Pilot Project - Mitigation of Gypsum Mine Voids Beneath SR2 in Ottawa County

2013

Geohazards – ITGUAM Technical Forum

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DANGER

OLD MINES - UNSTABLE GROUND

NO TRESPASSING

VIOLATORS WILL BE PROSECUTED

United State Gypsum Co.
419-734-3161
* Gypsum mined from 1902 to 1977
* Section under SR-2 mined 1950’s – 1960’s
* SR-2 constructed in 1965
* Mines flooded in 1979
* Active sinkholes since Dec. 2004
• AN EXTENSIVE INVESTIGATION WAS COMPLETED FROM 2005 & 2011 AND WAS PRESENTED LAST YEAR AT OTEC 2011

• SUBSURFACE INVESTIGATION, GEOPHYSICAL SURVEY, RECORDS REVIEW, AND ALTERNATIVE ASSESSMENT

• THE ALTERNATIVE ASSESSMENT INCLUDED RE-Routing of SR 2 AROUND THE MINE VOIDS, LAND BRIDGING OVER THE MINED AREA, AND STABILIZING OF THE VOIDS BY GROUTING
Land Bridge – Eliminated from further consideration

- High construction cost
- Long construction schedule
- High impact to existing traffic

Mine Stabilization – Continued for further consideration

- Minimally satisfy all key elements of the Purpose & Need
Shift SR-2: Alt. 3A and 3B – Eliminated from further consideration

- High right-of-way needs
- Long construction schedule
- Alter existing roadway network

Shift SR-2: Alt. 3C and 3D – Continued for further consideration

- Minimally satisfy all key elements of the Purpose & Need
ORIGINAL INVESTIGATION RECOMMENDATIONS

- Prepare a design for a small pilot project. There is a concern regarding the feasibility of grouting and providing barriers for voids possibly exceeding 13 feet in height.

- Evaluate the results of the pilot project to determine the most feasible approach to stabilizing these massive voids.

- Develop design documents in accordance with the best alternative.
PILOT PROJECT – FINDINGS, CONCLUSIONS & RECOMMENDATIONS
PILOT PROJECT –
There were too many unknowns to proceed to the large scale project
• Would grouting in a 13 foot void laterally displace the pillars?
• Would the grout stack enough for roof contact?
• Would the mine pool become elevated and discharge at the ground surface?
• Would the grout laterally flow too far?
Drilling Options: Sonic vs. Air Rotary/Mud
Sonar Mapping of Voids
EXECUTIVE SUMMARY

Zapata Incorporated (ZAPATA), as a team member to Howard Concrete Pumping (Howard), performed OTT-2-25.05 U.S. Gypsum Mine Stabilization Project (Task 4.5) Scope of Work, as per the State of Ohio Department of Transportation project scope document. ZAPATA’s services consisted of providing borehole sonar imaging of voids associated with abandoned gypsum mines near the State Route 2 corridor, Portage Township, Ottawa County, Ohio.

A total of 35 boreholes were accessible for surveying using borehole sonar. Data collection was conducted over one mobilization from May 21 through May 24, 2012.

ZAPATA analyzed and interpreted the data obtained from the sonar imaging using our understanding of geophysics and mining engineering practices. Based on the results, the void volume was determined as follows:

<table>
<thead>
<tr>
<th>Void Space Area</th>
<th>Open Void Space (cubic yards)</th>
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<tbody>
<tr>
<td>Open Mine Void</td>
<td>11,093</td>
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<tr>
<td>Open Void Space in Floor Rubble</td>
<td>349</td>
</tr>
<tr>
<td>Open Void Space in Rubble Piles</td>
<td>133</td>
</tr>
<tr>
<td><strong>Total Open Void Volume:</strong></td>
<td><strong>11,575</strong></td>
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TEST TRENCHES — TO VISUALLY
OBSERVE THE FLOW ABILITY OF THE
BARRIER GROUT AND DETERMINE THE
STACKING ABILITY IN ORDER TO OBTAIN
ROOF CONTACT
Barrier Placement –

3 barrier types were installed to evaluate most effective method:

- Conventional Concrete / Grout mix
- Aggregate Barrier
- Grouted Aggregate Barrier
Aggregate Barrier Placement
Grouted Aggregate Barrier Placement
Grouted Aggregate Barrier Placement
Conventional Concrete/Grout Barrier Placement
Barrier Conclusions:

Aggregate Barriers were very difficult to place down a 6” hole, very labor intensive and questionable effectiveness. The conventional barriers worked as expected and the test trenches proved to be very valuable, batch pumping of the barriers increased the effectiveness and insured stack ability and roof contact!!
Production Grouting
- Production Grout  5,207 yds$^3$
- Sand/Gravel  1,062 yds$^3$
- Neat Cement  12 yds$^3$
- Barrier B  172 yds$^3$
- Barrier C  1,835 yds$^3$
- All  8,288 yds$^3$
FINAL PLANS FOR OTTAWA STATE ROUTE 2 ARE IN FINAL REVIEW AND DUE TO BE BID IN EARLY 2013 AND COMPLETED IN May 2014.

Plans include:

Drilling 450 injections holes @ 80’ ave. - 36,000 lf,

Grouting Totals - 113,000 YDS³
QUESTIONS ????