HMS Geophysics

Memo

To: Tom Boyd, Phil Romig, and Renee Elmquist

From: Another Typical Mines Student

Date: 03/02/98

Re: Request for Bid

Description of Problem

The problem presented to us deals with detecting shallow tunnels remaining from the 1890's New White Ash Mine. The mine worked the lower 200 feet of the Laramie formation for coal seams. Mine records tell us that the tunnels should range from 3 to 5 meters in diameter, and are located anywhere from 5 to 100 meters in depth. The tunnels run along strike, which is North--South. The developers of this plot have requested a bid for a geophysical survey to locate any tunnels within 15 meters of the surface and deeper if possible. To detect the tunnels, we will use a gravimeter and records change in gravitational acceleration that are observed. If a tunnel is under the gravimeter, it will be noticed as a gravity anomaly. If numerous tests take place, we can ascertain the possibility of hazardous tunnels on the site by examining the results.

Survey Considerations

The client has requested that the initial survey cross East-West through the center of the 500 X 500 meters plot, and that a coordinate system based on (0,0) as the center be used. Gravity stations located across the entire project from (-250,0) to (250,0) will give us a profile across the underlying bedrock and should locate any hazardous tunnels. Recording the changes in gravity requires a base station. The base station will be located at (0,0) barring no problems with the location.

The plot we are surveying has no elevation change. No correction for the elevation profile is needed.

Survey Plan

Any tunnels on the premises will follow the N-S strike and range in size from 3 to 5 meters. We have modeled this survey to take in the minimum size and maximum depth needed. It is critical for the survey crew to maintain a .01 mGal standard deviation (S.D.). A smaller S.D. would be acceptable, but any higher than .01 mGal S.D. might result in noise levels that are too high to read the data correctly. High S.D.'s would hide any tunnels approaching minimum size and maximum depth. To ensure that the standard deviation is at a required minimum, reoccupation of the base station must take place every 1.5 hours and five readings should be taken at each station. The proposed survey would require 13 days in the field, and another 13 days in the office.

Limitations and Success

The client has requested tunnel detection at the greatest depths possible. Much deeper detection than 15 meters is possible with this technique, but the ensuing costs are overwhelming. To obtain guaranteed results for 15 meters, five tests for each station spaced 2.75 meters is required. For deeper tunnels, a great many more readings at closer station spacing would be required. Costs would dramatically increase with each more stations and an increase in readings per station. If the client desires testing at deeper levels, a resubmission of the bid will be necessary.

Success is definite, barring unforeseen variables in the geology or variables not stated in the request. Again, important factors to keep in mind are the Standard Deviation (<0.01mGal), recorded tunnel size (mine records), and the maximum detection depth required with certainty.

Please contact us if you have any questions or concerns. You can contact us at 279-2421, or via email at the following addresses:

Tom Boyd – tboyd@mines.edu.

Thank you for your consideration and time.

Appendix A: Project Cost Breakdown

TOTAL COSTS:	
Labor	$4,160.00
Fringe Benefits	$1,040.00
Equipment	$3,900.00
Operating costs and expenses	$2,600.00
Overhead	$7,800.00
Profit	$2,925.00
~~TOTAL BID FOR PROJECT:~~	**~~$22,425.00~~**

Chart detailing the categories of costs. Total cost included. (Double click to see entire spreadsheet)

Appendix B: If-Then Statements:

Qualitative Description of the Physics Involved

If the tunnel were deeper, then the observed gravity anomaly would be smaller in amplitude and broader in shape.

If the tunnel were shallow, then the observed gravity anomaly would be larger in amplitude and narrower in shape.

If the tunnel were smaller, then the observed gravity anomaly would be smaller in amplitude and narrower in shape.

If the tunnel were larger, then the observed gravity anomaly would be greater in amplitude and wider in shape.

The above statements give a qualitative understanding of what is observed when some of the parameters are varied.