Large Landslide Repair in an Area of Limited Data
I-64, MP 45.65 Slope Repair – Horizontal Drains

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Staunton District Materials
Timeline

- November 13, 2013 – Google Earth Image
- January, 2014 – Local Resident reports Slope Failure
- July, 2014 – Geotechnical Drilling
- July, 2014 to Present – Slope Inclinometer Monitoring
- February, 2015 – Cleaning and Survey of Drainage Pipe
- November, 2015 – Construction begins
- Late-December, 2015 to February, 2016 – Horizontal Drains
- April, 2016 – Project Complete
Project Site
Scarp
Scarp
Slide Dimensions
J’ed Trees on the Slope
Scarp
Drainage out of Slope
Drainage into Cistern
Sag in Drainage Pipe

Rockbridge, VA. I 64 EB MP 45.65
CUT IN ACCESS ← END OF PIPE
Concrete Pipe (non reinforced) Circular 15

Deposits Settled Gravel, 30% of cross sectional area, from 01 to 08 o’clock, within 8 inches of joint. Yes, start, appears to be the point where we ran out of cleaning hose approximately 300 feet extented down hillside before reaching cut in access point.
Frogs
Back-Calculation - Circular
Back-Calculation - Wedge
Improved Drainage
Full Buttress
Soil Nails along Slope

![Soil Nail Diagram]
Soil Nail Walls
Lower Buttress
## Slope Stability Results

<table>
<thead>
<tr>
<th>Concept</th>
<th>Factor of Safety</th>
<th>Rough Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing Slope</td>
<td>1.02</td>
<td>NA</td>
</tr>
<tr>
<td>Improved Drainage</td>
<td>1.08</td>
<td>NA</td>
</tr>
<tr>
<td>Full Buttress *</td>
<td>1.36</td>
<td>$3,000,000±</td>
</tr>
<tr>
<td>Soil Nails on Existing Slope, with Lower Buttress **</td>
<td>1.30</td>
<td>$16,000,000±</td>
</tr>
<tr>
<td>Soil Nails on Benched Slope, with Lower Buttress **</td>
<td>1.34</td>
<td>$5,500,000±</td>
</tr>
<tr>
<td>Lower Buttress Only</td>
<td>1.15 (1.32)</td>
<td>$2,000,000±</td>
</tr>
<tr>
<td>Soil Nails in Scarp Only (3 ft. spacing)</td>
<td>1.15 (1.18)</td>
<td>$600,000±</td>
</tr>
</tbody>
</table>

* – 1.5:1 Buttress for stratified cross-section. 2:1 Buttress for f’ = 30°.
** – 3 ft. spacing for stratified cross-section. 5 ft. spacing for f’ = 30°.
( ) – Global Factor of Safety.
Scarp
Buttress
Horizontal Drains
Buttress Construction
Buttress Construction
Buttress Construction
Horizontal Drains
Horizontal Drains
Horizontal Drains
Horizontal Drains
Horizontal Drains
Horizontal Drains
Monitoring
Questions?