Technical Memorandum

To: Kathy Arnold
From: Mike Thornbrue
Company: Rosemont Copper Company
Date: August 26, 2010
Re: Liner Puncture Testing for the Proposed Rosemont Heap Leach Pad
Doc #: 232/10-320877-5.3
CC: Joel Carrasco (Tetra Tech); and David R. Krizek, P.E. (Tetra Tech)

1.0 Introduction
This Technical Memorandum summarizes the protocol and test results for additional liner puncture tests performed in support of the Rosemont Heap Leach Pad liner system at the Rosemont Copper Project (Project) in Pima County, Arizona. This information is in response to the April 14, 2010 Comprehensive Request for Additional Information from the Arizona Department of Environmental Quality (ADEQ) to Rosemont Copper Company (Rosemont). Specifically, this Technical Memorandum answers item no. 5 on page 7 of 18.

- **Geomembrane Protection and Liner Puncture Test** – Rosemont has proposed a minimum of 36 inches of overliner drain fill over the Heap Leach Pad as specified in the design criteria (Tetra Tech 2009) for the geomembrane protection. The material will be screened and or crushed, as needed, to produce a gradation with 100 percent of the material passing the 1.5 inch screen and less than five percent passing the No. 200 screen. (Ref. Tetra Tech Technical Memorandum – Rosemont Heap Leach Geomembrane Protection, May 4, 2009).

As stated above, placement of ¾ -inch minus, well draining material with a minimum thickness of 18 inches is a design requirement to meet prescriptive BADCT.

ADEQ will consider the use of the 1 ½ -inch crushed overliner material if the proposed GCL liner of 6-mm thickness is demonstrated to show no severe indentations when puncture tested under simulated loading conditions by placing the subgrade material, geosynthetic(s), and the overliner material in the test cell. Rosemont has done puncture testing (3 tests) of 60-mil LLDPE with 1.5 inches minus overliner (QMP) drainage layer. However, the test results do not indicate the severity of indentation whether “minor”, “moderate”, or “severe”. Dimpling of the geomembrane sample has occurred. There is no indication how these indentations or dimpling affects durability of the geomembrane. ADEQ considers three trials of puncture tests inadequate to verify the liner system behavior under simulated field conditions. Please conduct additional tests. If severe dimpling is noticed in higher frequency which causes noticeable decrease in achievable strain, ADEQ
recommends that a cushion or bedding layer should be included between the overliner and the geomembrane as an added protective layer.

The current design of the Project Heap Leach Pad liner system calls for 1.5-inch minus Overliner Drain Fill (ODF) material over a 60-mil, double-sided textured, linear low-density, polyethylene (LLDPE) geomembrane. The additional liner puncture testing performed evaluated 1.5-inch minus ODF material and its potential effect on the proposed 60-mil LLDPE liner. The Heap Leach Pad is planned for a maximum depth of material over the pad liner of about 330 feet.

2.0 Recommended Design Section

The following is the current proposed liner and drainage system design section (bottom to top) to be employed at Rosemont:

- Six (6) inches (minimum) thickness of bedding soil (Liner Bedding Fill) derived from local grading or borrow sources with a maximum particle size of 1.5 inch minus material compacted to 95% of the maximum dry density and within two (2) percent of the optimum moisture content as determined by ASTM D-698. The surface of the Liner Bedding Fill will be prepared to produce a relatively smooth surface suitable for installation of geosynthetics. The sample (TTTP-09-01, BU-01) (Gila Conglomerate) was used for this bedding soil in the liner puncture tests;

- Reinforced geosynthetic clay liner (GCL) consisting of a layer of sodium bentonite between two (2) non-woven geotextiles, which are needle-punched together (Cetco Bentomat DN, or equivalent);

- 60-mil, double-sided textured, LLDPE geomembrane liner; and

- A drainage layer (ODF) placed over the 60-mil LLDPE liner, crushed to minus 1.5-inch and screened over 0.5 inch, with no more than five (5) percent fines (passing 200 mesh). The QMP 30Jan2009 sample (QMP) was used for this drainage layer in the liner puncture tests.

3.0 Test Program

3.1 Initial Liner Puncture Testing (2009)

In support of the Rosemont Heap Leach Facility Permit Design Report (Tetra Tech, 2009), liner puncture testing was previously completed for the Heap Leach Pad. The testing was conducted to 390 psi which is equivalent to a geostatic load of 450 feet of stacked heap leach material. The previous testing also used 1.5-inch minus QMP ODF, a 60-mil, double-sided textured, LLDPE liner, a GCL, and site specific subgrade materials.

The initial testing included three (3) puncture tests that resulted in minor to moderate indentations with no punctures. These 2009 test results are provided in Attachment 1.
3.2 Additional Liner Puncture Testing (2010)

The additional high-stress compression testing for liner puncture evaluated the following combinations:

- A Heap Leach Pad liner section using 60-mil, double-sided textured, LLDPE liner coupled with 1.5-inch minus ODF; and

- A Heap Leach Pad liner section using 60-mil, double-sided textured, LLDPE liner coupled with 1.5-inch ODF with a 1/2-inch angular rock under the GCL and above the Liner Bedding Fill (planned defect).

Four (4) additional tests were completed using the standard (no defect) puncture testing scenario. Additionally, two (2) tests were completed with the planned defect. Table 1 provides a matrix of the liner puncture testing scenarios.

<table>
<thead>
<tr>
<th></th>
<th>ODF Max Grain Size</th>
<th>60-mil LLDPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Defect</td>
<td>1.5-inch</td>
<td>4 Tests</td>
</tr>
<tr>
<td>Planned Defect*</td>
<td>1.5-inch</td>
<td>2 Tests</td>
</tr>
<tr>
<td><strong>Total Tests</strong></td>
<td></td>
<td><strong>6 Tests</strong></td>
</tr>
</tbody>
</table>

* Planned Defect is an angular 1/2-inch rock placed under the GCL and above the Liner Bedding Fill.

The testing apparatus was prepared to resemble field loading conditions. The bedding layer (Liner Bedding Fill) was compacted to a minimum of 95% of the maximum dry density at the optimum moisture content as determined by ASTM D-698. The surface of the Liner Bedding Fill was prepared to produce a relatively smooth surface suitable for installation of the geosynthetics. The GCL was placed directly on the bedding layer.

When evaluating the planned defect, a 1/2-inch QMP rock was placed directly on the Liner Bedding Fill in the approximate center of the apparatus, followed by the GCL and the LLDPE liner. Prior to placing the ODF, the location of the planned defect was indicated both on the LLDPE and GCL using a marker, such as a white-out pen. The QMP ODF was preferentially selected for its angularity and was placed on the liner using standard methods.

The maximum planned depth of material on the Heap Leach Pad will be about 330 feet. The test load used was 508 psi, which is equivalent to about 585 feet of material. Assuming that the material has a density of 125 pounds per cubic foot (pcf), the depth of the material can be converted to a pressure as follows:

\[
585 \text{ feet} \times \frac{125 \text{ lbs}}{\text{ft}^3} \times \frac{1 \text{ ft}^2}{144 \text{ in}^2} = 508 \text{ psi}
\]

Based on these criteria, the following loading and testing procedures were followed:
An estimated test load of 508 psi was applied to the liner system to simulate the equivalent static load of 585 feet of material on the Heap Leach Pad. Tracking numbers were provided on the liners (both GCL and LLDPE) prior to loading;

- The static load was held for 48 hours;

- Following unloading of the apparatus, the liners (both GCL and LLDPE) were photographed and examined for indentations. The indentations were classified as minor, moderate, major, or severe. Major or severe indentations were noted (numbered) and the liners re-photographed. The location of the planned defect, as appropriate, was also noted;

- The LLDPE liner was vacuum tested to five (5) psi and results noted. If leaks were detected, they were correlated to the numbered indentations;

- The major or severe indentations (indentation depths) on the LLDPE liner were counted and measured immediately after unloading, including the planned defect location; and

- The indentation on the GCL was noted and measured in the location of the planned defect.

The gradation of the Liner Bedding Fill and Overliner Drain Fill were provided along with photographs of the material. A gradation was run for each test to account for possible breakdown of the materials if reused.

The results of the additional testing indicated minor to moderate indentations on the liner with no punctures. The results are provided in Attachment 2.

4.0 Conclusion

To date, seven (7) standard liner puncture tests have been performed using the proposed liner cross section consisting of the following from bottom to top:

- A prepared subgrade;
- A GCL;
- A 60-mil, double sided textured, LLDPE geomembrane, and
- 1.5-inch minus QMP ODF.

The results of all of the tests have indicated minor to moderate indentations with no puncture failures. Therefore, the 1.5-inch minus ODF has been demonstrated to show no severe indentations when tested under simulated loading conditions.

Additionally, there have been two (2) liner puncture tests conducted using a planned defect between the subgrade and the GCL. The puncture testing with the planned defect caused significant damage to the GCL. However, the LLDPE experienced moderate to major indentation with no puncture failure.
REFERENCES
ATTACHMENT 1
LINER PUNCTURE TESTING RESULTS
MARCH 2009
March 23, 2009

Mr. Troy Meyer
Tetra Tech M&M
3031 West Ina Road
Tucson, Arizona 85741

Report for Rosemont Project
Results of Geosynthetic Liner Puncture Test
ATT Job No. 2688-20

Dear Mr. Troy Meyer,

The following report presents the results of the liner puncture test performed using the TTTP-09-01 Bedding Layer, QMP 30Jan2009 Drainage Layer, Bentomat DN (Lot #200839LO, Roll # 10699) GCL, and 60 mil double sided textured LLDPE (No Lot # or Roll # provided) samples, in accordance with your request. The purpose of the liner puncture test was to determine if the 60 mil double sided textured LLDPE liner, when placed between compacted layers of TTTP-09-01 Bedding Layer and QMP 30Jan2009 Drainage Layer material with the Bentomat DN GCL under the liner, would develop punctures or pinholes when a simulated 450 foot heap height load (390 psi) was placed on the sample.

The scope of work was authorized and defined in e-mail messages and conversations between Troy Meyer of Tetra Tech M&M (TTMM), with Mr. Kerry Repola of Advanced Terra Testing (ATT). The work described in this document itemizes the testing requirements, which were followed and are described in subsequent sections of this report.
SAMPLE RECEIPT AND CONDITION
The TTTP-09-01 Bedding Layer sample (6 5-gallon buckets) and the QMP 30Jan2009 Drainage Layer (6 5-gallon buckets) was shipped to ATT via UPS. The samples arrived at the ATT laboratory in Lakewood, Colorado on February 04, 2009. Following receipt inspection, Tetra Tech M&M forwarded instructions regarding the preparation of the material for the subsequent test program.

SAMPLE PREPARATION
The TTTP-09-01 sample was prepared over the 1" sieve prior to testing in accordance with the instructions provided by Tetra Tech M&M. The QMP 30Jan2009 sample was manually crushed over the 1.5" sieve prior to testing. A representative sized sample was then split from the total bulk sample to perform other requested testing. A portion of the -1" TTTP-09-01 material was also used in performing a modified proctor test (ASTM D1557). The remaining material was moisture conditioned to an 8.1% moisture content as determined by the proctor. The QMP 30Jan 2009 material was assumed to be at a dry condition and a drcp density was determined by pouring the material from approximately 3’to simulate field conditions. A total of 3 trials were run and the results were averaged. A maximum of 2% difference in density was allowed between each trial.

TEST APPARATUS
The test cell designed for this application is 12.0 inches in inside diameter (ID) and is 19 inches in inside height. The actual size of the test specimen was 12.0 inches in diameter with a height of 6 inches for the bottom TTTP-09-01 Bedding Layer, and 12.0 inches of height for the QMP 30Jan2009 Drainage Layer. The base plate for the cylinder is 1.0 inches thick. The base plate is machined to fit inside the cylinder and is sealed with an "O" ring to prevent leakage. A removable bail affixed to the
base plate, facilitates transportation by crane, as the assembled cell with specimen and loading plates has an approximate mass of 350 pounds.

Load was applied by means of a wide-bay loading frame. The loading frame has a capacity of 220,000 pounds, and is hydraulically controlled such that a constant load can be applied to the sample to imitate a constant heap height throughout the test.

PROCEDURE - LINER PUNCTURE TEST
A six inch layer of TTTP-09-01 Bedding Layer was compacted in the base of the test cell, to a dry density of 122 pcf at 8.1% moisture content. A twelve inch diameter sample of GCL was placed, non-woven side up, on top of the compacted Bedding Layer. A twelve inch diameter sample of Double Sided Textured 60 mil LLDPE liner material was placed on top of the GCL. A twelve inch layer of QMP 30Jan2009 Drainage Material was then placed at 78.84 pcf dry density on top of the LLDPE material. The one inch loading plate was then placed on top of the QMP 30Jan2009 drainage material, and the test cell was placed into the load frame. Hydraulic pressure was then applied to the sample via the loading plate, until a load equivalent to 450 feet of heap height (390 psi) was achieved. See figure 1 for the diagram. The load was maintained on the sample for a minimum of 24 hours. The load was then released from the sample and the top layer of QMP 30Jan2009 material was carefully removed to expose the geosynthetic liner material.

SUMMARY AND OBSERVATIONS - LINER PUNCTURE TEST
Visual observations of the Double Sided Textured 60 mil LLDPE liner material revealed that although several indentations were present, no punctures were detected when the sample was inspected over a bright light source. Additionally, vacuum testing performed on the liner sample indicated that no punctures were present. Pictures of the LLDPE are included in this report.
This concludes the presentation of data and observations pertinent to this project. During the testing process we observed no anomalies or circumstances that deviate
from our standard approach in conducting these tests. The data presented are applicable only to this sample and described test conditions. The test results do not apply to other materials or test conditions. It has been a pleasure to provide these testing services for you. If you have any questions or require further information, please feel free to contact us.

Yours very truly,
ADVANCED TERRA TESTING, Inc.

[Signature]
William Rausch
Senior Geosynthetics Technician

[Signature]
Christopher Wienecke
Laboratory Director/Owner
Figure 1. Cell Cross Section for Tetra Tech M&M.
Tetra Tech M+M
2688-20
Rosemont
60mil Double Sided Textured LLDPE
(After Puncture Test)

TM2688/TMDP60M2
03/09/09
Tetra Tech M&M
2688-20
Rosemont
60mil Double Sided Textured LLDPE (After Puncture Test)

TM2688/TMDP60M2
03/09/09
ATTACHMENT 2
LINER PUNCTURE TESTING RESULTS
AUGUST 2010
Mike Thornbrue  
Tetra Tech  
3030 West Ina Road  
Tucson, AZ 85741

August 24, 2010

RE: Geostatic Point Load on  
TTTP-09-01(BU-01), Gila Conglomerate  
Bentomat DN, Lot 201005LO, Roll 1308  
Agru, 60 mil LLDPE Double Sided Textured, Roll 330443-09  
QMP 30Jan2009, Drainage Layer

Mike Thornbrue,

In accordance with your request, we have completed the six Geostatic Point Load Tests consisting of four tests configured in a typical configuration, and two utilizing a planned defect. A Final report is enclosed. If you have any questions, please feel free to give us a call.

Sincerely,

Advanced Terra Testing, Inc.

Mary McFadden  
Geosynthetic Technician  
Signing For Kerry M. Repola  
Laboratory Manager

William Rausch  
Geosynthetic Senior Technician
FINAL REPORT
Geostatic Point Load Testing

Prepared for:

Mike Thornbrue
Tetra Tech
3030 West Ina Road
Tucson, AZ 85741

Prepared by:

Advanced Terra Testing, Inc.
833 Parfet Street, Unit A
Lakewood, Colorado 80215

Project No. 2688-29

August 20, 2010
This laboratory test program report is for the exclusive use of Tetra Tech and consists of six Geostatic Point Load Tests. The series tests consisted of four tests configured with six inches of bedding layer, a clay liner, a LLDPE liner and twelve inches of drainage aggregate, while the other 2 tests were the same configuration with an angular half inch rock placed in between the bedding layer and the clay liner. All materials were supplied to Advanced Terra Testing, Inc. (ATT) by Tetra Tech. The test series was performed at a normal stress of 508 pounds per square inch, as required by Tetra Tech.

GEOSYNTHETIC AND SOIL MATERIAL

- TTTP-09-01(BU-01), Gila Conglomerate  
- Bentomat DN, Lot 201005LO, Roll 1308  
- Agru, 60 mil LLDPE Double Sided Textured, Roll 330443-09  
- -1.5” QMP 30Jan2009, Drainage Layer

GEOSTATIC POINT LOAD TEST

Sample Preparation
The soil samples, TTTP-09-01(BU-01) and QMP 30Jan2009, used were collected from a previous job for the Rosemont Copper Project, ATT job number 2688-20. A proctor was run in accordance with ASTM D698 on the TTTP-09-01(BU-01) sample in order to determine the maximum dry density and optimum moisture content of the sample. A Grain Size Analysis was conducted on the QMP 30Jan2009 sample in order to determine whether the grain size distribution was within the requirements. Due to limited sample size, material for both of the soil samples were reused as needed. Each time it was necessary to reuse the QMP 30Jan2009 sample a Grain Size Analysis was ran to ensure the material was still within the requirements. The actual test data for the Proctor and the Grain Size Analysis are presented in Appendix A.

Geostatic Point Load Configurations

The Geostatic Point Load Tests as requested by Tetra Tech were configured as follows:

Geostatic Point Load Test Numbers 1-4:

For this set of tests, the TTTP-09-01(BU-01) sample was compacted in a six inch layer to 95% of its maximum dry density at optimum moisture content (125.4 pounds per cubic foot and 9.9% moisture content) in a twelve inch diameter mold. A twelve inch diameter piece of Bentomat DN was then placed on top of the compacted TTTP-09-01(BU-01), a twelve inch diameter piece of the 60 mil textured liner was then placed on top of the Bentomat DN. Finally, a twelve inch layer of -1.5” QMP 30Jan2009 was placed at a
density of 83.6 pounds per cubic foot into the top of the twelve inch diameter mold. A one inch thick steel plate was placed on top of the configuration to distribute the load evenly across the surface. Pressure was applied through a fifty five ton hydraulic press. Pressure was held at a continuous pressure of five hundred and eight pounds per square inch for a minimum of forty-eight hours. The actual test data as reported is presented in Appendix A.

For each test in this Geostatic Point Load Test, fresh Geosynthetic materials were prepared for each Puncture Test. Due to limited sample the TTTP-09-01(BU-01) and QMP 30Jan2009 material was reused as needed, a Grain Size Analysis was used to confirm that the drainage layer had not broken down and still met the requirements.

**Geostatic Point Load Test Numbers 5 & 6:**

For this set of tests, the TTTP-09-01(BU-01) sample was compacted in a six inch layer to 95% of its maximum dry density at optimum moisture content (125.4 pounds per cubic foot and 9.9% moisture content) in a twelve inch diameter mold. A half inch angular rock was placed on top of the compacted soil layer. A twelve inch diameter piece of Bentomat DN was then placed on top of the compacted TTTP-09-01(BU-01) and angular rock, then a twelve inch diameter piece of the 60 mil textured liner was then placed on top of the Bentomat DN. Finally a twelve inch layer of -1.5” QMP 30Jan2009 was placed at a density of 83.6 pounds per cubic foot into the top of the twelve inch diameter mold. A one inch thick steel plate was placed on top of the configuration to distribute the load evenly across the surface. Pressure was applied through a fifty five ton hydraulic press. Pressure was held at a continuous pressure of five hundred and eight pounds per square inch for a minimum of forty eight hours. The actual test data as reported is presented in Appendix A.

For each test in this Geostatic Point Load Test, fresh Geosynthetic materials were prepared for each Puncture Test. Due to limited sample the TTTP-09-01(BU-01) and QMP 30Jan2009 material was reused as needed, a Grain Size Analysis was used to confirm that the drainage layer had not broken down and still met the requirements.

**Observations**

After each test was performed a vacuum test was performed on the 60 mil textured liner to determine if any punctures were present in the liner, for all six samples it was determined that no punctures were in the liner. Depth measurements were taken on six of the most apparent indentations in the liner, moderate indentation were observed in all six tests, the actual depth measurements as reported are presented in Appendix A. For tests five and six major indentations were present at the position of half inch angular rock.

Although a major indentation was present no punctures were detected during the vacuum test of the liner. Pictures of the two liners, the half inch angular rocks used, the top surface of the QMP 30Jan2009 layer and bottom inch of the QMP Jan2009 layer are presented in Appendix B.
For each Geostatic Point Load Test conducted the actual data and a schematic of the configuration are presented in Appendix A. The consolidation of each configuration was measured and a final density of the QMP 30Jan2009 was calculated. Consolidation was assumed to have occurred in the QMP 30Jan2009 layer.

This concludes our report for the Geostatic Point Load Testing performed as requested by Tetra Tech. The results reported apply only to the materials supplied and do not apply to other materials or test conditions.
APPENDIX A

GEOSTATIC POINT LOAD TEST DATA,

SCHEMATIC of the CONFIGURATION,

PROCTOR

&

GRAIN SIZE ANALYSIS
Geostatic Point Load Test
ATT Method

Client: Tetra Tech M&M
Job No.: 2688-29
Location: Rosemont Copper Project
Project No.: --
Test Series: Puncture 1
Test Date: 7/19/10 WAR

Load Applied: 508 psi
Duration of Test: 48 Hours
Initial Height (in): -0.23
Final Height (in): 2.51
Total Height Change (in): 2.74

Configuration (Bottom to Top)
Bottom Layer
Boring Number: TTTP-09-01(BU-01)
Sample Number: Gila Conglomerate
Sample Depth: --
Dry Density: 125.4 pcf
Moisture Content: 9.9%
Height: 6.0 in
Diameter: 12.0 in

Puncture Test Results
Vacuum Test (pass/fail): Pass
Indentation Depth 1 (in): 0.1296
Indentation Depth 2 (in): 0.1221
Indentation Depth 3 (in): 0.1049
Indentation Depth 4 (in): 0.1398
Indentation Depth 5 (in): 0.1185
Indentation Depth 6 (in): 0.1324

Geosynthetic Configuration
Bottom Layer: Bentomat DN, Lot 201005LO, Roll1308
Top Layer: Agru, 60 mil LLDPE Double Sided Textured, Roll 330443-09

Top Layer
Boring Number: QMP 30Jan2009
Sample Number: Drainage Layer
Sample Depth: --
Initial Dry Density: 83.6 pcf
Moisture Content: 0.00%
Height: 12.0 in
Diameter: 12.0 in

Data Entered By: WAR
Date: 7/30/2010
File Name: TMGSP1

Data Checked By: [Signature]
Date: [Signature]
Figure 1. Cell Cross Section for Tetra Tech M&M.

Note: consolidation assumed to occur in the Drainage layer section.
Geostatic Point Load Test
ATT Method

Client: TETRA Tech M&M
Job No.: 2688-29
Location: Rosemont Copper Project
Project No.: --
Test Series: Puncture 2
Test Date: 7/22/10 WAR

Load Applied: 508 psi
Duration of Test: 48 Hours
Initial Height (in): -0.15
Final Height (in): 2.20
Total Height Change (in): 2.35

Configuration (Bottom to Top)

Bottom Layer
Boring Number: TTPP-09-01(BU-01)
Sample Number: Gila Conglomerate
Sample Depth: --
Dry Density: 125.4 pcf
Moisture Content: 9.9%
Height: 6.0 in
Diameter: 12.0 in

Puncture Test Results
Vacuum Test (pass/fail): Pass
Indentation Depth 1 (in): 0.0826
Indentation Depth 2 (in): 0.1348
Indentation Depth 3 (in): 0.106
Indentation Depth 4 (in): 0.1076
Indentation Depth 5 (in): 0.0924
Indentation Depth 6 (in): 0.1243

Geosynthetic Configuration
Bottom Layer: Bentomat DN, Lot 201005LO, Roll1308
Top Layer: Agru, 60 mil LLDPE Double Sided Textured, Roll 330443-09

Top Layer
Boring Number: QMP 30Jan2009
Sample Number: Drainage Layer
Sample Depth: --
Initial Dry Density: 83.6 pcf
Moisture Content: 0.00%
Height: 12.0 in
Diameter: 12.0 in

Data Entered By: WAR
Date: 7/30/2010
File Name: TMGSP2

Data Checked By: [signature]
Date: 8/2/10
Figure 1. Cell Cross Section for Tetra Tech M&M.
Geostatic Point Load Test
ATT Method

Client: Tetra Tech M&M
Job No.: 2688-29
Location: Rosemont Copper Project
Project No.: --
Test Series: Puncture 3
Test Date: 7/26/10 WAR

Load Applied: 508 psi
Duration of Test: 48 Hours
Initial Height (in): 0.05
Final Height (in): 2.35
Total Height Change (in): 2.30

**Configuration (Bottom to Top)**

**Bottom Layer**

- Boring Number: TTTP-09-01(BU-01)
- Sample Number: Gila Conglomerate
- Sample Depth: --
- Dry Density: 125.4 pcf
- Moisture Content: 9.9%
  - Height: 6.0 in
  - Diameter: 12.0 in

**Puncture Test Results**

- Vacuum Test (pass/fail): Pass
- Indentation Depth 1 (in): 0.1188
- Indentation Depth 2 (in): 0.1111
- Indentation Depth 3 (in): 0.1271
- Indentation Depth 4 (in): 0.1082
- Indentation Depth 5 (in): 0.1245
- Indentation Depth 6 (in): 0.1506

**Geosynthetic Configuration**

- Bottom Layer: Bentomat DN, Lot 201005LO, Roll1308
- Top Layer: Agru, 60 mil LLDPE Double Sided Textured, Roll 330443-09

**Top Layer**

- Boring Number: QMP 30Jan2009
- Sample Number: Drainage Layer
- Sample Depth: --
- Initial Dry Density: 83.6 pcf
- Moisture Content: 0.00%
  - Height: 12.0 in
  - Diameter: 12.0 in

Data Entered By: WAR
Date: 7/30/2010
File Name: TMGSP3

Data Checked By: [Signature]
Date: 8/1/10
LINER PUNCTURE TEST
CELL CROSS SECTION

508 psi
Normal Load
For 48 Hours

LOADING PLATE

QMP 30Jan2009
Drainage Layer
83.6 lbs/ft^3
0% Moisture

60 mil. Double Sided
Textured LLDPE

Bentomat DN GCL

Gila Conglomerate
TTTP-09-01(BU-01)
125.4 lbs/ft^3
9.9% Moisture

BASE

Initial Height
.05"

Final Height
2.35"

Height Change
2.30"

Density of
Drainage
Layer

Initial
83.6 lbs/ft^3

Final
103.4 lbs/ft^3

Note: consolidation
assumed to occur in the
Drainage layer section.

Figure 1. Cell Cross Section for Tetra Tech M&M.
Geostatic Point Load Test
ATT Method

Client: Tetra Tech M&M
Job No.: 2688-29
Location: Rosemont Copper Project
Project No.: --
Test Series: Puncture 4
Test Date: 08/02/10 WAR

Load Applied: 508 psi
Duration of Test: 48 Hours
Initial Height (in): -0.11
Final Height (in): 2.19
Total Height Change (in): 2.30

Configuration (Bottom to Top)

Bottom Layer
- Boring Number: TTTP-09-01(BU-01)
- Sample Number: Gila Conglomerate
- Sample Depth: --
  - Dry Density: 125.4 pcf
  - Moisture Content: 9.9%
  - Height: 6.0 in
  - Diameter: 12.0 in

Puncture Test Results
- Vacuum Test (pass/fail): Pass
- Indentation Depth 1 (in): 0.1061
- Indentation Depth 2 (in): 0.0924
- Indentation Depth 3 (in): 0.1063
- Indentation Depth 4 (in): 0.1243
- Indentation Depth 5 (in): 0.1188
- Indentation Depth 6 (in): 0.0805

Geosynthetic Configuration

Bottom Layer: Bentomat DN, Lot 201005LO, Roll1308
Top Layer: Agru, 60 mil LLDPE Double Sided Textured, Roll 330443-09

Top Layer
- Boring Number: QMP 30Jan2009 -1.5"
- Sample Number: Drainage Layer
- Sample Depth: --
- Initial Dry Density: 83.6 pcf
- Moisture Content: 0.00%
  - Height: 12.0 in
  - Diameter: 12.0 in

Data Entered By: MLM
Date: 8/16/2010
File Name: TMGSP4

Data Checked By: 
Date: 8/16/10
Liner Puncture Test
Cell Cross Section

508 psi
Normal Load For 48 Hours

LOADING PLATE

QMP 30Jan2009 Drainage Layer
83.6 lbs/ft^3
0% Moisture

60 mil. Double Sided Textured LLDPE

Bentomat DN GCL

Gila Conglomerate TTTP-09-01(BU-01)
125.4 lbs/ft^3
9.9% Moisture

BASE

12 in

Initial Height -.11"

Final Height 2.19"

Height Change 2.30"

Density of Drainage Layer
Initial 83.6 lbs/ft^3
Final 103.4 lbs/ft^3

12 in

Note: consolidation assumed to occur in the Drainage layer section.

Figure 1. Cell Cross Section for Tetra Tech M&M.
Geostatic Point Load Test
ATT Method

Client: Tetra Tech M&M
Job No.: 2688-29
Location: Rosemont Copper Project
Project No.: --
Test Series: Puncture 5 (Planned Defect)
Test Date: 08/05/10 WAR

Load Applied: 508 psi
Duration of Test: 48 Hours
Initial Height (in): -0.18
Final Height (in): 2.07
Total Height Change (in): 2.25

Configuration (Bottom to Top)
Bottom Layer
Boring Number: TTTP-09-01(BU-01)
Sample Number: Gila Conglomerate
Sample Depth: --
  Dry Density: 125.4 pcf
  Moisture Content: 9.9%
  Height: 6.0 in
  Diameter: 12.0 in

Puncture Test Results
Vacuum Test (pass/fail): Pass
  Indentation Depth 1 (in): 0.2763
  Indentation Depth 2 (in): 0.1120
  Indentation Depth 3 (in): 0.0928
  Indentation Depth 4 (in): 0.0884
  Indentation Depth 5 (in): 0.1001
  Indentation Depth 6 (in): 0.0969

Geosynthetic Configuration
Bottom Layer: Bentomat DN, Lot 201005LO, Roll 1308
  Top Layer: Agru, 60 mil LLDPE Double Sided Textured, Roll 330443-09

Top Layer
Boring Number: QMP 30 Jan 2009 -1.5"
Sample Number: Drainage Layer
Sample Depth: --
  Initial Dry Density: 83.6 pcf
  Moisture Content: 0.00%
  Height: 12.0 in
  Diameter: 12.0 in

Data Entered By: MLM
Date: 8/16/2010
File Name: TMGSP5

Data Checked By: [Signature]
Date: 8/16/10
LINER PUNCTURE TEST
CELL CROSS SECTION

508 psi
Normal Load
For 48 Hours

LOADING PLATE

QMP 30Jan2009
Drainage Layer
83.6 lbs/ft^3
0% Moisture

60 mil. Double Sided
Textured LLDPE

Bentomat DN GCL

Gila Conglomerate
TTTP-09-01(BU-01)
125.4 lbs/ft^3
9.9% Moisture

BASE

Initial Height
-.18"

Final Height
2.07"

Height Change
2.25"

Density of Drainage Layer
Initial
83.6 lbs/ft^3
Final
102.9 lbs/ft^3

12 in

6 in

Note: consolidation assumed to occur in the Drainage layer section.

Figure 1. Cell Cross Section for Tetra Tech M&M.
Geostatic Point Load Test
ATT Method

Client: Tetra Tech M&M
Load Applied: 508 psi
Job No.: 2688-29
Duration of Test: 48 Hours
Location: Rosemont Copper Project
Initial Height (in): 0.04
Project No.: --
Final Height (in): 2.04
Test Series: Puncture 6 (Planned Defect)
Test Date: 08/07/10 WAR
Total Height Change (in): 2.00

Configuration (Bottom to Top)

Bottom Layer
Boring Number: TTTP-09-01(BU-01)
Sample Number: Gila Conglomerate
Sample Depth: --
Dry Density: 125.4pcf
Moisture Content: 9.9%
Height: 6.0 in
Diameter: 12.0 in

Puncture Test Results
Vacuum Test (pass/fail): Pass
Indentation Depth 1 (in): 0.2107
Indentation Depth 2 (in): 0.0863
Indentation Depth 3 (in): 0.0746
Indentation Depth 4 (in): 0.1176
Indentation Depth 5 (in): 0.0785
Indentation Depth 6 (in): 0.1103

Geosynthetic Configuration

Bottom Layer: Bentomat DN, Lot 201005LO, Roll 1308
Top Layer: Agru, 60 mil LLDPE Double Sided Textured, Roll 330443-09

Top Layer
Boring Number: QMP 30Jan2009 -1.5"
Sample Number: Drainage Layer
Sample Depth: --
Initial Dry Density: 83.6 pcf
Moisture Content: 0.00%
Height: 12.0 in
Diameter: 12.0 in

Data Entered By: MLM
Date: 8/16/2010
File Name: TMGSP6

Data Checked By: [Signature] Date: [Signature] Date: [Signature] Date:
Tetra Tech M&M  2688-29  
Rosemont Copper project  
Puncture 6 (Planned Defect)

LINER PUNCTURE TEST  
CELL CROSS SECTION  
508 psi  
Normal Load  
For 48 Hours  

LOADING PLATE  

QMP 30Jan2009  
Drainage Layer  
83.6 lbs/ft^3  
0% Moisture  

60 mil. Double Sided  
Textured LLDPE  

Bentomat DN GCL  

Gila Conglomerate  
TTTP-09-01(BU-01)  
125.4 lbs/ft^3  
9.9% Moisture  

BASE  

12 in  

Initial Height  
-.04"  

Final Height  
2.04"  

Height Change  
2.00"  

Density of Drainage Layer  
Initial  
83.6 lbs/ft^3  
Final  
100.3 lbs/ft^3  

Note: consolidation assumed to occur in the Drainage layer section.

Figure 1. Cell Cross Section for Tetra Tech M&M.
## Moisture Determination

<table>
<thead>
<tr>
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<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<tbody>
<tr>
<td>Wt of Moisture added (ml)</td>
<td>240.00</td>
<td>200.00</td>
<td>160.00</td>
<td>120.00</td>
<td>80.00</td>
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<tr>
<td>Wt. of soil &amp; dish (g)</td>
<td>508.20</td>
<td>541.56</td>
<td>495.09</td>
<td>438.24</td>
<td>502.50</td>
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<td>Dry wt. soil &amp; dish (g)</td>
<td>434.69</td>
<td>469.54</td>
<td>436.23</td>
<td>392.45</td>
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<td>Net loss of moisture (g)</td>
<td>73.51</td>
<td>72.02</td>
<td>58.86</td>
<td>45.79</td>
<td>45.92</td>
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<td>Wt. of dish (g)</td>
<td>6.78</td>
<td>6.71</td>
<td>6.80</td>
<td>6.50</td>
<td>8.17</td>
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<tr>
<td>Net wt. of dry soil (g)</td>
<td>427.91</td>
<td>462.83</td>
<td>429.43</td>
<td>385.95</td>
<td>448.41</td>
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<tr>
<td>Moisture Content (%)</td>
<td>17.18</td>
<td>15.56</td>
<td>13.71</td>
<td>11.86</td>
<td>10.24</td>
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<tr>
<td>Corrected Moisture Content</td>
<td>13.66</td>
<td>12.37</td>
<td>10.90</td>
<td>9.44</td>
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## Density determination

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<td>Wt of soil &amp; mold (lb)</td>
<td>14.69</td>
<td>14.75</td>
<td>14.85</td>
<td>14.81</td>
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<td>Wt. of mold (lb)</td>
<td>10.28</td>
<td>10.28</td>
<td>10.28</td>
<td>10.28</td>
<td>10.28</td>
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<td>Net wt. of wet soil (lb)</td>
<td>4.41</td>
<td>4.47</td>
<td>4.57</td>
<td>4.53</td>
<td>4.33</td>
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<tr>
<td>Net wt of dry soil (lb)</td>
<td>3.88</td>
<td>3.98</td>
<td>4.12</td>
<td>4.14</td>
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<tr>
<td>Dry Density, (pcf)</td>
<td>116.40</td>
<td>119.34</td>
<td>123.63</td>
<td>124.18</td>
<td>120.11</td>
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<tr>
<td>Corrected Dry Density (pcf)</td>
<td>124.68</td>
<td>127.34</td>
<td>131.19</td>
<td>131.69</td>
<td>128.04</td>
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**Volume Factor**

|       | 30   | 30   | 30   | 30   | 30   |

Note: If a rock correction is used the dry density has been calculated using the corrected moisture content.
Proctor Compaction Test
TTTP-09-01(BU-01), Gila Conglomerate

Zero Air Voids Curve @ SG reported below

Best Fit Curve
Actual Data
Zero Air Voids Curve @ SG = 2.75

OPTIMUM MOISTURE CONTENT = 9.9
MAXIMUM DRY DENSITY = 132.0
ASTM D 698 B, Rock correction applied? Y
MECHANICAL ANALYSIS - SIEVE TEST DATA
ASTM D 6913

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<th>CLIENT</th>
<th>Tetra Tech M&amp;M</th>
<th>JOB NO.</th>
<th>2688-29</th>
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<tr>
<td>BORING NO.</td>
<td>QMP 30Jan2009</td>
<td>SAMPLED</td>
<td>DRY SIEVED 07/28/10 QRs</td>
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<tr>
<td>DEPTH</td>
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<td>DATE - #4 WASHED 07/29/10 PW</td>
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<td>SAMPLE NO.</td>
<td>Drainage Layer</td>
<td>WASH SIEVE</td>
<td>Yes</td>
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<td>SOIL DESCR.</td>
<td>-1.5&quot; post-test</td>
<td>DRY SIEVE</td>
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<td>LOCATION</td>
<td>Rosemont Copper Project</td>
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MOISTURE DATA

| HYGROSCOPIC | Yes |
| NATURAL     | No  |

| Wt. Wet Soil & Pan (g) | 192.19 |
| Wt. Dry Soil & Pan (g) | 190.93 |
| Wt. Lost Moisture (g)  | 1.26   |
| Wt. of Pan Only (g)    | 8.17   |
| Wt. of Dry Soil (g)    | 182.76 |
| Moisture Content %     | 0.7    |

| Wt. Partial - #4 Sample Wet (g) | 209.98 |
| Wt. Partial Sample Dry (g)      | 208.54 |

WASH SIEVE ANALYSIS

| Wt. Total Sample Wet (g) | 15409.40 |
| Weight of + #4 Before Washing (g) | 13799.00 |
| Weight of + #4 After Washing (g) | 13799.00 |
| Weight of - #4 Wet (g) | 1610.40 |
| Weight of - #4 Dry (g) | 1599.37 |
| Wt. Total Sample Dry (g) | 15398.37 |

Calc. Wt. "W" (g) | 2007.79 |
Calc. Mass + #4 | 1799.25 |

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<th>Sieve Number (Size)</th>
<th>Pan Weight (g)</th>
<th>Indiv. Weight + Pan (g)</th>
<th>Indiv. Retain.</th>
<th>Cumulative Weight Retain.</th>
<th>Cumulative Retain.</th>
<th>% Fner By Wt.</th>
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<td>#100</td>
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Data entered by: MLM  Date: 08/12/2010
Data checked by:  Date: 8/12/10
FileName: TMM03009
APPENDIX B

PHOTOGRAPHS
Tetra Tech M+M 2688-29
Rosemont Copper Project
PUNCTURE 1
Tetra Tech M&MT 2688-27
Rosemont Copper Project

Puncture 1
Tetra Tech MUS 2488-29
Rosemont Copper Project
PUNCTURE
Rosemont Copper Project

Puncture Z
Tetra Tech M&I Z688-29
Rosemont Copper Project

Puncture 3
Puncture 3
Tetra Tech MtM 2688-29
Rosemont Copper Project
PUNCTURE 4
Tetra Tech M&M 2688-29
Rosemont Copper Project
PUNCTURE
5
1
Tetra Tech M+M 2688-29
Rosemont Copper Project
PUNCTURE 5
Rosemont Copper Project

Puncture
TetraTech MtM 2688-29
Rosemont Copper Project
PUNCTURE 6
Tetra Tech M+M 2688-29
Rosemont Copper Project
PUNCTURE 6
Tetra Tech M-32M 2688-29
Rosemont Copper Project

Puncture 6