APPENDIX V

EXPERT REPORT OF MARC LOMBARDI

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION

—

CLEANUP AND ABATEMENT ORDER NO. R5-2014-XXXX

ATLANTIC RICHFIELD COMPANY
UNITED STATES DEPARTMENT OF AGRICULTURE,
UNITED STATES FOREST SERVICE

WALKER MINE TAILINGS
PLUMAS COUNTY

—

CLEANUP AND ABATEMENT ORDER NO. R5-2014-YYYY
ATLANTIC RICHFIELD COMPANY

WALKER MINE
PLUMAS COUNTY

Expert Report of
Marc R. Lombardi, PG, CEM

California Regional Water Quality Control Board
Central Valley Region

Cleanup and Abatement Order No. R5-2014-YYYY
Atlantic Richfield Company
Walker Mine
Plumas County

Cleanup and Abatement Order No. R5-2014-XXXX
Atlantic Richfield Company
United States Department of Agriculture, United States Forest Service

Walker Mine Tailings
Plumas County

Prepared for:
Atlantic Richfield Company

Submitted by:
AMEC Environment & Infrastructure, Inc.
Rancho Cordova, CA

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EXPERT REPORT OF
MARC R. LOMBARDI, PG, CEM
Walker Mine Site
Plumas County, California

1.0 INTRODUCTION

I, Marc R. Lombardi, PG, CEM, of AMEC Environment & Infrastructure, Inc. (AMEC), have been retained by Atlantic Richfield Company (Atlantic Richfield) to provide expert review and evaluation of the environmental conditions at the former Walker Mine Site (site) in Plumas County, California. Specifically, I have been asked to review information that has been collected over many years relating to the site. Information reviewed included various historical reports, documents, and related information that describe mine exploratory development, mining, ore processing, mine closure, activities of previous owners, operators, leasees/leasors including remediation activities by private parties, state and federal agencies, and regulatory actions. Finally, I have been asked to provide expert opinions concerning pollution abatement measures that were implemented by the California Regional Water Quality Control Board – Central Valley Region (CVRWQCB) and the U.S. Department of Agriculture, Forest Service (USFS) at the site and to provide this expert report detailing my opinions and conclusions and the basis for those opinions and conclusions. I visited the site on November 6, 2013.

2.0 QUALIFICATIONS

This report was prepared under my supervision and direction. I have been assisted in this work by various staff including Dr. Robert C. Starr, PE, who provided input and expertise related to contaminant hydrogeology and environmental remediation. The use of staff to assist me is both necessary and common for this type of evaluation given the scope and nature of the data, information, and technical issues associated with the site.

I am a Principal of AMEC, a full-service environmental, geotechnical, water resources, and infrastructure consulting company. My area of expertise is geology with a professional practice emphasis on assessment of soil and groundwater contamination and remediation. I hold a Bachelor of Science in Geology from the University of California at Davis, conferred in 1988, and a Master of Science in Geology from San Diego State University, conferred in 1992. I am a member of the Groundwater Resources Association of California and the Association of Engineering Geologists. My curriculum vitae is provided in Appendix A.

Over the past four years I have testified by deposition in one case: *Atlantic Richfield Company vs. State of California, et. al.*, BC380474, Superior Court of the State of California, County of Los Angeles.

I am compensated for my time in this matter at a rate of $160 per hour for consulting and $240 per hour for deposition and trial testimony.

In preparation of this report, I have relied on historical reports, documents, and information related to the site in this matter. Finally, I have relied on my consulting education, training, and more than 24 years of experience in the environmental consulting field in forming the opinions in this report. The opinions I provide in this report are given to a reasonable degree of scientific certainty and are based on my knowledge, skill, experience, training, education, and the information and data about this matter that were available to me at the time these opinions were rendered. If additional information becomes available, including the submission of new or revised expert reports on or after submission of the present report by Atlantic Richfield in this matter, or if I receive any other information or data that were not made available as of the time I prepared this report, I may supplement my opinions to reflect such information.

3.0 SUMMARY OF OPINIONS AND CONCLUSIONS

The following list summarizes my opinions to date and is intended only as a summary. My opinions and testimony in this case are and will be based on all of the supporting information, analysis, and statements contained in this Expert Report.

1. Environmental impacts at the site are the result of mining and processing of ore, not exploration or development activities. The Walker Mine ore deposit was a discrete fissure or vein emplaced between distinctive walls of barren country rock. The vein consisted of mainly silica (quartz) with pockets of sulfide-bearing minerals. Mining activities exposed these sulfide-bearing minerals to air (oxygen) and water resulting in oxidation and formation of acid mine drainage (AMD).

2. The wall rock, or country rock, bracketing the vein is largely composed of schists that are intermediate to felsic in chemical composition. They are dense, hard rock typically containing no, to trace quantities, of sulfide-bearing minerals. Intermediate to felsic composition rocks do not oxidize to create AMD when exposed to air and water.

3. Water quality in Dolly Creek and Little Grizzly Creek near the Walker Mine is impaired by contaminants resulting from AMD, primarily elevated concentrations of copper, released from sources related to mining and processing of ore. Sources of contaminants from mining and processing ore to surface water are: mine drainage, tailings at the mill site, and tailings in the tailings impoundment area.

4. Prior to International Smelting & Refining's (IS&R) becoming a shareholder in Walker Mining Company in 1918, Walker Mining Company had removed ore and created underground workings, a mill, a tailings pond, and other mining related infrastructure and support facilities that were already operating at the site. Walker Mining Company milled ore and directed the resulting tailings to a pond located near the mill.

5. The CVRWQCB installation of the adit seal was not a comprehensive remedy, because it did not address the control of water into the mine, the long-term implications of water impoundment, or other sources of copper loading to the creeks. Design and placement of the mine adit seal has had some short-term benefit, but it may prove ineffective over the longer term and has likely deferred the implementation of a more protective permanent solution.

6. The effects of mine flooding implemented by the CVRWQCB on hydrology and geochemistry (i.e. production of AMD and dissolved metals) are likely contributing to the degradation of water quality in the flooded mine behind the seal, degradation of groundwater in the vicinity of the mine and downgradient surface water contamination; however, insufficient data have been collected for proper evaluation.

7. Numerous site owners or operators have followed Walker Mining Company. Since 1957, the CVRWQCB has received numerous recommendations, plans, alternatives, and options for the mitigation or remediation of AMD at the site. In

response, the CVRWQCB constructed the concrete seal in the 700 Level Adit portal in 1987. Between 1957 and 1987, continued production of AMD significantly contributed to degradation of water quality.

8. Attainment of water-quality objectives for Dolly Creek and other surface waters requires coordination of upstream and downstream response actions. Issues at the mine site and tailings impoundment area are interrelated. A cooperative effort between the CVRWQCB and the USFS would benefit the remedial activities in both locations.

4.0 BASIS FOR OPINIONS AND CONCLUSIONS

1. **Environmental impacts at the site are the result of mining and processing of ore, not exploration or development activities. The Walker Mine ore deposit was a discrete fissure or vein emplaced between distinctive walls of barren country rock. The vein consisted of mainly silica (quartz) with pockets of sulfide-bearing minerals. Mining activities exposed these sulfide-bearing minerals to air (oxygen) and water resulting in oxidation and formation of AMD.**

The Walker Mine ore deposits are lenticular veins consisting of massive chalcopyrite-pyrite seams and stringers in a granular quartz gangue with local concentrations of magnetite. The veins are essentially conformable with the enclosing country rock schists (Prochnau, 1986). The sulfide minerals are interspersed in pods and bands of magnetite (Fe_3O_4), barite ($BaSO_4$), pyrite (FeS_2), pyrrhotite ($Fe_{1-x}S$, x=0-0.2), and chalcopyrite ($CuFeS_2$), and locally they form 1- to 2-foot-thick pods of massive sulfide ore (Kilbreath and Leger, 1978).

The country rock surrounding the ore deposit consists primarily of iron, magnesium, and aluminum silicates and contains no, to trace quantities, of sulfide minerals. Ore, mine waste, or mill tailings that contain sulfide-bearing minerals have a high potential for acid production (Deutsch, 1997). When rock is reduced to a finer particle size through the mining and milling process, the increased surface area of the sulfide-bearing minerals allows for increased oxidation and weathering. Pyritic sulfur is oxidized to sulfate and the ferrous iron is released to solution (Langmuir, 1997). The hydrogen ions that are also released create an acidic solution with elevated concentrations of metals. The general chemical reaction representing oxidation of pyrite follows:

$$\underset{\text{pyrite}}{FeS_2} + \underset{\text{atmospheric oxygen}}{(7/2)O_2} + \underset{\text{water}}{H_2O} \longrightarrow \underset{\text{iron}}{Fe^{2+}} + \underset{\text{sulfate}}{2(SO_4)^{2-}} + \underset{\text{hydrogen ions}}{2H^+}$$

Oxidation of copper sulfide minerals follows a similar reaction, resulting in an acidic solution with elevated concentrations of copper ions. Thus, the sulfide-bearing ore, mine waste, and mill tailings are the source of AMD at the Walker Mine.

Activities during the operational phase of the mine included exploration, development, mining ore, and milling ore. Exploration is delineating the three dimensional geometry and grade of the ore, and is primarily done by drilling holes and collecting rock samples and analyzing samples to determine concentrations of metals in the ore rock. Exploration activities produce small quantities of drill cuttings and core samples. Development consists of creating mine openings (e.g. shafts, tunnels) to provide access to the orebody. These are excavated in country rock, and therefore development activities produce country rock that has little or no sulfide mineralization. Rock that has sulfide mineralization is processed as ore. During mining activities, sulfide mineral bearing ore is excavated, crushed, and transported to the mill for processing. Milling consists of reducing the rock to fine size particles and then extracting the valuable components from the fine rock particles. The portion that contains the valuable components is called the concentrate, which was shipped off site for smelting. The portion that remains after the valuable components were removed is called the tailings, which were disposed on site. Both mining ore and milling ore produce rock or tailings that contain appreciable concentrations of sulfide minerals, which can be oxidized and release acid and metals.

2. **The wall rock, or country rock, bracketing the vein is largely composed of schists that are intermediate to felsic in chemical composition. They are dense, hard rock typically containing no, to trace quantities, of sulfide-bearing minerals. Intermediate to felsic composition rocks do not oxidize to create AMD when exposed to air and water.**

The Walker Mine claims are principally underlain by Jurassic-age metasediment and metavolcanic rocks overthrust by Paleozoic sediments on the west and intruded and terminated by granitic rocks to the north and south. Tertiary volcanic rocks cap the older rocks (Prochnau, 1986).

The Jurassic-age country rock has been variously described. The country rock was initially termed blocky, fissured diorite (Hart, 1915a,b) (Cowan, 1915). Later, descriptions of underground workings identified granite dikes, gneisses, and clays (associated with faulting) (Gidel, 1920). More recent descriptions of the country rock is as schists that are probably derived from intermediate to felsic-composition tuffs and volcanic agglomerates (Prochnau, 1986).

The country rock is also intruded by a large body of augite-hornblende-biotite quartz diorite, possibly related to Sierra Nevada batholithic emplacement (Kilbreath and Leger, 1978). The country rock, including the intrusive rock, consist primarily of iron, magnesium and aluminum silicate minerals. These types of silicate minerals do not contain sulfur and therefore do not produce AMD during weathering. Thus, the country rock at the Walker Mine does not oxidize to create AMD when exposed to air and water.

3. **Water quality in Dolly Creek and Little Grizzly Creek near the Walker Mine is impaired by contaminants resulting from AMD, primarily elevated concentrations of copper, released from sources related to mining and processing ore. Sources of contaminants from mining and processing of ore**

to surface water are: mine drainage, tailings at the mill site, and tailings in the tailings impoundment area.

The Walker Mine is located in Plumas County, California, approximately 15 miles northeast of Quincy (Figure 1). The Walker Mine 700 Level Adit portal, the mill site, a former tailings pond, and a current settling pond in the mill site area are located near the upper reaches of Dolly Creek. Dolly Creek is a tributary to Little Grizzly Creek (Figure 2). The 100 acre or tailings impoundment area (called the "lower" tailings impoundment) is located at the confluence of Dolly Creek and Little Grizzly Creek. Analytical data is not available before 1957; the Prosecution Team materials provide no record of conditions at the mine at the time of mine closure and transfer for the property to Safeway Signal Corporation in 1945.

Recent analytical data collected by the Regional Board staff and others shows that surface water in the vicinity of the mine and tailings impoundment area is impacted by AMD from the 700 Level Adit portal, tailings in the mill site area, the settling pond in the mill site area, and the lower tailings impoundment.

Figure 3 illustrates surface water sampling locations and groundwater monitoring wells in the vicinity of the mill site area, the tailings impoundment, and creeks and tributaries to the north of the Walker Mine.

2006 through 2013 – Effect of Sources in the Mill Site Area and the Tailings Impoundment Area

Surface water locations monitored by the CVRWQCB, representing post-700 Level Adit seal emplacement conditions, are shown on Figures 4 and 5. Figure 4 illustrates dissolved copper concentrations at locations near the mine and lower tailings impoundment, and Figure 5 shows the dissolved copper concentrations for multiple creek and tributary locations north-northwest of the Walker Mine.

Mill Site Area

Figure 4 illustrates similar relationships in dissolved copper loading as those in the historical data set. Lower concentrations resulting from placement of the adit seal and the addition of sampling locations at the mill site allow for the identification of more discrete and ongoing sources of dissolved copper loading to surface water in the former mill area, which were not addressed by the adit seal.

There are three primary sources of copper in the former mill area that contribute to stream loading. These are the continued direct discharge from the portal, dissolved copper in the settling pond, and copper leaching from the mill tailings area.

Dissolved copper in the flow from the 700 Level Adit (WM-1) was significantly reduced because of the seal, although samples of standing water at the base of the seal have similar concentrations (mean of 13,000 µg/L copper) to historical, free flow conditions. The flow at this point was significantly reduced from approximately 275 gpm (SRK, 1985) pre-seal emplacement flows to an estimated 0.15 gpm seepage around the seal (Pujol, 2002). In addition, the source of the water in the pool at the base of the plug does not appear to have been sufficiently investigated and is thought to be either seepage around the seal, or seepage into the tunnel between the seal and the portal opening.

Dissolved copper in the settling pond water is presumably leaching from tailings in the mill site area and outfall collected from the 700 Level Adit portal. Outflow from the settling pond (WM-19) has high dissolved copper concentrations (mean of about 950 µg/L) relative to the adit flow discharge (WM-1), and the pond currently appears to be the most significant source of dissolved copper loading to Dolly Creek.

The tailings in the mill site area have elevated concentrations of both total and leachable copper and hence are a source of copper to surface water.

Sampling locations along Dolly Creek downstream of the former mine (WM-3, -4, -7A, -7B, and -6) all reflect increased dissolved copper concentrations from this loading in this area.

Tailings Impoundment

In 2007, the USFS constructed the Dolly Creek diversion, which routed Dolly Creek through a lined diversion channel across the lower tailings impoundment (Huggins and Rosenbaum, 2007). Renovations to the diversion channel headworks were required in 2009 because there was a considerable amount of subsurface drainage from Dolly Creek passing beneath the diversion structure and making its way through the Old Dolly Creek Channel (Huggins and Little, 2009). Dissolved copper concentrations in water quality samples collected from Dolly Creek show no appreciable increase in copper loading from sampling locations at the upstream (WM-7A) to downstream (WM-7B) end of the lined channel, indicating that the channel isolates water in Dolly Creek from the tailings. Visual inspection of the lined diversion channel does show sedimentation from wind-blown tailings to the diversion channel that may add some copper load to the creek, although it does not appear to be significant based upon the data available for review at this time. The lined diversion channel was observed to have mature vegetation growth that could compromise the liner. Leakage from Dolly Creek through the lined diversion channel to the tailings impoundment would result in increased copper loading to Little Grizzly Creek.

Flow across the western portion of the lower tailings impoundment in the unlined former channel of Dolly Creek is readily apparent visually in the field and on current aerial photographs, with well developed vegetation along the drainage-way. The source of water in the unlined channel does not appear to have been evaluated. This drainage contributes an ongoing and significant copper load to Little Grizzly Creek as evident in the sampling results at monitoring location WM-6 (Figure 4).

Little Grizzly Creek upstream of the lower tailings impoundment (WM-5) has low mean dissolved copper concentrations (1.1 µg/L), likely reflective of surface water conditions unaffected by mining. Downstream locations along Little Grizzly Creek but upstream of the confluence of Dolly Creek (WM-7C and WM-7) have slightly higher mean dissolved copper concentrations relative to location WM-5. This increase is likely due to groundwater infiltration through the lower tailings impoundment and discharge to the creek along the southwestern boundary of the lower tailings impoundment.

Figure 6 illustrates groundwater flow conditions and dissolved copper in groundwater in the lower tailings impoundment based on data from monitoring wells installed and monitored by the USFS (2014). Groundwater occurs at very shallow depths in the tailings, typically less than 10 feet below the surface and the groundwater flow direction in the tailings is south-southwest toward Little Grizzly Creek. Currently, the USFS is required under Waste Discharge Requirements (WDRs) to monitor water quality semiannually in three wells (W3, W5, and W7) installed in the tailings, (Figures 3 and 6). Dissolved copper from these well samples collected during the fourth quarter 2013 are shown on Figure 6, with the highest concentration of 1.0 µg/L detected in well W7. Since July 1994, dissolved copper as high as 51 µg/L, 10.1 µg/L, and 5.3 µg/L have been detected in samples from wells W3, W5, and W7, respectively. Although consistently high dissolved copper concentrations in groundwater in the tailings are not indicated, some dissolved copper loading to Little Grizzly Creek due to groundwater discharge from the lower tailings impoundment cannot be ruled out. It is not clear from the available data whether dissolved copper in groundwater is generated in-situ as result of residual sulfide minerals in the tailings, or is a result of dissolved copper in groundwater up-gradient of the tailings piles (e.g., beneath the former mill area) flowing downgradient into the tailings.

Little Grizzly Creek Downstream of the Tailings Impoundment

Surface water samples collected downstream of the confluence of Dolly Creek and Little Grizzly Creek (WM-8 and -9) have lower mean dissolved copper concentrations of about 11 µg/L reflecting the mixing of the two creeks. Sample location WM-9 is the compliance point of the USFS WDRs relative to meeting the WQPS of 5 µg/L. These data show that the standard is not being met at the compliance point. Mean dissolved copper concentrations of 4.8 µg/L and 1.1 µg/L in Little Grizzly Creek downstream sampling locations WM-20 and WM-10, respectively, indicate downstream attenuation of dissolved copper relative to the compliance point at WM-9 (Figure 5).

Northern Streams and Tributaries

Further evaluation of the water quality data shows that the three sample locations on Ward Creek (MW-12, WM-11) and Nye Creek (WM-13) are the most proximal to the flooded orebody (Figure 5). The available head data collected for water impounded behind the adit seal shows that water levels in the flooded mine have fluctuated since approximately 1999 within an elevation range that is precisely correlative with the elevations of all three of these surface water sample collection locations (Figure 10). This suggests that seepage from the water impounded in the mine may be contributing to these higher dissolved copper concentrations. These data are discussed and presented in more detail in Opinion 6.

4. **Prior to IS&R's becoming a shareholder in Walker Mining Company in 1918, Walker Mining Company had removed ore and created underground workings, a mill, a tailings pond, and other mining related infrastructure and support facilities that were already operating at the site. Walker Mining Company milled ore and directed the resulting tailings to a pond located near the mill.**

The ore deposit at Walker Mine was discovered in 1904 (Plumas County, California, 2011), and the initial exploration and development of the Central Orebody was conducted from 1911 to 1916. By 1915, the extent of the Central Orebody had been explored by sinking a shaft to a depth of approximately 125 feet and excavating horizontal tunnels at two levels (Hart, 1915a). At that time, mine related facilities at the mine included a blacksmith shop, steel shop, machine shop, mess hall, commissary, theater, schoolhouse, recreation hall, gas station, post office, hospital, sawmill, and boarding houses and other residences and steam operated equipment including a hoist, air-compressor, and pumps (Hansen, 1915). The shaft was located about 4,700 feet from what would become the mill site and was about 1,000 feet higher in elevation than the mill site. A gravity-powered aerial tramway was constructed in late 1915 or early 1916 to transport ore from the Central Orebody to the mill (Hart, 1915b) (U.S. Bureau of Mines, 1932).

Walker Mining Company constructed and began operation of a 75 ton per day mill by June 1916 (U.S. Bureau of Mines, 1932). Tailings from the mill were discharged to a nearby tailings pond. The tailings pond is shown in the southern portion of the mill site area on a 1921 map (Unknown Author, 1919) (Figure 7), which is the earliest map of the mill camp area discovered to date in the reference materials reviewed. To facilitate relating the tailings pond and other historic features to current features in the mill site area the features from the 1921 map, a 1928 map, and a modern aerial photograph were visually aligned and are illustrated in Figure 8. The larger lower tailings impoundment, approximately 80 to 100 acres, located near the confluence of Dolly Creek and Little Grizzly Creek was not constructed until 1919 (DeArrieta, 1926).

IS&R became a majority shareholder of Walker Mining Company in October 1918 (Hennesy, 1918).

A 1993 study prepared for the CVRWQCB characterized waste and soil in the mill site area. The study described as "processed waste tailings" in the area where the 1921 map shows the tailings pond Welch Engineering Science and Technology (WESTEC, 1993).

The WESTEC study measured total and extractable concentrations of copper and other metals in samples of tailings and unmilled ore, in waste rock (hornfelds, granitic sand, fill), and in soil (WESTEC, 1993, Tables 4-1, 4-2, 4-3, and 4-4). WESTEC's data show that total copper concentrations in tailings and unmilled ore (WESTEC's category "oxide") samples are substantially higher than concentrations reported for waste rock and in other materials. Their data also show that concentrations of extractable copper are higher in tailings and unmilled ore, as compared with concentrations reported for waste rock and other non-mineralized materials.

WESTEC also evaluated the potential for various materials in the mill site area to generate acid (WESTEC, 1993, Table 4-5). Materials WESTEC classified as being acid generating or possibly being acid generating are tailings or unmilled ore. Only one sample of a rock other than tailings or unmilled ore was classified as being acid-generating material. Acid generated from water coming in contact with tailings and unmilled ore would enhance leaching of extractable copper. Tailings and unmilled ore, which have the potential for being acid generating and having extractable copper, are sources of copper loading to surface water as discussed in evaluation of water quality data in Opinion 3 above.

5. **The CVRWQCB's installation of the adit seal was not a comprehensive remedy, because it did not address the control of water into the mine, the long-term implications of water impoundment, or other sources of copper loading to the creeks. Design and placement of the mine adit seal has had some short-term benefit, but it may prove ineffective over the longer term and has likely deferred the implementation of a more protective permanent solution.**

The overall hydrology of the mine includes inflow of surface runoff through the subsidence features, inflow from groundwater into portions of the mine, discharge of surface water through the 700 Level Adit portal (prior to placement of the adit seal); and outflow from the mine to groundwater within the fractured bedrock. The existing measures implemented to mitigate inflow into the subsidence features have limited effectiveness, and interactions between water in the mine and groundwater have not been fully evaluated. The existing remedy addresses only the discharge of water from the portal.

Mine Inflow

Adequate control of waters flowing into the mine through the Central and Piute subsidence areas has not been addressed despite the numerous evaluations and conclusions of several consultants working at the site. The Steffen Robertson and Kirsten, Inc. (SRK), *Final Feasibility and Design Report* published in November 1985 reported that "Much of the portal flow is believed to originate as surface flow, which is captured by sinkholes which connect the mine to the South and Middle Forks of Ward Creek." SRK's report indicates that flows out of the mine discharge at a 275 gpm with a maximum spring time flow rate of 3,000 gpm (presumed to be essentially surface water inflow). SRK's design report estimated an average total annual inflow through the Central and Piute subsidence features of 525 gpm (SRK, 1985) and that a significant portion of the flow through the mine could be removed by adequately addressing the control of flow into the mine.

In December 1989, SRK reported that "the surface diversions around the Central Orebody are in reasonable condition but are probably only effective in diverting some of the higher storm or snowmelt flows" (Hutchinson, 1989). However, SRK concluded that improving the efficiency of the diversions would likely involve costly engineering works for effective flow cutoff and SRK did not recommend improving the surface diversions around the sinkholes but rather recommended sealing off some of the openings in those areas as a means of inflow control.

In November 1996, WESTEC indicated that the diversion system diverts approximately 77 percent of the surface flow away from the sinkholes (WESTEC, 1996). WESTEC made the following recommendations to the CVRWQCB in the 1996 report:

- retrofit the existing diversion system with a clay liner and rip rap;
- construct an additional 1,000 lineal feet of diversion and line with clay and rip rap;
- install subsurface drains to intercept lateral subsurface flow.

Evidence that CVRWQCB acted on WESTEC's recommendations for improving inflow diversion system has not been included in the Prosecution materials.

The CVRWQCB has not provided consistent inspection and maintenance of the diversion ditches to keep them in optimum condition. Review of the CVRWQCB semi-annual site inspection reports between 2006 and 2013 (CVRWQCB, report that the diversion channels are often noted as in need of repairs and sometimes are partially obstructed with fallen trees and other debris. The presence of debris in the diversion channels would reduce their ability to convey runoff, and effectively reduce inflow into the mine.

Long-term Implications of Water Impoundment and Mine Adit Seal Placement

The long-term implications of water impoundment from the installation of the adit seal have not been adequately evaluated. Although surface water quality improved after installing the adit seal, the long-term effects of mine flooding on the production of AMD, potential discharge of contaminated water from the mine to nearby surface water, and contaminant migration in groundwater have not been adequately evaluated.

In 1986, Condor Minerals Management (CMM) provided comment to the SRK *Final Feasibility and Design Report* and concluded that "more work is needed to properly understand the flow mechanisms in the Walker Mine" (Dohms, 1986a). CMM noted that impounded water in the flooded mine workings, potentially contaminated by formation of acid from sulfide mineral oxidation will infiltrate into the surrounding subsurface and may contaminate areas that would otherwise remain unsaturated and uncontaminated. This scenario may significantly increase the overall cost of a long-term remedy. In particular, before the adit seal was installed, the AMD was a well-defined flow that discharged from the 700 Level Adit portal. The well-defined flow could be easily captured for further management. Sealing of the adit has caused additional flow of contaminated water into an extensive groundwater flow system. As a consequence of the CVRWQCB's remedy, a much larger area has been affected by AMD from the mine.

CMM indicated the adit seal would be, at best, a temporary solution. CMM also concluded that there are alternatives to sealing the mine that would treat the AMD without causing a long-term threat to other watersheds.

In a June 7, 1999 letter from the Department of Water Resources (DWR), Division of Engineering to the CVRWQCB, DWR indicated that most adit seals are typically used as part of a comprehensive AMD treatment program, not as a stand-alone remedial option (Torres, 1999). In their letter, DWR informs the CVRWQCB that they cannot support the approach to the problem of maintaining the mine seal as defined in their Interagency Agreement. DWR recommends that the CVRWQCB revisit the assumptions in the Interagency Agreement relating to the design life of the seal, seepage, and the ability of the mine to contain future inflow. Finally, DWR recommended that the CVRWQCB begin permitting and design of an AMD treatment facility as a contingency plan to relieve excessive build up of water that may overflow out of the Piute Shaft.

Recent site inspections indicate the exterior of the mine seal is in good condition but the overall life expectancy of the plug is unknown. During construction, valved piping was installed through the seal in order to drain and collect the water from the upstream side of the plug if necessary. However, CVRWQCB field inspection reports indicate that the valves have not been operated since installation in 1987, despite recommendations from several consultants and CVRWQCB staff inspecting the mine (Pujol, 2002) (Huggins and Rosenbaum, 2006 and 2007) (Huggins and Little, 2009) (Huggins, 2010, 2013a, and 2013b).

Deferred Remedy

The adit seal was installed in November 1987. Water quality in Dolly Creek and Little Grizzly Creek improved afterwards as the amount of AMD flowing directly from the mine to surface water was reduced. However, water quality in the streams did not improve enough to reach water quality goals, indicating that the overall remedy for the site is incomplete. The USFS has an on-going remedy that is addressing the lower tailings impoundment. Surface water monitoring data collected after the adit seal was installed show that sources other than the mine discharge continue to contribute copper to surface water from the mill site area. The CVRWQCB has not addressed other sources of copper to surface waters, such as tailings in the mill site area, water that leaks past the adit seal, or water that drains from the settling pond near the mill site. It is likely that loading from all of these flows impacts the remedial efforts of the USFS at the lower tailings impoundment area. In addition, the CVRWQCB has not conducted investigations sufficient to evaluate the long-term effect of sealing the mine on hydrology, acid generation, and contaminant transport and how those effects may interact with other parts of the site or future remedial actions. The effect of flooding the mine workings and impoundment of the AMD behind the adit seal is discussed further in Opinion 6.

6. **The effects of mine flooding implemented by the CVRWQCB on hydrology and geochemistry (i.e. production of AMD and dissolved metals) are likely contributing to the degradation of water quality in the flooded mine behind the seal, degradation of groundwater in the vicinity of the mine and downgradient surface water contamination; however, insufficient data have been collected for proper evaluation.**