Memo

To: Anthony Brown – Atlantic Richfield Company

From: Greg Lambeth, CEG
Engineering Geologist
Peter Yuan, PE
Geotechnical Engineer

Project: 0013091150.7TM.700E

Date: May 22, 2017

Subject: Crusher Road Slope Instability Monitoring Plan
Leviathan Mine Site
Alpine County, California

This slope monitoring program (Monitoring Plan) has been developed by Amec Foster Wheeler Environment & Infrastructure, Inc. (Amec Foster Wheeler) on behalf of Atlantic Richfield Company (Atlantic Richfield) in order to monitor the surface conditions in the vicinity of Pond 4 and the slope below the "Crusher Road" (herein referred to as the Crusher Road slope). The monitoring and review of site conditions presented in this Monitoring Plan are intended to support assessment of surface conditions with regards to potential hazards to site personnel, equipment and property associated with the Crusher Road Slope Instability, and is not intended to be a full geotechnical evaluation.

BACKGROUND

On April 27, 2017, site personnel observed evidence of ground surface movement on the slope east of and above Pond 4. The area of the slope movement is located on the slope immediately below the Crusher Road and is referred to herein as the Crusher Road Slope Instability.

Evidence of the Crusher Road Slope Instability consists of:

- an approximately 300-foot-long zone of tension cracks (ground cracks with no vertical offset) and scarps (ground cracks with vertical offset) along the west side of the Crusher Road and extending down slope toward the California Access Road at its northern and southern extents, and
- a subordinate slump defined by an arcuate main scarp, a down-dropped soil mass head and bulging toe area in the lower portion of the Crusher Road slope and within the California Access Road across from the south end of Pond 4.

MONITORING PLAN

The purpose of the Monitoring Plan is to provide guidance to personnel making observations and gathering data sufficient to inform decisions regarding the safety of site personnel with respect to the Crusher Road Slope Instability. The monitoring program consists of:

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- qualitative observations and mapping of slope deformation features (e.g., tension cracks, scarps, toe bulges), water seepage, and surface water drainage conditions;
- quantitative measurements of deformation using multiple monitoring points installed across the upper zone of ground cracking along the Crusher Road and survey monuments installed in the Crusher Road and Pond 4 areas;
- measurements of groundwater levels from multiple wells in the vicinity of the instability; and
- documentation of site conditions and monitoring activities using photographs and the attached monitoring inspection forms.

Monitoring System and Methods

Monitoring will be performed by site personnel early in the work day during site operations in the areas of the Crusher Road near the top of the Crusher Road Slope, the Crusher Road Slope, the California Access Road below the Crusher Road Slope, and Pond 4. Recommended monitoring procedures and initial monitoring frequency consist of the following:

- installation of monitoring points as described in the Installation and Measurement of Monitoring Points section below;
- daily measurement of the distance between the tops of pairs of fixed monitoring points at the Crusher Road slope crest using a steel tape measure stretched between the tops of each pair of monuments;
- daily visual observations of ground deformation features including extent and magnitude of ground cracking, scarps, bulging and subsidence, and deformation of the Pond 4 liner and Pond 4 slopes (if encountered), etc.;
- daily visual observation of areas of water seepage, surface water flow, and surface water ponding;
- ground water level measurements of the six wells in the vicinity of the Crusher Road Instability as shown on the Monitoring Map (Attachment 1), three times per week for the first two weeks and then once per week and following major precipitation events thereafter; and
- survey of the relative change in location of seventeen survey monuments and wells shown on the Monitoring Map (Attachment 1) using total station survey. Survey will initially be performed three times per week for a period of two weeks, and then one to two times per week afterward.

The frequency of any or all of the components of the monitoring will be periodically reviewed and adjusted based on the results of the monitoring.

Monitoring observations will be documented on the Monitoring Map and Monitoring Inspection Form (Attachments 1 and 2), both of which are intended to be used for a full work week. Documentation of the monitoring will include:

- brief description of the major ground deformation features, water seepage and surface water conditions at the beginning of each week, including any changes to the site conditions noted from the previous week;

- description of changes to the site conditions throughout the week;
- locations of new features and changes to site conditions will be noted and plotted on the Monitoring Map;
- measurements of the distance between the three scarp monitoring point pairs and the height of the scarp, as well as the water levels in the six wells to be monitored; and
- photographs of the site, including two photographs (of differing orientations) of each major feature taken from the same location, angle, and zoom daily, and photographs of new features and changed site conditions. Photograph logs will also include a brief description of the feature including location, geometry, and estimated horizontal and vertical offset.

An engineering geologist or geotechnical engineer will also inspect the site periodically and following each heavy precipitation event. A weekly monitoring report, including the monitoring inspection forms, will be prepared by an engineering geologist or geotechnical engineer and submitted to Atlantic Richfield.

Personnel performing inspection and photographic documentation shall not access the slope movement zones between the ground cracking extents of Crusher Road Slope Instability and Pond 4 without prior approval by Site Health, Safety, Security, and Environment (HSSE) personnel.

Installation and Measurement of Monitoring Points

Three crack monitoring point pairs will be installed across the ground cracks at the top of the Crusher Road Slope at the approximate locations shown on the Monitoring Map (Attachment 1). The monitoring points of each pair will be installed on opposite sides of a ground crack such that ground movement at that crack would change the distance between the points. The monitoring points will be installed where the ground cracks are situated along the berm outside of the Crusher Road traffic lane, to limit the potential for future disturbance to the monitoring points due to vehicular traffic. Each monitoring point will consist of a minimum 4-foot-long piece of No. 4 steel reinforcing bar (rebar) driven at least 3 feet into the ground. Approximately 12 inches of reinforcing bar will extend above the ground surface at each point. The monitoring points will be installed with a minimum of two feet of separation from either side of the ground crack. The western (downhill-side) monitoring point will be modified to create a flat face in the side of the upper 6 inches of the bar that the hook at the end of a steel tape can rest on, and a permanent mark will be made on the upper 6 inches of the eastern monitoring point to provide a consistent reference point. All rebar monitoring points will be covered with a safety cap at the top of the bar.

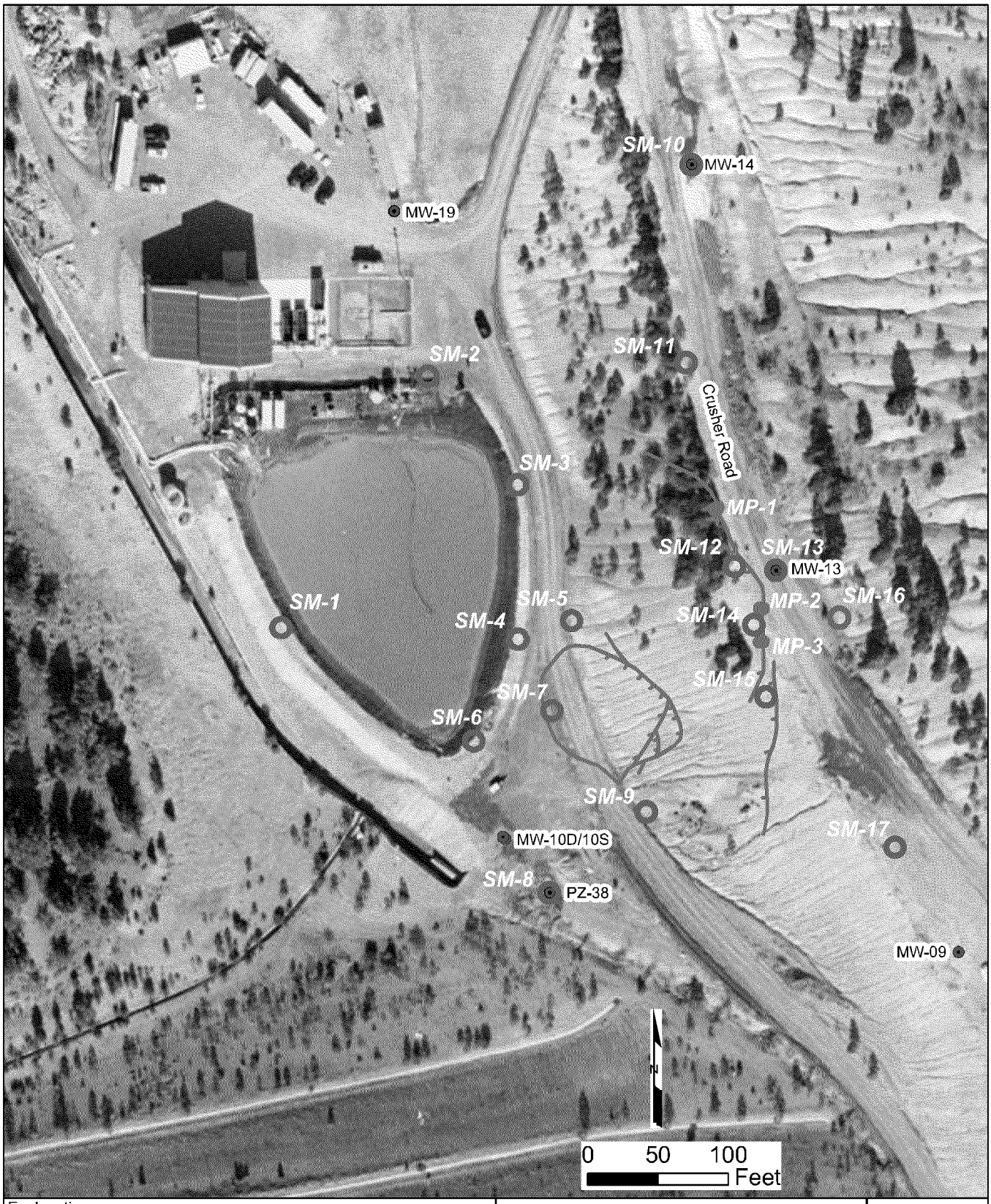
Survey monuments will be installed at the approximate locations shown on the Monitoring Map (Attachment 1). Survey monuments will be comprised of a steel bar with a minimum diameter of 0.5 inches which will be driven into the ground two to three feet in depth. A survey prism will be fixed to the top of each steel bar.

Each monitoring point and survey monument shall be labeled with the identifier shown on Attachment 1. The locations on Figure 1 are approximate. Final locations will be determined in the field based on considerations such as safety, access, and line of sight visibility from the selected base survey point.

Monitoring points and monuments will not be installed on or above the Crusher Road Slope without first obtaining permission from Lahontan Regional Water Quality Control Board staff.

Attachment 1 – Monitoring Map

Attachment 2 – Monitoring Inspection Form



Explanation:

- Instability Features
- Monitoring Well
- Approximate Location of Proposed Monuments Across Ground Cracks
- Approximate Location of Proposed Surface Survey Monuments

Proposed locations of survey monuments are approximate. Final locations of survey monuments to be determined in the field.

CRUSHER ROAD SLOPE
INSTABILITY MONITORING PLAN MAP
Leviathan Mine Site
Alpine County, California

By: DPV
Date: 05/15/2017

Project No. 13091

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Attachment 1

P:\Project\13000s\13091 Leviathan\14000 Database_CAD\CAD\DrawingFiles\HSP\HazConditions.mxd

CRUSHER ROAD INSTABILITY MONITORING FORM

Leviathan Mine Site – Alpine County, California

Project Number: 0013091150.7TM.700E

Week Ending:_____

DATE	Saturday _____ (DATE)	Sunday _____ (DATE)	Monday _____ (DATE)	Tuesday _____ (DATE)	Wednesday _____ (DATE)	Thursday _____ (DATE)	Friday _____ (DATE)
Observations Made by:							
DISTANCE BETWEEN MONITORING POINTS (feet and inches – measurements to nearest 1/16th inch)							
Monitoring Pair #1							
Monitoring Pair #2							
Monitoring Pair #3							
SCARP HEIGHT (feet and inches - measurements to nearest ¼ inch)							
Monitoring Pair #1							
Monitoring Pair #2							
Monitoring Pair #3							

OBSERVATIONS

Date	Time	Observation

Form checked by (initials and date):_____

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Week Ending:_____

Date	Time	Observation

Form checked by (initials and date):_____

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