# Full Reclamation and Closure Plan
# Molycorp Questa Mine, NM

**For**

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**By**


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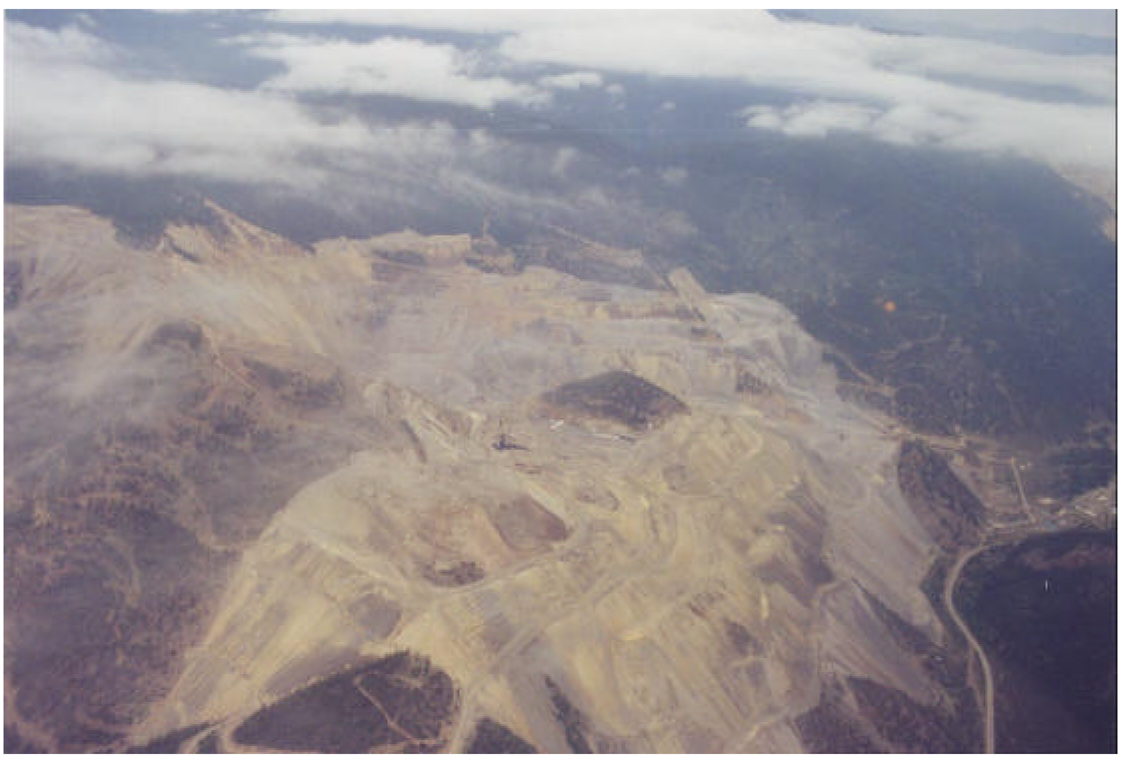

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## Executive Summary

The Amigos Bravos Full Reclamation and Closure Plan for the Molycorp molybdenum mine in Questa, New Mexico, has been developed to meet the requirements of the New Mexico Water Quality Act, the New Mexico Mining Act and other relevant state and federal regulations. This plan seeks to provide a public interest alternative to address the long-term protection of human, wildlife and fisheries health by preventing and treating water and air pollution emanating from Molycorp's Questa mining operations.

Amigos Bravos, Inc., Friends of the Wild Rivers, is a public interest non-profit river advocacy organization with offices in Taos and Albuquerque, New Mexico. The mission of Amigos Bravos is: To return New Mexico's rivers and the Río Grande watershed to drinkable quality wherever possible, and to contact quality everywhere else; to see that natural flows are maintained and where those flows have been disrupted by human intervention, to see that they are regulated to protect and reclaim the river ecosystem by approximating natural flows; and to preserve and restore the native riparian and riverine biodiversity. Amigos Bravos supports the environmentally sound, sustainable traditional ways of life of indigenous cultures and holds that environmental justice and social justice go hand in hand. The organization, founded in 1988, includes many people from Questa and the local area among its 1,400 members. Members of Amigos Bravos use the local groundwater and the Red River for domestic purposes, irrigation of gardens and crops, stock watering, fishing, swimming and other recreational activities.

Amigos Bravos has been an active participant and has advocated with state and federal regulators and the mining company for responsible mining practices, including requiring adequate plans and financial assurance for reclamation and closure measures. The organization believes that the necessary measures should be taken by Molycorp, consistent with regulatory and industry practices, to eliminate and prevent pollution from the mine and tailings facilities into the environment (primarily groundwater and surface water). The organization also believes that financial assurance, based on a conservative estimate of the state and/or federal agencies potential cost to perform required reclamation and closure tasks, should be required of Molycorp in accordance with applicable state and federal regulations.

The Full Reclamation and Closure Plan, described in further detail in this report, has been developed on Amigos Bravos' behalf by James R. Kuipers, a professional mining engineer, of the Center for Science in Public Participation. The plan is based on an evaluation of the existing conditions, state and federal regulatory requirements, and available reclamation and closure options consistent with modern reclamation practice. Based on this evaluation a "full" reclamation and closure plan has been developed representing a conservative approach to the necessary reclamation and closure measures and corresponding estimated costs.

Modern mine reclamation techniques employ a variety of measures including resloping, covers, revegetation, stormwater and groundwater controls and other measures to minimize, eliminate, prevent, collect and treat pollution such as acid mine drainage, which is commonly associated with hard rock mining activities. The Full Reclamation and Closure Plan selects from those measures to recommend those tasks that will affect a high level of environmental protection and restoration of natural resources.

The Molycorp Questa molybdenum mine, located in northern New Mexico, has been operating intermittently since the 1920s, and since the 1960s has been a large-scale mining operation. The mine operations, consisting of a total disturbed area of approximately 2,080 acres, includes waste rock dumps, an open pit, underground mine subsidence area, a tailings facility, and other facilities, roads and features. The mine's operational capacity is reportedly 20,000 tons per day, although the mine has not operated consistently at that level. According to the company, there may be economically justifiable reserves to support mining for at least another 20 years.

The Red River, prior to 1965, was characterized as a prime trout fishery with excellent water quality. Strong evidence, both anecdotal and in the form of data, indicates that the trout fishery in the mine's stretch of the river has virtually disappeared, and that water quality has been significantly degraded, coinciding with and as a result of mining activities. Molycorp's mining activities have the potential for enormous generation of acid mine drainage (AMD) and associated metal contaminants. AMD has polluted groundwater in the area of the mine and tailing facility that in turn is causing impacts to the Red River. Because of the nature and extent of the mining activities at Molycorp's Questa mine, maintenance of underground dewatering facilities in the area of the mine and seepage capture facilities in the area of the tailings facility, will be necessary over the long-term. Treatment in perpetuity (for up 1,000 years or more) will be necessary to ensure that pollution from the mine does not impact groundwater and surface water in the Red River even more than it does today.

Molycorp, as the owner and operator of the mine, is required by state and federal statutes to eliminate and prevent pollution from the Questa mine site, to reclaim and close the facilities when they are no longer active, and to provide financial assurance to ensure reclamation and to protect the State against potential liability. Currently the mine is required by New Mexico's regulatory agencies to obtain approved discharge plans and reclamation and closure plans; it is required by the EPA to renew its National Pollutant Discharge Elimination System (NPDES) permit; and the mine has been listed, with approval from the Governor of New Mexico, by the EPA as a proposed Superfund project.

The Full Reclamation and Closure Plan proposes aggressive measures to affect reclamation of the waste rock dumps, open pit, underground mine subsidence area, tailings facility, and other mine related features. Consistent with industry and regulatory practice, all mine facilities are regraded to maximum slopes of 2H:1V and 3H:1V or flatter wherever possible. A cover consisting of 2-ft of non acid generating (NAG) material overlain by 18 inches of growth medium would be placed over potential acid generating material, with 18 inches of growth medium placed over all other areas. Medium and high duration and intensity vegetation methods would be employed to ensure short-term erosion control and long term revegetation success. Stormwater controls would be employed to divert, capture, direct and if necessary treat surface water runoff. Groundwater seepage would be monitored and if necessary intercepted, collected and treated.

In addition, this plan includes measures to address water treatment requirements in-perpetuity and to address pollution of the Red River from tailings spills. Dedicated wastewater treatment facilities would be constructed to process contaminated groundwater and stormwater runoff. The facilities would use advanced water treatment processes to remove contaminants to standards that would allow discharge of the effluent to surface water without causing degradation of existing water quality. The tailings line along the Red River would be removed, and areas of historic tailings spills remediated by conducting removals and reclamation of those areas. Supplemental water to improve streamflow and dilute contamination of the river in the area of the mine would also be employed as an environmental mitigation.

The total cost to perform the tasks as identified for the Full Reclamation and Closure Plan is estimated at $382 million. The cost estimate assumes that reclamation and closure tasks are performed by a third party under contract to the state and/or federal agencies. The cost estimate includes approximately $253 million in direct costs for reclamation tasks, $91 million in indirect costs associated with those tasks, and $26 million in costs for a water treatment trust fund and $12 million for a Red River restoration fund. It should be noted that the estimated costs for this Plan do not include the additional cost of full mine and subsidence area backfilling and potentially higher water treatment costs. The full extent of the subsidence areas is unknown at this time. However, backfilling of subsidence areas is required under state statutes, and in the final analysis will significantly raise the final cost of reclamation. At the same time, Molycorp could undertake performance of the required reclamation and closure tasks using its own resources, both significantly reducing the inferred costs and reducing the company's liability for those costs.

## 1.0 Introduction

Molycorp, Inc (Molycorp) owns and operates a molybdenum mining operation located near and adjacent to the town of Questa, New Mexico. The mining operation includes open pit and underground mine workings with associated subsidence areas, waste rock dumps, an ore processing mill, tailings pipeline, tailings impoundment facility, and various other roads and facilities.

Production from the original underground mine started in 1921. The first workings were in Sulphur Gulch, an intermittent tributary of the Red River. From 1941 until 1956 underground mining continued with more extensive development and continued production, followed by use for exploration purposes until the early 1960s. Initial waste rock from the underground mines was deposited primarily in Sulphur Gulch. The original mill tailing disposal pile is in the vicinity of the present day mill yard and mine shop (Closeout Plan for Molycorp, Inc. 1996).

Modern day large-scale mining operations began in 1965 with open pit mining and construction of a new 15,000 ton per day ore processing plant, and the operations have run with intermittent closures up to the present day. Molycorp anticipates that the operations will continue for at least another 20 years with favorable economics. However, in accordance with state and federal laws Molycorp must make provisions for the eventual reclamation and closure of the mining operations. The provisions include the requirement to submit closure/closeout plans and provide bonding to ensure that the mining operations are reclaimed as required by applicable state and federal laws.

Molycorp is required to obtain the following permits relevant to reclamation and closure requirements:

- An approved Revised Closure Plan for the Questa mining operations as required under the New Mexico Water Quality Act by the Groundwater Protection and Remediation Bureau of the New Mexico Environment Department (NMED) for tailings impoundment Discharge Plan (DP-933) and waste rock Discharge Plan (DP-1055).

- An approved Mine Closeout Plan for the Questa mining operations as required under the New Mexico Mining Act by the Mining and Minerals Division of the New Mexico Energy, Minerals and Natural Resources Department (MMD).

- The National Pollutant Discharge Elimination System (NPDES) Permit issued by the U.S. Environmental Protection Agency (EPA) under the Clean Water Act for the mining operations is up for renewal and has been proposed in draft form.

In addition, the EPA, with the approval of New Mexico’s Governor, is seeking to list the Molycorp Questa mine site on the National Priorities List (NPL). If the mine is listed the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) would be applied to address remediation of the mine site, and the mine operations area would be treated as a Superfund site.

Amigos Bravos, Inc., Friends of the Wild Rivers, is a public interest non-profit river advocacy organization with offices in Taos and Albuquerque, New Mexico. The mission of Amigos Bravos is: To return New Mexico's rivers and the Río Grande watershed to drinkable quality wherever possible, and to contact quality everywhere else; to see that natural flows are maintained and where those flows have been disrupted by human intervention, to see that they are regulated to protect and reclaim the river ecosystem by approximating natural flows; and to preserve and restore the native riparian and riverine biodiversity. Amigos Bravos supports the environmentally sound, sustainable traditional ways of life of indigenous cultures and holds that environmental justice and social justice go hand in hand.

Amigos Bravos was founded in 1988 to protect the Río Grande and Red River from pollution from the Molycorp (Unocal) molybdenum mine near Questa, New Mexico, in response to a proposal to site a new tailings disposal facility on Guadalupe Mountain. The Red River is at the heart of the 400 year-old sustainable agrarian practices of the Hispanic and Native American communities of Taos County. The Red River, once a pristine waterway revered for its clean water and prized for its trout fishing, is the main source of water for wildlife, livestock, and the irrigation of crops and kitchen gardens for the community of Questa. The Taos Pueblo people consider the Red River sacred.

Amigos Bravos is comprised of over 1,400 dues-paying members, six employees, and governed by a nine-member Board of Directors. All members have a special interest in the Red River, and the Río Grande downstream from the Molycorp mine. Some members of Amigos Bravos avail themselves of the waters of the Red River for domestic uses, for irrigating kitchen gardens, for raising crops, and for livestock watering. Members of Amigos Bravos fish, swim and participate in other recreational, educational, and contemplative activities on or near the Red River and the Río Grande downstream of the Red River. In addition, members of Amigos Bravos have domestic wells that may be hydrologically connected to the Red River, and/or to Molycorp facilities.

Amigos Bravos has been an active public participant and has organized citizen advocacy in the state and federal regulatory processes directed by the NMED and MMD. To support their efforts, Amigos Bravos contracted with the Center for Science in Public Participation ($CSP^2$) with assistance from the Southwest Research and Information Center (SRIC) to develop an alternative Full Reclamation and Closure Plan for the Molycorp Questa mining operations. $CSP^2$ is a nonprofit corporation that provides technical expertise and assistance on mining and associated water quality issues to public interest groups, tribal, state and federal governments, and industry. The author of the report, James R. Kuipers, PE, is a consulting mining engineer to $CSP^2$.

Professional standards and approaches consistent with accepted industry practice have been used in the development of this Full Reclamation and Closure Plan. Molycorp and others developed information used in this plan with respect to the closure and closeout plans and investigations that have been carried out to date to evaluate potential environmental impacts from the mine. The plan has been oriented towards the issues that have been raised by Amigos Bravos and other public interest groups (New Mexico Environmental Law Center, Sierra Club, and interested citizens), Native American government organizations (Taos Pueblo Environment Department) and state (NMED and MMD) and federal (EPA) agencies. Specifically, this plan seeks to address protection of human, wildlife and fisheries health by preventing and treating water and air pollution from Molycorp's Questa mining operations.

Section 2 of this plan describes Amigos Bravos Full Reclamation and Closure Plan developed to achieve the desired level of environmental protection and treatment sought by Amigos Bravos and other public interests. Section 3 of this plan describes the exiting site conditions of the mine site including the waste rock piles, open pit mine, underground mine and subsidence area, tailings pipeline, tailings impoundment, facilities and roads, and water management facilities. Section 4 describes the environmental issues pertinent to the mining operations including applicable requirements and regulations, groundwater and surface water pollution, land reclamation, water management and site maintenance, and makes recommendations for reclamation measures to address those issues. In Section 5 reclamation and closure options are discussed for the various site features. Section 6 contains a reclamation and closure cost estimate prepared to determine a recommended bond amount for the alternative plan.

This Full Reclamation and Closure Plan is based upon the limited information available to the public, and is consistent with that information available to state and federal regulators. It may not contain information otherwise available to Molycorp. It should be recognized that Molycorp and its consultants, state and federal regulatory agencies, and Amigos Bravos and other public interest groups and tribal governments are currently engaged in a cooperative effort to obtain critical additional information and develop and evaluate reclamation and closeout options for the mine site. The presently existing technical information is only applicable to a conceptual level of reclamation and closure plan development. This alternative plan is dependent on numerous assumptions, and should be modified as additional information becomes available and increased certainty about environmental cause and effect becomes known. The plan represents a conservative approach to design and cost estimation based upon the limited information available.

## 2.0 Amigos Bravos Full Reclamation and Closure Plan

This Full Reclamation and Closure Plan was developed to be consistent with Amigos Bravos goals and objectives for the Rio Grande watershed. Amigos Bravos believes that full reclamation and closure using state of the art techniques should be used to obtain compliance with state and federal laws, and that mine reclamation should be performed in the most thorough and complete manner possible. This includes objectives of complete reclamation of the mine and tailings facility sites such that they are no longer readily evident as mining or post-mining sites; and closure such that no on-going operations and maintenance, including water treatment, are necessary.

The presently available information indicates, that as a consequence of the type and extent of mining operations at the Molycorp Questa mine, water treatment in perpetuity will likely be required as a feature of mine closure. The barren and unreclaimed pit walls, waste rock dumps, and underground mine subsidence areas expose a significant quantity of mineralized material with the potential to cause acid mine drainage and pollute groundwater and surface water. Combined with extensive underground workings affecting the hydrology of the local area, an artificial cone of depression needs to be maintained in the underground mine area to act as a hydrologic sink and prevent the spread of pollution into other areas. To protect water quality, surface reclamation is also required in accordance with state law to re-establish a self-sustaining ecosystem. In addition to this necessity to mitigate irreversible damage to water resources, surface reclamation is also required as a mitigation, consistent with state and federal regulations affecting mine reclamation.

There is little merit in evaluating reclamation and closure methods that have little or no likelihood of meeting the applicable state and federal regulations and fail to address the environmental and socioeconomic issues that have been raised around Molycorp's Questa mining operations. Methods that might just barely meet environmental regulations, and only marginally address the issues, should not be accepted, particularly in the presence of industry accepted and scientifically sound alternatives. The best reclamation alternative is based on fundamental principles consistent with accepted practice such as are necessary to fully comply with the law and address the issues.

Innovation should not be promoted at the expense of potential liability to the state and federal government and ultimately the taxpaying public. The approved and bonded reclamation plan should take a conservative approach and require actions and financial assurance consistent with that necessary to ensure the legally mandated outcome under less than optimistic assumptions. If the company is able to prove their contentions to the satisfaction of the regulatory agencies and the public by instituting innovative measures at their own monetary risk, then through their success the plan and financial assurance can be adjusted. However, until such proof is born out in measurable and verifiable success, the most effective measures necessary and practical should be required.

Amigos Bravos Full Reclamation and Closure plan for Molycorp's Questa mine is based upon a conservative level of application of reclamation techniques such as are presently utilized in mine reclamation practice in the United States and other developed countries when dealing with potential acid mine drainage (AMD) generating materials. In choosing reclamation options for the Questa mine modern day practices limiting and isolating the area of disturbance and potential contamination by potentially AMD generating materials are utilized. For example, certain features such as potentially AMD generating waste rock dumps are removed from distinct drainages in order to restore those drainages to a pre-mining condition. In other cases, potentially AMD generating waste rock dumps are reduced in slope a maximum of no greater than 2H:1V by a combination of partial or complete removal, regrading, earthworks or other means in order to create a stable slope and allow for installation of a cover and revegetation in order to minimize erosion and air and water infiltration. Additional reclamation measures to institute source controls by isolating the materials include the use of stormwater controls, water balance covers and revegetation to reduce the infiltration of air and water and minimize AMD production.

This Full Reclamation and Closure Plan for Molycorp's Questa mine recommends both groundwater control and treatment, and surface reclamation, for the long-term maintenance of both water quality and the requirement of re-establishment of a self-sustaining ecosystem appropriate for the life zone of the surrounding areas. From a long-term viewpoint the need to treat the surface to protect both its values and those of groundwater, surface water and other resources is clear. This alternative plan seeks through its recommended actions to ensure the best long-term result through the application of conservative measures that suggest a high level of required performance from the reclamation and closure measures to be taken.

Large amounts of potentially AMD generating waste rock, tailing, open pits and other mine operations features, require the actions necessary to protect the environment, and their corresponding costs, increase significantly. The cost of mines dealing with acid mine drainage in terms of reclamation and closure typically rises by roughly an order of magnitude, typically ranging from about $20,000 to $50,000 per acre for surface reclamation plus the cost of any ongoing treatment operations and maintenance (J. Kuipers, 2000). The Questa mine is no different except that the existence of the waste rock dumps in existing very steep slopes, the natural topography, and the lack of existing environmental management features, present an unusually difficult effort which can only be assessed by the most conservative of approaches until conclusive proof is provided of the need for or existence of less arduous means to address reclamation and closure of these features.

## Questa Mine Operations

## Full Reclamation and Closure Plan

Waste Rock Dumps

**Resloping:** A variety of the three different options discussed as in Section 5 would be used on the various waste rock dumps. On areas where it can be accomplished, such as the Blind Gulch (in-pit), Spring Gulch, Sugar Shack West, Goat Hill and Goat Hill South waste rock dumps, the waste rock dumps would be resloped to increase stability, reduce erosion, increase maintainability, allow placement of a cover, and to affect stormwater control and revegetation. Reslope angles would range in steepness up to 2H:1V to 3H:1V or flatter. Resloping in some areas would include additional slope stabilization measures such as gabbions, riprap, and rock retaining walls.

Partial removal and resloping would be used to accomplish 2H:1V slope angles or less on areas that could not be reclaimed in-situ or otherwise require reduction in size or shape to accommodate their reclamation by standard accepted means. The Spring and Sulphur Gulch, Sugar Shack South and Middle waste rock dumps would be partially removed and reclaimed.

Full removal would be used where full removal accomplishes restoration of an otherwise undisturbed watershed or where it is necessary to accomplish resloping. Full removal would also be used where AMD is present and other measures have not been demonstrated capable of achieving long-term watershed protection and abatement of AMD. In areas where complete removal is performed cover material would be placed and the area revegetated similar to other reclaimed areas. The Capulin waste rock dump would be completely removed and placed as backfill into the open pit.

**Cover:** A standard 2-ft non-acid generating (NAG) layer and 18" growth-medium cover would be used over the potentially AMD generating waste rock dump areas with steep slopes greater than 3H:1V. Given the steepness of these slopes, infiltration will be minimized and the installation of a more complex cover might not be practical. A water balance or water evaporation cover would be installed over the waste rock dump areas with slopes of 3H:1V or less. For the purposes of this plan and its corresponding cost estimate, the application of covers would be consistent over the entire waste rock areas to be reclaimed and it is further assumed that the design and cost of both covers is similar.

**Revegetation:** A combination of revegetation methods would be utilized to establish revegetation to re-establish a self-sustaining ecosystem on the resloped and covered waste rock areas. Medium intensity and term revegetation methods would be utilized to establish short-term erosion control and build up cover soil composition with an emphasis on grasses, forbs and legumes. High intensity long-term methods would be used to ensure establishment of native plant ecosystems comparable to those in the surrounding areas. Additional measures including soil amendment, plant propagation, soil nutrients and microbiota would also be applied to revegetation establishment.

**Stormwater Control and Groundwater Control:** The design criteria for the stormwater control features would be for a 100-year 24-hour precipitation event. The stormwater control system would be enhanced to minimize stormwater infiltration and maximize collection and storage to the extent practical so as to result in zero discharge of stormwater.

Groundwater control would be addressed using enhanced groundwater monitoring and seepage interception. Additional groundwater flow barriers would be installed beneath or below the waste rock dumps and employ pump and treat technology.

<u>Open Pit</u>

**Resloping:** On areas where it can be accomplished either in-situ or as a result of partial backfill the pit area slope angles would be resloped to range in steepness 2H:1V to 3H:1V or less. Resloping in some areas would include additional slope stabilization measure such as gabbions, riprap and rock retaining walls.

**Cover:** A standard 2-ft non-acid generating (NAG) layer and 18" growth-medium cover would be installed over areas of the pit that are resloped to from 2H:1V to 3H:1V. A water balance or evaporative cover would be installed over resloped open pit areas with slope angles of 3H:1V or less, including all pit benches and terraces.

**Revegetation:** A combination of revegetation methods would be utilized to establish revegetation to re-establish a self-sustaining ecosystem on the resloped and covered waste rock areas. Medium intensity and term revegetation methods would be utilized to establish short-term erosion control and build up cover soil composition with an emphasis on grasses, forbs and legumes. High intensity long-term methods would be used to ensure establishment of native plant ecosystems comparable to those in the surrounding areas. Additional measures including soil amendment, plant propagation, soil nutrients and microbiota would also be applied to revegetation establishment.

**Stormwater Control and Groundwater Control:** The design criteria for the stormwater control features in the open pit area would be for a 100-year 24-hour precipitation event. The stormwater control system would be enhanced to minimize stormwater infiltration and maximize collection and storage to the extent practical so as to result in zero discharge of stormwater. Stormwater control features would be installed on all reclaimed areas in the open pit and to the extent practical on other areas.

Groundwater control would be addressed using enhanced groundwater monitoring and seepage interception. Additional groundwater flow barriers would be installed beneath or below the waste rock dumps and employ pump and treat technology.

<u>Underground Mine Subsidence Area</u>

**Backfill:** Future tailings would be used to backfill subsidence areas, eliminating future need for the existing tailings facility. Backfill would also be accomplished coincidentally with partial or complete removal of waste rock dumps being reclaimed. The backfill of future tailings would coincide with short-term closure of the tailings facility and allow reclamation to be completed at that site in a more expeditious manner.

**Surface Reclamation:** The subsidence areas would be resloped, covered and revegetated to increase stability, reduce erosion, increase maintainability, allow placement of a cover, and to enhance stormwater control and revegetation. Reslope angles would range in steepness up to 2H:1V or less. Resloping in some areas would include additional slope stabilization measure such as gabbions, riprap, and rock retaining walls.

Further consideration of reclamation of underground mine subsidence areas is contained in Appendix D – Open Pit Mine and Subsidence Area Reclamation.

<u>Tailings Impoundment</u>

**Resloping:** The sides of the tailing impoundments would be resloped to increase stability, reduce erosion, increase maintainability, allow placement of a cover, and to enhance stormwater control and revegetation. The top areas of the tailings impoundment would be graded to obtain slopes of approximately 1-2% in all areas and side slopes would be regraded to 3H:1V or less. Resloping would also be done in some areas outside the tailings impoundments within the tailings facility area to improve reclamation and aesthetics on other disturbed areas.

**Cover:** A 2-ft NAG and 18" growth-medium cover would be established over the tailing impoundments area side slopes. A water balance or water evaporation cover would be installed over the flatter lying tailing impoundments areas. The covers would minimize infiltration and contaminated seepage generation, and prevent uptake of molybdenum and other metals.

**Revegetation:** A combination of revegetation methods would be utilized to establish revegetation to re-establish a self-sustaining ecosystem on the resloped and covered tailing impoundments areas. Medium intensity and term revegetation methods would be utilized to establish short-term erosion control and build up cover soil composition with an emphasis on grasses, forbs and legumes. High intensity long-term methods would be used to ensure establishment of native plant ecosystems comparable to those in the surrounding areas. Additional measures including soil amendment, plant propagation, soil nutrients and microbiota would also be applied to revegetation establishment.

**Stormwater Control and Groundwater Control:** The design criteria for the stormwater control features on the top of the tailing impoundments would be for a 100-year 24-hour precipitation event. The stormwater control system would be enhanced to minimize stormwater infiltration and maximize collection and storage to the extent practicable so as to result in zero discharge of stormwater from the tailings impoundment area.

Groundwater control would be addressed using enhanced groundwater monitoring and seepage interception. Additional groundwater flow barriers would be installed beneath or below the tailing impoundments and employ pump and treat technology.

Water Treatment

Mine Area

**Water Collection and Treatment Facilities:** The existing pump and treat scheme would be improved by providing better and more reliable infrastructure and treatment systems. More advanced pump and treatment processes would be installed including advanced wastewater treatment technology (such as reverse osmosis or ion exchange) to affect water quality to the extent practical so that it can be discharged without degrading receiving waters.

Tailings Facility Area

**Water Collection and Treatment Facilities:** The existing pump and treat scheme would be improved by providing better and more reliable infrastructure and treatment systems. More advanced pump and treatment processes would be employed, including advanced wastewater treatment technology (such as reverse osmosis or ion exchange) to affect water quality that to the extent practical so that it can be discharged without degrading receiving waters.

Red River

**Flow, Chemistry and Geomorphology:** Water will be provided to restore or supplement original stream flows in the Red River. If necessary, mine wastewater will be treated prior to being put in the Red River. In discrete areas, contaminated sediments and tailings from the mine in the Red River floodplain will be removed, and the river and floodplain geomorphology and ecology will be restored.

Facilities, Roads and Other

All facilities, roads and other mine site features would be reclaimed. All buildings and other facilities and infrastructures would be removed, as well as any other introduced features not consistent with post-mining land use. Reclamation in all areas would involve at a minimum revegetation efforts consistent with those described elsewhere in this plan, and where necessary and consistent with other areas include additional resloping, cover and other reclamation features. In addition, garbage dumps and other potentially polluting features at the mine site would also be investigated and addressed.

Full Reclamation and Closure Cost

The cost to Molycorp of the Full Reclamation and Closure Plan is estimated at from $150-$200 million. A financial assurance cost of $382 million has been estimated as being necessary in the event Molycorp fails to fulfill its responsibilities to reclaim the mine site and the state were to become responsible for reclamation (see Section 6). However, the financial assurance cost represents the potential cost for the responsible state or federal agencies to perform reclamation and closure. It should be possible for Molycorp, using its own resources, to carry out the same reclamation and closure measures for approximately one-half the cost of the financial assurance estimate. The reclamation liability and corresponding financial assurance costs would be reduced as work is carried out at the mine site, which should serve as an incentive to Molycorp to perform reclamation and closure tasks.

## 3.0 Background

The Questa mining operations are located near and adjacent to the town of Questa in Taos County, New Mexico (see Figure 1). The open pit operations have been intermittently active since 1965 to the present, with intermittent closures in 1982, from 1987 to 1988, and from 1992 to 1996 (Questa Tailings Facility Revised Closure Plan, 1998).

Mine Operations Area

The mine area is located between three and six miles east of the town of Questa. It lies in the Red River valley at an elevation of from about 7,600 feet to in excess of 9,000 feet at its upper elevations. The mine area consists of the open pit, various waste rock dumps, the underground mine area and subsidence (caved area) zone, and mill site as shown in Figure 2.

The town of Red River is the nearest and most similar weather recording station to Molycorp's Questa mining operations area. The station has recorded total annual precipitation ranging from a low of 11.21 inches to a high of 27.41 inches over a 44-year period.

The hydrology of the Questa mine area appears to be characterized by a shallow flow system with groundwater moving through alluvium in the side canyons to emerge in springs and seeps along the river; and a deeper groundwater aquifer below the river at approximately the water draw-down level of the underground mine. Water is currently pumped for use in the process plant where it is mixed with the ore and sent with the tailings to the tailing facility. The water level in the mine working is reported to be approximately 200 feet below the river level. The mine waste dumps contribute to the shallow ground water aquifer and surface runoff. The shallow and deep groundwater systems may be interconnected and allow movement of water and leachate from shallow groundwater to the deeper bedrock aquifer. Water quality monitoring along the north side of the Red River indicates that contaminated groundwater from the waste rock dumps and other areas flows into the springs and seeps that contribute to base flow of the Red River (Molycorp and the Red River, 1995).

Tailings Facility Area

The Questa Tailings Facility is located adjacent to the town of Questa. It lies in an alluvial plain at an elevation of about 7,600 feet a.s.l. bordered by the Sangre de Cristo Mountains to the east and the Guadalupe Mountains to the west. To the south, the Red River has cut a prominent valley 100 to 200 feet below the level of the alluvial plain as indicated in Figure 3. The piedmont alluvial plain extends to the north of the tailing impoundments.

The climate of the tailing impoundments is semi-arid with highly variable precipitation and temperature. Nearby weather stations in the alluvial plain record an average of 12.24 inches annual precipitation with most of the precipitation occurring as summer thunderstorms (over 40% of total precipitation occurs from July to September). Summer temperatures range from minimum temperatures in the low 40s to maximums in the low 80s. Winter temperatures typically go as low as in the 0s (but have been measured at minus 30 or below) with daytime highs generally above freezing. Snow falls in the area of the tailing impoundments, with the amount of snow pack varying from year to year. The maximum 100-year 24-hour precipitation prediction by the U.S. Weather Bureau for the area is 2.8 inches.

Pan evaporation rate for the tailing impoundments area are not available. The nearest comparable weather station records pan evaporation of approximately 65-70 inches per year (during April to October).

The tailing impoundment area has an average growing season of 120 days. Grasses, forbs and shrubs adapted to the environment grow despite the short growing season. The pre-existing vegetation in the area of the tailing impoundments was primarily pinon-juniper woodland in combination with sagebrush. The bottoms of the arroyos were mainly grasses with some woody vegetation.

The Questa Tailings Facility is located approximately 5 miles northeast of the confluence of the Red River and the Rio Grande. The Red River runs approximately one quarter mile adjacent and down-gradient of the tailing impoundments. The lower four miles of the Red River were designated a Wild and Scenic River by the U.S. Congress in 1968.

The tailing impoundments were constructed in two deep arroyos that run in a southwesterly direction towards the Red River valley. The arroyos drained the eastern slopes of the Guadalupe Mountain and the alluvial plain to the north. The arroyos likely supported intermittent stream flow only during intense summer thunderstorm activity with short-duration, high peak flows.

The eastern section of the Tailings Facility was entirely constructed on recent alluvial sediments, whereas the western section was constructed partially on alluvial sediments and partially on volcanic rocks (basalt flows). Beneath the tailings facility and underlying recent alluvial sediments the basalt flows gradually dip eastward.

The water table is typically 60 to 160 feet below ground surface in the alluvial sediments. Most irrigation and water supply wells in the area, including those located downgradient below the tailing impoundments and above the Red River, are completed in the recent alluvial sediments. The water table in the volcanic aquifer(s) is typically several hundred feet below ground surface. The interaction of shallow groundwater flowing from the alluvial sediments to the deeper volcanic aquifer is an important feature of groundwater flow at the Questa tailings site. Groundwater from the alluvial aquifer moves through a confining layer of clay or silt material recharging the deeper volcanic aquifer below. Perched conditions (i.e., shallow groundwater) in the vicinity of Dam No. 1 are also very important in that they control the flow paths and mixing of the tailings pond seepage and the natural groundwater.

Groundwater in the tailing impoundments area generally moves from areas of higher elevation to the north and west, to areas of lower elevation to the south and east (i.e., discharge areas along the Rio Grande and the Red River). The groundwater generally moves in a westerly direction through the alluvial sediments, and drains eventually into the underlying, permeable volcanics. The groundwater is discharging at natural discharge points in and adjacent to the Rio Grande and Red River (Questa Tailings Facility Revised Closure Plan, 1998).

## 4.0 General Site Descriptions

The existing mining operations disturb a total of 2,080 acres within a total Molycorp property of approximately 6,000 acres (Closeout Plan for Molycorp, Inc. 1996). Table 1 shows the approximate distribution of the various acres disturbed by the mine operations.

**Table 1**
**Mine Operations Area Disturbance by Location**
**(Closeout Plan for Molycorp, Inc. 1996)**

| Mine Operations Area | Disturbance Area (acres) |
|---|---|
| Waste Rock Dumps | |
| Blind Gulch (in-pit) | 118 |
| Spring Gulch | 78 |
| Spring and Sulphur Gulch | 102 |
| Middle | 100 |
| Sugar Shack South | 83 |
| Sugar Shack West | 95 |
| Capulin | 65 |
| Goat Hill | 74 |
| Goat Hill South | 35 |
| Sub-Total Waste Rock Dumps | 750 |
| Open Pit | 300 |
| Underground Mine Subsidence Area | 80 |
| Tailings Facility | 640 |
| Facilities, Roads and Other | 310 |
| Total Mine Operations Area | 2,080 |

Waste Rock Dumps

The waste rock dumps were formed simultaneous with open pit mining activities. In general, waste from the open pit was hauled horizontally and dumped at similar levels in the waste rock dumps. Nine discrete waste rock disposal areas have been created as identified in Table 2.

The total waste rock area disturbs approximately 750 acres. Future waste rock dumps, if open pit mining were to be conducted in the future, would increase the disturbance area to approximately 1,145 acres (Closeout Plan for Molycorp, Inc. 1996).

Open Pit Mine

The open pit mine started in 1965 and was active until 1983 (Questa Tailings Facility Revised Closure Plan, 1998).

According to Molycorp, in the future, depending on economic conditions, the present open pit could be mined again. This would expand the existing excavation. Most of the burden would be placed in Capulin Canyon. The mining method would be similar to that previously used during open pit operations (Closeout Plan for Molycorp, Inc. 1996).

**Table 2**
**Waste Rock Disposal Area Quantities by Location**
**(Closeout Plan for Molycorp, Inc. 1996)**

| Waste Rock Disposal Area | Waste Rock Quantity (tons) |
|---|---|
| Blind Gulch (in-pit) | 36,000,000 |
| Spring Gulch | 31,000,000 |
| Spring and Sulphur Gulches | 80,000,000 |
| Middle | 46,000,000 |
| Sugar Shack South | 53,000,000 |
| Sugar Shack West | 31,000,000 |
| Capulin | 26,000,000 |
| Goat Hill | 16,000,000 |
| Goat Hill South | 9,000,000 |
| Total Waste Rock | 328,000,000 |

Presently approximately 300 acres are disturbed by the open pit. If possible future open pit mining activities are conducted approximately 87 acres of open pit would remain (with the future open pit largely becoming part of the NE subsidence area) (Closeout Plan for Molycorp, Inc. 1996).

Underground Mine and Surface Subsidence Area

The underground mine has been operated intermittently from 1982 to the present time (Questa Tailings Facility Revised Closure Plan, 1998). According to Molycorp, there is a minimum of 25 years of ore reserves left in the present underground ore body which could extend the life of the underground mine through the year 2020, assuming that favorable conditions will exist for the life of the orebody.

According to Molycorp, they are presently in a new phase of the underground mine, and will be mining ore to the east rather than the west as has been done in the recent past. The molybdenum ore will be mined using the underground block caving method employed at the Questa mine using both gravity and mechanical loading systems of ore drawdown. In both draw methods, panels of ore are undercut to induce caving, permitting the broken ore to be drawn off from below. The gravity draw system uses the force of gravity and draw and transfer raises to move the broken ore vertically from the undercut and caving level to the chutes in the haulage drifts. The mechanical method uses mechanized equipment to handle the ore flowing through the draw points. The chutes load ore onto underground trains that transport the ore to a belt conveyor that brings the ore to the surface mill. Shafts, conveyor decline, and a surface plant service and ventilate the underground mine.

The underground mining method employed at Questa will leave a surface subsidence zone. The ore mined to date has left a visible subsidence cave area. The final mine plan would leave two cave areas. According to Molycorp, surface subsidence of the underground mine will stop once underground mining has been terminated.

According to Molycorp approximately 80 acres are disturbed by the existing subsidence area. If possible additional underground mining were to be conducted the final subsidence area would total approximately 1228 acres (Closeout Plan for Molycorp, Inc. 1996).

Tailings Facility

The Questa Tailings Facility is subdivided into sections based on historic development. As they currently exist they comprise three impoundment systems (See Figure 3 – Tailings Facility Overview). The first system located in Section 36 consists of Dams 1 in the south, Dams 1B, 1C, and 2A on the east and a separator dike between this impoundment and the second system. The second system located in Section 35 consists of Dam 4 in the south, Dam 3A in the north and a discontinuous containment dike along the west. The third system, also located in Section 35, consists of Dam 5A in the south and impounds against Dam 3A. The third system is the currently active (receiving) tailings area.

Dam 1 was constructed in 1966 as an earth fill dam across an arroyo. It contains a blanket and chimney drain and was raised by downstream construction using earth fill. The last raising was upstream construction using earth fill. The dam includes a 120-foot wide toe berm installed in 1981 that was required for stability. Initially water was decanted from the tailings impoundment through two vertical, lined concrete penstocks to a horizontal decant conduit. This conduit was abandoned and plugged with approximately 20 feet of concrete in the early 1970s. Old Dam 1C was constructed of cycloned sand 650 feet upstream of Dam 1. New Dam 1C was constructed at its present location, replacing the old dam, contained within the tailings deposited behind the new dam. The new dam was designed to address static and dynamic stability criteria. It incorporates a chimney and blanket drain and includes a downstream berm to provide stability. The separator dike between the Section 35 and Section 36 impoundment was stabilized in 1991 by installing a downstream berm.

Dam 4 was constructed in 1974 as an earthfill dam across an arroyo and incorporates a chimney and blanket drain. Seepage is “controlled” by an upstream asphalt membrane. More recently changes have been made to the design and a change of material for what Molycorp calls the “seepage cut-off” to a high-density polyethylene (HDPE) geomembrane. Dam 3A is an earthfill dam constructed in 1973. Dam 5A was constructed in 1990 in the old west decant channel on the north side of the Dam 3A. It was raised in 1996 as a zoned rockfill dam and tailings are currently being placed in the impoundment.

Two diversion ditches, the East and West Drainage Ditches, were constructed around the tailing impoundments to collect runoff from areas above and adjacent to the tailings facility. According to Molycorp, both ditches were designed to pass the one hundred-year frequency storm event over the entire catchment basin, with three feet of freeboard. No flow has been observed in the west diversion ditch, and only minor flows have been observed in the east diversion ditch (apparently associated with irrigation water discharges rather than storm water flows).

The only significant structures in the tailings facility area are associated with the water decant, water treatment and discharge channels. For most of the facility life tailings water discharge has been along the western decant channel of Dam 4. The decant channel discharged over the western abutment of Dam 4 to Pope Lake and its downstream drainage into the arroyo and eventual into the Red River. Since1983 Molycorp has been required to treat process water prior to discharge. Water exceeding discharge standards is transferred to the ion exchange plant where it is treated and then discharged from Pope Lake to the Red River. The ion exchange plant is a structural steel building with a concrete floor containing water treatment process equipment. In addition a small administration building is located on the site.

Over the years the tailings have been deposited in a variety of location and by varying methods, resulting in a high variability of tailings deposits in the impoundments. In many places the coarsest tailings (sands) are deposited near the discharge point creating a “beach,” while the finest fraction (slimes or fines) are carried to near the pond. The sand beaches drain rapidly and allow for construction traffic. The slimes areas are very soft with low shear strength and cannot be accessed when wet and saturated.

Over the depositional history of the tailing impoundments site, from 1966 to 1997, approximately 96 million tons of tailings were produced by mining operations and impounded within the tailings facility. The tailings within the tailing impoundments cover a surface area of approximately 546 acres within the approximately 1,000-acre area of the tailings facility.

The mining history and depositional history of tailings over the approximately 25-year life of the tailings facility are intimately related. Geochemical variability in the ore zones mined at Questa has resulted in different geochemical types within the tailings facility. Ore has been mined as a mixture of either andesite or aplite rocks. The andesites have a higher sulfide content than the aplites. Andesite and aplite tailings can be separately identified in the tailing impoundments.

During the ore milling process, lime is added to maintain a relatively high pH (depressing specifically iron pyrite, a sulfide mineral commonly associated with acid mine drainage). The high pH can retard the oxidation of sulfides and formation of acid mine drainage (AMD). Due to the introduced alkalinity the Questa tailings are not currently acid generating, and the pH of the tailings is near neutral at surface and depth. According to Molycorp, using a modified neutralization potential (NP) and acid generation potential (AP) acid/base accounting (ABA) ratio of 1.5 for tailings materials to indicate acid generating potential, approximately 80% of the tailings have been initially characterized as acid consuming, 14% were considered uncertain, and 6% were considered to be potentially acid generating.

However, ongoing oxidation is occurring in the exposed tailings and to a lesser degree at depth. Ongoing oxidation is evidenced by increased sulfate ($SO_{4-}$) levels and increased levels of iron, manganese and molybdenum in leach extraction samples. Geochemical characterization indicates that these constituents in tailings leachate exceed concentrations greater than those defined by the New Mexico groundwater standards. Sulfate concentrations in the medium and long term are expected to be in the order of 3,000 mg/L, well in excess of New Mexico's groundwater quality standards.

Wind erosion and dust from the tailings has historically been a problem at the tailing impoundments. To control dusting, in the early 1990s a program of interim cover placement was implemented. This comprised the placement of approximately nine inches of alluvial gravel material as a cover onto the tailings beaches followed by the establishment of vegetation on the covers. Some areas of the tailing impoundments had been covered previously by similar methods. Most exposed beach areas of the tailing impoundments were covered between 1992 and 1998. The cover material is alluvial gravels borrowed from the impoundment area. Extensive deposits of material of similar nature are available locally. The gravel contains coarse rock material that is desirable for both wind and soil erosion control. Historically, a spray tackifier (magnesium chloride) has also been used for dust control. Tackifiers control dust by bonding surface particles together, preventing their being carried away by wind and water erosion.

Future operations call for continued use of the Questa Tailings Facility. Molycorp projects a requirement for an additional 82 million tons of tailings for a further 23.5 years of operation, with operations projected until approximately 2020. It is presently anticipated that the existing dams will be raised to accommodate the additional tailings, with no new surface area disturbance. The tailing impoundments would be completed in sections to allow for concurrent reclamation. Other facility operations will continue similar to the present including the installation of interim covers, wastewater treatment and discharge, seepage interception, and groundwater and surface water monitoring (Questa Tailings Facility Revised Closure Plan, 1998).

However, other information by Molycorp suggests either the facility will be increased in size, or the existing size is greater than reported. According to the Molycorp Closeout Plan there are presently approximately 640 disturbed acres at the tailings facility, and with additional possible mining the future tailings facility would disturb approximately 1100 acres (Closeout Plan for Molycorp, Inc. 1996).

Facilities, Roads and Other

Processing Plant

Molybdenum disulfide (molybdenite) is extracted from the ore in a 20,000-ton per day capacity crushing, grinding and flotation beneficiation plant. A molybdenum concentrate is produced and tailings from the plant are hydraulically transported via the tailings line to the tailings facility. The processing plant site, including old tailings, disturbs approximately 310 acres (Closeout Plan for Molycorp, Inc. 1996).

Tailings Line

A 50,000-foot tailings line system connects the mill to the tails disposal facility. The system runs from the mill and parallels State Highway 38 to the Questa US Forest Service (USFS) ranger station, where it swings south and west along USFS and private land. The lines then cross State Highway 522 just south of the Village of Questa and go northwest into the tailings disposal property. The tailing transportation system could: (a) be used for the life of the mine; or (b) be used to transport excess mill water to the tailings disposal facility; or (c) be removed if the present open pit were to be used as a tailings disposal facility. If (a) or (b) were selected, reclamation of the right-of-way and support facilities including dump sumps, tailing line support structures and trestles, etc would not be started until final shutdown of the mine. If (c) were selected, the tailings transportation system could be salvaged, and reclamation of the facility could start after the lines right-of-way is cleared (Closeout Plan for Molycorp, Inc. 1996).

Water Management

Mine Area Stormwater Management

According to Molycorp, they have developed and utilize a stormwater management plan to divert and contain runoff from runoff events and maintain all interception, diversion and containment systems and facilities. Runoff from upper Capulin Canyon is intercepted and passed through a borehole into Goat Hill Gulch where it mixes with runoff from upper Goat Hill Gulch. This runoff is then intercepted down-canyon, by the present underground subsidence area. Runoff generated from the terrain below the Goat Hill subsidence area is contained in a multiple catchment system constructed in lower Goat Hill Gulch. The benches on the waste rock dumps have been bermed and sloped towards the open pit excavation to ensure that runoff is diverted to the open pit. Runoff from the upper mill area is diverted down the access road to the primary crusher. Runoff not touched by the plant process is diverted off the mill area property just before it reaches the lower mill yard. Runoff in and around the lower mill yard area is contained behind a berm located just west of the assay lab. The west mill yard runoff is contained in a large concrete sump. The runoff from this yard catchments can be pumped into the mill process. According to Molycorp, all diversions are designed to minimize possible adverse impacts to the embankments and groundwater.

The pre-mining watershed configuration will not match the post-mining watersheds configuration because open pit waste rock has been placed in several of the canyons on the mine property. The open pit excavation has also opened up the Sulphur Gulch canyon it is located in (Closeout Plan for Molycorp, Inc. 1996).

Mine Area Groundwater and Surface Water Discharge

According to Molycorp, potential water contamination from the property should not be a problem since possible seepage from the waste rock dumps and other areas is intercepted by the cone of depression created by maintaining an artificially lowered groundwater level in the underground workings. The open pit excavation also intercepts the surface and shallow groundwater drainage from the mine area (Closeout Plan for Molycorp, Inc. 1996).

Tailings Water Treatment and Discharge

The tailings ponds wastewater has been discharged to a decant channel which discharged over the west abutment of Dam 4 to Pope Lake and its downstream drainage into the Red River. Since 1983 Molycorp has been required to operate the ion exchange (IX) water treatment plant to reduce molybdenum in tailings pond wastewater prior to discharge. The ion exchange process removes molybdenum by first acidifying the tailings wastewater to a low pH using acid, then passing it through resin filled ion exchange columns where molybdenum is removed, recovered and disposed of. The wastewater is then neutralized with lime to a pH between 6.0 and 9.0 prior to being discharged into Pope Lake and eventually the Red River (Questa Tailings Facility Revised Closure Plan, 1998).

Tailings Water Seepage Interception System

Since 1975 a series of seepage interception systems have been progressively developed, consisting of shallow drains and extraction wells, has been progressively developed down gradient of Dam 1 to intercept seepage originating from the tailings impoundments. The tailings water seepage interception system is used to extract poor quality tailings water seepage with high concentrations of sulfate in the order of 800 to 900 mg/L (compared to 20 mg/L in unimpacted groundwater). The seepage interception system continuously removes from approximately 250 – 350 gpm of mixed tailings leachate and shallow groundwater. The intercepted groundwater is then discharged to a ditch that flows into the Red River. Deep groundwater extraction wells have also been installed that intercept groundwater impacted by tailings seepage as evidenced by elevated sulfate and total dissolved solids (TDS) concentrations (Questa Tailings Facility Revised Closure Plan, 1998). Information evaluated by NMED and others indicates that as much as 50% of the seepage in not captured by the tailings water seepage interception system.

Tailings Groundwater Monitoring

19 monitoring wells have been installed over the past twenty years to monitor groundwater quality downstream of the Questa Tailings Facility. The groundwater monitoring indicates that the seepage from the tailings facility has resulted in a significant increase in the concentration of sulfate, molybdenum and total dissolved solids (TDS) in the shallow groundwater immediately downstream of Dam 1. Monitoring of deep groundwater monitoring wells indicates only slightly elevated sulfate levels indicating tailings seepage entering the deep aquifer is diluted by the deep groundwater flows (Questa Tailings Facility Revised Closure Plan, 1998). Monitoring wells show that the interception system is not capturing seepage water to the extent necessary to prevent contamination of groundwater outside of the area of influence of the seepage capture system.

Red River

Red River stream flows have been measured by the U.S. Geological Survey (USGS) at the Questa Ranger Station (just upstream of the confluence of Cabresto Creek with the Red River) since 1913. The drainage area above the Questa gauging station extends over 113 square miles with much of the area in river canyon and high mountain country. The highest peak instantaneous flow recorded at the Questa gauging station was 886 cfs.

During operation of the Questa Tailings Facility tailings wastewater is typically decanted, treated if necessary, and discharged into the Red River using Outfall 001. In addition, tailings seepage from the interception system downgradient of Dam 1 is also discharged into the Red River using Outfall 002. Finally, any tailing seepage not intercepted and mixing with groundwater flowing beneath the tailings impoundments also discharges into the Red River. This implies that the Red River receives all the tailings process water and seepage from the Questa Tailings Facility (Questa Tailings Facility Revised Closure Plan, 1998).

## 5.0 Environmental Issues and Recommendations

A number of environmental issues exist at the Molycorp Questa mine operations relevant to ground and surface water pollution, mined land reclamation practices, water management, site maintenance, and employee and public safety. Most of these issues are typical to most mining operations, but are compounded by the size of the Questa mine, the presence of significant acid mine drainage generating materials, and complex topography and hydrology. The issues relevant to reclamation and closure are described further in this section.

<u>Ground and Surface Water Pollution</u>

There is very limited data available on the "baseline" water quality of the Red River pre-dating the development of the Questa mining operations. Up to the time of modern-day mining activities in the mid-1960's, the Red River was characterized as a prime fishery with "exceptional" chemical quality and "good" biological condition. In 1982, after over 15 years of open pit mining activity the EPA reported that the Red River had "acute" concentrations of ambient total arsenic, cadmium, and silver; that levels of all metals except zinc had increased at control stations that had been established for periodic resampling; and that "some biological response may be occurring in the Red River" (Molycorp and the Red River, 1995).

While there is limited hard data available, there is a significant body of evidence from personal accounts – both verbal and written – of community members, fishermen, and visitors indicating that the Red River was a healthy stream where people remember playing, swimming and drinking from its waters, and catching large native trout no longer to be found. Since 1997, Amigos Bravos has collected over forty oral histories documenting personal recollections of living near or visiting the Red River. All of the people interviewed perceived the river to be clean and healthy prior to the 1960s. Most of the oral history participants identified a rapid deterioration of water quality beginning in the late 1970s. They share a common perception that the river is no longer safe for their children to play in, and that the Molycorp mining operations have been the single greatest contributor to the pollution of the Red River.

Mine Area

According to the US Environmental Protection Agency (EPA), more than twenty seeps have been identified along the north side of the Red River between the towns of Questa and Red River. Available data indicate a correlation between the mine waste rock dumps and erosional scar leachate chemistry and seep water chemistry. In addition, the presence of seeps also appears to coincide with disturbed areas, including the waste rock dumps (Abshire, D., 1998). According to NMED, acid mine drainage impacted groundwater seeps, derived in part from infiltration through waste rock dumps, release contaminants to the Red River from the mining site. While most of the leachate from the waste rock dumps is directed to groundwater through the mine workings, some of the leachate may drain to the Red River. In addition, contaminated surface water runoff is collected and discharged (during high runoff events) to the Red River. Other discharges may also occur where rock drains have been constructed at the toes of waste rock dumps to convey water to the river (Slifer, D., 1996).

Water chemistry varies between the seeps. However, the EPA reports that all are acidic and contain elevated concentrations of total dissolved solids (TDS), including sulfate, aluminum, iron, manganese, cobalt, copper, nickel, zinc, cadmium and fluorine. The concentrations typically exceed New Mexico Ground Water Standards, with the highest concentrations of metals in all seeps being dominated by aluminum, magnesium and iron (Abshire, D., 1998). According to NMED, USGS seepage studies in 1965 and 1988 indicate that groundwater seepage to the Red River below the mine increased substantially over the 23 years spanning the period before and after open pit and waste rock dump development (Slifer, D., 1996).

Molycorp contends that erosional scars are the primary cause for metals loading to the Red River. However, the EPA suggests that unconsolidated waste rock dump material appears to deliver greater concentrations of dissolved metals to ground water than the consolidated erosional scars. The EPA concluded that although erosional scars can also release high metals concentrations to groundwater which may discharge to surface water, the additional waste rock dump materials increases the concentrations delivered to the underlying aquifer well above those concentrations contributed by erosional scarring (Abshire, D., 1998). Molycorp's consultants have concluded that acid generation is occurring in the waste rock dumps and is a relatively immature process in some of the dumps. This means that over time the dumps may produce more or worse quality acid mine drainage, and could cause even greater increases in metals loadings to local springs and seeps flowing into the Red River (Slifer, D., 1996).

Road-building and other construction activities, abandoned mines, septic tank discharges, and hydrothermal scar areas have been identified as sources of some of the environmental impacts to the Red River, both above and within the reach where Molycorp's operations are located. However, a significant deterioration in water quality has been consistently observed beginning downstream of the mine area (Molycorp and the Red River, 1995). In addition, to at least some extent the hydrothermal scars are initiated by a loss of cover that is often associated with human activities such as road building, mining, and other human activity. In those cases, the process can not be described as "natural".

EPA also found that data supports the presence of a hydrologic connection between the waste rock dump seepage and the immediate groundwater. Red River seep water quality indicates that seeps considered hydrologically connected to the waste rock dumps discharge high metals concentrations to the river. It is theorized that the perched nature of the shallow bedrock aquifer in the immediate area apparently causes a longer ground water residence time, and therefore, greater concentrations (Abshire, D., 1998). NMED concurs with EPA, finding that the role of bedrock fracture flow as a pathway between mine waste sources and river seeps cannot be overlooked. In addition, NMED found that the open pit and underground mine workings should also be considered as acid mine drainage sources that may impact water quality of the Red River seeps (Slifer, D., 1996).

Tailings Facility Area

According to EPA, sampling indicates that the only probable source for elevated sulfate and metals concentrations found in ground water in the area of the tailings facility are the tailings impoundments. Infiltration of tailing impoundment leachate to the underlying shallow alluvial aquifer is supported by a correlation between ground water quality below and down gradient of the facility. Ground water samples taken immediately down gradient of the ponds show sulfate and metals concentrations above New Mexico Ground Water Standards (Abshire, D., 1998).

NMED has identified approximately 25 seeps along the Red River below the Tailings Facility. The tailings ponds have hydrologically influenced some of the seeps. Five seeps have elevated sulfate concentrations that correlated with seepage attributable to the tailing impoundments (including two that provide a portion of the water supply for the Red River Fish Hatchery). Molycorp has provided information to NMED verifying contamination in wells downgradient from the tailings ponds. Seepage from the tailings has contaminated the underlying shallow alluvial aquifer and elevated concentrations of total dissolved solids (TDS) and sulfate are present in most of the wells, with occasional elevated concentrations of molybdenum and manganese (Slifer, D., 1996).

Molycorp has conducted several field investigations to evaluate the impact of tailings seepage on the water quality of the local aquifers. Monitoring and extraction wells have been installed down-gradient of the tailing impoundments (Questa Tailings Facility Revised Closure Plan, 1998). As an initial groundwater contamination containment measure, Molycorp constructed seepage collection barriers between the toe of the dams and the Red River. Collected seepage water is removed from the groundwater system and discharged directly to the Red River.

According to Molycorp, surface water monitoring indicates that the discharge of tailings wastewater and seepage into the Red River causes sulfate and TDS concentrations to rise slightly, which is primarily detectable below the discharge points. The input of sulfate and soluble metals is diluted by Red River flow and groundwater recharge from other areas to surface water (Questa Tailings Facility Revised Closure Plan, 1998).

Land Reclamation Practices

The land reclamation practices currently exhibited at Molycorp's Questa mine bear little or no resemblance to modern accepted reclamation practice. Fundamental reclamation science, employing resloping, covers and revegetation has been ignored in apparent favor of a minimalist approach that seeks to take advantage of existing circumstances and practices and it has resulted in neither serious reclamation nor significant expenditure. Unlike the majority of modern mining operations that take pride in demonstrating their reclamation expertise, Molycorp has instead chosen to offer excuses and barely token efforts at reclamation.

Picture 1 (see Appendix B) shows the Molycorp Questa Mine open pit and waste rock dumps. In the entire mine facility area, with the exception of some small test plot areas, no reclamation consistent with modern practice has been performed by Molycorp to date. Picture 2 shows the Molycorp Questa Mine tailings facility. The only reclamation performed at the tailings facility was interim reclamation, which the company is now proposing to serve as final reclamation.

Picture 3 shows the Spring and Sulphur Gulch and Middle waste rock dumps as viewed from the highway next to the mill facility. Although mining in the open pit was discontinued in the early 1980s, no significant reclamation has been performed on the mine waste rock dumps. Picture 4 shows a closer view of the Spring and Sulphur Gulch waste rock dump. Molycorp has attempted some in-situ revegetation on the angle of repose dump slopes, but as shown in this and the following photographs, significant revegetation is absent on the dumps.

Picture 5 shows the deep erosion gullies present in the Spring and Sulphur waste rock dumps, and Picture 6 shows the eroded material at the toe of the dump. The significant amount of eroded material at the toe of the dump is direct evidence of the unstable and highly erosive nature of the dumps. Picture 7 shows even deeper erosion gullies on the upper sections of the Middle waste rock dumps. Molycorp claims to have installed stormwater controls in the waste rock dump areas, but as demonstrated in Picture 8, those stormwater controls are rudimentary at best, and in many cases do not serve their intended purpose.

The only significant revegetation efforts at the mine facility area are the revegetation test plots shown in Picture 9. Molycorp claims to have done some seeding of the waste rock dumps, however it is not evident on inspection and the techniques used are inconsistent with accepted practice.

Picture 10 shows the open pit highwall. The highwall shows numerous areas where seepage, likely contaminated by acid mine drainage generating rock, is evident. As shown in Picture 11, some areas of the highwall appear to be fairly stable and intact, as demonstrated by the obvious pit benches in the section of highwall shown in this picture. However, as shown in Pictures 12, 13 and 14, large areas of the pit highwall were unstable at the end of mining and have since either eroded, sloughed or failed leaving large areas of unreclaimed ground. Molycorp has requested a waiver from state requirements to avoid reclamation of the open pit area.

Picture 15 shows the Goathill Creek area. The underground mine underlies Goathill Creek and the ridges to the east and west. The Goathill Creek subsidence area, towards the east ridge, is shown in Picture 16. The subsidence area undercuts an older scar area, which will eventually lead to additional instability and likely a larger expansion of the old scar area. Molycorp has requested a waiver from state requirements to avoid reclamation of the underground subsidence area.

Picture 17 shows the tailings facility pond deposition area where tailings are deposited. As shown, some areas have been revegetated as an interim measure, but the tailings impoundment is presently sloped so as to form ponds, with contaminated process water primarily lost as seepage through the tailings and into groundwater.

Modern reclamation practice uses a variety of resloping, covers, revegetation, stormwater and groundwater controls, and interim measures to effect reclamation on mined land for the purposes typically desired, including the reestablishment of productive post-mining land-use and the protection of environmental resources. The following sections provide more information on modern reclamation techniques to prevent the type of problems demonstrated by present conditions at the Molycorp Questa mine operations.

Resloping

The goal of reclamation is to restore natural slopes that blend with surrounding landforms. In order to accomplish this sinuous slopes that are irregular in profile should be created. Irregular slopes will intercept more runoff and reduce its velocity and improve revegetation success. The steepness of the slope is a major factor affecting the amount of sediment production. Surface-water runoff velocities increase on longer, steeper slopes, resulting in greater soil erosion.

Stable slopes should be integral to reclamation. If pioneer plants cannot establish themselves naturally, or if slopes ravel or show signs of creep and tension cracks, or if land sliding is noted, slopes are considered unstable. Unconsolidated materials in general are stable and can sustain vegetation at slopes of 3H:1V. Although steeper slopes may be created (if stable), especially if site conditions warrant their consideration, steep slopes greatly increase the potential for erosion. Long, steep slopes produce a greater erosion affect and allow less infiltration. A series of short, gentle slopes separated by benches or terraces is preferred. Guidelines for reclamation suggest that slopes steeper than 3H:1V should be kept shorter than 75 feet by creating breaks in slope, such as benches or berms. (D. Norman, et al, 1997)

Consistent with recommended reclamation practices and applicable state and federal regulatory policies, the Full Reclamation and Closure Plan recommends resloping of the mine waste rock dump surfaces, the open pit and underground mining subsidence area, and the tailing impoundments side slopes to no steeper than 2H:1V and where practical reslope to 3H:1V or flatter. The majority of the waste rock dumps and the open pit area and subsidence area would be reclaimed with 2H:1V side slopes with 3H:1V or flatter slopes where possible. The tailing impoundments side slopes would be reclaimed at 3H:1V or flatter. This will create stable reclamation slopes amenable to the placement of covers, revegetation and stormwater controls, which are necessary to protect water quality and for re-establishment of a self-sustaining ecosystem.

Covers

The type of vegetative treatment planned for reclamation should dictate soil replacement depth. Deeper soils are needed for establishing trees, particularly where timber production is a goal. Just as important as depth is how growth-medium placement is performed to avoid compaction. Cover placement should be performed immediately after resloping. Different cover materials should be replaced separately in a designed order in order to facilitate the purpose of the cover (whether revegetation only and/or for infiltration control).

The minimum recommended thickness of soil depth for timber production, which generally requires a rooting depth of at least 48 inches, is 48 inches over rock and 24 inches over broken materials such as waste rock. Where potentially acid mine drainage (AMD) generating materials are involved, a minimum of 36 inches of topsoil or growth medium is generally recommended

Where AMD is not present, and timber production is not desired, a minimum soil replacement depth of 12 inches of topsoil is recommended for reclamation at most mine sites to meet post-mine land use requirements. Where topsoil is not available, alternative growth-mediums may be used with depths ranging from a minimum of 12 inches to 24 inches or more depending on the growth mediums characteristics. In more arid climates or where seasonal droughts are common additional topsoil or growth medium is generally recommended to a minimum thickness of 18 inches or more (D. Norman, et al, 1997).

Consistent with recommended reclamation practices and applicable state and federal regulatory policies, the Full Reclamation and Closure Plan recommends that a water balance cover consisting of 2-ft of non acid generating (NAG) material overlain by 18 inches of suitable growth medium material be placed over all potentially acid mine drainage generating areas, and that at least 18 inches of growth medium material be placed as a revegetation cover over all other areas. The covers will reduce infiltration of precipitation and formation of leachate, and enable effective revegetation to take place, which is necessary for protection of water quality and re-establishment of a self-sustaining ecosystem.

Revegetation

Successful revegetation in semi-arid climates is more dependent on proper plant selection, appropriate timing of planting, adequate fertilization, presence of organic matter in the soil, and irrigation (typically in the form of incidental precipitation only). Although often times initial planting appear to be “successful,” they frequently rapidly decline over time if ample amounts of organic matter are not provided or supplemental chemical fertilizers are not added to imitate the cycle of plant growth, decomposition, and nutrient cycling.

Natural plant communities develop by evolving from pioneer species to climax species. Pioneer species tend to grow rapidly in otherwise unvegetated areas, whereas climax plant communities are slower growing and tend to develop over long periods. In the best revegetation strategies, nature is copied by using the initial phase of revegetation to prepare the ground for the next. For example, nitrogen-fixing legumes in combination with a pioneer grass/forb community may be used to reconstruct the soil for growing shrubs and trees in the long-term.

Some operators make the mistake of planting only climax species (for example, Pinon pine) in ground that has not been adequately prepared. However, natural climax communities develop slowly and it may take 20 to 50 or more years before they are effective from a revegetation standpoint. In the meantime erosion may in some cases exceed the rate of plant growth, jeopardizing permanent establishment of revegetation. While mimicking the actions of nature may be impractical, a combination of ground cover and trees will allow for succession of a climax community while still providing stormwater and erosion control, wildlife habitat and forage, reduction of visual impact, and more quickly restoring beneficial land use (D. Norman, et al, 1997).

The experience of most revegetation scientists has shown that successive years of planting are typically necessary to establish healthy revegetation. Given varying climatic conditions and other factors, it is likely that in any given year the revegetation success rate is typically less than 50%. For that reason, in order to assure revegetation success, successive planting in each of the first three years, followed by additional planting in years 5, 10 and 20 are in most cases necessary as a measure to bring about sustained and diverse growth. Where forest climax species are involved, the process may be even more lengthy.

Consistent with recommended reclamation practices and applicable state and federal regulatory policies, the Full Reclamation and Closure Plan recommends that both medium and high duration and intensity revegetation methods be used. Medium intensity and term revegetation methods consist of planting during three consecutive growing seasons with a subscribed native plant seed and woody plant mix and fertilization twice per year for five years following resloping and cover placement. High intensity long-term revegetation methods consist of planting over three or more consecutive growing seasons with intensive planting of tree seedlings (1000 or more per acre). Alternatively, planting could take place with non-native soil building plant species followed by assisted introduction of native plants and forest management over a 30+ year period. Soil amendments, plant propagation, soil nutrients and microbiota would also be used to promote revegetation. The revegetation will increase slope stability and erosion resistance, reduces infiltration of precipitation and formation of leachate, and enable effective revegetation to take place, which is necessary for protection of water quality and re-establishment of a self-sustaining ecosystem.

Stormwater and Groundwater Control

Following resloping, new drainage or contour ditches should be established within the reclaimed area to contain and direct the expected surface water runoff. Water drainage should be restored to the same drainage it occupied before mining to restore baseline flow to areas downstream. If runoff water quality is of unacceptable quality it should be contained in lined ditches and ponds and treated as necessary prior to discharge.

Protection of water quality and preventing erosion go hand in hand in modern mine reclamation practice. Even small or temporary discharges of stormwater can be harmful in the presence of erosion. Turbid (sediment containing) water can be avoided by incorporating stormwater and erosion control techniques into the mine development plans. Under most conditions a good stormwater control system can minimize or even eliminate stormwater discharge.

Stormwater control is accomplished by a combination of integrated design that manages and controls stormwater flow starting from the top of the watershed above the mine operations and extending to below the area influenced by mining operations. The numerous individual components must function both separately and as a unit to control stormwater – one weak component can cause the whole system to fail to protect water quality. Good operation and maintenance practices are also a key component in stormwater control systems, although if practical the systems should be designed to function without long-term operation and maintenance.

A variety of practices can be employed for either short-term or long-term erosion control, with considerable overlap between the two. In all cases they assume that resloping, covers and revegetation are also being instituted to minimize erosion and sediment in runoff in combination with stormwater controls. Short–term erosion control methods include: mulch, slash windrows, straw bales, filter fabric fences, jute netting and/or mulch fabrics, brush sediment barriers, and plastic coverings. Long-term erosion control methods include vegetation, diversion ditches, rock check dams, rock-lined ditches, and contours, berms, swales, and ditches (D. Norman, et al, 1997).

Additional treatment may be required to reduce the turbidity of stormwater prior to discharge. Alternative treatment methods include percolation, land application, and chemical aided mechanical separation (clarification, filtration, etc.). Advanced wastewater treatment processes include reverse osmosis and ion exchange. If necessary, advanced wastewater treatment processes are available to remove metal pollutants down to levels below water quality standards. The means exist with or without advanced water treatment techniques to treat the stormwater discharge from almost any mine to meet water quality standards and/or the existing quality of almost any receiving water using modern wastewater treatment techniques (J. Kuipers, 1996).

Consistent with recommended reclamation practices and applicable state and federal regulatory policies, the Full Reclamation and Closure Plan recommends that stormwater controls be used to control erosion, reduce infiltration, and to allow for collection, monitoring and treatment, if necessary, of polluted stormwater. Adequate stormwater controls are necessary for protection of water quality and re-establishment of a self-sustaining ecosystem.

Interim Reclamation

Interim reclamation is a standard modern reclamation strategy that reduces impacts during operations and allows for a smooth transition into final reclamation when mine operations are completed and final reclamation and closure operations commence. In some circumstances operators can use interim reclamation to accomplish final reclamation in areas of the mine site and demonstrate their reclamation proficiency, reduce costs and liability, and speed up the process of reclamation and closure completion. At the best reclamation sites interim reclamation combined with concurrent reclamation is seamless with final reclamation.

Modern standards suggest that if a mine feature is to remain inactive for more than 2 years, or if a stockpile, excavated slope, or disposal area needs rapid stabilization, it may be appropriate to temporarily reclaim the area by doing resloping and revegetating with fast-growing grasses and legumes (D. Norman, et al, 1997).

<u>Water Management</u>

Molycorp's water management practice presently utilizes groundwater extracted from wells in the Red River alluvium as process water for the milling facilities. The water is combined with water taken from the underground workings to maintain a cone of depression in the area of the mine facilities, and used in the milling process, where it is sent as tailings to the tailings impoundment area. The combined taking of water from the alluvial aquifer and the underground mine certainly leads to a decrease in the baseflow of the Red River and subsequently impacts the water quality of the river.

Practice should incorporate means to recycle process water from the tailing impoundments back to the mill and decrease the amount of make-up water to the minimum necessary to facilitate mine operations. It should be possible through good water management practice to eliminate the need for drawdown from the alluvial aquifer, which is likely to directly benefit the river. In addition, to the extent practicable, the water from the underground mine should be treated and possibly used to supplement the flow of the Red River past the mine area as a mitigation measure.

Site Maintenance

In general, along with a lack of modern reclamation practice, has been a tendency by the mine to overlook standard practices such as good housekeeping. This is evidenced by the unkempt look of the mine facilities, particularly in the area of the open pit and waste rock dumps, and the haphazard construction of facilities and roads with little regard for final reclamation and closure requirements.

Public and Employee Health and Safety

There is a concern that Molycorp's Questa mine might harbor some additional unknown hazards to public and employee health and safety that have either not been discovered or disclosed. For example, beryllium in unusual quantities has been identified in the mine area water, prompting the mine to issue a warning to its employees not to drink the mine water. This warning has brought concern to many that beryllium might pose a threat to both the workers and potentially the public.

Recently the Libby Vermiculite Mine in Montana has made national news. In the course of mining vermiculite, tremolite asbestos, an extremely toxic form of asbestos known to cause the debilitating and deadly form of lung cancer known as asbestosis, was encountered. Evidence indicates the mine knew about the hazard of the asbestos long before the workers, and only recently informed the community. Since then, information has been accumulated which indicates over 300 people, both workers at the mine as well as family members exposed from most likely workers clothing, have been diagnosed with asbestosis and related diseases, with most having already died.

Although it is not suggested that a similar situation exists at Molycorp's Questa mining facility, the presence of beryllium is of great concern. Considering the devastating impacts of beryllosis, which is similar to that of asbestosis, and also caused by even exposure to only minute amounts of the substance, a thorough investigation should be initiated to address this potentially serious matter. The source of the beryllium should be determined, and any potential threat to human or environmental health assessed.

## 6.0 Reclamation and Closure Options

A large number of reclamation and closure options exist to meet state and federal regulations and address the environmental and socioeconomic issues raised by the existing conditions of the Questa mine operations. Alternative measures such as resloping and reshaping, partial and complete removal, cover types, revegetation approaches, etc. can be considered for the various waste rock dumps, open pit, underground mine subsidence areas, tailing impoundments and other roads and facilities.

The number of options that might be employed for reclamation of the various areas is nearly infinite. To simplify consideration of the options they can be considered in terms of degree of effort and/or environmental benefit. Table 3 describes the various options that could be considered for reclamation in this manner.

The options represent the range of normal activities that have been proposed and are common to reclamation and closure practice by the mining industry in the United States and elsewhere. As indicated by the list of options presented, a wide range of options exist and have been applied in practice for a variety of circumstances and requirements.

The options A through C are not meant as alternative reclamation and closure plans, but rather to identify the range of options for each unit. In a similar manner, different options might be chosen for different subunits. A range of alternatives may be available within each option (i.e., regrade/reform to varying slope angles of 2H:1V to less than 3H:1V). The following discussion provides additional description to the options presented in Table 3.

<u>Waste Rock Dumps</u>

The waste rock dumps consist of nine discrete subunits as follow: Blind Gulch (in-pit), Spring Gulch, Spring and Sulphur Gulches, Sugar Shack South/Middle/North, Capulin, Goat Hill and Goat Hill South.

**Resloping:** At present the waste rock dumps have undergone no regrading/reforming with angle of repose (approximately 1.5H:1V) slopes in most areas. The proposed action by Molycorp would leave the waste rock dump slopes in an as-is condition. The waste rock dumps will not be reshaped other than to maintain berms at the crest lines of the benches so that runoff cannot run from the bench areas down the dumps faces (Closeout Plan for Molycorp, Inc. 1996).

Option A would reslope the waste rock dumps to increase stability, reduce erosion, increase maintainability, allow placement of a cover, and to enhance stormwater control and revegetation. Reslope angles could range in steepness up to 2H:1V to 3H:1V or less. Resloping in some areas could include additional slope stabilization measure such as gabbions, riprap, and rock retaining walls.

Option B and Option C would consider partial or full relocation of the waste rock dumps. In the case of Option B partial removal would occur to facilitate regrading to slopes of 2H:1V or less. In the case of Option C, full removal of the waste rock dump would take place to facilitate revegetation of contours regraded to approximate the original undisturbed landform or similar. Waste rock material removed under Option B or Option C would go to either backfill the open pit mine, or underground mine subsidence area, based on proximity and logistics.

## Table 3 - Reclamation Options
## Molycorp Questa Mine, NM

| Units | Existing Condition | Proposed Action (by Molycorp) | Option A | Option B | Option C |
|---|---|---|---|---|---|
| **Waste Rock Dumps** | | | | | |
| Resloping | angle of repose in most areas | as-is (angle of repose) | regrade/reform | partial removal and regrade/reform | full removal and regrade/reform |
| Cover | none | none | 2-ft NAG layer and 18" growth medium cover | water balance or evaporation cover | water barrier cover |
| Revegetation | no significent re-vegtation evident | direct revegetation w/ primarily trees | low intensity short-term revegetation | medium intensity and form revegetation | high intensity long-term revegetation |
| Stormwater Control | none to limited | capture of surface runoff in lined sediment traps | 10-yr 24-hr containment and enhanced capture | 100-yr 24-hr containment enhanced capture | zero discharge |
| Groundwater Control | none to limited | seepage interception (in some areas) | enhanced groundwater monitoring | enhanced seepage interception | install groundwater barriers, pump and treat |
| **Open Pit** | | | | | |
| Resloping | angle of repose in most areas | as-is (angle of repose) | regrade/reform | partial backfill (bottom buttress) | complete backfill (2:1 or flatter slopes) |
| Cover | none | none | 2-ft NAG layer and 18" growth-medium cover | water balance or evaporation cover | water barrier cover |
| Revegetation | none | none | low intensity short-term revegetation | medium intensity and term revegetation | high intensity long-term revegetation |
| Stormwater Control | none to limited | as-is (none to limited) | 10-yr 24-hr containment and enhanced capture | 100-yr 24-hr containment and enhanced capture | zero discharge |
| Groundwater Control | none to limited | as-is (none to limited) | enhanced groundwater monitoring | enhanced seepage interception | install groundwater barriers, pump and treat |
| **Subsidence Areas** | | | | | |
| Backfill | none (tailings not backfilled | none (tailings not backfilled) | backfill future tailings into subsidence areas | | |
| Surface Reclamation | none | none | regrade/cover/reveg some perimeter areas | regrade/cover/reveg additional select areas | intensive surface reclamation |
| **Tailings Impoundment** | | | | | |
| Resloping | none to limited | limited additional regrad/reform | additional regrade/reform | | |
| Cover | existing 9" interim cover on most areas | alluvial growth cover, 9" on sand, 18" on slimes | 18" growth-medium cover on all areas | water balance or evaporation cover | water barrier cover on all areas |
| Revegetation | interim revegetation | revegetation with amendments | low intensity short-term revegetation | medium intensity and term revegetation | high intensity long-term revegetation |
| Stormwater Control | 100-yr 24-hr primary capture | as-is 100-yr 24-hr primary capture | | 100-yr 24-hr containment and enhanced capture | zero discharge |
| Groundwater Control | none to limited | as-is (none to limited) | enhanced groundwater monitoring | enhanced seepage interception | install groundwater barriers, pump and treat |
| **Water Treatment** | | | | | |
| Water Collection and Treatment Facilities | existing condition | dedicated pump and treat system | improved pump and treat system | advanced pump and treat system | |
| **Red River** | | | | | |
| Flow, Chemistry and Geomorphology | impaired by mining activities | as-is (impaired by mining activities) | supplement or restore | treat water quality | remove contaminated sediments/restore geomorphology |

**Cover:** At present the waste rock dumps have no growth medium cover. The proposed action by Molycorp would leave the waste rock dump slopes in an as-is condition without a growth-medium cover.

Option A would utilize a standard 2-ft non-acid generating (NAG) layer and 18" growth-medium cover over the potentially acid generating waste rock dump areas. Resloping to a 2H:1V or less would be required prior to installation of the cover. Option B would install a water balance (also sometimes referred to as a water evaporation cover) over the waste rock dump areas. The water balance cover would consist of an engineered composite of cover materials that incorporate a growth-medium layer underlain by a water retention layer designed to result in minimal infiltration through the liner as a consequence of evapotranspiration and surface runoff. The engineered composite is typically constructed of locally available materials and typically ranges from 2-ft to 5-ft or more in thickness. Resloping to a 2H:1V or less would be required prior to installation of the water barrier or evaporation cover. Option C would install a water barrier cover over the waste rock dump areas. The water barrier cover would consist of an engineered composite of cover materials that incorporate a growth-medium layer underlain by an semi-impermeable layer of either natural (clay) or synthetic (geomembrane) materials which prevent water infiltration.

**Revegetation:** At present the waste rock dumps have no significant revegetation. Some revegetation efforts have been undertaken by Molycorp, however no success in terms of visible revegetation has been observed. Molycorp proposes to conduct revegetation with amendments consisting of primarily tree planting into the waste rock material in-situ with some planting of grasses in some areas (primarily areas less steep).

Option A would utilize standard methods of low-intensity short-term revegetation consisting of a one-time planting with a subscribed native plant seed and tree/shrub mix and fertilization immediately following resloping and cover placement. Option B would utilize medium intensity and term revegetation methods consisting of planting during three consecutive growing seasons with a subscribed native plant seed and woody plant mix and fertilization twice per year for five years immediately following resloping and cover placement. Option C would utilize high intensity long-term revegetation methods consisting of planting over three or more consecutive growing seasons with intensive planting of tree seedlings (1000 or more per acre) and planting of non-native soil builders followed by assisted introduction of native plants and forest management over a 30+ year period. In addition to the options listed, additional alternatives with respect to soil amendment, plant propagation, soil nutrients and microbiota can also be considered.

**Stormwater Control and Groundwater Control:** At present only limited stormwater and groundwater control features are present at the site. Molycorp proposes to construct engineered structures at the toes of mine waste rock dumps where run-off and/or seepage water recovery is determined to be necessary. The number of areas where run-off and/or seepage water will have to be recovered will be decided based upon the results of the characterization program. However, for the purposes of their plan, Molycorp assumed that collection systems will be required at the base of three mine waste rock dumps. It is estimated that approximately 100 gpm of run-off and/or seepage water will be collected from three dumps and piped to a water treatment plant.

Stormwater control Option A would install 10-year 24-hour stormwater drainage, conveyance and capture systems on and below all waste rock dump areas. Option B would increase the design criteria for the stormwater control features to a 100-year 24-hour precipitation event. Option C would enhance the stormwater control system to minimize stormwater infiltration and maximize collection and storage so as to result in zero discharge of stormwater.

Groundwater control Option A would enhance groundwater monitoring at all the waste rock dumps to detect and determine seepage water quality. Option B would enhance seepage interception where indicated necessary or desirable by additional monitoring. Option C would install groundwater flow barriers beneath or below the waste rock dumps and employ pump and treat technology to minimize seepage infiltration into groundwater.

<u>Open Pit</u>

The open pit consists of areas of steep stable and unstable walls, and pit benches and terraces.

**Resloping:** At present the open pit area has undergone no regrading/reforming with angle of repose (approximately 1.0H to 1.5H:1V) slopes in most areas. The proposed action by Molycorp would leave the open pit in an as-is condition and seek a waiver from reclamation and closure requirements.

Option A would reslope the open pit area to increase stability, reduce erosion, increase maintainability, allow placement of a cover, and to enhance stormwater control and revegetation. Reslope angles could range in steepness up to 2H:1V to 3H:1V or less. Resloping in some areas could include additional slope stabilization measure such as gabbions, riprap, and rock retaining walls. Resloping would be limited in area by practical consideration to only the benches and terraces and the outer perimeter of the pit.

Option B would consider partial backfill of the open pit with material coincidentally removed from the waste rock dumps. It might also be accomplished by backfill of future tailings. In the case of Option B partial backfilling would facilitate regrading of additional areas to slopes of 2H:1V or less.

Option C would completely backfill the open pit with waste rock and/or future tailings to accomplish regrading to 2H:1V slopes or less in all areas of the open pit. The amount of material removed from the waste rock dump and/or accommodation of future tailings would be dictated by the amount of backfill necessary to establish resloping of the entire pit area.

**Cover:** At present the open pit area has no growth medium cover. The proposed action by Molycorp would leave the open pit area in an as-is condition without a growth-medium cover.

Option A would utilize a standard 2-ft non-acid generating (NAG) layer and 18" growth-medium cover over areas of the pit that could be covered by resloping to a 2H:1V or less. Option B would install a water balance or water evaporation cover over the resloped open pit areas. Option C would install a water barrier cover over the resloped open pit areas.

**Revegetation:** At present the open pit has not been revegetated. The proposed action by Molycorp would leave the open pit area in an as-is condition without revegetation.

Option A would utilize standard methods of low-intensity short-term revegetation. Option B would utilize medium intensity and term revegetation methods. Option C would utilize high intensity long-term revegetation methods.

**Stormwater Control and Groundwater Control:** At present only limited stormwater and groundwater control features are present at the site. The proposed action by Molycorp would leave the open pit area in an as-is condition without additional stormwater and groundwater control features.

Stormwater control Option A would install 10-year 24-hour stormwater drainage, conveyance and capture systems on and below all open pit areas. Option B would increase the design criteria for the stormwater control features in the open pit area to a 100-year 24-hour precipitation event. Option C would enhance the stormwater control system to minimize stormwater infiltration and maximize collection and storage so as to result in zero discharge of stormwater. Stormwater control features would be installed on all reclaimed areas in the open pit and to the extent practical on other areas.

Groundwater control Option A would enhance groundwater monitoring at all the open pit to detect and determine seepage water quality. Option B would enhance seepage interception where indicated necessary or desirable by additional monitoring. Option C would install groundwater flow barriers beneath or below the open pit and employ pump and treat technology to minimize seepage infiltration into groundwater.

Underground Mine Subsidence Area

**Backfill:** The existing condition of the subsidence area is directly as a result of coincidental subsidence to underground mining and no reclamation and closure activities have been directed toward it. The proposed action by Molycorp would leave the underground mine surface subsidence area in an as-is condition and seek a waiver from reclamation and closure requirements.

Option A would backfill future tailings into subsidence areas. Backfill might also be accomplished coincidentally with partial or complete removal of waste rock dumps being reclaimed. Variations on Option A would determine the techniques and amount or extent of backfill into subsidence areas.

**Surface Reclamation:** No reclamation activities have been conducted in the subsidence area. The proposed action by Molycorp would leave the underground mine surface subsidence area in an as-is condition and seek a waiver from reclamation and closure requirements.

Option A would reslope/cover/revegetate some of the perimeter around the subsidence areas to increase stability, reduce erosion, increase maintainability, allow placement of a cover, and to enhance stormwater control and revegetation. Reslope angles could range in steepness up to 2H:1V or less. Resloping in some areas could include additional slope stabilization measure such as gabbions, riprap, and rock retaining walls. Resloping would be limited in area by practical consideration to only selected areas on the outer perimeter of the underground mine subsidence area.

Option B would reslope/cover/revegetate additional parts of the subsidence areas coincidental to backfilling. Option C would completely backfill the subsidence area with waste rock and/or future tailings to accomplish regrading to 2H:1V slopes or less in all subsidence areas to the extent practical. The amount of material removed from the waste rock dump and/or accommodation of future tailings would be dictated by the amount of backfill necessary to establish resloping of the entire underground mine surface subsidence area.

Tailings Impoundment

**Resloping:** At present the tailing impoundments have undergone no intentional regrading/reforming with approximately 2H:1V or less steep side slopes in most areas. The proposed action by Molycorp would leave the waste tailing impoundments slopes in an as-is condition. The slopes will not be reshaped other than to maintain berms at the crest lines of the benches so that runoff cannot run from the bench areas down the slopes faces. Molycorp is assuming that future tailings operations will result in a free draining tailings system and has not included provisions for regrading of the top slopes of the tailings impoundment to create a free draining condition without areas of impounded water.

Option A would reslope the sides of the tailings impoundments to increase stability, reduce erosion, increase maintainability, allow placement of a cover, and to enhance stormwater control and revegetation. The top areas of the tailings impoundment would be graded to obtain slopes of approximately 1-2% in all areas and side slopes would be regraded to 3H:1V or less. Resloping could also be done in some areas outside the tailings impoundments within the tailings facility area to improve reclamation and aesthetics on other disturbed areas.
**Cover:** At present the tailing impoundments have an interim nine-inch growth medium cover. The proposed action by Molycorp would leave the existing interim covers as final covers and place an 18-inch cover on slimes areas.

Option A would utilize a 2-ft NAG layer and 18" growth-medium cover over the entire tailing impoundments areas. Option B would install a water balance or water evaporation cover over the tailing impoundments areas. Option C would install a water barrier cover over the tailing impoundments areas.

**Revegetation:** At present the tailings impoundment have a significant interim revegetation cover on some areas. Molycorp proposes to conduct revegetation with amendments consisting of a mixture of grass and tree areas.

Option A would utilize standard methods of low-intensity short-term revegetation. Option B would utilize medium intensity and term revegetation methods. Option C would utilize high intensity long-term revegetation methods. In addition to the options listed, additional alternatives with respect to soil amendment, plant propagation, soil nutrients and microbiota can also be considered.

**Stormwater Control and Groundwater Control:** At present only limited drainage features exist on the tailings impoundments but primary capture and diversion structures exist for the facility area capable of handling 100-yr 24-hr storm events. Molycorp proposes to leave the stormwater controls in an as-is condition. Groundwater control ranges at present from none in some areas to an extensive system downgradient of Dam 1.

Stormwater control Option A would install 10-year 24-hour stormwater drainage, conveyance and capture systems on the surface of the tailing impoundments areas. Option B would increase the design criteria for the stormwater control features on the top of the tailing impoundments to a 100-year 24-hour precipitation event. Option C would enhance the stormwater control system to minimize stormwater infiltration and maximize collection and storage so as to result in zero discharge of stormwater from the tailing impoundments area.

Groundwater control Option A would conduct additional groundwater monitoring at all areas around the tailings impoundment to detect and determine seepage water quality. Option B would install additional seepage interception where indicated necessary or desirable by additional monitoring. Option C would install groundwater flow barriers around the tailing impoundments and employ pump and treat technology to minimize seepage infiltration into groundwater.

<u>Water Treatment</u>

Mine Area

**Water Collection and Treatment Facilities:** Presently Molycorp uses the existing process plant to treat water collected from mine area seepage and runoff and water from mine pumping operations to maintain an artificial cone of depression in the mine area. As a result of the artificial cone of depression in the groundwater system beneath the mine workings, Molycorp believes groundwater impacts are minimized to the local area as long as the drawdown condition is maintained and the resulting water is treated and/or discharged elsewhere.

Upon cessation of underground mining activities, Molycorp will continue to keep the mine partially dewatered. The purpose of de-watering is to maintain the cone of depression, which has minimized constituent loading to the Red River by reversing ground water flow direction into the underground mine and also diverting some surface water into the underground mine. The elevation to which the mine water will be allowed to rebound will be determined by ground water modeling. The mine water collected will be piped to a water treatment plant at surface to reduce certain constituents to concentrations levels to allow discharge to the Red River through an NPDES permit. The water treatment plant will also handle any seepage water recovered from the toes of mine waste rock dumps. The closure plan provides for a water treatment plant with an operating capacity of 350 gallons per minute (gpm); 250 gpm for mine water and 100 gpm for seepage water from the mine waste rock. (Questa Mine Waste Rock Discharge Plan, 1998)

The existing process plant treats the water by using it as process make-up water in the flotation milling process. Coincidentally to the process, lime is added (to depress pyrite) raising the slurry pH in excess of 10.0, additionally causing the precipitation of many metals species present in the mine water. Molycorp proposes to construct a dedicated treatment system. Water treatment will be by lime neutralization and the accompanying removal of constituents of concern. The location of the treatment plant will be determined after identification of waste rock dumps requiring seepage water collection. Water treatment will result in final concentrations of constituents that will meet NPDES permit discharge criteria, and the treated water will be discharged to the Red River. The sludge generated (principally calcium sulfate with some metal hydroxides) from the water treatment plant will be disposed of on-site in a lined impoundment. (Questa Mine Waste Rock Discharge Plan, 1998)

Option A would improve the existing pump and treat scheme by providing better and more reliable infrastructure and treatment systems. Option B would employ more advance pump and treatment schemes including advanced wastewater treatment technology (such as reverse osmosis or ion exchange) to affect water quality that could be discharged without degrading receiving waters.

Tailings Facility Area

**Water Collection and Treatment Facilities:** Presently Molycorp uses the existing dedicated process plant to treat discharge water from the tailings impoundment area. Molycorp uses the seepage and groundwater capture system downgradient of Dam 1 to remove and discharge groundwater that otherwise would affect the local aquifer underlying local residences. Molycorp proposes to maintain the existing systems as final reclamation and closure measures.

Option A would improve the existing pump and treat scheme by providing better and more reliable infrastructure and treatment systems. Option B would employ more advance pump and treatment schemes including advanced wastewater treatment technology (such as reverse osmosis or ion exchange) to affect water quality that could be discharged without degrading receiving waters.

<u>Red River</u>

**Flow, Chemistry and Geomorphology:** Although some controversy exists as to the degree of impact, it is fairly certain the mine plays a significant role in the presently impaired condition of the river within and below the mine area. Molycorp presently does not acknowledge this condition and does not propose any remediation measures to address water quantity, quality and tailings and contaminate related geomorphology in the Red River.

Option A would either restore or supplement original stream flows in the Red River. In addition, the underground mine dewatering is likely to also significantly decrease baseline surface water flow, also potentially affecting water quality. Option B would treat the water in the Red River with additional alternatives such as passive or active methods of contaminant removal. Option C would involve removal of contaminated sediments and tailings from tailings spills that occurred the Red River floodplain and restoration of river and floodplain geomorphology and ecology.

Facilities, Roads and Other

Although not shown in Table 4, facilities, roads and other areas are an important component of the Questa mine operations reclamation and closure plans.

Molycorp proposes to leave and maintain the existing site access roads for the duration of the closeout work. Existing fencing in the mill area will be left in place; but the only other fencing that will be installed is fencing required to keep wildlife from feeding on the revegetation planting units until they are of sufficient size to survive wildlife foraging.

At final closeout all mill reagents, fuels, etc. will be removed from the property and disposed of in a safe and proper manner. The plant surface structures will be taken down and (in most cases) the concrete foundations removed, shafts and decline portal plugged. This would include removal of pre-1965 mine structures east and west of Columbine Park and the tailings line system lower dump sump.

Grass only will be planted along the tailings transportation system right-of-way after the system is removed.

Mine site perimeter property boundaries, subsidence areas, and the open pit will be posted with appropriate signs and markers (Closeout Plan for Molycorp, Inc. 1996).

It is likely, and has been reported, that a number of old dumps exist on the Molycorp Questa mine and tailings facility areas. The dumps may contain refuse from the mining operation, including construction materials and debris, oil and grease, discarded chemicals, and other forms of garbage generated by the mining operations or otherwise disposed of at the site. These dumps may contain harmful constituents and will require special identification and care during reclamation operations.

## 7.0 Financial Assurance Estimate for Full Reclamation Alternative

The NMED and MMD are required to obtain a financial assurance bond to ensure that the state is able to perform the necessary activities in accordance with the approved reclamation and closure plan in the event Molycorp fails to complete its reclamation responsibilities. The financial assurance requirements for both agencies are contained in their statutes. As noted below, some interpretations of the statutes may differ as noted.

The estimated cost for Amigos Bravos Full Reclamation and Closure Plan is summarized in Table 4. Additional information, including details of the estimate and assumptions used in support of the cost estimate, is included in the Bond Estimate Details Section (see Appendix C). The following sections also provide additional details on the cost estimate.

**Table 4**
**Financial Assurance Estimate**
**Full Reclamation and Closure Plan**
**Molycorp Questa Mine, NM**

| Task | Total Cost |
|---|---|
| Direct Costs | |
| Waste Rock Area Reclamation | $203,043,563 |
| Open Pit Area Reclamation | $17,520,550 |
| Subsidence Area Reclamation[1] | $4,555,740 |
| Tailings Facility Reclamation | $15,712,156 |
| Facilities, Roads and Other Reclamation | $8,782,115 |
| Interim Operations and Maintenance | $3,600,000 |
| Sub-Total Direct Costs | $253,214,124 |
| Indirect Costs | $91,157,085 |
| Water Treatment Trust Fund[2] | $25,612,500 |
| Red River Restoration Fund | $12,000,000 |
| Total Costs | $381,983,708 |
| Mine Facility Area Costs | $340,124,741 |
| Tailing Facility Area Costs | $29,858,968 |

[1] The subsidence area reclamation costs shown in this estimate may not include all the applicable costs as inferred by statute. For more information see Appendix D – Open Pit Mine and Subsidence Area Reclamation.

[2] According to the proposed draft rules 20 NMAC 6.2.VI.6102.D. The estimate shall not be reduced by: 1. Salvage/resale value of any equipment or buildings. 2. Discounting or present valuing of any estimates. The estimate shown in Table 4 is for a cash Trust Fund based on discounted O&M costs over a 100-year period. It is recommended that a cash trust fund would better serve the purpose of financial assurance in this particular case, compared to a surety bond, which is designed to ensure short-term reclamation (and thus should not be discounted). It is unlikely that "treatment in perpetuity" requirements were envisioned when the draft rules were proposed.

The estimate has been performed in accordance with standard engineering cost estimation procedures and is consistent with cost estimate methods commonly used by industry and regulatory agencies in bond calculations. Where possible the estimate has been modified to meet the site-specific conditions and information available at this time.

The basis for the financial assurance cost estimate is for work done by a third party under contract to the state or federal agencies. As such, factors including contractor ownership, standby, overhead and other costs result in higher costs than are typical for mining operations conducting their own reclamation and closure tasks. In addition, indirect costs are added in the event of agency management that would not necessarily be incurred by the company. As a result, the company's cost of doing reclamation can be as little as one-third to one-half that of the costs suggested by the financial assurance estimate.

Waste Rock Area Reclamation

The financial assurance cost of waste rock area reclamation is based on estimated costs for removing waste rock, regrading waste rock surfaces, installing slope stabilization, hauling and spreading a 2-ft non-acid generating (NAG) cover and 18-inches of growth medium, revegetation and weed control, and installation of stormwater and additional groundwater controls, as specified in the Full Reclamation and Closure Plan (see Section 2).

100% of the Capulin waste rock dump is relocated to the open pit and the original surface under the dump reclaimed. It is assumed that 25% of the Middle, Sugar Shack South and Spring/Sulphur Gulch waste rock dumps will be removed and relocated to the open pit in order to facilitate the creation of 2H:1V or flatter overall slopes. Some of the material on the slopes may be relocated within the dump area rather than moved to the pit. The estimated costs for removing waste rock are based on typical costs calculated at other job sites for similar construction activities performed by a third party contractor. Based on experience, cost factors of $0.45/ton for loading and unloading, and $0.75 per ton per mile for hauling, were used in the estimate. The estimate assumes an average haul distance of three miles for the Capulin waste rock dump, and two miles for the other dumps. The cost includes support equipment such as excavators, dozers, trucks, vehicles, materials, labor and supervision.

The cost estimate for regrading waste rock dump area surfaces is based on an estimate of 16 hours per acre equivalent to a D10 Dozer at $181 per hour. The hour equivalent cost includes support equipment such as excavators, scrapers, dozers, trucks, drilling, vehicles, materials, labor and supervision. The 16 hours per acre equivalent is a highly conservative estimate based on the steep and difficult nature of the waste rock dump slopes.

An allowance is made in the cost estimate for installation of slope stabilization measures. Resloping in steeper areas would include additional slope stabilization measures such as gabbions, riprap and rock retaining walls. An allowance of 5000 linear feet of slope stabilization measures at a cost of $1,000 per linear foot was used in the cost estimate.

The costs for hauling and spreading a 2-ft NAG cover and 18-inches of growth medium were estimated similar to those for removing waste rock material. Based on experience, cost factors of $0.45/ton for loading and unloading, and $0.75 per ton per mile for hauling, were used in the estimate. NAG material was assumed to be available at the mine site at an average distance of two miles. Growth medium was assumed to come from alluvial material near the tailings facility; and a haul distance of eight miles was assumed. The cost estimate for spreading NAG and growth medium over the waste rock dump surfaces is based on an estimate of eight hours per acre equivalent to a D10

Dozer at $181 per hour. The hour equivalent cost includes support equipment such as excavators, dozers, trucks, vehicles, materials, labor and supervision. The eight hours per acre equivalent is a highly conservative estimate based on the steep and difficult nature of the waste rock dump slopes.

Revegetation and weed control costs assumes high-intensity long-term revegetation measures for the recontoured waste rock dump slopes. The estimated costs for revegetation are based on typical costs calculated at other job sites for similar revegetation activities performed by a third party contractor. Based on experience, a cost factor of $5,000 per acre was used in the estimate.

An allowance is made in the estimate for stormwater controls such as ditches, conveyances, sediment basins and other features. An allowance of 10,000 linear feet of stormwater controls at a cost of $300 per linear foot was used in the cost estimate. An allowance of $1.0 million for additional groundwater controls such as additional monitoring, wells, interception and other measures was also included in the estimate.

Open Pit Area Reclamation

The financial assurance cost of open pit area reclamation is based on estimated costs for regrading the open pit area either in-situ or as reposited waste rock surfaces, installing slope stabilization, hauling and spreading a 2-ft non-acid generating (NAG) cover and 18-inches of growth medium, revegetation and weed control, and installation of stormwater and additional groundwater controls, as specified in the Full Reclamation and Closure Plan.

The open pit area reclamation cost assumes 200 of the 300 acres in the open pit area will be reclaimable following placement of waste rock dump material removed and reposited in the open pit. Some of the pit highwall would be pushed and or blasted to conform with backfilled material slopes. The cost estimate for regrading open pit area surfaces is based on an estimate of eight hours per acre equivalent to a D10 dozer at $181 per hour. The hour equivalent cost includes support equipment such as excavators, scrapers, dozers, trucks, drilling and blasting, vehicles, materials, labor and supervision. The eight hours per acre equivalent is a highly conservative estimate based on the steep and difficult nature of the open pit area.

An allowance is made in the cost estimate for installation of slope stabilization measures. Resloping in steeper areas would include additional slope stabilization measures such as gabbions, riprap, and rock retaining walls. An allowance of 5000 linear feet of slope stabilization measures at a cost of $1,000 per linear foot was used in the cost estimate.

The costs for hauling and spreading a 2-ft NAG cover and 18-inches of growth medium were estimated using cost factors of $0.45/ton for loading and unloading, and $0.75 per ton per mile for hauling. NAG material was assumed to be available at the mine site at an average distance of two miles. Growth medium was assumed to come from alluvial material near the tailings facility and a haul distance of eight miles was assumed. The cost estimate for spreading NAG and growth medium over the waste rock dump surfaces is based on an estimate of four hours per acre equivalent to a D10 Dozer at $181 per hour. The hour equivalent cost includes support equipment such as excavators, dozers, trucks, vehicles, materials, labor and supervision. The four hours per acre equivalent is a highly conservative estimate based on the steep and difficult nature of the open pit area slopes.

Revegetation and weed control costs assumes high-intensity long-term revegetation measures for the recontoured open pit area slopes. The estimated costs for revegetation are based on typical costs calculated at other job sites for similar revegetation activities performed by a third party contractor. Based on experience, a cost factor of $5,000 per acre was used in the estimate.

An allowance is made in the estimate for stormwater controls such as ditches, conveyances, sediment basins and other features. An allowance of 10,000 linear feet of stormwater controls at a cost of $300 per linear foot was used in the cost estimate. An allowance of $1.0 million for additional groundwater controls such as additional monitoring, wells, interception and other measures was also included in the estimate.

Subsidence Area Reclamation

The financial assurance cost of subsidence area reclamation is based on estimated costs for regrading the subsidence area, hauling and spreading a 2-ft non-acid generating (NAG) cover and 18-inches of growth medium, revegetation and weed control, and installation of stormwater and additional groundwater controls, as specified in the Full Reclamation and Closure Plan.

This cost estimate assumes reclamation of the subsidence area, although evidence indicates that more extensive reclamation may be necessary, at significant cost, for additional surface impacts related to the subsidence area. Reclamation requirements and potential costs of the underground mine subsidence area is discussed in more detail in Appendix D – Open Pit and Underground Mine Subsidence Area Reclamation.

The subsidence area reclamation cost assumes the 80 acres in the subsidence area will be reclaimable. The cost estimate for regrading subsidence area surfaces is based on an estimate of eight hours per acre equivalent to a D10 dozer at $181 per hour. The hour equivalent cost includes support equipment such as excavators, scrapers, dozers, trucks, drilling and blasting, vehicles, materials, labor and supervision. The eight hours per acre equivalent is a highly conservative estimate based on the steep and difficult nature of the subsidence area.

The costs for hauling and spreading a 2-ft NAG cover and 18-inches of growth medium were estimated using cost factors of $0.45/ton for loading and unloading, and $0.75 per ton per mile for hauling. NAG material was assumed to be available at the mine site at an average distance of two miles. Growth medium was assumed to come from alluvial material near the tailings facility and a haul distance of eight miles was assumed. The cost estimate for spreading NAG and growth medium over the subsidence area surfaces is based on an estimate of four hours per acre equivalent to a D10 Dozer at $181 per hour. The hour equivalent cost includes support equipment such as excavators, dozers, trucks, vehicles, materials, labor and supervision. The four hours per acre equivalent is a highly conservative estimate based on the steep and difficult nature of the subsidence area slopes.

Revegetation and weed control costs assumes high-intensity long-term revegetation measures for the recontoured subsidence area slopes. The estimated costs for revegetation are based on typical costs calculated at other job sites for similar revegetation activities performed by a third party contractor. Based on experience, a cost factor of $5,000 per acre was used in the estimate.

An allowance is made in the estimate for stormwater controls such as ditches, conveyances, sediment basins and other features. An allowance of 1,000 linear feet of stormwater controls at a cost of $300 per linear foot was used in the cost estimate. An allowance of $0.5 million for additional groundwater controls such as additional monitoring, wells, interception and other measures was also included in the estimate.

Tailings Facility

The financial assurance cost of tailings facility area reclamation is based on estimated costs for regrading the tailings facility area, hauling and spreading a 2-ft non-acid generating (NAG) cover and 18-inches of growth medium, revegetation and weed control, and installation of stormwater and additional groundwater controls, as specified in the Full Reclamation and Closure Plan.

The tailings facility area reclamation cost assumes 700 acres in the tailings facility area will be reclaimed. The cost estimate for regrading tailings facility area surfaces is based on an estimate of four hours per acre equivalent to a D10 dozer at $181 per hour. The hour equivalent cost includes support equipment such as excavators, scrapers, trucks, vehicles, materials, labor and supervision. The four hours per acre equivalent is a highly conservative estimate based on establishing positive drainage from the tailings facility area.

The costs for hauling and spreading a 2-ft NAG cover and 18-inches of growth medium were estimated using cost factors of $0.45/ton for loading and unloading, and $0.75 per ton per mile for hauling. NAG and growth medium material were assumed to come from alluvial material near the tailings facility and a haul distance of two miles was assumed. The cost estimate spreading NAG and growth medium over the tailings facility area surfaces is based on an estimate of two hours per acre equivalent to a D10 Dozer at $181 per hour. The hour equivalent cost includes support equipment such as excavators, dozers, trucks, vehicles, materials, labor and supervision.

Revegetation and weed control costs assumes high-intensity long-term revegetation measures for the recontoured subsidence area slopes. The estimated costs for revegetation are based on typical costs calculated at other job sites for similar revegetation activities performed by a third party contractor. Based on experience, a cost factor of $3,000 per acre was used in the estimate.

An allowance is made in the estimate for stormwater controls such as ditches, conveyances, sediment basins and other features. An allowance of 10,000 linear feet of stormwater controls at a cost of $150 per linear foot was used in the cost estimate. An allowance of $2.0 million for additional groundwater controls such as additional monitoring, wells, interception and other measures was also included in the estimate.

Facilities, Roads and Other

The financial assurance cost of facilities, roads and other reclamation is based on estimated costs for demolition and removal of buildings, equipment and other facilities, regrading, hauling and spreading a 2-ft non-acid generating (NAG) cover and 18-inches of growth medium, revegetation and weed control and installation of stormwater controls, as specified in the Full Reclamation and Closure Plan.

The cost estimate provides an allowance of $1.0 million for demolition and removal of buildings, equipment and other facilities.

The facility, roads and other area reclamation cost assumes 310 acres in the tailings facility area will be reclaimed. The cost estimate for regrading facility, roads and other area surfaces is based on an estimate of four hours per acre equivalent to a D10 dozer at $181 per hour. The hour equivalent cost includes support equipment such as excavators, scrapers, trucks, vehicles, materials, labor and supervision.

The costs for hauling and spreading a 2-ft NAG cover and 18-inches of growth medium were estimated using cost factors of $0.45/ton for loading and unloading, and $0.75 per ton per mile for hauling. NAG and growth medium material were assumed to come from alluvial material near the tailings facility and a haul distance of two miles was assumed. The cost estimate spreading NAG and growth medium over the facility, roads and other area surfaces is based on an estimate of two hours per acre equivalent to a D10 Dozer at $181 per hour. The hour equivalent cost includes support equipment such as excavators, dozers, trucks, vehicles, materials, labor and supervision.

Revegetation and weed control costs assumes high-intensity long-term revegetation measures for the recontoured subsidence area slopes. The estimated costs for revegetation are based on typical costs calculated at other job sites for similar revegetation activities performed by a third party contractor. Based on experience, a cost factor of $3,000 per acre was used in the estimate.

An allowance is made in the estimate for stormwater controls such as ditches, conveyances, sediment basins and other features. An allowance of 10,000 linear feet of stormwater controls at a cost of $150 per linear foot was used in the cost estimate. An allowance of $2.0 million for additional groundwater controls such as additional monitoring, wells, interception and other measures was also included in the estimate.

Interim Operation and Maintenance

Interim operation and maintenance costs are those costs which would be necessary for the agencies to incur in the event the company abandoned the project as a result of bankruptcy or otherwise. Those costs would include labor, materials, supply, power, and other requirements to operate and maintain critical systems such as the underground mine pumps, seepage collection pumps, treatment systems and to maintain site security. Based on experience at other sites an allowance of $1.2 million per year for a period of 3-years has been estimated for interim operations and maintenance until such time as permanent facilities and arrangements can be made for those activities to be provided for longer-term and addressed in other cost areas (such as the Water Treatment Trust Fund).

Indirect Costs

The financial assurance cost estimate includes indirect costs for contingency, contractors profit and bond, contract administration, agency administration and mobilization. Based on experience and standard cost estimating procedures factors of direct costs of 10% for contingency, 5% for contractors profit, 2% for contractors bond, 10% for contract engineering, procurement and management (administration), 5% for agency administration, and 4% for mobilization were used in the estimate.

Additional Costs

Mine Area Water Treatment Trust Fund

The financial assurance cost of mine area water treatment in perpetuity is based on estimated costs for future operations and maintenance of the mine area water treatment facilities as specified in the Full Reclamation and Closure Plan.

The estimate is based on a typical water treatment and seepage capture cost estimate treating from 300 – 450 gallons per minute acid mine drainage at a mine site. The estimate assumes operation and maintenance of a water management program to include seepage or water capture, pumping to a treatment plant, and/or direct discharge. The operating and maintenance costs are calculated over 100-year period. Capital costs are discounted over a 100-year period. Water treatment capital costs are based on conversion of an existing mill facility into a water treatment plant. The estimate includes the cost of environmental monitoring, sampling and testing. Operating and maintenance costs are typical to other mining water treatment facilities.

Appendix C – Cost Estimate Details, Water Treatment Trust Fund Estimate shows the details of the mine area water treatment trust fund bond estimate. Over a 100-year period the total costs would be $99.7 million dollars. The net present value (NPV) of those costs discounted at a rate of 4.5% would be $20.5 million dollars, which was used in the financial assurance cost estimate.

Tailings Facility Area Water Treatment Trust Fund

The financial assurance cost of tailings facility area water treatment in perpetuity is based on estimated costs for future operations and maintenance of the tailings facility area water treatment facilities as specified in the Full Reclamation and Closure Plan. The financial assurance cost estimate assumes that the tailings facility area water treatment operations would be run in coordination with the mine area water treatment operations at an additional cost equal to 25% of the mine area treatment costs.

Red River Restoration Fund

The financial assurance cost estimate includes an allowance of $2.0 million per mile or $12 million total for restoration costs of the Red River. This includes costs for tailings pipeline removal and tailings spill remediation, including removal and restoration of the streamside/riparian area. It might also include restoration of the fluvial function of the streambed and floodplain to post-mining conditions. $2.0 million per mile is considered a conservative estimate of streamside reclamation costs and is consistent with costs experienced at other cleanup sites.

<u>Cost Estimate References</u>

Caterpillar Handbook, Edition 27.

Dataquest Cost Reference Guide.

Means Heavy Construction Cost Data.

Caterpillar VEHSIM Vehicle Simulation Program.

J. Kuipers, Hardrock Reclamation Bonding Practices in the Western United States, Center for Science in Public Participation for the National Wildlife Federation, February 2000.

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(Slifer, D., 1996). Slifer, D., Red River Groundwater Investigation, New Mexico Environment Department Surface Water Quality Bureau, March, 1996.

## Appendix A - Figures

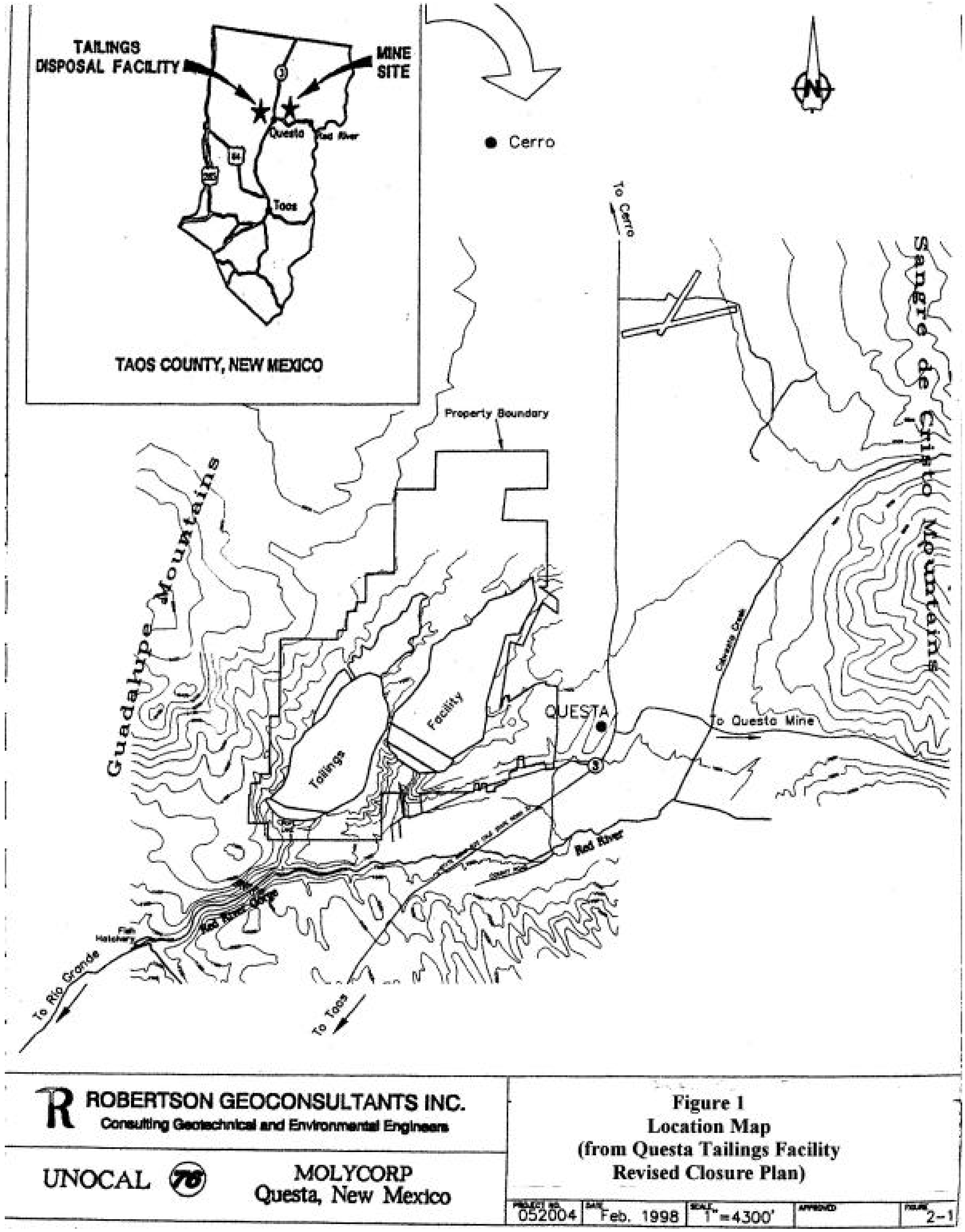



Figure 1
Location Map
(from Questa Tailings Facility
Revised Closure Plan)

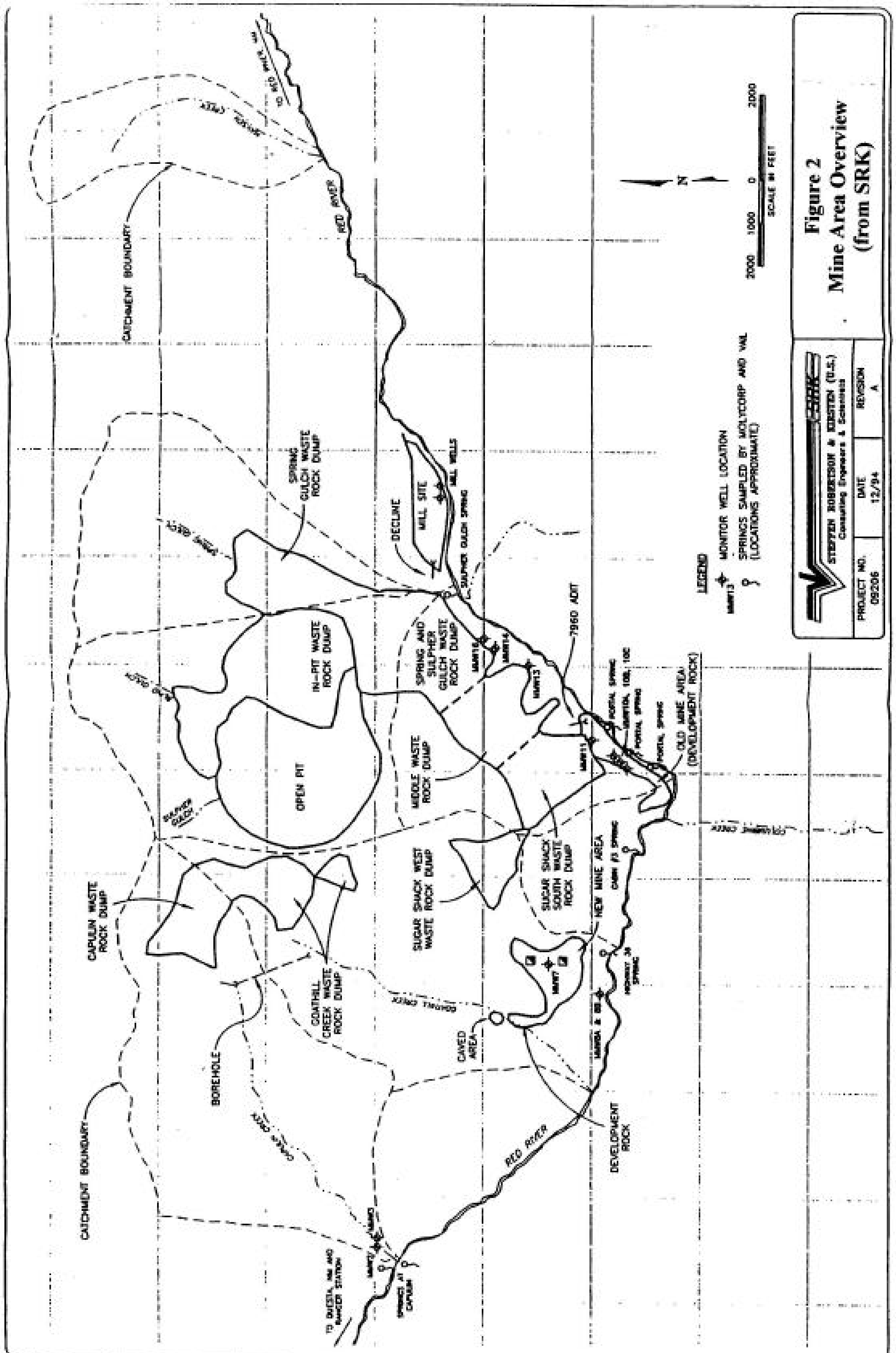



**Figure 2**
**Mine Area Overview**
**(from SRK)**

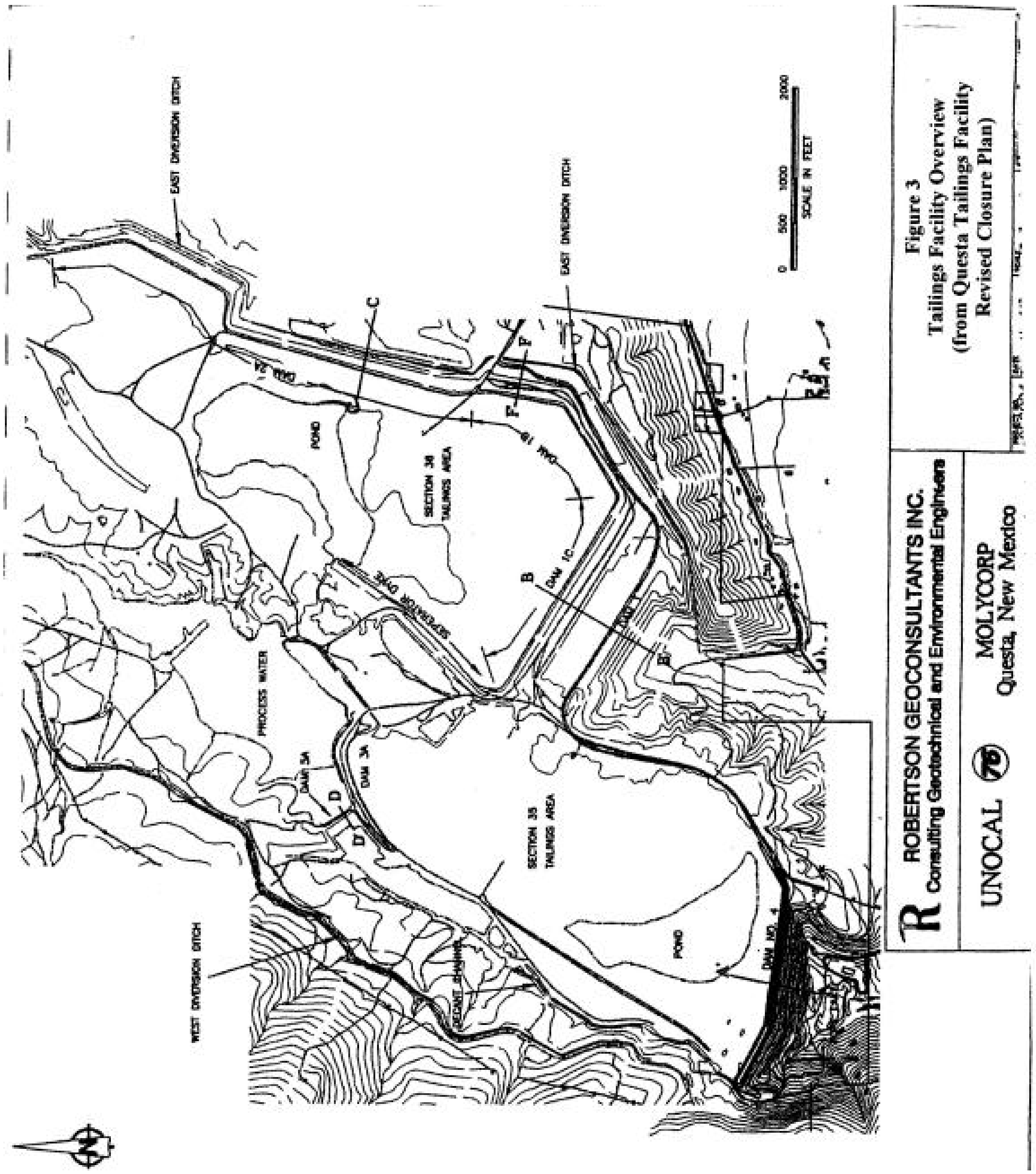
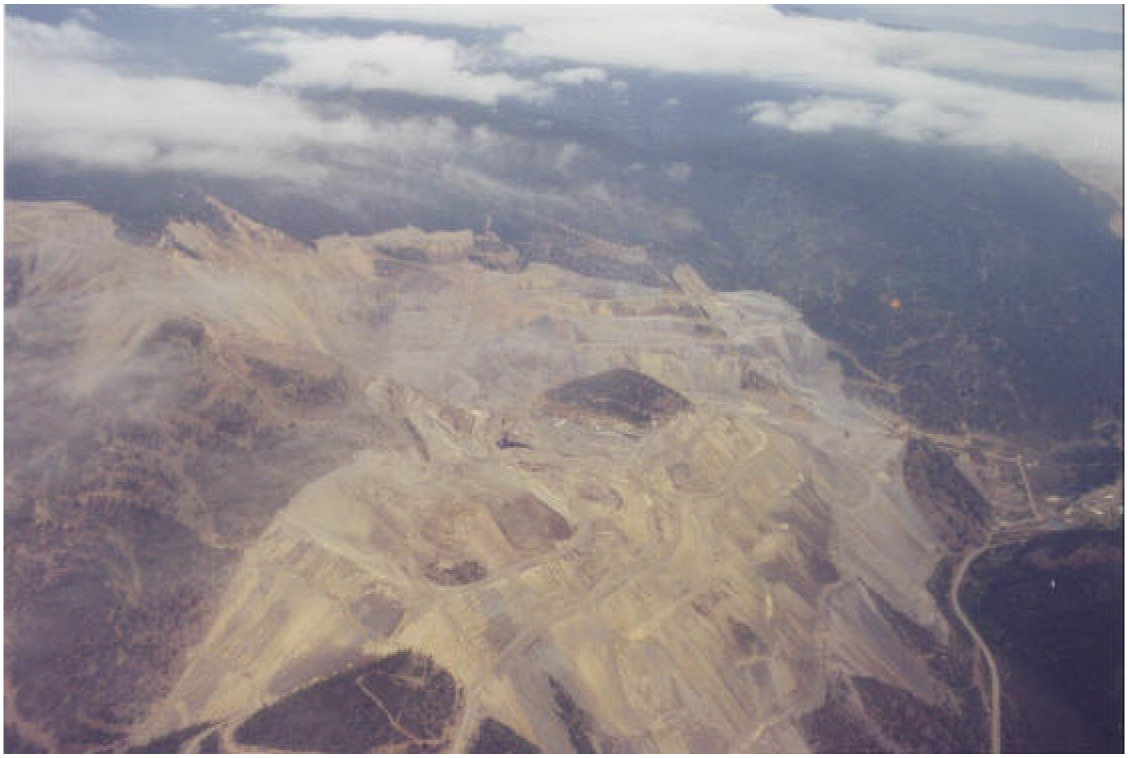



**Figure 3**
**Tailings Facility Overview**
**(from Questa Tailings Facility Revised Closure Plan)**

## Appendix B – Pictures

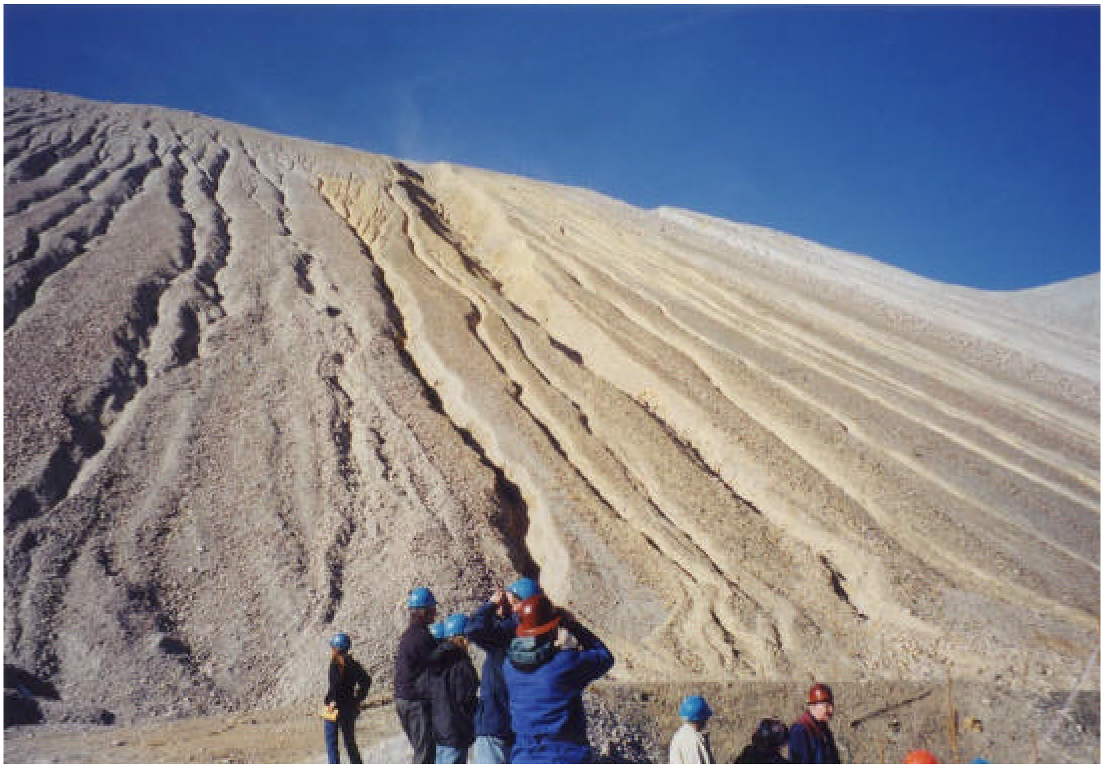


Picture 1. Open Pit and Waste Rock Dumps.

Picture 2. Tailings Facility (with town of Questa and upper mine waste rock piles in background).

Picture 3. Waste Rock Dumps (Spring/Sulphur Gulch and Middle) from Highway.

Picture 4. Waste Rock Dump (Spring/Sulphur Gulch).



Picture 5. Waste Rock Dump (Spring/Sulphur Gulch) Erosion Gullies.

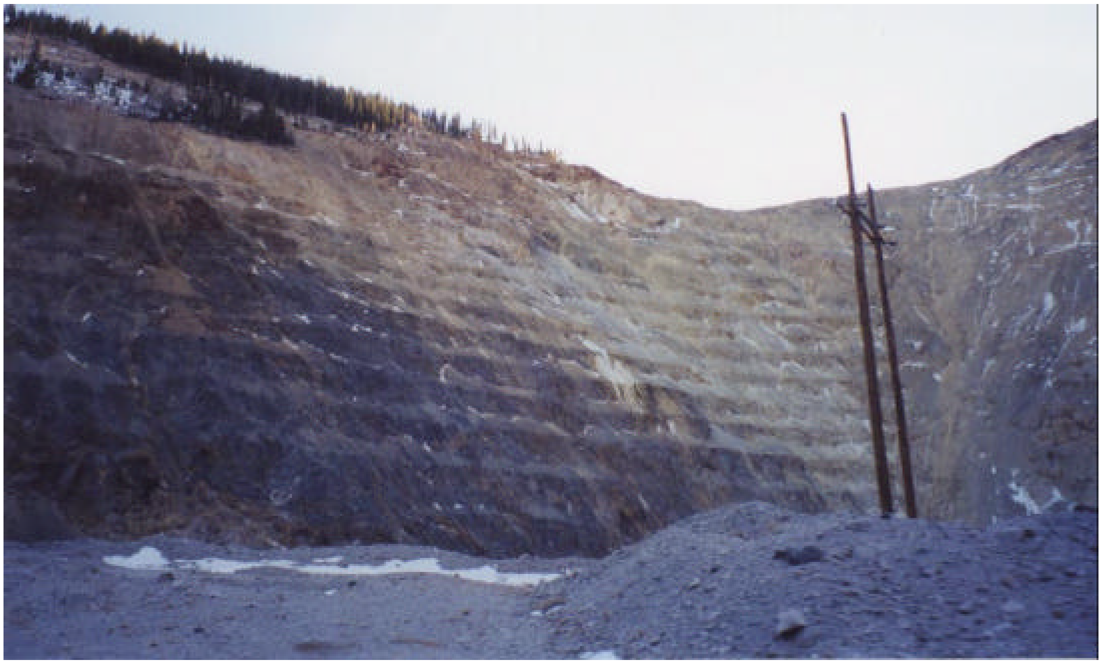
Picture 6. Waste Rock Dump (Spring/Sulphur Gulch) Eroded Material.

Picture 7. Waste Rock Dump (Middle) Erosion Gullies and Eroded Material.

Picture 8. Waste Rock Dump (Middle) Bench (note stormwater control ditch and bench slump area).

Picture 9. Mine Area Revegetation Test Plots.

Picture 10. Open Pit Highwall (note wet seepage areas).



Picture 11. Open Pit Highwall.

Picture 12. Open Pit Highwall.


Picture 13. Open Pit Highwall.


Picture 14. Open Pit Highwall.

Picture 15. GoatHill Creek.

Picture 16. GoatHill Creek Subsidence Area.

Picture 17. Tailings Facility Pond Deposition Area.

## Appendix C - Bond Estimate Details

Detailed Reclamation Bond Cost Estimate
Full Reclamation Alternative Reclamation and Closure Plan
Molycorp Questa Mine, NM

J. Kuipers
CSP2
15-May-00

| Tasks | Unit | No. Units | Unit Cost | Total Cost |
|---|---|---|---|---|
| Waste Rock Area Reclamation | | | | |
| Remove waste rock | | | | |
| Capulin @ 100% | tons | 26,000,000 | $2.70 | $70,200,000 |
| Middle @ 25% | tons | 11,500,000 | $1.95 | $22,425,000 |
| Sugar Shack South @25% | tons | 13,250,000 | $1.95 | $25,837,500 |
| Spring/Sulphur Gulch @25% | tons | 20,000,000 | $1.95 | $39,000,000 |
| Regrade waste rock surfaces | acres | 750 | $2,896 | $2,172,000 |
| Install additional slope stabilization | lf | 5000 | $1,000 | $5,000,000 |
| Haul and spread cover | | | | |
| Haul NAG (2-feet) | tons | 3,915,000 | $1.95 | $7,634,250 |
| Haul growth-medium (18-inches) | tons | 2,936,250 | $6.45 | $18,938,813 |
| Spread | acres | 750 | $1,448 | $1,086,000 |
| Revegetate and weed control | acres | 750 | $5,000 | $3,750,000 |
| Install stormwater controls | lf | 20000 | $300 | $6,000,000 |
| Install additional groundwater controls | lot | 1 | | $1,000,000 |
| Subtotal Waste Rock Area Reclamation | | | | $203,043,563 |
| Open Pit Area Reclamation | | | | |
| Regrade open pit surfaces | acres | 200 | $1,448 | $289,600 |
| Install additional slope stabilization | lf | 5000 | $1,000 | $5,000,000 |
| Haul and spread cover | | | | |
| NAG (2-feet) | tons | 1,044,000 | $1.95 | $2,035,800 |
| Growth-medium (18-inches) | | 783,000 | $6.45 | $5,050,350 |
| Spread | acres | 200 | $724 | $144,800 |
| Revegetate and weed control | acres | 200 | $5,000 | $1,000,000 |
| Install stormwater controls | lf | 10000 | $300 | $3,000,000 |
| Install additional groundwater controls | lot | 1 | | $1,000,000 |
| Subtotal Open Pit Area Reclamation | | | | $17,520,550 |
| Subsidence Area Reclamation | | | | |
| Regrade subsidence area surfaces (perimeter) | acres | 20 | $1,448 | $28,960 |
| Regrade subsidence area surfaces (interior) | acres | 60 | $7,240 | $434,400 |
| Haul and spread cover | | | | |
| NAG (2-feet) | tons | 417,600 | $1.95 | $814,320 |
| Growth-medium (18-inches) | | 313,200 | $6.45 | $2,020,140 |
| Spread | acres | 80 | $724 | $57,920 |
| Revegetate and weed control | acres | 80 | $5,000 | $400,000 |
| Install stormwater controls | lf | 1000 | $300 | $300,000 |
| Install additional groundwater controls | lot | 1 | | $500,000 |
| Subtotal Subsidence Area Reclamation | | | | $4,555,740 |

| Tasks | Unit | No. Units | Unit Cost | Total Cost |
|---|---|---|---|---|
| Tailings Facility | | | | |
| Regrade tailings area surfaces | acres | 700 | $724 | $506,800 |
| Haul and spread cover | | | | |
| NAG (2-feet) | tons | 2,740,500 | $1.95 | $5,343,975 |
| Growth-medium (18-inches) | | 2,055,375 | $1.95 | $4,007,981 |
| Spread | acres | 700 | $362 | $253,400 |
| Revegetate and weed control | acres | 700 | $3,000 | $2,100,000 |
| Install stormwater controls | lf | 10000 | $150 | $1,500,000 |
| Install additional groundwater controls | lot | 1 | | $2,000,000 |
| Subtotal Tailings Facility Reclamation | | | | $15,712,156 |
| Facilities Roads and Other | | | | |
| Dismantling and equipment removal | | | | $1,000,000 |
| Regrade facilities and roads area surfaces | acres | 310 | $724 | $224,440 |
| Haul and spread cover | | | | |
| NAG (2-feet) | tons | 1,213,650 | $1.95 | $2,366,618 |
| Growth-medium (18-inches) | | 1,213,650 | $1.95 | $2,366,618 |
| Spread | acres | 310 | $724 | $224,440 |
| Revegetate and weed control | acres | 700 | $3,000 | $2,100,000 |
| Install stormwater controls | lf | 10000 | $150 | $1,500,000 |
| Subtotal Tailings Facilities Roads Reclamation | | | | $8,782,115 |
| Interim Operations and Maintenance | lot | 1 | | $3,600,000 |
| Sub-Total Direct Costs | | | | $253,214,124 |
| Indirect Costs | | | | |
| Contingency | | | 10% | $25,321,412 |
| Contractors Profit | | | 5% | $12,660,706 |
| Contractors Bond | | | 2% | $5,064,282 |
| Contract Administration | | | 10% | $25,321,412 |
| Agency Administration | | | 5% | $12,660,706 |
| Mobilization | | | 4% | $10,128,565 |
| Sub-Total Indirect Costs | | | 36% | $91,157,085 |
| Additional Costs | | | | |
| Mine Area Water Treatment Trust Fund | | | | $20,490,000 |
| Tailings Area Water Treatment Trust Fund | | | | $5,122,500 |
| Red River Restoration Fund | miles | 6 | $2,000,000 | $12,000,000 |
| Sub-Total Additional Costs | | | | $37,612,500 |
| Total Costs | | | | $381,983,708 |

| | |
|---|---|
| Mine Facility Area Costs | $340,124,741 |
| Tailing Facility Area Costs | $29,858,968 |
| Red River Restoration Fund | $12,000,000 |
| Total Costs | $381,983,708 |

Detailed Reclamation Bond Cost Estimate Assumptions
Full Reclamation Alternative Reclamation and Closure Plan
Molycorp Questa Mine, NM

| Task | Assumption |
|---|---|
| Waste Rock Area Reclamation | |
| Remove waste rock | |
| Capulin @ 100% | assumes load and unload @$0.45/ton and 3 mile haul @ $0.75/ton/mile = $2.70/ton |
| Middle @ 25% | assumes load and unload @$0.45/ton and 2 mile haul @ $0.75/ton/mile = $1.95/ton |
| Sugar Shack South @25% | assumes load and unload @$0.45/ton and 2 mile haul @ $0.75/ton/mile = $1.95/ton |
| Sugar Shack West @25% | assumes load and unload @$0.45/ton and 2 mile haul @ $0.75/ton/mile = $1.95/ton |
| Regrade waste rock surfaces | assumes work equivalent to 16 hours/acre w/ D10 Dozer @ $181 per hour = $2,896/hr |
| Install additional slope stabilization | assumes 5,000 linear feet of designed earthworks @ $1,000 per ft |
| Haul and spread cover | |
| NAG (2-feet) | assumes load and unload @$0.45/ton and 2 mile haul @ $0.75/ton/mile = $1.95/ton |
| Growth-medium (18-inches) | assumes load and unload @$0.45/ton and 8 mile haul @$0.75/ton/mile = $6.45/ton |
| Spread | assumes work equivalent to 8 hours/acre w/ D10 Dozer @ $181 per hour = $2,896/hr |
| Revegetate and weed control | assumes high-intensity long-term revegetation and weed control at $5,000 per acre (present value) |
| Install stormwater controls | assumes 10,000 linear feet of stormwater controls at $300 per ft |
| Install additional groundwater controls | assumes $1.0m for additional groundwater controls such as additional monitoring, wells, interception, etc.,. |
| Subtotal Waste Rock Area Reclamation | |
| Open Pit Area Reclamation | |
| Regrade open pit surfaces | assumes work equivalent to 8 hours/acre w/ D10 Dozer @ $181 per hour = $1,448/hr |
| Install additional slope stabilization | assumes 5,000 linear feet of designed earthworks @ $1,000 per ft |
| Haul and spread cover | |
| NAG (2-feet) | assumes load and unload @$0.45/ton and 2 mile haul @ $0.75/ton/mile = $1.95/ton |
| Growth-medium (18-inches) | assumes load and unload @$0.45/ton and 8 mile haul @$0.75/ton/mile = $6.45/ton |
| Spread | assumes work equivalent to 4 hours/acre w/ D10 Dozer @ $181 per hour = $724/hr |
| Revegetate and weed control | assumes high-intensity long-term revegetation and weed control at $5,000 per acre (present value) |
| Install stormwater controls | assumes 10,000 linear feet of stormwater controls at $300 per ft |
| Install additional groundwater controls | assumes $1.0m for additional groundwater controls such as additional monitoring, wells, interception, etc.,. |
| Subtotal Open Pit Area Reclamation | |

| Task | Assumption |
| --- | --- |
| Subsidence Area Reclamation | |
| Regrade subsidence area surfaces | assumes work equivalent to 8 hours/acre w/ D10 Dozer @ $181 per hour = $1,448/hr |
| Haul and spread cover | |
| NAG (2-feet) | assumes load and unload @$0.45/ton and 2 mile haul @ $0.75/ton/mile = $1.95/ton |
| Growth-medium (18-inches) | assumes load and unload @$0.45/ton and 8 mile haul @$0.75/ton/mile = $6.45/ton |
| Spread | assumes work equivalent to 4 hours/acre w/ D10 Dozer @ $181 per hour = $724/hr |
| Revegetate and weed control | assumes high-intensity long-term revegetation and weed control at $5,000 per acre (present value) |
| Install stormwater controls | assumes 1,000 linear feet of stormwater controls at $300 per ft |
| Install additional groundwater controls | assumes $0.5m for additional groundwater controls such as additional monitoring, wells, interception, etc.,. |
| Subtotal Subsidence Area Reclamation | |
| Tailings Facility | |
| Regrade tailings area surfaces | assumes work equivalent to 4 hours/acre w/ D10 Dozer @ $181 per hour = $724/hr |
| Haul and spread cover | |
| NAG (2-feet) | assumes load and unload @$0.45/ton and 2 mile haul @$0.75/ton/mile = $1.95/ton |
| Growth-medium (18-inches) | assumes load and unload @$0.45/ton and 2 mile haul @$0.75/ton/mile = $1.95/ton |
| Spread | assumes work equivalent to 2 hours/acre w/ D10 Dozer @ $181 per hour = $724/hr |
| Revegetate and weed control | assumes high-intensity long-term revegetation and weed control at $3,000 per acre (present value) |
| Install stormwater controls | assumes 10,000 linear feet of stormwater controls at $150 per ft |
| Install additional groundwater controls | assumes $2.0m for additional groundwater controls such as additional monitoring, wells, interception, etc.,. |
| Subtotal Tailings Facility Reclamation | |
| Facilities Roads and Other | |
| Dismantling and equipment removal | assumes $1,000,000 allowance for building, equipment and facilities dismantling and removal |
| Regrade facilities and roads area surfaces | assumes work equivalent to 4 hours/acre w/ D10 Dozer @ $181 per hour = $724/hr |
| Haul and spread cover | |
| NAG (2-feet) | assumes load and unload @$0.45/ton and 2 mile haul @$0.75/ton/mile = $1.95/ton |
| Growth-medium (18-inches) | assumes load and unload @$0.45/ton and 2 mile haul @$0.75/ton/mile = $1.95/ton |
| Spread | assumes work equivalent to 2 hours/acre w/ D10 Dozer @ $181 per hour = $724/hr |
| Revegetate and weed control | assumes high-intensity long-term revegetation and weed control at $3,000 per acre (present value) |
| Install stormwater controls | assumes 10,000 linear feet of stormwater controls at $150 per ft |
| Subtotal Facilities Roads Reclamation | |
| Interim Operation and Maintenance | assumes $1,200,000 allowance per year for three years for interim operations and maintenance costs |

Sub-Total Direct Costs

| Task | Assumption |
|---|---|
| Indirect Costs | |
| Contingency | assumes 10% of direct costs for contingency |
| Contractors Profit | assumes 5% of direct costs for contractors profit |
| Contractors Bond | assumes 2% of direct costs for contractors performance bond |
| Contract Administration | assumes 10% of direct costs for engineering, procurement and construction management |
| Agency Administration | assumes 5% of of direct costs for state agency administration |
| Mobilization | assumes 4% of direct costs for mobilization |
| Sub-Total Indirect Costs | |
| Additional Costs | |
| Mine Area Water Treatment Trust Fund | assumes 4.5% discount rate on 350 gpm AMD water treatment plant with costs for 100 years |
| Tailings Area Water Treatment Trust Fund | assumes 0.25% of mine area water treatment trust fund costs with Tailings water treatment run ancillary to mine operations |
| Red River Restoration Fund | assumes 6 miles impaired at $2.0 million per mile restoration cost |
| Sub-Total Additional Costs | |
| Total Costs | |

Water Treatment Trust Fund Estimate
350 gpd AMD seepage capture and water treatment

| Task | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Capital Cost** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Water Treatment Plant | [illegible] | | | | | | | | | | | | | | | | | | | | | | | | | |
| Seepage Capture System | [illegible] | | | | | | | | | | | | | | | | | | | | | | | | | [illegible] |
| **Capital Equipment Replacement Cost** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Water Treatment Plant | | | | | | | | | | | [illegible] | | | | | | | | | | [illegible] | | | | | |
| Seepage Capture System | | | | | | [illegible] | | | | | [illegible] | | | | | [illegible] | | | | | [illegible] | | | | | [illegible] |
| **Operation and Maintenance Costs** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Water Treatment Plant | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| Seepage Capture System | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| **Total Water Treatment Costs (1998 $)** | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |

**Net Present Value (NPV)**

| | |
|---|---|
| @ 0% Discount Rate | $99,717,717 |
| @ 2.5% Discount Rate | $34,691,612 |
| @ 4.5% Discount Rate | $20,490,208 |
| @ 6.5% Discount Rate | $14,355,301 |
| @ 8.5% Discount Rate | $11,113,677 |

| | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | 2036 | 2037 | 2038 | 2039 | 2040 | 2041 | 2042 | 2043 | 2044 | 2045 | 2046 | 2047 | 2048 | 2049 | 2050 | 2051 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Capital Cost** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Water Treatment Plant | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Seepage Capture System | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Capital Equipment Replacement Cost** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Water Treatment Plant | | | | | [illegible] | | | | | | | | | | [illegible] | | | | | | | | | | [illegible] | |
| Seepage Capture System | | | | | [illegible] | | | | | [illegible] | | | | | [illegible] | | | | | [illegible] | | | | | [illegible] | |
| **Operation and Maintenance Costs** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Water Treatment Plant | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| Seepage Capture System | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| **Total Water Treatment Costs (1998 $)** | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |

| | 2052 | 2053 | 2054 | 2055 | 2056 | 2057 | 2058 | 2059 | 2060 | 2061 | 2062 | 2063 | 2064 | 2065 | 2066 | 2067 | 2068 | 2069 | 2070 | 2071 | 2072 | 2073 | 2074 | 2075 | 2076 | 2077 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Capital Cost** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Water Treatment Plant | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Seepage Capture System | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Capital Equipment Replacement Cost** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Water Treatment Plant | | | | | | | | | [illegible] | | | | | | | | | | [illegible] | | | | | | | |
| Seepage Capture System | | | | [illegible] | | | | | [illegible] | | | | | [illegible] | | | | | [illegible] | | | | | [illegible] | | |
| **Operation and Maintenance Costs** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Water Treatment Plant | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| Seepage Capture System | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| **Total Water Treatment Costs (1998 $)** | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |

| | 2078 | 2079 | 2080 | 2081 | 2082 | 2083 | 2084 | 2085 | 2086 | 2087 | 2088 | 2089 | 2090 | 2091 | 2092 | 2093 | 2094 | 2095 | 2096 | 2097 | 2098 | 2099 | 2100 | 2101 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Capital Cost** | | | | | | | | | | | | | | | | | | | | | | | | | |
| Water Treatment Plant | | | | | | | | | | | | | | | | | | | | | | | | | [illegible] |
| Seepage Capture System | | | | | | | | | | | | | | | | | | | | | | | | | [illegible] |
| **Capital Equipment Replacement Cost** | | | | | | | | | | | | | | | | | | | | | | | | | |
| Water Treatment Plant | | | [illegible] | | | | | | | | | | [illegible] | | | | | | | | | | [illegible] | | [illegible] |
| Seepage Capture System | | | [illegible] | | | | | [illegible] | | | | | [illegible] | | | | | [illegible] | | | | | [illegible] | | [illegible] |
| **Operation and Maintenance Costs** | | | | | | | | | | | | | | | | | | | | | | | | | |
| Water Treatment Plant | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| Seepage Capture System | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| **Total Water Treatment Costs (1998 $)** | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |

## Appendix D – Open Pit Area and Underground Mine Subsidence Area Reclamation

The following New Mexico statutes specifically address reclamation of the Open Pit Area and Underground Mine Subsidence Area:

- The permit area will be reclaimed to a condition that allows for re-establishment of a self-sustaining ecosystem appropriate for the life zone of the surrounding areas following closure unless conflicting with the approved post-mining land use. Each closeout plan must be developed to meet the site-specific characteristics of the mining operation and the site. The closeout plan must specify incremental work to be done within specific time frames to accomplish the reclamation. [19 NMAC 10.2.507.A]

- Waiver for Pits and Waste Units - An operator may apply for a waiver for open pits or waste units from the requirement of achieving a post-mining land use or self-sustaining ecosystem. The operator must show that achieving a post-mining land use or self-sustaining ecosystem is not technically or economically feasible or is environmentally unsound. The Director may grant the waiver for an open pit or waste unit if he finds measures will be taken to ensure that the open pit or waste unit will meet all applicable federal and state laws, regulations and standards for air, surface water and ground water protection following closure; and the open pit or waste unit will not pose a current or future hazard to public health or safety. [19 NMAC 10.2.507.B]

The open pit and underground mine subsidence areas both are part of Molycorp's Questa Mine permit area. According to Molycorp[3], reclamation of the pit and subsidence area is economically and/or technically infeasible and/or environmentally unsound. Molycorp cites disturbance of the waste rock dumps and creation of new scar areas that would occur in areas backfill was taken from, the technical infeasibility of reclamation of steep slopes without backfill, and the cost of backfill (estimated at greater than $700 million for the pit alone). Based on their justification the company will seek a waiver from reclamation of the open pit and underground mine subsidence area.

It would certainly be technically feasible to backfill the open pit and it may be possible to backfill the underground mine subsidence area as well. As demonstrated by the Full Reclamation and Closure Plan, it is likely that in order to create stable revegetated slopes that a significant amount of material will have to be removed from some of the waste rock dumps. This will only involve moving a portion of those dumps and would mitigate the company's concerns about creation of new scar areas. In addition, the Capulin Gulch waste rock dump would be removed entirely, providing a significant amount of backfill. The consolidated native ground beneath the Capulin Gulch waste rock dump would be covered with 2-ft of NAG and 18 inches of topsoil and revegetated, and not result in a new scar area. As a result of these actions, effective reclamation will be facilitated at the waste rock dumps and some backfilling in the open pit, and potentially the subsidence area, will be accomplished.

The company's only real argument against backfill is economic feasibility. However, the removal of portions of the waste rock dumps coinciding with backfill of the open pit and possibly the subsidence area results in a cost-effective solution to reclamation of the combined facilities. In addition,

[3] see Questa Mine Closeout Plan and Molycorp Response to Comments by MMD dated August 31, 1999.

complete backfill of the pit may not be necessary to accomplish suitable slopes for reclamation. As a result, it is probable that the cost of backfilling might actually be more economically feasible than the company has indicated. Since about $200 million would be spent coincidental on backfilling the open pit in the Full Reclamation and Closure Plan, the additional cost to achieve stable slopes in the open pit might run from no additional cost to as much as $500 million.

A major issues that should preclude Molycorp from obtaining the waiver from reclamation is public health and safety. The open pit and subsidence area in their present condition are extremely steep and unstable and present a hazard for humans and potentially for wildlife. Molycorp proposes to provide for public safety by closing and reclaiming unnecessary access roads, gating other roads, and signs will be installed along a perimeter fence.

As demonstrated by the pictures of the Goathill Gulch subsidence area contained in the Full Reclamation and Closure Plan, the subsidence area is occurring within an existing and more extensive older scar area. However, the picture also shows that the subsidence area has caused a slip fault below the upper areas of the older scar area (which show some natural revegetation). This fault, without some type of buttressing, will most likely eventually lead to and cause the entire scar area to become more active, probably extending to, and potentially beyond, the existing ridgeline. This in affect will mean that the existing 80 acre subsidence area could lead to a larger disturbance area, potentially disturbing 1,000 or more acres. In addition, under the right circumstances this condition could potentially lead to a catastrophic landslide and/or mudslide with enormous consequences.

In order to mitigate the potentially significant and possibly extreme consequences of the subsidence area it is strongly recommended that more extensive analysis of the geotechnical stability of the underground mine and subsidence area be undertaken. Without proof to the contrary that it is unnecessary, it is recommended that contingencies be made for backfilling the subsidence area and buttressing the material that is overhanging the slip fault caused by the subsidence. The cost for the backfill operations, which may present difficult technical and worker safety considerations, may be difficult, and is likely to run from $50 million to as much as $500 million.

Mining methods such as those employed underground at Molycorp's Questa mine and causing significant surface subsidence, resulting in potential hazards and rendering an area entirely unusable, create a regulatory conundrum. It is most likely not possible to ensure long-term safety without reclamation, therefore a waiver should not be allowed. Given that consideration, future mining activities causing further subsidence should be further examined. The willful creation of a ruined area with unknown and potentially severe hazards should be weighted with the benefits and the technology reconsidered as an acceptable modern mining practice. On the basis of what is acceptable to modern society, unless the company is willing and can afford to undertake reclamation in such areas it creates that could harm the environment, future mining activities known to create surface subsidence in topography and their potential consequences should be outlawed.