

TITLE AND LOCATION (CITY AND STATE) <b>BHP/MINERA ESCONDIDA SITE GEOTECHNICAL INVESTIGATION CHILE</b>		YEAR COMPLETED <b>2009-PRESENT</b>
PROJECT OWNER'S INFORMATION		
a. PROJECT OWNER <b>BHP Billiton</b>	b. POINT OF CONTACT NAME	c. POINT OF CONTACT TELEPHONE NUMBER

BHP BILLITON (BHPB) is working on the project EOA-CS-02 for Minera Escondida Ltda. The main task is to assess the relocation and reconstruction of the existing equipment of the crushing plants and/or the material transportation systems, from El Rajo Escondida, located at the interior of Minera Escondida Ltda. Buildings, in the Second Region of the country (Chile).

BHPB has hired Rizzo Associates Chile to develop a geotechnical investigation to determine the actual site subsurface conditions, where the equipment foundations will be placed (crashing machines No. 2 and No. 3). These foundations will be analyzed under static and dynamic loading conditions. RIZZO CHILE will account for local seismic conditions, local building codes, and international seismic design criteria.

RIZZO's next task is to define the best alternative of foundation (technically and economically) that would meet all BHPB detailed design requirements, an in-situ geotechnical study is being performed at the site in order to determine the soil profile and corresponding properties. This study consists primarily in geophysical surveys, the construction of test pits, and field and laboratory tests. Based on this information, RIZZO will select the most adequate foundation solution; including the possibility of soil improvement as an alternative (i.e. dynamic compaction), if needed.



## FIELD WORK

### 1. Drilling, testing and survey sampling

Under RIZZO's continuous supervision by Qualified staff, drilling and in-situ testing activities are performed by subcontractors (i.e. Geotec).

The work effort consists in drilling two boreholes (S-03 y S-04) of 115 m (380 ft). At the mining dump zones (+/- 75 m deep), a reverse air drilling will be considered. From this depth (75m or 246 ft) to the end of the borehole the drilling will be performed using a diamond crown of diameter PQ and continuous sampling recovery. During drilling, SPT and sampling will be done using 3" Shelby tubes, in order to determine the compaction level and to obtain undisturbed samples of the layers with softer material (high fines content) from either natural soil or mining waste (tailing).

The recovered samples are described, marked, and kept in their boxes, indicating the corresponding depth. Photographs of all the samples are taken prior to their description.



### 2. Geophysical survey (Downhole)

RIZZO CHILE supervised the geophysical survey using the Downhole method for the two aforementioned boreholes of 115 m.

The purpose of this survey is to assess the dynamic properties of the different subsurface materials under vibratory loading (P and S waves). These properties include the Shear Modulus, Young's Modulus, and Poisson's ratio of the soil layers at the site.



### 3. Laboratory testing

RIZZO is responsible for the design and execution of the laboratory testing program. Lab testing of selected samples is required to complement the in-situ field surveys and to obtain representative soil parameters. The lab tests that are commonly performed are: complete soil classification, lab permeability, Atterberg limits, specific gravity, proctor test, humidity, triaxial tests, unconfined compressive strength, consolidation tests, direct shear 60x60, CBR, etc.



#### **SAFETY AND QUALITY ASSURANCE**

Safety assurance for the work of this project will follow the RIZZO CHILE Health and Safety Plan requirements and the Environmental and community requirements (HSEC), which are based on the corresponding MEL standards. In addition, there is an emergency plan associated with the project.

Quality assurance for the work of this project will follow RIZZO procedures, which are included in the RIZZO QA Manual and associated procedures, unless the subcontractor has its own approved Quality Program.

#### **SEISMIC ANALYSIS AND DESIGN**

The site is located in a zone with high seismicity which will be considered in the analysis and design process. RIZZO will utilize available site specific information along with Chilean design codes and specifications to obtain the site specific response spectra and the associated seismic forces for the structural and geotechnical analysis of the foundation system. In case it is found to be a critical issue for the stability of the foundation, RIZZO will perform a detailed soil-structure interaction analysis using specialized software.

#### **FOUNDATION DESIGN**

The design of the foundation system will be engineered for both static (live and dead loads) and dynamic loading (seismic loads). RIZZO's analysis will include the calculation of bearing capacity and total and differential settlements due to these loads. Also, the analysis will address the dynamic forces and maximum displacements due to the equipment's rotational natural vibrations. Adequate factors of safety will be used, based on current design codes and specifications. In addition to the foundation final design, recommendations for the excavation and construction sequence will also be provided.

