Globeville Landing Outfall Project
Follow up on Liner Questions

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Environmental Consulting
What We’ll Cover

• Liner Requirements and Standards
• Liner Testing
  – Construction-related
  – Long-term
• Liner warranty
• Questions and Discussion
Liner standards and testing during installation?

- Liner material properties
  - Thickness
  - Tensile strength
  - Resistance to tear and puncture
  - Others
- All seams tested and must pass
  - Non-destructive: air pressure and/or vacuum box
  - Destructive: shear and peel strength

### TABLE 5-1 LLDPE GOMEMBRANE CQA CONFORMANCE TESTING

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Test Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thickness</td>
<td>ASTM D 5994/5199</td>
<td>1 per 100,000 sq ft</td>
</tr>
<tr>
<td>Density</td>
<td>ASTM D 792/1505</td>
<td>1 per 100,000 sq ft</td>
</tr>
<tr>
<td>Melt Flow Index (max)</td>
<td>ASTM D 1238</td>
<td>1 per 100,000 sq ft</td>
</tr>
<tr>
<td>Tensile Properties</td>
<td>ASTM D 6693</td>
<td>1 per 100,000 sq ft</td>
</tr>
<tr>
<td>Axi-Symmetric Strain</td>
<td>ASTM D 5617</td>
<td>1 per 100,000 sq ft</td>
</tr>
<tr>
<td>Tear Resistance</td>
<td>ASTM D 1004</td>
<td>1 per 100,000 sq ft</td>
</tr>
<tr>
<td>Puncture Resistance</td>
<td>ASTM D 4833</td>
<td>1 per 100,000 sq ft</td>
</tr>
<tr>
<td>Carbon Black Content</td>
<td>ASTM D 1603</td>
<td>as required</td>
</tr>
<tr>
<td>Carbon Black Dispersion</td>
<td>ASTM D 5596</td>
<td>as required</td>
</tr>
<tr>
<td>Oxidative Induction Time</td>
<td>ASTM D 3895</td>
<td>as required</td>
</tr>
</tbody>
</table>

### TABLE 5-2 LLDPE GOMEMBRANE NDT CQA SEAM TESTING REQUIREMENTS

<table>
<thead>
<tr>
<th>Test Method</th>
<th>Frequency</th>
<th>Specified</th>
<th>Documented</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM D 5641 Vacuum Box</td>
<td>100% Extrusion</td>
<td>Pass</td>
<td>Pass/Fail</td>
</tr>
<tr>
<td>ASTM D 5820 Air Channel</td>
<td>100% Dual Fusion</td>
<td>Pass</td>
<td>Pass/Fail</td>
</tr>
</tbody>
</table>

### TABLE 5-3 LLDPE GOMEMBRANE DESTRUCTIVE SEAM TESTING CQA REQUIREMENTS

<table>
<thead>
<tr>
<th>Test Method</th>
<th>Frequency</th>
<th>Specified</th>
<th>Documented</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM D 6392 Seam Shear Strength</td>
<td>As Required</td>
<td>72 lb/in FTB</td>
<td>Pass/Fail</td>
</tr>
<tr>
<td>ASTM D 6392 Seam Peel Strength</td>
<td>As Required</td>
<td>60 lb/in FTB</td>
<td>Pass/Fail</td>
</tr>
</tbody>
</table>

Note: Peel incursion shall be less than 25% by area

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Electrical Leak Location Survey

• 100% of liner
• Tested after installation and placement of overlying soil cover
• Conduct performance test on area with known holes prior to full test
• Leak signals identified
• Leak excavated and repaired
• ASTM D 7007 “Standard Practice for Locating Leaks in Geomembranes Covered with Water or Earth Materials”

For more information:
– Final Design Report
– Appendix D, Geomembrane Lining System Design Recommendations, FDR
– Appendix H, Specifications, FDR
– Appendix I, Construction QA Plan for Geosynthetics Liner System
• Manufacturer warranty = 20 years
  – Covers polymer and sheet against deterioration
• Installation warranty = 2 years
  – Covers installation-related defects or connections
• Life expectancy 50 - 100 years
• “a geomembrane’s calculated hydraulic conductivity will range from 10E-10 to 10E-14 cm/s.”
  Appendix D, FDR
Operation and maintenance long-term components?

- Will be addressed in Environmental Operations and Maintenance Plan
- Key components:
  - Inspection and maintenance of GLO channel soil cover
  - Inspection and maintenance of concrete walls
  - Repair of any surface damage such as erosion, soil cover damage
  - Removal of undesired vegetation
  - Electrical Leak Location Survey when indicated
  - Staff training
  - Land use and notification processes
  - Documentation and reporting
Thank you

Questions and discussion