EXHIBIT 9

Protecting Geomembranes from Puncture During Installation
Rosemont Heap Leach Facility
Permit Design Report

Rosemont Copper Company

Volume 2

Prepared for:

ROSEMONT COPPER
Resourceful.

4500 Cherry Creek South Drive, Suite #1040
Denver, Colorado 80246
(303) 300-0138
Fax (303) 300-0135

Prepared by:

TETRATECH

3031 West Ina Road
Tucson, Arizona 85741
(520) 297-7723
Fax (520) 297-7724
Tetra Tech Project No. 114-320807

May 2009
APPENDIX G
LINER PROTECTION
Geomembrane Protection
Design Manual

Co-Authors:

Dhani Narejo, Ph.D.
GSE Lining Technology, Inc.

and

Greg Corcoran, P.E.
GeoSyntec Consultants, Inc.

First Edition
Chapter 3
DESIGN METHOD

3.1 Protecting Geomembranes from Puncture During Installation

Puncture of geomembranes during installation can occur from both subgrade conditions and overlying soil. Each of these two concerns is discussed in the following sections.

3.1.1 Geomembrane Puncture from Subgrade

Geomembranes should be placed on subgrades free of coarse particles, earth clods, uneven areas, ruts, roots, debris and wood pieces. The following steps should be followed to ensure that a geomembrane is not damaged from underlying surface during installation:

a) Any survey stakes, if used, should be pulled out of the soil surface. Breaking off of the survey stakes at the ground surface is not recommended.

b) Insitu soil or compacted clay liner must be smooth drum rolled to achieve the necessary compaction and to ensure that particles coarser than 1 cm (3/8 inches) do not protrude from the surface.

c) Alternately, where the preparation of the surface, as recommended above, is not feasible, a cushioning material should be placed between the geomembrane and the subgrade to protect the geomembrane from puncture.

d) A qualified and certified Construction Quality Assurance (CQA) inspector and the geomembrane installer must inspect and approve the surface prior to the placement of the geomembrane.

e) No vehicular traffic should be allowed on top of an installed geomembrane. However the use of light equipment, such as ATVs, approved by the project engineer, CQA inspector and installer, may be allowed.

f) Workers with sharp shoe soles, or shoes with treading that can trap stones, should not be allowed to traverse directly on top of the geomembrane.

3.1.2 Geomembrane Puncture from Overlying Soil

A soil cover or aggregate drainage layer is almost always placed over the geomembrane. For example, an aggregate drainage layer is typically placed over the primary geomembrane in a landfill liner system (see Koerner, 1998, pp. 551 for details). The placement of these overlying materials is typically performed using construction equipment such as trucks and bulldozers. For this reason puncture of geomembrane is of greater concern during the placement of overlying soil than the installation of the geomembrane itself. The following recommendations should be followed to ensure that the geomembrane is well protected during the placement of overlying soil:
a) Soil particles coarser than 1 cm (3/8 inch) should never be placed directly on a geomembrane without first placing a suitable nonwoven needlepunched geotextile as a protection layer.

b) Sudden breaking and turning of vehicles over the geomembrane should be avoided.

c) A minimum soil cover of thickness proposed in Table 3.1 should be maintained at all times between the tires or treads of the equipment and the geomembrane.

Table 3.1 Recommended Minimum Soil Cover Thickness Over Geomembranes for the Operation of Construction Equipment.

<table>
<thead>
<tr>
<th>Equipment Ground Pressure</th>
<th>Recommended Minimum Lift Thickness, m (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>kPa</td>
<td>psi</td>
</tr>
<tr>
<td>&lt; 70</td>
<td>&lt; 10</td>
</tr>
<tr>
<td>70 - 140</td>
<td>10-20</td>
</tr>
<tr>
<td>&gt; 140</td>
<td>&gt; 20</td>
</tr>
</tbody>
</table>

A number of researchers have evaluated geomembrane protection requirements during the construction process by building test pads. The methodology followed for such an evaluation can be summarized as follows:

a) A subgrade is prepared to the site-specific compaction and moisture content requirements.

b) A sample of the desired geomembrane is placed over the subgrade.

c) A nonwoven needlepunched protection geotextile is placed over the geomembrane.

d) A controlled thickness of overlying material is placed on top of the geomembrane.

e) Construction equipment, such as a truck or a dozer with a known weight, is moved over the soil a fixed number of times to simulate traffic during the construction project.

f) At the completion of the desired number of passes, soil overlying the geotextile is carefully removed. Coupons of geotextile and geomembrane are removed and observed visually for signs of damage and tested in a laboratory for changes in the physical or mechanical properties.

A study of the type described above was performed by Reddy et. al. (1996) to determine protection requirements for AASHTO # 8 (12 mm max diameter) stone. The conclusion of this study was to use a minimum of 270 gram/m² (8 oz. per square yard) nonwoven needle punched geotextile for the protection of a 1.5 mm (60 mil) thick HDPE geomembrane.

A similar study has been described by Richardson & Johnson (1998). They evaluated protection requirements for a 1.5 mm thick HDPE geomembrane under an AASHTO # 57 (max diameter 38 mm) stone. They recommend using at a minimum a 405 g/m² (12 oz. per square yard) nonwoven needlepunched geotextile to protect the geomembrane from damage by a # 57 stone.

A number of other researchers have performed similar testing for project-specific conditions. Generally, their recommendations have ranged from 270 grams/m² to 540 grams/m² (8 oz. to 16 oz.) geotextile depending on the type of soil and construction equipment.
Design recommendations provided in Table 3.2 are based on studies reported in the literature and authors own experience with protection requirements for HDPE geomembranes.

### Table 3.2 Mass per Unit Area of Nonwoven Needlepunched Geotextile Recommended for Geomembrane Protection During Installation.

<table>
<thead>
<tr>
<th>Maximum Stone Size (mm)</th>
<th>Mass per Unit Area (g/m²)</th>
<th>(oz/sq. yard)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 12</td>
<td>≥ 335</td>
<td>≥ 10</td>
</tr>
<tr>
<td>≤ 25</td>
<td>≥ 405</td>
<td>≥ 12</td>
</tr>
<tr>
<td>≤ 38</td>
<td>≥ 540</td>
<td>≥ 16</td>
</tr>
<tr>
<td>≤ 50</td>
<td>≥ 1080</td>
<td>≥ 32</td>
</tr>
</tbody>
</table>

#### 3.2 Protecting Geomembrane from Puncture Due to Static Loads

The equations presented in this section were derived based on extensive quasi-performance and performance puncture testing. The final empirical relationship presented at the end of this chapter was obtained as follows:

a) An empirical equation relating truncated cone height and mass per unit area of a nonwoven needlepunched geotextile used as protection for a 1.5 mm (60 mil) HDPE geomembrane was obtained from Hydrostatic Truncated Cone Puncture Tests performed according to ASTM procedure D 5514.

b) The basic equation in (a) above was modified for the influence of geomembrane thickness.

c) The equation in step (b) above was modified for the influence of creep of the geomembrane and geotextiles.

d) The effect of type of overburden stress (hydrostatic vs. geostatic) on the equation in (c) above was evaluated.

e) The equation obtained from step (d) above was then adjusted for protrusion shape and arrangement.

f) Finally, the equation was modified for chemical and biological degradation of geomembranes and protection geotextiles.

All of the above work was performed by the author and other researchers at the Geosynthetic Institute, Drexel University, PA, using geotextiles from a number of different manufacturers. Thus the geotextile performance and the resulting design equations are representative of nonwoven needlepunched geotextiles manufactured and supplied in the US. The following sections provide details of each of the above steps.

#### 3.2.1 Basic Equation

The failure pressure of a 1.5 mm (60 mil) thick HDPE geomembrane in Truncated Cone Puncture Test (ASTM D 5514) is related to the cone height $H$ (mm) and the mass per unit area of