Saluda Dam Remediation
Dewatering Program

John E. Charlton and Eric A. Itle
Paul C. Rizzo and Associates
Site Location
Liquefaction Analysis

Factor of Safety < 1

Extensive liquefaction; Post seismic
Thrown House, Summerville S.C.
Bent Railroad Tracks
Locations of South Carolina Earthquakes: 1698-1995

[Map of South Carolina showing locations of earthquakes with different magnitudes marked by various symbols.]

Http://scsn.seis.sc.edu/html/scsn.html
Regional Geological Map 1

Lake Murray Gneiss
Pelitic Schist and Granitic Sheets
Pelitic Schist and Granitic sheets
Intrusive (Granite/Quartz Monzonite)
N-5 Excavation looking North
Dewatering Problems

- Dam Soil
- Residual Soil and Saprolite
- Alluvium
- Rock
## Packer Test Results

### PACKER TEST PERMEABILITY DATA
**FRACTURED SCHIST/BORING PH-7A**

<table>
<thead>
<tr>
<th>Top of Zone Depth (ft)</th>
<th>Bottom of Zone Depth (ft)</th>
<th>Recovery (%)</th>
<th>RQD (%)</th>
<th>K (cm/sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>72.65</td>
<td>78.15</td>
<td>85</td>
<td>42</td>
<td>6.57 x 10^{-4}</td>
</tr>
<tr>
<td>78.65</td>
<td>84.15</td>
<td>98</td>
<td>86</td>
<td>8.96 x 10^{-4}</td>
</tr>
<tr>
<td>80.3</td>
<td>85.8</td>
<td>98</td>
<td>86</td>
<td>1.14 x 10^{-5}</td>
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<tr>
<td>85.3</td>
<td>90.8</td>
<td>98</td>
<td>86</td>
<td>9.72 x 10^{-6}</td>
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<tr>
<td>95.3</td>
<td>100.8</td>
<td>99</td>
<td>69</td>
<td>4.19 x 10^{-4}</td>
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<tr>
<td>100.3</td>
<td>105.8</td>
<td>91</td>
<td>15</td>
<td>4.31 x 10^{-4}</td>
</tr>
<tr>
<td>105.3</td>
<td>110.8</td>
<td>91-100</td>
<td>15-57</td>
<td>9.56 x 10^{-6}</td>
</tr>
</tbody>
</table>

### PACKER TEST PERMEABILITY DATA
**FRACTURED SCHIST/BORING PH-9**

<table>
<thead>
<tr>
<th>Top of Zone Depth (ft)</th>
<th>Bottom of Zone Depth (ft)</th>
<th>Recovery (%)</th>
<th>RQD (%)</th>
<th>K (cm/sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>57.95</td>
<td>63.45</td>
<td>58-100</td>
<td>58-80</td>
<td>1.78 x 10^{-5}</td>
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<tr>
<td>61.05</td>
<td>66.55</td>
<td>100</td>
<td>80</td>
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<td>64.05</td>
<td>69.55</td>
<td>100</td>
<td>45</td>
<td>5.65 x 10^{-6}</td>
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<td>79.05</td>
<td>84.55</td>
<td>96-88</td>
<td>82-25</td>
<td>9.78 x 10^{-5}</td>
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<tr>
<td>84.05</td>
<td>89.55</td>
<td>88</td>
<td>25</td>
<td>3.68 x 10^{-5}</td>
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</tbody>
</table>
### Dam and Soil Permeability

FALLING HEAD PERMEABILITY DATA
DAM AND RESIDUAL SOIL

<table>
<thead>
<tr>
<th>Piezometer</th>
<th>Boring (1)</th>
<th>Dam STA</th>
<th>Screen EL (ft)</th>
<th>USCS (2)</th>
<th>Soil Type</th>
<th>K (cm/sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-5</td>
<td>CC-5</td>
<td>32+76</td>
<td>182.7</td>
<td>sm</td>
<td>Residual</td>
<td>1.72 x 10^-5</td>
</tr>
<tr>
<td>C-9C</td>
<td>BB-4</td>
<td>37+53</td>
<td>174.1</td>
<td>cl</td>
<td>Residual</td>
<td>9.61 x 10^-7</td>
</tr>
<tr>
<td>C-9B</td>
<td>BB-4</td>
<td>37+41</td>
<td>199.1</td>
<td>sm</td>
<td>Residual</td>
<td>3.32 x 10^-6</td>
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<tr>
<td>C-14</td>
<td>Law B-7</td>
<td>53+00</td>
<td>211.4</td>
<td>sm</td>
<td>Residual</td>
<td>6.14 x 10^-4</td>
</tr>
<tr>
<td>C-13A</td>
<td>AA-3</td>
<td>52+53</td>
<td>245.3</td>
<td>sm</td>
<td>Dam</td>
<td>8.10 x 10^-5</td>
</tr>
<tr>
<td>D-3A</td>
<td>DD-1</td>
<td>42+24</td>
<td>183.6</td>
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<td>Dam</td>
<td>5.87 x 10^-5</td>
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<tr>
<td>D-3B</td>
<td>DD-1</td>
<td>42+03</td>
<td>164.3</td>
<td>-</td>
<td>Residual</td>
<td>2.79 x 10^-4</td>
</tr>
<tr>
<td>E-3</td>
<td>FF-3</td>
<td>12+00</td>
<td>270.0</td>
<td>SM</td>
<td>Residual</td>
<td>3.0 x 10^-6</td>
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<tr>
<td>SW46</td>
<td>-</td>
<td>73+62</td>
<td>317.8</td>
<td>-</td>
<td>Dam</td>
<td>4.15 x 10^-4</td>
</tr>
</tbody>
</table>
Dewatering System

• Eductors, Deep Wells, Well Points, Shallow Wells
• Necessary for lowering phreatic head in the Dam for safe excavation
• Designed for Factor of Safety $= 1.5$
Typical Deep Well
Deep Wells
Eductors
Typical Eductor System
Shallow Wells
Discharge Line
Dewatering System (North)
Dewatering System (South)
Eductor Spacing

• Spaced 10 - 20 ft based on amount of water produced and depth to rock.
Eductor Design

Typical single pipe eductor installed in a 50 mm wellpoint
Implementation
Implementation
Implementation
Implementation
CELL C-5 Rock Piezometers
Deep Wells DW10 & DW12 Pumping

Elevation (MSL, ft)

Ground Elevation (MSL, ft)

Subgrade Elevation

Initial Water Level

Water Level on 9-11-02

PP06-R PP07-R PP08-R PP19-R PP21-R
CELL C-5 Soil Piezometers
Deep Wells DW10 & DW12 Pumping

[Graph showing elevation data for various piezometers (PP06-S, PP07-S, PP08-S, PP18-S, PP19-S, PP21-S) with different colored bars representing ground elevation, subgrade elevation, initial water level, and water level on 9-12-02.]
CELL C-7 (Old RiverBed) SOIL PIEZOMETERS
Deep Wells DW5, 7,10,12,23,25 & 27 Pumping

Elapsed Time (days)

Water Elevation

Subgrade Elevation El. 165

9-23-02

6-17-02
Construction Facts

- 1.3 million yd$^3$ of RCC
- 3.5 million yd$^3$ of rock fill
- Total length of dam will be 2700 ft
- Total height of RCC section will be 200 ft
- Completed early 2005
This computer illustration shows the look of the Lake Murray Dam with the new backup dam and two additional highway lanes.