Appendix D

Assessment of Underground Workings within Limits of Phase 5 Valley Leach Facility

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1.0 INTRODUCTION

This report presents the results of an assessment conducted by Golder Associates Inc. (Golder) regarding the historic underground workings within the proposed Phase IV Valley Leach Facility (VLF) at the Cripple Creek & Victor Gold Mining Company's (CC&V's) operation near Victor, Colorado. This report addresses the current stability of the historic mine workings, the potential impact of the workings on the stability of the VLF foundation, and the typical remediation measures that may be needed to ensure that the integrity of the VLF foundation above the workings.

A similar assessment to the one presented herein was undertaken by Golder for the Phase III VLF. The conclusions and recommendations of the assessment of the Phase III VLF are presented in Golder's report titled *Assessment of Underground Workings Within Limits of Phase III Valley Leach Facility (CC&V 1998)*.

2.0 UNDERGROUND MINING

2.1 Historical Setting

A summary of the geology, mineralization, and mining within the Cripple Creek Mining District is presented by Lindgren et al. (1906). The areas within and around the Phase IV area were mined for many years by underground means starting in the 1890's. The gold ore that was mined in the Cripple Creek Mining District was contained in a series of steeply dipping veins. The various veins were generally sub-parallel to one another and aligned in a northeast-southwest orientation, which is reflected in the underground workings alignment shown on Drawing Nos. 1 and 2. Production mining of the veins proceeded upwards from these working level excavations.

Based on field investigations conducted within the Phase IV area and observations made during the remediation of the Phase III VLF, the mined excavations on the working levels generally followed the mineralized veins, and were typically less than 12 feet wide. Mined stopes were typically less than 10 to 12 feet wide, although the mining plans also indicate locally wider stopes in some areas. The ore appears to have been extracted by various forms of open stoping or shrinkage mining methods. Mining techniques employed at that time rarely incorporated backfilling of the stopes and there is no evidence that any of the excavations in the Phase IV area were ever backfilled with development rock or other backfill material. The historical mine plan maps do indicate that some of the excavations had collapsed and caved.

2.2 Current Conditions

Surface disturbances from mining are present throughout the Phase IV area. These disturbances generally consist of open shafts or mines. In addition, some of the features in the Phase IV area are tunnel portals that provided access to deeper underground workings. Most of the disturbances in the Phase IV area do not show any evidence of subsidence, caving, or collapse from the impact of underground mining. Northeast of Phase IV, the area was mined or collapsed through to the surface over a long narrow area. These workings are related to the Thompson, Elkton, Katherine, and Tornado shafts and are located sufficiently outside the Phase IV area as to not to have any impact on the stability of the foundation. The only area beneath the Phase IV facility where the collapse of underground workings is evident is immediately adjacent to the Ophir Incline shown in Drawing No. 1.

The surficial soils within the Phase IV area range up to approximately 15-feet-thick over most of the area, although locally the thickness has been shown to be up to 50 feet in some of the drainages. As discussed in more detail later, this additional overburden thickness in

specific areas has been taken into account in the exploratory investigation and remediation programs.

2.3 Rock Quality

The bedrock within the Phase IV area primarily consists of Cripple Creek Lapilli Breccia. The immediate 3 to 6 feet of bedrock beneath the surficial soils is often quite fractured and moderately weathered. The bedrock beneath this is strong and competent with only limited evidence of weathering. Joints are widely spaced (typically in excess of 1 to 3 feet spacing), and generally steeply dipping. The joints are also relatively planar but quite rough with a high frictional strength. The resulting rock mass is essentially an assemblage of large sized interlocking blocks that are massive and of good to very good rock quality. The strength of the rock is sufficiently high that stress fracturing would not occur even in the deep workings.

According to core samples from the Main Cresson Mine (see Amendment No. 7, Volume 4, Appendix 4), the Cripple Creek Lapilli Breccia has an unconfined strength ranging from approximately 11,000 to 27,000 pounds per square inch (psi). Based on the rock strength and degree of jointing, the bedrock within the Phase IV area would have a Rock Mass Rating (RMR, Bieniawski 1989) ranging between 60 to 70, which is considered as good quality rock.

The veins that were mined in the Phase IV area are generally aligned in a north-south orientation, which is reflected in the underground working alignment shown on Drawing Nos. 1 and 2. The underground workings indicate that the veins are steeply dipping (approximately 75 degrees).

3.0 SCOPE OF INVESTIGATION

The main activities that were undertaken by Golder to assess the current stability of the Phase IV area and to provide recommendations to remediate the foundations were as follows:

- A detailed review was undertaken of all of the available historical records, including the historical mining plan maps filed at the CC&V offices, in Victor, Colorado.
- A detailed surface reconnaissance program was undertaken and the characteristics of the surface disturbance features were photographed and documented.
- Selected surface disturbance features which had exhibited characteristics suggesting deeper level workings (i.e., conical shaped mine with adjacent overburden piles of sufficient magnitude, evidence of timbering support, feature excavated into bedrock, etc.), were excavated to allow more detailed inspections to be undertaken by Golder's site engineer.
- A drilling program was undertaken to locate excavations beneath the ground surface that might adversely impact the stability of the foundation.

In the Phase III report, it is indicated that "*For the prevailing conditions, and stopes that are less than 10 to 12 feet wide, the stability of the crown pillar should be acceptable if the bottom of the pillar is more than 50 to 60 feet below surface*". This makes allowance for 15 feet of surficial soils overlying the rock, which is the maximum overburden thickness in the Phase III area. In some of the Phase IV area, the thickness of the overburden is greater than 15 feet, and in these locations drilling targets were set at greater depths so that surficial soils do not contribute to the stability of the pillar above the mined openings.

3.1 Historic Mining Maps

Many mining plan maps were prepared over the years showing the development openings that have been progressively excavated on different mining levels and accessed from various shafts. The plan maps only show the excavations on the working levels and do not show stoping activities that were undertaken above or between the levels.

In order to develop a database of the underground workings within the limits of Phase IV, Golder reviewed the underground working drawings stored at the Cresson site, and copied all of the relevant drawings to a common scale of 1 inch to 50 feet. More than 70 plan maps were identified and copied.

The plan maps were overlaid on one another to compare the relative accuracy and to determine the maximum extent of the indicated workings on each level. Once overlaid, the geometry of common areas shown on different drawings was noted to be very consistent. Discrepancies between the position of excavations were generally less than 5 feet, with some local extremes being up to 25 feet. Many of the drawings showed areas that overlapped with other drawings. It was possible to use these overlaps to construct a single composite mine-plan drawing of the entire workings in the area (Drawing Nos. 1 and 2). This mine-plan drawing identified the major shaft locations, and these compared favorably with the locations of the shafts on the surface survey plans mentioned later.

In the Phase III area, many of the historical plan maps indicated the elevation of the levels being depicted. This was not always the case for the historical plans within the Phase IV area. The relative sequence of the levels below surface (i.e. whether one level was higher or lower than another level) could often not be estimated from the information provided, and it was not possible to assign elevations (known or estimated) in a similar manner to that presented for the Phase III level plans. This influenced the location of the exploratory drilling that was undertaken to date (e.g., workings where the depth below surface was

uncertain were preferentially drilled), and will precipitate added conservatism in undertaking future exploratory investigation and remediation activities.

The search of the files at the Cresson site for all of the mining plan maps in the area was done in a very comprehensive manner, and no significant discrepancies were identified between drawings. Based on this, the composite mine plan is felt to provide an accurate and comprehensive depiction of the underground workings beneath Phase IV. While the process of maintaining accurate mining records over a very long period of time is such that additional workings may be present underground and not depicted in the plan, the probability of this is considered small.

3.1.1 Locations of Surface Disturbance

A topographic survey of the area was undertaken by Western States Surveying Inc. (WSSI). A plan showing topographic contours, which identifies some of the shafts and surface dumps that were identified as part of the topographic survey, was prepared and this information is shown in Drawing Nos. 3 and 4.

Many of the disturbance features observed on surface are cone-shaped shallow surface mines typically about 25 feet in diameter and about 10 feet deep. The sides of the mines are comprised of soil and rock fragments. Subsequent excavation of the mines indicated that many were old shafts (based in part on the observation of timber reinforcements or working levels which extended from the shaft) in which the unsupported surficial soils had bridged across the shaft, or sloughed into the shaft. Some of the features in the Phase IV area are collapsed portals of adits that historically provided access to the underground workings.

3.2 Surface Reconnaissance and Exploratory Excavation

During May and June 1998, Golder representatives with previous experience in conducting the exploratory investigation for the Phase III area were on-site to perform the surface reconnaissance within the limits of Phase IV. The work included the development of a written description and photographic record of each feature (copies of the written descriptions and copies of the catalogued photographs have been included in the Golder project files, but are not incorporated in this report). The reference numbering and location of documented surface features is presented in Drawing Nos. 3 and 4.

A backhoe with a maximum reach of approximately 20 feet was then used to excavate a representative number of the cone-shaped shallow surface mines. Observations of these excavations were recorded, and the excavated material was then replaced back into the excavation.

Over 140 surface features were inspected and documented, and approximately 20 of these were excavated. The results are summarized in Table 1. This table identifies for each feature whether it is an open shaft (and therefore not excavated), or whether the observations made during the excavation of the feature indicated that it was historically excavated completely in surficial soils, "bottomed" at the bedrock contact, or had previously been excavated down into bedrock. A record was also maintained of any timber that was encountered or observed, indicating that the feature was likely a shaft, and whether any lateral excavations could be identified connecting to the shaft. Some of the features were visually identified as being collapsed tunnel portals, and others have been shown to be such from the documented evidence of tunnels presented in the working plan maps. Such adit portals are identified in Drawing Nos. 3 and 4.

The main objectives of the exploratory excavation of the shallow surface mines were to determine if the features were previous shallow mine excavations or deep shafts, (which

would identify if the area required different remediation treatment), and whether any lateral shallow workings were evident extending from the shafts.

3.3 Exploratory Drilling

Based on a combined assessment of composite mining plan (Drawing Nos. 1 and 2), the topographic survey which includes identified surface disturbances (Drawing Nos. 3 and 4), and the results of the surface reconnaissance and exploratory excavation programs, an exploratory drilling program was developed and implemented. The objectives of the exploratory drilling program were as follows:

- Conduct a "first-pass" assessment to locate open voids underground that might become unstable in the future
- Obtain an approximate estimate of the vertical height of the surface crown pillar, in areas where such voids were identified

Various approaches and criteria were used to select the locations of the drill holes. These included the following:

- General trends in the underground workings can be noted from surface disturbance information developed from the surface reconnaissance and topographic survey information, which provide an indication of possible connection of workings between shafts. Holes were drilled across these lineaments between the shafts to determine if the underground workings between shafts had been mined up close to surface.
- Underground workings which appeared to connect between shafts or to be located along lineaments, even in some cases where the workings were relatively deep, may have been mined up close to surface. Holes were drilled across the alignment of such underground workings.

- Underground workings of moderate to shallow depth may have been mined up close to surface. Holes were drilled across the alignment of such workings.

- Some areas that had been mined or caved through to surface locally indicated that shallow stopes extended away from the area. Holes were drilled to provide an indication of how far such stopes might extend away from the open surface features.

- Areas indicated on the mining plans as having been excavated as wide open stopes, or where multiple openings appeared to be very close together, and that may have been shallow or deep, may have caved up to close to surface. Holes were drilled vertically down into these areas to determine if open voids close to surface were present.

- Lateral extensions that were observed extending from open shafts or shafts that were excavated are inherently shallow and may represent potentially unstable excavations. Holes were drilled across such features to determine the approximate geometry of such features and the thickness of the crown pillar.

Specific discussions on what was encountered as part of the field investigation are identified in Section 4. All holes indicated above as being drilled "across" features or known openings were drilled at an angle to increase the potential of intersecting the feature along the wall exposure. Such holes were drilled at an initial angle of approximately 60 degrees. Targets were established for each hole, and the objective was to "hit" the target approximately 50 feet below ground surface, except where the overburden was more than about 15 feet deep, in which case the target depth was correspondingly deeper. The inclined holes were generally 100 feet long, and hence each hole extended past the specified target area by about 40 feet or more. Holes which intersected stopes or level workings were drilled again at angles that were progressively flatter to determine the approximate depth of the back of the excavation below surface.

The vertical holes were drilled into areas where the mine plans indicated wide stope spans. Such wide spans require greater crown pillar thicknesses to ensure stability. Hence, some

of the vertical holes were drilled to depths up to about 150 feet, compared with 100 feet for the inclined holes. Even wide spans that were indicated on the drawings to have been excavated relatively deep below ground surface were exploratory drilled in this manner in case prior caving upwards had already occurred.

All drilling was undertaken using a reverse circulation rig with a hammer bit. The objective was to locate voids and identify "soft" zones that might represent backfill or caved material. Golder representatives with previous experience in investigating the Phase III area were on site full time to locate the drillholes, oversee the drilling and document the field investigation. The quality of the drilling was enhanced by the experience of the drilling company and drilling crews in having drilled the Phase III site area previously and many other areas of the mine site where underground workings were present.

Approximately 100 exploratory holes were drilled at approximately 80 drill hole locations. A summary of the drilling details for each hole, including distances along the holes that excavations were encountered, is presented in Table 2. The location of the holes and the orientation and lateral extent of the inclined holes are shown on Drawing Nos. 5 and 6. The location of the voids that were encountered by the drilling are also shown in Drawing Nos. 5 and 6.

4.0 CONCLUSIONS FROM EXPLORATORY INVESTIGATIONS

Site observations and the results from the exploratory excavation and drilling programs indicate that remediation is required for:

- isolated shafts and other isolated excavations carried out on surface (e.g., shallow surface mines and adit portals)

- underground mine workings that may or may not be evident currently as surface disturbances, with the depth of approximately 50 feet below the Soil Liner Fill subgrade elevation.

All of the isolated features that are directly evident on surface consist of (1) open shafts, (2) old shafts now completely or partially filled with soil and rock fragments (and often pieces of timber) forming cone-shaped depressions in the surficial soil material, (3) mines excavated in the surficial soils generally down to bedrock forming similar cone-shaped depressions on surface, and collapsed adit portals These are referred to in this report as isolated shafts and shallow surface mines.

The underground workings within the Phase IV area that will require remediation are generally mine workings which have been: (1) mined up so that the resulting crown pillar is sufficiently thin to be of concern; (2) mined up to surface and are now evident as "daylighting" open features; or (3) collapsed and caved, and are now evident as surface subsidence features.

5.0 RECOMMENDED REMEDIATION MEASURES

The general remediation measures for the underground workings are summarized in Table 3, and discussed below. These remediation measures were developed based on the results of the Phase III underground remediation program conducted during the Summer of 1999. The completed Phase III remediation program (which included over 70 workings) provided important insights on the stabilization of underground workings. This experience was used in the development of the remediation measures presented herein.

5.1 Remediation of Isolated Shafts, Stopes, And Shallow Surface Mines

Based on observations made in the Phase IV area, none of the shafts appear to be more than approximately 12 feet square in plan dimensions (many are 8 feet or less), although some are very deep. The general approach to remediate isolated shafts and shallow surface mines are as follows:

- For open excavations where the depth to bedrock is less than 7 feet to the final Soil Liner Fill subgrade surface: Backfill open shafts with Coarse Shaft Backfill to approximately 10 feet below the finished surface grade and then place concrete, cemented rockfill, and Structural Fill as discussed below.

- For open excavation where the depth to bedrock is greater than 7 feet to the final Soil Liner Fill subgrade surface: Backfill the open shafts with Coarse Shaft Backfill to 3 feet below the soil/bedrock interface. Then place concrete, cemented rockfill, and Structural Fill as discussed below.

- For collapsed excavations where the depth to bedrock is less than 7 feet to the final Soil Liner Fill subgrade surface: Excavate collapsed materials from shafts to a depth of 25 feet below finished grade, then backfill with Coarse Shaft Backfill to approximately 10 feet below the finished grade, and then place concrete, cemented rockfill, and Structural Fill as discussed below.

- For collapsed excavations where the depth to bedrock is greater than 7 feet to the final Soil Liner Fill subgrade surface: Excavate collapsed materials from shafts to a depth of 25 feet below finished grade, then backfill with Coarse Shaft Backfill to approximately 3 feet below the soil/bedrock interface, and then place concrete, cemented rockfill, and Structural Fill as discussed below.

- Excavate shallow surface mines to rock or to 25 feet below the final Soil Liner Fill subgrade surface. The shallow surface mines will then be backfilled with compacted Select Structural Fill and/or Structural Fill to the final subgrade elevation.

Any laterals off of the shafts will be remediated as identified in Section 5.2. These recommendations are based on Golder's experience in underground mining applications and the experienced gained during the Phase III remediation program. The Structural Fill, which is supported by the concrete and cemented rockfill, is designed to form the VLF Foundation. The concrete and cemented rockfill plugs are designed so that the plugs are in compression and develop frictional resistance along the sides of the excavated opening.

For the shafts that are proposed to be backfilled in the upper portion with concrete and cemented rockfill, the upper layer of Coarse Shaft Backfill will be compacted using a method specification. A three feet layer of construction grade concrete will then be placed on top of the compacted Coarse Shaft Backfill. The role of the concrete is to form a competent base to the cemented rockfill plug above the backfill. The design requirements for the concrete are that if the backfill beneath the concrete settles or is dislodged in any way, the cemented rockfill will not unravel. The cemented rockfill plug above the concrete will be inverted cone shaped, and even if the backfill settles, the vertical loads from the VLF will largely be transmitted through the cemented rockfill and into the surficial soils and bedrock. The walls of the shaft will be naturally sufficiently rough that the concrete layer will not move under gravity loading if the backfill settles.

While the cemented rockfill is capable of spanning across the shaft opening (or even larger openings) without any concrete layer beneath, it is proposed that cement be added to the rockfill above the concrete layer as a conservative redundancy in the event the concrete layer moves for some unexpected reason. It is routine practice in many underground mines to completely undercut cemented rockfill of this nature over exposed spans of 20 feet or more without experiencing any instabilities of the fill. The concrete layer provides added security that unraveling of the cemented rockfill cannot occur.

More detailed descriptions of the proposed remediation of the shafts and shallow surface pits are presented below.

5.1.1 Remediation Of Open Shafts/Stopes

The proposed approach for remediation of open shafts is as follows:

- Backfill the shaft with Coarse Shaft Backfill (12 inch minus) to an elevation approximately 10 feet below the final Soil Liner Fill subgrade surface where the soil thickness is 7 feet or less. In areas with soil thicknesses greater than 7 feet, the shaft is to be backfilled with Coarse Shaft Backfill to 3 feet below the soil/rock interface. The 12-inch minus Coarse Shaft Backfill material should be suitable to minimize the bridging across the void, and minimize the amount of processing required to meet the specification.
- Compact final layer of Coarse Shaft Backfill using a method specification approved by the construction manager and engineer.
- Remove weak weathered rock and surficial soils at the collar to form a cone with minimum side slopes of 0.5H:1V.
- Place 3 feet of concrete as initial backfill.
- Backfill with 7 feet of compacted cemented rockfill (2 inch minus Fine Shaft Backfill with 6 percent cement by weight).
- Backfill to grade, as needed, with Structural Fill.

5.1.2 Remediation of Shafts/Stopes More Than 25 Feet Deep That Are Collapsed

The proposed approach for remediation of currently collapsed shafts deeper than 25 feet is as follows:

- Excavate collapsed materials in the shaft 25 feet below the final Soil Liner Fill subgrade surface.
- Compact upper layer of native material.

- Backfill the shaft with Coarse Shaft Backfill to an elevation approximately 10 ft below the final Soil Liner Fill subgrade surface in areas with a soil thickness of 7 feet or less. If the soil thickness exceeds 7 feet, backfill the shaft with Coarse Shaft Backfill to 3 feet below the soil/rock interface.

- Compact final layer of Coarse Shaft Backfill.

- Remove weak weathered rock and surficial soils at the collar to form a cone with minimum side slopes of 0.5H:1V.

- Place 3 feet of concrete as initial backfill.

- Backfill with 7 feet of compacted cemented rockfill (2 inch minus Fine Shaft Backfill with 6 percent cement by weight).

- Backfill to grade, as needed, with Structural Fill.

Any shafts identified on Drawing Nos. 1 and 2 that cannot be located on the surface will be remediated by placing geogrid over an area sufficiently large to account for inaccuracies in precisely locating the portals on surface (approximately 50 feet x 50 feet). The geogrid will be designed to span across potentially opening sizes of 10 to 12 feet at the entrance to the tunnel.

5.1.3 Remediation of Shallow Shafts and Surface Mines

The proposed approach for remediation of shallow shafts and pits is as follows:

- Excavate feature down to rock or 25 feet below the final Soil Liner Fill subgrade surface.

- Backfill with compacted Select Structural Fill and/or Structural Fill to final Soil Liner Fill subgrade surface.

5.2 Remediation of Open or Collapsed Laterals/Inclines/Adits

A number of laterals, inclines, or adits have been excavated in the Phase IV area to provide access to various mining locations. The locations of these as determined from the historical mining plans are presented in Drawing Nos. 1 and 2. The accuracy to which features on the mining plans can be referenced to the surface topographic surveying and physically located on surface is very good, and there is a high probability that all of these will be located on surface during the remediation program.

Those that have been located to date or that are located in the future will have collapsed material and surficial material around the portal removed as the first step of the remediation process. The stability of the immediate portal area will be reviewed so that any potential adverse structural features can be identified. Potential instabilities will be excavated. The crown pillar of the lateral will then be blasted. The blasted material will be left in-place. If a depression exists after the blast, the depression will then be backfilled with Structural Fill. The area will then be capped with geogrid at the surface to control settlement.

Alternatively, the open lateral may be plugged via injection of a flowable fill into the excavation, without further excavation or blasting. A suitable, low compressibility, inert fill material will be identified prior to implementation of the remediation program.

5.3 Mined Slot

During the remediation program for the Phase III VLF, numerous mined slots were identified. Mined slots are narrow, nearly vertical excavations that were created as narrow veins were mined. These slots are typically less than 3 feet wide and range in depth from 10 to greater than 50 feet deep.

The mined slots will be remediated by backfilling the excavation with either Coarse Shaft Backfill, Select Structural Fill, or Structural Fill. After backfill, the slot will be capped with geogrid to minimize settlement under the VLF load.

5.4 Remediation of Areas Influenced by Underground Workings

The areas requiring remediation to account for the presence of underground workings and surface disturbances created by underground mining are shown in Drawing Nos. 7 and 8. Each of the areas to be remediated or areas where remediation may be required following further investigation are discussed in the following sections.

5.4.1 Area 1

There is minor encroachment of underground workings in this area from mining activities undertaken from Thompson and Elkton Shafts. Although precise elevation for these workings have not been determined, the limited level information that is available suggests that these workings are more than 100 feet below. The drilling undertaken to date has not indicated any underground workings sufficiently close to surface to require remediation. Additional exploratory drilling will be undertaken at the time of remediation to confirm the depth to workings.

5.4.2 Area 2

This is the area of St. John Bostwich Shaft. One of the holes drilled in the area identified an open excavation at a depth of approximately 80 feet below surface, but no shallower workings at this location. Further exploratory drilling will be undertaken in this area at the time of remediation, and if this confirms that workings shallower than this are not present, no remediation will be undertaken in the area.

5.4.3 Area 3

This is the area of Molle Bell Shaft. One of the holes in the area identified open excavations at approximately 20 feet below the ground surface. Further exploratory drilling will be undertaken in this area at the time of remediation to define the area that requires remediation.

5.4.4 Area 4

This is the area of Savage Shaft. One of the holes in the area identified an open excavations at a depth of approximately 35 feet below surface. Further exploratory drilling will be undertaken in this area at the time of remediation to define the area that requires remediation.

5.4.5 Area 5

This is the area of Ella Shaft. None of the holes drilled in the area identified any open excavations. Further exploratory drilling will be undertaken in this area at the time of remediation. Present evidence is that remediation may not be required in this area.

5.4.6 Area 6

Area 6 extends from Winchester Shaft and Ophir Incline in the north to the workings to the south of Minnehaha Shaft, an overall distance of approximately 1500 feet. While the area does not show evidence of large scale caving, it has been extensively mined relatively close to surface, and in some areas, the mining continued through to surface.

Several holes identified underground excavations along the 1500 foot trend of the workings. The underground workings that were identified were between approximately

10 feet and 80 feet below surface. Further exploratory drilling will be required to define the extent and type of remediation for this area

5.4.7 Area 7

This is the area of Ophir Tunnel. Other than the tunnel opening, it does not incorporate or access any underground workings. The hole that was drilled in the area did not encounter any underground workings. The tunnel portal will be remediated as discussed in the previous sections, and further exploratory may be undertaken at the time of remediation. However it is not expected that further remediation will be required in this area.

5.4.8 Areas 8 to 10

These are the areas of Alice, Raven Beacon, and Commonwealth Workings/Narcissus Shafts, respectively. None of the holes drilled in these three areas identified any open excavations. Further exploratory drilling will be undertaken in this area at the time of remediation. Present evidence is that remediation will not be required in these areas.

6.0 CONCLUDING COMMENTS

The remediation program discussed above is based on a thorough assessment of the information presented in the historical mining plan maps, and a limited site investigation program undertaken by Golder. The main objectives were to characterize the type of conditions requiring remediation, to determine the types of remediation that will be required, and to indicate the approximate areas where these different types of remediation will need to be implemented. These objectives have been met to the degree that the range of conditions requiring remediation have been identified, and the necessary range of different types of remediation activities have been developed.

The remediation activities themselves will involve further excavation of the features that have been identified. This excavation process will provide important additional knowledge about the features, and will allow for the progressive development of the final remediation program. Every feature observed on surface, and identified underground as potentially requiring remediation, will be re-assessed even more thoroughly than the present investigation process as part of the excavation and backfilling remediation process. The final remediation requirements will be based on these re-assessments, but will still generally be based on the concepts and approaches discussed in this report.

7.0 REFERENCES

Cripple Creek & Victor Gold Mining Company, 1998. Amendment No. 7 to Permit M-80-244.

Bieniawski, Z.T., 1989. Engineering Rock Mass Classifications, New York: Wiley.

Lindgren, Waldemar, and Ransome, Professional Paper U.S. Geological Survey No. 54, 1906.

TABLES

SURFACE RECONNAISSANCE SUMMARY TABLE

Surface Disturbance ID	Date Disturbance was Observed Visually	Date Disturbance was Excavated	Open Shaft	Open Stope	Backfilled/ Collapsed Shaft	Excavated in Soil	Excavated to Bedrock Contact	Excavated into Bedrock	Timbers Present	Lateral Extension	Total Depth of Excavation (ft)	Depth of Shaft (ft)	Photographic Log / Picture ID
UG200	May-30-98		capped									?	12-1
UG201	May-30-98		X										12-5, 12-6
UG202	May-30-98		X										12-2, 12-3
UG202a	May-30-98												
UG203	May-30-98		X										12-4
UG204	May-30-98		X						X			deep	12-13
UG205	May-30-98												12-11, 12-12
UG205a	May-30-98												
UG206	May-30-98				X							>20	12-15,12-16
UG206a	May-30-98		horizontal							N30E			
UG207	May-30-98		X						X	N45E		>20	12-17, 12-20
UG207a	May-30-98												
UG208a	May-30-98	May-31-98			X				X	AZ325	15	>15	12-18, 14-23
UG208b	May-30-98												12-19
UG209a	May-30-98		X										
UG209b	May-30-98		X										
UG210a	May 30-98												14-6
UG210b	May-30-98												14-7
UG211a	May-30-98												14-9
UG211b	May-30-98												14-16
UG212a	May-30-98												14-17
UG212b	May-30-98												14-18
UG213	May-30-98												14-8
UG214	May-30-98												14-10
UG215	May-30-98												14-11
UG216	May-30-98								X				14-12
UG217	May-30-98												14-15
UG218a	May-30-98												14-13
UG218b	May-30-98												14-14
UG219a	May-30-98												14-3
UG219b	May-30-98												14-4
UG220													
UG221	May-30-98		X						X	SE		>20	12-22, 12-23
UG222	May-30-98	May-31-98			X				X		12	>12	14-5
UG223	May-30-98		capped									?	12-7
UG224	May-30-98		horizontal							?			12-8, 12-9
UG225	May-30-98												12-10
UG226	May-30-98		X						X				12-21
UG227a	May-30-98												

SURFACE RECONNAISSANCE SUMMARY TABLE

Surface Disturbance ID	Date Disturbance was Observed Visually	Date Disturbance was Excavated	Open Shaft	Open Stope	Backfilled/ Collapsed Shaft	Excavated in Soil	Excavated to Bedrock Contact	Excavated into Bedrock	Timbers Present	Lateral Extension	Total Depth of Excavation (ft)	Depth of Shaft (ft)	Photographic Log Picture ID
UG227b	May-30-98												
UG227c	May-30-98												
UG227d	May-30-98												
UG228a	May-30-98												14-2
UG228b	May-30-98												14-2
UG229	May-30-98		X						X				12-24, 14-1
UG230	May-31-98				?								16-18
UG231	May-30-98												
UG231b	Jun-12-98												D1-8
UG232	May-30-98	May-31-98			?	X					23		14-19, 18-8
UG233	number not used												
UG234	May-30-98		capped						X			?	11-23, 11-24
UG234b	Jun-12-98												D1-7
UG234c	Jun-12-98												D1-10
UG234d	Jun-12-98												D1-9
UG234e	Jun-12-98												D1-10
UG234f	Jun-12-98												D1-11
UG234g	Jun-12-98												D1-11
UG234h	Jun-12-98												D1-11
UG234i	Jun-12-98												D1-11
UG234j	Jun-12-98												D1-12
UG234k	Jun-12-98												D1-13
UG235	May-31-98												14-22
UG236	May-30-98	May-31-98			X	X			X			>20	11-21, 16-1
UG236b	Jun-12-98												D1-6
UG237	May-30-98												11-22
UG238	May-30-98	May-31-98			X	X			X		23	>23	14-20
UG239	May-30-98	May-31-98			?				X		20		16-2
UG239b	Jun-12-98												D1-1
UG239c	Jun-12-98												D1-2
UG239d	Jun-12-98												D1-3
UG239e	Jun-12-98												D1-4
UG239f	Jun-12-98												D1-5
UG240	May-31-98												
UG241	May-31-98												18-7
UG242	May-31-98		capped						X				14-21
UG243	May-30-98	May-31-98			X				X	NW			13-1, 16-3
UG244	May-30-98		X							AZ45		21	13-2
UG245	May-30-98	May-31-98						X			15	15	13-3, 16-4

SURFACE RECONNAISSANCE SUMMARY TABLE

Surface Disturbance ID	Date Disturbance was Observed Visually	Date Disturbance was Excavated	Open Shaft	Open Stope	Backfilled/ Collapsed Shaft	Excavated in Soil	Excavated to Bedrock Contact	Excavated into Bedrock	Timbers Present	Lateral Extension	Total Depth of Excavation (ft)	Depth of Shaft (ft)	Photographic Log Picture ID
UG246	May-30-98				X				X			>7	13-5
UG246b	May-30-98		capped									?	13-4
UG247	May-31-98												16-19
UG248	May-31-98	May-31-98				X					15		16-20, 18-9
UG249	May-31-98												16-21
UG250	May-31-98	May-31-98			X				X		19	>19	16-21, 18-10
UG251	May-31-98	May-31-98			X				X		11	>11	18-3, 18-12
UG252	May-30-98												
UG253	May-31-98												16-22
UG254	May-30-98	May-31-98									23		13-7, 16-5
UG255	May-30-98	May-31-98				X					23		13-6, 16-7
UG256	May-30-98	May-31-98					X				15		13-8, 16-6
UG257	May-30-98												13-9, 13-10
UG258	May-30-98												13-16
UG259	May-30-98												13-12
UG259b	May-30-98												13-11
UG259c	May-30-98												13-11
UG259d	May-30-98												13-11
UG260	May-30-98		X									>30	13-17
UG261	May-30-98												
UG262	May-30-98				X				X			>25	15-19
UG263	May-31-98		X						X				16-23
UG264a	May-31-98												16-24
UG264b	May-31-98												18-1
UG265	May-31-98		X										18-6
UG266	May-31-98				?				X				18-4, 18-5
UG267	May-30-98				X							>12	15-16
UG267b	Jun-12-98	caved stope/tunnel											D1-16
UG267c	Jun-12-98												D1-17
UG268	May-30-98		X						X			>50	15-17
UG269	May-30-98		X									>25	15-18
UG270	May-30-98		X						X			>30	15-4
UG271	May-30-98		X									>3	15-3
UG272	May-30-98			X					X			>25	15-2
UG273	May-30-98			X					X			>25	15-2
UG274	May-30-98		X									>14	13-13
UG275	May-30-98	May-31-98			X	X		?	X		17	>17	13-14, 16-8, 16-9
UG276	beyond pad limits												
UG277	May-30-98												13-18, 13-19

SURFACE RECONNAISSANCE SUMMARY TABLE

Surface Disturbance ID	Date Disturbance was Observed Visually	Date Disturbance was Excavated	Open Shaft	Open Stope	Backfilled/ Collapsed Shaft	Excavated in Soil	Excavated to Bedrock Contact	Excavated into Bedrock	Timbers Present	Lateral Extension	Total Depth of Excavation (ft)	Depth of Shaft (ft)	Photographic Log Picture ID
UG278	May-30-98		X									>30	13-20
UG279	May-30-98												13-15
UG280	May-30-98												13-21
UG280b	May-30-98												13-22
UG280c	May-30-98												13-23
UG280d	May-30-98												13-24
UG280e	May-30-98												13-25
UG281	May-30-98	May-31-98					X				10		15-1, 16-10
UG282	May-30-98		X									>30	15-6
UG283	May-30-98												15-7
UG283b	May-30-98												15-7
UG284	May-30-98	May-31-98			X				X		15	>15	15-9, 16-11, 16-12
UG285	May-30-98												15-10
UG286	May-30-98	May-31-98			X				X		15	>15	15-11
UG287	May-30-98												15-5
UG288	beyond pad limits												
UG289	beyond pad limits												
UG290	May-31-98												
UG290b	Jun-12-98												D1-14
UG291	Jun-12-98												D1-19
UG292	Jun-12-98												D1-18
UG292a	Jun-12-98												D1-20
UG293	May-30-98												15-12
UG294	May-30-98												15-13
UG294b	May-30-98												15-13
UG295	May-30-98												
UG295b	Jun-12-98												D1-15
UG296	May-30-98												
UG297	May-30-98												
UG298	May-31-98												18-2
UG299	May-30-98												
UG300	May-30-98												
UG301	May-30-98												15-14
UG302	May-31-98												
UG303	May-31-98												
UG303b	Jun-12-98												D1-21
UG303c	Jun-12-98												D1-21
UG304	Jun-12-98		X						X			>35	D1-22
UG304a	May-31-98	May-31-98									17		18-11

TABLE 1

SURFACE RECONNAISSANCE SUMMARY TABLE

Surface Disturbance ID	Date Disturbance was Observed Visually	Date Disturbance was Excavated	Open Shaft	Open Stope	Backfilled/ Collapsed Shaft	Excavated in Soil	Excavated to Bedrock Contact	Excavated into Bedrock	Timbers Present	Lateral Extension	Total Depth of Excavation (ft)	Depth of Shaft (ft)	Photographic Log Picture ID
UG304b	May-31-98												
UG304c	May-31-98												
UG305	May-30-98												
UG306	May-30-98												
UG307	May-31-98												
UG308	Jun-12-98				X							>16	D1-25
UG309	Jun-12-98			X						N/S		>20	D1-23, D1-24
UG310	Jun-12-98			X						N/S		>20	D1-26
UG311	Jun-12-98			X									D1-27, D2-1
UG311a	Jun-12-98			X									D1-27, D2-1
UG312	Jun-12-98			X									D1-27, D2-1
UG313	May-31-98												
UG314	Jun-12-98		X									>30	D2-2
UG315	Jun-12-98												D2-5
UG316	Jun-12-98								X				D2-4
UG317	Jun-12-98												D2-3

TABLE 2

DRILLHOLE SUMMARY

RR-40	53995.224	36623.863	9835.4311	308	55	100	57.36	N/A							
RR-41	53950.113	36599.837	9835.4396	238	65	100	42.26	N/A							
RR-42	53988.92	36675.556	9843.1538	252	60	100	50.00	N/A							
RR-43	53937.025	36686.783	9844.466	204	60	100	50.00	N/A							
RR-44	53947.605	36696.922	9844.4669	205	60	100	50.00	N/A							
	53847.449	36668.044	9837.0077	289	60	65	32.50	46.00	65.00	23.00	32.50	39.84	56.29	29.84	46.29
	53848.685	36665.097	9836.6258	289	50	100	64.28	22.00	26.00	14.14	16.71	16.85	19.92	11.85	14.92
	53848.685	36665.097	9836.6258	289	50	100	64.28	55.00	59.00	35.35	37.92	42.13	45.20	32.13	35.20
	53849.865	36662.338	9836.3465	289	40	63	48.26	51.00	63.00	39.07	48.26	32.78	40.50	22.78	30.50
RR-46	53867.275	36597.998	9816.9487	---	90	100	0.00	N/A							
	53865.695	36600.592	9816.8791	90	70	100	34.20	81.00	86.00	27.70	29.41	76.12	80.81	82.12	86.81
	53866.232	36602.793	9816.9741	90	60	70	35.00	14.00	21.00	7.00	10.50	12.12	18.19	14.12	20.19
	53866.232	36602.793	9816.9741	90	60	70	35.00	39.00	45.00	19.50	22.50	33.77	38.97	39.77	44.97
	53866.232	36602.793	9816.9741	90	60	70	35.00	55.00	70.00	27.50	35.00	47.63	60.62	53.63	66.62
	53866.677	36605.178	9817.1893	90	50	55	35.35	15.00	24.00	9.64	15.43	11.49	18.39	13.49	20.39
	53866.677	36605.178	9817.1893	90	50	55	35.35	39.00	55.00	25.07	35.35	29.88	42.13	35.88	48.13
	53867.131	36607.714	9817.3472	90	40	100	76.60	25.00	27.00	19.15	20.68	16.07	17.36	18.07	19.36
	53867.131	36607.714	9817.3472	90	40	100	76.60	42.00	45.00	32.17	34.47	27.00	28.93	33.00	34.93
RR-48	53839.843	36599.025	9816.8361	---	90	100	0.00	N/A							
	53806.027	36662.297	9816.8	260	60	70	35.00	53.00	70.00	26.50	35.00	45.90	60.62	45.90	60.62
RR-49b	53805.527	36659.297	9837.454	260	50	100	64.28	N/A							
RR-50	53803.857	36685.657	9837.5125	255	55	100	57.36	N/A							
RR-51	53851.566	36767.957	9854.2503	23	60	100	50.00	N/A							
RR-52	53855.093	36789.497	9854.5527	13	60	100	50.00	N/A							
RR-53	53679.433	36633.917	9816.7897	255	60	100	50.00	N/A							
RR-54	53602.428	36694.787	9815.1946	280	60	100	50.00	N/A							
	53584.003	36691.085	9814.1753	275	60	100	50.00	76.00	78.00	38.00	39.00	65.82	67.55	57.82	59.55
RR-55b	53582.804	36686.864	9814.1349	275	50	100	64.28	N/A							
RR-56	53512.767	36662.517	9801.5116	220	60	100	50.00	N/A							
RR-57	53506.273	36683.379	9802.9735	170	60	100	50.00	N/A							
RR-58	53482.408	36729.098	9803.4127	200	60	100	50.00	N/A							
RR-59	53436.148	36693.736	9794.4466	220	60	100	50.00	N/A							
RR-60	53469.941	36570.755	9775.9049	138	40	100	76.60	N/A							
RR-61	53675.908	37326.389	9844.5919	125	60	100	50.00	N/A							
RR-62	53566.752	37323.718	9819.9514	270	60	100	50.00	N/A							
RR-63	53428.298	37292.96	9781.0023	303	60	100	50.00	N/A							
RR-64	53210.054	37676.122	9831.8435	255	60	100	50.00	N/A							

TABLE 2

DRILLHOLE SUMMARY

	53173.144	37682.806	9820.9762	180	60	100	50.00	93.00	96.00	46.50	48.00	80.54	83.14	60.54	63.14
RR-65b	53171.144	37682.806	9821	180	50	100	64.28	N/A							
RR-66	53141.707	37623.42	9797.1439	350	75	100	25.88	N/A							
RR-67	53122.325	37625.654	9796.822	250	60	100	50.00	N/A							
RR-68	53161.406	37549.03	9792.5603	171	45	100	70.71	N/A							
RR-69	53653.195	37376.805	9848.5107	150	60	100	50.00	N/A							
	53651.455	37377.744	9848.4164	150	50	38	24.43	20.00	38.00	12.86	24.43	15.32	29.11	15.32	29.11
	53648.56	37379.834	9848.2973	150	40	70	53.62	33.00	37.00	25.28	28.34	21.21	23.78	21.21	23.78
RR-70	53870.523	37004.886	9866.5104	275	60	100	50.00	N/A							
RR-71	53801.86	36971.592	9859.2588	128	60	100	50.00	N/A							
	53782.614	37004.53	9851.5741	202	60	100	50.00	42.00	45.00	21.00	22.50	36.37	38.97		
RR-72b	53779.767	37003.878	9851.3682	202	50	100	64.28	N/A							
RR-73	53758.244	36959.932	9852.01	178	60	100	50.00	N/A							
RR-74	53756.338	36904.48	9852.3704	185	60	100	50.00	N/A							
RR-75	54165.301	36348.702	9786.7388	23	60	100	50.00	N/A							
RR-76	54163.424	36532.173	9805.8534	195	60	100	50.00	N/A							
RR-77	53979.501	36209.581	9754.2941	46	60	100	50.00	N/A							
RR-78	53965.972	36292.596	9764.157	320	60	100	50.00	N/A							
RR-79	53294.759	37044.451	9722.5897	80	60	100	50.00	N/A							
RR-80 test	53228	37046	9708	---	90	40	0.00	N/A							
RR-80	53227.574	37045.955	9708.2177	82	60	100	50.00	N/A							
RR-81	53217.149	37857.358	9857.1201	20	60	100	50.00	N/A							
RR-82	53131.962	36263.446	9631.8618	129	60	100	50.00	N/A							
RR-83	53144.943	36645.534	9719.2152	274	60	100	50.00	N/A							
RR-84	52954.4	36530.826	9609.6595	70	50	100	64.28	N/A							
RR-85	52879.606	36598.163	9628.0851	247	60	100	50.00	N/A							
RR-86	52816.652	36582.978	9629.8819	175	60	100	50.00	N/A							
RR-87	52704.627	36985.988	9589.8328	277	60	100	50.00	N/A							
RR-88	52596.24	36970.196	9588.8596	173	60	100	50.00	N/A							
RR-89	52491.586	37101.884	9583.5704	302	65	100	42.26	N/A							
RR-90	Did not drill borehole due to water line, trailer, and retaining wall in area.														
RR-91	52461.802	37110.247	9581.8821	265	55	100	57.36	N/A							
RR-92	52809.035	37726.896	9737.7278	255	60	100	50.00	N/A							
RR-93	52716.317	37748.024	9716.8682	250	50	100	64.28	N/A							
RR-94	52542.005	37684.323	9675.1176	4	48	100	66.91	N/A							
RR-95	52181.97	37691.714	9646.32	203	55	100	57.36	N/A							
RR-96	52092.353	37704.209	9685.4112	22	60	100	50.00	N/A							

TABLE 2

DRILLHOLE SUMMARY

RR-97	53976.392	36594.066	9834.7995	312	60	100	50.00	N/A							
RR-98	53944.288	36612.01	9835.3872	245	65	100	42.26	N/A							
RR-99	53847.218	36580.386	9811.6374	---	90	100	0.00	N/A							
RR-100	53857.913	36694.513	9842.3154	220	60	100	50.00	45.00	50.00	22.50	25.00	38.97	43.30	35.47	39.80
RR-100b	53842.682	36681.369	9837.2332	---	90	95	0.00	N/A							
RR-100c	53846.56	36686.241	9837.5564	---	90	55	0.00	N/A							
RR-100d	53845.214	36683.724	9837.4944	---	90	65	0.00	N/A							
RR-100e	53848.574	36687.402	9837.6654	---	90	65	0.00	N/A							
RR-100f	53831.668	36674.193	9836.7081	42	60	70	35.00	N/A							
RR-101	53857.097	36712.718	9843.6836	25	60	100	50.00	N/A							
RR-102	53758.439	36672.992	9835.5143	263	50	100	64.28	N/A							
RR-103	53414.017	36660.455	9792.918	283	60	100	50.00	N/A							
RR-104	53409.176	36576.466	9772.2994	142	45	100	70.71	N/A							
RR-105	53427.178	36710.683	9794.7372	205	50	100	64.28	N/A							
RR-106	53453.674	36771.737	9799.6113	200	60	100	50.00	N/A							
RR-107	53361.496	36957.654	9746.6879	0	50	100	64.28	N/A							
GYR-3	53545.537	35447.317	9745.6655	210	60	100	50.00	N/A							
GYR-4	53509.682	35469.234	9730.4669	224	60	100	50.00	N/A							
GYR-5	53480.434	35450.142	9731.7903	175	60	100	50.00	N/A							
GYR-6	53677.842	35551.458	9735.6523	198	60	100	50.00	N/A							
GYR-7	52644.194	35501.996	9642.2569	202	60	100	50.00	N/A							
GYR-8	52469.904	35271.213	9633.7758	235	65	100	42.26	N/A							
GYR-9	52303.247	35490.874	9539.3875	315	45	100	70.71	N/A							
BH-88	51230.346	34980.711	9486.1163	---	90	100	0.00	N/A							
BH-89	51259.795	35091.769	9458.5081	240	60	100	50.00	46.00	50.00	23.00	25.00	39.84	43.30		43.30
BH-89b	51258.295	35089.169	9458.5	240	45	100	70.71	N/A							
BH-90	51213.485	35069.831	9457.8832	139	60	100	50.00	N/A							
BH-91	51237.533	35083.756	9457.7481	---	90	100	0.00	N/A							
BH-92	51244.932	35112.333	9456.4699	---	90	100	0.00	N/A							

Note:

1 Shaded Borehole designation identifies drillhole in which no underground working was encountered.

2 Boreholdes with northing, easting and elevation given to two decimal places were surveyed by Western States Surveying Inc.

3 Depth of intersection of stope calculated from orientation of borehole, and location of intersection along hole, assuming ground surface is horizontal local to borehole.

GENERAL REMEDIATION PLANS

Type of Underground Working	Range of Depth Below Finished Grade	Max. Excavation Dimensions	Depth to Competent Bedrock (ft)	Remediation Plan
Open Shaft or Stope	>25 feet	12' square opening	Above finished grade	1. Excavate/grade surface to finished grade. 2. Excavate around shaft opening forming 0.5H:1V minimum. 3. Backfill shaft with Coarse Shaft Backfill to 10 feet below final Soil Liner Fill subgrade surface. 4. Cast 3' thick concrete plug in shaft. 5. Backfill final 7 feet with Cemented Rockfill material. 6. Place Structural Fill as needed to finished grade.
Open Shaft or Stope	>25 feet	12' square opening	< 7' below finished grade	1. Excavate around shaft opening forming 0.5H:1V minimum taper in overburden and rock. 2. Backfill shaft with Coarse Shaft Backfill to 10 feet below final Soil Liner Fill subgrade. 3. Cast 3' thick concrete plug in shaft. 4. Backfill final 7 feet with Cemented Rockfill material. 5. Place Structural Fill as needed to finished grade.
Open Shaft or Stope	>25 feet	12' square opening	> 7' below finished grade	1. Excavate around shaft opening forming 0.5H:1V miminum taper in overburden. 2. Backfill shaft with Coarse Shaft Backfill to 3 feet below overburden/rock interface. 3. Cast 3' thick concrete plug in shaft. 4. Backfill final 7 feet with Cemented Rockfill material. 5. Place Structural Fill as needed to finished grade.
Shallow Open Shaft	< 25 feet	12' square opening	Above finished grade	1. Excavate/grade surface to finished grade. 2. Backfill shaft with Select Structural Fill and/or Structural Fill to final Soil Liner Fill subgrade surface. 3. Compact backfill surface.
Shallow Open Shaft	< 25 feet	12' square opening	Below finished grade	1. Backfill shaft with Select Structural Fill and/or Structural Fill to existing surface. 2. Compact backfill surface. 3. Finish grade with Structural Fill.
Collapsed/Backfilled Shaft	> 25 feet	12' square opening	Above finished grade	1. Excavate/grade surface to finished grade. 2. Excavate collapsed materials to 25 feet below final Soil Liner Fill subgrade surface. 2. Excavate around shaft opening forming 0.5:1V minimum taper. 3. Backfill shaft with Coarse Shaft Backfill to 10 feet below final Soil Liner Fill subgrade surface. 4. Cast 3' thick concrete plug in shaft. 5. Backfill final 7 feet with Cemented Rockfill material. 6. Place Structural Fill as needed to finished grade.
Collapsed/Backfilled Shaft	> 25 feet	12' square opening	< 7' below finished grade	1. Excavate collapsed materials to 25 feet below finished grade. 3. Excavate around shaft opening forming 0.5:1V minimum taper in overburden and rock. 4. Backfill shaft with Coarse Shaft Backfill to 10 feet below final Soil Liner Fill subgrade. 5. Cast 3' thick concrete plug in shaft. 6. Backfill final 7 feet with Cemented Rockfill material 7. Place Structural Fill as needed to finished grade.
Collapsed/Backfilled Shaft	> 25 feet	12' square opening	> 7' below finished grade	1. Excavate collapsed materials to 25 feet below finished grade. 2. Excavate around shaft opening forming 0.5H:1V minimum taper in overburden. 3. Backfill shaft with Coarse Shaft Backfill to 3 feet below overburden/soil interface. 4. Cast 3' thick concrete plug in shaft. 5. Backfill final 7 feet with Cemented Rockfill material. 6. Place Structural Fill as needed to final grade.

GENERAL REMEDIATION PLANS

Type of Underground Working	Range of Depth Below Finished Grade	Min. Excavation Dimensions	Depth to Competent Bedrock (ft)	Remediation Plan
Collapsed/Backfilled Shaft	< 25 feet	12' square opening	Above finished grade	1. Excavate/grade surface to finished grade. 2. Excavate collapsed materials to 25 feet or depth of shaft. 3. Backfill shaft with Select Structural Fill to final Soil Liner Fill subgrade surface. 4. Compact backfill surface.
Collapsed/Backfilled Shaft	< 25 feet	12' square opening	Below finished grade	
Lateral (option 1)	< 50 feet	< 12 feet wide, < 12 feet hig	n/a	1. Drill and blast crown pillar. 2. Excavate collapsed materials to 25 feet. 3. Backfill with Coarse Shaft Backfill to within 1' of the final Soil Liner Fill subgrade surface. 4. Place double layer geogrid cap.
Lateral (option 2)	< 50 feet	< 12 feet wide, < 12 feet hig	n/a	1. Drill flowable fill access holes into crown pillar. 2. Pump low compressibility, inert flowable fill material into void. 3. Final fill level to be 5' typical above lateral back.
Lateral	> 50	> 12 feet wide, > 12 feet hi	n/a	Treat as a stope.
Mine Slot	At surface	< 3 feet wide	n/a	1. Backfill slot with Coarse Shaft Backfill, Structural Fill, or Select Structural Fill to within 1' of final Soil Liner Fill subgrade surface. 2. Place double layer geogrid cap.
Mine Slot	\	> 3 feet wide	n/a	Treat as a stope.