 | -               | 732.8      | ML    |    |                |                         | 0      | 1.5    | 75.8   | 22.7  |            |                            |                  |                |                 |                |                      |      |       |                       |          |              |                      |                        |                            |                  |                      |          |    |      |
| 09-202B    | S-2        | OST         | 761.26            | 28.5       | -    | 31.0           | 732.8 | -               | 730.3      |       |    |                |                         |        |        |        |       |            | 97.3                       |                  |                |                 |                |                      |      |       |                       |          |              |                      |                        |                            |                  |                      |          |    |      |
| 09-202B    | S-2        | OST         | 761.26            | 29.5       | -    | 31.0           | 731.8 | -               | 730.3      |       |    |                |                         |        |        |        |       |            |                            |                  |                |                 |                |                      |      |       |                       |          |              |                      |                        |                            |                  |                      |          |    |      |
| 09-202B    | S-3        | OST         | 761.26            | 31.0       | -    | 33.5           | 730.3 | -               | 727.8      | CL-ML | 19 | 14             | 5                       | 2.72   |        |        |       |            |                            | 109.83           | 18.69          | 0.118           | 0.013          | 0.55                 | 3.60 | 18.80 | CIU                   | 0.380    | 0.0          | 38.0                 | 1.34                   | 24.9                       |                  |                      |          |    |      |
| 09-203B    | S-1        | OST         | 759.13            | 18.5       | -    | 21.0           | 740.6 | -               | 738.1      | ML    |    |                |                         | 0      | 36.1   | 59.7   | 4.2   |            |                            | 97.6             |                |                 |                |                      |      |       |                       |          |              |                      |                        |                            |                  |                      |          |    |      |
| 09-203B    | S-3        | OST         | 759.13            | 23.5       | -    | 26.0           | 735.6 | -               | 733.1      |       |    |                |                         |        |        |        |       |            |                            |                  |                |                 |                |                      |      |       |                       |          |              |                      |                        |                            |                  |                      |          |    |      |
| 09-203B    | S-3        | OST         | 759.13            | 23.5       | -    | 26.0           | 735.6 | -               | 733.1      |       | 21 | 18             | 3                       |        |        |        |       |            |                            |                  |                |                 |                |                      |      |       |                       |          |              |                      |                        |                            |                  |                      |          |    |      |
| 09-203B    | S-4        | OST         | 759.13            | 26.0       | -    | 28.5           | 733.1 | -               | 730.6      | CL    |    |                |                         |        |        |        |       |            |                            |                  |                |                 |                |                      |      |       |                       |          |              |                      |                        |                            |                  |                      |          |    |      |
| 09-203B    | S-5        | OST         | 759.13            | 28.5       | -    | 31.0           | 730.6 | -               | 728.1      | CL    | 25 | 19             | 6                       | 2.71   |        |        |       |            |                            | 114.18           | 18.39          | 0.133           | 0.020          | 0.48                 | 3.50 | 15.50 | CIU                   | 0.350    | 0.0          | 42.1                 | 2.29                   | 20.7                       | 95.05            | 18.25                | 12.002   | 0  | 27.4 |
| 09-203B    | S-6        | OST         | 759.13            | 31.0       | -    | 33.5           | 728.1 | -               | 725.6      | CL    | 26 | 16             | 10                      | 2.68   |        |        |       |            |                            | 112.42           | 18.68          | 0.156           | 0.020          | 0.49                 | 4.20 | 18.40 | CIU                   | 0.390    | 0.0          | 36.3                 | 1.87                   | 13.9                       |                  |                      |          |    |      |
| 09-203B2   | S-1        | OST         | 759.14            | 21.0       | -    | 23.5           | 738.1 | -               | 735.6      |       |    |                |                         |        |        |        |       |            | 95.8                       |                  |                |                 |                |                      |      |       |                       |          |              |                      |                        |                            |                  |                      |          |    |      |
| 09-203B2   | S-1        | OST         | 759.14            | 21.0       | -    | 23.5           | 738.1 | -               | 735.6      | ML    |    |                |                         | 0      | 11.3   | 75.8   | 12.9  |            |                            | 90.6             |                |                 |                |                      |      |       |                       |          |              |                      |                        |                            |                  |                      |          |    |      |
| 09-203B2   | S-2        | OST         | 759.14            | 23.5       | -    | 26.0           | 735.6 | -               | 733.1      |       |    |                |                         |        |        |        |       |            |                            |                  |                |                 |                |                      |      |       |                       |          |              |                      |                        |                            |                  |                      |          |    |      |
| 09-203B2   | S-2        | OST         | 759.14            | 23.5       | -    | 26.0           | 735.6 | -               | 733.1      |       |    |                |                         |        |        |        |       |            |                            |                  |                |                 |                |                      |      |       |                       |          |              |                      |                        |                            |                  |                      |          |    |      |
| 09-203B2   | S-3        | OST         | 759.14            | 26.0       | -    | 28.5           | 733.1 | -               | 730.6      | CL-ML | 19 | 15             | 4                       | 2.72   |        |        |       |            |                            | 113.81           | 17.74          | 0.113           | 0.011          | 0.49                 | 2.65 | 17.40 | CIU                   | 0.640    | 0.0          | 36.5                 | 2.05                   | 20.5                       |                  |                      |          |    |      |
| 09-204B    | S-1        | OST         | 750.03            | 6.0        | -    | 8.5            | 744.0 | -               | 741.5      | ML    |    |                |                         | 0      | 1.0    | 85.6   | 13.4  |            |                            |                  |                |                 |                |                      |      |       |                       |          |              |                      |                        |                            |                  |                      |          |    |      |
| 09-204B    | S-2        | OST         | 750.03            | 8.5        | -    | 11.0           | 741.5 | -               | 739.0      |       |    |                |                         |        |        |        |       |            |                            | 20.65            | 0.178          | 0.023           | 0.57           | 2.65                 |      |       |                       |          |              |                      |                        |                            |                  |                      |          |    |      |
| 09-204B    | S-3        | OST         | 750.03            | 11.0       | -    | 13.5           | 739.0 | -               | 736.5      | CL    | 33 | 17             | 16                      |        |        |        |       |            |                            |                  |                |                 |                |                      |      |       |                       |          |              |                      |                        |                            |                  |                      |          |    |      |
| 09-204B    | S-4        | OST         | 750.03            | 13.0       | -    | 15.5           | 737.0 | -               | 734.5      | CL    | 43 | 20             | 23                      |        |        |        |       |            |                            |                  |                |                 |                |                      |      |       |                       |          |              |                      |                        |                            |                  |                      |          |    |      |
| 09-204B    | S-5        | OST         | 750.03            | 15.5       | -    | 18.0           | 734.5 | -               | 732.0      | CL-ML | 21 | 15             | 6                       | 2.69   |        |        |       |            |                            | 113.81           | 20.73          | 0.186           | 0.023          | 0.61                 | 3.50 | 21.40 | CIU                   | 0.200    | 0.0          | 36.9                 | 1.14                   | 13.0                       | 105.6            | 20.67                | 12.013   | 0  | 32.3 |
| 09-204B    | S-6        | OST         | 750.03            | 18.0       | -    | 20.5           | 732.0 | -               | 729.5      | CL    | 23 | 15             | 8                       | 2.70   |        |        |       |            |                            | 111.61           | 20.82          | 0.182           | 0.020          | 0.51                 | 4.10 | 20.40 | CIU                   | 0.230    | 0.0          | 38.0                 | 0.96                   | 19.9                       |                  |                      |          |    |      |
| 09-204B    | S-6        | OST         | 750.03            | 20.5       | -    | 23.0           | 729.5 | -               | 727.0      |       |    |                |                         |        |        |        |       |            |                            |                  |                |                 |                |                      |      |       |                       |          |              |                      |                        |                            |                  |                      |          |    |      |
| 09-204B    | S-7        | OST         | 750.03            | 20.5       | -    | 20.5           | 729.5 | -               | 729.5      |       |    |                |                         |        |        |        |       |            |                            |                  |                |                 |                |                      |      |       |                       |          |              |                      |                        |                            |                  |                      |          |    |      |
| 09-205B    | S-1        | OST         | 755.26            | 11.0       | -    | 13.5</td       |       |                 |            |       |    |                |                         |        |        |        |       |            |                            |                  |                |                 |                |                      |      |       |                       |          |              |                      |                        |                            |                  |                      |          |    |      |

TABLE 3.1\_T1 SUMMARY OF LABORATORY TESTING

| Boring No. | Sample No. | Sample Type | Surface Elevation | Tube Depth |      | Tube Elevation |       | USCS (computed) | Atterbergs |    |    | ASTM D422 Size Analysis | Grain | ASTM D1140 | Consolidation  |          |        |        |        |      | Triaxial                   |                  |                |                 |                | Direct Shear         |       |       |                       |          |       |                      |                        |                            |                  |                      |          |    |  |  |  |  |  |  |
|------------|------------|-------------|-------------------|------------|------|----------------|-------|-----------------|------------|----|----|-------------------------|-------|------------|----------------|----------|--------|--------|--------|------|----------------------------|------------------|----------------|-----------------|----------------|----------------------|-------|-------|-----------------------|----------|-------|----------------------|------------------------|----------------------------|------------------|----------------------|----------|----|--|--|--|--|--|--|
|            |            |             | ft.               | ft.        | ft.  | ft.            | ft.   |                 | LL         | PL | PI |                         |       |            | G <sub>s</sub> | % Gravel | % Sand | % Silt | % Clay | P200 | Density (yd <sub>3</sub> ) | W/C <sub>0</sub> | C <sub>c</sub> | C <sub>cr</sub> | e <sub>0</sub> | P <sub>c</sub> (tsf) | W/C   | Test  | S <sub>3'</sub> (tsf) | c' (tsf) | ϕ'    | S <sub>u</sub> (tsf) | ε <sub>1</sub> at Peak | Density (yd <sub>3</sub> ) | W/C <sub>0</sub> | S <sub>n</sub> (tsf) | c' (tsf) | ϕ' |  |  |  |  |  |  |
| 09-301B    | S-1        | OST         | 816.30            | 25.0       | 27.5 | 791.3          | -     | 788.8           |            |    |    |                         |       |            |                |          |        |        |        |      |                            | 96.9             |                |                 |                |                      |       |       |                       |          |       |                      |                        |                            |                  |                      |          |    |  |  |  |  |  |  |
| 09-301B    | S-2        | OST         | 816.30            | 35.0       | 37.5 | 781.3          | -     | 778.8           |            |    |    |                         |       |            |                |          |        |        |        |      |                            | 98.8             |                |                 |                |                      |       |       |                       |          |       |                      |                        |                            |                  |                      |          |    |  |  |  |  |  |  |
| 09-301B    | S-3        | OST         | 816.30            | 40.0       | 42.5 | 776.3          | -     | 773.8           |            |    |    |                         |       |            |                |          |        |        |        |      |                            | 99.3             |                |                 |                |                      |       |       |                       |          |       |                      |                        |                            |                  |                      |          |    |  |  |  |  |  |  |
| 09-301B    | S-4        | OST         | 816.30            | 70.0       | 72.5 | 746.3          | -     | 743.8           |            |    |    |                         |       |            |                |          |        |        |        |      |                            | 99.0             |                |                 |                |                      |       |       |                       |          |       |                      |                        |                            |                  |                      |          |    |  |  |  |  |  |  |
| 09-301B    | S-5        | OST         | 816.30            | 85.0       | 87.5 | 731.3          | -     | 728.8           |            |    |    |                         |       |            |                |          |        |        |        |      |                            | 98.6             |                |                 |                |                      |       |       |                       |          |       |                      |                        |                            |                  |                      |          |    |  |  |  |  |  |  |
| 09-301B    | S-6        | OST         | 816.30            | 87.5       | 90.0 | 728.8          | -     | 726.3           |            |    |    |                         |       |            |                |          |        |        |        |      |                            | 85.7             |                |                 |                |                      |       |       |                       |          |       |                      |                        |                            |                  |                      |          |    |  |  |  |  |  |  |
| 09-301B    | S-7        | OST         | 816.30            | 90.0       | 92.0 | 726.3          | -     | 724.3           | CL         | 26 | 18 | 8                       | 2.67  |            |                |          |        |        |        |      |                            | 106.11           |                |                 | 0.183          | 0.023                | 0.57  | 3.25  | 18.57                 | CIU      | 1.080 | 0.0                  | 30.1                   | 1.26                       | 26.3             |                      |          |    |  |  |  |  |  |  |
| 09-301B    | S-7        | OST         | 816.30            | 90.0       | 92.5 | 726.3          | -     | 723.8           |            |    |    |                         |       |            |                |          |        |        |        |      |                            | 70.2             |                |                 |                |                      |       |       |                       |          |       |                      |                        |                            |                  |                      |          |    |  |  |  |  |  |  |
| 09-301B    | S-8        | OST         | 816.30            | 92.5       | 94.5 | 723.8          | -     | 721.8           | CL-ML      | 22 | 17 | 5                       | 2.67  |            |                |          |        |        |        |      |                            | 112.85           | 18.38          | 0.128           | 0.023          | 0.48                 | 3.50  | 21.90 | CIU                   | 1.120    | 0.0   | 29.6                 | 1.09                   | 24.3                       |                  |                      |          |    |  |  |  |  |  |  |
| 09-301B    | S-8        | OST         | 816.30            | 92.5       | 95.0 | 723.8          | -     | 721.3           |            |    |    |                         |       |            |                |          |        |        |        |      |                            | 69.7             |                |                 |                |                      |       |       |                       |          |       |                      |                        |                            |                  |                      |          |    |  |  |  |  |  |  |
| 09-301B    | S-8A       | OST         | 816.30            | 94.5       | 95.0 | 721.8          | -     | 721.3           |            |    |    |                         |       |            |                |          |        |        |        |      |                            |                  |                |                 |                |                      |       |       |                       |          |       |                      |                        |                            |                  |                      |          |    |  |  |  |  |  |  |
| 09-303B    | S-1        | OST         | 817.42            | 20.0       | -    | 22.5           | 797.4 | -               | 794.9      |    |    |                         |       |            |                |          |        |        |        |      |                            |                  |                |                 |                |                      |       |       |                       |          |       |                      |                        |                            |                  |                      |          |    |  |  |  |  |  |  |
| 09-303B    | S-2        | OST         | 817.42            | 30.0       | -    | 32.5           | 787.4 | -               | 784.9      |    |    |                         |       |            |                |          |        |        |        |      |                            |                  |                |                 |                |                      |       |       |                       |          |       |                      |                        |                            |                  |                      |          |    |  |  |  |  |  |  |
| 09-303B    | S-3        | OST         | 817.42            | 42.5       | -    | 45.0           | 774.9 | -               | 772.4      |    |    |                         |       |            |                |          |        |        |        |      |                            |                  |                |                 |                |                      |       |       |                       |          |       |                      |                        |                            |                  |                      |          |    |  |  |  |  |  |  |
| 09-303B    | S-4        | OST         | 817.42            | 70.0       | -    | 72.5           | 747.4 | -               | 744.9      |    |    |                         |       |            |                |          |        |        |        |      |                            |                  |                |                 |                |                      |       |       |                       |          |       |                      |                        |                            |                  |                      |          |    |  |  |  |  |  |  |
| 09-303B    | S-5        | OST         | 817.42            | 75.0       | -    | 77.5           | 742.4 | -               | 739.9      |    |    |                         |       |            |                |          |        |        |        |      |                            |                  |                |                 |                |                      |       |       |                       |          |       |                      |                        |                            |                  |                      |          |    |  |  |  |  |  |  |
| 09-303B    | S-6        | OST         | 817.42            | 80.0       | -    | 82.5           | 737.4 | -               | 734.9      | ML | 22 | 24                      | NP    | 2.61       | 0              | 1.7      | 73.9   | 24.4   |        |      |                            |                  |                |                 |                |                      |       |       |                       |          |       |                      |                        |                            |                  |                      |          |    |  |  |  |  |  |  |
| 09-303B    | S-7        | OST         | 817.42            | 85.0       | -    | 87.5           | 732.4 | -               | 729.9      |    |    |                         |       |            |                |          |        |        |        |      |                            |                  |                |                 |                |                      |       |       |                       |          |       |                      |                        |                            |                  |                      |          |    |  |  |  |  |  |  |
| 09-303B    | S-8        | OST         | 817.42            | 87.5       | -    | 90.0           | 729.9 | -               | 727.4      |    |    |                         |       |            |                |          |        |        |        |      |                            |                  |                |                 |                |                      |       |       |                       |          |       |                      |                        |                            |                  |                      |          |    |  |  |  |  |  |  |
| 09-303B    | S-9        | OST         | 817.42            | 90.0       | -    | 92.5           | 727.4 | -               | 724.9      | CL | 31 | 20                      | 11    | 2.70       | 0              | 25.6     | 42.0   | 32.4   |        |      | 104.78                     | 20.47            | 0.134          | 0.013           | 0.61           | 3.10                 | 21.30 | CIU   | 1.090                 | 0.0      | 35.0  | 1.76                 | 0.9                    |                            |                  |                      |          |    |  |  |  |  |  |  |
| 09-303B    | S-10       | OST         | 817.42            | 90.0       | -    | 92.5           | 727.4 | -               | 724.9      | CL | 32 | 18                      | 14    | 2.70       |                |          |        |        |        |      | 104.78                     | 20.47            | 0.134          | 0.013           | 0.63           | 3.30                 | 19.22 | UU    |                       | 0.1      | 31.7  | 0.58                 |                        |                            |                  |                      |          |    |  |  |  |  |  |  |
| 09-303B    | S-10       | OST         | 817.42            | 90.0       | -    | 92.5           | 727.4 | -               | 724.9      |    |    |                         |       |            |                |          |        |        |        |      | 106.2                      | 19.39            | 0.136          | 0.020           | 0.59           | 3.70                 | 21.70 | CIU   | 1.120                 | 0.0      | 34.8  | 3.60                 | 26.9                   |                            |                  |                      |          |    |  |  |  |  |  |  |
| 09-303B    | S-11       | OST         | 817.42            | 92.5       | -    | 95.0           | 724.9 | -               | 722.4      | CL | 32 | 18                      | 14    | 2.70       |                |          |        |        |        |      | 108.7                      | 18.75            | 0.128          | 0.009           | 0.54           | 4.25                 | 19.70 | CIU   | 1.140                 | 0.0      | 37.3  | 2.38                 | 22.1                   |                            |                  |                      |          |    |  |  |  |  |  |  |
| 09-303B    | S-12       | OST         | 817.42            | 95.0       | -    | 97.5           | 722.4 | -               | 719.9      | ML | 20 | 18                      | 2     | 2.69       |                |          |        |        |        |      |                            |                  |                |                 |                |                      |       |       |                       |          |       |                      |                        |                            |                  |                      |          |    |  |  |  |  |  |  |
| 09-303B    | S-13       | OST         | 817.42            | 97.5       | -    | 100.0          | 719.9 | -               | 717.4      |    |    |                         |       |            |                |          |        |        |        |      |                            |                  |                |                 |                |                      |       |       |                       |          |       |                      |                        |                            |                  |                      |          |    |  |  |  |  |  |  |
| 09-402B    | S-3        | OST         | 764.91            | 21.0       | 23.0 | 743.9          | -     | 741.9           |            |    |    |                         |       |            |                |          |        | 2.71   |        |      |                            |                  |                |                 |                |                      |       |       |                       |          |       |                      |                        |                            |                  |                      |          |    |  |  |  |  |  |  |
| 09-402B    | S-4        | OST         | 764.91            | 36.0       | 38.5 | 728.9          | -     | 726.4           | CL         | 38 | 17 | 21                      | 2.71  |            |                |          |        |        |        |      | 98.314                     | 27.83            | 0.210          | 0.025           | 0.72           | 2.00                 |       | </    |                       |          |       |                      |                        |                            |                  |                      |          |    |  |  |  |  |  |  |

TABLE 3.1\_T1 SUMMARY OF LABORATORY TESTING

| Boring No. | Sample No. | Sample Type | Surface Elevation | Tube Depth |      | Tube Elevation |       | USCS (computed) | Atterbergs |       |    | G <sub>s</sub> | ASTM D422 Size Analysis |        |        |        | Grain | ASTM D1140                 | Consolidation    |                |                 |                |                      |      | Triaxial |                       |          |       |                      |                        | Direct Shear               |                  |                      |          |    |       |       |        |   |      |
|------------|------------|-------------|-------------------|------------|------|----------------|-------|-----------------|------------|-------|----|----------------|-------------------------|--------|--------|--------|-------|----------------------------|------------------|----------------|-----------------|----------------|----------------------|------|----------|-----------------------|----------|-------|----------------------|------------------------|----------------------------|------------------|----------------------|----------|----|-------|-------|--------|---|------|
|            |            |             | ft.               | ft.        | ft.  | ft.            | ft.   |                 | LL         | PL    | PI |                | % Gravel                | % Sand | % Silt | % Clay | P200  | Density (yd <sub>3</sub> ) | W/C <sub>0</sub> | C <sub>c</sub> | C <sub>cr</sub> | e <sub>0</sub> | P <sub>c</sub> (tsf) | W/C  | Test     | S <sub>3'</sub> (tsf) | c' (tsf) | ϕ'    | S <sub>u</sub> (tsf) | ε <sub>1</sub> at Peak | Density (yd <sub>3</sub> ) | W/C <sub>0</sub> | S <sub>n</sub> (tsf) | c' (tsf) | ϕ' |       |       |        |   |      |
| 09-502B    | 1          | OST         | 752.82            | 24.0       | 5.0  | 7.5            | 747.8 |                 |            |       |    |                |                         |        |        |        |       | 80.3                       |                  |                |                 |                |                      |      |          |                       |          |       |                      |                        |                            |                  |                      |          |    |       |       |        |   |      |
| 09-502B    | 2          | OST         | 752.82            | 24.0       | 10.0 | 12.5           | 742.8 |                 |            |       |    |                |                         |        |        |        |       | 94.9                       |                  |                |                 |                |                      |      |          |                       |          |       |                      |                        |                            |                  |                      |          |    |       |       |        |   |      |
| 09-503B    | S-3        | OST         | 768.25            | 37.5       | 38.0 | 730.8          | -     | 730.3           | ML         | 24    | 27 | NP             | 2.44                    |        |        |        |       |                            | 83.668           | 31.22          | 0.112           | 0.027          | 0.82                 | 3.50 |          |                       |          |       |                      |                        |                            |                  |                      |          |    |       |       |        |   |      |
| 09-503B    | S-4        | OST         | 768.25            | 40.0       | 40.5 | 728.3          | -     | 727.8           | CL         | 31    | 17 | 14             | 2.75                    |        |        |        |       |                            | 103.17           | 21.30          | 0.196           | 0.027          | 0.67                 | 2.20 |          |                       |          |       |                      |                        |                            |                  |                      |          |    |       |       |        |   |      |
| 09-600B    | S-1        | OST         | 776.66            | 32.0       | -    | 34.5           | 744.7 | -               | 742.2      |       |    |                |                         |        |        |        |       |                            |                  |                |                 |                |                      |      |          |                       |          |       |                      |                        |                            |                  |                      |          |    |       |       |        |   |      |
| 09-600B    | S-2        | OST         | 776.66            | 44.0       | -    | 46.5           | 732.7 | -               | 730.2      |       |    |                |                         |        |        |        |       |                            |                  |                |                 |                |                      |      |          |                       |          |       |                      |                        |                            |                  |                      |          |    |       |       |        |   |      |
| 09-600B    | S-2        | OST         | 776.66            | 44.0       | 46.5 | 732.7          | -     | 730.2           |            |       |    |                | 2.735                   |        |        |        |       |                            |                  |                |                 |                |                      |      |          |                       |          |       |                      |                        |                            |                  |                      |          |    |       |       |        |   |      |
| 09-600B    | S-3        | OST         | 776.66            | 46.5       | 49.0 | 730.2          | -     | 727.7           |            |       |    |                |                         |        |        |        |       |                            |                  |                |                 |                |                      |      |          |                       |          |       |                      |                        |                            |                  |                      |          |    |       |       |        |   |      |
| 09-600B    | S-4        | OST         | 776.66            | 49.0       | -    | 51.5           | 727.7 | -               | 725.2      | CL-ML | 22 | 17             | 5                       | 2.63   |        |        |       |                            |                  | 94.024         | 28.10           | 0.189          | 0.023                | 0.74 | 2.80     | 21.00                 | CIU      | 0.600 | 0.0                  | 28.8                   | 1.00                       | 24.5             |                      |          |    |       |       |        |   |      |
| 09-600B    | S-4        | OST         | 776.66            | 49.0       | 51.5 | 727.7          | -     | 725.2           |            |       |    |                |                         |        |        |        |       |                            |                  |                |                 |                |                      |      |          |                       |          |       |                      |                        |                            |                  |                      |          |    |       |       |        |   |      |
| 09-600B    | S-5        | OST         | 776.66            | 55.0       | 57.5 | 721.7          | -     | 719.2           |            |       |    |                |                         |        |        |        |       |                            |                  |                |                 |                |                      |      |          |                       |          |       |                      |                        |                            |                  |                      |          |    |       |       |        |   |      |
| 09-600B    | S-6        | OST         | 776.66            | 55.0       | -    | 57.5           | 721.7 | -               | 719.2      |       |    |                |                         |        |        |        |       |                            |                  |                |                 |                |                      |      |          |                       |          |       |                      |                        |                            |                  |                      |          |    |       |       |        |   |      |
| 09-601     | S-10       | OST         | 773.44            | 55.0       | 57.5 | 718.4          | -     | 715.9           |            |       |    |                | 2.31                    |        |        |        |       |                            |                  |                |                 |                |                      |      |          |                       |          |       |                      |                        |                            |                  |                      |          |    |       |       |        |   |      |
| 09-601     | S-16       | OST         | 773.44            | 55.0       | 57.5 | 718.4          | -     | 715.9           |            |       |    |                | 2.67                    |        |        |        |       |                            |                  |                |                 |                |                      |      |          |                       |          |       |                      |                        |                            |                  |                      |          |    |       |       |        |   |      |
| 09-601     | S31A       | OST         | 773.44            | 55.0       | 57.5 | 718.4          | -     | 715.9           |            |       |    |                | 2.68                    |        |        |        |       |                            |                  |                |                 |                |                      |      |          |                       |          |       |                      |                        |                            |                  |                      |          |    |       |       |        |   |      |
| 09-601B    | S-8        | OST         | 775.05            | 55.0       | 57.5 | 720.1          | -     | 717.6           |            |       |    |                | 2.30                    |        |        |        |       |                            |                  |                |                 |                |                      |      |          |                       |          |       |                      |                        |                            |                  |                      |          |    |       |       |        |   |      |
| 09-602B    | S-5        | OST         | 781.42            | 67.0       | 67.5 | 714.4          | -     | 713.9           | ML         | 16    | 15 | 1              | 2.70                    |        |        |        |       |                            | 107.73           | 20.89          | 0.128           | 0.023          | 0.57                 | 3.75 |          |                       |          |       |                      |                        |                            |                  |                      |          |    |       |       |        |   |      |
| 09-603B    | 1-TIP      | OST         | 780.56            | 25.0       | 27.5 | 755.6          | -     | 753.1           |            |       |    |                |                         |        |        |        |       |                            | 94.2             |                |                 |                |                      |      |          |                       |          |       |                      |                        |                            |                  |                      |          |    |       |       |        |   |      |
| 09-603B    | 2-TIP      | OST         | 780.56            | 30.0       | 32.5 | 750.6          | -     | 748.1           |            |       |    |                |                         |        |        |        |       |                            | 92.8             |                |                 |                |                      |      |          |                       |          |       |                      |                        |                            |                  |                      |          |    |       |       |        |   |      |
| 09-603B    | 4-TOP      | OST         | 780.56            | 45.0       | 45.7 | 735.6          | -     | 734.9           |            |       |    |                |                         |        |        |        |       |                            | 95.1             |                |                 |                |                      |      |          |                       |          |       |                      |                        |                            |                  |                      |          |    |       |       |        |   |      |
| 09-603B    | 5-TOP      | OST         | 780.56            | 49.0       | 51.5 | 731.6          | -     | 729.1           |            |       |    |                |                         |        |        |        |       |                            | 78.7             |                |                 |                |                      |      |          |                       |          |       |                      |                        |                            |                  |                      |          |    |       |       |        |   |      |
| 09-604B    | S-6        | OST         | 782.36            | 63.5       | 65.5 | 718.9          | -     | 716.9           | CL         | 38    | 18 | 20             | 2.73                    |        |        |        |       |                            | 104.92           | 20.93          | 0.173           | 0.027          | 0.62                 | 3.70 |          |                       |          |       |                      |                        |                            |                  |                      |          |    |       |       |        |   |      |
| 09-604B    | S-6A       | OST         | 782.36            | 65.5       | 66.0 | 716.9          | -     | 716.4           | CL         | 38    | 18 | 20             |                         |        |        |        |       |                            |                  |                |                 |                |                      |      |          |                       |          |       |                      |                        |                            |                  |                      |          |    |       |       |        |   |      |
| 09-604B    | S-7        | OST         | 782.36            | 66.0       | 68.0 | 716.4          | -     | 714.4           | CL         | 38    | 17 | 21             | 2.77                    |        |        |        |       |                            | 101.83           | 22.59          | 0.206           | 0.027          | 0.70                 | 4.15 |          |                       |          |       |                      |                        |                            |                  |                      |          |    |       |       |        |   |      |
| 09-604B    | S-7A       | OST         | 782.36            | 68.0       | 68.5 | 714.4          | -     | 713.9           | CL         | 38    | 17 | 21             |                         |        |        |        |       |                            |                  |                |                 |                |                      |      |          |                       |          |       |                      |                        |                            |                  |                      |          |    |       |       |        |   |      |
| 09-604B    | S-8        | OST         | 782.36            | 68.5       | 71.0 | 713.9          | -     | 711.4           | CL         | 32    | 17 | 15             | 2.74                    |        |        |        |       |                            | 97.722           | 26.99          | 0.239           | 0.027          | 0.75                 | 3.00 |          |                       |          |       |                      |                        |                            |                  |                      |          |    |       |       |        |   |      |
| 09-604B    | S-9        | OST         | 782.36            | 71.0       | 73.0 | 711.4          | -     | 709.4           | CL         | 25    | 17 | 8              | 2.65                    |        |        |        |       |                            | 89.727           | 30.54          | 0.284           | 0.030          | 0.85                 | 2.50 | 24.50    | CIU                   | 0.860    | 0.0   | 35.0                 | 0.89                   | 17.4                       |                  |                      |          |    |       |       |        |   |      |
| 09-605B    | S-9        | OST         | 781.64            | 52.0       | 54.0 | 729.6          | -     | 727.6           | CL         | 33    | 19 | 14             | 2.75                    |        |        |        |       |                            | 104.99           | 20.64          | 0.176           | 0.020          | 0.63                 | 3.85 |          |                       |          |       |                      |                        |                            |                  |                      |          |    | 103.8 | 21.53 | 11.996 | 0 | 30.4 |
| 09-605B    | S-9A       | OST         | 781.64            | 54.0       | 54.5 | 727.6          | -     | 727.1           |            |       |    |                |                         |        |        |        |       |                            |                  |                |                 |                |                      |      |          |                       |          |       |                      |                        |                            |                  |                      |          |    |       |       |        |   |      |

Table 3.1\_T2


**Specific Gravity of Soils  
ASTM D-854**

Consulting Engineers

Laboratory Services Group

750 Corporate Woods Parkway

Vernon Hills, IL 60061

Phone: (847) 279-2500 Fax: (847) 279-2550

| Boring/Source | Sample No. | Depth     | Sample Description | Specific Gravity |
|---------------|------------|-----------|--------------------|------------------|
| 09-102        | 14A        | 31-31.5   | Ash                | 2.186            |
| 09-102B       | OST-1      | 20.22.5   | Ash                | 2.315            |
| 09-102B       | OST-2 B    | 29.5-32   | Organic Clay       | 2.640            |
| 09-102B       | OST-2 T    | 29.5-32   | Ash                | 2.309            |
| 09-102B       | OST-4      | 43.7-46.2 | Silty Clay         | 2.696            |
| 09-103A       | ST-1       | 36-37.5   | Silt               | 2.676            |
| 09-103A       | ST-1       | 36-37.5   | Silty Sand         | 2.676            |
| 09-103A       | ST-1A      | 36-37.5   | Silt               | 2.662            |
| 09-103A       | ST1-A      | 36-37.5   | Silty Sand         | 2.662            |
| 09-103A       | ST-4       | 42-44     | Silty Clay         | 2.754            |
| 09-103A       | ST-4       | 42-44     | Silty Clay         | 2.754            |
| 09-103B       | OST-1      | 20-22     | Ash                | 2.319            |
| 09-103B       | OST-5      | 43-43.5   | Sandy Clay         | 2.718            |
| 09-104        | 6          | 29.5-30   | Silt               | 2.711            |
| 09-104B       | 7          | 31.5-32   | Silt               | 2.694            |
| 09-104B       | OST-9      | 35-37     | Silty Clay         | 2.749            |
| 09-105A       | ST-2A      | 15-17     | Silty Clay         | 2.678            |
| 09-105B       | OST-1      | 13-15.5   | Silty Clay         | 2.704            |
| 09-105B       | OST-2      | 15.5-18   | Silty Clay         | 2.697            |
| 09-105B       | OST-5      | 25-27.5   | Silty Clay         | 2.705            |
| 09-105B       | OST-5      | 25-27.5   | Silty Clay         | 2.704            |
| 09-105B       | OST-8      | 32-32     | Silty Clay         | 2.701            |
| 09-107A       | 2          | 30-31.5   | Sandy Silt         | 2.699            |
| 09-108A       | ST-1       | 25.5-27.5 | Clayey Silt        | 2.686            |
| 09-108B       | OST-3      | 26-28.5   | Silty Clay         | 2.697            |
| 09-109B       | OST-4      | 28-30.5   | Silty Clay         | 2.697            |
| 09-109B       | OST-5      | 30.5-33   | Silty Clay         | 2.691            |
| 09-109B       | OST-6      | 33-35.5   | Silty Clay         | 2.696            |
| 09-200A       | ST-1       | 35-37     | Silt               | 2.664            |
| 09-200B       | Combined   | Sample    | Ash                | 2.333            |
| 09-201A       | ST-1       | 26-28     | Silty Clay         | 2.701            |
| 09-201A       | ST-3       | 29.5-31.5 | Silty Clay         | 2.692            |
| 09-201B       | OST-1      | 16-18.5   | Ash                | 2.274            |
| 09-201B       | OST-3      | 28-30.5   | Silty Clay         | 2.710            |
| 09-203A       | OST-6      | 31-33.5   | Silty Clay         | 2.683            |
| 09-203B       | OST-1      | 18.5-21   | Ash                | 2.362            |
| 09-203B       | OST-5      | 28.5-30   | Silty Clay         | 2.707            |
| 09-203B2      | OST-3      | 26-28.5   | Silty Clay         | 2.709            |
| 09-204A       | ST-3       | 17-18.5   | Silty Clay         | 2.699            |
| 09-204A       | ST-3       | 17-18.5   | Silty Clay         | 2.699            |
| 09-204A       | ST-5       | 20-21.5   | Silty Clay         | 2.708            |
| 09-204B       | OST-5      | 15.5-18   | Silty Clay         | 2.692            |
| 09-205A       | OST-6      | 18-20.5   | Silty Clay         | 2.702            |
| 09-205A       | ST-2A      | 17-19     | Silty Clay         | 2.744            |

Table 3.1\_T2

**AECOM****Specific Gravity of Soils  
ASTM D-854**

Consulting Engineers

Laboratory Services Group

750 Corporate Woods Parkway

Vernon Hills, IL 60061

Phone: (847) 279-2500 Fax: (847) 279-2550

| Boring/Source | Sample No. | Depth     | Sample Description | Specific Gravity |
|---------------|------------|-----------|--------------------|------------------|
| 09-205B       | OST-2      | 18-18.5   | Sandy Silt         | 2.712            |
| 09-205B       | OST-3      | 20.5-21   | Sandy Silt         | 2.710            |
| 09-206A       | ST-2       | 15.5-17   | Silty Clay         | 2.701            |
| 09-206A       | ST-4       | 18.5-20   | Silty Clay         | 2.706            |
| 09-206B       | OST-3      | 15-17.5   | Silty Clay         | 2.692            |
| 09-206B       | OST-4      | 17.5-20   | Silty Clay         | 2.784            |
| 09-207B       | OST-1      | 8-10.5    | Ash                | 2.311            |
| 09-207B       | OST-2      | 10.5-13   | Ash                | 2.317            |
| 09-207B       | OST-6      | 27.5-30   | Silty Clay         | 2.725            |
| 09-207B       | OST-7      | 25-25.5   | Clayey Silt        | 2.725            |
| 09-209A       | ST-3       | 10.5-12.5 |                    | 2.686            |
| 09-209B       | OST-2      | 10.5-11   | Silty Clay         | 2.697            |
| 09-211A       | 1          | 24-26     | Silty Sand         | 2.646            |
| 09-211A       | 1A         | 24-26     | Sandy Silt         | 2.731            |
| 09-211B       | OST-4      | 29-29.5   |                    | 2.700            |
| 09-301B       | OST-7      | 90-92.5   | Silty Clay         | 2.669            |
| 09-301B       | Ost-8      | 94-94.5   | Sandy Clay         | 2.669            |
| 09-302        | S-12       | 52-54     | Ash                | 2.395            |
| 09-302        | S-14       | 56-58     | Ash                | 2.364            |
| 09-302        | S-16       | 60-62     | Ash                | 2.303            |
| 09-302        | S-18       | 64-66     | Ash                | 2.439            |
| 09-302        | S-2        | 5.0-7     | Ash                | 2.375            |
| 09-302        | S-23       | 74-76     | Ash                | 2.321            |
| 09-302        | S-26       | 80-82     | Ash                | 2.435            |
| 09-302        | S-27       | 82-84     | Ash                | 2.431            |
| 09-302        | S-29       | 89-91     | Ash                | 2.459            |
| 09-302        | S-30       | 91-93     | Ash                | 2.453            |
| 09-302B       | S-20       | 68-70     | Ash                | 2.404            |
| 09-303A       | ST-3       | 90.5-92   | Silty Clay         | 2.702            |
| 09-303A       | ST-4       | 92-93.5   | Silty Clay         | 2.764            |
| 09-303B       | OST-10     | 90-92.5   | Silty Clay         | 2.698            |
| 09-303B       | OST-10     | 90-92.5   | Silty Clay         | 2.726            |
| 09-303B       | OST-11     | 92.5-95   | Silty Clay         | 2.704            |
| 09-303B       | OST-12     | 95-97.5   | Silty Clay         | 2.690            |
| 09-303B       | OST-3      | 42.5-45   | Ash                | 2.287            |
| 09-303B       | OST-4      | 70-72.5   | Ash                | 2.374            |
| 09-303B       | OST-6      | 80-82.5   | Ash                | 2.397            |
| 09-303B       | OST-7      | 82.5-85   | Ash                | 2.613            |
| 09-303B       | OST-8      | 85-87.5   | Ash                | 2.441            |
| 09-402A       | 2          | 38.5-40.5 | Clayey Silt        | 2.663            |
| 09-402A       | 6          | 46.5-48.5 | Silt               | 2.658            |
| 09-402B       | OST-4      | 36-38.5   | Silty Clay         | 2.713            |
| 09-402B       | OST-5      | 38.5-41   | Silty Clay         | 2.709            |
| 09-402B       | OST-6      | 41-43.5   | Silty Clay         | 2.696            |
| 09-402B       | OST-7      | 43.5-46   | Silty Clay         | 2.704            |
| 09-402B       | OST-8      | 46-48.5   | Silty Clay         | 2.700            |
| 09-402B       | OST-9      | 43.5-46   | Silty Clay         | 2.695            |

Table 3.1\_T2



**Specific Gravity of Soils  
ASTM D-854**

Consulting Engineers

Laboratory Services Group

750 Corporate Woods Parkway

Vernon Hills, IL 60061

Phone: (847) 279-2500 Fax: (847) 279-2550

| Boring/Source | Sample No. | Depth     | Sample Description | Specific Gravity |
|---------------|------------|-----------|--------------------|------------------|
| 09-404A       | 4          | 43-45     | Ash                | 2.385            |
| 09-404B       | OST-3      | 40-40.5   | Silt               | 2.697            |
| 09-404B       | OST-4      | 42.5-43   | Sandy Clay         | 2.700            |
| 09-404B       | OST-5      | 45-45.5   | Silty Clay         | 2.667            |
| 09-406A       | ST-3       | 38-40     | Silty Clay         | 2.706            |
| 09-406A       | ST-4       | 46-48     | Silty Clay         | 2.718            |
| 09-406A       | ST-5       | 42-44     | Silty Clay         | 2.699            |
| 09-408B       | OST-9      | 41.5-42   |                    | 2.650            |
| 09-413A       | ST-1       | 6.0-8     | Silty Clay         | 2.709            |
| 09-413A       | ST-3       | 10.0-12   | Silty Clay         | 2.723            |
| 09-413A       | ST-5       | 14-16     | Silty Clay         | 2.729            |
| 09-500A       | 2          | 32-34     | Sandy Silt         | 2.703            |
| 09-500B       | OST-3      | 24-26.5   | Ash                | 2.434            |
| 09-500B       | OST-7      | 35.5-36   | Silty Clay         | 2.624            |
| 09-500B       | OST-8      | 33.5-34   | Sandy Silt         | 2.669            |
| 09-503A       | ST-2       | 37.5-39.5 | Ash                | 2.479            |
| 09-503B       | OST-3      | 37.5-38   | Ash                | 2.438            |
| 09-503B       | OST-4      | 38-40     |                    | 2.754            |
| 09-503B       | OST-4      | 40-40.5   |                    | 2.715            |
| 09-600        | SS-35A     | 74-74.5   | Silty Clay         | 2.735            |
| 09-600A       | ST-2       | 47.5-49.5 |                    | 2.765            |
| 09-600B       | OST-1      | 32-34.5   | Ash                | 2.294            |
| 09-600B       | OST-4      | 51-51.5   | Sandy Silt         | 2.627            |
| 09-601        | SS-10      | 19-21     | Ash                | 2.310            |
| 09-601        | SS-16      | 31.5-33.5 | Silty Sand         | 2.667            |
| 09-601        | SS-31B     | 65.5-66.5 | Silty Sand         | 2.679            |
| 09-601        | SS-8       | 15-17     | Ash                | 2.301            |
| 09-601A       | 2          | 42-44     | Sandy Silt         | 2.715            |
| 09-602A       | ST-3       | 63-63.5   |                    | 2.709            |

Table 3.1\_T2



**Specific Gravity of Soils  
ASTM D-854**

Consulting Engineers

Laboratory Services Group

750 Corporate Woods Parkway

Vernon Hills, IL 60061

Phone: (847) 279-2500 Fax: (847) 279-2550

| Boring/Source | Sample No. | Depth     | Sample Description | Specific Gravity |
|---------------|------------|-----------|--------------------|------------------|
| 09-602B       | OST-5      | 67-67.5   |                    | 2.704            |
| 09-604A       | 2          | 66-68     |                    | 2.675            |
| 09-604B       | OST-6      | 65.5-66   | Silty Clay         | 2.731            |
| 09-604B       | OST-7      | 68-68.5   | Silty Clay         | 2.772            |
| 09-604B       | OST-8      | 69-69.5   |                    | 2.742            |
| 09-604B       | OST-9      | 71-73.5   |                    | 2.655            |
| 09-605B       | OST-1      | 28-30.5   | Ash                | 2.326            |
| 09-605B       | OST-10     | 55-55.5   | Silty Clay         | 2.759            |
| 09-605B       | OST-11     | 59-59.5   |                    | 2.750            |
| 09-605B       | OST-9      | 54-54.5   | Silty Clay         | 2.736            |
| 09-700A       | ST-3       | 27-29     |                    | 2.726            |
| 09-708A       | ST-3       | 39-41     |                    | 2.688            |
| 09-708A1      | ST-2       | 30-32     |                    | 2.591            |
| 09-712A2      | ST-3       | 44.5-46   |                    | 2.717            |
| 09-712A2      | ST-2       | 44-45.8   |                    | 2.747            |
| 09-712A2      | ST-3       | 46-47     |                    | 2.660            |
| 09-800A       | ST-2       | 30.5-32   |                    | 2.687            |
| 09-801A       | ST-2       | 39.5-41.5 |                    | 2.716            |
| 09-801A       | ST-6A      | 47.5-49.5 |                    | 2.692            |
| 09-804A       | ST-6A      | 47.5-49.5 |                    | 2.682            |
| Test Trench   | ST-73V     |           | Ash                | 2.301            |
| Test Trench   | ST-81V     |           | Ash                | 2.301            |
| Test Trench   | ST-90H     |           | Ash                | 2.291            |

Table 3.1\_T3

**pH Determination****ASTM D 4972****Consulting Engineers****Laboratory Services Group***750 Corporate Woods Parkway**Vernon Hills, Illinois 60061**Phone: (847) 279-2500 Fax: (847) 279-2510*

Project No.: **60095742**  
 Project Name: **TVA Kingston Coal**  
 Date: **3/27/2009**

**Summary of Test Results**

| Boring No. | Sample No. | Depth (ft) | pH    |
|------------|------------|------------|-------|
| 09-302     | 2          | 5.0-7.0    | 10.12 |
| 09-302     | 12         | 52.0-54.0  | 9.27  |
| 09-302     | 14         | 56.0-58.0  | 7.82  |
| 09-302     | 16         | 60.0-62.0  | 7.58  |
| 09-302     | 18         | 64.0-66.0  | 7.51  |
| 09-302     | 20         | 68.0-70.0  | 7.46  |
| 09-302     | 23         | 74.0-76.0  | 7.36  |
| 09-302     | 26         | 80.0-82.0  | 7.3   |
| 09-302     | 27         | 82.0-87.0  | 7.52  |
| 09-302     | 29         | 89.0-91.0  | 7.57  |
| 09-302     | 30         | 91.0-93.0  | 7.58  |

Table 3.1\_T4



## ORGANIC CONTENT TEST

ASTM D-2974

Method C

Consulting Engineers

Laboratory Services Group

750 Corporate Woods Parkway, Vernon Hills, Illinois 60061

Phone: (847) 279-2500 Fax:(847) 279-2550

| Boring / Source | Sample No. | Depth (ft.)        | Moisture Content (%) | Organic Content (%) |
|-----------------|------------|--------------------|----------------------|---------------------|
| 09-102          | 14A        | 30.5-31.5          | 1.03                 | 3.37                |
| 09-106          | 13A        | 24.25-26.0         | 0.15                 | 1.50                |
| 09-107          | 15A        | 28.5-30.0          | 51.20                | 2.61                |
| 09-605B         | OST-3      | 32.5-35.0          | Note 1               | 3.51                |
| 09-605B         | OST-4      | 40.0-42.5          | Note 1               | 0.63                |
| 09-605B         | OST-5      | 42.5-44.5          | Note 1               | 0.26                |
| 09-605B         | OST-6      | 44.5-46.5          | Note 1               | 0.20                |
| 09-604B         | OST-3      | 56.0-58.0          | Note 1               | 0.60                |
| 09-604B         | OST-4      | 58.5-61.0          | Note 1               | 2.77                |
| 09-605B         | OST-1      | 28.0-30.5          | Note 1               | 0.06                |
| 09-605B         | OST-2      | 30.5-32.0          | Note 1               | 0.14                |
| 09-102B         | OST- 2     | 29.5'-32.0' Top    | 43.97                | 6.59                |
| 09-102B         | OST- 2     | 29.5'-32.0' Bottom | 24.14                | 3.39                |
| 09-303B         | OST-8      | 85.0-87.5          | Note 1               | 0.89                |
| 09-408B         | OST-1      | 15.0-17.5          | Note 1               | 0.44                |
| 09-500B         | OST-1      | 10.0-12.5          | Note 1               | 1.11                |
| 09-500B         | OST-3      | 24.0-26.5          | Note 1               | 1.05                |
| 09-103B         | OST-1      | 20.0-22.5          | Note 1               | 2.28                |
| 09-103B         | OST-2      | 35.5-39.0          | 32.23                | 2.18                |
| 09-301B         | OST-1      | 25.0-27.5          | Note 1               | 4.08                |
| 09-303B         | OST-2      | 30.0-32.5          | Note 1               | 0.57                |
| 09-303B         | OST-6      | 80.0-82.5          | Note 1               | 0.45                |
| 09-408          | 18A        | 35.5-36.0          | 48.48                | 3.62                |
| 09-500          | 15.00      | 28.0-29.0          | 50.35                | 5.68                |
| 09-600          | 21A        | 45.0-45.5          | Note 1               | 3.49                |

\*\* Note: Test performed by heating the sample to 440 degrees Centigrade until constant weight of ash is attained.

\*\* Note 1: Test performed on previously oven dried sample

### **3.2 Testing Program at University of Massachusetts**

AECOM retained Dr. Don DeGroot, P.E., of the University of Massachusetts (UMass) to perform laboratory testing on select Osterberg tube samples from Kingston. On several occasions AECOM hand-delivered a total of 34, 3-inch diameter Osterberg tubes from Tennessee and Illinois to attempt to locate the interface between the sluiced ash and foundation soils (typically silt and clay). The goal was to carefully open the tubes to observe the slide plane and extract samples for testing.

Dr. DeGroot performed sieve/hydrometer analyses, specific gravity, water content, Atterberg limits, organic content, unit weight and controlled rate-of-strain consolidation tests (CRS), monotonic,  $K_0$ -consolidated undrained direct simple shear tests ( $CK_0$ UDSS) and one creep  $CK_0$ UDSS test. A summary of Dr. DeGroot tests are presented in Appendix 3H.

During the UMass study, a thin silt and fine fly ash slime layer was discovered at the interface between the clay and fly ash in certain tubes. Dr. DeGroot was able to perform seven CRS tests, ten  $CK_0$ UDSS tests and one  $CK_0$ UDSS creep test in the slimes. The slimes under Cell 2 have unusually high water contents (49 to 131%) and high Liquidity Indices (4.7 to 7.0). In addition, Dr. DeGroot ran five CRS and two  $CK_0$ UDSS tests on the native clayey silt foundation soils under the ash.

Dr. DeGroot logged each tube, photographed the material and took special care to use a microscope to photograph clays and slimes. The work was invaluable in defining the undrained strength of the slimes, to supplement a limited number of vane shear tests (5) in the slimes.

A list of Osterberg tubes transported to the UMass is provided on Table 3.2\_T1. These tubes contained the interface between ash and foundation soils (slimes and clay).

**Table 3.2\_T1**  
**Summary of Osterberg Tube Samples Sent to UMass for Testing**

| Boring  | Sample | Depth        | Inspection and Sample Log             |
|---------|--------|--------------|---------------------------------------|
| 09-100B | S4     | 30.5-33.0 ft | Complete Tube                         |
| 09-100B | S5     | 33.0-35.5 ft | Complete Tube                         |
| 09-100B | S6     | 35.5-38.0 ft | Complete Tube                         |
| 09-101B | S5     | 38.0-40.5 ft | Complete Tube                         |
| 09-103B | S2     | 33.5-36.0 ft | Partial Tube (as received)            |
| 09-103B | S3     | 36.0-38.5 ft | Complete Tube                         |
| 09-103B | S4     | 38.5-39.0 ft | Partial Tube (as received)            |
| 09-103B | S5     | 41.0-42.0 ft | Partial Tube (as received)            |
| 09-104B | S4     | 22.5-25.0 ft | Complete Tube                         |
| 09-108B | S2     | 23.5-26.0 ft | Complete Tube                         |
| 09-109B | S3     | 25.5-28.0 ft | Complete Tube                         |
| 09-200B | S4     | 32.5-35.0 ft | Complete Tube                         |
| 09-201B | S2     | 25.5-28.0 ft | Complete Tube                         |
| 09-202B | S2     | 28.5-31.0 ft | Complete Tube                         |
| 09-206B | S5     | 20.0-22.5 ft | Tube cut in sections but not extruded |
| 09-207B | S3     | 13.0-15.5 ft | Complete Tube                         |
| 09-210B | S2     | 10.5-11.0 ft | Partial Tube (as received)            |
| 09-301B | S6     | 87.5-90.0 ft | Complete Tube                         |
| 09-303B | S9     | 87.5-90.0 ft | Complete Tube                         |
| 09-408B | S6     | 33.0-35.5 ft | Complete Tube                         |
| 09-408B | S7     | 35.5-38.0 ft | Complete Tube                         |
| 09-500B | S4     | 26.5-29.0 ft | Complete Tube                         |
| 09-500B | S5     | 29.0-31.5 ft | Complete Tube                         |
| 09-502B | S4     | 22.0-24.5 ft | Complete Tube                         |
| 09-503B | S2     | 31.0-33.5 ft | Complete Tube                         |
| 09-503B | S3     | 35.5-37.5 ft | Complete Tube                         |
| 09-600B | S2     | 44.0-46.5 ft | Complete Tube                         |
| 09-601B | S5     | 49.5-52.0 ft | Tube cut in sections but not extruded |
| 09-602B | S4     | 54.0-56.5 ft | Tube cut in sections but not extruded |
| 09-605B | S7     | 47.0-49.5 ft | Complete Tube                         |
| 09-605B | S8     | 49.5-52.0 ft | Tube cut in sections but not extruded |
| 09-700B | S3     | 22.5-25.0 ft | Complete Tube                         |
| 09-800B | S4     | 26.5-29.0 ft | Complete Tube                         |
| 09-801B | S5     | 37.5-40.0 ft | Complete Tube                         |

### **3.3 Microscopy Analysis on Slimes**

One sample of the slimes from AECOM Boring 09-503B (37.5 – 38.0 feet) was tested by the University of Kentucky Center for Applied Energy Research, using a scanning electron microscope (SEM). Their letter report is included in Appendix 3I.

## **Appendices**

- Appendix 3A - Index Tests
- Appendix 3B - Proctor Tests
- Appendix 3C - Hydraulic Conductivity Testing
- Appendix 3D - Direct Shear Testing
- Appendix 3E - Consolidation Testing
- Appendix 3F - Triaxial Testing
- Appendix 3G - Tube Photographs (by AECOM boring series)
- Appendix 3H - University of Massachusetts Report
- Appendix 3I - University of Kentucky Petrographic Analysis

## **Appendix 3A - Index Tests**

# **Atterberg Limits - 100 Series**

# **Atterberg Limits - 200 Series**

# **Atterberg Limits - 300 Series**

# **Atterberg Limits - 400 Series**

# **Atterberg Limits - 500 Series**

# **Atterberg Limits - 600 Series**

# **Atterberg Limits - 700 Series**

# **Atterberg Limits - 800 Series**

# **Grain Size Analysis - 100 Series**

# **Grain Size Analysis - 200 Series**

# **Grain Size Analysis - 200 Series Combined**

# **Grain Size Analysis - 300 Series**

# **Grain Size Analysis - 400 Series**

# **Grain Size Analysis - 500 Series**

# **Grain Size Analysis - 600 Series**

# **Grain Size Analysis - 700 Series**

# **Grain Size Analysis - 800 Series**

# **Grain Size Analysis – Permeability**

## **Appendix 3B - Proctor Tests**

## **Appendix 3C - Hydraulic Conductivity Testing**

## **Appendix 3D - Direct Shear Testing**

## **Appendix 3E - Consolidation Testing**

## **Appendix 3F - Triaxial Testing**

# **Clay - CIU**

## **Reconstituted Ash – CIU**

## **Reconstituted Ash – CKU**

## **Reconstituted Ash – CID**

# **Reconstituted Ash – RTXE**

## **Appendix 3G - Tube Photographs (by boring series)**

## **Appendix 3H - University of Massachusetts Report**

## **Appendix 3I – University of Kentucky Petrographic Analysis**