MINISTRY OF ENERGY AND MINES
Mines and Mineral Resources Division

REPORT OF GEOTECHNICAL INSPECTOR
(Issued pursuant to Section 15 of the Mines Act)

Name of Property: Highland Valley Copper Mine
Permit No.: M-11

Mine Manager: Chris Dechert

Company: Teck Highland Valley Copper Partnership
Address: P.O. Box 1500
Logan Lake, BC
V0K 1W0

Persons Contacted: Loyed Shwydiuk, Chris Fleming

Copies To: George Warnock, Manager Geotechnical Engineering, MEM
Al Hoffman, Chief Inspector of Mines, MEM
Diane Howe, Deputy Chief Inspector of Mines, MEM
Stephen Rothman, Inspector of Mines, Health & Safety, MEM
Heather Narynski, Senior Geotechnical Inspector, MEM

Date of Inspection: July 9, 2013

In this document, “Code” means the Health, Safety and Reclamation Code for Mines in British Columbia

INTRODUCTION

An inspection of the Highland Valley Copper Mine was conducted by Chris Carr on July 9, 2013 in the company of Steve Rothman (BC Ministry of Energy and Mines). The inspection of the open pits and waste rock dumps was carried out with the assistance of Loyed Shwydiuk (Geotechnical Project Coordinator, Mine Engineering). The inspection of the tailings storage facility was carried out with the assistance of Chris Fleming (Superintendent, Tailings and Water Management). Observations made during the inspection, and actions required to follow-up on this inspection report are summarized below.

The purpose of this inspection was as follows:

- To determine if the mine is meeting the requirements of the Code.
- To determine if geotechnical practices at the mine are consistent with generally accepted engineering practices at mines in British Columbia.
- To identify potential ground stability hazards or concerns at the mine.

The following areas were inspected during the mine tour:

- Highmont East Pit
- Lornex Pit
- Valley Pit
- Valley South Dump
- Lornex Southeast Dump
- Highmont West Pit Backfill
- Waste Rock Dumps W-27 and P-23
- Tailings Storage Facility L-L Dam
The Highland Valley Copper Mountain Mine is currently mining the Valley Pit, Lornex Pit and Highmont East Pit with waste rock hauled to the Valley South Dump, Lornex Southeast Dump and the mined out Highmont West Pit. Dam raises will continue this year at the H-H Dam and L-L Dam of the Highland Tailings Storage Facility (TSF).

Meetings were held with mine personnel prior to the inspection to review the mining progress during the past year and to discuss the geotechnical engineering management programs.

External geotechnical services associated with the design and performance monitoring of the open pits and waste rock dumps is provided by Piteau Associates. External geotechnical services associated with the design and performance monitoring of the Highland TSF is provided by Klohn Crippen Berger (KCB). An independent Geotechnical Review Board meets twice a year to review open pit design and operational issues (most recent meeting in June 2013).

The following reports were reviewed prior to the mine inspection:


The following reports were reviewed by the Ministry of Energy and Mines (MEM) previously and review comments provided to Teck Highland Valley Copper (THVC):

- L-L Dam Break and Inundation Study, Dam at elevation 1279 m prepared by KCB, dated June 2012. (ref. MEM letter dated November 29, 2012).

**OBSERVATIONS AND INSPECTION ORDERS**

**Location: Highmont East Pit**

At the time of the inspection Shovel #17 was mining on the 1675 bench (Photo 1). Single benches are being developed. Overall, clean pit walls and benches are being established.

**Location: Lornex Pit**

At the time of the inspection a loader was digging a new ramp on the north side of the pit. Shovel #20 and Shovel #22 were mining the 1530 bench on the south wall pushback (Photo 2).

**Location: Valley Pit**

Shovel #19 was mining the 890 bench and Shovel #21 was mining the 875 bench near the bottom of the pit.

Shovel #16 was mining the 1295 bench on the upper southwest wall (Photo 3). The poor condition of the bench face is due to toppling failure and stability monitoring relies on visual monitoring (it is understood that survey prisms have proven to be ineffective).

*Improvements to blast design and/or modifications to pit wall design shall be developed and implemented to improve overall pit wall performance for future mining in this area.*
The horizontal drain hole water collection and piping system located on the upper west wall above the 1310 bench (Photo 4) has been damaged by local pit wall collapse. The drainage system is to be replaced by a collection ditch with pumps. Recommendations provided by Piteau Associates include 5 m step-outs at the 1400 and 1340 m levels to improve catchment.

*Improvements to blast design shall be developed and implemented to reduce the loss of catch benches and to improve overall pit wall performance for future mining in this area.*

Shovel #18 was removing waste dump material above the southeast corner of the pit in an area required for the new Crusher location.

The South Buttress has been extended to improve stability in the area of the “Avalanche Zone” (Photo 5). Phase 2 of the buttress was completed at the end of January 2013 and future work to complete Phase 3 has been recommended.

Groundwater wells have been installed to control seepage discharge from the base of the aquifer below the 10B Buttress (Photo 6). Piezometers have been installed and automated readings are taken every 6 hours.

Cracking and rock fall experienced on the pit slope above the main access road on the south side of the pit has been controlled by the construction of “mesh drape” (Photo 7). The slope is monitored using strain gauges.

*Regular visual and instrumentation monitoring of the slope and crest shall be undertaken.*

It is understood that a recent dangerous occurrence, involving slope failure near the bottom of the pit that partially buried an excavator, was reported to the Ministry office in Kamloops. The dangerous occurrence is considered to be geotechnical incident.

*A geotechnical incident that is classified as a dangerous occurrence shall be documented using the Ministry “Advice of Geotechnical Incident” form. The form (copy attached to this inspection report) shall be completed by July 31, 2013 and forwarded to the Ministry.*

**Location: Highmont West Pit Backfill**

Waste rock continues to be dumped into the mined out pit. Settlement cracks were noted behind the dump crest (Photo 8).

*The method being used to backfill the pit using dump short and push procedures shall be continued.*

**Location: Lornex Southeast Dump**

The dump is being developed in angle-of-repose lifts with benches (Photo 9).

**Location: Valley South Dump**

The dump material is a mixture of waste rock and mineral soil overburden. The toe of the dump is on relatively flat terrain and is being developed in angle-of-repose lifts with benches (Photo 10).
**Location: Waste Rock Dump W-27**

The W-27 dump located above the truck shop and administration offices has been classified as high risk (Photo 11). The lower 20 m high, angle-of-repose dump slope has been eroded in places by surface water runoff.

*The sections of dump above the truck shop and administration offices that have not been reclaimed shall be re-sloped in accordance with recommendations provided by Piteau Associates (ref. September 2012 Waste Dump Audit Report). An update on actions taken with respect to the recommendations shall be included in the next annual report. Due to the risk posed by this dump the installation of piezometers to monitor the phreatic surface should be considered.*

Construction is in progress on the bench above the lower dump slope (Photo 12).

*The location of the building shall be assessed by Piteau Associates to confirm that dump stability will not be compromised and that suitable drainage measures are incorporated to remove water from foundation and roof drains and also to control surface water runoff in the area.*

**Location: Waste Rock Dump P-23**

The P-23 dump located at the conveyor corridor has been classified as high risk (Photo 13).

*Installation of piezometers to monitor the phreatic level and insitu density testing to assess the liquefaction potential of the dump shall be completed as recommended by Piteau Associates (ref. September 2012 Waste Dump Audit Report). An update on actions taken with respect to the recommendations shall be included in the next annual report.*

**Location: Waste Rock Dump Y-12**

The Y-12 dump, located above the access road to Trojan Dam, has been classified as high risk. Failure of part of the dump slope has been reported. This dump is not active and was not included in the MEM inspection.

*The dump shall be re-sloped to an angle no greater than 25° in accordance with recommendations provided by Piteau Associates (ref. September 2012 Waste Dump Audit Report). An update on actions taken with respect to the recommendations shall be included in the next annual report.*

**Location: Highland TSF**

The dam classifications for the Highland TSF dams are under review. The current classifications are as follows:

- **L-L Dam:** Very High (Extreme based on 2012 DSR)
- **H-H Dam:** Low (Very High based on 2012 DSR)
- **24 Mile Lake:** High based on 2012 DSR

*The updated dam classifications shall be included in the 2012 annual dam safety inspection report.*

At the time of the MEM inspection the L-L Dam crest was at approximate elevation 1250.1 m and the H-H Dam crest was at approximate elevation 1264.4 m. The pond water elevation was at 1243.46 m.

A very wide beach has developed upstream of the H-H Dam (Photo 14).
Except for the south end of the dam a wide beach has developed upstream of the L-L Dam (Photo 15).

Downstream cyclone sand construction is continuing at the L-L Dam (Photo 16 and 17).

The 2012 annual dam safety inspection report for the Highland TSF has not been received.

A copy of the 2012 annual dam safety inspection report for the Highland TSF shall be submitted by August 31, 2013. THVC is requested to submit the annual dam safety inspection report within six months of the inspection date for future submissions.

The OMS manual, including piezometer and slope inclinometer threshold levels and response alert criteria, was being updated in April and was due to be submitted to the Ministry by 30 June 2013.

A copy of the updated OMS manual shall be submitted to the Ministry by August 31, 2013.

A dam break inundation study is being prepared for the H-H Dam.

A copy of the dam break inundation study for H-H Dam shall be submitted to the Ministry by December 31, 2013. The results of the inundation study shall be used to inform the Emergency Preparedness and Response Plan (EPRP)

A table top exercise to test the Emergency Preparedness and Response Plan was conducted in July 2012 followed by a full scale test of the EPRP on November 15, 2012.

THVC has developed a very comprehensive tailings management workshop for training purposes. The five hour course is presented to personnel employed by Teck, KCB, Cantex and other contractors who are involved in work at the tailings/water storage facilities. The course is planned to be held twice a year and covers Safety, Environmental and Operational Considerations; Dam Construction and Tailings Management Activities; Maintenance Activities; Surveillance (Identification and Reporting of Unusual Conditions); and Emergency Preparedness and Response.

**Location: Bethlehem and Highmont TSFs**

The dam classifications for the Bethlehem and Highmont Dams are under review. The current classifications are as follows:

Bethlehem Dam #1: Low  
Bethlehem Bose Lake Dam: Low  
Bethlehem Trojan Dam: High  
Highmont Dam: Low  

The updated dam classifications shall be included in the 2012 annual dam safety inspection report.

The 2012 annual dam safety inspection reports for the Bethlehem TSFs and Highmont TSF have not been received.

A copy of the annual dam safety inspection reports for the Bethlehem TSFs and Highmont TSF shall be submitted by August 31, 2013. THVC is requested to submit the annual dam safety inspection reports within six months of the inspection date for future submissions.

It is understood that the 2012 Dam Safety Reviews for the Trojan Dam, Bose Lake Dam and Bethlehem Dam #1 have been completed.
A copy of the 2012 Dam Safety Review report for Trojan Dam, Bose Lake Dam and Bethlehem Dam #1 shall be submitted by December 31, 2013.

It is understood that dam break inundation studies are planned or in progress for Highmont, Trojan and Bose Lake Dams.

A copy of the dam break inundation studies for Highmont, Trojan and Bose Lake Dams shall be submitted to the Ministry by December 31, 2013.

Inventory of Dams

As discussed on-site, MEM is updating the database of mine dams on a province wide basis.

*Highland Valley Copper has been requested to prepare an inventory of all dams on the mine site (including sediment control ponds). The inventory is to include:*

- the name of the facility,
- UTM coordinates or a descriptive location,
- the maximum height of embankment (measured between the downstream toe and the embankment crest),
- the capacity of the impoundment,
- an indication of whether or not the structure would be defined as a “major dam” or “major impoundment” under the Code (see page 10-2 of the Code),
- the Consequence classification using the BC Dam Safety Regulation (for non-major dams) or the CDA Dam Safety Guideline (for major dams),
- an indication as to whether or not a water license is required for the facility, and
- the date of the last external dam safety inspection.

The requested information shall be submitted to the Ministry by October 31, 2013.

CLOSURE

Under Section 15 (6) of the Mines Act, a written response is required from the Mine Manager within 15 days of the receipt of this Inspection Report. In addition, Section 30 (1) of the Mines Act requires this Inspection Report to be posted in a conspicuous location at the mine site for 30 days.

Please feel free to contact the undersigned with any questions or comments.

*Chris Carr, P. Eng.*
*Geotechnical Mines Inspector*
*On behalf of Ministry of Energy and Mines*
Photo 1: Highmont East Pit at Shovel #17, view to south

Photo 2: Lornex Pit south pushback, view to east
Photo 3: Valley Pit upper west wall at Shovel #16

Photo 4: Valley Pit upper west wall at 1310 bench
Photo 5: Valley Pit, view to east towards South Buttress

Photo 6: Valley Pit, view to north towards 10B Buttress
Photo 7: Valley Pit mesh drape area

Photo 8: Highmont Pit backfill crest
Photo 9: Lornex SE Dump

Photo 10: Valley South Dump
Photo 11: W-27 Dump lower slope above Truck Shop

Photo 12: W-27 Dump with new construction on bench
Photo 13: P-23 Dump at conveyor

Photo 14: TSF H-H Dam and 24 Mile Lake, view to west
Photo 15: TSF L-L Dam and upstream beach, view to south

Photo 16: TSF L-L Dam downstream slope and Valley Buttress Berm
Photo 17: TSF L-L Dam downstream slope and south abutment