



**US Army Corps  
of Engineers ®**  
Detroit District

## **APPENDIX B**

### **GEOTECHNICAL DATA**

## **APPENDIX B**

### **Geotechnical Data**

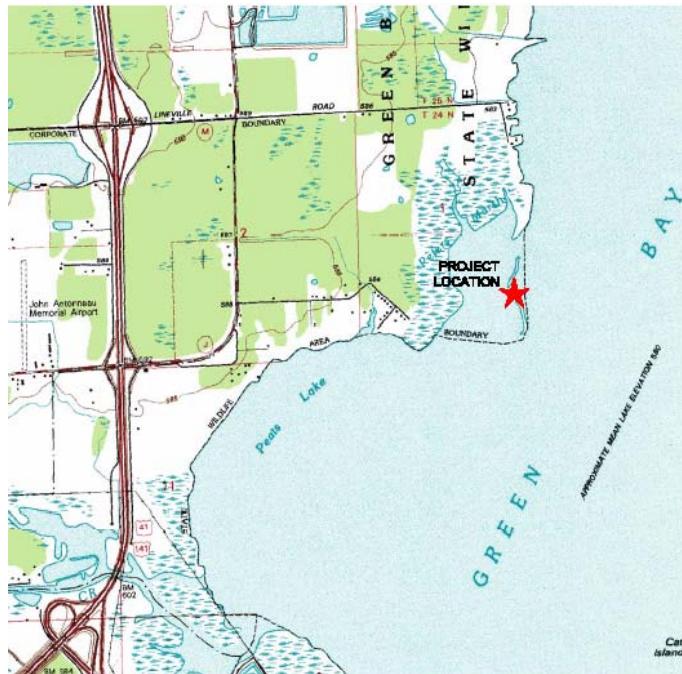
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## Cat Islands Restoration – Section 204 Subsurface Conditions

### Project Location

The project site for the Cat Island Restoration is located along the western shore of Green Bay, Wisconsin. Refer to Figure 1 below for the approximate project location.



**Figure 1. Project Location Map.**

### Field Explorations and Laboratory Testing

In May of 1997, 3 test borings were drilled by Coleman Engineering along the submerged islands to characterize the soils in the vicinity of project site. All 3 borings were located in Green Bay Harbor in approximately 3.5 to 4.5 feet of water and required the use of barge to access the locations. Soil boring locations are shown on page B-3. Geotechnical laboratory testing was completed by Coleman Engineering on selected samples as directed by the USACE – Detroit District. Results from the 1997 investigation are included in this Appendix.

In February of 2007, three additional borings were drilled by STS Consultants along the proposed access road location. The approximate depth of water along this location ranged from 1.5 feet to at ground surface. Because of the shallow water, an ATV rig was able to access these locations during the winter. Soil boring locations are shown on page B-3. Geotechnical

laboratory testing was completed by STS Consultants on selected samples as directed by the USACE – Detroit District. Results from the 2007 investigation are included in this Appendix.

### Site Geology

The lake bed soil consists of organic sands and silts underlain by silts, sands and clays. Unconsolidated native soils in the vicinity of the site consist of lacustrine sand, silt and clay. The lacustrine clay and silt was deposited in areas formerly inundated by glacial Great Lakes. More detailed descriptions of the soil conditions encountered in the soil borings are provided on the individual boring logs in this Appendix.

### Geotechnical Considerations

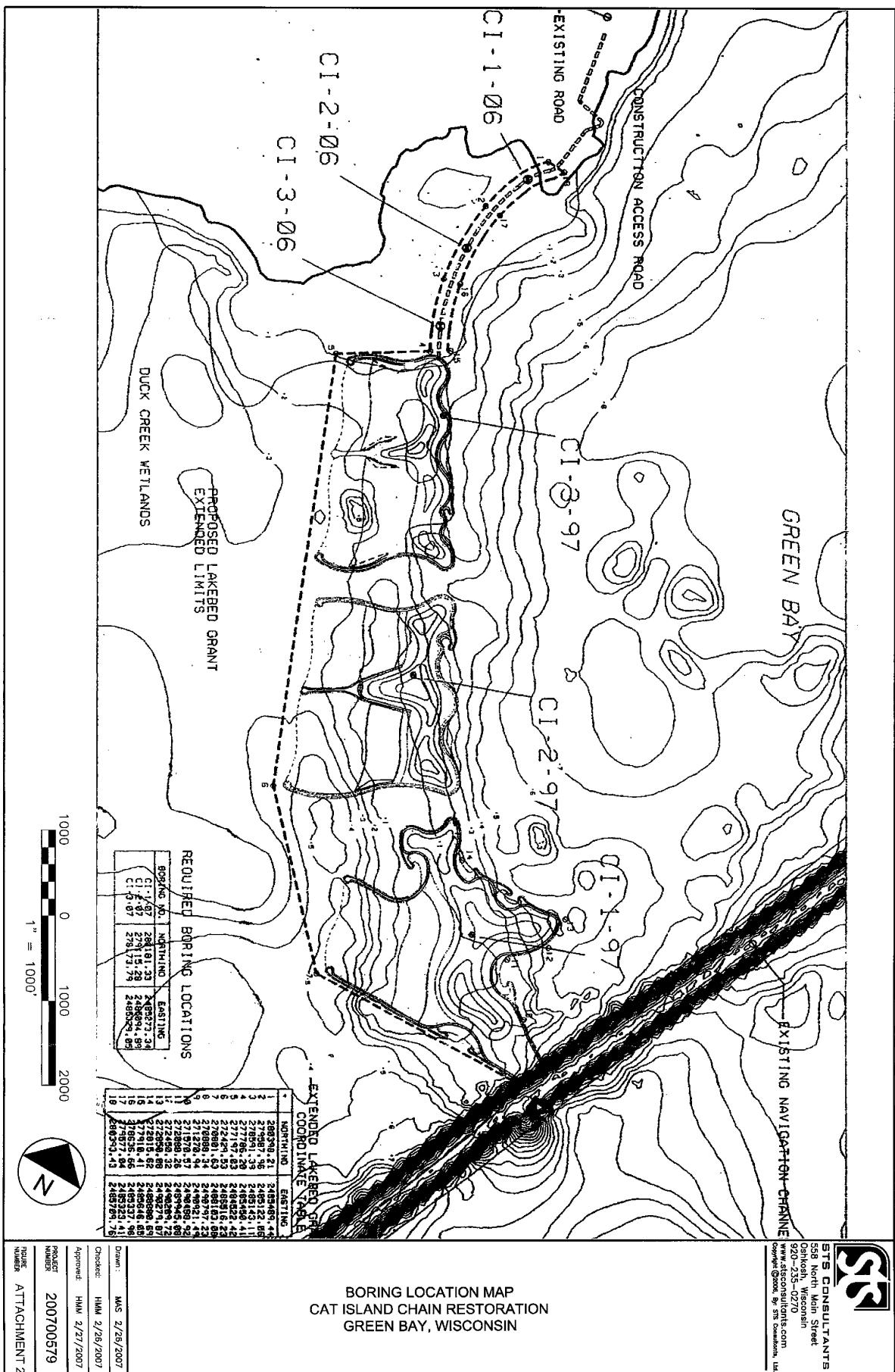
Settlement calculations were performed for the access road to determine overbuild for quantity and cost estimating purposes (See Settlement Calculations). No slope stability analysis on the access road was performed at this time because it is expected to be a temporary structure. During the detailed design phase, it may be warranted to analyze the access road for stability depending on the final design cross section and any additional project requirements. However, a preliminary bearing capacity calculation was done to check if the existing foundation soils can support the proposed access road and additional construction loading (See Bearing Capacity Calculations). Based on the calculation, the maximum allowable load for the access road construction is 2280 pounds per square foot using a recommended factor of safety of 2.5.

No analyses were done on the proposed stone revetment alternatives for the island restoration portions of the project. A stability analysis is highly recommended for the selected stone revetment (wave barrier) design alternative once it is developed.

The analyses, conclusions, and recommendations contained in this appendix are based on site conditions as they presently exist. It is assumed that the exploratory borings are representative of the subsurface conditions throughout the site, i.e., the subsurface conditions everywhere are not significantly different from those disclosed by the explorations.

### References

- 1) Geotechnical Evaluation for the Cat Island Chain Restoration, prepared by STS Consultants, May 2007.
- 2) Report of Subsurface Investigation: Cat Island, Green Bay, Wisconsin, prepared by Coleman Engineering, July 1997.



BORING LOCATION MAP  
CAT ISLAND CHAIN RESTORATION  
GREEN BAY, WISCONSIN

STS CONSULTANTS

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| DRILLING LOG                                                                                                               |            |             | DIVISION<br>North Central                                                                                                             | INSTALLATION<br>Detroit      | SHEET<br>1<br>OF 2 SHEETS    |                                                                                        |
|----------------------------------------------------------------------------------------------------------------------------|------------|-------------|---------------------------------------------------------------------------------------------------------------------------------------|------------------------------|------------------------------|----------------------------------------------------------------------------------------|
| 1. PROJECT<br>Cat Island - Green Bay, WI                                                                                   |            |             | 10. SIZE AND TYPE OF BIT 4-1/4" HSA, SPT                                                                                              |                              |                              |                                                                                        |
| 2. LOCATION (Coordinates or Station)<br>See Remarks                                                                        |            |             | 11. DATUM FOR ELEVATION SHOWN (TBM or MSL)                                                                                            |                              |                              |                                                                                        |
| 3. DRILLING AGENCY<br>Coleman Engineering Company                                                                          |            |             | 12. MANUFACTURER'S DESIGNATION OF DRILL<br>Diedrich D-50 ATV                                                                          |                              |                              |                                                                                        |
| 4. HOLE NO. (As shown on drawing<br>title and file number) CI-1-97                                                         |            |             | 13. TOTAL NO. OF OVER-<br>BURDEN SAMPLES TAKEN DISTURBED 9 UNDISTURBED 1                                                              |                              |                              |                                                                                        |
| 5. NAME OF DRILLER<br>Scott Strigel                                                                                        |            |             | 14. TOTAL NUMBER CORE BOXES 0                                                                                                         |                              |                              |                                                                                        |
| 6. DIRECTION OF HOLE<br><input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED 0.0 DEG. FROM VERT. |            |             | 15. ELEVATION GROUND WATER 579.7                                                                                                      |                              |                              |                                                                                        |
| 7. THICKNESS OF OVERTURDEN N/A                                                                                             |            |             | 16. DATE HOLE STARTED MAY 21 97 COMPLETED MAY 21 97                                                                                   |                              |                              |                                                                                        |
| 8. DEPTH DRILLED INTO ROCK 0                                                                                               |            |             | 17. ELEVATION TOP OF HOLE 579.7                                                                                                       |                              |                              |                                                                                        |
| 9. TOTAL DEPTH OF HOLE 24.2                                                                                                |            |             | 18. TOTAL CORE RECOVERY FOR BORING 0 %                                                                                                |                              |                              |                                                                                        |
| ELEVATION<br>a                                                                                                             | DEPTH<br>b | LEGEND<br>c | CLASSIFICATION OF MATERIALS<br>(Description)<br>d                                                                                     | % CORE<br>RECOV-<br>ERY<br>e | BOX OR<br>SAMPLE<br>NO.<br>f |                                                                                        |
|                                                                                                                            |            |             | Water                                                                                                                                 |                              |                              | REMARKS<br>(Drilling time, water loss, depth<br>weathering, etc., if significant)<br>g |
| 576.0                                                                                                                      | 3.7        |             | Wet, loose, SAND, grayish-light brown, fine, some organics, shells, trace of silt                                                     | 47%                          | 1<br>3.7<br>5.2              | 4-1/4" HSA, SPT Sampling<br>140# Hammer, 30" Drop<br>2" Split Spoon                    |
| 574.5                                                                                                                      | 5.2        |             | Wet, SAND, grayish-light brown, fine, trace of gravel, organics, trace of silt, loose                                                 | 80%                          | 2<br>5.2<br>6.7              | Lat = 44° 33' 43.94"<br>Long = 88° 00' 03.97                                           |
| 573.0                                                                                                                      | 6.7        |             | Wet, SAND, grayish-light brown, fine, trace of gravel, trace of organics, trace of silt, loose                                        | 87%                          | 3<br>6.7<br>8.2              | SPT 3.7' to 5.2'<br>Blows 1 - 1 - 4<br>N = (5)                                         |
| 571.5                                                                                                                      | 8.2        |             | Wet, SAND, grayish-light brown, fine, trace of gravel, trace of organics, trace of silt, loose                                        | 80%                          | 4<br>8.2<br>9.7              | SPT 5.2' to 6.7'<br>Blows 4 - 4 - 4<br>N = (8)                                         |
| 569.4                                                                                                                      | 10.3       |             | Wet, SAND, grayish-light brown, fine, trace of gravel, trace of organics, trace of silt, loose                                        | 93%                          | 5<br>9.7<br>11.2             | SPT 6.7' to 8.2'<br>Blows 4 - 3 - 2<br>N = (5)                                         |
| 568.5                                                                                                                      | 11.2       |             | Wet, SILTY SAND, grayish-light brown, fine, loose                                                                                     | 80%                          | 6<br>11.2<br>12.7            | SPT 8.2' to 9.7'<br>Blows 5 - 3 - 4<br>N = (7)                                         |
| 567.0                                                                                                                      | 12.7       |             | Wet, SAND, grayish-light brown, fine, trace of organics, trace of gravel and silt, very loose (wet, clayey, silty sand 2.5' to 12.6') | 27%                          | 7<br>12.7<br>14.2            | SPT 9.7' to 11.2'<br>Blows 3 - 2 - 2<br>N = (4)                                        |
| 565.5                                                                                                                      | 14.2       |             | Wet, SILTY SAND, dark brown, fine, very loose, trace of clay                                                                          | 90%                          | 8<br>14.2<br>16.2            | SPT 11.2' to 12.7'<br>Blows 1/12" - 1<br>N = (1)                                       |
| 564.1                                                                                                                      | 15.6       |             | Gray, fine to medium, SAND, trace of silt                                                                                             |                              |                              | SPT 12.7' to 14.2'<br>Blows 1/12" - 1<br>N = (1)                                       |
| 563.5                                                                                                                      | 16.2       |             | Brown, varved, plastic, CLAY, medium stiff                                                                                            |                              |                              | 3" ST 14.2' to 16.2'<br>Sampler Pushed 2.0'<br>Rec - 1.8'                              |
| 562.4                                                                                                                      | 17.3       |             | Wet, CLAY, grayish-brown, plastic, medium stiff                                                                                       |                              |                              | SPT 16.2' to 17.7'<br>Blows 1 - 2 - 3<br>N = (5)                                       |
| 562.0                                                                                                                      | 17.7       |             | Wet, CLAY, brown, plastic, medium stiff                                                                                               |                              |                              | Torvane 0.4 to 0.5                                                                     |

Hole No. CI-1-97

| DRILLING LOG                                                                                                               |            |             | DIVISION<br>North Central                                                                                                                                                    | INSTALLATION<br>Detroit      | SHEET<br>2<br>OF 2 SHEETS    |                                                                                        |
|----------------------------------------------------------------------------------------------------------------------------|------------|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|------------------------------|----------------------------------------------------------------------------------------|
| 1. PROJECT<br>Cat Island - Green Bay, WI                                                                                   |            |             | 10. SIZE AND TYPE OF BIT 4-1/4" HSA, SPT                                                                                                                                     |                              |                              |                                                                                        |
| 2. LOCATION (Coordinates or Station)<br>See Remarks                                                                        |            |             | 11. DATUM FOR ELEVATION SHOWN (TBM or MSL)<br>IGLD '55                                                                                                                       |                              |                              |                                                                                        |
| 3. DRILLING AGENCY<br>Coleman Engineering Company                                                                          |            |             | 12. MANUFACTURER'S DESIGNATION OF DRILL<br>Diedrich D-50 ATV                                                                                                                 |                              |                              |                                                                                        |
| 4. HOLE NO. (As shown on drawing<br>title and file number)                                                                 |            |             | 13. TOTAL NO. OF OVER-<br>BURDEN SAMPLES TAKEN 9 1 DISTURBED UNDISTURBED                                                                                                     |                              |                              |                                                                                        |
| 5. NAME OF DRILLER<br>Scott Strigel                                                                                        |            |             | 14. TOTAL NUMBER CORE BOXES 0                                                                                                                                                |                              |                              |                                                                                        |
| 6. DIRECTION OF HOLE<br><input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED 0.0 DEG. FROM VERT. |            |             | 15. ELEVATION GROUND WATER 579.7                                                                                                                                             |                              |                              |                                                                                        |
| 7. THICKNESS OF OVERBURDEN N/A                                                                                             |            |             | 16. DATE HOLE STARTED COMPLETED<br>MAY 21 97 MAY 21 97                                                                                                                       |                              |                              |                                                                                        |
| 8. DEPTH DRILLED INTO ROCK 0                                                                                               |            |             | 17. ELEVATION TOP OF HOLE 579.7                                                                                                                                              |                              |                              |                                                                                        |
| 9. TOTAL DEPTH OF HOLE 24.2                                                                                                |            |             | 18. TOTAL CORE RECOVERY FOR BORING 0 %                                                                                                                                       |                              |                              |                                                                                        |
|                                                                                                                            |            |             | 19. SIGNATURE OF INSPECTOR <i>Chris Rasmussen</i>                                                                                                                            |                              |                              |                                                                                        |
| ELEVATION<br>a                                                                                                             | DEPTH<br>b | LEGEND<br>c | CLASSIFICATION OF MATERIALS<br>(Description)<br>d                                                                                                                            | % CORE<br>RECOV-<br>ERY<br>e | BOX OR<br>SAMPLE<br>NO.<br>f | REMARKS<br>(Drilling time, water loss, depth<br>weathering, etc., if significant)<br>g |
| 557.0                                                                                                                      | 22.7       |             | Wet, CLAY, brown, plastic, medium stiff                                                                                                                                      | 53%                          | 10<br>22.7<br>24.2           | SPT 22.7' to 24.2'<br>Blows 3 - 2 - 5<br>N = (?)<br>Pen .75 tp 1.25, Torvane 0.4       |
| 555.5                                                                                                                      | 24.2       |             | 24.2'<br><br>End of Boring<br><br>Borehole was backfilled with a mixture of<br>95% cement and 5% quick gel (3 bags<br>cement approximately 45 gallons) from<br>24.2' to 3.7' |                              |                              |                                                                                        |

Hole No. CI-2-97

| DRILLING LOG                                                                                                                     |            | DIVISION<br>North Central |                                                                                                                  | INSTALLATION<br>Detroit                                      |                              | SHEET 1<br>OF 2 SHEETS                                                                              |                                                                                                     |
|----------------------------------------------------------------------------------------------------------------------------------|------------|---------------------------|------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|------------------------------|-----------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|
| 1. PROJECT<br>Cat Island - Green Bay, WI                                                                                         |            |                           |                                                                                                                  | 10. SIZE AND TYPE OF BIT<br>4-1/4" HSA, SPT                  |                              |                                                                                                     |                                                                                                     |
| 2. LOCATION (Coordinates or Station)<br>See Remarks                                                                              |            |                           |                                                                                                                  | 11. DATUM FOR ELEVATION SHOWN (TBM or MSL)<br>IGLD '55       |                              |                                                                                                     |                                                                                                     |
| 3. DRILLING AGENCY<br>Coleman Engineering Company                                                                                |            |                           |                                                                                                                  | 12. MANUFACTURER'S DESIGNATION OF DRILL<br>Diedrich D-50 ATV |                              |                                                                                                     |                                                                                                     |
| 4. HOLE NO. (As shown on drawing<br>title and file number)                                                                       | CI-2-97    |                           |                                                                                                                  | 13. TOTAL NO. OF OVER-<br>BURDEN SAMPLES TAKEN               | DISTURBED<br>10              | UNDISTURBED<br>1                                                                                    |                                                                                                     |
| 5. NAME OF DRILLER<br>Scott Strigel                                                                                              |            |                           |                                                                                                                  | 14. TOTAL NUMBER CORE BOXES<br>0                             |                              |                                                                                                     |                                                                                                     |
| 6. DIRECTION OF HOLE<br><input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED    0.0    DEG. FROM VERT. |            |                           |                                                                                                                  | 15. ELEVATION GROUND WATER<br>579.7                          |                              |                                                                                                     |                                                                                                     |
| 7. THICKNESS OF OVERBURDEN<br>N/A                                                                                                |            |                           |                                                                                                                  | 16. DATE HOLE<br>MAY 21 97                                   | STARTED<br>MAY 21 97         | COMPLETED<br>MAY 21 97                                                                              |                                                                                                     |
| 8. DEPTH DRILLED INTO ROCK<br>0                                                                                                  |            |                           |                                                                                                                  | 17. ELEVATION TOP OF HOLE<br>579.7                           |                              |                                                                                                     |                                                                                                     |
| 9. TOTAL DEPTH OF HOLE<br>23.8                                                                                                   |            |                           |                                                                                                                  | 18. TOTAL CORE RECOVERY FOR BORING<br>0 %                    |                              |                                                                                                     |                                                                                                     |
|                                                                                                                                  |            |                           |                                                                                                                  | 19. SIGNATURE OF INSPECTOR<br><i>Chris Rasmussen</i>         |                              |                                                                                                     |                                                                                                     |
| ELEVATION<br>a                                                                                                                   | DEPTH<br>b | LEGEND<br>c               | CLASSIFICATION OF MATERIALS<br>(Description)<br>d                                                                | % CORE<br>RECOV-<br>ERY<br>e                                 | BOX OR<br>SAMPLE<br>NO.<br>f | REMARKS<br>(Drilling time, water loss, depth<br>weathering, etc., if significant)<br>g              |                                                                                                     |
|                                                                                                                                  |            |                           | Water to 3.5'                                                                                                    |                                                              |                              | 4-1/4" HSA, SPT Sampling<br>140# Hammer, 30" Drop<br>2" Split Spoon                                 |                                                                                                     |
| 576.2                                                                                                                            | 3.5        |                           | Wet, SAND, light grayish-brown, fine,<br>trace of silt, organics, loose                                          | 67%                                                          | 1<br>3.5<br>5.0              | Lat = 44° 34' 07"<br>Long = 88° 00' 33"                                                             | SPT 3.5' to 5.0'<br>Blows 1 - 4 - 3<br>N = (7)                                                      |
| 574.7                                                                                                                            | 5.0        |                           | Wet, SAND, grayish-brown, fine, trace of<br>silt and organics, loose                                             | 67%                                                          | 2<br>5.0<br>6.5              | SPT 5.0' to 6.5'<br>Blows 2 - 3 - 1<br>N = (4)                                                      | SPT 6.5' to 8.0'<br>Blows 2 - 2 - 3<br>N = (5)                                                      |
| 573.2                                                                                                                            | 6.5        |                           | Wet, SILTY SAND, grayish-brown, fine to<br>medium, loose<br>...fine                                              | 67%                                                          | 3<br>6.5<br>8.0              | SPT 8.0' to 9.5'<br>Blows 3 - 1 - 2<br>N = (3)                                                      | SPT 9.5' to 11.0'<br>Blows 19 - 21 - 35<br>N = (56)<br>Pen 2.5 to 5.0, Torvane 0.4 to 0.9           |
| 571.7                                                                                                                            | 8.0        |                           | Wet, SILTY SAND, light grayish-brown,<br>fine, loose, clay at 9.4' (stiff)                                       | 67%                                                          | 4<br>8.0<br>9.5              | SPT 11.0' to 12.5'<br>Blows 29 - 29 - 34<br>N = (63)<br>Pen 3.5 to 5.0, Torvane 0.1 to 0.2          | SPT 12.5' to 14.0'<br>Blows 20 - 28 - 38<br>N = (66)<br>Pen 0.3, Torvane 0.1                        |
| 570.2                                                                                                                            | 9.5        |                           | Wet, CLAYEY SILT, sandy, brown, thinly<br>layered, low plasticity, hard                                          | 67%                                                          | 5<br>9.5<br>11.0             | SPT 14.0' to 15.5'<br>Blows 17 - 31 - 41<br>N = (72)                                                | SPT 14.0' to 15.5'<br>Blows 17 - 31 - 41<br>N = (72)                                                |
| 568.7                                                                                                                            | 11.0       |                           | Wet, SILTY SAND, brown, fine, trace of<br>clay, very dense                                                       | 100%                                                         | 6<br>11.0<br>12.5            | 3" Shelby Tube 15.5' to 16.3'<br>Pushed 0.8'<br>Rec - 0.8'<br>Standing drilling rig up when pushing | 3" Shelby Tube 15.5' to 16.3'<br>Pushed 0.8'<br>Rec - 0.8'<br>Standing drilling rig up when pushing |
| 567.2                                                                                                                            | 12.5       |                           | Wet, SILT, with sand, brown, trace of<br>clay, very stiff, non-plastic                                           | 93%                                                          | 7<br>12.5                    | SPT 17.3' to 18.8'<br>Blows 33 - 33 - 33<br>N = (66)                                                | SPT 17.3' to 18.8'<br>Blows 33 - 33 - 33<br>N = (66)                                                |
| 566.4                                                                                                                            | 13.3       |                           | Wet, SILTY SAND, brown, fine, very<br>dense                                                                      |                                                              | 14.0                         |                                                                                                     |                                                                                                     |
| 565.7                                                                                                                            | 14.0       |                           | Wet, SILTY SAND, brown, fine, very<br>dense                                                                      | 80%                                                          | 8<br>14.0<br>15.5            |                                                                                                     |                                                                                                     |
| 564.2                                                                                                                            | 15.5       |                           |                                                                                                                  |                                                              |                              |                                                                                                     |                                                                                                     |
| 563.4                                                                                                                            | 16.3       |                           | Wet, non-plastic, SANDY SILT, gray                                                                               | 53%                                                          | 9<br>15.5<br>16.3            |                                                                                                     |                                                                                                     |
| 562.4                                                                                                                            | 17.3       |                           | Wet, SILT, brown, hard, non-plastic, thin<br>layer of wet, silty sand, fine, gray, trace<br>of organics at 18.5' | 100%                                                         | 10<br>17.3<br>18.8           |                                                                                                     |                                                                                                     |

Hole No. CI-2-97

| DRILLING LOG                                                                                                                             |            |             | DIVISION<br>North Central                                                                                                                  | INSTALLATION<br>Detroit      | SHEET<br>2<br>OF 2 SHEETS    |                                                                                            |
|------------------------------------------------------------------------------------------------------------------------------------------|------------|-------------|--------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|------------------------------|--------------------------------------------------------------------------------------------|
| 1. PROJECT<br>Cat Island - Green Bay, WI                                                                                                 |            |             | 10. SIZE AND TYPE OF BIT 4-1/4" HSA, SPT                                                                                                   |                              |                              |                                                                                            |
| 2. LOCATION (Coordinates or Station)<br>See Remarks                                                                                      |            |             | 11. DATUM FOR ELEVATION SHOWN (TBM or MSL)<br>IGLD '55                                                                                     |                              |                              |                                                                                            |
| 3. DRILLING AGENCY<br>Coleman Engineering Company                                                                                        |            |             | 12. MANUFACTURER'S DESIGNATION OF DRILL<br>Diedrich D-50 ATV                                                                               |                              |                              |                                                                                            |
| 4. HOLE NO. (As shown on drawing<br>title and file number) CI-2-97                                                                       |            |             | 13. TOTAL NO. OF OVER-<br>BURDEN SAMPLES TAKEN DISTURBED UNDISTURBED<br>10 1                                                               |                              |                              |                                                                                            |
| 5. NAME OF DRILLER<br>Scott Strigel                                                                                                      |            |             | 14. TOTAL NUMBER CORE BOXES 0                                                                                                              |                              |                              |                                                                                            |
| 6. DIRECTION OF HOLE<br><input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED 0.0 DEG. FROM VERT.               |            |             | 15. ELEVATION GROUND WATER 579.7                                                                                                           |                              |                              |                                                                                            |
| 7. THICKNESS OF OVERBURDEN N/A                                                                                                           |            |             | 16. DATE HOLE STARTED COMPLETED<br>MAY 21 97 MAY 21 97                                                                                     |                              |                              |                                                                                            |
| 8. DEPTH DRILLED INTO ROCK 0                                                                                                             |            |             | 17. ELEVATION TOP OF HOLE 579.7                                                                                                            |                              |                              |                                                                                            |
| 9. TOTAL DEPTH OF HOLE 23.8                                                                                                              |            |             | 18. TOTAL CORE RECOVERY FOR BORING 0 %                                                                                                     |                              |                              |                                                                                            |
| ELEVATION<br>a                                                                                                                           | DEPTH<br>b | LEGEND<br>c | CLASSIFICATION OF MATERIALS<br>(Description)<br>d                                                                                          | % CORE<br>RECOV-<br>ERY<br>e | BOX OR<br>SAMPLE<br>NO.<br>f | REMARKS<br>(Drilling time, water loss, depth<br>weathering, etc., if significant)<br>g     |
| 556.9                                                                                                                                    | 22.8       |             |                                                                                                                                            | 100%                         | 11<br>22.3<br>23.8           | SPT 22.8' to 23.8'<br>Blows 20 - 20 - 32<br>N = (52)<br>Pen 4.5 to 5.0, Torvane 0.7 to 0.8 |
| 555.9                                                                                                                                    | 23.8       |             | Alternating layers of moist, SANDY SILT,<br>non-plastic, grayish-brown, and silty clay,<br>brown, fine, plastic, hard<br><br>End of Boring | 23.8'                        |                              |                                                                                            |
| Borehole was backfilled with mixture of<br>95% cement and 5% quick gel (3 bags<br>cement approximately 45 gallons) from<br>23.8' to 3.5' |            |             |                                                                                                                                            |                              |                              |                                                                                            |

| DRILLING LOG                                                                                                                   |            | DIVISION<br>North Central                                                              |                                                                                                       | INSTALLATION<br>Detroit                                 |                    | SHEET 1<br>OF 2 SHEETS                               |                                                                     |
|--------------------------------------------------------------------------------------------------------------------------------|------------|----------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|---------------------------------------------------------|--------------------|------------------------------------------------------|---------------------------------------------------------------------|
| 1. PROJECT<br>Cat Island - Green Bay, WI                                                                                       |            | 10. SIZE AND TYPE OF BIT<br>4-1/4" HSA, SPT                                            |                                                                                                       | 11. DATUM FOR ELEVATION SHOWN (TBM or MSL)<br>IGLID '55 |                    |                                                      |                                                                     |
| 2. LOCATION (Coordinates or Station)<br>See Remarks                                                                            |            | 12. MANUFACTURER'S DESIGNATION OF DRILL<br>Diedrich D-50 ATV                           |                                                                                                       | 13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN<br>19        |                    | DISTURBED<br>1                                       |                                                                     |
| 3. DRILLING AGENCY<br>Coleman Engineering Company                                                                              |            | 14. TOTAL NUMBER CORE BOXES<br>0                                                       |                                                                                                       | 15. ELEVATION GROUND WATER<br>579.7                     |                    | 16. DATE HOLE<br>STARTED MAY 22 97                   |                                                                     |
| 4. HOLE NO. (As shown on drawing<br>title and file number)<br>CI-3-97                                                          |            | 17. ELEVATION TOP OF HOLE<br>579.7                                                     |                                                                                                       | 18. TOTAL CORE RECOVERY FOR BORING<br>0 %               |                    | COMPLETED<br>MAY 22 97                               |                                                                     |
| 5. NAME OF DRILLER<br>Scott Strigel                                                                                            |            | 19. SIGNATURE OF INSPECTOR<br><i>Chris Rasmussen</i>                                   |                                                                                                       |                                                         |                    |                                                      |                                                                     |
| 6. DIRECTION OF HOLE<br><input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED   0.0   DEG. FROM VERT. |            | CLASSIFICATION OF MATERIALS<br>(Description)                                           |                                                                                                       | % CORE RECOVERY<br>e                                    |                    | BOX OR SAMPLE NO.<br>f                               |                                                                     |
| 7. THICKNESS OF OVERBURDEN<br>N/A                                                                                              |            | REMARKS<br>(Drilling time, water loss, depth<br>weathering, etc., if significant)<br>g |                                                                                                       |                                                         |                    |                                                      |                                                                     |
| 8. DEPTH DRILLED INTO ROCK<br>0                                                                                                |            |                                                                                        |                                                                                                       |                                                         |                    |                                                      |                                                                     |
| 9. TOTAL DEPTH OF HOLE<br>35.1                                                                                                 |            |                                                                                        |                                                                                                       |                                                         |                    |                                                      |                                                                     |
| ELEVATION<br>a                                                                                                                 | DEPTH<br>b | LEGEND<br>c                                                                            | Water to 4.6'                                                                                         |                                                         |                    |                                                      | 4-1/4" HSA, SPT Sampling<br>140# Hammer, 30" Drop<br>2" Split Spoon |
| 575.1                                                                                                                          | 4.6        |                                                                                        | Wet, SAND, light grayish-brown, fine,<br>trace of silt, trace of organics, loose                      | 67%                                                     | 1<br>4.6<br>6.1    | SPT 4.6' to 6.1'<br>Blows 1 - 2 - 3<br>N = (5)       |                                                                     |
| 573.6                                                                                                                          | 6.1        |                                                                                        | Wet, SAND, light grayish-brown, fine,<br>trace of silt, trace of organics, very loose                 | 60%                                                     | 2<br>6.1<br>7.6    | SPT 6.1' to 7.6'<br>Blows 2 - 2 - 1<br>N = (3)       |                                                                     |
| 572.1                                                                                                                          | 7.6        |                                                                                        | Wet, SAND, light grayish-brown, fine,<br>trace of silt, trace of organics, very loose                 | 47%                                                     | 3<br>7.6<br>9.1    | SPT 7.6' to 9.1'<br>Blows 1/18"<br>N = (< 1)         |                                                                     |
| 570.6                                                                                                                          | 9.1        |                                                                                        | Wet, SAND, light grayish-brown, fine,<br>some silt, trace of organics, very loose                     | 60%                                                     | 4<br>9.1<br>10.6   | SPT 9.1' to 10.6'<br>Blows WH/12" - 1<br>N = (< 2)   |                                                                     |
| 569.1                                                                                                                          | 10.6       |                                                                                        | Wet, SAND, light grayish-brown, fine,<br>some silt, trace of organics, trace of shells                | 67%                                                     | 5<br>10.6<br>12.1  | SPT 10.6' to 12.1'<br>Blows 1 - 2 - 1<br>N = (3)     |                                                                     |
| 567.6                                                                                                                          | 12.1       |                                                                                        | Wet, SAND, light grayish-brown, fine,<br>some silt, trace of organics, trace of<br>shells, very loose | 80%                                                     | 6<br>12.1<br>13.6  | SPT 12.1' to 13.6'<br>Blows 1 - 2 - 1<br>N = (3)     |                                                                     |
| 566.1                                                                                                                          | 13.6       |                                                                                        | Wet, SAND, light grayish-brown, fine,<br>some silt, trace of organics, very loose                     | 67%                                                     | 7<br>13.6<br>15.1  | SPT 13.6' to 15.1'<br>Blows 2 - 1 - 1<br>N = (2)     |                                                                     |
| 564.6                                                                                                                          | 15.1       |                                                                                        | Wet, SAND, light grayish-brown, fine,<br>some silt, trace of shells, trace of<br>organics, very loose | 53%                                                     | 8<br>15.1<br>16.6  | SPT 15.1' to 16.6'<br>Blows 2 - 1 - 1<br>N = (2)     |                                                                     |
| 563.1                                                                                                                          | 16.6       |                                                                                        | Wet, SILTY SAND, light grayish-brown,<br>fine, with silt, trace of organics, very<br>loose            | 100%                                                    | 9<br>16.6<br>18.1  | SPT 16.6' to 18.1'<br>Blows 1 - 1/12"<br>N = (< 1)   |                                                                     |
| 561.6                                                                                                                          | 18.1       |                                                                                        | Wet, SILTY SAND, light grayish-brown,<br>fine, trace of shells, very loose                            | 100%                                                    | 10<br>18.1<br>19.6 | SPT 18.1' to 19.6'<br>Blows WR/12" - WH<br>N = (< 1) |                                                                     |
| 560.1                                                                                                                          | 19.6       |                                                                                        |                                                                                                       | 100%                                                    | 11                 |                                                      |                                                                     |

Hole No. CI-3-97

| DRILLING LOG                                                                                                               |            |             | DIVISION<br>North Central                                                                                                         | INSTALLATION<br>Detroit               | SHEET<br>2<br>OF 2 SHEETS    |                                                                                                                           |                     |
|----------------------------------------------------------------------------------------------------------------------------|------------|-------------|-----------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|------------------------------|---------------------------------------------------------------------------------------------------------------------------|---------------------|
| 1. PROJECT<br>Cat Island - Green Bay, WI                                                                                   |            |             | 10. SIZE AND TYPE OF BIT 4-1/4" HSA, SPT                                                                                          |                                       |                              |                                                                                                                           |                     |
| 2. LOCATION (Coordinates or Station)<br>See Remarks                                                                        |            |             | 11. DATUM FOR ELEVATION SHOWN (TBM or MSL)                                                                                        |                                       |                              |                                                                                                                           |                     |
| 3. DRILLING AGENCY<br>Coleman Engineering Company                                                                          |            |             | 12. MANUFACTURER'S DESIGNATION OF DRILL<br>Diedrich D-50 ATV                                                                      |                                       |                              |                                                                                                                           |                     |
| 4. HOLE NO. (As shown on drawing<br>title and file number) CI-3-97                                                         |            |             | 13. TOTAL NO. OF OVER-<br>BURDEN SAMPLES TAKEN DISTURBED 19 UNDISTURBED 1                                                         |                                       |                              |                                                                                                                           |                     |
| 5. NAME OF DRILLER<br>Scott Strigel                                                                                        |            |             | 14. TOTAL NUMBER CORE BOXES 0                                                                                                     |                                       |                              |                                                                                                                           |                     |
| 6. DIRECTION OF HOLE<br><input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED 0.0 DEG. FROM VERT. |            |             | 15. ELEVATION GROUND WATER 579.7                                                                                                  |                                       |                              |                                                                                                                           |                     |
| 7. THICKNESS OF OVERBURDEN N/A                                                                                             |            |             | 16. DATE HOLE STARTED MAY 22 97 COMPLETED MAY 22 97                                                                               |                                       |                              |                                                                                                                           |                     |
| 8. DEPTH DRILLED INTO ROCK 0                                                                                               |            |             | 17. ELEVATION TOP OF HOLE 579.7                                                                                                   |                                       |                              |                                                                                                                           |                     |
| 9. TOTAL DEPTH OF HOLE 35.1                                                                                                |            |             | 18. TOTAL CORE RECOVERY FOR BORING 0 %                                                                                            |                                       |                              |                                                                                                                           |                     |
|                                                                                                                            |            |             | 19. SIGNATURE OF INSPECTOR <i>Chris Rasmussen</i>                                                                                 |                                       |                              |                                                                                                                           |                     |
| ELEVATION<br>a                                                                                                             | DEPTH<br>b | LEGEND<br>c | CLASSIFICATION OF MATERIALS<br>(Description)<br>d                                                                                 | % CORE<br>RECOV-<br>ERY<br>e          | BOX OR<br>SAMPLE<br>NO.<br>f | REMARKS<br>(Drilling time, water loss, depth<br>weathering, etc., if significant)<br>g                                    |                     |
| 558.6                                                                                                                      | 21.1       |             | Wet, SILTY SAND, light grayish-brown, fine, trace of shells, very loose                                                           | 19.6<br>21.1                          | 12<br>21.1<br>22.6           | SPT 19.6' to 21.1'<br>Blows WR/18"<br>N = (<1)                                                                            |                     |
| 557.1                                                                                                                      | 22.6       |             | Wet, SILTY SAND, light grayish-brown, fine, trace of shells, trace of organics, very loose                                        | 73%                                   | 22.6<br>24.1                 | SPT 21.1' to 22.6'<br>Blows WR/18"<br>N = (<1)                                                                            |                     |
| 555.6                                                                                                                      | 24.1       |             | Wet, SILTY SAND, light grayish-brown, fine, trace of shells, trace of organics, very loose                                        | 100%                                  | 13<br>22.6<br>24.1           | SPT 22.6' to 24.1'<br>Blows WR/18"<br>N = (<1)                                                                            |                     |
| 554.1                                                                                                                      | 25.6       |             | Wet, SILTY SAND, light grayish-brown, fine, trace of shells, trace of organics, very loose (24.4' to 25.1' sample is moist)       | 100%                                  | 14<br>24.1<br>25.6           | SPT 24.1' to 25.6'<br>Blows WR/18"<br>N = (<1)                                                                            |                     |
| 552.6                                                                                                                      | 27.1       |             | Wet, SANDY SILT, light grayish-brown, fine, trace of organics, very soft, non-plastic                                             | 100%                                  | 15<br>25.6<br>27.1           | SPT 25.6' to 27.1'<br>Blows WR/6" - WH/12"<br>N = (<1)<br>Pen 0, Torvane 0.1 to .2                                        |                     |
| 551.1                                                                                                                      | 28.6       |             | Wet, SANDY SILT, light grayish-brown, fine, trace of organics, very soft, non-plastic                                             | 100%                                  | 16<br>27.1<br>28.6           | SPT 27.1' to 28.6'<br>Blows WH/18"<br>N = (<1)<br>Pen 0.0, Torvane 0.15 - 0.25                                            |                     |
| 549.6                                                                                                                      | 30.1       |             | Wet, SANDY SILT, light grayish-brown, fine, trace of organics, trace of shells, very soft, non-plastic                            | 100%                                  | 17<br>28.6<br>30.1           | SPT 28.6' to 30.1'<br>Blows WH/12" - 2<br>N = (2)<br>Pen 0.0, Torvane 0.1                                                 |                     |
| 548.1                                                                                                                      | 31.6       |             | Wet, ORGANIC SOIL, light grayish-brown, trace of fine sand, soft, low plasticity                                                  | 100%                                  | 18<br>30.1<br>31.6           | SPT 30.1' to 31.6'<br>Blows 1 - 2 - 1<br>N = (3)<br>Pen 0.25, Torvane 0.15                                                |                     |
| 545.7                                                                                                                      | 34.0       |             | Wet, ORGANIC SOIL, light grayish-brown, trace of fine sand, slightly plastic, soft                                                | 73%                                   | 19<br>31.6<br>33.1           | 3" Shelby Tube 31.6' to 33.6'<br>Pushed 2.0'<br>Rec. - 1.1'<br>Test taken from tip of Shelby Tube<br>Pen 0.0, Torvane 0.1 |                     |
| 544.6                                                                                                                      | 35.1       |             | Moist, ORGANIC SOIL, gray, soft, low plasticity                                                                                   | 100%                                  | 20<br>33.6<br>35.1           | SPT 33.6' to 35.1'<br>Blows 1 - 2 - 1<br>N = (3)<br>Pen .2 to .25, Torvane .15 to .25                                     |                     |
|                                                                                                                            |            |             | End of Boring                                                                                                                     |                                       |                              |                                                                                                                           |                     |
|                                                                                                                            |            |             | Borehole was backfilled with a mixture of 95% cement and 5% quick gel (5 bags cement approximately 65 gallons) from 35.1' to 4.6' |                                       |                              |                                                                                                                           |                     |
| ENG FORM<br>MAR 71                                                                                                         |            |             | 1836 PREVIOUS EDITIONS ARE OBSOLETE.<br>(modified by GCA 1/94)                                                                    | PROJECT<br>Cat Island - Green Bay, WI |                              |                                                                                                                           | HOLE NO.<br>CI-3-97 |

## Hole No. CI-1-07

| DRILLING LOG                                                                                                           |           |           | DIVISION                                                                            | INSTALLATION                                                                  |                   | SHEET<br>1<br>OF 1 SHEETS                                                      |
|------------------------------------------------------------------------------------------------------------------------|-----------|-----------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|-------------------|--------------------------------------------------------------------------------|
| 1. PROJECT<br>Cat Island                                                                                               |           |           | JOB NUMBER<br>200700579                                                             | 10. SIZE AND TYPE OF BIT<br>11. DATUM FOR ELEVATION SHOWN (TBM or MSL)<br>MSL |                   |                                                                                |
| 2. LOCATION (Coordinates or Station)<br>280, 181, 33N 2,485,273,34E                                                    |           |           | 12. MANUFACTURER'S DESIGNATION OF DRILL                                             |                                                                               |                   |                                                                                |
| 3. DRILLING AGENCY<br>STS Consultants, Ltd.                                                                            |           |           | 13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN   DISTURBED   UNDISTURBED<br>11   11   2 |                                                                               |                   |                                                                                |
| 4. HOLE NO. (As shown on drawing title and file number)                                                                |           |           | 14. TOTAL NUMBER CORE BOXES                                                         |                                                                               |                   |                                                                                |
| CI-1-07                                                                                                                |           |           | 15. DEPTH GROUND WATER 1.5                                                          |                                                                               |                   |                                                                                |
| 5. NAME OF DRILLER<br>John D.                                                                                          |           |           | 16. DATE HOLE STARTED 2-19-07 COMPLETED 2-19-07                                     |                                                                               |                   |                                                                                |
| 6. DIRECTION OF HOLE<br><input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED DEG. FROM VERT. |           |           | 17. ELEVATION TOP OF HOLE 578.5                                                     |                                                                               |                   |                                                                                |
| 7. THICKNESS OF OVERBURDEN                                                                                             |           |           | 18. TOTAL CORE RECOVERY FOR BORING %                                                |                                                                               |                   |                                                                                |
| 8. DEPTH DRILLED INTO ROCK                                                                                             |           |           | 19. SIGNATURE OF INSPECTOR                                                          |                                                                               |                   |                                                                                |
| 9. TOTAL DEPTH OF HOLE 29.5                                                                                            |           |           |                                                                                     |                                                                               |                   |                                                                                |
| ELEVATION                                                                                                              | DEPTH     | LEGEND    | CLASSIFICATION OF MATERIALS<br>(Description)                                        | CORE RECOVERY (ft.)                                                           | BOX OR SAMPLE NO. | REMARKS<br>(Drilling time, water loss, depth weathering, etc., if significant) |
| a                                                                                                                      | b         | c         | d                                                                                   | e                                                                             | f                 | g                                                                              |
| 578.50                                                                                                                 | 0         | 0.0-2.0   | Gray to black silty sand with organics and trace wood (SM)                          | 1                                                                             | 1                 | 5 - 4 - 3 - 3                                                                  |
|                                                                                                                        | 2         | 2.0-4.0   | Brown silty sand with trace roots (SM)                                              | 1.2                                                                           | 2                 | WOH - 3 - 2 - 3                                                                |
|                                                                                                                        | 4         | 4.0-5.0   | Brown sandy silt (ML)                                                               | 1.8                                                                           | 3                 | 2 - 5 - 2 - 3                                                                  |
|                                                                                                                        | 6         | 6.0-8.0   | Red brown silty clay (CL)                                                           | 1.3                                                                           | 4                 | 2 - 2 - 3 - 5<br>Qp = 2.5 tsf                                                  |
|                                                                                                                        | 8         | 8.0-10.0  | Red brown silty clay - varved - with gray silt (4mm) (CL)                           | 1.5                                                                           | 5                 | 4 - 5 - 7 - 9<br>Qp = 1.0 tsf<br>Set casing to 8.0 feet                        |
| 568.50                                                                                                                 | 10        | 10.0-12.0 |                                                                                     | 1.7                                                                           | 6                 | Osterberg Sample<br>Qp = 1.25 tsf                                              |
|                                                                                                                        | 12        | 12.0-12.5 | Drilled with rock bit                                                               |                                                                               | NS                | 3 - 3 - 2 - 3<br>Qp = 0.75 tsf                                                 |
|                                                                                                                        | 12.5-14.0 |           | Red brown silty clay - varved - with sand seams at 14.0 feet (5mm thick) (CL)       | 2                                                                             | 7                 |                                                                                |
|                                                                                                                        | 14        | 14.5-15.0 | Drilled with rock bit                                                               |                                                                               | NS                |                                                                                |
|                                                                                                                        | 15.0-17.0 |           | Brown sandy silt - wet (ML)                                                         | .6                                                                            | 8                 | Osterberg Sample                                                               |
|                                                                                                                        | 16        |           |                                                                                     |                                                                               |                   |                                                                                |
|                                                                                                                        | 17.0-17.5 |           | Drilled with rock bit                                                               |                                                                               | NS                | 8 - 7 - 9 - 7                                                                  |
|                                                                                                                        | 17.5-19.5 |           | Brown silty fine to medium sand (SM)                                                | 1.8                                                                           | 9                 |                                                                                |
| 558.50                                                                                                                 | 20        | 19.5-20.0 | Drilled with rock bit                                                               |                                                                               | NS                |                                                                                |
|                                                                                                                        | 20.0-22.0 |           | Brown silty fine to medium sand (SM)                                                | 1.3                                                                           | 10                | 5 - 6 - 7 - 8                                                                  |
|                                                                                                                        | 22        | 22.0-22.5 | Drilled with rock bit                                                               |                                                                               | NS                |                                                                                |
|                                                                                                                        | 22.5-24.5 |           | Brown silty fine to medium sand (SM)                                                | 1.1                                                                           | 11                | 5 - 6 - 8 - 8                                                                  |
|                                                                                                                        | 24        |           |                                                                                     |                                                                               |                   |                                                                                |
|                                                                                                                        | 24.5-25.0 |           | Drilled with rock bit                                                               |                                                                               | NS                |                                                                                |
|                                                                                                                        | 25.0-27.0 |           | Brown silty fine to medium sand (SM)                                                | 1.7                                                                           | 12                | 1 - 2 - 3 - 3                                                                  |
|                                                                                                                        | 26        |           |                                                                                     |                                                                               |                   |                                                                                |
|                                                                                                                        | 27.0-27.5 |           | Drilled with rock bit                                                               |                                                                               | NS                |                                                                                |
|                                                                                                                        | 27.5-29.5 |           | Brown silty fine to medium sand (SM)                                                | .6                                                                            | 13                | 3 - 6 - 7 - 9                                                                  |
| 549.00                                                                                                                 |           |           | End of Boring                                                                       |                                                                               |                   |                                                                                |

## Hole No. CI-2-07

| DRILLING LOG                                                                                                           |            |             | DIVISION                                                                                  | INSTALLATION                                                                  |                              |                                                                                        | SHEET<br>1<br>OF 1<br>SHEETS |
|------------------------------------------------------------------------------------------------------------------------|------------|-------------|-------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|------------------------------|----------------------------------------------------------------------------------------|------------------------------|
| 1. PROJECT<br>Cat Island                                                                                               |            |             | JOB NUMBER<br>200700579                                                                   | 10. SIZE AND TYPE OF BIT<br>11. DATUM FOR ELEVATION SHOWN (TBM or MSL)<br>MSL |                              |                                                                                        |                              |
| 2. LOCATION (Coordinates or Station)<br>279.115.28N 2,485.094.89E                                                      |            |             |                                                                                           | 12. MANUFACTURER'S DESIGNATION OF DRILL                                       |                              |                                                                                        |                              |
| 3. DRILLING AGENCY<br>STS Consultants, Ltd.                                                                            |            |             |                                                                                           | 13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN                                    |                              |                                                                                        | DISTURBED      UNDISTURBED   |
| 4. HOLE NO. (As shown on drawing title and file number)                                                                |            |             | CI-2-07                                                                                   | 8                                                                             |                              |                                                                                        | 5                            |
| 5. NAME OF DRILLER<br>John D.                                                                                          |            |             |                                                                                           | 14. TOTAL NUMBER CORE BOXES                                                   |                              |                                                                                        |                              |
| 6. DIRECTION OF HOLE<br><input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED DEG. FROM VERT. |            |             |                                                                                           | 15. DEPTH GROUND WATER                                                        |                              |                                                                                        |                              |
| 7. THICKNESS OF OVERBURDEN                                                                                             |            |             |                                                                                           | 16. DATE HOLE STARTED<br>2-19-07                                              |                              |                                                                                        | COMPLETED<br>2-19-07         |
| 8. DEPTH DRILLED INTO ROCK                                                                                             |            |             |                                                                                           | 17. ELEVATION TOP OF HOLE<br>578.0                                            |                              |                                                                                        |                              |
| 9. TOTAL DEPTH OF HOLE<br>29.5                                                                                         |            |             |                                                                                           | 18. TOTAL CORE RECOVERY FOR BORING %                                          |                              |                                                                                        |                              |
|                                                                                                                        |            |             |                                                                                           | 19. SIGNATURE OF INSPECTOR                                                    |                              |                                                                                        |                              |
| ELEVATION<br>a                                                                                                         | DEPTH<br>b | LEGEND<br>c | CLASSIFICATION OF MATERIALS<br>(Description)<br>d                                         | CORE<br>RECOVERY<br>(ft.)<br>e                                                | BOX OR<br>SAMPLE<br>NO.<br>f | REMARKS<br>(Drilling time, water loss, depth<br>weathering, etc., if significant)<br>g |                              |
| 578.00                                                                                                                 | 0          | 0-2.0       | Ice                                                                                       | 2                                                                             | 1                            | 65 -77                                                                                 |                              |
|                                                                                                                        |            |             | Black silty fine sand - trace organics (SM)                                               |                                                                               |                              |                                                                                        |                              |
|                                                                                                                        | 2          | 2.0-4.0     | Brown silty sand - trace roots (SM)                                                       | 1.3                                                                           | 2                            | 33 - 4 - 5 - 4                                                                         |                              |
|                                                                                                                        | 4          | 4.0-6.0     | Brown silty very fine sand with trace clay (SM)                                           | 1.6                                                                           | 3                            | 4 - 3 - 2 - 4                                                                          |                              |
|                                                                                                                        | 6          | 6.0-8.0     |                                                                                           | 2                                                                             | 4                            | 4 - 4 - 3 - 6<br>Clay -- Qp = 1.25 tsf                                                 |                              |
|                                                                                                                        | 8          | 8.0-10.0    | Red brown silty clay - trace 2mm sand seams (CL)                                          | 1                                                                             | 5                            | Osterberg Sample<br>Qp = 1.5 tsf                                                       |                              |
| 568.00                                                                                                                 | 10         | 10.0-12.0   |                                                                                           | 1.2                                                                           | 6                            | Osterberg Sample<br>Qp = 4.5 tsf                                                       |                              |
|                                                                                                                        | 12         | 12.0-12.5   | Drilled with rock bit                                                                     |                                                                               | NS                           | 3" Shelby Tube<br>Qp = 4.5 tsf                                                         |                              |
|                                                                                                                        | 12.5-14.0  |             | Red brown silty clay - trace 2mm sand seams (CL)                                          | 1.2                                                                           | 7                            |                                                                                        |                              |
|                                                                                                                        | 14         | 14.5-15.0   | Drilled with rock bit                                                                     |                                                                               | NS                           | 3" Shelby Tube<br>Qp = 1.25 tsf                                                        |                              |
|                                                                                                                        | 15.0-17.0  |             | Red brown silty clay - trace 2mm sand seams (CL)                                          | 2                                                                             | 8                            |                                                                                        |                              |
|                                                                                                                        | 17.0-17.5  |             | Drilled with rock bit                                                                     |                                                                               | NS                           | 1 - 2 - 2 - 2<br>Qp = 0.5 tsf                                                          |                              |
|                                                                                                                        | 17.5-19.0  |             | Red brown silty clay - trace 2mm sand seams (CL)                                          | 2                                                                             | 9                            |                                                                                        |                              |
| 558.00                                                                                                                 | 19         | 19.5-20.0   | Drilled with rock bit                                                                     |                                                                               | NS                           | 3" Shelby Tube<br>Qp = 1.0 tsf                                                         |                              |
|                                                                                                                        | 20         | 20.0-22.0   | Red brown silty clay - trace 2mm sand seams (CL)                                          | 1.3                                                                           | 10                           |                                                                                        |                              |
|                                                                                                                        | 22         | 22.0-22.5   | Drilled with rock bit                                                                     |                                                                               | NS                           | 3 - 10 - 7 - 7<br>Qp = 2.5 tsf                                                         |                              |
|                                                                                                                        | 22.5-24.0  |             | Red brown silty clay - trace 2mm sand seams (CH) - with sand seam at 23.5 to 23.9 feet    | 2                                                                             | 11                           |                                                                                        |                              |
|                                                                                                                        | 24         | 24.5-25.0   | Drilled with rock bit                                                                     |                                                                               | NS                           | WOH - 2<br>Qp = 0.25 tsf                                                               |                              |
|                                                                                                                        | 25         | 25.0-27.0   | Red brown silty clay - trace 2mm sand seams (CL) - with 10mm thick sand seam at 25.2 feet | 2                                                                             | 12                           |                                                                                        |                              |
|                                                                                                                        | 27         | 27.0-27.5   | Drilled with rock bit                                                                     |                                                                               | NS                           | WOH - 2 - 2<br>Qp = 0 tsf                                                              |                              |
| 548.50                                                                                                                 | 28         | 27.5-29.5   | Red brown silty clay - trace 2mm sand seams (CH)                                          | 2                                                                             | 13                           |                                                                                        |                              |
|                                                                                                                        |            |             | End of Boring                                                                             |                                                                               |                              |                                                                                        |                              |

## Hole No. CI-3-07

| DRILLING LOG                                                                                                                 |            |             | DIVISION                                                                        | INSTALLATION                                                                  |                        | SHEET<br>1<br>OF<br>2<br>SHEETS                                                     |
|------------------------------------------------------------------------------------------------------------------------------|------------|-------------|---------------------------------------------------------------------------------|-------------------------------------------------------------------------------|------------------------|-------------------------------------------------------------------------------------|
| 1. PROJECT<br>Cat Island                                                                                                     |            |             | JOB NUMBER<br>200700579                                                         | 10. SIZE AND TYPE OF BIT<br>11. DATUM FOR ELEVATION SHOWN (TBM or MSL)<br>MSL |                        |                                                                                     |
| 2. LOCATION (Coordinates or Station)<br>278,173.79N 2,485,329.05E                                                            |            |             |                                                                                 | 12. MANUFACTURER'S DESIGNATION OF DRILL                                       |                        |                                                                                     |
| 3. DRILLING AGENCY<br>STS Consultants, Ltd.                                                                                  |            |             |                                                                                 | 13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN                                    |                        | DISTURBED<br>19      UNDISTURBED<br>4                                               |
| 4. HOLE NO. (As shown on drawing title and file number)                                                                      |            |             | CI-3-07                                                                         | 14. TOTAL NUMBER CORE BOXES                                                   |                        |                                                                                     |
| 5. NAME OF DRILLER<br>John D.                                                                                                |            |             |                                                                                 | 15. DEPTH GROUND WATER                                                        |                        |                                                                                     |
| 6. DIRECTION OF HOLE<br><input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT. |            |             |                                                                                 | 16. DATE HOLE STARTED<br>2-20-07                                              | COMPLETED<br>2-20-07   |                                                                                     |
| 7. THICKNESS OF OVERBURDEN                                                                                                   |            |             |                                                                                 | 17. ELEVATION TOP OF HOLE<br>577.8                                            |                        |                                                                                     |
| 8. DEPTH DRILLED INTO ROCK                                                                                                   |            |             |                                                                                 | 18. TOTAL CORE RECOVERY FOR BORING %                                          |                        |                                                                                     |
| 9. TOTAL DEPTH OF HOLE<br>59.5                                                                                               |            |             |                                                                                 | 19. SIGNATURE OF INSPECTOR                                                    |                        |                                                                                     |
| ELEVATION<br>a                                                                                                               | DEPTH<br>b | LEGEND<br>c | CLASSIFICATION OF MATERIALS<br>(Description)<br>d                               | CORE RECOVERY (ft.)<br>e                                                      | BOX OR SAMPLE NO.<br>f | REMARKS<br>(Drilling time, water loss, depth weathering, etc., if significant)<br>g |
| 577.80                                                                                                                       | 0          | 0.0-2.0     | Drilled with auger --- ice with frost                                           | 0                                                                             | NS                     | Too hard to sample                                                                  |
|                                                                                                                              | 2          | 2.0-4.0     | Brown to black silty fine to medium sand with organics (SM) - trace roots (wet) | 1.7                                                                           | 1                      | WOH - 1 - 3 - 4                                                                     |
|                                                                                                                              | 4          | 4.0-6.0     | Brown silty sand - trace roots (SM)                                             | 1.5                                                                           | 2                      | 2 - 3 - 8 - 7                                                                       |
|                                                                                                                              | 6          | 6.0-8.0     | Brown silty sand (SM)                                                           | 1.4                                                                           | 3                      | 6 - 7 - 10 - 7<br>Set casing at 8.0 feet                                            |
|                                                                                                                              | 8          | 8.0-10.0    |                                                                                 | 1.3                                                                           | 4                      | 2 - 2 - 1 - 1                                                                       |
| 567.80                                                                                                                       | 10         | 10.0-12.0   |                                                                                 | 1.9                                                                           | 5                      | WOH - 1 - 1 - 1                                                                     |
|                                                                                                                              | 12         | 12.0-12.5   | Drilled with rock bit                                                           |                                                                               | NS                     | WOH                                                                                 |
|                                                                                                                              |            | 12.5-14.5   | Brown silty sand (SM) becoming more silty                                       | 2                                                                             | 6                      |                                                                                     |
|                                                                                                                              | 14         | 14.5-15.0   | Drilled with rock bit                                                           |                                                                               | NS                     | WOH                                                                                 |
|                                                                                                                              |            | 15.0-17.0   | Brown very silty fine to medium sand (SM)                                       | 2                                                                             | 7                      |                                                                                     |
|                                                                                                                              | 16         |             |                                                                                 |                                                                               |                        | WOH                                                                                 |
|                                                                                                                              |            | 17.0-17.5   | Drilled with rock bit                                                           |                                                                               | NS                     | WOH                                                                                 |
|                                                                                                                              |            | 17.5-19.5   | Brown very silty fine to medium sand (SM)                                       | 2                                                                             | 8                      |                                                                                     |
| 557.80                                                                                                                       | 19         | 19.5-20.0   | Drilled with rock bit                                                           |                                                                               | NS                     | WOH                                                                                 |
|                                                                                                                              | 20         | 20.0-22.0   | Brown very silty fine to medium sand (SM) - with trace shells - more silt       | 2                                                                             | 9                      |                                                                                     |
|                                                                                                                              | 22         | 22.0-22.5   | Drilled with rock bit                                                           |                                                                               | NS                     | WOH - 2 - 1                                                                         |
|                                                                                                                              |            | 22.5-23.0   | Gray brown fine sandy silt - trace shells (MH)                                  | 2                                                                             | 10                     |                                                                                     |
|                                                                                                                              | 24         | 24.5-25.0   | Drilled with rock bit                                                           |                                                                               | NS                     | WOH - 3                                                                             |
|                                                                                                                              |            | 25.0-27.0   | Gray brown fine sandy silt - trace shells (ML)                                  | 2                                                                             | 11                     |                                                                                     |
|                                                                                                                              | 26         |             |                                                                                 |                                                                               |                        | WOH - 3                                                                             |
|                                                                                                                              |            | 27.0-27.5   | Drilled with rock bit                                                           |                                                                               | NS                     |                                                                                     |
|                                                                                                                              |            | 27.5-28.0   | Gray brown fine very silty clay - trace shells (CL)                             | 2                                                                             | 12                     |                                                                                     |
| 547.80                                                                                                                       | 29         | 29.5-30.0   | Drilled with rock bit                                                           |                                                                               | NS                     | WOH - 3 - 2 - 3                                                                     |
|                                                                                                                              | 30         | 30.0-32.0   | Gray brown fine sandy silt - trace shells (ML)                                  | 2                                                                             | 13                     |                                                                                     |
|                                                                                                                              | 32         | 32.0-32.5   | Drilled with rock bit                                                           |                                                                               | NS                     | WOH - 2 - 3 - 3                                                                     |
|                                                                                                                              |            | 32.5-34.5   | Gray silt - with trace shells and trace wood chips (ML)                         | 2                                                                             | 14                     |                                                                                     |
|                                                                                                                              | 34         | 34.5-35.0   | Drilled with rock bit                                                           |                                                                               | NS                     |                                                                                     |

## Hole No. CI-3-07

| DRILLING LOG                                                                                           |            |             | DIVISION                                                                                | INSTALLATION                                                                  |                              | SHEET<br>2<br>OF<br>2<br>SHEETS                                                        |
|--------------------------------------------------------------------------------------------------------|------------|-------------|-----------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|------------------------------|----------------------------------------------------------------------------------------|
| 1. PROJECT<br>Cat Island                                                                               |            |             | JOB NUMBER<br>200700579                                                                 | 10. SIZE AND TYPE OF BIT<br>11. DATUM FOR ELEVATION SHOWN (TBM or MSL)<br>MSL |                              |                                                                                        |
| 2. LOCATION (Coordinates or Station)<br>278, 173.79N 2,485,329.05E                                     |            |             |                                                                                         | 12. MANUFACTURER'S DESIGNATION OF DRILL                                       |                              |                                                                                        |
| 3. DRILLING AGENCY<br>STS Consultants, Ltd.                                                            |            |             |                                                                                         | 13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN                                    |                              | DISTURBED<br>19      UNDISTURBED<br>4                                                  |
| 4. HOLE NO. (As shown on drawing title and file number)                                                |            |             | CI-3-07                                                                                 | 14. TOTAL NUMBER CORE BOXES                                                   |                              |                                                                                        |
| 5. NAME OF DRILLER<br>John D.                                                                          |            |             |                                                                                         | 15. DEPTH GROUND WATER                                                        |                              |                                                                                        |
| 6. DIRECTION OF HOLE<br><input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED |            |             | DEG. FROM VERT.                                                                         | 16. DATE HOLE                                                                 | STARTED<br>2-20-07           | COMPLETED<br>2-20-07                                                                   |
| 7. THICKNESS OF OVERBURDEN                                                                             |            |             |                                                                                         | 17. ELEVATION TOP OF HOLE                                                     | 577.8                        |                                                                                        |
| 8. DEPTH DRILLED INTO ROCK                                                                             |            |             |                                                                                         | 18. TOTAL CORE RECOVERY FOR BORING                                            | %                            |                                                                                        |
| 9. TOTAL DEPTH OF HOLE                                                                                 |            |             | 59.5                                                                                    | 19. SIGNATURE OF INSPECTOR                                                    |                              |                                                                                        |
| ELEVATION<br>a                                                                                         | DEPTH<br>b | LEGEND<br>c | CLASSIFICATION OF MATERIALS<br>(Description)<br>d                                       | CORE<br>RECOVERY (ft.)<br>e                                                   | BOX OR<br>SAMPLE<br>NO.<br>f | REMARKS<br>(Drilling time, water loss, depth<br>weathering, etc., if significant)<br>g |
|                                                                                                        | 35.0-37.0  |             | Gray silt - with trace shells and trace wood chips (ML)                                 | 2                                                                             | 15                           | 3" Shelby Tube                                                                         |
|                                                                                                        | 36         |             |                                                                                         |                                                                               |                              |                                                                                        |
|                                                                                                        | 37.0-37.5  |             | Drilled with rock bit                                                                   |                                                                               | NS                           |                                                                                        |
|                                                                                                        | 37.5-39.5  |             | Gray silt - with trace shells and trace wood chips (ML)                                 | 2                                                                             | 16                           | 3" Shelby Tube                                                                         |
|                                                                                                        | 38         |             |                                                                                         |                                                                               |                              |                                                                                        |
|                                                                                                        | 39.5-40.0  |             | Drilled with rock bit                                                                   |                                                                               | NS                           |                                                                                        |
| 537.80                                                                                                 | 40         |             | Gray silty clay - with trace shells and trace wood chips (CL)                           | 1.5                                                                           | 17                           | WOH - 2 - 2                                                                            |
|                                                                                                        | 42         |             | Drilled with rock bit                                                                   |                                                                               | NS                           |                                                                                        |
|                                                                                                        | 42.0-42.5  |             | Gray silt - with trace shells and trace wood chips (MH)                                 | 2                                                                             | 18                           | 3" Shelby Tube                                                                         |
|                                                                                                        | 44         |             |                                                                                         |                                                                               |                              |                                                                                        |
|                                                                                                        | 44.5-45.0  |             | Drilled with rock bit                                                                   |                                                                               | NS                           |                                                                                        |
|                                                                                                        | 45.0-45.7  |             | Gray silt - with trace shells and trace wood chips (ML)                                 |                                                                               | 19                           | 2 - 1 - 4 - 3                                                                          |
|                                                                                                        | 45.7-47.0  |             | Light gray clayey silt (ML)                                                             |                                                                               | 19A                          | Qp = 0.25 tsf                                                                          |
|                                                                                                        | 47.0-47.5  |             | Drilled with rock bit                                                                   |                                                                               | NS                           |                                                                                        |
|                                                                                                        | 47.5-49.5  |             | No sample - tried twice                                                                 | 0                                                                             |                              | 3" Shelby Tube                                                                         |
|                                                                                                        | 48         |             |                                                                                         |                                                                               |                              |                                                                                        |
|                                                                                                        | 49.5-50.0  |             | Drilled with rock bit                                                                   |                                                                               | NS                           |                                                                                        |
| 527.80                                                                                                 | 50         |             | 50.0-52.0 Light gray clayey silt (ML)                                                   | 1.5                                                                           | 20                           | Osterberg<br>Qp = 0.25 tsf                                                             |
|                                                                                                        | 52         |             |                                                                                         |                                                                               |                              |                                                                                        |
|                                                                                                        | 52.0-52.5  |             | Drilled with rock bit                                                                   |                                                                               | NS                           |                                                                                        |
|                                                                                                        | 52.5-54.5  |             | 52.5-54.5 Gray brown organic silt - trace fine sand - trace shells - trace wood (ML)    | 2                                                                             | 21                           | WOH                                                                                    |
|                                                                                                        | 54         |             |                                                                                         |                                                                               |                              |                                                                                        |
|                                                                                                        | 54.5-55.0  |             | Drilled with rock bit                                                                   |                                                                               | NS                           |                                                                                        |
|                                                                                                        | 55.0-57.0  |             | 55.0-57.0 Gray brown very silty clay - trace fine sand - trace shells - trace wood (CL) | 2                                                                             | 22                           | WOH - 2                                                                                |
|                                                                                                        | 56         |             |                                                                                         |                                                                               |                              |                                                                                        |
|                                                                                                        | 57.0-57.5  |             | Drilled with rock bit                                                                   |                                                                               | NS                           |                                                                                        |
| 518.30                                                                                                 | 57.5-59.5  |             | 57.5-59.5 Gray brown organic silt - trace fine sand - trace shells - trace wood (ML)    | 2                                                                             | 23                           | 2 - 2 - 3 - 4                                                                          |
|                                                                                                        | 58         |             | End of Boring                                                                           |                                                                               |                              |                                                                                        |



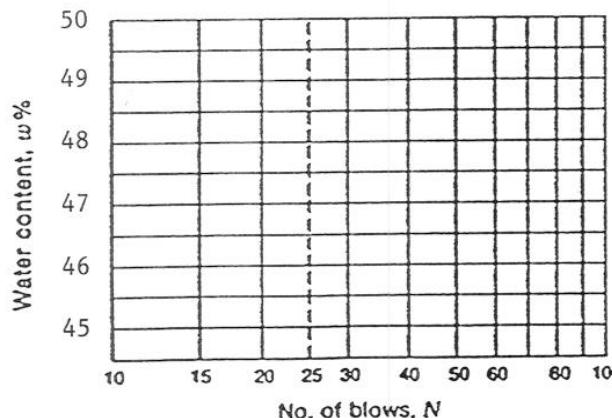
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### ATTERBERG LIMITS DETERMINATION

Project Cat Island, Green Bay Harbor Job No. G-97019  
 Location of Project Green Bay, Wisconsin Boring No. CI-1-97 Sample No. 9  
 Description of Soil (CL) CLAY, brown, moderately plastic  
 Depth of Sample 17.2' - 17.7' Tested By D. Edlebeck, Date 6/13/97

#### Liquid Limit Determination

| Can no.               | 9     | 17    | 11    |  |  |  |
|-----------------------|-------|-------|-------|--|--|--|
| Wt. of wet soil + can | 31.48 | 31.28 | 30.73 |  |  |  |
| Wt. of dry soil + can | 28.46 | 28.46 | 28.04 |  |  |  |
| Wt. of can            | 22.35 | 22.38 | 22.13 |  |  |  |
| Wt. of dry soil       | 6.11  | 6.08  | 5.91  |  |  |  |
| Wt. of moisture       | 3.02  | 2.82  | 2.69  |  |  |  |
| Water content, w%     | 49.4  | 46.4  | 45.5  |  |  |  |
| No. of blows, N       | 17    | 22    | 30    |  |  |  |



Flow index  $F_i = \underline{\hspace{2cm}}$

Liquid limit = 46.2

Plastic limit = 17.6

Plasticity index  $I_p = \underline{\hspace{2cm}}$

#### Plastic Limit Determination

| Can no.                   | 30    | 5     |              |  |
|---------------------------|-------|-------|--------------|--|
| Wt. of wet soil + can     | 30.32 | 29.97 |              |  |
| Wt. of dry soil + can     | 29.07 | 28.82 |              |  |
| Wt. of can                | 22.16 | 22.10 |              |  |
| Wt. of dry soil           | 6.91  | 6.72  |              |  |
| Wt. of moisture           | 1.25  | 1.15  |              |  |
| Water content, w% = $w_p$ | 18.1  | 17.1  | Ave. = 17.6% |  |



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### ATTERBERG LIMITS DETERMINATION

Project Cat Island, Green Bay Harbor Job No. G-97019

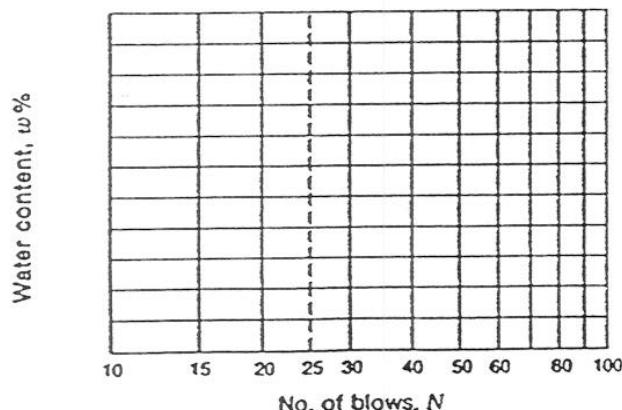
Location of Project Green Bay, Wisconsin Boring No. CI-3-97 Sample No. 12

Description of Soil Gray, fine, SILTY SAND (SM)

Depth of Sample 21.5' - 21.6' Tested By D. Edlebeck Date 6/13/97

#### Liquid Limit Determination

| Can no.               | 1     | 3     | 5     |  |  |  |
|-----------------------|-------|-------|-------|--|--|--|
| Wt. of wet soil + can | -     | -     | -     |  |  |  |
| Wt. of dry soil + can |       |       |       |  |  |  |
| Wt. of can            | 22.31 | 22.41 | 22.10 |  |  |  |
| Wt. of dry soil       |       |       |       |  |  |  |
| Wt. of moisture       |       |       |       |  |  |  |
| Water content, w%     |       |       |       |  |  |  |
| No. of blows, N       | -     | -     | -     |  |  |  |



Flow index  $F_f$  = -

Liquid limit = -

Plastic limit = -

Plasticity index  $I_p$  = Non-Plastic

#### Plastic Limit Determination

| Can no.                   | 2     | 4     |  |  |  |
|---------------------------|-------|-------|--|--|--|
| Wt. of wet soil + can     | -     | -     |  |  |  |
| Wt. of dry soil + can     |       |       |  |  |  |
| Wt. of can                | 22.21 | 22.28 |  |  |  |
| Wt. of dry soil           |       |       |  |  |  |
| Wt. of moisture           |       |       |  |  |  |
| Water content, w% = $w_p$ | -     | -     |  |  |  |

Remarks: liquid limit could not be determined



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### ATTERBERG LIMITS DETERMINATION

Project Cat Island, Green Bay Harbor Job No. G-97019

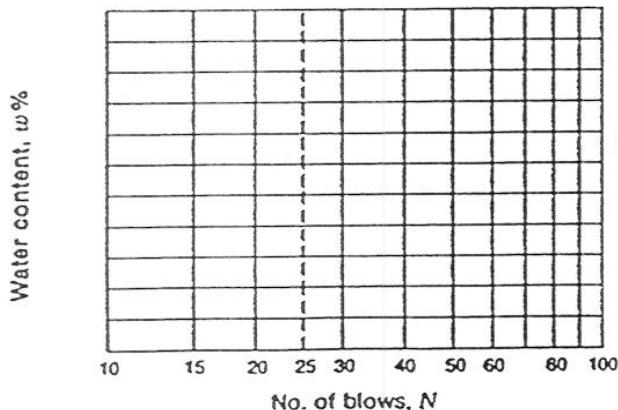
Location of Project Green Bay, Wisconsin Boring No. CI-3-97 Sample No. 16

Description of Soil (ML) Gray, non-plastic, SILT, rapid dilatancy, trace of organics

Depth of Sample 25.6' - 26.1' Tested By D. Edlebeck Date 6/13/97

#### Liquid Limit Determination

| Can no.               | 31    | 32    | 35    |  |  |  |
|-----------------------|-------|-------|-------|--|--|--|
| Wt. of wet soil + can | -     | -     | -     |  |  |  |
| Wt. of dry soil + can |       |       |       |  |  |  |
| Wt. of can            | 22.29 | 22.19 | 22.31 |  |  |  |
| Wt. of dry soil       |       |       |       |  |  |  |
| Wt. of moisture       |       |       |       |  |  |  |
| Water content, w%     |       |       |       |  |  |  |
| No. of blows, N       | -     | -     | -     |  |  |  |



Flow index  $F_i = \text{---}$

Liquid limit =  $\text{---}$

Plastic limit =  $\text{---}$

Plasticity index  $I_p = \text{Non-Plastic}$

#### Plastic Limit Determination

| Can no.                   | 15    | 18    |  |  |  |
|---------------------------|-------|-------|--|--|--|
| Wt. of wet soil + can     | -     | -     |  |  |  |
| Wt. of dry soil + can     |       |       |  |  |  |
| Wt. of can                | 22.18 | 22.25 |  |  |  |
| Wt. of dry soil           |       |       |  |  |  |
| Wt. of moisture           |       |       |  |  |  |
| Water content, w% = $w_p$ | -     | -     |  |  |  |

Remarks: liquid limit could not be determined



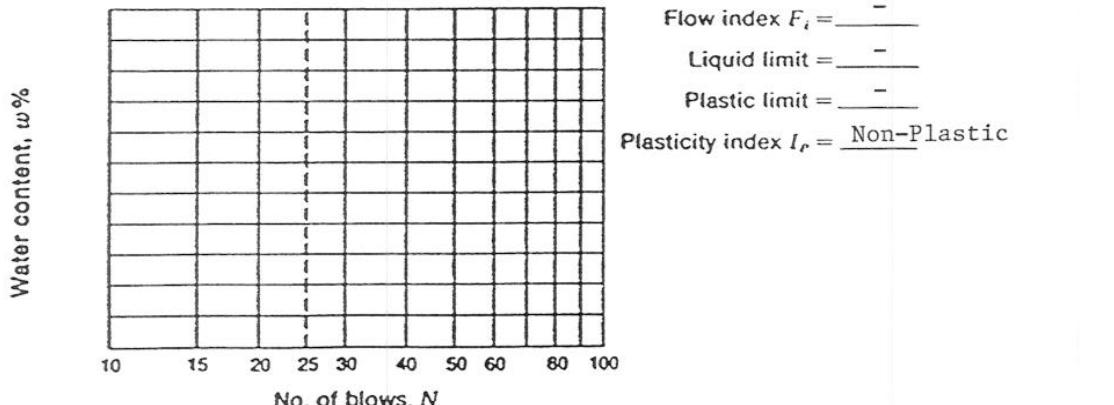
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### ATTERBERG LIMITS DETERMINATION

Project Cat Island, Green Bay Harbor Job No. G-97019  
Location of Project Green Bay, Wisconsin Boring No. CI-3-97 Sample No. 18A  
Description of Soil (ML) Gray, non-plastic, SILT, trace of organics, rapid dilatancy  
Depth of Sample 29.6' - 31.1' Tested By D. Edlebeck Date 6/13/97

#### Liquid Limit Determination

|                       |       |       |       |  |  |  |
|-----------------------|-------|-------|-------|--|--|--|
| Can no.               | 21    | 24    | 28    |  |  |  |
| Wt. of wet soil + can | -     | -     | -     |  |  |  |
| Wt. of dry soil + can |       |       |       |  |  |  |
| Wt. of can            | 22.20 | 22.31 | 22.28 |  |  |  |
| Wt. of dry soil       |       |       |       |  |  |  |
| Wt. of moisture       |       |       |       |  |  |  |
| Water content, w%     |       |       |       |  |  |  |
| No. of blows, N       | -     | -     | -     |  |  |  |



Flow index  $F_i = \underline{\quad}$

Liquid limit =  $\underline{\quad}$

Plastic limit =  $\underline{\quad}$

Plasticity index  $I_p = \text{Non-Plastic}$

#### Plastic Limit Determination

|                           |       |       |  |  |
|---------------------------|-------|-------|--|--|
| Can no.                   | 12    | 13    |  |  |
| Wt. of wet soil + can     | -     | -     |  |  |
| Wt. of dry soil + can     |       |       |  |  |
| Wt. of can                | 22.19 | 22.35 |  |  |
| Wt. of dry soil           |       |       |  |  |
| Wt. of moisture           |       |       |  |  |
| Water content, w% = $w_p$ | -     | -     |  |  |

Remarks: liquid limit could not be determined



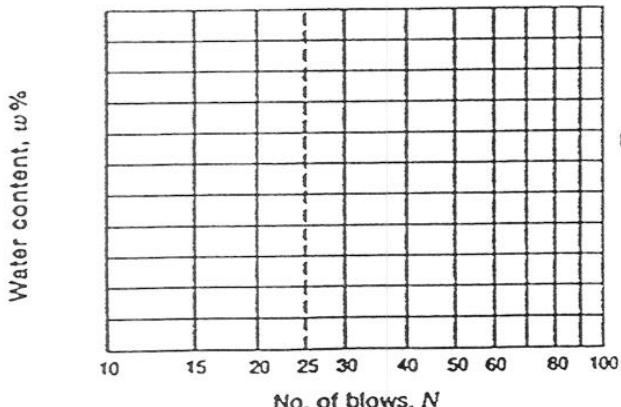
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### ATTERBERG LIMITS DETERMINATION

Project Cat Island, Green Bay Harbor Job No. G-97019  
Location of Project Green Bay, Wisconsin Boring No. CI-3-97 Sample No. 20B  
Description of Soil (OL) Dark gray to black ORGANIC SOIL  
Depth of Sample 34.6' - 35.1' Tested By D. Edlebeck Date 6/13/97

#### Liquid Limit Determination

| Can no.               | 7     | 9     | 11    |  |  |  |
|-----------------------|-------|-------|-------|--|--|--|
| Wt. of wet soil + can | -     | -     | -     |  |  |  |
| Wt. of dry soil + can |       |       |       |  |  |  |
| Wt. of can            | 22.10 | 22.35 | 22.12 |  |  |  |
| Wt. of dry soil       |       |       |       |  |  |  |
| Wt. of moisture       |       |       |       |  |  |  |
| Water content, w%     |       |       |       |  |  |  |
| No. of blows, N       | -     | -     | -     |  |  |  |



Flow index  $F_f$  = \_\_\_\_\_

Liquid limit = \_\_\_\_\_

Plastic limit = \_\_\_\_\_

Plasticity index  $I_p$  = Non-Plastic

#### Plastic Limit Determination

| Can no.                   | 6     | 8     |  |  |
|---------------------------|-------|-------|--|--|
| Wt. of wet soil + can     | -     | -     |  |  |
| Wt. of dry soil + can     |       |       |  |  |
| Wt. of can                | 23.01 | 22.56 |  |  |
| Wt. of dry soil           |       |       |  |  |
| Wt. of moisture           |       |       |  |  |
| Water content, w% = $w_p$ | -     | -     |  |  |

Remarks: liquid limit could not be determined



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### MOISTURE CONTENT DETERMINATION

Project Cat Island, Green Bay Harbor Job No. G-97019

Location of Project Green Bay, Wisconsin

Description of Soil \_\_\_\_\_

Tested By B. Gardner Date 6/4/97

| Pan No.            | 25          | 20          | 28            | 24            |
|--------------------|-------------|-------------|---------------|---------------|
| Boring No.         | CI-1-97     | CI-1-97     | CI-1-97       | CI-1-97       |
| Sample No.         | 2B          | 4           | 6             | 10            |
| Depth              | 6.2' - 6.4' | 8.5' - 8.7' | 11.2' - 11.7' | 23.4' - 23.7' |
| Weight-Wet Sample  | 41.5        | 60.9        | 38.7          | 103.6         |
| Weight-Dry Sample  | 32.4        | 50.3        | 31.5          | 85.5          |
| Weight of Moisture | 9.1         | 10.6        | 7.2           | 18.1          |
| Moisture Content % | 28.1        | 21.1        | 22.9          | 21.2          |

| Pan No.            | 27          | 26          | 13            | 17           |
|--------------------|-------------|-------------|---------------|--------------|
| Boring No.         | CI-2-97     | CI-2-97     | CI-2-97       | CI-3-97      |
| Sample No.         | 2           | 4           | 6             | 4            |
| Depth              | 5.0' - 5.7' | 8.0' - 8.5' | 11.0' - 11.5' | 9.7' - 10.1' |
| Weight-Wet Sample  | 97.9        | 78.9        | 89.2          | 83.6         |
| Weight-Dry Sample  | 75.4        | 60.6        | 75.7          | 62.6         |
| Weight of Moisture | 22.5        | 18.3        | 13.5          | 21.0         |
| Moisture Content % | 29.8        | 30.2        | 17.8          | 33.5         |

Remarks: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_



Coleman Engineering Company  
of Iron Mountain  
Iron Mountain, Michigan 49801

### MOISTURE CONTENT DETERMINATION

Project Cat Island, Green Bay Harbor Job No. G-97019

Location of Project Green Bay, Wisconsin

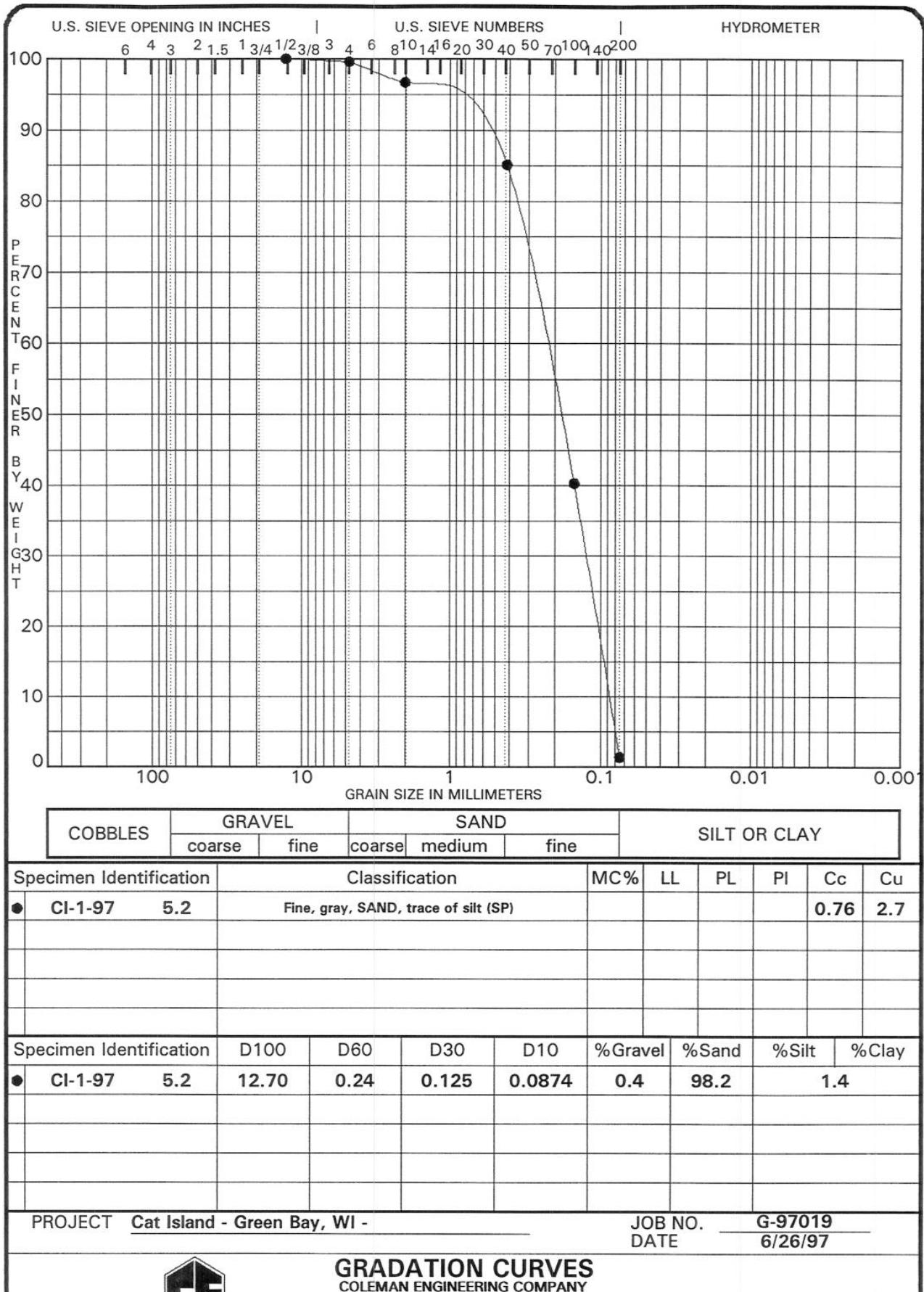
Description of Soil \_\_\_\_\_

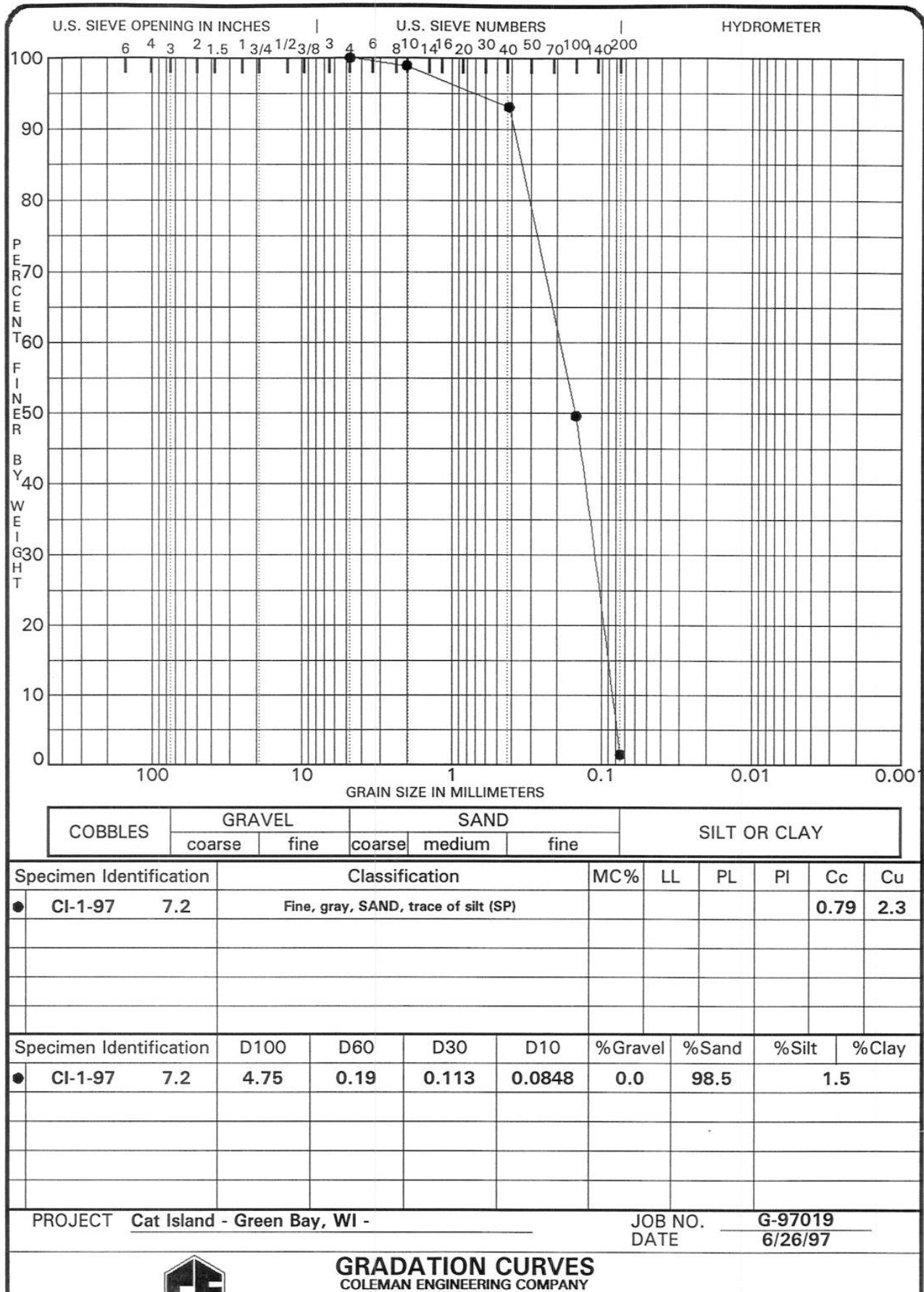
Tested By B. Gardner Date 6/4/97

|                    |               |  |  |  |
|--------------------|---------------|--|--|--|
| Pan No.            | 18            |  |  |  |
| Boring No.         | CI-3-97       |  |  |  |
| Sample No.         | 8             |  |  |  |
| Depth              | 15.1' - 16.6' |  |  |  |
| Weight-Wet Sample  | 118.9         |  |  |  |
| Weight-Dry Sample  | 82.5          |  |  |  |
| Weight of Moisture | 36.4          |  |  |  |
| Moisture Content % | 44.1          |  |  |  |

|                    |  |  |  |  |
|--------------------|--|--|--|--|
| Pan No.            |  |  |  |  |
| Boring No.         |  |  |  |  |
| Sample No.         |  |  |  |  |
| Depth              |  |  |  |  |
| Weight-Wet Sample  |  |  |  |  |
| Weight-Dry Sample  |  |  |  |  |
| Weight of Moisture |  |  |  |  |
| Moisture Content % |  |  |  |  |

Remarks: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_



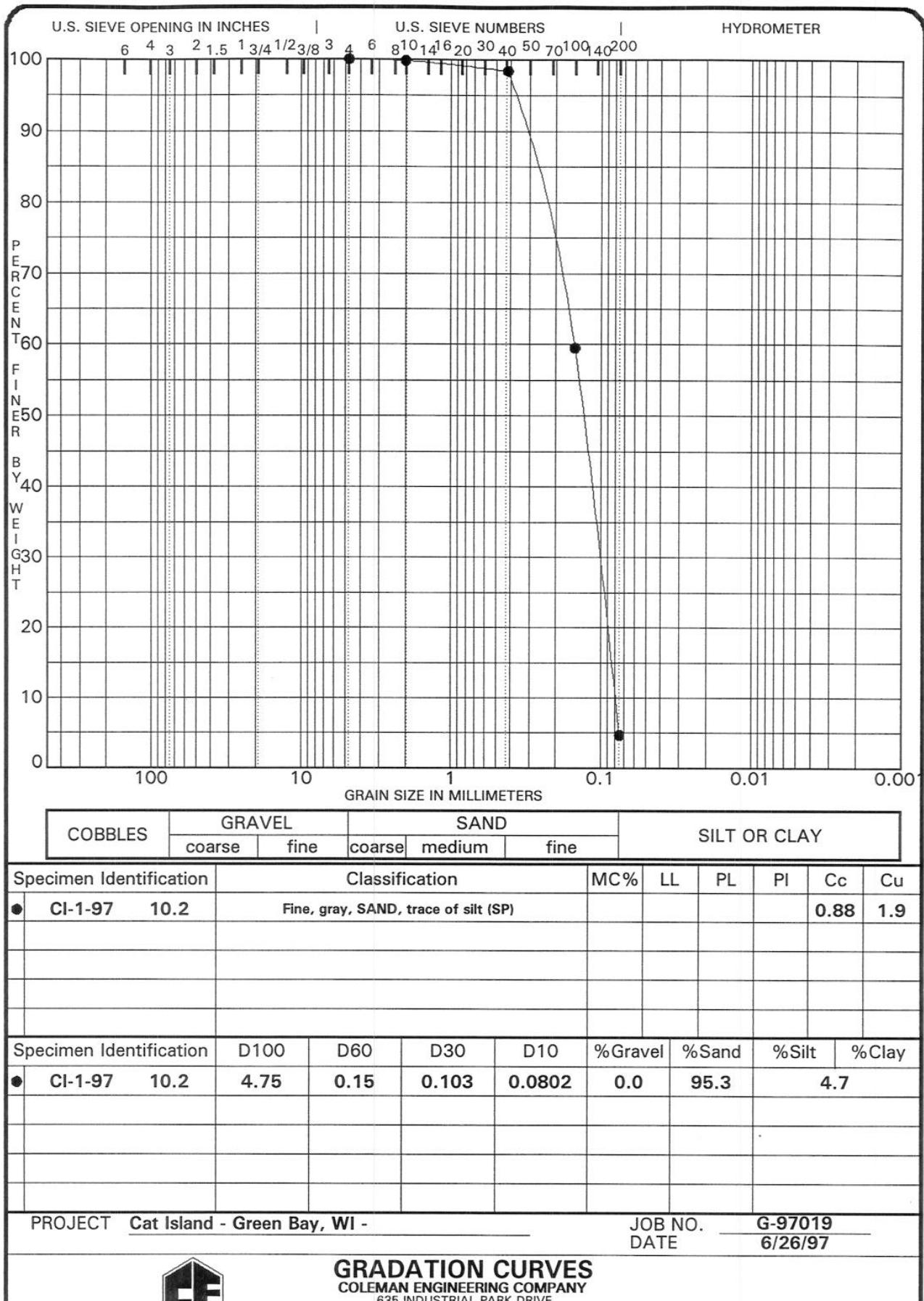


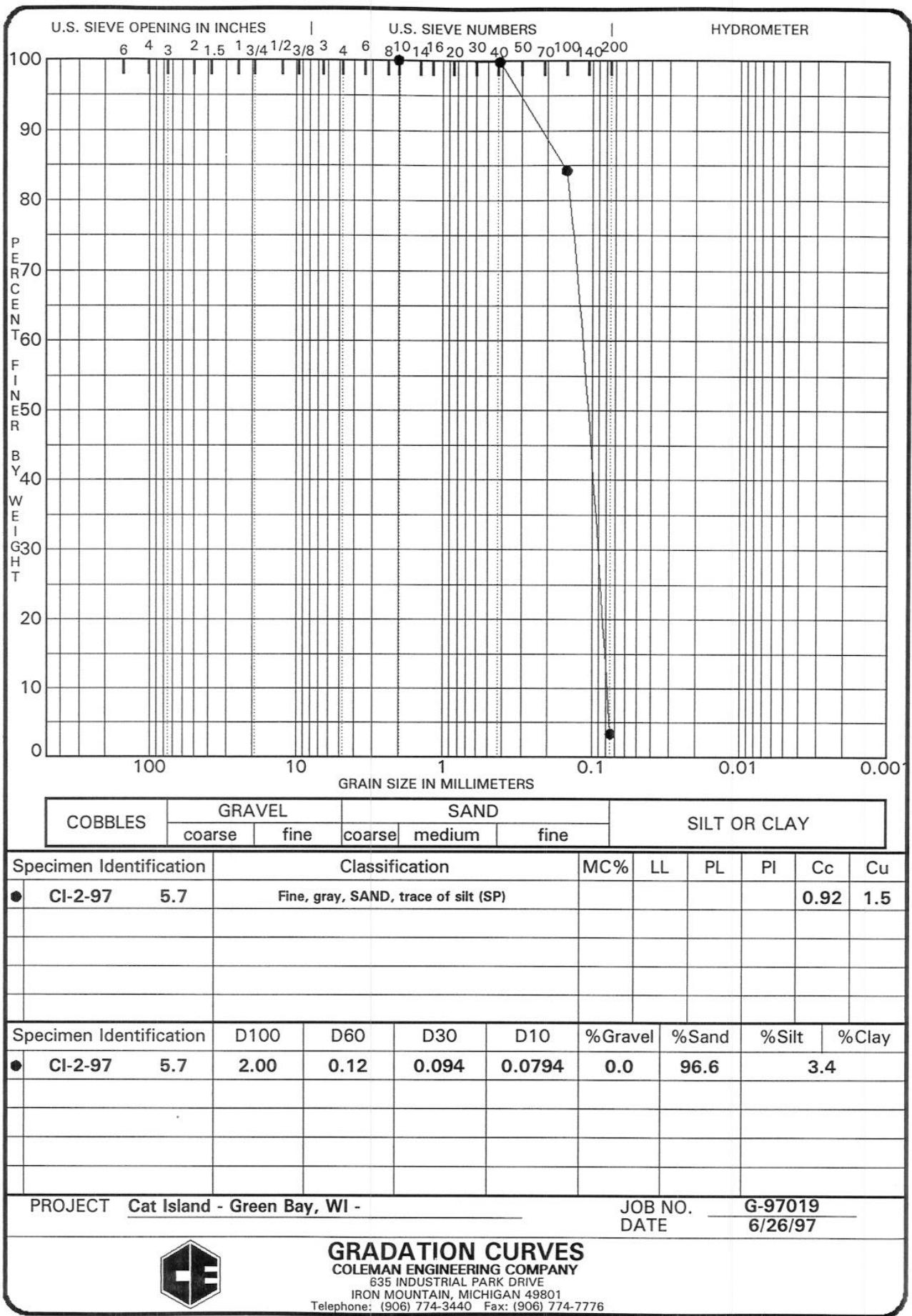
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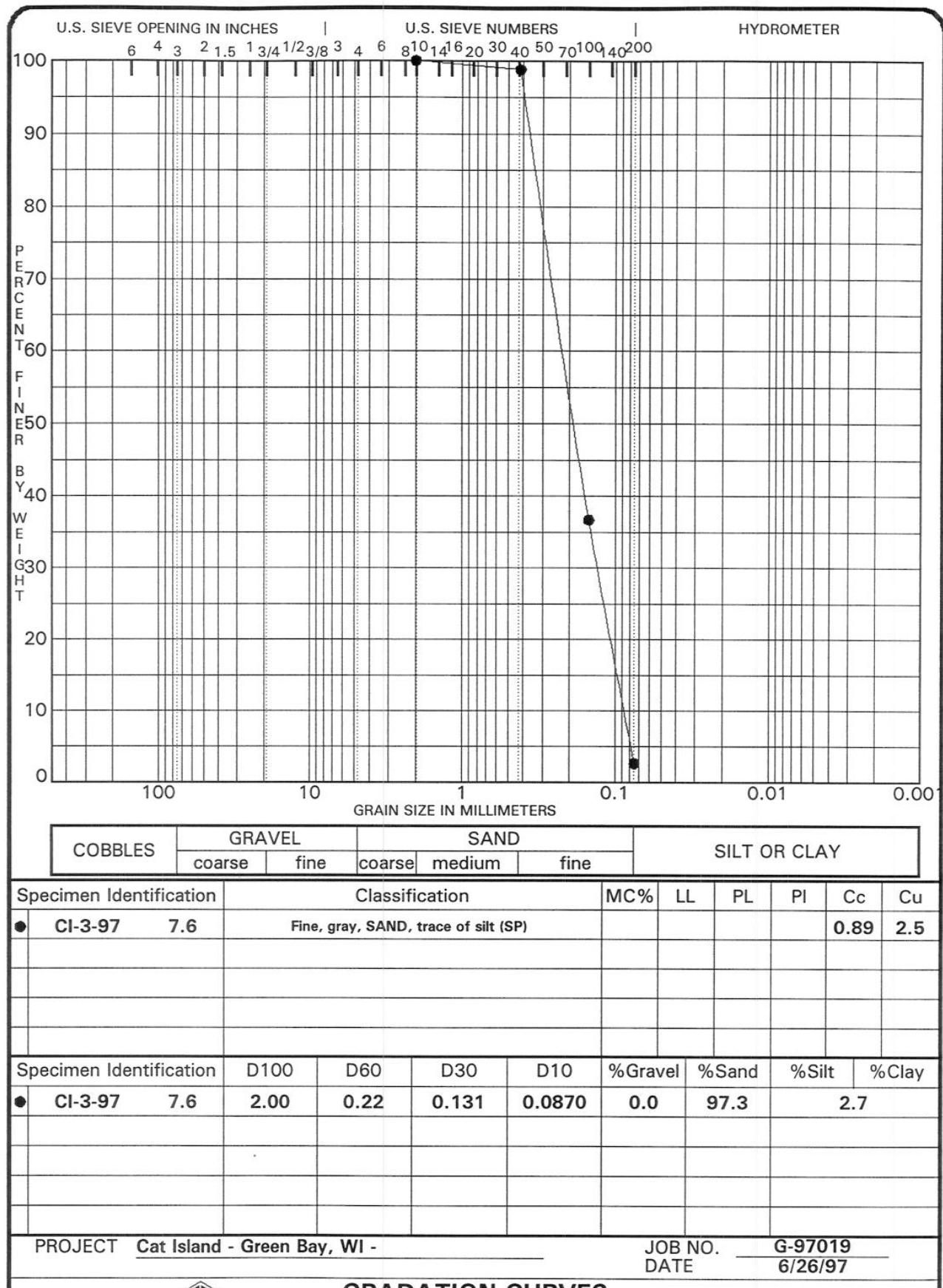
# GRADATION CURVES COLEMAN ENGINEERING COMPANY

**LEMAN ENGINEERING COMPANY**  
635 INDUSTRIAL PARK DRIVE

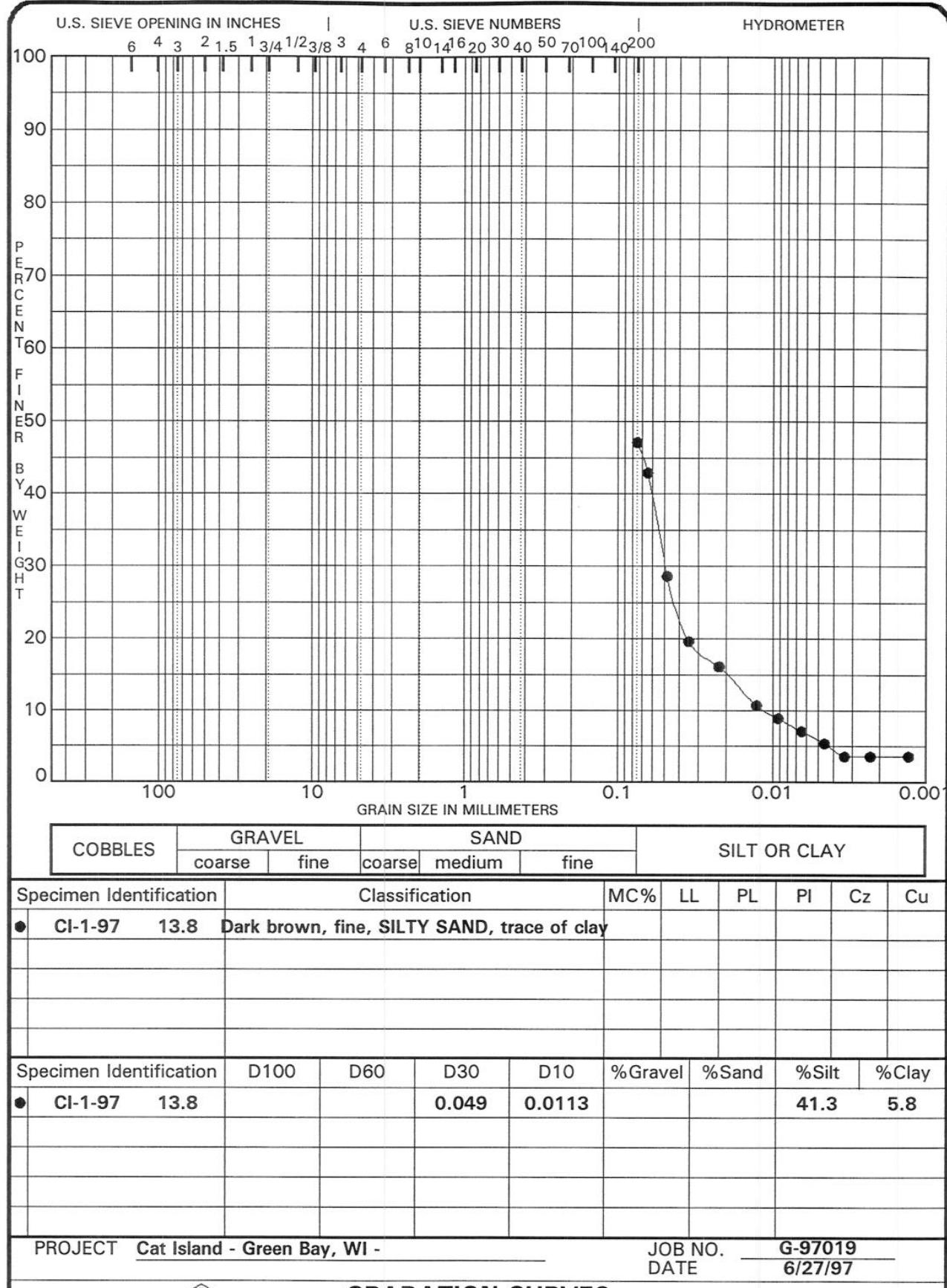
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IRON MOUNTAIN, MICHIGAN 49801  
Telephone: (906) 774-3440 Fax: (906) 774-7776







**GRADATION CURVES**  
COLEMAN ENGINEERING COMPANY  
635 INDUSTRIAL PARK DRIVE  
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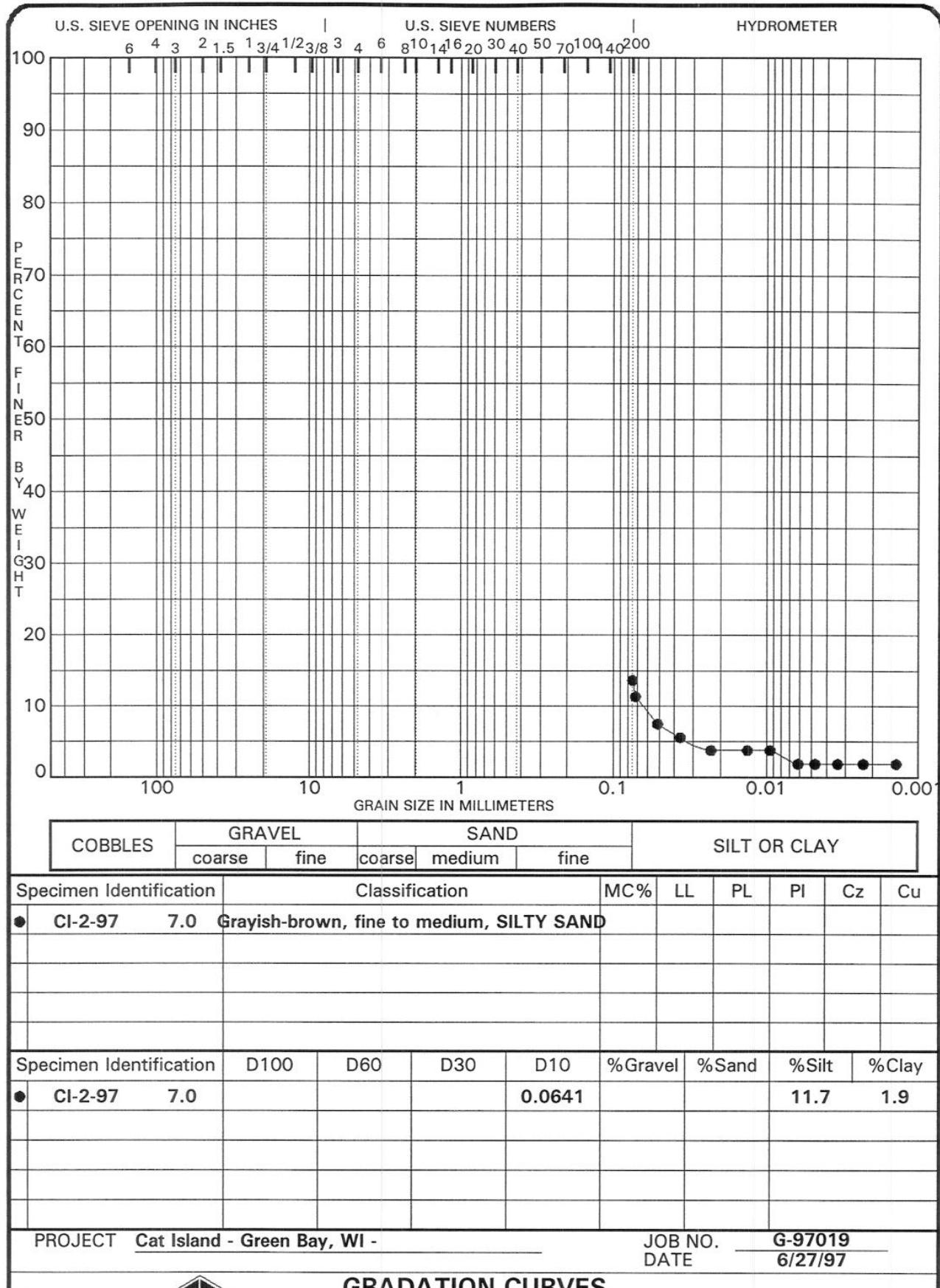
## **GRADATION CURVES**

**GRADATION CORVEE  
COLEMAN ENGINEERING COMPANY**

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IRON MOUNTAIN, MICHIGAN 49801  
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JOB NO. G-97019  
DATE 6/27/97



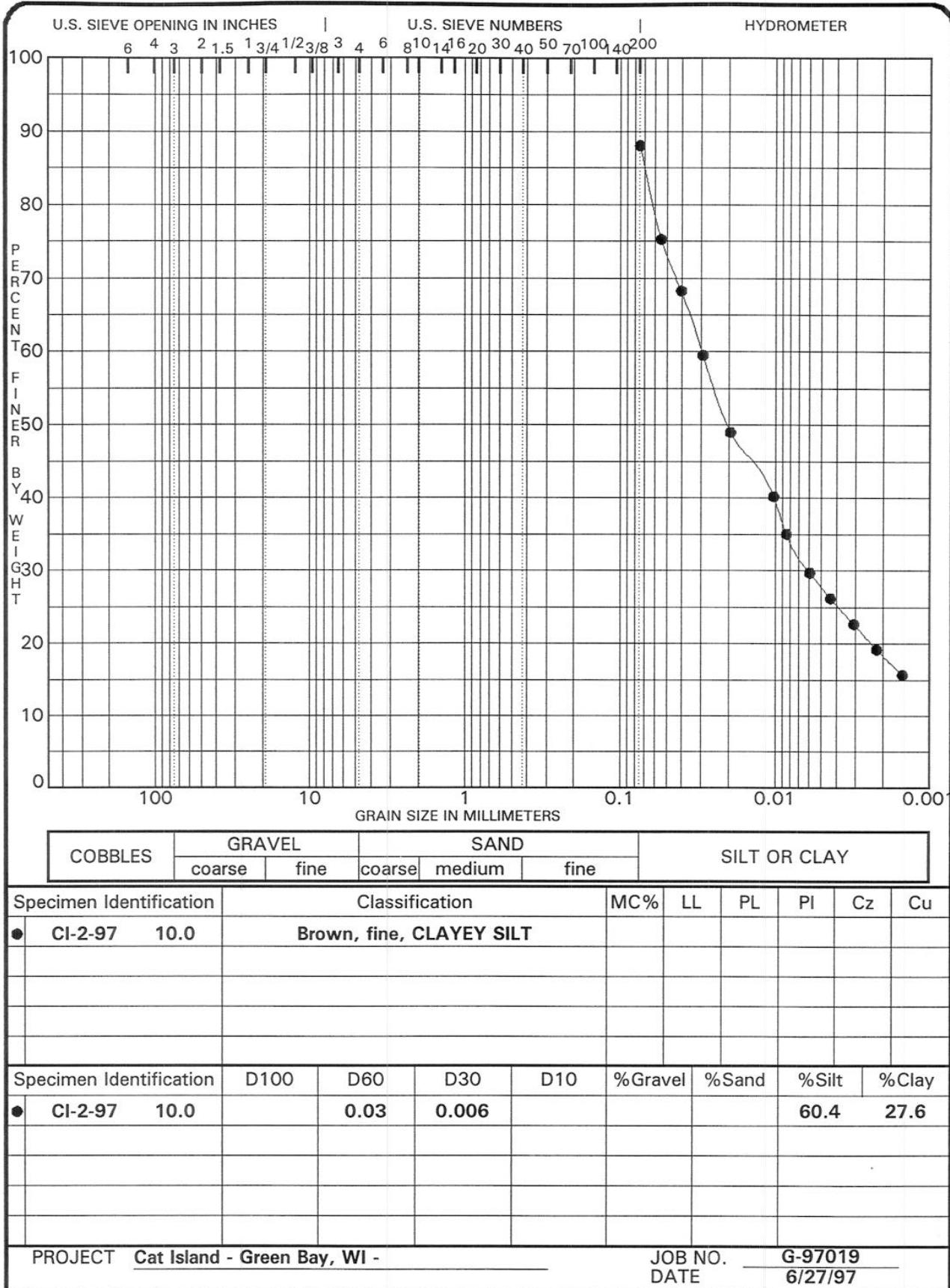
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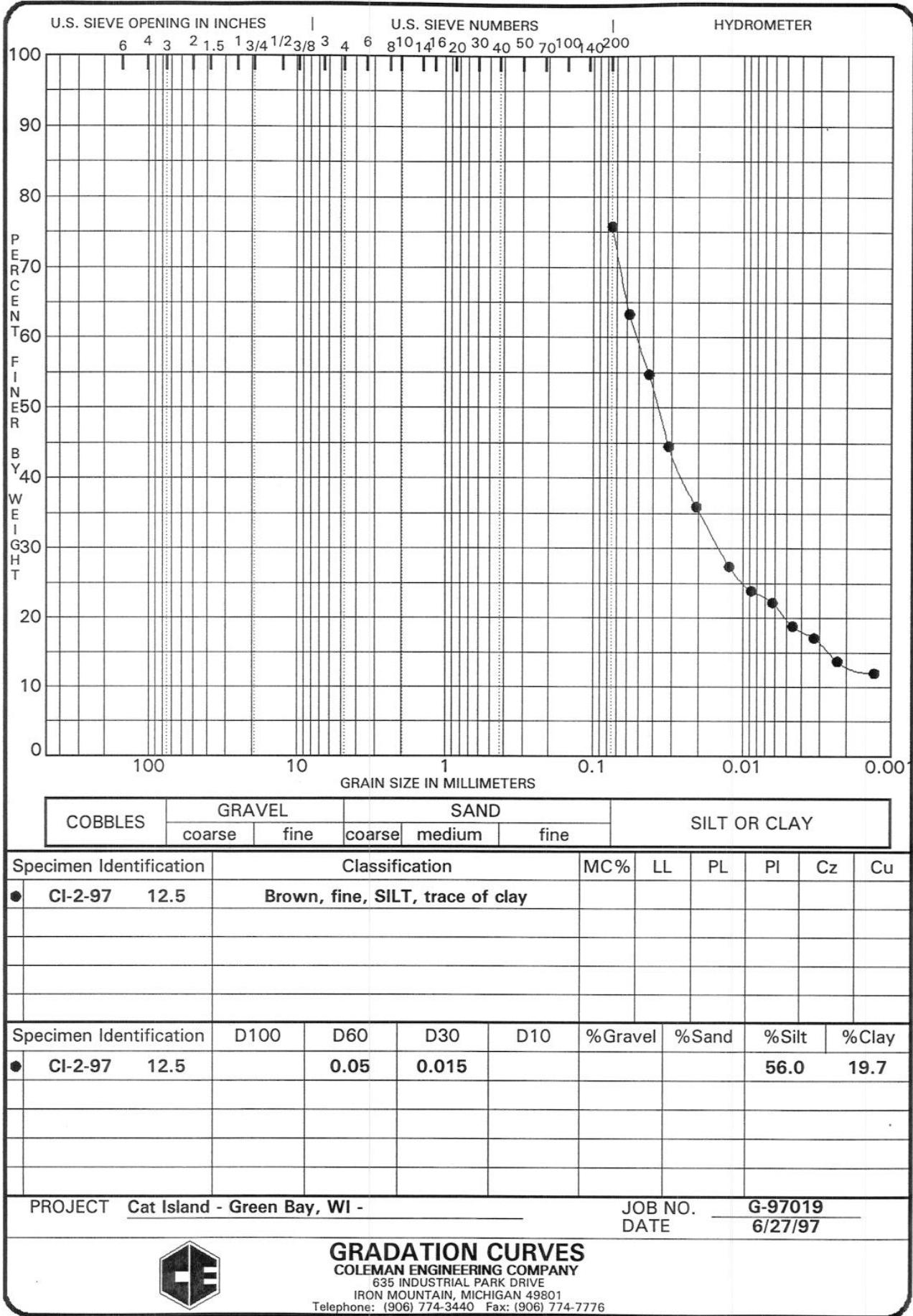
## **GRADATION CURVES**

COLEMAN ENGINEERING COMPANY

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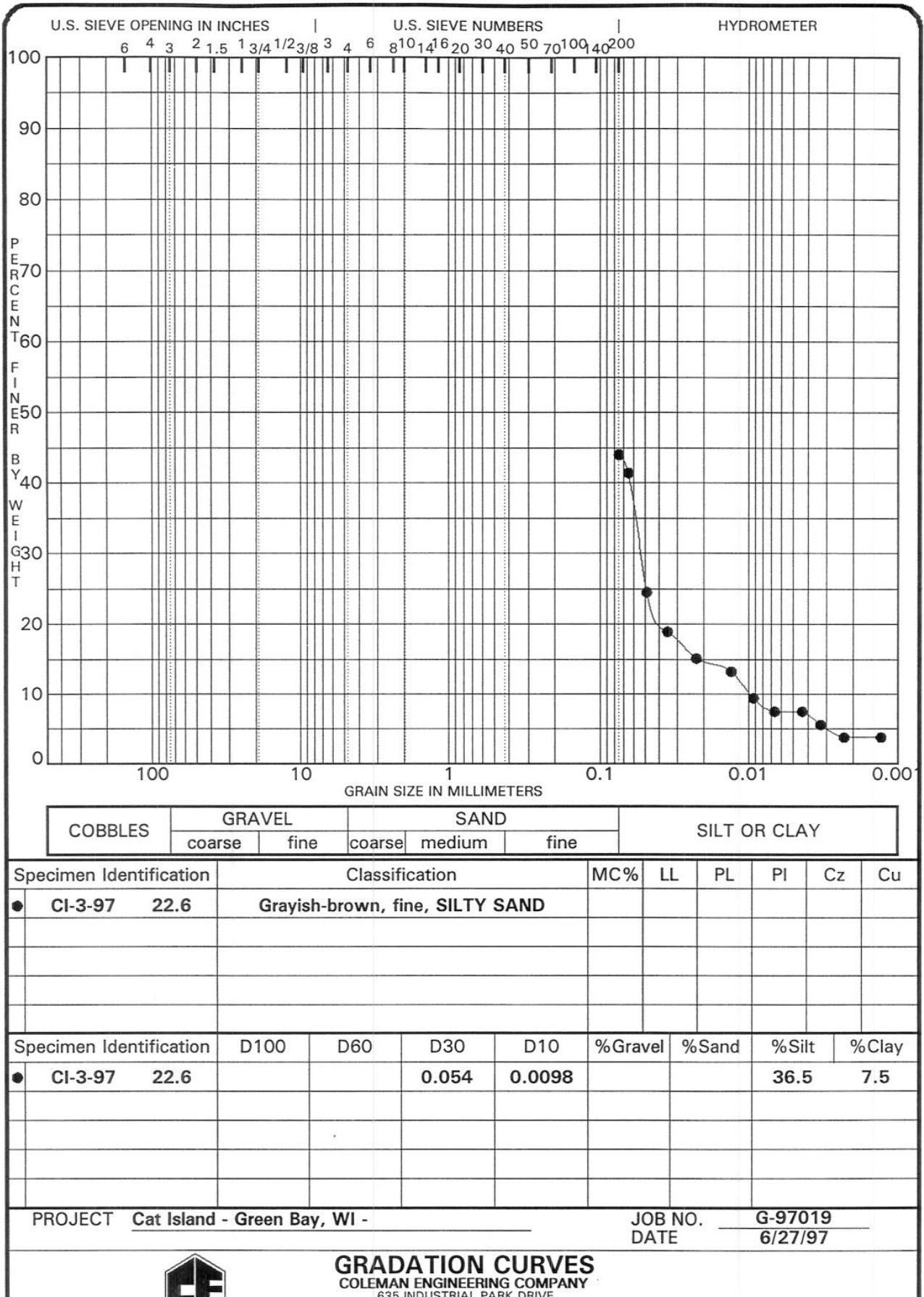




Table 2 - Laboratory Test Summary

| Boring  | Sample No. | Sample Depth (ft. bgs) | USCS/visual Soil Description <sup>(1)</sup>                                           | Dry Density (pcf) | Natural Moisture Content (%) | Specific Gravity (Gs) | Atterberg Limits |    |    | Sieve #4 / P-200 and Hydrometer                                                               | Remarks/Comments                                                                                   |
|---------|------------|------------------------|---------------------------------------------------------------------------------------|-------------------|------------------------------|-----------------------|------------------|----|----|-----------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|
|         |            |                        |                                                                                       |                   |                              |                       | LL               | PL | PI |                                                                                               |                                                                                                    |
| CI-1-07 | S-1        | 0.0' - 2.0'            | Gray to black silt with organics and trace wood ML                                    | --                | 40.00                        | --                    | --               | -- | -- | See enclosed laboratory data                                                                  | --                                                                                                 |
|         | S-3        | 4.0' - 6.0'            | Brown silty sand with trace roots SM                                                  | --                | 25.20                        | --                    | --               | -- | -- | See enclosed laboratory data                                                                  | --                                                                                                 |
|         | S-5        | 8.0' - 10'             | Red brown silty clay - varved - with gray silts (CL)                                  | --                | 30.10                        | --                    | --               | -- | -- | See enclosed laboratory data                                                                  | --                                                                                                 |
|         | S-6        | 10' - 12'              | Red brown silty clay - varved - with gray silts (CL)                                  | 98.05             | 27.83                        | --                    | --               | -- | -- | Consolidation test and unconfined compression test data results see enclosed laboratory data. |                                                                                                    |
|         | S-8        | 15' - 17'              | Brown silty sand - wet SM                                                             | --                | 18.30                        | --                    | --               | -- | -- | See enclosed laboratory data                                                                  | --                                                                                                 |
|         | S-10       | 20' - 22'              | Brown silty fine to medium sand (SM)                                                  | --                | 25.00                        | --                    | --               | -- | -- | See enclosed laboratory data                                                                  | --                                                                                                 |
|         | S-13       | 27.5' - 29.5'          | Brown silty fine to medium sand (SM)                                                  | --                | 18.30                        | --                    | --               | -- | -- | See enclosed laboratory data                                                                  | --                                                                                                 |
| CI-2-07 | S-2        | 2.0' - 4.0'            | Brown silty sand - trace roots (SM)                                                   | --                | 24.10                        | --                    | --               | -- | -- | See enclosed laboratory data                                                                  | --                                                                                                 |
|         | S-4A       | 6.0' - 7.0'            | Brown silty very fine sand with trace clay SM                                         | --                | 28.80                        | --                    | --               | -- | -- | See enclosed laboratory data                                                                  | --                                                                                                 |
|         | S-4B       | 7.0' - 8.0'            | Red brown silty clay - trace 2mm sand seams CL                                        | --                | 24.00                        | --                    | --               | -- | -- | See enclosed laboratory data                                                                  | --                                                                                                 |
|         | S-5        | 8.0' - 10'             | Red brown silty clay - trace 2mm sand seams (CL)                                      | 101.00            | --                           | --                    | --               | -- | -- | See enclosed laboratory data                                                                  | Unconfined compression test data results, see enclosed laboratory data.                            |
|         | S-6        | 10' - 12'              | Red brown silty clay - trace 2mm sand seams (CL)                                      | --                | 22.40                        | --                    | 31               | 13 | 18 | See enclosed laboratory data                                                                  | --                                                                                                 |
|         | S-8        | 15' - 17'              | Red brown silty clay - trace 2mm sand seams (CL)                                      | --                | 32.10                        | --                    | 45               | 19 | 26 | See enclosed laboratory data                                                                  | Triaxial compression test data and consolidation test data, see enclosed laboratory data.          |
|         | S-10       | 20' - 22'              | Red brown silty clay - trace 2mm sand seams (CL)                                      | 97.98             | --                           | --                    | --               | -- | -- | See enclosed laboratory data                                                                  | Unconfined compression test data and triaxial compression test data, see enclosed laboratory data. |
|         | S-11A      | 22.5' - 24.5'          | Red brown silty clay - trace 2mm sand seams CL - with sand seams at 23.5 to 23.9 feet | --                | 46.50                        | --                    | --               | -- | -- | See enclosed laboratory data                                                                  | --                                                                                                 |
|         | S-11B      | 22.5' - 24.5'          | Red brown silty clay - trace 2mm sand seams CL - with sand seams at 23.5 to 23.9 feet | --                | 15.20                        | --                    | --               | -- | -- | See enclosed laboratory data                                                                  | --                                                                                                 |
|         | S-13       | 27.5' - 29.5'          | Red brown silty clay - trace 2mm sand seams CL                                        | --                | 43.30                        | --                    | --               | -- | -- | See enclosed laboratory data                                                                  | --                                                                                                 |
| CI-3-07 | S-2        | 4' - 6'                | Brown silty sand - trace roots (SM)                                                   | --                | 29.00                        | --                    | --               | -- | -- | See enclosed laboratory data                                                                  | --                                                                                                 |
|         | S-4        | 8.0' - 10'             | Brown silty sand (SM)                                                                 | --                | 33.10                        | --                    | --               | -- | -- | See enclosed laboratory data                                                                  | --                                                                                                 |
|         | S-6        | 12.5' - 14.5'          | Brown silty sand becoming more silty (SM)                                             | --                | 32.30                        | --                    | --               | -- | -- | See enclosed laboratory data                                                                  | --                                                                                                 |
|         | S-11       | 25' - 27'              | Gray brown fine sandy silt - trace shells ML                                          | --                | 53.80                        | --                    | --               | -- | -- | See enclosed laboratory data                                                                  | --                                                                                                 |
|         | S-13       | 30' - 32'              | Gray brown fine sandy silt - trace shells ML                                          | --                | 75.60                        | --                    | --               | -- | -- | See enclosed laboratory data                                                                  | --                                                                                                 |
|         | S-16       | 37.5' - 39.5'          | Gray silt - with trace shells and trace wood chips ML                                 | --                | --                           | --                    | --               | -- | -- | Consolidation test data, see enclosed laboratory data.                                        |                                                                                                    |
|         | S-17       | 40' - 42'              | Gray silt - with trace shells and trace wood chips ML                                 | --                | 85.70                        | --                    | 65               | 24 | 40 | See enclosed laboratory data                                                                  | Triaxial compression test data, see enclosed laboratory data.                                      |
|         | S-19       | 45' - 45.7'            | Gray silt - with trace shells and trace wood chips ML                                 | --                | 111.90                       | --                    | 126              | 94 | 32 | See enclosed laboratory data                                                                  | Triaxial compression test data, see enclosed laboratory data.                                      |
|         | S-19A      | 45.7' - 47'            | Light gray clayey silt ML                                                             | --                | 75.50                        | --                    | 73               | 27 | 46 | See enclosed laboratory data                                                                  | Triaxial compression test data, see enclosed laboratory data.                                      |
|         | S-22       | 55' - 57'              | Gray brown organic silt - trace fine sand - trace shells - trace wood DL              | --                | 48.30                        | --                    | 62               | 27 | 35 | See enclosed laboratory data                                                                  | Consolidation test data and triaxial compression test data, see enclosed laboratory data.          |

Notes: (1) Italicized USCS material descriptions selected automatically from STS laboratory software, and do not necessarily reflect the STS Soil Classification System. Non-italicized material descriptions are visual classifications in accordance with the STS Soil Classification System.

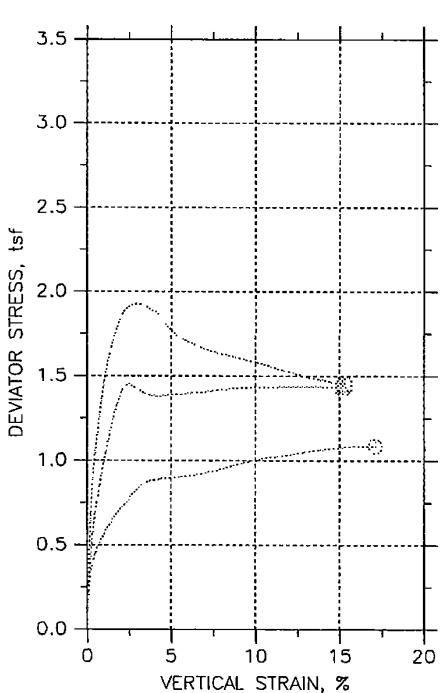
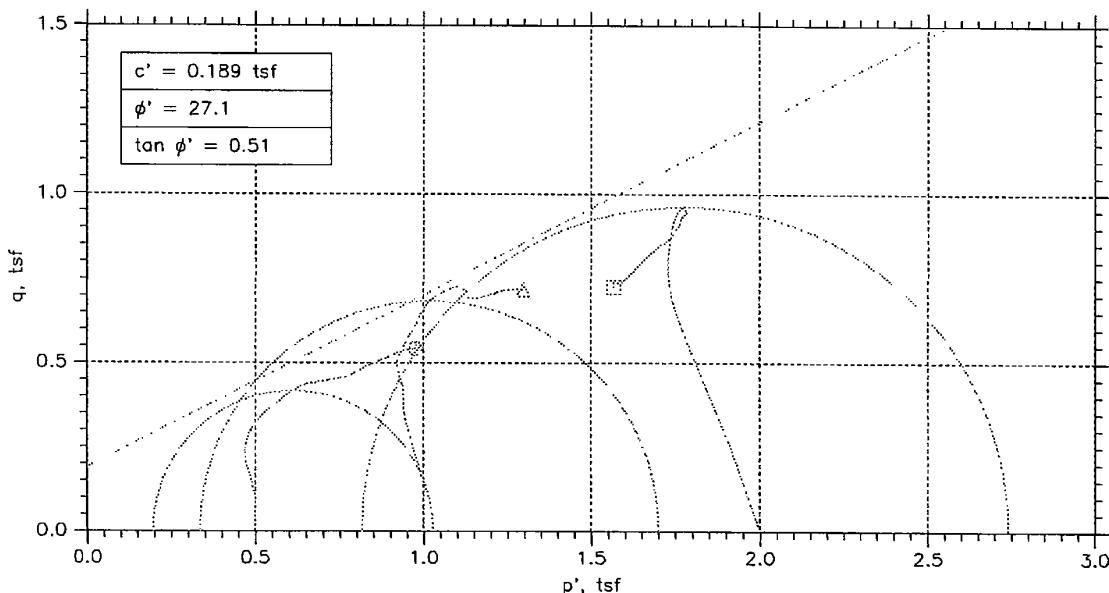
T200700579-TABLES-2-3-TEST-SUMMARY.XLS

## LABORATORY TEST SUMMARY

**Project Number:** 200700579      **Project:** CAT ISLAND DRILLING AND TESTING  
**Client** : U.S ARMY CORPS OF ENGINEERS

| Boring No. | Sample No. | Depth (ft.) | Description                                              | USCS | % WC                   | Sp. Gr. | LL      | PL       | PI       | % Gravel | % Sand   | % Silt   | % Clay |
|------------|------------|-------------|----------------------------------------------------------|------|------------------------|---------|---------|----------|----------|----------|----------|----------|--------|
| CI-1-07    | 1          | 0.0'-2.0'   | FINE SAND LITTLE SILT TRACE CLAY - LIGHT BROWN           | SM   | 40.0                   |         |         |          |          | 0.0      | 77.2     | 18.1     | 4.7    |
|            | 3          | 4.0'-6.0'   | SILT AND FINE SAND TRACE CLAY - BROWN                    | ML   | 25.2                   |         |         |          |          | 0.0      | 43.1     | 52.3     | 4.6    |
|            | 5          | 8.0'-10.0'  | SILTY CLAY - LIGHT REDDISH BROWN                         | CL   | 30.1                   |         |         |          |          | 0.0      | 0.5      | 37.6     | 61.9   |
|            | 8          | 15.0'-17.0' | SILT AND FINE SAND TRACE CLAY - LIGHT BROWN              | ML   | 18.3                   |         |         |          |          | 0.0      | 39.9     | 58.2     | 1.9    |
|            | 10         | 20.0'-22.0' | SILTY FINE SAND TRACE CLAY - BROWN                       | SM   | 25.0                   |         |         |          |          | 0.0      | 68.2     | 29.1     | 2.7    |
|            | 13         | 27.5'-29.5' | SILTY FINE SAND TRACE CLAY - LIGHT BROWN                 | SM   | 18.3                   |         |         |          |          | 0.0      | 75.0     | 22.5     | 2.5    |
| CI-2-07    | 2          | 2.0'-4.0'   | FINE SAND LITTLE SILT TRACE CLAY - BROWN                 | SM   | 24.1                   |         |         |          |          | 0.0      | 81.2     | 16.3     | 2.5    |
|            | 4A         | 6.0'-8.0'   | SILTY CLAY - LIGHT BROWN                                 | CH   | 28.8                   |         |         |          |          | 0.0      | 1.0      | 27.6     | 71.4   |
|            | 4B         | 6.0'-8.0'   | CLAYEY SILT LITTLE FINE SAND - LIGHT BROWN               | ML   | 24.0                   |         |         |          |          | 0.0      | 14.2     | 75.5     | 10.3   |
|            | 6          | 10.0'-12.0' | SILTY CLAY TRACE FINE TO COARSE SAND - BROWN             | CL   | 22.4                   |         | 31      | 13       | 18       | 0.0      | 1.1      | 25.9     | 73.0   |
|            | 8          | 15.0'-17.0' | SILTY CLAY - REDDISH BROWN                               | CL   |                        |         | 45      | 19       | 26       | 0.0      | 1.0      | 16.6     | 82.4   |
|            | 11A        | 22.5'-24.5' | SILTY CLAY - LIGHT REDDISH BROWN                         | CH   | 46.5                   |         |         |          |          | 0.0      | 0.2      | 7.7      | 92.1   |
|            | 11B        | 22.5'-24.5' | SILT SOME FINE SAND LITTLE CLAY - SLIGHTLY REDDISH BROWN | ML   | 15.2                   |         |         |          |          | 0.0      | 20.8     | 60.9     | 18.3   |
|            | 13         | 27.5'-29.5' | SILTY CLAY TRACE FINE SAND - LIGHT REDDISH BROWN         | CH   | 43.3                   |         |         |          |          | 0.0      | 3.0      | 17.1     | 79.9   |
| CI-3-07    | 2          | 2.0'-4.0'   | SILTY FINE SAND TRACE CLAY - GRAYISH BROWN               | SM   | 29.0                   |         |         |          |          | 0.0      | 79.7     | 18.0     | 2.3    |
|            | 4          | 6.0'-8.0'   | SILTY FINE SAND TRACE CLAY - BROWN                       | SM   | 33.1                   |         |         |          |          | 0.0      | 66.2     | 31.6     | 2.2    |
|            | 6          | 10.0'-12.0' | SILTY FINE SAND TRACE CLAY - GRAYISH BROWN               | SM   | 32.3                   |         |         |          |          | 0.0      | 56.5     | 40.9     | 2.6    |
|            | 11         | 22.5'-24.5' | CLAYEY SILT SOME FINE TO MEDIUM SAND - GRAY              | MH   | 53.8                   |         |         |          |          | 0.0      | 25.0     | 58.4     | 16.6   |
|            | 13         | 27.5'-29.5' | SILTY CLAY TRACE FINE SAND - DARK GRAY                   | CL   | 75.6                   |         |         |          |          | 0.0      | 10.0     | 56.6     | 33.4   |
|            | 17         | 37.5'-39.5' | SILTY CLAY LITTLE FINE TO COARSE SAND                    | CH   | 85.7/<br>57.3/<br>78.7 |         | 65      | 25       | 40       | 0.0      | 12.8     | 52.7     | 34.5   |
|            | 19         | 42.5'-44.5' | CLAYEY SILT LITTLE FINE SAND - DARK BROWN, BLACK         | MH   | 111.9                  |         | 126     | 94       | 32       | 0.0      | 19.5     | 69.5     | 11.0   |
|            | 19A        | 45.0'-47.0' | SILTY CLAY TRACE FINE TO MEDIUM SAND - GRAY              | CH   | 75.5                   |         | 73      | 27       | 46       | 0.0      | 9.1      | 14.5     | 76.4   |
|            | 22         | 50.0'-52.0' | SILTY CLAY TRACE FINE TO MEDIUM SAND - GRAYISH BROWN     | CH   |                        |         | 62      | 27       | 35       | 0.0      | 2.1      | 26.3     | 71.6   |
|            |            |             |                                                          |      | total=6                |         | total=6 | total=23 | total=23 | total=23 | total=23 | total=23 |        |

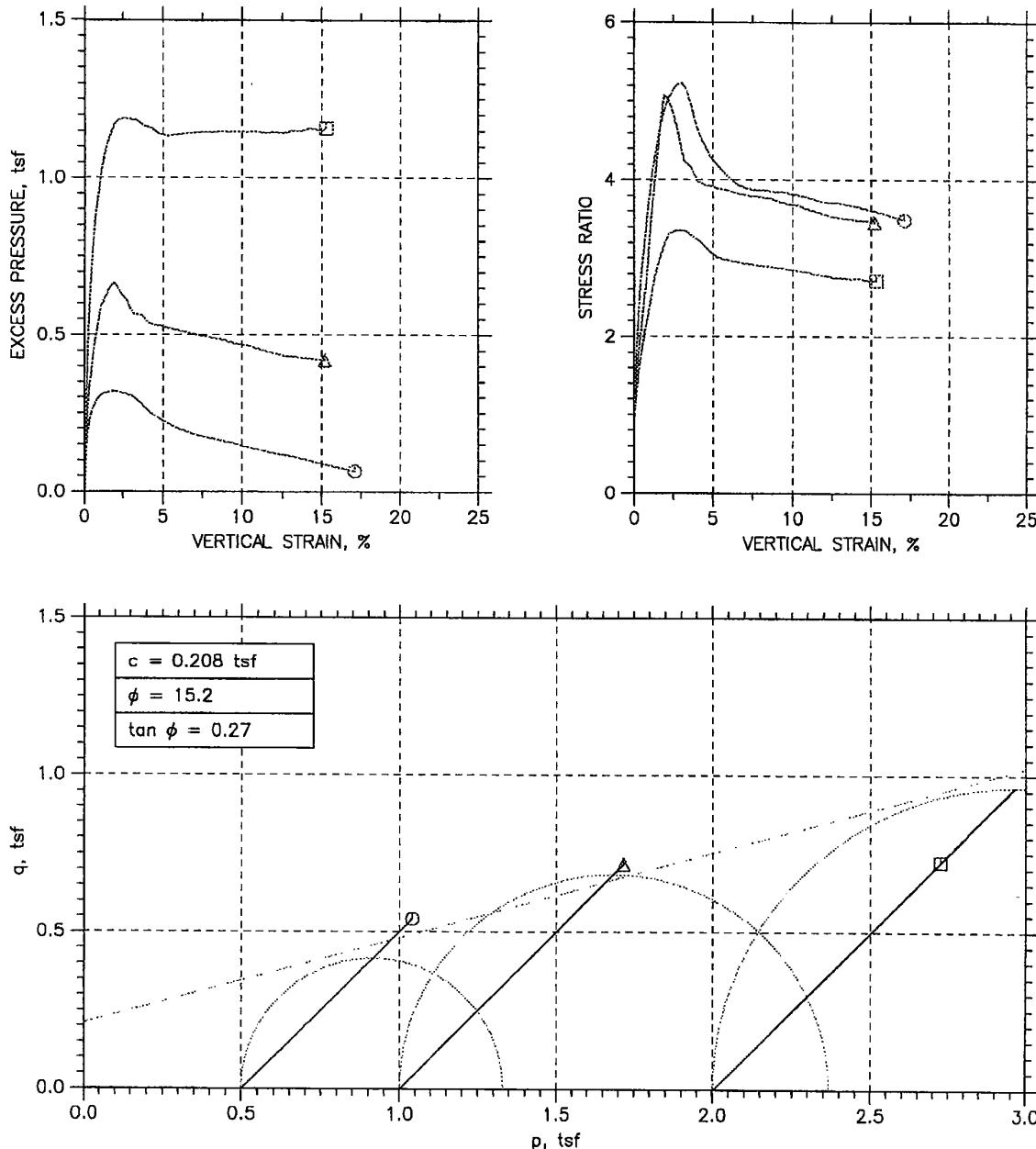
# TRIAXIAL COMPRESSION TEST REPORT



| Symbol                                                                                       | ○                          | △         | □         |        |  |
|----------------------------------------------------------------------------------------------|----------------------------|-----------|-----------|--------|--|
| Test No.                                                                                     | CI206S8T1                  | CI206S8T2 | CI206S8T3 |        |  |
| Initial                                                                                      | Diameter, in               | 2.8307    | 2.8445    | 2.8465 |  |
|                                                                                              | Height, in                 | 5.7339    | 5.8043    | 5.9098 |  |
|                                                                                              | Water Content, %           | 31.41     | 28.23     | 29.63  |  |
|                                                                                              | Dry Density, pcf           | 92.82     | 93.88     | 90.59  |  |
|                                                                                              | Saturation, %              | 102.54    | 94.53     | 91.79  |  |
|                                                                                              | Void Ratio                 | 0.83618   | 0.81535   | 0.8813 |  |
| Before Shear                                                                                 | Water Content, %           | 30.40     | 30.50     | 29.63  |  |
|                                                                                              | Dry Density, pcf           | 93.37     | 94.83     | 90.59  |  |
|                                                                                              | Saturation, %              | 100.56    | 104.46    | 91.79  |  |
|                                                                                              | Void Ratio                 | 0.82532   | 0.79717   | 0.8813 |  |
|                                                                                              | Back Press., tsf           | 5.0401    | 5.04      | 5.0402 |  |
| Failure Sketch                                                                               | Minor Prin. Stress, tsf    | 0.49958   | 1.0008    | 2.0014 |  |
|                                                                                              | Max. Dev. Stress, tsf      | 1.0818    | 1.45      | 1.9236 |  |
|                                                                                              | Time to Failure, min       | 234       | 48.002    | 44.001 |  |
|                                                                                              | Strain Rate, %/min         | 0.069     | 0.068     | 0.0676 |  |
|                                                                                              | B-Value                    | ---       | ---       | ---    |  |
|                                                                                              | Estimated Specific Gravity | 2.73      | 2.73      | 2.73   |  |
|                                                                                              | Liquid Limit               | 45        | 45        | 45     |  |
|                                                                                              | Plastic Limit              | 19        | 19        | 19     |  |
|                                                                                              | Plasticity Index           | 26        | 26        | 26     |  |
|                                                                                              |                            |           |           |        |  |
| Project: CAT ISLAND                                                                          |                            |           |           |        |  |
| Location:                                                                                    |                            |           |           |        |  |
| Project No.: 200700579                                                                       |                            |           |           |        |  |
| Boring No.: CI-2-07 S-8                                                                      |                            |           |           |        |  |
| Sample Type: 3 INCH ST                                                                       |                            |           |           |        |  |
| Description: SILTY CLAY TRACE F-M SAND - REDDISH BROWN CL                                    |                            |           |           |        |  |
| Remarks: FAILURE CRITERIA = MAXIMUM EFFECTIVE STRESS RATIO TEST PERFORMED AS PER ASTM D 4767 |                            |           |           |        |  |

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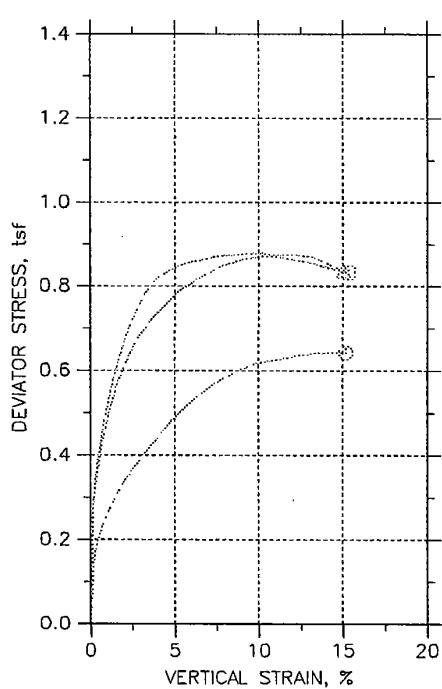
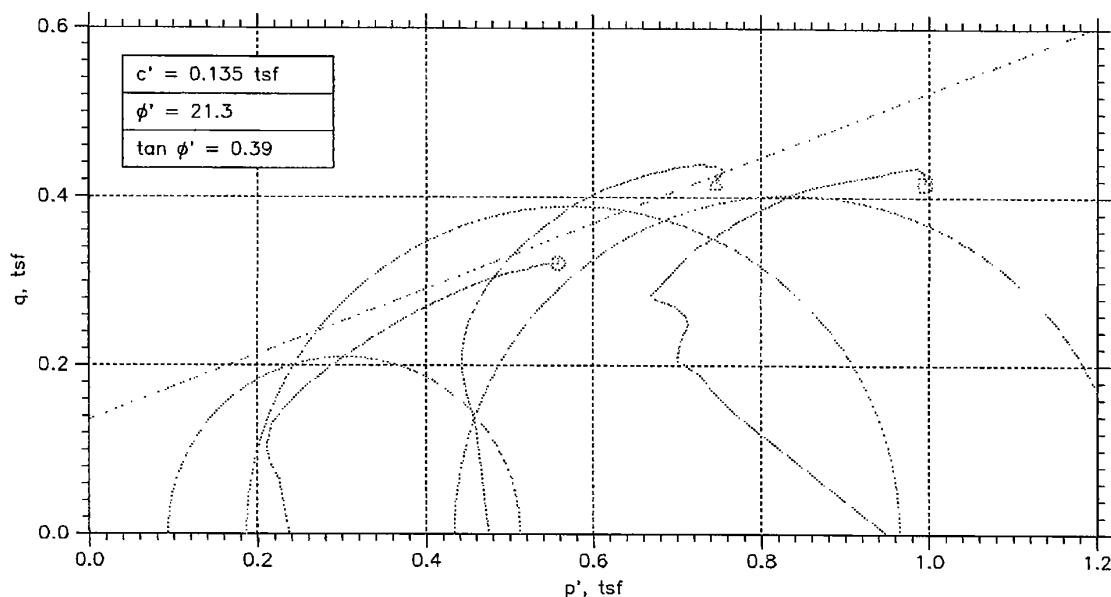
## TRIAXIAL COMPRESSION TEST REPORT



|                                                                                              |                        |                        |
|----------------------------------------------------------------------------------------------|------------------------|------------------------|
| Project: CAT ISLAND                                                                          | Location:              | Project No.: 200700579 |
| Boring No.: CI-2-07 S-8                                                                      | Tested By: MS          | Checked By: WPQ        |
| Sample No.: S-8                                                                              | Test Date: 3/16/07     | Depth: 15.0'-17.0'     |
| Test No.: CI206S8T1                                                                          | Sample Type: 3 INCH ST | Elevation:             |
| Description: SILTY CLAY TRACE F-M SAND - REDDISH BROWN CL                                    |                        |                        |
| Remarks: FAILURE CRITERIA = MAXIMUM EFFECTIVE STRESS RATIO TEST PERFORMED AS PER ASTM D 4767 |                        |                        |
|                                                                                              |                        |                        |

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## TRIAXIAL COMPRESSION TEST REPORT

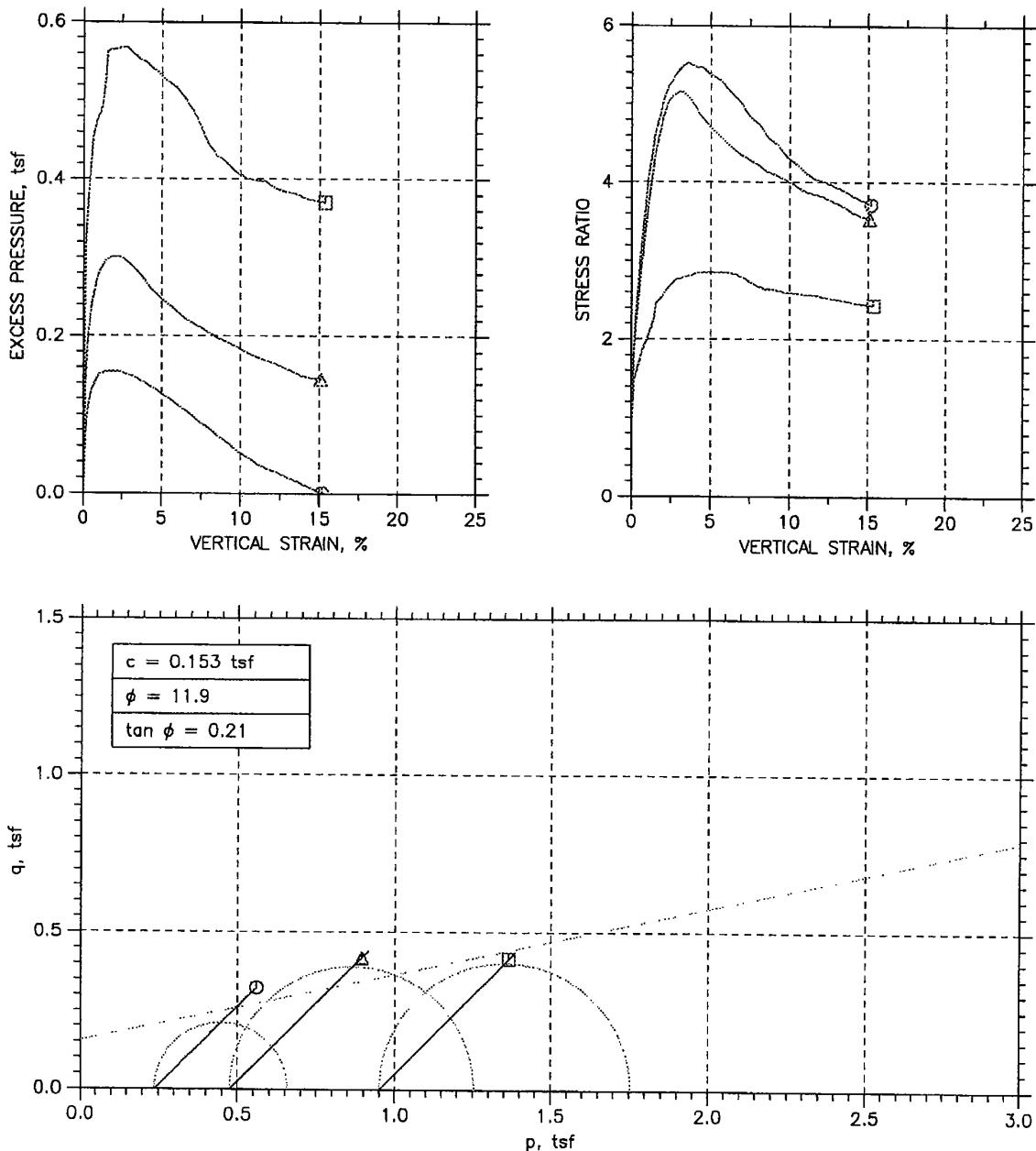


| Symbol       | ○                          | △          | □          |         |  |
|--------------|----------------------------|------------|------------|---------|--|
| Test No.     | CI206S10T1                 | CI206S10T2 | CI206S10T3 |         |  |
| Initial      | Diameter, in               | 2.85       | 2.8461     | 2.8807  |  |
|              | Height, in                 | 5.5185     | 5.6126     | 5.2626  |  |
|              | Water Content, %           | 31.00      | 31.23      | 30.14   |  |
|              | Dry Density,pcf            | 91.84      | 90.44      | 94.76   |  |
|              | Saturation, %              | 98.89      | 96.41      | 103.04  |  |
|              | Void Ratio                 | 0.85568    | 0.88435    | 0.79859 |  |
| Before Shear | Water Content, %           | 31.16      | 32.46      | 28.56   |  |
|              | Dry Density,pcf            | 92.31      | 91.29      | 96.63   |  |
|              | Saturation, %              | 100.51     | 102.22     | 102.09  |  |
|              | Void Ratio                 | 0.84633    | 0.86696    | 0.76368 |  |
|              | Back Press., tsf           | 5.0402     | 5.0401     | 5.0398  |  |
|              | Minor Prin. Stress, tsf    | 0.23743    | 0.47508    | 0.9506  |  |
|              | Max. Dev. Stress, tsf      | 0.64259    | 0.87809    | 0.86982 |  |
|              | Time to Failure, min       | 202.76     | 140        | 132     |  |
|              | Strain Rate, %/min         | 0.072      | 0.0707     | 0.0754  |  |
|              | B-Value                    | ---        | ---        | ---     |  |
|              | Estimated Specific Gravity | 2.73       | 2.73       | 2.73    |  |
|              | Liquid Limit               | 0          | 0          | 0       |  |
|              | Plastic Limit              | 0          | 0          | 0       |  |
|              | Plasticity Index           | 0          | 0          | 0       |  |
|              | Failure Sketch             |            |            |         |  |
|              |                            |            |            |         |  |
|              |                            |            |            |         |  |
|              |                            |            |            |         |  |

|                                                                                              |
|----------------------------------------------------------------------------------------------|
| Project: CAT ISLAND                                                                          |
| Location:                                                                                    |
| Project No.: 200700579                                                                       |
| Boring No.: CI-2-07 S10                                                                      |
| Sample Type: 3 INCH ST                                                                       |
| Description: SILTY CLAY TRACE F-C SAND - REDDISH BROWN (CL)                                  |
| Remarks: FAILURE CRITERIA = MAXIMUM EFFECTIVE STRESS RATIO TEST PERFORMED AS PER ASTM D 4767 |

Tue, 17-APR-2007 13:40:56

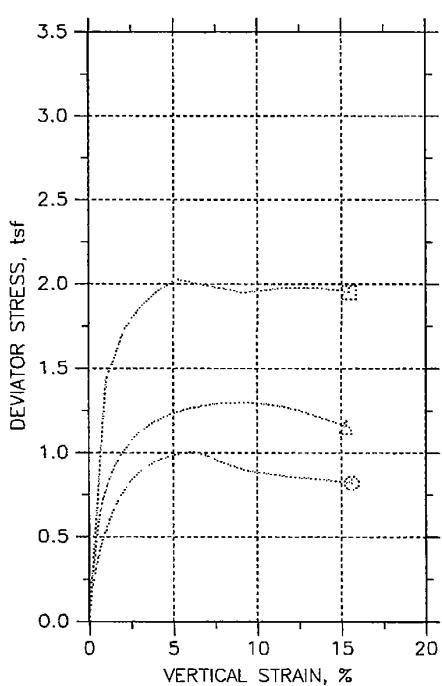
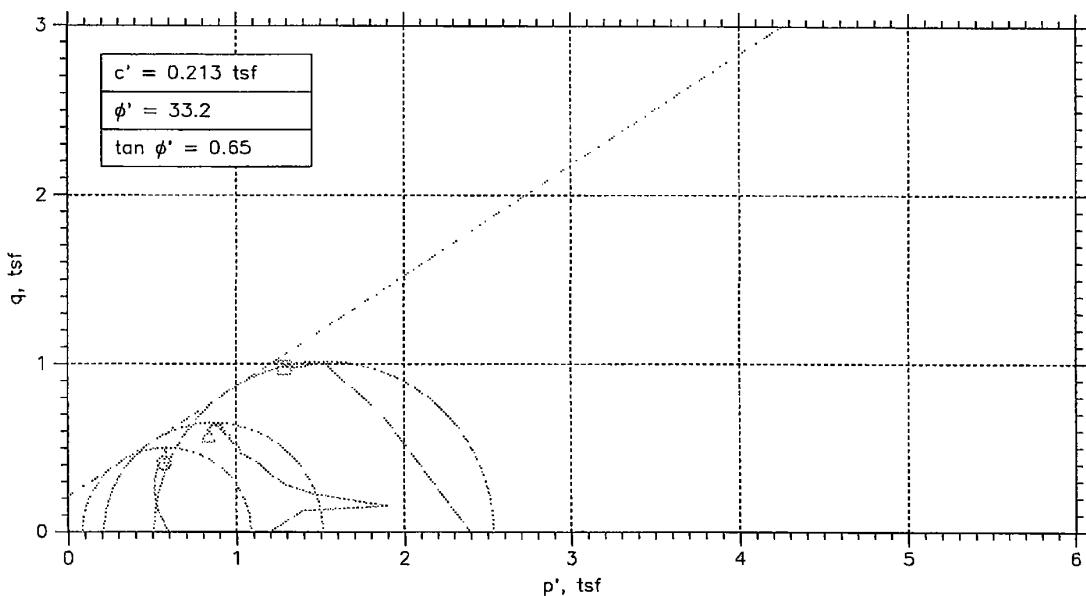
# TRIAXIAL COMPRESSION TEST REPORT



|                                                                                              |                        |                        |
|----------------------------------------------------------------------------------------------|------------------------|------------------------|
| Project: CAT ISLAND                                                                          | Location:              | Project No.: 200700579 |
| Boring No.: CI-2-07 S10                                                                      | Tested By: MJS         | Checked By: WPQ        |
| Sample No.: S-10                                                                             | Test Date: 4/5/07      | Depth: 20.0'-22.0'     |
| Test No.: CI206S10T1                                                                         | Sample Type: 3 INCH ST | Elevation:             |
| Description: SILTY CLAY TRACE F-C SAND - REDDISH BROWN (CL)                                  |                        |                        |
| Remarks: FAILURE CRITERIA = MAXIMUM EFFECTIVE STRESS RATIO TEST PERFORMED AS PER ASTM D 4767 |                        |                        |
|                                                                                              |                        |                        |

Wed, 16-MAY-2007 11:56:35

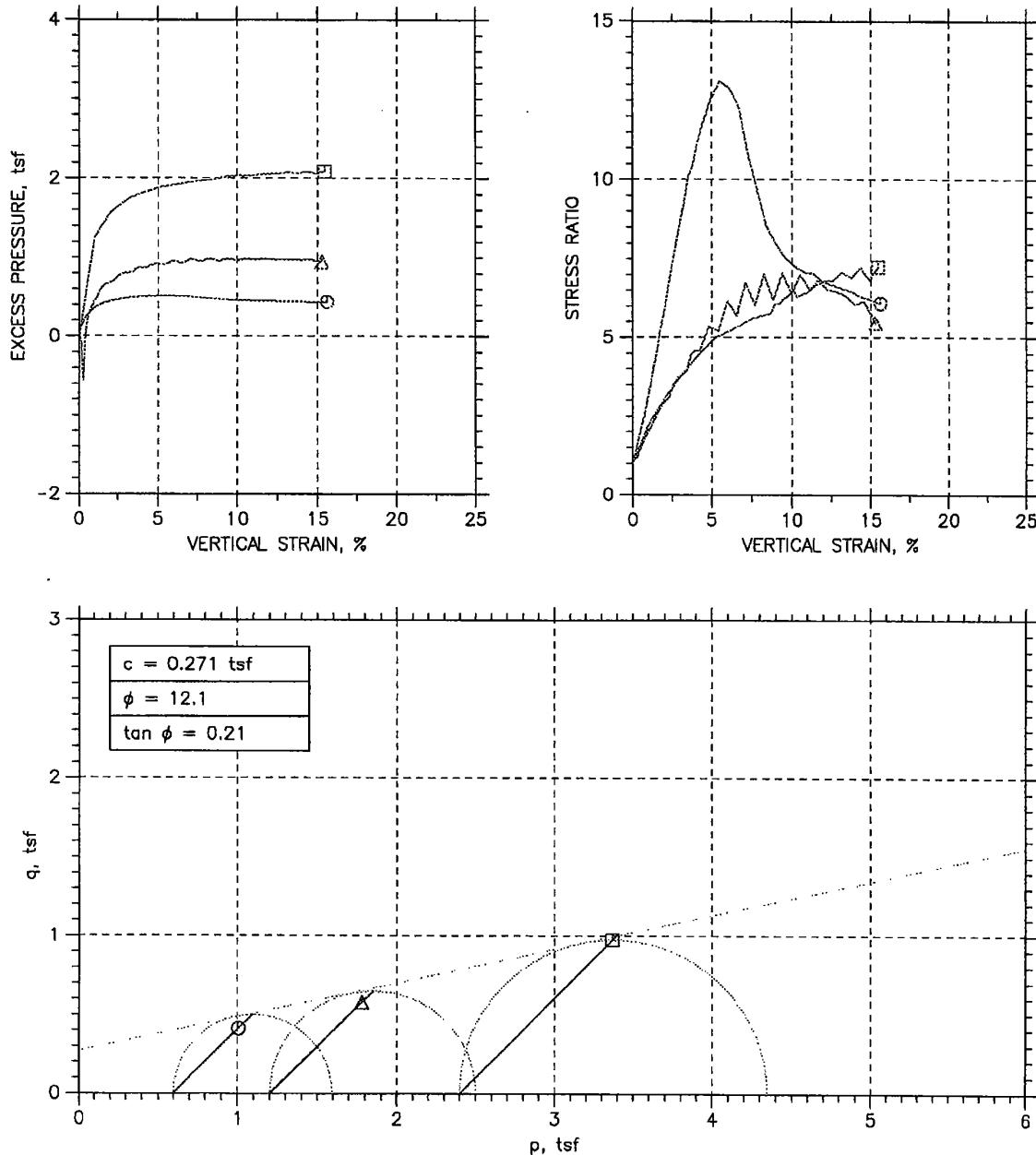
## TRIAXIAL COMPRESSION TEST REPORT



| Symbol                     | ○          | △          | □          |  |
|----------------------------|------------|------------|------------|--|
| Test No.                   | CI306S17T0 | CI306S17T1 | CI306S17T3 |  |
| Initial                    |            |            |            |  |
| Diameter, in               | 2.8366     | 2.8177     | 2.8272     |  |
| Height, in                 | 5.7106     | 5.7791     | 5.8563     |  |
| Water Content, %           | 85.74      | 57.30      | 78.67      |  |
| Dry Density, pcf           | 48.35      | 61.43      | 51.89      |  |
| Saturation, %              | 93.12      | 88.71      | 94.48      |  |
| Void Ratio                 | 2.486      | 1.7439     | 2.2482     |  |
| Shear                      |            |            |            |  |
| Water Content, %           | 88.78      | 60.46      | 70.89      |  |
| Dry Density, pcf           | 49.42      | 65.84      | 57.86      |  |
| Saturation, %              | 99.42      | 104.63     | 100.06     |  |
| Void Ratio                 | 2.411      | 1.5602     | 1.9129     |  |
| Before                     |            |            |            |  |
| Back Press., tsf           | 5.0402     | 5.0398     | 5.0402     |  |
| Minor Prin. Stress, tsf    | 0.59743    | 1.2026     | 2.3974     |  |
| Max. Dev. Stress, tsf      | 1.0002     | 1.2972     | 2.0253     |  |
| Time to Failure, min       | 84.004     | 132        | 10         |  |
| Strain Rate, %/min         | 0.0694     | 0.0703     | 0.0694     |  |
| B-Value                    | ---        | ---        | ---        |  |
| Estimated Specific Gravity | 2.70       | 2.70       | 2.70       |  |
| Liquid Limit               | 65         | 65         | 0          |  |
| Plastic Limit              | 25         | 25         | 0          |  |
| Plasticity Index           | 40         | 40         | 0          |  |

|                                                                                              |                |
|----------------------------------------------------------------------------------------------|----------------|
| Project: CAT ISLAND                                                                          | Failure Sketch |
| Location:                                                                                    |                |
| Project No.: 200700579                                                                       |                |
| Boring No.: CI-3-07 S17                                                                      |                |
| Sample Type: 3 INCH ST                                                                       |                |
| Description: SILTY CLAY LITTLE F-C SAND - BROWN CH                                           |                |
| Remarks: FAILURE CRITERIA = MAXIMUM EFFECTIVE STRESS RATIO TEST PERFORMED AS PER ASTM D 4767 |                |

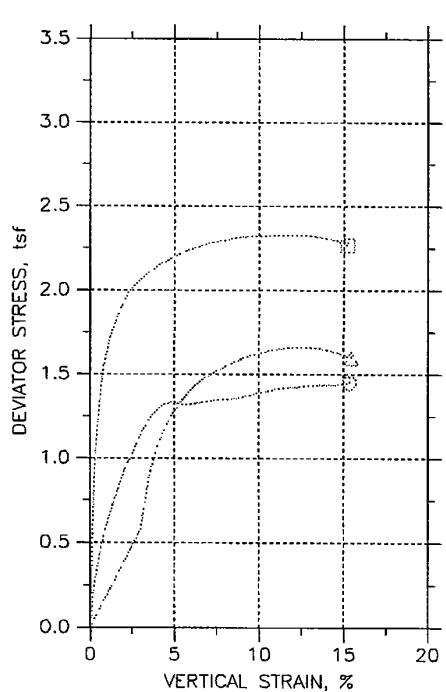
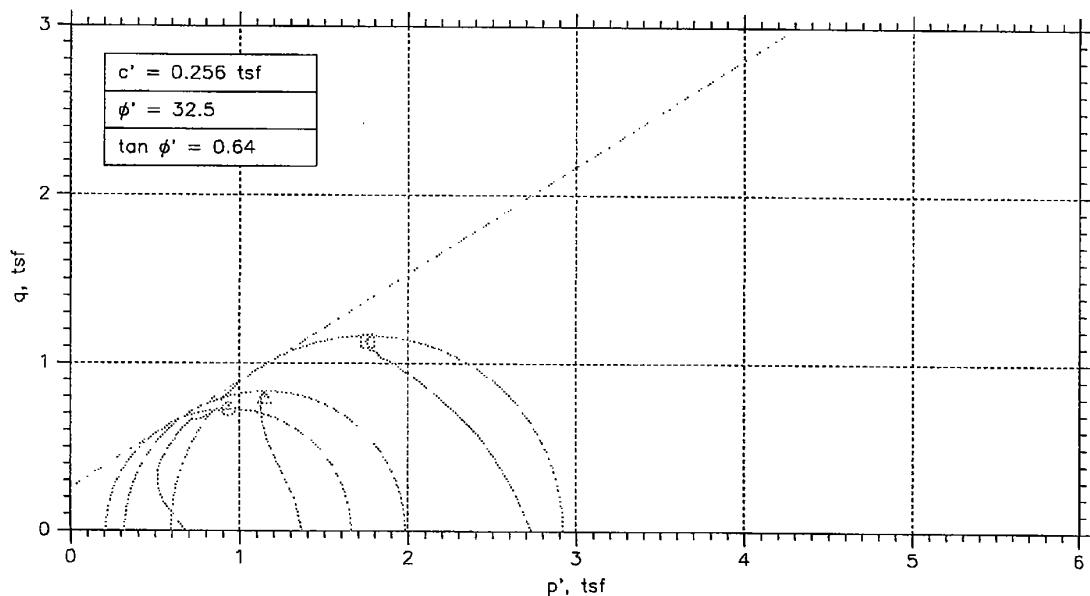
## TRIAXIAL COMPRESSION TEST REPORT



|                                                                                              |                        |                        |
|----------------------------------------------------------------------------------------------|------------------------|------------------------|
| Project: CAT ISLAND                                                                          | Location:              | Project No.: 200700579 |
| Boring No.: CI-3-07 S17                                                                      | Tested By: MJS         | Checked By: WPQ        |
| Sample No.: S-17                                                                             | Test Date: 3/28/07     | Depth: 37.5'-39.5'     |
| Test No.: CI306S17T1                                                                         | Sample Type: 3 INCH ST | Elevation:             |
| Description: SILTY CLAY LITTLE F-C SAND - BROWN CH                                           |                        |                        |
| Remarks: FAILURE CRITERIA = MAXIMUM EFFECTIVE STRESS RATIO TEST PERFORMED AS PER ASTM D 4767 |                        |                        |
|                                                                                              |                        |                        |

Wed, 16-MAY-2007 12:06:02

## TRIAXIAL COMPRESSION TEST REPORT



| Symbol       | ○                          | △          | □          |        |
|--------------|----------------------------|------------|------------|--------|
| Test No.     | C1306S19T01                | C1306S19T2 | C1306S19T3 |        |
| Initial      | Diameter, in               | 2.8496     | 2.8571     | 2.8591 |
|              | Height, in                 | 5.7681     | 5.6173     | 5.4858 |
|              | Water Content, %           | 84.69      | 63.27      | 47.82  |
|              | Dry Density, pcf           | 44.46      | 58.58      | 67.17  |
|              | Saturation, %              | 81.94      | 90.99      | 85.54  |
|              | Void Ratio                 | 2.7909     | 1.8774     | 1.5094 |
| Before Shear | Water Content, %           | 104.77     | 63.45      | 47.51  |
|              | Dry Density, pcf           | 45.29      | 61.97      | 74.55  |
|              | Saturation, %              | 103.93     | 99.61      | 101.73 |
|              | Void Ratio                 | 2.7219     | 1.7198     | 1.261  |
|              | Back Press., tsf           | 5.0402     | 5.04       | 5.0398 |
|              | Minor Prin. Stress, tsf    | 0.68383    | 1.368      | 2.7362 |
|              | Max. Dev. Stress, tsf      | 1.4456     | 1.6595     | 2.3252 |
|              | Time to Failure, min       | 214        | 132        | 172    |
|              | Strain Rate, %/min         | 0.692      | 0.0717     | 0.0758 |
|              | B-Value                    | ---        | ---        | ---    |
|              | Estimated Specific Gravity | 2.70       | 2.70       | 2.70   |
|              | Liquid Limit               | 126        | 126        | 126    |
|              | Plastic Limit              | 94         | 94         | 94     |
|              | Plasticity Index           | 32         | 32         | 32     |
|              | Failure Sketch             |            |            |        |
|              |                            |            |            |        |

Project: CAT ISLAND

Location:

Project No.: 200700579

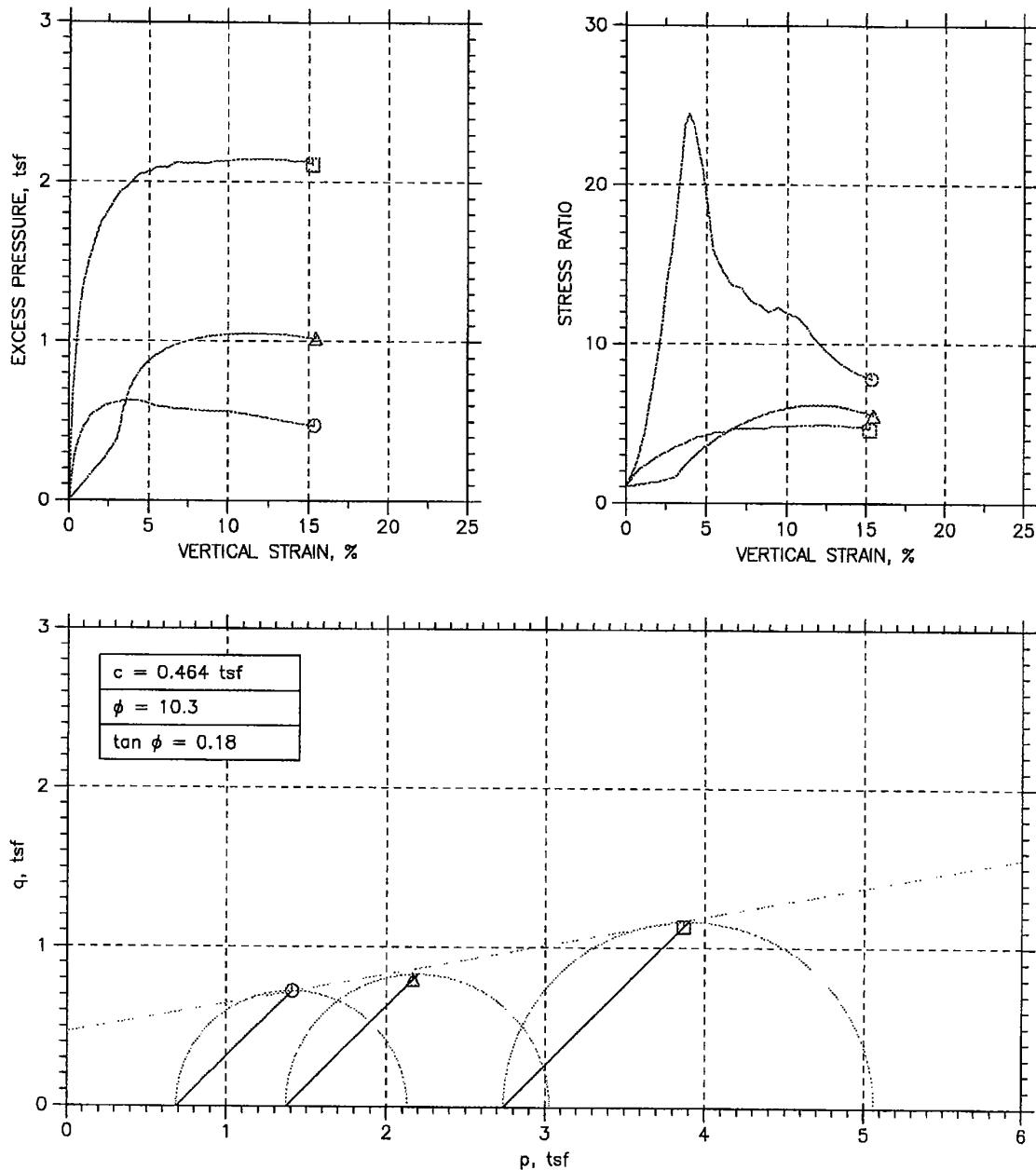
Boring No.: CI-3-07 S19

Sample Type: 3 INCH ST

Description: ELASTIC SILT AND CLAY TRACE F-C SAND - VERY DARK BROWN MH

Remarks: FAILURE CRITERIA=MAXIMUM EFFECTIVE STRESS RATIO TEST CONDUCTED AS PER ASTM D 4767

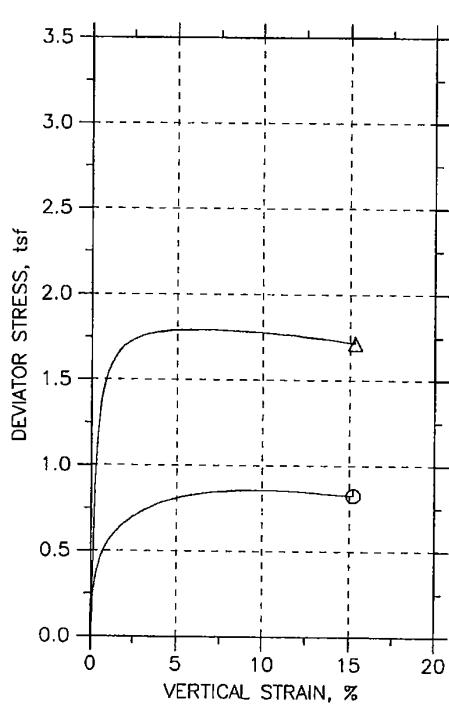
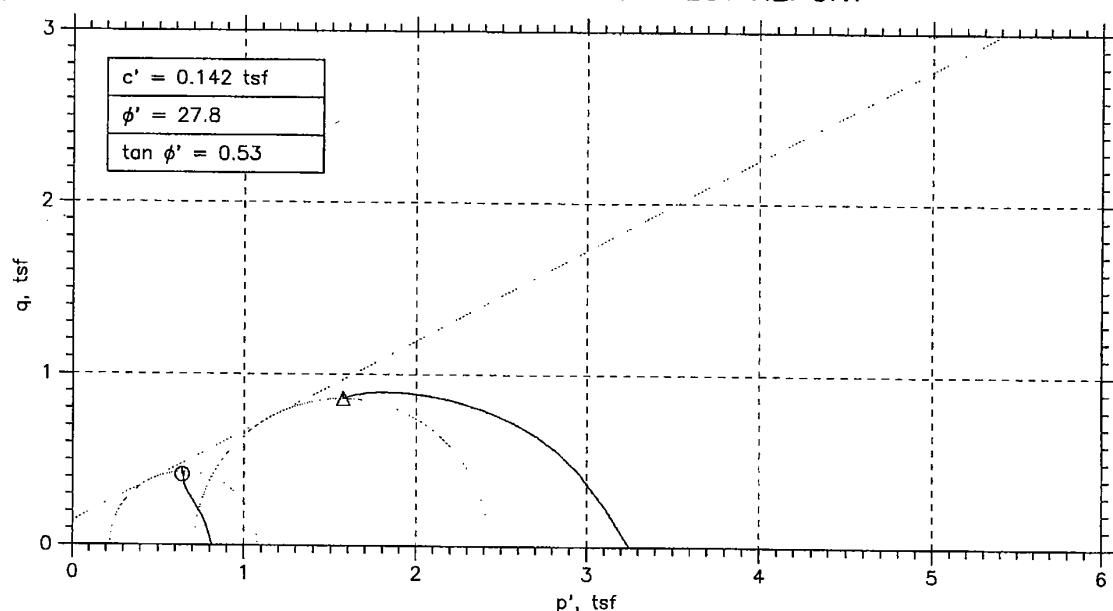
## TRIAXIAL COMPRESSION TEST REPORT



|                                                                                            |                        |                        |
|--------------------------------------------------------------------------------------------|------------------------|------------------------|
| Project: CAT ISLAND                                                                        | Location:              | Project No.: 200700579 |
| Boring No.: CI-3-07 S19                                                                    | Tested By: MJS         | Checked By: WPQ        |
| Sample No.: S-19                                                                           | Test Date: 4/2/07      | Depth: 42.5'-44.5'     |
| Test No.: CI306S19T1                                                                       | Sample Type: 3 INCH ST | Elevation:             |
| Description: ELASTIC SILT AND CLAY TRACE F-C SAND - VERY DARK BROWN MH                     |                        |                        |
| Remarks: FAILURE CRITERIA=MAXIMUM EFFECTIVE STRESS RATIO TEST CONDUCTED AS PER ASTM D 4767 |                        |                        |
|                                                                                            |                        |                        |

Wed, 16-MAY-2007 12:19:44

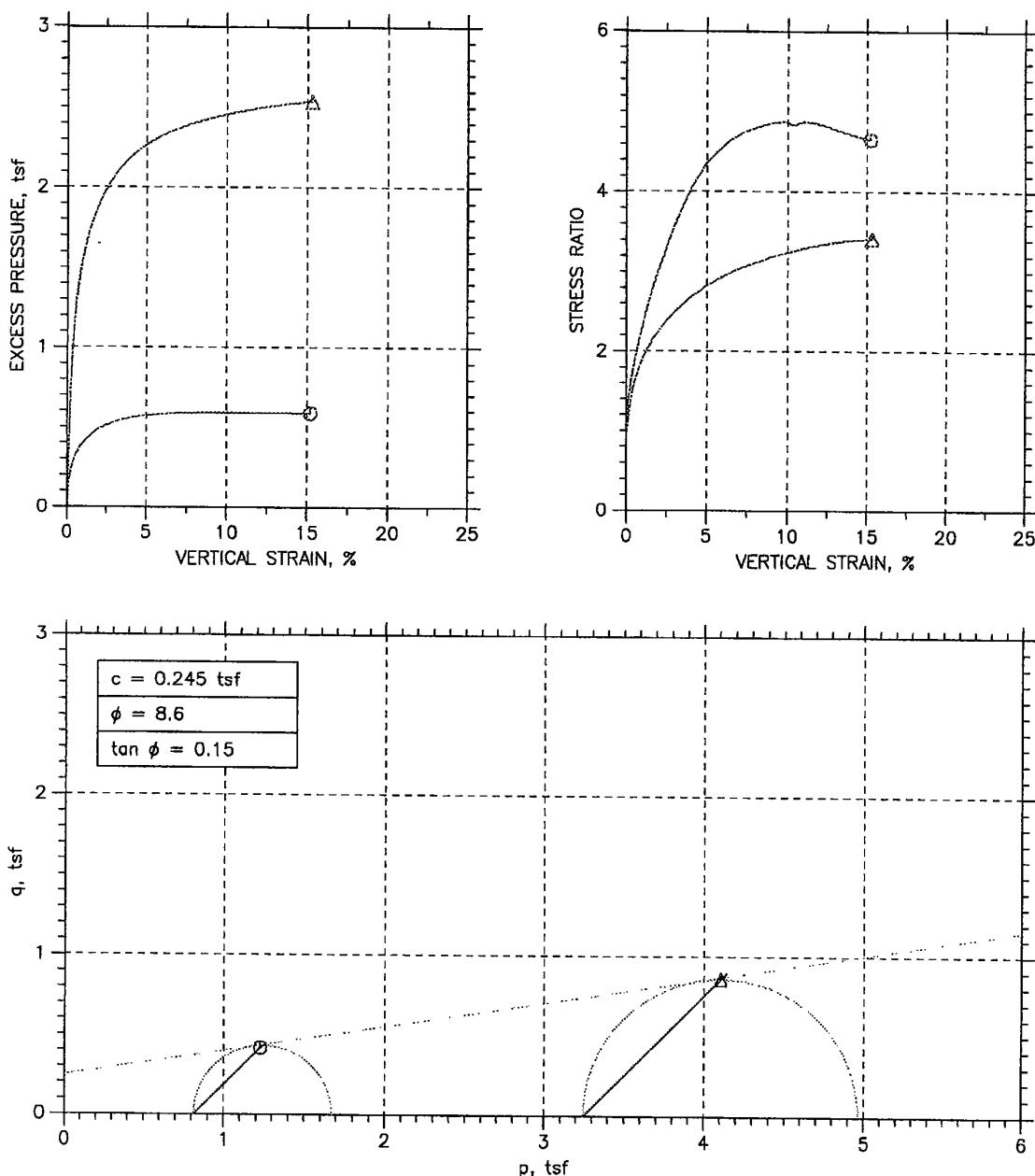
# TRIAXIAL COMPRESSION TEST REPORT



| Symbol                     | ○                   | △      |  |  |
|----------------------------|---------------------|--------|--|--|
| Test No.                   | CI306S22TCI306S22T2 |        |  |  |
| Initial                    |                     |        |  |  |
| Diameter, mm               | 72.15               | 72.19  |  |  |
| Height, mm                 | 140.87              | 144.66 |  |  |
| Water Content, %           | 61.79               | 60.08  |  |  |
| Dry Density, pcf           | 61.78               | 63.35  |  |  |
| Saturation, %              | 96.52               | 97.67  |  |  |
| Void Ratio                 | 1.7284              | 1.6608 |  |  |
| Before Shear               |                     |        |  |  |
| Water Content, %           | 58.79               | 50.93  |  |  |
| Dry Density, pcf           | 65.37               | 71.35  |  |  |
| Saturation, %              | 100.55              | 100.93 |  |  |
| Void Ratio                 | 1.5787              | 1.3623 |  |  |
| Back Press., tsf           | 5.04                | 5.0401 |  |  |
| Minor Prin. Stress, tsf    | 0.8136              | 3.2471 |  |  |
| Max. Dev. Stress, tsf      | 0.85837             | 1.7931 |  |  |
| Time to Failure, min       | 124                 | 100    |  |  |
| Strain Rate, %/min         | 0.0732              | 0.0744 |  |  |
| B-Value                    | ---                 | ---    |  |  |
| Estimated Specific Gravity | 2.70                | 2.70   |  |  |
| Liquid Limit               | 62                  | 62     |  |  |
| Plastic Limit              | 27                  | 27     |  |  |
| Plasticity Index           | 35                  | 35     |  |  |
| Failure Sketch             |                     |        |  |  |

|                                                                                              |  |
|----------------------------------------------------------------------------------------------|--|
| Project: CAT ISLAND                                                                          |  |
| Location:                                                                                    |  |
| Project No.: 200700579                                                                       |  |
| Boring No.: CI-3-07 S22                                                                      |  |
| Sample Type: 3 INCH ST                                                                       |  |
| Description: SILTY CLAY TRACE M-F SAND - BROWN AND GRAY (CH)                                 |  |
| Remarks: FAILURE CRITERIA = MAXIMUM EFFECTIVE STRESS RATIO TEST PERFORMED AS PER ASTM D 4767 |  |

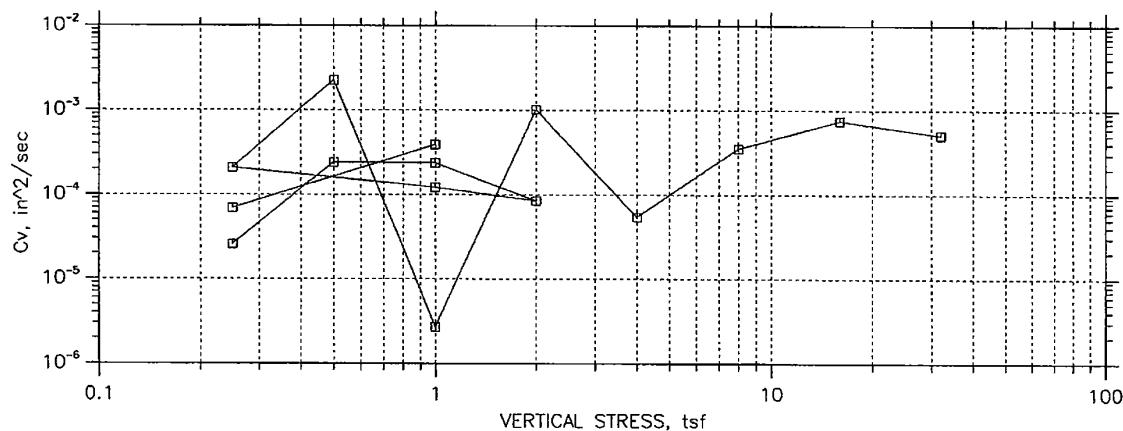
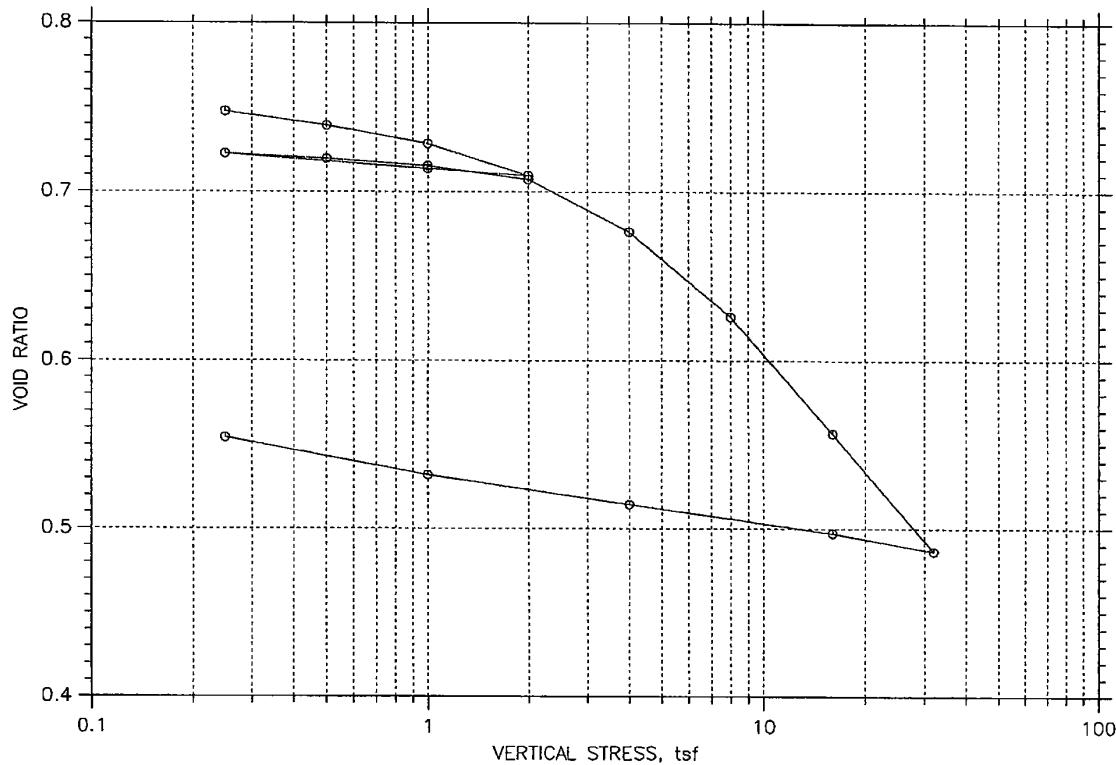
# TRIAXIAL COMPRESSION TEST REPORT



|                                                                                              |                        |                        |
|----------------------------------------------------------------------------------------------|------------------------|------------------------|
| Project: CAT ISLAND                                                                          | Location:              | Project No.: 200700579 |
| Boring No.: CI-3-07 S22                                                                      | Tested By: MJS         | Checked By: WPQ        |
| Sample No.: S-22                                                                             | Test Date: 3/28/07     | Depth: 50.0'-52.0'     |
| Test No.: CI306S22T1                                                                         | Sample Type: 3 INCH ST | Elevation:             |
| Description: SILTY CLAY TRACE M-F SAND - BROWN AND GRAY (CH)                                 |                        |                        |
| Remarks: FAILURE CRITERIA = MAXIMUM EFFECTIVE STRESS RATIO TEST PERFORMED AS PER ASTM D 4767 |                        |                        |

Wed, 16-MAY-2007 12:29:06

**CONSOLIDATION TEST DATA  
SUMMARY REPORT**



|                                                                                           |                        |                        |
|-------------------------------------------------------------------------------------------|------------------------|------------------------|
| Project: CAT ISLAND                                                                       | Location:              | Project No.: 200700579 |
| Boring No.: C1-1-07                                                                       | Tested By: MJS         | Checked By: WPQ        |
| Sample No.: S-6                                                                           | Test Date: 3/6/07      | Depth: 10.0'-12.0'     |
| Test No.: 18C1-1S6                                                                        | Sample Type: 3 INCH ST | Elevation:             |
| Description: SILTY CLAY TRACE F-C SAND - LIGHT REDDISH BROWN (CL)                         |                        |                        |
| Remarks: $P_c = 3.1$ tsf $C_c = 0.232$ $C_{cr} = 0.015$ TEST PERFORMED AS PER ASTM D 2435 |                        |                        |
|                                                                                           |                        |                        |

Wed, 16-MAY-2007 11:33:50

CONSOLIDATION TEST DATA

Project: CAT ISLAND  
 Boring No.: C1-1-07  
 Sample No.: S-6  
 Test No.: 18C1-1S6

Location:  
 Tested By: MJS  
 Test Date: 3/6/07  
 Sample Type: 3 INCH ST

Project No.: 200700579  
 Checked By: WPQ  
 Depth: 10.0'-12.0'  
 Elevation:

Soil Description: SILTY CLAY TRACE F-C SAND - LIGHT REDDISH BROWN (CL)  
 Remarks:  $P_c = 3.1 \text{ tsf}$   $C_c = 0.232$   $C_{cr} = 0.015$  TEST PERFORMED AS PER ASTM D 2435

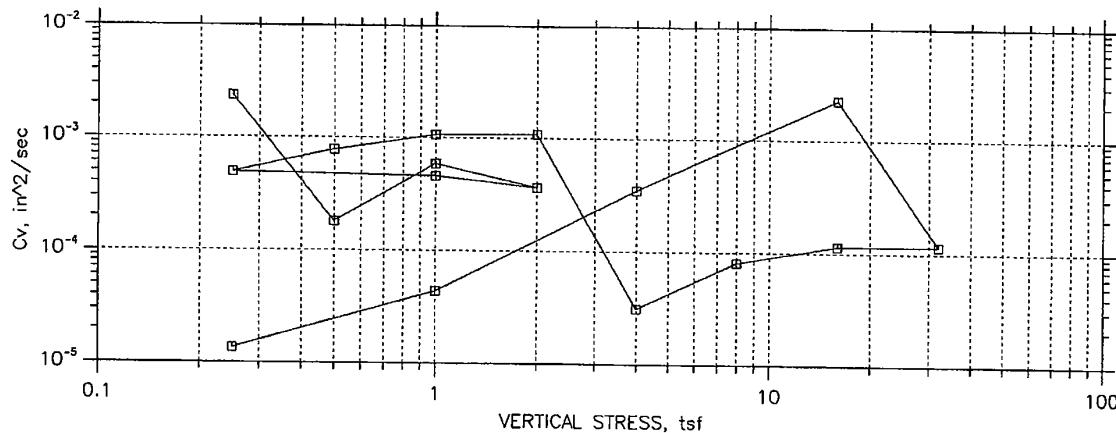
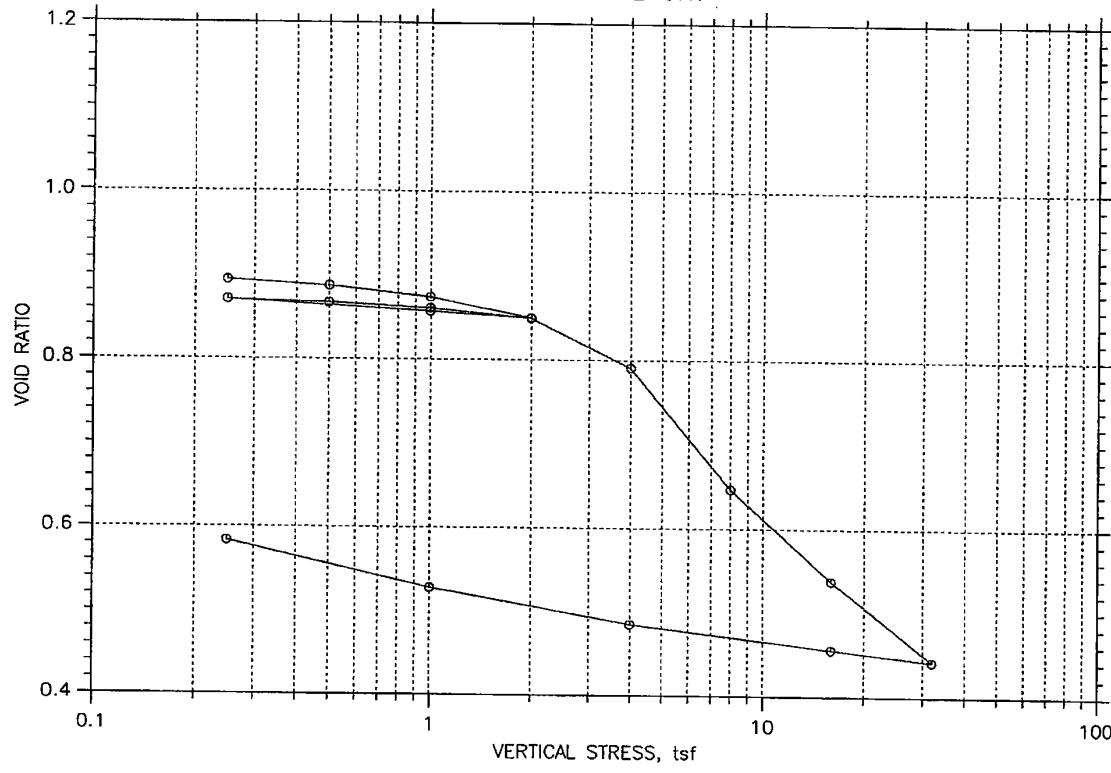
Estimated Specific Gravity: 2.74  
 Initial Void Ratio: 0.76  
 Final Void Ratio: 0.55

Liquid Limit: 0  
 Plastic Limit: 0  
 Plasticity Index: 0

Initial Height: 0.75 in  
 Specimen Diameter: 2.50 in

| Container ID                 | Before Consolidation |               | After Consolidation |           |
|------------------------------|----------------------|---------------|---------------------|-----------|
|                              | Trimmings            | Specimen+Ring | Specimen+Ring       | Trimmings |
| Wt. Container + Wet Soil, gm | X-14                 | RING          | RING                | RING      |
| Wt. Container + Dry Soil, gm | 157.43               | 196.34        | 190.41              | 190.41    |
| Wt. Container, gm            | 132.47               | 170.9         | 170.9               | 170.9     |
| Wt. Dry Soil, gm             | 44.55                | 77.22         | 77.22               | 77.22     |
| Water Content, %             | 87.92                | 93.68         | 93.68               | 93.68     |
| Void Ratio                   | 28.39                | 27.16         | 20.83               | 20.83     |
| Degree of Saturation, %      | ---                  | 0.76          | 0.55                | ---       |
| Dry Unit Weight, pcf         | ---                  | 97.32         | 102.96              | ---       |
|                              |                      | 96.938        | 110.06              | ---       |

**CONSOLIDATION TEST DATA**  
**SUMMARY REPORT**



|                                                                                                                          |                        |                        |
|--------------------------------------------------------------------------------------------------------------------------|------------------------|------------------------|
| Project: CAT ISLAND                                                                                                      | Locotion:              | Project No.: 200700579 |
| Boring No.: CI-2-07                                                                                                      | Tested By: MJS         | Checked By: WPQ        |
| Sample No.: S-8                                                                                                          | Test Date: 3/13/07     | Depth: 15.0'-17.0'     |
| Test No.: 16CI2S8                                                                                                        | Sample Type: 3 INCH ST | Elevation:             |
| Description: SILTY CLAY TRACE F-C SAND - REDDISH BROWN (CH)                                                              |                        |                        |
| Remarks: P <sub>c</sub> = 2.2 tsf   C <sub>c</sub> = 0.357   C <sub>cr</sub> = 0.024   TEST PERFORMED AS PER ASTM D 2435 |                        |                        |

Thu, 17-MAY-2007 11:38:35

CONSOLIDATION TEST DATA

Project: CAT ISLAND  
 Boring No.: CI-2-07  
 Sample No.: S-8  
 Test No.: 16CI2S8

Location:  
 Tested By: MJS  
 Test Date: 3/13/07  
 Sample Type: 3 INCH ST

Project No.: 200700579  
 Checked By: WPQ  
 Depth: 15.0'-17.0'  
 Elevation:

Soil Description: SILTY CLAY TRACE F-C SAND - REDDISH BROWN (CH)  
 Remarks:  $P_c = 2.2$  tsf    $C_c = 0.357$     $C_{cr} = 0.024$    TEST PERFORMED AS PER ASTM D 2435

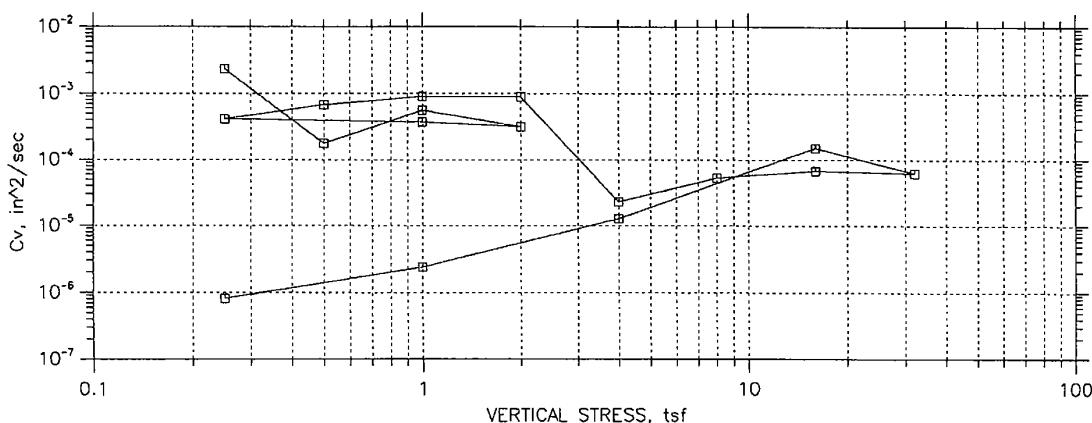
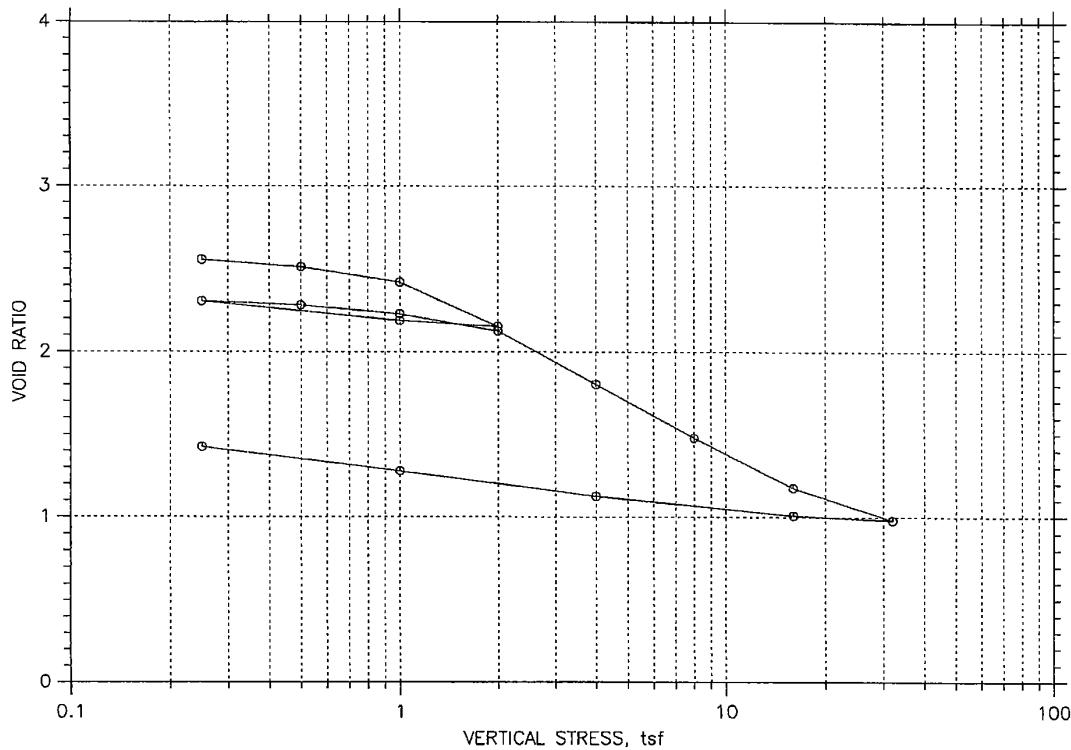
Estimated Specific Gravity: 2.73  
 Initial Void Ratio: 0.91  
 Final Void Ratio: 0.58

Liquid Limit: 0  
 Plastic Limit: 0  
 Plasticity Index: 0

Initial Height: 0.75 in  
 Specimen Diameter: 2.50 in

| Container ID                 | Before Consolidation |               | After Consolidation |          |
|------------------------------|----------------------|---------------|---------------------|----------|
|                              | Trimming             | Specimen+Ring | Specimen+Ring       | Trimming |
|                              | X-5                  | RING          | RING                | RING     |
| Wt. Container + Wet Soil, gm | 142.93               | 188.3         | 179.33              | 179.33   |
| Wt. Container + Dry Soil, gm | 118.15               | 160.65        | 160.65              | 160.65   |
| Wt. Container, gm            | 44.3                 | 74.38         | 74.38               | 74.38    |
| Wt. Dry Soil, gm             | 73.85                | 86.27         | 86.27               | 86.27    |
| Water Content, %             | 33.55                | 32.05         | 21.65               | 21.65    |
| Void Ratio                   | ---                  | 0.91          | 0.58                | ---      |
| Degree of Saturation, %      | ---                  | 96.24         | 101.40              | ---      |
| Dry Unit Weight, pcf         | ---                  | 89.27         | 107.66              | ---      |

**CONSOLIDATION TEST DATA**  
**SUMMARY REPORT**



|                                                                                                                            |                        |                        |
|----------------------------------------------------------------------------------------------------------------------------|------------------------|------------------------|
| Project: CAT ISLAND                                                                                                        | Location:              | Project No.: 200700579 |
| Boring No.: CI-3-07                                                                                                        | Tested By: MJS         | Checked By: WPQ        |
| Sample No.: S-16                                                                                                           | Test Date: 3/7/07      | Depth: 35.0'-37.0'     |
| Test No.: 19CI-3S16                                                                                                        | Sample Type: 3 INCH ST | Elevation:             |
| Description: ORGANIC SILT TRACE F-C SAND TRACE CLAY - BLACK (OL)                                                           |                        |                        |
| Remarks: P <sub>c</sub> = 1.0 tsf    C <sub>c</sub> = 0.98    C <sub>cr</sub> = 0.170    TEST PERFORMED AS PER ASTM D 2435 |                        |                        |

Wed, 16-MAY-2007 12:15:35

## CONSOLIDATION TEST DATA

Project: CAT ISLAND  
 Boring No.: CI-3-07  
 Sample No.: S-16  
 Test No.: 19CI-3S16

Location:  
 Tested By: MJS  
 Test Date: 3/7/07  
 Sample Type: 3 INCH ST

Project No.: 200700579  
 Checked By: WPQ  
 Depth: 35.0'-37.0'  
 Elevation:

Soil Description: ORGANIC SILT TRACE F-C SAND TRACE CLAY - BLACK (OL)  
 Remarks:  $P_c = 1.0 \text{ tsf}$   $C_c = 0.98$   $C_{cr} = 0.170$  TEST PERFORMED AS PER ASTM D 2435

Estimated Specific Gravity: 2.60  
 Initial Void Ratio: 2.62  
 Final Void Ratio: 1.42

Liquid Limit: 0  
 Plastic Limit: 0  
 Plasticity Index: 0

Initial Height: 0.75 in  
 Specimen Diameter: 2.50 in

## Container ID

|                              | Before Consolidation | After Consolidation |               |           |
|------------------------------|----------------------|---------------------|---------------|-----------|
|                              | Trimmings            | Specimen+Ring       | Specimen+Ring | Trimmings |
| Container ID                 | X-14                 | RING                | RING          | RING      |
| Wt. Container + Wet Soil, gm | 109.68               | 159.92              | 142.37        | 142.37    |
| Wt. Container + Dry Soil, gm | 75.44                | 118.95              | 118.95        | 118.95    |
| Wt. Container, gm            | 44.52                | 75.58               | 75.58         | 75.58     |
| Wt. Dry Soil, gm             | 30.92                | 43.37               | 43.37         | 43.37     |
| Water Content, %             | 110.74               | 94.47               | 54.00         | 54.00     |
| Void Ratio                   | ---                  | 2.62                | 1.42          | ---       |
| Degree of Saturation, %      | ---                  | 93.86               | 98.72         | ---       |
| Dry Unit Weight, pcf         | ---                  | 44.878              | 67.01         | ---       |

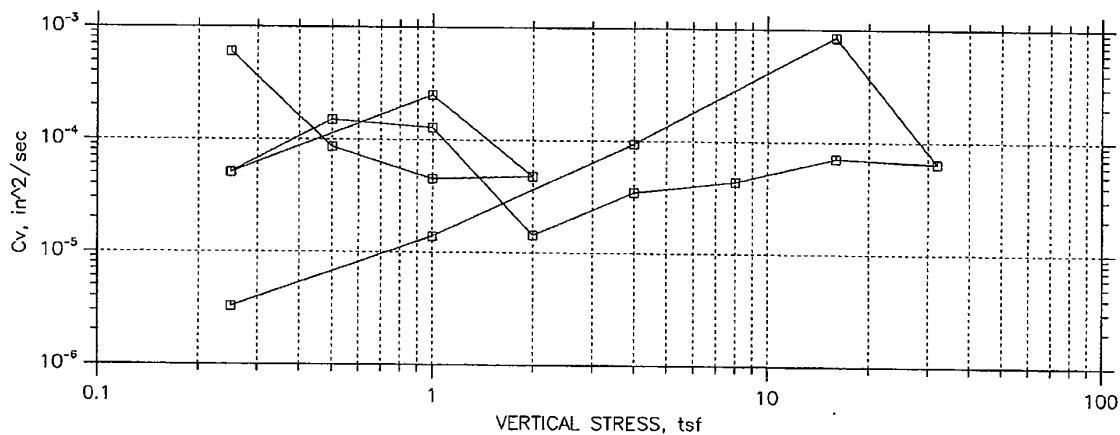
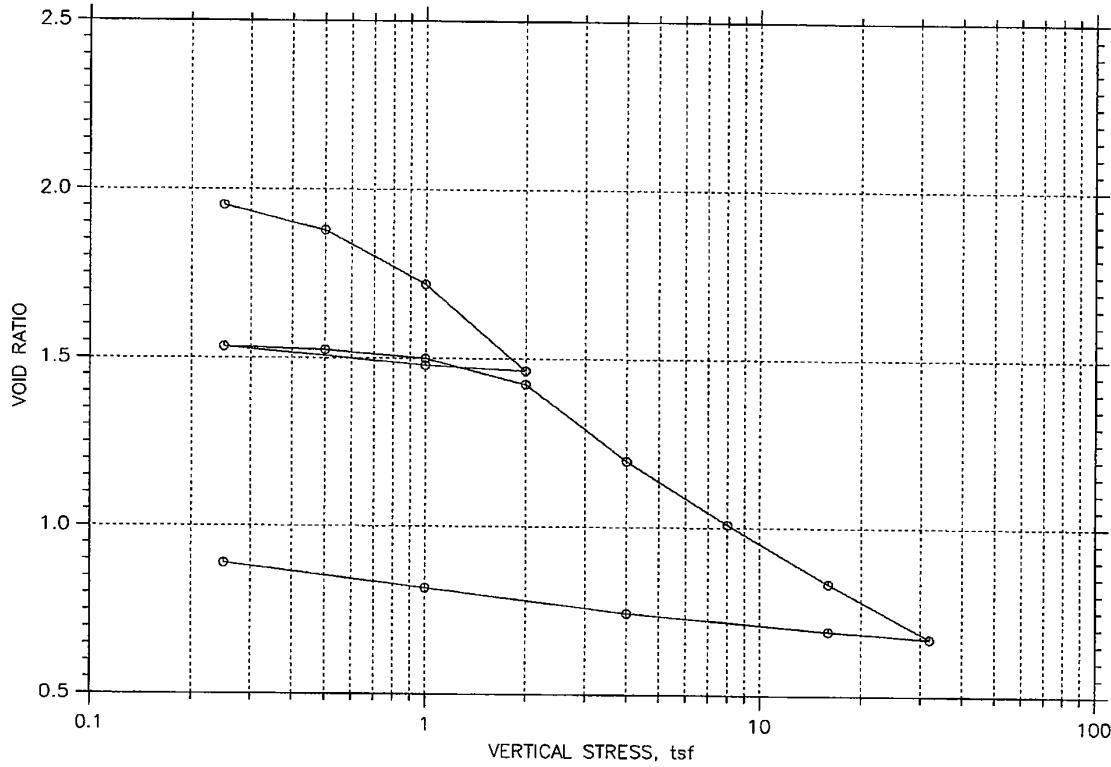
## Trimmings

## Specimen+Ring

## Specimen+Ring

## Trimmings

**CONSOLIDATION TEST DATA  
SUMMARY REPORT**



|                                                                                           |                        |                        |
|-------------------------------------------------------------------------------------------|------------------------|------------------------|
| Project: CAT ISLAND                                                                       | Location:              | Project No.: 200700579 |
| Boring No.: CI-3-07                                                                       | Tested By: MJS         | Checked By: WPQ        |
| Sample No.: S-22                                                                          | Test Date: 03/26/07    | Depth: 50.0'-52.0'     |
| Test No.: 16CI3S22                                                                        | Sample Type: 3 INCH ST | Elevation:             |
| Description: SILTY CLAY TRACE F-C SAND - BROWN & GRAY (CL)                                |                        |                        |
| Remarks: $P_c = 0.6$ tsf $C_c = 0.700$ $C_{cr} = 0.080$ TEST PERFORMED AS PER ASTM D 2435 |                        |                        |

Wed, 16-MAY-2007 16:07:06

CONSOLIDATION TEST DATA

Project: CAT ISLAND  
 Boring No.: CI-3-07  
 Sample No.: S-22  
 Test No.: 16CI3S22

Location:  
 Tested By: MJS  
 Test Date: 03/26/07  
 Sample Type: 3 INCH ST

Project No.: 200700579  
 Checked By: WPQ  
 Depth: 50.0'-52.0'  
 Elevation:

Soil Description: SILTY CLAY TRACE F-C SAND - BROWN & GRAY (CL)  
 Remarks:  $P_c = 0.6 \text{ tsf}$   $C_c = 0.700$   $C_{cr} = 0.080$  TEST PERFORMED AS PER ASTM D 2435

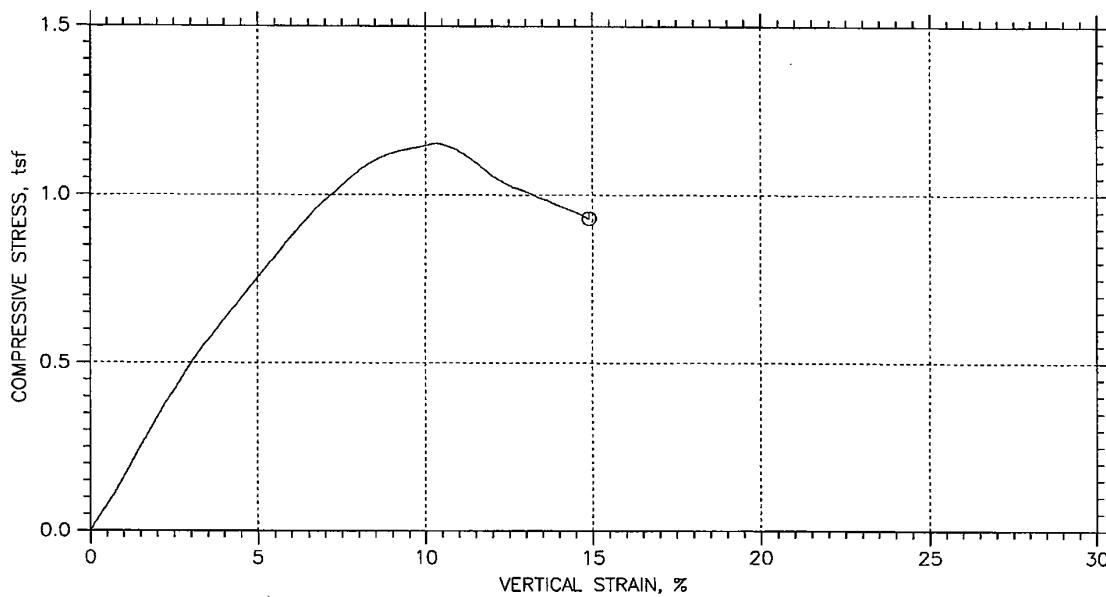
Estimated Specific Gravity: 2.70  
 Initial Void Ratio: 1.95  
 Final Void Ratio: 0.89

Liquid Limit: 0  
 Plastic Limit: 0  
 Plasticity Index: 0

Initial Height: 0.75 in  
 Specimen Diameter: 2.50 in

| Container ID                 | Before Consolidation |               | After Consolidation |           |
|------------------------------|----------------------|---------------|---------------------|-----------|
|                              | Trimmings            | Specimen+Ring | Specimen+Ring       | Trimmings |
| Wt. Container + Wet Soil, gm | 113.09               | 167.9         | 146.62              | 146.62    |
| Wt. Container + Dry Soil, gm | 85.27                | 129.55        | 129.55              | 129.55    |
| Wt. Container, gm            | 45.23                | 74.37         | 74.37               | 74.37     |
| Wt. Dry Soil, gm             | 40.04                | 55.18         | 55.18               | 55.18     |
| Water Content, %             | 69.48                | 69.50         | 30.94               | 30.94     |
| Void Ratio                   | ---                  | 1.95          | 0.89                | ---       |
| Degree of Saturation, %      | ---                  | 96.13         | 94.07               | ---       |
| Dry Unit Weight, pcf         | ---                  | 57.099        | 89.284              | ---       |

### UNCONFINED COMPRESSION TEST REPORT

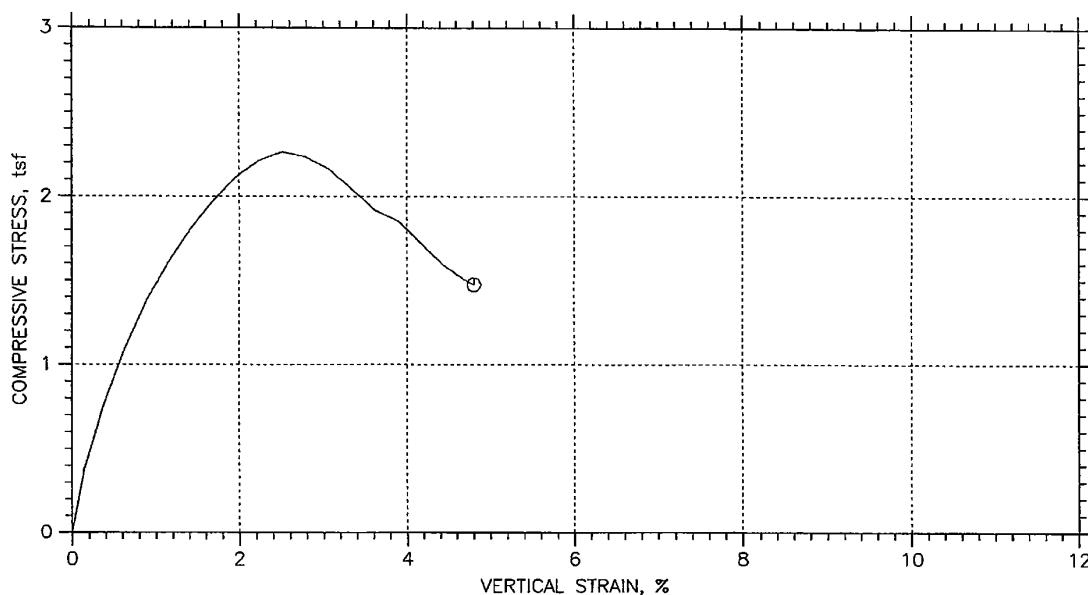


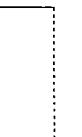
| Symbol                               | ⊖                                                                                   |                                                                                      |                                                                                       |                                                                                       |
|--------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Test No.                             | QUC1-1S6                                                                            |                                                                                      |                                                                                       |                                                                                       |
| Initial                              | Diameter, in                                                                        | 2.8173                                                                               |                                                                                       |                                                                                       |
|                                      | Height, in                                                                          | 5.5311                                                                               |                                                                                       |                                                                                       |
|                                      | Water Content, %                                                                    | 27.83                                                                                |                                                                                       |                                                                                       |
|                                      | Dry Density, pcf                                                                    | 98.05                                                                                |                                                                                       |                                                                                       |
|                                      | Saturation, %                                                                       | 102.94                                                                               |                                                                                       |                                                                                       |
|                                      | Void Ratio                                                                          | 0.73821                                                                              |                                                                                       |                                                                                       |
| Unconfined Compressive Strength, tsf | 1.1526                                                                              |                                                                                      |                                                                                       |                                                                                       |
| Undrained Shear Strength, tsf        | 0.5763                                                                              |                                                                                      |                                                                                       |                                                                                       |
| Time to Failure, min                 | 19.004                                                                              |                                                                                      |                                                                                       |                                                                                       |
| Strain Rate, %/min                   | 0.5395                                                                              |                                                                                      |                                                                                       |                                                                                       |
| Estimated Specific Gravity           | 2.73                                                                                |                                                                                      |                                                                                       |                                                                                       |
| Liquid Limit                         | 0                                                                                   |                                                                                      |                                                                                       |                                                                                       |
| Plastic Limit                        | 0                                                                                   |                                                                                      |                                                                                       |                                                                                       |
| Plasticity Index                     | 0                                                                                   |                                                                                      |                                                                                       |                                                                                       |
| Failure Sketch                       |  |  |  |  |

|                                                                   |
|-------------------------------------------------------------------|
| Project: CAT ISLAND                                               |
| Location:                                                         |
| Project No.: 200700579                                            |
| Boring No.: C1-1-07 S-6                                           |
| Sample Type: 3 INCH ST                                            |
| Description: SILTY CLAY TRACE F-C SAND - LIGHT REDDISH BROWN (CL) |
| Remarks: TEST PERFORMED AS PER ASTM D 2166                        |

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## UNCONFINED COMPRESSION TEST REPORT

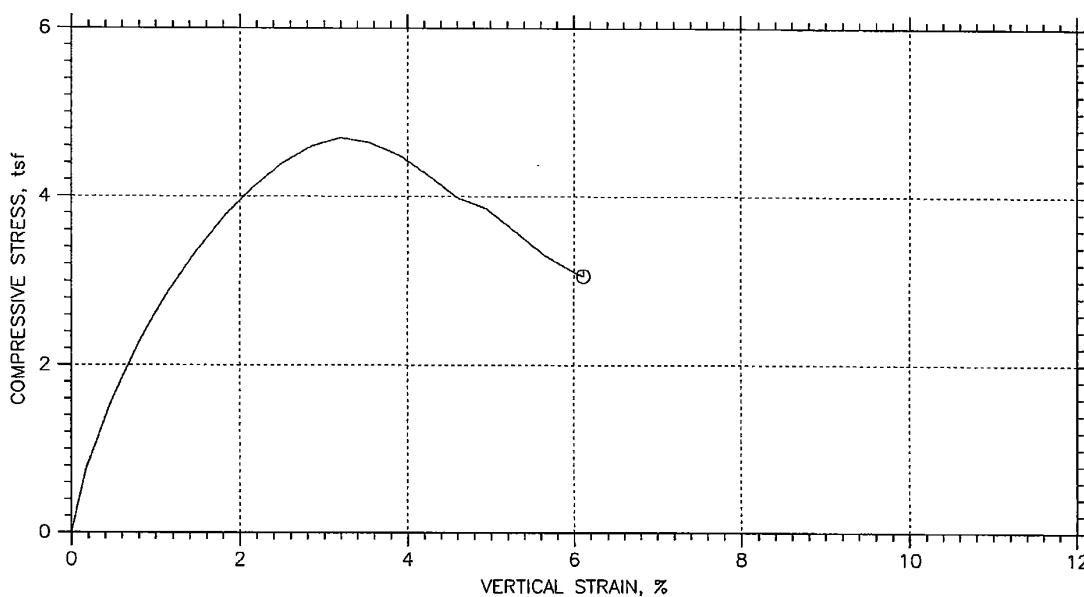


| Symbol                               | Ø                |                                                                                     |                                                                                      |                                                                                       |                                                                                       |
|--------------------------------------|------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Test No.                             | QUCI206S5        |                                                                                     |                                                                                      |                                                                                       |                                                                                       |
| Initial                              | Diameter, in     | 2.8339                                                                              |                                                                                      |                                                                                       |                                                                                       |
|                                      | Height, in       | 5.6894                                                                              |                                                                                      |                                                                                       |                                                                                       |
|                                      | Water Content, % | 26.14                                                                               |                                                                                      |                                                                                       |                                                                                       |
|                                      | Dry Density, pcf | 101.                                                                                |                                                                                      |                                                                                       |                                                                                       |
|                                      | Saturation, %    | 104.44                                                                              |                                                                                      |                                                                                       |                                                                                       |
|                                      | Void Ratio       | 0.68088                                                                             |                                                                                      |                                                                                       |                                                                                       |
| Unconfined Compressive Strength, tsf |                  | 2.2627                                                                              |                                                                                      |                                                                                       |                                                                                       |
| Undrained Shear Strength, tsf        |                  | 1.1313                                                                              |                                                                                      |                                                                                       |                                                                                       |
| Time to Failure, min                 |                  | 5.0042                                                                              |                                                                                      |                                                                                       |                                                                                       |
| Strain Rate, %/min                   |                  | 0.5259                                                                              |                                                                                      |                                                                                       |                                                                                       |
| Estimated Specific Gravity           |                  | 2.72                                                                                |                                                                                      |                                                                                       |                                                                                       |
| Liquid Limit                         |                  | 0                                                                                   |                                                                                      |                                                                                       |                                                                                       |
| Plastic Limit                        |                  | 0                                                                                   |                                                                                      |                                                                                       |                                                                                       |
| Plasticity Index                     |                  | 0                                                                                   |                                                                                      |                                                                                       |                                                                                       |
| Failure Sketch                       |                  |  |  |  |  |

|                                                             |
|-------------------------------------------------------------|
| Project: CAT ISLAND                                         |
| Location:                                                   |
| Project No.: 200700579                                      |
| Boring No.: CI-2-07 S-5                                     |
| Sample Type: 3 INCH ST                                      |
| Description: SILTY CLAY TRACE F-C SAND - REDDISH BROWN (CL) |
| Remarks: TEST PERFORMED AS PER ASTM D 2166                  |

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## UNCONFINED COMPRESSION TEST REPORT

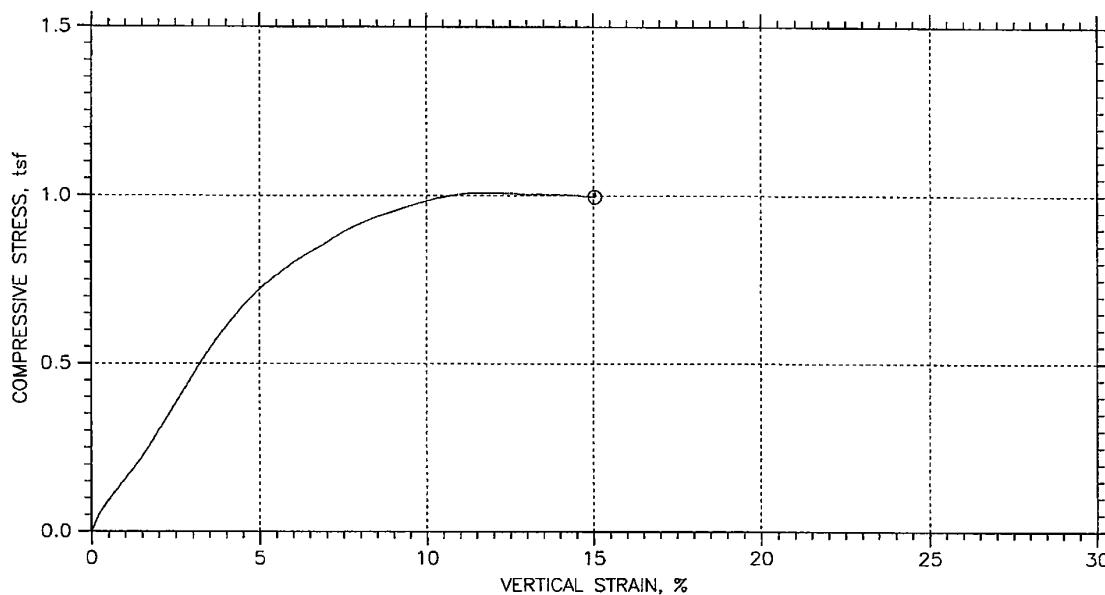


| Symbol                               | Ø         |  |  |  |
|--------------------------------------|-----------|--|--|--|
| Test No.                             | QUCI206S8 |  |  |  |
| Diameter, in                         | 1.9665    |  |  |  |
| Height, in                           | 4.4732    |  |  |  |
| Initial Water Content, %             | 36.37     |  |  |  |
| Dry Density, pcf                     | 86.47     |  |  |  |
| Saturation, %                        | 102.67    |  |  |  |
| Void Ratio                           | 0.96364   |  |  |  |
| Unconfined Compressive Strength, tsf | 4.6986    |  |  |  |
| Undrained Shear Strength, tsf        | 2.3493    |  |  |  |
| Time to Failure, min                 | 5.0042    |  |  |  |
| Strain Rate, %/min                   | 0.5259    |  |  |  |
| Estimated Specific Gravity           | 2.72      |  |  |  |
| Liquid Limit                         | 45        |  |  |  |
| Plastic Limit                        | 19        |  |  |  |
| Plasticity Index                     | 26        |  |  |  |
| Failure Sketch                       |           |  |  |  |

|                                                                    |
|--------------------------------------------------------------------|
| Project: CAT ISLAND                                                |
| Location:                                                          |
| Project No.: 200700579                                             |
| Boring No.: CI-2-07 S-8                                            |
| Sample Type: 3 INCH ST                                             |
| Description: SILTY CLAY TRACE F-C SAND TRACE F GRAVEL ~ BROWN (CL) |
| Remarks: TEST PERFORMED AS PER ASTM D 2166                         |

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## UNCONFINED COMPRESSION TEST REPORT



| Symbol                               | Ø          |  |  |  |
|--------------------------------------|------------|--|--|--|
| Test No.                             | QUCI206S10 |  |  |  |
| Diameter, in                         | 2.8173     |  |  |  |
| Height, in                           | 5.9413     |  |  |  |
| Initial Water Content, %             | 29.72      |  |  |  |
| Dry Density, pcf                     | 97.98      |  |  |  |
| Saturation, %                        | 110.28     |  |  |  |
| Void Ratio                           | 0.73302    |  |  |  |
| Unconfined Compressive Strength, tsf | 1.007      |  |  |  |
| Undrained Shear Strength, tsf        | 0.5035     |  |  |  |
| Time to Failure, min                 | 23.002     |  |  |  |
| Strain Rate, %/min                   | 0.5036     |  |  |  |
| Estimated Specific Gravity           | 2.72       |  |  |  |
| Liquid Limit                         | 0          |  |  |  |
| Plastic Limit                        | 0          |  |  |  |
| Plasticity Index                     | 0          |  |  |  |
| Failure Sketch                       |            |  |  |  |

|                                                             |
|-------------------------------------------------------------|
| Project: CAT ISLAND                                         |
| Location:                                                   |
| Project No.: 200700579                                      |
| Boring No.: CI-2-07 S10                                     |
| Sample Type: 3 INCH ST                                      |
| Description: SILTY CLAY TRACE F-C SAND - REDDISH BROWN (CL) |
| Remarks: TEST PERFORMED AS PER ASTM D 2166                  |

Wed, 16-MAY-2007 11:29:58

## **Cat Island Restoration Section 204 Settlement Calculations**

### **Introduction**

Estimates of foundation and access road settlement were performed for three sections of the proposed construction access road (Attachments 1 and 2). Section 1 is located at the northern end of the proposed road (Station 0+00). Section 2 is located at Station 10+00 and Section 3 is located at the southern end (Station 20+00). Hand calculations, equations used, lab test data, graphs and correlations are also attached.

### **Analysis Assumptions**

The assumptions used for this settlement analysis are listed below:

- Additional road surcharge of 1056 psf provided by Design Engineer, Jihad Safa.
- Top of structure assumed to be 6 ft above a dominant seasonal water level of 2 ft above LWD with the base located at LWD, therefore a structure height of 8 ft was assumed with 1.3 on 1 side slopes (see Attachment 1).
- Assumed existing surface elevation is at 578 ft (IGLD85) based on boring logs along proposed access road (See Attachment 2).
- Shot rock is assumed to be limestone with an average unit weight of 165 pcf and a porosity of 30%.
- Consolidation of the access road shot rock is based on the recommendation for uncompacted material in EM1110-2-1913, paragraph 6-9.
- This analysis only estimates post-construction settlement. Long-term and secondary settlements are not evaluated because the access road is expected to be temporary.
- Depth of analysis used is 30 ft, except for Section 3, which used 42.5 ft. EM1110-1-1904 calls for a minimum of twice the width of the foundation, or 30 ft in this case.
- Clay soils are assumed overconsolidated due to fluctuating water levels and seasonal/historic ice loading.
- Settlement of cohesionless soils are determined empirically using the Alpan Approximation and the Schultze and Sherif Approximation.
- All soil layers are assumed to be homogeneous.

## Results and Conclusions

The results in Table 1 below show the estimated settlement for each section using the above assumptions. A revised access road height due to 15% consolidation of shot rock was used for calculating foundation settlement. To check the consistency of the results, an additional section was analyzed between Sections 1 and 2 (Station 5+00) using the average of values from Sections 1 and 2. The difference in total settlement between the three sections is mainly due to differing layer thicknesses, lab data, and selected parameters. Graph 1 was developed using the settlement results from Table 1 to show the predicted settlement for other stations based on the results of this analysis.

**Table 1. Estimated Access Road Foundation Settlement and Overbuild.**

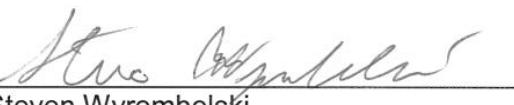
| Station | Access Road Consolidation | Foundation Settlement |        | Total Overbuild |
|---------|---------------------------|-----------------------|--------|-----------------|
| 0+00    | 1.2 ft                    | 0.11 ft               | 1.4 in | 1.31 ft         |
| 5+00    | 1.2 ft                    | 0.22 ft               | 2.6 in | 1.42 ft         |
| 10+00   | 1.2 ft                    | 0.34 ft               | 4.0 in | 1.54 ft         |
| 20+00   | 1.2 ft                    | 0.35 ft               | 4.1 in | 1.55 ft         |

## Recommendations

The settlement amounts obtained from Graph 1 should be treated as approximate but are suitable to use in feasibility phase quantity and cost calculations. The consolidation of the access road shot rock is considered consistent using the recommended 15% from EM1110-2-1913. Therefore, 1.2 ft needs to be added to the settlement result from Graph 1 to get the estimated overbuild at each station.

**References**

- 1) EM1110-1-1904, Settlement Analysis, 30 Sept 1990.
- 2) EM1110-2-1913, Design and Construction of Levees, 30 April 2000.
- 3) NAVFAC Soil Mechanics Design Manual 7.1, Sept 1986.
- 4) Day, R. W. (2000), Geotechnical Engineer's Portable Handbook, McGraw-Hill.
- 5) Hough, B. K. (1957), Basic Soil Engineering, the Ronald Press Co., New York, N.Y., pp 114-115.
- 6) Terzaghi, K., Peck, R. B., and Mesri, G. (1996), Soil Mechanics in Engineering Practice, John Wiley and Sons, Inc., New York, N.Y.
- 7) Geotechnical Evaluation for the Cat Island Chain Restoration, prepared by STS Consultants, May 2007.

Prepared by:   
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Checked by:   
Tina Kowitz, P.E.  
Geotechnical and Structural Eng. Branch

## Section 1 (Sta 0+00) Settlement Calculations

### Access Road

Estimated Consolidation = 15 % -> (uncompacted shot rock)

Initial Height of Structure = 8 ft

Estimated Overbuild = 1.2 ft

Final Height of Structure = 9.2 ft -> use for calculations

### Foundation

#### Cohesive Layers

| Layer   | H <sub>o</sub> (ft) | z (ft) | a/z  | b/z  | I*    | $\sigma_{vo}'$ (psf) | $\Delta\sigma_v$ (psf) | C <sub>c</sub> | C <sub>r</sub> | S <sub>c</sub> (ft) | S <sub>c</sub> (in) |
|---------|---------------------|--------|------|------|-------|----------------------|------------------------|----------------|----------------|---------------------|---------------------|
| RB CL 1 | 3                   | 7.5    | 1.40 | 1.00 | 0.920 | 316.5                | 1953.2                 | 0.232          | 0.027          | 0.039               | 0.47                |
| RB CL 2 | 3                   | 10.5   | 1.00 | 0.71 | 0.852 | 498.3                | 1808.8                 | 0.232          | 0.027          | 0.031               | 0.37                |
| RB CL 3 | 3                   | 13.5   | 0.78 | 0.56 | 0.780 | 680.1                | 1655.9                 | 0.232          | 0.027          | 0.025               | 0.30                |

\* Influence factor is determined from attached Figure. Also it is doubled to account for both halves of road.

Total = 1.1 in

$$\begin{aligned} q &= 2123 \text{ psf} & Y_w &= 62.4 \text{pcf} \\ a &= 10.5 \text{ ft} & \sigma_p' &= 5800 \text{ psf} \\ b &= 7.5 \text{ ft} & e_o &= 0.76 \end{aligned}$$

#### Cohesionless Layers

| Layer | H (ft) | L/B | H/B | m'   | N' | $\alpha_o$ (in/psf) | $N_{ave}^{0.87}$ | f     | $p_i$ (in) | $p_i$ (ft) | A/pan | Schultze/Sherif |
|-------|--------|-----|-----|------|----|---------------------|------------------|-------|------------|------------|-------|-----------------|
| B SM  | 6      | 6.7 | 0.4 | 2.10 | 20 | 0.17                | 5                | 0.034 | 0.11       | 0.03       | 0.35  |                 |

$$\begin{aligned} q &= 1.06 \text{ tsf} & \sigma_o' &= 0.3 \text{ tsf} \\ B &= 15 \text{ ft} & D &= 0 \text{ ft} \\ L &= 100 \text{ ft} & N_{ave} &= 6 \end{aligned}$$

Estimated Post Construction Settlement @ Sta 0+00 = 1.37 in

## Section 1.5 (Sta 5+00) Settlement Calculations

### Access Road

Estimated Consolidation =  $\frac{15}{8}$  % -> (uncompacted shot rock)  
 Initial Height of Structure =  $\frac{8}{8}$  ft

Estimated Overbuild =  $\frac{1.2}{1.2}$  ft  
 Final Height of Structure =  $\frac{9.2}{9.2}$  ft -> use for calculations

### Foundation

#### Cohesive Layers

| Layer   | H <sub>o</sub> (ft) | z (ft) | a/z  | b/z  | I*    | $\sigma_{vo}'$ (psf) | $\Delta\sigma_v$ (psf) | C <sub>c</sub> | C <sub>r</sub> | S <sub>c</sub> (ft) | S <sub>c</sub> (in) |
|---------|---------------------|--------|------|------|-------|----------------------|------------------------|----------------|----------------|---------------------|---------------------|
| RB CL 1 | 5                   | 9      | 1.17 | 0.83 | 0.910 | 393.4                | 1931.9                 | 0.295          | 0.044          | 0.092               | 1.11                |
| RB CL 2 | 5                   | 14     | 0.75 | 0.54 | 0.770 | 691.4                | 1634.7                 | 0.295          | 0.044          | 0.063               | 0.76                |
| RB CL 3 | 5                   | 19     | 0.55 | 0.39 | 0.650 | 989.4                | 1380.0                 | 0.295          | 0.044          | 0.045               | 0.54                |

\* Influence factor is determined from attached Figure. Also it is doubled to account for both halves of road.

Total = 2.4 in

$$\begin{aligned} q &= 2123 \text{ psf} & Y_w &= 62.4 \text{ pcf} \\ a &= 10.5 \text{ ft} & \sigma_p' &= 5200 \text{ psf} \\ b &= 7.5 \text{ ft} & e_o &= 0.84 \\ \text{SM } Y_m &= 100 \text{ pcf} \\ \text{CL } Y_{sat} &= 122 \text{ pcf} \end{aligned}$$

#### Cohesionless Layers

| Layer | H (ft) | L/B | H/B  | m'   | N' | $\alpha_o$ (in/psf) | $N_{ave}^{0.87}$ | f     | $p_i$ (in) | $p_i$ (ft) | A/pan | Schultze/Sherif |
|-------|--------|-----|------|------|----|---------------------|------------------|-------|------------|------------|-------|-----------------|
| B SM  | 6.5    | 6.7 | 0.43 | 2.10 | 20 | 0.17                | 5                | 0.034 | 0.11       | 0.03       | 0.35  |                 |

$$\begin{aligned} q &= 1.06 \text{ tsf} & \sigma_o' &= 0.325 \text{ tsf} \\ B &= 15 \text{ ft} & D &= 0 \text{ ft} \\ L &= 100 \text{ ft} & N_{ave} &= 6 \end{aligned}$$

Estimated Post Construction Settlement @ Sta 0+00 = 2.64 in

## Section 2 (Sta 10+00) Settlement Calculations

### Access Road

Estimated Consolidation =  $\frac{15}{8}$  % -> (uncompacted shot rock)  
 Initial Height of Structure =  $\frac{8}{ft}$   
 Estimated Overbuild =  $\frac{1.2}{ft}$   
 Final Height of Structure =  $\frac{9.2}{ft}$  -> use for calculations

### Foundation

#### Cohesive Layers

| Layer   | $H_o$ (ft) | $z$ (ft) | $a/z$ | $b/z$ | $I^*$ | $\sigma_{vo}'$ (psf) | $\Delta\sigma_v$ (psf) | $C_c$ | $C_r$ | $S_c$ (ft) | $S_c$ (in) |
|---------|------------|----------|-------|-------|-------|----------------------|------------------------|-------|-------|------------|------------|
| RB CL 1 | 5          | 9.5      | 1.11  | 0.79  | 0.900 | 409.7                | 1910.7                 | 0.357 | 0.06  | 0.118      | 1.42       |
| RB CL 2 | 5          | 14.5     | 0.72  | 0.52  | 0.750 | 702.7                | 1592.3                 | 0.357 | 0.06  | 0.081      | 0.97       |
| RB CL 3 | 5          | 19.5     | 0.54  | 0.38  | 0.640 | 995.7                | 1358.7                 | 0.357 | 0.06  | 0.059      | 0.70       |
| RB CL 4 | 7          | 25.5     | 0.41  | 0.29  | 0.540 | 1347.3               | 1146.4                 | 0.357 | 0.06  | 0.059      | 0.71       |

\* Influence factor is determined from attached Figure. Also it is doubled to account for both halves of road.

$$\text{Total} = \underline{\hspace{2cm}} \text{ in}$$

$$\begin{aligned}
 q &= 2123 \quad \text{psf} & Y_w &= 62.4 \quad \text{pcf} \\
 a &= 10.5 \quad \text{ft} & \sigma_p' &= 4600 \quad \text{psf} \\
 b &= 7.5 \quad \text{ft} & e_o &= 0.91 \\
 \text{SM } Y_m &= 100 \quad \text{pcf} \\
 \text{CL } Y_{sat} &= 121 \quad \text{pcf}
 \end{aligned}$$

#### Cohesionless Layers

| Layer | $H$ (ft) | $L/B$ | $H/B$ | $m'$ | $N'$ | $\alpha_o$ (in/tsf) | $N_{ave}^{0.87}$ | $f$  | $\rho_i$ (in) | $\rho_i$ (ft) | $P_i$ (in) |
|-------|----------|-------|-------|------|------|---------------------|------------------|------|---------------|---------------|------------|
| B SM  | 7        | 6.7   | 0.5   | 2.10 | 20   | 0.17                | 5                | 0.04 | 0.11          | 0.03          | 0.36       |

$$\begin{aligned}
 q &= 1.06 \quad \text{tsf} & \sigma_o' &= 0.35 \quad \text{tsf} \\
 B &= 15 \quad \text{ft} & D &= 0 \quad \text{ft} \\
 L &= 100 \quad \text{ft} & N_{ave} &= 7
 \end{aligned}$$

$$\text{Estimated Post Construction Settlement @ Sta 10+00} = \underline{\hspace{2cm}} \text{ in}$$

### Section 3 (Sta 20+00) Settlement Calculations

#### Access Road

Estimated Consolidation =  $\frac{15}{8}$  ft % -> (uncompacted shot rock)  
 Initial Height of Structure =  $\frac{8}{1.2}$  ft  
 Estimated Overbuild =  $\frac{1.2}{9.2}$  ft  
 Final Height of Structure =  $\frac{9.2}{9.2}$  ft -> use for calculations

#### Foundation

##### Cohesive Layers

| Layer      | $H_o$ (ft) | $z$ (ft) | a/z  | b/z  | $I^*$ | $\sigma_{vo}'$ (psf) | $\Delta\sigma_v$ (psf) | $C_c$ | $C_r$ | $S_c$ (ft) | $S_c$ (in) |
|------------|------------|----------|------|------|-------|----------------------|------------------------|-------|-------|------------|------------|
| GB CL      | 2.5        | 28.75    | 0.37 | 0.26 | 0.500 | 1091.0               | 1061.5                 | 0.486 | 0.073 | 0.018      | 0.22       |
| Gr ML/OL 1 | 5          | 32.5     | 0.32 | 0.23 | 0.450 | 1232.0               | 955.4                  | 0.980 | 0.240 | 0.122      | 1.47       |
| Gr ML/OL 2 | 5          | 37.5     | 0.28 | 0.20 | 0.410 | 1400.0               | 870.4                  | 0.980 | 0.240 | 0.126      | 1.51       |
| Gr CL      | 2.5        | 41.25    | 0.25 | 0.18 | 0.370 | 1541.0               | 785.5                  | 0.486 | 0.073 | 0.011      | 0.13       |

\* Influence factor is determined from attached Figure. Also it is doubled to account for both halves of road.

$$\text{Total} = \frac{3.3}{\text{in}}$$

$$\begin{aligned}
 q &= 2123 \text{ psf} & \text{Gr CL } Y_{sat} &= 108 \text{ pcf} \\
 a &= 10.5 \text{ ft} & Y_w &= 62.4 \text{ pcf} \\
 b &= 7.5 \text{ ft} & \text{ML/OL } \sigma_p' &= 2000 \text{ psf} \\
 \text{SM/ML } Y_m &= 100 \text{ pcf} & \text{ML/OL } e_o &= 2.62 \\
 \text{GB CL } Y_{sat} &= 108 \text{ pcf} & \text{CL } \sigma_p' &= 4165 \text{ psf} \\
 \text{Gr ML } Y_{sat} &= 96 \text{ pcf} & \text{CL } e_o &= 1.95
 \end{aligned}$$

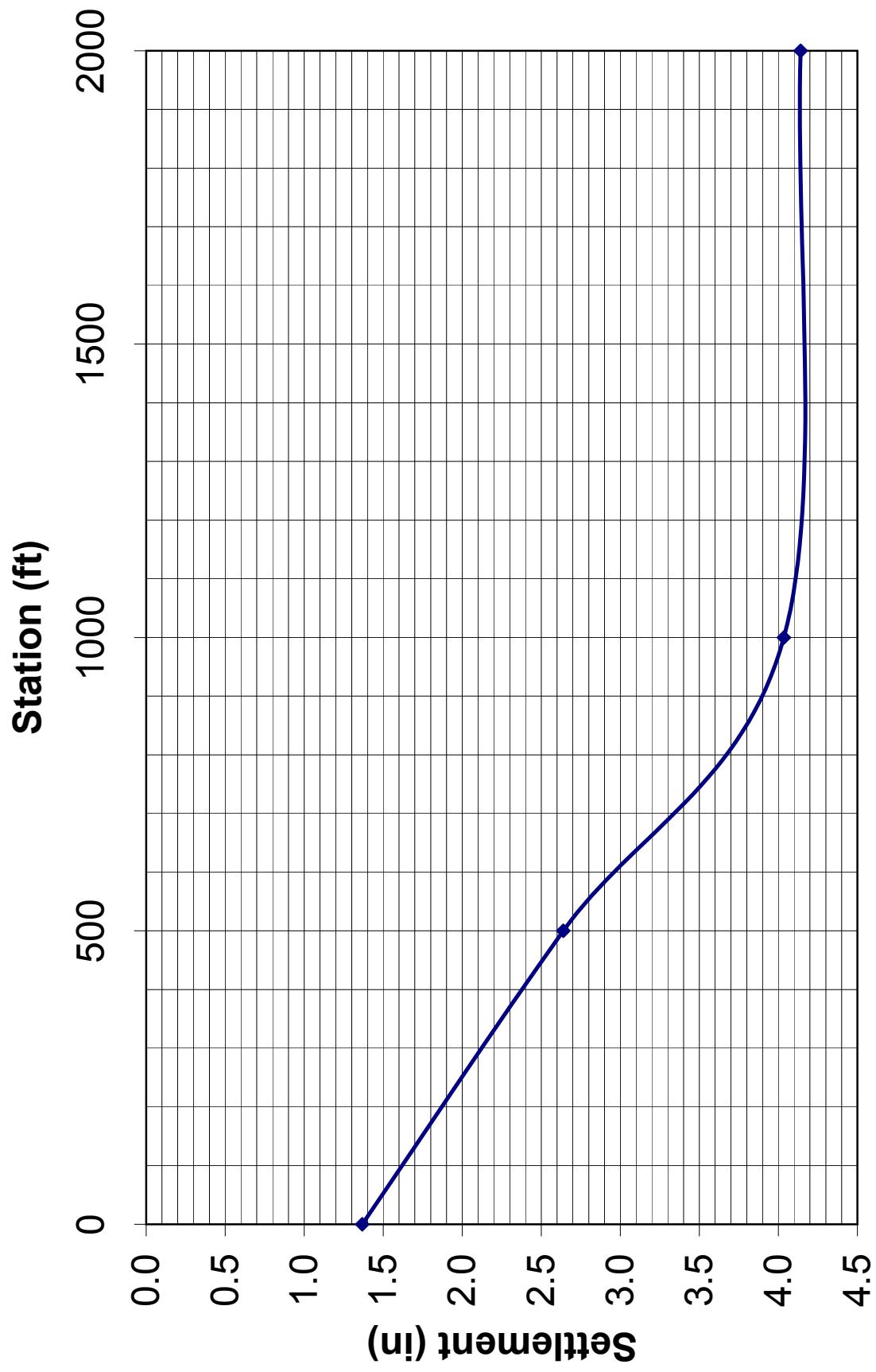
##### Cohesionless Layers

| Layer | $H$ (ft) | $L/B$ | $H/B$ | $m'$ | $N'$ | $\alpha_o$ (in/tsf) | $N_{ave}^{0.87}$ | $f$   | $\rho_i$ (in) | $\rho_i$ (ft) | Alpan | Schultze/Sherif |
|-------|----------|-------|-------|------|------|---------------------|------------------|-------|---------------|---------------|-------|-----------------|
| SM/ML | 27.5     | 6.7   | 1.8   | 2.10 | 9    | 0.38                | 3                | 0.093 | 0.25          | 0.11          | 1.37  |                 |

$$\begin{aligned}
 q &= 1.06 \text{ tsf} & \sigma_o' &= 1.375 \text{ tsf} \\
 B &= 15 \text{ ft} & D &= 0 \text{ ft} \\
 L &= 100 \text{ ft} & N_{ave} &= 4
 \end{aligned}$$

$$\text{Estimated Post Construction Settlement @ Sta 10+00} = \underline{\underline{4.14}} \text{ in}$$

**Graph 1. Cat Island Access Road Foundation Settlement**



## Cat Island Settlement Analysis Equations

### References:

- 1) EM1110-2-1913, 30 April 2000, paragraph 6-9.
- 2) Nav Fac Design Manual 7.1, page 7.1-170.
- 3) Day, R. W., Geotechnical Engineer's Portable Handbook, 2000, page 9.33.

### Settlement for cohesive soils

For:  $\sigma_{vo}' + \Delta\sigma_v \leq \sigma_p'$

$$\text{Use: } S_c = C_r \frac{H_o}{1+e_o} \log \frac{\sigma_{vo}' + \Delta\sigma_v}{\sigma_{vo}'}$$

For:  $\sigma_{vo}' + \Delta\sigma_v \geq \sigma_p'$

$$\text{Use: } S_c = C_r \frac{H_o}{1+e_o} \log \frac{\sigma_p'}{\sigma_{vo}'} + C_c \frac{H_o}{1+e_o} \log \frac{\sigma_{vo}' + \Delta\sigma_v}{\sigma_p'}$$

$$p_p' = 3.5(S_u) \text{ to } 5.0(S_u)$$

where

$p_p'$  = preconsolidation pressure, in the same units as  $S_u$

$S_u$  = undrained shear strength (pressure units)

$$C_c = 0.009(LL - 10) \quad C_c = 0.30(e_0 - 0.27)$$

Cr = 0.1(Cc) to 0.2(Cc)

### Settlement for cohesionless soils

Alpan

$$p_i = m' \cdot \left[ \frac{2B}{1+B} \right]^2 \cdot \frac{\alpha_o}{12} \cdot q$$

$p_i$  = immediate settlement, ft

$m'$  = shape factor,  $(L/B)^{0.39}$

L = length of footing, ft

B = width of footing, ft

$\alpha_o$  = parameter from Figure 3-1a using an adjusted blowcount N' from Figure 3-1b, inches/tsf

q = average pressure applied by footing on soil, tsf

Schultze and Sherif

$$p_i = \frac{f \cdot q \cdot \sqrt{B}}{N_{ave}^{0.57} \cdot (1 + 0.4 \frac{D}{B})}$$

f = influence factor from elasticity methods for isotropic half space, Figure 3-2

H = depth of stratum below footing to a rigid base, ft

D = depth of embedment, ft

$N_{ave}$  = average blowcount/ft in depth H

## COMPUTATION SHEET

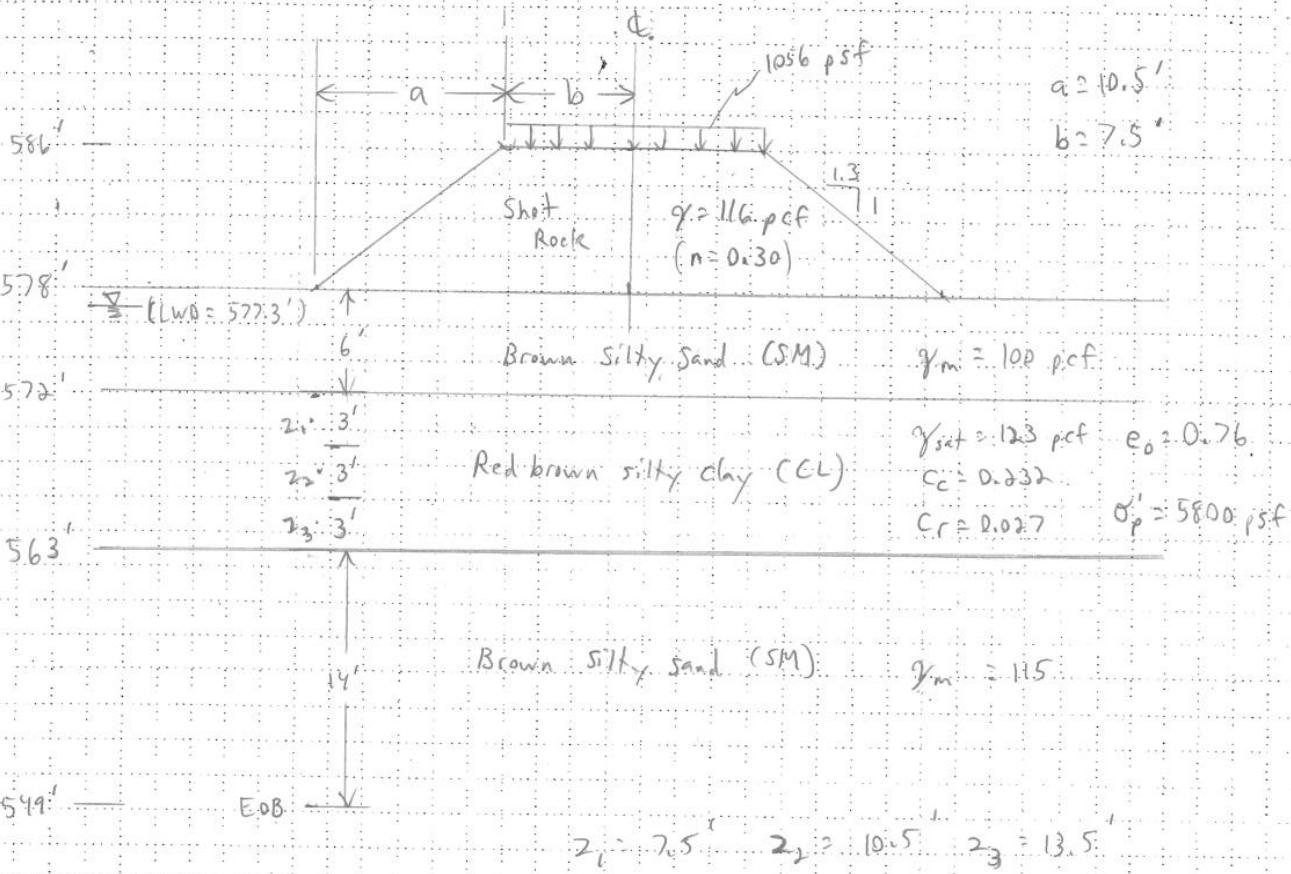
PROJECT Cat IslandITEM Access RoadSUBJECT Settlement AnalysisCOMPUTED BY SAWCHECKED BY JPK

4 Sept 07

SHEET NO. 1 OF 9 SHEETSDATE 13 Aug 07FILE /

REF DRAWING NO. \_\_\_\_\_

Section 1 (Boring CI-1-07, Consolidation Test CI-1-07, S-6.)  
 Sta. 0+0.0



height of structure including overbuild = 9.2 ft.

Surcharge on foundation  $q = (116 \text{ pcf} \cdot 9.2 \text{ ft}) + 1056 \text{ psf} = 2123 \text{ psf}$

## COMPUTATION SHEET

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SUBJECT Settlement Analysis

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COMPUTED BY JAWCHECKED BY JPK4 Sept 07

REF DRAWING NO. \_\_\_\_\_

Section 1 Calculations

Clay Saturated unit weight

$$\gamma_{sat} = (S.G. + \gamma_w)(1 + w)$$

$$( + (SG - w))$$

$$S.G. = 2.74 \text{ (from consolidation test; CI-1-07, S-6)} \quad \gamma_w = 62.4 \text{ psf}$$

$$w = 0.301 + 0.2783 = 0.2897 \text{ (from lab test summary)}$$

$$\gamma_{sat} = (2.74 + 62.4 \text{ psf})(1 + 0.2897) \\ ( + (2.74 \cdot 0.2897))$$

$$\gamma_{sat} = 123 \text{ psf}$$

From consolidation test (CI-1-07, S-6):

$$C_c = 0.232$$

$$e_0 = 0.76$$

$$C_r = 0.532 - 0.505 = 0.027$$

$$\sigma'_p = 2.9 \text{ tsf} = 5800 \text{ psf}$$

From Cross-Section (sublayer 1):

$$H_o = 3 \text{ ft} \quad z_1 = 6' + \frac{3'}{2} = 7.5' \quad a = 10.5' \quad b = 7.5'$$

$$\frac{a}{2} = \frac{10.5'}{2} = 5.25' \quad \frac{b}{2} = \frac{7.5'}{2} = 3.75' \quad \text{From Figure 6} \quad I = 0.46$$

Chart 13 for only half section so double I  $\rightarrow I = 2 \cdot 0.46 = 0.92$ 

$$\Delta \sigma_v = q \cdot I$$

$$q = 2123 \text{ psf (sheet 1)}$$

$$\Delta \sigma_v = 2123 \text{ psf} \cdot 0.92$$

$$\Delta \sigma_v = 1953.2 \text{ psf}$$

## COMPUTATION SHEET

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COMPUTED BY JAWCHECKED BY DPK4 Sept 07

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Assume L.W.D. = 5.78' (ef. at ground surface)

$$\sigma_{v_0}' = (6' \cdot 100 \text{ psf}) + \left( \frac{3'}{2} \cdot 123 \text{ psf} \right) - (7.5' \cdot 62.4 \text{ psf})$$

$$\sigma_{v_0}' = 600 \text{ psf} + 184.5 \text{ psf} = 784.5 \text{ psf} \quad \Delta\sigma_v' = 316.5 \text{ psf}$$

$$\text{Because } \sigma_{v_0}' + \Delta\sigma_v' \leq \sigma_p' \quad 784.5 \text{ psf} + 1953.2 \text{ psf} \leq 5800 \text{ psf}$$

and clay is considered overconsolidated so use equation:

$$S_c = C_r \frac{H_o}{1+e_o} \log \frac{\sigma_{v_0}' + \Delta\sigma_v'}{\sigma_{v_0}'} \quad H_o = 3 \quad C_r = 0.027 \quad e_o = 0.76 \quad \Delta\sigma_v' = 1953.2 \text{ psf} \\ \sigma_{v_0}' = 316.5 \text{ psf}$$

$$S_c = 0.027 \cdot \frac{3'}{1+0.76} \log \frac{316.5 + 1953.2}{316.5} = 0.046 \log 2.171$$

$$S_c = 0.039 \text{ ft} \rightarrow 0.47 \text{ inches}$$

Sublayer 2'

$$H_o = 3 \text{ ft} \quad z_2 = 6' + 3' + 3' = 10.5' \quad \frac{9}{2} \cdot \frac{10.5'}{0.5'} = 1.0 \quad b = \frac{7.5'}{2} = 0.75$$

$$I = 0.476 \rightarrow 2I = 0.852 \quad \Delta\sigma_v = 2123 \text{ psf} \cdot 0.852$$

$$\Delta\sigma_{v_2} = 1808.8 \text{ psf}$$

## COMPUTATION SHEET

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$$\sigma_{v_2} = (6' \cdot 100 \text{ psf}) + ((3 + \frac{3}{2}) \cdot 123 \text{ psf}) - (10.5' \cdot 62.4 \text{ psf})$$

$$\sigma_{v_2} = 600 \text{ psf} + 553.5 \text{ psf} - 655.2 \text{ psf} \quad \sigma_{v_2} = 498.3 \text{ psf}$$

$$S_{c_2} = 0.027 \cdot \frac{3'}{1+0.76} \log \frac{498.3 + 1808.8}{498.3} = 0.046 \log 4.63$$

$$S_{c_2} = 0.031 \text{ ft} \rightarrow 0.37 \text{ inches}$$

Sublayer 3

$$H_0 = 3 \text{ ft} \quad Z_3 = 6' + 3' + 3' + 3' = 13.5' \quad \frac{a}{2} = \frac{10.5'}{2} = 0.78 \quad \frac{b}{2} = \frac{2.5'}{2} = 0.56$$

$$I \geq 0.35 \rightarrow 2I \geq 0.78 \quad \sigma_{v_3} = 2123 \text{ psf} \cdot 0.78 \quad \sigma_{v_3} = 1655.9 \text{ psf}$$

$$\sigma_{v_3} = (6' \cdot 100 \text{ psf}) + ((3' + 3' + \frac{3}{2}') \cdot 123 \text{ psf}) - (13.5' \cdot 62.4 \text{ psf})$$

$$\sigma_{v_3} = 600 \text{ psf} + 922.5 \text{ psf} - 842.4 \text{ psf} \quad \sigma_{v_3} = 680.1 \text{ psf}$$

$$S_{c_3} = 0.027 \cdot \frac{3'}{1+0.76} \log \frac{680.1 + 1655.9}{680.1} = 0.046 \log 3.435$$

$$S_{c_3} = 0.025 \text{ ft} \rightarrow 0.30 \text{ inches}$$

$$\text{Subtotal cohesive settlement} \rightarrow S_c = S_{c_1} + S_{c_2} + S_{c_3}$$

$$S_c = 0.47'' + 0.37'' + 0.30'' \quad S_c \approx 1.14 \text{ inches}$$

## COMPUTATION SHEET

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Settlement of cohesionless layer (Sta 0 ft 0 in)

$$q = 2123 \text{ psf} = 1.06 \text{ tsf} \quad B = 2b = 2 \times 7.5' = 15'$$

Assume  $L = 100 \text{ ft}$  Average  $N$  value for layer from Log C1-1-07

$$\bar{N}_{ave} = \frac{7 + 5 + 7}{3} \approx 6 \quad \gamma_m = 100 \text{ psf} \quad D = 0$$

effective overburden pressure (assume layer is unsaturated)

$$\sigma_e = 6 \text{ ft} \cdot 100 \text{ psf} = 600 \text{ psf} \rightarrow 0.3 \text{ tsf}$$

Adjusted blowcount from Figure 3-1-a)  $N' = 20$ Parameter  $\alpha_0$  from Figure 3-1-b)  $\alpha_0 = 0.17 \text{ in/tsf}$ 

$$\text{Alpan Approximation} \quad p = m' \cdot \left[ \frac{2B}{1+B} \right]^2 \cdot \frac{\alpha_0}{18} \cdot q$$

$$m' = \left( \frac{L}{B} \right)^{0.39} = \left( \frac{100}{15} \right)^{0.39} = 2.1$$

$$p = 2.1 \cdot \left[ \frac{2 \cdot 15'}{1+15'} \right]^2 \cdot \frac{0.17 \text{ in/tsf}}{18} \cdot 1.06 \text{ tsf} = (2.1)(3.516)(0.017 \text{ in})(1.06)$$

p = 0.11 inches

## COMPUTATION SHEET

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Schultz and Sheriff Approximation

$$P = \frac{f \cdot q}{(1 + 0.4 \cdot D)} \quad D = \text{depth of embedment} = 0 \text{ ft}$$

$$\text{Nave } 0.87 \quad H/B = \frac{6}{15} = 0.4 \quad L/B = \frac{100}{15} = 6.7$$

Influence factor,  $f$ , from Figure 3-2.  $f = 0.034$ 

$$P = \frac{0.034 \cdot 1.06 \text{ tsf}}{(6)^{0.87} \cdot (1 + 0.4 \cdot \frac{6}{15})} = \frac{0.14}{4.75} \quad P = 0.03 \text{ ft} \rightarrow 0.35 \text{ inches}$$

Average settlement between the two approximations

$$0.11 \text{ in.} + 0.35 \text{ in.} = 0.23 \text{ in.}$$

Estimated post construction settlement @ 8% def.

$$1.14 \text{ in.} + 0.23 \text{ in.} = 1.37 \text{ inches}$$

## COMPUTATION SHEET

PROJECT Cat IslandITEM Access RoadSUBJECT Settlement AnalysisCOMPUTED BY JAWCHECKED BY JPK 4 Sept 07SHEET NO. 7 OF 9 SHEETS

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Section 3 (20+0.0)

 $\sigma'_p$ ,  $C_c$  and  $C_r$  from consolidation test (C-3-07, S-22)

are questionable. So estimate using undrained strength from triaxial test (C-3-07, S-22), liquid limit and initial void ratio.

$$LL = 62 \quad C_c = 0.009 (LL - 10) \quad (Terzaghi, Peck & Mesri, 1996)$$

$$C_c = 0.009 (62 - 10) \quad C_c = 0.468 \quad e_0 = 1.95$$

$$C_c = 0.30 (e_b - 0.27) = 0.30 (1.95 - 0.27) \quad C_c = 0.504$$

$$\text{use average } C_c = 0.468 + 0.504 \quad C_c = 0.486$$

$$C_f = 0.1 C_c \text{ to } 0.2 C_c \quad C_f = 0.0486 \text{ to } 0.0972$$

$$\text{use average } C_f = 0.0486 + 0.0972 \quad C_f = 0.073$$

$$\sigma'_p = p_p' = 3.5 (S_u) \text{ to } 5 (S_u) \quad S_u = 2c = 2(490, \text{psf}) = 980, \text{psf}$$

$$\sigma'_p = 3430 \text{ to } 4900 \text{ psf} \quad \text{use average } \sigma'_p = 3430 + 4900$$

$$\sigma'_p = 4165 \text{ psf}$$

## COMPUTATION SHEET

PROJECT Cat IslandITEM Access RoadSUBJECT Settlement AnalysisCOMPUTED BY JAWCHECKED BY JPV

4 Sept 07

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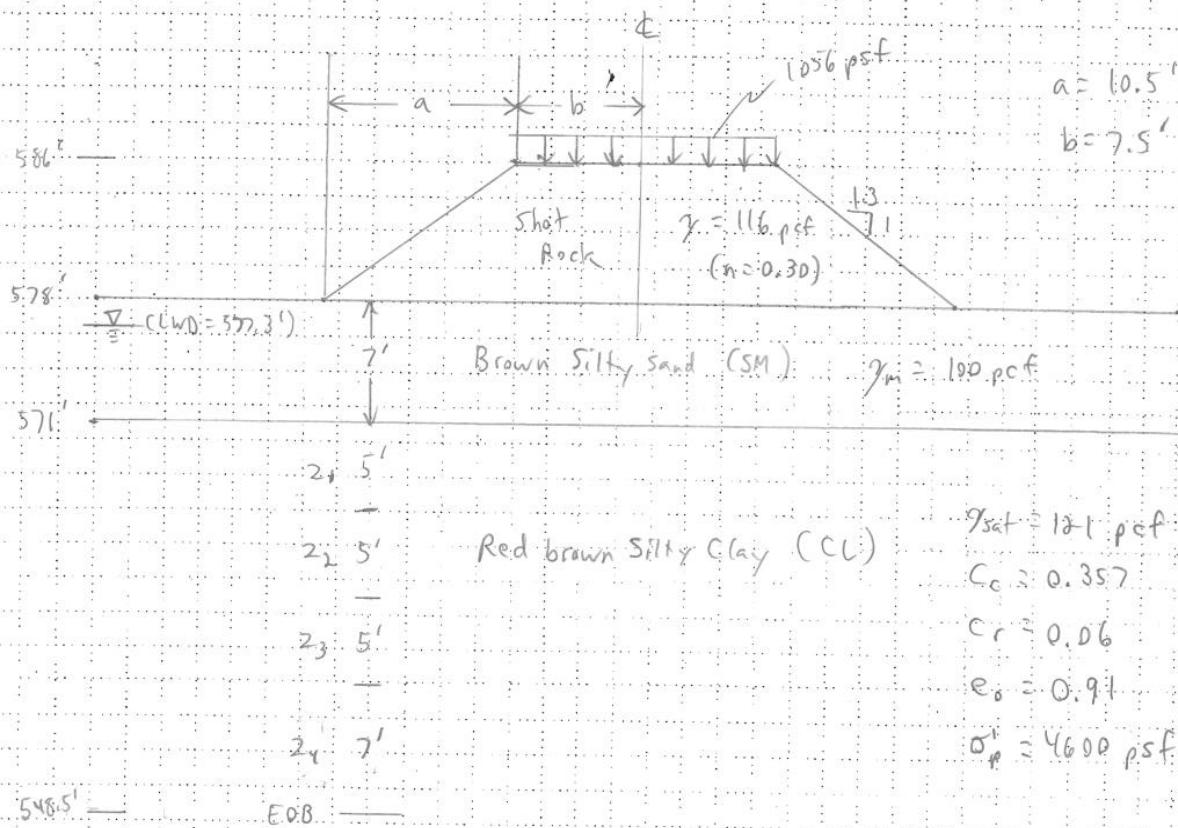
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Section 2  
Sta 10+00

(Boring CT-2-07, Consolidation Test CT-2-07, S-8)



$$z_1 = 9.5' \quad z_2 = 14.5' \quad z_3 = 19.5' \quad z_4 = 24.5'$$

## COMPUTATION SHEET

PROJECT Cat IslandITEM Access RoadSUBJECT Settlement AnalysisCOMPUTED BY SAWCHECKED BY JPK 4/5/07SHEET NO. 9 OF 9 SHEETS

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Section 3

(Boring CI-3-07, Consolidation Tests CF-3-07, S-16, and S-22)

Sta. 20+00

586'

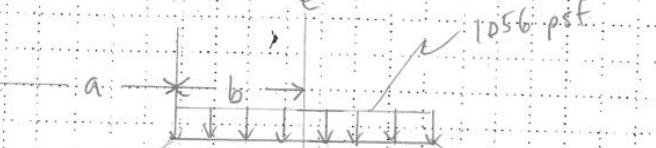
578'

556'

550.5'

538'

535.5'



Brown Silty Sand (SM)

 $\gamma_m = 100 \text{ pcf}$ 

Gray Sandy silt (ML)

 $\gamma_{sat} = 100 \text{ pcf}$ 

Gray Brown Silty Clay (CL) see ① below

Gray Silt w/ organics (ML) see ② below

Gray Silty Clay (CL) see ③ below

\* Note: EOB @ 518'

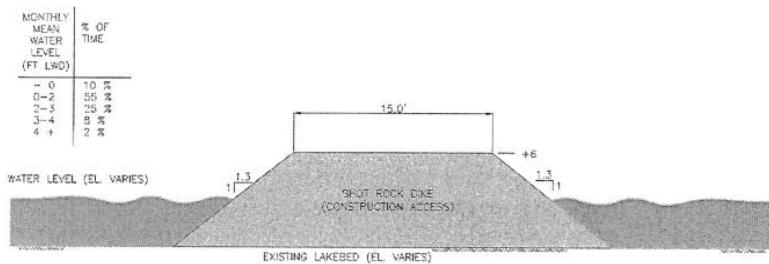
(Test S-22)

(Test S-16)

(Test S-22)

 $\gamma_{sat} = 108 \text{ pcf}$  $\gamma_{sat} = 96 \text{ pcf}$  $\gamma_{sat} = 108 \text{ pcf}$  $C_c = 0.486$  $C_c = 0.98$  $C_c = 0.486$  $C_r = 0.073$  $C_r = 0.24$  $C_r = 0.073$  $e_o = 1.95$  $e_o = 2.62$  $e_o = 1.95$  $\sigma'_p = 4165 \text{ psf}$  $\sigma'_p = 2000 \text{ psf}$  $\sigma'_p = 4165 \text{ psf}$

# Attachment 1



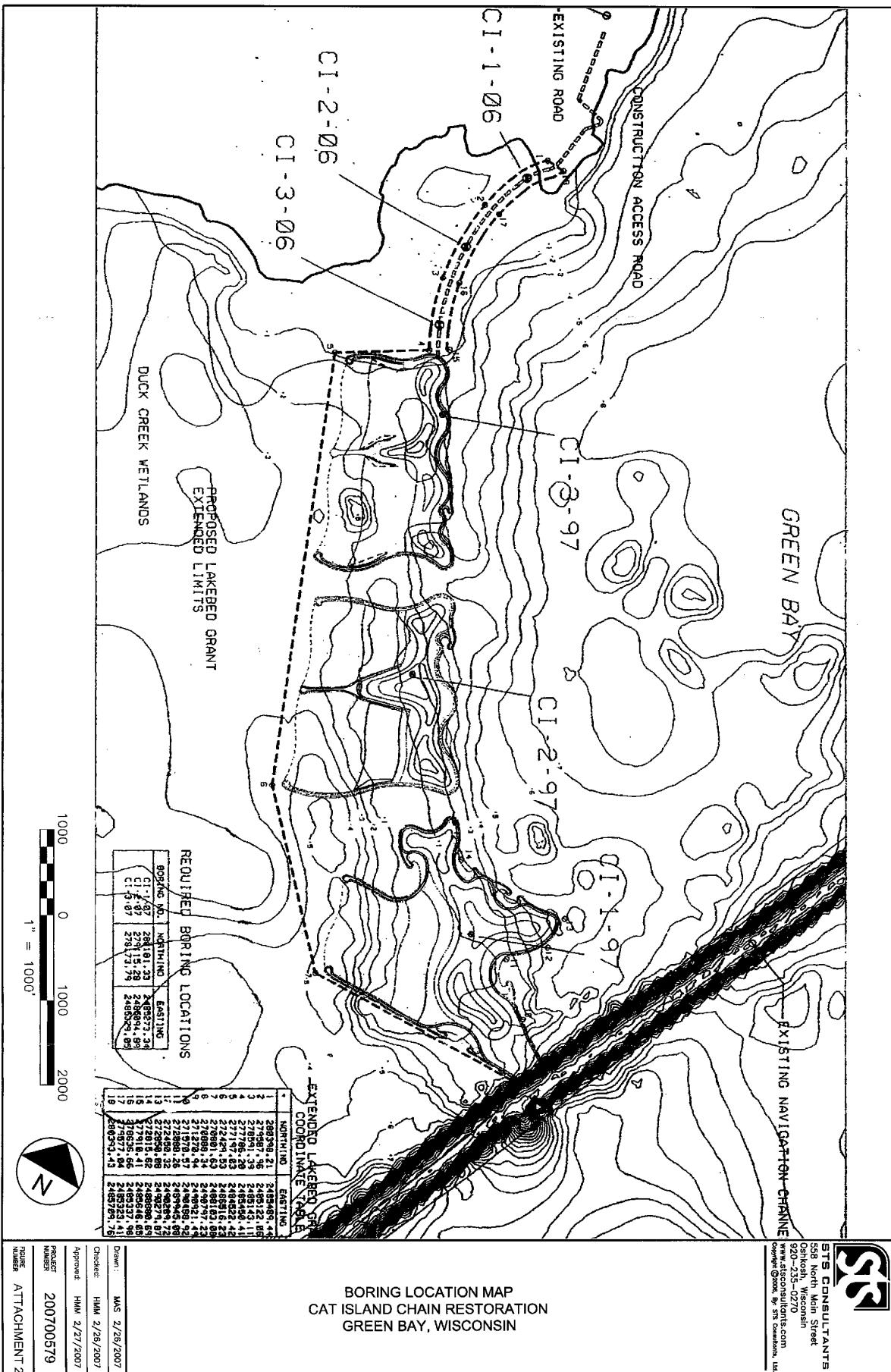
Note: Elevations are in ft, LWD

**Figure 9.5 – Construction Access Road – Preliminary Design**

During the final design phase it may be possible to optimize this cross section. If special construction sequencing and material delivery scheduling is utilized there are opportunities to reduce the width and/or crest height of this section and therefore reduce cost. This may be accomplished through the refinement of the revetment design to allow excavators to place stone while trucks maintain delivery of materials and/or the use of a one way roadway system with periodic bump-outs to allow trucks to pass. If the construction road is placed during periods of low water it may be possible to reduce the crest height, which will also reduce stone quantities and costs.

### 9.3.2 Stone Revetment/Headland Cross-Sections

Two alternative revetment and headland cross-sections have been developed, including a “conventional” design concept and a “berm” design concept. The latter allows the use of smaller riprap with a wider gradation, but requires an increase in the overall quantity of riprap. Figure 9.6 presents these two alternative cross-sections.



Attachment 3

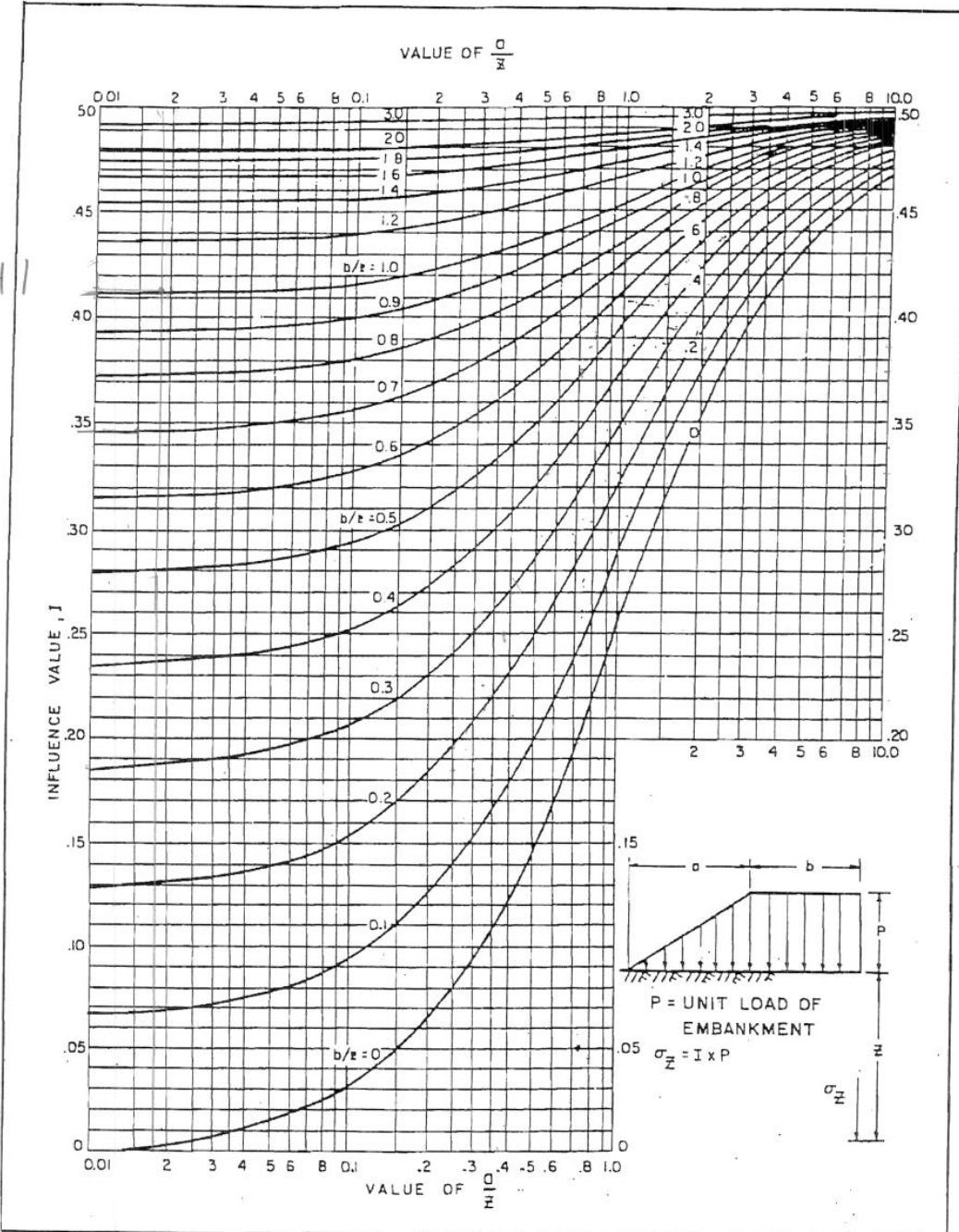
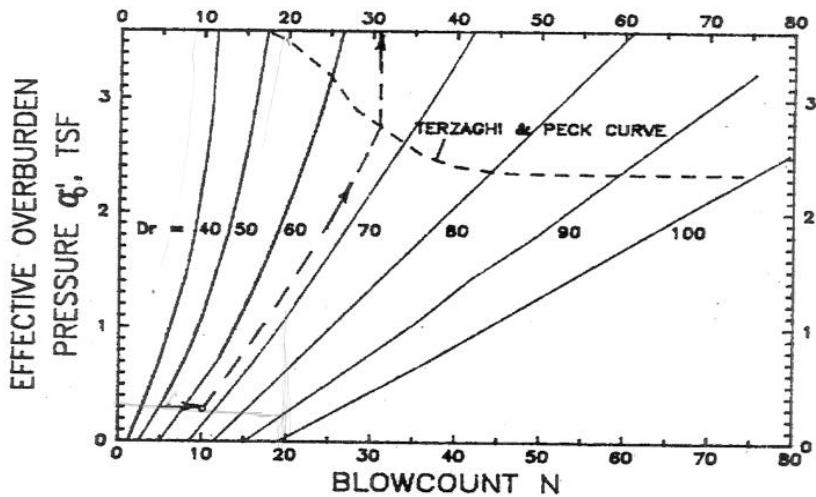


FIGURE 6  
Influence Value for Vertical Stress Under Embankment Load of Infinite Length  
(Boussinesq Case)

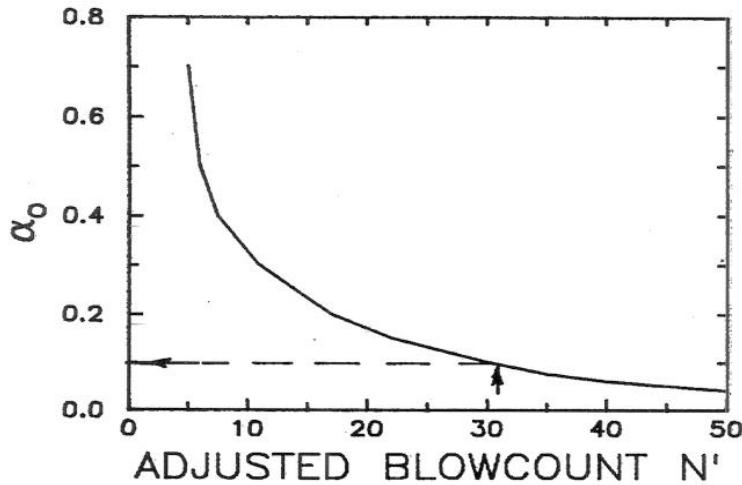
7.1-170

Attachment 4

EM 1110-1-1904  
30 Sep 90



a. ADJUSTED BLOWCOUNT FROM  $N$  AND  $\sigma'_o$



b. PARAMETER  $\alpha_o$  FROM ADJUSTED BLOWCOUNT

Figure 3-1. Chart to apply Alpan's procedure (data from item 1)

$$N' = N \cdot C_w \cdot C_n \quad (3-6)$$

where

$N$  = average blowcount per foot in the sand

$C_w$  = correction for water table depth

$C_n$  = correction for overburden pressure, Figure 3-3b

# Attachment 5

EM 1110-1-1904  
30 Sep 90

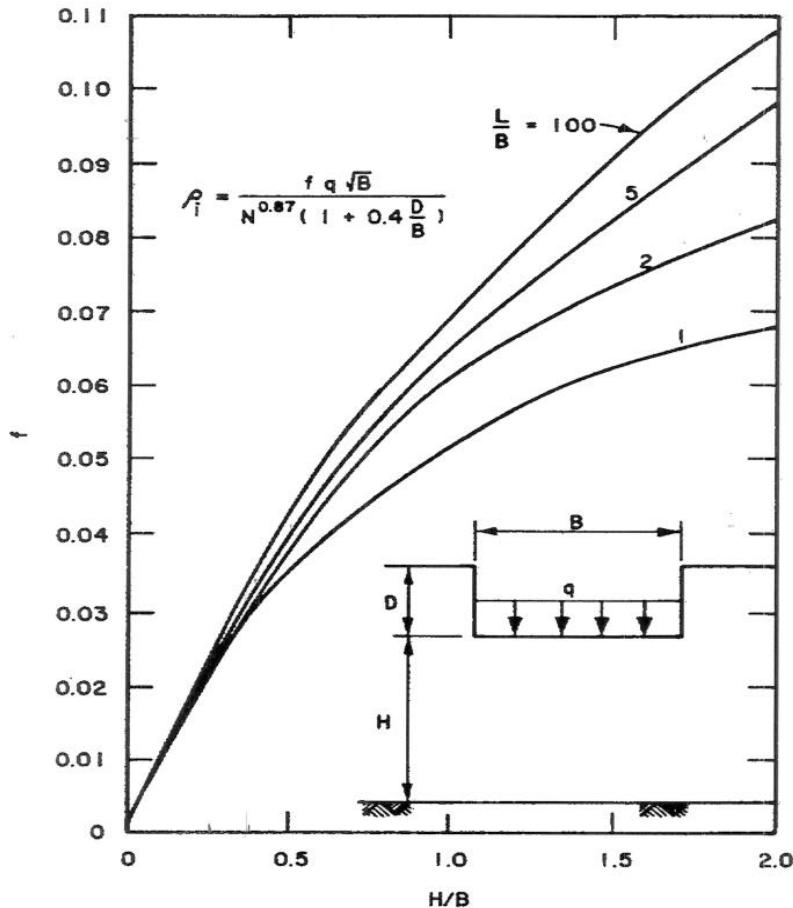


Figure 3-2. Settlement from the standard penetration test  
(Data from item 60)

Equation 3-5 calculates settlements 2/3 of the Terzaghi and Peck method (item 51) as recommended by Peck and Bazzara (item 50).

(1) Water table correction. The correction  $C_w$  is given by

$$C_w = 0.5 + 0.5 \cdot \frac{D_w}{D + B} \quad (3-7)$$

where  $D_w$  = depth to groundwater level, ft. The correction factor  $C_w = 0.5$  for a groundwater level at the ground surface. The correction factor is 1 if the sand is dry or if the groundwater level exceeds the depth  $D + B$  below the ground surface.

(2) Overburden pressure correction. The correction factor  $C_n$  is found from Figure 3-3b as a function of the effective vertical overburden pressure  $\sigma'_v$ .



**US Army Corps  
of Engineers  
Detroit District**

## Cat Island - Section 204

### Soil Foundation Bearing Capacity Calculations Section 2 of Access Road, End-of-Construction

Computed by: SW  
Checked by: JPK

Date: 19-Dec-07  
Date: 19 Dec 07

\*Refer to attached cross-section for more detail on inputs

#### Inputs

|                  |       |                                  |
|------------------|-------|----------------------------------|
| Height (ft)      | 9.2   | embankment height                |
| c (psf)          | 1000  | fdn soil cohesion                |
| $\gamma$ (pcf)   | 116   | embankment unit wt               |
| $\gamma_D$ (pcf) | 0     | soil unit wt ground to fdn depth |
| $\gamma_H$ (pcf) | 121   | soil unit wt below fdn base      |
| $\gamma_W$ (pcf) | 62.4  | water unit weight                |
| $\phi$ (deg)     | 0     | fdn soil friction angle          |
| Foundation type  | strip | strip, square, or circular       |
| D or Df (ft)     | 0.0   | foundation depth                 |
| Dw (ft)          | 0.0   | depth to water table             |
| B' (ft)          | 36.0  | effective foundation width       |
| q (psf)          | 1056  | any external loads               |

#### Assumptions

- 1) Shallow Foundation, Strip Footing
- 2) Silty Clay Foundation, No Silty Sand Layer
- 3) 1056 psf road load
- 4) No eccentric loading  $\rightarrow B = B'$
- 5) Terzaghi model solution

#### Bearing Capacity Factors (see table)

|    |      |
|----|------|
| Nq | 1.00 |
| Ny | 0.00 |
| Nc | 5.70 |

#### Results

|                                        |        |                                        |
|----------------------------------------|--------|----------------------------------------|
| $\zeta_q$                              | 1.0    | correction factor                      |
| $\zeta_y$                              | 1.0    | "                                      |
| $\zeta_c$                              | 1.0    | "                                      |
| $\gamma_D'$ (pcf)                      | 0.0    | eff. soil unit weight                  |
| $\gamma_H'$ or (pcf)                   | 58.6   | eff. soil unit weight below foundation |
| $\sigma_D'$ (psf)                      | 0.0    | eff. surcharge pressure @ fdn depth    |
| $q_u$ (psf)                            | 2123.2 | structure load + add'l load(s)         |
| $q_u$ (psf)                            | 5700.0 | ultimate bearing capacity              |
| Factor of Safety                       | 2.68   | using design loads                     |
| Max allowable load (psf) $\rightarrow$ | 2280   | using FS of 2.5                        |

$q_u = \frac{q_u}{FS}$

$$\text{Equations from EM1110-1-1905} \rightarrow q_u = \frac{q_u}{FS} \quad q_u = cN_c\zeta_c + \frac{1}{2}B'\gamma'_y N_y \zeta_y + \sigma'_d N_d \zeta_d$$

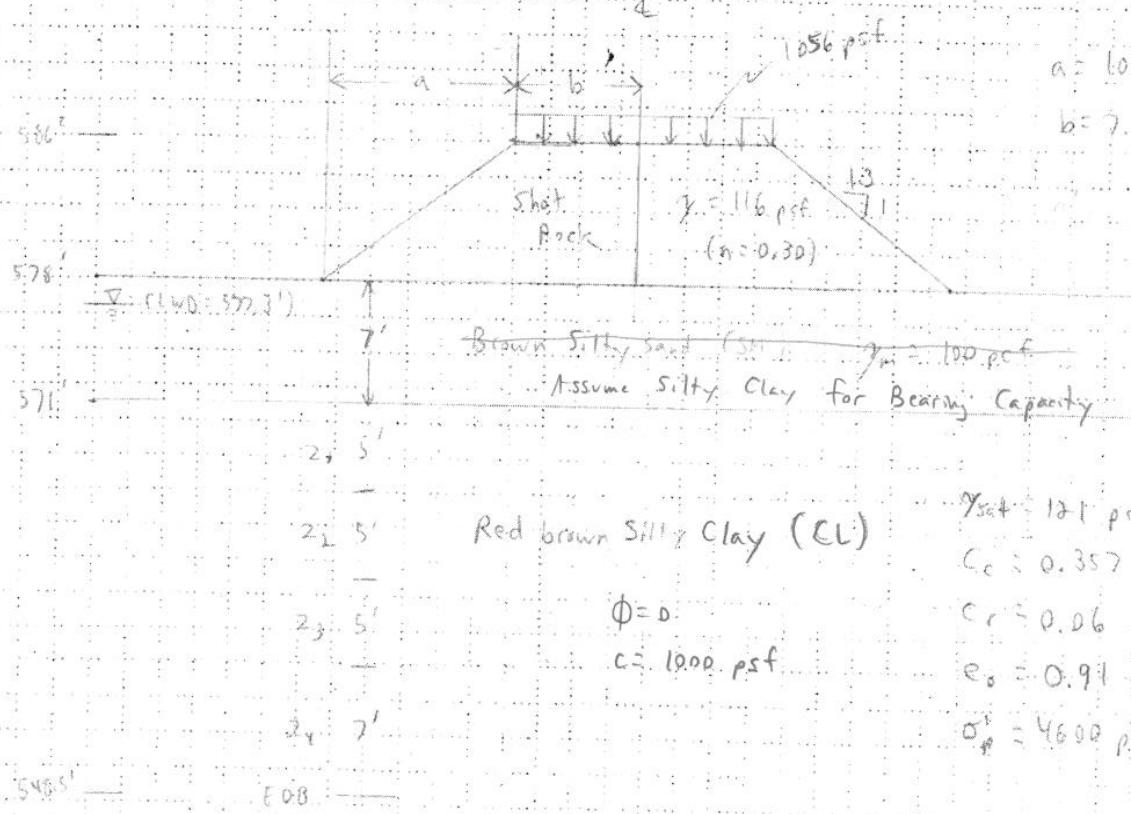
Terzaghi Dimensionless Bearing Capacity Factors (after Bowles 1988)

| $\phi'$ | N <sub>q</sub> | N <sub>c</sub> | N <sub>y</sub> | $\phi'$ | N <sub>q</sub> | N <sub>c</sub> | N <sub>y</sub> |
|---------|----------------|----------------|----------------|---------|----------------|----------------|----------------|
| 28      | 17.81          | 31.61          | 15.7           | 0       | 1.00           | 5.70           | 0.0            |
| 30      | 22.46          | 37.16          | 19.7           | 2       | 1.22           | 6.30           | 0.2            |
| 32      | 28.52          | 44.04          | 27.9           | 4       | 1.49           | 6.97           | 0.4            |
| 34      | 36.50          | 52.64          | 36.0           | 6       | 1.81           | 7.73           | 0.6            |
| 35      | 41.44          | 57.75          | 42.4           | 8       | 2.21           | 8.60           | 0.9            |
| 36      | 47.16          | 63.53          | 52.0           | 10      | 2.69           | 9.60           | 1.2            |
| 38      | 61.55          | 77.50          | 80.0           | 12      | 3.29           | 10.76          | 1.7            |
| 40      | 81.27          | 95.66          | 100.4          | 14      | 4.02           | 12.11          | 2.3            |
| 42      | 108.75         | 119.67         | 180.0          | 16      | 4.92           | 13.68          | 3.0            |
| 44      | 147.74         | 151.95         | 257.0          | 18      | 6.04           | 15.52          | 3.9            |
| 45      | 173.29         | 172.29         | 297.5          | 20      | 7.44           | 17.69          | 4.9            |
| 46      | 204.19         | 196.22         | 420.0          | 22      | 9.19           | 20.27          | 5.8            |
| 48      | 287.85         | 258.29         | 780.1          | 24      | 11.40          | 23.36          | 7.8            |
| 50      | 415.15         | 347.51         | 1153.2         | 26      | 14.21          | 27.09          | 11.7           |

## COMPUTATION SHEET

PROJECT Cat IslandITEM Access RoadSUBJECT Bearing Capacity CheckCOMPUTED BY JAWCHECKED BY JPKSHEET NO. 1 OF 2 SHEETSDATE —FILE —REF DRAWING NO. —Section 2  
Sta 10+00

(Boring CI-2-07) Consolidation test CI-2-07 S-8)



Undrained condition, so use undrained shear strength from UCS test data and assume  $\phi = 0$

Lowest undrained shear strength from test CI-2-07, S10 20-22'

$c = 0.5035 \text{ tsf} = 1007 \text{ psf}$  say 1000 psf

## COMPUTATION SHEET

PROJECT Cat Island SHEET NO. 2 OF 2 SHEETS  
 ITEM Access Road DATE \_\_\_\_\_  
 SUBJECT Bearings Capacity Check FILE \_\_\_\_\_  
 COMPUTED BY SAW CHECKED BY PK REF DRAWING NO. \_\_\_\_\_

Reference Section 2. Cross-Section (sts. 10±09), bearing lag CI-2-07.

Ultimate bearing capacity

$$q_u = c N_c I_c + \frac{1}{2} B' \gamma'_H N_y I_y + \sigma'_D N_q L_g$$

See attached for definition of terms

$$\sigma'_D = \gamma'_H \cdot D \quad D=0 \rightarrow \sigma'_D = 0$$

$$\text{at } \phi' = 0 \quad N_y = 0$$

Therefore

$$q_u = c N_c I_c$$

$$q_u = (10.00 \text{ psf})(5.70)(1.0) \quad q_u = 57.00 \text{ psf or } 5.7 \text{ kips}$$

Recommended factor of safety = 2.5 per EM 1110-1-1905 pg 1-4

$$\text{max allowable load} \leq q_a = \frac{q_u}{FS} = \frac{57.00}{2.5} = 22.80 \text{ psf or } 2.28 \text{ kips}$$