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$000215187 WA/NP/PE

3-4-13-1 FTW-01-01-032-2-014-01-004

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Technical Issue: Direct Hydrologic Connection

Molycorp Mine, Questa, New Mexico

Several Molycorp contractors have conducted studies at the mine site. All generally agree that the sulfide rich volcanic rock material "rhyolite" is most likely responsible for generating the highly acidic metal laden waters within the Red River watershed. This acidic metal laden water is called Acid Rock Drainage (ARD). The most common mechanism for the formation of ARD involves the oxidation and hydration of sulfide minerals (e.g., pyrite, or iron sulfide), resulting in the generation of sulfuric acid. The acidic waters then remove metals from the weathered rock material and delivers them to the river via ground or surface water flow.

Naturally occurring erosional scars, which are exposed rhyolitic volcanic flows; and Molycorp's Waste Rock Dumps (WRDs), which contain rhyolitic material, are the most probable sources of low pH and high metals discharge to the local watershed environment. Red River water quality and a localized concentration of acidic, high metals seeps indicate that the general area of the source is within the Molycorp property boundary. Geochemical analysis of erosional scar and WRD leachate indicates similar geochemical signatures. Monitor well ground water samples support a correlation between ground water chemistry and WRD and erosional scar leachate chemistry. USGS gage station data indicate ground water flow to the river. Although attenuation appears to be a factor for seep discharge, a correlation exists between seep and ground water quality. Therefore, verification has been adequately established to support a ground water hydrological connection between the two sources and Red River seep discharge. However, the percentage of constituent concentrations or discharge volume supplied by each probable source to a specific seep could not be determined using the available data. To attempt to determine these volumes and percentages would be impractical considering the geologic complexity of the area.

The Office of Inspector General (OIG) finalized a report entitled: "EPA Can Do More To Help Minimize Hardrock Mining Liabilities" on June 11, 1997. The OIG conducted this investigation in response to a request from Region 8 for an audit of the environmental and financial liabilities that could result from active hardrock mines. The OIG found that the low level of financial assurance requirements at mine sites may leave EPA in the position of assuming responsibility for cleanup of future abandoned hardrock mines under the Superfund Program. The EPA media-based program most often applied to hardrock mining is the CWA NPDES program, which calls for permits to limit the discharge of pollutants into U.S. waters. However, a serious limitation of the CWA is that it provides protection for surface waters only; ground water is not subject to regulation under the CWA.

The OIG investigation determined that the most serious environmental threat of current hardrock mining methods is the risk of acid mine drainage (i.e., ARD). Water and oxygen flowing over and through the metal-rich, sulfide rock exposed by mining activities can contaminate surface and ground waters and damage aquatic life. Predicting the probability and extent of acid mine drainage at a specific mine is difficult because drainage may not occur until long after active

mining ends. Reclamation may require water treatment in perpetuity. Although the OIG considered ARD as the most serious environmental threat; the OIG's investigation concentrated on mines which use the heap leaching method for the study.

Legal Issue: Citizens Suit

Amigos Bravos, et al. v. U.S. EPA (Molycorp Citizens Suit)

On March 25, 1999, Amigos Bravos and New Mexico Citizens for Clean Air and Water ("Plaintiffs"), two non-profit organizations dedicated to protecting New Mexico's water resources, filed a citizens suit against EPA under § 505 of the Clean Water Act, alleging that EPA has failed to perform non-discretionary duties under the Clean Water Act ("CWA") by 1) failing to take enforcement action either through the issuance of a compliance order or through a civil suit against Molycorp, Inc. ("Molycorp") for discharging pollutants into waters of the U.S. without a National Pollutant Discharge Elimination System (NPDES) permit, and 2) failing to either issue an NPDES permit for Molycorp's waste rock pile discharges or to prohibit such discharges pursuant to Section 301 of the Act.

Molycorp owns and operates a massive molybdenum mine on the banks of the Red River in New Mexico. Plaintiffs allege that pollutants leaching from Molycorp's waste rock piles are discharging to the Red River via a direct hydrologic groundwater connection and that these discharges are point sources requiring a NPDES permit.

On June 15, 1999, EPA filed a Motion to Dismiss contending 1) enforcement is a discretionary function under the CWA; 2) Plaintiffs were collaterally estopped by prior litigation on this same issue; and 3) Plaintiffs failed to provide proper notice under CWA §505. Plaintiffs filed a Response to EPA's Motion to Dismiss and a Motion for Summary Judgement on July 29, 1999. EPA's reply to Plaintiff's Response to EPA's Motion to Dismiss and to Plaintiff's Motion for Summary Judgment is due September 30, 1999.

ADDITIONAL BACKGROUND INFORMATION

In a 1993 NPDES permit action, EPA declined to impose effluent limitations on the discharges at issue, despite public comment raising the issue. In 1997, these same Plaintiffs filed a citizen suit against Molycorp contending Molycorp was discharging without a permit because Molycorp's 1993 permit did not authorize the overburden pile discharges. The District Court dismissed that case, essentially on the grounds that whether the overburden piles required a permit was an issue that should have been litigated in a challenge to EPA's permit action. Because it had not been, it could not be raised after the fact via a citizen's suit. The Tenth Circuit affirmed the District Court's decision. After its action against Molycorp was dismissed, Plaintiffs brought the instant action against EPA. Molycorp's 1993 permit is now up for renewal and the issue of whether the discharges from the overburden piles should be permitted is before EPA again.

Permit Issues

Molycorp's Molybdenum mine located near Questa, New Mexico is an extensive operation which began in the 1920's. Mining at the site has involved both surface and subterranean activities. Molycorp's current permit authorizes discharges from four outfalls. Two outfalls are located west of Questa at the tailings ponds. The other outfalls are for storm water discharges at the mine site. The storm water outfalls have never been used. Molycorp's NPDES permit has expired and a new permit is being drafted. The currently permitted discharges from the mine and tailings ponds are not expected to be controversial.

There are several seeps located adjacent to the mine site which are controversial and are presently the subject of a citizens suit. As their name describes, the seeps are areas along the stream where water is trickling into the Red River at a low rate. That water is highly acidic, often having a pH as low as 2.0, and contains high concentrations of metals. Although there are some natural seeps in the canyon, activities at the mine are thought to be responsible for the seeps located adjacent to the mine site. The seeps contribute to water quality problems in the Red River by their contribution of metals.

Since NPDES permit can only regulate point sources, the seeps can only be controlled if we can claim that they are point source discharges. This has been previously done in NPDES permits issued in Region 6 by determining that there is a "direct hydrologic connection" between the pollutant source and the receiving stream. The previous permit for Concentrated Animal Feeding Operations and the permit recently issued to US Liquids of Louisiana both contain requirements based on a direct hydrologic connection. A weakness to this approach was found in the Animal Feeding Operations model permit written by EPA Headquarters. The judge reviewing the model permit frowned on the direct hydrologic connection approach because EPA has not issued a policy statement. We should push Headquarters to develop such a policy statement so that this issue does not hurt our case in the event of a challenge.

Ecosystems/TMDL/Tribal Issues

Molycorp/ Red River issues from 6WP-EP

No Tribal concerns are expected on this issue. Tribal groundwater resources are not affected. After the confluence with the Red River, the Rio Grande flows approximately 12 miles before entering the Pueblo of Taos, which has partial jurisdiction over a 10 milestretch of the River. The state of New Mexico also has partial jurisdiction over this part of the Rio Grande. The Pueblo of Taos has jurisdiction over three separate tracts of land, one of which includes the Rio Grande. The Pueblo's traditional housing and tribal offices are located on the largest tract, which includes tributaries to the Rio Grande. The next Tribal jurisdiction (Pueblo of San Juan) is located approximately 30 miles south on the Rio Grande. EPA sends public notices of proposed NPDES permits in New Mexico to all Tribal leaders and environmental offices.

NMED has included the Red River from the mouth on the Rio Grande to Placer Creek in their 1998 303(d) list as Not Supporting water quality standards. The listing is for metals (Al, Cd, and Cu) at acute levels and for metals (Al, Zn) at chronic levels. The segment and numerous tributaries are also listed as not supported for stream bottom deposits. There are no T&E species issues for this reach. The state classifies this as a Class 1 (high) priority. This segment includes the MolyCorp mine area and the Town of Red River.

NMED is currently conducting intensive surface water sampling on this segment and its tributaries. The sampling design was developed through a consensus process that included NMED, NM Game and Fish, Amigos Bravos, MolyCorp., the Village of Red River, and the Red River Watershed Group. There are 42 sampling locations selected to characterize the mainstem, using sites, above and below known seeps or arroyos, and tributaries to the river. The sampling effort is being supported in part by a $100,000 104(b)(3) TMDL development grant awarded through R6. If the results of the sampling indicate that a TMDL is warranted NMED expects that it could be completed as early as spring 2000. This TMDL would most probably take a simple mass balance type approach.

INTERIM STUDY OF THE ACIDIC DRAINAGE TO THE MIDDLE RED RIVER, TAOS COUNTY, NEW MEXICO

FOR

UNOCAL MOLYCORP, INC.
QUESTA DIVISION

VAIL ENGINEERING, INC.
SANTA FE, NEW MEXICO

6WQ-SG

JULY 9, 1993

VAIL ENGINEERING, INC.

PHONE: (505)
988-5575

1588 SAN MATEO LANE
SANTA FE, NEW MEXICO
87501

INTERIM STUDY OF THE ACIDIC DRAINAGE TO THE MIDDLE RED RIVER TAOS, COUNTY, NEW MEXICO JULY 9, 1993

Introduction and Summary

The Red River, between the town of Red River and the Questa Ranger Station, was investigated in October and November of 1988, on November 22, 1992 and on February 16, 1993 to determine the location and magnitude of sources of acidic drainage to the river. In addition numerous springs, seeps and drainages have been investigated. Reports prepared by HEW-1966, (The Department of Health, Education and Welfare, now the EPA), EPA-1971, Smolka and Tague-NMEID for surveys conducted in 1986 and 1988 and USGS Stream Flow and Water Quality data have been extensively reviewed.

The acidic drainage to the river originates primarily in sulfidized, hydrothermal-scar areas which occur in tributary drainage basins, principally to the north of the river. Pyrite in hydrothermal scar areas breaks down in the presence of air and water to form sulfuric acid. The acid leaches aluminum and other metals from the rocks. Sulfuric acid and the dissolved elements are transported to the river in ephemeral streams, ground water flow, and episodic flood runoff.

Molycorp's mining operation has had an affect on the acidic drainage to Red River. Up to 1956, over 35 miles of underground workings had been developed which intercepted a significant amount of ground water flow and resulted in a lowering of the water table and decrease in the natural acidic drainage from Sulfur Gulch and possibly Goat Hill Gulch and Capulin Canyon. In 1965, Molycorp converted the mine to an open pit operation located in Sulfur Gulch. Overburden above the main ore body was excavated and deposited in dumps along the ridge lines to the west and south. A significant portion of the overburden deposited in the dumps at the heads of Goat Hill and Capulin Canyons consisted of altered rock from the Sulfur Gulch hydrothermal scar area. The dumps to the south above Red River Canyon were mainly composed of fairly inert non-acid forming types

of rock. The open pit mine substantially reduced the natural acidic drainage from Sulfur Gulch. Drainage from the dumps at the heads of Goat Hill and Capulin Canyons may be higher in both flow and acidity than the natural drainage from the hydrothermal scar and altered rock areas which underlie much of the dump areas.

In 1983 Molycorp ceased open pit mining and started ore production from the new underground mine located mainly beneath Goat Hill Gulch. Ore removal resulted in a significant caved in area in the bottom of Goat Hill Gulch which, since 1990 has intercepted all of the drainage from the dump area and from the natural scar areas in the upper reaches of the Gulch. In 1992 Molycorp constructed works which intercepted most of the drainage from the dump and natural scar areas at the head of Capulin Canyon. This drainage is being discharged through a bore hole drilled through the ridge between Capulin Canyon and Goat Hill Gulch. The drainage is discharged to the caved area in Goat Hill Gulch. Drainage flowing into the caved area seeps down through the broken rock into the mine. Mining operations were suspended at the end of 1992 and the drainage is presently being allowed to accumulate in the mine. A separate study is in progress to determine what action may be required to prevent drainage of acidic water from the mine to Red River when the water level in the mine approaches the river elevation.

Additional barriers are under construction farther downstream in Capulin Canyon to intercept any drainage from the dump area which may be flowing around the upper catchment system. Preliminary analysis indicates that the downstream flow may be on the order of 15% of that intercepted by the upper catchment system; however, the acidity is much lower indicating that much of the lower flow is from areas outside of the dump area. It is anticipated that the lower catchment system will be in operation by the end of July 1993.

It is anticipated that the dump areas will consolidate and the porosity will decrease as a result of infilling with clays generated by oxidation of the surface material. As this occurs it is expected that drainage from the dumps will approach that of the natural drainage resulting from the hydrothermal scars and altered rock underlying the dumps.

Tributary stream waters near the bases of the hydrothermal scars and below the mine dumps have aluminum concentrations up to approximately 800 mg/l at pH 2.5. Acidic springs along the river contain up to 300 mg/l aluminum at pH values from 3.5 to 5.0. The upper Red River normally has a pH of approximately 8.0 and less than 1 mg/l dissolved aluminum. Spring water entering the middle reach of the river depresses the pH of the river and decreases the alkalinity.

The solubility of aluminum increases exponentially with decreasing pH, from a minimum at pH 6.5. Solubility also rises at high pH (>6.5). The low solubility of aluminum in the river causes precipitation of aluminum hydroxide (gibbsite) which in concentrations of a few mg/l creates a whitish-bluish turbidity in the river. Concentrations of suspended gibbsite generally are fairly low but have been sufficient to create the observed cloudiness in the lower portion of middle Red River during most of the low flow periods of the past several years. Occasionally the turbidity extends upstream to near the Town of Red River and downstream to near the fish hatchery.

Storm runoff creates floods which briefly cause large increases in suspended loads including aluminum and sulfate and a decrease in pH in the Red River.

The milky appearance of the water in Red River has been observed during periods over the past several decades and probably has been more or less prevalent for several thousands of years. A cyclic precipitation pattern probably results in long-term variation in the turbidity in the river. The average discharge of Red River from 1979 through 1992 was more than double of that during the preceding nine year period. This indicates a presently above-normal ground water flow from the hydrothermal scar areas. The above-normal ground water flow may continue for some years after the end of the wet cycle. The higher than normal turbidity in Red River during the past several years may largely be the result of this climatological sequence.

The most acidic spring area located was near the Questa Ranger Station in an area not influenced by Molycorp's operations.

The concentration of aluminum is variable as a result of pH changes both in ground water and river water flow. Suspended gibbsite settles out and then is remobilized as a result of variations in stream flow. Since the dissolved sulfate concentration is much more stable, such has been used for much of the analysis even though the sulfate concentrations in the river are well below water quality standards.

Significant portions of this report were taken from a preliminary report titled "A Geochemical Investigation of the Origin of Aluminum Hydroxide Precipitate in the Red River" which was prepared in 1989 by Scott G. Vail, PHD, while he was employed as the senior geologist with the Vail Engineering firm.

The acidic drainage to Red River is a complex phenomenon which may require observation over many years in order to comprehensively understand what appears to be significant and fairly long term variations in both flow and acidity.

A significant amount of data and information has been accumulated and analyzed for this report. Some of the original goals and objectives, however, have not as yet been fully accomplished and new desirable study areas have developed. For this reason this report is being submitted as an interim report and the study and analysis will continue until all of the goals and objectives are obtained.

Preliminary findings and conclusions resulting from the study and analysis for this report are:

(1) The mass loading of aluminum, sulfates and several other elements increase in a downstream direction with the more significant increases occurring along reaches containing drainage from prominent hydrothermal scar areas.

(2) The acidic drainage results from oxidation of altered rock. The altered rock areas are extensive over much of the region. It appears, however, that most of the acidic drainage is from the hydrothermal scars where erosion maintains a surface of unoxidized soil.

(3) The acidic drainage is not proportional to the area of the scars. It appears that the acidity may increase toward the west where the scars are in an earlier stage of development.

(4) For comparable stream flow rates the mass loading of aluminum, sulfate and some other constituents has been higher in all reaches of middle Red River than the mass loadings several years ago. Such may be due in part to increased spring and seepage flow from an extended above average precipitation period.

(5) Molycorp's mine dumps in Goat Hill Gulch and Capulin Canyon influence the acidic drainage from these areas. Presently most of the drainage from below the dumps is being captured and construction is underway to intercept the balance. This also includes the natural drainage from the hydrothermal scars beneath the dumps. It appears that the acidity and aluminum entering Red River from Goat Hill Gulch has already decreased as a result of interception of drainage from the upper area. The acidic drainage to Red River from these areas, however, may continue to be high for several years because of the slow ground water flow rate from below the catchment areas.

(6) Molycorp's operations have eliminated the potential of major flood and mud flows from Sulfur Gulch and upper Goat Hill Gulch. Substantial storm drainage improvements have also been completed in Capulin Canyon and along the area between the mill and Columbine Creek.

Respectfully Submitted:
VAIL ENGINEERING, INC.

Seal

Ralph E. Vail
Chief Engineer

INTERIM STUDY OF THE ACIDIC DRAINAGE TO THE MIDDLE RED RIVER, TAOS COUNTY, NEW MEXICO

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DRAWINGS FURNISHED SEPARATELY

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Capulin Canyon Seepage Collection System

INTERIM STUDY
OF THE ACIDIC DRAINAGE
TO THE MIDDLE RED RIVER
TAOS, COUNTY, NEW MEXICO
JULY 9, 1993

Purpose

This report has been prepared at the request of Molycorp, Inc. The purpose is to provide a quantitative assessment of the origin and sources of acidic drainage accretions to the Red River between the town of Red River and the Questa Ranger Station.

Background

A cloudy, white precipitate, tentatively identified as gibbsite [$Al(OH)_3$] occurs in the Red River from the town of Red River to below the Questa Ranger Station, mainly at times of low water flow. The affected reach includes the area of Molycorp's Questa Operations, particularly the Sulfur Gulch, Goathill Gulch and Capulin Canyon drainages.

The precipitate has historically been considered to be the product of leaching of aluminum from "hydrothermal scar" areas by acidic ground and surface water, followed by re-precipitation in the river. The scar areas are at least several thousands of years old, and the precipitate is known to have existed for at least several decades (A. Greslin, pers. comm., 1988). The cloudiness in the river, however, has perhaps been more noticeable and/or has received increased attention in recent years. For this

reason, in part, this investigation has been commissioned to evaluate the effect, if any, that the mine dumps at the Molycorp Questa Operations have on the acidic drainage to Red River. The possible effect of the dumps on the acidic drainage is confused by the fact that the dumps in part overlie natural hydrothermal scars.

Several studies of the Red River have been made in recent years (Federal Water Pollution Control Administration, 1966; U.S. Environmental Protection Agency, 1971; Smolka and Tague, 1987, 1989). Thorne Ecological Institute (1972) Investigated the Red River for Molycorp. They noted that natural springs and hydrothermal scars were affecting the water quality of the river. A substantially large number of sampling points were used for Molycorp's surveys which defines and limits the sources of aluminum and other factors to a much greater degree than previous studies. Nevertheless, in relationship to the complexity of the acidic water accretions, this report is based on limited data, especially long term historical data. Seasonal variability in the chemistry of the river is substantial. Additional data are needed to evaluate several influences on the chemistry of the Red River including seasonal variability and stream-water inhomogeneity over short distances and short times, and to identify long-term changes caused by climatic change and evolution of the mine dumps.

Method of Investigation

Three principal objectives were identified as being fundamental to evaluating the origin and controls of acidic drainage to Red River: 1. define the chemical controls of aluminum dissolution, transport and precipitation in the

ground and surface water environment; 2. determine the magnitude and distribution of acidic drainage to the Red River; and 3. evaluate the relative importance of the mine dumps and natural scars as sources of acidic drainage. The following tasks were outlined to achieve these objectives:

- A literature study was made of the chemical systematics of aluminum in the weathering environment.
- Detailed surveys of the affected river area were performed to quantify the location and magnitude of acidic drainage.
- An accretion profile of the Red River was calculated to provide a baseline for the chemical mass flow analysis.
- Limited geological field investigations were carried out in the scar areas and dumps.

The field studies of the dump and natural scar areas were briefer than originally planned, owing to time limitations.

Geological Setting

The Questa mine area is very complex geologically, as is typical of sulfide ore deposits. However, for the purposes of this report, a few basic observations are significant.

Rocks in the district can be divided into three groups. The oldest is a complex of Precambrian quartzite, amphibolite and granite. Tertiary volcanic rocks, dominantly andesite, were erupted over the Precambrian rocks. Eruption of the lavas and silicic tuffs led to caldera collapse. The youngest group, Tertiary granitic rocks, were intruded into the Precambrian and volcanic rocks late in

the history of the caldera. Hydrothermal solutions, related to the younger granites, altered and sulfidized the county rocks, especially the volcanics. The principal ore deposits of the district are within altered volcanic rocks.

Exposures in the mine area are dominantly andesite north of the Red River and Precambrian granite south of the river. Tertiary granite intrudes both of these. Rocks in the mine area are extensively fractured and faulted.

Hydrothermally Altered Areas. Volcanic rocks in the mine area and over much of the area around the town of Red River are extensively altered. Significant zones of alteration extend as far west as the ranger station near Questa. The alteration is characterized by replacement of feldspars and ferromagnesian minerals by clays, sericite, secondary feldspars, chlorite, epidote and pyrite. The areal extent of alteration has not been mapped in detail.

Weathering of the altered areas has produced prominent "hydrothermal scars" in Hanson Creek Canyon, Goathill Gulch and many of the other canyons along the Red River. The scars originate from deep erosion in sulfidized areas. The location and areal extent of the prominent hydrothermal scars as determined from aerial photos and USGS mapping is shown on Drawing A and on Figure A. Pyrite in these rocks dissolves and oxidizes to form sulfuric acid. Most of the acid is formed at or near the surface because of a depletion of oxygen at depth. The acid causes further degradation of the rocks to clay end-products. Metallic elements including aluminum are leached and removed. The result is a "scar" area which is deeply eroded and lacking in plant cover. Little infiltration of precipitation appears to occur below the steep slopes of the scars, as the clay-rich surface is highly impermeable. Consequently, most precipitation is removed through surface run off. Mud flow

Buried Scars NO oxygenation

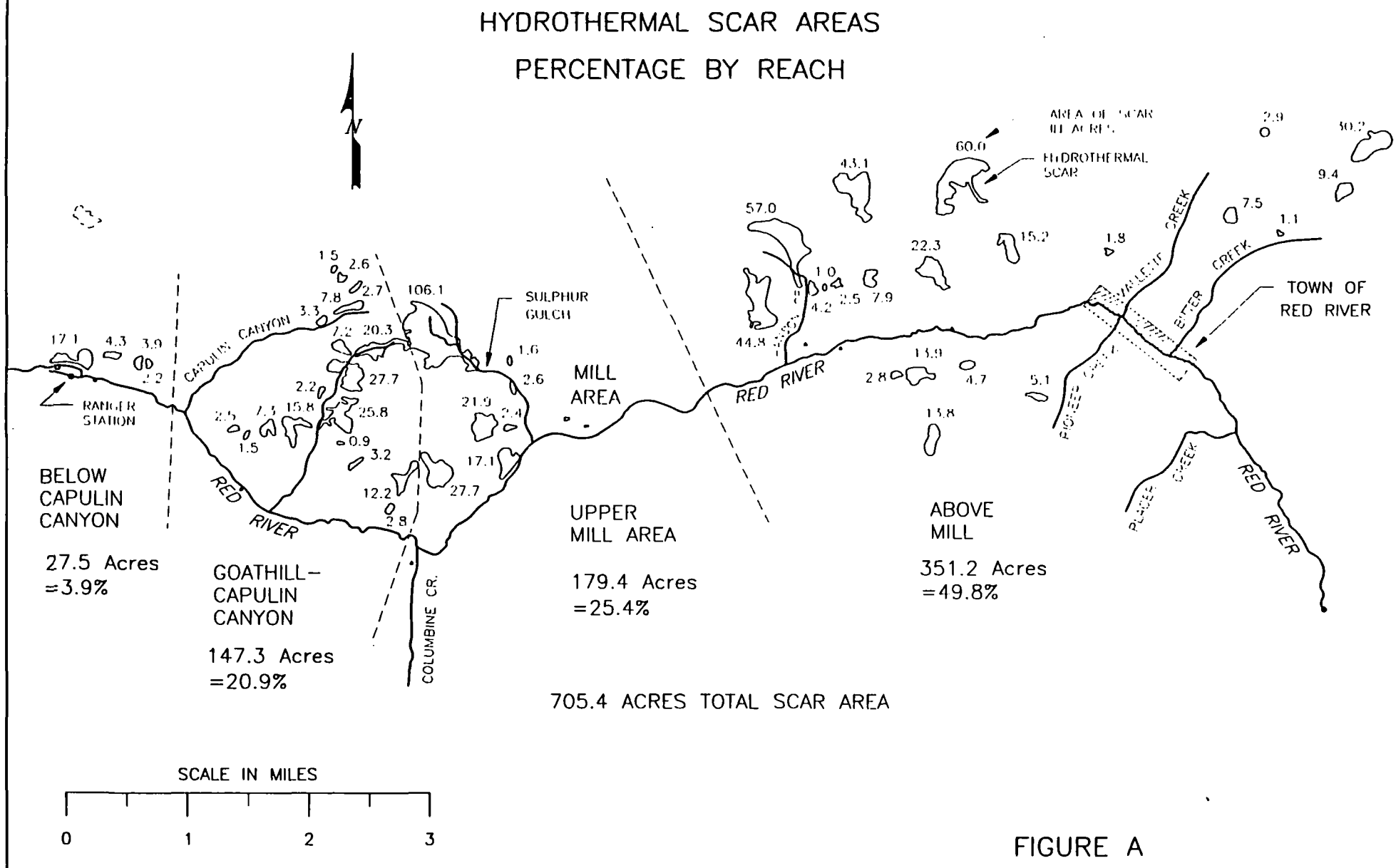


FIGURE A

HYDROTHERMAL SCAR AREAS

deposits, caused by summer flash floods are extensive below the base of the scars and extend to the Red River. The flow deposits are also very clay-rich and fairly impermeable, further limiting infiltration of precipitation.

Mine Dumps

The principal dumps are located in the heads of Capulin Canyon and Goathill Gulch (185 acres combined) and to the north of the Red River between the Molycorp mill and Columbine Creek (413 acres). The dumps consist of overburden which was excavated from the open-pit mine area. The rock types are mainly andesite and granite, as is the area in general. A considerable part of the dump material in the Goathill Gulch and Capulin Canyon areas is altered, sulfidized, hydrothermal-scar material; however, the proportion of sulfidized material and the sulfide content have not been determined.

Highly aluminous, acidic streams emanate from the base of the Goathill and Capulin dumps. The combined flow of these streams is generally about 60 gpm with somewhat higher and less acidic flow occurring following the spring snow melt. The degree to which the acidity of the stream water is caused by the dumps is difficult to determine. According to Schilling's mapping (1956) the dumps are built on altered, sulfidized material, which, generates acidic water.

By analogy to Hanson Creek, it can be expected that the greater part of natural flow from scar areas comes from the base of cliffs at the head of the scars. The lower areas are too impermeable to permit significant gain.

The dumps are located at the heads of their respective canyons, overlying the natural upper spring areas. A significant amount of additional study and analysis will be required before a realistic determination can be made of

the difference between the drainage from the dump areas and the original natural scar areas.

The dump area to the south of the open pit mine generates water that is only mildly acidic, although it also is partly underlaid by altered bedrock and hydrothermal scars. The degree of alteration and sulfidization of the underlying rock is not known, but the relatively small areal extent of presently exposed scar areas and altered rock and type of dump material may be a partial explanation of the low aluminum gain along the reach.

Prior to extensive mine development, the scar area in Sulfur Gulch was a significant source of acidic drainage to the Red River. This drainage to the river was substantially reduced by the underground and the open pit mine. The volume of water originally flowing in Sulfur Gulch was probably more than that in Hansen Creek or Goathill Gulch, or in excess of 30 gpm.

Ground Water Flow

There is little data available for determination of the ground water flow characteristics of the canyon areas north of the Red River. Several test holes were drilled in Goathill Gulch upstream from the underground mine. Indications were that a ground water table was present at a fairly shallow depth; however, inflow was at such a slow rate that a pump test was not conducted. The low inflow rate did indicate a very low hydraulic conductivity. Based on this observation and an evaluation of the fine-grained, clayey nature of the material, we estimate that the conductivity of the material is probably less than 10^{-4} Cm/sec. The permeability of the underlying bedrock is even less.

The hydraulic gradient of the water table is estimated to be on the order of 15 percent. These values indicate that ground water movement is on the order of a few hundred feet per year.

A significant portion of the drainage flow from some of the active natural scar areas is by surface flow over much of the distance to the Red River. Prior to development of the caved area in Goat Hill Gulch and the catchment system in Capulin Canyon, much of the drainage from these areas was by surface flow to within a short distance of the river. After seepage into the ground, this flow may be conducted fairly rapidly through more permeable material near the surface. In contrast the portion of the drainage that is transported by ground water flow over much of the distance down gradient of the scars, may have travel times extending for many years.

In consideration of the foregoing, further study and analysis will be necessary to project the rate of decrease of the acidic drainage to Red River in the Goat Hill Gulch and Capulin Canyon areas which is anticipated as a result of the catchment provisions effected and in progress by Molycorp. The latest stream surveys indicate that highly acidic drainage from Goat Hill Gulch is already declining. This may reflect the elimination of the surface flow. Continued high sulfate accretions indicate that the deeper ground water seepage, which probably is less acidic, has not significantly decreased as of February 1993.

Historical Data

Stream flow records have been kept for the Red River since 1913. Figure B gives a summary of the mean daily flow rates since 1960.

Chemical data are available for the Red River for studies in 1965, 1970, 1986 and 1988 (Federal Water Pollution Control Administration, 1966; U.S. Environmental Protection Agency, 1971; Smolka and Tague, 1987, 1989). Monthly data for the gauging station near Questa are available for 1979 to 1982. There has been a significant increase between the time of the earlier surveys (1965-1970) to the time of the more recent surveys in acidic drainage along all of the middle Red River. This probably has been caused by significantly higher precipitation during the past several years. There also is a significant difference between the surveys, in the amount of stream flow. The amount of stream flow substantially affects both concentrations and mass flow. This makes comparisons on such basis very difficult. Comparison of the percent of the total gain in sulfate for each individual segment of the middle Red River, was found to be the most informative indicator of possible change in the relative amounts of acidic drainage from the individual stream segments. Table 1 summarizes the results of such an analysis. The data base and method of calculation of the values in Table 1 are set forth in Appendix 4.

TABLE 1

HISTORICAL REVIEW OF TOTAL

SULFATE GAIN TO MIDDLE RED RIVER

Percent for Each Segment of the Total
Sulfate Gain from Above Town of Red River
to Ranger Station

Station	(1) 1965	(2) 1970	(3) 1988	(4) 1988	(5) 1988	(6) 1992	(7) 1993
Above Town Red River	32.9	17.2	19.6	8.3	8.3	17.7	18.2
Below Town	33.9	28.7	14.2	20.5	20.5	16.8	22.3
Above Molycorp Mill	5.1*	24.5	22.7	10.9**	39.7	38.6	25.3
Below Col.Crk.	28.2	29.6	43.5	60.2	31.5	26.9	34.1
@ Ranger Station							

(1) HEW 11-04-1965 (*Probable low value resulting from sample biased with excess of Columbine Creek water).
(2) EPA 11-04-1970 (Gains in lower two reaches include estimated 6.5 CFS diversion at Mill by Molycorp @ 65 mg/l SO_4).
(3) Smolka-Tague 10-25-1988 (Sampling point below Columbine Creek was father downstream at Goat Hill Camp Ground).
(4) Scott Vail 11-29-1988 (*Probable low value resulting from sample biased with excess of Columbine Creek water).
(5) Scott Vail 11-29-1988 (Concentration at Goat Hill Camp Ground used instead of below Columbine Creek).
(6) Ralph Vail 10-22-1992.
(7) David Shoemaker 2-16-1993.

* Low value may be due to interception of drainage by original under ground mine.

** The "Below Columbine Creek" sampling point is at a fairly short distance downstream from the mouth of Columbine Creek which generally has a flow of about 25% of that in Red River above the creek. It appears that the sample for Scott Vail 1988 (and possibly HEW 1965) may have been collected from near the south shoreline where there was an above average percentage of creek water. As evidence of this for Scott Vail's survey the calculated mass sulfate flow was higher above Columbine Creek than that calculated using the below Columbine Creek concentration. Subsequent surveys indicate that there is only a nominal sulfate gain from below Columbine Creek to Goat Hill Camp Ground. The percentage of gain for Scott's survey using the Goat Hill sampling point is, therefore, believed to be more representative.

The analysis indicates that the percentage of sulfate gain may have increased from Molycorp's mill to the ranger station. This section includes drainage from Goat Hill Gulch and Capulin Canyon and from scar areas near the ranger station. Part of the increase may reflect exceptionally low drainage from the downstream scar areas at the time of the early surveys. Below normal stream flow for several years preceded these surveys. Unfortunately the early surveys had too few sampling points for a determination of specific areas where possible increases in the percentage of the total gain may have occurred.

A cloudy appearance of the water in Red River has been observed during periods of low water over the past several decades and probably has existed for several thousands of years. The variation in the amount of cloudiness (aluminum- hydroxide precipitate) is undoubtedly influenced by fairly long-term precipitation cycles. Years of high precipitation increase the amount of ground water flow. Ground water moves very slowly, and the aquifer acts as a storage reservoir. Higher than normal ground water flow, therefore, may continue for several years beyond the end of the high precipitation period. It is probable that the

milky appearance of Red River is most pronounced when the ground water flow is relatively high at a time of below average river flow.

The yearly mean flow in Red River varies with the amount of precipitation and in particular with the winter snowfall precipitation as shown in Figure B and Table 2.

Table 2

Mean daily flow in cfs of the Red River at the gauging station near Questa for water years 1961 to 1992.

Year	flow	Year	flow	Year	flow	Year	flow
1961	44.80	1969	40.50	1977	13.40	1985	72.30
1962	47.80	1970	34.90	1978	25.70	1986	61.40
1963	19.70	1971	11.80	1979	87.60	1988	35.10
1964	24.40	1972	15.50	1980	47.00	1989	41.1
1965	60.60	1973	51.70	1981	14.00	1990	35.3
1966	39.60	1974	19.10	1982	39.40	1991	57.7
1967	40.50	1975	41.70	1983	71.00	1992	53.8
1968	34.90	1976	32.60	1984	48.60		
8 year average	39.03		30.98		43.34		
				32 year average			41.37

Near drought conditions prevailed from 1970 through 1978 during which the discharge of Red River was only 66% of the 32 year average. Since 1983 the discharge has been 130% of the 32 year average or nearly double that of the preceding eight years. Near record snowfall during the winter of 92-93 indicates continued above average flow for water year 1993 (water years extend from October 1 of the preceding year through September of the water year).

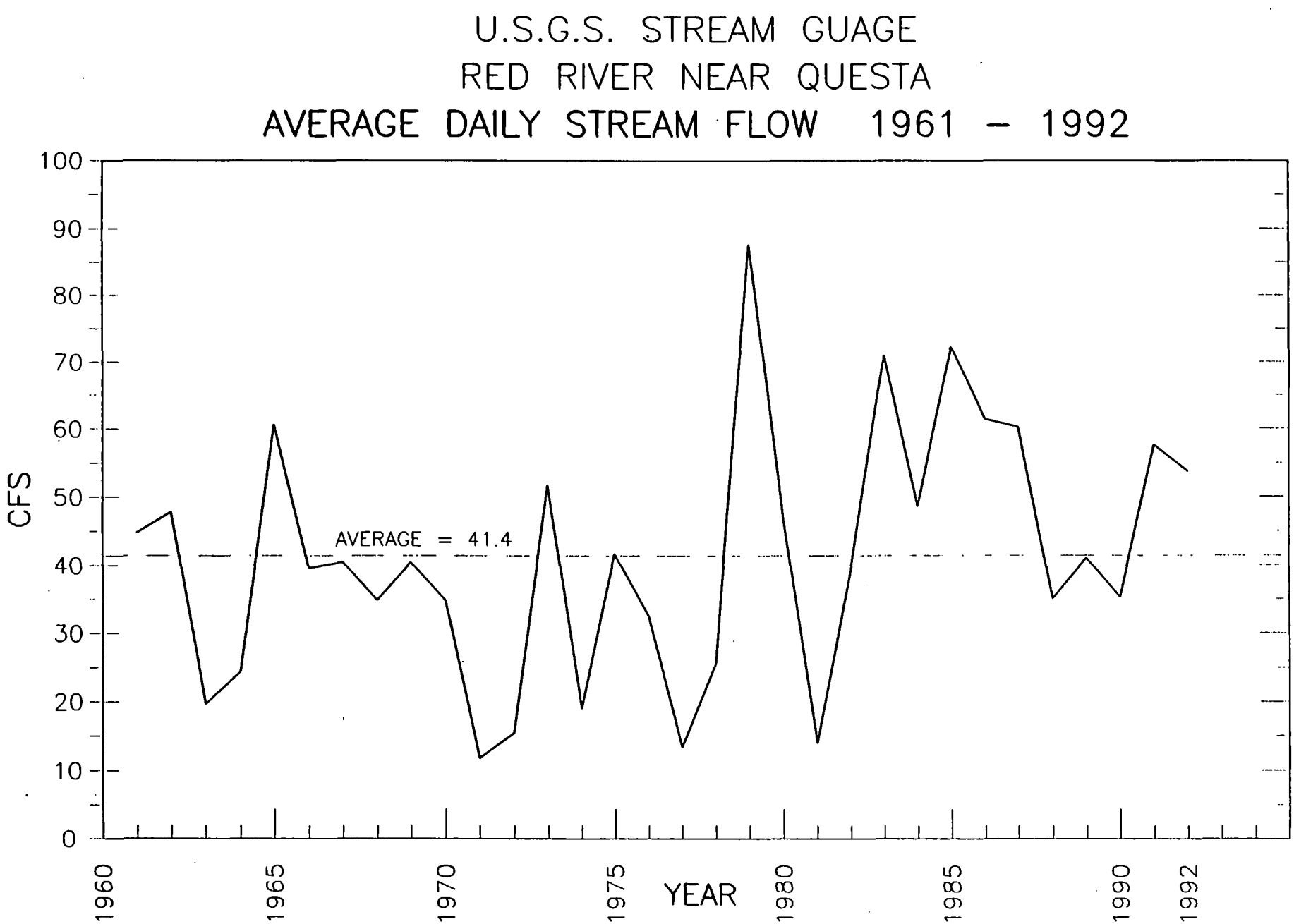

U.S.G.S. STREAM GUAGE
RED RIVER NEAR QUESTA
AVERAGE DAILY STREAM FLOW 1961 – 1992
CFS
100
90
80
70
60
50
40
30
20
10
0
AVERAGE = 41.4
1960
1965
1970
1975
1980
1985
1990
1992
YEAR

FIGURE B

One can hypothesize that after several years of below normal precipitation, the ground water flow from the hydrothermal scar areas decreases and generally the river has low turbidity (1973-1978). During years of above normal precipitation, there is generally sufficient river flow to dilute the gibbsite precipitate and the resulting turbidity (1979-1987). Following several years of above normal precipitation there is a high ground water flow from the scar areas, and during periods of low river flow, increased gibbsite precipitation results in high turbidity (1988-1992).

Geochemical Overview

Relatively little research has been done regarding the chemical behavior of aluminum in natural waters; however, sufficient data are available to permit a general overview (Roberson and Hem, 1969, Hem 1970). Aluminum is generally present in natural waters in concentrations of 0.1 to 1 ppm. Higher values are reported; but those are thought to reflect the presence of minute colloidal particles which can pass through most filter media (Hem, 1970). The exception is low pH waters, including mine waters, in which aluminum concentrations can exceed 1000 ppm.

The principal control of aluminum stability in solution is acidity. In natural systems the solubility curve for gibbsite [$Al(OH)_3$] as a function of pH approximately represents the solubility controls of dissolved aluminum species. Figure C (Drever, 1982) shows that aluminum is highly soluble in both strongly acid and strongly alkaline solutions. In approximately neutral solutions, including most river waters, the solubility of aluminum is quite low, on the order of 10^{-7} to 10^{-6} moles/liter (0.27 to 2.7 ppm).

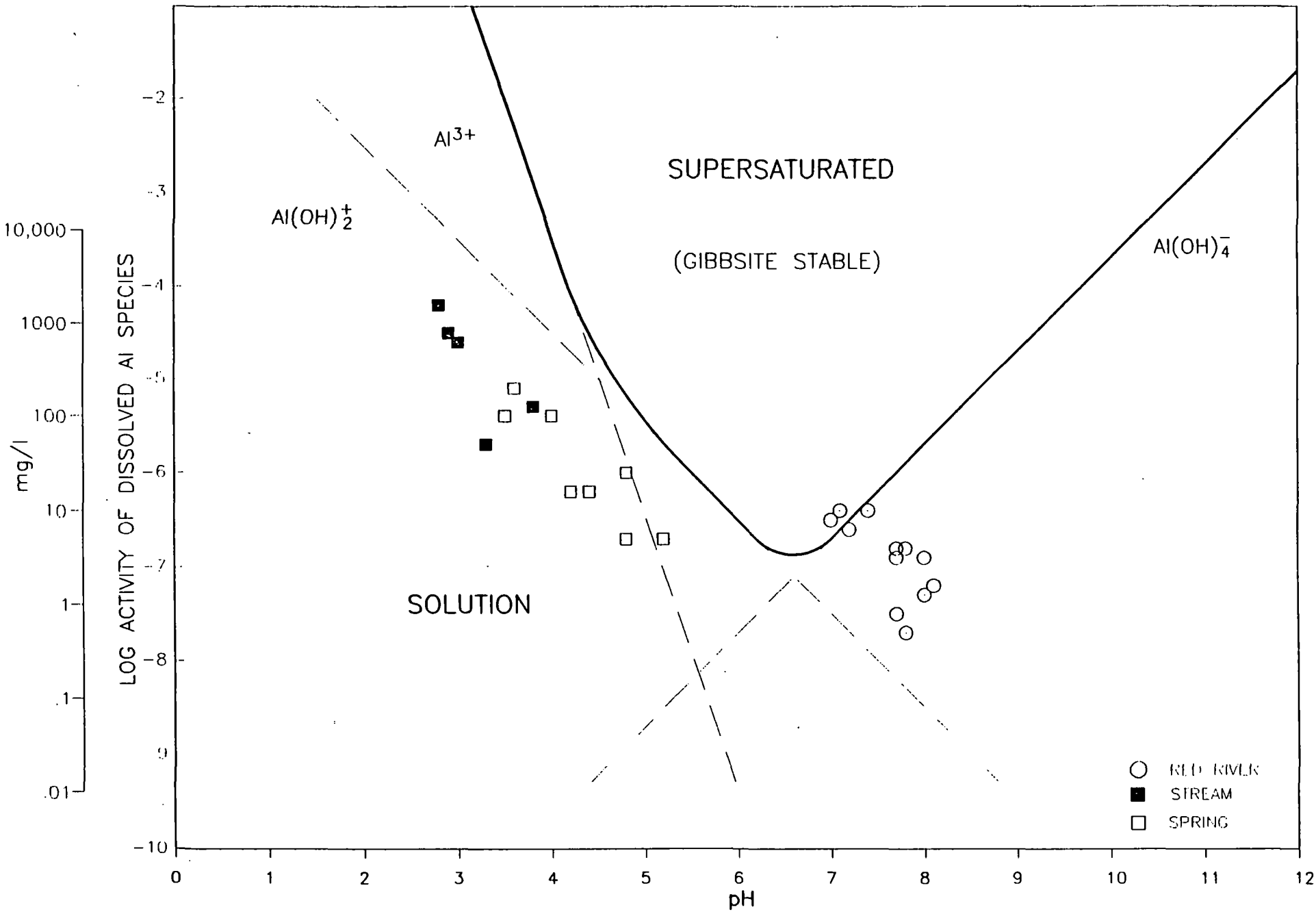


FIGURE C – ACTIVITIES OF DISSOLVED ALUMINUM SPECIES IN EQUILIBRIUM WITH GIBBSITE [$AL(OH)_3$] AT 25°C.

RED RIVER DATA ARE FROM 11/29/88. STREAM & SPRING DATA ARE FROM VARIOUS DATES.

The presence of other ions which can combine with aluminum can affect solubility. High concentrations of fluoride and sulfate can respectively increase or decrease the solubility of aluminum. At fairly high concentrations of dissolved silica (greater than 10^{-4} molar) clay minerals precipitate before gibbsite and solubility of aluminum is decreased.

Application to the Red River. The maximum concentrations of fluoride (1.6 mg/l) and sulfate (202 mg/l) in the Red River for the period of the investigation are well below the levels at which they would affect aluminum solubilities. Few data for silica are available, but older U.S.G.S. data (Water Supply Report NM-80-1) indicate concentrations on the order of 10 mg/l ($10^{-6.7}$ molal), well below the concentration at which clay minerals would precipitate; therefore, gibbsite is the expected precipitate in the Red River.

Samples of precipitate collected above the river near the ranger station and along Hanson Creek were scanned by X-ray diffraction at the Molycorp laboratory at Louviers, Colorado. The material was found to be too poorly crystallized to yield a mineral identification. Thus, it is still somewhat conjectural that gibbsite is the mineral causing cloudiness in the river.

Total aluminum concentration (suspended + dissolved) for Red River samples and tributary springs and streams are cross-plotted with pH in Figure C. The river data are from November 29, 1988. The spring and stream data are from various dates.

The river data show a steep trend of increasing aluminum concentration with falling pH. In general, the higher concentrations come from downstream locations, especially below Capulin Canyon. The lower concentrations cluster around an aluminum concentration of roughly 1 mg/l and tend toward a pH of 8.0.

Compositions of spring and stream waters fall on the left side of the diagram at low pH values and high aluminum concentrations. Dilution of any of these waters would cause the concentration to move on a straight line path toward the diluting water. It can be seen that most of the spring and stream waters would cross the stability boundary and precipitate gibbsite if diluted by pH 8.0/1 ppm Al water.

Solubility of aluminum decreases with increasing total ionic strength. Because the spring waters have very high concentrations of total dissolved solids, the solubility boundary may lie closer to the spring and creek samples than indicated by the curve in Figure C.

Most of the river waters fall outside the gibbsite stability boundary, even though moderate amounts of gibbsite are visible along much of the river course. This suggests that gibbsite is unstable along most of the river. The dissolution rate is probably too low, however, to have an appreciable effect on the turbidity of the river.

If the diluting water were consistently the composition of Columbine Creek and Pioneer Creek (about pH 8.0 and less than 0.5 mg/l Al) no precipitation would occur. Precipitation occurs only at times when the aluminum concentration increases to above 1 ppm. Above this concentration, dilution lines of spring waters cross the gibbsite boundary. This affords an explanation of why gibbsite is not visible at the town of Red River although milky water has been

observed on occasion in Bitter Creek upstream from Red River. The aluminum concentration probably seldom exceeds 1 mg/l in the town area.

Spring and stream waters also exhibit a trend of increasing aluminum with falling pH. Stream samples are mostly more acidic and more aluminous than spring samples (which were collected at the river). No acidic streams were reaching the river by surface flow at the time of Molycorp's surveys. Rather, these streams infiltrated gravels above the river area. Many of the springs are probably fed by infiltration of the streams. The spring water is diluted by ground water and subsurface river water flowing in gravels adjacent to the river. Dilution raises the pH of the water and lowers the solubility of aluminum. Comparison of aluminum concentrations in the upper reaches of Capulin Canyon (655 mg/l) and Goathill Gulch (560 mg/l) with that in corresponding springs (113-225 mg/l) indicates that the streams may be diluted by a factor of three to six. It is also probable that the acidity of the drainage water is buffered during ground water flow by carbonates and other elements in the soil which would result in precipitation and deposition of the aluminum along the flow route.

The majority of the aluminum entering the Red River appears to originate at springs emerging downstream from Capulin Canyon. It is likely that aluminum concentrations at these springs are high as a result of the spring water in this area being more acidic than elsewhere (pH 3.5-4.5). This could be caused by low precipitation/infiltration rates and/or because of fairly small drainage areas, a low dilution in the narrow canyons and relatively short distance between the scar areas and the river.

Red River Survey - pH

A detailed survey of the pH of the Red River in the study area was carried out from October 15 to October 21, 1988. The objective of the survey was to determine the locations of the sources of acid water accreting to the river by recording variations in the pH of the river water.

Measurements were made with a pH meter at 300-foot or smaller intervals. Where found, the location and pH of springs were noted. Portions of the survey were carried out on three separate days. The weather and river level were similar on each of the survey days, and data from overlapping river survey segments indicate that no significant changes in the chemistry of the river as a whole affect the data.

The results are plotted on Drawing 1 and Drawing A. The pH of the river ranged from 6.8 to 8.1. The local average pH varied considerably from place to place, varying from about 7.3 to 8.0. It was found that a sharp dip in acidity of 0.3 or more pH units occurred at all observed acid springs. Similar dips, as shown on the drawings, infer the location of additional springs and seeps. Measured pH values generally returned to the local background level within abut 500 feet downstream of a source.

The rebound of pH cannot be explained by dilution, as not enough water is available. Roughly 1000 times the volume of the acid water would be required, as pH 5 water contains 1000 times the H^+ ion content of pH 8 water. It is apparent that the acidity of the river is buffered by bicarbonate ion (HCO_3^-) and related species. Bicarbonate buffering is normal for river waters (Drever, 1982). Without buffering, the pH of the river would be 6.0 or less at the Questa Ranger Station. Correspondingly, total alkalinity decreases downstream (Drawing 3).

Spring waters were generally acidic on the north bank of the river and slightly alkaline on the south bank. More springs were observed on the north bank, probably because they were easier to identify because of their associated low pH and white precipitate. Also, much of the water in the southern drainage flows to the river in tributary streams rather than springs. The acid springs ranged from pH 3.5 to near neutral. Both spring and creek waters from the south side of the river were about pH 8.0.

The pH data indicate that acid springs occur at irregular intervals along the entire river segment from Red River to the ranger station. The frequency of springs is highest between the ranger station and Goathill Gulch (ten or more indicated).

Only one spring was identified in the Red River town area; however, the relatively low pH (7.5) of the river indicates that acid seepage occurs in this area. Bitter Creek was only intermittently flowing when sampled. It was somewhat acidic (pH 6.3).

Large hydrothermal scars are present from Hanson Creek to the town of Red River; however, significant acidic springs do not appear to be associated with these scars, except below Hanson Creek. Very little accretion and only one observable spring were noted in this area. The scar areas are deeply weathered to a heavy clay soil. Consequently, surface runoff predominates and apparently very little ground-water flow is present. Sulfides have largely been removed from the surface by weathering. Freshly broken boulders in the cliff area do contain disseminated pyrite on fractures. Nominal gains in sulfate and aluminum in the Red River indicate some continued dissolution of pyrite in these areas.

Red River Survey - Geochemical

Water samples were collected along the middle Red River on November 29, 1988, October 22, 1992 and on February 16, 1993. There is evidence that the survey in November 1988 was carried out during a time when aluminum concentrations were unusually high (see Table 4). From eleven to nineteen samples were collected during each run over a 12-mile segment of the river. Sample locations were selected to separate and measure the effect of each of the major tributary drainages to the river. Care was taken to choose locations in which the river water and emerging spring waters should be well mixed. The runs were made over about four-hour time periods. PH and conductivity were measured in the field.

The samples were analyzed by the assay laboratory at the Questa mine. Determinations were made for Al, $SO_4^{=}$, TDS, TSS, total alkalinity, turbidity, F^- and several metallic cations. Analytical results are presented in Appendix 2.

Stream Flow. In order to make quantitative comparison, it was necessary to weight the data at individual sample locations for accretions to stream flow. Data for two U.S.G.S. stream surveys of the Red River were used as a baseline. Flow rate at the time of these surveys was comparable with the flow rates during Molycorp's sampling surveys. Stream flow at locations along the river for the dates of the surveys was estimated to be proportional to that of the two surveys (Table 3). Adjustments were made for the size of the drainage basins of the tributary canyons. The measured flows at the stream gauge near the Questa Ranger Station on the dates of the surveys were used as datum.

Table 3

Stream flow surveys for Red River and proportionally calculated stream flows in cfs for 11-29-88.

Water Sample Location	Survey Location	11-4-65	10-25-88	11-29-88 (Calculated)
	Below Zwergle damsite	11	11	7
	Below Placer Creek	9.94		
1	Red River (town)			8.5
	Below Red River	16.3		
5	Elephant Rock C.G.		16	10.0
7	Above Moly Mill	16.2	20	10.6
10	Above Columbine Creek	18.2	19	11.3
11	Below Columbine Creek	23.6		16.3
13	Above Bear Canyon		29	16.6
16	Ranger Station	25.5	30	17(gauged)
2	Pioneer Creek	.81	.78	.4
9	Columbine Creek	5.29	6.0	4.5

Table 4

Aluminum and Sulfate Discharge past the Questa Gauging Station for Dates from 1987 to 1989

Date	Stream Flow (cfs)	S^{O4} (mg/l)	Al (mg/l)	SO^4 (g/sec)	Al (g/sec)	Comments
2-27-86*	17	123	3.4	59	1.6	Low stable stream flow
8-18-86*	42	105	3.34	125	4.0	Moderate stable stream flow
8-19-86*	40	115	3.26	130	3.7	Moderate stable stream flow
8-19-86*	40	160		182		Questionable analysis
8-20-86*	38	118	3.41	127	3.7	Moderate stable stream flow
11-12-87	21	178	5.7	106	3.4)	Low slowly declining flow-decrease
11-20-87	19	152	3.7	82	2.0>	in SO^4 indicates declining gr.water
11-25-87	18	139	3.9	71	2.0)	Al probably precipitating
1-05-88	8-19	186	13.4	100	7.2	Sudden flow increase-Al.remobilizing
2-27-88	23	246	6.0	160	3.9	Low stable flow
3-14-88	21		6.4		3.8	Low stable flow
3-19-88	21	185	8.0	110	4.8	Low stable flow
5-16-88	51	80	10.6	116	15.3	Increasing flow-Al.remobilizing
6-06-88	74	54	3.4	113	9.2	Steady high flow
7-26-88	37	278	1456.0	292	1528	Probable short thunderstorm
9-13-88*	138	120	17.0	470	67	Thunderstorm
9-20-88*	57	85	2.0	137	3.2	Moderate stable flow
9-26-88*	47	96	2.1	128	2.8	Slowly declining flow
10-14-88	39	110	5.4	127	6.0	Slowly declining flow
10-18-88	32	130	4.3	118	3.9	Low stable flow
10-21-88	32	126	3.8	114	3.5	Low stable flow
10-25-88*	30	118	1.3	131	1.1	Slowly declining low flow
11-29-88	14-17	137	11.5	66	5.5	Small sudden flow increase
4-14-89	88	77	3.3	192	8.2	Increasing flow
4-18-89	99	68	1.4	191	4.6	Increasing flow

* From Smolka and Tague, 1989

The calculated incremental gains in stream flow are illustrated in Figure 1.

Results. Analytical results are summarized in Appendix 2. Aluminum, sulfate, TDS, TSS and turbidity generally increased downstream from Red River to the Ranger Station. Alkalinity was variable, but overall showed a decreasing trend. In order to make quantitative comparisons of gains and losses to the river, analytical values were multiplied by the estimated stream flow at each sample location. The result is the mass flow rate of each parameter passing by the sample location, expressed as grams per second. These values are plotted on Drawings 1 to 6. The magnitude of each line at any point expresses the total flow of a parameter in the river at that point. The slope of the line reflects the rate of input or removal of the parameter from the river.

The rate of constituent increase to the river can more readily be seen by plotting the incremental changes from location to location as histograms. Histograms for stream flow and five stream factors are shown in Figures 1 to 6.

Incremental values for sulfate and TDS (g/sec) should nearly always be positive, as no known mechanism for substantive removal from the river was present at the time of the survey. At times during the year significant stream flow is lost to ground water in the Molycorp mill and Columbine Park areas; however, it is doubtful that significant losses were occurring on the dates of the surveys. Apparent decreases of sulfate and TDS occurred in a few samples. These probably represent either analytical error or non-representative samples. Obtaining representative samples of well-mixed river water is difficult in areas of spring activity. Interpretation of these anomalies was made by comparison to samples up and downstream from the

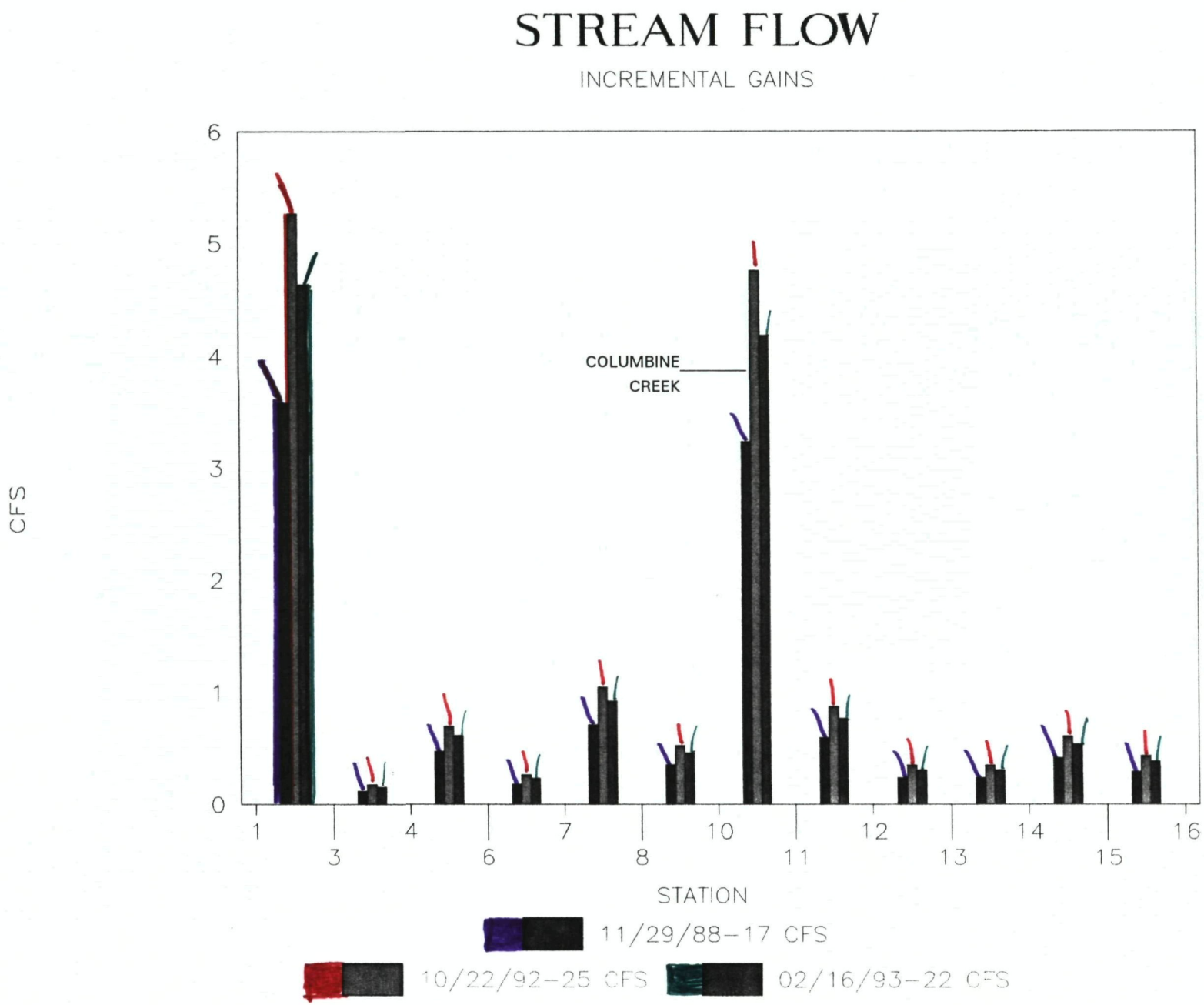

STREAM FLOW
INCREMENTAL GAINS
CFS
0
1
2
3
4
5
6
COLUMBINE
CREEK
1
3
4
6
7
8
10
11
12
13
14
15
16
STATION
11/29/88–17 CFS
10/22/92–25 CFS
02/16/93–22 CFS

FIGURE 1

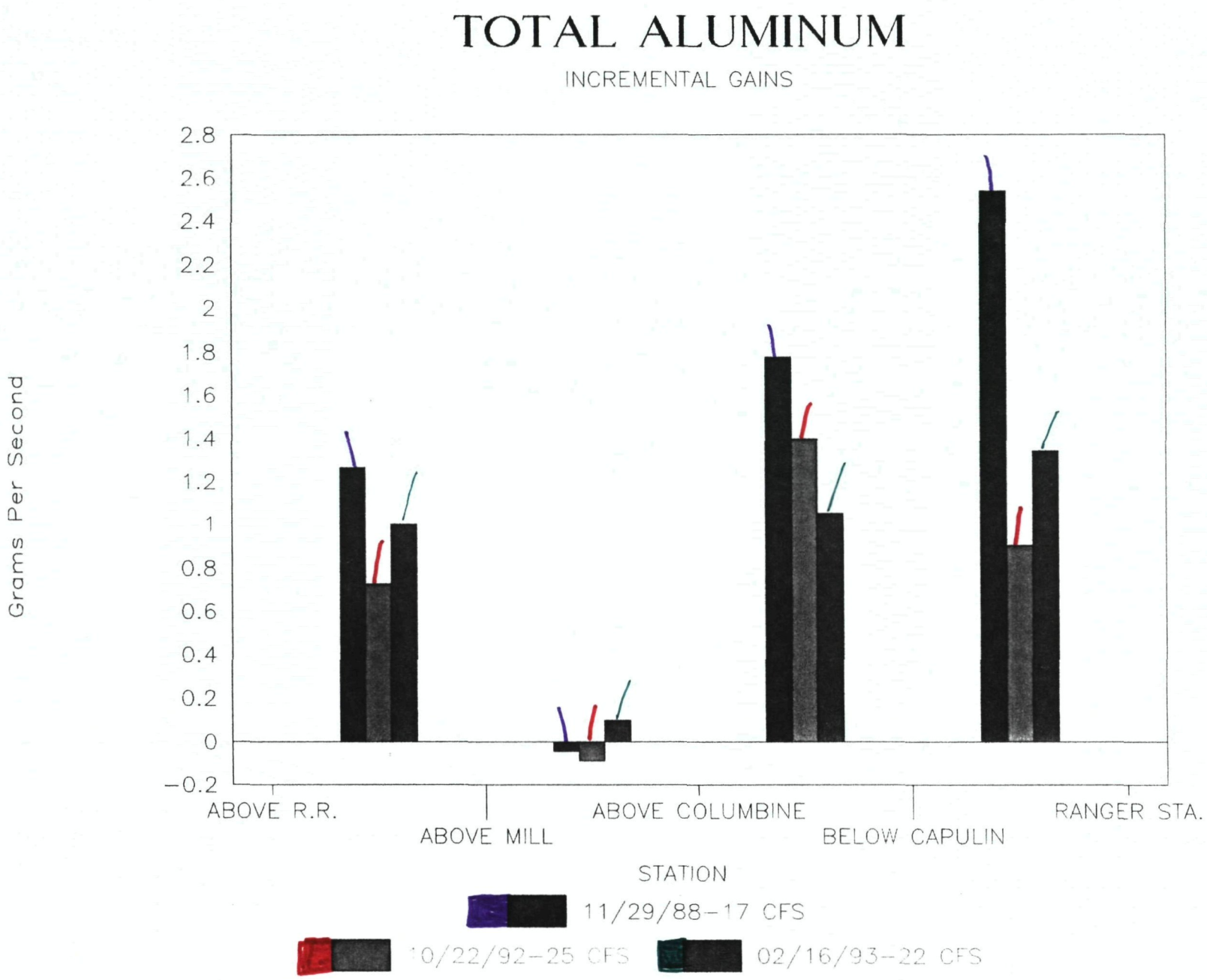

TOTAL ALUMINUM
INCREMENTAL GAINS
Grams Per Second
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
−0.2
ABOVE R.R.
ABOVE MILL
ABOVE COLUMBINE
BELOW CAPULIN
RANGER STA.
STATION
11/29/88−17 CFS
10/22/92−25 CFS
02/16/93−22 CFS

FIGURE 2

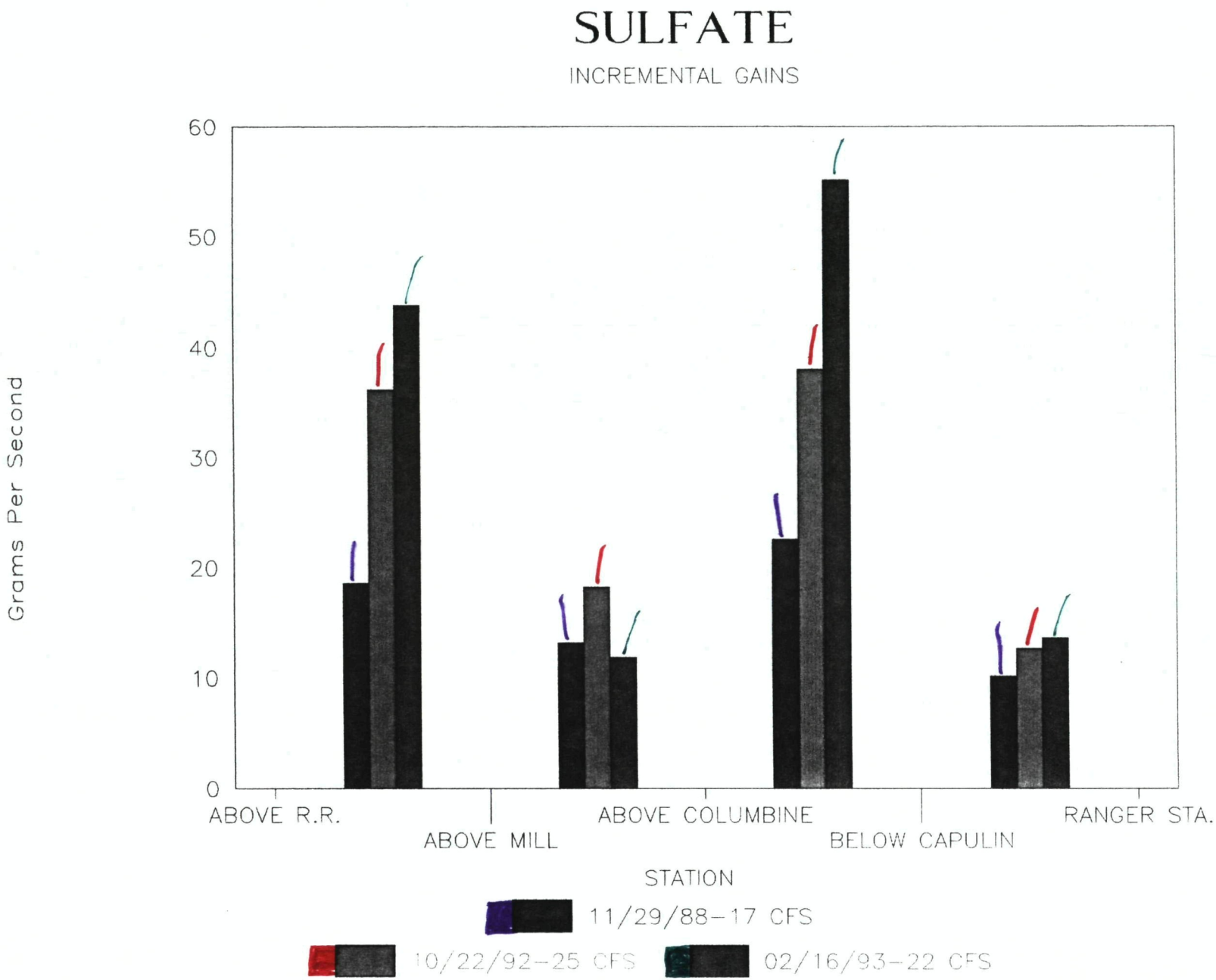

SULFATE
INCREMENTAL GAINS
Grams Per Second
60
50
40
30
20
10
0
ABOVE R.R.
ABOVE MILL
ABOVE COLUMBINE
BELOW CAPULIN
RANGER STA.
STATION
11/29/88-17 CFS
10/22/92-25 CFS
02/16/93-22 CFS

FIGURE 3

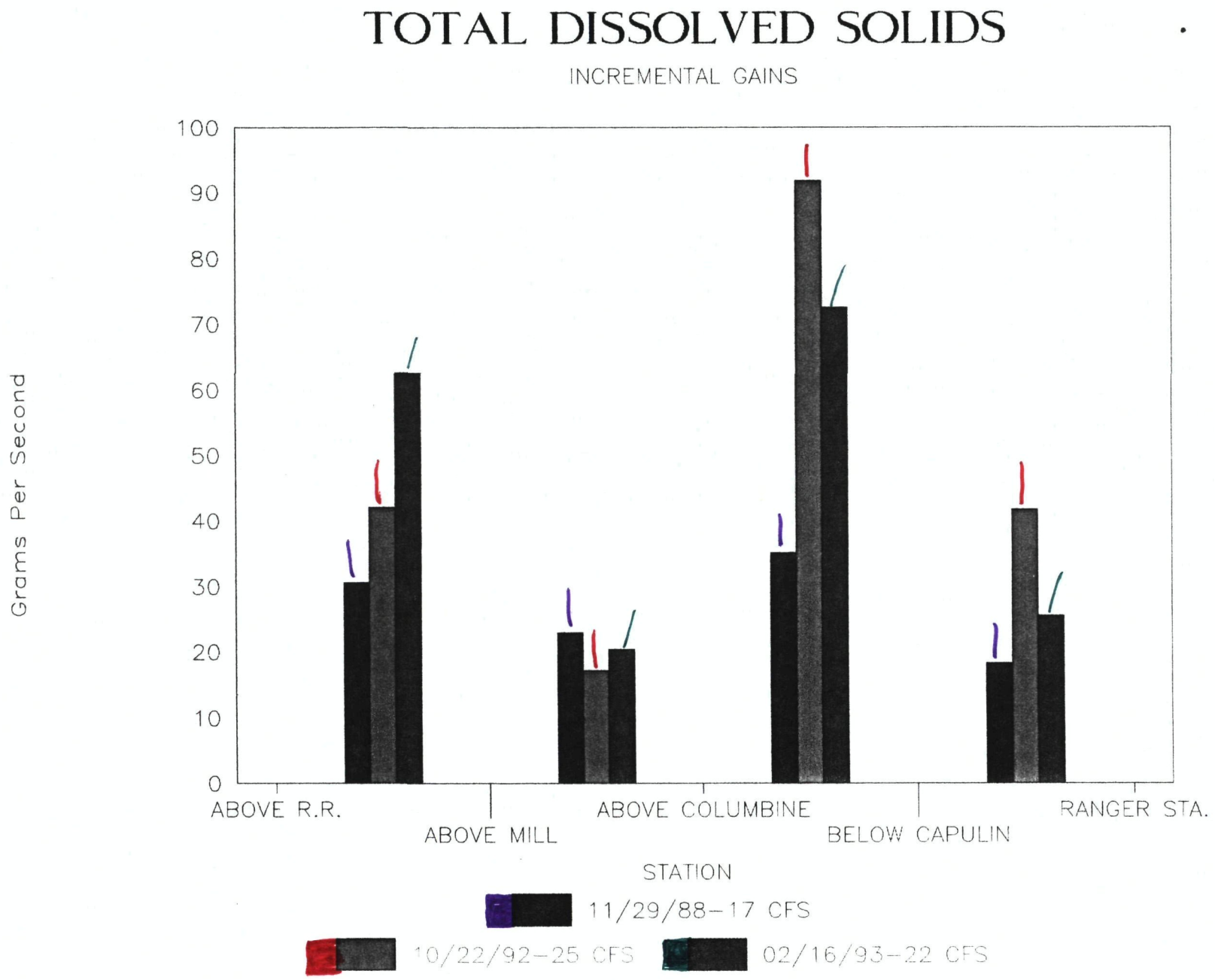

TOTAL DISSOLVED SOLIDS
INCREMENTAL GAINS
Grams Per Second
100
90
80
70
60
50
40
30
20
10
0
ABOVE R.R.
ABOVE MILL
ABOVE COLUMBINE
BELOW CAPULIN
RANGER STA.
STATION
11/29/88-17 CFS
10/22/92-25 CFS
02/16/93-22 CFS

FIGURE 4

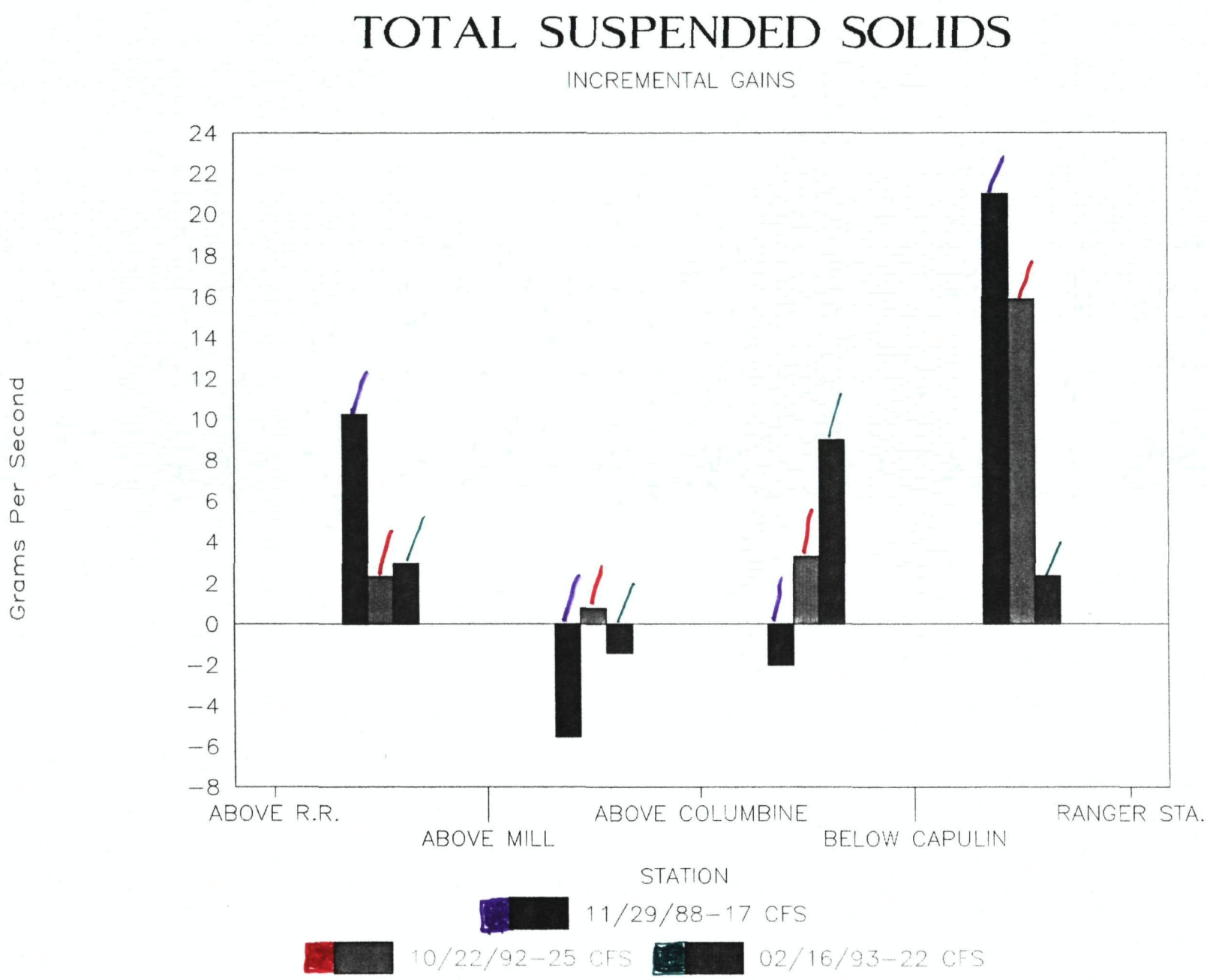

TOTAL SUSPENDED SOLIDS
INCREMENTAL GAINS
Grams Per Second
24
22
20
18
16
14
12
10
8
6
4
2
0
−2
−4
−6
−8
ABOVE R.R.
ABOVE MILL
ABOVE COLUMBINE
BELOW CAPULIN
RANGER STA.
STATION
11/29/88−17 CFS
10/22/92−25 CFS
02/16/93−22 CFS

FIGURE 5

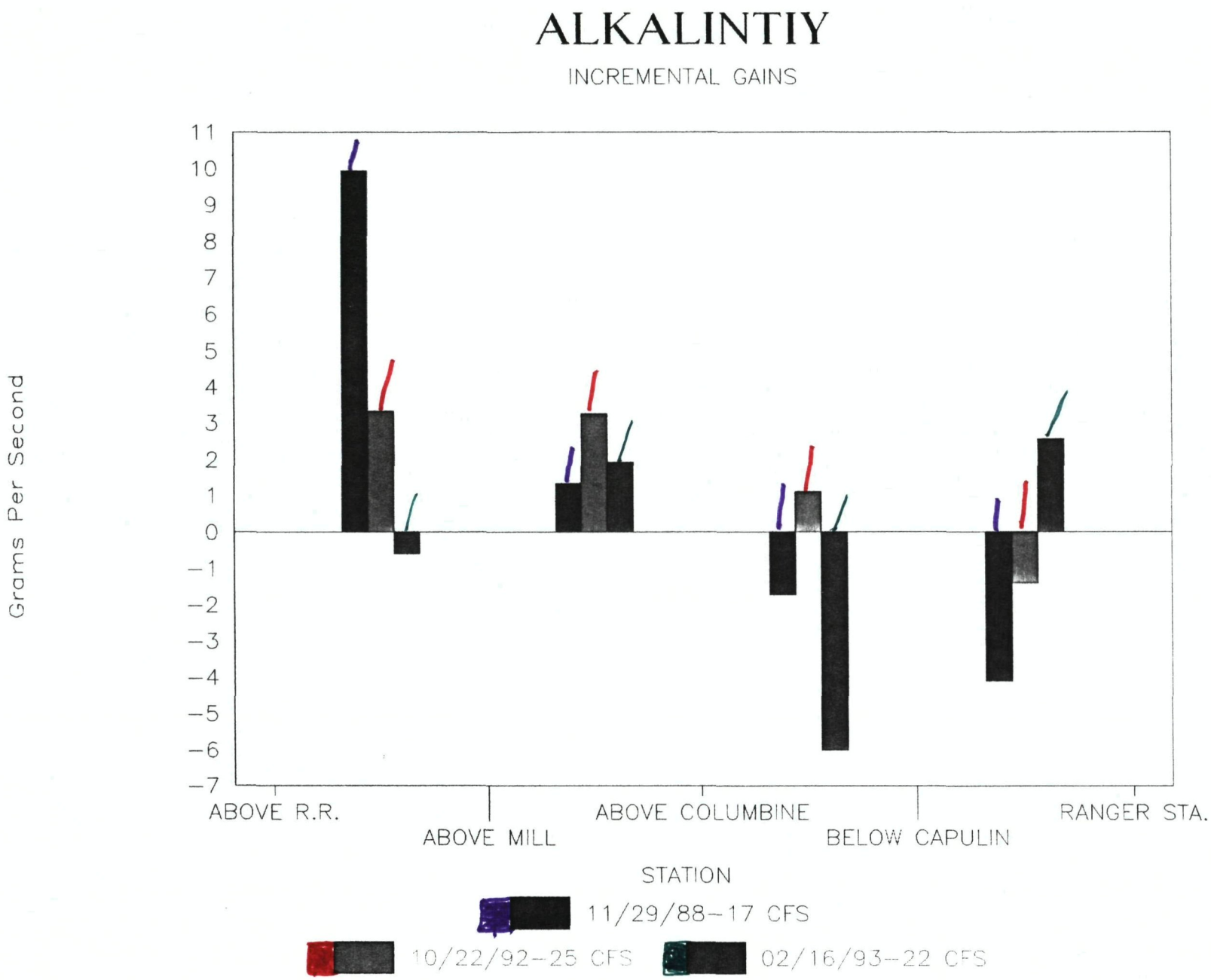

ALKALINTIY
INCREMENTAL GAINS
Grams Per Second
11
10
9
8
7
6
5
4
3
2
1
0
−1
−2
−3
−4
−5
−6
−7
ABOVE R.R.
ABOVE MILL
ABOVE COLUMBINE
BELOW CAPULIN
RANGER STA.
STATION
11/29/88−17 CFS
10/22/92−25 CFS
02/16/93−22 CFS

FIGURE 6

affected value, and by comparison to similar sample runs on other dates.

Aluminum. Aluminum increased fairly steadily downstream. There were fairly sharp rises at Hanson Creek, Goathill Gulch and Capulin Canyon; however, by far the greatest part of the gain was from below Capulin Canyon to the ranger station.

The indicated gains in aluminum correlate well with the location of acid springs in which aluminum precipitate was observed. Moreover, there is a particularly strong association of aluminum in river water with the pH of the springs. Only springs with pH 5.0 or lower input significant quantities of aluminum to the river. The largest gains are from downstream springs with pH as low as 3.5. The solubility relationships shown in Figure C indicate that dissolved aluminum is mainly transportable at pH values less than 5.0.

There was a significant indicated loss of aluminum between some stations for some surveys. This generally was attributed to settling out of precipitated gibbsite along the stream bed. Similarly substantial gains in aluminum may have resulted in part from remobilization of the precipitate.

Sulfate. The distribution of sulfate gains to the river does not correlate proportionally with aluminum gains. Sulfate gain is informative, as it is a measure of the distribution of acid ground water sources. The distribution of sulfate gains indicates that sources of acidic water are fairly extensive along the river. Observed pH and transportation of aluminum, however, are not always proportional to the sulfate content of the water.

In particular, the Goathill Gulch area was responsible for a significantly large percentage of the sulfate gain and a fairly low percentage of the aluminum gain.

Total Dissolved Solids. Gains in total dissolved solids (TDS) agree somewhat with the pattern of gains in sulfate. This is to be expected, as roughly 60 percent of the gain in TDS is sulfate. Thus, TDS is also apparently controlled principally by stream accretion.

Total Suspended Solids. Changes in total suspended solids (TSS) vary widely over the study area. The largest gains agree with the gains in aluminum at Hanson Creek and at the ranger station. The amount of suspended solids can decrease along some reaches settling out along the stream bed and plating of rocks by the gibbsite. At other times, particularly with rising stream flow, the suspended solids may increase above natural accretions as a result of re-mobilization of the precipitated material. Gibbsite also precipitates out as suspended material and re-dissolves with increases and decreases in river pH.

Alkalinity. Total alkalinity (as $CO_3^{=}$) also varies considerably, although there is a general, decreasing trend of incremental changes. This is to be expected, as acid waters react with and neutralize alkaline components downstream.

Bicarbonate is the principal alkaline ion. It is principally atmospherically derived, and thus tends to replenish downstream, buffering the pH at around 8.0. The decline in alkalinity reflects the input of sulfuric acid overwhelming the natural buffer. The declines occur at roughly downstream locations from Hanson Creek, Goathill

Gulch and Capulin Canyon with a one-half to one-mile lag indicating that neutralization is not instantaneous. The cause of the sharp gain at Red River has not been determined. Perhaps a man-made source of alkalinity is present in the town area.

Turbidity (Jackson Turbidity Units). Turbidity was not converted to flow-compensated values, as it is measured in light absorption units rather than concentration; however, it is useful in that the turbidity plot in Drawing 3 closely follows suspended aluminum and TSS, confirming that the most important sites of clouding occur below Capulin Canyon, at Goathill Gulch, and at Hanson Creek.

Other Metals and Fluoride. Samples collected during the river surveys were also analyzed for several other trace metals and fluoride.

Cadmium, barium and molybdenum concentrations were below the detection limit in all samples for the analytical methods used.

The lead concentration was below the detection limit in most samples.

Copper concentrations remained nearly constant at .01 mg/l, suspended and .02 mg/l, dissolved from the Town of Red River to above Capulin Creek. Below Capulin Creek the copper concentration increased slightly.

Concentrations of zinc, manganese and iron are shown on Drawings 2, 4 and 6. There was a general increase in a downstream direction in the concentration of all of these elements. The pattern of increase was similar to that of aluminum, with the larger incremental increases occurring downstream of Capulin Canyon. Such adds evidence of the high leaching activity in the mountain slopes above the lower stream reach even though there is evidently only a small ground water flow.

Most of the iron concentration is suspended matter. The significant fluctuation in iron concentration along the stream is attributed to oxidation and precipitation. Red staining by iron oxide is present along several reaches of Red River.

The zinc concentration at the Ranger Station ranged from .27 mg/l to .37 mg/l. The zinc concentration increased slightly in a downstream direction to Capulin Canyon with larger increases indicated along the lower reach.

Manganese concentrations were largely dissolved matter.

Discussion

For the purposes of discussion, we have divided the length of the Red River studied into four segments. Figure A shows the location of the prominent hydrothermal scars and the percentage of the total scar area along each segment.

1. Red River town to Molycorp mill area (stations 1 - 7). This reach is characterized by low accretion to the river and widespread scar and mud flow areas on the north and the smaller June Bug Creek scar on the south. Pioneer Creek, Mallette Creek, Bitter Creek, and Hansen Creek are intermittent flowing tributary streams in this reach. Below Hanson Creek, springs are the only significant source of acidic water and aluminum. Mildly acidic water enters the river in the town area, but no precipitate was observed there.

This reach contains approximately 45% of the middle Red River stream length and about 50% of the hydrothermal scar area.

Approximately 40% of the flow in Red River at the Ranger Station, during periods when the flow is less than 40 cfs, originates above the Town of Red River. The stream

water above the Town has a high pH, and concentrations of aluminum, sulfate and other constituents are very low. About 34% of the flow accretion to the middle Red River occurs in the vicinity of the Town of Red River and another 7%± originates from springs and seepage flow from below the Town to above Molycorp's mill area.

For Molycorp's surveys the gain in aluminum along this reach ranged from 24 to 28% of the total gain above the ranger station and the gain in sulfate ranged from 27 to 34% of the total. There was, however, a significant variation in the location of the accretions between the segment in the vicinity of the Town and the segment from below the Town to above the mill. Approximately one-half of the gain in both aluminum and sulfate along this reach appears to originate from drainage below the hydrothermal scar areas in the vicinity of Hansen Creek. Hansen Creek has surface flows on the order of 20 to 30 gpm at pH 3.5 during much of the time. The surface flows often extend all the way to the Red River.

2. Mill area to Columbine Creek (sample stations 8 - 11). This area contains the upstream mine dumps. There are a few acidic springs, notably at Sulfur Gulch, but little aluminum precipitate. Columbine Creek (sample 9), flowing from the south, is near the west end of this reach. Water quality in Columbine Creek is non-acidic with very low aluminum and sulfate concentrations. Chambers Spring, flowing from the south, discharges a small flow of moderately alkaline water to the river near the west end of the mill area. The river was generally relatively clear over this reach.

This reach extends over approximately 23% of the length of the middle Red River survey area. About 25% of the original hydrothermal scar area is drained along this reach

including Sulfur Gulch which probably was one of the most active of the scar areas. An estimated 25% of the total stream flow accretion along the middle Red River accrues along this reach which includes about 19% flowing from Columbine Creek.

Aluminum gains along this reach ranged from 7% of the total at the Ranger Station in 1988 to 13% in 1992 and 11% in 1993. Sulfate gains ranged from 18% in 1988 to 36% in 1992 and 26.6% in 1993. Most of both the aluminum and sulfate gain originated near the westerly end of this reach. Springs located along this reach on the north side of Red River had slightly acidic water (ph > 5.0).

3. Above Goathill Gulch to below Capulin Canyon (sample stations 12 - 14).

This reach extends along approximately 23% of the middle Red River survey area. Approximately 21% of the hydrothermal scar area including Goat Hill Gulch and Capulin Canyon, drain to Red River along this reach. The mine dumps at the heads of these drainages contain the majority of the altered rock material placed in the mine dumps. An estimated 6.3% of the total accretion to middle Red River occurs along this reach. This includes flow from Bear Canyon, a small non-acidic intermittent creek flowing from the south and the Goat Hill and Capulin drainages which had surface flow extending nearly to Red River a significant amount of the time until the flow was intercepted by Molycorp's activities.

Aluminum gain along this reach increased from 30.6% of the total in 1988 to 39.5% in 1992 and then decreased to 25.5% in 1993. Sulfate gain decreased from 41% in 1988 to 22% in 1992 and then increased to 32.5% in 1993. There was a significant variability between the three Molycorp surveys along this reach; however, all surveys indicated that

there was a significantly higher aluminum gain from the Capulin drainage than the Goat Hill drainage and less sulfate gain from the Capulin than the Goat Hill drainage. In 1988 and 1992 the aluminum gain from Goat Hill was about 12% of the total at the ranger station. In 1993 the survey indicated a slight decrease in aluminum in this reach. In the reach below Capulin Canyon the aluminum gain was 19% in 1988, 28% in 1992 and about 25% in 1993. Sulfate gain in the Goat Hill reach was 28% of the total at the ranger station in 1988; 11% in 1992 and 25% in 1993. Sulfate gain in the Capulin reach was about 12% in 1988 and 1992 and 7% in 1993.

There apparently is a significant difference in the drainage between Capulin Canyon and Goat Hill Gulch. The seeps and springs below Capulin are considerably more acidic resulting in higher aluminum transportation relative to the sulfate loading which is similar to that indicated from the drainage below Capulin to the ranger station. Drainage from Goat Hill Gulch is less acidic and more like the drainage from the scar areas upstream from the mill.

4. Below Capulin Canyon to Questa Ranger Station.

The downstream segment of the river is relatively short (.85 miles or 8% of the length of the river studied) and contains only 4% of the hydrothermal scar area. The acidity of the springs and seeps along this reach was generally lower and the aluminum gains generally higher than any of the other stream reaches. In this reach the pH of the river dropped to as low as 6.8 owing to the presence of many small acidic springs (pH 3.5 to 4.5). The greatest increase in cloudiness of the river was along this reach and the alkalinity was the lowest. Accretion to stream flow was low here as well (Figure 1). Taken together, these observations indicate that a small flow of very low

pH water carries concentrated amounts of metals to the river. Many small springs were observed in this area, mostly at pH 3.5 to 4.5. The solubility of aluminum increases 50-fold between pH 5.0 and 4.0, (Figure C) more than compensating for the low ground water flow.

The source of aluminum accretion from this segment is in all likelihood the small altered area which lies above the river on the north. Conditions here seem to favor generation of low pH waters. The altered area is rocky, fractured and not deeply weathered, which promotes infiltration of precipitation. The area is close to the river and no live streams are present. Consequently, the opportunity for dilution is diminished.

The aluminum gain along this reach was 38.6% of the total gain to the ranger station in 1988, 21% in 1992 and 36% in 1993. The sulfate gain was 14% in 1988, 9% in 1992 and 7% in 1993. The largest gains in zinc, copper and other trace metals occur along this reach. Accretions of aluminum and acid in the reaches upstream have raised the river to near saturation level, so that the large additions in the lower reach must precipitate rather than staying dissolved. This results in the greatest amount of turbidity occurring along this reach.

Temporal Variability of Mass Loading

There are significant variations over time in both concentration and total discharge of aluminum and sulfate in the Red River. Analysis of the available data, part of which is shown in Table 4, has led to development of reasonable correlations between aluminum and sulfate variations and variations in surface and ground water flow.

The primary controls on water chemistry are the quantity and source areas of surface and ground water discharge. Stream flow resulting from snow melt at higher elevations

and south of the river is relatively dilute. Stream and ground water flow from lower, altered areas has comparatively high concentrations of dissolved constituents. Increases in stream flow principally result from surface runoff. As most of the surface runoff is comparatively dilute, increased stream flow generally causes a decrease in aluminum and sulfate (and other) concentrations simultaneously with an increase in total mass loading. The change in concentration and mass flow is not proportional to the change in stream flow. In general, and except for ephemeral events, it appears that as the stream flow increases, the percentage of the flow that originates from acidic drainages becomes less and less. Above a flow of about 40 cfs at the ranger station, the concentration does not decrease substantially and the mass loading of constituents becomes more proportional to stream flow. This indicates that nearly all of the flow above 40 cfs originates from snow melt or precipitation runoff which reaches the stream by surface flow. The data also indicates that for any specific flow rate the percentage of the flow that is attributable to acidic drainage may vary substantially over a period of years. This again reflects the probable effects of the long term precipitation cycles.

Relative loadings of aluminum and sulfate, measured at the Questa Ranger Station vary substantially. The data indicates that aluminum decreases relative to sulfate during declining and stable stream flow conditions. Aluminum increases relative to sulfate when stream flow rapidly increases. Apparently, gibbsite precipitated during low stream flow settles to the stream bed and is remobilized by the increased velocity and turbulence of rising stream flow. It appears that even small increases in stream flow are sufficient to remobilize significant amounts of the

precipitate. It is probable that stream flow of 200 cfs or greater would be sufficient to substantially scour the stream bed; however, the data was insufficient to confirm this.

Sulfate is fully dissolved in the river. Variability in sulfate is caused only by variation in the rate of input to the stream system. Changes in sulfate loading, therefore, are not as pronounced as aluminum changes, except during thunderstorm flood flows.

Changes in the composition and flow of ground water accreting to the river are generally gradual over fairly short periods of time but may be significant over long periods of time. Short- term changes in aluminum to sulfate ratios in the river as a result of change in ground water flow are probably insignificant compared to the effects of surface tributary variation.

The data indicates that except for thundershower-type events, the highest aluminum and sulfate loadings may occur following the spring snow melt period at the lower elevations. The data also indicates that there may generally be a significant decrease in total drainage from the altered areas in the late fall and early winter months. This may be due to decreased surface flow from the scar areas to near the river. The data was insufficient for analysis of loadings during the winter months.

It is difficult to obtain analytical results from stream samples with a high degree of consistency. For example during one survey the stream was sampled three times in one day at several locations. The reported sulfate concentrations for the three runs were 76, 66 and

49 mg/l at one station; 47.5, 40 and 42.8 mg/l at another station; and 56, 64 and 80 mg/l at another station. During this survey the flow in Red River was reportedly fairly stable.

Comparison of the sampling surveys of Red River; however, indicates a generally good consistency of overall results in that most of the surveys indicated comparable percentages of constituent gain for the major stream reaches (Table 1).

Erratic data points occur in most of the stream surveys. Such points varied from survey to survey. It is believed that at least part of the apparent discrepancy was caused by sampling bias. In particular it appears that some samples may have been collected from near the stream shore where water from hidden springs or flow from upstream tributaries had not been completely mixed in the stream flow. Most of the aluminum is in the suspended fraction. It is possible, therefore, that the collected samples captured varying amounts of the precipitate depending on whether the sample was collected from relatively quiescent or highly turbulent areas or from near the surface or near the stream bottom. There were a much higher number of sampling points for Molycorp's surveys which made the identification of the location and magnitude of erratic data points more apparent.

In order to minimize sampling bias it is proposed that future samples be consistently taken from the portions of stream reaches with high velocity and turbulent flow, and from about the midpoint of stream width. For consistency the samples for each run should be collected from the identical locations to the extent practical.

In areas where complete mixing of spring or tributary water may not be present, a conductivity survey should be made across the stream section to insure selection of a sampling point which reflects the average stream concentrations.

As stated, there appears to be a high variability in both short term and long term discharge of aluminum and sulfate by the Red River. Therefore, estimates of contributions to the river from various sources are somewhat tenuous. Continuation of sampling and analysis will make it possible to better define the average discharge and variation of aluminum and sulfate in the river. This will lead to more precise determination of the relative and absolute contributions from Goathill Gulch, Capulin Canyon and other drainages.

Interception of Acidic Drainage

For years the original underground and open pit mine have intercepted a large portion of the acidic drainage from the hydrothermal scars in the Sulfur Gulch area. The dumps to the south of the open pit mine are partially underlain by natural hydrothermal scars. These dumps are mainly composed of un-altered non acid forming rocks which probably have reduced the precipitation infiltration into and oxidation of the scar material. There are still a few mildly acidic springs and seeps along this reach of Red River. It is believed that these are attributable mainly to drainage down the southern outer slopes of the mountain.

Removal of ore from beneath Goat Hill Gulch by the new underground mine has resulted in the subsidence of a large area in the bottom of the gulch which is generally referred to as the caved area. This area has the shape of an inverted cone with a diameter of about 600 feet and a depth of approximately 175 feet. Since 1990 all of the drainage

from the mine dumps and scar areas in the upper part of Goat Hill Gulch has been drained into this caved area. Prior to this, there was a highly acidic surface flow in Goat Hill Gulch that extended to near Red River much of the time. As indicated by Hansen Creek, it is probable that the surface flow was present much of the time even before the dumps were developed. In addition to drainage from the Goat Hill dumps and underlying hydrothermal scars, the caved area is probably intercepting the natural drainage from over 60% of the other scar areas along the gulch.

Drainage into the caved area seeps through the fractured rock and into the underground mine where the water level is substantially below the river level. At the present time the mine is not in operation and the water is being allowed to accumulate and fill the mine. A separate study is being conducted to determine how the drainage water will be modified by dilution with the natural and presumably greater amount of non-acidic ground water flow and by the buffering effect of flow through the non-altered formations prevalent in most of the mine workings. The study will also access measures that may be required to prevent drainage of acidic water from reaching Red River when the water level within the mine reaches a critical elevation.

In 1992 Molycorp constructed six collection sumps downstream of the mine dumps in Capulin Canyon. The sumps were constructed at spring areas and across the natural drainage channels. Concrete cutoff walls or plastic liners were installed to restrict downstream flow from the sumps and perforated pipes were installed to collect the intercepted drainage. This was piped away to the upper end of the bore hole. The sumps were backfilled with clean gravel.

An 1130 foot long, nearly horizontal bore hole was drilled across the ridge between Capulin Canyon and Goat Hill Gulch. The bore hole was cased with 6 5/8" steel pipe with a 5" PVC inner conduit. Drainage water from the collection sumps is diverted through the bore hole from Capulin Canyon to Goat Hill Gulch upstream of the caved area. The discharge end of the bore hole is 64 feet below the inlet end in Capulin Canyon. The 5" inner casing has a capacity of over 500 gpm.

The following table lists the measured flows collected from Capulin Canyon and discharged through the bore hole.

TABLE 5

CAPULIN CANYON BORE HOLE DISCHARGE

Date	GPM	Date	GPM	Date	GPM
		9-08-92	31.5	12-08-92	24
7-09-92	40	9-18-92	31.5	12-17-92	23
8-10-92	33	9-24-92	34	1-06-93	22
8-12-92	33	10-13-92	28	4-01-93	38*
8-13-92	36	10-20-92	27	4-27-93	75*
8-20-92	31	10-27-92	26	5-10-93	50*
8-21-92	32	11-05-92	26	5-19-93	43*
8-24-92	34	11-10-92	26	6-15-93	31.5*
8-26-92	36	11-25-92	24	6-22-93	26

* Larger flows attributed to snow melt.

Measurements and samples indicate that the drainage flow from the Goat Hill Gulch dump area is generally slightly greater in flow and a little less acidic than the drainage from the Capulin dump area.

In 1993 a continuing drainage flow was observed downstream of the collection sumps below the dump area in Capulin Canyon. This flow appears to be on the order of 15% of the flow captured by the sumps. Since the down-

stream flow is less acidic, it is probable that at least part of the flow is from natural drainage outside of dump and scar areas. A portion of this flow may also be residual drainage from the aquifer after the completion of the upper collection system. In consideration that part of the lower drainage flow may be seepage that is flowing past the upper collection system; Molycorp is presently constructing a catchment basin some 1200 feet downstream from the existing collection system. The downstream catchment basin is also being constructed to collect and retain storm drainage which may flow past the upper system. The downstream catchment basin is over 200 feet lower in elevation than the bore hole inlet. Molycorp, therefore, has constructed an electric power line into the area and is constructing a station to pump the drainage from the lower catchment basin up to the bore hole inlet works. The lower seepage collection system is scheduled to be completed and in operation by the end of July 1993.

Molycorp Drawings 152-27, 152-28 and 152-29 which are included with this report, show the location and details of the Capulin Canyon seepage collection system.

A detailed analysis of the flow time from the heads of Capulin Canyon and Goat Hill Gulch has not been made. For the portion of the drainage that was transported over most of the distance by surface flow, the travel time was probably fairly short. For this portion of the flow, the drainage collection system should decrease the discharge to Red River within a fairly short period of time if such is not already occurring. Ground water flow is considerably much slower and drainage from the dump areas which occurred prior to the construction of the collection system may continue to reach Red River at a decreasing rate over the next several years.

There are extensive areas of altered rock and hydrothermal scars downstream of the drainage collection systems in both Goat Hill Gulch and Capulin Canyon. These will result in some continuing acidic drainage from these basins. It is anticipated, however, that within a reasonable period of time, the total acidic drainage from these basins will be significantly less than the natural drainage before the mine was developed.

Storm Drainage

Intense thunderstorms frequently occur in the area during the summer months. Moderately intense storms on the order of one to two inches result in surface drainage from some of the hydrothermal scars directly to Red River. These flows have low pH and very high concentrations of aluminum, sulfate, other dissolved metals and suspended solids. Drainages from the moderately intense storms have a significant short term impact on the water quality of Red River. Very intense thunderstorms, on the order of three inches or more, result in large mud flows from the hydrothermal scar areas which sometimes blocks the highway near the mouth of the canyons and may temporarily dam the river. Such intense storms may occur about once a decade. At such times, suspended solids in Red River may exceed 10% with high turbidity extending in the Rio Grande to Cochiti Lake. Investigations by the Thorne Ecological Institute (1972) indicate that storm runoff has only transient effects on water quality and faunal assemblages of the Red River.

Molycorp's open pit mine intercepts nearly all of the storm drainage from the Sulfur Gulch area and the caved area in Goat Hill Gulch intercepts the drainage from the dump area and hydrothermal scars in the upper portion of Goat Hill Gulch. The caved area has sufficient volumetric

capacity to contain the drainage from several flows resulting from three inch and greater amounts of precipitation.

Molycorp has also constructed a number of catchment basins in Capulin Canyon and the lower reach of Goat Hill Gulch and has constructed large berms above the highway along reaches below the mine dumps from the mill area to Columbine Creek. These catchment basins and berms significantly reduce the amount of flood drainage which directly flows to Red River.

The effects of a moderately intense storm were observed by Smolka and Tague on September 13, 1988 and data from other events are contained in USGS publications. Observed concentrations in the Red River following a storm are shown in Table 6. A large increase in suspended aluminum was observed which is probably attributable in large part to metallic aluminum in suspended clays, rather than aluminum hydroxide.

Table 6

Analytical data for a flood water sample from the Red River at the Questa Gauging Station, July 26, 1988.

Al (susp) mg/l	1453
Al (dis) mg/l	3
SO_4	278
TDS mg/l	1112
TSS mg/l	47844

Another storm occurred on June 25, 1992 with a measured precipitation of 1.05 inches at Molycorp's mill area. This storm extended over the mine area and up the river basin past Hansen Creek. Water samples were collected at several locations immediately following the passage of the storm. The results of the analysis are shown on the following Exhibit No. 1. The analysis indicates that drainage from the hydrothermal scars and mine dumps in the mine area

TABLE 7

STORM WATER ANALYSIS
COMPOSITE SAMPLES OF RAIN STORM OF JULY 25, 1992
TOTAL RAINFALL 1.05 INCHES
ALL UNITS IN PPM

SAMPLE SOURCE	PH	TSS	F	TDS	CD	PB	FEME	MO	ZN	CU	AL	SO4
RED RIVER ABOVE TOWN OF RED RIVER	8.4	21.0	0.1	94	<.01	<.1	1.3	.05	<.01	.010	<.02	1.0	13.4
BITTER CREEK	NO FLOW ENTERING RED RIVER											
HAUT N TAUT WASH CREEK	NO FLOW ENTERING RED RIVER											
HANSEN WASH CREEK	3.1	43000	1.0	4094	<.01	5.2	2500	25.4	8.0	7.4	3.0	755	686
MILL DRAINAGE BASIN	7.9	2500	1.7	268	<.01	1.2	144	9.2	5.9	1.4	0.76	113	61
RED RIVER ACROSS AND UP FROM MILL YARD	7.3	829	0.3	194	<.01	<.1	52	.85	0.45	.184	<.02	16	62
GOAT HILL GULCH WASH CREEK	6.5	530	0.8	200	<.01	<.1	43	.72	0.82	.230	<.02	16	37
CAPULIN CANYON	NO FLOW ENTERING RED RIVER											
RED RIVER AT RANGER STATION	7.5	450	0.8	236	<.01	0.12	27.9	1.2	0.50	.281	.114	12.8	59

LESS THAN SYMBOLS ARE DETECTION LIMITS
ALL METAL ANALYSIS ARE FOR TOTAL METAL
TOTAL METALS: THE CONCENTRATION OF METALS DETERMINED ON AN UNFILTERED SAMPLE:

was mainly contained in the mine area. In comparison, there was a significant amount of low pH drainage and high suspended solids from Hansen Creek where there was no drainage control.

A detailed investigation of the chemistry of the storm runoff waters is beyond the scope of this report.

Summary

In the preceding pages it has been shown that significant gains in aluminum, sulfate and other constituents occur in the Red River from the town of Red River to the Questa Ranger Station. The details of the mechanism of aluminum hydroxide accretion in the river are still uncertain; however, a tentative model can be made:

. Aluminum is leached from sulfidized country rocks and transported to the river by sulfuric acid which is created by the breakdown of pyrite.

. Aluminum is transported in the subsurface and in small streams at concentrations up to about 1000 mg/l and pH 2.5.

. Dilution of the aluminum laden water occurs by intermingling with ground water above the river. This reduces the composition of the aluminous water to about 200 mg/l Al or less at pH 3.5 to 5.0.

. Aluminum emerges at springs along the river. Increase of pH to near neutral causes precipitation of gibbsite [$Al(OH)_3$].

. The greatest concentration of gibbsite occurs where the pH of the acid spring water is lowest. This occurs between Capulin Canyon and the Questa Ranger Station. Apparently, the spring water is relatively undiluted in this reach.

. Natural sources account for most of the aluminum and sulfate gains to the river. Contributions may vary seasonally.

. Long term variations in seepage and springs, controlled by precipitation cycles, are possibly responsible for observed increases in sulfate and aluminum hydroxide in the Red River in recent years. Long term, systematic sampling of the Red River is needed to establish this relationship conclusively.

The results of this investigation are tentative. In large part this is because of several limitations to the present data base. One drawback is that ground water accretion along the individual stream reaches is too small to be accurately quantified by the obtainable precision of standard stream gauging field methods. In addition, the spacing of measurement stations in the available U.S.G.S. data is too great to clearly define local accretion rates. A second problem is that large changes in stream chemistry occur from sample to sample at the present data spacing. In many instances, it is not possible to determine if an apparent abrupt change is caused by real change in the river, by sampling technique, analytical error or by inhomogeneity of the river water. There is a substantial variation in the concentrations of sulfates, aluminum etc. over short periods of time. For example, at the ranger station, sulfate increased from 186 mg/l on 1-5-88 to 356 mg/l on 2-27-88 while aluminum declined from 13.4 mg/l to 6.0 mg/l on the same dates. Recorded flow on these dates increased from 19 cfs to 23.

The earlier stream surveys conducted by HEW in 1965 and EPA in 1970 are not comparable with the more recent surveys conducted by Smolka and Tague - EID 1986-1988 and Molycorp 1988-93. The 1965 survey was conducted following two years of very low precipitation and it is probable that spring and ground water flow from the hydrothermal scar areas was a much lower percentage of the total river flow. In 1970 Molycorp was diverting several cubic feet per second of water from the river. The survey data indicates a decrease in flow from below Hansen Creek to Goat Hill of over 3 cfs even though Columbine Creek and Chambers Springs enter along this reach. This survey also indicated a large decrease in the sulfate concentration which would have been due to the dilution of the remaining stream flow below the mill with Columbine Creek water.

References

Drever, J.I., 1982, The Geochemistry of Natural Waters: Prentice Hall, Englewood Cliffs, N.J., 388p.

Hem, J.D., 1970, Chemical Characteristics of Natural Water: U.S. Geological Services Water Supply Paper 1473 (revised).

Hem, J.D. and C.E. Roberson, 1967, Form and Stability of Aluminum Hydroxide Complexes in Dilute Solution: U.S. Geological Survey Water Supply Paper 1827-A, 55p.

Federal Water Pollution Control Administration, U.S. Department of the Interior, 1966, A Water Quality Survey, Red River ofthe Rio Grande, New Mexico: Ada Facility, Ada Oklahoma 54p.

Reesman, A.L., E.E. Pickett, and W.P. Keller, 1969: Aluminum ions in Aqueous Solutions: Am J. Sci. 267, pp 99-113.

Roberson, C.E., and J.D. Hem, 1969, Solubility of Aluminum in the Presence of Hydroxide, Fluoride and Sulfate: U.S. Geological Survey Water Supply Ppr 1827-c, 37 p.

Schilling, J.H., 1956, Geology of the Questa Molybdenum (Moly) Moly Mine Area, Taos County, New Mexico: N.M. Bureau of Mines and Min. Res. Bull 51, 87p.

Smolka, L.R. and D.F. Tague, 1987, Intensive Survey of the Red River, Taos County, New Mexico August 18-21, 1986: New Mexico Environmental Improvement Division, Surveillance and Standards Section, Surface Water Quality Bureau, Santa Fe, New Mexico 55p.

Smolka, L.R. and D.F. Tague, 1989, Intensive Water Quality of the Red River, Taos County, New Mexico, September 12 - October 25, 1988: New Mexico Environmental Division Surveillance and Standards Section, Surface Water Quality Bureau, Santa Fe, New Mexico, 89p.

Thorne Ecological Institute, 1972, Final Report on Ecological Research and Rehabilitation Done for the Molybdenum Corporation of America: Boulder, Colorado, unpublished report, 44p.

United States Environmental Protection Agency, Region VI, Surveillance and Analysis Division, m 1971, A Water Quality Survey Red River and Rio Grande, New Mexico: Ada Facility, Ada, Oklahoma, 54p.

U.S. Geological Survey, 1988, Stream flow data for the Red River, Rio Grande Basin: unpublished data.

U.S. Geological Survey, 1970, Surface Water Supply of the United States, 1961-1965, part 8. Western Gulf of Mexico Basins: Geological Survey Water Supply Paper 1923, 786p.

U.S. Geological Survey, 1965-1987, Water Resource Data for New Mexico: Water-Data Reports NM-65-1 to NM 87-1.

APPENDIX 1

Analytical data for water samples from the Red River, November 29, 1988

Major Consituents

Station	pH	Al mg/l (Suspended)	Al mg/l (Dissolved)	$SO_4^=$ mg/l	TDS mg/l	TSS mg/l	Tot. Alk.	JTU
1	7.8	<.5	<.5	8	106	<1	38	1
2	8.1	<.5	<.5	33	115	5.2	67	1
3	7.7	<.5	.8	34	138	1.9	71	3
4	8.0	.5	.7	43	133	1.6	68	4
5	8.1	.5	1.0	40	140	6.0	65	4
6	7.7	1.2	1.8	46	149	17.8	62	8
7	7.7	2.3	1.8	65	163	33.7	55	10
8	7.7	1.6	1.9	85	173	8.7	56	7
9	8.4	<.5	<.5	5	73	<1	60	2
10	8.0	1.6	2.0	98	216	14.4	54	9
11	7.7	1.6	1.8	68	171	16.1	54	6
12	7.8	1.7	2.6	106	229	14.6	54	5
13	7.7	1.6	3.0	131	246	9.2	45	5
14	6.2	2.9	3.6	121	235	6.2	36	7
15	7.0	5.2	4.0	136	276	14.9	26	14
16	7.1	7.1	4.4	137	263	49.6	26	22
17	7.4	6.6	4.0	140	296	35.3	30	20

Appendix 1 continued

Spring and Creek Data
Major Constituents

	Date	pH	Al suspended mg/l	Al dissolved mg/l	SO_4= mg/l	TDS mg/l	TSS mg/l	Tot Alk mg/l	JTU
Streams:									
Haut N Taut Cr.	3-16-88	3.3	32	19	450	925			
Hanson Creek	3-15-88	3.8	50	65	1130	1785			
Goathill Gulch	3-16-88	3.0	41	560	9560	5820			
Goathill Gulch	4-14-88	2.6	7	611	9730	11832	127	<2.0	50
Capulin Creek	3-15-88	3.0	5	650	8980	11440			
Springs:									
Junebug Seep	9-06-88	4.8		6.0	796	1466	14.1		
Hanson Spring	10-15-88	4.4	<.5	18.2	573	813	3.6		2
Assay Lab	10-21-88	5.2	1.8	3.1	359	600	115.1		34
Above Goathill	10-21-88	4.2	1.4	16.1	836	1492	15.9		4
Goathill Seep	3-16-88	3.6	9.2	216	3100	5155			
Above Capulin	10-14-88	4.8	10.9	321	520	366			100
Capulin Seep	10-14-88	4.0	1.1	110.4	1244	2296	43.8		20
Old Channel (near Capulin)	10-14-88	3.5	<.5	116.5	1404	2463			

Appendix 1 continued

Spring and Creek Data (continued)
Trace Constituents (mg/l)

	F^-	Cd	Pb	FE	Mn	Mo	Zn	Cu
Streams:								
Hot & Tot Creek	3.0	.020	.24	82	4.84	<.02	2.03	.47
Hanson Creek	3.8	.018	.11	5.3	8.42	<.02	3.83	.16
Goathill Gulch	32	.300	.23	274	222	<.02	52	7.4
Capulin Creek	38	.320	.20	238	296	<.02	60	7.2
Springs:								
Junebug Seep	4.8	.018	<.05	.32	3.59	<.02	1.10	.26
Hanson Spring	1.6	<.018	<.05	.13	3.16	<.02	.70	.13
Assay Lab	3.5	<.01	<.05	.85	.68	<.02	.52	.05
Above Goathill	4.6	.017	<.05	.68	4.82	<.02	1.46	.26
Goathill Seep	8.0	.070	.18	106.20	38.72	.05	9.63	1.22
Above Capulin	2.4	.010	<.05	16.76	3.23	<.02	.83	.47
Capulin Seep	4.2	.018	.10	25.42	16.33	.03	4.35	1.26
Old Channel (near Capulin)	4.1	.032	.06	2.65	18.42	<.02	4.90	1.46

MOLYCORP INC.
RED RIVER ALUMINUM SURVEYS

SUMMARY OF RED RIVER DATA 11-29-88 (SGV)
Laboratory Analytical Results

STATION LOCATION	STA.	SO4 mg/l	Sus. Al mg/l	Dis. Al mg/l	Total Al mg/l	ALK mg/l	TDS mg/l	TSS mg/l	Turb. JTU	F mg/l	Fe mg/l	Mn mg/l	Zn mg/l	Cond uMHO	pH
1 ABOVE RED RIVER	60600	8	0.01	0.00	0.01	38	106	1.0	1	0.2	0.15	0.03	0.01		7.8
3 BELOW RED RIVER	55300	24	0.02	0.80	0.82	71	138	1.9	3	0.4	0.15	0.11	0.04	N	7.7
4 JUNEBUG CAMPGROUND	50400	43	0.53	0.70	1.23	68	133	1.6	4	0.3	0.41	0.13	0.04	O T	8.0
5 ELEPHANT ROCK CG	43800	40	0.53	1.00	1.53	65	140	6.0	4	0.4	0.51	0.11	0.02	R	8.1
6 BELOW HANSON CR.	39100	46	1.20	1.80	3.00	62	149	17.8	8	0.5	0.64	0.18	0.04	U N	7.7
7 ABOVE MILL	31800	65	2.30	1.80	4.10	55	163	33.7	10	0.5	1.48	0.23	0.08		7.7
8 BELOW SULFUR GULCH	29800	88	1.60	1.90	3.50	56	173	8.7	7	0.7	0.39	0.16	0.07		7.7
10 ABOVE COLUMBINE CR.	22400	98	1.60	2.00	3.60	54	216	14.4	9	0.4	0.58	0.2	0.03		8.0
9 COLUMBINE CR. (Not Red River)		5	<0.5	<0.5	<0.5	60	73	<0.1	2	0.2	0.13	0.02	0.01		8.4
11 ABOVE THUNDER BR.	18300	63	1.60	1.80	3.40	54	171	16.1	6	0.5	0.62	0.32	0.08		7.7
12 GOAT HILL TURNOUT	14400	106	1.70	2.60	4.30	54	229	14.6	5	0.7	0.44	0.33	0.08		7.8
13 ABOVE CAPULIN	10300	131	1.60	3.00	4.60	45	246	9.2	5	0.8	0.23	0.39	0.1		7.7
14 BELOW CAPULIN	7800	121	2.90	3.60	6.50	36	235	6.2	7	0.9	0.4	0.53	0.14		6.2
15 EAGLE ROCK CG	5500	136	5.20	4.00	9.20	26	276	14.9	14	1.3	1.27	1.27	0.31		7.0
16 RANGER STATION	3300	137	7.10	4.40	11.50	26	263	49.6	22	1.2	2.17	1.39	0.37		7.1
17 EAGLE ROCK LAKE	1400	140	6.60	4.00	10.60	30	296	35.3	20	1	1.27	1.3	0.35		7.4

MOLYCORP INC.

RED RIVER ALUMINUM SURVEYS

SUMMARY OF RED RIVER DATA 10-22-92 (REV)
Laboratory Analytical Results

STATION	LOCATION	STA.	SO4 mg/l	Sus. Al mg/l	Dis. Al mg/l	Total Al mg/l	ALK mg/l	TDS mg/l	TSS mg/l	Turb. JTU	F mg/l	Fe mg/l	Mn mg/l	Zn mg/l	Cond uMHO	pH
1	ABOVE RED RIVER	60600	9	<0.5	<0.5	0.00	91	152	1.5	1	0.1	0.214	0.01	0.013		7.80
3	BELOW RED RIVER	55300	50	0.78	0.70	1.48	78	186	8.0	5	0.26	0.673	0.224	0.085	240	7.53
4	JUNEBUG CAMPGROUND	50400	53	0.39	0.50	0.89	88	154	2.0	3	0.263	0.396	0.154	0.054	265	8.15
6	BELOW HANSON CR.	39100	66	0.39	0.50	0.89	72	176	4.7	4	0.268	0.359	0.126	0.053	286	8.23
7	ABOVE MILL	31800	85	0.90	0.70	1.60	62	184	6.0	4	0.358	0.31	0.21	0.071	317	8.19
8	BELOW SULFUR GULCH	29800	98	0.84	0.50	1.34	56	214	7.0	5	0.452	0.305	0.21	0.092	334	7.69
8A	ABOVE PORTAL	25000	97	0.86	0.50	1.36	62	214	5.0	5	0.452	0.203	0.234	0.072	336	8.06
10	ABOVE COLUMBINE CR.	22400	114	0.78	0.50	1.28	63	202	7.0	5	0.222	0.252	0.21	0.084	343	8.19
9	COLUMBINE CR. (Not Red River)		9	<0.5	<0.5	<0.5	72	98	1.0	2	0.211	0.04	0.03	0.01	161	8.28
10A	COMPANY CABINS	21000	113	1.1	0.50	1.60	61	210	16.7	4	0.776	0.147	0.462	0.108	356	7.61
11	ABOVE THUNDER BR.	18300	125	1.10	0.77	1.87	56	216	8.0	4	0.762	0.249	0.476	0.133	352	7.86
11A	THUNDER BRIDGE	16400	131	1.4	0.62	2.02	68	200	5	4	0.744	0.159	0.434	0.127	391	7.62
12	GOAT HILL TURNOUT	14400	132	1.50	0.55	2.05	54	266	3.3	3	0.762	0.191	0.378	0.12	401	7.88
13	ABOVE CAPULIN	10300	125	1.50	0.50	2.00	62	244	6.7	5	0.772	0.209	0.448	0.135	400	7.76
14	BELOW CAPULIN	7800	140	2.50	0.50	3.00	48	284	10.0	6	0.841	0.272	0.658	0.206	416	7.45
14A	BEAR CANYON	6650	143	2.74	0.65	3.39	51	328	20	8	0.877	0.231	0.742	0.197	419	7.46
15	EAGLE ROCK CG	5500	156	3.56	1.20	4.76	38	336	24.0	9	0.921	0.361	1.13	0.263	431	7.24
16	RANGER STATION	3300	152	3.36	0.79	4.15	44	331	32.0	9	0.948	0.2	1.13	0.273	427	7.39
17	EAGLE ROCK LAKE	1400	153	3.00	0.79	3.79	34	326	27.0	9	1.09	0.181	1.18	0.323	436	7.51

MOLYCORP INC.
RED RIVER ALUMINUM SURVEYS

SUMMARY OF RED RIVER DATA 02-16-93 (DRS)
Laboratory Analytical Results

STATION LOCATION	STA.	SO4 mg/l	Sus. Al mg/l	Dis. Al mg/l	Total Al mg/l	ALK mg/l	TDS mg/l	TSS mg/l	Turb. JTU	F mg/l	Fe mg/l	Mn mg/l	Zn mg/l	Cond uMHO	pH
1 ABOVE RED RIVER	60600	6	<0.5	<0.5	0.00	84	122	1.0	N	0.1	0.101	0.03	0.02	194	7.6
6 BELOW HANSON CR.	39100	86	0.83	0.50	1.33	46	200	6.0	O T	0.32	0.467	0.179	0.041	305	7.6
7 ABOVE MILL	31800	113	2.00	0.50	2.50	49	230	8.0	R	0.37	0.442	0.274	0.083	336	7.7
8A ABOVE PORTAL	25000	105	1.80	0.50	2.30	43	238	7.0	U N	0.498	0.281	0.234	0.072	371	7.8
10 ABOVE COLUMBINE CR.	22400	130	2.00	0.50	2.50	49	256	4.0		0.606	0.636	0.309	0.504	393	7.8
10A COMPANY CABINS	21000	131	1.80	0.50	2.30	49	266	7.0		0.812	0.278	0.221	0.063	369	7.6
11A THUNDER BRIDGE	16400	166	1.6	0.50	2.10	47	292	6		0.812	0.214	0.504	0.111	416	7.3
12 GOAT HILL TURNOUT	14400	182	1.40	0.50	1.90	47	302	11.0		0.831	0.236	0.474	0.112	414	7.6
13 ABOVE CAPULIN	10300	177	1.40	0.50	1.90	43	302	12.0		0.862	0.245	0.518	0.127	436	7.5
14 BELOW CAPULIN	7800	188	3.10	0.50	3.60	26	310	18.0		0.968	0.421	0.755	0.179	444	7.3
16 RANGER STATION	3300	202	5.10	0.50	5.60	29	338	21.0		1.1	0.524	1.5	0.348	458	7.2

MOLYCORP INC.

RED RIVER ALUMINUM SURVEYS

SUMMARY OF RED RIVER DATA 11-29-88 (SGV)
Calculated Mass Flow Data (Grams/Sec)

STATION	LOCATION	STA.	FLOW CFS	SO4	Sus. Al	Dis. Al	Total Al	ALK	TDS	TSS	Turb. JTU	F	Fe	Mn	Zn	Cond uMHO	p
1	ABOVE RED RIVER	60600	6.6	1.49	0.00	0.00	0.00	7.06	19.68	0.19	1	0.04	0.03	0.01	<0.01		7.
3	BELOW RED RIVER	55300	10.1	6.89	0.01	0.23	0.24	20.38	39.60	0.55	3	0.11	0.04	0.03	0.01	N	7.
4	JUNEBUG CAMPGROUND	50400	10.3	12.48	0.15	0.20	0.36	19.74	38.62	0.46	4	0.09	0.12	0.04	0.01	O T	8.
5	ELEPHANT ROCK CG	43800	10.6	11.95	0.16	0.30	0.46	19.42	41.83	1.79	4	0.12	0.15	0.03	0.01	R U	8.
6	BELOW HANSON CR.	39100	10.7	13.98	0.36	0.55	0.91	18.84	45.27	5.41	8	0.15	0.19	0.05	0.01	N	7.
7	ABOVE MILL	31800	10.9	20.08	0.71	0.56	1.27	16.99	50.35	10.41	10	0.15	0.46	0.07	0.02		7.
8	BELOW SULFUR GULCH	29800	11.6	28.96	0.53	0.63	1.15	18.43	56.93	2.86	7	0.23	0.13	0.05	0.02		7.
10	ABOVE COLUMBINE CR	22400	12.0	33.24	0.54	0.68	1.22	18.32	73.26	4.88	9	0.14	0.20	0.07	0.01		8.
9	COLUMBINE CR. (Not Red River)		3.2	0.45	<0.05	<0.05	<0.05	5.46	6.64	< 0.1	2	0.02	0.01	<0.01	<0.01		8.
11	ABOVE THUNDER BR.	18300	15.2	40.00	0.69	0.78	1.46	23.25	73.63	6.93	6	0.22	0.27	0.14	0.03		7.
12	GOAT HILL TURNOUT	14400	15.8	47.43	0.76	1.16	1.92	24.16	102.46	6.53	5	0.31	0.20	0.15	0.04		7
13	ABOVE CAPULIN	10300	16.0	50.00	0.73	1.36	2.09	20.44	111.72	4.18	5	0.36	0.10	0.18	0.05		7
14	BELOW CAPULIN	7800	16.3	55.77	1.34	1.66	3.00	16.59	108.31	2.86	7	0.41	0.18	0.24	0.06		6
15	EAGLE ROCK CG	5500	16.7	64.28	2.46	1.89	4.35	12.29	130.46	7.04	14	0.61	0.60	0.60	0.15		7
16	RANGER STATION	3300	17.0	65.91	3.42	2.12	5.53	12.51	126.53	23.86	22	0.58	1.04	0.67	0.18		7
17	EAGLE ROCK LAKE	1400	17.0	67.35	3.18	1.92	5.10	14.43	142.41	16.98	20	0.48	0.61	0.63	0.17		7

MOLYCORP INC.

RED RIVER ALUMINUM SURVEYS

SUMMARY OF RED RIVER DATA 10-22-92 (REV)
Calculated Mass Flow Data (Grams/Sec)

STATION	LOCATION	STA.	FLOW CFS	SO4	Sus. Al	Dis. Al	Total Al	ALK	TDS	TSS	Turb. JTU	F	Fe	Mn	Zn	Cond uMHO	pH
1	ABOVE RED RIVER	60600	9.7	2.46	0.00	0.00	0.00	24.85	41.51	0.41	1	0.03	0.06	0.00	0.00	--	7.8
3	BELOW RED RIVER	55300	14.9	21.10	0.33	0.30	0.62	32.92	78.50	3.38	5	0.11	0.28	0.09	0.04	240	7.5
4	JUNEBUG CAMPGROUND	50400	15.1	22.63	0.17	0.21	0.38	37.57	65.75	0.85	3	0.11	0.17	0.07	0.02	265	8.1
6	BELOW HANSON CR.	39100	15.8	29.49	0.17	0.22	0.40	32.17	78.63	2.10	4	0.12	0.16	0.06	0.02	286	8.2
7	ABOVE MILL	31800	16.1	38.61	0.41	0.32	0.73	28.17	83.59	2.73	4	0.16	0.14	0.10	0.03	317	8.1
8	BELOW SULFUR GULCH	29800	17.1	47.43	0.41	0.24	0.65	27.10	103.56	3.39	5	0.22	0.15	0.10	0.04	334	7.6
8A	ABOVE PORTAL	25000	17.4	47.70	0.42	0.25	0.67	30.49	105.23	2.46	5	0.22	0.10	0.12	0.04	336	8.0
10	ABOVE COLUMBINE CR	22400	17.6	56.86	0.39	0.25	0.64	31.42	100.76	3.49	5	0.11	0.13	0.10	0.04	343	8.1
9	COLUMBINE CR. (Not Red River)		4.7	1.20	<0.05	<0.05	<0.05	9.63	13.10	0.13	2	0.03	0.01	<0.01	<0.01	161	8.2
10A	COMPANY CABINS	21000	22.4	71.47	0.70	0.32	1.01	38.58	132.83	10.56	4	0.49	0.09	0.29	0.07	356	7.6
11	ABOVE THUNDER BR.	18300	22.4	79.15	0.70	0.49	1.18	35.46	136.77	5.07	4	0.48	0.16	0.30	0.08	352	7.8
11A	THUNDER BRIDGE	16400	23.0	85.36	0.91	0.40	1.32	44.31	130.32	3.26	4	0.48	0.10	0.28	0.08	391	7.6
12	GOAT HILL TURNOUT	14400	23.3	86.85	0.99	0.36	1.35	35.53	175.02	2.17	3	0.50	0.13	0.25	0.08	401	7.8
13	ABOVE CAPULIN	10300	23.6	83.48	1.00	0.33	1.34	41.41	162.96	4.47	5	0.52	0.14	0.30	0.09	400	7.7
14	BELOW CAPULIN	7800	24.0	94.89	1.69	0.34	2.03	32.53	192.49	6.78	6	0.57	0.18	0.45	0.14	416	7.4
14A	BEAR CANYON	6650	24.3	98.14	1.88	0.45	2.33	35.00	225.10	13.73	8	0.60	0.16	0.51	0.14	419	7.4
15	EAGLE ROCK CG	5500	24.6	108.44	2.47	0.83	3.31	26.41	233.56	16.68	9	0.64	0.25	0.79	0.18	431	7.2
16	RANGER STATION	3300	25.0	107.54	2.38	0.56	2.94	31.13	234.18	22.64	9	0.67	0.14	0.80	0.19	427	7.3
17	EAGLE ROCK LAKE	1400	25.0	108.25	2.12	0.56	2.68	24.06	230.64	19.10	9	0.77	0.13	0.83	0.23	436	7.5

MOLYCORP INC.

RED RIVER ALUMINUM SURVEYS

SUMMARY OF RED RIVER DATA 02-16-93 (DRS)
Calculated Mass Flow Data (Grams/Sec)

STATION LOCATION	STA.	FLOW CFS	SO4	Sus. Al	Dis. Al	Total Al	ALK	TDS	TSS	Turb. JTU	F	Fe	Mn	Zn	Cond uMHO	p
1 ABOVE RED RIVER	60600	8.5	1.44	0.00	0.00	0.00	20.19	29.32	0.24	N	0.02	0.02	0.01	0.00	194	7
6 BELOW HANSON CR.	39100	13.9	33.81	0.33	0.20	0.52	18.09	78.63	2.36	O T	0.13	0.18	0.07	0.02	305	7
7 ABOVE MILL	31800	14.1	45.17	0.80	0.20	1.00	19.59	91.95	3.20	R	0.15	0.18	0.11	0.03	336	7
8A ABOVE PORTAL	25000	15.3	45.43	0.78	0.22	1.00	18.61	102.98	3.03	U N	0.22	0.12	0.10	0.03	371	7
10 ABOVE COLUMBINE CR	22400	15.5	57.06	0.88	0.22	1.10	21.51	112.37	1.76		0.27	0.28	0.14	0.22	393	7
10A COMPANY CABINS	21000	19.7	72.92	1.00	0.28	1.28	27.27	148.06	3.90		0.45	0.15	0.12	0.04	369	7
11A THUNDER BRIDGE	16400	20.1	94.26	0.91	0.28	1.19	26.69	165.80	3.41		0.46	0.12	0.29	0.06	416	7
12 GOAT HILL TURNOUT	14400	20.5	105.38	0.81	0.29	1.10	27.21	174.86	6.37		0.48	0.14	0.27	0.06	414	7
13 ABOVE CAPULIN	10300	20.8	104.03	0.82	0.29	1.12	25.27	177.50	7.05		0.51	0.14	0.30	0.07	436	7
14 BELOW CAPULIN	7800	21.1	112.13	1.85	0.30	2.15	15.51	184.90	10.74		0.58	0.25	0.45	0.11	444	7
16 RANGER STATION	3300	22.0	125.77	3.18	0.31	3.49	18.06	210.44	13.07		0.68	0.33	0.93	0.22	458	7

APPENDIX 4

COMPUTATIN OF THE PERCENT OF THE TOTAL GAIN
WHICH WAS INDICATED FOR MAJOR STREAM SEGMENTS

HEW-11/04/1965

	FLOW CFS	CONC. mg/l	FLOW X CONC.	MASS GAIN	% OF TOTAL
ABOVE RR TOWN	9.9	5.3	52.5		
				278.4	17.2
BELOW RR TOWN	16.3	20.3	330.9		
				464.7	28.7
BELOW HANSEN	17.0	46.8	795.6		
				396.2	24.5
BLW COL. CREEK	23.6	50.5	1191.8		
				478.2	29.6
RANGER STATION	26.3	63.5	1670.1		
TOTALS				1617.6	100.0

EPA-11/04/1970

	FLOW CFS	CONC. mg/l	FLOW X CONC.	MASS GAIN	% OF TOTAL
ABOVE RR TOWN	4.2	10.1	42.5		
				369.9	32.9
BELOW RR TOWN	10.0	41.2	412.4		
				380.7	33.9
BELOW HANSEN	12.7	62.5	793.1		
				56.9	5.1
BLW COL. CREEK	9.6	44.4	427.6		
+ EST MC DIVER.	6.5	65.0	422.5		
				316.6	28.2
RANGER STATION	11.2	66.5	744.1		
+ EST MC DIVER.	6.5	65.0	422.5		
TOTALS				1124.1	100.0

SMOLKA-TAGUE 10/25/1988

	FLOW CFS	CONC. mg/l	FLOW X CONC.	MASS GAIN	% OF TOTAL
ABOVE RR TOWN	11.6	12.0	139.2		
				666.3	19.6
BELOW RR TOWN	17.9	45.0	805.5		
				484.3	14.2
BELOW HANSEN	19.3	67.0	1289.8		
				770.5	22.7
@ GOAT HILL	28.3	72.8	2060.2		
				1479.8	43.5
RANGER STATION	30.0	118.0	3540.0		
TOTALS				3400.8	100.0

APPENDIX 4 - (continued)

COMPUTATIN OF THE PERCENT OF THE TOTAL GAIN
WHICH WAS INDICATED FOR MAJOR STREAM SEGMENTS

SCOTT VAIL 11/29/1988 W/BLW COL CREEK

	FLOW CFS	CONC. mg/l	FLOW X CONC.	MASS GAIN	% OF TOTAL
ABOVE RR TOWN	6.6	8.0	52.8		
				189.6	8.3
BELOW RR TOWN	10.1	24.0	242.4		
				466.1	20.5
BELOW HANSEN	10.9	65.0	708.5		
				249.1	10.9
BLW COL. CREEK	15.2	63.0	957.6		
				1371.4	60.2
RANGER STATION	17.0	137.0	2329.0		
TOTALS				2276.2	100.0

SCOTT VAIL 11/29/1988 W/GOAT HILL

	FLOW CFS	CONC. mg/l	FLOW X CONC.	MASS GAIN	% OF TOTAL
ABOVE RR TOWN	6.6	8.0	52.8		
				189.6	8.3
BELOW RR TOWN	10.1	24.0	242.4		
				466.1	20.5
BELOW HANSEN	10.9	65.0	708.5		
				902.7	39.7
@GOAT HILL	15.2	106.0	1611.2		
				717.8	31.5
RANGER STATION	17.0	137.0	2329.0		
TOTALS				2276.2	100.0

RALPH VAIL 10/22/1992

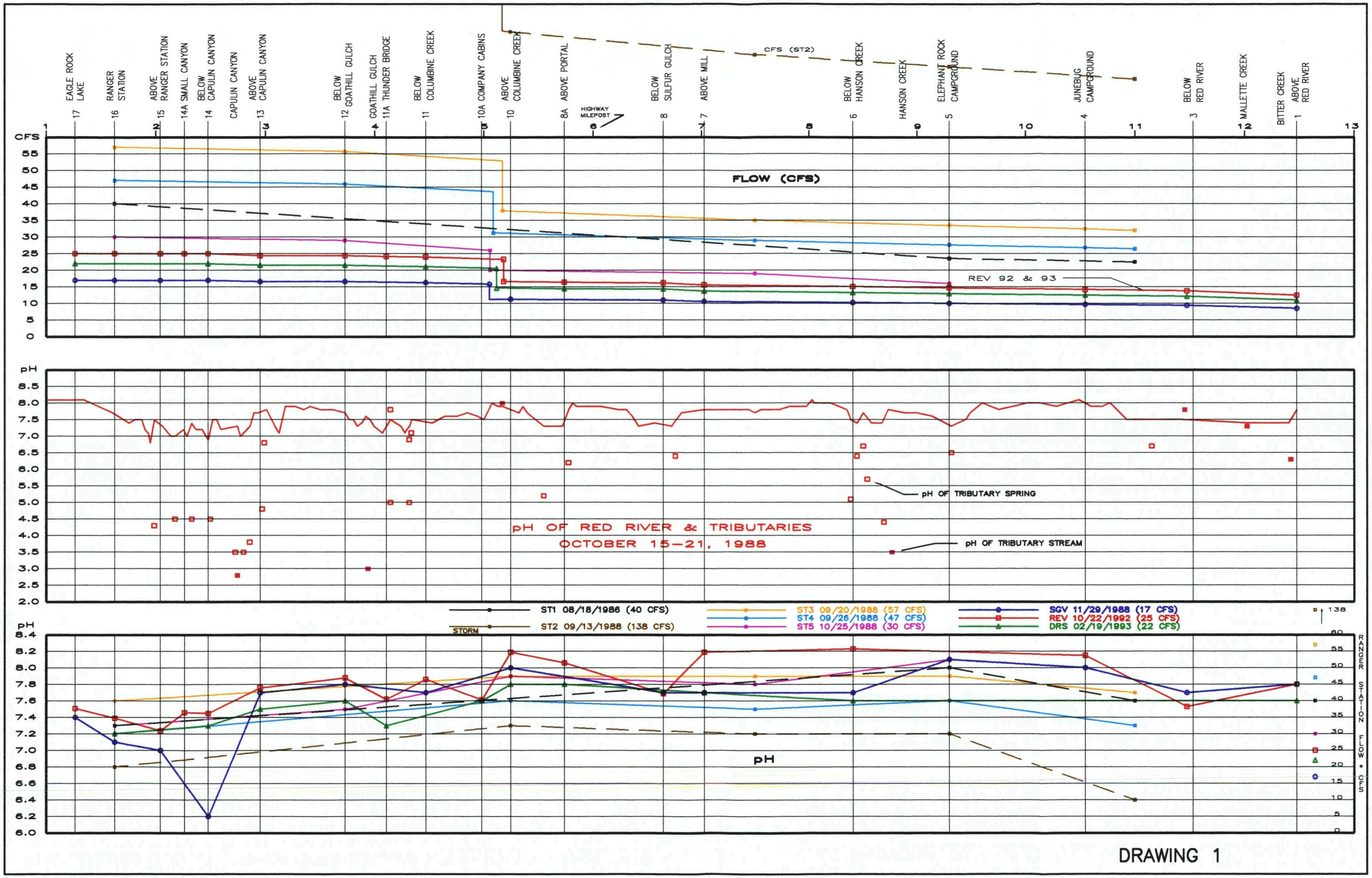
	FLOW CFS	CONC. mg/l	FLOW X CONC.	MASS GAIN	% OF TOTAL
ABOVE RR TOWN	9.7	9.0	87.3		
				657.7	17.7
BELOW RR TOWN	14.9	50.0	745.0		
				623.5	16.8
BELOW HANSEN	16.1	85.0	1368.5		
				1431.5	38.6
BLW COL. CREEK	22.4	125.0	2800.0		
				1000.0	26.9
RANGER STATION	25.0	152.0	3800.0		
TOTALS				3712.7	100.0

APPENDIX 4 - (continued)

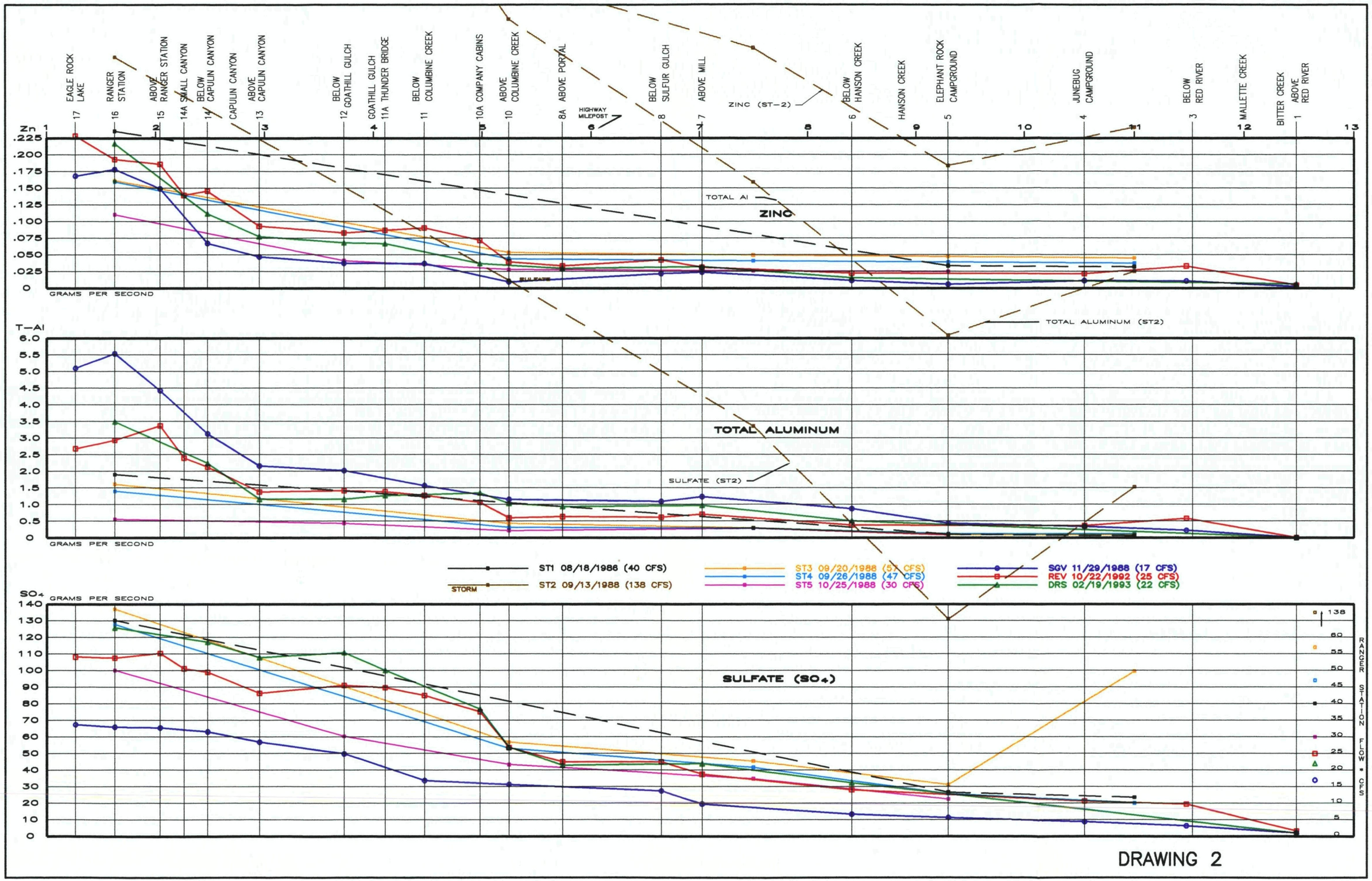
COMPUTATIN OF THE PERCENT OF THE TOTAL GAIN
WHICH WAS INDICATED FOR MAJOR STREAM SEGMENTS

DAVID SHOEMAKER 02/16/1993

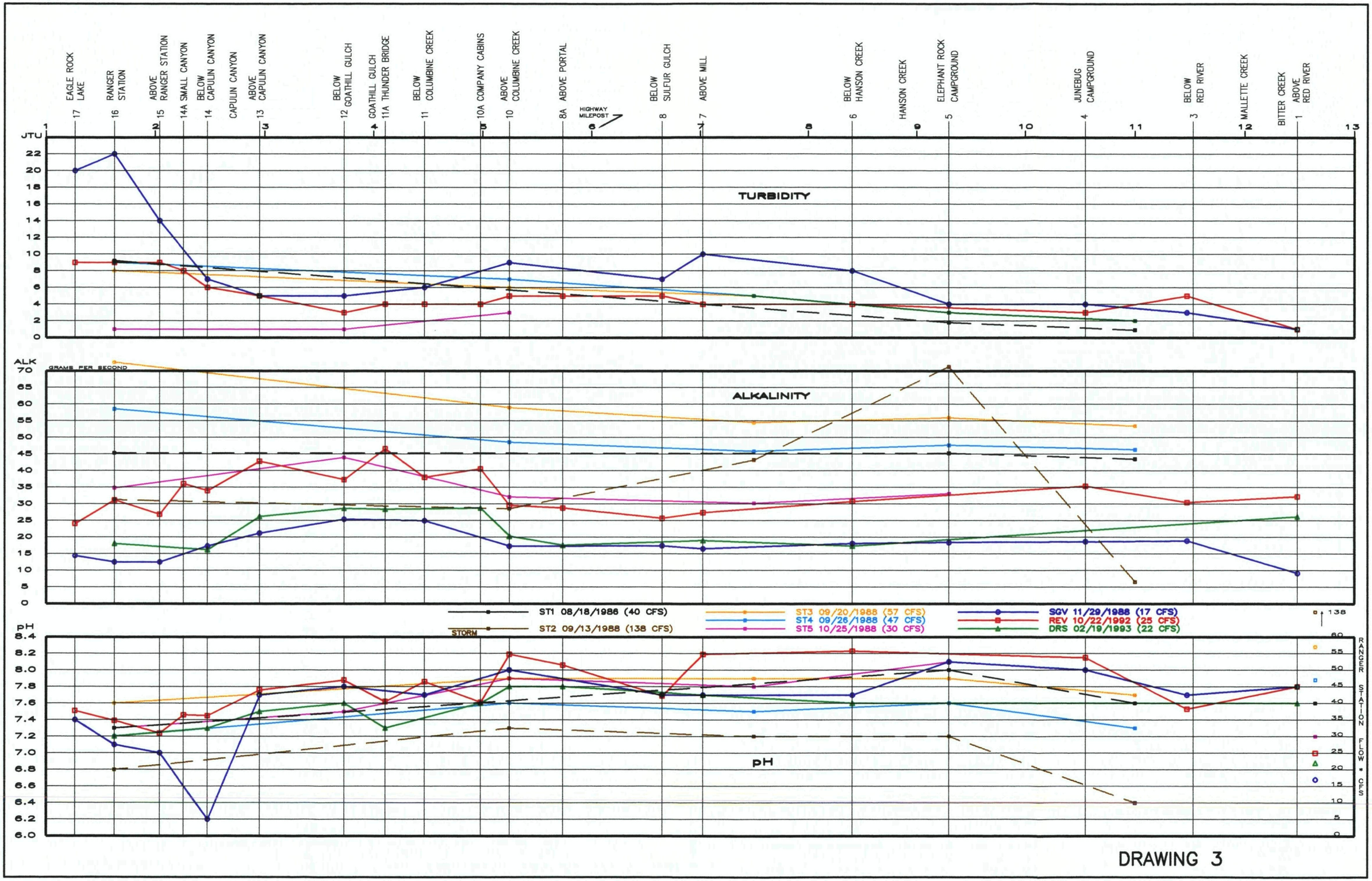
	FLOW CFS	CONC. mg/l	FLOW X CONC.	MASS GAIN	% OF TOTAL
ABOVE RR TOWN	8.5	6.0	51.0		
				800.5	18.2
BELOW RR TOWN	13.1	65.0	851.5		
				981.5	22.3
BELOW HANSEN	14.1	130.0	1833.0		
				1112.2	25.3
BLW COL. CREEK	19.9	148.0	2945.2		
				1498.8	34.1
RANGER STATION	22.0	202.0	4444.0		
TOTALS				4393.0	100.0


EAGLE ROCK LAKE 17
RANGER STATION 16
ABOVE RANGER STATION 15
14A SMALL CANYON
BELOW CAPULIN CANYON 14
CAPULIN CANYON
ABOVE CAPULIN CANYON 13
BELOW GOATHILL GULCH 12
GOATHILL GULCH
11A THUNDER BRIDGE
BELOW COLUMBINE CREEK 11
10A COMPANY CABINS
ABOVE COLUMBINE CREEK 10
8A ABOVE PORTAL
HIGHWAY MILEPOST 6
BELOW SULFUR GULCH 8
ABOVE MILL 7
BELOW HANSON CREEK 6
HANSON CREEK
ELEPHANT ROCK CAMPGROUND 5
JUNEBUG CAMPGROUND 4
BELOW RED RIVER 3
MALLETTE CREEK
BITTER CREEK
ABOVE RED RIVER 1
CFS (ST2)
FLOW (CFS)
REV 92 & 93
pH
pH OF TRIBUTARY SPRING
pH OF TRIBUTARY STREAM
pH OF RED RIVER & TRIBUTARIES
OCTOBER 15-21, 1988
ST1 08/18/1986 (40 CFS)
ST2 09/13/1988 (138 CFS)
STORM
ST3 09/20/1988 (57 CFS)
ST4 09/26/1988 (47 CFS)
ST5 10/25/1988 (30 CFS)
SGV 11/29/1988 (17 CFS)
REV 10/22/1992 (25 CFS)
DRS 02/19/1993 (22 CFS)
RANGER STATION FLOW - CFS

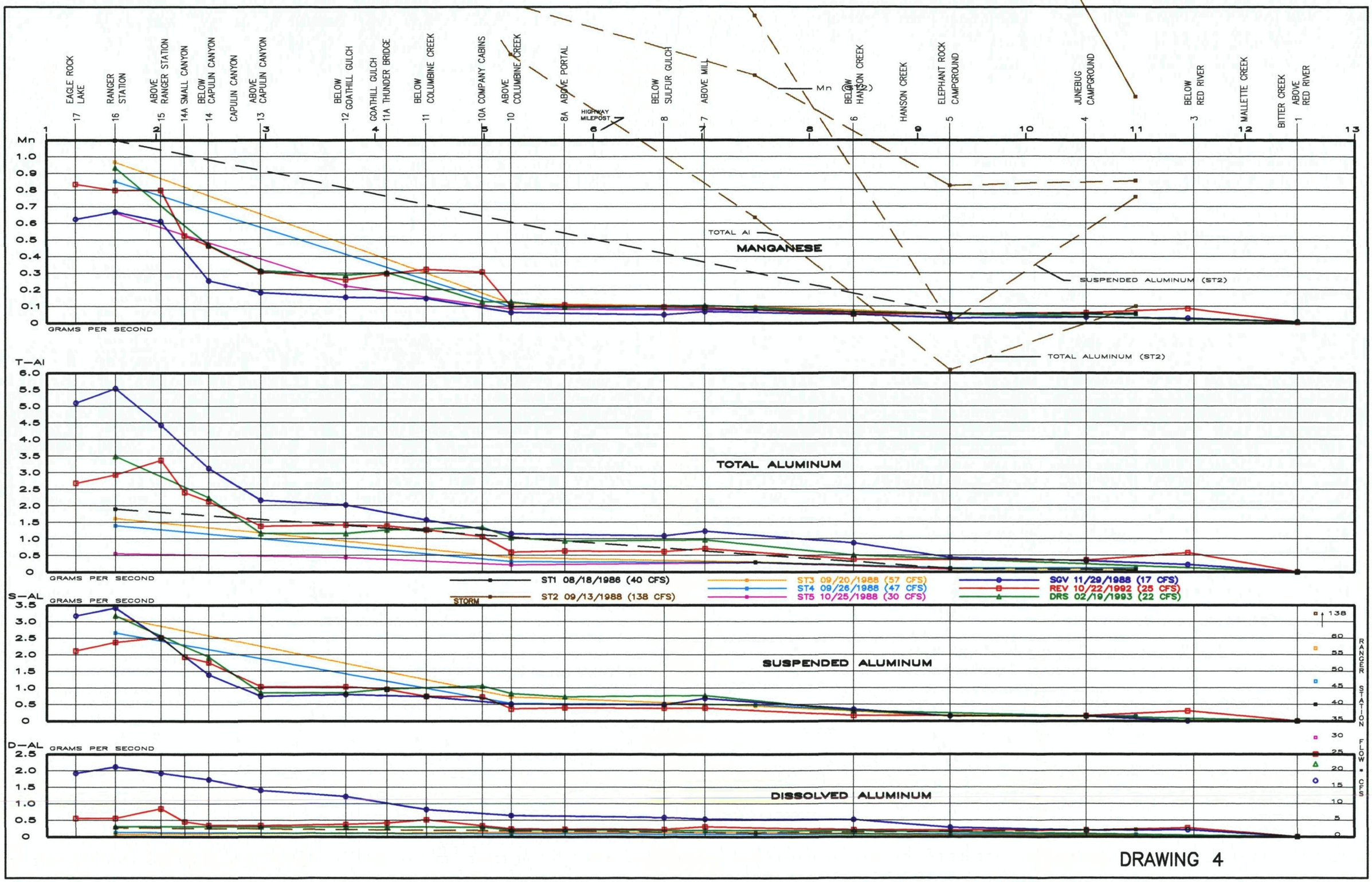
DRAWING 1


EAGLE ROCK LAKE
RANGER STATION
ABOVE RANGER STATION
SMALL CANYON
BELOW CAPULIN CANYON
CAPULIN CANYON
ABOVE CAPULIN CANYON
BELOW GOATHILL GULCH
GOATHILL GULCH
THUNDER BRIDGE
BELOW COLUMBINE CREEK
COMPANY CABINS
ABOVE COLUMBINE CREEK
ABOVE PORTAL
HIGHWAY MILEPOST
BELOW SULFUR GULCH
ABOVE MILL
BELOW HANSON CREEK
HANSON CREEK
ELEPHANT ROCK CAMPGROUND
JUNEBUG CAMPGROUND
BELOW RED RIVER
MALLETTE CREEK
BITTER CREEK
ABOVE RED RIVER
Zn
ZINC (ST-2)
TOTAL Al
ZINC
GRAMS PER SECOND
T-Al
TOTAL ALUMINUM (ST2)
TOTAL ALUMINUM
SULFATE (ST2)
GRAMS PER SECOND
ST1 08/18/1986 (40 CFS)
STORM
ST2 09/13/1988 (138 CFS)
ST3 09/20/1988 (57 CFS)
ST4 09/26/1988 (47 CFS)
ST5 10/25/1988 (30 CFS)
SGV 11/29/1988 (17 CFS)
REV 10/22/1992 (25 CFS)
DRS 02/19/1993 (22 CFS)
SO4
GRAMS PER SECOND
SULFATE (SO4)
RANGER STATION FLOW - CFS

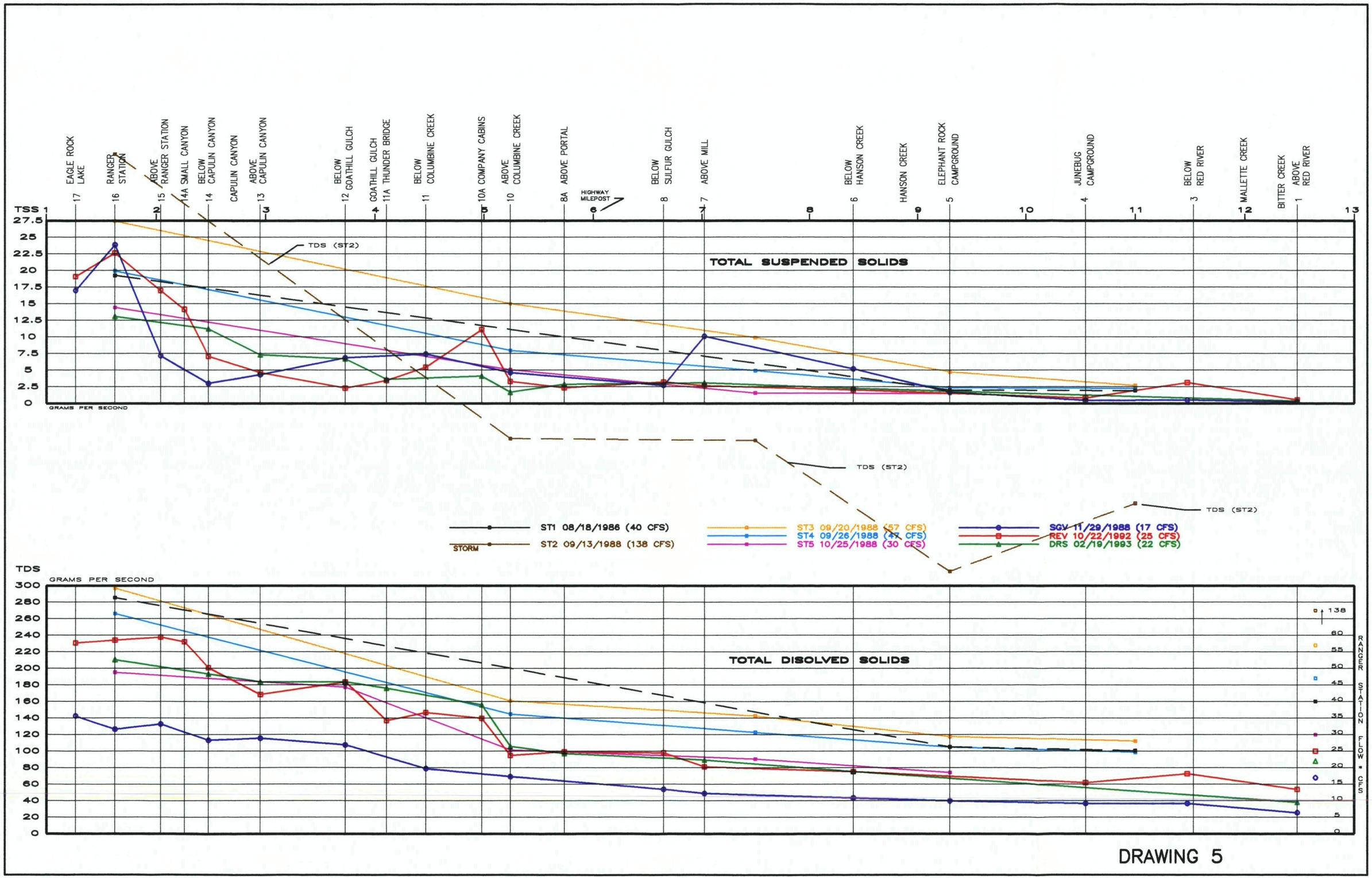
DRAWING 2


EAGLE ROCK LAKE 17
RANGER STATION 16
ABOVE RANGER STATION 15
SMALL CANYON 14A
BELOW CAPULIN CANYON 14
CAPULIN CANYON
ABOVE CAPULIN CANYON 13
BELOW GOATHILL GULCH 12
GOATHILL GULCH
THUNDER BRIDGE 11A
BELOW COLUMBINE CREEK 11
COMPANY CABINS 10A
ABOVE COLUMBINE CREEK 10
ABOVE PORTAL 8A
HIGHWAY MILEPOST 6
BELOW SULFUR GULCH 8
ABOVE MILL 7
BELOW HANSON CREEK 6
HANSON CREEK
ELEPHANT ROCK CAMPGROUND 5
JUNEBUG CAMPGROUND 4
BELOW RED RIVER 3
MALLETTE CREEK
BITTER CREEK
ABOVE RED RIVER 1
TURBIDITY
JTU
ALKALINITY
GRAMS PER SECOND
ALK
pH
STORM
ST1 08/18/1986 (40 CFS)
ST2 09/13/1988 (138 CFS)
ST3 09/20/1988 (57 CFS)
ST4 09/26/1988 (47 CFS)
ST5 10/25/1988 (30 CFS)
SGV 11/29/1988 (17 CFS)
REV 10/22/1992 (25 CFS)
DRS 02/19/1993 (22 CFS)
RANGER STATION FLOW - CFS

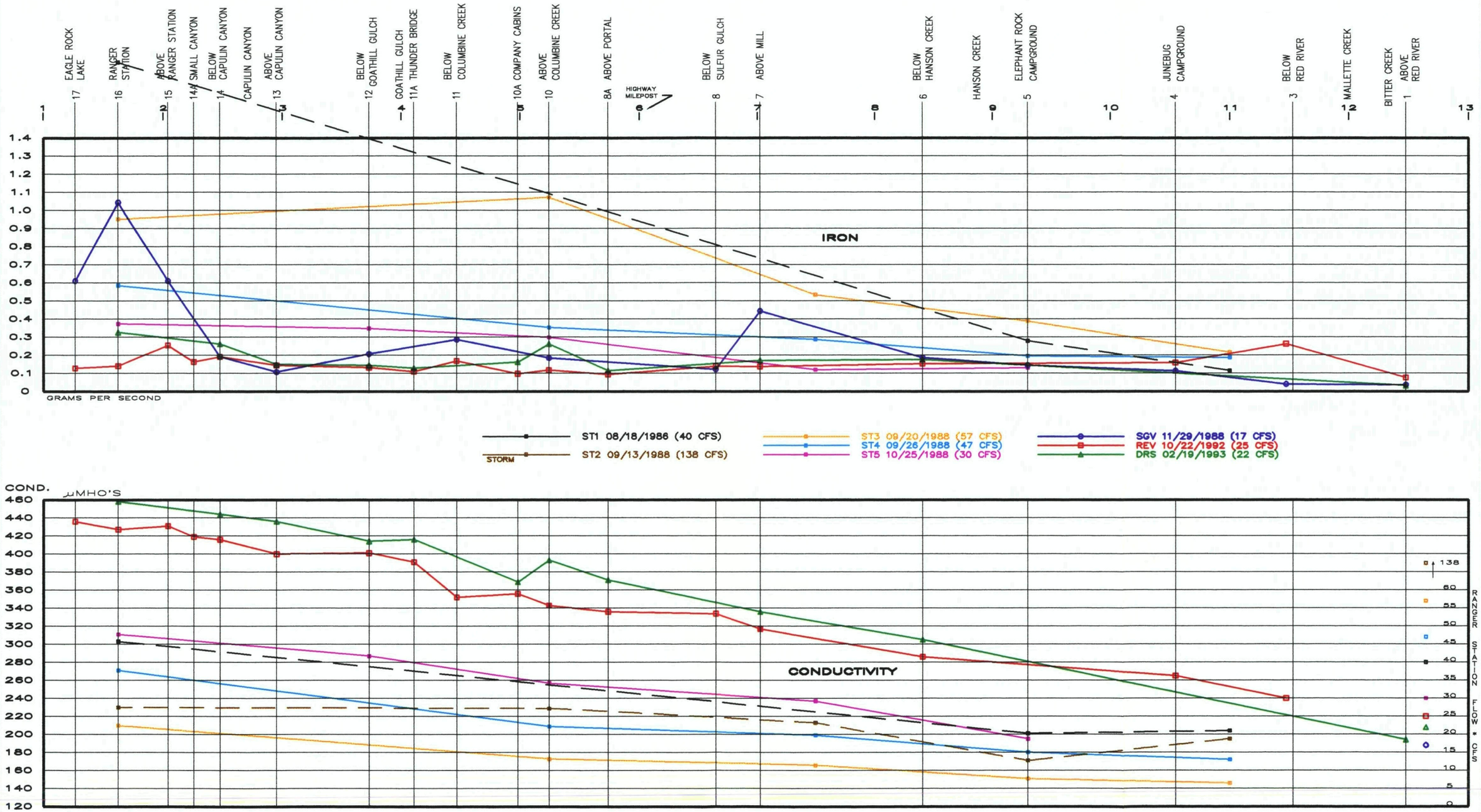
DRAWING 3


EAGLE ROCK LAKE 17
RANGER STATION 16
ABOVE RANGER STATION 15
14A SMALL CANYON
BELOW CAPULIN CANYON 14
CAPULIN CANYON
ABOVE CAPULIN CANYON 13
BELOW GOATHILL GULCH 12
GOATHILL GULCH
11A THUNDER BRIDGE
BELOW COLUMBINE CREEK 11
10A COMPANY CABINS
ABOVE COLUMBINE CREEK 10
8A ABOVE PORTAL
HIGHWAY MILEPOST
BELOW SULFUR GULCH 8
ABOVE MILL 7
BELOW HANSON CREEK 6
HANSON CREEK 9
ELEPHANT ROCK CAMPGROUND 5
JUNEBUG CAMPGROUND 4
BELOW RED RIVER 3
MALLETTE CREEK
BITTER CREEK
ABOVE RED RIVER 1
Mn
TOTAL Al
MANGANESE
SUSPENDED ALUMINUM (ST2)
TOTAL ALUMINUM (ST2)
GRAMS PER SECOND
T-Al
TOTAL ALUMINUM
S-AL
SUSPENDED ALUMINUM
D-AL
DISSOLVED ALUMINUM
ST1 08/18/1986 (40 CFS)
ST2 09/13/1988 (138 CFS)
STORM
ST3 09/20/1988 (57 CFS)
ST4 09/26/1988 (47 CFS)
ST5 10/25/1988 (30 CFS)
SGV 11/29/1988 (17 CFS)
REV 10/22/1992 (25 CFS)
DRS 02/19/1993 (22 CFS)
RANGER STATION FLOW - CFS

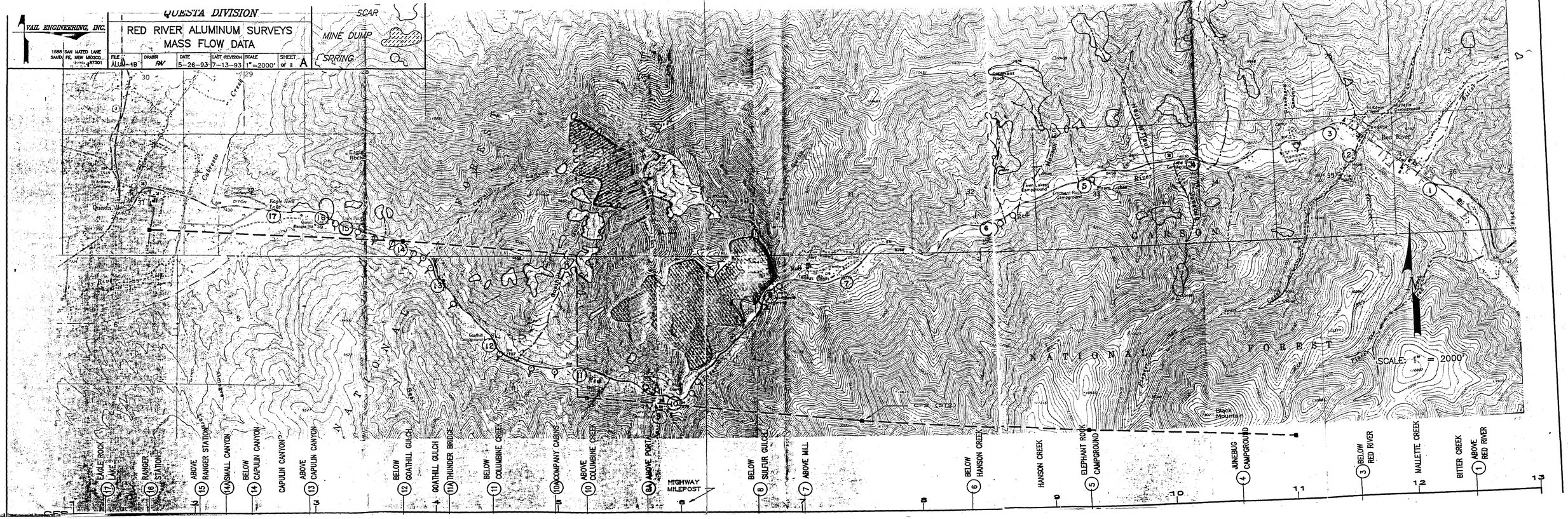
DRAWING 4


EAGLE ROCK LAKE
RANGER STATION
ABOVE RANGER STATION
SMALL CANYON
BELOW CAPULIN CANYON
CAPULIN CANYON
ABOVE CAPULIN CANYON
BELOW GOATHILL GULCH
GOATHILL GULCH
THUNDER BRIDGE
BELOW COLUMBINE CREEK
COMPANY CABINS
ABOVE COLUMBINE CREEK
ABOVE PORTAL
HIGHWAY MILEPOST
BELOW SULFUR GULCH
ABOVE MILL
BELOW HANSON CREEK
HANSON CREEK
ELEPHANT ROCK CAMPGROUND
JUNEBUG CAMPGROUND
BELOW RED RIVER
MALLETTE CREEK
BITTER CREEK
ABOVE RED RIVER
TSS
GRAMS PER SECOND
TOTAL SUSPENDED SOLIDS
TDS (ST2)
ST1 08/18/1986 (40 CFS)
STORM
ST2 09/13/1988 (138 CFS)
ST3 09/20/1988 (57 CFS)
ST4 09/26/1988 (47 CFS)
ST5 10/25/1988 (30 CFS)
SGV 11/29/1988 (17 CFS)
REV 10/22/1992 (25 CFS)
DRS 02/19/1993 (22 CFS)
TDS
GRAMS PER SECOND
TOTAL DISOLVED SOLIDS
RANGER STATION FLOW * CFS

DRAWING 5


EAGLE ROCK LAKE
RANGER STATION
ABOVE RANGER STATION
SMALL CANYON
BELOW CAPULIN CANYON
CAPULIN CANYON
ABOVE CAPULIN CANYON
BELOW GOATHILL GULCH
GOATHILL GULCH
THUNDER BRIDGE
BELOW COLUMBINE CREEK
COMPANY CABINS
ABOVE COLUMBINE CREEK
ABOVE PORTAL
HIGHWAY MILEPOST
BELOW SULFUR GULCH
ABOVE MILL
BELOW HANSON CREEK
HANSON CREEK
ELEPHANT ROCK CAMPGROUND
JUNEBUG CAMPGROUND
BELOW RED RIVER
MALLETTE CREEK
BITTER CREEK
ABOVE RED RIVER
IRON
GRAMS PER SECOND
ST1 08/18/1986 (40 CFS)
STORM
ST2 09/13/1988 (138 CFS)
ST3 09/20/1988 (57 CFS)
ST4 09/26/1988 (47 CFS)
ST5 10/25/1988 (30 CFS)
SGV 11/29/1988 (17 CFS)
REV 10/22/1992 (25 CFS)
DRS 02/19/1993 (22 CFS)
COND. µMHO'S
CONDUCTIVITY
RANGER STATION FLOW - CFS

DRAWING 6


YAIL ENGINEERING, INC.
1588 SAN MATEO LANE
SANTA FE, NEW MEXICO
87501
QUESTA DIVISION
RED RIVER ALUMINUM SURVEYS
MASS FLOW DATA
FILE ALUM-1B
DRAWN RW
DATE 5-26-93
LAST REVISION 7-13-93
SCALE 1" = 2000'
SHEET 2 OF 2
A
SCAR
MINE DUMP
SPRING
SCALE: 1" = 2000'
NATIONAL FOREST
Red River
Black Mountain
1 BITTER CREEK
2 ABOVE RED RIVER
3 BELOW RED RIVER
4 MALLETTE CREEK
5 JUNEBUG CAMPGROUND
6 ELEPHANT ROCK CAMPGROUND
7 HANSON CREEK
8 BELOW HANSON CREEK
9 ABOVE MILL
10 BELOW SULFUR GULCH
11 MILEPOST
12 ABOVE PORTAL
13 COMPANY CABINS
14 ABOVE COLUMBINE CREEK
15 BELOW COLUMBINE CREEK
16 THUNDER BRIDGE
17 GOATHILL GULCH
18 BELOW GOATHILL GULCH
19 ABOVE CAPULIN CANYON
20 CAPULIN CANYON
21 BELOW CAPULIN CANYON
22 SMALL CANYON
23 ABOVE RANGER STATION
24 RANGER STATION
25 LAKE
26 EAGLE ROCK

ROUTING AND TRANSMITTAL SLIP 7-27-00

TO: (Name, office symbol, room number, building, Agency/Post)	Initials	Date
1. WATSON		
2. ENGINEER - Wilson		
3. PERMIT FILE NO. NM22306		
4.		
5.		

X Action	File	Note and Return
Approval	For Clearance	Per Conversation
As Requested	For Correction	Prepare Reply
Circulate	For Your Information	See Me
Comment	Investigate	Signature
Coordination	Justify	

REMARKS

COMMENT LETTER - PN DATED: 5-27-00

ENGINEER HAS FILE

PERMIT FILE ATTACHED

DO NOT use this form as a RECORD of approvals, concurrences, disposals, clearances, and similar actions

FROM: (Name, org. symbol, Agency/Post)	Room No.—Bldg.
Rosborough	Phone No.

5041-102

OPTIONAL FORM 41 (Rev. 7-76)
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FPMR (41 CFR) 101-11.206

* GPO : 1982 O - 381-529 (703)

Molycorp, Inc.
Molybdenum Group
P.O. Box 469
Questa, NM 87556-0469
Telephone (505) 586-7601
Facsimile (505) 586-0811

S. Wilson
PN 5-27-00
7/25/00

David R. Shoemaker
General Manager, Molybdenum Group

Molycorp

CERTIFIED MAIL – RETURN RECEIPT REQUESTED
U.S. Postal Service 7000 0600 0025 7984 8161

July 25, 2000

Ms. Evelyn Rosborough
Customer Service Branch (6WQ-CA)
U.S. Environmental Protection Agency
1445 Ross Avenue
Dallas, TX 75202-2733

Re: NPDES Permit No. NM0022306

Dear Ms. Rosborough:

Enclosed please find a summary of comments by Molycorp, Inc. on the draft of the referenced permit, which is currently under review.

Should you or Mr. Scott Wilson have any questions concerning this package, please call me at (505) 586-7601 or Geyza Lorinczi at (505) 586-7626.

Sincerely,

David R. Shoemaker
General Manager, Molybdenum Group

Enclosure

xc: J. Scott Wilson, EPA
J. H. Pugh
R. E. Schwartz

JUL 27 2000

SUMMARY OF MOLYCORP'S DRAFT PERMIT COMMENTS
JULY 24, 2000

NPDES Permit No. NM0022306

I. Seeps Collection

Molycorp supports the conditions in Part II.A. ("Best Management Practices") of the draft permit, which requires Molycorp to install a seepage interception and management system. Molycorp supports these conditions because this program should improve water quality in the Red River.

Molycorp intends to fully comply with these permit conditions and, if they are unchanged in the final permit, Molycorp does not intend to legally challenge them. Accordingly Molycorp recognizes that these conditions (if unchanged) will be binding on Molycorp even though Molycorp does not believe that they are mandated by the Clean Water Act.

Molycorp does, however, feel constrained to explain the basis for its view that these permit conditions are not compelled by the Clean Water Act. In short, Molycorp does not believe that there is a point source discharge from (or related to) its mine operation that enters the Red River through seepage. We do not believe, for example, that Spring 13, Spring 39, or the ground water that will be extracted from the well below the toe of the Sugar Shack south deposit represent point source discharges from mine operations. Nevertheless, as noted above, we are willing to collect this water under the conditions set forth in the draft permit.

The reasons for our view that these conditions are not mandated by the Clean Water Act are set forth below.

NO HYDROLOGIC CONNECTION HAS BEEN IDENTIFIED BETWEEN THE WASTE ROCK PILES AND THE RED RIVER

The scientific data do not establish a hydrologic connection from the waste rock piles to the Red River, in fact, the available data suggest the absence of such a connection.

I-A. Available Data Show That Evaporation And Drying Occur Within The Waste Rock Piles, Rather Than Migration of Drainage

A September 1999 Interim Report prepared by Robertson GeoConsultants, Inc. ("RGC") discusses the only data that exist to date analyzing the actual presence or absence of acid rock drainage migration from the waste rock piles. By drilling holes in the Spring, Sugar Shack South and West, and Capulin waste rock piles, RGC was able to sample and determine pH, conductivity and moisture content within and at the bottom of the waste rock piles. Detectable levels of moisture at the base of a waste rock pile, indicating migration, was found only at Capulin Canyon.[1] Toe seeps were observed only at the Capulin waste rock pile.

The remainder of the samples from the other waste rock piles illustrated a drying effect of convective air transfer through the piles and yielded the following observations: (1) a low overall moisture content; (2) a decrease in the moisture content in the holes at lower elevations; and (3) a decrease in the moisture content in the profiles of each hole, particularly near the base. RGC's data and findings strongly indicate that drying is occurring at the base of the waste rock piles, and together with surface

[1] Molycorp already captures the seepage from the Capulin Canyon waste rock piles.

water evaporation, is controlling and in fact preventing migration of water through the waste rock piles. (RGC 1999) There is no contradictory data illustrating migration of water through the waste rock piles that would be necessary (although not sufficient) to establish a hydrologic connection to the Red River. The Capulin Canyon waste rock pile is more than two miles from the river, and its seepage is collected.

I-B. There Are Numerous Alternative Sources (Other Than The Waste Rock Piles) That Could Cause Acidic Drainage

The Molycorp mine is located in a naturally, highly mineralized area. Both natural regional geochemistry and anthropogenic sources (including many non-mining sources) [2] affect particulate and dissolved metals loading to the Red River. Natural mineralization is highly variable and its impact on surface water quality varies from one location to another. The natural geology of the area includes hydrothermally-altered rock and conditions conducive to formation of alteration scars, a dominant visual feature of the region. The scars erode rapidly, contributing to pollutant loading in surface water and ground water. Because large volumes of scar material were moved to the waste rock piles to gain access to the ore body, the geochemical characteristics of the waste rock piles are similar to those of the scars and hydrothermally altered rocks that are prominent in the region.

At the mine site and the surrounding area, hydrothermal solutions evolved from magma carrying dissolved metals (e.g. silicon, potassium, calcium, sodium, iron, aluminum, molybdenum, tungsten, tin, copper, bismuth, silver, rubidium, thallium, manganese, magnesium, etc.) and non-metals (e.g. sulfur, fluoride, chlorine, oxygen, carbon dioxide, etc.). This mineralizing event occurred about 25 million years ago. Because of the chemistry of the mineralizing fluids and the resulting hydrothermal alteration, Questa mine area rocks, as well as the Red River area, generally carry cations (metals) and anions (non-metals) in highly elevated amounts in relation to unaltered rocks of similar composition elsewhere in the earth's crust.

This hydrothermally altered system has a high acid generating capacity. When water (i.e. rain, snowmelt, ground water seeps) comes into contact with minerals in the altered system, acid rock drainage ("ARD") containing high concentrations of dissolved metals is formed. The significant difference between the scars and the surrounding altered rocks is that the scars erode at a much higher rate. This high rate of erosion contributes to a higher potential for ARD and for particulate and dissolved constituent loading to surface water and indirectly to ground water. Particulate and dissolved constituent loading to surface and ground water also occurs from mudflows and debris aprons within the Red River basin. It is therefore very difficult to pinpoint the source of any ARD due to the numerous possible sources, and in no instance has a specific seep of ARD been traced to a waste rock pile. The piles are geochemically identical to the scars, and very similar to the mudflow debris, colluvium, and soil.

I-C. The Kent Report Data Does Not Show That the Waste Rock Piles Are Chemically Distinguishable From the Hydrothermal Scars

The Fact Sheet for Molycorp's draft NPDES permit cites to the 1995 Kent report's comparison of the waste rock piles to the hydrothermal scars:

---

[2] Anthropogenic sources of loading to the Red River include historic mining, highway and campground development, stream diversions, town development, ski hill development, the Red River water treatment plant, village development, and agricultural activities.

> "reported average concentrations of molybdenum, zinc, copper and manganese . . . were two to five times higher in the samples from the waste rock piles than those from the alteration scars. Kent's report also compared analyses of water from hydrothermal scars with leachate from Molycorp's waste rock piles. That comparison showed significantly higher concentrations of metals in the waste rock pile leachate than in water draining to the Red River from the alteration scars."

Permit Fact Sheet Text at 7. These conclusions are supported by invalid and unusable data. The sample data used by Kent to characterize the waste rock piles and the scar areas are not legally or technically defensible for the following reasons:

- The field notes do not document any sampling, preservation, decontamination, or chain of custody ("COC") procedures for these samples, with the exception of brief descriptions of composites and homogenizing. Therefore, it is not possible to confirm if the samples were properly collected and preserved, if equipment was decontaminated, or if COC was maintained.

- The field notes do not document sample depths. Therefore, it is not possible to determine if these samples are surface soils or subsurface soil. Soil samples are only comparable to one another when sample depths are similar.

- The ESI work plan (NMED, 1994) states that waste rock pile samples will be sieved through a # 9 mesh prior to x-ray fluorescence (XRF) screening and collection. There is no mention of sieving in the field notes, but no deviation from the workplan is documented.

- None of the field notes for these samples is signed (initialed) and only field notes for SS-1 and SS-2 are dated. Therefore, it is not possible to verify sample dates or who recorded the sampling event.

- No field duplicate was collected with the waste rock pile samples. Therefore, it is not possible to evaluate sampling precision.

- No field rinsate sample was collected with these samples. Therefore, it is not possible to evaluate if the samples were contaminated with metals during sample collection, which compromises data quality. This is especially significant for metals detected near the sample quantitation limit ("SQL"), such as cadmium and beryllium in sample SS-10.

- In the field notes, there are two different and separate entries for the collection of SS-10. It is not possible to tell which entry is correct or if two samples were collected. It is noteworthy that SS-10 was the only waste rock pile sample in which cadmium was detected.

- There is no documentation of the XRF calibration. Therefore, it is not possible to determine if the XRF was calibrated and working properly.

The quality of sample SS-10 is especially compromised because there are two conflicting field logbook entries for this sample. Therefore, it is not possible to verify which field logbook entry corresponds to the sample that was actually analyzed from location SS-10. Metal concentrations in the waste rock pile samples which are near the sample quantitation limit ("SQL"), such as cadmium and beryllium in SS-10, are highly suspect because field/equipment contamination cannot be ruled out. In addition, the scar area samples used as a reference were composited, which could have diluted out low levels of metals. Therefore, sample data from samples SS-1 through SS-12 are unreliable and invalid. Without

these samples, the Kent Report has no sample data for identifying hazardous substances in the waste rock piles.

As a result, the Kent Report's conclusion that the waste rock pile samples have higher concentrations is invalid because the comparison is not valid. The waste rock piles were sampled in a different manner from the scar areas. The waste rock pile samples are discrete samples collected from distinct locations, while the scar area samples are composites of samples collected from several locations. EPA Guidance for Establishing Background Levels states "In all evaluations, release and background samples must be similar for comparison. Factors which determine sample similarity include location, type, depth, medium, sampling method, preservation, handling timing, and weather conditions during sampling" EPA, Establishing Background Levels, EPA 540-F-94-030, at 3.

Comparing discrete sampling results to composite sampling results is the same as comparing an individual result to an average result, which is statistically invalid. Maximum or minimum values that may be present in the composite are effectively masked. In addition, depths were not documented for any of the waste rock pile samples or scar samples. Therefore, it is not possible to determine if the waste rock piles samples and the scar area samples were collected from comparable depths.

It is possible to examine the results from the waste rock pile samples and the scar area samples and note some general trends. First of all, several metals were present in the composites from the naturally occurring scar areas at higher concentrations than most of the discrete samples collected from the Rock Piles. These metals include aluminum, arsenic, barium, chromium, iron, selenium, and thallium. Second, most metal concentrations in discrete waste rock pile samples are not significantly higher than metal concentrations in the composites from the naturally occurring scar areas. The few exceptions include cadmium, manganese, and zinc from location SS-10; copper from location SS-9; and lead from location SS-4. However, variability between sampling locations was extremely high for both discrete samples collected from the waste rock piles and composites collected from the scar areas. This variability is a common characteristic of the natural geology in highly mineralized areas. Although variability is apparent in the scar area samples, the magnitude of this variability was masked by the compositing of samples.

Molycorp performed a statistical comparison of the discrete samples from the waste rock piles and the composite samples from the scar areas. The results indicate that concentrations of metals in the discrete samples from the waste rock piles are not statistically higher than metal concentrations in composites collected from the scar areas, with the sole exception of copper. This similarity is hardly surprising because the waste rock piles are partially comprised of rocks from the scar areas. This statistical analysis confirms that the Kent Report's conclusion is unfounded.

Even though the Kent Report attempts to compare metal concentrations in the waste rock piles to metal concentrations in the scar areas, no comparison is made to other background materials. As described above, the Molycorp mine is located in a complex geological setting. Without information about naturally-occurring metal concentrations in background materials other than the scar areas, it is not possible to determine whether the metals detected in the waste rock piles or scar areas are elevated above naturally-occurring metal concentrations in the Red River watershed. The Kent Report does not demonstrate that the waste rock piles have metal concentrations above background.

In addition, a 1998 EPA report by Region 6 Geologist David Abshire concluded that the leachate from the alteration scars and the waste rock piles "indicate similar geochemical signatures." Abshire at 5.2. Abshire also found that the data did not establish a connection between any particular seep and any particular source: "At the mine site, the percentage of metals concentrations or discharge volume supplied to a particular seep by each probable source (erosional scar or waste rock dump) could not be determined using the available information." Abshire at p. 4. The indistinguishable

nature of the scar and waste rock pile material further undermines Kent's conclusions on the sources of loadings to the Red River.

I-D. The Vail Report Demonstrates That Alluvial Flow Originating Upstream of the Mine Is a Significant Source of Seepage at the Mine Site

A recent study released by Vail Engineering, Inc. also provides additional evidence of alternative sources of concentrations and loads in the Red River. In particular, the study focused on the increase in sulfate and metal concentrations in the Red River along the mine reach, which in past studies has been attributed to acid rock drainage from the mine area. Vail discovered that these past studies had ignored the presence of acid rock drainage-contaminated groundwater from upstream sources that is discharged to the Red River along the mine reach.

Vail conducted a detailed flow and sulfate load balance study and reached the following conclusions:

- There is substantial ground water discharge from the alluvial aquifer to the river flow in the reach through the Town of Red River from station # 1 to station # 3 (Vail, 2000). The ground water in this alluvium is high in sulfate due to the alluvial flows from mineralized side drainages (with scars) some of which are also anthropogenically affected by the ski hill and historic mining, in the drainages of Placer, Bitter and Pioneer Creeks. There is a resulting increase in the sulfate loading and concentration (from 17 ppm to 46 ppm) in the Red River flow. This increase occurs during periods of very low surface flows from these drainages indicating that this increase is not entering the Red River as surface flows from these tributaries. Instead the source is mineral concentrations in ground water from the alluvial valley fills affected by these drainages. This is a graphic demonstration of inorganic transport via ground water in valley alluvium and its impact on the Red River where such ground water enters the river.

- Between the Town of Red River and Portal Springs, the water table in the alluvium is below or at river level and there is generally little interchange between the River and the alluvial aquifer. Only minor increases in Red River flow occur due to some localized small discharges. There is therefore a tendency for inorganics from side drainages to accumulate in the valley alluvium, increasing the load in the alluvium. At Portal Springs, the alluvial water table is also below river level during periods of water extraction by the mine from the mill and Columbine wells. Hence, during period of high extraction, the Portal Springs dry up. During periods of low or no pumping the water table rises and there is recharge from the alluvial aquifer to the river flow, with Portal Springs being one manifestation of this discharge. The source for this ground water is upstream of the springs and represents a mix of ground waters from ground water in the alluvial aquifer immediately below the Town of Red River and the acidic metal-bearing discharges from all the drainages located on the north side of Red River down to Portal Springs. The surface and ground water quality from these north side drainages are naturally highly acidic and the resulting discharges from the north bank of the Red River reflect this natural acidic drainage from upriver.

- Cabin Springs are located in a reach of the river that loses water to the alluvial aquifer during periods of pumping from the Molycorp supply wells. Thus, Cabin Springs were not active, and hence not observed in the approximately 30 years of high rates of water extraction by the mine, from 1965 to 1992. It was only with the temporary discontinuation of pumping in 1992 that there was a recovery of the water level in the alluvial aquifer to the elevation at which the alluvial water table was again above river level and discharge from the alluvial aquifer to the river resumed. Similar to Portal Springs, the source of water to Cabin Springs is the ground water flow in the alluvial aquifer from upstream of the springs. Again, the source of these impacted ground waters includes all the north slope drainages above the mine recharging to the alluvial ground water at and south of the Town of Red River.

- The primary ground water to surface water discharge zone is between stations # 11A (above Thunder bridge) and # 11C (below Thunder bridge and above Goat Hill culvert). In this reach the capacity of the alluvial aquifer to transmit water diminishes due to a reduction in cross-sectional area and/or transmissivity of the alluvial material. Old mudflow deposits washed in from Goat Hill Gulch could explain the lower transmissivity in this reach of the aquifer. This large decrease in the flow capacity in the alluvial aquifer results in a corresponding discharge to, and increase in the flow in, the Red River. In these ground water discharge areas the high inorganic concentrations in the ground water add to the concentrations in the Red River. Because these increases occur opposite the mine site, the inorganics have been erroneously attributed by some authors (Slifer, 1996; Allen et al., 1999) to mine-related sources. The Vail (2000) study demonstrates that the inorganic loads to the Red River adjacent to and below the Questa mine site include a very large component of inorganics derived from natural scars and mineralized areas, as well as anthropogenic sources, upstream of the mine site.

- The Vail measurements of net sulfate load in the Red River, adjusted for inorganic loads in the ground water derived from upstream of the mine, demonstrate that the sulfate load gain in the reach adjacent to the mine site is considerably less than the load that is estimated for pre-mining conditions (Vail, 2000). Sulfate serves as an indicator chemical and the same conclusions apply to other inorganics.

The failure in prior studies to account for the groundwater load from upstream sources has resulted in significant overestimation of the contaminant load attributed to the Molycorp mine. It provides evidence of the additional alternative sources of contamination and the lack of evidence of a hydrological connection between Molycorp's waste rock piles and the Red River.

I-E. The Robertson Background Study Shows That Many Non-Mine Related Ground Waters Have More Acidity and Mineral Concentrations Than Drainage That Is or May Be Mine Related

A recent background study of various sources of acid rock drainage provides further support for the absence of an established hydrological connection between the waste rock piles and the Red River. Acid rock drainage entering the Red River alongside or upstream of the Molycorp mine can also be attributed to (1) mineralized bedrock (including erosional scars) upstream of the Molycorp mine, (2) mineralized bedrock (including erosional scars) within the Molycorp mine area (either exposed or covered by mine rock material); or (3) mineralized rock exposed or disturbed by other anthropogenic activity in the Red River Valley, such as road, town site, campground and ski hill development. The concentrations of the various metals found at the site are naturally highly variable. For this reason, it is not surprising that the study identified numerous samples of natural ground water (unaffected by Molycorp mining activity) with more acidity and higher mineral concentrations than samples that are (Capulin waste rock pile seepage) or may be (samples from other locations proximate to waste rock piles) related to the waste rock piles.

The technical report (June 2000) by RGC, "Interim Background Characterization Study, Questa Mine, New Mexico," studied the above three sources and concluded, among other things, that:

High concentrations of contaminants occur naturally in ground and surface waters draining the mineralized area of the Red River basin;

A number of minerals are found in higher concentrations on the Questa mine site than elsewhere in the mineralized area. The background values applicable to the mine site (both the waste rock piles

and the hydrothermal scars) may therefore be higher for these minerals than values measured over the remainder of the mineralized area;

Considerable interchange occurs between surface and groundwater flows in the drainage systems over the mineralized area, and there is no distinction between these surface or ground water flows with respect to background water quality or contaminant concentrations;

Extremely high particulate contaminant loads to the Red River occur episodically during extreme precipitation events that cause mud and debris flows into the Red River;

Anthropogenic activity in the Red River basin and off the mine site, including road and powerline construction, town development, campground and ski hill development has resulted in substantial exposure of mineralized soils and rocks with high concentrations of contaminants;

No controls are applied to prevent contaminant discharges from the above listed anthropogenically affected sources (as opposed to the numerous controls in place at the Molycorp mine); and

Contaminant loads from anthropogenic sources are likely small compared with contaminant loads from natural sources.

I-F. Courts Have Held That Regulation Of Groundwater Flow To Surface Water Is Beyond The Scope Of The Clean Water Act

In the Fact Sheet Text to the draft permit, EPA cites to judicial authority for the proposition that "EPA has the authority to regulate discharges, such as seeps, which result from a direct hydrologic connection." Fact Sheet Text at 13. Of course, the cited cases are inapposite due to the absence of an established hydrological connection from the waste rock piles to the Red River. Additionally, other courts have ruled that EPA does not have the authority to require NPDES permits for discharges to ground water that flows into surface waters nor to regulate discharges to waters with no connection to the waters of the United States:

Village of Oconomowoc Lake v Dayton Hudson Corp., 24 F.3d 962 (7th Cir. 1994) ("[n]either the Clean Water Act nor the EPA's definition asserts authority over ground waters, just because these may be hydrologically connected with surface waters");

Hoffman Homes, Inc. v Administrator, EPA, 999 F.2d 256 (7th Cir. 1993) (isolated surface water);

Town of Norfolk v United States Army Corps of Engineers, 968 F.2d 1438 (1st Cir. 1992) (upholding Corps exclusion of groundwater resources from consideration despite connection with surface water);

Inland Steel Co. v EPA, 901 F.2d 1419 (7th Cir. 1990) (connection between surface waters and deep groundwater injection too tenuous to be regulated under Clean Water Act).

II. Revisions to the New Mexico Section 303(d) List Relating to Red River

The Fact Sheet Text for the draft permit discusses the Clean Water Act section 303(d) list for New Mexico and cites to the 1998-2000 list. However, the New Mexico Environment Department has released the draft Record of Decision for the 2000-2002 section 303(d) list, and it contains some changes from what is discussed in the draft permit. The Red River (from the mouth on the Rio Grande to Placer Creek) had been previously listed as a reach requiring TMDLs for aluminum,

cadmium, copper, and zinc. However, more recent sampling demonstrated zero exceedances for zinc, copper, and cadmium. Therefore, zinc, copper, and cadmium have been removed from the list of chemicals impairing this portion of the Red River, and only aluminum has been retained. A new TMDL listing has been added, again for aluminum only, for another reach of the Red River (from Placer Creek to the headwaters), which is upstream of the Questa mine site.

III. Tailing Seep Collection

During the Public Hearing held in Questa on July 13, 2000, a commenter said that the seep water collection system and associated extraction wells above Outfall 002 were not effective and that impacted groundwater was escaping the collection system. Molycorp does not believe this is the case, and our conclusion is based upon recent sampling data (see EXHIBIT I, "1st QUARTER 2000, GROUNDWATER SAMPLING RESULTS"). Sample locations 1, 3 and 9 represent the official points of compliance for the State groundwater discharge permit and are the monitoring locations that are most likely to detect pollutants that are not being captured. The data indicate that water quality is equivalent to unimpacted background water quality.

Over the past 15 years, Molycorp has commissioned numerous studies by recognized groundwater hydrology experts to characterize the groundwater below the tailings area, to design an effective barrier and collection system; and develop an appropriate monitoring system. Two of the more recent studies in this regard are "Study of Groundwater Flow and Tailings Seepage near Questa, New Mexico" Volume 1: Report by Robertson GeoConsultants Inc., October 1997, and "Questa Tailings Facility Revised Closure Plan", also by Robertson GeoConsultants Inc., April 1998. We believe that EPA has copies of these reports; however, copies can be forwarded to your office if required.

In particular, the Robertson GeoConsultants' report of April 1998 provides an excellent description of the historic design and operation of the seep collection system (pages 3-24). It is clear after reading this section that over the past 25 years the seep collection system has been repeatedly evaluated and improved to the point today where effective collection and control is in place. This conclusion is supported by the most recent quarterly groundwater monitoring reports that show continuous improvements up until the most recent report (1st Quarter 2000) where manganese, a key indicator parameter, is less than detection (<0.01 mg/l) in the three compliance wells.

Molycorp has requested approval from the State for the installation of one additional collection well that would provide additional assurance that all impacted water is collected. This application, which was submitted a year and one-half ago, has yet to be acted upon.

IV. 4Q3 Low Flow

Below, Molycorp presents three 4Q3 low flow proposals. All three proposals are technically sound and could be properly integrated into the new permit. Of the three proposals (Items IV-B, IV-C and IV-D), EPA should first consider the proposal under Item IV-B. Following EPA's detailed analysis of this proposal, if it determines that the proposal cannot be incorporated into the permit, then EPA should next consider the proposal under Item IV-C. Similarly, following EPA's detailed review of this proposal, should it conclude that this proposal cannot be incorporated into the permit, EPA should consider our third low flow proposal under Item IV-D.

For clarity, subsequent information presented in this document, particularly the effluent limitations presented in Items VII (Manganese) and XI (Molybdenum Effluent Limitations), is based on our proposed 4Q3 low flow for the fish hatchery gage (see Item IV-B).

IV-A. Modeling Results

Molycorp has recently completed low flow modeling studies of the Red River and one of its tributaries (see Exhibit II, attached). The studies were performed using USGS data for gages 08265000, Red River near Questa, 08266000, Cabresto Creek, and 08266820, Red River Below Fish Hatchery. We performed the studies with the Hydrotec flow model which is the same model used by the New Mexico Environment Department as referenced in its June 3, 1999 letter submitted to EPA (Ms. Jane Watson) by NMED (Glenn E. Saums). That letter responded to EPA's request for water quality and low flow information regarding Molycorp's draft permit.

Molycorp's modeling results for USGS gage 08265000, Red River near Questa yielded a 4Q3 low flow value of 7.8 cfs. Results for the USGS gage 08266000, Cabresto Creek near Questa indicated a 4Q3 value of 2.4 cfs. This yields a combined low flow for these gages of 10.2 cfs. The 4Q3 low flow for USGS gage 08266820, Red River Below Fish Hatchery, was 32.8 cfs. We believe that these values correctly estimate the 4Q3 low flows and that EPA should incorporate these values into the permit.

IV-B. 4Q3 Low Flow Based on the Fish Hatchery Gage

The 4Q3 low flow (7.05 cfs) contained in the draft permit Fact Sheet on Pages 4 and 7 does not represent the true low flow value for Outfalls 001 and 002. The USGS Gage at the Ranger Station (08265000), from which the 7.05 cfs low flow is based, is over 3 miles <u>upstream</u> of Outfall 002 and nearly 4 miles <u>upstream</u> of Outfall 001. The true low flow (32.8 cfs) for these outfalls should be based on the USGS Gage at the Fish Hatchery (08266820). This gage is closer to and is <u>downstream</u> of both outfalls. The gage's downstream placement represents the critical low flow of the <u>receiving</u> stream. This flow rate is consistent with our existing permit that is based on 4Q3 of 33.1 cfs including 001 and 002, or 25.84 cfs without including 001 and 002 maximum permissible flows. EPA has not provided any rationale as to why the 4Q3 in the existing permit is incorrect. The 4Q3 low flow in the existing permit could not possibly have been developed based on the Ranger Station gage because even the peak flows at the gage have never reached this level.

IV-C. 4Q3 Low Flow Based on the Combined Ranger Station and Cabresto Creek Gages

Alternatively, Molycorp believes EPA should, as a minimum, redefine the 4Q3 low flow basis in the draft permit as the sum of the 4Q3 low flow for the ranger station gage <u>and</u> the 4Q3 low flow for the Cabresto Creek gage. The reasons for this are three-fold: 1) the distance between the ranger station gage and the confluence of Cabresto Creek with the Red River is less than 1 mile, 2) Molycorp's two primary discharges, Outfalls 001 and 002, are downstream of the confluence, and 3) Outfalls 004 and 005 have never discharged stormwater in any quantity. Molycorp has determined (see attachment) that the combined low flow value for the gages for Ranger Station and Cabresto Creek is 10.2 cfs. This is the minimum value that should be incorporated into the draft permit. We refer to the 4Q3 low flow estimates presented above in Item IV-A.

IV-D. 4Q3 Low Flow Based On Zero Discharge From Outfalls 001 And 002 During December Through February

Molycorp has considered a zero-discharge approach for its outfalls that would comprise a zero-discharge scenario during the low flow months of December, January, and February. The prohibition would apply to Outfalls 001 and 002 only since Outfalls 004 and 005 have never discharged stormwater and are not expected to discharge in the future. In particular, winter conditions would preclude any possibility of discharges from 004 and 005 during these low flow months. With this concept in mind, Molycorp proposes alternative 4Q3 low flow values that would apply to the ranger station, Cabresto Creek, and fish hatchery gages. These low flow values were developed by running

the Hydrotec flow model using the existing USGS flow data for the gages, except we excluded all flow data within the period December 1 through February 28th (inclusive) for each year of record. The flow model results generated low flow values of 9.8 cfs for the ranger station gage, 3.0 cfs for the Cabresto Creek gage, and 35.6 cfs for the Red River gage below the Fish Hatchery. Molycorp requests that these 4Q3 low flow values be incorporated into the draft permit limitations and critical dilution calculations. Of course, in that case we would expect that the draft permit would also be conditioned to prohibit discharges from the outfalls during the months of December, January, and February except under emergency circumstances.

V. Instream Hardness

We note that the existing permit was based on an instream hardness level of 178 mg/l. The draft permit is based on an instream hardness value of 127 mg/l. There is no information in either permit or accompanying Fact Sheets that explains the basis of these hardness values or the reduction in hardness from our existing permit.

Molycorp understands that STORET water quality data was used by EPA in calculating instream hardness in both permits. Accordingly, we have reviewed the data and conclude that different hardness data sets may have been used to calculate the hardness values in each permit. We refer to a letter submitted to Ms. Jane Watson of EPA by the New Mexico Environment Department (Glenn E. Saums) dated June 3, 1999. The letter contained several attachments including USGS gage information, Storet Retrieval (NMED Upstream Ambient Water Quality), and Storet Retrieval (NMED Effluent Water Quality). Among other data, the Upstream Ambient Water Quality attachment contains water quality data for STORET stations identified as "URG120028045, Red River Above Molycorps Boundary" and "URG120028015, Red River at Hwy 3 Bridge". The station "Red River Above Molycorps Boundary" is located about 0.1 miles upstream of the mine site's east boundary and the station "Red River at Hwy 3 Bridge" is located about 1.5 miles south of the Town of Questa. The water quality data set for both stations also includes hardness data, the statistical analysis of which is presented below.

The arithmetic mean of the hardness data for each STORET station was computed and equals 133 mg/l for the "Red River above Molycorps Boundary" and 163 mg/l for the "Red River at Hwy 3 Bridge". The data used for calculating these hardness levels is presented in Exhibit III. The 163 mg/l value suggests that hardness data for the station "Red River at Hwy 3 Bridge" was used for the hardness calculation in the existing permit. It more or less correlates with the hardness value contained in the existing permit (178 mg/l). On the other hand, it would appear that the hardness value contained in the draft permit (127 mg/l) is based on the station "Red River above Molycorps Boundary" as the 127 mg/l value roughly compares to the 133 mg/l value.

With the above information in mind, Molycorp believes that it appropriate to include the 163 mg/l value in the draft permit because it is more representative and proximate (about 1 mile) to hardness conditions near the mixing zone of Outfalls 001 and 002 and the Red River. The 127 mg/l value is inappropriate for inclusion in the draft permit because this hardness level is indicative of Red River hardness conditions well upstream of the outfalls (over 7 miles) and associated mixing zone. Therefore, Molycorp requests that the 127 mg/l hardness level contained in the draft permit be replaced by the 163 mg/l level and that all corresponding hardness-based water quality standards and effluent limitations for Outfalls 001, 002, 004, and 005 be modified.

VI. Gross Alpha Effluent Limits

Molycorp notes that the draft permit Fact Sheet (Page 10) contains both mass and concentration based limits for gross alpha for combined Outfalls 001 and 002. We also note that the draft permit (Page 2 of Part I) presents a "report only" requirement for Period 1 of the draft permit and numeric concentration-based limits for Period 2 (Years 3 through 5 of the permit) for Outfall 001. First, it is our understanding that the effluent limits for Period 1 are based on the effluent limits from the existing permit. This being the case, the existing permit contained no monitoring or effluent limit provisions for gross alpha. Therefore, Molycorp believes it is not appropriate to institute a "report only" requirement as a mass-based limit for Period 1 in the draft permit. Secondly, the concentration-based limits for Period 2 appear to be incorrectly based on the mass (pounds/day) limits contained on Page 10 of the Fact Sheet. Given the Livestock/Wildlife and Domestic Criteria standard of 15 pCi/l for gross alpha (Page 9 of the Fact Sheet), the calculated monthly average and daily maximum concentration limits for gross alpha for Period 2 at Outfall 001 should be approximately 45 and 68 pCi/l, respectively. The draft permit should also clarify whether these limits are to be reported on a dissolved, suspended, or total basis. Language describing required sample results accuracy is also requested. Finally, Molycorp believes that the mass limits shown on Page 10 of the Fact Sheet should be omitted. The rationale for this is that since the measurement of gross alpha levels in water is based on a radiological decay rate, it is inappropriate to convert such a rate into a mass limit. Molycorp would appreciate EPA's clarification of this issue.

VII. Manganese

VII-A. Compliance Schedule

Molycorp notes that while the draft permit has been conditioned to include a 2-year compliance schedule (Period 1) for Outfalls 001 and 002, it includes no such compliance period provision for manganese. This provision includes the retention of the mass- and concentration-based limits from the existing permit. As such, while Molycorp agrees with the concentration-based manganese limits for Outfall 001, the draft permit should also retain the "Report Only" mass-based limits as was the case in the existing permit for Outfall 001. Period 1 "Report Only" requirements for both the mass-based and concentration-based limits for Outfall 002 should be also incorporated into the permit. No Period 2 limitations for manganese are required for Outfall 001. Period 2 limits for manganese for Outfall 002 are described below.

VII-B. Manganese Limitations

Molycorp has carefully considered the regulatory and legislative basis for how mass- and concentration-based effluent limits for manganese should be included in the draft permit. EPA's stated rationale for including these limits are based on regulations promulgated at 40CFR122.44(a). These regulations require 1) technology-based effluent limitations to be placed in NPDES permits based on effluent limitation guidelines where possible, 2) Best Professional Judgment (BPJ) in the absence of guidelines, or 3) a combination of the two. In the case of Molycorp's permit, BPJ has been EPA's basis for regulating Molycorp's discharges with respect to manganese.

Manganese concentrations at Outfall 002 have been well documented and have previously been added to the administrative record (Molycorp's application for renewal of its NPDES permit, dated April 13, 1998). EXHIBIT IV presents a portion of Exhibit I-9 (Table 2) taken from the April 13, 1998 application that contains manganese concentrations provided in historic Discharge Monitoring Reports.

Molycorp proposes effluent limits for manganese, as set forth below, based on Best Engineering Judgment.

Our analysis of the effluent limits in the draft permit for manganese indicates that Molycorp would be unable to consistently meet the mass and concentration limits at Outfall 002. As can be seen in Exhibit IV, monthly average manganese concentration for Outfall 002 is as high as 1.97 mg/l. The highest daily maximum concentration is 2.03 mg/l. Given the proposed concentration limits of 1.0 and 1.5 mg/l (monthly average and daily maximum, respectively), Molycorp could be forced into an immediate non-compliance situation for manganese at Outfall 002. This would also be true for the mass limits for 002. Water treatment technologies currently in place for Molycorp's discharges are specific only for molybdenum removal, therefore, new treatment technology, at substantial cost, would be required for manganese removal.

Clearly, there is not a technology standard for manganese that would apply to 002 discharges. Nor is there an appropriate water quality-based stream standard from which to calculate a manganese discharge limitation at 002. Assuming that EPA feels strongly that a manganese limit is required, Molycorp believes that an alternative approach described below represents BPJ effluent limits for manganese, which should be increased from the limits currently in the draft permit.

The concentration limits at Outfall 002 should be based on the 2.03 mg/l value presented above. Specifically, Molycorp believes a 100 percent factor should be added to the daily maximum value of 2.03 mg/l arriving at a new daily maximum value of 4 mg/l. In dividing this value by 1.5 (as was done for many of the other parameters in the draft permit), this generates a monthly average limit of 2.67 mg/l. Similarly, given the highest daily maximum mass load for manganese is 5.47 pounds/day and adding in a 100 percent factor, the daily maximum mass limit becomes 11 pounds/day. The monthly average limit would be calculated as 7.3 pounds/day.

These concentration and mass limits would apply at Outfall 002 whether or not Outfall 001 is discharging. This approach is reasonable. If the manganese limits were calculated based on a toxicity-based approach (table value standards), the concentration and mass limits above would be protective of toxicity-based water quality standards developed for manganese by a considerable margin. An example would be if the standards were developed based on the instream hardness value of 163 mg/l (see Item V), equivalent acute and chronic water quality standards for manganese could exceed 3.5 and 2.5 mg/l, respectively. The resulting effluent concentration limits for Outfall 002 could actually be in the range of 16 mg/l (daily maximum) and 11.7 mg/l (monthly average). This assertion is based on Criterion Maximum Concentrations and Criterion Continuous Concentrations that have been accepted by state water quality control commissions elsewhere, notably in the State of Colorado. Molycorp would be pleased to provide these details upon EPA's request.

VII-C. Anti-backsliding

Molycorp's proposed manganese concentrations for Outfall 002 would not in any way implicate the anti-backsliding provision (Section 402(o)) of the Clean Water Act. Not only are there no published effluent limitations guidelines for manganese, but in the existing permit there is no limit for manganese discharges at Outfall 002. While BPJ governed EPA's regulation for Molycorp's discharges of manganese (indeed, Outfall 001 was subject to numeric concentration-based limits), Outfall 002 has had a "report only" requirement. As the purpose of the anti-backsliding rules is to prevent the decline of established standards, this set of circumstances for Outfall 002, in which there are no existing standards at all, does not trigger requirements for section 402(o).

EPA was quite clear in its guidance that the anti-backsliding rules of section 402(o) govern only two situations:

> The first situation occurs when a permittee seeks to revise a technology-based effluent limitation based on best professional judgment (BPJ) to reflect a subsequently promulgated effluent guideline which is less stringent. The second situation addressed by § 402(o) arises when a permittee seeks relaxation of an effluent limitation which is based upon a State treatment standard or water quality standard.

Office of Water Enforcement and Permits, Interim Guidance on Implementation of Section 402(o) Anti-Backsliding Rules for Water Quality-Based Permits, at 1. Neither of those two situations is present here with regard to manganese, and therefore section 402(o) is not an obstacle to the incorporation of Molycorp's proposed alternative to manganese concentrations at Outfall 002.

With this in mind, Molycorp believes that it is well within EPA's authority to consider and incorporate the alternative limitations for manganese proposed by these comments.

VIII. Mercury Water Quality Standards and Effluent Limit Calculations

a Molycorp would like to point out a typographical error on Page 7 of Part I of the draft permit. The second line of mercury mass and concentration limits should be noted as "Total Mercury(*2)" rather than "Total Mercury(*1)".

b During discussions conducted on June 21, 2000 with EPA, it was Molycorp's understanding based on information provided by EPA that the aquatic life chronic criteria for mercury (Page 9 of the Fact Sheet) was used to calculate the daily maximum effluent limit for both Outfalls 001 and 002. Molycorp is not aware of any published guidance that justifies the use of the aquatic life chronic criteria in this regard and, therefore, believes that the aquatic life acute criteria should be used for calculating the daily maximum effluent concentrations for mercury for both outfalls. The monthly average limits should then be calculated by dividing the daily maximum limit by 1.5 as is the case for most of the other parameters. With this in mind, Molycorp requests that the effluent limits for Outfalls 001 and 002 be recalculated.

Barring resolution of this issue, Molycorp believes that many of the concentration-based limits for mercury as contained in the draft permit would be less than laboratory detection. This would pose a conflict with the possible use of the Minimum Quantification Level (0.2 ug/l or 0.0002 mg/l) should Molycorp elect to calculate a Method Detection Limit (Page 3 of Part II of the draft permit) for mercury under Appendix B of 40 CFR 136 as the permit would allow. In this case, Molycorp would request replacement of the concentration-based limits with a "Report Only" requirement for limits that are less than the 0.2 ug/l (0.0002 mg/l) PQL.

IX. Whole Effluent Testing - Low Flow Critical Dilution Concentration

While Molycorp concurs with the calculation methodology for determining the low flow critical dilution value noted on Page 20 of the Fact Sheet and Page 7 of Part II of the draft permit, the value would change pending revision to the 4Q3 low flow. We refer to Item IV above, and request that the low flow critical dilution concentration incorporate a more appropriate 4Q3 low flow.

X. Outfall 002 Effluent Limits During Outfall 001 Discharges

Molycorp notes in the draft permit that a second tier of more stringent effluent limits for Outfall 002 (Page 10 of Part I of the draft permit) would be triggered when Outfall 001 discharges occur. EPA's

rationale for dual limits at Outfall 002 is to minimize constituent loading on the Red River in the event both outfalls should discharge simultaneously. However, Molycorp believes that the second tier of Outfall 002 effluent limits should revert back to the first tier of effluent limits (Page 6 of Part I of the draft permit) that apply when discharges at Outfall 001 cease. Molycorp believes this is EPA's intent and believes that language should be added to the draft permit to clarify this important issue.

XI. Molybdenum Effluent Limitations

Molycorp notes that EPA had responded to its request for changing the molybdenum limits for Outfall 002 in the previous version of the draft permit to represent concentrations achievable by the application of Best Achievable Technology (BAT). These new limits, 3.3 mg/l (monthly average) and 5.03 mg/l (daily maximum), should apply at Outfall 002 independent of whether discharges occur at Outfall 001. Molycorp notes, however, that the current draft permit contains additional proposed limits (1.34 mg/l as a monthly average) and (2.01 mg/l as a daily maximum) for Outfall 002 under Period 2 of the permit when Outfall 001 discharges occur. Molycorp believes that this approach is not justified by water quality considerations. BAT limits should apply so long as the stream standard of 1.0 mg/l remains protected.

As demonstrated in Table 1 below, Molycorp notes that the Red River's (Segment 2-119) carrying capacity for molybdenum, given the 1.0 mg/l agricultural standard for molybdenum, would remain adequate under the 4Q3 low flow conditions proposed in Item IV above for the fish hatchery gage to accept molybdenum loading even when both outfalls discharge simultaneously. Table 1 below shows, based on the proposed effluent limits for molybdenum, that the combined monthly average mass from Outfalls 001 and 002 would be about 45.5 pounds per day and that the combined daily maximum mass equals 86.4 pounds/day. Given the carrying capacity of the Red River (176.8 pounds/day) which is based on our proposed 4Q3 low flow for the Red River for the fish hatchery gage (32.8 cfs), the mass loads based on simultaneous discharges from the outfalls are within the 176.8 pounds/day carrying capacity. This means that the BAT limits for molybdenum would be adequate through the full term of the permit.

Table 1

MOLYBDENUM LOADING IN THE RED RIVER BASED ON THE PROPOSED EFFLUENT LIMITATIONS
(all mass loadings in pounds/day and concentrations in mg/l)

Location	Flow			Monthly Average		Daily Maximum	
	Cfs	Gal./min.	# /day	mg/l	# /day	mg/l	# /day
Fish Hatchery Gage Flow Less Outfall Flows	25.8	11,490	137,990,880	-	-	-	-
Outfall 001	6.6495	2984.5	35,842,592	1*	35.8	2*	71.6
Outfall 002	0.5425	243.5	2,924,221	3.3**	9.7	5.03**	14.7
Outfall 001/002	7.192	3228	38,766,813	-	45.5	-	86.4
Total Flow at Fish Hatchery Gage	32.792	14,718	176,757,693	1***	176.8	1***	176.8

*Proposed effluent limits
** Proposed BAT Limits
***Red River Agricultural Standard for Molybdenum

Molycorp requests that EPA include the above BAT limits (3.3 mg/l as the monthly average and 5.03 mg/l as the daily maximum) for Outfall 002 under both periods of the draft permit as was the case in the previous permit.

XII. Outfall Coordinates

Molycorp would like to point out that the latitude/longitude coordinates for Outfalls 001, 002, 004, and 005 as presented in the draft permit are slightly in error. Presented below are coordinates recently obtained via GPS by our staff for each outfall:

Outfall 001:	36 degrees 41 minutes 40.15 seconds north 105 degrees 38 minutes 3.37 seconds west Elevation: 7331.2 ft.
Outfall 002:	36 degrees 41 minutes 31.36 seconds north 105 degrees 37 minutes 16.58 seconds west Elevation: 7226.3 ft.
Outfall 004:	36 degrees 41 minutes 13.76 seconds north 105 degrees 32 minutes 6.54 seconds west Elevation: 7838.8 ft.
Outfall 005:	36 degrees 41 minutes 42 seconds north 105 degrees 29 minutes 22 seconds west 8124.5 ft.

REFERENCES

Abshire, D., *Report on Hydrological Connection Associated with Molycorp Mining Activity, Questa, New Mexico*, USEPA, Region 6, February 13, 1998.

Allen, B.D., A.R. Groffman, M.C. Moles Jr., R.Y. Anderson, and L.J. Crossey, *Geochemistry of the Red River Stream System Before and After Open Pit Mining, Questa Area, Taos County, New Mexico*, October, 1999.

Kent, S., *Expanded Site Inspection Workplan (Draft), Molycorp Site, Questa, New Mexico*, New Mexico Environment Department, February 28, 1994.

Kent, S., *Expanded Site Inspection Report on Molycorp, Inc., Questa Division, Taos County, New Mexico*, New Mexico Environment Department, 1995.

Robertson GeoConsultants, Inc., *Study of Ground Water Flow and Tailings Seepage near Questa, New Mexico*, October, 1997.

Robertson GeoConsultants Inc., *Questa Tailings Facility Revised Closure Plan*, April, 1998.

Robertson GeoConsultants Inc., *Interim Report: Questa Waste Rock Pile Drilling, Instrumentation and Characterization Study*, September 13, 1999.

Robertson GeoConsultants Inc., *Interim Background Characterization Study, Questa, New Mexico*, June, 2000.

Slifer, D., *Red River Groundwater Investigation*, New Mexico Environment Department for USEPA, March, 1996.

Vail Engineering, Inc., *Analysis of Acid Rock Drainage in the Middle Reach of the Red River, Taos County, New Mexico, Interim Report*, July 4, 2000.

(The references listed are part of the administrative record for NPDES Permit No. NM0022306)

EXHIBIT 1

1ST QUARTER 2000, GROUNDWATER SAMPLING RESULTS

MOLYCORP, INC.
DISCHARGE PLAN 933
1ST QTR, 2000

	NEW MEXICO GROUNDWATER STANDARDS														
SAMPLE NO.	SITE DESC.	DATE OF SAMPLE	DEPTH TO WATER	Ph	CONDUCT	C TEMP	CARBONATE	BI-CARBONATE	HYDROXIDE	TOTAL ALK	CHLORIDE	FLUORID	NITRATE	TDS	SULFATE
1	EW-1	3/6/00	84.41	7.62	833	11.2	<5	150	<5	150	2	0.57	<.01	600	10
2	EW-2	3/9/00	58.1	7.70	380	11.5	<5	27	<5	27	12	0.57	<.01	770	470
3	EW-3	***													
4	EW-4	3/9/00	22.58	7.25	1268	12.2	<25	160	25	170	17	<0.5	<.01	940	490
5	MW-1	3/6/00	53.13	7.23	1655	11.7	<5	160	<5	160	14	<0.5	<.01	1400	790
6	MW-2	3/9/00	38.53	8.56	1066	11.8	<25	110	<25	110	4.9	<0.5	<.01	270	66
7	MW-3	3/9/00	19.18	7.23	1774	12.7	<25	190	<25	190	17	<0.5	<.01	1500	850
8	MW-4	3/9/00	42.53	7.9	770	12.8	<25	190	<25	190	4.6	0.86	<.01	580	230
9	MW-6		PLUGGED												
10	MW-7A	3/7/00	59.35	7.14	1770	11.9	<5	120	<5	120	14	<0.5	<.01	1600	910
11	MW-7B	CASING COLLASPED													
12	MW-7C		DRY												
13	MW-9A	3/9/00	28.78	7.47	1300	13.2	<25	160	<25	160	23	<0.5	<.01	950	500
14	MW-9B		DRY												
16	MW-10	3/9/00	30.79	7.7	232	13.6	<25	77	<25	77	1.9	<0.5	<.01	160	37
17	MW-11	3/6/00	193.46	7.93	445	16.4	<5	84	<5	84	11	1.3	<.01	330	120
18	MW-12	3/9/00	129.3	8.02	311	14.4	<25	120	<25	120	4.1	<0.5	<.01	210	39
19	MW-13	3/6/00	202.18	8.66	652	16.3	<5	61	<5	61	11	0.86	<.01	490	240
20	MW-14	3/9/00	47.65	7.34	943	13.8	<25	130	<25	130	21	<0.5	<.01	680	340
21	MW-A	3/7/00	32.79	7.13	1677	11.8	<5	180	<5	180	13	<0.5	<.01	1400	800
22	MW-B		DRY												
23	MW-C	3/7/00	2.61	7.33	227	10.6	<5	170	<5	170	15	2.4	<.01	2000	1200
24	EW-5A	3/7/00	29.43	7.3	194	10.8	<5	190	<5	190	13	1.5	<.01	1600	890
25	EW-5B	3/6/00	21.88	7.32	178	10.8	<5	200	<5	200	12	1.4	<.01	1500	810
26	EW-5C	3/6/00	36.5	7.17	191	12.4	<5	140	<5	140	13	<0.5	<.01	1600	950
27	EW-5D	3/6/00	4.38	6.84	229	11.5	<5	130	<5	130	14	<0.5	<.01	2100	1400
EW-3															
PUMP WAS REPLACED ON 3/22/00 SAMPLE WAS TAKEN ON 3/23/00 RESULTS PENDING															

MOLYCORP, INC.
DISCHARGE PLAN 933
1ST QTR, 2000

	STATE														
SAMPLE NO.	SITE DESC.	ALUMINIUM	ARSENIC	BARIUM	BERYLLIUM	CADMIUM	CHROMIUM	COBALT	COPPER	IRON	LEAD	MERCURY	CALCIUM		
1	EW-1	<.1	<.005	0.024	<.004	<.001	<.01	<.01	<.01	<.1	<.003	<.0002	120		
2	EW-2	<.1	<.005	0.075	<.004	<.001	<.01	<.01	<.01	<.1	<.003	<.0002	46		
3	EW-3														
4	EW-4	<.1	<.005	0.048	<.004	<.001	<.01	<.01	<.01	<.1	<.003	<.0002	180		
5	MW-1	<.1	<.005	0.030	<.004	<.001	<.01	<.01	<.01	<.1	<.003	<.0002	270		
6	MW-2	<.1	<.005	0.012	<.004	<.001	<.01	<.01	<.01	<.1	<.003	<.0002	85		
7	MW-3	<.1	<.005	0.028	<.004	<.001	<.01	<.01	<.01	<.14	<.003	<.0002	280		
8	MW-4	<.1	<.005	0.040	<.004	<.001	<.01	<.01	<.01	<.1	<.003	<.0002	89		
9	MW-6														
10	MW-7A	<.1	<.005	0.022	<.004	<.001	<.01	<.01	<.01	<.1	<.003	<.0002	310		
11	MW-9A	<.1	<.005	0.056	<.004	<.001	<.01	<.01	<.01	<.1	<.003	<.0002	180		
12	MW-10	<.1	<.005	0.036	<.004	<.001	<.01	<.01	<.01	<.1	<.003	<.0002	23		
13	MW-11	<.1	<.005	0.016	<.004	<.001	<.01	<.01	<.01	<.1	<.003	<.0002	38		
14	MW-12	<.1	<.005	0.072	<.004	<.001	<.01	<.01	<.01	<.1	<.003	<.0002	36		
15	MW-13	<.1	<.005	0.028	<.004	<.001	<.01	<.01	<.01	<.1	<.003	<.0002	61		
16	MW-14	<.1	<.005	0.068	<.004	<.001	<.01	<.01	<.01	<.1	<.003	<.0002	120		
17	MW-A	<.1	<.005	0.029	<.004	<.001	<.01	<.01	<.01	<.61	<.003	<.0002	300		
18	MW-C	<.1	<.005	0.019	<.004	<.001	<.01	<.01	<.01	<.1	<.003	<.0002	420		
19	EW-5A	<.1	<.005	0.025	<.004	<.001	<.01	<.01	<.01	<.1	<.003	<.0002	320		
20	EW-5B	<.1	<.005	0.023	<.004	<.001	<.01	<.01	<.01	<.1	<.003	<.0002	290		
21	EW-5C	<.1	<.005	0.017	<.004	<.001	<.01	<.01	<.01	<.1	<.003	<.0002	350		
22	EW-5D	0.11	<.005	0.016	<.004	<.001	<.01	<.01	<.01	<.1	<.003	<.0002	430		

MOLYCORP, INC.
DISCHARGE PLAN 933
1ST QTR, 2000

	STATE								
SAMPLE NO.	SITE DESC.	MAGNESIUM	MANGANESE	NICKEL	POTASSIUM	SELENIUM	SILVER	VANADIUM	ZINC
1	EW-1	24	<.01	<.02	4.1	<.005	<.002	<.01	<.02
2	EW-2	7.4	<.01	<.02	3.4	<.005	<.002	<.01	0.025
3	EW-3								
4	EW-4	29	<.01	<.02	2.9	<.005	<.002	<.01	<.02
5	MW-1	51	<.01	<.02	3.9	<.005	<.002	<.01	<.02
6	MW-2	22	0.41	<.02	3.5	<.005	<.002	<.01	<.02
7	MW-3	48	0.02	<.02	2.2	<.005	<.002	<.01	<.02
8	MW-4	17	<.01	<.02	1.3	<.005	<.002	<.01	<.02
9	MW-6								
10	MW-7A	52	<.01	<.02	3.6	<.005	<.002	<.01	<.02
11	MW-9A	30	<.01	<.02	2	<.005	<.002	<.01	<.02
12	MW-10	3.7	<.01	<.02	0.96	<.005	<.002	<.01	<.02
13	MW-11	11	<.01	<.02	3.4	<.005	<.002	<.01	<.02
14	MW-12	6.2	<.01	<.02	2.3	<.005	<.002	<.01	<.02
15	MW-13	11	<.01	<.02	9.2	<.005	<.002	<.01	<.02
16	MW-14	21	<.01	<.02	1.9	<.005	<.002	<.01	<.02
17	MW-A	47	0.22	<.02	4.4	<.005	<.002	<.01	<.02
18	MW-C	62	3.4	<.02	8.4	<.005	<.002	<.01	<.02
19	EW-5A	47	1.3	<.02	4.7	<.005	<.002	<.01	<.02
20	EW-5B	44	2.2	<.02	5.8	<.005	<.002	<.01	<.02
21	EW-5C	56	<.01	<.02	4.3	<.005	<.002	<.01	<.02
22	EW-5D	74	<.01	<.02	4.1	<.005	<.002	<.01	<.02

EXHIBIT II

LOW FLOW MODELING RESULTS

John C. Halepaska and Associates, Inc.
Water Resources Consultants
26 West Dry Creek Circle, Suite 640
Littleton, Colorado 80120
(303) 794-1335
FAX (303) 794-3245

July 21, 2000

Montgomery Watson
165 South Union Boulevard, Suite 410
Lakewood, Colorado 80228

Attn: Mr. Ken Kloska
Manager, Environmental Services

Subject: Calculation of Low Flow Estimates for Various U.S. Geological Survey Gaging Stations on the Red River and a Tributary Near Questa, New Mexico.

Project No. 5661

Dear Ken:

As requested, we have prepared statistical estimates of the four-day low flow with a three-year recurrence interval (4Q3) for three U.S. Geological Survey (USGS) gaging stations, two located on the Red River and one located on a tributary to the Red River, Cabresto Creek.

The USGS gaging stations that were used in this analysis are the Red River gage near Questa, New Mexico (Station No. 08265000), the Red River gage below the fish hatchery near Questa (Station No. 08266820), and the Cabresto Creek gage near Questa (Station No. 08266000). The period of record used from each gage in the statistical analysis and drainage area at each gage location are presented in Table 1.

A Pearson three-parameter log-normal distribution was used to fit the four-day minimum stream flows to assess the probability of flow on a three-year recurrence interval. The 4Q3 values for each of the stations is shown in Table 2, and the graphical and tabular representations of these data are presented in Appendix A.

If you have any questions regarding these statistical data, please feel free to give us a call.

Yours truly,

Bruce A. Lytle, P.E.
Vice President

BAL/pk
enclosures

TABLE 1
USGS GAGING STATION DATA

Station Name	Station No.	Period of Record	Drainage Area (mi^2)
Red River Near Questa	08265000	1/1/1930-9/30/1997	114.
Red River Below Fish Hatchery Near Questa	08266820	8/9/1978-9/30/1997	185.
Cabresto Creek Near Questa	08266000	10/1/1943-9/30/1996	36.7

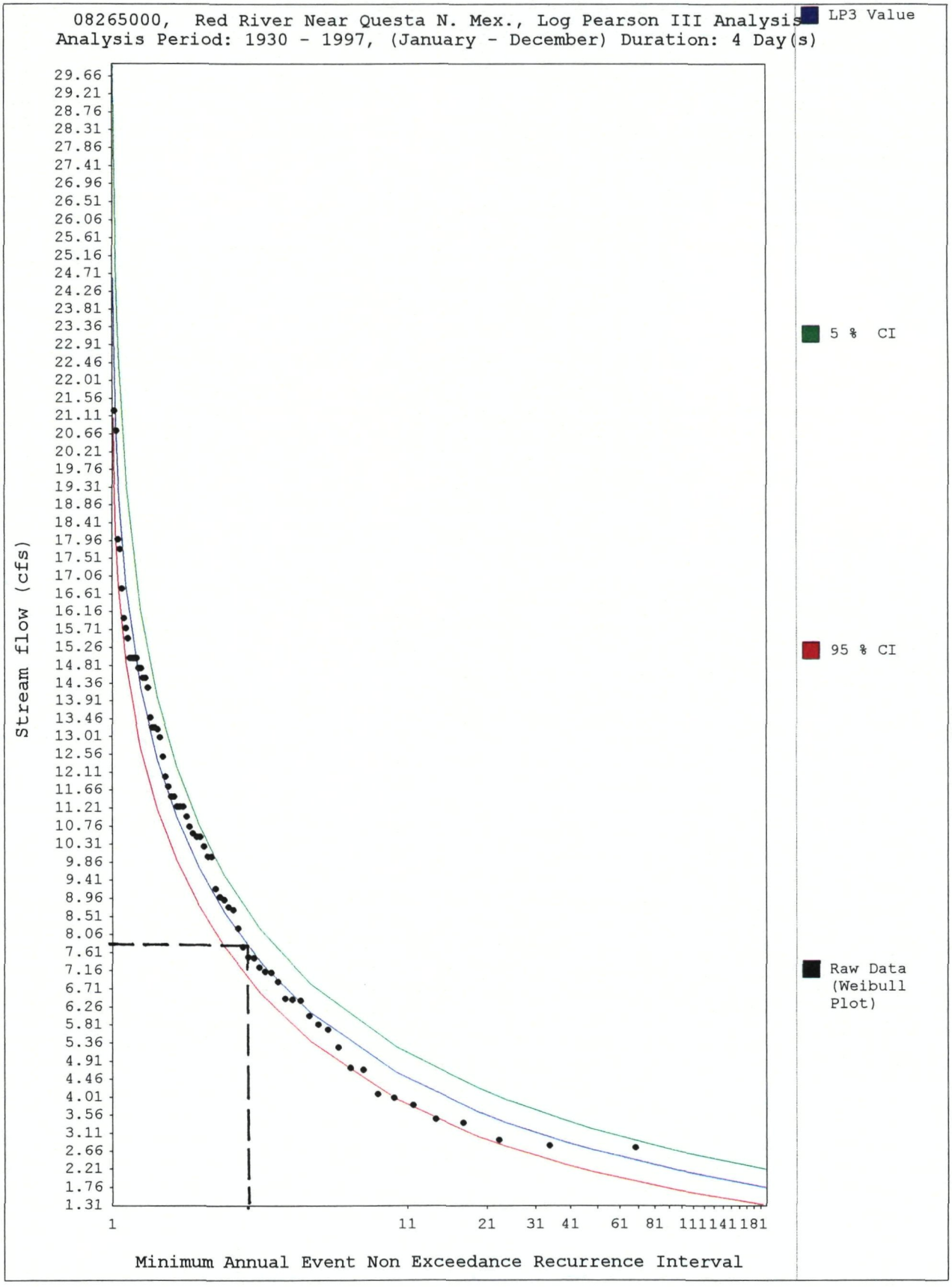
TABLE 2
4Q3 FLOWS FOR SELECT STATIONS

Station Name	4Q3 (cfs) 1)
Red River Near Questa	7.8
Red River Below Fish Hatchery Near Questa	32.8
Cabresto Creek Near Questa	2.4

1) Based on daily data for the period of record shown in Table 1.

APPENDIX A
PEARSON THREE-PARAMETER
LOG-NORMAL DISTRIBUTION DATA

08265000, Red River Near Questa N. Mex., Log Pearson III Analysis
Analysis Period: 1930 - 1997, (January - December) Duration: 4 Day(s)



Log Pearson Type III Duration-Frequency Analysis

1. 08265000, Red River Near Questa N. Mex.
2. Latitude and Longitude (degrees, minutes, and seconds)... .. 36421, .. 105340
3. # basin name..... Upper Rio Grande
4. Record Length: 01/01/1930-09/30/1997
5. # contributing drainage area (square miles).....
6. File Type: Stream flow (cfs)

Parameter Type.....Minimum Annual Event
Probability Type.....Non Exceedance
Analysis Start Year.....1930
Analysis End Year.....1997
Analysis Start Month.....January
Analysis End Month.....December
Number of Analysis Years.....68
Duration (moving average).....4 day(s)

Gauge Station Series Statistics

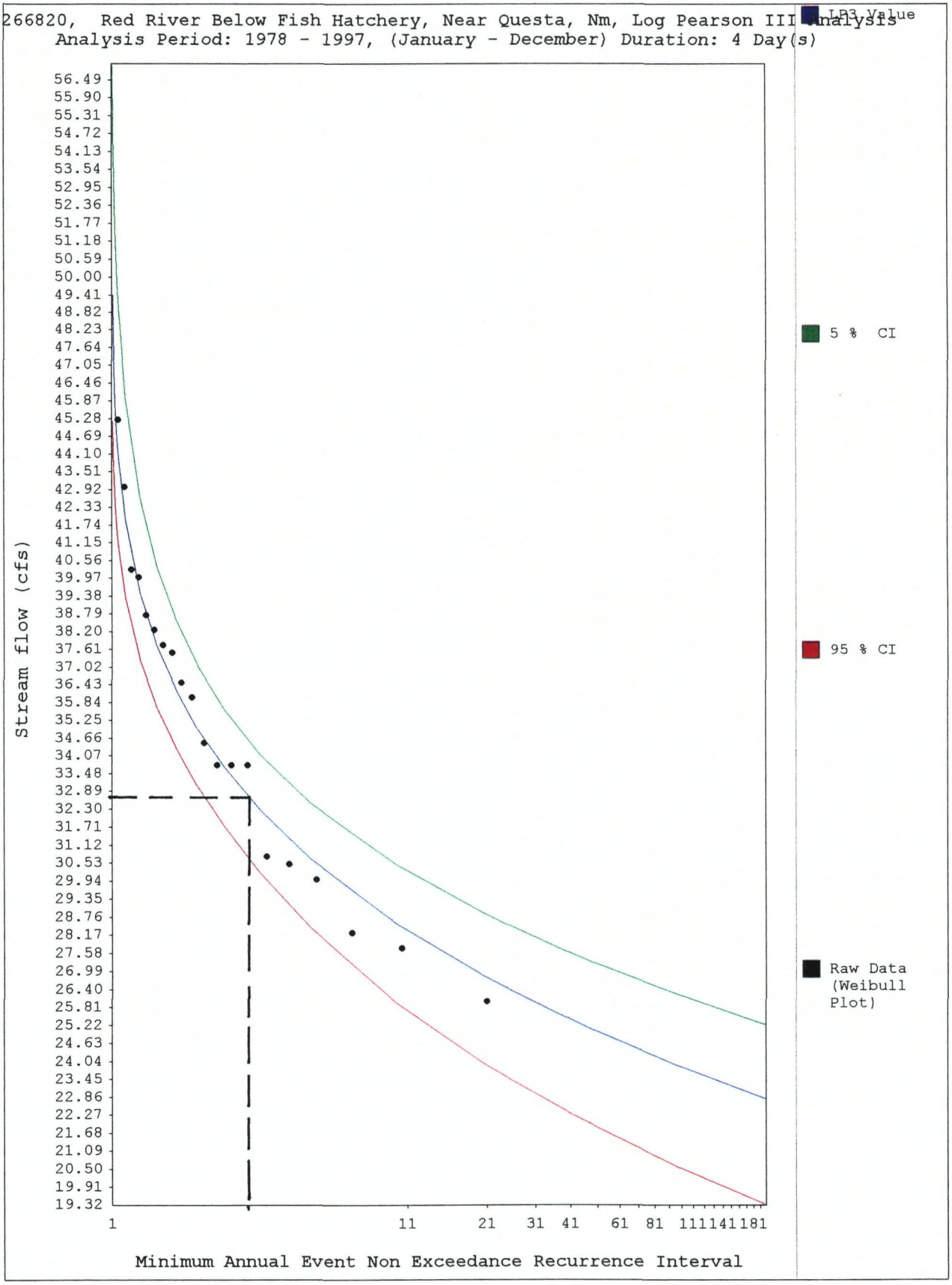
1)	Mean.....	10.3
2)	Mean Logs.....	0.96
3)	Minimum.....	2.8
4)	Minimum Logs.....	0.44
5)	Maximum.....	21.3
6)	Maximum Logs.....	1.33
7)	Standard Deviation.....	4.51
8)	Standard Deviation Logs..	0.22
9)	Skew.....	0.21
10)	Skew Logs.....	-0.70

Duration Frequency Characteristics

Probability	Recurrence Interval	Parameter Value	Confidence Limits 5 %	95 %
0.995	1.005	24.61	29.95	21.06
0.990	1.010	23.15	27.94	19.92
0.980	1.020	21.52	25.72	18.64
0.975	1.026	20.95	24.95	18.20
0.960	1.042	19.68	23.25	17.19
0.950	1.053	19.03	22.40	16.67
0.900	1.111	16.84	19.52	14.89
0.800	1.250	14.25	16.23	12.73
0.700	1.429	12.47	14.03	11.21
0.600	1.667	11.02	12.31	9.95
0.500	2.000	9.75	10.83	8.80
0.400	2.500	8.56	9.48	7.70
0.300	3.333	7.38	8.18	6.59
0.200	5.000	6.13	6.85	5.40

0.100	10.000	4.64	5.28	3.97
0.050	20.000	3.62	4.21	3.00
0.040	25.000	3.36	3.93	2.75
0.025	40.000	2.88	3.42	2.31
0.020	50.000	2.68	3.21	2.12
0.010	100.000	2.16	2.65	1.66
0.005	200.000	1.76	2.21	1.31

08266820, Red River Below Fish Hatchery, Near Questa, Nm, Log Pearson III Analysis
Analysis Period: 1978 - 1997, (January - December) Duration: 4 Day(s)



Log Pearson Type III Duration-Frequency Analysis

1. 08266820, Red River Below Fish Hatchery, Near Questa, Nm
2. Latitude and Longitude (degrees, minutes, and seconds)... .. 36405, .. 105392
3. # basin name..... Upper Rio Grande
4. Record Length: 08/09/1978-09/30/1997
5. # contributing drainage area (square miles)..... 185
6. File Type: Stream flow (cfs)

Parameter Type.....Minimum Annual Event
Probability Type.....Non Exceedance
Analysis Start Year.....1978
Analysis End Year.....1997
Analysis Start Month.....January
Analysis End Month.....December
Number of Analysis Years.....20
Duration (moving average).....4 day(s)

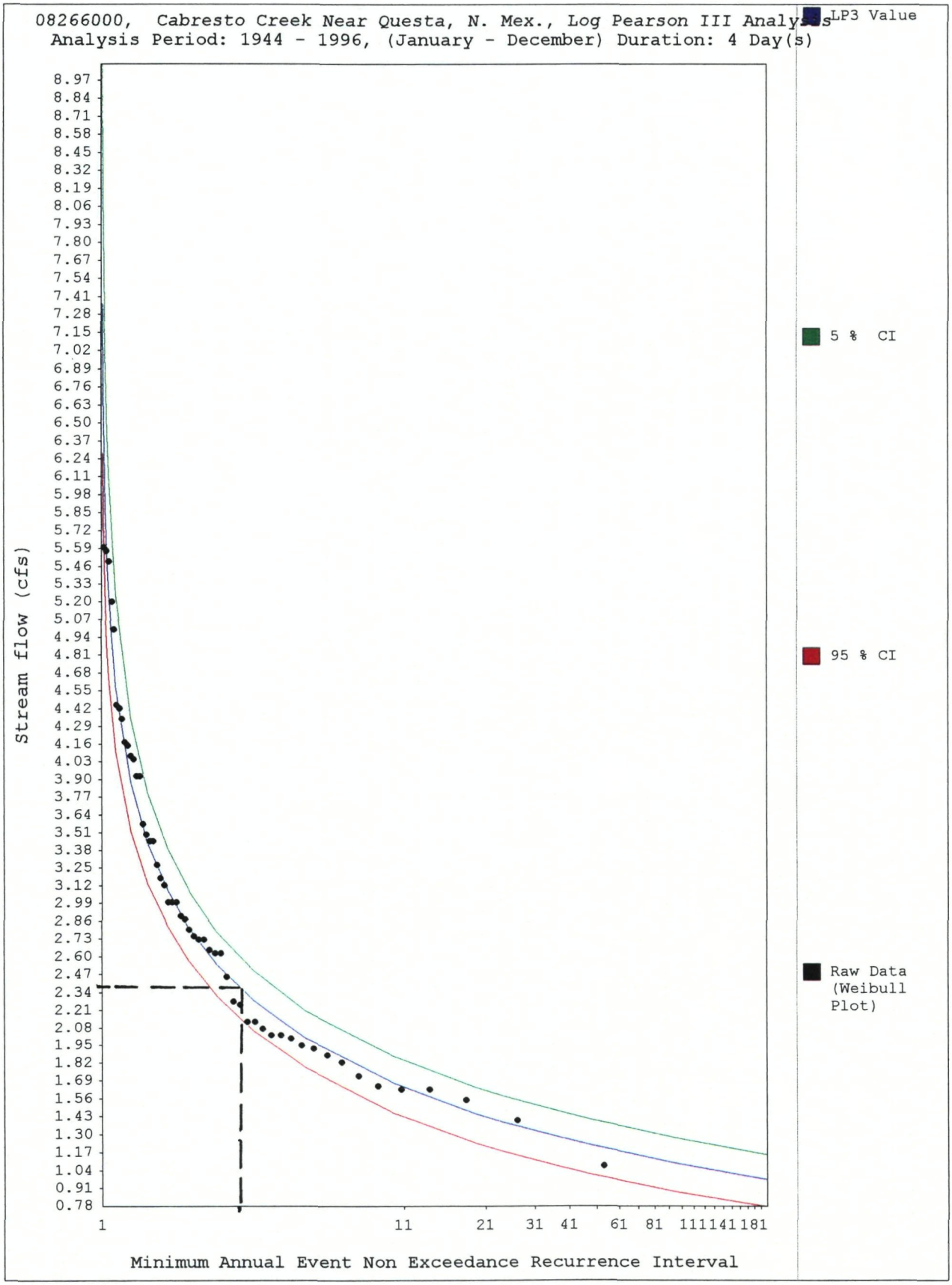
Gauge Station Series Statistics

1)	Mean.....	35.1
2)	Mean Logs.....	1.54
3)	Minimum.....	26.0
4)	Minimum Logs.....	1.41
5)	Maximum.....	45.3
6)	Maximum Logs.....	1.66
7)	Standard Deviation.....	5.18
8)	Standard Deviation Logs..	0.07
9)	Skew.....	0.04
10)	Skew Logs.....	-0.25

Duration Frequency Characteristics

Probability	Recurrence Interval	Parameter Value	Confidence Limits 5 %	95 %
0.995	1.005	49.39	56.99	45.18
0.990	1.010	47.93	54.76	44.06
0.980	1.020	46.34	52.39	42.84
0.975	1.026	45.80	51.58	42.42
0.960	1.042	44.59	49.82	41.47
0.950	1.053	43.98	48.94	40.98
0.900	1.111	41.92	46.01	39.31
0.800	1.250	39.48	42.67	37.24
0.700	1.429	37.75	40.42	35.70
0.600	1.667	36.29	38.61	34.34
0.500	2.000	34.96	37.04	33.03
0.400	2.500	33.64	35.57	31.67
0.300	3.333	32.27	34.10	30.18
0.200	5.000	30.69	32.52	28.41

0.100	10.000	28.57	30.49	25.97
0.050	20.000	26.87	28.93	24.00
0.040	25.000	26.39	28.49	23.44
0.025	40.000	25.45	27.64	22.35
0.020	50.000	25.04	27.26	21.87
0.010	100.000	23.86	26.19	20.51
0.005	200.000	22.80	25.24	19.32


08266000, Cabresto Creek Near Questa, N. Mex., Log Pearson III Analysis
Analysis Period: 1944 - 1996, (January - December) Duration: 4 Day(s)
LP3 Value
5 % CI
95 % CI
Raw Data (Weibull Plot)
Stream flow (cfs)
8.97
8.84
8.71
8.58
8.45
8.32
8.19
8.06
7.93
7.80
7.67
7.54
7.41
7.28
7.15
7.02
6.89
6.76
6.63
6.50
6.37
6.24
6.11
5.98
5.85
5.72
5.59
5.46
5.33
5.20
5.07
4.94
4.81
4.68
4.55
4.42
4.29
4.16
4.03
3.90
3.77
3.64
3.51
3.38
3.25
3.12
2.99
2.86
2.73
2.60
2.47
2.34
2.21
2.08
1.95
1.82
1.69
1.56
1.43
1.30
1.17
1.04
0.91
0.78
1
11
21
31
41
61
81
111
141
181
Minimum Annual Event Non Exceedance Recurrence Interval

Log Pearson Type III Duration-Frequency Analysis

1. 08266000, Cabresto Creek Near Questa, N. Mex.
2. Latitude and Longitude (degrees, minutes, and seconds)... .. 36435, .. 105331
3. # basin name..... Upper Rio Grande
4. Record Length: 10/01/1943-09/30/1996
5. # contributing drainage area (square miles).....
6. File Type: Stream flow (cfs)

Parameter Type.....Minimum Annual Event
Probability Type.....Non Exceedance
Analysis Start Year.....1944
Analysis End Year.....1996
Analysis Start Month.....January
Analysis End Month.....December
Number of Analysis Years.....53
Duration (moving average).....4 day(s)

Gauge Station Series Statistics

1)	Mean.....	3.0
2)	Mean Logs.....	0.45
3)	Minimum.....	1.1
4)	Minimum Logs.....	0.03
5)	Maximum.....	5.6
6)	Maximum Logs.....	0.75
7)	Standard Deviation.....	1.16
8)	Standard Deviation Logs..	0.17
9)	Skew.....	0.62
10)	Skew Logs.....	-0.11

Duration Frequency Characteristics

Probability	Recurrence Interval	Parameter Value	Confidence Limits 5 %	95 %
0.995	1.005	7.36	9.08	6.29
0.990	1.010	6.73	8.18	5.81
0.980	1.020	6.10	7.29	5.32
0.975	1.026	5.90	7.01	5.16
0.960	1.042	5.46	6.41	4.82
0.950	1.053	5.25	6.13	4.65
0.900	1.111	4.59	5.25	4.12
0.800	1.250	3.89	4.36	3.53
0.700	1.429	3.44	3.81	3.15
0.600	1.667	3.10	3.41	2.84
0.500	2.000	2.81	3.07	2.57
0.400	2.500	2.54	2.78	2.32
0.300	3.333	2.28	2.50	2.06
0.200	5.000	2.01	2.21	1.79

0.100	10.000	1.68	1.88	1.47
0.050	20.000	1.45	1.64	1.24
0.040	25.000	1.39	1.57	1.17
0.025	40.000	1.27	1.46	1.06
0.020	50.000	1.22	1.41	1.01
0.010	100.000	1.09	1.27	0.89
0.005	200.000	0.98	1.16	0.78

EXHIBIT III

STORET WATER QUALITY DATA

EXHIBIT III

STORET WATER QUALITY DATA

URG120.028045 URG120028045
36 41 55.0 105 28 46.0 5
RED RIVER ABOVE MOLYCORPS BOUNDARY
35055 NEW MEXICO TAOS
WESTERN GULF 120900
UPPER RIO GRANDE ABOVE THE PECOS RIVER
21NMEX 881217 13020101
0000 FEET DEPTH 2490 METERS ELEVATION
21M SOUTHERN ROCKIES

/TYPA/AMBNT/STREAM/BIO

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00010 WATER TEMP CENT	00400 PH SU	00900 TOT HARD CACO3 MG/L	00530 RESIDUE TOT NFLT MG/L	70300 RESIDUE DISS-180 C MG/L	01106 ALUMINUM AL,DISS UG/L	01105 ALUMINUM AL,TOT UG/L	01000 ARSENIC AS,DISS UG/L	01002 ARSENIC AS,TOT UG/L	01010 BERYLIUM BE,DISS UG/L
88/03/25	1721	WATER		9.0	6.80		6	214					
88/09/13	1040	WATER		8.5	7.25	183	611	198	50	8900		12	
88/09/20	1015	WATER		5.8	7.90	188	10	144	140	600		5K	
88/09/26	0915	WATER		5.4	7.50	170	6	150	100	700		5K	
88/10/25	1300	WATER		6.0	7.80	134	3	174		1075		5K	
92/02/26	1230	WATER		2.1	8.00	166	6	232	100K	1300	5K		100.00K
92/03/25	1205	WATER		5.0	7.70	144	20	230	100K	1700	5K		100.00K
92/04/29	1145	WATER		7.2	7.50	69	206	108	100	6800	5K		100.00K
92/05/27	1215	WATER		8.5	7.70	66	16	118					
92/06/30	1205	WATER		11.0	7.70	86	7	118					
92/07/29	1200	WATER		12.0	8.10	114	6	146					
92/08/26	1145	WATER		12.0	8.10	121	9	145					
92/09/30	1015	WATER		5.3	7.60	135	8	190					
92/10/28	0905	WATER		3.9	7.30	134	8	196					
92/11/24	1155	WATER		.1	7.50	146	8	246					
92/12/16	1125	WATER		.2	7.50	141	8	204					

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36 41 55.0 105 28 46.0 5
RED RIVER ABOVE MOLYCORPS BOUNDARY
35055 NEW MEXICO TAOS
WESTERN GULF 120900
UPPER RIO GRANDE ABOVE THE PECOS RIVER
21NMEX 881217 13020101
0000 FEET DEPTH 2490 METERS ELEVATION
21M SOUTHERN ROCKIES

/TYPA/AMBNT/STREAM/BIO

0 DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01012 BERYLIUM BE,TOT UG/L	01020 BORON B,DISS UG/L	01022 BORON B,TOT UG/L	01025 CADMIUM CD,DISS UG/L	01027 CADMIUM CD,TOT UG/L	01030 CHROMIUM CR,DISS UG/L	01034 CHROMIUM CR,TOT UG/L	01035 COBALT CO,DISS UG/L	01037 COBALT CO,TOTAL UG/L	01040 COPPER CU,DISS UG/L
88/09/13	1040	WATER					1K	1K	5K	17			50K
88/09/20	1015	WATER					1K	1K	8	5K			50K
88/09/26	0915	WATER					1K	1K	5K	5K			50K
88/10/25	1300	WATER						1K		5K			
92/02/26	1230	WATER			100K		1K		5K		50K		100K
92/03/25	1205	WATER			100K		1K		5K		50K		100K
92/04/29	1145	WATER			100K		1K		5K		50K		100K

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35055 NEW MEXICO TAOS
WESTERN GULF 120900
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21NMEX 881217 13020101
0000 FEET DEPTH 2490 METERS ELEVATION
21M SOUTHERN ROCKIES

/TYPA/AMBNT/STREAM/BIO

0 DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01042 COPPER CU,TOT UG/L	01049 LEAD PB,DISS UG/L	01051 LEAD PB,TOT UG/L	71890 MERCURY HG,DISS UG/L	71900 MERCURY HG,TOTAL UG/L	01060 MOLY MO,DISS UG/L	01062 MOLY MO,TOT UG/L	01065 NICKEL NI,DISS UG/L	01067 NICKEL NI,TOTAL UG/L	01145 SELENIUM SE,DISS UG/L
88/09/13	1040	WATER		100	10K	60	.5K	.5K	10K	10	50K	50K	5K
88/09/20	1015	WATER		50K	10K	20	.5K	.5K	10K	10K	50K	50K	5K
88/09/26	0915	WATER		50K	10K	10K	.5K	.5K	10K	10K	50K	50K	5K
88/10/25	1300	WATER		50K		5K		.5K		10K			
92/02/26	1230	WATER			5K			.5K	100K		100K		5K
92/03/25	1205	WATER			5K			.5K	100K		100K		5K
92/04/29	1145	WATER			5K			.5K	100K		100K		5K

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RED RIVER ABOVE MOLYCORPS BOUNDARY
35055 NEW MEXICO TAOS
WESTERN GULF 120900
UPPER RIO GRANDE ABOVE THE PECOS RIVER
21NMEX 881217 13020101
0000 FEET DEPTH 2490 METERS ELEVATION
21M SOUTHERN ROCKIES

/TYPA/AMBNT/STREAM/BIO

0 DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01147 SELENIUM SE,TOT UG/L	01075 SILVER AG,DISS UG/L	01077 SILVER AG,TOT UG/L	01085 VANADIUM V,DISS UG/L	01087 VANADIUM V,TOT UG/L	01090 ZINC ZN,DISS UG/L	01092 ZINC ZN,TOT UG/L	00610 NH3+NH4-N TOTAL MG/L	00619 UN-IONZD NH3-NH3 MG/L	00625 TOT KJEL N MG/L
88/03/25	1721	WATER									.250	.0003$	.100
88/09/13	1040	WATER		5K	1.0K	1.0			50K	150	.350	.001$	.800
88/09/20	1015	WATER		5K	1.0K	1.0K			50K	50K	.100K	.001$	.230
88/09/26	0915	WATER		5K	1.0K	1.0K			50K	50K	.100K	.0005$	.100K
88/10/25	1300	WATER		5K		1.0K				50K			
92/02/26	1230	WATER			100.0K		100K		100K		.210	.002$	.440
92/03/25	1205	WATER			100.0K		100K		100K		.100K	.0008$	.100K
92/04/29	1145	WATER			100.0K		100K		100K		.100K	.0006$	.500
92/05/27	1215	WATER									.100K	.0010$	.390
92/06/30	1205	WATER									.100K	.001$	.100K
92/07/29	1200	WATER									.150	.005$	.410
92/08/26	1145	WATER									.270	.009$	.480
92/09/30	1015	WATER									.100K	.0006$	.100K
92/10/28	0905	WATER									.100K	.0003$	.100K
92/11/24	1155	WATER									.130	.0004$	.150
92/12/16	1125	WATER									.100K	.0003$	.100K

URG120.028045 URG120028045
36 41 55.0 105 28 46.0 5
RED RIVER ABOVE MOLYCORPS BOUNDARY
35055 NEW MEXICO TAOS
WESTERN GULF 120900
UPPER RIO GRANDE ABOVE THE PECOS RIVER
21NMEX 881217 13020101
0000 FEET DEPTH 2490 METERS ELEVATION
21M SOUTHERN ROCKIES

/TYPA/AMBNT/STREAM/BIO

0 DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00630 NO2&NO3 N-TOTAL MG/L	00640 T INORG. NITROGEN MG/L N	00665 PHOS-TOT MG/L P	00680 T ORG C C MG/L	11503 RA-226 + RA-228 PC/L	39348 A-CHLRDN WHL SMPL UG/L	00720 CYANIDE CN-TOT MG/L	31616 FEC COLI MFM-FCBR /100ML
88/03/25	1721	WATER		.27	.52	.018	1.3				
88/09/13	1040	WATER		.13	.48	1.000	8.9				
88/09/20	1015	WATER		.15	.25	.310	4.5				
88/09/26	0915	WATER		.24	.34	.010	3.5				
92/02/26	1230	WATER		.29	.50	.030					
92/03/25	1205	WATER		.36	.46	.060	5.0K				
92/04/29	1145	WATER		.12	.22	.410	5.0				
92/05/27	1215	WATER		.10	.20C	.010	5.0K				
92/06/30	1205	WATER		.23	.33C	.020	1.0				
92/07/29	1200	WATER		.04K	.19C	.020	1.0				
92/08/26	1145	WATER		.19	.46C	.010	1.0				
92/09/30	1015	WATER		.25	.35C	.010	1.0				
92/10/28	0905	WATER		.23	.33C	.010	1.0				
92/11/24	1155	WATER		.36	.49C	.020	1.0				
92/12/16	1125	WATER		.41	.51C	.020	1.0K				

1THAT'S ALL FOLKS

/TYPA/AMBNT/STREAM/BIO

HRG25 URG120028015 08266500
36 41 33.0 105 36 42.0 4
RED RIVER AT HWY 3 BRIDGE
35055 NEW MEXICO TAOS
NEW MEXICO 120900
WESTERN GULF RIO GRANDE
21NMEX 800607 13020101027 0006.160 ON
0003 FEET DEPTH

0

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00010 WATER TEMP CENT	00400 PH SU	00900 TOT HARD CACO3 MG/L	00530 RESIDUE TOT NFLT MG/L	70300 RESIDUE DISS-180 C MG/L	01106 ALUMINUM AL,DISS UG/L	01105 ALUMINUM AL,TOT UG/L	01000 ARSENIC AS,DISS UG/L	01002 ARSENIC AS,TOT UG/L	01010 BERYLIUM BE,DISS UG/L
79/11/05	1715	WATER		5.0	7.20								
79/11/20	1045	WATER		2.0	7.30								
79/12/13	0800	WATER		-.5	7.20								
80/01/17	0955	WATER		1.8									
80/02/17	1545	WATER		5.3									
80/03/20	1330	WATER		9.8	7.30								
80/04/09	0845	WATER		3.0	7.30								
80/05/06	1405	WATER		10.5	7.30								
80/06/18	1600	WATER		11.9	7.40								
80/07/30	1200	WATER		14.0	7.30								
80/09/25	1600	WATER		15.2	7.30								
80/10/20	1810	WATER		8.5	7.30								
80/11/19	0915	WATER		2.0	7.30								
81/01/13	1550	WATER		2.5	7.20								
81/03/30	1250	WATER		11.0	7.30								
84/01/25	1715	WATER		.5	7.20		23						
84/01/26	0825	WATER		-.2	7.20		17						
84/01/26	1220	WATER		.0	7.00		20						
84/01/26	1615	WATER		.2	7.00		20						
84/01/26	2130	WATER		-.2	7.10		112						
84/01/27	1015	WATER		.2	7.00		22					5	
84/01/27	1215	WATER						520					
84/10/15	1420	WATER					20						
84/12/12	1450	WATER		2.8	7.30								
85/04/15	1205	WATER		8.0	7.30		65	133				5K	
85/04/16	1110	WATER		6.8	7.30		81	113				5K	
85/04/16	1510	WATER		10.1	7.30		80	110				5K	
85/04/17	1215	WATER		8.1	7.20		82	125				5K	
85/04/17	1630	WATER		8.7	7.30		80	135				5K	
86/08/18	1710	WATER		17.5	7.50		16	226		2470		5K	
86/08/19	1120	WATER		14.0	7.50		20	236		2610		5K	
86/08/19	1600	WATER		16.0	7.50		16	238					
86/08/20	0920	WATER		11.1	7.50		14	240		2540		5K	
86/08/20	1550	WATER		17.5	7.50		14	234					
88/03/25	1830	WATER		10.1	7.40		23	282					
92/02/26	1325	WATER		3.5	7.50	180	22	164	100K	4600	5K		100.00K
92/03/25	1240	WATER		7.8	7.10	167	41	270	100K	7300	5K		100.00K
92/04/29	1215	WATER		8.6	7.30	234	155	129	100K	7700	5K		100.00K
92/05/27	1250	WATER		9.0	7.60	88	48	149					
92/06/30	1240	WATER		12.8	6.70	116	10	180					
92/07/29	1240	WATER		13.5	7.60	154	10	217					

HRG25 URG120028015 08266500
36 41 33.0 105 36 42.0 4
RED RIVER AT HWY 3 BRIDGE
35055 NEW MEXICO TAOS
NEW MEXICO 120900
WESTERN GULF RIO GRANDE
21NMEX 800607 13020101027 0006.160 ON
0003 FEET DEPTH

/TYPA/AMBNT/STREAM/BIO

TSS

0 DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00010 WATER TEMP CENT	00400 PH SU	00900 TOT HARD CACO3 MG/L	00530 RESIDUE TOT NFLT MG/L	70300 RESIDUE DISS-180 C MG/L	01106 ALUMINUM AL,DISS UG/L	01105 ALUMINUM AL,TOT UG/L	01000 ARSENIC AS,DISS UG/L	01002 ARSENIC AS,TOT UG/L	01010 BERYLIUM BE,DISS UG/L
92/08/26	1225	WATER		14.5	7.70	157	16	207					
92/09/30	1100	WATER		8.3	7.30	169	17	260					
92/10/28	0935	WATER		6.5	7.30	187	12	280					
92/11/24	1245	WATER		2.3	7.00	154	16	288					
92/12/16	1215	WATER		.3	7.20	187	15	296					

MEAN = 16.2

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NEW MEXICO 120900
WESTERN GULF RIO GRANDE
21NMEX 800607 13020101027 0006.160 ON
0003 FEET DEPTH

/TYPA/AMBNT/STREAM/BIO

0 DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01012 BERYLIUM BE,TOT UG/L	01020 BORON B,DISS UG/L	01022 BORON B,TOT UG/L	01025 CADMIUM CD,DISS UG/L	01027 CADMIUM CD,TOT UG/L	01030 CHROMIUM CR,DISS UG/L	01034 CHROMIUM CR,TOT UG/L	01035 COBALT CO,DISS UG/L	01037 COBALT CO,TOTAL UG/L	01040 COPPER CU,DISS UG/L
84/01/27	1015	WATER						1					
85/04/15	1205	WATER						1		5K			
85/04/16	1110	WATER						1		47			
85/04/16	1510	WATER						1		11			
85/04/17	1215	WATER						1K		5K			
85/04/17	1630	WATER						1		10			
86/08/18	1710	WATER						1K		5K			
86/08/19	1120	WATER						1K		5K			
86/08/20	0920	WATER						1K		5K			
92/02/26	1325	WATER			100K		1		5K		50K		100K
92/03/25	1240	WATER			100K		2		5K		50K		100K
92/04/29	1215	WATER			100K		1K		5K		50K		100K

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21NMEX 800607 13020101027 0006.160 ON
0003 FEET DEPTH

/TYPA/AMBNT/STREAM/BIO

0 DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01042 COPPER CU,TOT UG/L	01049 LEAD PB,DISS UG/L	01051 LEAD PB,TOT UG/L	71890 MERCURY HG,DISS UG/L	71900 MERCURY HG,TOTAL UG/L	01060 MOLY MO,DISS UG/L	01062 MOLY MO,TOT UG/L	01065 NICKEL NI,DISS UG/L	01067 NICKEL NI,TOTAL UG/L	01145 SELENIUM SE,DISS UG/L
84/01/27	1015	WATER				5K		.5K		10K			
85/04/15	1205	WATER		50K		10K		.5K		10K		50K	
85/04/16	1110	WATER		120		10K		.5K		10K		50K	
85/04/16	1510	WATER		50K		10K		.5K		10K		50K	
85/04/17	1215	WATER		50K		10K		.5K		10K		50K	
85/04/17	1630	WATER		50K		10K		.5K		10K		50K	
86/08/18	1710	WATER		50K		10K		.5K		10K		50K	
86/08/19	1120	WATER		50K		10K		.5K		10K		50K	
86/08/20	0920	WATER		50K		10K		.5K		10K		50K	
92/02/26	1325	WATER			5K			.5K	100K		100K		5K
92/03/25	1240	WATER			5K			.5K	100K		100K		5K
92/04/29	1215	WATER			5K			.5K	100K		100K		5K

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21NMEX 800607 13020101027 0006.160 ON
0003 FEET DEPTH

/TYPA/AMBNT/STREAM/BIO

0 DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01147 SELENIUM SE,TOT UG/L	01075 SILVER AG,DISS UG/L	01077 SILVER AG,TOT UG/L	01085 VANADIUM V,DISS UG/L	01087 VANADIUM V,TOT UG/L	01090 ZINC ZN,DISS UG/L	01092 ZINC ZN,TOT UG/L	00610 NH3+NH4- N TOTAL MG/L	00619 UN-IONZD NH3-NH3 MG/L	00625 TOT KJEL N MG/L
79/11/05	1715	WATER									.012	.00003$	.260
79/11/20	1045	WATER									.016	.00004$	.140
79/12/13	0800	WATER									.020	.00003$	.030
80/01/17	0955	WATER									.054		.120
80/02/17	1545	WATER									.050		.360
80/02/25		WATER									.069		.340
80/03/20	1330	WATER									.155	.0007$	.460
80/04/04		WATER									.028		.350
80/04/09	0845	WATER									.117J	.0003$	.220
80/04/30	1515	WATER									.096		.370
80/05/06	1405	WATER									.072	.0003$	.230
80/06/04	1545	WATER									.073		.620
80/06/18	1600	WATER									.043	.0003$	.320
80/07/09	1510	WATER									.027		.370
80/07/30	1200	WATER									.054	.0003$	.210
80/08/27	1330	WATER									.134		.510
80/09/25	1600	WATER									.034	.0002$	.500
80/10/20	1810	WATER									.021	.00008$	.030
80/11/19	0915	WATER									.114	.0003$	.280
81/01/13	1550	WATER									.078	.0002$	.120
81/03/30	1250	WATER									.090	.0004$	.430
84/01/25	1715	WATER									.020	.00003$	.150
84/01/26	0825	WATER									.026	.00004$	.110
84/01/26	1220	WATER									.082	.00008$	.210
84/01/26	1615	WATER											.110
84/01/26	2130	WATER									.044	.00005$	.310
84/01/27	1015	WATER		5K						120			
84/10/15	1420	WATER									.060		.100K
84/12/12	1450	WATER									.010K	.00003$	.100
85/04/15	1205	WATER		5K		2.0K				130	.030	.0001$	.060
85/04/16	1110	WATER		5K		2.0K				120	.070	.0002$	.660
85/04/16	1510	WATER		5K		2.0K				120	.160	.0007$	.790
85/04/17	1215	WATER		5K		2.0K				120	.030	.00009$	.110
85/04/17	1630	WATER		5K		2.0K				240	.010K	.00004$	.230
86/08/18	1710	WATER		5K		1.0K				140	.140	.002$	.100
86/08/19	1120	WATER		5K		1.0K				160	.100K	.0010$	.100K
86/08/19	1600	WATER									.100K	.001$	.100K
86/08/20	0920	WATER		5K		1.0K				160	.100K	.0008$	.100K
86/08/20	1550	WATER									.100K	.001$	.100K
88/03/25	1830	WATER									.150	.0009$	.210
92/02/26	1325	WATER			100.0K		100K		300		.190	.0008$	.190

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36 41 33.0 105 36 42.0 4
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WESTERN GULF RIO GRANDE
21NMEX 800607 13020101027 0006.160 ON
0003 FEET DEPTH

/TYPA/AMBNT/STREAM/BIO

0 DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01147 SELENIUM SE,TOT UG/L	01075 SILVER AG,DISS UG/L	01077 SILVER AG,TOT UG/L	01085 VANADIUM V,DISS UG/L	01087 VANADIUM V,TOT UG/L	01090 ZINC ZN,DISS UG/L	01092 ZINC ZN,TOT UG/L	00610 NH3+NH4-N TOTAL MG/L	00619 UN-IONZD NH3-NH3 MG/L	00625 TOT KJEL N MG/L
92/03/25	1240	WATER			100.0K		100K		400		.100K	.0002$	.100K
92/04/29	1215	WATER			100.0K		100K		100K		.100K	.0004$	.460
92/05/27	1250	WATER									.100K	.0008$	.350
92/06/30	1240	WATER									.100K	.0001$	.150
92/07/29	1240	WATER									.100K	.001$	.100K
92/08/26	1225	WATER									.100K	.002$	.100K
92/09/30	1100	WATER									.120	.0005$	.140
92/10/28	0935	WATER									.100K	.0003$	.100K
92/11/24	1245	WATER									.100K	.0001$	.100K
92/12/16	1215	WATER									.100K	.0002$	.100K

HRG25 URG120028015 08266500
36 41 33.0 105 36 42.0 4
RED RIVER AT HWY 3 BRIDGE
35055 NEW MEXICO TAOS
NEW MEXICO 120900
WESTERN GULF RIO GRANDE
21NMEX 800607 13020101027 0006.160 ON
0003 FEET DEPTH

/TYPA/AMBNT/STREAM/BIO

0 DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00630 NO2&NO3 N-TOTAL MG/L	00640 T INORG. NITROGEN MG/L N	00665 PHOS-TOT MG/L P	00680 T ORG C C MG/L	11503 RA-226 + RA-228 PC/L	39348 A-CHLRDN WHL SMPL UG/L	00720 CYANIDE CN-TOT MG/L	31616 FEC COLI MFM-FCBR /100ML
79/11/05	1715	WATER		.11		.040					
79/11/20	1045	WATER		.13		.010					
79/12/13	0800	WATER		.14		.020					
80/01/17	0955	WATER		.17		.030					
80/02/17	1545	WATER		.26		.030					
80/02/25		WATER		.28		.070					
80/03/20	1330	WATER		.27		.060					
80/04/04		WATER		.24		.194					
80/04/09	0845	WATER		.22		.024					
80/04/30	1515	WATER		.12		.175					
80/05/06	1405	WATER		.14		.062					
80/06/04	1545	WATER		.09		.062					
80/06/18	1600	WATER		.11		.061					
80/06/19	0930	WATER									10
80/07/09	1510	WATER		.08		.037					
80/07/29	1205	WATER									7
80/07/30	1200	WATER		.15		.053					
80/08/27	1330	WATER		.16		.170					
80/09/25	1600	WATER		.11		.020					
80/10/20	1810	WATER		.15		.068					
80/10/21	1145	WATER									10K
80/11/19	0915	WATER		.12		.006					
81/01/13	1550	WATER		.19		.012					
81/03/30	1250	WATER		.21		.027					
84/01/25	1715	WATER		.28	.30	.020					
84/01/26	0825	WATER		.39	.42	.030					
84/01/26	1220	WATER		.39	.47	.040					
84/01/26	1615	WATER		.24							
84/01/26	2130	WATER		.33	.37	.200					
84/01/27	1015	WATER		.29							
84/01/27	1215	WATER									1K
84/10/15	1420	WATER		.04K	.10K	.060					
84/12/12	1450	WATER		.24	.25C	.020					
85/04/15	1205	WATER		.12	.15C	.140					
85/04/16	1110	WATER		.13	.20C	.160					
85/04/16	1510	WATER		.14	.30C	.150					
85/04/17	1215	WATER		.09	.12C	.160				.001K	
85/04/17	1630	WATER		.01K	.02K	.160					
86/08/18	1710	WATER		.24	.38C	.020					
86/08/19	1120	WATER		.25	.35C	.020					
86/08/19	1600	WATER		.23	.33C	.020					

HRG25 URG120028015 08266500
36 41 33.0 105 36 42.0 4
RED RIVER AT HWY 3 BRIDGE
35055 NEW MEXICO TAOS
NEW MEXICO 120900
WESTERN GULF RIO GRANDE
21NMEX 800607 13020101027 0006.160 ON
0003 FEET DEPTH

/TYPA/AMBNT/STREAM/BIO

0 DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00630 NO2&NO3 N-TOTAL MG/L	00640 T INORG. NITROGEN MG/L N	00665 PHOS-TOT MG/L P	00680 T ORG C C MG/L	11503 RA-226 + RA-228 PC/L	39348 A-CHLRDN WHL SMPL UG/L	00720 CYANIDE CN-TOT MG/L	31616 FEC COLI MFM-FCBR /100ML
86/08/20	0920	WATER		.27	.37C	.020				.000U	
86/08/20	1550	WATER		.23	.33C	.020					
86/08/21	0950	WATER									20K
88/03/25	1830	WATER		.41	.56	.010K	1.0				
92/02/26	1325	WATER		.34	.53	.020					
92/03/25	1240	WATER		.32	.42	.050	5.0K				
92/04/29	1215	WATER		.16	.26	.370	4.0				
92/05/27	1250	WATER		.18	.28C	.040	5.0K				
92/06/30	1240	WATER		.29	.39C	.020	1.0				
92/07/29	1240	WATER		.31	.41C	.010K	1.0K				
92/08/26	1225	WATER		.21	.31C	.020	1.0				
92/09/30	1100	WATER		.32	.44C	.010K	2.0K				
92/10/28	0935	WATER		.34	.44C	.010	1.0K				
92/11/24	1245	WATER		.35	.45C	.020	1.0				
92/12/16	1215	WATER		.43	.53C	.010	1.0				
93/01/27	0945	WATER									9J

1THAT'S ALL FOLKS

EXHIBIT IV

OUTFALL 002 DATA FROM HISTORICAL DISCHARGE MONITORING REPORTS

TABLE 2
OUTFALL 002 DATA FROM HISTORICAL DISCHARGE MONITORING REPORTS
JANUARY 6, 1998

DATE	MANGANESE (tot.)				MOLYBDENUM (tot.)				SILVER (tot.)				VANADIUM (tot.)				ZINC (tot.)			
	(lb/day)		(mg/l)		(lb/day)		(mg/l)		(lb/day)		(mg/l)		(lb/day)		(mg/l)		(lb/day)		(mg/l)	
	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.
2/1/85			1.20	1.30	9.00	12.00	2.30	2.60												0.02
3/1/85			1.40	1.50	8.40	12.00	2.17	2.83												0.03
4/1/85			1.38	1.48	10.80	12.10	2.42	2.63												0.03
1/1/96	4.00	4.20	1.85	1.90	5.00	5.30	2.30	2.40	0.022	0.022	<0.01	<0.01	0.022	0.022	<0.01	<0.01	0	0	<0.020	<0.020
2/1/96	3.95	4.11	1.84	1.90	4.80	4.97	2.24	2.30	0.021	0.021	<.010	<.010	0.021	0.021	<.010	<.010	0	0	<.020	<.020
3/1/96	4.01	4.19	1.90	2.00	4.97	5.05	2.35	2.40	0.021	0.021	<.010	<.010	0.021	0.021	<.010	<.010	0	0	<.020	<.020
4/1/96	3.92	4.06	1.93	2.00	5.04	5.25	2.48	2.60	0.021	0.021	<.010	<.010	0.021	0.021	<.010	<.010	0	0	<.020	<.020
5/1/96	3.56	3.70	1.76	1.80	5.14	5.25	2.54	2.61	0.020	0.020	<.010	<.010	0.020	0.020	<.010	<.010	0	0	<.020	<.020
6/1/96	3.89	3.95	1.91	1.93	4.88	5.03	2.40	2.46	0.021	0.021	<.010	<.010	0.021	0.021	<.010	<.010	0	0	<.020	<.020
7/1/96	4.32	4.48	1.97	2.03	5.44	5.60	2.48	2.54	0.021	0.021	<.010	<.010	0.021	0.021	<.010	<.010	0	0	<.020	<.020
8/1/96	4.21	4.47	1.91	1.95	5.63	5.90	2.55	2.63	0	0	<.002	<.002	0.022	0.022	<.010	<.010	0.045	0.047	0.021	0.022
9/1/96	4.15	4.29	1.86	1.87	5.52	5.61	2.47	2.50	0	0	<.002	<.002	0.022	0.022	<.010	<.010	0	0	<.020	<.020
10/1/96	2.84	3.95	1.90	1.90	4.58	4.97	2.45	2.50	0	0	<.002	<.002	0.021	0.021	<.010	<.010	0	0	<.020	<.020
11/1/96	3.24	3.35	1.82	1.90	4.50	4.65	2.52	2.60	0	0	<.002	<.002	0.018	0.018	<.010	<.010	0	0	<.020	<.020
12/1/96	3.19	4.54	1.60	1.60	4.84	7.38	2.38	2.50	0	0	<.002	<.002	0.020	0.020	<.010	<.010	0	0	<.020	<.020
1/1/97	4.43	4.54	1.58	1.61	6.28	6.98	2.24	2.29	0	0	<.002	<.002	0.028	0.028	<.010	<.010	0.076	0.109	0.027	0.039
2/1/97	4.55	4.66	1.78	1.86	5.89	6.08	2.31	2.43	0	0	<.002	<.002	0.028	0.028	<.010	<.010	0	0	<.015	<.020
3/1/97	4.62	4.80	1.82	1.91	6.09	6.23	2.39	2.48	0	0	<.002	<.002	0.025	0.025	<.010	<.010	0	0	<.020	<.020
4/1/97	4.56	4.71	1.74	1.76	6.32	6.51	2.41	2.43	0	0	<.0005	<.0005	0.027	0.027	<.010	<.010	0	0	<.010	<.010
5/1/97	4.26	4.49	1.65	1.73	6.02	6.26	2.33	2.41	0	0	<.0005	<.0005	0.013	0.013	<.005	<.005	0	0	0.002	0.010
6/1/97	4.35	4.41	1.70	1.75	6.30	6.84	2.46	2.50	0	0	<.0005	<.0005	0.013	0.013	<.005	<.005	0	0	0.005	0.010
7/1/97	4.23	4.46	1.72	1.80	5.96	6.44	2.40	2.60	0	0	<.0005	<.0005	0.025	0.025	<.010	<.010	0	0	<.020	<.020
8/1/97	4.15	4.28	1.65	1.70	5.77	6.01	2.30	2.40	0	0	<.002	<.002	0.025	0.025	<.010	<.010	0	0	<.020	<.020
9/1/97	4.09	4.11	1.60	1.60	6.06	6.36	2.38	2.50	0	0	<0.002	<0.002	0.025	0.025	<0.010	<0.010	0	0	<0.020	<0.020
10/1/97	4.57	5.47	1.58	1.80	6.07	6.68	2.10	2.20	0	0	<0.002	<0.002	0.028	0.028	<.010	<.010	0	0	<.020	<.020

AUTHORIZATION TO DISCHARGE UNDER THE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with the provisions of the Clean Water Act, as amended, (33 U.S.C. 1251 et. seq; the "Act"),

Molycorp, Inc.
P. O. Box 469
Questa, New Mexico 87556

is authorized to discharge from a facility located at Questa, Taos County, New Mexico

to receiving waters named Red River, Waterbody Segment Code No. 2-119 of the Rio Grande Basin, from

Outfall 001: Latitude - N36°41'49"; Longitude - W105°37'53".
Outfall 002: Latitude - N36°41'29"; Longitude - W105°37'53"
Outfall 004: Latitude - N36°41'08"; Longitude - W105°31'51"
Outfall 005: Latitude - N36°41'41"; Longitude - W105°31'48"

in accordance with effluent limitations, monitoring requirements and other conditions set forth in Parts I (11 pages), II (8 pages), and III (7 pages) hereof.

This permit supersedes and replaces NPDES Permit No. NM0022306 issued May 20, 1988.

This permit shall become effective on October 15, 1993.

This permit and the authorization to discharge shall expire at midnight, October 14, 1998

Prepared by:

Frederick O. Humke, P.E.
Environmental Engineer
Industrial Permits Section (6W-PI)

Signed this 10thday of September 1993

Myron O. Knudson, P.E.
Director
Water Management Division (6W)

PART I
REQUIREMENTS FOR NPDES PERMITS

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

OUTFALL 001

During the period beginning the effective date and lasting through the expiration date, the permittee is authorized to discharge from Outfalls 001 - process water from milling operations and tailings disposal.

Such discharges shall be limited and monitored by the permittee as specified below:

EFFLUENT CHARACTERISTIC	DISCHARGE LIMITATIONS			
	MASS (LBS/DAY)		OTHER UNITS (mg/L UNLESS STATED)	
	DAILY AVG	DAILY MAX	DAILY AVG	DAILY MAX
Flow (MGD)	N/A	N/A	(*1)	(*1)
Chemical Oxygen Demand	(*1)	(*1)	60	90
Total Suspended Solids	(*1)	(*1)	20	30
Total Arsenic	(*1)	(*1)	0.5	1.0
Total Cadmium	(*1)	(*1)	0.05	0.05
Total Copper	(*1)	(*1)	0.15	0.30
Total Cyanide	(*1)	(*1)	0.025	0.05
Fluoride	(*1)	(*1)	3.0	3.0
Total Iron	(*1)	(*1)	0.6	0.6
Total Lead	(*1)	(*1)	0.3	0.6
Total Manganese	(*1)	(*1)	1.0	1.5
Total Mercury	(*1)	(*1)	0.001	0.002
Total Molybdenum	(*1)	(*1)	1.0	2.0
Total Zinc	(*1)	(*1)	0.2	0.2
Total Aluminum	(*1)	(*1)	(*1)	(*1)
Total Cobalt	(*1)	(*1)	(*1)	(*1)
Total Selenium	(*1)	(*1)	(*1)	(*1)
Total Vanadium	(*1)	(*1)	(*1)	(*1)
Total Beryllium	(*1)	(*1)	(*1)	(*1)
Total Silver	(*1)	(*1)	(*1)	(*1)
Chlordane	(*1)	(*1)	(*1)	(*1)
Total Residual Chlorine	(*1)	(*1)	(*1)	(*1)
Temperature	N/A	N/A	(*1)°F	(*1)°F
Biomonitoring	N/A	N/A	N/A	N/A

EFFLUENT CHARACTERISTIC	MONITORING REQUIREMENTS	
	MEASUREMENT FREQUENCY	SAMPLE TYPE
Flow (MGD)	(*2)	Record
Chemical Oxygen Demand	1/Week	Composite(*3)
Total Suspended Solids	1/Week	Composite(*3)
Total Arsenic(*5)	1/Week	Composite(*3)
Total Cadmium(*5)	1/Week	Composite(*3)
Total Copper(*5)	1/Week	Composite(*3)
Total Cyanide(*5)	1/Week	Composite(*3)
Fluoride	1/Week	Composite(*3)
Total Iron	1/Week	Composite(*3)
Total Lead(*5)	1/Week	Composite(*3)
Total Manganese	1/Week	Composite(*3)
Total Mercury(*5)	1/Week	Composite(*3)
Total Molybdenum	1/Week	Composite(*3)

Total Zinc(*5)	1/Week	Composite(*3)
Total Aluminum	1/Month	Composite(*3)
Total Cobalt	1/Month	Composite(*3)
Total Selenium(*5)	1/Month	Composite(*3)
Total Vanadium	1/Month	Composite(*3)
Total Beryllium(*5)	1/Month	Composite(*3)
Total Silver(*5)	1/Month	Composite(*3)
Chlordane(*5)	1/Month	Composite(*3)
Total Residual Chlorine(*5)	1/Month	Composite(*3)
Temperature	1/Week	Grab
Biomonitoring	1/Quarter	(*4)

The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored 1/Week by grab sample.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): Outfall 001, which is the discharge spillway from Pope Lake.

FOOTNOTES

(*1) Report.
(*2) Continuous and totalized monitoring.
(*3) See Part II, Paragraph A.
(*4) See Part II, Paragraph E.
(*5) See Part II, Paragraph D.

OUTFALLS 002

During the period beginning the effective date and lasting through the expiration date, the permittee is authorized to discharge from Outfall 002 - seepage from tailings impoundment.

Such discharges shall be limited and monitored by the permittee as specified below:

EFFLUENT CHARACTERISTIC	DISCHARGE LIMITATIONS			
	MASS (LBS/DAY)		OTHER UNITS (mg/L UNLESS STATED)	
	DAILY AVG	DAILY MAX	DAILY AVG	DAILY MAX
Flow (MGD)	N/A	N/A	(*1)	(*1)
Chemical Oxygen Demand	(*1)	(*1)	60	90
Total Suspended Solids	(*1)	(*1)	20	30
Total Arsenic	(*1)	(*1)	0.5	1.0
Total Cadmium	(*1)	(*1)	0.05	0.05
Total Copper	(*1)	(*1)	0.15	0.30
Total Cyanide	(*1)	(*1)	0.025	0.05
Fluoride	(*1)	(*1)	3.0	3.0
Total Iron	(*1)	(*1)	0.6	0.6
Total Lead	(*1)	(*1)	0.3	0.6
Total Manganese	(*1)	(*1)	(*1)	(*1)
Total Mercury	(*1)	(*1)	0.001	0.002
Total Molybdenum	(*1)	(*1)	(*1)	(*1)
Total Zinc	(*1)	(*1)	0.2	0.2
Total Aluminum	(*1)	(*1)	(*1)	(*1)
Total Cobalt	(*1)	(*1)	(*1)	(*1)
Total Selenium	(*1)	(*1)	(*1)	(*1)
Total Vanadium	(*1)	(*1)	(*1)	(*1)
Total Beryllium	(*1)	(*1)	(*1)	(*1)
Total Silver	(*1)	(*1)	(*1)	(*1)
Chlordane	(*1)	(*1)	(*1)	(*1)
Total Residual Chlorine	(*1)	(*1)	(*1)	(*1)
Temperature	N/A	N/A	(*1)°F	(*1)°F
Biomonitoring	N/A	N/A	N/A	N/A

EFFLUENT CHARACTERISTIC	MONITORING REQUIREMENTS	
	MEASUREMENT FREQUENCY	SAMPLE TYPE
Flow (MGD)	(*2)	Record
Chemical Oxygen Demand	1/Week	Composite(*3)
Total Suspended Solids	1/Week	Composite(*3)
Total Arsenic(*5)	1/Week	Composite(*3)
Total Cadmium(*5)	1/Week	Composite(*3)
Total Copper(*5)	1/Week	Composite(*3)
Total Cyanide(*5)	1/Week	Composite(*3)
Fluoride	1/Week	Composite(*3)
Total Iron	1/Week	Composite(*3)
Total Lead(*5)	1/Week	Composite(*3)
Total Manganese	1/Week	Composite(*3)
Total Mercury(*5)	1/Week	Composite(*3)
Total Molybdenum	1/Week	Composite(*3)
Total Zinc(*5)	1/Week	Composite(*3)
Total Aluminum	1/Month	Composite(*3)
Total Cobalt	1/Month	Composite(*3)
Total Selenium(*5)	1/Month	Composite(*3)
Total Vanadium	1/Month	Composite(*3)

Total Beryllium(*5)	1/Month	Composite(*3)
Total Silver(*5)	1/Month	Composite(*3)
Chlordane(*5)	1/Month	Composite(*3)
Total Residual Chlorine(*5)	1/Month	Composite(*3)
Total Zinc(*5)	1/Week	Composite(*3)
Temperature	1/Week	Grab
Biomonitoring	1/Quarter	(*4)

The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored 1/Week by grab sample.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): Outfall 002, which is the collected and combined seepage from the tailings impoundment.

FOOTNOTES

(*1) Report.
(*2) By gauging on a daily basis.
(*3) See Part II, Paragraph A.
(*4) See Part II, Paragraph E.
(*5) See Part II, Paragraph D.

OUTFALLS 004 and 005

During the period beginning the effective date and lasting through the expiration date, the permittee is authorized to discharge individually from Outfalls 004 and 005 - periodic mine drainage consisting only of all mine contacted surface stormwater runoff.

Such discharges shall be limited and monitored by the permittee as specified below:

EFFLUENT CHARACTERISTIC	DISCHARGE LIMITATIONS			
	MASS (LBS/DAY)		OTHER UNITS (mg/L UNLESS STATED)	
CONVENTIONAL	DAILY AVG	DAILY MAX	DAILY AVG	DAILY MAX
Flow (MGD)	----	----	(*1)	(*1)
Total Suspended Solids	(*1)(*2)	(*1)	20	30
Chemical Oxygen Demand	N/A	N/A	125	125
Total Arsenic	N/A	N/A	(*1)	(*1)
Total Cadmium	(*1)(*2)	(*1)	0.05	0.10
Total Copper	(*1)(*2)	(*1)	0.15	0.30
Total Zinc	(*1)(*2)	(*1)	0.75	1.5
Total Lead	(*1)(*2)	(*1)	0.3	0.6
Total Mercury	(*1)(*2)	(*1)	0.001	0.002
Total Aluminum	(*1)(*2)	(*1)	(*1)	(*1)
Total Cobalt	(*1)(*2)	(*1)	(*1)	(*1)
Total Selenium	(*1)(*2)	(*1)	(*1)	(*1)
Total Vanadium	(*1)(*2)	(*1)	(*1)	(*1)
Total Beryllium	(*1)(*2)	(*1)	(*1)	(*1)
Total Silver	(*1)(*2)	(*1)	(*1)	(*1)
Chlordane	(*1)(*2)	(*1)	(*1)	(*1)
Total Residual Chlorine	(*1)(*2)	(*1)	(*1)	(*1)
Biomonitoring	N/A	N/A	N/A	N/A

EFFLUENT CHARACTERISTIC	MONITORING REQUIREMENTS	
CONVENTIONAL	MEASUREMENT FREQUENCY	SAMPLE TYPE
Flow (MGD)	1/Day(*3)	Measure(*7)
Total Suspended Solids	1/Day(*3)	Composite(*6)
Chemical Oxygen Demand	1/Day(*3)	Composite(*6)
Total Arsenic(*5)	1/Day(*3)	Composite(*6)
Total Cadmium(*5)	1/Day(*3)	Composite(*6)
Total Copper(*5)	1/Day(*3)	Composite(*6)
Total Zinc(*5)	1/Day(*3)	Composite(*6)
Total Lead(*5)	1/Day(*3)	Composite(*6)
Total Mercury(*5)	1/Day(*3)	Composite(*6)
Total Aluminum	1/Month(*3)	Composite(*6)
Total Cobalt	1/Month(*3)	Composite(*6)
Total Selenium(*5)	1/Month(*3)	Composite(*6)
Total Vanadium	1/Month(*3)	Composite(*6)
Total Beryllium(*5)	1/Month(*3)	Composite(*6)
Total Silver(*5)	1/Month(*3)	Composite(*6)
Chlordane(*5)	1/Month(*3)	Composite(*6)
Total Residual Chlorine(*5)	1/Month(*3)	Composite(*6)
Biomonitoring	1/Quarter	(*4)

The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored 1/day(*1) by grab sample.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): Prior to discharge from the settling basins.

FOOTNOTES

(*1) Report
(*2) Daily discharges averaged over the number of days in the monthly period.
(*3) During periods of discharge.
(*4) See Part II, Paragraph E.
(*5) See Part II, Paragraph D.
(*6) See Part II, Paragraph A.
(*7) By calibrated weir.

INTERIM LIMITATIONS SUM1

During the period beginning the effective date and lasting through June 30, 1996, the permittee is authorized to discharge combined loads, SUM1 - Sum total of Outfalls 001 and 002 (technology levels) for the month.

Such discharges shall be limited and monitored by the permittee as specified below:

EFFLUENT CHARACTERISTIC	DISCHARGE LIMITATIONS			
	MASS (LBS/DAY)		OTHER UNITS (mg/L UNLESS STATED)	
	DAILY AVG (*2)	DAILY MAX	DAILY AVG	DAILY MAX
Chemical Oxygen Demand	2364	N/A	N/A	N/A
Total Suspended Solids	788	N/A	N/A	N/A
Total Arsenic	19.6	N/A	N/A	N/A
Total Cadmium	2.00	N/A	N/A	N/A
Total Copper	5.88	N/A	N/A	N/A
Total Cyanide	0.98	N/A	N/A	N/A
Flouride	118	N/A	N/A	N/A
Total Iron	23.6	N/A	N/A	N/A
Total Lead	11.8	N/A	N/A	N/A
Total Manganese	39.4	N/A	N/A	N/A
Total Mercury	0.04	N/A	N/A	N/A
Total Molybdenum	25.0(*1)	N/A	N/A	N/A
Total Zinc	7.84	N/A	N/A	N/A

EFFLUENT CHARACTERISTIC	MONITORING REQUIREMENTS	
	MEASUREMENT FREQUENCY	SAMPLE TYPE
Chemical Oxygen Demand	1/Month	Calculate
Total Suspended Solids	1/Month	Calculate
Total Arsenic	1/Month	Calculate
Total Cadmium	1/Month	Calculate
Total Copper	1/Month	Calculate
Total Cyanide	1/Month	Calculate
Flouride	1/Month	Calculate
Total Iron	1/Month	Calculate
Total Lead	1/Month	Calculate
Total Manganese	1/Month	Calculate
Total Mercury	1/Month	Calculate
Total Molybdenum	1/Month	Calculate
Total Zinc	1/Month	Calculate

FOOTNOTES

(*1) Calculate the average of monthly reported daily averages for Outfall 001 for six months preceeding the reporting period end date, then calculate the average of monthly reported daily averages for Outfall 002 for six months preceeding the reporting period end date. The stated discharge limitation applies to the sum total of these two calculated values.

(*2) Sum total of daily average mass loads for Outfalls 001 and 002.

FINAL LIMITATIONS SUM1

During the period beginning July 1, 1996, and lasting through the expiration date, the permittee is authorized to discharge combined loads, SUM1 - Sum total of Outfalls 001 and 002 (technology levels) for the month.

Such discharges shall be limited and monitored by the permittee as specified below:

EFFLUENT CHARACTERISTIC	DISCHARGE LIMITATIONS			
	MASS (LBS/DAY)		OTHER UNITS (mg/L UNLESS STATED)	
	DAILY AVG (*2)	DAILY MAX	DAILY AVG	DAILY MAX
Chemical Oxygen Demand	2364	N/A	N/A	N/A
Total Suspended Solids	788	N/A	N/A	N/A
Total Arsenic	19.6	N/A	N/A	N/A
Total Cyanide	0.98	N/A	N/A	N/A
Flouride	118	N/A	N/A	N/A
Total Iron	23.6	N/A	N/A	N/A
Total Manganese	39.4	N/A	N/A	N/A
Total Mercury	0.04	N/A	N/A	N/A
Total Molybdenum	25.0(*1)	N/A	N/A	N/A
Total Zinc	7.84	N/A	N/A	N/A

EFFLUENT CHARACTERISTIC	MONITORING REQUIREMENTS	
	MEASUREMENT FREQUENCY	SAMPLE TYPE
Chemical Oxygen Demand	1/Month	Calculate
Total Suspended Solids	1/Month	Calculate
Total Arsenic	1/Month	Calculate
Total Cyanide	1/Month	Calculate
Flouride	1/Month	Calculate
Total Iron	1/Month	Calculate
Total Mercury	1/Month	Calculate
Total Manganese	1/Month	Calculate
Total Molybdenum	1/Month	Calculate
Total Zinc	1/Month	Calculate

FOOTNOTES

(*1) Calculate the average of monthly reported daily averages for Outfall 001 for six months preceeding the reporting period end date, then calculate the average of monthly reported daily averages for Outfall 002 for six months preceeding the reporting period end date. The stated discharge limitation applies to the sum total of these two calculated values.

(*2) Sum total of daily average mass loads for Outfalls 001 and 002.

INTERIM LIMITATIONS SUM2

During the period beginning the effective date and lasting through June 30, 1996, the permittee is authorized to discharge combined loads, SUM2 - Sum total of Outfalls 001, 002, 004 and 005 (water quality standard levels)) for the month.

Such discharges shall be limited and monitored by the permittee as specified below:

EFFLUENT CHARACTERISTIC	DISCHARGE LIMITATIONS			
	MASS (LBS/DAY)		OTHER UNITS (mg/L UNLESS STATED)	
	DAILY AVG	DAILY MAX	DAILY AVG	DAILY MAX
	(*2)	(*3)		
Total Cadmium	(*1)	(*1)	N/A	N/A
Total Copper	(*1)	(*1)	N/A	N/A
Total Lead	(*1)	(*1)	N/A	N/A
Total Silver	(*1)	(*1)	N/A	N/A
Total Residual Chlorine	(*1)	(*1)	N/A	N/A
Total Aluminum	(*1)	(*1)	N/A	N/A
Chlordane	(*1)	(*1)	N/A	N/A

EFFLUENT CHARACTERISTIC	MONITORING REQUIREMENTS	
	MEASUREMENT FREQUENCY	SAMPLE TYPE
Total Cadmium	1/Month	Calculate
Total Copper	1/Month	Calculate
Total Lead	1/Month	Calculate
Total Silver	1/Month	Calculate
Total Residual Chlorine	1/Month	Calculate
Total Aluminum	1/Month	Calculate
Chlordane	1/Month	Calculate

FOOTNOTES

(*1) Report.
(*2) Sum total of daily average mass loads for Outfalls 001, 002, 003 and 004.
(*3) Sum total of maximum daily mass loads for Outfalls 001, 002. 003 and 004.

FINAL LIMITATIONS SUM2

During the period beginning July 1, 1996, and lasting through the expiration date, the permittee is authorized to discharge combined loads, SUM2 - Sum total of Outfalls 001, 002, 004 and 005 (water quality standard levels) for the month.

Such discharges shall be limited and monitored by the permittee as specified below:

EFFLUENT CHARACTERISTIC	DISCHARGE LIMITATIONS			
	MASS (LBS/DAY)		OTHER UNITS (mg/L UNLESS STATED)	
	DAILY AVG	DAILY MAX	DAILY AVG	DAILY MAX
	(*2)	(*3)		
Total Cadmium	(*1)	0.90	N/A	N/A
Total Copper	(*1)	4.39	N/A	N/A
Total Lead	(*1)	4.63	N/A	N/A
Total Silver	(*1)	0.005	N/A	N/A
Total Residual Chlorine	(*1)	0.35	N/A	N/A
Total Aluminum	(*1)	4.31	N/A	N/A
Chlordane	(*1)	0.0008	N/A	N/A

EFFLUENT CHARACTERISTIC	MONITORING REQUIREMENTS	
	MEASUREMENT FREQUENCY	SAMPLE TYPE
Total Cadmium	1/Month	Calculate
Total Copper	1/Month	Calculate
Total Lead	1/Month	Calculate
Total Silver	1/Month	Calculate
Total Residual Chlorine	1/Month	Calculate
Total Aluminum	1/Month	Calculate
Chlordane	1/Month	Calculate

FOOTNOTES

(*1) Report.
(*2) Sum of daily average mass loads for Outfalls 001, 002, 003 and 004.
(*3) Sum of daily maximum mass loads for Outfalls 001, 002, 003 and 004.

what the Hell was
Fred thinking

B. SCHEDULE OF COMPLIANCE

The permittee shall achieve compliance with the effluent limitations specified for discharges in accordance with the following schedule:

Mass limitations for SUM1 and SUM2

Status Report	12/31/93
Status Report	3/31/94
Status Report	6/30/94
Status Report	9/30/94
Status Report	12/31/94
Status Report	3/31/95
Status Report	6/30/95
Status Report	9/30/95
Status Report	12/31/95
Status Report	3/31/96
Achieve Compliance	7/01/96

Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of this permit shall be submitted no later than 14 days following each schedule date. Any reports of noncompliance shall include the cause of noncompliance, any remedial actions taken, and the probability of meeting the next scheduled requirement.

C. REPORTING OF MONITORING RESULTS

Monitoring results shall be reported in accordance with the provisions of Part III.D.4 of the permit. Monitoring results obtained during the previous month shall be summarized and reported on a Discharge Monitoring Report form postmarked no later than the 15th day of the month following the completed reporting period.

The first report is due on November 15, 1993 .

PART II
OTHER CONDITIONS

A. The term "composite sample" means a sample consisting of a minimum of two grab samples of effluent collected not less than four hours apart over a normal eight hour operating day and combined proportional to flow or a sample continuously collected proportional to flow over a normal eight hour operating day. All such samples shall be typical and representative of effluent generated during the period since the last sample was collected.

B. The Molycorp thiocyanate colorimetric method is approved for the analysis of molybdenum unless susequently determined to be inappropriate by the NMED or EPA.

C. As soon as practicable after the arrival of Molycorp's environmental staff at the site of a tailings spill that reaches the Red River, but no later than two (2) hours after arrival at the site, water quality sampling shall commence. Samples shall be taken at three sites:

(1) Approximately 100 feet above the point where tailings enter the river;

(2) Approximately 100 feet below the point where tailings enter the river; and

(3) Approximately one-half mile below the point where tailings enter the river.

All samples shall be properly preserved and analyzed for:

Chemical Oxygen Demand
Total Suspended Solids
Total Arsenic
Total Cadmium
Total Copper
Total Cyanide
Fluoride
Total Iron
Total Lead
Total Manganese
Total Mercury
Total Molybdenum
Total Zinc
Total Aluminum
Total Boron
Total Chromium
Total Cobalt
Total Selenium
Total Vanadium
Total Beryllium
Total Nickel
Total Silver
Un-ionized Ammonia (as N)
Total Residual Chlorine
Temperature
pH

The results of the analysis shall be submitted to the EPA Water Division Enforcement Branch (6W-EA) and the NMED within 30 days following a tailings spill.

Consistent with the procedures described in the Preventative Maintenance and Surveillance Plan and the Contingency Action and Reporting Plan (June 1975), a written report containing the following information will be sent to the EPA (6E) and the NMED within ten (10) days following any spill:

(1) Date of Spill.

(2) Time when the spill was observed and time when tailings flow into the river was stopped.

(3) Location (pipe or coupling number).

(4) Estimated amount of tailings that entered the river.

(5) Sketch and dimension of size of hole or failure that caused the spill.

(6) Position of failure in the pipe or coupling.

(7) Copy of the latest computer printout covering the pipe or coupling which failed.

(8) Comments, if required for clarification.

D. MINIMUM QUANTIFICATION LEVELS

If any individual analytical test result is less than the minimum quantification level (MQL), a value of zero (0) may be reported for that individual result for the Discharge Monitoring Report (DMR) calculation and reporting requirements.

PARAMETER	MQL
Total Arsenic	0.01 mg/l
Total Beryllium	0.005 mg/l
Total Cadmium	0.001 mg/l
Total Chromium	0.01 mg/l
Total Copper	0.01 mg/l
Total Lead	0.005 mg/l
Total Mercury	0.0002 mg/l
Total Selenium	0.005 mg/l
Total Zinc	0.02 mg/l
Total Cyanide	0.01 mg/l
Total Nickel	0.04 mg/l
Total Silver	0.002 mg/l
Chlordane	0.0002 mg/l
Total Residual Chlorine	0.011 mg/l

This permit may be reopened if MQLs change during the term of the permit.

E. WHOLE EFFLUENT TOXICITY TESTING REQUIREMENTS (Chronic, Freshwater)

1. SCOPE, FREQUENCY AND METHODOLOGY

		Old P.	WQ Anal	
	nat/CN			
		500/1000		
001	Arsenic		5.14/3.42	— Lower New limits
	Cadmium	50/50		
	Copper	150/300	64/43	—— Lower New limits
	Cyanide	25/50	22/14.7	—— missed in F.S.
	Fluoride	3000/3000	—	
	Iron	600/600	—	
	Lead	300/600	125/83	— Lower New limit
002 now	Manganese	1000/1500	—	
	Mercury	1/2	.064/.043	— Lower New limit
002 now	Molybdenum	1000/2000		
	Zinc	200/200		
	Aluminum		87/58	— New limit

004 + 005

Add Aluminum

? WQ cadmium, copper, zinc ??

The results of the analysis shall be submitted to the EPA Water Division Enforcement Branch (6W-EA) and the NMED within 30 days following a tailings spill.

Consistent with the procedures described in the Preventative Maintenance and Surveillance Plan and the Contingency Action and Reporting Plan (June 1975), a written report containing the following information will be sent to the EPA (6E) and the NMED within ten (10) days following any spill:

(1) Date of Spill.

(2) Time when the spill was observed and time when tailings flow into the river was stopped.

(3) Location (pipe or coupling number).

(4) Estimated amount of tailings that entered the river.

(5) Sketch and dimension of size of hole or failure that caused the spill.

(6) Position of failure in the pipe or coupling.

(7) Copy of the latest computer printout covering the pipe or coupling which failed.

(8) Comments, if required for clarification.

D. MINIMUM QUANTIFICATION LEVELS

If any individual analytical test result is less than the minimum quantification level (MQL), a value of zero (0) may be reported for that individual result for the Discharge Monitoring Report (DMR) calculation and reporting requirements.

PARAMETER	MQL
Total Arsenic	0.01 mg/l
Total Beryllium	0.005 mg/l
Total Cadmium	0.001 mg/l
Total Chromium	0.01 mg/l
Total Copper	0.01 mg/l
Total Lead	0.005 mg/l
Total Mercury	0.0002 mg/l
Total Selenium	0.005 mg/l
Total Zinc	0.02 mg/l
Total Cyanide	0.01 mg/l
Total Nickel	0.04 mg/l
Total Silver	0.002 mg/l
Chlordane	0.0002 mg/l
Total Residual Chlorine	0.011 mg/l

This permit may be reopened if MQLs change during the term of the permit.

E. WHOLE EFFLUENT TOXICITY TESTING REQUIREMENTS (Chronic, Freshwater)

1. SCOPE, FREQUENCY AND METHODOLOGY

Ce'= reported concentration in effluent x 2.13 (mg/l)

Cs = water quality standard (mg/l)

Ca = ambient stream concentration upstream of discharge (mg/l)

Qa = critical low flow of stream = 16.7 MGD

Qe = combined daily average flow of dry weather Outfalls 001 and 002

= 4.7 MGD

and Me = Ce x 8.34 x 4.7

where Me = total daily average water quality based mass limits for combined Outfalls 001, 002, 004 and 005 (lb/day)

WQ PARAMETER	Ca	Cs	Ce'	Cd	Ce	Me
T. Arsenic	0.005	0.049	0.022	0.009(*1)	N/A	N/A
T. Cadmium	0.00	0.005	0.036	0.008	0.023	0.90
T. Copper	0.044	0.059	0.155	0.068	0.112	4.39
T. Lead	0.022	0.043	0.214	0.064	0.118	4.63
T. Zinc	0.058	0.595	0.032	0.051(*1)	N/A	N/A
T. Aluminum	2.500	0.087	0.109	1.975	0.087(*2)	3.41
T. Boron	0.00	0.750	0.214	0.047(*1)	N/A	N/A
T. Chromium	0.006	0.546	0.023	0.010(*1)	N/A	N/A
T. Cobalt	0.00	0.050	0.023	0.005(*1)	N/A	N/A
T. Selenium	0.00	0.005	0.009	0.002(*1)	N/A	N/A
T. Vanadium	0.00	0.100	0.064	0.014(*1)	N/A	N/A
Ra226 + Ra228	0.00	30	3.195	0.702(*1)	N/A	N/A
	pCi/l	pCi/l	pCi/l	pCi/l		
T. Beryllium	0.00	0.005	0.009	0.002(*1)	N/A	N/A
T. Mercury	0.00	0.000012	0.0043	0.00000094(*1)	N/A	N/A
T. Nickel	0.00	0.759	0.041	0.009(*1)	N/A	N/A
T. Silver	0.001	0.00012	0.003	0.001	0.00012(*2)	0.005
Chlordane	N/A	0.0000043	0.00009	0.00002	0.00002	0.0008
Un-ion. Amm.(as N)	N/A	0.03	0.0006	0.0001(*1)	N/A	N/A
T. Resid. Chlorine	N/A	0.002	0.023	0.005	0.009	0.35

(*1) Cd<Cs.
(*2) WQS level.

ISSUE NO. 2

As a condition of certification, the NMED specifies that combined biomonitoring should not be conducted for the four permitted outfalls which are spread over approximately 8.75 river miles; and that individual biomonitoring shall be applied at each outfall.

RESPONSE No. 2

The draft permit was based on the discharges of "periodic mine drainage, including collected stormwater" for Outfalls 004 and 005. Subsequently the permittee has specified that the discharges from Outfalls 004 and 005 be limited to stormwater only, as specified in the Form 2D applications; and that "any acid mine drainage will be diverted and retained in the underground mine, where it will be neutralized, pumped from the underground mine to a tailings line and conveyed to the tailings impoundment area." Therefore, Outfalls 004 and 005 are now designated for "periodic mine drainage consisting only of all

Report on Hydrological Connection Associated With Molycorp Mining Activity, Questa, New Mexico

Prepared for:

USEPA, Region 6
NPDES Permits Branch (6WQ-P)

by:

David Abshire
Geologist,
USEPA, Region 6
Groundwater/UIC (6WQ-SG)

Date:

February 13, 1998

EXECUTIVE SUMMARY

This study was initiated following a request from the EPA Region 6 National Pollution Discharge Elimination Systems (NPDES) Permits Branch for assistance in determining if mining activities at the Union Oil of California Molycorp (Molycorp) Questa Molybdenum Mine and associated tailings ponds are a source of contamination to the Red River. Specifically, the request was to determine if these mining activities are resulting in the discharge of acidic, metal laden ground water to surface water via seeps along the Red River through a ground water hydrological connection. The study was conducted by the EPA Region 6 Ground Water Center of Excellence (GWCE). The NPDES Permits Branch supplied several technical reports and correspondence pertaining to the Molycorp site for review. Additional information was acquired from the New Mexico Environment Department (NMED), Molycorp, conservation groups, and a site visit.

With respect to this report, the Molycorp site consists of the actual mine located between the towns of Red River and Questa, New Mexico; and the Questa Valley tailings pond area, located approximately 10 miles downstream from the mine area near the town of Questa. This study focuses on river seeps (ground water flowing gently from the river bank above river water level) in reaches of the Red River adjacent to the Molycorp mining operations and tailings ponds. The seeps are the primary non-point source discharge relative to the NPDES program at these sites. For this investigation, the GWCE evaluated the available geologic, water quality and well test data to determine 1) if ground water and adjacent Red River seep water contamination exist, 2) the probable source for ground water contamination, and 3) if a ground water hydrological connection exists between the source and the contaminated ground water discharged by seeps to the river. As with all reports reviewed during this study, some conclusions in this report are based on the application of scientific principles relative to the issues.

The Red River has 21 perennial tributaries which originate as very high quality mountain streams. Those tributaries which are not near sulfide rich outcrops or historic or recent mining areas remain high quality streams until their confluence with the Red River. The NMED reported that long-time residents considered the Red River pristine prior to mining operations. However, Molycorp contends that its mining operations cannot be the only source for the acidic, high metals seep discharge due to the fact that place names such as Sulphur Gulch, Bitter Creek and Red River allude to the conditions that existed when the region was settled. River water quality in some areas up-river of the mine site is periodically affected by storm events which deliver elevated metals concentrations (above surface water standards) to the river. The NMED states that there are a number of ground water related nonpoint sources of contamination to the river, and that sampling shows that the greatest impact is from acidic, high metals seeps.

Seeps discharge acid rock drainage (ARD) into the river in the mountainous region of the Red River watershed. ARD is characterized by low pH, and elevated concentrations of metals and total dissolved solids (TDS) which typically exceed New Mexico Ground Water Standards (NMGWS). The most common mechanism for its formation involves the oxidation and hydration of sulfide minerals (e.g., pyrite, or iron sulfide) resident in the source rock (volcanic rhyolite).

This chemical reaction results in the generation of sulfuric acid and elevated concentrations of iron. Rhyolite is found in naturally occurring erosional scars within the watershed, and in Molycorp's waste rock dumps (WRDs). The primary metals involved in contaminant transport include; aluminum, magnesium, arsenic, cadmium, chromium, cobalt, copper, iron, lead, manganese, molybdenum, nickel, and zinc.

There are two general modes of contaminant transport in the mountainous region (which incorporates the mining area) of the Red River watershed: steady-state, and pulse loading. In pulse loading, large volumes of weathered sulfide rock are periodically transported to stream channels by storm events. Regional sampling conducted by the NMED revealed that metal loading problems associated with pulse events are largely temporal, and that in most cases a degree of equilibrium is restored to affected stream reaches within a few days. Molycorp has recently constructed a surface water collection system to capture and redirect most of the runoff within the mining area. This system is designed to reduce pulse loading to this reach of the river. Steady-state refers to the relatively continuous discharge of ground water to the river.

At the mine site, the erosional scar and WRD geochemistry are correlative to the adjacent ground water quality. Constituent correlation also exists between ground water and the discharge at seeps along the river. Data from several monitor wells indicate that the shallow alluvial aquifers are saturated, and that these aquifers have the potential to transport low pH ground water with high metals concentrations to surface water. In addition, United States Geological Survey (USGS) data indicate that this particular reach of the Red River is a gaining stream supplied by ground water. Therefore, the erosional scars and WRDs are most probably hydrologically connected through a shallow alluvial aquifer conduit to the Red River seeps within the mine property.

The tailings ponds contain spent slurry from the mine site. Surface water runoff, which contains ARD, is collected and used for milling operations. The milling operations generate the spent slurry which is then piped to the ponds for disposal. The pond fluid is characterized by low pH and high metals concentrations (i.e., ARD). Although Molycorp has constructed a surface water drainage system to divert runoff from entering the pond area, sulfate and metals concentrations found in ground water below and down gradient of the tailings ponds exceed NMGWS due to infiltration of pond slurry water containing ARD. Due to the area's gentle surface gradient and the surface water collection system, steady-state (i.e., ground water) appears to be the only mode of transport within the tailings pond area.

A ground water hydrological connection via the shallow alluvial aquifer exists between the tailings ponds and seeps adjacent to the Red River. Seep discharges in this area are characterized by sulfate concentrations slightly above ground water background. However, metals concentrations do not exceed NMGWS or NMSWS at these seeps. River water quality adjacent to the tailings ponds appears to meet New Mexico Surface Water Standards (NMSWS).

According to the NMED, the seeps down gradient of the tailings ponds are part of a continuing Molycorp monitoring program, which indicates that seep water quality is not deteriorating. Molycorp has constructed a shallow ground water collection system to capture pond leachate being transported to the river; however, some contaminants bypass this system. Molycorp is presently installing extraction wells to capture leachate that bypasses the collection system.

In summary, this investigation concluded that the possible sources for the high metals and sulfate concentrations discharged to the river at the mine site are: 1) historic and recent mine waste rock, 2) erosional scars, 3) remnant deposits of tailings resulting from pipeline breaks, 4) a landfill area at the head of Spring Gulch, 5) the Moly tunnel, (6) the caved area in Goathill Gulch, and 7) runoff directed to the underground workings for collection. Of these, the most probable sources are considered to be the WRDs and the erosional scars based upon the results of material analysis and water quality; and that the acidic seeps and these two sources are wide spread while other sources are localized. The only probable source of ground water contamination at the tailings ponds area are the ponds.

The NPDES Program regulates point sources. NPDES regulations (40 CFR, §122.2) define point source as "any discernible, confined, and discrete conveyance, including but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure,...from which pollutants are or may be discharged..." A documented ground water hydrological connection between a source and surface water discharge may be viewed as a conduit; or a discernible, confined, and discrete conveyance. To identify the source for surface water contamination, proper sampling and monitor wells are required to verify constituent correlation and a ground water hydrological connection between the source and the discharge to surface water. Support exists for a ground water hydrological connection between a source and surface water discharge if water quality analysis and monitor well data determine that 1) there is reasonable constituent correlation between surface discharge, source leachate, and ground water; 2) the ground water gradient is to surface water (gaining stream); and 3) aquifer characteristics support a connection. The most probable sources (erosional scars, waste rock dumps, and the tailings ponds) satisfy these requirements. The tailings ponds supply water and elevated metals concentrations to the ground water through infiltration, but no documentation exists for the ponds being a source of river metals concentrations. Therefore, it appears that contaminants in ground water are attenuated prior to the discharge of ground water and pond water to the river in this area. At the mine site, the percentage of metals concentrations or discharge volume supplied to a particular seep by each probable source (erosional scar or waste rock dump) could not be determined using the available information.

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1.0 INTRODUCTION

The objective of this report is to determine the source for the acidic, high metals seeps (ground water flowing gently from the soil) along the Red River bank and to determine if sufficient documentation exists to substantiate a ground water or surface water hydrological connection between the source and seep discharge to the river. Surface water drainage pathways were evaluated to determine if surface water runoff could supply contaminants to the seeps. Monitor well tests and ground water quality data were evaluated to determine if subsurface pathways existed between the source and the seeps

The Amigos Bravos and New Mexico Citizens for Clean Air and Water conservation groups (hereafter referred to as Amigos et al) contend that the Union Oil of California Molycorp (or Molycorp) excavation and disposal activities at the mine site are the cause for the increase in metals concentrations delivered to the river through a ground water hydrological connection to seeps located along the river bank. Amigos et al, have requested that the Region 6, National Pollution Discharge Elimination System (NPDES), Permits Branch require Molycorp to obtain a permit for this ground water discharge. The New Mexico Environment Department (NMED) considers the acidic, high metals seeps, which exist within the Molycorp mine boundary, the principal cause for metals loading to this reach. In contrast, Molycorp considers the erosion and surface water transport of sulfide rich naturally occurring erosional scar material as the major source of metals loading to the river. Therefore, although all possible sources were evaluated as to their relative metals contribution to surface water, this report concentrates on historic and recent mine sites and natural factors which may be a source for the continuing degradation of the Red River.

The Red River watershed is located in north central New Mexico, Taos County. Studies by the United States Geological Survey (USGS) and others have documented that for most of its length, the Red River is a gaining stream supplied by groundwater. As indicated in Appendix 1, the river is classified in the New Mexico Standards for Interstate and Intrastate Streams from the Rio Grande upstream to the mouth of Placer Creek with the following uses: coldwater fishery, fish culture, irrigation, livestock watering, wildlife habitat, and secondary contact. It has been documented (NMED, March 1996) that Red River standards are most often not attained due to various non-point sources. Its impairment is mainly due to the influx of low pH levels, metals, biological toxins, septic tank effluent, municipal sludge, petroleum products, and sediment loading due to storm events. The most incessant and wide-spread effect to river water quality is from the influx of fluids with low pH and high metals concentrations, which are delivered to the river via ground water transport to seeps along the river and surface water runoff.

As illustrated by Figures 1 and 2, the Molycorp mining operations include the open pit, old and new underground mining areas, waste rock dumps (WRDs), a mill site and associated tailings piles. The Molycorp mine property is located north of the Red River and Highway 38 between the towns of Red River and Questa and incorporates approximately five square miles. Molycorp began the underground mine workings in 1923 for molybdenum, an element used in strengthening steel. In

1941, mining had extended to such depths that a mile-long tunnel (hereafter referred to as the Moly Tunnel) was constructed to facilitate drainage of the underground workings into the Red River. In 1965, Molycorp abandoned the underground working and switched to open pit operations over the existing underground mine. Within this period, the Moly Tunnel was closed by placing concrete plugs at each end. To obtain access to the subsurface molybdenum deposits, during open pit operations the overlying surface material was excavated and deposited progressively down gradient in canyons as WRDs. Molycorp has covered approximately 500 surface acres near the operations with hundreds of feet of this waste rock material. In 1983, Molycorp ceased open pit operations and commenced new underground mining approximately 4,000 feet southwest of the old location. Mining operations were temporarily suspended from 1986 to 1989 and from 1992 to 1995 due to general economic conditions.

To alleviate the low pH and high metals loadings to the Red River adjacent to the Molycorp mine site, Molycorp (with NMED assistance) dug trenches and installed a series of anoxic alkaline (limestone) filters in early 1996 at a site along the river (Capulin Canyon) where NMED considers several of the seeps particularly active. Prior to limestone placement, the NMED determined that ground water quality from the trenches was correlative to the adjacent Red River seep water quality. However, after a short period of time, these filters became ineffective in modifying the pH and metals content.

The tailings impoundment is located approximately six miles west of the mine near the town of Questa and incorporates approximately 640 acres. After the molybdenite is extracted at the mine site through milling operations, the spent slurry is pumped out of the mining area through a ten mile pipeline constructed along the Red River to the tailings ponds at Questa. Since 1965, Molycorp has discharged approximately 95 million tons of tailings into the Questa impoundments.

The tailings impoundment, as illustrated on Figure 3, consists of several inactive and two active unlined ponds. The ponds were constructed consecutively within two arroyos by placing earthen dams at the down gradient end of each pond. South Pass Resources (April 13, 1995) reported that the slurry delivered to the ponds consists of 38 percent solids and 62 percent liquids. Standing water in the ponds was originally collected by surface drains and directed to Pope Lake, which is located south of Dam No. 4, and then to the Red River. In the 1970's Molycorp installed seepage barriers to intercept seepage and shallow ground water south of Dam No. 1 and southeast of Dam No. 4. Vail (September 24, 1993) states that these barriers were effective for some time but recent evidence indicates they are less effective in decreasing metals concentrations. In 1983, Molycorp installed an ion exchange facility to process the water at Pope Lake prior to discharging it to the river. An additional drainage system has been installed beneath both dams which consists of chimney drains connected to under drains at the base of the dam. Vail (September 24, 1993) states that Molycorp is presently investigating the feasibility of constructing additional seepage barriers and/or other facilities to substantially reduce the seepage flow down gradient of the tailings ponds in this area.

Several private wells located down gradient of the ponds were used by residents for drinking water purposes. In 1976 Molycorp plugged several of these wells and re-routed service from the Questa community well system due to elevated sulfate and Total Dissolved Solids (TDS) concentrations making private well water unacceptable as a drinking or irrigation source.

The NMED (March, 1996) states that in 1966, in response to Molycorp operations, the United States Department of Health, Education and Welfare conducted a baseline water quality survey of the Red River. The survey revealed that although there was periodic metals loading due to storm events from small historic mine sites adjacent to the river, the overall river water quality was determined to be good to exceptional. In 1971, the EPA determined the chemical water quality of the river remained good except for contamination resulting from occasional breaks in the tailings pipeline. However, in the same time period, the New Mexico Department of Game and Fish discovered the absence of a once thriving fish population in the reach adjacent to the mine. A 1982 EPA study concluded that the river was substantially impaired from metal loading, but no definitive source was determined. The NMED (March, 1996) reports that in 1984, the Bureau of Land Management documented pollution sources and found a downstream increase of various constituents, which at times exceeded water quality standards, and determined the major impacts on water quality were due to mining activities.

As indicated by Figure 2, there are three National Pollution Discharge Elimination System (NPDES) permitted point sources (outfalls) within the Red River watershed: the town of Red River treatment plant, the trout hatchery at Questa, and one permit for four Molycorp discharges (two outfalls at the tailings ponds (Questa) and two at the mine site). The NMED (March 1996) concluded that only the waste treatment plant discharges upstream of the most impacted reach of the river, with the effluent considered good quality. The hatchery is downstream of the impacted portion of the river, with its effluent apparently improving river water quality through dilution.

2.0 INVESTIGATIVE APPROACH

Molycorp operates within two topographically diverse areas of the Red River watershed. As illustrated by Figures 4 and 5, the mining operations are located within a mountainous region. The tailings ponds are located within the Questa valley, which is an area of low relief (Figure 3). Due to differing depositional environments; aquifers in each area have different relief, intrinsic characteristics (grain size, porosity, etc.) and ground water chemistry. In addition, surface gradient and vertical hydraulic conductivity dictate the percentage of precipitation which will infiltrate to recharge ground water. Therefore, the tailings ponds and mining area were evaluated separately.

Reports on sample studies and historic observations from Molycorp, conservation groups, and the NMED were reviewed to determine if sampling methodology, surface/subsurface geology and historic research were adequate to identify the probable sources for the acidic, high metals Red River seeps in these areas. Available data for this evaluation consisted of 1) pre and post-mining

topographic maps; 2) ground water data (well tests, depth to water, and quality); 3) whole rock and soils geochemistry; 4) water quality analysis of, selected natural spring and Red River seeps (historic data limited); 5) historic and recent Red River water quality data (historic data limited); 6) subsurface lithologic data; and 7) climatological data. Historic and recent aerial photographs were not available for review. The NMED states that aerial surveys are sparse and do not indicate any relevant data. Chemical constituents found in ground water and surface water samples were compared to New Mexico Ground Water Standards (NMGWS) and New Mexico Surface Water Standards (NMSWS) in establishing if ground water or surface water contamination did exist (see Appendix 1 and Appendix 2 for relevant data on NMGWS and NMSWS). In so doing, it was assumed that acceptable sampling methodology was employed and that samples are representative of the immediate area.

The NMED (March, 1996) reports that acidic, high metals seeps at the mine site exist only on the north side of the Red River. The majority of seep and spring discharge and field drainage occurs north of the river at the tailings ponds. Therefore, although a general evaluation was conducted in the Red River watershed to determine the source location, this investigation concentrated on the geology and hydrology north of the river. The following investigative approach was the most appropriate in determining the source for high metals and sulfate buildup within the Red River watershed:

1) Red River water quality was evaluated to determine the general area of the source. Degradation of a particular reach of a drainage system, or a marked decrease (spike) in water quality at a specific sample location along the river would indicate that the source exists in the general area. Degradation of a small portion of the river would indicate a specific source. However, if contamination was discovered to be wide spread, more than one source or a large source could be expected. A concentration of seeps in a particular area was used as an additional indicator of source location.

2) Surface topography, within the general area of the source, was evaluated to define surface water pathways to the Red River. All possible sources within surface flow paths (i.e., subwatersheds) to the river were evaluated to determine their possible metals contribution to the river.

3) Available source leachate quality was evaluated to determine the geochemical fingerprint of each possible source. A geochemical assessment of each source was performed to determine its capability to discharge high metals concentrations to ground water, and in concert with a geochemical assessment of ground water and seep discharge, determine the specific source location.

4) Near-surface geology and subsurface strata and hydrogeology were evaluated to determine if a ground water hydrological connection exists between the probable

source and the river. A knowledge of the local depositional environments leads to a better understanding of an aquifer's capability to deliver ground water to surface water.

5) Spring and seep water quality, monitor well tests, and ground water quality are of particular interest in documenting a hydrological connection between a most probable source and seep discharge. Background surface water and ground water samples were evaluated to determine if only natural sources are the cause of degradation to the water system. Monitor well tests were used to characterize the aquifer's ability to act as a conduit for transport of contaminants from a source to surface water. Spring , seep and ground water samples were utilized to identify a chemical correlation to a particular source.

3.0 TAILINGS PONDS AREA

Documentation for several geologic and hydrologic conclusions were omitted from some of the reports reviewed for this study. Therefore, a concentrated evaluation of pond water and associated metals concentrations (hereafter referred to as leachate), ground water and Red River water quality was considered the principal approach in determining if pond leachate has impacted the ground water and the river. Water samples from pond leachate and ground water down gradient of the ponds were evaluated to determine if a chemical correlation existed, and therefore, establish a tailings pond source for immediate ground water contamination. Seep, spring, field drainage and ground water quality, which are summarized on Table 1 and 2, were evaluated to determine if a correlation existed, and if so, establish a ground water hydrological connection between the source, and seep, spring (artesian) and field drainage (groundwater seeping onto the surface of the ground). Attenuation is a factor in ground water transport. Therefore, utilizing background ground water quality, and seep/spring/field drainage water quality was evaluated to determine if pond leachate still affected the water quality at the seep/spring/field drainage locations.

Ground water data from Molycorp's peizometers and shallow alluvium monitor wells indicated that tailings pond leachate has affected the ground water quality down gradient (towards the Red River) of the ponds. Peizometers have documented infiltration of ponds leachate to the shallow aquifers below the ponds and dams. Although attenuation through ground water transport is a factor in this area, monitor wells document ground water flow from the ponds to the river. As a consequence, Molycorp is presently installing capture wells to intercept ground water between the tailings ponds and the river.

Data concerning the question of whether or not the tailings ponds are hydrologically connected to the Red River were limited to those found in Vail (September 24, 1993) and South Pass Resources, Inc. (April 13, 1995). The South Pass Resources, Inc. (SPRI) report contained monitor well test and ground water quality data and descriptions of the lithology encountered by a select number of

wells. Screened intervals for several wells were not supplied in the report. However, focusing on wells with complete information regarding separate aquifer systems; ground water chemistry, velocity, and direction; and barriers to ground water flow; the shallow aquifers were determined to be the primary conduit to the river. A few monitor well tests discussed within the narrative of the SPRI report were not available within the study for review. Vail conducted a hydrological study of the area using USGS stream data; surface, seep, and monitor well water quality data; and tailings pond leachate quality data. Vail has identified volumes and quality of tailings pond leachate delivered to the Red River, and therefore, has documented a hydrological connection between the ponds and Red River.

In reviewing the previously mentioned investigative approach, more weight was given to a geochemical assessment in determining a ground water hydrological connection to the river. The reason for this is related to several factors which affect the water level and water quality results for all monitor wells, and therefore, the geochemical assessment was deemed to be more reliable. These factors include: 1) ground water chemical reactions with materials used for construction of monitor wells; 2) monitor wells screened in hydraulically separated aquifers, which lead to problems in defining area aquifer systems; 3) location of monitor wells relative to barriers (i.e., faults, etc.), which may re-direct or impede ground water flow; 4) different sample periods (e.g., spring, winter, etc.), which lead to ground water quality and elevation differences; 5) hydraulic head in the ponds relative to the dilution potential of the underlying aquifers; and 8) sampling methodology.

3.1 GENERAL AREA OF SOURCE

As illustrated on Figure 3 and summarized in Table 1 and 2, river water samples, collected by Vail (September 4, 1993), were collected from up to down gradient of the tailings ponds. The permitted discharge from outfall 002 and 003 was considered in evaluating river water quality. No definitive change or spike in sulfate or metals concentrations was observed from up to down gradient of the ponds, which indicated that river water quality could not identify the source location. However, as indicated by Tables 1 and 2, a correlation did exist between seep/spring/field water quality, ground water quality, and pond leachate chemistry; which indicated the tailings ponds as the probable ground water contaminant source.

3.2 POTENTIAL SURFACE PATHWAYS FOR CONTAMINATION

The surface topography is a sloping alluvial plain, with surface gradient being generally to the Red River. It appears that no surface runoff avenues to the Red River exist south of the tailings ponds due to the construction of dams and barriers. Drainage ditches were constructed up gradient of the tailings ponds to divert natural runoff from entering the pond area.

3.3 SOURCE GEOCHEMICAL CHARACTERIZATION

As evidenced by surface discharge and ground water samples collected by SPRI (April 13. 1995), the area's alluvial and volcanic deposits, which include the aquifers considered hydrologically connected to the river, cannot geochemically account for the metals and sulfate concentrations observed in ground water down gradient of the ponds, or the sulfate concentrations observed at the seeps/springs/field discharge. The ground water at monitor well number 10 (MW-10), as seen on Figure 6, is the best water quality within the area (TDS 150 mg/l, sulfate 35 mg/l). Because of this, and the fact that the well is located east of the ponds, where it is evidently outside of the influence of pond infiltrate due to a ground water flow direction to the southwest, samples taken from this well are considered to be indicative of ground water quality before mining activities took place (i.e., background). In comparison to the samples taken at MW-10, several ground water samples south of the ponds show moderately elevated concentrations of sulfate, TDS, manganese and molybdenum. In addition, there exists no natural source for the elevated molybdenum concentrations found in ground water at MW-2 and MW-C; however, tailings are derived directly from the milling operations for molybdenum. Therefore, the elevated sulfate and metals concentrations found in ground water are considered to be from the tailings ponds and not from natural sources.

3.4 SURFACE AND SUBSURFACE GEOLOGY AND HYDROGEOLOGY

Establishing a hydrological connection between a source and contaminated surface water requires the evaluation of several hydrogeological parameters. It must be determined that ground water below the source has been affected by infiltration of source leachate and that conduits exist for the ground water transport of this leachate to surface water.

The surface geology was characterized to determine the erosional and depositional factors which may affect the flow directions within the subsurface aquifers. The subsurface was evaluated through monitor well tests and lithologic samples to determine which aquifers may be conduits for ground water flow from a source to surface water. Monitor well tests and lithologic samples were utilized to define individual aquifers (vertical hydraulic separation), aquifer lateral continuity, and to determine the transport capabilities of the aquifers.

3.4.1 SURFACE AND SUBSURFACE GEOLOGY

Surface topography and subsurface geology characterize the area as one of active structural deformation, deposition, and erosion. The structurally active nature of the area is represented by several faults which displace the shallow alluvial and deeper basaltic aquifer deposits. However, this displacement does not appear to halt ground water flow to the river, which is apparently due to the juxtaposition of different but permeable aquifers or juxtaposed impermeable aquifers redirecting ground water flow to the south (to the river).

SPRI (April 13, 1995) used borehole and geophysical logs to characterize the subsurface. The area consists of volcanic rocks, and sedimentary and lacustrine deposits. The upper alluvial and lacustrine deposits (Santa Fe Group) consist of an Upper Aquifer Unit (UAU), Middle Aquitard Unit (MAU), Lower Aquifer Unit (LAU), and Basal Aquitard Unit (BAU). SPRI states that each unit exhibits vertical variation in lithology; each unit containing clay, gravel and sand lenses. The Santa Fe Group overlies a major regional aquifer which exists in the basalts and volcanics (basalt/andesite unit (BAAU)). The UAU (upper Santa Fe Group) underlies Dam No. 1. However, only 50 feet of the lower Santa Fe Group exists immediately down gradient of Dam No. 4 because of the erosion of some upper Santa Fe Group units.

3.4.2 HYDROGEOLOGY

Monitor well placement and aquifer tests were used to determine several aquifer parameters including ground water gradient, if vertical hydraulic separation exists between aquifer units, if aquifers have lateral continuity, and if barriers exist to redirect ground water flow. Vertical hydraulic separation would indicate that a basal aquitard does exist. An aquitard would indicate no further migration of contaminants into deeper aquifers, and substantiate ground water transport of pond leachate down gradient. The lateral continuity of a hydrologic unit (one aquifer or juxtaposed aquifers) must be determined to define the conduit (i.e., that the hydrologic unit exists from the ponds to the river) for the ground water transport of pond leachate to the Red River. If hydraulic separation or lateral continuity is established at monitor wells, it is assumed that they exist within the general area of the wells.

3.4.2.1 GROUND WATER GRADIENT AND BARRIERS

SPRI (April 13, 1995) conducted aquifer tests on 3 wells (EW-2, EW-3, and MW-7), which are completed (screened) in separate units of the Santa Fe Group (Figure 6). Analyses of well tests indicate good conductivity, recharge and localized barriers to flow. Recharge and barriers to flow may be caused by changes in hydraulic conductivity or faults. Monitor well ground water elevations indicate that the ground water flow direction is generally to the southwest in the UAU and the BAAU. Ground water flow direction for the LAU is unknown; however, it is expected to flow to the southwest because the LAU lies between the UAU and BAAU. SPRI (April 13, 1995) states that USGS stream gage data indicate an overall gain (approximately 30 cfs) between the Questa ranger station and the fish hatchery. Therefore, although faults and juxtaposed units may locally redirect ground water flow, flow is still directed to the river.

SPRI (April 13, 1995) reports that the underdrains (connected to the chimney drains), which were installed to intercept leachate below each dam, would rest on a shallow upper aquifer unit beneath Dam No. 1 and probably on the upper sandy member of the basalt aquifer unit at Dam 4 (Figure 6). Piezometers were installed into the dams to measure the saturated surface to determine the infiltration rate to the underlying aquifers. However, SPRI has only submitted information on the pond leachate infiltration capacity below Dam No. 1. The slope of the saturated surface showed

discharge to the under drain system beneath Dam No. 1. As illustrated on Figure 6 and 7, piezometers within Dam No. 1 and monitoring wells south of the dam document that ground water gradient is to the south from Dam No. 1 to at least MW-7. Because the ponds are unlined, the drain system apparently captures some but not all of the seepage through the dam. The remaining leachate enters the underlying shallow aquifer over the area of the ponds and moves down gradient towards the river, thus bypassing the drain collection system.

Ground water levels from monitor wells located south of Dam No. 1 and 4 were evaluated to determine the ground water elevation relative to the Red River to establish which portions of the river were a gaining or losing stream. MW-11, located south of Dam No. 4, showed water levels below the adjacent Red River level. SPRI (April 13, 1995) states that this situation may indicate river recharge to ground water in this area but not enough to impact the overall gain recorded by stream gages. It must be noted that only one monitor well exists in this area, therefore, ground water gradient in this immediate area cannot be substantiated. For the segment of the Red River between Big Springs and Pope Lake, the water table in the basalt unit appears to be just above river level. MW-1, located south of Dam No. 1, showed water levels above the level of the river, indicating ground water recharge to the river. Ground water elevations do establish ground water flow in a general southwest direction (to the river).

3.4.2.2 VERTICAL HYDRAULIC SEPARATION

Vertical hydraulic separation of aquifers was investigated to determine basal aquitards, and in so doing, define the hydrologic unit capable of transporting contaminants to the river. Separate flow systems (vertical hydraulic separation), due to confining clay beds, occur within the Santa Fe Group (shallow alluvial aquifers) and the underlying basalt aquifer. Monitor wells screened in different aquifers show different depths to water indicating vertical hydraulic separation to some degree. Local vertical hydraulic separation can be supported by a pump test conducted by SPRI (April 13, 1995) at monitor well EW-2, which is illustrated on Figure 6. During the EW-2 (screened in upper portion of LAU) pump test, water levels in MW-7C (screened in lower portion of LAU) were monitored. SPRI reports that only minor water level fluctuations (range of 3.2 inches), which SPRI attributes to barometric changes, were observed in MW-7C, indicating that these wells are apparently screened in hydraulically separated lenses of the LAU.

3.4.2.3 LATERAL CONTINUITY

Lateral continuity must be established to document a continuous conduit for ground water flow from the source to surface water. Establishing lateral continuity over a great distance for a specific hydrologic unit is not possible due to the present monitor well scheme. However, local lateral continuity has been demonstrated by the EW-3 pump test. Water levels within MW-7A were monitored during the EW-3 pump test (both screened in the lower UAU). Observed water level fluctuations in MW-7A established a lateral ground water hydrologic connection between MW-7A and EW-3. These tests indicate good hydraulic conductivity and local lateral continuity. The

perched nature of some aquifers suggests lateral discontinuity most probably caused by juxtaposition, due to fault displacement, of different aquifers with differing conductivity. Although juxtaposition is assumed due to faulting, ground water flow through the fault cannot be documented due to the present monitor well scheme. However, fault trend is north-northeast to south-southwest and ground water gradient is to the river, and therefore, ground water flow direction is to the river. In addition, studies of USGS gage station data indicate the river to be a gaining stream supplied by ground water, which indicates that ground water flow is to the river within a major portion of the tailings area.

3.5 RIVER, SPRING, SEEP AND GROUND WATER QUALITY

Pond, river, spring, seep and ground water quality were evaluated to determine if a water quality correlation existed. In doing so, documentation could be established for a hydrological connection from the ponds to the river via ground water transport.

Vail (September 24, 1993) states that tailings pond water and associated contaminants (leachate) seep to the ground water which flows generally in a southwesterly direction and discharges to Red river. This seepage contains elevated concentrations of sulfates (840+-mg/l), molybdenum (2+-mg/l), manganese (1.4+-mg/l), and total dissolved solids (1700+-mg/l). In his discussion of pond leachate avenues below Dam No. 1, Vail concluded that this seepage flow is generally in the shallow alluvium. Vail believes that a large percentage of the seepage from Pond No. 4 is transported by ground water flow in the volcanic formations and that most of this ground water flow is discharged to Red River at the numerous springs along the Red River Gorge. SPRI (April 13, 1995) reports that the section of the Red River that may be impacted by the tailings ponds is 1.84 miles in length (roughly from the 002/003 Outfall west to the area of the Fish Hatchery)."

3.5.1 RIVER

As illustrated on Figure 3, Vail collected seep/spring and river water samples at several locations between State Road 522 and the Red River State Fish Hatchery. Comparisons of up-river metals concentrations with river water samples adjacent to the ponds suggests that river water quality is not affected by a pond source. For example, river water samples collected from up to down gradient of the ponds show that only a small difference in river metals concentrations, with the most up river sample normally having the greater concentrations. There is a slight influence on river water quality down gradient of outfall 002 and 003 (Figure 3) due to the permitted discharge. This influence was considered in the evaluation of river water quality. Analysis of submitted river water samples, as summarized on Table 1, and conversations with the State of New Mexico and EPA surface water staff, indicate that river water quality is within surface water standards.

3.5.2 SPRINGS

Some Red River springs have sulfate concentrations below NMGWS. Questa Springs, as seen on Figure 6, is most likely due to a north-northeast to south-southwest trending fault which redirects a portion or the total southwesterly flow of ground water to the south (to Questa Springs). Questa Springs water quality has a TDS of 173 mg/l and a sulfate concentration of 80 mg/l, which is just above background (TDS 150 mg/l, sulfate 35 mg/l) and below NMGWS (TDS 1000 mg/l, sulfate 600 mg/l). Questa Springs TDS and sulfate concentrations are lower than ground water concentrations below Dam No. 1, which indicates that attenuation through ground water transport is a factor in concentrations delivered to seeps and springs along the river.

3.5.3 SEEPS

Seep water quality (collected by Vail, September 24, 1993, and summarized in Table 1) was used to some degree as a ground water quality indicator to evaluate the general ground water quality in the immediate area. Two field drainage (field surface seepage) sites immediately south of Dam No. 1 have moderately elevated TDS concentrations; one has elevated sulfate and the other elevated iron concentrations above NMGWS. One field drainage sample, located midpoint of Dam No. 1 and the river, has molybdenum concentrations above NMGWS. These field drainage samples indicate a tailings source. Although sulfate concentrations discharged at Red River seeps are just above ground water background concentrations, which indicate a probable tailings source, they are below NMGWS. These observations are an additional indication that attenuation of pond leachate through ground water transport is a factor in decreasing sulfate and metals concentrations in ground water delivered to seeps and springs along the river.

3.5.4 GROUND WATER QUALITY

Analyses of ground water samples collected below and down gradient of the ponds establishes a correlation between pond leachate, and ground water and seeps/springs/field discharges south of the ponds. Several ground water samples show moderately elevated concentrations of sulfate, TDS, manganese, and molybdenum. The ground water at MW-10 (Figure 6) is the best water quality within the area (TDS 150 mg/l, sulfate 35 mg/l). South of the ponds, the UAU and upper portion of the MAU usually have high TDS and high sulfate concentrations. The highest sulfate concentrations were detected at MW-C (970 mg/l), a shallow piezometer at the toe of the Dam No. 1. The down gradient MW-A has lower sulfate concentrations (560 mg/l) indicating dilution. Piezometer MW-9A, located approximately 1200 feet down gradient (south) of MW-A, has greater sulfate concentrations (680 mg/l) than MW-A. Apparently, inconsistencies between ground water flow direction and ground water quality indicate local attenuation, interflow between aquifer members (dilution), and/or redirection of ground water flow paths. This redirection is most likely due to faults and/or changes in hydraulic conductivity. However, ground water gradient and quality indicate that pond leachate does infiltrate to the UAU and moves down gradient towards the river.

3.6 SUMMARY

A water quality comparison of pond leachate, ground water and seep/spring/field drainage down gradient of the ponds indicates that the only probable source for elevated sulfate and metals concentrations found in ground water are the ponds. However, the available information indicates that ground water discharge via seeps along the river and river water quality are within NMGWS and NMSWS. A complete summary of the tailings ponds and the Molycorp mine site is found at the end of this report.

4.0 MOLYCORP MINE SITE

The mine site is located in a more complex geologic setting than the tailings pond area. The mine property is located in a mountainous region, which is cut by deep canyons. The extreme topographic gradient was formed through erosion of volcanic flows associated with the Questa caldera (a large crater formed by the collapse of a volcanic cone). As indicated by Figures 4 and 5, the surface gradient directs surface water runoff, and shallow ground water, to the Red River.

Historic and recent mining operations and natural sources, within the Molycorp mine area and up-river of the mine, were investigated to determine their potential contribution of metals to the river. Investigations revealed that the possible sources are: 1) historic and recent mine waste rock, 2) naturally occurring erosional scars, 3) remnant deposits of tailings resulting from pipeline breaks, 4) the landfill area at the head of Spring Gulch, 5) the Moly tunnel, (6) the caved area in Goathill Gulch, 7) runoff directed to the underground workings for collection, and 8) the mill site. Of these, the most probable sources are considered to be the WRDs and the erosional scars because of source material and water quality (leachate and ground water) analysis results. An additional indicator of source location is that the acidic seeps and these two sources are wide spread and other possible sources (land fill, Moly tunnel, etc.) are localized.

Approximately 59 historic mine sites exist within seven tributaries of the upper Red River watershed. All of these mines were fairly small operations, with associated waste rock piles being relatively minor. The NMED (March, 1996) states that although these sites contribute some contamination to the river through surface water runoff associated with storm events, none appear to be a significant source of metals loading to ground water or surface water.

4.1 GENERAL AREA OF SOURCE

The most significant water quality degradation occurs within the middle reach of the Red River from Questa to the town of Red River (Figure 2), which contains the Molycorp mine and most of the major scar areas. River surveys have documented declines in river water quality progressing downstream from the town of Red River. The most acceptable method for determining the general

area of the source was the river water analysis for sulfate gain, which used sulfate as a proxy for metals to examine how the loading of metals to the Red River has changed over time.

As illustrated in Figure 8 and summarized in Table 3, Red River water quality data, collected in May 1994 by SPRI (April 21, 1995), indicate a spike in sulfate concentrations. A Red River sample collected just up river of the confluence with Columbine Creek (RR-12) indicates a two-fold gain in sulfates compared to up river samples from Hot-N-Tot Creek to just up river of Portal Springs (RR-5 to RR-10). Sample RR-13 shows a decrease in sulfate concentrations due to inflow from Columbine Creek. However, RR-13 concentrations remain greater than up river samples. Red River sulfate concentrations down river of sample RR-13 are generally the same as the RR-12 sample. This area of increased sulfate concentrations is most probably due to the numerous seeps located within and just down river of the Molycorp boundary.

Seeps are considered the primary and most incessant source for metals loading to the river. Consequently, an additional indicator of source location is that the greater percentage of and most active acidic, high metals seeps exist in the vicinity of the Molycorp mine. Therefore, Red River water quality data and seep locations indicate the source to be within the general area of the Molycorp mine property.

4.2 POTENTIAL SURFACE PATHWAYS FOR CONTAMINATION

Surface avenues to the Red River were evaluated to determine the probability of surface water runoff supplying a portion of or the total metals load and ground water discharge to the river via seeps. The surface topography ranges in elevation from approximately 7600 to 10,800 feet within the mining area. Most of the topography consists of very steep slopes. Major tributary canyons have gradients on the order of 11 to 15 degrees. Due to the topographic gradient, unconsolidated nature of the area alluvium, and storm events; sediment and surface water runoff is directed to the river.

As can be seen by comparing Figures 4, 5 and 9, the steep gradient within the mountainous region facilitates the formation of erosional scars. Erosional scars are so easily eroded that mudflows are produced by heavy precipitation, creating debris aprons where tributaries enter the Red River. Mudflows have at times damned the river. However, the NMED (March, 1996) has determined through water quality analysis that metals loading problems associated with these events are largely temporal, and that in most cases river water quality is restored within a few days.

Molycorp has implemented a water management and sediment collection program at the mine site, which incorporates the majority of the mine property (Figure 4). Surface water within the majority of the mine boundary is redirected to the open pit and caved area (a surface depression within Goathill Gulch canyon caused by the collapse of a portion of the roof of the underground mine) and collected in the underground mine workings. Apparently, due to the collection system,

sediment loading and surface water runoff to the river adjacent to the mine property is not the principal factor in metals loading to this reach of the river.

Molycorp's collection system captures surface water runoff, and spring discharge in unlined catchment basins. The unlined basins undoubtedly allow infiltration to the underlying aquifers. Although a surface system has been installed to intercept surface water runoff and spring discharge, ground water has the potential to bypass the system and flow down gradient to the river Therefore, the shallow upper valley fill aquifer has the potential to transport high metals concentrations to the Red River. Subwatersheds (canyons), as described below, were individually evaluated to determine if they could function as contamination pathways.

Surface water runoff and seepage from the Capulin Canyon WRDs and erosional scars (Figures 1, 4, and 9) are collected in surface impoundments. However, ground water flow has not been affected by the collection system and has the potential to transport high metals concentrations to the river.

The Goathill Gulch topography indicates surface and ground water flows to the river. However, a sink, the caved area (Figure 1), within Goathill Gulch canyon may restrict surface and ground water flow. Apparently, the caved area is a vertical rubble zone of displaced aquifers and bedrock material, which extends from the surface to the underground mine workings. This rubble zone acts as a conduit between the surface and the underground mine. The caved area may capture most of the surface water runoff from upper Goathill Gulch canyon. The caved area captures and directs surface water to the underground mine, where it is redirected to the mill for milling operations. The caved area may also capture ground water within the immediate area, and in so doing, cause a local cone of depression (not to be confused with the cone of depression caused by the dewatering of the open pit and underground workings).

All Goathill Gulch ground water, up gradient of the caved area, may be captured by the caved area. However, no information is available to indicate whether the shallow aquifers have been sufficiently displaced (due to the collapse of the stratigraphic section) such that all up gradient ground water is captured by this area. SPRI (April 21, 1995) states that mounding of the water table surface may occur due to redirection of surface runoff to the caved area, and that the water mound might extend to the valley fill in Goathill Gulch from which it could more easily reach the river. Surface water runoff down gradient of the caved area is intercepted by the surface water collection system. However, no subsurface collection system exists down gradient of the caved area. Therefore, if up gradient ground water is captured by the caved area, subsurface flow is still probable from the caved area to the river. However, the area of ground water available for discharge to the river would be defined by the location of the down gradient outer rim of the local cone of depression, which forms due to the ground water being captured by the caved area. The location of the outer rim is dependent on the depth to the area's undisturbed basement rock, vertical hydraulic conductivity of the rubble (i.e., discharge rate), hydraulic conductivity of lithologic members, and the canyon gradient within the vicinity of the caved area to the river. Therefore, the area of ground

water available for discharge to the river, and contaminants from sources within that area, would be from the local depression's southern outer rim location to the river. However, no information exists to define the location of the local cone of depression's outer rim, or in fact, indicate that a local cone of depression does exist.

Surface water runoff from the Sugar Shack South and Middle WRDs is collected in unlined catchment basins. Due to the unlined nature of these catchment basins, leachate from these sources, and the erosional scars which underlie these WRDs, has the potential to infiltrate to the shallow alluvial aquifer and move down gradient to the river.

Natural drainage has been drastically altered in the Sulphur Gulch subwatershed by the placement of Spring Gulch WRD, and Spring and Sulphur Gulch WRD. Surface water runoff is assumed to be captured by the Molycorp collection system. However, surface water can potentially migrate down to the shallow aquifers through infiltration.

There are other unnamed tributary canyons which exist within the Molycorp boundary and direct surface and ground water flow to the river. MW- 7 (Figure 1) is located within a tributary valley which extends up gradient to the Capulin Canyon and Sugar Shack West WRDs. MW-11 and 13 are within minor tributary valleys which were overlaid by the Sugar Shack South and Middle WRDs.

As summarized above, surface water runoff to the river, via canyons, has generally been intercepted by the surface water collection system. Therefore, surface runoff is not considered the primary transport mechanism for metals loading to the Red River.

4.3 SOURCE GEOCHEMICAL CHARACTERIZATION

Mining operations were evaluated to determine the most probable source for the high metals concentrations delivered to the river. In addition, the geochemistry of different rock types within the mine area was evaluated to identify the source with the potential to generate the acidic waters necessary for the leaching of metals. The only whole rock, ground water and seep water quality geochemical data available for review were collected by SPRI (April 21, 1995) and Steffen, Robertson and Kirsten (SRK) (April 13, 1995). The geochemical assessment of possible source leachate and ground water chemistry revealed that the most probable source for the generation of acidic, high metals waters (or ARD) is the WRDs and the naturally occurring erosional scars.

ARD is characterized by low pH and elevated concentrations of metals and TDS. The most common mechanism for its formation involves the oxidation and hydration of sulfide minerals (e.g., pyrite, or iron sulfide), resulting in the generation of sulfuric acid. The mine area rhyolite consists primarily of the mineral pyrite. Rhyolite is exposed north of the Red River as erosional scars. The upper Sulphur Gulch erosional scar (rhyolite) and other non-acid generating rock types

were excavated during open pit mining and placed in several WRDs. Therefore, each WRD was evaluated to determine which WRDs contained the rhyolitic material.

A search was conducted to determine if comprehensive WRD disposal records existed to identify WRDs which were composed primarily of rhyolite, and consequently, determine the most acidic, high metals generating WRDs. However, Molycorp has indicated that historical records concerning the development of the WRDs are limited. Generally, mixed volcanic waste rock (rhyolite and andesite) was excavated from the Sulphur Gulch erosional scar area and deposited in the Blind Gulch, Goathill, Sugar Shack South, Sugar Shack West and Middle WRDs and the western portion of Spring and Sulphur Gulch WRD. The remaining waste rock was derived from black andesite, aplite and granite, which are considered to have low potential to generate acidic waters. The majority of this waste rock was placed in the western portion of Spring and Sulphur Gulch, in Spring Gulch and within the pit. SRK (April 13, 1995) states that later in the open pit operations, this waste rock was used to encase the lower faces of the Middle, Sugar Shack South and Spring and Sulphur Gulch WRDs. The rhyolite appears to exist in all WRDs. However, the volume of rhyolite within each WRD could not be determined from the available data.

Other minor waste rock areas were also evaluated for acid generating potential. SRK (April 13, 1995) reports that waste rock from the new underground mine workings, considered non-acid generating, was placed in lower Goathill Gulch, adjacent to the surface facilities. The historic tailings piles at the mine's mill site exhibit acid generating potential, and therefore, have the potential to generate ARD.

The NMED (March, 1996) and SRK (April 13, 1995) conducted a geochemical analysis of waste rock pile, erosional scar, and soils material for metals concentrations. Sugar Shack South WRD has the greatest metals concentrations. ARD from the waste rock is similar in composition to drainage from erosional scar areas. However, leachate analysis, conducted by NMED revealed that average metals concentrations were greater in WRD leachate than scar leachate. SRK states "Over time, ongoing acid generation in the waste rock disposal areas adjacent to the Red River, and the consumption of the neutralizing potential of the waste rock, and consumption of the remaining attenuation capacity in the alluvium in seepage flow paths has the potential to increase sulfate and metal loads in local springs and seeps. Seepage of water impacted by the hydrothermal scars that underlie the waste rock disposal areas will likely continue" (page 35).

SRK's (September 13, 1995) geochemical analysis of soils outside the influence of erosional scars or WRDs indicates that these soils have low metals leaching potential. Therefore, the dissolved metals contribution to the local environment by these soils is low compared to erosional scars and WRDs. SRK collected soil samples from within the mine area and concluded that the alluvium has the potential to contribute sulfate to surface or ground water, however, the potential for acidic waters is low. Mud and debris from erosional scars outside the mine surface water collection system are considered a localized source of intermittent river contamination through surface flows during periods of high runoff.

Most investigators acknowledge that waste rock material and erosional scars have similar geochemical properties, and that weathering of sulfide-rich erosional scars is associated with acidic, high metals storm water runoff. Although an increase in excavation activity (historic and recent mining, unpaved roads, etc.) appears to be related to the metals buildup in the watershed, the natural processes of weathering are the primary cause for the leaching of high metals into the local watershed environment. Natural weathering of sulfide-rich erosional scar material is relatively slow due to its compacted nature. However, when this material is excavated and placed in thick unconsolidated piles (i.e., WRDs), a large sulfide rich surface area is exposed to oxidation. The unconsolidated WRDs undoubtedly allow greater infiltration rates than the more consolidated natural soils or erosional scars. Therefore, the WRDs should have greater acid generation potential, storage capacity, metals transport capability; and consequently, greater recharge to the underlying aquifers than erosional scars. The upper valley fill aquifer should be saturated below and down gradient of the WRDs due to the recharge.

4.4 SURFACE AND SUBSURFACE GEOLOGY AND HYDROGEOLOGY

An evaluation of the surface geology and topography was performed in order to understand the erodibility and depositional factors at work in the area. Surface geology was evaluated to determine the erodibility and infiltration capabilities of differing rock types to define their relative contribution of alluvium within the subwatershed and recharge potential to ground water. The subsurface geology was evaluated to define the limits and avenues to ground water flow. Monitor well tests were used to determine the hydrogeological controls which influence flow direction and volumes delivered to seeps.

4.4.1 SURFACE AND SUBSURFACE GEOLOGY

The mine area geology is characterized as volcanic. Precambrian granite is exposed south of the Red River. The outcrops north of the river are primarily exposed Tertiary rhyolitic intrusive plugs (erosional scars). The primary hydrologic units north of the river are the fractured Tertiary volcanic bedrock (encountered by monitor wells between 60 - 120 feet below surface) and the overlying lower and upper valley fill alluvium. Several studies indicate that the Precambrian, which underlies these units, acts as an aquitard precluding any deeper ground water infiltration.

The rhyolitic erosional scar is a brecciated rock, which is easily eroded due to a lack of cementation and its highly fractured nature. Its erodibility is one source of alluvial deposits down gradient of scars. Molycorp drilled several 90 foot holes into erosional scars within the area (see SPRI April 21, 1995), apparently to determine the scar's discharge, storage and infiltration capacity. Molycorp found that the scars were either dry or produced very little discharge (less than one gallon per minute), which indicated near surface storage, with little to no infiltration at depth. The infiltration rates for the highly unconsolidated WRD material therefore exceeds that of the more consolidated erosional scar material. Thus, due to the similar geochemical properties of erosional scars and WRDs, the unconsolidated WRDs pose a greater ground water contamination potential than scars.

The steep slopes within the area encompass a greater surface area than the canyon floor. Runoff and ground water flow from the slopes are directed to the canyon floor deposits. The canyon aquifers are saturated due to infiltration through the unconsolidated alluvium. The shallow alluvial aquifers presumably have good lateral flow due to their unconsolidated gravel/sand mix and gradient, and less downward flow due to a basal clay aquitard. Therefore, surface water should infiltrate to the shallow aquifer and move down gradient along the clay aquitard to the river.

4.4.2 HYDROGEOLOGY

Twelve monitor wells were installed in July and August of 1994 (Figures 1 and 4). All wells are located within the Molycorp property and between 400 to 700 feet north of the Red River. The wells were installed to determine: 1) aquifer characteristics, 2) ground water gradient and barriers, and 3) ground water quality. A number of these wells indicate separate hydrologic units, and a possible cone of depression created by the dewatering of the open pit and underground mine workings. In addition, studies of USGS gage station data, and ground water elevations (relative to river elevation) obtained from monitor wells and two mine shafts, indicate that the river is supplied by ground water (i.e., gaining stream) throughout most of its length.

It appears that all investigators agree that there are two aquifers in the mine area: a valley fill and an underlying shallow fractured bedrock aquifer. Based on analysis of monitor well data supplied by SPRI (April 21, 1995), EPA believes that at times three different ground water aquifer systems may exist: a shallow fractured bedrock, an overlying lower valley fill, and an upper valley fill aquifer. It must be noted that monitor well tests only determine the hydrologic parameters within the immediate area of the well. However, considering that the alluvial deposits are confined to a relatively small canyon area, an assumption that the hydrologic parameters determined from monitor well tests are indicative of the general lower canyon area is acceptable.

Well tests confirm a weak hydraulic separation between the bedrock and lower valley fill stratigraphic units. Although bedrock and lower valley fill ground water elevations indicate these units may act as one hydrologic unit (one aquifer), well tests also confirm that the valley fill has greater horizontal hydraulic conductivity than the bedrock unit. Therefore, the lower valley fill may act to some degree as an independent aquifer during periods of high recharge. Well tests support some vertical hydraulic separation of the upper valley fill and lower valley fill aquifers by an intermediate clay layer. The clay layer retards further downward flow of upper valley fill ground water. The gradient on the upper surface of the clay layer is apparently to the river due to the depositional environment, and therefore, ground water flow is towards the river.

Monitor well ground water elevations relative to river elevations indicate that a cone of depression, centered on the open pit or underground mine, may exist north of the river. As discussed in Section 4.4.2.1, the cone of depression may affect the bedrock and lower valley fill aquifers between the monitor wells and the open pit and new underground workings, but not the upper valley fill aquifer. Therefore, the upper valley fill has the potential to transport contaminants to the

Red River. The bedrock and lower valley fill ground water located outside the influence of the suspect cone of depression, still has the potential to flow to the river.

The NMED (March, 1996) states that shallow bedrock fractures support preferential ground water flow to Red River seeps. Although geologic observations imply fracture orientation, faults intersecting the shallow bedrock aquifer may redirect ground water flow. Ground water elevations in MW-7 indicate a perched nature to the fractured bedrock aquifer in the immediate area. Therefore, support exists for faults or other geologic impediment to retard or redirect ground water flow.

Monitor well data and the steep surface topography support a distinct ground water flow system to the river via the upper valley fill aquifer. Although monitor well data indicate that a cone of depression may exist in an area north of the river, and that the cone of depression may affect the bedrock and lower valley fill aquifers, ground water south of that area still has the potential to flow to the river via all aquifers. However, the upper valley fill aquifer is a separate system, apparently unaffected by the cone of depression, and therefore, has the potential to transport acidic, high metals concentrations from a large portion of the mine site to the Red River.

4.4.2.1 GROUND WATER GRADIENT AND BARRIERS

Monitor well ground water elevation and river elevation data were compared to establish if the ground water gradient is to the river, which would indicate that ground water would flow to the river, and consequently, transport contaminants to the river. The presence of seeps, in general, indicates that the ground water gradient for at least one of the aquifers is to the river in the immediate area. In addition, studies of USGS gage station data indicate that throughout most of its length, the Red River is a gaining stream supplied by ground water; therefore, the ground water gradient is to the river. A comparison of monitor well ground water and river water elevations, in the eastern portion of the mine site, may imply sporadic recharge to ground water in this area. Therefore, monitor well data and river water levels in this area were evaluated to define the ground water gradient.

Previous investigators have generally compared monitor well ground water elevations to adjacent river elevations in establishing the ground water gradient. Investigators conclude that ground water and river elevations in the eastern portion of the mine property, in the vicinity of MW-13, 14 and 16, indicate ground water to be at or just below the river level. Ground water elevations below river elevation would indicate that the river is recharging ground water, and therefore, contaminants in ground water would not be discharged to the river. Although not stated, these comparisons of ground water elevation to river elevation may have been made in a direction perpendicular from the monitor well to the river. However, due to the Red River gradient (obtained from submitted topographic maps) within the mine area (approximately 1.2/45 feet, east to west), a comparison of monitor well ground water elevation at a right angle to the river may yield inaccurate information by several feet. Ground water flows down gradient along the axis of

the canyon; however, the canyon gradient is not the controlling factor for ground water flow direction in the fan delta deposits. The lower limits of the fan delta deposits conform to the river gradient, which is perpendicular to the canyon gradient. Therefore, ground water flow within the fan delta deposits will not be directly to the river as the canyon gradient would imply; but more along a resultant of the angles of the river and canyon gradients, which is more down-river of the canyon axis. Therefore, a conclusion, based on monitor well water levels, that the river may periodically recharge the ground water in the immediate area may be inaccurate. Although there is insufficient data to document a change in ground water flow direction due to a combination of river and fan delta gradients, it is likely, based on a qualitative examination of the gradient of the river and fan delta deposits, that ground water in fact always flows to the river in the eastern portion of the mine site, and therefore, throughout the mine site. However, because the methodology of the gradient measurements was not supplied, it is not known if this correction was applied. Granted, ground water flow velocity and the size of the fan delta are factors which determine the degree the river gradient would have on diverting the ground water flow direction from the canyon axis.

Subsurface barriers exist which impede or re-direct ground water flow. The ground water elevation in MW-7 indicates a perched natured to the bedrock aquifer, which indicates a barrier to ground water flow, possibly caused by faulting. The low pH and high metals concentrations found in MW-7 indicate a long ground water residence time, which is most probably due to faults. Although barriers may impede flow, ground water does flow to the river.

4.4.2.1.1 CONE OF DEPRESSION

Ground water elevations appear to support a cone of depression (not to be confused with the possible cone of depression caused by the caved area) within the bedrock aquifer which is apparently caused by the dewatering of the open pit and underground mine workings. If the cone of depression does exist, it would indicate that the ground water gradient (ground water flow direction) for a portion of the mine site would be towards the open pit and underground workings (to the north, away from the river). The cone of depression's outer rim, which defines the point at which ground water flows to and from the center of the depression, appears to exist just north of the monitor wells in the eastern portion of the mine site, near the Middle and Spring, and Sulphur Gulch WRDs. Monitor wells in the western and middle portion of the mine site do not appear to have encountered the cone of depression. Ground water elevations and the very active nature of seeps in these areas indicate that the outer rim of the cone of depression should be north of the river, between the new underground workings or open pit and the monitor wells. However, although a cone of depression may exist north of the river and within the mine site, studies of USGS gage station data and seeps indicate that overall the Red River is a gaining stream supplied by ground water; therefore, ground water flow for at least one aquifer is to the river.

An attempt was made to define the outer rim of the suspect cone of depression and its affect on the hydrologic units within the mine area utilizing monitor well/mine shaft data and historic mine dewatering data. There is insufficient historic dewatering information and monitor well data to

define the location of the outer rim of the cone of depression. However, subsequent to the monitor well installations, which are illustrated on Figures 1 and 4, ground water elevations appeared to indicate that the cone of depression may only affect the bedrock aquifer. This interpretation is supported by the following observations:

1) Molycorp contends that the water level within the mine defines the lower limit of the cone of depression at that point. However, there is no indication as to the shallowest elevation ground water is entering the mine. If ground water enters the mine from the shallowest aquifers, the radius of influence of the cone of depression would be closer to the entry point than if water was entering at a deeper point (i.e., less drawdown, less area encompassed by the cone of depression). Therefore, the cone of depression would not have as great an influence on the upper aquifers as the observed mine water levels may suggest. SPRI (April 21, 1995) states that a steep sided cone of depression would probably develop over the deep mine due to the lower hydraulic conductivity at depth. SPRI also concluded that the cone probably did not extend to the river.

2) Ground water elevations, from existing monitor wells, for the period February, 1996, to August, 1997, were obtained from Molycorp to evaluate the effects dewatering of the mine had on aquifers. As summarized in Table 4, observed fluctuations in monitor well ground water elevations show an influence from seasonal infiltration. MW-8, 2, 3, 11 and 10 are outside of the cone of depression. Bedrock wells MW-13, 14 and 16 may define the outer rim of the cone. However, subsequent to SPRI's installation and evaluation of these wells (which can be found in SPRI's April 21, 1995 report), MW-13 showed the valley fill saturated but the bedrock aquifer dry, indicating that the cone of depression may affect the bedrock aquifer but not the shallow alluvial aquifer. Therefore, the valley fill is to some degree unaffected by the cone of depression and has the potential to deliver ground water to the river in the immediate area.

3) Seeps and springs occur at the upper elevations, which are apparently within the cone of depression. Considering that shallow ground water supplies these seeps and springs, the cone of depression does not affect the shallow aquifers to a great extent. Therefore, ground water gradient for the shallow aquifer, throughout a major portion of the mine site, must be to the river.

The cone of depression apparently does not adversely affect the upper valley fill aquifer. Dewatering of the underground workings ceased between 1992 to 1994. SPRI (April 21, 1995) states that during post-1994 dewatering of the new underground mine workings, there was no noticeable effect on the rates of ground water recharge to the Red River in the vicinity of the mine and that most of the ground water recharge to the river may have come from the upper part of the ground water system. Stability of water levels in monitor wells, as post-1994 dewatering

proceeded, supports a steep cone of depression existing over the mine, and that the outer rim of the cone is north of the river. Accepting that the cone of depression exists and that ground water recharge to the Red River is not significantly affected by dewatering of the mine, it is concluded that the shallow upper valley fill aquifer is the most probable conduit between the source and the acidic, high metals discharged to the Red River.

4.4.2.2 VERTICAL HYDRAULIC SEPARATION

Local vertical hydraulic separation between the upper valley fill and underlying aquifers is supported by well test data from MW-2, 11, 13 and 10. MW-13 shows the valley fill aquifer saturated but the bedrock aquifer dry, which establishes vertical hydraulic separation. Aquifer tests at MW-10A (completed in the lower valley fill aquifer) established some vertical hydraulic connection between the lower valley fill aquifer and the underlying bedrock aquifer (MW-10B). However, the aquifer test indicated that the upper valley fill aquifer (MW-10C) appears to be separated from the lower aquifers to some degree due to an intermediate clay layer. This clay layer retards the downward flow of upper valley fill ground water to some degree, allowing two different and sustainable flow systems to exist: the upper valley fill and the lower valley fill/bedrock aquifer. WRD and erosional scar leachate should move downward to the upper valley fill aquifer, along the clay layer, and to the Red River. The lower valley fill and bedrock aquifer may receive some of the leachate over time due to the degree of upper valley fill and lower valley fill hydraulic separation within the immediate area.

4.4.2.3 LATERAL CONTINUITY

Lateral continuity, and good hydraulic conductivity, have been established for the lower valley fill aquifer through pump tests conducted on a select number of monitor wells. However, as previously mentioned, the upper valley fill aquifer is considered the primary conduit for Red River contamination through a ground water hydrological connection. No pump tests have been conducted on the upper valley fill aquifer to determine if lateral continuity exists. However, the upper and lower valley fill deposits (i.e., alluvium) are similar, more so than the bedrock aquifer; and therefore, it is assumed that the hydraulic conductivity and lateral continuity are similar.

SPRI (April 21, 1995) states that most of the bedrock wells went dry during development. This indicates that although lateral conductivity may exist in the fractured bedrock aquifer, the hydraulic conductivity was insufficient to supply recharge to these well. However, the bedrock aquifer well MW-11 was pumped at a rate of approximately 60 gallons per minute (gpm). The MW-10A, lower valley fill well, was pumped at a rate of 140 gpm with little drawdown, indicating recharge balanced discharge. A comparison of these two tests indicates that the lower valley fill aquifer has greater hydraulic conductivity than the bedrock aquifer. The fact that the lower valley fill has good hydraulic conductivity and that it exists above the bedrock aquifer (i.e., nearer the source), the lower valley fill (and consequently, the upper valley fill) has a higher potential than the bedrock aquifer to receive and transport metals to the river in the immediate area of the wells.

4.5 RIVER, SPRING, SEEP AND GROUND WATER QUALITY

Ground water, seep and spring water quality, as shown on Figure 8 and summarized in Table 3 and 5, was evaluated to determine if a water quality correlation exists between WRD or erosional scar leachate and ground water, spring, and Red River seep discharge. Attenuation was considered a factor in water quality delivered to the seeps. However, background samples were compared to all samples evaluated to determine if WRD or erosional scar leachate was present in the seep, spring or ground water samples.

4.5.1 RIVER

Review of the NMED (March, 1996) and Vail (July 9, 1993) studies indicated that although most seep constituent concentrations are usually above NMGWS, mixing of seep and Red River water results in dissolved metals concentrations that are at times diluted below NMSWS. However, during storm events, river metals concentrations are above State standards due to pulse loading. During base flow, river metals concentrations increase due to seep discharge, with some metals precipitating out onto the river bed.

4.5.2 SPRINGS

Although background ground water quality appears to have been excluded from the sampling events, the spring drainage sample CCS-2 (Figure 8) has relatively low metals concentrations and neutral pH. Therefore, the CCS-2 sample was selected as background ground water quality for evaluating ground water within the mine site.

4.5.3 SEEPS

The NMED (March, 1996) has identified more than twenty seeps along the north side of the Red River between the towns of Questa and Red River. Investigations continue to discover additional seeps along the north side of the river. The Portal Springs seep was discovered by an NMED field survey in January 1994, even after numerous earlier surveys. The most recent river survey found the Milk seep (seep at Waldo Curves) approximately one-half mile up river of the mill site. Utilizing the CCS-2 sample as background ground water quality, available Red River seep water chemistry data appear to correlate to WRD and erosional scar leachate chemistry.

The NMED apparently has identified all seeps within the general area of the Molycorp mine property, and has determined that seeps exist only on the north side of the river, with the most active seeps existing within the Molycorp boundary. Both sides of the river have similar topography; therefore, if seeps exist only on the north side of the river, it must be due to other than natural factors which increase recharge to ground water. The major concentrations of erosional scars (Figure 9) and historic and recent-mining activity are located on the north side of the river. One iron rich seep was located near the town of Red River (approximately 6 miles up gradient of

the mine), which the NMED (March, 1996) believes is due to anthropogenic factors. If a connection can be substantiated between anthropogenic factors and the formation of seeps, it may be assumed that subsequent excavation activities could add to the contamination of the watershed.

As illustrated on Figures 1 and 2, several seeps exist within and just down river of the Molycorp property. However, the NMED (March, 1996) reports that there are three principal seeps which exhibit concentrated discharge and appear to have the most impact on Red River water quality: Capulin Canyon, Portal Spring, and Cabin Spring. The NMED states that water chemistry varies between seeps. However, all are acidic and contain elevated concentrations of TDS, including sulfates, Al, Fe, Mn, Co, Cu, Ni, Zn, Cd, and F, which exceed NMGWS. The most dominant metals in all seeps are Ca, Al, Mg, and Fe, respectively.

Ground water samples, as summarized on Table 5, were collected from monitor wells and compared to the Portal Springs, Cabin Springs and Capulin Canyon seeps. Portal Springs and Capulin Canyon waters appear to be more similar to ground water in the valley fill aquifer than to the underlying bedrock aquifer. All ground water samples have TDS and sulfate concentrations above the concentrations in the Red River seeps, and exhibit a pH lower than seep discharge. The following is a water quality evaluation of each seep and its possible source location.

Portal Springs seep is characterized as calcium sulfate waters with a pH of 4.5 and TDS of 1800. Some correlation is apparent between this seep and well MW-10C (upper valley fill, calcium sulfate waters, pH of 4.7, TDS 1400). However, the correlation between MW-10C ground water and Portal Springs seep waters is not clearly defined. Ground water within the upper valley fill aquifer is expected to flow southwest in this area, following the surface topography. Therefore, the ground water supplied to the Portal Springs seep may originate further east of MW-10 and 11, in close proximity to the Moly Tunnel. No closure data on this mine drainage tunnel were available to determine if it may be a probable source for the Portal springs seep.

There exists no up gradient monitor well to attempt a correlation between ground water and the Cabin Springs seep. This seep is located southwest of the nearest WRD and may be caused by preferential flow paths within the bedrock aquifer. No Cabin Springs seep water quality analysis was available for review.

The Capulin Canyon seeps are located west of the main mining operations and appear to be out of the influence of any probable source (WRD or erosional scar). However, the Capulin Canyon seeps and MW-2 (completed in valley fill) have similar low pH values, with sulfates and metals concentrations being greater in MW-2. This suggests the source for the seeps to be up gradient of MW-2. The most probable source for the Capulin Canyon seep is the Capulin Canyon WRD and scars located within this canyon.

Molycorp contends that erosional scars are the primary cause for metals loading to the Red River. Therefore, erosional scars and seeps outside the influence of WRD leachate were evaluated to determine their potential for the discharge of high metals concentrations to ground water and surface water. As illustrated on Figure 8, three water samples collected from erosional scars and seeps outside of the Molycorp mine boundary (HTS-1, from an erosional scar; and HCS-1 and 2, from ground water seeps) exhibit low pH, moderate to high TDS values, and high metals concentrations. The upper Hanson Creek seep (HCS-1, near a scar) has lower pH, and higher metals concentrations than the down gradient (HCS-2) seep, indicating attenuation. Although the weathering of excavated rhyolitic material may be a source for high metals buildup within the Red River watershed, the available information does not indicate whether historic mine sites are located near these erosional scars or seeps. Therefore, erosional scars have the potential to release high metals concentrations to the local watershed. Red River samples, down gradient of the Hanson Creek tributary, showed that dilution had decreased metals concentrations and increased pH.

The unconsolidated WRD material appears to deliver greater concentrations of dissolved metals to the ground water than the consolidated erosional scars. The GHS-3 seep (Figure 8) at Goathill Gulch is from an erosional scar and near the Capulin canyon WRD. SPRI (April 21. 1995) states that this erosional scar extends below the Capulin Canyon WRD, and that the GHS-3 chemistry may reflect a mixture of erosional scar and WRD seepage. The HCS-1 and HTS-1 seeps are also within erosional scars. The GHS-3 seep has greater TDS concentrations, and higher metals concentrations; with sulfates, aluminum, and magnesium concentrations being two to nine times greater than the HCS-1 and HTS-1 (erosional scar) seeps. This indicates that the additional WRD material increases the concentrations delivered to the underlying aquifer, well above those concentrations contributed by the erosional scar. Although WRD leachate can supply greater metals concentrations to ground water than erosional scars, erosional scars can also release high metals concentrations to ground water which may discharge to local surface water.

Water samples GHS-1, from Capulin Canyon WRD seepage (considered the worst water quality sample reviewed); GHS-2, from a nearby borehole; and GHS-3 are similar. This correlation supports a hydrological connection between waste rock dump seepage and the immediate ground water.

Hutchison (April 23, 1997) contends that natural factors cause the Red River seeps and if ground water contamination did exist, it would not effect the river due to attenuation. Samples GHS-1, GHS-2 and GHS-3 appear to substantiate ground water contamination from Capulin Canyon WRD infiltration. Red River seep water quality indicates that although attenuation appears to be a factor in seep discharge concentrations, seeps considered hydrologically connected to the probable sources (WRD and erosional scar) discharge high metals concentrations to the river. In addition, ground water samples from monitor wells and anoxic alkaline trenches (located immediately up gradient of seeps) document that ground water has a lower pH and higher concentrations of metals than the hydrologically connected seep discharge, indicating that seep discharge is not a true indication of immediate ground water quality.

4.5.4 GROUND WATER QUALITY

Generally within the valley fill aquifer, ground water acidity, sulfates, and metals concentrations increase down gradient along the river. However, bedrock well MW-7 has the lowest pH and highest sulfate, TDS, and metals concentrations recorded; with much greater values than the other ground water wells. The MW-7 water quality values are similar to the Capulin Canyon and Goathill Gulch (CCS-1 and GHS-1) waste rock seepage concentrations. The perched nature of the bedrock aquifer in the immediate area apparently causes a longer ground water residence time, and therefore, greater concentrations.

The remaining bedrock wells have a pH around 7.0, with the exception of MW-11 (pH 5.6), which is completed below the South Sugar Shack waste rock dump. MW-10B (bedrock well, 7.9 pH) is located immediately down gradient of MW-11 and exhibits lower concentrations of metals than MW-11. The low pH and high metals concentrations for MW-11 is probably a result of infiltration from the WRD. MW-10C (upper valley fill aquifer) water quality (pH 4.7) and ground water level indicate that the upper valley fill aquifer appears to be hydraulically separated from the lower aquifers to some degree. Therefore, there exists support for a ground water flow direction toward the topographic low (the Red River) within the upper valley fill aquifer.

5.0 CONCLUSIONS

The most probable sources for the continuing degradation of the Red River watershed through seep discharge of high metals concentrations are the Molycorp WRDs and the naturally occurring erosional scars. The "most probable" source, indicating that it is the source within a reasonable degree of certainty, has been a defensible argument in the past through specific sampling for verification. Verification of a source requires a comparison of a suspect facility's product or waste stream constituents with contaminants found in ground water and/or surface water. If a correlation exists between facility constituents and contamination, additional support for a hydrological connection is required through water quality, geological and monitor well evidence.

5.1 TAILINGS PONDS

Water quality samples collected from tailings pond leachate, ground water, and Red River seeps indicate that the only probable source for elevated sulfate and metals concentrations found in ground water in this area are the tailings ponds. Ground water samples, which were collected from up and down gradient of the tailings ponds, document infiltration of pond leachate to the underlying shallow alluvial aquifer. A correlation exists between ground water quality below and down gradient of the ponds. Monitor well ground water elevations show a ground water gradient to the river. USGS gage station data indicate the reach adjacent to the tailings ponds is a gaining stream supplied by ground water. Therefore, support exists for a ground water hydrological connection between the ponds and the river. However, although several ground water samples taken

immediately down gradient of the ponds show sulfate and metals concentrations above NMGWS, seeps along the river discharge concentrations below NMGWS and NMSWS. There is insufficient information to document a ground water discharge of metals concentrations above NMGWS and NMSWS to the river in this area.

5.2 MOLYCORP MINE SITE

Naturally occurring erosional scars (exposed and located below some WRDs) and WRDs are the most probable sources of low pH and high metals discharge to the local watershed environment. Red River water quality and a localized concentration of acidic, high metals seeps indicate that the general area of the source is within the Molycorp boundary. Geochemical analysis of erosional scar and WRD leachate indicates similar geochemical signatures. Monitor well ground water samples support a correlation between ground water chemistry and WRD and erosional scar leachate chemistry. USGS gage station data indicate ground water flow to the river. Although attenuation appears to be a factor for seep discharge, a correlation exists between seep and ground water quality. Therefore, verification has been adequately established to support a ground water hydrological connection between the two sources and Red River seep discharge. However, the percentage of constituent concentrations or discharge volume supplied by each probable source to a specific seep could not be determined using the available data.

6.0 REFERENCES

1) Chadwick Ecological Consultants, Inc.; Aquatic Biological Assessment of the Red River, New Mexico, In The Vicinity Of The Questa Molybdenum Mine; April 1997

2) Coleman, Michael W. and Slifer, Dennis W., New Mexico Environment Department; ABSTRACT: Alkaline Drain Treatment of Acidic Seeps on the Red River; November 15, 1995

3) Crowell and Moring LLP to USEPA; May 9, 1997, correspondence

4) Hutchison, Ian P.G.; Questa Mine Site Expert Report; April 23, 1997

5) Kelsey, Richard K., P.E.; Plaintiffs Rule 26(a)(2)(B) Expert Report, U.S. District Court, New Mexico; March 17, 1997

6) Meyer, Jeff and Leonardson, Robert; Tectonic, Hydrothermal and Geomorphic controls On alteration Scar Formation Near Questa, New Mexico; 1990

7) Meyer, Jeff and Leonardson, Robert; Geology of the Questa Mining District: Volcanic, Plutonic, Tectonic and Hydrothermal History

8) Mink, Leland Leroy, Ph.D., P.G.; Plaintiffs Rule 26(a)(2)(B) Expert Report, U.S. District Court, New Mexico; March 17, 1997

9) Schafer, William M.; Expert Report; April 23, 1997

10) Slifer, Dennis W.; New Mexico Environment Department Surface Water Quality Bureau; Red River Groundwater Investigation Final Report; March 1996

11) South Pass Resources, Inc.; Progress Report on the Geology, Hydrogeology, and Water Quality of the Mine Area Molycorp Facility Taos County, New Mexico; April 21, 1995

12) South Pass Recources, Inc.; Discussion of Geology, Hydrogeology, and Water Quality of the Tailings Area Molycorp Facility Taos County, New Mexico; April 13, 1995

13) State of New Mexico Ground Water and Surface Water Quality Protection Regulations (20 NMAC 6.2); December 1, 1995

14) State of New Mexico Standards for Interstate and Intrastate Streams; January 23, 1995

15) Steffen, Robertson and Kirsten, Inc.; Questa Molybdenum mine Geochemical Assessment; April 13. 1995

16) Vail, Ralph E., P.E.; Analysis of Tailings Pond Seepage Flow To Red River; September 24, 1993

17) Vail, Ralph E., P.E.; Interim Study of the Acidic Drainage to the Middle Red River, Taos County, New Mexico; July 9, 1993

18) Western Environmental Law Center to USEPA, May 16, 1997, correspondence

19) Western Environmental Law Center; Plaintiffs vs. Molycorp; U.S. District Court, NM

20) Williams, Barbars C.; Plaintiffs Rule 26(a)(2)(B) Expert Report, U.S. District Court, New Mexico; March 17, 1997

21) Wisconsin Seventh Circuit Court of Appeals; Docket No. 93-3380; February 15, 1994

TABLE 1 (1 OF 2) (TAKEN FROM VAIL, October 1994)

WATER QUALITY SURVEY ALONG RED RIVER
BETWEEN STATE ROAD 522 AND FISH HATCERY
APRIL 12, 1993

SAMPLE SOURCE	PH	TOT ALK	F	TDS	SO4	TSS	MO	DIS. AL	CD	SUS. AL	FE	PB	CU	ZN	MN
#1 R/R Below Highway Bridge	7.23	38	0.84	255	119	31	<.03	<.5	<.005	7.8	0.594	<.1	0.036	0.250	[illegible]
#2 Spring N. Side R/R	6.76	90	0.55	247	92	20	<.03	<.5	<.005	0.5	0.543	<.1	0.007	0.021	0.02
#3 Field Drainage to R/R 500'E. of 002	7.44	99	0.60	246	92	7	0.20	<.5	<.005	<.5	0.405	<.1	<.005	0.047	0.05
#4 Field Drainage to R/R 450'E. of 002	8.22	94	0.46	648	172	6	<.03	<.5	<.005	<.5	0.115	<.1	0.008	0.012	0.05
#5 R/R 300'E. of 002	7.60	43	0.90	240	118	22	<.03	<.5	<.005	8.0	0.569	<.1	0.028	0.222	0.88
#6 Outfall 002	7.26	152	1.90	1764	840	2.0	1.80	<.5	<.005	<.5	0.102	<.1	<.005	0.010	1.40
#7 Field Drainage 75'W of 002	7.20	165	0.80	727	228	39	0.20	<.5	<.005	2.7	1.090	<.1	0.009	0.017	0.03
#8 R/R Above Questa Spring	7.14	50	0.88	268	141	21	<.03	<.5	<.005	6.2	0.573	<.1	0.029	0.207	0.88
#9 Near Questa Springs SE of Conc.Box	7.02	158	0.38	1094	504	88	<.03	<.5	<.005	8.5	2.940	<.1	0.016	0.047	0.07
#10 Near Questa Springs End of Old Pipe	7.50	177	0.60	576	210	7	<.03	<.5	<.005	<.5	<.05	<.1	0.005	0.010	0.01
#11 R/R 500'W. of Questa Springs	7.45	54	0.90	269	138	22	<.03	<.5	<.005	3.10	0.618	<.1	0.033	0.215	0.88

TABLE 1 (2 OF 2)

WATER QUALITY SURVEY ALONG RED RIVER
BETWEEN STATE ROAD 522 AND FISH HATCERY
APRIL 12, 1993

SAMPLE SOURCE	PH	TOT ALK	F	TDS	SO4	TSS	MO	DIS. AL	CD	SUS. AL	FE	PB	CU	ZN	MN
#12 Spring – N. Side R/R Sta. 47 + 20	6.94	82	0.80	271	115	47	<.03	<.5	<.005	1.70	2.36	<.1	0.011	0.046	0.13
#13 R/R Sta. 47 + 70 Above Hatchery	7.45	51	0.90	259	128	22	<.03	<.5	<.005	3.00	0.590	<.1	0.026	0.206	0.83
#14 Spring S. Side R/R Sta. 36 + 80	8.14	82	0.80	304	126	<1	<.03	<.5	<.005	<.5	<.05	<.1	<.005	0.005	0.01
#15 Spring N. Side R/R Sta. 36 + 40	7.26	80	1.10	145	20	<1	<.03	<.5	<.005	<.5	<.05	<.1	<.005	<.005	<.0
#16 R/R Sta.	7.80	49	0.90	247	129	24	<.03	<.5	<.005	3.10	0.527	<.1	0.024	0.191	0.781
#17 Hatchery Inlet Cold Water	7.14	43	0.64	176	80		<.03	<.5	<.005	<.5	0.138	<.1	<.005	<.005	<.0
#18 Hatchery Inlet Warm Water	7.87	77	1.10	284	63		<.03	<.5	<.005	<.5	0.181	<.1	<.005	0.010	<.0
#19 Seep Water in Irrigation Ditch Above 002 Line X @ Road	7.73	174	0.54	1304	660		<.03	<.5	<.005	<.5	0.160	<.1	<.005	0.013	0.05
#20 Molycorp Drain Below Culver Above Ditch	8.10	153	1.90	1702	790		1.70	<.5	<.005	4.00	2.4	<.1	0.016	0.010	2.00

TABLE 2
1994 MONITOR WELL WATER QUALITY DATA FOR TAILINGS AREA
MOLYCORP, INC. - QUESTA, NEW MEXICO

(TAKEN FROM SOUTH PASS RESOURCES, April 13, 1995)

MONITOR WELL	SAMPLE DATE 1994	WELL TD (feet)	Corrected DEPTH TO WATER (feet)	DEPTH TO PUMP INTAKE (feet)	pH (1)	CONDUC-TIVITY (1) (uhmos)	TEMP (1) (°C)	CARBO -NATE (mg/L)	BICARBO -NATE (mg/L)	HYDR-OXIDE (mg/L)	TOTAL ALK (mg/L)	CHLORIDE (mg/L)	FLUORIDE (mg/L)	NITRATE (mg/L)	SUFATE (mg/L)
EW-1	7-Nov	157	83.00	102	7.50	1,460	NA	<1	156	<1	156	23	0.25	0.72	620
EW-2	8-Nov	204	147.91	170	7.48	850	12.9	<1	122	<1	122	4.8	0.49	0.2	96
EW-2	17-Nov	NA	NA	NA	NA	NA	NA	<1	118	<1	118	4.6	0.5	0.38	90
EW-3	8-Nov	78	57.74	70	7.48	1,135	11.4	<1	110	<1	110	17	0.16	0.6	440
EW-3	19-Nov	NA	NA	NA	NA	NA	NA	<1	136	<1	136	18	0.19	0.49	410
EW-4	7-Nov	58	18.49	50	7.78	650	11.6	<1	152	<1	152	26	0.21	0.35	150
EW-4	16-Nov	NA	NA	NA	NA	NA	NA	<1	156	<1	156	26	0.2	0.36	160
MW-1	7-Nov	100	53.17	80	7.28	1,322	NA	<1	136	<1	136	14	0.27	0.45	610
MW-2	7-Nov	80	22.07	60	7.96	1,701	NA	<1	80	<1	80	15	0.96	<0.06	860
MW-3	8-Nov	60	19.97	55	7.38	1,679	12.4	<1	183	<1	183	18	0.44	0.31	780
MW-4	8-Nov	96	40.77	65	7.61	1,157	12.3	<1	184	<1	184	7.3	0.73	0.24	460
MW-7A	7-Nov	90	58.84	80	7.50	1,565	11.9	<1	126	<1	126	16	0.18	0.72	730
MW-7C	9-Nov	146	111.79	135	7.10	2,160	12.4	<1	124	<1	124	16	0.17	0.32	790
MW-9A	8-Nov	44	26.30	35	7.32	1,021	13.1	<1	174	<1	174	20	0.44	0.33	680
MW-10	8-Nov	129	26.23	100	8.16	236	12.3	<1	77	<1	77	1.6	0.36	0.27	35
MW-11	9-Nov	249	191.93	210	7.00	440	19.8	<1	82	<1	82	10.3	1.28	0.39	58
MW-11AB	9-Nov	NA	NA	NA	NA	NA	NA	<1	79	<1	79	10.1	1.29	NA	58
MW-12	7-Nov	234	128.11	210	NA	NA	NA	<1	120	<1	120	5.1	0.46	NA	66
MW-A	7-Nov	38	30.58	NA	7.28	1,332	NA	<1	154	<1	154	14	0.35	0.37	560
MW-C	7-Nov	14.5	1.80	NA	7.24	1,902	NA	<1	185	<1	185	19	1.16	<0.06	970
CH	8-Nov	NA	NA	NA	7.97	539	13.5	<1	206	<1	206	2.3	0.71	0.44	75

NOTES:

(1) pH, CONDUCTIVITY AND TEMPERATURE WERE RECORDED WHEN SAMPLED

SOURCE: SAMPLES TAKEN BY SPRI. ANALYTICAL RESULTS FROM MOLYCORP.

NA - NOT AVAILABLE

TABLE 2

1994 MONITOR WELL WATER QUALITY DATA FOR TAILINGS AREA

MOLYCORP, INC. - QUESTA, NEW MEXICO

MONITOR WELL	TDS (mg/L)	SILVER (mg/L)	ALUMINUM (mg/L)	ARSENIC (mg/L)	BARIUM (mg/L)	BERYLLIUM (mg/L)	CALCIUM (mg/L)	CADMIUM (mg/L)	COBALT (mg/L)	CHROMIUM (mg/L)	COPPER (mg/L)	IRON (mg/L)	MERCURY (mg/L)
EW-1	1,200	<0.10	<0.05	<0.005	0.053	<0.004	240	<0.0005	<0.010	<0.010	<0.010	<0.050	<0.0002
EW-2	240	<0.10	<0.05	<0.005	0.068	<0.004	59.4	<0.0005	<0.010	<0.010	<0.010	<0.050	<0.0002
EW-2	290	<0.010	<0.05	<0.005	0.065	<0.004	57.8	0.0036	<0.010	<0.010	<0.010	<0.050	<0.0002
EW-3	830	<0.10	<0.05	<0.005	0.074	<0.004	179	<0.0005	<0.010	<0.010	<0.010	<0.050	<0.0002
EW-3	750	<0.010	<0.05	<0.005	0.054	<0.004	158	<0.0005	<0.010	<0.010	<0.010	<0.050	<0.0002
EW-4	440	<0.10	<0.05	<0.005	0.065	<0.004	101	<0.0005	<0.010	<0.010	<0.010	<0.050	<0.0002
EW-4	450	<0.010	<0.05	<0.005	0.068	<0.004	104	<0.0005	<0.010	<0.010	0.012	<0.050	<0.0002
MW-1	1,100	<0.10	<0.05	<0.005	0.025	<0.004	207	<0.0005	<0.010	<0.010	<0.010	0.068	<0.0002
MW-2	1,400	<0.10	<0.05	<0.005	0.022	<0.004	241	<0.0005	<0.010	<0.010	<0.010	4.6	<0.0002
MW-3	1,400	<0.10	<0.05	<0.005	0.032	<0.004	264	<0.0005	<0.010	<0.010	<0.010	0.07	<0.0002
MW-4	890	<0.10	<0.05	<0.005	0.084	<0.004	166	<0.0005	<0.010	<0.010	<0.010	<0.050	<0.0002
MW-7A	1,300	<0.10	<0.05	<0.005	0.028	<0.004	273	<0.0005	<0.010	<0.010	<0.010	<0.050	<0.0002
MW-7C	1,300	<0.10	<0.05	<0.005	0.028	<0.004	279	<0.0005	<0.010	<0.010	<0.010	<0.050	<0.0002
MW-9A	1,200	<0.10	<0.05	<0.005	0.061	<0.004	247	<0.0005	<0.010	<0.010	<0.010	<0.050	<0.0002
MW-10	150	<0.10	<0.05	<0.005	0.038	<0.004	28.2	<0.0005	<0.010	<0.010	<0.010	<0.050	<0.0002
MW-11	200	<0.10	<0.05	<0.005	0.014	<0.004	28.6	<0.0005	<0.010	<0.010	<0.010	<0.050	<0.0002
MW-11AB	220	<0.10	<0.05	<0.005	0.015	<0.004	28.5	<0.0005	<0.010	<0.010	<0.010	<0.050	<0.0002
MW-12	260	<0.10	<0.05	<0.005	0.096	<0.004	47.1	<0.0005	<0.010	<0.010	<0.010	<0.050	<0.0002
MW-A	1,000	<0.10	<0.05	<0.005	0.03	<0.004	214	<0.0005	<0.010	<0.010	<0.010	0.066	<0.0002
MW-C	1,700	<0.10	<0.05	<0.005	0.04	<0.004	334	<0.0005	<0.010	<0.010	<0.010	<0.050	<0.0002
CH	340	<0.10	<0.05	<0.005	0.059	<0.004	48.5	<0.0005	<0.010	<0.010	<0.010	<0.050	<0.0002

NOTES:

(1) pH, CONDUCTIVITY AND TEMPERATURE WERE RECORDED WHEN SAMPLED.

SOURCE: SAMPLES TAKEN BY SPRI. ANALYTICAL RESULTS FROM MOLYCORP.

NA - NOT AVAILABLE

TABLE 2

1994 MONITOR WELL WATER QUALITY DATA FOR TAILINGS AREA

MOLYCORP, INC. - QUESTA, NEW MEXICO

MONITOR WELL	POTASSIUM (mg/L)	MAGNESIUM (mg/L)	MANGANESE (mg/L)	MOLYBDENUM (mg/L)	SODIUM (mg/L)	NICKEL (mg/L)	LEAD (mg/L)	ANTI..ONY (mg/L)	SELENIUM (mg/L)	SILICON (mg/L)	THALLIUM (mg/L)	VANADIUM (mg/L)	ZINC (mg/L)
EW-1	3.7	47.9	0.017	<0.02	41.7	<0.020	<0.002	<0.05	<0.005	13.8	<0.005	<0.010	<0.050
EW-2	3.3	10.4	0.169	<0.02	20.0	<0.020	<0.002	<0.05	<0.005	15.7	<0.005	<0.010	<0.050
EW-2	3.6	10	0.138	<0.02	19.6	<0.020	<0.002	<0.05	<0.005	17.3	<0.005	<0.010	0.091
EW-3	2.6	31.8	0.056	<0.02	28.6	<0.020	<0.002	<0.05	<0.005	12.4	<0.005	<0.010	<0.050
EW-3	2.2	27.8	0.036	<0.02	28.9	<0.020	<0.002	<0.05	<0.005	11.9	<0.005	<0.010	0.364
EW-4	1.5	17.8	<0.010	<0.02	15.5	<0.020	<0.002	<0.05	<0.005	12.4	<0.005	<0.010	<0.050
EW-4	2.1	18.1	0.019	<0.02	16	<0.020	<0.002	<0.05	<0.005	12.7	<0.005	<0.010	0.364
MW-1	3.0	41.2	0.035	0.04	55.4	<0.020	<0.002	<0.05	<0.005	11.9	<0.005	<0.010	<0.050
MW-2	3.1	52.2	0.37	1.7	95.6	<0.020	<0.002	<0.05	<0.005	1.8	<0.005	<0.010	<0.050
MW-3	1.5	48.6	0.032	<0.02	71.6	<0.020	<0.002	<0.05	<0.005	10.3	<0.005	<0.010	<0.050
MW-4	1.1	32.7	<0.010	0.21	64.2	<0.020	<0.002	<0.05	<0.005	10.3	<0.005	<0.010	<0.050
MW-7A	2.6	47.1	<0.010	<0.02	39.5	<0.020	<0.002	<0.05	<0.005	12.3	<0.005	<0.010	<0.050
MW-7C	3.9	48.4	<0.010	<0.02	45.1	<0.020	<0.002	<0.05	<0.005	12.1	<0.005	<0.010	<0.050
MW-9A	1.7	45.5	0.111	<0.02	66.0	<0.020	<0.002	<0.05	<0.005	10.5	<0.005	<0.010	<0.050
MW-10	1.3	4.4	<0.010	<0.02	14.7	<0.020	<0.002	<0.05	<0.010	10.8	<0.005	<0.010	<0.050
MW-11	2.8	8.6	<0.010	0.06	25.8	<0.020	<0.002	<0.05	<0.005	15.5	<0.005	<0.010	<0.050
MW-11AB	2.6	8.6	<0.010	0.06	25.7	<0.020	<0.002	<0.05	<0.005	15.5	<0.005	0.01	<0.050
MW-12	2.9	8.5	<0.010	0.02	24.5	<0.020	<0.002	<0.05	<0.005	13.6	<0.005	<0.010	<0.050
MW-A	2.8	35.7	0.04	0.63	50.6	<0.020	<0.002	<0.05	<0.005	10.9	<0.005	<0.010	<0.050
MW-C	2.1	56.1	0.774	1.12	82.2	<0.020	<0.002	<0.05	<0.005	11.6	<0.005	<0.010	<0.050
CH	1.2	9.4	<0.010	<0.02	57.8	<0.020	<0.002	<0.05	<0.005	9.8	<0.005	<0.010	0.946

NOTES:

(1) pH, CONDUCTIVITY AND TEMPERATURE WERE RECORDED WHEN SAMPLED.

SOURCE: SAMPLES TAKEN BY SPRI. ANALYTICAL RESULTS FROM MOLYCORP.

NA - NOT AVAILABLE

TABLE 3

WATER QUALITY DATA FOR THE RED RIVER - (SPRI, MAY 1994)

MINE AREA - MOLYCORP, INC. - QUESTA, NEW MEXICO

(TAKEN FROM SOUTH PASS RESOURCES, April 21, 1995)

Sample ID	Sample Description	pH Meter	pH Strip	Temp (F°)	Conduc-tivity (uhmos)	Total Alkalinity (mg/L)	TDS (mg/L)	TSS (mg/L)	Aluminum Susp. (mg/L)	Aluminum Dis. (mg/L)	Fluoride (mg/L)	Iron (mg/L)
BC-1	BC 75' N of High St. bridge	6.40	5.0	44.9	49.8	20	82	26	0.75	0.60	0.15	2.70
BC-2	BC 500' S of Spring flow from BCS-1	6.55	5.5	43.6	66.2	18	78	10	<.5	0.60	0.12	1.00
BCS-1	Spring, 1.2 mi. N High St.	4.42	5.0	44.7	478.0	0	530	<1	<.5	5.20	0.30	<.01
BOS-1	Spring, W side of Bobita Campground		6.0	61.0	605.0	44	737	8	<.5	<.5	0.32	0.16
CCS-1	Middle sump Capulin Canyon		3.0	50.9	13,440	0	24,950	8	1.00	1,310	53.30	258.30
CCS-2	Spring drainage W side Capulin Canyon		7.0	56.9	260.0	54	416	107	2.80	2.2	0.62	11.72
CCS-3	Adit W side Capulin Canyon		4.0	45.1	2,960	0	2,686	295	1.60	53.6	12.00	25.20
CCS-4	Seep, Capulin Canyon S of adit		4.0	48.2	1,775	0	1,193	12.7	<.5	23.2	5.70	2.35
CCS-5	Culvert drain W side of Capulin Canyon		4.0	66.7	1,700	0	1,896	3.7	<.5	74.8	9.80	0.21
CCS-6	Seep, 200' E Capulin Canyon		3.0	73.7	2,430	0	2,673	6.4	<.5	116.2	13.00	7.68
CLB-1	Columbine Creek-200' up from confluence		6.5	57.7	134.0	49	70	3	<.5	<.5	0.18	0.34
ECCS-1	Seep near river, E of Capulin Canyon		6.5	60.5	580.0	26	413	8	<.5	<.5	1.50	0.32
ECCS-2	Seep S of Hwy 38, E of Capulin Canyon		4.0	62.0	1,752	0	913	1	<.5	73	5.20	0.79
EGHS-1	Seep, S of Hwy 38, E of Goathill		7.0	55.6	810.0	47	843	1.2	<.5	<.5	0.47	0.15
GHS-1	Seepage Goat Hill dump		2.0	69.1	11,140	0	23,890	39	0.97	1,183	36.70	257.00
GHS-2	Seep from bore hole +GHS1		2.0	73.0	11,350	0	17,623	29	1.70	1,125	43.30	252.00
GHS-3	Natural seep from volcanic rock					0	11,980	94	1.30	645	26.00	250.00
HCS-1	seeps, Upper Hanson Creek Canyon		2.5	44.2	5,520	0	6,493	13.6	<.5	185.4	15.00	177.90
HCS-2	seep, downgradient from HCS-1		2.5	50.6	5,390	0	6,230	7.6	<.5	154	15.60	164.80
HCS-3	Seep S of Hwy 38, W Hanson Creek		4.0	77.0	1,232	0	1,773	<1	<.5	2.6	1.40	0.43
HTS-1	Upper Hot-N-Tot Canyon	2.86	2.3	48.2	2,670	0	2,610	43	<.5	97.8	2.30	212.80
MC-1	Mallette Creek-Alpine Lodge	6.86	6.0	52.2	80.4	22	96	16	0.65	0.60	0.25	1.20
PC-1	Pioneer Creek, Arrowhead Lodge	7.34	7.0	45.1	107.0	43	94	15	<.5	0.50	0.10	0.70
POS-1	seep, Portal Springs W of mine portal		4.5	54.4	1,900	1[illegible]	1,800	34	<.5	21.3	153.00	8.24
RR-1	RR W of confluence w/BitCrk	7.40	6.0	43.8	99.3	43	82	4	<.5	0.50	0.86	1.10
RR-2	RR 50' E of BC Confluence	7.58	6.5	45.9	108.0	70	88	18	<.5	0.50	0.08	0.80
RR-3	RR behind Alpine Lodge	7.53	6.0	48.2	93.7	51	92	22	0.5	0.50	0.10	2.10
RR-4	RR, Goose Lake Rd/East RR	7.73	7.0	43.5	130.0	47	98	13	<.5	<.5	0.10	0.70
RR-5	RR, Hot-N-Tot Creek/upstream	7.45	7.0	47.0	144.0	59	100	32	0.75	0.50	0.11	2.20

TABLE 3

WATER QUALITY DATA FOR THE RED RIVER - (SPRI, MAY 1994)

MINE AREA - MOLYCORP, INC. - QUESTA, NEW MEXICO

Sample ID	Sample Description	pH Meter	pH Strip	Temp (F°)	Conduc-tivity (uhmos)	Total Alkalinity (mg/L)	TDS (mg/L)	TSS (mg/L)	Aluminum Susp. (mg/L)	Aluminum Dis. (mg/L)	Fluoride (mg/L)	Iron (mg/L)
RR-6	RR, Hot-N-Tot Creek/dwnstream	7.52	6.5	48.0	145.0	43	92	34	0.60	<.5	0.11	1.90
RR-7	RR down from Sulpher Gulch	7.48	7.0	62.0	122.0	48	108	49	0.75	<.5	0.16	2.10
RR-8	RR upstream from mill gate	7.53	6.5	57.0	129.0	56	106	57	0.50	0.60	0.12	2.14
RR-9	RR, 200' up from Hanson Creek confluence	7.46	7.0	54.5	144.0	53	104	31.2	<.5	<.5	0.13	1.70
RR-10	RR, downstream of Portal Springs	7.46	7.0	54.5	196.0	48	112	61.2	1.60	<.5	0.20	2.41
RR-11	RR, Down from Hanson Creek confluence	7.51	6.5	51.5	177.0	61	104	17.6	<.5	<.5	0.11	1.29
RR-12	RR 100' E of Columbine Creek Confluence		6.5	55.5	196.0	48	213	58	0.54	0.6	0.30	2.35
RR-13	RR, highway bridge W of Columbine Creek		6.5	55.5	196.0	50	163	54	0.54	<.5	0.20	1.80
RR-14	RR up from Goathill Gulch		6.5	58.1	241.0	42	123	52	0.72	<.5	0.32	2.05
RR-15	RR down from Goathill Gulch		7.0	57.0	224.0	52	130	62	0.83	<.5	0.32	2.24
RR-16	RR Questa Ranger Station		6.5	54.0	171.0	41	150	106	0.83	<.5	0.35	2.72
SGS-1	Sulpher Gulch-spring pond	6.65	7.0	75.5	753.0	83	620	6.5	<.5	<.5	1.30	0.75
SSC-1	seep, S of west end Sugar Shack South		5.0	55.0	2,350	33	2,017	214	2.20	5.3	92.00	<.01

NOTES:

Sampling by SPRI; analytical results from Molycorp. Inc.

(1) - pH Strip, Temperature and Conductivity were measured field measurements.

All samples are total metals except Alum. Suspended and Alum. Dissolved

< symbols are detection limits.

TABLE 3

WATER QUALITY DATA FOR THE RED RIVER - (SPRI, MAY 1994)

MINE AREA - MOLYCORP, INC. - QUESTA, NEW MEXICO

Sample ID	Ferrous Iron (mg/L)	Lead (mg/L)	Manganese (mg/L)	Zinc (mg/L)	Copper (mg/L)	Molybdenum (mg/L)	Sodium (mg/L)	Potassium (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Silica (mg/L)	Chlorine (mg/L)	Cadmium (mg/L)	Sulfate (mg/L)
BC-1		0.003	0.041	0.025	0.03	<.02	2.5	<1.0	6	1.6	20	2.5	<.005	12
BC-2		0.002	0.034	0.025	0.02	<.02	2.7	<1.0	12.5	3.5	22	3	<.005	13.7
BCS-1		<.002	1.360	0.491	0.18	<.02	9.4	1.5	48.9	27.2	46	5	0.005	171
BOS-1		<.002	<.01	0.060	0.01	<.02	13.1	1.2	85.2	21.5	20	20	<.005	217
CCS-1	7.0	<.002	416.20	146.00	15.3	<.02	23.7	<1.0	504	1,032	92.4	30	0.75	11,996
CCS-2		0.036	0.213	0.149	0.024	<.02	9.5	2.6	20.2	4.2	46.6	7.5	<.005	56.8
CCS-3	<1.0	0.078	12.600	6.960	0.162	<.02	70.3	9.6	348	84	76	14.5	0.021	1,736
CCS-4		<.002	10.300	2.620	0.21	<.02	30.9	2	145	38.5	52	9.5	0.007	541.7
CCS-5		0.004	28.900	7.600	1.21	<.02	19.1	1.7	118	76.9	112	9.5	0.036	1,152
CCS-6		0.003	13.600	4.470	0.998	<.02	30	3.5	233	65	62	35	0.017	1,649
CLB-1		<.002	<.01	0.022	0.008	<.02	1.5	<1.0	17	1.8	14	2.5	<.005	1.7
ECCS-1		<.002	<.01	0.115	0.01	<.02	9.8	1.2	52.8	12.7	28	18.5	<.005	128.3
ECCS-2		0.003	8.740	2.820	0.921	<.02	55.7	3.5	138	41	28	95	0.015	669
EGHS-1		<.002	<.01	0.042	0.009	<.02	9.5	1.7	104.4	23.1	18	10.5	<.005	190
GHS-1	8.0	<.010	239.50	82.70	8.6	<.02	11.7	<1.0	444	760	104	37	0.381	13,312
GHS-2	10.0	<.010	263.80	86.40	8.5	<.02	18.4	<1.0	432	704	96.7	40	0.409	11,667
GHS-3	1.0	0.017	22.00	4.22	1.58	<.02	32.6	<1.0	504	405	102	15	<.005	7,763
HCS-1	2.0	0.004	20.300	3.740	0.512	<.02	17.8	<1.0	504	274	63.5	10	0.012	3,876
HCS-2		<.002	17.100	3.880	0.629	<.02	17.2	<1.0	454	199	75.9	16	0.013	3,436
HCS-3		0.004	0.445	0.183	0.025	<.02	48	2.6	156	18	22	90	<.005	377
HTS-1	7.0	0.009	6.250	2.960	1.14	<.02	2.1	<1.0	55.9	43.5	100	16	0.012	848
MC-1		<.002	0.054	0.043	0.02	<.02	3.9	1.4	8.2	3.1	32	4.5	<.005	16.4
PC-1		<.002	0.036	0.014	0.02	<.02	2	<1.0	19.8	2.4	15	5	<.005	20
POS-1		<.002	6.830	2.490	0.05	<.02	26.2	3.4	206	16.6	32	27	0.01	622
RR-1		<.002	0.033	0.048	0.02	<.02	2.2	<1.0	15	2.5	14	4	<.005	7
RR-2		<.002	0.039	0.012	0.01	<.02	2	<1.0	17.7	2.4	14	2.5	<.005	3
RR-3		0.004	0.086	0.018	0.02	0.03	2.3	<1.0	15.7	2.5	17	4	<.005	13.8
RR-4		<.002	0.030	0.006	0.01	<.02	1.9	<1.0	17	2.2	12	5	<.005	2.2
RR-5		0.003	0.065	0.022	0.02	<.02	2.3	<1.0	17	2.5	14	5	<.005	17.4

TABLE 3

WATER QUALITY DATA FOR THE RED RIVER - (SPRI, MAY 1994)

MINE AREA - MOLYCORP, INC. - QUESTA, NEW MEXICO

Sample ID	Ferrous Iron (mg/L)	Lead (mg/L)	Manganese (mg/L)	Zinc (mg/L)	Copper (mg/L)	Molybdenum (mg/L)	Sodium (mg/L)	Potassium (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Silica (mg/L)	Chlorine (mg/L)	Cadmium (mg/L)	Sulfate (mg/L)
RR-6		0.003	0.080	0.034	0.02	<.02	2.3	<1.0	16.6	2.4	14	5	<.005	17.7
RR-7		0.004	0.080	0.030	0.02	<.02	2.8	1.0	20	3.1	16	5	<.005	15.9
RR-8		0.004	0.082	0.027	0.02	<.02	2.8	<1.0	19.1	3	24	4.5	<.005	19.5
RR-9		0.003	0.064	0.202	0.01	<.02	2.6	<1.0	18.6	3.4	14	5	<.005	14.5
RR-10		0.004	0.109	0.018	0.02	<.02	2.9	<1.0	20.4	3.9	17	5	<.005	17.4
RR-11		0.004	0.048	<.005	0.02	<.02	2.6	<1.0	18.5	3.3	20	4	<.005	11.4
RR-12		0.004	0.126	0.042	0.018	<.02	3	<1.0	21.4	4.6	64	2.5	<.005	33.6
RR-13		0.004	0.078	0.031	0.016	<.02	2.9	<1.0	21	4.4	18	3	<.005	23.5
RR-14		0.006	0.242	0.067	0.02	<.02	3	1	23	5	18	3	0.007	29.7
RR-15		0.004	0.213	0.062	0.018	<.02	3	<1.0	22.8	4.9	20	3.5	<.005	34.7
RR-16		0.014	0.290	0.073	0.024	<.02	2.7	<1.0	22.1	4.5	14	6.5	<.005	28.9
SGS-1		<.002	0.252	0.099	0.01	0.19	17.6	4	119	17.7	24	22.5	<.005	160
SSC-1		0.026	12.300	2.920	0.213	0.88	58.7	5.3	298	13.5	30	72.5	0.02	679.8

TABLE 4
MINE SITE MONITOR WELL GROUND WATER ELEVATIONS
(FROM MOLYCORP)

MOLYCORP, INC. - QUESTA DIVISION
MMW WATER ELEVATIONS

WELL	REFERENCE ELEVATION	H20 ELEV 2/22/96	H20 ELEV 3/13/96	H20 ELEV 4/18/96	H20 ELEV 5/23/96	H20 ELEV 6/21/96	H20 ELEV 7/25/96	H20 ELEV 8/21/96	H20 ELEV 9/20/96	H20 ELEV 1/27/97	H20 ELEV 2/17/97	H20 ELEV 3/7/97	H20 ELEV 3/31/97	H20 ELEV 4/25/97	H20 ELEV 5/21/97	H20 ELEV 6/25/97	H20 ELEV 7/22/97	H20 ELEV 8/20/97
MMW-2	7700.05	7665.59	7665.60	7665.47	7665.10	7665.52	7665.10	7665.52	7665.73	7665.41	7665.49		7665.95	7665.88	7665.92	7665.26	7665.04	7665.28
MMW-3	7701.07	7669.10	7669.14	7669.10	7668.69	7669.08	7668.69	7669.08	7669.17	7668.79	7668.89		7669.44	7669.24	7669.36	7668.78	7668.50	7668.72
MMW-7	8090.16	8028.41	8028.58	8028.80	8028.26	8029.00	8029.00	8028.26	8028.69	8028.71	8028.59		8028.46	8028.59	8028.74	8028.58	8028.46	8028.66
MMW-8A	7858.22	7761.69	7761.8	7761.77	7762.06	7762.60	7762.06	7762.60	7762.77	7762.07	7761.80		7761.99	7761.41	7762.56	7762.62	7762.05	7761.91
MMW-8B	7859.47	7763.73	7763.84	7763.87	7764.14	7764.51	7764.14	7764.51	7764.63	7763.76	7763.57		7763.75	7764.14	7764.53	7764.72	7763.52	7763.88
MMW-10A	7939.33	7917.58	7917.37	7917.36	7918.19	7917.55	7918.19	7917.55	7916.64	7911.40	7909.49	7907.48	7907.17	7906.45	7907.87	7915.41	7916.10	7914.09
MMW-10B	7939.20	7917.52	7917.32	7917.31	7918.05	7917.53	7918.05	7917.53	7916.57	7911.25	7909.32	7907.26	7906.9	7905.85	7905.60	7915.20	7916.00	7913.90
MMW-10C	7939.44	7917.18	7916.99	7916.99	7917.75	7917.23	7917.75	7917.23	7916.31	7911.29	7909.48	7907.47	7907.1	7906.29	7907.72	7914.94	7915.99	7914.00
MMW-11	8004.93	7917.50	7915.3	7915.28	7916.11	7915.57	7916.11	7915.57	7914.64	7909.74	7908.07	7906.09	7905.61	7904.77	7906.05	7913.82	7914.43	7912.50
MMW-13	8072.45	7963.75	7963.32	7963.25	7965.05	7965.19	7965.05	7965.19	7961.17	7947.13	7945.30	7942.75	7941.86	7941.35	7942.41	7954.32	7956.64	7953.50
MMW-14	8166.50	0	0				0	0	0	8106.14	8106.28	8106.28	8106.28	8106.25	8106.27	8106.27	8106.28	8106.27
MMW-16	8139.66	8057.03	8056.86	8056.66	8057.32	8056.05	8057.32	8056.05	8053.86	8053.33	8053.24	DRY	DRY	MUD	MUD	MUD	MUD	MUD
P-1	7827.08										7805.43		7804.46	7805.08		7804.08	7806.80	7807.56
P-2	7822.34										7806.24		7805.56	7805.88		7804.99	7807.34	7807.95
P-3	7842.71										7811.46		7810.86	7811.44		7816.15	7813.77	7813.78
P-4A	7834.36										7810.72		7810.23	7810.41		7814.36	7812.21	7812.45
P-4B	7834										7809.89		7809.27	7809.74		7813.89	7811.58	7811.85
P-5A	7840.37										7872.07		7818.86	7819.68		7823.82	7822.07	7821.43
P-5B	7840.18										7817.68		7817.65	7818.28		7821.83	7820.08	7819.69
P-5C	7840.29										7816.19		7816.26	7816.79		7819.66	7818.17	7817.83

MMWELEV.XLS

TABLE 5

1994 MONITOR WELL WATER QUALITY DATA FOR MINE AREA

MOLYCORP, INC. - QUESTA, NEW MEXICO

(TAKEN FROM SOUTH PASS RESOURCES, April 21, 1995)

MONITOR WELL	SAMPLE DATE 1994	WELL TD (feet)	Corrected DEPTH TO WATER (feet)	DEPTH TO PUMP INTAKE (feet)	pH (1)	CONDUC-TIVITY(1) (uhmos)	TEMP.(1) (°C)	CARBO-NATE (mg/L)	BICARBO-NATE (mg/L)	HYDR-OXIDE (mg/L)	TOTAL ALK (mg/L)	CHLORIDE (mg/L)	FLUORIDE (mg/L)	SULFATE (mg/L)
MMW-2	8-Nov	68	31.69	50	4.90	3,680	7.9	<1	<1	<1	<1	6.8	24.0	2,100
MMW-3	7-Nov	140	27.76	80	7.50	3,970	10.9	<1	222	<1	222	5.8	2.59	1,700
MMW-7	7-Nov	161	61.11	120	4.40	9,490	17.2	<1	<1	<1	<1	21	1.12	10,400
DUP-11A (2)	7-Nov	NA	NA	NA	NA	NA	NA	<1	<1	<1	<1	21	0.98	10,500
MMW-8A	8-Nov	178	96.77	140	7.00	2,860	8.4	<1	165	<1	165	8.7	2.72	1,300
MMW-8B	8-Nov	129	96.03	112	6.40	1,780	7.1	<1	19	<1	19	5.6	1.83	730
MMW-10A	8-Nov	144	21.70	100	5.80	2,400	7.8	<1	<1	<1	<1	27	11.2	1,100
DUP-12B (3)	8-Nov	NA	NA	NA	NA	NA	NA	<1	<1	<1	<1	26	7.96	1,100
MMW-10A (4)	19-Nov	NA	NA	NA	NA	NA	NA	<1	<1	<1	<1	26	8.28	1,200
MMW-10B	7-Nov	189	21.57	140	7.90	2,250	10.1	10	<1	66	76	28	12.2	1,100
MMW-10C	8-Nov	50	21.80	40	4.70	2,000	11.8	<1	<1	<1	<1	20	15.4	880
MMW-11	7-Nov	184	86.71	150	5.60	2,450	15.7	<1	<1	<1	<1	22	17.6	1,300
MMW-13	8-Nov	145	105.98	130	7.90	2,280	8.9	<1	200	<1	200	14	1.67	770

NOTES:

(1) pH, CONDUCTIVITY AND TEMPERATURE WERE RECORDED WHEN SAMPLED.

(2) - Dup 11A = DUPLICATE SAMPLE FOR MMW-7

(3) - Dup 12B = DUPLICATE SAMPLE FOR MMW-10A

(4) - SAMPLED AFTER AQUIFER TEST

NA - Not Available

SOURCE: SAMPLES TAKEN BY SPRI, ANALYTICAL RESULTS FROM MOLYCORP.

TABLE 5

1994 MONITOR WELL WATER QUALITY DATA FOR MINE AREA

MOLYCORP, INC. - QUESTA, NEW MEXICO

MONITOR WELL	TDS (mg/L)	SILVER (mg/L)	ALUMINUM (mg/L)	ARSENIC (mg/L)	BARIUM (mg/L)	BERYLLIUM (mg/L)	CALCIUM (mg/L)	CADMIUM (mg/L)	COBALT (mg/L)	CHROMIUM (mg/L)	COPPER (mg/L)	IRON (mg/L)	MERCURY (mg/L)
MMW-2	3,400	<0.10	63.5	<0.005	<0.010	0.015	501	0.024	0.280	<0.010	0.088	50.8	<0.0002
MMW-3	2,900	<0.10	0.75	<0.005	0.047	<0.004	567	0.0024	0.089	<0.010	<0.010	0.076	<0.0002
MMW-7	16,000	<0.50	943	<0.05	0.108	0.104	544	0.096	4.91	0.193	4.84	384	<0.0002
DUP-11A (2)	16,000	<0.50	961	<0.05	0.074	0.122	534	0.092	4.99	0.17	5.04	375	<0.0002
MMW-8A	2,200	<0.10	<0.05	<0.005	0.103	<0.004	466	0.002	<0.010	<0.010	<0.010	2.84	<0.0002
MMW-8B	1,100	<0.10	0.44	<0.005	0.016	<0.004	206	<0.0005	<0.010	<0.010	<0.010	<0.050	<0.0002
MMW-10A	1,700	<0.10	33.4	<0.005	<0.010	0.008	275	0.028	0.148	<0.010	0.558	<0.050	<0.0002
DUP-12B (3)	1,700	<0.10	34.2	<0.005	<0.010	0.008	270	0.024	0.137	<0.010	0.58	<0.050	<0.0002
MMW-10A (4)	1,700	<0.010	31.6	<0.005	<0.010	0.006	245	0.0224	0.141	<0.010	0.534	0.086	<0.0002
MMW-10B	1,800	<0.10	8.74	<0.005	0.034	0.007	347	0.025	0.074	<0.010	0.179	0.101	<0.0002
MMW-10C	1,400	<0.10	31.1	<0.005	0.014	0.007	204	0.026	0.106	<0.010	0.38	<0.050	<0.0002
MMW-11	2,000	<0.10	56.3	<0.005	0.016	0.013	276	0.036	0.266	0.036	0.919	0.129	<0.0002
MMW-13	1,400	<0.10	<0.05	<0.005	0.036	<0.004	316	<0.0005	0.013	<0.010	<0.010	0.198	<0.0002

NOTES:

(1) pH, CONDUCTIVITY AND TEMPERATURE WERE RECORDED WHEN SAMPLED.

(2) - Dup 11A = DUPLICATE SAMPLE FOR MMW-7

(3) - Dup 12B = DUPLICATE SAMPLE FOR MMW-10A

(4) - SAMPLED AFTER PUMP TEST

SOURCE: SAMPLES TAKEN BY SPRI, ANALYTICAL RESULTS FROM MOLYCORP.

TABLE 5

1994 MONITOR WELL WATER QUALITY DATA FOR MINE AREA

MOLYCORP, INC. - QUESTA, NEW MEXICO

MONITOR WELL	POTASSIUM (mg/L)	MAGNESIUM (mg/L)	MANGANESE (mg/L)	MOLYBDENUM (mg/L)	SODIUM (mg/L)	NICKEL (mg/L)	LEAD (mg/L)	ANTIMONY (mg/L)	SELENIUM (mg/L)	SILICON (mg/L)	THALLIUM (mg/L)	VANADIUM (mg/L)	ZINC (mg/L)
MMW-2	10.8	137	52.1	<0.02	64.6	0.61	<0.002	<0.05	<0.05	20.3	<0.005	<0.010	9.48
MMW-3	7.5	96.2	34.5	<0.02	103	0.236	<0.002	<0.05	<0.005	7.6	<0.005	<0.010	1.36
MMW-7	12.0	1250	72.1	<0.10	175	10.5	0.10	<0.25	<0.025	22.7	<0.005	0.104	11.7
DUP-11A (2)	12.1	1230	73.3	<0.10	178	10.7	0.06	<0.25	<0.025	22.6	<0.005	0.106	11.9
MMW-8A	3.8	85.6	7.15	<0.02	41.5	<0.020	<0.002	<0.05	<0.005	11.1	<0.005	<0.010	<0.050
MMW-8B	2.9	55.5	0.202	<0.02	33.9	0.059	<0.002	<0.05	<0.005	17.3	<0.005	<0.010	0.211
MMW-10A	2.8	77.9	13.8	<0.02	26.5	0.325	<0.002	<0.05	<0.005	14.3	<0.005	<0.010	2.29
DUP-12B (3)	2.5	76.7	12.8	<0.02	26.4	0.293	<0.002	<0.05	<0.005	14.0	<0.005	<0.010	2.07
MMW-10A (4)	3.7	69.7	13.1	<0.02	25.6	0.279	0.004	<0.05	<0.005	14.1	<0.005	<0.010	2.68
MMW-10B	3.5	80.3	8.55	<0.02	25.8	0.201	0.021	<0.05	<0.05	12.8	<0.005	<0.010	1.5
MMW-10C	2.8	75.2	16.3	<0.02	20.2	0.0347	<0.002	<0.05	<0.005	9.9	<0.005	<0.010	3.2
MMW-11	3.4	133	31.7	<0.02	25.5	0.593	0.086	<0.05	<0.005	14.2	<0.005	<0.010	5.0
MMW-13	5.4	38.7	1.02	0.05	30	<0.020	<0.002	<0.05	<0.005	8.8	<0.005	<0.010	0.222

NOTES:

(1) Ph, CONDUCTIVITY AND TEMPERATURE WERE RECORDED WHEN SAMPLED.

(2) - Dup 11A = DUPLICATE SAMPLE FOR MMW-7

(3) - Dup 12B = DUPLICATE SAMPLE FOR MMW-10A

(4) - SAMPLED AFTER PUMP TEST

SOURCE: SAMPLES TAKEN BY SPRI, ANALYTICAL RESULTS FROM MOLYCORP.

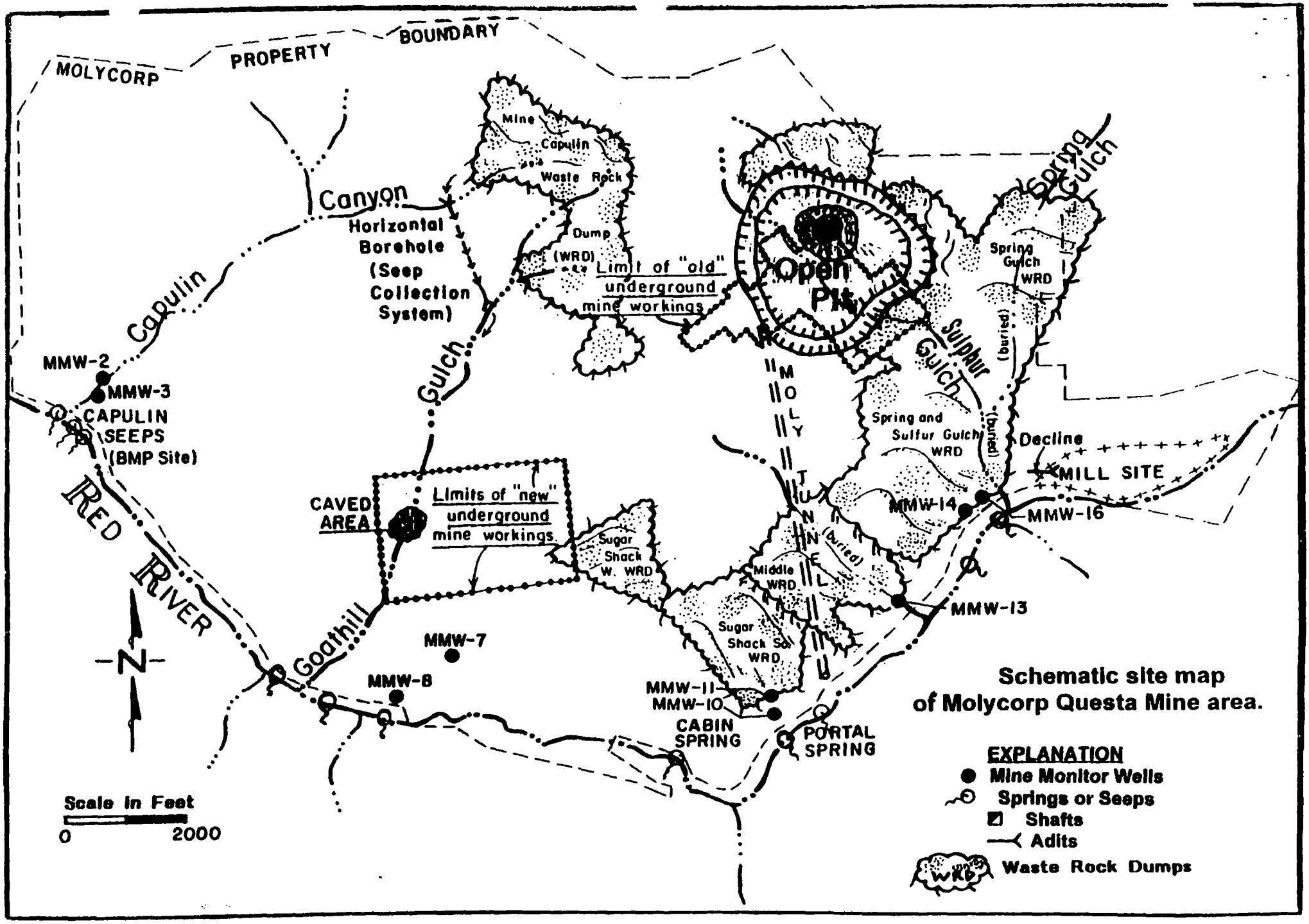
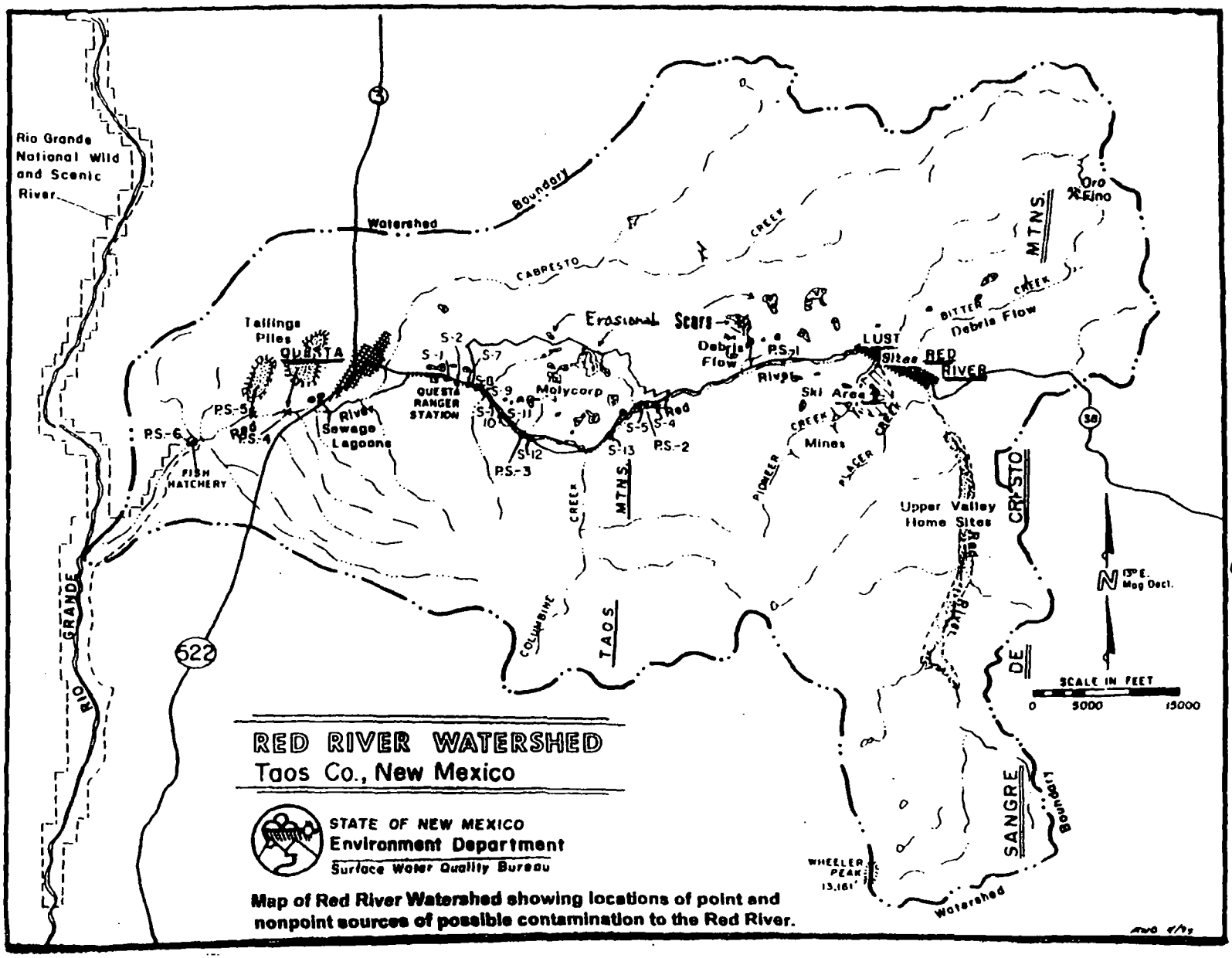


FIGURE 1

(MODIFIED FROM NMED, March 1996)

FIGURE 2

(MODIFIED FROM NMED, March 1996)



Map of Red River Watershed showing locations of point and nonpoint sources of possible contamination to the Red River.

EXPLANATION

POINT SOURCE POLLUTION:

PS-1: Town of Red River Wastewater Treatment Plant

PS-2: Molycorp Mill Site Outfall #005

PS-3: Molycorp Mine, Goathill Gulch Outfall #004

PS-4: Molycorp East Tailings Pile Outfall #002

PS-5: Molycorp Pope Lake/W.Tailings Outfall #001

PS-6: Red River Fish Hatchery (NMDG&F)

NONPOINT SOURCE POLLUTION:

S-1 to S-13: Red River Groundwater Seeps (ARD)

Hydrothermally Altered Volcanic Rock Scars

Molycorp Mine

Scattered Abandoned Mine and Mill Sites (Esp. Pioneer and Bitter Creeks)

Upper RR Valley Home Sites: septic tanks, leach fields

Town of Red River: Leaking Underground Storage Tanks (LUST)

Red River Ski Area

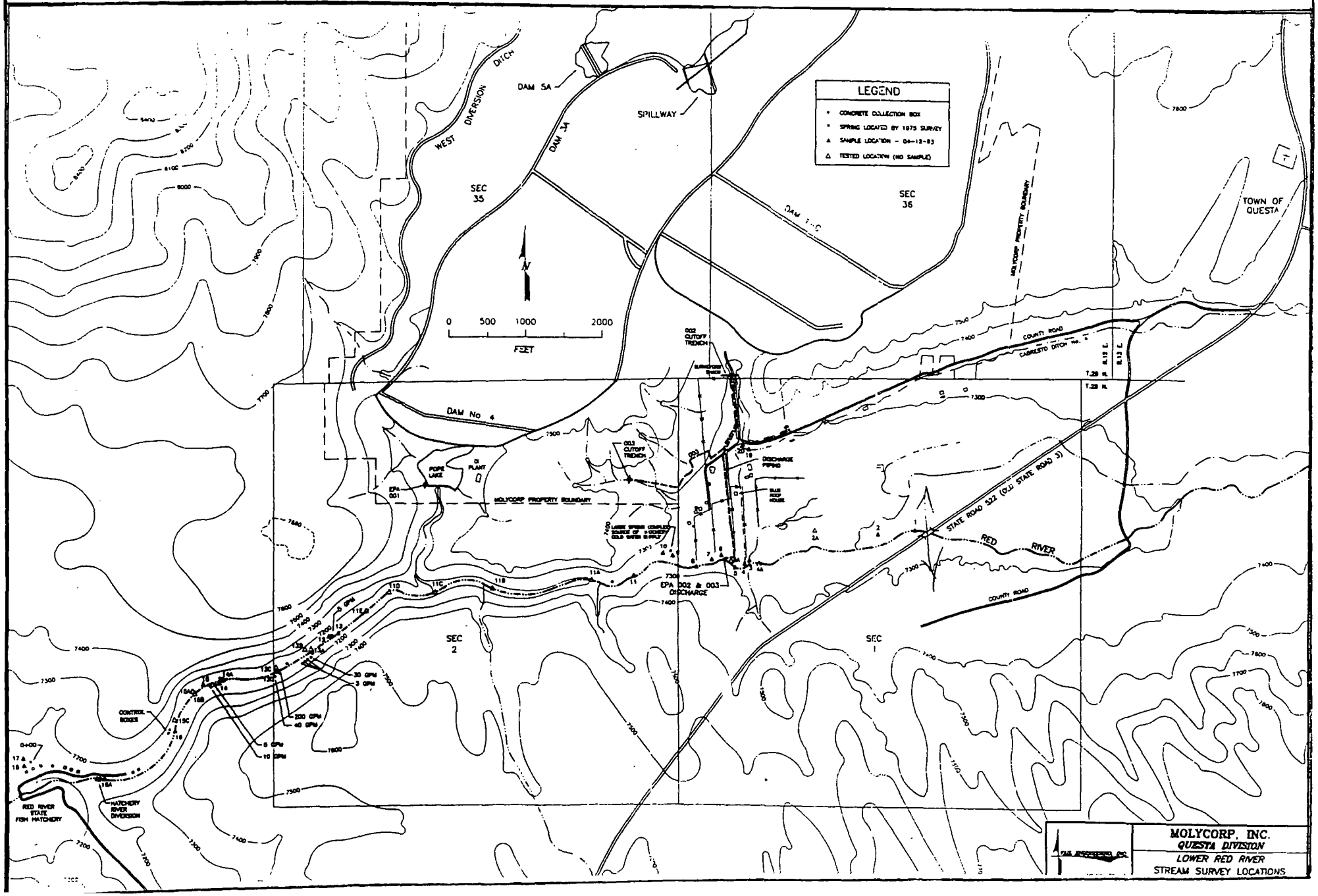
Town of Questa Sewage Lagoons

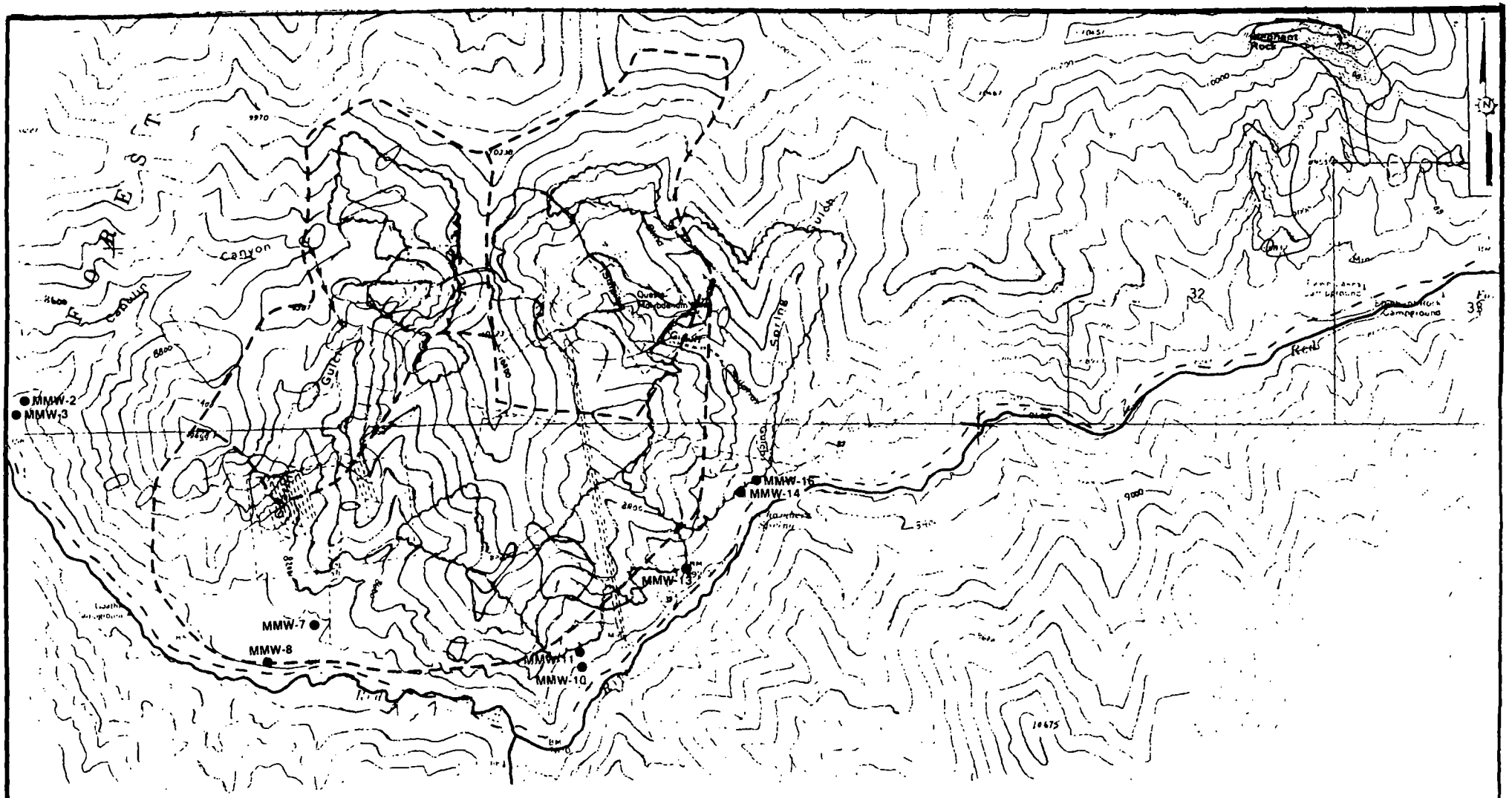
Landslide/ Debris Flow Gravels and Sediment (Bitter, Hansen and Hotentot Creeks)

FIGURE 3

TAILINGS PONDS

Topography and Sample Locations (TAKEN FROM VAIL, October 1994)





(MODIFIED FROM NMED, March 1996)

Approximate Surface Water Collection System Boundary

SCAR AREAS (SRK 1995)

OVERBURDEN DISPOSAL PILES (SRK 1995)

0 2000 4000 FEET

SCALE

REFERENCE U S G S TOPOGRAPHIC MAPS OF QUESTA AND RED RIVER NEW MEXICO DATED 1963

FIGURE 4

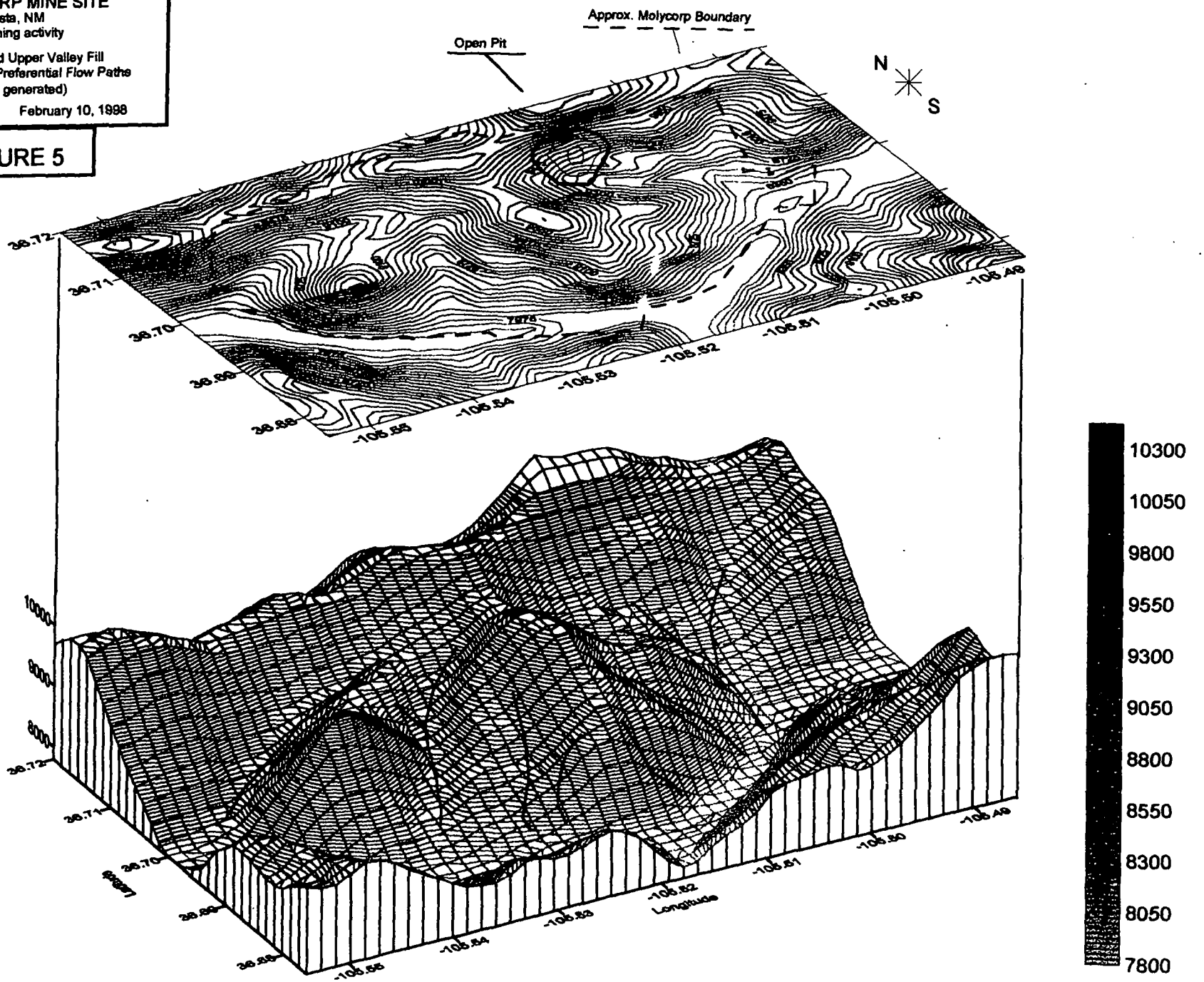
MINE SITE TOPOGRAPHY
Erosional Scars and WRDs

MOLYCORP MINE SITE
Questa, NM
Pre-mining activity

Surface and Upper Valley Fill
Groundwater Preferential Flow Paths
(Surfer generated)

USEPA February 10, 1998

FIGURE 5



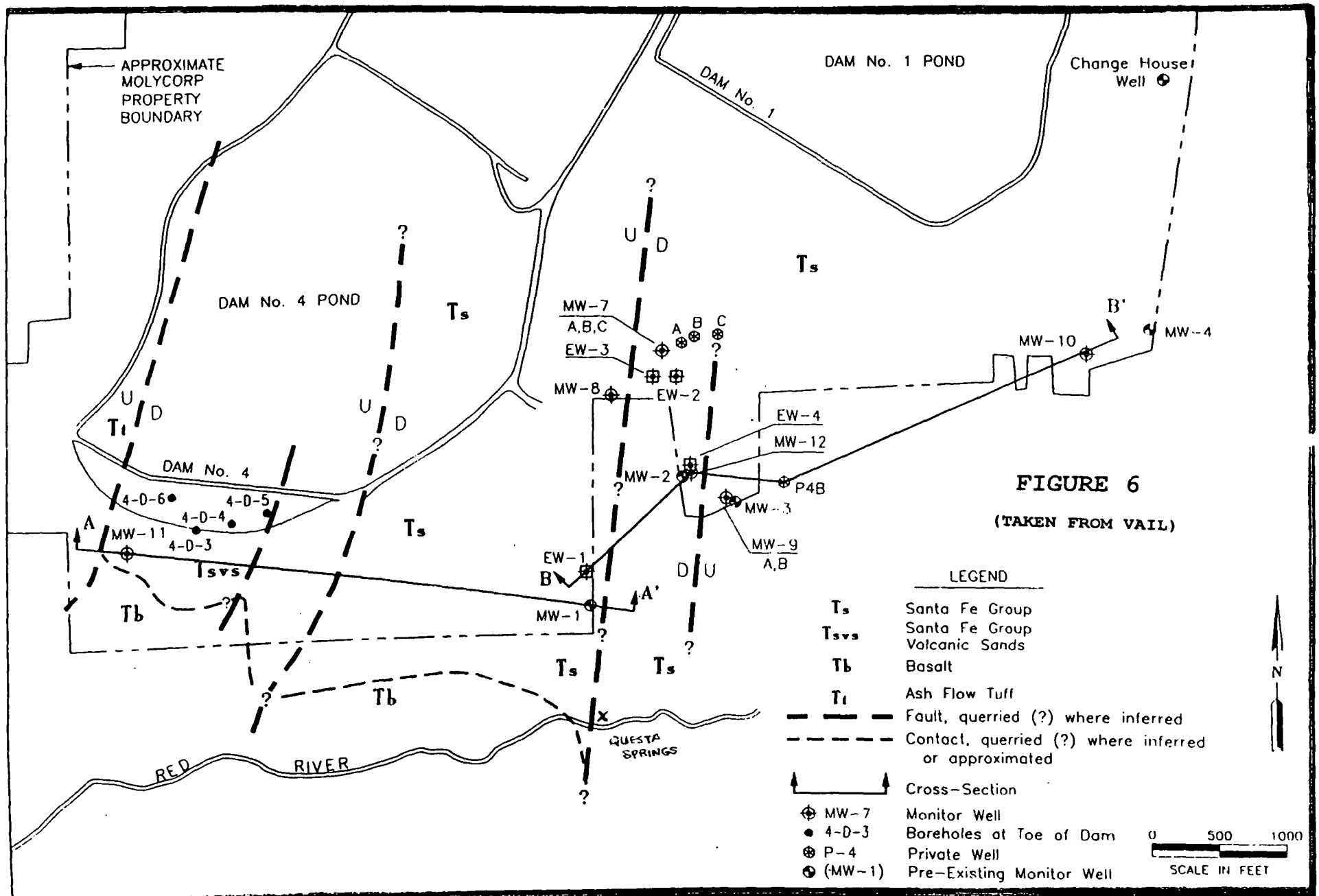


FIGURE:

SOUTH PASS RESOURCES, Inc.

PROJECT No:	DATE:	AUTHOR:	DRAWN BY:
001-06	3/31/95		M.O'M.

GEOLOGIC MAP – TAILINGS AREA
Molycorp, Inc.
Questa, New Mexico

UPPER PORTION OF UAU AT DAM No. 1

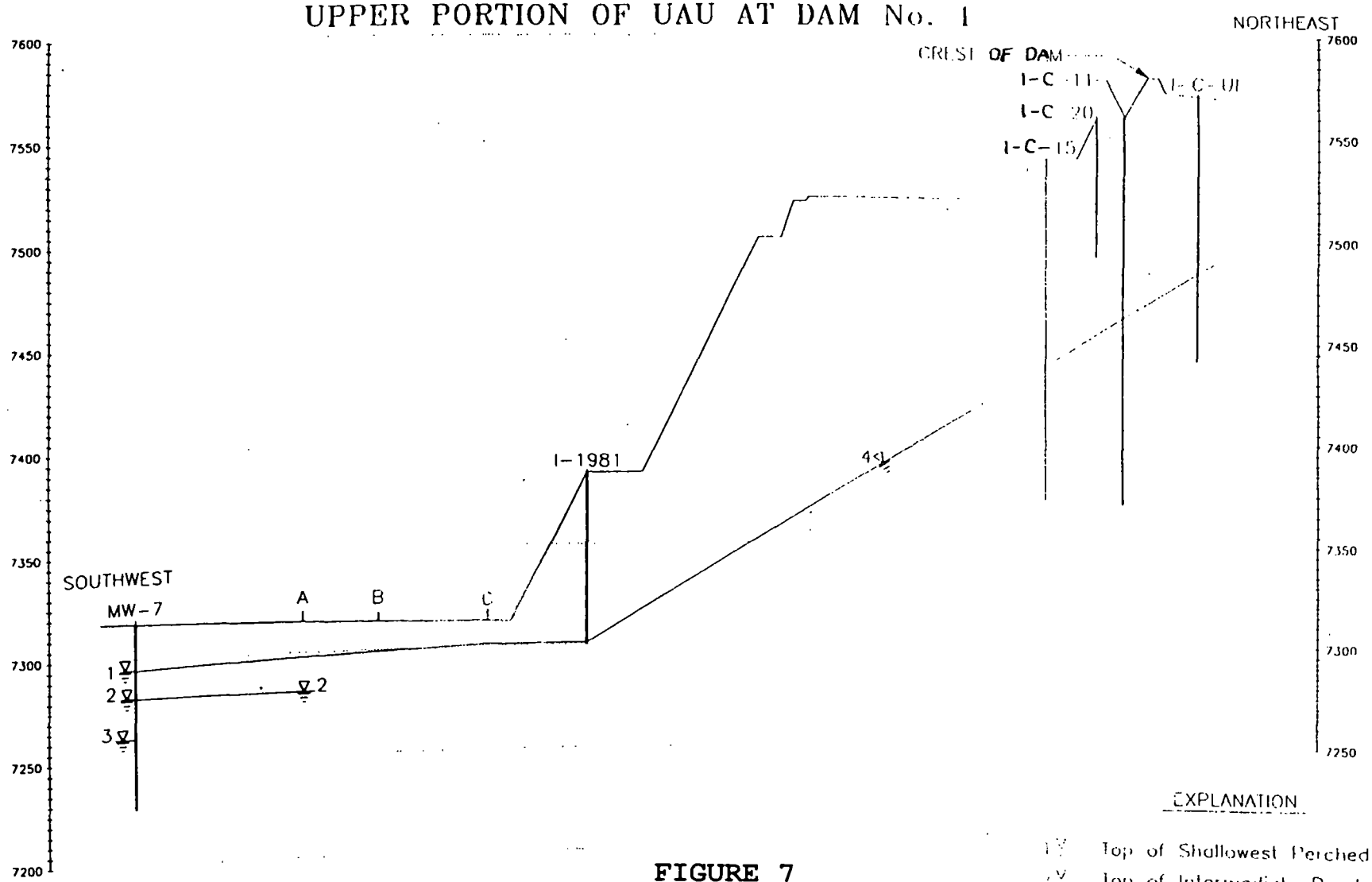


FIGURE 7

(TAKEN FROM SOUTH PASS RESOURCES, April 13, 1995)

0 37.5 75 VERTICAL SCALE IN FEET

0 150 300 HORIZONTAL SCALE IN FEET

EXPLANATION

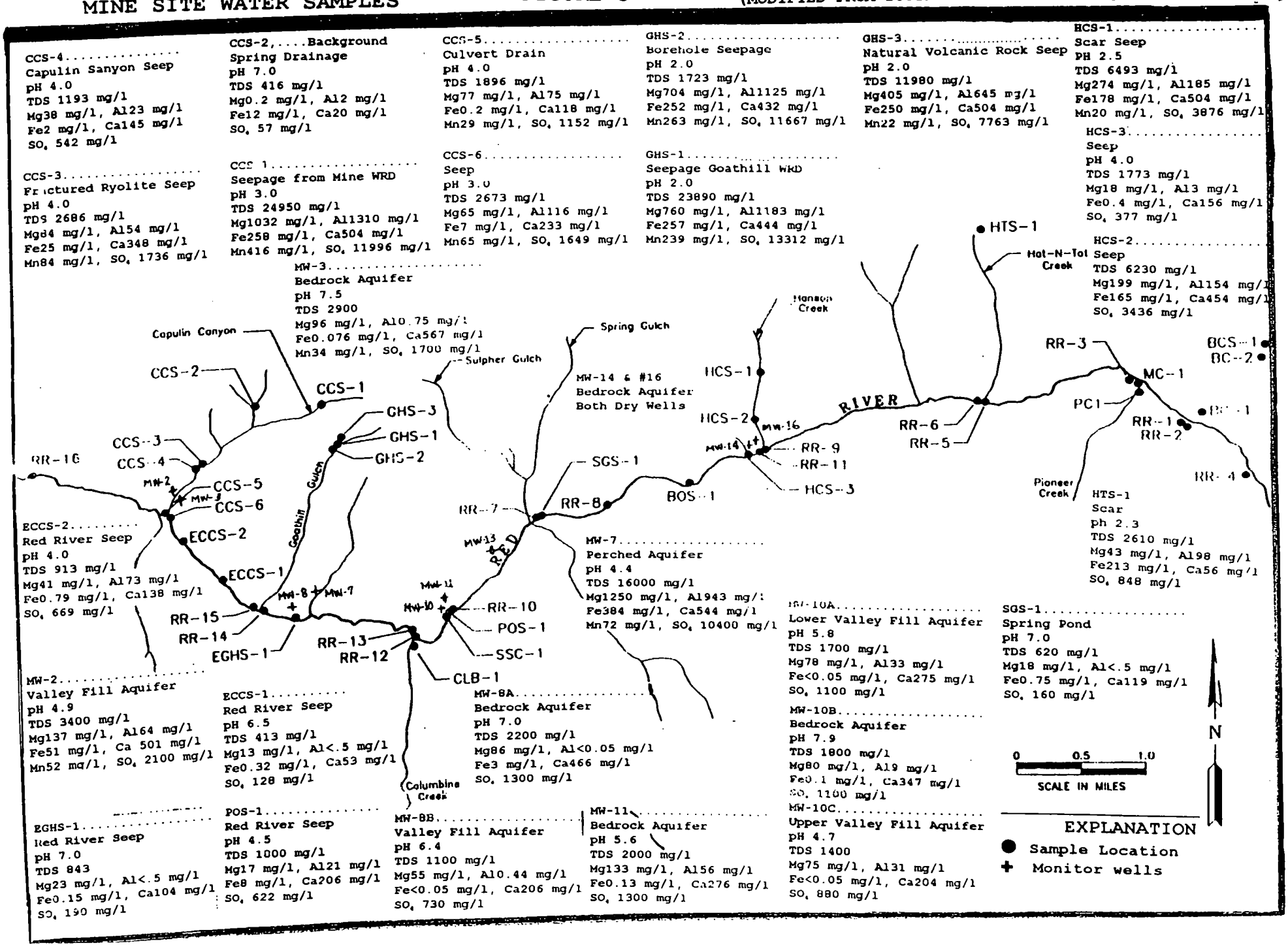
- Top of Shallowest Perched Zone
- Top of Intermediate Perched Zone
- Top of Main Perched Zone
- Water Level in Tailings Dam
- Piezometers projected into line of section

FIGURE:	SOUTH PASS RESOURCES, Inc.				WATER LEVELS FOR PERCHED ZONES (APRIL 1993) Tailings Area -- Molycorp, Inc. Questa, New Mexico
	PROJECT No.: 001-06	DATE: 3/31/95	AUTHOR:	DRAWN BY: M.O'M.	

MINE SITE WATER SAMPLES

FIGURE 8

(MODIFIED FROM SOUTH PASS RESOURCES, April 21, 1995)



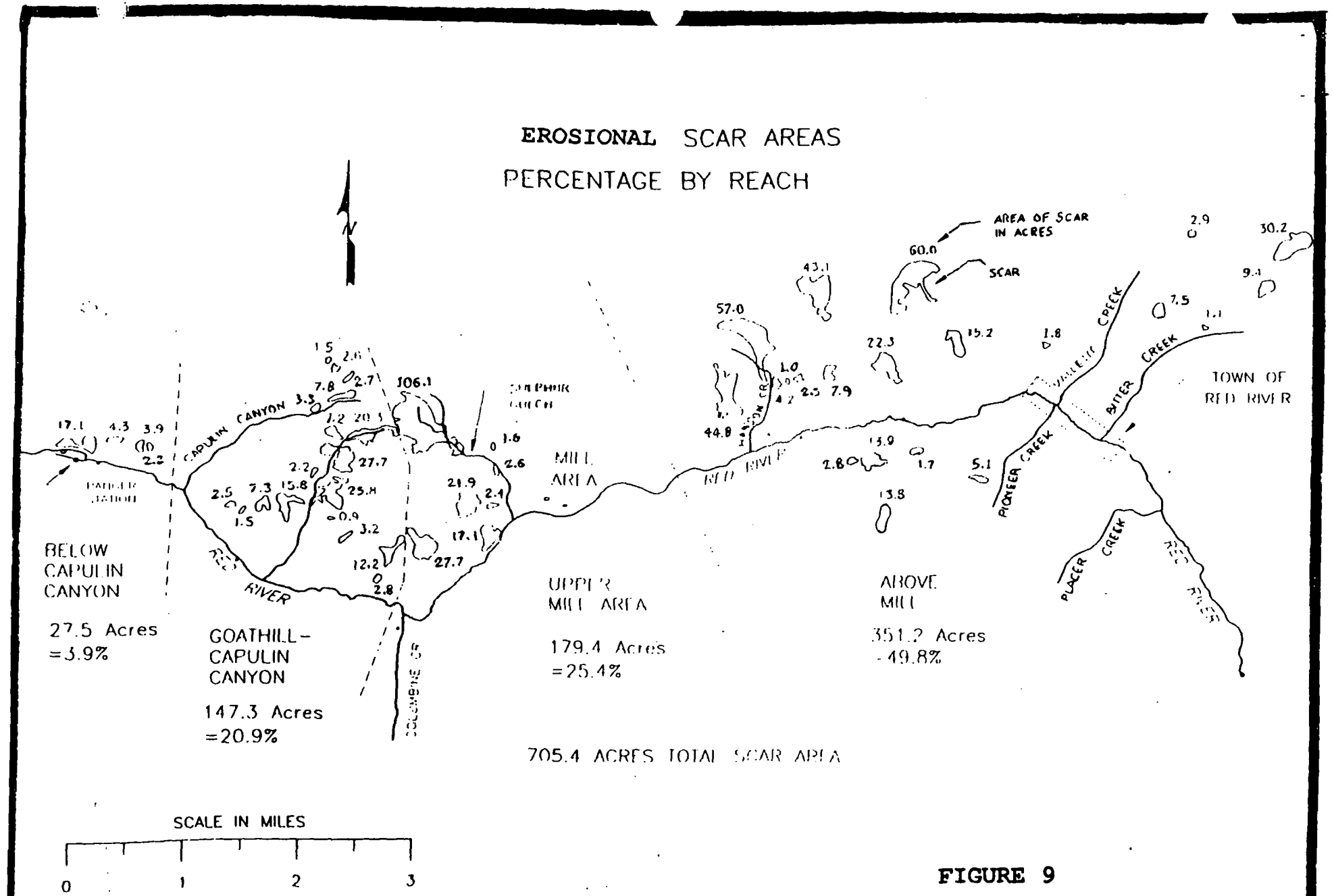


FIGURE 9

EROSIONAL SCAR AREAS

(MODIFIED FROM VAIL, July 9, 1993)

APPENDIX 1

Appendix 1 is an excerpt from the State of New Mexico Standards for Interstate and Intrastate Streams [effective January 23, 1995].

B. Standards:

1. In any single sample: conductivity shall not exceed 300 μmhos, pH shall be within the range of 6.6 to 8.8, temperature shall not exceed 20 C (68 F), and turbidity shall not exceed 10 NTU. The use-specific numeric standards set forth in Section 3101 are applicable to the designated uses listed above in Section 2118.A.

2. The monthly geometric mean of fecal coliform bacteria shall not exceed 100/100 ml; no single sample shall exceed 200/100 ml (see Section 1103.B).

2119. The main stem of the Rio Grande from Taos Junction Bridge upstream to the New Mexico-Colorado line, the Red River from its mouth on the Rio Grande upstream to the mouth of Placer Creek, and the Rio Pueblo de Taos from its mouth on the Rio Grande upstream to the mouth of the Rio Grande del Rancho.

A. Designated Uses: coldwater fishery, fish culture, irrigation, livestock watering, wildlife habitat, and secondary contact.

B. Standards:

1. In any single sample: pH shall be within the range of 6.6 to 8.8, temperature shall not exceed 20 C (68 F), and turbidity shall not exceed 50 NTU. The use-specific numeric standards set forth in Section 3101 are applicable to the designated uses listed above in Section 2119.A.

2. The monthly geometric mean of fecal coliform bacteria shall not exceed 100/100 ml; no single sample shall exceed 200/100 ml (see Section 1103.B).

2120. The Red River upstream of the mouth of Placer Creek, all tributaries to the Red River, and all other perennial reaches of tributaries to the Rio Grande in Taos and Rio Arriba counties unless included in other segments.

A. Designated Uses: domestic water supply, fish culture, high quality coldwater fishery, irrigation, livestock watering, wildlife habitat, and secondary contact.

B. Standards:

1. In any single sample: conductivity shall not exceed 400 μmhos (500 μmhos for the Rio Fernando de Taos), pH shall be within the range of 6.6 to 8.8, temperature shall not exceed 20 C (68 F), and turbidity shall not exceed 25 NTU. The use-specific numeric standards set forth in Section 3101 are applicable to the designated uses listed above in Section 2120.A.

2. The monthly geometric mean of fecal coliform bacteria shall not exceed 100/100 ml; no single sample shall exceed 200/100 ml (see Section 1103.B).

2200. PECOS RIVER BASIN.

2201. The main stem of the Pecos River from the New Mexico-Texas line upstream to the mouth of the Black River.

A. Designated Uses: irrigation, livestock watering, wildlife habitat, secondary contact, and warmwater fishery.

B. Standards:

1. In any single sample: pH shall be within the range of 6.6 to 8.8 and temperature shall not exceed 32.2 C (90 F). The use-specific numeric standards set forth in Section 3101 are applicable to the designated uses listed above in Section 2201.A.

2. The monthly geometric mean of fecal coliform bacteria shall not exceed 200/100 ml; no single sample shall exceed 400/100 ml (see Section 1103.B).

3. At all flows above 50 cfs: TDS shall not exceed 20,000 mg/l, sulfate shall not exceed 3,000 mg/l, and chloride shall not exceed 10,000 mg/l.

2202. The main stem of the Pecos River from the mouth of the Black River upstream to Lower Tansil Dam,[1] including the Black River. the Delaware River and Blue Spring.

A. Designated Uses: industrial water supply, irrigation, livestock watering, wildlife habitat, secondary contact, and warmwater fishery.

B. Standards:

1. In any single sample: pH shall be within the range of 6.6 to 9.0, and temperature shall not exceed 34 C (93.2 F). The use-specific numeric standards set forth in Section 3101 are applicable to the designated uses listed above in Section 2202.A.

2. The monthly geometric mean of fecal coliform bacteria shall not exceed 200/100 ml; no single sample shall exceed 400/100 ml (see Section 1103.B).

3. At all flows above 50 cfs: TDS shall not exceed 8,500 mg/l, sulfate shall not exceed 2,500 mg/l, and chloride shall not exceed 3,500 mg/l.

---

[1]Diversion for irrigation frequently limits summer flow in this reach to that contributed by springs along the watercourse.

3101. STANDARDS[1] APPLICABLE TO ATTAINABLE OR DESIGNATED USES UNLESS OTHERWISE SPECIFIED IN SUBPART II OF THESE STANDARDS (SECTIONS 2100 through 2805).

A. Coldwater Fishery: Dissolved oxygen shall not be less than 6.0 mg/l, temperature shall not exceed 20 C (68 F), and pH shall be within the range of 6.6 to 8.8. The acute and chronic standards set out in Section 3101.J are applicable to this use. The total ammonia standards set out in Section 3101.N are applicable to this use.

B. Domestic Water Supply: Waters designated for use as domestic water supplies shall not contain substances in concentrations that create a lifetime cancer risk of more than one cancer per 100,000 exposed persons. The following numeric standards shall not be exceeded:

Dissolved arsenic	0.05	mg/l
Dissolved barium	1.	mg/l
Dissolved cadmium	0.010	mg/l
Dissolved chromium	0.05	mg/l
Dissolved lead	0.05	mg/l
Total mercury	0.002	mg/l
Dissolved nitrate (as N)	10.	mg/l
Dissolved selenium	0.05	mg/l
Dissolved silver	0.05	mg/l
Dissolved cyanide	0.2	mg/l
Dissolved uranium	5.0	mg/l
Radium-226 + radium-228	30.0	pCi/l
Tritium	20,000	pCi/l
Gross alpha	15	pCi/l

C. High Quality Coldwater Fishery: Dissolved oxygen shall not be less than 6.0 mg/l, temperature shall not exceed 20 C (68 F), pH shall be within the range of 6.6 to 8.8, total phosphorus (as P) shall not exceed 0.1 mg/l, total organic carbon shall not exceed 7 mg/l, turbidity shall not exceed 10 NTU (25 NTU in certain reaches where natural background prevents attainment of lower turbidity), and conductivity (at 25 C) shall not exceed a limit varying between 300 μmhos/cm and 1,500 μmhos/cm depending on the natural background in particular stream reaches (the intent of this standard is to prevent excessive increases in dissolved solids which would result in changes in stream community structure). The acute and chronic standards set out in Section 3101.J are applicable to this use. The total ammonia standards set out in Section 3101.N are applicable to this use.

D. Irrigation: The monthly geometric mean of fecal coliform bacteria shall not exceed 1,000/100 ml; no single sample shall exceed 2,000/100 ml. The following numeric standards shall not be exceeded:

Dissolved aluminum	5.0	mg/l
Dissolved arsenic	0.10	mg/l
Dissolved boron	0.75	mg/l
Dissolved cadmium	0.01	mg/l
Dissolved chromium	0.10	mg/l
Dissolved cobalt	0.05	mg/l
Dissolved copper	0.20	mg/l
Dissolved lead	5.0	mg/l
Dissolved molybdenum	1.0	mg/l
Dissolved selenium	0.13	mg/l
Dissolved selenium in presence of >500 mg/l SO_4	0.25	mg/l
Dissolved vanadium	0.1	mg/l
Dissolved zinc	2.0	mg/l

E. Limited Warmwater Fishery: Dissolved oxygen shall not be less than 5 mg/l, pH shall be within the range of 6.5 to 9.0, and on a case by case basis maximum temperatures may exceed 32.2 C. The acute and chronic standards set out in Section 3101.J are applicable to this use. The total ammonia standards set out in Section 3101.M are applicable to this use.

F. Marginal Coldwater Fishery: Dissolved oxygen shall not be less than 6 mg/l, on a case by case basis maximum temperatures may exceed 25 C and the pH may range from 6.6 to 9.0. The acute and chronic standards set out in Section 3101.J are applicable to this use. The total ammonia standards set out in Section 3101.N are applicable to this use.

G. Primary Contact: The monthly geometric mean of fecal coliform bacteria shall not exceed 200/100 ml, no single sample shall exceed 400/100 ml, pH shall be within the range of 6.6 to 8.8 and turbidity shall not exceed 25 NTU.

H. Warmwater Fishery: Dissolved oxygen shall not be less than 5 mg/l, temperature shall not exceed 32.2 C (90 F), and pH shall be within the range of 6.5 to 9.0. The acute and chronic standards set out in Section 3101.J are applicable to this use. The total ammonia standards set out in Section 3101.M are applicable to this use.

I. Fish culture, secondary contact, and municipal and industrial water supply and storage are also designated in particular stream reaches where these uses are actually being realized. However, no numeric standards apply uniquely to these uses. Water quality adequate for these uses is ensured by the general standards and numeric standards for bacterial quality, pH, and temperature which are established for all stream reaches listed in Subpart II of these standards (Sections 2100 through 2805).

J. The following schedule of numeric standards and equations for the substances listed shall apply to the subcategories of fisheries identified in Section 3101 of these standards:

1. Acute Standards[2]

Dissolved aluminum	750	µg/l
Dissolved beryllium	130	µg/l
Total mercury	2.4	µg/l
Total recoverable selenium	20.0	µg/l
Dissolved silver[4]	e(1.72[ln(hardness)]-6.52)	µg/l
Cyanide, amenable to chlorination	22.0	µg/l
Total chlordane	2.4	µg/l
Dissolved cadmium	e(1.128[ln(hardness)]-3.828)	µg/l
Dissolved chromium[5]	e(0.819[ln(hardness)]+3.688)	µg/l
Dissolved copper	e(0.9422[ln(hardness)]-1.464)	µg/l
Dissolved lead	e(1.273[ln(hardness)]-1.46)	µg/l
Dissolved nickel	e(0.8460[ln(hardness)]+3.3612)	µg/l
Dissolved zinc	e(0.8473[ln(hardness)]+0.8604)	µg/l
Total chlorine residual	19	µg/l

2. Chronic Standards[3]

Dissolved aluminum	87.0	µg/l
Dissolved beryllium	5.3	µg/l
Total mercury	0.012	µg/l
Total recoverable selenium	2.0	µg/l
Cyanide, amenable to chlorination	5.2	µg/l
Total chlordane	0.0043	µg/l
Dissolved cadmium[4]	e(0.7852[ln(hardness)]-3.49)	µg/l
Dissolved chromium[5]	e(0.819[ln(hardness)]+1.561)	µg/l
Dissolved copper	e(0.8545[ln(hardness)]-1.465)	µg/l
Dissolved lead	e(1.273[ln(hardness)]-4.705)	µg/l
Dissolved nickel	e(0.846[ln(hardness)]+1.1645)	µg/l
Dissolved zinc	e(0.8473[ln(hardness)]+0.7614)	µg/l
Total chlorine residual	11	µg/l

K. Livestock Watering: The following numeric standards shall not be exceeded:

Dissolved aluminum	5.0	mg/l
Dissolved arsenic	0.2	mg/l
Dissolved boron	5.0	mg/l
Dissolved cadmium	0.05	mg/l
Dissolved chromium[5]	1.0	mg/l
Dissolved cobalt	1.0	mg/l

Dissolved copper	0.5	mg/l
Dissolved lead	0.1	mg/l
Total mercury	0.01	mg/l
Dissolved selenium	0.05	mg/l
Dissolved vanadium	0.1	mg/l
Dissolved zinc	25.0	mg/l
Radium-226 + radium-228	30.0	pCi/l
Tritium	20,000	pCi/l
Gross alpha	15	pCi/l

L. Wildlife Habitat: The following narrative standard shall apply:

1. Except as provided below in Paragraph 2 of this section, no discharge shall contain any substance, including, but not limited to selenium, DDT, PCB's and dioxin, at a level which, when added to background concentrations, can lead to bioaccumulation to toxic levels in any animal species. In the absence of site-specific information, this requirement shall be interpreted as establishing a stream standard of 2 μg/l for total recoverable selenium and of 0.012 μg/l for total mercury.

2. The discharge of substances that bioaccumulate in excess of levels specified above in Paragraph 1, is allowed if, and only to the extent that, the substances are present in the intake waters which are diverted and utilized prior to discharge, and then only if the discharger utilizes best available treatment technology to reduce the amount of bioaccumulating substances which are discharged.

3. Discharges to waters which are designated for wildlife habitat uses, but not for fisheries uses, shall not contain levels of ammonia or chlorine in amounts which reduce biological productivity and/or species diversity to levels below those which occur naturally, and in no case shall contain chlorine in excess of 1 mg/l nor ammonia in excess of levels which can be accomplished through best reasonable operating practices at existing treatment facilities.

4. A discharge which contains any heavy metal at concentrations in excess of the concentrations set forth in Section 3101.J.1 of these standards shall not be permitted in an amount, measured by total mass, which exceeds by more than 5 percent the amount present in the intake waters which are diverted and utilized prior to the discharge, unless the discharger has taken steps (an approved program to require industrial pretreatment; or a corrosion program) appropriate to reduce influent concentrations to the extent practicable.

APPENDIX 2

NEW MEXICO GROUND WATER STANDARDS AND U.S. EPA DRINKING WATER STANDARDS FOR ALUMINUM, MANGANESE, MOLYBDENUM, AND SULFATE

Christopher A. King
U.S. EPA Region 6 Ground Water/UIC Section
November, 1997

Currently there are no national ambient ground water quality standards. The United States Environmental Protection Agency (U.S. EPA) drinking water Maximum Contaminant Levels (MCL's) are frequently used as a reference by State and federal agencies when determining clean up levels for individual contaminated sites. The MCL's are for finished drinking water quality, not for raw water quality. States have the authority to develop their own ground water standards related to ambient water quality. Some State ground water standards are the same as U.S. EPA MCL's for finished drinking water. If a U.S. EPA primary or secondary MCL does not exist, a health advisory limit is often used. The State of New Mexico has developed ambient ground water standards for certain inorganic and organic contaminants. These standards represent the maximum allowable concentration of contaminants in the ground waters of New Mexico.

U.S. EPA Drinking Water Standards:

In March 1975 the U.S. EPA proposed the National Interim Primary Drinking Water Regulations under provisions of the Public Health Service Act as amended by the Safe Drinking Water Act. Based in part on Public Health Service regulations developed in 1946 and 1962 and later modified, the interim regulations became final in June 1977, but are continually under review. These federal regulations specify MCL's for finished drinking water supplies and apply to all public water systems. At the recommended maximum contaminant levels, no adverse health effects are known to exist.

MCL's were established for finished drinking water by the Safe Drinking Water Act in two different categories: primary and secondary. Primary MCL's are federally enforceable and based on health risk. The secondary MCL's represent reasonable goals for drinking water quality, but are not federally enforceable. Instead, states are encouraged to implement these standards. Contaminants covered by secondary MCL's are those which may adversely affect the aesthetic qualities of drinking water such as taste, odor, color, and appearance and which thereby may deter public acceptance of drinking water provided by public water systems. Contaminants found at concentrations considerably higher than the secondary MCL may also be associated with adverse health implications (Driscoll, 1989).

New Mexico Ground Water Standards:

Aluminum:

The State of New Mexico maximum allowable concentration for aluminum in ground water is 5.0 mg/l. The U.S. EPA currently does not have a primary MCL for aluminum in drinking water, but instead has a secondary MCL of 0.05 to 0.2 mg/l.

Manganese:

The State of New Mexico maximum allowable concentration for manganese in ground water is 0.2 mg/l. The U.S. EPA secondary MCL for manganese is 0.05 mg/l, in order to avoid manganese staining. Stains caused by manganese in plumbing fixtures and laundry are more objectionable and harder to remove than those from iron.

Molybdenum:

The State of New Mexico maximum allowable concentration for molybdenum in ground water is 1.0 mg/l. The U.S. EPA currently does not have a primary or secondary MCL for molybdenum in drinking water, but has issued a health advisory limit of 0.05 mg/l.

Sulfate:

The State of New Mexico maximum allowable concentration for sulfate in ground water is 600.0 mg/l. The U.S. EPA secondary MCL for sulfate is currently 250 mg/l, based upon the laxative effects of sulfate in high concentrations. The secondary MCL for sulfate is under debate, and the U.S. EPA has proposed a primary MCL of 500 mg/l (Federal Register, December 20, 1994).

Sulfate in ground water is derived principally from the evaporite minerals gypsum and anhydrite; it may also come from the oxidation of pyrite, which is an iron sulfide mineral. Ground water in igneous or metamorphic rocks generally contains less than 100 mg/l sulfate (Davis and DeWiest, 1966).

Table 1: Comparison of New Mexico Ground Water Standards and U.S. EPA's Drinking Water Standards for Finished Water Quality (note: concentrations in mg/l).

CONTAMINANT	New Mexico Standard for Ground Water	U.S. EPA Primary MCL	U.S. EPA Secondary MCL
Aluminum	5.0	none	0.05 - 0.2
Manganese	0.2	none	0.05
Molybdenum	1.0	none	none
Sulfate	600.0	none	250

References:

Davis, S.N., and DeWiest, R.J.M., 1966. Hydrogeology. John Wiley Sons, Inc., New York, NY, 463 p.

Driscoll, F.G., 1989. Ground Water and Wells, Second Edition. Johnson Filtration Systems, St. Paul, MN, pp. 99 - 109.

Fetter, C.W., 1993. Contaminant Hydrogeology. Macmillan Publishing, New York, NY, pp. 11 - 14.

New Mexico Quality Control Commission, December, 1995. State of New Mexico Ground and Surface Water Quality Protection Regulations (20 NMAC 6.2) and Utility Operator Certification Regulations (20 NMAC 7.4). pp. 23 - 25.

One Hundred Fourth Congress, United States of America, 1996. Safe Drinking Water Act Amendments of 1996, Section 109.

U.S. Environmental Protection Agency Region 6 Drinking Water Section, May 1997. Current and Proposed National Primary and Secondary Drinking Water Regulations & Health Advisories for Other Contaminants.

6WQ-SG
SEP 16 1997

STEFFEN ROBERTSON & KIRSTEN

Consulting Engineers and Scientists

QUESTA MOLYBDENUM MINE
GEOCHEMICAL ASSESSMENT

Prepared for:

Molycorp Inc.
P.O. Box 469
Questa, New Mexico 87556

Prepared by:

Steffen Robertson and Kirsten (U.S.) Inc.
3232 South Vance Street
Lakewood, Colorado 80227

6WQ-SG
SEP 16 1997

SRK Project No. 09206
April 13, 1995

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1.0 INTRODUCTION

1.1 Background and Scope of Work

1.1.1 Location

The Questa molybdenum mine is located approximately 5 miles east of the town of Questa in Taos County in north central New Mexico. The mine property lies within the Taos range of the Sangre De Cristo mountains. The mine area is bounded on the south by the Red River and on the north by the Cabresto Creek drainage. The location of the mine is shown on Figure 1.1. Mine facilities are shown on Figure 1.2.

1.1.2 Requirement for Mine Waste Characterization Study

This report describes the execution and results of an initial study to characterize the mine waste rock that has been produced by the mines activities. This waste rock has been placed in dumps on the southward sloping hillsides and valleys north of Red River. Sulfides contained in some of the waste rock is oxidizing to produce acidic drainage which drains to the south towards the Red River. Most, if not all, of this acidic drainage is intercepted. In order for the nature, quantity and flowpaths of this acidic drainage to be evaluated, it is necessary to determine the geochemical characteristics of the waste in the various dumps; their current state of oxidation and contaminant generation; and to evaluate how this state may change with time as the oxidation processes mature. Natural exposures of sulfide bearing rocks occur as "scars" on and adjacent to the mining impacted area. These exposures are subject to the same oxidation processes as are the dump waste rock. It is therefore necessary also to characterize the geochemical nature of these natural scars, in order to be able to better understand the relative contributions of acidic drainage to the Red River from both natural and mine derived sources.

1.1.3 Geologic Setting

The Questa molybdenum mine is located in the Taos Range of the Sangre De Cristo mountains within in the Latir volcanic field. The area has been subject to a complex geologic and structural history associated with plate boundary tectonics, mid-Tertiary volcanism and development of the Rio Grande rift. The volcanic and tectonic history of the Questa area is described by Lipman (1981). Schilling (1956) described the surficial geology and early mining history at Questa.

Basement rocks in the Questa area consist of Precambrian metamorphic rocks, including schists, amphibolites and metasedimentary rocks that have been intruded by Precambrian granite. In the vicinity of the mine, Precambrian rocks are exposed primarily south of the Red River. Precambrian schist and amphibolite are overlain by a Tertiary aged (40-35 m.y.) sequence of intermediate volcanic rocks. These volcanic rocks were intruded and overlain by Miocene aged (23 m.y.) granitic rocks and associated cogenetic silicic volcanic rocks. Rocks associated with these episodes of volcanic activity correspond to the upper and lower volcanic sequences defined by Molycorp geologists and others who have investigated local geology and mineral resources.

The granitic and aplitic intrusives at Questa and the surrounding region have been interpreted to be part of a regional batholithic complex. Following the pulse of intense Miocene volcanic activity at Questa, the Questa caldera collapsed into the underlying batholith. Evidence of the existence of the Questa caldera includes the presence of a thick sheet of welded tuff and megabreccias that have been interpreted by others, as intra-caldera fill and collapse breccias, respectively.

Later north-south oriented normal faulting associated with crustal extension and the development of the Rio Grande rift zone has exposed the caldera core and ring fracture. The trace of the caldera is truncated to the west by later rift-associated faulting and buried by younger sedimentary rocks.

Intrusions, mineralization and alteration in the Questa molybdenum mine area were focused along the southern portion of the ring fracture that defines the wall of the Questa caldera. Structural deformation associated with caldera collapse and concurrent rift development prepared the area for emplacement of rhyolitic and aplitic intrusives and the migration of mineralizing hydrothermal fluids.

In the mine area, hydrothermal alteration is intense and wide spread as indicated by the existence of areas locally referred to as hydrothermal scars. The hydrothermal scars appear to be spatially related to Tertiary rhyolitic intrusive plugs. The cores of the scar areas are highly brecciated, erodible and, where well developed, support little vegetation. Mineralization in hydrothermal scar areas consists primarily of pyrite although chalcopyrite, quartz and carbonates are also present. Secondary minerals in the hydrothermal scars include kaolinite and sericite, and weathering has produced limonite, jarosite, copper and manganese oxides and selenite gypsum.

Mineralization at Questa is associated with the mine aplite and consists primarily of a zone of closely spaced, high grade molybdenum veins in the outer shell of the aplite intrusive (the mine aplite) that locally extends into the surrounding volcanic rocks.

Tertiary Rhyolitic Intrusive Plugs

1.1.4 Environmental Setting

1.1.4.1 Physical Conditions

The mine is located within an area of high topographic relief. Elevations at the site range from approximately 7550 feet adjacent to the Red River below the mine to over 10,750 feet at the divide between the Red River and Cabresto Creek drainage basins north of the mine area. The mine site and surrounding area are dissected by deeply incised valleys. North of the Red River, many of the valleys contain areas of hydrothermal scar.

Areas exhibiting the most intense hydrothermal alteration are identified by highly erodible material that supports little or no vegetation. These areas are contained within larger zones that have been subjected to varying degrees of hydrothermal alteration and mineralization. The hydrothermal scars have produced periodic mud and debris flows and, locally, thick alluvial mud flow debris has accumulated adjacent to the Red River.

Outside the mine area, the hydrothermal scars continue to generate mud flows and contribute to the sediment loads in the Red River due to the high degree of erodibility. In the mine area, surface water and sediment generated from naturally occurring hydrothermal scars are contained within Molycorp's surface water and sediment collection facilities.

1.1.4.2 Geochemical Conditions

Under low flow conditions, the Red River exhibits a milky white appearance that has been attributed to the formation of aluminum hydroxide that occurs when low pH water containing dissolved aluminum mixes with the neutral pH water in the Red River. The aluminum hydroxide precipitates and forms fine particles that tend to remain in suspension for an extended period of time. The milky appearance of the Red River has been observed upstream and downstream of the mine site. Aluminum in the Red River, as well as other metals and sulfate, are potentially derived from both mine waste sources and naturally occurring hydrothermal scars.

Prior to the initiation of mining at Questa, the quality of the Red River was impacted by drainage from hydrothermal scars. Place names such as Sulphur Gulch, Bitter Creek and Red River allude to the conditions that existed when the region was settled and the mineral resources at Questa were identified. Drainage from hydrothermal scars contains elevated concentrations of sulfate, fluoride and dissolved metals. Scars located outside the mine site, such as those in Hansen Creek and Haut N Taut Creek, will continue to contribute to the concentration of sulfate and metals in the Red River as they did prior to the initiation of mining operations at Questa.

Within the mine site, hydrothermal scars occur in Capulin Canyon, Goathill Gulch, Sulphur Gulch and beneath the waste rock placed adjacent to the Red River. Prior to the mining operation, these areas contributed runoff and subsurface drainage containing elevated sulfate, fluoride and metals to the Red River. Currently, the majority of seepage and surface runoff from mine area hydrothermal scars is collected in Molycorp's seepage and runoff collection systems.

1.1.5 Mine Operations

The site has been the focus of several periods of exploration and mining dating from 1920. Both underground and open pit mining methods have been employed at the site. Facilities include the existing open pit, old and new underground mining areas, waste rock disposal areas, a mill site and a tailings impoundment located approximately 6 miles west of the mine adjacent to the town of Questa.

The last period of mining activity at the new underground workings was terminated 1992 due to general economic conditions, however, developed reserves remain in place in the new underground mine. Following the cessation of underground mining, the mine was placed on care and maintenance and the underground workings were flooded. Underground mine water is periodically pumped to the nearby tailings impoundment to maintain the underground mine water level below the elevation of surface openings. Mine dewatering has recently been commenced.

1.1.6 Mining Impacts

1.1.6.1 Physical Impacts

Physical impacts at the site are primarily associated with open pit mining operations. In addition to the open pit, these operations resulted in the placement of approximately 328 million tons of waste rock in the mine waste rock disposal facilities.

Local drainage patterns have been altered as a result of mining and the implementation of Molycorp's surface water management and sediment collection program. Currently, surface water and seepage from areas in upper Sulphur Gulch drain through the open pit and are collected in the underground mine workings.

A caved area was developed over the new underground mine area in Goathill Gulch. This area intercepts subsurface flow and seepage from upper Goathill Gulch, as well as mine waste impacted seepage that is intercepted in Capulin Canyon and transferred to Goathill Gulch through a horizontal drainage borehole.

All watersheds within the mine disturbed area contain exposures of hydrothermal scar. These drainages are equipped with surface water and sediment collection facilities that prevent discharge of surface water and sediment from the mine disturbed area to the Red River.

1.1.6.2 Geochemical Impacts

At present, the extent of impacts to local water resources from mine disturbed materials is unknown. Acid rock drainage (ARD) has been observed at the site. ARD is associated with the waste rock generated during open pit mining operations and specifically, from material that appears to have been derived from the hydrothermal scar located in upper Sulphur Gulch. This material has been placed in several of the waste rock disposal areas. Drainage affected by ARD from the waste rock is similar in composition to drainage from hydrothermal scar areas and contains elevated sulfate, fluoride, aluminum, iron, manganese, copper and zinc.

Most of the surface water and seepage impacted by acid generating waste rock, as well as the runoff and subsurface drainage affected by the hydrothermal scars within the mine area, is collected in the underground workings and has no impact on Red River water quality. Affected seepage is collected in the new underground mine area through drainage into the floor of the open pit, and from the caved area in Goathill Gulch.

The potential exists for a portion of the seepage from waste rock placed in Capulin Canyon to bypass the seepage collection and pump back system located in Capulin Creek. Seepage from the waste rock disposal areas located adjacent to the Red River and from upper Capulin Canyon potentially contributes sulfate and metals to the Red River, however, hydrothermal scars located in upper Capulin Canyon and beneath the waste rock disposal areas are also potential sources of sulfate, aluminum and other metals. The relative contribution of mine waste and naturally

occurring hydrothermal scars to the sulfate and metal concentrations in the Red River is currently unknown.

1.1.7 Other Impacts

The Red River area has experienced considerable growth and development during the period of active mining operations at Questa. Most notable is the development associated with the commercial skiing facilities in Red River. Many new homes have been and are being constructed in the Town of Red River. Existing roads have been improved and new roads have been constructed in residential areas. Development also includes new surface water management facilities such as storm drains and highway culverts. The area's National Forest attracts visitors who participate in outdoor recreational activities that include hunting, fishing and off-road vehicle use.

While the impacts associated with residential, recreational and commercial development have not been investigated as part of this study or quantified by other sources, these activities have contributed to current water quality conditions in the Red River. Physical impacts that can alter regional water quality include alteration of local surface water drainage patterns, increases in runoff resulting from development and increases in erosion. Areas of hydrothermal scar occur in the vicinity of the town of Red River where most development has occurred, and in areas frequented by outdoor recreationists. The disturbance of these areas has potentially altered both the sediment loads in the Red River, and the quality of surface runoff.

1.1.8 Study Approach and Scope

Steffen Robertson and Kirsten (U.S.) (SRK) has been commissioned by Molycorp to conduct a geochemical assessment of the mine area and a geochemical characterization of the waste rock. The purpose of this work is to determine the geochemical properties of mine waste materials at the site, assess the current state of acid generation in the mine and the potential for future acid generation, and identify potential areas of concern with respect to impacts to local and regional water quality resources. The data obtained from the geochemical assessment will form part of the basis for the development of a closure and reclamation plan for the site.

The work has been performed with assistance from Vail Engineering Inc. for the characterization of regional and local hydrological conditions, and in developing water quality data for springs and seeps identified in the mine area and in the Red River.

To conduct the study, SRK personnel visited the site in October 1994 and conducted the following work:

- Collection of water samples from mine waste and hydrothermal scar impacted areas to determine the chemical composition of drainage from each source;
- Field testing of paste pH and total dissolved solids content (paste TDS) to determine the present state of acid generation in the mine waste rock;

- Collection of waste rock samples to determine acid generating potential and leachable metals content;
- Collection of samples from hydrothermal scars to determine acid generating potential and leachable metals content;
- Collection of samples of soils, colluvium and alluvium unimpacted by the mining operation to determine background geochemical conditions;
- Review of mine records to assist in determining the mine operational and waste placement history; and
- Review of water quality monitoring data collected by Molycorp.

As discussed above, the Red River was impacted by conditions that existed prior to the initiation of mining activities at Questa. Therefore, the geochemical assessment of the mine area included an investigation of the geochemical properties of naturally occurring hydrothermal scar areas located in and adjacent to the mine site to assess the potential impacts of these areas on local surface water and groundwater quality.

1.1.9 Report Content

The remainder of this section of the report (1.2 to 1.5) describes the existing mine site conditions; including its development history (section 1.2); the water quality that is derived from both natural scar areas and the mine disturbed area (section 1.3); the drainage routes from the various water sources (section 1.4); and the water quality at the various springs and monitoring wells along the Red River (section 1.5).

Section 2.0 describes and summarizes the hydrological investigations that have been performed in order to develop an understanding of the hydrological conditions influencing the movement of contaminants from the point where they are generated (sources) and the receiving waters.

Section 3.0 describes the geochemical characterization work performed to better understand the geochemical conditions and processes that have, and are, occurring at the source locations.

Section 4.0 provides an overall summary and conclusions and this is followed in section 5.0 by recommendations for the next phase of more detailed investigation of mine waste geochemical characteristic and behaviour.

1.2 Mine Layout and Development History

1.2.1 Early Underground Mining Operations

Small scale mining operations were initiated at Questa in 1918. In 1920, the Molybdenum Corporation of America acquired several claim groups and commenced underground development

and mining. Early underground mining was concentrated in the Sulphur Gulch area in and beneath the area presently occupied by the open pit.

Over 35 miles of underground workings were developed. Early mining operations were conducted by tunnelling and stoping, and targeted the high grade vein deposits that occur in the mine aplite. Over 18 million pounds of concentrates were produced prior to 1956. The old underground workings were accessed from openings in Sulphur Gulch, and from the 7960 adit that daylights adjacent to the Red River approximately 1/2 mile east of its confluence with Columbine Creek. The development rock and facilities near the 7960 adit and the old tailings deposits at the current mill site are the only surface remnants of the early underground mining operation.

1.2.2 Open Pit Mine

Open pit mining operations were conducted between 1965 and 1983. During this time, facilities near Questa were constructed for tailings disposal. This facility now contains approximately 95,000,000 tons of flotation tailings.

Approximately 328,000,000 tons of waste rock were produced during open pit mining and placed in waste rock disposal areas located in Capulin Canyon, Goathill Gulch, Spring Gulch, in the mine pit area (in-pit waste disposal area), and adjacent to the Red River in the Sugar Shack South, Middle and Spring and Sulphur Gulch waste rock disposal areas. Waste rock quantities in each waste disposal area are summarized in Table 1.1. The general composition and geochemical characteristics of the waste rock located in each of the waste disposal areas is discussed in Section 3.0.

Historical records concerning the development of the waste rock disposal areas are limited. In general, mixed volcanic waste rock excavated from the Sulphur Gulch hydrothermal scar area of the western pit zone was deposited in the Blind Gulch, Goathill, Sugar Shack South, Sugar Shack West, Middle and Spring and Sulphur Gulch waste rock disposal areas. The mixed volcanic rocks were derived from the upper rhyolitic and lower andesitic series rocks of Tertiary age. Much of the mixed volcanic waste rock was derived from the Sulphur Gulch hydrothermal scar area.

Molycorp aerial photographs indicate that the disposal of the mixed volcanic waste rock was typically accomplished by end dumping at the upper dump limits of the waste rock disposal areas. Based on materials exposed on the surface, mixed volcanic waste rock composes the majority of the waste rock located west and south of the open pit.

The remainder of waste rock was derived from propylitic black andesite generally located in the southern pit area, and aplite and granite from the eastern pit area. The majority of this waste rock was placed in Spring Gulch, Spring and Sulphur Gulch and locally within the in-pit disposal areas. Later in the open pit mine operation, these materials were used to armor the lower faces of the Middle, Sugar Shack South and Spring and Sulphur Gulch waste disposal areas.

WASTE ROCK PILE COMPOSITION

1.2.3 New Underground Mining Operations

Underground mining at the new site was conducted between 1983 and 1992 by block caving methods. The surface facilities at the new mine site were developed in Goathill Gulch by side hill cut and fill methods. The mine development was conducted from two shafts sunk to the mine haulage level (7130 elevation). A decline was driven from the existing mill area to the mine haulage level to facilitate the transport of ore to the mill facilities. The old underground mine workings were connected to the new workings by a vertical borehole from the decline. The relationship of the major surface and underground mine features is shown schematically on Figure 1.3. Mine development waste rock from the new underground workings was placed in a small disposal area in lower Goathill Gulch.

A caved area has developed in Goathill Gulch above the block caving area. Surface water in Goathill Gulch drains to the underground workings through the broken rock in the caved zone.

Following cessation of mining operations in 1992, the new underground workings were flooded. Mine dewatering recommenced in December 1994, and mine water is being discharged to the tailings impoundment near the town of Questa. Prior to mine dewatering, the water level in the underground workings had recovered to an elevation of 7600 feet.

1.3 Characteristics of Hydrothermal Scar and Mine Waste Drainage

During the October 1994 site visit, surface runoff and seepage samples were collected from mine waste and hydrothermal scar areas. The characteristics of the runoff and seepage from mine waste and hydrothermal scar areas have been determined to allow a comparison with site water quality monitoring data contained in Section 1.5. The current fate and/or management of the runoff and seepage from these areas is discussed in Section 1.4.

1.3.1 Characteristics of Hydrothermal Scar Drainage

As discussed above, areas of hydrothermally altered rock contribute surface water and groundwater seepage to the Red River. The distribution of hydrothermal scars in the vicinity of the mine is shown on Figure 1.4. These areas are representative of the most intense alteration and are commonly treeless, highly erodible, and often sources of periodic mud and debris flows. These scars are often part of larger altered zones that may be characterized by thin vegetative cover, a high degree of fracturing, moderate erodibility, mineralization and low pH runoff and seepage. Figure 1.4 indicates the approximate limit of the altered zone that extends from Sulphur Gulch, through Goathill Gulch into Capulin Canyon.

As part of the site work conducted by SRK in October 1994, water samples from seeps and springs originating in a number of the hydrothermal scar areas were collected and analyzed to determine their contribution to local water quality. Water sampling locations are shown on Figure 1.5.

Scar areas that are unaffected by recent mining operations were identified in Capulin Canyon, Goathill Creek Canyon, upper Sulphur Gulch above the open pit and in the Hansen Creek

MINE WATER (1994)
7600 ft

drainage located approximately 2 miles east of the mine site. Water quality in seepage and runoff from undisturbed scar material is summarized in Table 1.2.

Scar seepage and runoff contain on average approximately 4000 mg/l sulfate. Metals present in significant concentrations include calcium, iron, zinc, nickel, manganese and aluminum. Traces of cadmium and chromium were also measured.

Samples of runoff discharging to the Red River from local sources are shown in Table 1.3. Both Haut N Taut and Hansen Creek, located east of the mine site, contain areas of well developed hydrothermal scar. Seepage from a scar area located below the mine site at the USFS Ranger station are also shown. The characteristics of the surface waters from Haut N Taut and Hansen creek are similar to those of the direct scar area seepage samples collected by SRK in October, 1993 and summarized in Table 1.2. Seepage water from the Ranger Station scar area exhibits very high aluminum and sulfate content and is similar in nature to the scar seepage and runoff samples summarized in Table 1.2.

Table 1.2 also contains water quality data for seep sample CAP-2 (background) collected in an area that is presumed to be unaffected by mining or significant hydrothermal alteration in western Capulin Canyon. The sample contained slightly elevated sulfate concentrations at 140 mg/l suggesting that areas exhibiting minor alteration may contribute significant sulfate to local surface waters. The sample contained traces of dissolved iron and zinc.

Selected samples from hydrothermal scar areas were analyzed for fluoride content. Seepage from the hydrothermal scar in the Hansen Creek (sample HC-1) area contained fluoride at a concentration of 28.9 mg/l. Seepage from undisturbed hydrothermal scars located in the Goathill Canyon and Sulphur Gulch (samples GC-6 and Pit-2) contained fluoride at concentrations of 28.5 and 34.0 mg/l, respectively.

1.3.2 Characteristics of Drainage From Mine Disturbed and Mine Waste Areas

Mine disturbed and mine waste seepage and runoff sampling locations are shown on Figure 1.5. Water quality data from mine disturbed areas are summarized in Table 1.2.

Mine affected drainage samples represent ARD from the Capulin (CAP1) and Goathill (GC1 and GC2) waste disposal areas, seepage from disturbed materials in the open pit (PIT 1) and temporarily ponded surface water in the Sugar Shack South and Spring and Sulphur Gulch waste rock disposal areas (WS1, SS1 and SS2). Sample WS2 was collected from a seep in lower Capulin Canyon at the Red River. The water quality at this sample location is potentially impacted by both natural scars and seepage from the Capulin waste rock disposal area.

From a comparison of water quality, both mine impacted and scar impacted drainage exhibit similar pH conditions. With the exception of iron, the sulfate and metals concentrations in mine waste impacted water appears to moderately exceed that of scar impacted water. The most substantial increases in ion concentrations in mine waste impacted drainage over that of drainage from the hydrothermal scars appear to be sulfate, aluminum, manganese and zinc.

TABLE 1.2
SCAR Wt. Quality

Selected samples of mine waste drainage were subjected to analysis for fluoride. Seepage from the failed pit wall area (sample Pit-1) contained fluoride at a concentration of 3.55 mg/l. Drainage from the waste rock in Capulin Canyon (sample Cap-1) contained fluoride at a concentration of 39.5 mg/l.

1.4 Fate of Natural and Mine Impacted Drainage

1.4.1 Drainage from Hydrothermal Scars

1.4.1.1 Physical Conditions

Previous to mining operations, drainage from hydrothermal scar areas in the mine area discharged to the Red River through groundwater flow and surface water runoff.

Presently, runoff and seepage from the Sulphur Gulch scar is intercepted by the pit and drains to the underground mine workings.

Goathill Gulch is almost entirely located within an area of well developed hydrothermal scar. Currently, seepage and runoff from the majority of scar areas in Goathill Canyon flow into the new underground mine through the caved zone. Surface runoff from the area located below the caved zone is intercepted by Molycorp's surface water management facilities. Groundwater flow through scar derived alluvium to the Red River may still occur from below the caved area.

Hydrothermal scars are located in the upper and lower reaches of the Capulin Canyon. In upper Capulin Canyon, the hydrothermal scar has been buried with waste rock. Seepage from the scars and waste rock are currently collected in a series of surface impoundments and pumped to Goathill Gulch where they enter the new underground mine workings. Surface water flow in Capulin Canyon to the Red River is prevented by Molycorp's surface water management facilities.

Scar areas occur beneath the Sugar Shack South and Middle waste rock disposal areas. Prior to development of the waste rock disposal sites, these areas discharged surface runoff, sediment and groundwater seepage to the Red River. Presently, surface runoff is collected by Molycorp's surface water management facilities and sediment is no longer generated from buried scars. Mining activities have not altered the potential for subsurface flow from hydrothermal scars beneath the Sugar Shack South and Middle waste rock disposal areas to the Red River.

1.4.1.2 Chemical Conditions

Drainage and surface runoff from the hydrothermal scars has occurred over geologic time. As such, the neutralization potential and sulfate, acidity and metal attenuating capacity of seepage and surface water flow paths ~~have been consumed.~~ Therefore, the hydrothermal scars represent a mature source of metals, sulfate and low pH drainage, and the contribution of hydrothermal scars to local surface water and groundwater quality is influenced only by long term variations in climatic conditions.

During periods of high precipitation, the rates of affected runoff and subsurface seepage from hydrothermal scar areas will increase. Following extended periods of above normal precipitation, spring and seepage flow from hydrothermal scars to the Red River would be anticipated to increase. Conversely, during drought conditions, affected spring and seepage flow would be reduced.

The quality of seepage and runoff from hydrothermal scars, prior to the construction of the mine surface and seepage collection systems and the alteration of pre-mine flow paths, was likely similar to present scar area water quality as discussed in Section 1.3.1.

Currently, the majority of seepage and runoff from hydrothermal scar areas within the mine area is collected in the underground workings. Mine water is pumped to the tailings impoundment located west of Questa in order to maintain the underground mine water level below elevation of surface openings. In contrast to pre-mine conditions, hydrothermal scar impacted drainage from the mine area that is collected in the underground mine currently has no impact on Red River water quality. Those hydrothermal scars located outside the mine contribute sulfate and metals to the Red River as they have over geologic time.

1.4.2 Mine Disturbed Areas

1.4.2.1 Physical Conditions

Runoff and seepage from the pit and in-pit waste rock disposal areas is collected in the open pit and drains to the underground workings through the pit floor. The majority of the seepage from the Capulin Creek waste rock disposal area is collected in a series of surface impoundments and discharged to Goathill Creek through the horizontal borehole. Seepage from the Capulin and Goathill waste disposal areas then enters the underground workings through the caved area in Goathill Gulch.

The water level in the new underground workings is maintained at an elevation well below Red River by the mine dewatering. Direct discharge of underground mine water through existing mine openings to Red River does not occur. The potential for releases from the mine workings through subsurface flow is under investigation. However, previous hydrogeological assessment work indicates low potential for a significant hydraulic connection of the new underground mine to the Red River.

Direct surface runoff from disturbed areas to the Red River does not occur under normal conditions. All significant areas of mine affected drainages contain surface water and sediment impounding facilities.

Potential paths of mine impacted drainage flow to the Red River include seepage and groundwater flow from the Capulin, Sugar Shack South, Middle and Spring and Sulphur Gulch waste rock disposal areas through alluvium and geologic structures possessing high hydraulic conductivity.

1.4.2.2 Chemical Conditions

The mine affected seepage and runoff from the in-pit, Capulin and Goathill waste rock disposal areas is collected in the new underground workings. The quality of mine waste drainage is improved through neutralization by the alkalinity contained in the mine wall rocks and the rubblized rock in the caved zone. Mine water is pumped to the tailings impoundment located west of Questa in order to maintain the underground mine water level below the elevation of surface openings. Therefore, mine affected drainage collected in the underground mine has no impact on Red River water quality.

The fate of mine waste impacted seepage from the Sugar Shack South, Middle and Spring and Sulphur Gulch waste rock disposal areas (the seepage that is currently not collected in the underground mine) is affected by several conditions:

- The mine waste rock represents a relatively new source of sulfate, acidity and metal loads. The process of acid generation within these areas may not be mature and the quality of seepage that currently migrates from these areas may be expected to change with time;

- As the mine waste has been in place for a relatively short period of time, the acidity, sulfate and metal attenuation capacity of the underlying rock and alluvium may not be consumed; and;

- The current extent of the migration of contaminated seepage plumes from these area may be limited by attenuation in the alluvium.

1.5 Water Quality Conditions

Table 1.4 summarizes recent and current water quality data from local springs and seeps, the under ground mine workings, and water supply and monitoring wells. The locations of springs and monitoring wells are shown on Figure 1.6.

The data contained in Table 1.4 is selected from Molycorp data files and does not contain all available data. The most recent data were selected for inclusion. Partial data from monitoring wells is included for the purposes of comparison to the larger historic data base that typically includes fewer analyses. Red River and Columbine Creek water quality data from November 1993 is shown in Table 1.5.

1.5.1 Springs Discharging to Red River

Springs at the mouth of Capulin Canyon contain sulfate in the range of 1000 to 1276 mg/l. They also contain concentrations of aluminum, manganese, zinc and copper that are higher than measured in other local springs and seeps adjacent to the river. A seepage collection system was recently installed in upper Capulin Canyon to intercept ARD from the Capulin waste rock disposal area. Several scars exist in Capulin Canyon that may contribute to the quality of the springs at the mouth of the Capulin Canyon.

Numerous springs and seeps have been identified in the area extending from the mouth of Sulphur Gulch to below Goathill Gulch. The Highway 38 spring east of Goathill gulch appears to be impacted by either hydrothermal scar or mine waste drainage. The spring lies beneath the new mine site fill area. Portions of the mine site fill were derived from hydrothermal scar areas. The area also contains extensive scar derived mud and debris flow deposits. Sulfate and metal concentrations are relatively low in the Highway 38 spring. Seepage from the Goathill Gulch scar areas (water samples CG3, 4 and 6) and the Highway 38 spring is high in manganese.

The Portal Springs exhibit variable quality. The pH varies from slightly acidic to neutral and sulfate concentrations are low to moderate. Metal concentrations are also moderate. The water quality in the Portal Springs does not appear to indicate conditions that could be identified as related to either hydrothermal scar or mine waste drainage.

The cabin springs indicate moderate water quality that could be attributed to either mine waste or hydrothermal scar impacts. Aluminum and manganese are elevated, sulfate concentration is moderate and pH indicates slightly acidic conditions.

Questa geologists mapped northeast-southwest and east-west trending Tertiary dike swarms that intersect in the area of the Cabin Springs. The northeast-southwest swarm underlies the existing Middle and Sugar Shack South waste rock disposal areas. The presence of the dikes may be indicative of structurally controlled zones that hydraulically connect the foundation of Middle and Sugar Shack waste rock disposal areas, and the hydrothermal scars that underlie the waste rock disposal areas to the Cabin Springs. The current water quality in the Cabin Springs may be impacted by ARD from the mine waste dumps or from local scars or both. The quality of the Cabin Springs is relatively good in comparison to both scar and mine waste drainage, and the signature of a specific source is not apparent.

The Sulphur Gulch spring has near neutral pH and contains low sulfate and metal concentrations. The spring appears to exhibit quality that reflects both the Red River water and limited impacts from mine waste or hydrothermal scar drainage.

1.5.2 Underground Mine Water Quality

Selected underground mine water quality is shown on Table 1.4. In general, the underground water contains low metal concentrations and moderate sulfate levels. Molycorp personnel indicate that during mine operations, mine waters were non-acidic. Corrosion of pipes, rails and other mine equipment was not noted. The mine area rocks provide a source of alkalinity that has resulted in maintenance of neutral pH conditions in the underground mine water despite inflows of acidic water from the caved zone in Goathill Gulch and the open pit.

A seep located at the 1000 foot station in the decline exhibits elevated sulfate, fluoride and metal concentrations. The source of the station 1000 seep appears to be dump drainage.

1.5.3 Water Supply Wells

The Columbine, Cabin and Molycorp Cabin wells are located in the vicinity of the confluence of Columbine Creek and the Red River. The Molycorp well exhibits water quality similar to the Red River. The Cabin and Columbine wells exhibit elevated sulfate levels that indicate potential impacted from hydrothermal scar and/or mine drainage sources. The quality of water in the Mill well is comparable to that of the Red River.

1.5.4 Monitor Wells

Monitor wells indicated on Figure 1.6 were installed in 1994. Both alluvial fill wells and bedrock wells were installed adjacent the Red River in locations beneath the mine and waste disposal sites.

Wells in Capulin Canyon (MMW-2 and MMW-3) exhibit low pH in the alluvium and neutral pH in the groundwater at depth. The shallow alluvial water exhibits a higher dissolved metals content while sulfate concentrations are similar at depth. The neutral pH conditions at depth would lead to precipitation of dissolved metals and a reduction of metal concentrations.

Zinc is elevated in the shallow alluvial water (9.48 mg/l) and at low levels at depth. Seepage from hydrothermal scar in Capulin Canyon (CAP4 in Table 1.2) exhibited low zinc concentrations (2.08 mg/l) while water samples collected from ARD below the Capulin waste dump exhibited high zinc content. The data suggest that the shallow alluvium in Capulin Creek may be impacted by mine waste drainage. The sulfate and metal concentrations in the deeper bedrock are potentially a result of mine waste or hydrothermal scar drainage.

Well MMW-7 was placed in bedrock in the mine area between the No.1 and 2 shafts. The quality of water in the well is poor and it contains dissolved aluminum and sulfate concentrations that exceed those measured in scar drainage and mine waste seepage samples. The source of poor quality water in well MMW-7 is unknown. It is not consistent with the underground mine water quality.

Wells MMW-8A and MMW-8B were placed in bedrock and alluvium, respectively, in the sewage pond area below the new mine site. Both wells exhibit neutral to near neutral pH. Sulfate concentrations are moderate. Well MMW-8A indicates elevated iron and zinc content at depth that is potentially an impact of mine waste or hydrothermal scar drainage.

Wells MMW-10A, 10B, 10C and 11 were placed beneath the Sugar Shack South waste rock disposal area at depths indicated in Table 1.4. Sulfate concentration is lower in the shallow alluvium that in deep alluvium or bedrock, possibly indicating mixing with water in the Red River alluvial aquifer. All wells indicate elevated aluminum and manganese. The quality of water in this area is consistent with drainage from either hydrothermal scar or mine waste.

1.5.5 Red River Water Quality

Vail (July 1993) conducted a study of the quality of water in the Red River in an attempt to identify sources of acidity and metal loading. A portion of the results of the November 1993 sampling are presented in Table 1.5. Sampling locations in the vicinity of the mine site are shown on Figure 1.7.

Water quality data was collected during a period in which the river historically approaches its low flow condition. As such the data better indicate local water quality impacts because the effects of dilution by stormwater runoff are minimized.

The November 1993 data indicate that at a point above the mill site (station 7), sulfate concentration was 80 mg/l. Below the Capulin Canyon, sulfate concentration increases to 133 mg/l. Increases in the loading rates of TDS, TSS, aluminum, iron, manganese and zinc are also indicated by the data.

Estimated loading rates for sulfate and selected metals are listed in Table 1.6. At near low flow conditions, the sulfate loading rate is approximately 2768 kg/day at station 7. Downstream of Capulin Canyon (below the mine site and mine area hydrothermal scars) sulfate loading increases to 8741 kg/day.

1.5.6 Columbine Creek

The concentration of selected constituents in Columbine Creek in November, 1993 is shown in Table 1.5. Hydrothermal scar development, and the more widespread mineralization and alteration associated with the ore deposits at Questa does not occur to the same degree south of the Red River. In November 1993, Columbine Creek contained 2 mg/l sulfate and trace concentrations of aluminum, iron, copper, zinc, manganese and fluoride.

1.6 Premine Water Quality

Water quality data that predate the mining operations at Questa are not available. Periodic sampling surveys have been conducted by the now defunct U.S. Department of Health Education and Welfare (HEW), by the EPA and others. The earliest water quality data are from the HEW which were obtained in 1965. The sampling post dates the early underground mining operations (1920 to 1956) and occurred near the time of the initiation of open pit mining activities.

Data developed by HEW in 1965 are summarized in Table 1.7. For comparison, water quality data collect by Vail in November 1993 for approximately equivalent sampling locations are shown. In comparison to the 1965 data, increases in sulfate, TDS, iron and zinc are indicated. These increases occur both above and below the mine site.

Total suspended solids (TSS), which would be influenced by rates of erosion and sedimentation, were elevated in 1965 in the samples collected upstream from the mine site. Samples collected at the Questa ranger station indicate an increase in TSS in 1993.

In reviewing the data shown in Table 1.7, consideration should be given to several factors. The present database and, in particular, the past database are limited and, therefore, do not represent statistically valid sample sets.

The potential effects of regional development in the Red River basin on Red River water quality, since collection of water samples in 1965 must be considered as having a finite affect on current (and recent) water quality.

In addition, the HEW samples were collected during a period of lower than average regional precipitation and discharge in the Red River. Discharge records (Section 2.3) indicate an increase in the annual average discharge in the Red River at Questa since 1978. Increased precipitation has resulted in increased runoff with an associated increase in erosion and, potentially, a resurgence of springs and seeps discharging hydrothermal scar impacted drainage to the Red River. These conditions could result in the increased concentrations of sulfate, TDS, iron and zinc that are indicated by the data in Table 1.7

2.0 HYDROLOGICAL INVESTIGATION

2.1 Previous Investigations

Recently completed studies of hydrological conditions and water quality of the Red River were conducted by Vail Engineering (Vail) in July 1993 and South Pass Resources Inc. (SPRI) in June 1994. Water quality data collected by Molycorp from Red River, tributary drainages, springs and seeps and the underground mine workings has been introduced in Section 1 of this report.

Vail researched historic discharge records for the Red River Basin and historic water quality data. Red River water quality data that predate the mining activities at Questa are not available. Chemical surveys of sulfate gain in the river conducted by various parties in 1965, 1970, 1988, 1992 and 1993 were evaluated with respect to historic discharge records. Variations in sulfate gain below Columbine Creek (below the waste rock disposal areas) were investigated.

Vail has noted that sulfate gains could not be directly correlated with the zones effected by operations at the mine and postulated that sulfate gains may also be influenced by long term variations in precipitation. Stream flow records indicated near drought conditions in the period from 1970 to 1978. An increase in precipitation and discharge since 1978 may have resulted in an increase in scar erosion as well as a resurgence in flows from springs and seeps, and thus the quality and quantity of the discharge waters impacted by the hydrothermally altered areas above, at and below the mine site.

A detailed water sampling study was conducted to identify sources and locations of elevated metals and sulfate input to the Red River. The study involved collection of water samples from below the Questa Ranger Station to the area above the town of Red River, New Mexico. Subwatershed contributions to the Red River were estimated in order to develop an accretion profile for the development of a chemical mass balance model of the river.

It was noted that the mass loading of aluminum, several metals, fluoride and sulfate increases in a downstream direction in the Red River. The most significant increases appear to be related to areas where hydrothermal scars are developed. The contribution of hydrothermal scars located in the western reaches of the river to aluminum and sulfate loading appears to be greater than those located above the mine site and the town of Red River. The greatest increases were noted in the area near the Questa Ranger Station where the scars occur in close proximity to the river. Minor increases in sulfate and aluminum loading were noted in the reach adjacent to the mine waste rock disposal areas located at and below Sulphur Gulch where several springs and seeps discharging low pH (3.5 to 5.0) water were identified.

Sulfate and aluminum loading were found to be more significant during periods of low flow in the Red River. Additional water quality data collected by Vail in the November 1993 were introduced in Section 1.

SPRI conducted a hydrological and hydrogeological assessment of the Questa site in June, 1994. Primary hydrogeologic units identified by SPRI include the Tertiary volcanic rocks that exhibit

secondary permeability as a result of fracturing and faulting, alluvial mudflow deposits and Red River alluvium.

SPRI noted that during dewatering of the new underground mine workings, no affect on the rates of groundwater recharge to the Red River in the vicinity of the mine was observed. It was postulated that a weak hydraulic connection exists between the new underground mine and the river. It was noted that dewatering rates in the new underground mine were approximately 225 gpm. Approximately 50 gpm of the mine water inflow was from the "rain forest" area located in the north of the underground mine at the haulage level. Dewatering rates in the old underground workings were reported to be between 15 to 30 gpm. Thus the inflow into the underground workings is very small compared with the surface and shallow alluvial and upper fractured bedrock groundwater flow quantities.

Based on observations of water levels in local monitoring wells and the rate of underground mine rewatering, SPRI estimated the configuration of the post mine rewatering piezometric surface. It was predicted that points of discharge from the underground mine workings, if dewatering or pumping was ceased, would be the 7960 adit and through the alluvium south of the caved zone in Goathill Gulch.

SPRI reviewed Red River accretion studies conducted by Vail and previous investigators and estimated groundwater recharge rates to the Red River to be between 0.66 and 1.6 cfs for the area between Sulphur Gulch and Capulin Canyon.

2.2 Data Developed for This Study

Additional hydrological evaluation of the mine area and the Red River basin is being conducted by Vail Engineering. Ongoing work includes estimation of average monthly yields for all subwatersheds within the Red River catchment above the Questa Ranger Station gaging station.

Subwatershed contributions to the Red River were estimated on the basis of a precipitation versus elevation relationship that accounts for observed variations in precipitation with elevation. The combined subsurface and surface water contributions of the subwatersheds were calibrated against discharge records for the stream gage at the Questa Ranger Station.

2.3 Regional Watershed

The mine facilities at Questa are contained entirely within the Red River basin. The basin upstream from the Questa Ranger Station covers an area of 112.7 square miles. Elevation ranges from approximately 7,450 feet at the Questa gaging station to over 12,000. Average annual precipitation rates vary over the basin as a function of elevation. Below 9,000 feet, annual precipitation is approximately 18 inches per year, and between 9,000 and 11,000 feet, annual average precipitation is approximately 35 inches. Annual snowfall can exceed 100 inches.

USGS discharge records from the Questa Gaging Station for the period from 1913 to 1925 and 1927 to 1965, when no diversions were in effect at the mine, indicate an average annual discharge

GR. WTR. Recharge

of 55.9 cfs. Records for the period from 1961 to 1993 indicate an average discharge of 41.6 cfs. Annual average discharge for the period from 1961 to 1993 are summarized in Table 2.1.

The region, has been subject to long term variations in precipitation and runoff. Figure 2.1 illustrates graphically the data contained in Table 2.1. For the period between 1961 and 1978, the average annual discharge at the Questa Ranger Station was 33.1 cfs. For the period between 1978 and 1993, mean annual discharge was 52.2 cfs. The average annual flow for 1991 to 1993 was 59.2 cfs. These large variations of flow also indicate that substantially different rates of erosion and seepage from natural scar areas would have accompanied the natural variations in weather conditions. The assessment of mine impacts on Red River drainage water quality must take into account the likely natural variations in contaminant loadings due to these variations of weather. Note that the open pit mine operation was from 1965 to 1983 and the new underground mine operation extended from 1983 to 1992.

The average monthly discharge in cfs for water years 1966 to 1993 at the Questa gaging station is summarized in Table 2.2.

Peak discharge occurs in May and June as a result of snowmelt in the higher elevations of the Red River basin. Low flow conditions occur from November through March with the lowest flows recorded in January.

2.4 Subwatersheds

An analysis of subwatershed yields to the Red River was conducted for this study. The overall Red River catchment was subdivided into individual subwatersheds and incremental areas were determined for each subwatershed by elevation. The areas of known hydrothermal scars within each subwatershed were also determined.

Subwatershed yields that include the combined surface runoff and groundwater flow contributions were calculated. Calculated yields for the overall basin were combined, compared to gaging station records and calibrated based on average monthly discharge conditions. A subwatershed map and tabulated yield data are contained in Appendix A. The estimation of the relative subsurface and surface contributions is in progress.

In the vicinity of the mine, Columbine Creek contributes the most significant quantity of flow to the Red River. The estimated combined surface and subsurface contribution of Columbine Creek to the Red River ranges from 2.4 to 28.4 cfs. Other basins in the mine area contribute average surface and subsurface flows of up to a few tenths of a cfs.

2.5 Hydrothermal Scar Areas and Flows

Hansen Creek (Figure 1.2) is representative of a small subwatershed in which a relatively high percentage of the surface area is in hydrothermal scar. The surface area of the Hansen Creek subwatershed is approximately 0.11 square miles and hydrothermal scar covers approximately 0.077

square miles. At low flow conditions, the average surface and subsurface contribution of Hansen Creek is approximately 0.1 cfs.

Other areas of hydrothermal scar are located in the drainages above and below the mine site. The area north of the Red River between Hansen Creek and the town of Red River contains several well developed scars that have produced mud and debris flows in the past and will continue to do so following periods of high runoff in the future. These subwatersheds contribute average yields of a few tenths of a cfs to the Red River under low flow conditions. They are also continuing sources of low pH water containing elevated dissolved metal concentrations and the runoff from these areas also contributes to the sediment loads in the Red River.

2.6 Site Impacted Subwatersheds

2.6.1 Pre-mine Conditions

Subwatersheds that contain significant areas of hydrothermal scar include Capulin Creek, Sulphur Gulch and Goathill Gulch and the areas occupied by the Sugar Shack South and Middle and rock disposal areas (Figure 1.4).

Prior to development of Molycorp's surface water management facilities, mining in the open pit and development of the caved area, these drainages contributed surface runoff and groundwater flow to the Red River. The quality of these flows, like those derived from areas outside the mine site, were impacted by drainage from the hydrothermal scars. Runoff from these areas also contributed to the sediment loads, sulfate and metals concentrations in the Red River. Vail (1993) estimated that historic surface flow from Sulphur Gulch was approximately 30 gpm (0.07 cfs).

In periods of high runoff, the hydrothermal scar areas also produced mud and debris flows. Significant accumulations of mud flow deposits that pre-date the mine can be seen at the mouths of Capulin and Goathill canyons. These scar derived mud flows represent distributed sources of contaminated drainage and are particularly significant as they occur directly in the surface water drainage path. They yield both suspended solids to surface flows, as a consequence of erosion, and dissolved contaminants, as a consequence of subsurface leaching.

Based on subwatershed yields estimated by Vail (Appendix A) for pre-mine conditions, the combined surface and subsurface contribution from mine impacted drainages is estimated to have been on the order of 0.4 cfs under low flow conditions.

2.6.2 Present Conditions

Drainage from mine impacted subwatersheds are now controlled by the mine's surface water management facilities and surface discharges to the Red River do not occur. All surface water in upper Sulphur Gulch is collected in the pit area and drains to the underground workings. The caved zone intercepts the drainage and shallow groundwater flow in Goathill Gulch from all areas located upstream of the caved zone. The water level maintained in the underground mine is

below the elevation of the Red River as it passes the mine site. Therefore, the potential for flows from the underground mine to Red River is limited.

In Goathill Gulch below the caved zone, surface runoff is collected in surface impoundments. Surface flow in Capulin Canyon is also impounded and retained. Surface water discharges from the waste rock disposal areas adjacent to the Red River are contained in sediment collection ponds located at the toes of the waste rock disposal areas.

The mud and debris flows that previously originated from these areas are controlled either through burial with waste rock or by collection in surface water impounding structures. The sediment load and natural sulfate and metal loading to Red River associated with surface discharges from mine area drainages have been substantially eliminated by Molycorp's surface water management facilities.

Groundwater flow from these areas still occurs but the rate of subsurface flow is currently undefined. The groundwater drawdown cone that has developed around the mine captures much of the groundwater flow in the low permeability bedrock. The main potential source of groundwater flow to the Red River is the flows of groundwater in the shallow alluvial and upper fractured bedrock perched water systems. Seepage through the waste rock disposal areas and the shallow underlying colluvium and alluvium potentially contributes to the quality of springs and seeps that have been identified adjacent to the Red River near the mine site. Potential pathways for seepage migration include through the alluvium and in structurally controlled zones of high permeability in bedrock.

AGREES:
Shallow Alluvium

3.0 GEOCHEMICAL CHARACTERIZATION

"GEOCHEMICAL"

3.1 Previous Studies

Previous geochemical characterization studies have been conducted by Vail (1993) and Molycorp personnel. The majority of this work involved sampling of local surface water and groundwater. Vail investigated the hydrothermal scar areas to determine their contribution to local and Red River water quality. Vail and Molycorp have investigated springs and seeps in the area and conducted an accretion and metal loading study of the Red River. These data were introduced in Section 1.0.

Molycorp continues to monitor surface water and underground mine water quality. Direct geochemical testing of mine waste and disturbed material has not been undertaken prior to this study.

The geology, mineralization and alteration at the site have been described by Shilling (1956) and later by Molycorp geologists.

3.2 Data Collected for This Study

The following geochemical testing was undertaken for this study;

- Field testing of the paste pH and paste TDS of mine waste, hydrothermal scar and mine disturbed areas to assess the present acid generating condition of materials in and adjacent to the mine site;
- Whole rock analysis of field samples by digestion and ICP scan;
- Collection of water samples for chemical characterization of drainage from mine waste and undisturbed hydrothermal scar areas;
- Static testing of waste rock, hydrothermal scar materials and old tailings to determine acid generating potential; and
- Shake flask testing of mine waste, hydrothermal scar and undisturbed materials to determine the soluble and leachable metals content, and potential effects of disturbed and undisturbed areas on surface water and groundwater quality.

Selected samples of alluvial material from the areas of springs and seeps discharging to the Red River were also subjected to titration testing to determine their potential to attenuate acidity.

Descriptions of the test procedures used in geochemical characterization of the site and the interpretation of test results are described in Appendix B. Complete test results are listed in Appendix C.

The purpose of this work was to enable the geochemical characterization of the mine waste at the site and assess the current behaviour of the waste, identify potential sources of sulfate and metals, and to assess potential long term waste behaviour and drainage water quality. Soils, rock, colluvium and alluvium from undisturbed areas were tested to determine the potential contribution of materials unaffected by the mining operation to local and regional surface water and groundwater quality. As the areas of hydrothermal scars have a significant influence on regional and local water quality, hydrothermal scar samples obtained inside and outside the mine area were subjected to the testing described above.

3.3 Surficial Geochemistry

3.3.1 Geochemical Properties and Drainage Chemistry of Hydrothermal Scars

Characterization of the geochemistry and current contaminant yield from the hydrothermal scar material is important, not only to estimate the total contaminant contribution from scars to the Red River, but also to obtain a better understanding of the long term evolutionary processes of the exposed sulfitic rocks of the region. The mine waste is the same rock material and is expected to pass through the same evolutionary stages of acid generation and contaminant production to reach the same final condition.

Metals data, ABA and shake flask data for hydrothermal scars are summarized in Tables 3.1, 3.2 and 3.3, respectively.

3.3.1.1 General Description of Hydrothermal Scars

Locations of hydrothermal scar samples collected for geochemical testing are shown on Figure 3.1. Hydrothermal scars are well developed in Goathill Gulch, Sulphur Gulch, Capulin Canyon and in Hansen Creek east of the mine site. Scars exist beneath the cover of waste rock in Goathill Canyon, Capulin Canyon and adjacent the Red River between the mouth of Sulphur Gulch and the old underground mine site.

Based on field observations, hydrothermal scars may be characterized as consisting of a central brecciated core that grades laterally to a less fractured, altered and mineralized material. Where observed, the brecciated rock is non-rotational in nature and lacks secondary cementing. Fracture spacings in the brecciated cores of the hydrothermal scars of 0.25 to 0.5 inches are common. The high degree of fracturing and lack of cementing result in highly erodible material that lacks vegetative cover and is the source of the alluvial mudflow deposits in and beneath the canyons where hydrothermal scars are developed.

3.3.1.2 Whole Rock Analysis

Selected scar samples were analyzed for metals by ICP. Test results are summarized in Table 3.1. The scar materials contain iron, potassium, calcium, sodium, magnesium and aluminum in concentrations that are consistent with the composition of typical rock forming minerals. Metals present in potentially leachable concentrations, in addition to the above, include barium, copper,

manganese, nickel, zinc, lead, chromium and vanadium. The scar materials also contain appreciable phosphorous.

3.3.1.3 Static Testing

Acid base accounting (ABA) is done to establish the balance between acid generating minerals (sulfides), and potentially acid consuming minerals (alkaline minerals) present in a sample (Sobek, 1978). The former is expressed as the acid generating potential (AP) and the latter as the acid neutralization potential (NP).

Paste pH and conductivity are simple tests that can be done in the laboratory or in the field to indicate the extent of oxidation of sulfides that has occurred in the rock prior to the testing. The procedures used for pH and conductivity, and for acid base accounting and shake flask tests are listed in Appendix B. Complete static test results are listed in Appendix C.

Samples of hydrothermal scar material typically exhibited low paste pH (1.8 to 3.5) and high paste TDS in field tests. These conditions indicate advanced, bacterially accelerated oxidation and acid generation is occurring in the surficial portions of the scars. High paste TDS content indicates the samples contain stored oxidation products (sulfate and dissolved metals). Static acid generation potential test results for typical hydrothermal scar materials are shown on Table 3.2.

Sample No. 35 was collected from an undisturbed scar located above the open pit in upper Sulphur Gulch. Sample HC-2 was collected from an area of high grade scar adjacent Hansen Creek. Samples exhibit oxidizable sulfide sulphur contents of 0.44 and 0.16 percent, respectively. In both samples, the neutralization potential has been consumed and much of the sulfide mineralization has been converted to sulfate. While the net acid producing potential of these materials is relatively low, they exhibit the potential to continue acid generation.

3.3.1.4 Shake Flask Tests

Distilled water extraction, or shake flask tests, indicate the amount of readily soluble (oxidized) metal salts present in the material. The testing procedure for shake flask tests is listed in Appendix B. Complete results are listed in Appendix C.

Table 3.3 contains the results of shake flask distilled water extraction tests conducted on hydrothermal scar samples. Samples were obtained from Goathill Gulch, Capulin Canyon and Sulphur Gulch. Samples HC1 through HC3 were obtained from the Hansen Creek area. The primary constituents in the shake flask extracts include calcium and aluminum. Metals found in trace concentrations include cadmium, cobalt, copper, iron, nickel and zinc. Lead was detected in the extract from a scar area located in Capulin Canyon (sample No. 71). Sulfate content in shake flask extracts ranged from 18.6 to 4450 mg/l. Extracts from scar samples collected in upper Sulphur Gulch and in lower Goathill Gulch contained 7.02 and 1.36 mg/l fluoride, respectively. These results indicate a significant availability and leachablity of aluminum and sulfate, and limited availability of copper, iron, nickel and zinc.

Sample HC3, obtained from the peripheral area of the large scar in Hansen Creek, is representative of a lesser degree of alteration and mineralization and exhibits a reduction in available aluminum. Sample No. 71, from Capulin Canyon, appears to be anomalous with respect to available aluminum content. Samples collected in the mine area (No.s 15, 35, and 80) exhibit relatively consistent test results.

3.3.1.5 Scar Area Drainage Composition

Analysis of seepage and surface water runoff from scar areas undisturbed by the mining operations (Table 1.2) indicates high average concentrations of sulfate (3018 mg/l), aluminum (230 mg/l), and iron (317 mg/l). Copper, manganese and zinc were also detected in significant concentrations. Hydrothermal scar seepage from the Hansen Creek and Goathill Gulch areas also contained fluoride at concentrations of 28.5 and 28.9 mg/l, respectively. The trace metal content of the scar area water samples is similar to that of the shake flask test extracts.

3.3.2 Geochemical Properties and Drainage Chemistry of Mine Waste and Mine Disturbed Materials

Mine waste and mine disturbed sampling locations are shown on Figure 3.2. All samples were subjected to field paste pH and TDS tests to assess their current acid generating condition. Selected samples of mine disturbed materials were subjected to whole rock analysis, static tests and shake flask extraction tests. Data from these analyses on waste rock and tailings are shown on Tables 3.4. 3.5 and 3.6.

3.3.2.1 Whole Rock Analysis

Analysis by ICP (Table 3.4) indicates the mine waste materials contain iron, potassium, calcium, sodium, magnesium and aluminum in concentrations that are consistent with the composition of typical rock forming minerals. Metals present in potentially leachable concentrations, in addition to the above, include barium, copper, manganese, nickel, zinc, lead, chromium and vanadium.

The mine waste materials exhibit increases in the quantities of potentially leachable manganese, molybdenum, zinc and chromium. Boron, which was not detected in mine waste or hydrothermal scar samples, is contained in two samples of old tailings collected at the mill site in concentrations of 225 and 112 mg/kg.

3.3.2.2 Field and Static Tests

Waste rock and disturbed materials at all sampling locations were subjected to field paste pH and TDS tests to assess their current behaviour. Field paste pH and TDS test results for all samples are listed in Table C-2 in Appendix C, and shown on Figure 3.2.

The waste rock observed on the surface was classified into three general types. Each type is described below along with the results of field tests:

- Mixed volcanic rocks are composed of the upper rhyolitic and lower andesitic rocks of Tertiary age that were defined by Molycorp geologists. These materials were derived from the western side of the pit in an area that contained the Sulphur Gulch hydrothermal scar. The majority of these materials have been placed in the waste rock disposal areas located to the north, south and west of the pit. Mixed volcanics were placed with other waste rock types in the in-pit disposal areas.

  The mixed volcanics are highly fractured and weathered, and contain abundant pyrite. Where these rocks were observed, they typically exhibited a paste pH in the range of 2.3 to greater than 6.0, with the majority less than 3.5. Paste extractions typically indicated a high TDS content. Based on these field test results, these materials are undergoing advanced, biologically catalyzed oxidation and they contain residual oxidation products (stored acidity, sulfate and dissolved metals). Their current acid generating behaviour is believed to have been influenced by the high degree of alteration and mineralization associated with the development of the Sulphur Gulch hydrothermal scar.

- Black andesite is presumed to be derived from the lower andesitic series volcanics of Tertiary age. The black andesite appears to be in fault contact with the highly fractured and intensely altered Sulphur Gulch scar in the south side of the open pit. The black andesite contains secondary mineralization that includes calcite, fluorite, quartz, chlorite, pyrite and chalcopyrite.

  Where exposed on the surface, this material typically exhibits near neutral paste pH and low paste TDS content. Field observations and testing indicate that this material is not currently generating acid.

- Ore grade mineralization at Questa is associated with Tertiary aged aplitic and granitic intrusives (the mine aplite). Aplite is exposed in the eastern pit wall and the bulk of the aplite waste rock has been placed in Spring Gulch, Sulphur Gulch, in the in-pit disposal areas, and over the lower toe of the Middle, Sugar Shack South, and Spring and Sulphur Gulch waste disposal areas as an erosion controlling cover.

  Where exposed on the surface, this material typically exhibits neutral paste pH and low paste TDS content. Field tests and observations indicate that the aplite exposed on the surface is not currently generating acid.

Static test results conducted on selected waste rock samples are shown in Table 3.5.

Aplite (and granite) samples contain between 0.06 and 0.61 percent sulfide sulphur (total sulphur minus unoxidizable sulfate sulphur). The neutralization potential (NP) of aplite is relatively consistent and varies between 19.35 to 38.83 tons per kiloton (T/KT). The aplite exhibits net neutralization potentials of between 11.85 and 34.43 T/KT indicating that the aplite is net acid consuming. The average ratio of acid neutralizing to acid generating potential (NP/AP) in aplite and granite is 3.5:1. Of the samples tested, 3 of 7 had NP/AP ratios greater than 3:1 indicating low potential for acid generation. The remaining 4 samples exhibited NP/AP ratios between 1:1

WRD Rock Types

and 3:1 indicating uncertain acid producing potential (Acid Rock Drainage Technical Guidelines, 1989).

Black andesite samples contain between 0.12 and 0.68 percent sulfide sulphur and exhibit a net acid neutralizing potential (NNP i.e. NP-AP) that varies between 16.28 and 43.93 T/KT. Of the samples tested, 5 of 7 had NP/AP ratios greater than 3:1 indicating low acid producing potential. The remaining 2 samples have NP/AP ratio between 1:1 and 3:1 indicative of uncertain acid producing potential.

Mixed volcanic materials typically contain low neutralizing potential and have a net acid producing potential as indicated by static tests. NNP values range from -27.78 to +24.27 T/KT. Of the 15 samples tested, 10 had NP/AP ratios less than 1:1, indicating high acid generating potential. In the majority of the samples, the neutralizing potential appears to have been consumed. However, they contain residual sulfide sulphur at levels sufficient to sustain oxidation and acid generation for an indefinite and potentially extended period of time.

Other mine disturbed samples subjected to static testing included development rock from the new underground mine site, tailings from the old tailings ponds at the mill site and fill materials placed in the new mine site foundation.

The development rock from the new underground mine has a high field paste pH and low paste TDS. The material tested had an NP/AP ratio of 4.4:1, indicating that it is net acid consuming.

Tailings from the old tailings ponds in the mill site, and the old tailings used to construct the mill site foundation exhibit low paste pH and high paste TDS. One of the samples tested had significant residual oxidizable sulfide sulphur content and its neutralizing potential appears to have been consumed. Based on and NP/AP ratio of 0:1, the material exhibits acid generating potential. The regraded mill site fill composed of old tailings contains low sulfide sulphur content and neutralizing potential and exhibits limited acid generating potential.

The new mine site foundation area was constructed by cut and fill methods. Much of the material exposed in the mine site area cut slopes appears to have been altered by local hydrothermal activity. The mine site foundation fill samples exhibited low paste pH and high paste TDS content. Static tests indicate the mine site fill is potentially acid generating.

3.3.2.3 Shake Flask Tests

Shake flask test results for selected waste rock and mine disturbed samples are shown in Table 3.6. Primary metals leachable in shake flask tests include aluminum, calcium, iron, manganese, copper and zinc. Metals leached in lesser concentrations included cobalt, chromium, molybdenum, cadmium and lead. Leachable sulfate in mine waste materials ranged from 68.1 to 3940 mg/l. The presence of leachable metals and sulfate in mine waste rock occurs primarily in the mixed volcanic waste rock that exhibits low paste pH and high paste TDS content in field tests.

Typically, the field tests indicate low TDS content in black andesite and aplite/granite waste rock. Therefore, the potential for leaching of metals and sulfate from these materials is limited.

In comparison to the leachable metals from hydrothermal scar samples (Table 3.3), shake flask extracts from mine waste and hydrothermal scars contain a similar group of metals with similar ranges in concentration.

3.3.2.4 Mine Waste Drainage Chemistry

The quality of seepage and drainage from mine waste and mine disturbed materials is summarized in Table 1.2. Complete water quality results are presented in Table C1, Appendix C.

Samples WS1, WS-SS1 and WS-SS2 were collected from temporarily impounded surface water runoff in areas containing primarily mixed volcanic waste rock in the Spring and Sulphur Gulch and Sugar Shack South waste rock disposal areas. The samples contained moderate sulfate contents and somewhat elevated concentrations of aluminum, iron, manganese and zinc.

Sample WS-Cap1 was collected from the base of the western lobe of the Capulin waste rock disposal area and is representative of the drainage from the waste rock. Samples WS-GC1 and WS-GC2 were collected from drainage immediately below the Goathill Gulch waste rock disposal area. These samples contain moderate to highly elevated sulfate and dissolved aluminum and manganese. In comparison to concentrations of aluminum and manganese in the drainage from the hydrothermal scar area, the drainage from the Capulin and Goathill waste rock contains up to an order of magnitude increase in the concentrations of aluminum and manganese. Fluoride analyses conducted on selected samples indicates similar concentrations of fluoride can be anticipated in mine waste and hydrothermal scar seepage.

Sample WS-Pit1 was collected from hydrothermal scar rubble that occurs in the failed western wall of the open pit. Sample WS-Pit1 represents the quality of water that is currently draining from disturbed, acid generating materials in the pit to the underground workings. The sample contains moderate to high concentrations of sulfate, aluminum and iron, and relatively high concentrations of manganese and zinc.

Sample WS-Cap3 represents the quality of waste rock drainage that escapes the surface water impoundments in upper Capulin Canyon. As there are hydrothermal scars in the area, the quality of WS-Cap3 may also be impacted by hydrothermal alteration. WS-Cap3 exhibits a reduction in sulfate and metals concentrations that potentially results from dilution with less affected groundwater or interaction with soils, rock and alluvium in the bed of the creek.

Sample WS-2 was collected from a seep at the mouth of Capulin Creek at its confluence with the Red River. The quality of WS-2 potentially reflects either further dilution and interaction of waste rock disposal drainage that bypasses the seepage collection system in upper Capulin Canyon, or hydrothermal scar impacted drainage. Sulfate, aluminum manganese and zinc concentrations are slightly elevated in WS-2.

DRAINAGE FROM WRD.

The metals present in waste rock disposal area seepage are also found in seepage from the hydrothermal scar areas. Based on available data, seepage from acid generating waste rock can be anticipated to have higher concentration of sulfate, aluminum, zinc and nickel with respect to seepage from undisturbed scar materials. Fluoride analyses conducted on selected samples indicates similar concentrations of fluoride occur in mine waste and hydrothermal scar seepage. The metals contained in trace concentration in waste rock seepage (Cd, Cr, Co, Cu and Pb) are present at similar levels in hydrothermal scar seepage. Only iron exhibits a concentration that on average, is greater in the seepage from hydrothermal scars, however, additional testing would be required to confirm this observation.

Much of the waste rock from which acidic fluids are currently draining is derived from the Sulphur Gulch hydrothermal scar and therefore, it would be anticipated to have similar drainage composition. In the mine area, the increase in the concentration of aluminum, manganese and zinc can be attributed to the physical condition of the waste rock. Oxidation of sulfides contained in the in-place hydrothermal scar is limited to near surface zones and areas where erosion and weathering processes have resulted in exposure of the near surface rock to oxidizing conditions. In contrast, the large dumps of waste rock have been rubblized by blasting, excavation and disposal practices. The conditions required for advanced rates of oxidization and acid generation, and the hydraulic properties required for ARD migration (infiltration and permeability) have been enhanced. The minerals within the waste rock and hydrothermal scar that liberate dissolved metals, either through oxidation or through dissolution in acidic drainage, are more readily available within the waste rock due to mining disturbance, and the increased exposure of fresh sulfides.

3.3.3 Rock, Soil, Alluvium and Colluvium from Other Areas

3.3.3.1 Field Tests

Samples of rock, soils, colluvium and alluvium from areas outside the mine disturbance and hydrothermal scars were subjected to field paste pH and TDS testing, and shake flask extraction tests. Sampling locations are shown on Figure 3.3. Results of field tests are shown on Table 3.7. Shake flask test results are contained in Table 3.8.

The alluvium samples 10 and 73 were collected from alluvial mud flow debris in Capulin Canyon. They have potentially been impacted by both drainage from hydrothermal scar areas and seepage from the Capulin waste rock disposal area. They exhibit low paste pH; however, as the paste TDS content is also low, these materials do appear to be, of themselves, acid generating.

Rock, soil and colluvium samples collected in Capulin Canyon outside the alluvial stream bed zone typically exhibit near neutral paste pH and low paste TDS content. Test results for samples 13, 14, 22 and 68 do not indicate acid generating conditions and as paste TDS is relatively low, the dissolved metals contribution of these materials to surface water and groundwater is anticipated to be low in comparison to hydrothermal scar and mine waste materials that exhibit acid generating behaviour.

Samples 43 and 44 were collected from rock outcrops above the mine disturbed area in Blind Gulch and Spring Gulch. These materials are also unaffected by significant hydrothermal alteration. They exhibit neutral paste pH and low paste TDS content. These conditions do not indicate acid generating behaviour or significant dissolved metals contributions to surface water or groundwater.

Samples HC-4, 5, 6 and 7 were collected in the Hansen Creek area. Sample HC-4 was collected from a soil/rock subcropping adjacent to the Hansen Creek drainage. The material exhibits neutral paste pH and low paste TDS.

Samples HC-5, 6 and 7 were collected from alluvial mudflow debris derived from the hydrothermal scar in upper Hansen Creek. The paste pH of the alluvium is low and paste TDS is high in comparison to other materials collected outside the mine or hydrothermal scar areas. As the metal contents measured in shake flask tests is low (Section 3.3.3.2) , the TDS content of the soils is anticipated to reflect high sulfate concentration. Based on visual examination, these materials are not believed to possess significant residual acid generating potential as they have undergone extensive weathering.

Several samples of river alluvium at active seeps, and mudflow deposits in the vicinity of the seeps, were collected near the Red River adjacent to the mine site. The paste pH and TDS content of the river alluvium samples collected in seepage path reflects the quality of the seepage water. The mudflow deposits exhibit variable paste pH while TDS content is low. The conditions suggest that the mudflow debris does not possess significant acid generating potential.

3.3.3.2 Shake Flask Tests

Shake flask test results for soils, rock and colluvium samples obtained outside mine disturbance areas are contained in Table 3.8. Most of the samples of mine-unaffected materials contain minor amounts of leachable calcium, iron, copper, zinc, manganese and aluminum. Calcium and aluminum appear to occur in somewhat anomalous concentrations in Hansen Creek samples HC-5, 6 and 7, however, the concentrations are low. Test results indicate that the contribution of dissolved metals from these materials to surface water or groundwater would be minimal.

Leachable sulfate concentration in mine area soils, rock, alluvium and colluvium varies between 6.2 and 381 mg/l, indicating that the undisturbed surficial materials in the mine area potentially contribute sulfate to surface water runoff and groundwater. The average sulfate concentration in mine area undisturbed material shake flask extracts was 86.8 mg/l.

3.3.3.3 Drainage Quality from Unaffected Areas

Water sample WS-Cap 2, was collected from a small tributary to Capulin Creek in an area undisturbed by mining activity or development of hydrothermal scar. This sample had neutral pH, contained trace concentrations of iron and zinc, and 42 mg/l calcium. The sulfate content of the sample was 140 mg/l (Table C-1, Appendix C).

3.3.3.4 Acidity Attenuation Capacity of Soils and Alluvium

Selected samples of alluvial material from the area of springs and seeps located beneath the waste rock disposal areas were subjected to titration testing to determine their potential to attenuate or neutralize acidity. Titration test data is shown in Table 3.9 and illustrated in Figure 3.4.

Titration test results indicate that the alluvial materials in and adjacent to the spring and seepage flow paths below the Middle and Sugar Shack waste rock disposal areas have limited potential to attenuate the acidity in seepage water.

Carbonates (calcite, siderite or magnesite etc.) that can modify or buffer seepage to near neutral pH have been consumed. Minor capacity to buffer seepage to a pH in the range of 3.7 to 4.3 is indicated. This capacity is assumed to be provided by aluminum and iron hydroxides.
Additional but limited capacity to buffer seepage in the range of 2.0 is provided by aluminosilicates.
In general, the neutralization potential of the alluvial materials adjacent to the Red River has been consumed and their ability to provide sustained acidity attenuation capacity is limited.

3.4 Discussion of Test Findings

3.4.1 Current State of Acid Generation

3.4.1.1 Waste Rock Disposal Areas

Although acid generation is occurring at the site it appears to be limited mainly to materials derived from waste rock obtained in or near the Sulphur Gulch hydrothermal scar and, to a lesser extent, from the cut and fill materials at the new mill site. This material is typically of mixed andesitic and rhyolitic composition. Field paste pH in the mixed volcanic waste rock is typically in the range of 3.5 or less indicating advanced, bacterially accelerated oxidation. As a group, static tests indicate low or consumed neutralizing potential. The mixed volcanics were derived from highly altered, highly fractured rock and their potential to generate acid has been influenced by geologic conditions created prior to mining. These materials have probably been exposed to oxidizing conditions over geologic time as a result of the history of structural disturbances (faulting and brecciation) and alteration to which they have been exposed.

Currently, acid generating conditions appear to be well advanced in the Blind Gulch, Capulin, Goathill, Sugar Shack South, Sugar Shack West, and Middle waste rock disposal areas. Lesser amounts of mixed volcanic waste rock have been placed in the in-pit and Spring and Sulphur Gulch waste rock disposal areas. Acid generation also appears to be occurring at these locations.

Black andesite from the southern pit area and aplite from the eastern side of the pit were not significantly affected by hydrothermal scar development in Sulphur Gulch. Black andesite has been placed with aplite and granite in Spring Gulch, in the in-pit disposal areas, and as an erosion controlling armor on the lower faces of the Sugar Shack South, Middle and Spring and Sulphur Gulch waste rock disposal areas. Field tests indicate neutral conditions and low paste TDS

content. These materials exhibit an average net acid neutralizing potential. The average NP/AP ratio for black andesite and aplite/granite exceeds 3:1, indicating low acid producing potential.

3.4.1.2 Open Pit

The western wall of the open pit mine is composed of up to 200 feet of rubblized, failed wall rock that has been affected by hydrothermal scar development in Sulphur Gulch. This material is currently acid generating.

Other exposed pit wall materials are composed of black andesite and aplite. The black andesite exposed in the pit wall exhibits zones of oxidation that appear to be fracture controlled. The oxidation of black andesite in the exposed pit wall areas is probably a result of natural oxidation that has occurred over geologic time at a slow rate within the fractures transporting oxidizing solutions (containing ferric iron, a strong oxidant) from oxidizing surficial materials.

The aplitic and granitic materials exposed in the northeast and eastern pit walls do not exhibit oxidizing or acid generating conditions.

3.4.1.3 Underground Mine Workings

Seepage entering at the 1000-foot station of the decline and draining to the underground workings contains elevated metal concentrations that suggest the overlying scar zones and waste dumps are the seepage source. Inflows through the caved area in Goathill Canyon contain low pH and high metal content and are water derived from ARD from the Capulin and Goathill waste rock disposal areas. Despite inflows of low pH water to the underground mine workings, the mine water quality data collected by Molycorp indicates that the underground mine water exists at near neutral conditions and is of relatively good quality. Dissolved metal concentrations are low and sulfate concentration is moderate. This indicates that extensive neutralization of acidic drainage, and possibly sulfate reduction, is occurring in the underground workings.

3.4.2 Potential For Future Acid Generation

3.4.2.1 Waste Rock Disposal Areas

Testing completed to date shows an excess of alkalinity over acid generating potential and no observed acidic paste pH values. Thus, black andesite and aplite/granite are anticipated not to generate acidity in the future unless they are subjected to an external source of acidity, such as drainage from acid generating waste rock, that would remove the reserve alkalinity. Slow but continued oxidization of the sulfides in this waste rock will contribute moderate levels of sulfate to drainage.

Where these materials have been intermingled with mixed volcanic waste rock in the in-pit disposal areas, the mixture may be acid generating. They are the only materials exposed on the surface of waste dumps in Spring Gulch and in the eastern portion of the Spring and Sulphur Gulch waste rock disposal area. If the rock exposed on the surface of the Spring Gulch and Spring

and Sulphur Gulch waste rock disposal areas is representative of subsurface composition, future acid generation is not anticipated in these areas.

The black andesite and aplite placed to armor the waste rock disposal areas is also not anticipated to generate acid in the future.

While the neutralizing potential of the mixed volcanic rocks has been, for the most part, consumed, this material contains sufficient residual oxidizable sulfide content to continue generating acid for an indefinite and potentially extended period of time.

3.4.2.2 Open Pit

The rate of oxidation of black andesite and aplite exposed in the pit walls is slow and is not anticipated to reach a level that would significantly increase the sulfate and metal loading to the pit water that drains to the underground mine workings.

The rubblized hydrothermal scar material that comprises the failure zone in the western pit area can be anticipated to continue generating acid for an extended and indefinite period of time. The quality of drainage from the failed scar area is currently of better quality than drainage from the Capulin and Goathill waste rock disposal areas. The concentration of sulfate and metals in drainage from this area can be expected to increase with time as the oxidizing conditions in the failed mass matures.

Several of the waste rock piles placed in the in-pit waste disposal area are exhibiting acid generating conditions. The maximum rate of acid generation may not yet have been reached in these relatively young deposits. Therefore, the concentration of sulfate and metals in runoff and seepage reporting to the pit and the underground workings could potentially increase with time.

The undisturbed portions of the hydrothermal scar located in upper Sulphur Gulch will continue to provide poor quality seepage and runoff to the open pit and underground mine workings at concentrations characteristic of mature acid generation conditions. The rate of sulfate and metal loading from the Sulphur Gulch hydrothermal scar is not anticipated to increase unless additional disturbance occurs in the scar.

3.4.2.3 Underground Mine

The flow of water discharged from the seepage collection system in Capulin Canyon to Goathill Gulch, as measured by Molycorp, varies between 25 and 75 gpm (during snowmelt) and averages approximately 35 gpm. Vail (1993) estimates that the seepage and runoff rates from Goathill Canyon are slightly greater than the borehole discharge. Therefore, caved area inflows to the new underground mine average approximately 70 gpm. Based on historic dewatering rates of 225 and 30 gpm, respectively, in the new and old underground mine workings, the total inflow to the underground mine is estimated to be in excess of 300 gpm. A significant portion of the inflow to the new mine is poor quality mine waste and hydrothermal scar impacted drainage with low pH and high concentrations of aluminum, iron, manganese, zinc, sulfate and fluoride.

Despite the high inflow rate of poor quality drainage, the mine water pumped from the decline exhibits near neutral pH conditions and contains relatively low concentrations of dissolved metals. Therefore, the mine wall rock, and the rubble in the caved area, provide a source of alkalinity that maintains mine water quality through buffering and subsequent precipitation of metals. The extent of the source of alkalinity in mine and caved area wall rocks, and the potential for future and continued maintenance of mine water quality are unknown at present. The potential exists for concentrations of sulfate and metals in the mine water to increase in the future, when the available alkalinity is exhausted.

3.4.3 Future Mine Waste Drainage Water Quality

The quality of the drainage from the "old" acid generating rock in Capulin Canyon is currently the most representative indication of the quality of drainage from similar acid generating sources in the future. The reasons to support this assumption include:

- The Capulin waste rock disposal area was developed early in the life of open pit mine. Molycorp aerial photographs indicate that the waste rock disposal areas in Capulin and Goathill Gulches were already well developed in 1969. The materials placed therein have been exposed to oxidizing conditions for in excess of 25 years.

- The majority of static tests conducted on the mixed volcanic rocks derived from the Sulphur Gulch scar area, such as those placed in the Capulin waste rock disposal area, indicate that much of the neutralization potential of this material has been consumed. Therefore, the pH of the drainage is not anticipated to decrease significantly and the material is oxidizing and generating acid at a rate that is uncontrolled by factors other than the availability of air and water that is required to sustain oxidation and acid generation.

- The means of flushing of oxidation reaction products and dissolved metals from the waste rock to the receiving environment has been established over a period of 25 years. The waste rock disposal area is considered to be in equilibrium with respect to the flux of oxygen and water that sustains oxidation and transports oxidation reaction products from the waste rock. Given the length of time that ARD has occurred in Capulin Canyon, it is anticipated that the neutralizing potential and attenuation capacity of the migration pathways are fully consumed.

- Static tests and field observations indicate that the mixed volcanic waste rock contains sufficient acid producing potential to continue oxidation and acid generation for an indefinite period of time, therefore, the acid generating process is unhindered by lack of oxidizable materials.

Drainage from the Capulin waste rock disposal area, as measured in October 1994, contains 12,700 mg/l sulfate, 39.5 mg/l fluoride, 1,300 mg/l total aluminum, 848 mg/l total iron, 787 mg/l total manganese, 132 mg/l total zinc 13.9 mg/l total copper and 445 mg/l total calcium. Constituents in concentrations of up to a few milligrams per litre include cadmium, cobalt and chromium. The drainage pH in October 1994 was 2.58.

The sulfate and metal concentrations measured by SRK in October 1994 are representative of near base flow conditions. The sulfate and metal concentrations can be expected to increase if any remaining neutralizing potential is consumed, or the waste material is disturbed to alter the flow paths within the waste. The flux of metals and sulfate from the waste rock disposal area would increase following the spring thaw when the waste rock disposal area experiences flushing.

3.4.4 Quality of Springs and Seeps Discharging to the Red River

The quality of springs and seeps currently discharging to the Red River adjacent to the mine area indicates impact from sources that potentially include drainage from mine waste and hydrothermal scar sources. The seeps at Capulin Canyon appear to be impacted by historic hydrothermal drainage as well as mine waste drainage that occurred prior to the construction of the seepage collection system in upper Capulin Canyon in 1992.

At present, the relative contributions of natural hydrothermal scar and mine waste drainage sources in other seeps and springs located between the mouths of Capulin Canyon and Sulphur Gulch are unknown. Spring and seep water quality does not exhibit a signature that could be positively assigned to either source.

Field and static tests conducted on the mixed volcanic waste rock placed in the Middle, Sugar Shack South and Spring and Sulphur Gulch waste rock disposal areas indicate that acid generation is occurring and shake flask testing indicates that these materials contain leachable aluminum, copper, iron, manganese and zinc. Over time, ongoing acid generation in the waste rock disposal areas adjacent to the Red River, and the consumption of the neutralizing potential of the waste rock, and consumption of the remaining attenuation capacity in the alluvium in seepage flow paths has the potential to increase sulfate and metal loads in local springs and seeps. Seepage of water impacted by the hydrothermal scars that underlie the waste rock disposal areas will likely continue.

4.0 SUMMARY AND CONCLUSIONS

4.1 Geochemical Properties

4.1.1 Hydrothermal Scars

Samples of hydrothermal scar material collected in and adjacent to the mine site are indicated by static testing to possess significant acid generating potential and by field testing to have acidic paste pH and high conductivity, indicative of a high soluble salt load. The hydrothermal scars produce surface runoff and drainage that is of low pH and contains elevated concentrations of sulfate, fluoride, aluminum, copper, iron, manganese and zinc. Metals that occur in the drainage and runoff from hydrothermal scars include cadmium, cobalt chromium and nickel. Shake flask extraction tests indicate a similar suite of leachable metals exists in hydrothermal scar solid samples.

4.1.2 Mine Waste Materials

4.1.2.1 Waste Rock

4.1.2.1.1 Mixed Volcanic Waste Rock

The waste rock in the various waste rock dumps exhibit variable geochemical properties that are related to waste rock type and source.

Field and static testing indicates acid generating potential, and current acid generation in mixed volcanic waste rock excavated from the area of the Sulphur Gulch hydrothermal scar zone during open pit mining operations. This material was located in the western portion of the pit and remains exposed in the west pit wall. The mixed volcanic waste rock forms the majority of the waste rock placed in the waste rock disposal areas located north, west and south of the open pit.

The mixed volcanic waste rock exhibits drainage chemistry and leachable metals content that are similar in composition to that of the hydrothermal scars. As the mixed volcanic waste rock and hydrothermal scars were subjected to similar geologic processes, the similarity in geochemical properties are anticipated.

The concentration of sulfate and copper, manganese and zinc in drainage derived from the mixed volcanic waste rock is, on average, somewhat elevated with respect to the drainage from hydrothermal scars. This is a result of the high degree of disturbance associated with blasting, excavation and disposal of waste rock that results in favorable conditions for oxidation and ARD generation.

4.1.2.1.2 Black Andesite and Aplite/Granite Waste Rock

Black andesite and aplite/granite form the remainder of the waste rock produced during open pit mining operations. These materials were derived from the south and east sides of the open pit where hydrothermal scar has not been developed. These materials were placed as an armoring cover on the Sugar Shack South, Middle and Spring and Sulphur Gulch waste rock disposal areas. Portions of this material were placed with mixed volcanic waste rock in the in-pit waste rock disposal areas and these materials appear to be the only waste rock type placed in Spring Gulch, and the eastern portion of the Spring and Sulphur Gulch waste rock disposal areas.

Field paste tests indicate that these materials do not nowgenerate acid and static tests indicate they have a low potential to develop acidic conditions. In addition, field tests showed low paste TDS content in black andesite and aplite/granite waste rock. Therefore, these materials have limited potential for leaching of sulfate and metals.

4.1.2.1.3 Other Mine Waste

Other mine waste materials include development rock from the old and new underground mine workings, mine site fill materials, and relic tailings from the old underground mining operation.

Field and static testing of development rock from the old and new underground workings indicates low potential for acid generation. Field tests indicate low paste TDS content and limited potential for leaching of metals and sulfate.

The new mine site area was developed by cut and fill methods. The exposed cut slopes in the mine site indicate that a portion of the fill was derived from areas affected by hydrothermal scar development. Based on field tests, portions of the fill currently exhibit acid generating behaviour and the potential for leaching of metals and sulfate.

The relic tailings from the old underground mining operation were placed at the site of the existing mill. A portion of the relic tailings were used to regrade the mill site prior to facility construction. Field and laboratory testing of relic tailings indicates current acid generating behaviour and the potential for leaching of metals and sulfate.

4.2 Sources of Sulfate and Metals Loads to the Red River

4.2.1 Hydrothermal Scars

The hydrothermal scars in the region represent a mature source of sulfate and metals loads to surface water and groundwater. The oxidation of the scars has been occurring over geologic time and the acidity and metal attenuating capacity of the seepage and flow paths from areas of hydrothermal scar to the river are depleted. The scars are highly erodible. Therefore, the potential for oxidation in hydrothermal scar areas remains relatively constant as surficial materials are removed by erosion, and underlying, unoxidized materials are exposed to oxidizing conditions. The rate of sulfate and metal loading from hydrothermal scars is influenced only by short and

NON-ACID WRDs

long term changes in climatic conditions that control the rates of erosion and the quantity of runoff and seepage from hydrothermal scar areas.

Outside the mine area, hydrothermal scars continue to contribute sulfate and metal loads to the Red River as they have over geologic time. Within the mine area, the majority of seepage and runoff from areas affected by hydrothermal alteration is collected in the underground mine. The scar impacted drainage and runoff collected in the underground mine is now being pumped to the tailings impoundment west of the town of Questa to dewater the underground mine. Therefore, the seepage and runoff from scar areas collected in the mine has no impact on the quality of water in the Red River.

In the mine area, drainage from several areas of hydrothermal scar are not collected in the underground mine and may still contribute to the sulfate and metals concentrations in the Red River. Hydrothermal scars occur under a cover of waste rock in the Sugar Shack South, Middle and Spring and Sulphur Gulch waste rock disposal areas. While surface runoff and sediment generation from these areas are controlled by Molycorp's surface water management facilities, the subsurface flow paths from these areas have not been substantially altered by the mining operation. Hydrothermal scars also occur adjacent to the Red River in the area between the mine site and the mouth of Capulin Canyon. The potential for the contribution of sulfate and metal loads from these sources has not been reduced or increased by the mining operation.

4.2.2 Mine Waste Materials

The drainage and runoff from waste rock placed in the in-pit waste rock disposal areas is currently collected in the open pit and drains to the new underground mine, and has no impact on the quality of water in the Red River.

At several locations, the potential for contributions of sulfate and metals from mine waste to the Red River exists.

Seepage from the Capulin waste rock disposal, together with seepage and runoff affected by hydrothermal scars located in Capulin Canyon, potentially migrates down Capulin Canyon as subsurface flow.

Subsurface seepage from the new mine site, the mill site and the Sugar Shack South, Middle and Spring and Sulphur Gulch waste rock disposal areas are currently not controlled by Molycorp's seepage collection systems. Acid generating materials in these areas have the potential to contribute sulfate and metals loads to the Red River.

In contrast to the hydrothermal scars, the mine waste at Questa represents a new source of sulfate and metal loads. Testing of the alluvial and colluvial materials located below the waste rock disposal areas adjacent to the Red River indicates a limited but measurable ability for attenuation of acidity. Therefore, contaminated mine waste drainage may still be buffered along the seepage path to the Red River and the current water quality as indicated by springs and seeps may not represent mine waste drainage quality. The location of the contaminant fronts of seepage plumes

from these areas is currently unknown. Moreover, since the chemistry of the hydrothermal scar and mine waste impacted drainage is similar in composition, the relative contributions of these sources cannot be identified.

4.3 Long Term Climatic Effects on Water Quality

As previously mentioned, the hydrothermal scars in the region represent a mature and relatively constant source of sulfate and metal loads to regional and local surface water and groundwater resources. However, these sources are influenced by climatic conditions and during extended periods of above average precipitation, loading from these sources can be anticipated to increase as a result of increased erosion, runoff and infiltration. Conversely a reduced loading is expected during periods of prolonged drought.

From 1961 to 1991, the average annual discharge at the Questa gaging station was 40.4 cfs. This period spans the life of the open pit and new underground mining operations at Questa when water was diverted for mill use. In the period between 1961 and 1978, average annual discharge at the Questa gaging station was 33.1 cfs while from 1978 to 1993, the average annual discharge was 52.2 cfs. These large changes in average flow rates are expected to have associated substantial erosion and seepage from scar material, resulting in large natural fluctuations in the mean annual contaminant loading to the Red River.

Because of the change in climatic conditions the "background" water quality data from 1965 may not be representative of that for 1993. Indeed it may be anticipated that the average natural contaminant loads to the Red River in the first half of the 1990's would be substantially greater than the average loading experienced in the first half of the 1960's.

5.0 RECOMMENDATIONS FOR NEXT PHASE OF INVESTIGATION AND CHARACTERIZATION

5.1 Requirements for Additional Investigation and Characterization

This initial mine waste rock investigation and characterization has served to identify the current and potential sources of the contaminant drainage to the Red River. It has been established that contaminant sources exist both as exposed sulfitic rocks in the waste rock dumps and open pit. This investigation focused mainly on the identification and qualitative characterization of these sources and the contaminant migratory routes to the Red River. A relatively good understanding of the qualitative characteristics has been developed for:

- The locations from which contaminated drainage is originating for both natural and mine induced drainage;
- the current quality of the pore water in these sources;
- the lithological and geochemical characteristics of the rock from which the contaminants originate;
- the surface flow and seepage pathways along which the contaminated drainage migrates;
- the physical and geochemical controls along the migratory routes; and
- the quality of surface and ground water discharges to the Red River and the contaminant loads in the Red River.

In the next phase, investigation of mine waste rock should attempt to extend this qualitative understanding to be more quantitative in regard to the characterization of the rock contaminant flow paths, and to both current and long term contaminant load generation and migration. Aspects to be investigated and characterized may be divided into four groups:

i) The definition of the quantities, and distribution of ARD characteristics of waste rock in the various dumps and portions of dumps, construction embankments and rock cuts on the mine disturbed site. This investigation should extend the current surficial survey to define conditions at depth within the deposits. This quantification and extension will be based on a detailed review of the mine plans and dump development records, additional surficial surveying and limited drilling to determine the rock characteristics at depth.

ii) The definition of the conditions other than rock characteristics controlling acid generation in the waste piles. This includes determining water and oxygen entry and distribution, and temperature conditions in the waste rock piles.

An understanding of the oxygen distribution in the piles indicates the zones where acid generation is occurring or is inhibited. It provides an understanding of the likely long term conditions which will control acid generation both without and with the addition of oxygen entry control measures such as covers.

Moisture content distributions are needed to understand the field capacity of the waste rock and the time required for dumps to become wetted to the extent that they yield seepage, as well as the factors controlling seepage in the piles.

Temperature profiles indicate where exothermic acid generation reactions are occurring, the temperature controls on bacterial oxidation in the dumps and the thermal convective forces that draw oxygen into the dumps (an important mechanism in the high rock dumps at Questa).

The data required for this characterization is obtained from a combination of drilling, sampling and testing, and drill hole instrumentation and monitoring.

iii) The kinetic behaviour of the various waste rock types. Quantification of the rates of oxidation and the definition of precise evolutionary stages of ARD development allows a better interpretation of the field observations and the modelling of long term behaviour of dumps under both controlled (remediated) and uncontrolled (no remediation) conditions. This requires laboratory kinetic testing of selected representative samples as well as a correlation between laboratory observed behaviour and field observed conditions.

iv) The detailed contaminant yield behaviour and load balance from a natural scar affected area such as the Hansen Creek drainage. Detailed characterization of the scars as well as the rest of the drainage basin, together with detailed monitoring of the contaminant load yielded to the Red River by both surface and ground water pathways will allow the natural loading from hydrothermally altered areas to be quantified and modelled. These results could then be extended to the modelling and estimation of natural (or pre-mining) contaminant load yield from the mine disturbed areas.

The recommended investigation and characterization studies appropriate for the next stage of waste rock characterization at the Questa mine are described in the following sub-sections.

5.2 Waste Rock Quantifications and Characterization

Spring Gulch Waste Rock

Based on surface exposures, the majority of waste rock placed in the Spring Gulch waste rock disposal area appears to be black andesite and aplite with low ARD potential. Thus, no ARD mitigation measures should be required in this area. This potential should be verified based on detailed rock characterization from surface surveys, mine waste rock records and, if necessary drilling to verify the nature of underlying deposits waste rock.

MINE Water of
MINE

FIGURE 3.2

Other Waste Rock Dumps

Detailed zones of different rock characteristics should be established from a detailed review of mine and waste rock development, together with more detailed surface surveys, and limited drilling and sampling in areas where uncertainty as to underlying rock types exist.

Drilling is best performed by a Becker Hammer type drill which uses air as the drilling fluid (avoiding the flushing out of oxidation products) and which minimizes the rock breakage (hence the exposure of fresh alkali which changes the geochemical characteristics of the sample). The one limitation of this type of drilling is that the depths of penetration may be limited to 100 to 150 ft.

Drilling should be extended into the underlying scar zones where possible to allow characterization of the underlying scar materials and conditions.

Samples should be selected from representative rock types and subject to the same range of static evaluation tests as were performed for this initial characterization study. Additional sampling and testing should be performed to define the geotechnical properties of the rock waste such as; grain size distribution, slaking characteristics, shear strength, field moisture content, infiltration and permeability characteristics. These properties will be required for the evaluation of long term behaviour, with and without ARD remediation.

5.3 Quantification and Characterization of ARD Conditions

The conditions which control oxidation and ARD migration in the waste dumps can only be investigated by drilling, instrumentation and monitoring. The drill holes used for such determinations can be combined with those used in 5.2 above. The instrumented holes would be located such as to determine the distribution of the ARD control conditions in a few select dump zones (two or three locations with 2 to 3 holes each).

During drilling of the holes, samples of waste rock will be taken to investigate current oxidation, acid product storage and moisture migration variation with depth. The holes would be instrumented with a water sampling standpipe at its base and strings of thermistors and pore gas sampling tubes. The pore gas sampling tubes will allow the determination of oxygen and carbon dioxide concentrations in the pore gas, and thus the oxidation conditions along the profile of the drill hole.

5.4 Characterization and Modelling of ARD Kinetics

ARD kinetics for the various rock types will be determined by NAG (net acid generation) and humidity column tests. The number of such columns will be limited since much kinetic behaviour and data can be deducted from the field observations.

The data from both this task and previous task will be used to develop a conceptual model of dump behaviour which can be used for long term prediction of ARD evolution from dumps under

both controlled and uncontrolled (remediated and unremediated) conditions. This will allow the cost effectiveness of any feasible remediation options to be evaluated and compared.

5.5 Quantification and Characterization of Natural ARD Contaminant Generation

Characterization of Hansen Creek drainage

A detailed geochemical survey should be made of the entire Hansen Creek drainage using the same techniques as for this study. In addition, regular sampling should be made of the surface drainage flows within the drainage and of discharges to Red River to characterize both its contaminant concentrations and flow quantity throughout the year. An estimate should be made of groundwater flow contribution seasonally. Based on these results, a model of the contaminant loads and drainage from the Hansen Creek drainage area can be developed.

The effect of seasonal and long term weather effects, mainly precipitation, erosion and weathering/oxidation rates must be considered in the extension of this model to described seasonal and long term contaminant yields.

Mine Site Area Characterization

The same characterization should be made of the undisturbed areas of the mine site. The pre-mining conditions should be estimated in order to develop a pre-mine characterization of all the individual drainages which are impacted by the mine site. Based on these results, models of contaminant loads and drainage from the individual drainages can be developed. These individual models can be calibrated against the results of the Hansen Creek model. These can then be combined to represent the interaction that has resulted from the mine development. This will allow the modelling and contaminant load estimation of the "natural components" of contamination flow in the current site water contaminant balance. This model would then be used to estimate the reduction in "natural contaminant load" resulting from the mine water control measures. Comparison of the current contaminant loads and the estimated pre-mining of remediation to be evaluated.

6.0 REFERENCES

British Columbia AMD Task Force, 1989. Draft Acid Rock Drainage Technical Guide, Vol. 1, Crown Publications, Victoria, B.C.

Lipman, Peter W., 1981, "Volcano Tectonic Setting of Tertiary Ore Deposits, Southern Rocky Mountains", in Arizona Geological Digest Volume XIV, Dickenson and Payne Eds.

Schilling, John H., 1956, Geology of the Questa Molybdenum Mine Area, Taos County, New Mexico, New Mexico Institute of Mining and Technology, State Bureau of Mines and Mineral Resources, Bulletin 51.

Sobek, A.A., Schiller, W.A., Freeman, J.R., and Smith, R.M., 1978. Field and Laboratory Methods Applicable to Overburden and Mine Soils. Report EPA-600/Z-78-054 Cinncinnati, Ohio - U.S. Environmental Protection Agency.

South Pass Resources Inc., 1994, Assessment of Site Located Near Questa, New Mexico.

Vail Engineering Inc., 1993, Interim Study of the Acidic Drainage to the Middle Red River, Taos County New Mexico.

TABLES

TABLE 1.1
Summary of Waste Rock Quantities by Location

Waste Disposal Area	Waste Rock Quantity (tons x 1,000,000)
Blind Gulch (in-pit)	36
Spring Gulch	31
Spring and Sulphur Gulch	80
Middle	46
Sugar Shack South	53
Sugar Shack West	31
Capulin	26
Goathill	16
Goathill South	9
Total	328

TABLE 1.2
Summary of 1994 Water Quality Data Collected from Seeps and Streams around the Questa Mine

	Background* (N=1)	Undisturbed Scar Material ** (N=8)				Disturbed Scar Material*** (N=9)			
		Mean	Median	Minimum	Maximum	Mean	Median	Minimum	Maximum
pH	6.9	2.774	2.725	2.33	3.2	3.09	3.12	2.58	3.63
Conductivity (μmhos)	409	3996	3865	1350	6830	5038	3390	1600	12300
Acidity (mg $CaCO_3$ eq./L)	14.2	2517	1933	326	5350	3432	856	435	12200
Alkalinity (mg $CaCO_3$ eq./L)	41	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
SO_4 (mg/L)	140	3018	2360	735	5900	4395	2500	976	12700
Al (mg/L)	18	229.6	173.8	50.3	582	471	138	6.37	1850
Cd (mg/L)	<0.01	0.026	0.01	<0.01	0.092	0.14	0.021	0.01	0.585
Co (mg/L)	0.018	0.484	0.234	0.04	1.63	1.238	0.511	0.187	4.45
Cr (mg/L)	<0.015	0.077	0.0585	<0.015	0.218	0.162	0.067	<0.015	0.495
Cu (mg/L)	0.094	2.191	1.23	0.022	7.25	3.89	2.31	0.19	13.9
Fe (mg/L)	17.2	316.7	183.5	6.83	890	230	59	3.66	848
Mo (mg/L)	<0.03	0.036	0.03	<0.03	0.079	0.099	0.03	<0.03	0.615
Mn (mg/L)	3.62	31.21	18.85	2.33	87.4	210	59.6	4.7	787
Ni (mg/L)	0.042	1.196	0.5395	0.107	4.08	2.54	0.97	0.369	9.43
Pb (mg/L)	0.146	0.104	0.05	<0.05	0.437	0.184	0.05	<0.05	1.04
Zn (mg/L)	0.527	7.177	4.59	0.498	20.6	36	8.01	1.86	132

Notes: All metal concentrations are total; dissolved concentrations are listed in Table C2, Appendix C. N = Number of Samples

*Sample: WS-Cap2

**Samples: WS-GC3, WS-GC4, WS-GC5, WS-GC6, WS-HC1, WS-HC2, WS-Pit2, WS-Cap4

***Samples: WS-1, WS-2, WS-Cap1, WS-Cap3, WS-GC1, WS-GC2, WS-SS1, WS-SS2, WS-Pit1

* Comparison of WRD To Scar Leachate

TABLE 1.3
Questa Molybdenum Mine and Regional Area
Representative Water Quality Data

Sample Location	Date	pH	TDS (mg/L)	SO_4 (mg/L)	Al (mg/L)	Cd (mg/L)	Cu (mg/L)	F (mg/L)	Fe (Mg/L)	Mn (Mg/L)	Pb (mg/L)	Zn (mg/L)
Hansen Creek	5/10/94	3.5	2620	1544	52	0.015	0.15	0.94	11.1	7.5	ND	2.3
Haut N Taut Creek	5/17/94	3.6	864	286	11.5	ND	0.5	1.4	9.3	3.7	ND	0.8
Seep Near Ranger Station	5/4/93	4.0	4316	1800	226	0.017	1.6	2.3	ND	124	ND	19.5

ND = No Data

TABLE 1.4
Selected Water Quality Monitoring Data

	Date	pH	TDS (mg/L)	SO_4 (mg/L)	Al (mg/L)	Cd (mg/L)	Cu (mg/L)	F (mg/L)	Fe (mg/L)	Mn (mg/L)	Zn (mg/L)
Mine Area Springs and Seeps at Red River											
Spring below Capulin Canyon	10/93	ND	2700	1021	157	0.082	1.8	4.26	10.3	55	13.4
Spring below Capulin Canyon	2/11/94	3.4	2206	1276	43	0.016	1.17	5	35.9	15.2	4.4
Culvert east of Goathill Gulch (Hwy 38)	8/28/93	3.3	1850	740		0.033	3.9	ND	1.5	36.4	8.8
Portal Spring No. 1 (near 7960 Adit)	2/11/94	7.5	362	181	1.80*	0.019	0.015	1	0.42	0.15	0.119
Portal Spring No. 2 (near 7960 Adit)	2/11/94	4.8	1434	788	19.4	0.016	0.27	11.4	0.315	10.6	2
Portal Spring No. 2a (near 7960 Adit)	2/11/94	4.9	956	634	10.9	0.019	0.35	10	2.4	4.7	1.3
Cabin Spring No. 3	9/17/92	5.1	1826	913	22.1	0.01	0.43	15.5	0.24	16.7	2.5
Cabin Spring No. 3	2/11/94	5.2	1950	978	30.4	0.019	0.405	14	0.063	18.1	3.5
Portal Spring Culvert	2/11/94	4.9	1450	551	22.4	0.016	0.45	14	2.8	4.7	2.3
Sulphur Gulch	2/11/94	6.0	540	260	8.8	ND	0.075	2.1	2	0.54	0.518
Mine Workings Water Quality											
7100 Level (old mine)	2/20/91	7.1	3100	1800	ND	ND	0.03	5.8	0.9	5	1.1
Decline Station 1000	2/20/91	6.0	3928	2123	ND	0.08	0.03	23.7	0.81	43.6	25.6
Underground Mine (old?)	2/20/91	7.9	2600	1650	ND	ND	0.03	3.7	0.1	1.97	0.15
7960 Portal	2/20/91	7.4	891	592	ND	ND	0.03	2.4	0.1	0.36	0.58
7960 Adit	9/17/92	6.8	2100	ND	1	ND	ND	ND	1	2.9	0.5
Decline	5/2/93	7.5	2468	1004	1	ND	ND	7.1	ND	1.2	2.8
Decline Station 1150	7/29/94	7.6	2578	1382	ND	0.019	ND	ND	ND	13.2	2.9
Decline Station 2500	7/29/94	7.4	2752	1500	ND	ND	0.01	ND	0.156	0.42	2.3
No. 1 Shaft (New Mine Deep)	1/21/94	7.7	3386	1480	ND	0.01	0.02	13.1	ND	15.5	0.3
No. 1 Shaft (Shallow?)	4/23/93	6.9	3072	1455	ND	ND	ND	8.8	0.3	8.6	1.3

TABLE 1.4
Selected Water Quality Monitoring Data (continued)

	Date	pH	TDS (mg/L)	SO_4 (mg/L)	Al (mg/L)	Cd (mg/L)	Cu (mg/L)	F (mg/L)	Fe (mg/L)	Mn (mg/L)	Zn (mg/L)
Water Supply Wells											
Cabin Well (private)	9/94	6.1	742	276	ND	0.008	ND	ND	6.5	1.2	3
Molycorp Cabin Well	9/94	7.6	160	24	ND	ND	ND	ND	0.18	ND	0.1
No. 1 Columbine Well	7/25/94	5.4	1450	756	5.5	0.013	0.083	ND	0.554	1.8	2.8
No. 1 Mill Well	7/25/94	6.6	204	104	ND	ND	ND	ND	0.138	0.05	0.035
Monitor Wells (Partial Data Set)											
MMW-2, Capulin Canyon Valley Fill	8/11/94	4.9	3400	2100	63.5	0.024	0.088	24	50.8	52.1	9.48
MMW-3, Capulin Canyon Bedrock	7/11/94	7.5	2800	1700	0.63	0.0024	ND	2.59	0.076	34.5	1.36
MMW-7, Shaft No. 1 Area Bedrock	7/11/94	4.4	16000	10400	943	0.096	4.84	1.12	384	72.1	11.7
MMW-8a, East of Sewage Pond Bedrock	8/11/94	7.0	2200	1300	ND	ND	ND	2.72	2.54	7.15	ND
MMW-8b, East of Sewage Pond Valley Fill	8/11/94	6.4	1100	730	0.44	ND	ND	1.83	ND	0.202	0.211
MMW-10a, Sugar Shack South Valley Fill	8/11/94	5.8	1700	1100	33.4	0.028	0.558	11.2	ND	13.1	2.29
MMW-10b, Sugar Shack South Bedrock	7/11/94	7.9	1800	1100	8.74	0.025	0.179	12.2	0.101	8.55	1.5
MMW-10c, Sugar Shack South Valley Fill	8/11/94	4.7	1400	880	31.1	0.026	0.38	15.4	ND	16.3	3.2
MMW-11, Sugar Shack South Bedrock	7/11/94	5.6	2000	1300	56.3	0.036	0.919	17.6	0.129	31.7	5
MMW-13, Middle Dump	8/11/94	7.9	1400	700	ND	ND	ND	1.67	0.198	1.02	0.222

ND = no data
* Suspended Al

TABLE 1.5
Upper Red River Water Quality Survey - November 10, 1993

ID No.	STATION	pH	TDS mg/L	TSS mg/L	SO_4 mg/L	$CaCo_3$ mg/L	Al mg/L	Al (Dissolved) mg/L	Cu mg/L	F mg/L	Fe mg/L	Mn mg/L	Mo mg/L	Pb mg/L	Zn mg/L
5	Elephant Rock Campground	7.50	1	70	67	0.305	<0.5	<0.5	0.015	0.01	0.943	0.144	<0.1	<0.1	0.058
6	Below Hansen Creek	7.46	164	7	71	63	0.65	<0.5	0.023	0.3	1.02	0.164	<0.1	<0.1	0.052
6A	Hansen Creek		102	0	2964	0.895	0.7	1904	0.139	0.024	26	9.1	<0.1	26	2.6
7	Above Mill	7.50	198	2	80	66	1.1	1.2	0.026	0.368	0.78	0.237	<0.1	<0.1	0.1
8	Below Sulphur Gulch	7.64	188	3	79	52	1.3	1.4	0.02	0.425	0.531	0.172	<0.1	<0.1	0.085
8A	Above Portal	7.75	198	2	83	64	1.3	1.6	0.02	0.435	0.534	0.19	<0.1	<0.1	0.09
9	Columbine Creek	7.84	60	4	2	71	<0.5	<0.5	0.06	0.222	0.211	0.011	<0.1	<0.1	0.024
10	Above Columbine Creek	7.80	228	7	84	52	1.4	2	0.027	0.569	0.575	0.256	<0.1	<0.1	0.099
10A	Company Cabins	7.30	226	7	77	61	0.61	1.8	0.022	0.817	0.453	0.504	<0.1	<0.1	0.149
11	Below Columbine Creek	7.18	218	8	86	53	1.7	1.8	0.033	0.804	0.665	0.693	<0.1	<0.1	0.18
11A	Thunder Bridge	7.42	256	7	117	58	1.7	1.6	0.037	0.859	1.01	0.511	<0.1	<0.1	0.174
11B	Above Thunder Bridge	7.62	276	13	105	64	1.7	1.6	0.032	0.866	0.6	0.509	<0.1	<0.1	0.139
12	Goat Hill Campground	7.69	270	8	128	59	1.5	1.4	0.073	0.855	2.04	0.442	<0.1	<0.1	0.147
13	Above Capulin	7.89	238	9	128	52	1.5	1.6	0.06	1	1.34	0.527	<0.1	<0.1	0.15
14	Below Capulin	7.77	244	14	133	48	2.4	2.6	0.236	1.01	7.2	0.752	<0.1	<0.1	0.202

Note: Metals are in total concentrations, except where noted.

TABLE 1.6
Estimated Contaminant Loading
Questa Mine Area
Undifferentiated with Respect to the Mine Area Source
Based on November 1993 Survey (Vail Eng.)

		Station 7 Above Mill	South Area	Station 14 Below Capulin	Mine Area Contribution	Loading Rate KG/Day Mine	Loading Rate KG/Day Above Station 7	Loading Rate KG/Day Below Station 14	Loading Rate KG/Day South of River
DISCHARGE	(CFS)	14.32	10.88	26.86	1.66	-	-	-	-
Sulfate	(Mg/l)	80	2	133	1448.81	5885.08	2803.28	8741.61	53.90
TDS	(Mg/l)	188	60	244	1933.06	7685.13	6587.72	16037.25	1616.99
Floride	(Mg/l)	0.425	0.222	1.01	11.22	45.58	14.89	66.38	5.98
Al (susp)	(Mg/l)	1.1	0.025	2.4	29.18	118.53	38.55	157.74	0.67
Al (dis)	(Mg/l)	1.2	0.025	2.6	31.55	128.17	42.05	170.89	0.67
Mn (tot)	(Mg/l)	0.237	0.011	0.752	10.05	40.83	8.30	49.43	0.30
Fe (tot)	(Mg/l)	0.78	0.211	7.2	108.39	440.28	27.33	473.23	5.69
Cu (tot)	(Mg/l)	0.26	0.06	0.236	1.18	4.80	9.11	15.51	1.62
Zn (tot)	(Mg/l)	0.1	0.024	0.202	2.25	9.13	3.50	13.28	0.65

Station 7 and 4 contained Water Quality data from November 1993 Survey by Vail
Quality of Water from South of Red River Assumed to be Similar to Columbine Creek
Columbine Water Quality from November 1993 Survey by Vail
Mine Area Seep and Spring Contribution Assumed to be 1.66 after SPRI (1994) Estimate
Aluminum Concentration in Columbine Creek = 1/2 detection limit

TABLE 1.7
Comparison of 1965 and 1993 Red River Water Quality

Location	Source	Sulfate (MG/L)	Alkalinity (MG/L)	TDS (MG/L)	TSS (MG/L)	pH (MG/L)	Fe (MG/L)	Zn (MG/L)
Above Red River	HEW 11/65*	5	78.5	133	8	7.7	<0.02	<0.1
	Vail 11/93**	12	85	80	1	7.5	0.763	0.027
Below Red River	HEW 11/65	20	71	138	8	7.4	<0.02	<0.1
	Vail 11/93	41	75	124	3	7.5	0.885	0.061
Below Hansen Creek	HEW 11/65	47	62	165	8	7.4	<0.02	<0.1
	Vail 11/93	71	63	164	7	7.46	1.02	0.052
Goat Hill Campground	HEW 11/65	51	60	172	8	7.4	<0.02	<0.1
	Vail 11/93	128	59	220	8	7.69	2.04	0.147
Ranger Station	HEW 11/65	64	56	188	8	7.56	<0.02	<0.1
	Vail 11/93	129	43	262	16	7.27	0.03	0.255

* Hew (1965); exact location of HEW samples unknown.

** Vail (1993); metals are total. Nearest Vail 1993 sampling point to HEW samples is shown.

TABLE 2.1

Summary of Discharge Records at the Questa Gaging Station in CFS

Year/Discharge	Year/Discharge	Year/Discharge	Year/Discharge
1961/44.8	1969/40.5	1977/13.4	1985/72.3
1962/47.8	1970/34.9	1978/25.7	1986/61.4
1963/19.7	1971/11.8	1979/87.6	1988/35.1
1964/24.4	1972/15.8	1980/47.0	1989/41.1
1965/60.6	1973/51.7	1981/14.0	1990/35.3
1966/39.6	1974/19.1	1982/39.4	1991/57.7
1967/40.5	1975/41.7	1983/71.0	1992/52.3
1968/34.9	1976/32.6	1984/48.6	1993/67.6

TABLE 2.2
Summary of Mean Monthly Discharge at the Questa Gaging Station in CFS

Month	Mean	Maximum	Minimum
October	22.6	38.1	7.93
November	16.2	32.8	8.09
December	11.2	24.1	3.58
January	11.2	23.4	3.91
February	11.8	22.8	4.81
March	14.7	40.0	5.11
April	36.5	84.1	9.73
May	113	267	17.5
June	134	405	22.7
August	39.4	70.6	11.8
September	28.6	62.2	88.1

TABLE 3.1
Hydrothermal Scars — Summary of ICP Data

SAMPLE ID	MATERIAL	LOCATION	Al %	As mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe %	Mn mg/L	Mo mg/L	Ni mg/L	Pb mg/L	Zn mg/L
15	In Situ Rock	Goathill	0.25	1	2	68	18	2.17	196	7	10	38	38
36	Disturbed Rock	Pit	0.6	1	6	115	417	3.1	772	25	28	56	57
HC2	In Situ Rock	Hansen Creek	0.43	1	ND	34	16	ND	139	9	18	97	28
27	Wall Rock	Pit	0.78	1	8	99	73	4.03	330	22	38	49	39
MEAN			0.52	1	5.3	79	131	3.1	359	15.8	23.5	60	40.5
MEDIAN			0.52	1	5	51	45.5	3.1	167.5	15.5	23	43.5	33
MINIMUM			0.25	1	2	34	16	2.17	139	7	10	38	28
MAXIMUM			0.78	1	8	115	417	4.03	772	25	38	97	57
N			4	4	3	4	4	3	4	4	4	4	4

TABLE 3.2
Hydrothermal Scars — ABA Data

SAMPLE ID	MATERIAL	LOCATION	FIELD pH	FIELD TDS	S(T) %	$S(SO_4)$ %	SULFIDE %	AP	NP	NNP	NP/AP
35	Scar Above Pit	Sulphur Gulch	3.2	>2000	3.56	3.12	0.44	13.75	0.00	-13.75	0.00
HC2	Scar Material	Hansen Creek	2.1	1920	3.64	3.48	0.16	5.00	0.00	-5.00	0.00

TABLE 3.3
Hydrothermal Scars — Shake Flask Data

SAMPLE ID	MATERIAL TYPE	LOCATION	SO_4 mg/L	Al mg/L	Cu mg/L	Co mg/L	Cr mg/L	F mg/L	Fe mg/L	Mo mg/L	Mn mg/L	Ni mg/L	Pb mg/L	Zn mg/L
15	Hydrothermal Scar	Goat Hill Canyon	415	39.9	0.47	0.146	<0.015	NA	2.69	<0.030	20.5	0.336	<0.050	0.134
35	Scar Above Pit	Sulphur Gulch	2080	59.2	0.759	0.191	0.054	7.02	5.6	<0.030	1.53	0.414	<0.050	<0.005
71	In Situ Rock/Scar	Capulin Canyon	4450	771	16.4	0.078	0.037	NA	5.69	<0.030	2.81	0.24	0.216	0.188
80	Scar North of Office	Goat Hill Canyon	1930	84.1	5.93	0.19	<0.015	1.36	4.39	<0.030	6.66	0.443	<0.050	0.399
HC1	Scar Material	Hansen Creek	1970	21.3	0.151	0.027	<0.015	NA	0.055	<0.030	0.68	0.074	<0.050	0.113
HC2	Scar Material	Hansen Creek	1780	35.8	0.315	0.056	<0.015	NA	12.7	<0.030	1.21	0.093	<0.050	0.399
HC3	Scar Material	Hansen Creek	18.6	0.33	0.022	<0.015	<0.015	NA	<0.030	<0.030	0.032	<0.020	<0.050	0.021
		MEAN	1806	144.5	3.44	0.1	0.024	4.19	4.45	<0.03	4.77	0.23	0.07	0.18
		MEDIAN	1930	39.9	0.47	0.078	<0.015	4.19	4.39	<0.03	1.53	0.24	0.05	0.134
		MINIMUM	18.6	.33	0.02	<.015	<0.015	1.36	<0.30	<0.030	0.03	<0.020	<0.050	<0.005
		MAXIMUM	4450	771	16.4	0.191	0.054	7.02	12.7	<0.03	20.5	0.44	0.2	0.40
		N	7	7	7	7	7	2	7	7	7	7	7	7

NA = Not Analyzed

TABLE 3.4
Waste Rock/Tailings - ICP Data

SAMPLE ID	ROCK TYPE	LOCATION	Al %	Cr mg/L	Cu mg/L	Fe %	Mn mg/L	Mo mg/L	Ni mg/L	Pb mg/L	Zn mg/L
26	Aplite	Sugar Shack South	0.5	145	81	1.99	633	109	26	97	570
30	Aplite	Pit	0.17	1725	68	0.88	313	147	7	16	17
37	Granite	Spring Gulch	0.85	174	234	3.22	832	448	61	37	47
43	Aplite	Spring Gulch	0.17	145	38	0.77	113	9	6	12	12
46	Granite	Blind Gulch	0.32	64	74	11	404	80	15	27	37
		Mean	0.40	451	99	3.57	459	159	23	38	137
6	Black Andesite	Spring/Sulphur Gulch	0.97	157	202	3.36	1054	306	60	83	141
40	Black Andesite	Blind Gulch	0.59	105	113	2.03	653	105	34	27	42
		Mean	78	131	158	2.70	854	206	47	55	92
1	Mixed Volcs	Middle Dump	0.69	95	136	3.13	871	15	34	72	100
24	Mixed Volcs	Capulin	0.41	51	20	2.07	307	16	19	118	79
35	Mixed Volcs	Sulphur Gulch	0.62	147	44	3.33	88	7	26	24	13
41	Mixed Volcs	Blind Gulch	0.94	48	79	3.63	299	191	29	43	20
78	Mixed Volcs	Goathill	0.5	137	72	2.37	635	416	31	54	75
57	Mixed Volcs	Middle Dump	0.59	64	49	2.77	413	71	27	70	53
59	Mixed Volcs	Sugar Shack South	0.77	133	42	3.05	448	55	33	96	59
84	Mixed Volcs	Mine Site	0.92	113	56	3.54	471	16	51	34	76
		Mean	0.68	99	62	2.99	442	98	31	64	59
9	Tailings	Mill Site	0.8	98	156	2.49	2286	1334	20	187	584
85	Tailings	Mill Site	5.3	206	97	2.78	398	1279	14	171	158
		Mean	3.1	152	127	2.64	1342	1307	17	179	371

TABLE 3.5
Waste Rock/Tailings - ABA Data

SAMPLE ID	MATERIAL TYPE	ROCK TYPE	LOCATION	FIELD pH	FIELD TDS*	S(T) %	$S(SO_4)$ %	SULFIDE %	AP	NP	NNP	NP/AP
26	Waste Rock	Aplite	Sugar Shack South Dump	6.96	140	0.20	0.14	0.06	1.88	36.30	34.43	19.36
30	Waste Rock	Aplite	Pit	7	140	0.61	0.37	0.24	7.50	19.35	11.85	2.58
37	Waste Rock	Granite	Spring & Sulphur Gulch Dump	6	120	1.75	1.14	0.61	19.06	33.60	14.54	1.76
46	Waste Rock	Granite	Blind Gulch Dump	>6.00	40	0.39	0.14	0.25	7.81	22.60	14.79	2.89
53	Waste Rock	Aplite	Spring Gulch Dump	>6.30	530	0.44	0.29	0.15	4.69	32.35	27.66	6.90
54	Waste Rock	Aplite	Spring & Sulphur Gulch Dump	>6.00	260	0.52	0.24	0.28	8.75	38.83	30.08	4.44
56	Dev'mt Rock	Aplite	Old Mine Site	>6.10	210	1.23	0.94	0.29	9.06	24.88	15.82	2.75
			Mean	6.337	205.7	0.73	0.466	0.2686	8.393	29.7	21.31	3.54
6	Waste Rock	Blk Andesite	Spring & Sulphur Gulch Dump	>6.00	ND	1.88	1.20	0.68	21.25	37.53	16.28	1.77
29	Pit Waste Rock	Blk Andesite	Pit	6.81	200	1.88	1.31	0.57	17.81	36.85	19.04	2.07
32	Waste Rock	Blk Andesite	Pit	>6.30	200	1.16	0.88	0.28	8.75	36.58	27.83	4.18
40	Waste Rock	Blk Andesite	Blind Gulch Dump	6.5	120	0.67	0.46	0.21	6.56	32.80	26.24	5.00
47	Waste Rock	Blk Andesite	Spring Gulch Dump	>7.10	30	0.44	0.32	0.12	3.75	47.68	43.93	12.71
51	Waste Rock	Blk Andesite	Spring & Sulphur Gulch Dump	>6.10	590	1.45	1.19	0.26	8.13	35.25	27.13	4.34
52	Waste Rock	Blk Andesite	Spring Gulch Dump	>6.00	360	1.41	1.12	0.29	9.06	35.80	26.74	3.95
			Mean	6.401	250	1.27	0.926	0.3443	10.76	37.5	26.74	3.49

TABLE 3.5
Waste Rock/Tailings - ABA Data (continued)

SAMPLE ID	MATERIAL TYPE	ROCK TYPE	LOCATION	FIELD pH	FIELD TDS*	S(T) %	$S(SO_4)$ %	SULFIDE %	AP	NP	NNP	NP/AP
1	Waste Rock	Mixed Volcanics	Middle Dump	2.98	1830	1.43	0.93	0.50	15.63	13.68	-1.95	0.88
7	Waste Rock	Mixed Volcanics	Spring & Sulphur Gulch Dump	>6.00	ND	0.38	0.29	0.09	2.81	27.08	24.27	9.63
11	Waste Rock	Mixed Volcanics	Capulin Dump	5	70	1.72	1.19	0.53	16.56	16.23	-0.33	0.98
24	Waste Rock	Mixed Volcanics	Capulin Dump	3.6	>2000	2.87	2.03	0.84	26.25	0.00	-26.25	0.00
25	Waste Rock	Mixed Volcanics	Goat Hill Dump	4.1	670	0.67	0.47	0.20	6.25	0.00	-6.25	0.00
27	Wall Rock/scar	Mixed Volcanics	Pit	4.3	810	1.83	1.17	0.66	20.63	0.00	-20.63	0.00
36	Scar Rubble	Mixed Volcanics	Pit	2.83	>2000	2.58	2.09	0.49	15.31	0.00	-15.31	0.00
41	Waste Rock	Mixed Volcanics	Blind Gulch Dump	2.97	1480	3.38	2.25	1.13	35.31	7.53	-27.78	0.21
57	Waste Rock	Mixed Volcanics	Middle Dump	>6.10	30	1.66	1.54	0.12	3.75	6.58	2.83	1.75
59	Waste Rock	Mixed Volcanics	Sugar South Shack Dump	2.68	1380	1.66	1.32	0.34	10.63	6.35	-4.28	0.60
60	Waste Rock	Mixed Volcanics	Spring & Sulphur Gulch Dump	3.18	770	1.32	1.12	0.20	6.25	4.63	-1.62	0.74
61	Waste Rock	Mixed Volcanics	Spring Gulch Dump	2.7	1090	2.70	1.92	0.78	24.38	3.45	-20.93	0.14
>65	Waste Rock	Mixed Volcanics	Sugar Shack West Dump	2.64	1820	2.68	2.08	0.60	18.75	3.21	-15.54	0.17
67	Waste Rock	Mixed Volcanics	Sugar Shack West Dump	4.13	>2000	2.01	1.77	0.24	7.50	13.74	6.24	1.83
78	Dev'mt Rock	Mixed Volcanics	New Mine Site	>6.00	810	0.55	0.35	0.20	6.25	27.47	21.22	4.40
			Mean	3.919	1197	1.8	1.443	0.3543	11.07	9.347	-1.724	0.844
9	Tailings	Tailings	Mill Site	3.25	>2000	3.04	2.58	0.46	14.38	0.00	-14.38	0.00
85	Foundation fill	Tailings (regraded)	Mill Site	3.41	1560	2.25	2.22	0.03	0.94	0.27	-0.67	0.29
84	Fill material	Fill	New Mine Site	2.79	>2000	2.41	2.13	0.28	8.75	0.00	-8.75	0.00

TABLE 3.5
Waste Rock/Tailings - ABA Data (continued)

SAMPLE ID	MATERIAL TYPE	ROCK TYPE	LOCATION	FIELD pH	FIELD TDS*	S(T) %	$S(SO_4)$ %	SULFIDE %	AP	NP	NNP	NP/AP
			Mean	3.15	4520	2.57	2.31	0.26	8.02	0.09	-7.93	0.01

ND = No Data

TABLE 3.6
Waste Rock/Tailings - Summary of Shake Flask Data

SAMPLE ID	ROCK TYPE	LOCATION	SO_4 mg/L	Al mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	Mn mg/L	Mo mg/L	Ni mg/L	Pb mg/L	Zn mg/L
26	Aplite & Andesite	Sugar Shack South Dump	-	<0.200	<0.010	<0.015	<0.010	<0.030	0.032	0.473	<0.020	<0.050	0.052
24	Black Andesite	Spring & Sulphur Gulch Dump	2830	76.90	0.192	<0.015	0.472	221	8.12	<0.030	0.468	<0.050	1.34
27	Black Andesite	Middle Dump	417	7.20	0.049	<0.015	0.323	0.223	0.825	<0.030	0.073	<0.050	0.12
78	Black Andesite	In-Pit Dump	-	<0.200	<0.015	<0.015	<0.010	<0.030	0.02	2.78	<0.020	<0.050	0.01
		Mean	1624	28.1	0.085	<0.015	0.268	73.8	2.99	0.95	0.187	<0.05	0.49
1	Mixed Volcanics	Middle Dump	-	4.59	0.043	<0.015	0.506	0.053	3.44	<0.030	0.051	<0.050	0.323
2	Mixed Volcanics	Middle Dump	1640	26.80	0.05	<0.015	0.534	6.05	1.19	<0.030	0.078	<0.050	0.225
9	Mixed Volcanics	Spring & Sulphur Gulch Dump	3940	297.00	0.682	0.16	10.9	203	517	<0.060	0.712	0.24	81
36	Mixed Volcanics	Middle Dump	1830	126.00	0.487	0.118	5.54	30.3	38.7	<0.030	0.854	<0.050	6.39
41	Mixed Volcanics	Middle Dump	798	15.50	0.091	0.015	0.618	21.6	1.31	<0.030	0.165	<0.050	0.134
42	Mixed Volcanics	Capulin Dump	1770	36.40	0.072	0.025	1.6	5.4	1.97	<0.030	0.13	<0.050	0.442
52	Mixed Volcanics	Blind Gulch Dump	896	<0.020	<0.015	<0.015	<0.010	<0.030	0.062	1.87	<0.020	<0.050	<0.005
59	Mixed Volcanics	Sulphur Gulch Dump	1270	84.50	0.481	0.063	1.48	11.2	5.58	<0.030	0.521	<0.050	2.34
60	Mixed Volcanics	Sulphur Gulch Dump	1300	20.40	0.052	<0.015	0.645	0.693	0.775	<0.030	0.101	<0.050	0.204
61	Mixed Volcanics	Sugar Shack South Dump	697	14.30	0.068	0.017	0.644	9.09	20.9	<0.030	0.122	<0.050	0.091
84	Mixed Volcanics	Pit/Wall Rock	3360	361.00	1.01	0.08	1.62	2.78	11.4	<0.030	2.32	<0.050	1.82
85	Mixed Volcanics	Sulphur Gulch Dump	1590	14.00	0.087	<0.015	1.61	0.187	8.21	1.18	0.099	<0.050	8.03
57	Mixed Volcanics	Middle Dump	-	133.00	0.709	0.104	2.03	17	8.38	<0.030	0.79	<0.050	3.26

TABLE 3.6
Waste Rock/Tailings - Summary of Shake Flask Data (continued)

SAMPLE ID	ROCK TYPE	LOCATION	SO_4 mg/L	Al mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	Mn mg/L	Mo mg/L	Ni mg/L	Pb mg/L	Zn mg/L
29	Mixed Volcanics	Pit	68.10	<0.200	<0.015	<0.015	<0.010	<0.030	0.006	0.872	<0.020	<0.050	0.009
51	Mixed Volcanics	Spring & Sulphur Gulch Dump	754	<0.200	<0.015	<0.015	0.01	<0.030	0.029	0.954	<0.050	<0.050	0.014
		Mean	1532	75.6	0.258	0.046	1.85	20.5	41.3	0.349	0.402	0.063	6.95

TABLE 3.7

Outside Mine Distubed Areas - Field Test Results

SAMPLE ID	MATERIAL	LOCATION	PASTE PH	PASTE TDS
10	Alluvium	Capulin Canyon at Red River	3.6	320
73	Alluvium/Mudflow	Capulin Canyon above Red River	3.72	220
70	Colluvium/Soil	Lower Capulin Canyon	3.68	80
68	Andesite from Undisturbed Area	Capulin Canyon	6.23	200
14	Soil	Capulin Canyon	6.1	100
22	Rhyolite Outcrop	Capulin Canyon	5.4	210
62	Rhyolite Outcrop, Bleached	Capulin Canyon	5.2	40
13	Rhyolite Outcrop	Capulin Canyon	6.05	140
44	Rhyolite Outcrop	Spring Gulch	6.82	<10
43	Aplite Outcrop	Blind Gulch	6.42	30
HC4	Soil/Subcrop	Hansen Creek	6.1	100
HC5	In Situ Rock/Soil	Hansen Creek	3.65	1210
HC6	Alluvium/Mudflow	Hansen Creek	3.6	540
HC7	Alluvium/Mudflow	Hansen Creek	3.39	1120
91	Alluvium/Mudflow	Hansen Creek	4.1	30
90	Alluvium in Red River at Seep	Goathill at Red River	5.68	680
89	Alluvium/Mudflow	Below New Mine at Red River	>6.1	60
88	Alluvium in Red River at Seep	Below Sugar Shack South	4.29	890
87	Alluvium/Mudflow	Below Sugar Shack South	3.95	180
86	Alluvium in Red River at Seep	Sulpher Gulch at Red River	5.7	550

TABLE 3.8
Outside Mine Disturbed Areas - Summary of Shake Flask Data

SAMPLE ID	MATERIAL	LOCATION	SO_4 mg/l	Al mg/l	Co mg/l	Cr mg/l	Cu mg/l	Fe mg/l	Mn mg/l	Mo mg/l	Pb mg/l	Zn mg/l
10	Alluvium	Capulin Canyon	117	4.23	0.021	<0.015	0.121	0.113	1.690	<0.030	<0.050	0.457
14	Soil	Capulin Canyon	6.2	<0.20	<0.015	<0.015	0.051	0.119	0.022	<0.030	<0.050	0.025
43	In Situ Rock	Spring Gulch	7.3	1.04	<0.015	<0.015	0.06	0.662	0.037	<0.030	<0.050	0.052
44	In Situ Rock	Blind Gulch	5.1	<0.20	<0.015	<0.015	<0.010	0.036	0.037	<0.030	<0.050	0.06
68	Colluvium/Soil	Capulin Canyon	4.9	0.27	<0.015	<0.015	0.02	0.184	0.015	<0.030	<0.050	0.006
69	In Situ Rock	Capulin Canyon	381	19	0.249	<0.015	0.504	9.57	21.8	<0.030	<0.050	21.8
73	Alluvial Outwash/Mud Flow	Capulin Canyon	81.6	0.96	0.015	<0.015	0.036	0.064	3.15	<0.030	<0.050	0.413
86	Alluvium	Spring Gulch	93	0.27	<0.015	<0.015	0.095	0.264	0.064	<0.030	<0.050	0.091
88	Alluvium	Below Sugar Shack South	152	0.71	0.067	<0.015	0.052	<0.030	18.5	<0.030	<0.050	0.188
94	Alluvium	Mine Site	20.7	<0.20	<0.015	<0.015	0.493	0.227	0.156	<0.030	<0.050	0.046
HC4	Soil/Subcrop	Hansen Creek	13.8	<0.20	<0.015	<0.015	0.523	0.088	0.021	<0.030	<0.050	0.06
HC5	In Situ Rock	Hansen Creek	1530	7.33	0.015	<0.015	0.076	0.19	0.706	<0.030	<0.050	0.076
HC6	Alluvium/Mud Flow	Hansen Creek	654	6.38	0.035	<0.015	0.077	0.049	0.204	<0.030	<0.050	0.323

TABLE 3.8
Outside Mine Disturbed Areas - Summary of Shake Flask Data (continued)

SAMPLE ID	MATERIAL	LOCATION	SO_4 mg/l	Al mg/l	Co mg/l	Cr mg/l	Cu mg/l	Fe mg/l	Mn mg/l	Mo mg/l	Pb mg/l	Zn mg/l
HC7	Alluvium/Mud Flow	Hansen Creek	1220	16.9	0.075	<0.015	0.122	0.116	0.558	<0.030	<0.050	0.645
MEAN			306	4.14	0.042	<0.015	0.160	0.840	3.35	<0.030	<0.050	0.24
MEDIAN			87.3	0.71	<0.015	<0.015	0.077	0.1175	0.18	<0.030	<0.050	0.0835
MINIMUM			4.90	<0.20	<0.015	<0.015	<0.010	<0.030	0.02	<0.030	<0.050	0.01
MAXIMUM			1530	19.0	0.25	<0.015	0.523	9.57	21.8	<0.030	<0.050	0.90
N			14	14	14	14	14	14	14	14	14	14

TABLE 3.9
Results of Titration Testing

SAMPLE NO.	MATERIAL	INITIAL pH	VOL. TO pH 6	VOL. TO pH 5	VOL. TO pH 4	VOL. TO pH 3	VOL. TO pH 2	VOL. TO pH 1
10	Outwash	4.77	N/A	N/A	1.35	3.95	8.00	74.10
86	Alluvium	6.74	0.25	2.80	4.05	5.95	10.05	22.40
86B	Alluvium	6.65	0.20	3.50	4.25	5.15	8.95	21.45
88	Alluvium	6.57	1.10	N/A	8.05	13.10	18.10	37.30
88B	Alluvium	6.48	0.80	2.15	5.25	11.15	17.20	41.25
94	Alluvium	5.54	N/A	N/A	1.90	3.40	6.60	32.80

Notes:

Sample size = 50 g

Water added = 50 ml

H_2SO_4 = 1.0 N; 1 ml of titrant per 50 g of solids is equal to an approximate neutralization capacity of 1 kg Ca CO_3 equivalent/tonne.

N/A = not analyzed

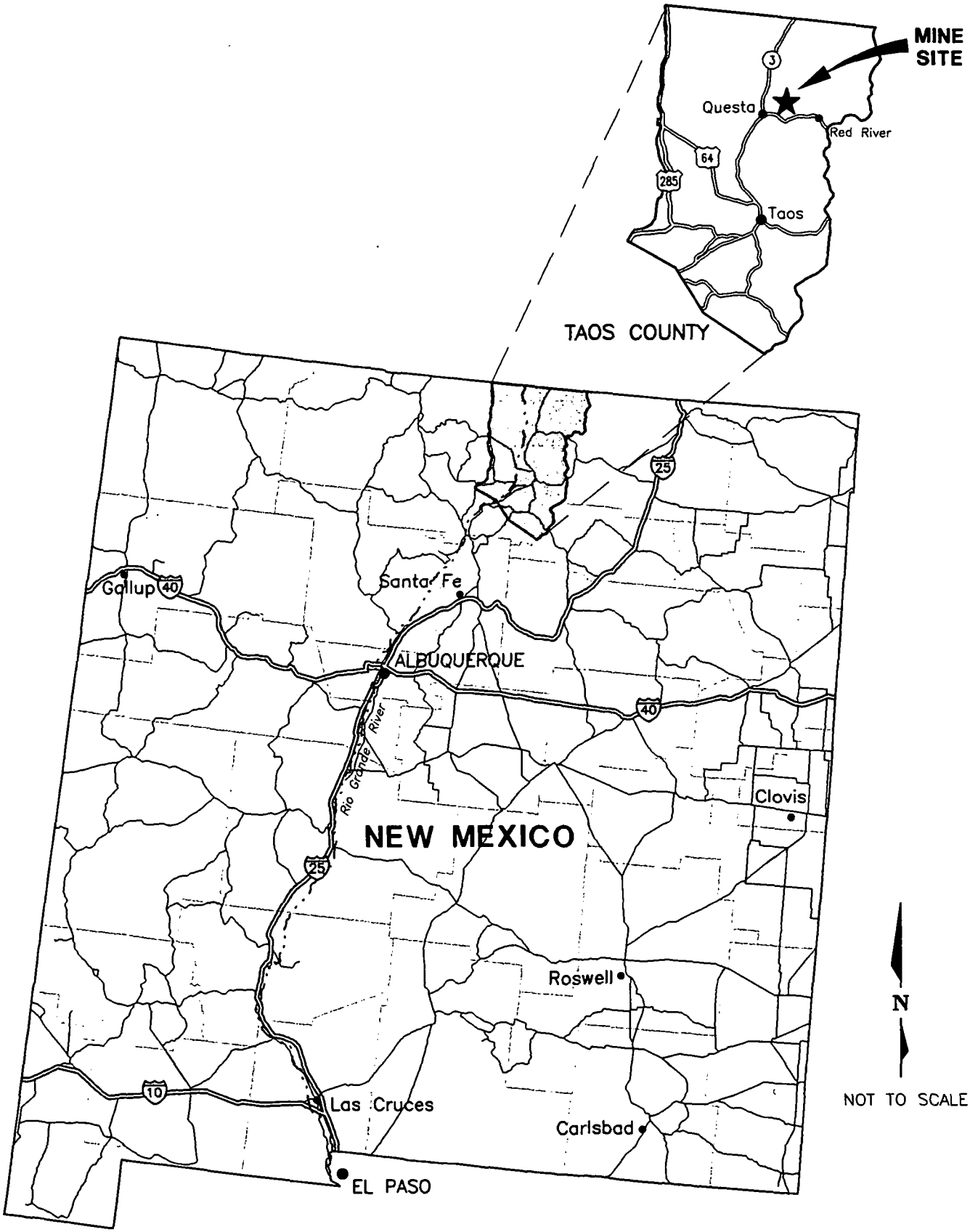

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FIGURE 1.1

LOCATION MAP

* STA.#1 * C:\MOLYCORP\09206\FIG01-1.DWG * DEC 22, 1994 * 4:01:08 PM *

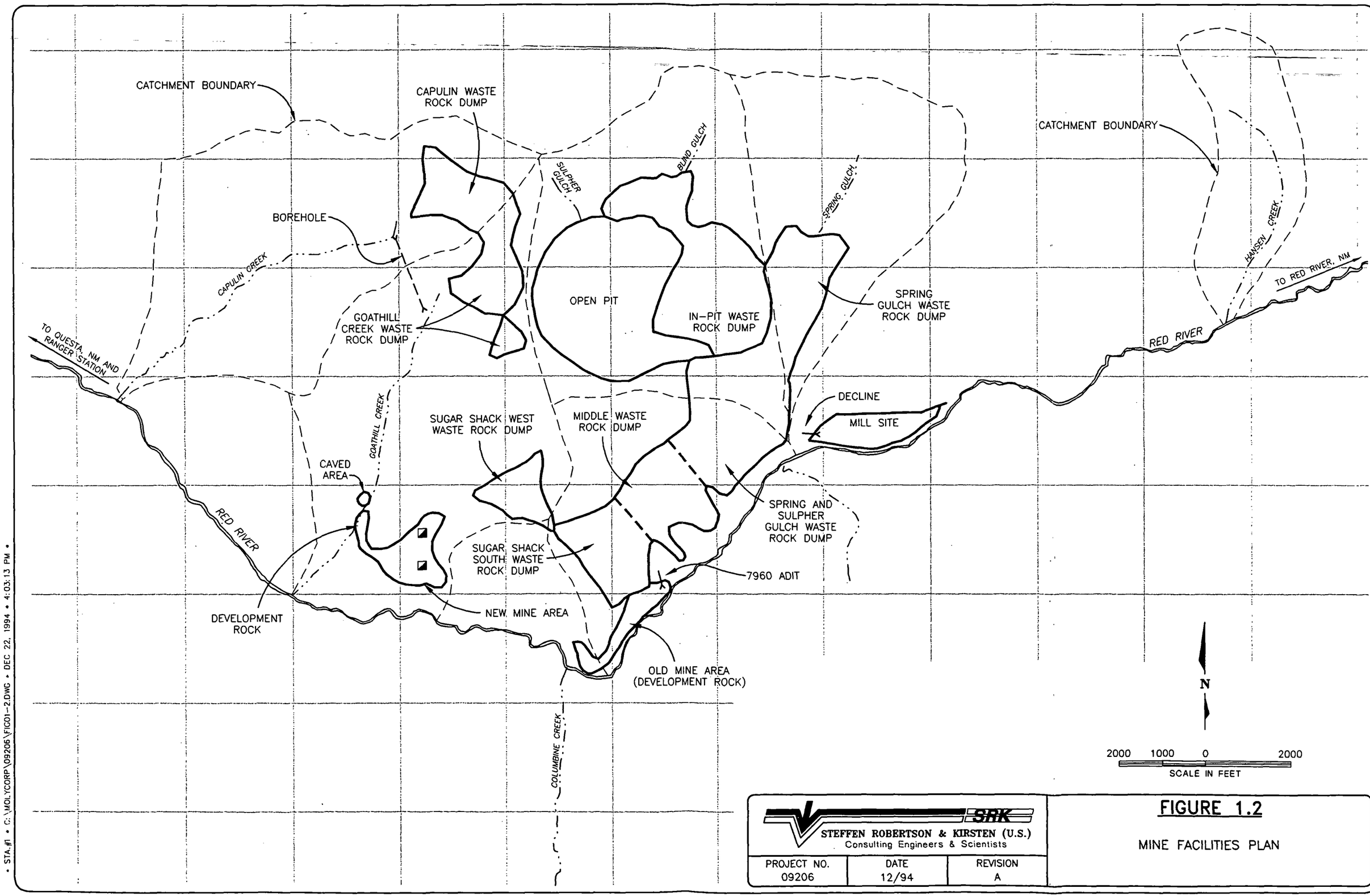

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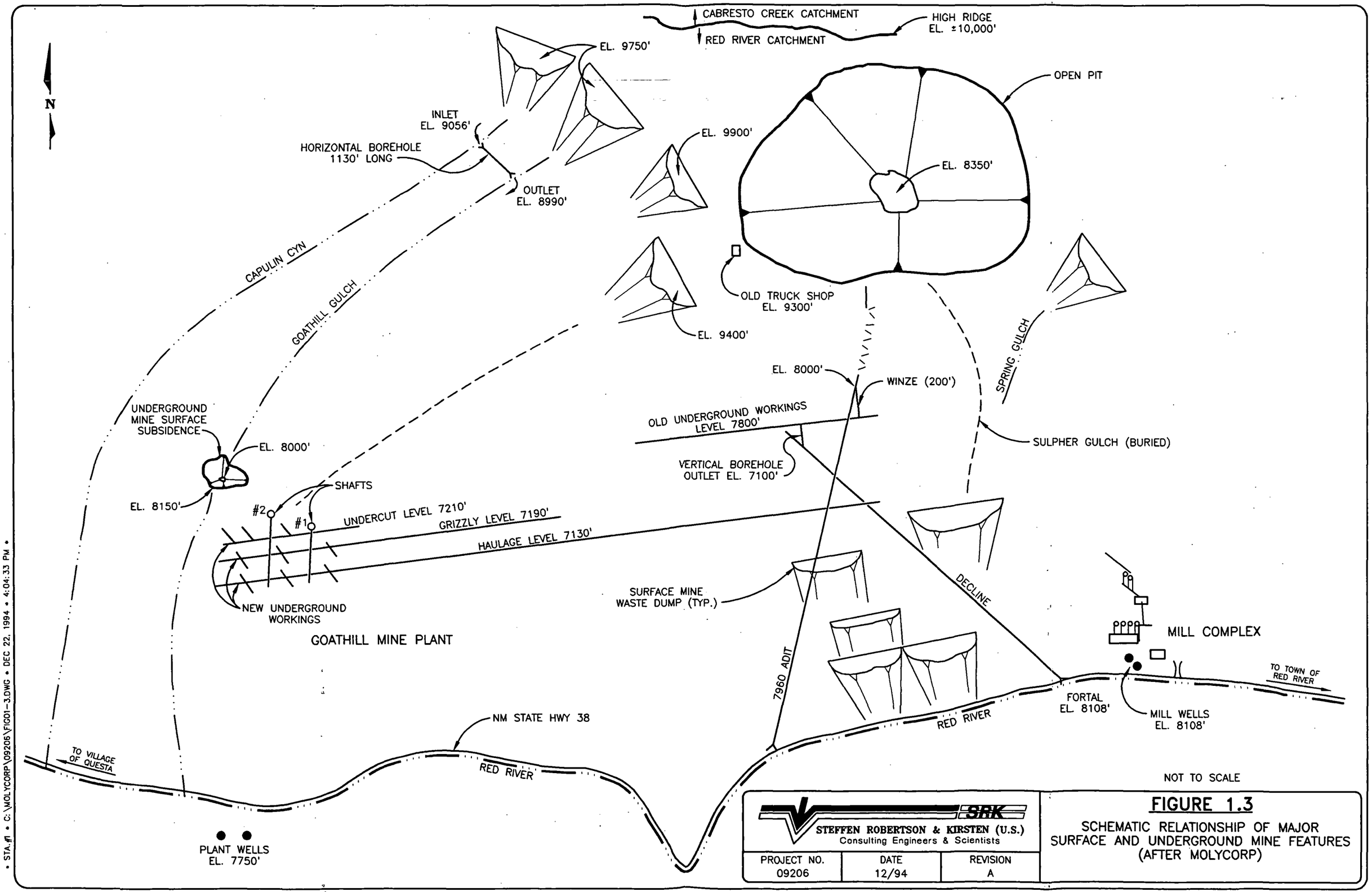
FIGURE 1.2

MINE FACILITIES PLAN

• STA.#1 • C:\MOLYCORP\09206\FIG01-2.DWG • DEC 22, 1994 • 4:03:13 PM •


N
CABRESTO CREEK CATCHMENT
RED RIVER CATCHMENT
HIGH RIDGE
EL. ±10,000'
EL. 9750'
OPEN PIT
INLET
EL. 9056'
HORIZONTAL BOREHOLE
1130' LONG
OUTLET
EL. 8990'
EL. 9900'
EL. 8350'
CAPULIN CYN
GOATHILL GULCH
OLD TRUCK SHOP
EL. 9300'
EL. 9400'
SPRING GULCH
EL. 8000'
WINZE (200')
UNDERGROUND
MINE SURFACE
SUBSIDENCE
OLD UNDERGROUND WORKINGS
LEVEL 7800'
SULPHER GULCH (BURIED)
EL. 8000'
VERTICAL BOREHOLE
OUTLET EL. 7100'
SHAFTS
EL. 8150'
#2
#1
UNDERCUT LEVEL 7210'
GRIZZLY LEVEL 7190'
HAULAGE LEVEL 7130'
SURFACE MINE
WASTE DUMP (TYP.)
DECLINE
NEW UNDERGROUND
WORKINGS
GOATHILL MINE PLANT
MILL COMPLEX
7960 ADIT
TO TOWN OF
RED RIVER
FORTAL
EL. 8108'
MILL WELLS
EL. 8108'
RED RIVER
NM STATE HWY 38
TO VILLAGE
OF QUESTA
RED RIVER
PLANT WELLS
EL. 7750'
NOT TO SCALE
SRK
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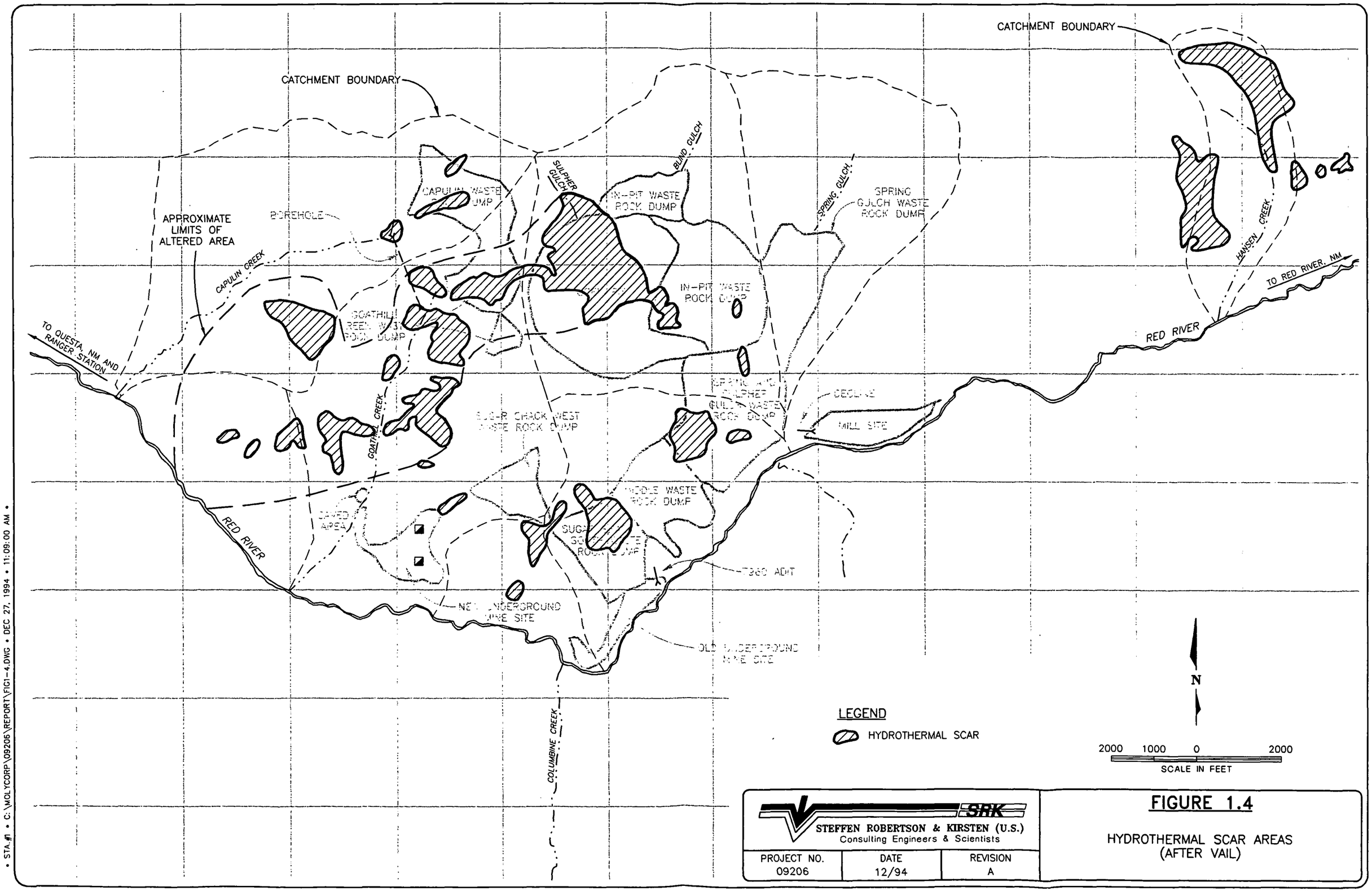
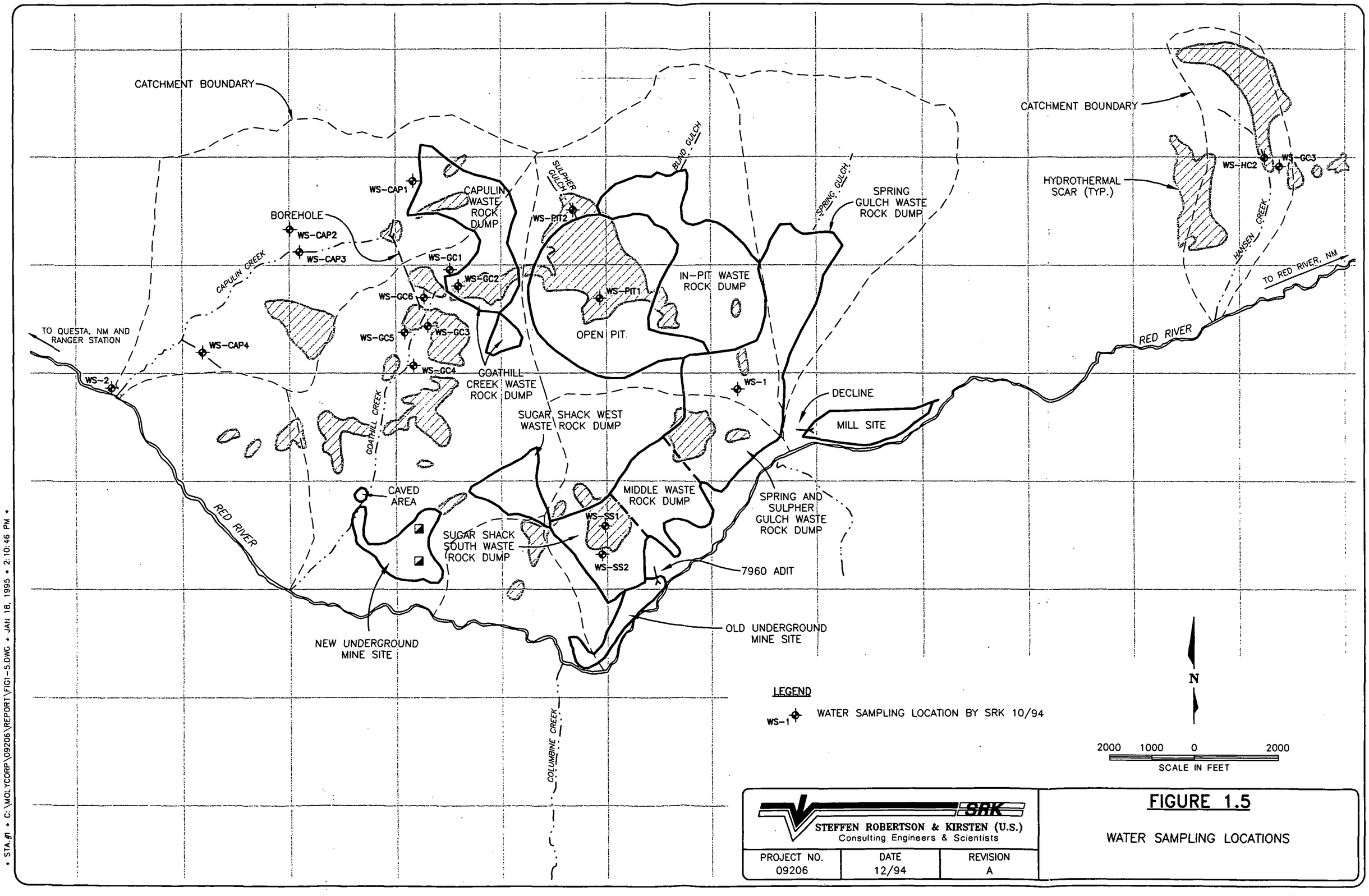
A
FIGURE 1.3
SCHEMATIC RELATIONSHIP OF MAJOR
SURFACE AND UNDERGROUND MINE FEATURES
(AFTER MOLYCORP)
• STA. #1 • C:\MOLYCORP\09206\FIG01-3.DWG • DEC 22, 1994 • 4:04:33 PM •



• STA.#1 • C:\MOLYCORP\09206\REPORT\FIG1-4.DWG • DEC 27, 1994 • 11:09:00 AM •



SRK
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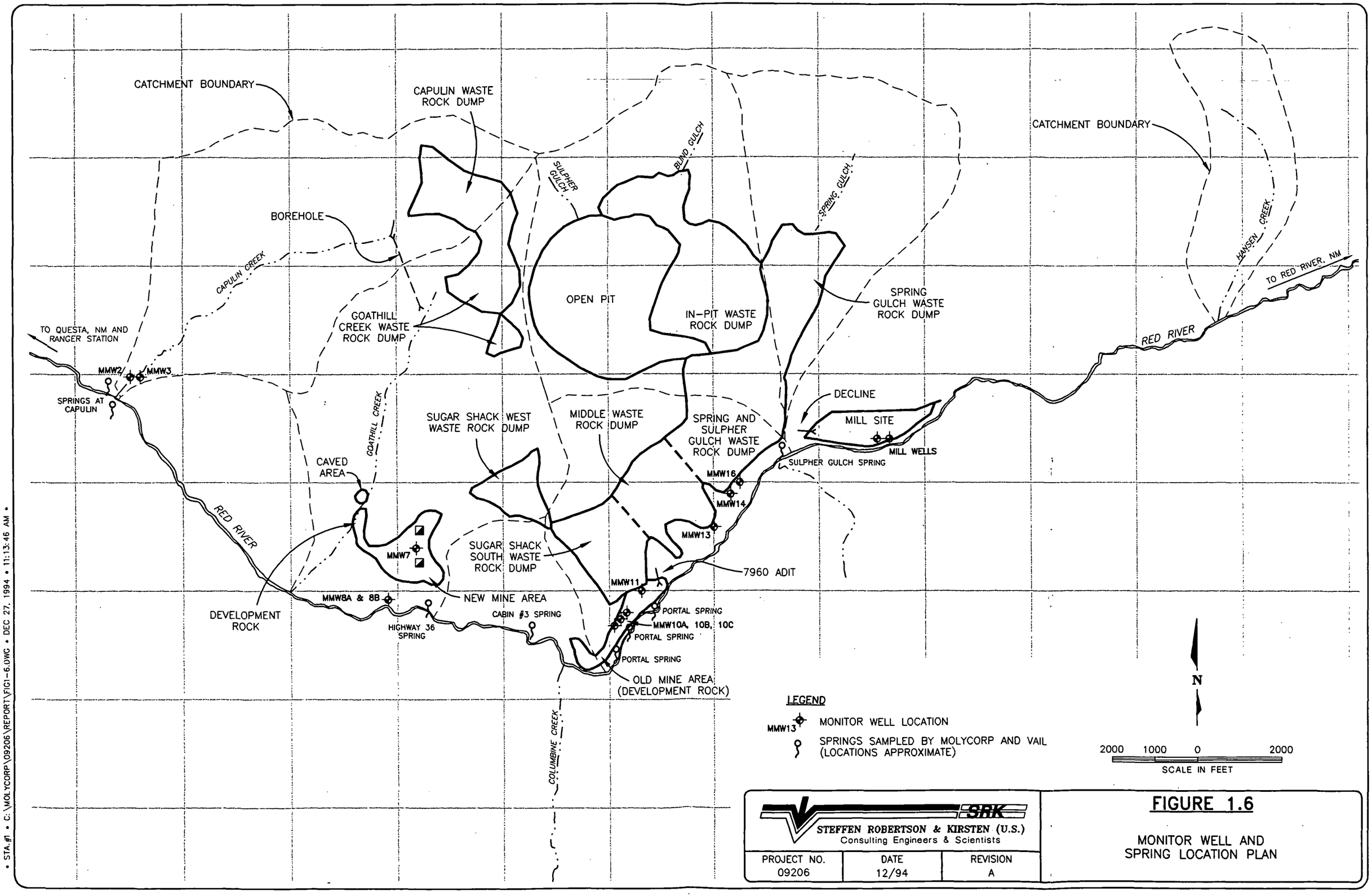
FIGURE 1.5

WATER SAMPLING LOCATIONS

• STA.#1 • C:\MOLYCORP\09206\REPORT\FIG1-5.DWG • JAN 18, 1995 • 2:10:46 PM •



• STA.#1 • C:\MOLYCORP\09206\REPORT\FIG1-6.DWG • DEC 27, 1994 • 11:13:46 AM •

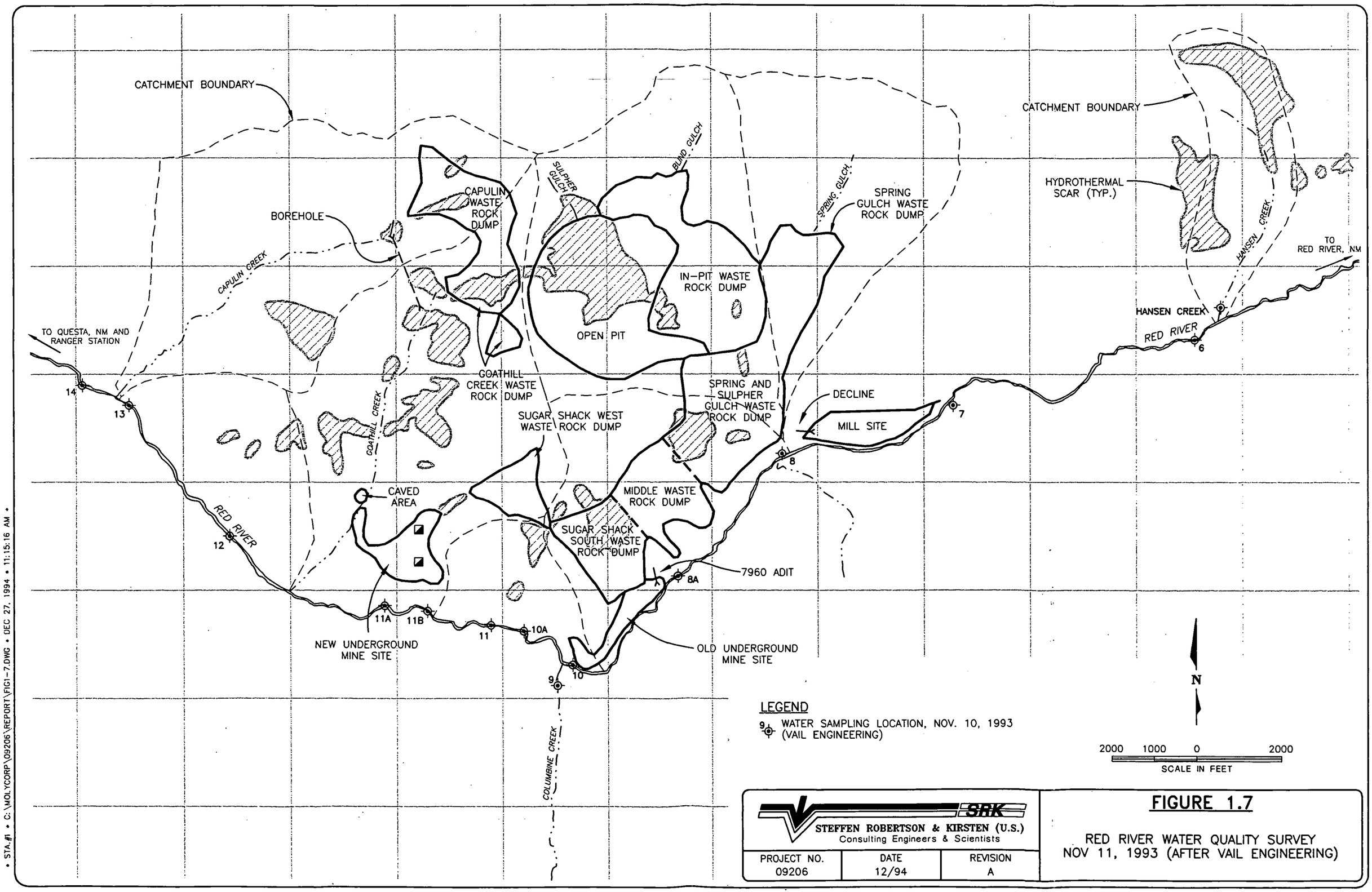


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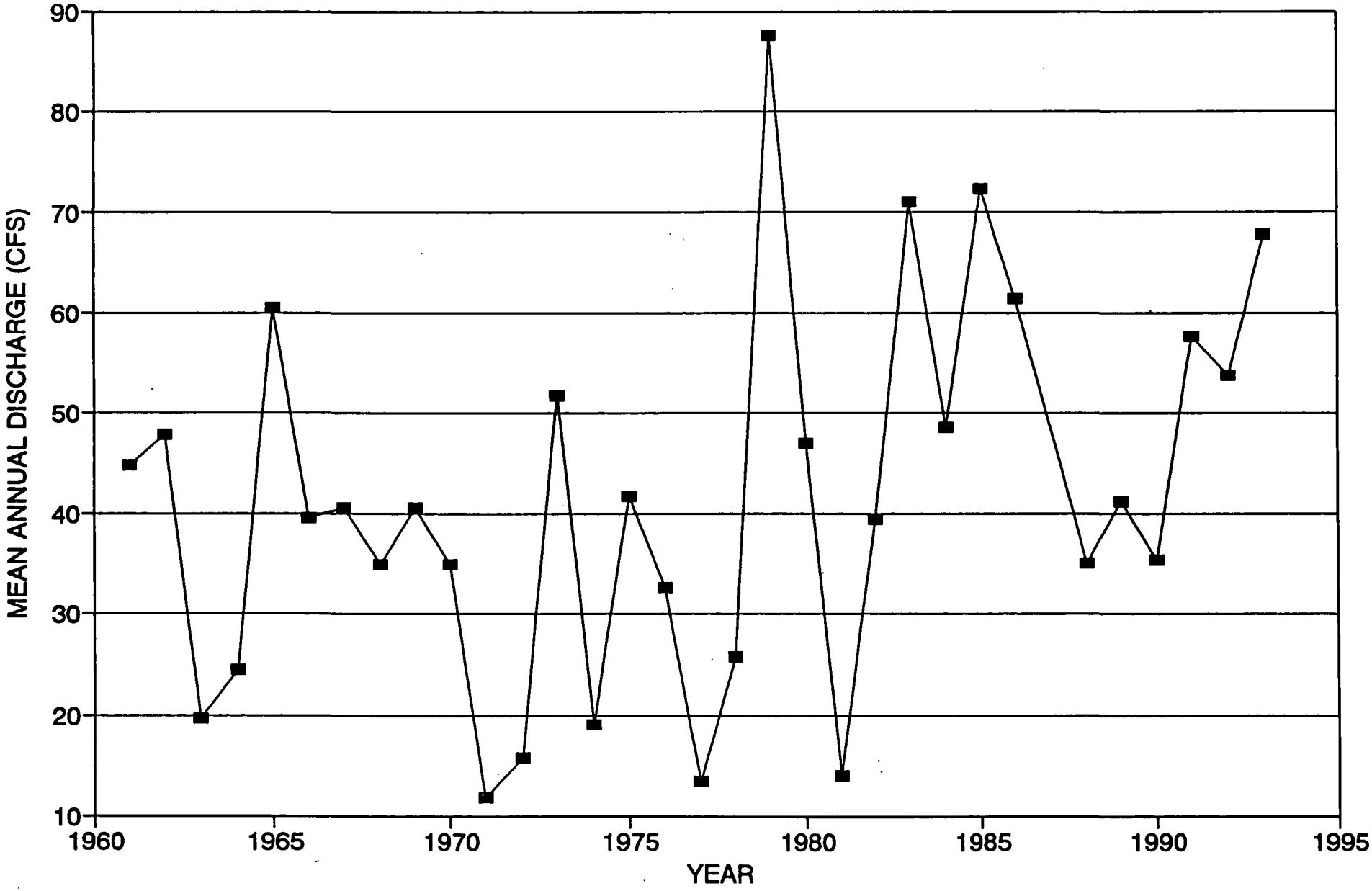
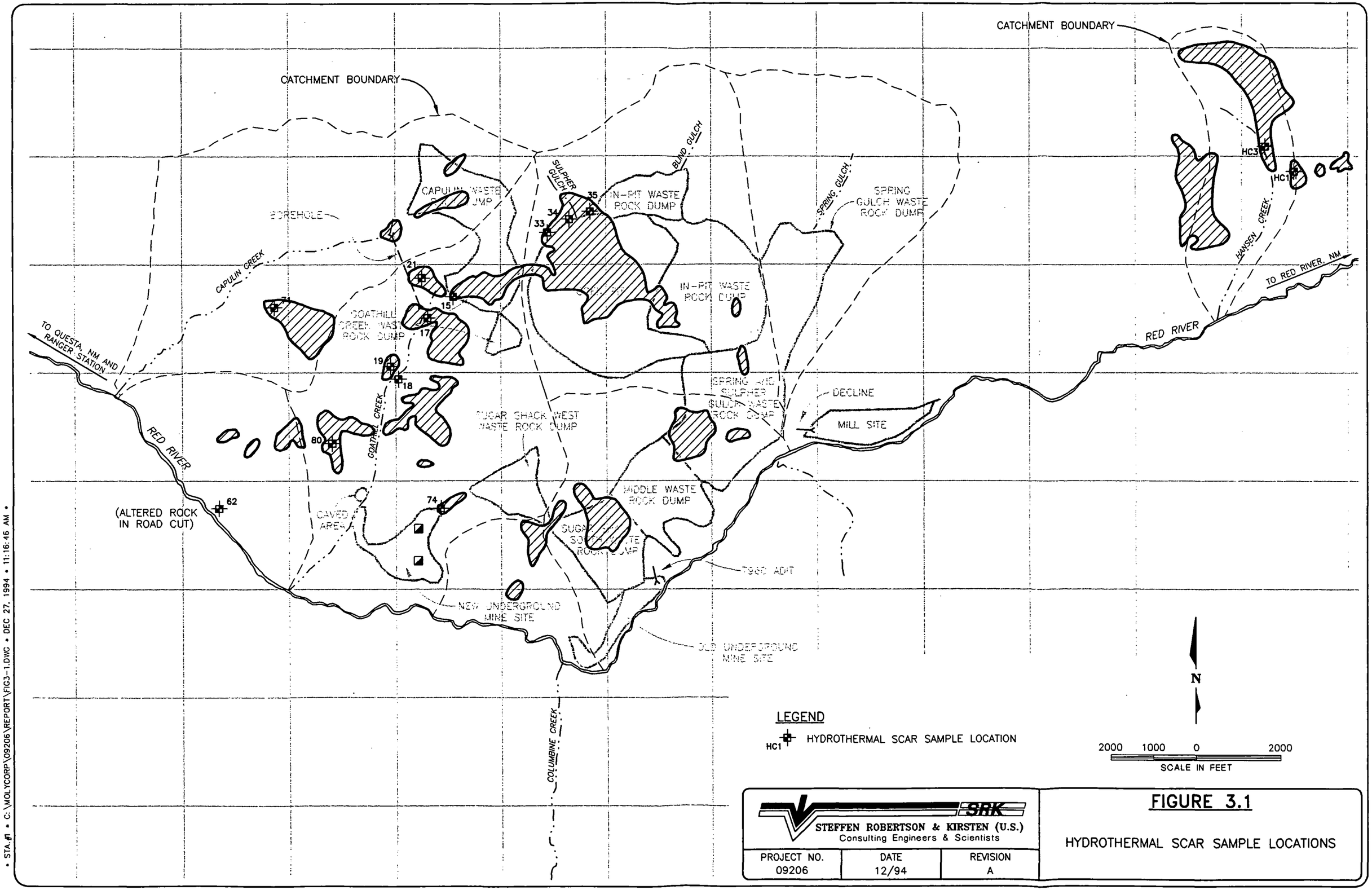
FIGURE 1.7

RED RIVER WATER QUALITY SURVEY
NOV 11, 1993 (AFTER VAIL ENGINEERING)

• STA.#1 • C:\MOLYCORP\09206\REPORT\FIG1-7.DWG • DEC 27, 1994 • 11:15:16 AM •

FIGURE 2.1 RED RIVER AT QUESTA GAGING STATION
ANNUAL MEAN DISCHARGE RATE





• STA_#1 • C:\MOLYCORP\09206\REPORT\FIG3-1.DWG • DEC 27, 1994 • 11:16:46 AM •

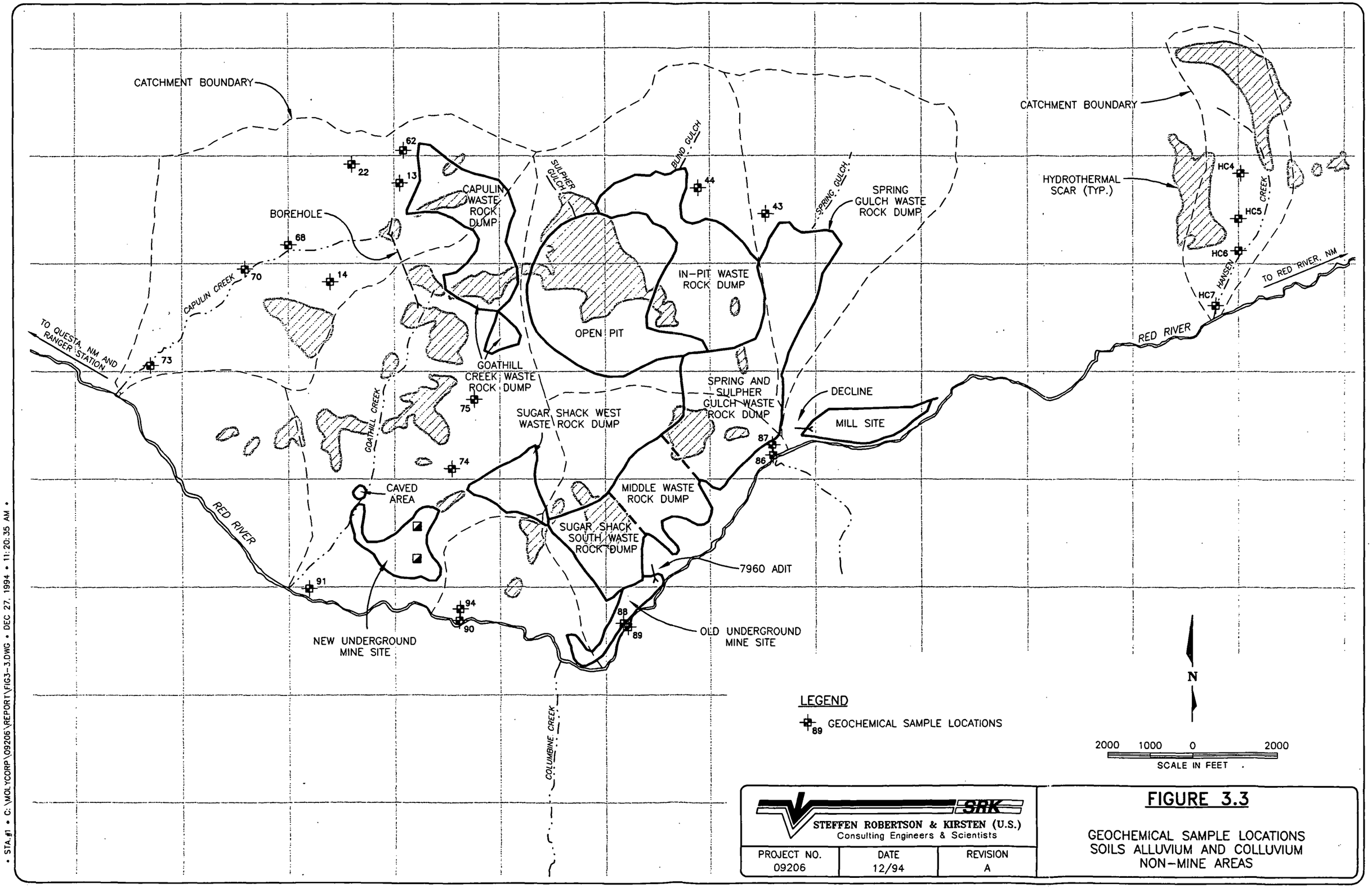


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FIGURE 3.3

GEOCHEMICAL SAMPLE LOCATIONS
SOILS ALLUVIUM AND COLLUVIUM
NON-MINE AREAS

• STA. #1 • C:\MOLYCORP\09206\REPORT\FIG3-3.DWG • DEC 27, 1994 • 11:20:35 AM •

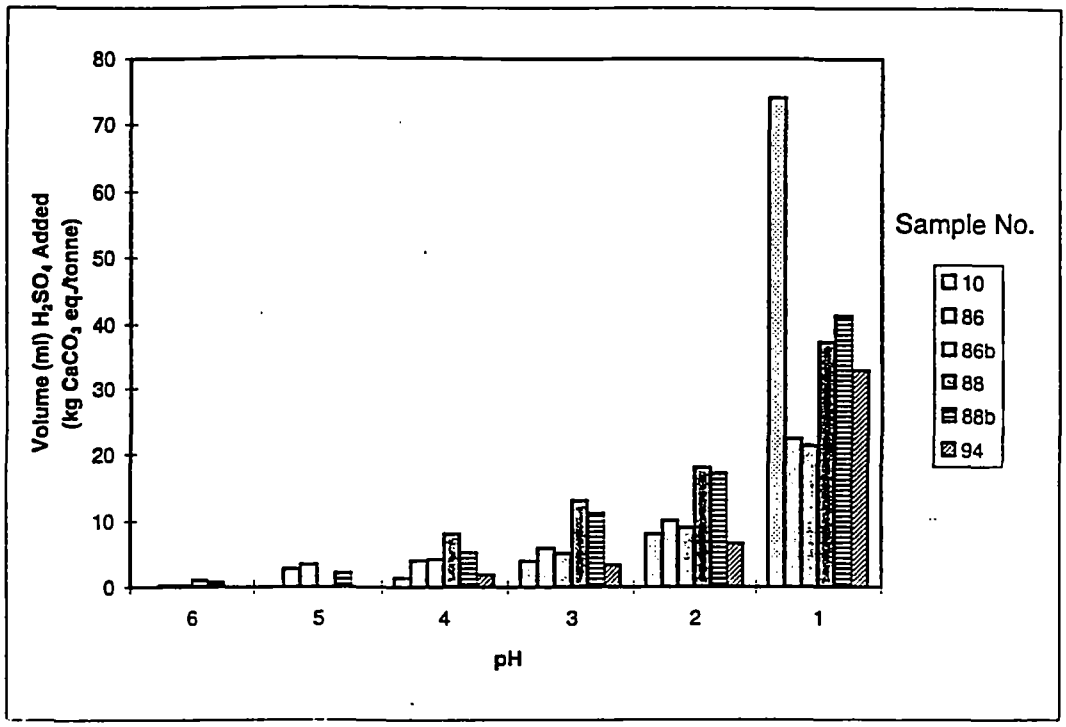

FIGURE 3.4 - RESULTS OF TITRATION TESTING

APPENDICES

APPENDIX A

RED RIVER BASIN HYDROLOGIC DATA

ACCUMULATED SUMMARY OF MONTHLY YEILDS CFS

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
ABV ZWERGLE	7.96	5.72	4.20	4.03	4.12	4.55	11.76	40.35	51.13	24.70	14.80	10.64
1-ABV RR	11.74	8.60	6.36	5.97	6.16	7.14	18.54	56.89	69.28	33.16	20.72	15.05
3-BLW RR N	16.08	11.63	8.56	8.00	8.27	9.71	26.56	77.13	89.76	40.94	26.48	19.58
3-BLW RR S	17.67	12.81	9.41	8.80	9.09	10.66	28.93	84.94	99.04	45.55	29.27	21.63
4-JUNEBUG N	17.92	13.01	9.57	8.94	9.24	10.87	29.41	85.75	99.84	45.96	29.63	21.90
4-JUNEBUG S	18.05	13.14	9.67	9.02	9.33	11.01	29.67	86.02	100.09	46.18	29.84	22.04
5-ELEPH RK N	18.24	13.30	9.80	9.13	9.45	11.18	30.06	86.68	100.75	46.52	30.13	22.25
5-ELEPH RK N	18.50	13.49	9.94	9.26	9.58	11.35	30.49	87.76	101.91	47.08	30.52	22.54
6-BLW HAN N	18.61	13.59	10.03	9.33	9.66	11.46	30.72	88.09	102.24	47.28	30.70	22.67
6-BLW HAN S	18.71	13.68	10.10	9.39	9.72	11.56	30.92	88.36	102.50	47.45	30.85	22.78
6A-DS HAN N	18.89	13.83	10.21	9.49	9.83	11.72	31.27	88.92	103.05	47.74	31.11	22.97
6A-DS HAN S	18.90	13.84	10.22	9.49	9.83	11.73	31.28	88.94	103.07	47.76	31.13	22.98
7-ABV MILL N	19.01	13.94	10.31	9.56	9.91	11.85	31.50	89.17	103.29	47.94	31.31	23.10
7-ABV MILL S	19.51	14.32	10.59	9.82	10.18	12.19	32.32	91.29	105.63	49.12	32.11	23.69
8-BLW SUL G N	19.70	14.49	10.73	9.93	10.30	12.38	32.70	91.83	106.15	49.45	32.41	23.90
8-BLW SUL G S	20.03	14.74	10.91	10.10	10.47	12.60	33.20	93.25	107.74	50.25	32.93	24.29
8A ABV PORT N	20.05	14.76	10.93	10.11	10.48	12.62	33.23	93.28	107.76	50.28	32.97	24.31
8A ABV PORT S	20.08	14.78	10.95	10.13	10.50	12.65	33.28	93.31	107.80	50.33	33.02	24.34
10-ABV COL N	20.09	14.79	10.96	10.14	10.51	12.67	33.30	93.33	107.82	50.35	33.04	24.35
10-ABV COL S	20.36	15.03	11.14	10.30	10.68	12.91	33.82	94.17	108.67	50.84	33.46	24.65
9-COLUMB CK	25.19	18.56	13.69	12.71	13.15	15.74	40.91	117.95	137.08	64.86	41.92	30.86
CABIN SPRINGS	25.46	18.80	13.88	12.87	13.32	16.00	41.47	118.73	137.84	65.31	42.34	31.16
11 BLW COL S	25.47	18.81	13.88	12.87	13.32	16.01	41.48	118.74	137.84	65.32	42.35	31.16
11B ABV TH B N	25.48	18.82	13.89	12.88	13.33	16.02	41.50	118.75	137.86	65.34	42.37	31.18
11B ABV TH B S	25.48	18.82	13.90	12.88	13.34	16.03	41.51	118.76	137.86	65.35	42.38	31.18
11A THUN BR N	25.49	18.82	13.90	12.89	13.34	16.03	41.51	118.76	137.87	65.36	42.38	31.18
11A THUN BR S	25.52	18.85	13.92	12.90	13.36	16.06	41.56	118.80	137.91	65.41	42.43	31.22
12 GOAT HILL N	25.72	19.04	14.08	13.03	13.49	16.28	41.95	119.21	138.30	65.74	42.76	31.44
12 GOAT HILL S	25.89	19.19	14.20	13.14	13.60	16.45	42.27	119.62	138.69	66.03	43.02	31.63
13 ABV CAPU N	25.91	19.21	14.22	13.15	13.62	16.48	42.31	119.65	138.72	66.07	43.06	31.65
13 ABV CAPU S	25.93	19.23	14.23	13.16	13.63	16.50	42.34	119.68	138.75	66.10	43.10	31.67
14 BLW CAPU N	26.17	19.45	14.42	13.31	13.80	16.76	42.82	120.20	139.25	66.49	43.48	31.94
14 BLW CAPU S	26.68	19.86	14.73	13.59	14.09	17.15	43.75	122.24	141.42	67.59	44.28	32.53
15-EAGLE RK N	26.71	19.88	14.75	13.61	14.11	17.18	43.79	122.27	141.46	67.64	44.33	32.56
15-EAGLE RK S	26.73	19.90	14.76	13.62	14.12	17.20	43.83	122.30	141.49	67.67	44.36	32.59
16-RAN STA N	26.75	19.92	14.78	13.63	14.13	17.22	43.84	122.32	141.50	67.70	44.39	32.60
16-RAN STA S	26.76	19.92	14.78	13.63	14.14	17.23	43.86	122.33	141.51	67.71	44.40	32.61

MOLYCORP SUMMARY OF MONTHLY YEILDS - CFS VAIL ENG 12/8/94

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
ABV ZWERGLE	7.958	5.719	4.203	4.029	4.116	4.553	11.764	40.346	51.132	24.703	14.801	10.640
1-ABV RR	3.780	2.877	2.155	1.944	2.045	2.586	6.774	16.545	18.149	8.452	5.917	4.409
3-BLW RR N	4.338	3.036	2.205	2.027	2.111	2.570	8.019	20.234	20.478	7.789	5.760	4.535
3-BLW RR S	1.598	1.180	0.848	0.801	0.822	0.947	2.368	7.819	9.282	4.604	2.789	2.049
4-JUNEBUG N	0.243	0.202	0.160	0.136	0.146	0.211	0.481	0.804	0.794	0.416	0.361	0.262
4-JUNEBUG S	0.129	0.121	0.101	0.082	0.089	0.142	0.261	0.272	0.259	0.215	0.210	0.143
5-ELEPH RK N	0.196	0.162	0.128	0.109	0.117	0.168	0.390	0.664	0.656	0.336	0.289	0.212
5-ELEPH RK N	0.253	0.193	0.143	0.129	0.135	0.174	0.432	1.077	1.161	0.561	0.391	0.291
6-BLW HAN N	0.118	0.102	0.082	0.069	0.074	0.113	0.228	0.331	0.325	0.200	0.181	0.128
6-BLW HAN S	0.100	0.088	0.072	0.060	0.064	0.098	0.199	0.271	0.264	0.169	0.155	0.109
6A-DS HAN N	0.173	0.146	0.116	0.099	0.106	0.155	0.349	0.560	0.551	0.296	0.260	0.189
6A-DS HAN S	0.012	0.011	0.009	0.008	0.008	0.014	0.019	0.016	0.016	0.020	0.020	0.013
7-ABV MILL N	0.109	0.101	0.084	0.069	0.074	0.119	0.218	0.232	0.221	0.181	0.176	0.120
7-ABV MILL S	0.499	0.384	0.285	0.258	0.268	0.345	0.819	2.123	2.338	1.176	0.799	0.589
8-BLW SUL G N	0.194	0.168	0.136	0.114	0.122	0.186	0.375	0.535	0.524	0.327	0.298	0.209
8-BLW SUL G S	0.325	0.246 ✓	0.181	0.165	0.171	0.215	0.508	1.424	1.590	0.800	0.526	0.388
8A ABV PORT N	0.024	0.021	0.018	0.015	0.015	0.027	0.030	0.024	0.024	0.039	0.039	0.024
8A ABV PORT S	0.026	0.024 ✓	0.020	0.017	0.017	0.030	0.043	0.037	0.036	0.043	0.043	0.028
10-ABV COL N	0.015	0.013	0.011	0.009	0.009	0.017	0.018	0.015	0.015	0.024	0.024	0.015
10-ABV COL S	0.271	0.231 ✓	0.184	0.156	0.167	0.245	0.526	0.845	0.850	0.489	0.418	0.300
9-COLUMB CK	4.831	3.539	2.544	2.413	2.470	2.825	7.084	23.772	28.410	14.020	8.467	6.207
CABIN SPRINGS	0.268	0.238	0.192	0.160	0.174	0.260	0.567	0.784	0.761	0.454	0.414	0.297
11 BLW COL S	0.007	0.006	0.005	0.004	0.004	0.007	0.008	0.006	0.006	0.011	0.011	0.007
11B ABV TH B N	0.011	0.010	0.009	0.007	0.008	0.013	0.018	0.015	0.015	0.019	0.019	0.012
11B ABV TH B S	0.006	0.005	0.004	0.004	0.004	0.006	0.007	0.006	0.006	0.010	0.010	0.006
11A THUN BR N	0.002	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.002	0.003	0.003	0.002
11A THUN BR S	0.030	0.027	0.023	0.019	0.020	0.034	0.049	0.042	0.041	0.049	0.049	0.032
12 GOAT HILL N	0.202	0.187	0.156	0.128	0.138	0.220	0.392	0.411	0.394	0.336	0.327	0.224
12 GOAT HILL S	0.169	0.150	0.124	0.103	0.110	0.171	0.320	0.404	0.393	0.284	0.266	0.185
13 ABV CAPU N	0.024	0.022	0.019	0.015	0.016	0.027	0.037	0.033	0.031	0.040	0.040	0.027
13 ABV CAPU S	0.020	0.018	0.015	0.013	0.013	0.022	0.030	0.026	0.025	0.033	0.033	0.022
14 BLW CAPU N	0.235	0.220	0.182	0.149	0.163	0.255	0.489	0.526	0.502	0.392	0.380	0.263
14 BLW CAPU S	0.518	0.412	0.313	0.276	0.292	0.392	0.929	2.040	2.173	1.101	0.808	0.596
15-EAGLE RK N	0.027	0.024	0.020	0.017	0.018	0.029	0.038	0.032	0.032	0.044	0.044	0.029
15-EAGLE RK S	0.020	0.019	0.016	0.013	0.014	0.023	0.035	0.031	0.030	0.034	0.034	0.023
16-RAN STA N	0.015	0.013	0.011	0.009	0.010	0.016	0.018	0.015	0.015	0.025	0.025	0.016
16-RAN STA S	0.009	0.008	0.007	0.006	0.006	0.010	0.013	0.011	0.011	0.015	0.015	0.010

SUMMARY OF MONTHLY YEILDS CFS

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
TOTAL	26.76	19.92	14.78	13.63	14.14	17.23	43.86	122.33	141.51	67.71	44.40	32.61
REV ADJ TOTAL	26.56	20.34	14.83	13.52	14.20	17.19	43.85	122.00	141.45	67.59	44.07	32.49

APPENDIX B

GEOCHEMICAL TEST METHODS AND INTERPRETATION OF TEST RESULTS

PASTE pH and CONDUCTIVITY

Objectives

- To determine the pH and conductivity of the pore water resulting from dissolution of secondary mineral phases on the surfaces of oxidized rock particles.

- To indicate whether oxidation, and accumulation of contaminants in the form of secondary mineral phases, has occurred in the waste rock prior to collection of the sample.

Description of Test

Water is added to the sample to form a paste or slurry thus mobilizing secondary mineral phases and providing a medium accessible to the pH and conductivity or TDS probe. The probe is placed in the paste or slurry and the pH or conductivity value is read directly from the meter.

Interpretation

High conductivity (or TDS) levels indicate there is a considerable store of contaminant salts. These are usually sulfates, but can be other metal salts. When a sample is collected over depth, it is not always clear wether the stored salts are due to oxidation at that point in the sediment profile, or if the salts were generated somewhere higher in the profile and moved downwards to the sample location. Look for stains along the flow path that may indicate if this is the case.

Low pH readings indicate oxidation and acid generation has occurred, usually at the location from which the sample was collected. Readings taken on uncrushed samples in the field or lab usually provide a much better indication of the extent of oxidation than crushed samples do.

ACID BASE ACCOUNTING

Objectives

To establish the balance between potentially acid generating minerals (sulphides), expressed as the acid generation potential (AP), and the potentially acid consuming minerals (alkaline minerals), expressed as the neutralization potential (NP), present in a sample.

Description of Test

The total sulphur is determined generally using a Leco furnace. Measuring total sulphur may overestimate the acid potential in a sample if all sulphur in a sample is not acid generating. Therefore, additional tests may be performed to determine the form of the sulphur.

The total amount of neutralizing potential in a sample is determined by treating a sample with a known excess of standardized hydrochloric acid. The sample is then titrated back to neutral with standard sodium hydroxide.

Interpretation

Total sulphur (as %S) is converted to maximum potential acidity in units of kilograms of $CaCO_3$ euivalent/tonnes of sample (kg CaCO3/tonne of material). Neutralization potenital is calculated by converting the amount of base to a calcium carbonate equivalent. This expression of neutralization potential as $CaCO_3$ is deceiving because most natural neutralizing minerals are not capable of neutralizing pH above a value of 6.

LEACH EXTRACTION TEST PROCEDURE

Objectives

To characterize and quantify the stored soluble contaminant load present in a rock sample.

Description of Test

The sample is mixed with water and is agitated in a sealed bottle or flask for up to 24 hours. The solution is collected at the end of the test, filtered, and pH and conductivity determined. The filtrate is then analyzed by a laboratory for acididty, sulphate and metals.

Interpretation

The pH and conductivity give a very quick indication of the stored soluble load:

- low pH and high conductivity indicate areas that have oxidized and produced metals;
- neutral pH and high conductivity indicates areas that have contaminant from other sources (eg. concentrate) or have accumulated metal or sulfate salts because the zone contains enough alkalinity to precipitate these products as they move past in solution;
- low pH and low conductivity indicates there is a relatively small accumulation of stored oxidation products.

The acidity is particularly useful for assessing potential of environmental degradation.

The sulfate and metals indicate which metal salts have accumulated, indicating:

- the metals which will leach under relatively aggressive flushing conditions (dumping rock into a lake);
- solubility conditions on precipitation; and,
- variability of the rock material.

Tests are ideally done in conjunction with a solids ICP so that the % leached can be calculated. For interpretation, the results should be converted to a mg leached/kg sample. This way tests carried out with different water to rock ratios can be normalized to the same scale.

ACID TITRATION TESTING

Objectives

To determine, qualitatively, the acid neutralizing capacity of a rock sample.

Procedure

1. Prepare sample for testing. Coarse grained samples may need to be crushed to less than 1 cm. Samples should not be ground, however, as grinding may release neutralizing minerals that would not normally be exposed.

2. Add an equal amount of water to the sample and mix. Usually 50 g of material is sufficient. Measure the pH.

3. Add a measured amount of H_2SO_4 to the sample to lower and maintain the pH to the next lowest whole number for one hour. For example, if the measured pH was 6.7, H_2SO_4 should be added until the pH was 6. The samples should be mixed throroughly throughtout testing.

4. Add measured amounts of acid to lower the pH to 5, 4, 3, 2 and 1.

Interpretation

The amount of acid required to reach each pH interval is dependent on the amount of neutralizing material available. As the pH decreases, the acid is neutralized by more resistant minerals. At pH of 7 to 9, less resistant carbonate minerals, such as calcite and dolomite, are the primary neutralizing agent. More resistant carbonates such as siderite ($FeCO_3$) and magnesite ($MgCO_3$) are neutralizing components at a pH of 5 to 6, and iron, aluminium and magnesium hydroxides buffer to pH 3.7. Below pH 2, silicate minerals become important buffering agents.

REFERENCES

Sobek, A.A., Schuller, W.A. Freeman, J.R. and Smith, R.M., 1978, Field and Laboratory

Methods Applicable to Overburden and Minesoils, EPA 600/2-78-054, 203pp.

British Columbia AMD Task Force, 1989, Draft Acid Rock Drainage Technical Guide, Vol I, Crown Publications, Victoria, B.C.

APPENDIX C

GEOTECHNICAL DATA

Table C-1 Questa Mine Water Quality - ICP Data
Table C-2 Field Paste pH and Total Dissolved Solids (TDS) Measurements
Table C-3 Questa Mine Solid Samples - ICP Data
Table C-4 Questa Mine Solid Samples - Acid Base Accounting Data
Table C-5 Questa Mine Solid Samples - Shake Flask Data

Appendix C.1
Questa Water Quality ICP Data

TABLE C1
Questa Mine Water Quality - ICP Data

		WS-1	WS-2	WS-Cap 1	WS-GC1	WS-GC2	WS-GC3
Physical Tests							
Conductivity	umhos/cm	3390	2240	11700	12300	4600	4630
pH		3.63	3.28	2.58	2.69	2.93	2.33
Dissolved Anions							
Acidity	CaCO3	973	856	11700	12200	3150	4110
Alkalinity - Total		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Sulphate	SO4	2500	1410	12700	11100	4220	2910
Total Metals							
Aluminum	T-Al	164	138	1300	1850	522	248
Antimony	T-Sb	<0.20	<0.20	<1.0	<1.0	<0.20	<0.20
Arsenic	T-As	<0.20	<0.20	<1.0	<1.0	0.21	<0.20
Barium	T-Ba	0.034	<0.010	<0.050	<0.050	0.623	0.224
Beryllium	T-Be	0.034	0.019	0.68	0.45	0.119	0.065
Bismuth	T-Bi	0.24	0.12	1.33	1.19	0.33	<0.10
Boron	T-B	<0.10	<0.10	<0.50	<0.50	<0.10	<0.10
Cadmium	T-Cd	0.013	0.021	0.42	0.585	0.148	0.034
Calcium	T-Ca	352	219	445	418	178	104
Chromium	T-Cr	0.067	<0.015	0.445	0.495	0.242	0.066
Cobalt	T-Co	1.04	0.187	2.76	4.45	1.23	0.314
Copper	T-Cu	3.06	0.853	13.9	10.1	2.94	7.25
Iron	T-Fe	8.57	3.66	848	493	290	866
Lead	T-Pb	<0.050	<0.050	<0.25	<0.25	1.04	0.437
Lithium	T-Li	0.318	0.075	1.19	1.33	0.393	0.106
Magnesium	T-Mg	239	57.9	1020	1080	295	44.5
Manganese	T-Mn	17.5	16	787	612	171	43.9
Molybdenum	T-Mo	0.031	<0.030	<0.15	<0.15	<0.030	0.079
Nickel	T-Ni	1.74	0.369	6.26	9.43	2.56	0.645
Phosphorus	T-P	0.36	<0.30	23.8	12.1	14.4	6.35
Potassium	T-K	3.1	2.9	<10	<10	10.4	11.1
Selenium	T-Se	<0.20	<0.20	<1.0	<1.0	<0.20	<0.20
Silicon	T-Si	8.23	27.3	43	52.4	75.8	25.2
Silver	T-Ag	<0.015	<0.015	<0.075	<0.075	<0.015	<0.015
Sodium	T-Na	3.1	23	24	15	4.3	9
Strontium	T-Sr	3.05	0.708	1.6	1.29	0.56	0.799
Thallium	T-Tl	<0.10	<0.10	0.64	<0.50	0.22	<0.10
Tin	T-Sn	<0.30	<0.30	<1.5	<1.5	<0.30	<0.30
Titanium	T-Ti	0.232	<0.010	<0.050	<0.050	0.052	0.044
Tungsten	T-W	<0.10	<0.10	<0.50	<0.50	<0.10	<0.10
Vanadium	T-V	<0.030	<0.030	<0.15	<0.15	0.125	0.03
Zinc	T-Zn	1.86	4.16	132	127	33.4	11.9

TABLE C1
Questa Mine Water Quality - ICP Data

		WS-1	WS-2	WS-Cap 1	WS-GC1	WS-GC2	WS-GC3
Dissolved Metals							
Aluminum	D-Al	164	135	1290	1850	434	246
Antimony	D-Sb	<0.20	<0.20	<1.0	<1.0	<0.20	<0.20
Arsenic	D-As	<0.20	<0.20	<1.0	<1.0	<0.20	<0.20
Barium	D-Ba	<0.010	<0.010	<0.050	<0.050	<0.010	<0.010
Beryllium	D-Be	0.034	0.019	0.67	0.44	0.109	0.065
Bismuth	D-Bi	0.22	0.11	1.33	1.19	0.29	<0.10
Boron	D-B	<0.10	<0.10	<0.50	<0.50	<0.10	<0.10
Cadmium	D-Cd	0.012	0.015	0.42	0.585	0.148	0.034
Calcium	D-Ca	352	219	439	416	173	104
Chromium	D-Cr	0.055	<0.015	0.44	0.485	0.106	0.062
Cobalt	D-Co	1.03	0.186	2.74	4.42	1.15	0.314
Copper	D-Cu	3.06	0.823	13.7	10	2.55	7.23
Iron	D-Fe	1.87	2.89	836	490	66	785
Lead	D-Pb	<0.050	<0.050	<0.25	<0.25	<0.050	<0.050
Lithium	D-Li	0.318	0.067	1.17	1.33	0.332	0.106
Magnesium	D-Mg	239	56.7	1010	1070	265	44
Manganese	D-Mn	17.5	16	777	612	160	43.9
Molybdenum	D-Mo	<0.030	<0.030	<0.15	<0.15	<0.030	<0.030
Nickel	D-Ni	1.74	0.369	6.26	9.38	2.44	0.645
Phosphorus	D-P	<0.30	<0.30	23.6	11.6	0.8	5.31
Potassium	D-K	<2.0	2.4	<10	<10	<2.0	<2.0
Selenium	D-Se	<0.20	<0.20	<1.0	<1.0	<0.20	<0.20
Silicon	D-Si	4.79	26.9	42.5	51.9	13.7	21.8
Silver	D-Ag	<0.015	<0.015	<0.075	<0.075	<0.015	<0.015
Sodium	D-Na	3.1	20.3	23	15	3.7	7.1
Strontium	D-Sr	3.05	0.695	1.59	1.26	0.372	0.532
Thallium	D-Tl	<0.10	<0.10	0.64	<0.50	0.13	<0.10
Tin	D-Sn	<0.30	<0.30	<1.5	<1.5	<0.30	<0.30
Titanium	D-Ti	<0.010	<0.010	<0.050	<0.050	<0.010	<0.010
Tungsten	D-W	<0.10	<0.10	<0.50	<0.50	<0.10	<0.10
Vanadium	D-V	<0.030	<0.030	<0.15	<0.15	<0.030	<0.030
Zinc	D-Zn	1.86	4.16	130	127	32.1	11.9

TABLE C1
Questa Mine Water Quality - ICP Data

		WS-GC4	WS-GC5	WS-GC6	WS-HC1	WS-HC2	WS-SS1
Physical Tests							
Conductivity	umhos/cm	4560	2640	6500	6830	2290	2410
pH		2.61	3	2.66	2.55	3.2	3.63
Dissolved Anions							
Acidity	CaCO3	3130	735	5350	5150	658	435
Alkalinity - Total		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Sulphate	SO4	3710	1680	5850	5900	1550	1640
Total Metals							
Aluminum	T-Al	332	97.1	582	375	99.6	95.8
Antimony	T-Sb	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Arsenic	T-As	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Barium	T-Ba	0.147	0.012	<0.010	0.258	0.042	0.291
Beryllium	T-Be	0.103	0.046	0.085	0.096	0.014	0.03
Bismuth	T-Bi	0.25	<0.10	0.29	0.2	<0.10	<0.10
Boron	T-B	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Cadmium	T-Cd	0.092	<0.010	<0.010	0.035	<0.010	0.02
Calcium	T-Ca	227	398	375	379	307	367
Chromium	T-Cr	0.091	<0.015	0.218	0.147	<0.015	0.1
Cobalt	T-Co	0.678	0.04	0.834	1.63	0.154	0.511
Copper	T-Cu	4.89	0.022	1.37	1.76	0.136	2.31
Iron	T-Fe	248	6.83	376	890	20.9	54.2
Lead	T-Pb	0.097	<0.050	<0.050	<0.050	<0.050	0.098
Lithium	T-Li	0.24	0.024	0.314	0.468	0.049	0.249
Magnesium	T-Mg	170	18.1	333	500	53.1	91.3
Manganese	T-Mn	87.4	12.8	24.9	62.6	7.65	12.6
Molybdenum	T-Mo	<0.030	<0.030	<0.030	<0.030	<0.030	0.615
Nickel	T-Ni	1.55	0.107	2.18	4.08	0.364	0.97
Phosphorus	T-P	3.33	<0.30	0.83	18.2	<0.30	2.28
Potassium	T-K	3.4	7.2	<2.0	6.5	5.4	11.3
Selenium	T-Se	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Silicon	T-Si	49.1	36.3	38.8	42.6	21.2	31.7
Silver	T-Ag	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015
Sodium	T-Na	5.9	14.6	32.5	7.8	8.4	<2.0
Strontium	T-Sr	0.261	0.82	1.5	3.91	1.21	3.52
Thallium	T-Tl	0.14	<0.10	0.13	0.15	<0.10	<0.10
Tin	T-Sn	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Titanium	T-Ti	<0.010	<0.010	<0.010	<0.010	<0.010	0.8
Tungsten	T-W	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Vanadium	T-V	<0.030	<0.030	<0.030	<0.030	<0.030	0.055
Zinc	T-Zn	20.6	5.46	3.72	10.8	2.38	3.08

TABLE C1
Questa Mine Water Quality - ICP Data

		WS-GC4	WS-GC5	WS-GC6	WS-HC1	WS-HC2	WS-SS1
Dissolved Metals							
Aluminum	D-Al	332	97	577	370	99.6	84.4
Antimony	D-Sb	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Arsenic	D-As	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Barium	D-Ba	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Beryllium	D-Be	0.103	0.046	0.085	0.096	0.014	0.029
Bismuth	D-Bi	0.25	<0.10	0.29	0.19	<0.10	<0.10
Boron	D-B	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Cadmium	D-Cd	0.092	<0.010	<0.010	0.035	<0.010	0.018
Calcium	D-Ca	227	398	373	379	307	367
Chromium	D-Cr	0.087	<0.015	0.218	0.132	<0.015	0.032
Cobalt	D-Co	0.678	0.037	0.834	1.63	0.154	0.509
Copper	D-Cu	4.89	0.02	1.36	1.74	0.136	2.23
Iron	D-Fe	225	4.14	375	763	4.64	1.46
Lead	D-Pb	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Lithium	D-Li	0.24	0.024	0.31	0.456	0.048	0.228
Magnesium	D-Mg	170	18.1	332	498	53.1	82.6
Manganese	D-Mn	87.4	12.8	24.9	62.6	7.65	12.2
Molybdenum	D-Mo	<0.030	<0.030	<0.030	<0.030	<0.030	0.043
Nickel	D-Ni	1.55	0.107	2.17	4.08	0.364	0.958
Phosphorus	D-P	2.15	<0.30	0.83	10	<0.30	<0.30
Potassium	D-K	<2.0	6.5	<2.0	<2.0	5.1	<2.0
Selenium	D-Se	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Silicon	D-Si	45.6	34.8	38.6	35.7	21	7.32
Silver	D-Ag	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015
Sodium	D-Na	5.7	14.6	32.4	6	8.4	<2.0
Strontium	D-Sr	0.209	0.82	1.49	3.3	1.21	3.1
Thallium	D-Tl	0.14	<0.10	0.13	0.1	<0.10	<0.10
Tin	D-Sn	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Titanium	D-Ti	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Tungsten	D-W	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Vanadium	D-V	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Zinc	D-Zn	20.6	5.46	3.7	10.8	2.38	3.06

TABLE C1
Questa Mine Water Quality - ICP D

		WS-SS2	WS-Pit 1	WS-Pit 2	WS-Cap 2	WS-Cap 3	WS-Cap 4
Physical Tests							
Conductivity	umhos/cm	1600	4600	3170	409	2500	1350
pH		3.12	2.82	2.79	6.9	3.14	3.05
Dissolved Anions							
Acidity	CaCO3	447	566	680	14.2	558	326
Alkalinity - Total		<1.0	<1.0	<1.0	41	<1.0	<1.0
Sulphate	SO4	976	3320	1810	140	1690	735
Total Metals							
Aluminum	T-Al	74.8	6.37	52.8	18	87.6	50.3
Antimony	T-Sb	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Arsenic	T-As	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Barium	T-Ba	0.244	0.017	<0.010	0.364	<0.010	<0.010
Beryllium	T-Be	0.014	0.041	0.01	0.019	0.056	0.011
Bismuth	T-Bi	<0.10	0.31	<0.10	<0.10	0.14	<0.10
Boron	T-B	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Cadmium	T-Cd	0.012	<0.010	<0.010	<0.010	0.025	<0.010
Calcium	T-Ca	134	442	437	69.3	237	67.1
Chromium	T-Cr	0.065	<0.015	0.051	<0.015	<0.015	<0.015
Cobalt	T-Co	0.366	0.298	0.135	0.018	0.298	0.114
Copper	T-Cu	1.16	0.19	1.01	0.094	0.465	1.09
Iron	T-Fe	59	305	119	17.2	10.9	6.95
Lead	T-Pb	0.064	<0.050	<0.050	0.146	<0.050	<0.050
Lithium	T-Li	0.28	0.1	0.077	0.015	0.141	0.103
Magnesium	T-Mg	72.1	309	66.2	15.4	90.9	41.6
Manganese	T-Mn	4.7	206	2.33	3.62	59.6	8.13
Molybdenum	T-Mo	0.125	<0.030	<0.030	<0.030	<0.030	<0.030
Nickel	T-Ni	0.436	0.51	0.434	0.042	0.62	0.21
Phosphorus	T-P	4.88	1.8	2.43	1.42	<0.30	<0.30
Potassium	T-K	7.3	7.8	<2.0	7.2	<2.0	2.9
Selenium	T-Se	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Silicon	T-Si	16.4	10.3	20.3	36.7	31.6	26.5
Silver	T-Ag	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015
Sodium	T-Na	<2.0	35.6	10.9	15.9	29.2	13.6
Strontium	T-Sr	0.572	9.36	1.42	0.677	1.15	0.082
Thallium	T-Tl	<0.10	0.26	<0.10	<0.10	<0.10	<0.10
Tin	T-Sn	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Titanium	T-Ti	0.137	0.056	<0.010	0.049	<0.010	<0.010
Tungsten	T-W	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Vanadium	T-V	0.103	<0.060	<0.030	<0.030	<0.030	<0.030
Zinc	T-Zn	1.93	8.01	0.498	0.527	8.85	2.06

TABLE C1
Questa Mine Water Quality - ICP D

		WS-SS2	WS-Pit 1	WS-Pit 2	WS-Cap 2	WS-Cap 3	WS-Cap 4
Dissolved Metals							
Aluminum	D-Al	60.9	4.22	52.8	<0.20	87.6	50.3
Antimony	D-Sb	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Arsenic	D-As	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Barium	D-Ba	<0.010	<0.010	<0.010	0.031	<0.010	<0.010
Beryllium	D-Be	0.013	0.041	0.01	<0.005	0.056	0.011
Bismuth	D-Bi	<0.10	0.26	<0.10	<0.10	0.14	<0.10
Boron	D-B	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Cadmium	D-Cd	0.01	<0.010	<0.010	<0.010	0.025	<0.010
Calcium	D-Ca	134	442	437	42.1	237	67.1
Chromium	D-Cr	0.029	<0.015	0.051	<0.015	<0.015	<0.015
Cobalt	D-Co	0.366	0.298	0.135	<0.015	0.298	0.114
Copper	D-Cu	1.13	0.137	1.01	<0.010	0.465	1.09
Iron	D-Fe	4.24	167	119	0.108	10.9	6.76
Lead	D-Pb	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Lithium	D-Li	0.27	0.099	0.077	<0.015	0.141	0.103
Magnesium	D-Mg	70.8	309	66.2	8.55	90.9	41.6
Manganese	D-Mn	4.69	206	2.33	<0.005	59.6	8.13
Molybdenum	D-Mo	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Nickel	D-Ni	0.436	0.51	0.434	<0.020	0.62	0.21
Phosphorus	D-P	<0.30	<0.30	2.34	<0.30	<0.30	<0.30
Potassium	D-K	<2.0	7	<2.0	3.5	<2.0	2.7
Selenium	D-Se	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Silicon	D-Si	8.47	7.39	19.5	15.1	31.6	26.5
Silver	D-Ag	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015
Sodium	D-Na	<2.0	35.6	10.9	14.7	29.2	13.6
Strontium	D-Sr	0.177	9.36	1.42	0.389	1.15	0.082
Thallium	D-Tl	<0.10	0.22	<0.10	<0.10	<0.10	<0.10
Tin	D-Sn	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Titanium	D-Ti	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Tungsten	D-W	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Vanadium	D-V	<0.030	<0.060	<0.030	<0.030	<0.030	<0.030
Zinc	D-Zn	1.93	8.01	0.498	0.007	8.85	2.06

Appendix C.2
Field Paste pH and Total Dissolved Solids (TDS) Measurements

TABLE C-2
Field Paste pH and Total Dissolved Solids (TDS) Measurements

Sample ID	Paste pH	Paste TDS	Sample ID	Paste pH	Paste TDS	Sample ID	Paste pH	Paste TDS
1	2.98	1830	44	6.82	<10	85	3.41	1560
2	2	1340	45	2.77	160	86	5.7	550
3	3	> 2000	46	> 6	40	87	3.95	180
4	3.5	1640	47	> 7.1	30	88	4.29	890
5	6.8	ND	48	2.57	1590	89	> 6.1	60
6	> 6	ND	49	3.15	1090	90	5.68	680
7	> 6	ND	51	> 6.1	590	91	4.1	30
8	3.25	> 2000	52	> 6	360	92	2.49	950
10	3.6	320	53	> 6.3	530	93	2.69	> 2000
11	5	70	54	> 6	260	5a	2.8	ND
12	3.77	40	55	> 6.5	20	HC1	3.25	1580
13	6.05	140	56	> 6.1	210	HC2	2.1	1920
14	6.1	100	57	> 6.1	30	HC3	3.1	990
15	2.35	> 2000	58	> 6	1580	HC4	6.1	100
16	3.34	230	59	2.68	1380	HC5	3.65	1210
17	1.8	790	60	3.18	770	HC6	3.6	540
18	3.6	740	61	2.7	1090	HC7	3.39	1120
19	4.8	ND	62	5.2	40			
21	3.7	1510	63	2.61	1650			
22	5.4	210	64	2.71	490	Mean	4.23	804.40
23	4	1110	65	2.64	1820	Median	3.68	590
24	3.6	> 2000	66	2.98	320	Minimum	1.8	0
25	4.1	670	67	4.13	> 2000	Maximum	7.1	2000
26	6.96	140	68	6.23	200	N	97	97
27	4.3	810	69	2.39	900			
28	5.77	130	70	3.68	80			
29	6.81	200	71	2.34	> 2000			
30	7	140	72	3.72	340			
31	2.9	1860	73	3.72	220			
32	> 6.3	200	74	4.71	120			
33	2.57	> 2000	75	4.3	20			
34	2.93	1710	76	3.48	220			
35	3.2	> 2000	77	2.5	1710			
36	2.83	> 2000	78	> 6	810			
37	6.3	120	79	2.68	> 2000			
39	2.83	1520	80	2.7	1580			
40	6.5	120	81	2.59	880			
41	2.97	1480	82	> 6.4	200			
42	3.15	6.4	83	3.2	1130			
43	6.42	30	84	2.79	> 2000			

ND = no data

Appendix C.3
ICP Assay Data

TABLE C-3
Questa Mine Solid Samples - ICP Data

Element		Sample 46	Sample 40	Sample 41	Sample 24	Sample 78	Sample 15	Sample HC2
Ag	ppm	0.6	1.5	0.9	1.2	1.5	0.4	0.7
Al	%	0.32	0.59	0.94	0.41	0.5	0.25	0.43
As	ppm	1	1	1	1	11	1	1
B	ppm	1	1	1	1	1	1	1
Ba	ppm	40	96	196	59	72	679	257
Be	ppm	0.7	1.3	1.5	1.1	1.5	0.7	1
Bi	ppm	3	7	8	4	13	3	5
Ca	%	0.77	1.07	0.59	0.49	1.09	0.12	0.81
Cd	ppm	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Co	ppm	5	7	7	4	7	2	4
Cu	ppm	74	113	79	20	72	18	16
Fe	%	1.1	2.03	3.63	2.07	2.37	2.17	4.64
K	%	0.23	0.43	0.97	0.37	0.42	0.35	0.58
Li	ppm	14	20	28	8	22	1	4
Mg	%	0.62	1.17	1.36	0.43	1.14	0.14	0.27
Mn	ppm	404	653	299	307	635	196	139
Mo	ppm	80	105	191	16	416	7	9
Na	%	0.02	0.02	0.02	0.01	0.02	0.03	0.22
Ni	ppm	15	34	29	19	31	10	18
P	ppm	480	820	1520	590	1070	490	1880
Pb	ppm	27	37	43	118	54	38	97
Sb	ppm	5	8	14	8	8	5	8
Sr	ppm	47	260	276	84	136	228	587
Th	ppm	18	15	6	4	7	2	3
Ti	%	0.02	0.1	0.04	0.01	0.13	0.01	0.01
V	ppm	22.5	46.7	48	23	64.2	13	32.3
Zn	ppm	37	42	20	79	75	38	28
Ga	ppm	4	5	8	6	7	3	5
Sn	ppm	1	1	1	1	1	1	1
W	ppm	4	8	6	4	11	4	3
Cr	ppm	64	105	48	51	137	68	34

TABLE C-3
Questa Mine Solid Samples - ICP Data

Element		Sample 9	Sample 85	Sample 84	Sample 36	Sample 30	Sample 27	Sample 6
Ag	ppm	2.5	5.1	0.6	0.5	0.4	0.7	1.4
Al	%	0.8	0.53	0.92	0.6	0.17	0.78	0.97
As	ppm	1	1	1	1	7	1	1
B	ppm	225	112	1	1	1	1	1
Ba	ppm	72	113	222	121	17	228	179
Be	ppm	16.6	7.7	1.3	1.5	0.6	1.2	2.1
Bi	ppm	16	19	8	6	2	7	10
Ca	%	2.45	2.12	0.36	0.33	0.52	0.4	1.42
Cd	ppm	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Co	ppm	4	3	9	6	2	8	12
Cu	ppm	156	97	56	417	68	73	202
Fe	%	2.49	2.78	3.54	3.1	0.88	4.03	3.36
K	%	0.93	1.04	0.7	0.56	0.17	0.55	0.74
Li	ppm	29	13	16	16	5	17	40
Mg	%	0.41	0.19	1.22	0.76	0.17	0.9	2
Mn	ppm	2286	398	471	772	313	330	1054
Mo	ppm	1334	1279	16	25	147	22	306
Na	%	0.1	0.14	0.05	0.02	0.03	0.03	0.03
Ni	ppm	20	14	51	28	7	38	60
P	ppm	750	640	1390	900	210	1420	1610
Pb	ppm	197	171	34	56	16	49	83
Sb	ppm	16	11	14	10	4	12	15
Sr	ppm	34	64	283	176	23	252	299
Th	ppm	33	13	3	5	21	5	6
Ti	%	0.02	0.02	0.06	0.01	0.01	0.05	0.1
V	ppm	20.1	14.9	55.1	26.2	7.9	48.4	88.4
Zn	ppm	584	158	76	57	17	39	141
Ga	ppm	4	8	7	4	3	7	7
Sn	ppm	1	1	1	1	1	1	1
W	ppm	10	14	9	8	9	8	12
Cr	ppm	98	206	113	115	172	99	157

TABLE C-3
Questa Mine Solid Samples - ICP Data

Element		Sample 59	Sample 26	Sample 35	Sample 1	Sample 57	Sample 43	Sample 37
Ag	ppm	1.1	1.7	0.9	0.5	0.7	0.4	1.2
Al	%	0.77	0.5	0.62	0.69	0.59	0.17	0.85
As	ppm	1	1	1	1	1	18	1
B	ppm	1	1	1	1	1	1	1
Ba	ppm	256	113	199	78	255	22	199
Be	ppm	1.5	0.9	1.2	1.4	1.3	0.5	1.8
Bi	ppm	7	8	6	8	6	2	11
Ca	%	0.28	0.87	0.62	0.55	0.29	0.1	0.81
Cd	ppm	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Co	ppm	6	5	4	7	5	1	11
Cu	ppm	42	81	44	136	49	38	234
Fe	%	3.05	1.99	3.33	3.13	2.77	0.77	3.22
K	%	0.79	0.48	0.75	0.33	0.66	0.14	0.9
Li	ppm	25	15	14	25	23	3	31
Mg	%	1.07	0.78	0.78	1.21	0.92	0.1	2.11
Mn	ppm	448	633	88	871	413	113	832
Mo	ppm	55	109	7	15	71	9	448
Na	%	0.05	0.03	0.04	0.02	0.03	0.04	0.05
Ni	ppm	33	26	26	34	27	6	61
P	ppm	1180	650	970	1210	1190	150	1310
Pb	ppm	96	97	24	72	70	12	37
Sb	ppm	12	9	10	11	9	3	12
Sr	ppm	330	101	83	113	199	22	177
Th	ppm	6	15	4	5	6	22	8
Ti	%	0.06	0.04	0.02	0.06	0.06	0.01	0.13
V	ppm	58.7	30	40.4	48.4	49.5	9.1	77.2
Zn	ppm	59	570	13	100	53	12	47
Ga	ppm	8	5	8	7	5	3	6
Sn	ppm	1	1	1	1	1	1	1
W	ppm	10	12	9	8	6	7	12
Cr	ppm	133	206	147	95	64	145	174

Appendix C.4
Acid Base Accounting Data

TABLE C-4
Questa Mine Rock Samples - Acid Base Accounting Data

SAMPLE ID	MATERIAL TYPE	FIELD pH	FIELD TDS	S(T) %	S(SO4) %	SULFIDE %	AP	NP	NNP	NP/AP
1	WASTE ROCK	2.98	1830	1.43	0.93	0.50	15.63	13.68	-1.95	0.88
6	WASTE ROCK	>6	ND	1.88	1.20	0.68	21.25	37.53	16.28	1.77
7	WASTE ROCK	>6	ND	0.38	0.29	0.09	2.81	27.08	24.27	9.63
9	TAILINGS	ND	ND	3.04	2.58	0.46	14.38	0.00	-14.38	0.00
11	WASTE ROCK	5	70	1.72	1.19	0.53	16.56	16.23	-0.33	0.98
24	WASTE ROCK	3.6	>2000	2.87	2.03	0.84	26.25	0.00	-26.25	0.00
25	WASTE ROCK	4.1	670	0.67	0.47	0.20	6.25	0.00	-6.25	0.00
26	WASTE ROCK	6.96	140	0.20	0.14	0.06	1.88	36.30	34.43	19.36
27	WALL ROCK/SCAR	4.3	810	1.83	1.17	0.66	20.63	0.00	-20.63	0.00
29	IN-PIT WASTE ROCK	6.81	200	1.88	1.31	0.57	17.81	36.85	19.04	2.07
30	WALL ROCK	7	140	0.61	0.37	0.24	7.50	19.35	11.85	2.58
32	WALL ROCK	>6.3	200	1.16	0.88	0.28	8.75	36.58	27.83	4.18
35	SCAR ABOVE PIT	3.2	>2000	3.56	3.12	0.44	13.75	0.00	-13.75	0.00
36	SCAR RUBBLE	2.83	>2000	2.58	2.09	0.49	15.31	0.00	-15.31	0.00
37	WASTE ROCK	6.3	120	1.75	1.14	0.61	19.06	33.60	14.54	1.76
40	WASTE ROCK	6.5	120	0.67	0.46	0.21	6.56	32.80	26.24	5.00
41	WASTE ROCK	2.97	1480	3.38	2.25	1.13	35.31	7.53	-27.78	0.21
46	WASTE ROCK	>6	40	0.39	0.14	0.25	7.81	22.60	14.79	2.89
47	WASTE ROCK	>7.1	30	0.44	0.32	0.12	3.75	47.68	43.93	12.71
51	WASTE ROCK	>6.1	590	1.45	1.19	0.26	8.13	35.25	27.13	4.34
52	WASTE ROCK	>6	360	1.41	1.12	0.29	9.06	35.80	26.74	3.95
53	WASTE ROCK	>6.3	530	0.44	0.29	0.15	4.69	32.35	27.66	6.90
54	WASTE ROCK	>6	260	0.52	0.24	0.28	8.75	38.83	30.08	4.44
56	DEVELOPMENT ROCK	>6.1	210	1.23	0.94	0.29	9.06	24.88	15.82	2.75
57	WASTE ROCK	>6.1	30	1.66	1.54	0.12	3.75	6.58	2.83	1.75
59	WASTE ROCK	2.68	1380	1.66	1.32	0.34	10.63	6.35	-4.28	0.60
60	WASTE ROCK	3.18	770	1.32	1.12	0.20	6.25	4.63	-1.62	0.74
61	WASTE ROCK	2.7	1090	2.70	1.92	0.78	24.38	3.45	-20.93	0.14
65	WASTE ROCK	2.64	1820	2.68	2.08	0.60	18.75	3.21	-15.54	0.17
67	WASTE ROCK	4.13	>2000	2.01	1.77	0.24	7.50	13.74	6.24	1.83
78	DEVELOPMENT ROCK	>6	810	0.55	0.35	0.20	6.25	27.47	21.22	4.40
81	OUTWASH/MUD LOW	2.59	880	1.37	1.14	0.23	7.19	0.00	-7.19	0.00
84	FILL MATERIAL	2.79	>2000	2.41	2.13	0.28	8.75	0.00	-8.75	0.00
85	FOUNDATION FILL	3.41	1560	2.25	2.22	0.03	0.94	0.27	-0.67	0.29
HC2	SCAR MATERIAL	2.1	1920	3.64	3.48	0.16	5.00	0.00	-5.00	0.00
	Mean	2.54	516	1.65	1.28	0.37	11.44	17.16	5.72	1.50
	Median	2.70	200	1.66	1.17	0.28	8.75	13.74	2.83	1.57
	Minimum	2.70	200	1.66	1.17	0.28	8.75	13.74	2.83	
	Maximum	7.00	1920	3.64	3.48	1.13	35.31	47.68	43.93	
	N	35	35	35	35	35	35	35	35	

ND = no data

Appendix C.5
Shake Flask Extraction Data

TABLE C-5

Questa Mine Samples - Shake Flask Data

Sample Number	Sample Weight (g)	Volume H2O (mL)	pH		Conductivity (uS/cm)		Redox (mV)
			3 Hr	24 Hr	3 Hr	24 Hr	
1	500	1500	3.73	3.89	785	834	503
2	400	1500	3.16	3.08	2130	2520	578
9	500	1500	2.61	2.49	4980	5500	548
10	500	1500	3.65	3.63	252	314	505
14	500	1500	6.95	6.47	12	19	340
15	500	1500	3.22	3.12	998	1203	508
24	500	1500	2.76	2.54	3200	3850	545
26	500	1500	5.58	6.63	83	160	501
27	500	1500	3.63	3.57	648	903	537
29	500	1500	6.92	7.02	184	277	471
35	500	1500	3.22	3.14	2380	2980	585
36	500	1500	3.07	2.98	2170	2770	536
41	500	1500	2.92	2.76	1272	1707	584
42	500	1500	3.23	3.10	1400	2760	574
43	500	1500	5.68	5.50	17	59	409
44	500	1500	6.15	6.65	9	18	287
51	500	1500	5.95	5.94	997	1287	481
52	500	1500	5.70	6.19	1000	1522	422
57	500	1500	2.97	2.89	2290	2520	561
59	500	1500	3.02	2.95	1717	2120	585
60	500	1500	3.48	3.39	1485	2160	549
61	500	1500	2.99	2.91	1177	1584	580
68	500	1500	6.89	6.99	19	29	265
69	500	1500	3.01	2.83	712	1043	605
71	500	1500	3.11	2.92	3320	4010	500
73	500	1500	4.33	4.44	143	193	369
78	500	1500	7.45	7.79	589	790	368
80	500	1500	3.22	3.08	2640	2800	511
84	500	1500	3.38	3.30	2820	3690	542
85	500	1500	4.34	4.36	2380	2510	329
86	500	1500	5.00	5.22	192	262	339
88	500	1500	5.11	5.21	259	311	344
94	500	1500	5.22	4.78	60	93	295
hc1	500	1500	4.01	3.97	2270	2250	505
hc2	500	1500	3.08	2.97	2580	2740	606
hc3	500	1500	4.09	4.06	59	72	520
hc4	500	1500	6.75	6.95	42	58	329
hc5	500	1500	3.83	3.80	2350	2250	491
hc6	500	1500	4.01	3.97	835	1048	493
hc7	500	1500	3.83	3.80	1517	1799	508
Mean			4.28	4.28	1299	1575	478
Median			3.78	3.80	999	1405	505
Minimum			2.61	2.49	9	18	265
Maximum			7.45	7.79	4980	5500	606

TABLE C-5

Questa Mine Samples - Shake Flask Data

Sample Number	24 Hr Alkalinity (mg/L CaCO3)	24 Hr Acidity (mg/L CaCO3) pH 4.5	24 Hr Acidity (mg/L CaCO3) pH 8.3	Al mg/L	Sb mg/L	As mg/L	Ba mg/L
1	0.0	7.0	41.0	4.59	<0.20	<0.20	< 0.010
2	0.0	90.0	240.0	26.8	<0.20	<0.20	< 0.010
9	0.0	735.0	2660.0	297	<0.40	<0.40	0.024
10	0.0	11.5	43.5	4.23	<0.20	<0.20	0.036
14	3.0	0.0	2.0	< 0.20	<0.20	<0.20	< 0.010
15	0.0	100.0	295.0	39.9	<0.20	<0.20	< 0.010
24	0.0	722.0	1163.0	76.9	<0.20	<0.20	< 0.010
26	48.0	0.0	7.9	< 0.20	<0.20	<0.20	0.022
27	0.0	42.2	79.1	7.2	<0.20	<0.20	0.015
29	42.0	0.0	2.6	< 0.20	<0.20	<0.20	0.047
35	0.0	139.7	524.4	59.2	<0.20	<0.20	< 0.010
36	0.0	513.8	1148.9	126	<0.20	<0.20	< 0.010
41	0.0	158.0	266.0	15.5	<0.20	<0.20	< 0.010
42	0.0	147.6	308.3	36.4	<0.20	<0.20	< 0.010
43	4.0	0.0	2.6	1.04	<0.20	<0.20	0.022
44	3.5	0.0	2.0	< 0.20	<0.20	<0.20	< 0.010
51	14.0	0.0	5.3	< 0.20	<0.20	<0.20	0.025
52	22.0	0.0	5.3	< 0.20	<0.20	<0.20	0.045
57	0.0	510.0	945.0	133	<0.20	<0.20	< 0.010
59	0.0	242.4	592.9	84.5	<0.20	<0.20	< 0.010
60	0.0	52.7	184.5	20.4	<0.20	<0.20	0.022
61	0.0	115.9	226.6	14.3	<0.20	<0.20	< 0.010
68	4.5	0.0	0.5	0.27	<0.20	<0.20	< 0.010
69	0.0	116.0	219.0	19	<0.20	<0.20	< 0.010
71	0.0	3030.0	4150.0	771	<0.20	0.35	< 0.010
73	0.0	0.0	12.5	0.96	<0.20	<0.20	< 0.010
78	36.0	0.0	2.0	< 0.20	<0.20	<0.20	0.043
80	0.0	125.0	515.0	84.1	<0.20	<0.20	< 0.010
84	0.0	1222.6	2113.3	361	<0.20	<0.20	< 0.010
85	0.0	0.0	100.1	14	<0.20	<0.20	< 0.010
86	2.0	0.0	10.5	0.27	<0.20	<0.20	0.035
88	1.5	0.0	9.5	0.71	<0.20	<0.20	0.022
94	0.0	0.0	7.9	< 0.20	<0.20	<0.20	0.022
hc1	0.0	10.0	125.0	21.3	<0.20	<0.20	< 0.010
hc2	0.0	145.0	315.0	35.8	<0.20	<0.20	< 0.010
hc3	0.0	3.0	9.0	0.33	<0.20	<0.20	0.039
hc4	9.0	0.0	3.0	< 0.20	<0.20	<0.20	0.035
hc5	0.0	10.0	50.0	7.33	<0.20	<0.20	< 0.010
hc6	0.0	5.0	46.0	6.38	<0.20	<0.20	0.015
hc7	0.0	15.0	110.0	16.9	<0.20	<0.20	< 0.010
Mean	4.74	206.74	413.60	57.20	<0.20	0.01	0.018
Median	0.00	10.75	89.59	10.67	<0.20	<0.20	< 0.010
Minimum	0.0	0.0	0.5	< 0.20	<0.20	<0.20	< 0.010
Maximum	48.00	3030.00	4150.00	771.00	<0.20	0.35	0.047

TABLE C-5

Questa Mine Samples - Shake Flask Data

Sample Number	Be mg/L	Bi mg/L	B mg/L	Cd mg/L	Ca mg/L	Cr mg/L	Co mg/L	Cu mg/L
1	0.006	< 0.10	<0.10	< 0.010	139	< 0.015	0.043	0.506
2	< 0.005	< 0.10	<0.10	< 0.010	468	< 0.015	0.05	0.534
9	0.54	0.32	<0.20	0.626	479	0.16	0.682	10.9
10	< 0.005	< 0.10	<0.10	< 0.010	18.8	< 0.015	0.021	0.121
14	< 0.005	< 0.10	<0.10	< 0.010	0.982	< 0.015	< 0.015	0.051
15	0.017	< 0.10	<0.10	0.017	89.5	< 0.015	0.146	0.47
24	0.011	0.15	<0.10	< 0.010	523	0.208	0.192	0.472
26	< 0.005	< 0.10	<0.10	< 0.010	22.3	< 0.015	< 0.015	< 0.010
27	0.005	< 0.10	<0.10	< 0.010	138	< 0.015	0.049	0.323
29	< 0.005	< 0.10	<0.10	< 0.010	35.5	< 0.015	< 0.015	< 0.010
35	0.007	0.1	<0.10	< 0.010	514	0.054	0.191	0.759
36	0.056	0.2	<0.10	0.028	208	0.118	0.487	5.54
41	0.006	< 0.10	<0.10	< 0.010	177	0.015	0.091	0.618
42	< 0.005	< 0.10	<0.10	< 0.010	547	0.025	0.072	1.6
43	< 0.005	< 0.10	<0.10	< 0.010	2.67	< 0.015	< 0.015	0.06
44	< 0.005	< 0.10	<0.10	< 0.010	1.78	< 0.015	< 0.015	< 0.010
51	< 0.005	< 0.10	<0.10	< 0.010	295	< 0.015	< 0.015	0.01
52	< 0.005	< 0.10	<0.10	< 0.010	350	< 0.015	< 0.015	< 0.010
57	0.023	0.18	<0.10	0.017	161	0.104	0.709	2.03
59	0.017	0.13	<0.10	0.015	139	0.063	0.481	1.48
60	< 0.005	< 0.10	<0.10	< 0.010	427	< 0.015	0.052	0.645
61	< 0.005	< 0.10	<0.10	< 0.010	156	0.017	0.068	0.644
68	< 0.005	< 0.10	<0.10	< 0.010	2.27	< 0.015	< 0.015	0.02
69	0.005	< 0.10	<0.10	< 0.010	16.5	0.065	0.249	0.504
71	0.028	< 0.10	<0.10	0.031	28.3	0.037	0.078	16.4
73	< 0.005	< 0.10	<0.10	< 0.010	18.1	< 0.015	0.015	0.036
78	< 0.005	< 0.10	<0.10	< 0.010	167	< 0.015	< 0.015	< 0.010
80	0.022	< 0.10	<0.10	0.012	568	< 0.015	0.19	5.93
84	0.028	0.15	<0.10	< 0.010	326	0.08	1.01	1.62
85	0.082	< 0.10	<0.10	0.037	569	< 0.015	0.087	1.61
86	< 0.005	< 0.10	<0.10	< 0.010	23.8	< 0.015	< 0.015	0.095
88	< 0.005	< 0.10	<0.10	< 0.010	29.3	< 0.015	0.067	0.052
94	< 0.005	< 0.10	<0.10	< 0.010	3.55	< 0.015	< 0.015	0.493
hc1	0.007	< 0.10	<0.10	< 0.010	571	< 0.015	0.027	0.151
hc2	< 0.005	< 0.10	<0.10	< 0.010	603	< 0.015	0.056	0.315
hc3	< 0.005	< 0.10	<0.10	< 0.010	1.81	< 0.015	< 0.015	0.022
hc4	< 0.005	< 0.10	<0.10	< 0.010	6.16	< 0.015	< 0.015	0.523
hc5	< 0.005	< 0.10	<0.10	< 0.010	578	< 0.015	0.015	0.076
hc6	0.005	< 0.10	<0.10	< 0.010	218	< 0.015	0.035	0.077
hc7	0.009	< 0.10	<0.10	< 0.010	396	< 0.015	0.075	0.122
Mean	0.025	0.11	< 0.10	0.028	225	0.034	0.136	1.37
Median	0.005	< 0.10	< 0.10	< 0.010	159	< 0.015	0.050	0.397
Minimum	< 0.005	< 0.10	< 0.10	< 0.010	1	< 0.015	< 0.015	< 0.010
Maximum	0.540	0.32	< 0.10	0.626	603	0.208	1.010	16.40

TABLE C-5

Questa Mine Samples - Shake Flask Data

Sample Number	Fe mg/L	Pb mg/L	Li mg/L	Mg mg/L	Mn mg/L	Mo mg/L	Ni mg/L	P mg/L
1	0.053	< 0.050	< 0.015	5.56	3.44	< 0.030	0.051	< 0.30
2	6.05	< 0.050	0.028	12.2	1.19	< 0.030	0.078	< 0.30
9	203	0.24	0.638	194	517	< 0.030	0.712	< 0.60
10	0.113	< 0.050	0.018	5.55	1.69	< 0.030	0.041	< 0.30
14	0.119	< 0.050	< 0.015	0.261	0.022	< 0.030	< 0.020	< 0.30
15	2.69	< 0.050	0.043	36.2	20.5	< 0.030	0.336	< 0.30
24	221	< 0.050	0.14	90.5	8.12	< 0.030	0.468	5.62
26	< 0.030	< 0.050	< 0.015	0.719	0.032	0.473	< 0.020	< 0.30
27	0.223	< 0.050	0.019	4.43	0.825	< 0.030	0.073	< 0.30
29	< 0.030	< 0.050	< 0.015	1.61	0.006	0.872	< 0.020	< 0.30
35	5.6	< 0.050	0.173	86.9	1.53	< 0.030	0.414	< 0.30
36	30.3	< 0.050	0.251	119	38.7	< 0.030	0.854	0.49
41	21.6	< 0.050	0.067	24	1.31	< 0.030	0.165	< 0.30
42	5.34	< 0.050	0.059	22.2	1.97	< 0.030	0.13	< 0.30
43	0.662	< 0.050	< 0.015	0.564	0.037	< 0.030	< 0.020	< 0.30
44	0.036	< 0.050	< 0.015	0.303	0.019	< 0.030	< 0.020	< 0.30
51	< 0.030	< 0.050	< 0.015	4.16	0.029	0.954	< 0.020	< 0.30
52	< 0.030	< 0.050	< 0.015	5.87	0.062	1.87	< 0.020	< 0.30
57	17	< 0.050	0.548	125	8.38	< 0.030	0.79	0.34
59	11.2	< 0.050	0.358	83.6	5.58	< 0.030	0.521	< 0.30
60	0.693	< 0.050	0.039	14.3	0.775	< 0.030	0.101	< 0.30
61	9.09	< 0.050	0.079	20.9	0.795	< 0.030	0.122	< 0.30
68	0.184	< 0.050	< 0.015	0.438	0.015	< 0.030	< 0.020	< 0.30
69	9.57	< 0.050	0.107	19.4	21.8	< 0.030	0.639	< 0.30
71	5.69	0.216	0.335	30.2	2.81	< 0.030	0.24	< 0.30
73	0.064	< 0.050	< 0.015	4.69	3.15	< 0.030	0.042	< 0.30
78	< 0.030	< 0.050	< 0.015	2.04	0.02	2.78	< 0.020	< 0.30
80	4.39	< 0.050	0.11	31.6	6.66	< 0.030	0.443	< 0.30
84	2.78	< 0.050	0.18	147	11.4	< 0.030	2.32	1.26
85	0.187	< 0.050	0.023	13	8.21	1.18	0.099	< 0.30
86	0.264	< 0.050	< 0.015	5.67	0.064	< 0.030	< 0.020	< 0.30
88	< 0.030	< 0.050	< 0.015	6.53	18.5	< 0.030	0.059	< 0.30
94	0.227	< 0.050	< 0.015	0.937	0.156	< 0.030	< 0.020	< 0.30
hc1	0.055	< 0.050	0.019	1.18	0.68	< 0.030	0.074	< 0.30
hc2	12.7	< 0.050	0.029	19.1	1.21	< 0.030	0.093	< 0.30
hc3	< 0.030	< 0.050	< 0.015	0.241	0.032	< 0.030	< 0.020	< 0.30
hc4	0.088	< 0.050	< 0.015	1.26	0.021	< 0.030	< 0.020	< 0.30
hc5	0.19	< 0.050	< 0.015	8.1	0.706	< 0.030	0.032	< 0.30
hc6	0.049	< 0.050	< 0.015	4.99	2.04	< 0.030	0.1	< 0.30
hc7	0.116	< 0.050	< 0.015	24.9	5.58	< 0.030	0.215	< 0.30
Mean	14.29	0.059	0.089	29.48	17.38	0.229	0.24	0.47
Median	0.225	< 0.050	0.019	7.32	1.26	0.030	0.08	< 0.30
Minimum	< 0.030	< 0.050	< 0.015	0.241	0.006	< 0.030	< 0.020	< 0.30
Maximum	221	0.24	0.638	194	517	2.78	2.32	5.62

TABLE C-5

Questa Mine Samples - Shake Flask Data

Sample Number	K mg/L	Se mg/L	Si mg/L	Ag mg/L	Na mg/L	Sr mg/L	Tl mg/L	Sn mg/L
1	< 2.0	<0.20	1.55	<0.015	< 2.0	0.165	< 0.10	<0.30
2	< 2.0	<0.20	1.63	<0.015	< 2.0	0.15	< 0.10	<0.30
9	< 4.0	<0.40	8.74	<0.030	< 4.0	0.81	0.33	<0.60
10	< 2.0	<0.20	2.09	<0.015	2.3	0.078	< 0.10	<0.30
14	< 2.0	<0.20	2.8	<0.015	< 2.0	0.012	< 0.10	<0.30
15	< 2.0	<0.20	1.85	<0.015	< 2.0	0.05	< 0.10	<0.30
24	< 2.0	<0.20	1.58	<0.015	< 2.0	0.574	< 0.10	<0.30
26	2.8	<0.20	0.601	<0.015	< 2.0	0.45	< 0.10	<0.30
27	< 2.0	<0.20	2.77	<0.015	< 2.0	0.129	< 0.10	<0.30
29	6.9	<0.20	1.18	<0.015	< 2.0	1.69	< 0.10	<0.30
35	< 2.0	<0.20	2.75	<0.015	< 2.0	0.093	< 0.10	<0.30
36	< 2.0	<0.20	1.72	<0.015	< 2.0	0.055	< 0.10	<0.30
41	< 2.0	<0.20	3.4	<0.015	< 2.0	0.164	< 0.10	<0.30
42	< 2.0	<0.20	2.53	<0.015	< 2.0	0.248	< 0.10	<0.30
43	< 2.0	<0.20	4.15	<0.015	< 2.0	0.02	< 0.10	<0.30
44	< 2.0	<0.20	1.81	<0.015	< 2.0	0.024	< 0.10	<0.30
51	4	<0.20	1.97	<0.015	< 2.0	1.09	< 0.10	<0.30
52	8.2	<0.20	1.96	<0.015	< 2.0	3.68	< 0.10	<0.30
57	< 2.0	<0.20	2.17	<0.015	< 2.0	0.039	< 0.10	<0.30
59	< 2.0	<0.20	2.96	<0.015	< 2.0	0.033	< 0.10	<0.30
60	20.8	<0.20	2.32	<0.015	< 2.0	0.081	< 0.10	<0.30
61	< 2.0	<0.20	3.59	<0.015	< 2.0	0.065	< 0.10	<0.30
68	2.1	<0.20	3.39	<0.015	< 2.0	0.02	< 0.10	<0.30
69	< 2.0	<0.20	3.03	<0.015	< 2.0	0.031	< 0.10	<0.30
71	15.9	<0.20	0.98	<0.015	44.9	0.428	< 0.10	<0.30
73	3.2	<0.20	1.73	<0.015	< 2.0	0.053	< 0.10	<0.30
78	4.3	<0.20	1.82	<0.015	< 2.0	1.53	< 0.10	<0.30
80	< 2.0	<0.20	1.68	<0.015	< 2.0	0.185	< 0.10	<0.30
84	< 2.0	<0.20	2.79	<0.015	< 2.0	0.015	< 0.10	<0.30
85	2.8	<0.20	2.53	<0.015	30.1	0.3	< 0.10	<0.30
86	6.4	<0.20	3.63	<0.015	3.7	0.15	< 0.10	<0.30
88	< 2.0	<0.20	1.23	<0.015	2.3	0.149	< 0.10	<0.30
94	< 2.0	<0.20	2.56	<0.015	6.9	0.015	< 0.10	<0.30
hc1	2	<0.20	3.29	<0.015	< 2.0	0.732	< 0.10	<0.30
hc2	< 2.0	<0.20	1.92	<0.015	< 2.0	0.108	< 0.10	<0.30
hc3	2.9	<0.20	1.88	<0.015	< 2.0	0.018	< 0.10	<0.30
hc4	4.8	<0.20	4.73	<0.015	< 2.0	0.035	< 0.10	<0.30
hc5	4.5	<0.20	1.68	<0.015	5.3	0.269	< 0.10	<0.30
hc6	4.4	<0.20	2.6	<0.015	< 2.0	0.384	< 0.10	<0.30
hc7	3.1	<0.20	2.15	<0.015	< 2.0	0.789	< 0.10	<0.30
Mean	3.7	<0.20	2.49	<0.015	4.1	0.373	0.11	<0.30
Median	2.0	<0.20	2.16	<0.015	2.0	0.139	< 0.10	<0.30
Minimum	< 2.0	<0.20	0.60	<0.015	< 2.0	0.012	< 0.10	<0.30
Maximum	20.8	<0.20	8.74	<0.015	44.9	3.68	0.33	<0.30

TABLE C-5

a Mine Samples - Shake Flask Data

Sample Number	Ti mg/L	W mg/L	V mg/L	Zn mg/L
1	< 0.010	<0.10	<0.030	0.323
2	< 0.010	<0.10	<0.030	0.255
9	< 0.010	<0.20	<0.060	81
10	< 0.010	<0.10	<0.030	0.457
14	< 0.010	<0.10	<0.030	0.025
15	< 0.010	<0.10	<0.030	4.67
24	< 0.010	<0.10	<0.030	1.34
26	< 0.010	<0.10	<0.030	< 0.005
27	< 0.010	<0.10	<0.030	0.12
29	< 0.010	<0.10	<0.030	0.009
35	< 0.010	<0.10	<0.030	0.233
36	< 0.010	<0.10	<0.030	6.39
41	< 0.010	<0.10	<0.030	0.134
42	< 0.010	<0.10	<0.030	0.442
43	0.021	<0.10	<0.030	0.052
44	< 0.010	<0.10	<0.030	0.06
51	< 0.010	<0.10	<0.030	0.014
52	< 0.010	<0.10	<0.030	< 0.005
57	< 0.010	<0.10	<0.030	3.26
59	< 0.010	<0.10	<0.030	2.34
60	< 0.010	<0.10	<0.030	0.204
61	< 0.010	<0.10	<0.030	0.091
68	< 0.010	<0.10	<0.030	0.006
69	< 0.010	<0.10	<0.030	0.9
71	< 0.010	<0.10	<0.030	9.98
73	< 0.010	<0.10	<0.030	0.413
78	< 0.010	<0.10	<0.030	0.01
80	< 0.010	<0.10	<0.030	2.84
84	< 0.010	<0.10	<0.030	1.82
85	< 0.010	<0.10	<0.030	8.03
86	< 0.010	<0.10	<0.030	0.091
88	< 0.010	<0.10	<0.030	0.188
94	< 0.010	<0.10	<0.030	0.046
hc1	< 0.010	<0.10	<0.030	0.113
hc2	< 0.010	<0.10	<0.030	0.399
hc3	< 0.010	<0.10	<0.030	0.021
hc4	< 0.010	<0.10	<0.030	0.06
hc5	< 0.010	<0.10	<0.030	0.076
hc6	< 0.010	<0.10	<0.030	0.323
hc7	< 0.010	<0.10	<0.030	0.645
Mean	0.010	<0.10	<0.030	3.18
Median	0.010	<0.10	<0.030	0.219
Minimum	< 0.010	<0.10	<0.030	< 0.005
Maximum	0.021	<0.10	<0.030	81.0

NMED/SWQ-93/1

INTENSIVE WATER QUALITY STREAM SURVEYS

1992

Surveillance and Standards Section
Surface Water Quality Bureau
New Mexico Environment Department
1190 St. Francis Drive - P.O. Box 26110
Santa Fe, New Mexico 87502

June 1993

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INTENSIVE WATER QUALITY SURVEYS COMPLETED IN 1992

The intensive water quality surveys and reports were completed in fulfillment of work-plan commitments 2.3.A of the "FY 92 Section 106 Work Program for Water Quality Management." This program was partially funded by a grant from the U.S. Environmental Protection Agency under Federal Assistance I.D. No. I-006350-92-0.

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INTENSIVE WATER QUALITY SURVEY OF THE PERENNIAL STREAMS IN HIDALGO COUNTY, NEW MEXICO, MAY 4-5, 1992

Introduction

During the week of May 4, 1992, the Surveillance and Standards Section conducted an intensive water quality survey of four perennial streams in Hidalgo County. The streams are Double Adobe Creek, Clanton Draw, Cloverdale Creek and Skeleton Canyon. All of these streams are currently unclassified.

Water Quality Standards

Water quality standards for these four streams are set forth in section 1-102 of the New Mexico water quality standards (NMWQCC 1991). There are no designated uses for these streams; however, the use-specific numeric standards in section 3-101 are applicable to any attainable use in these stream reaches.

Methods

Water quality sampling methods were in accordance with the Quality Assurance Project Plan for Water Quality Management Programs (NMED 1991).

Sampling Stations

The STORET identification codes and locations of stations selected for this survey are given below. A map of the study area is presented in Fig. 1.

STORET Code	Location
SWCANC.TDAC10	Double Adobe Creek
SWCANC.TCLD20	Clanton Draw near Gray Ranch headquarters
SWCANC.TCDC30	Cloverdale Creek
LCRSSC.TSCC05	Skeleton Canyon Creek

Water Quality Assessment

Water quality data collected during this survey are available on STORET and can be retrieved using the selector A=21NMEX and the restrictor IS=923501. Parametric coverage and survey data are provided in Table 1.

Double Adobe Creek drains the central Animas Mountains and flows to the northwest to join the ephemeral Animas Creek. During the survey this stream was warm, clear, slightly alkaline with high levels of dissolved oxygen and low levels of nutrients and chemical constituents. Results of analyses for dissolved metals have not been received at the time this report was prepared.

Clanton Draw drains the eastern face of the Peloncillo Mountains and flows eastward to Animas Creek. The upper third of this stream flows through the Coronado National Forest and the lower reach flows through the Gray Ranch. Clanton Draw supports a warmwater fishery, numerous waterfowl and a lush

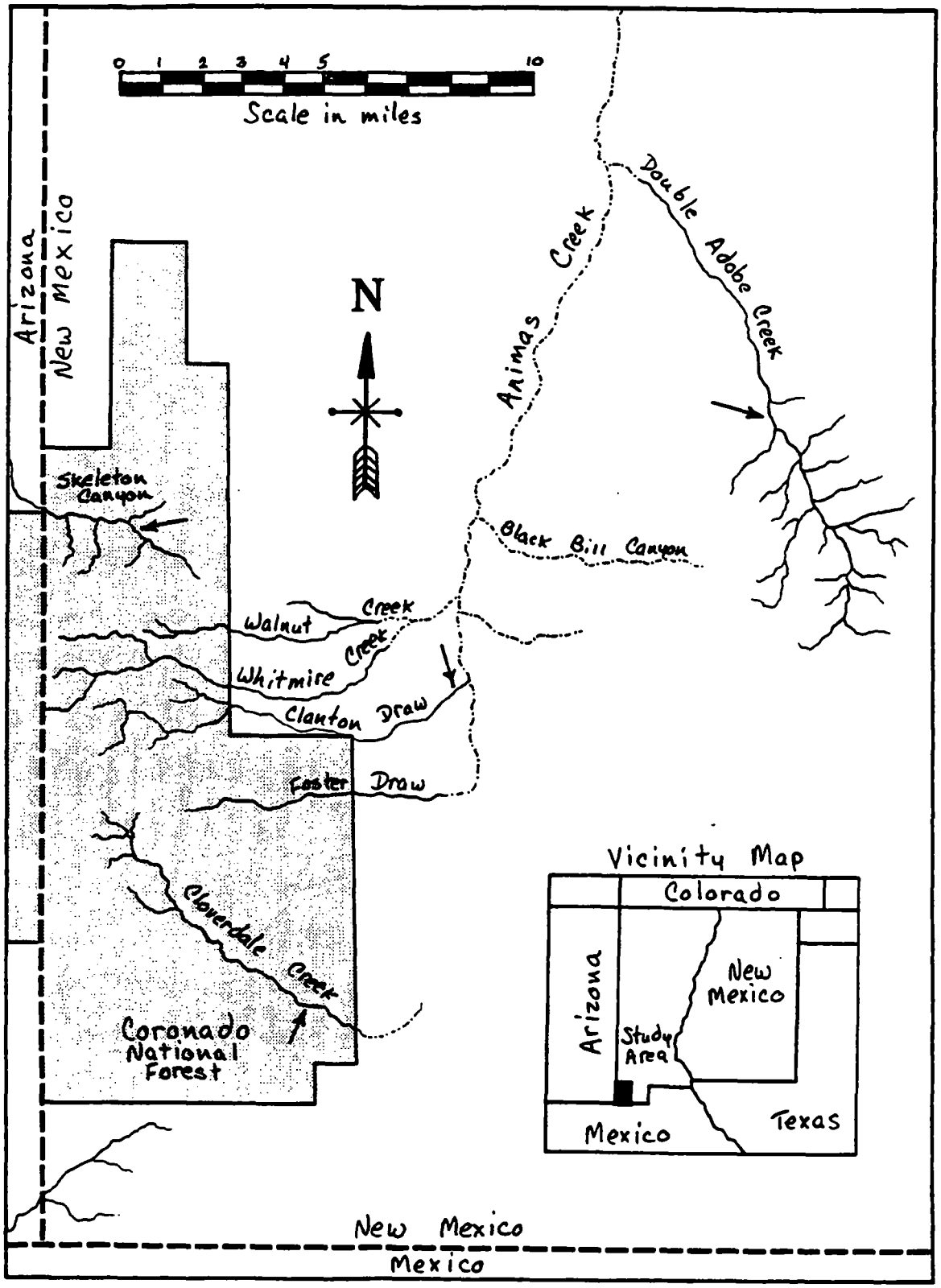

Figure 1. Sampling stations on Double Adobe Creek, Clanton Draw, Cloverdale Creek and Skeleton Canyon, 1992.

riparian habitat. During the survey this stream was warm and slightly alkaline with high levels of dissolved oxygen and low levels of chemical constituents. Total phosphorus and the nitrogen species were somewhat elevated. The water had a low turbidity but was yellow-brown in color. The color and elevated nutrients apparently were due to enrichment from the numerous small marshes upstream from the sampling station and one larger man-made impoundment and wetland. Samples for determination of organochlorine pesticide levels were collected at this station to ensure compliance with the water quality standards for chlordane. All results were less than the minimum quantification levels. Results of analyses for dissolved metals have not been received at the time this report was prepared.

Cloverdale Creek drains the southern end of the Peloncillo Mountains and disappears into the valley drained by the ephemeral Animas Creek. The perennial reach of this stream flows through the Coronado National Forest and private inholdings. During the survey this stream was warm and slightly alkaline with high levels of dissolved oxygen and low levels of nutrients and chemical constituents. The turbidity was slightly elevated and the water had a milky turquoise color. Results of analyses for dissolved metals have not been received at the time this report was prepared.

Skeleton Canyon Creek drains the northern Peloncillo Mountains through the colorful Skeleton Canyon. It flows to the west through the Coronado National Forest into Arizona. During the survey the stream was warm, slightly alkaline and moderately clear with a moderately high dissolved oxygen and low levels of nutrients and chemical constituents. Results of analyses for dissolved metals have not been received at the time this report was prepared.

Double Adobe Creek and the lower reaches of Clanton Draw and Cloverdale Creek flow through private ranch land and are essential livestock and wildlife watering streams. Since they are not currently open to the general public, they are probably adequately protected under the general standards. Skeleton Canyon Creek and the upper reaches of Clanton Draw and Cloverdale Creek are contained in the Coronado National Forest and are open to recreational use, although there are currently few pressures on these watercourses from recreational use, road cuts or discharges. During this survey these streams met the standards for limited warmwater fishery. The microbiological quality of these streams is unknown, since samples for fecal coliform bacteria could not be collected and transported to the SLD in Albuquerque within the six-hour time limit.

Water quality Standards Revisions

It is recommended that the description for water quality segment 2-501 be modified as follows to include these streams:

2-501. The main stem of the Gila River from the New Mexico-Arizona line upstream to State Highway 464 in Red Rock, and perennial reaches of streams in Hidalgo County.

Table 1. Water quality data collected from Clanton Draw and Double Adobe, Cloverdale and Skeleton Canyon creeks, May 4-5, 1992.

STORET RETRIEVAL DATE 93/03/01 PGM=RET
SWCANC.TDAC10 SWCANCTDAC10 DOUBLEADOBE
31 38 22.0 108 45 15.0 4
DOUBLE ADOBE CREEK
35023 NEW MEXICO HIDALGO Double Adobe Creek
21NMEX 920613 15040003
SURFACE SAMPLES 1567 METERS ELEVATION

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00010 WATER TEMP CENT	00095 CNDUCTVY AT 25C MICROMHO	00300 DO MG/L	00400 PH SU	82079 TURBIDTY LAB NTU	70300 RESIDUE DISS-180 C MG/L	00530 RESIDUE TOT NFLT MG/L	00665 PHOS-TOT MG/L P	00900 TOT HARD CACO3 MG/L	00612 UN-IONZD NH3-N MG/L
92/05/04	1605	WATER		19.2	151	7.7	7.83	2.8	132	3K	.120	47	<0.002

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3+NH4- N TOTAL MG/L	00640 T INORG. NITROGEN MG/L N	00625 TOT KJEL N MG/L	00605 ORG N N MG/L	00600 TOTAL N N MG/L	00410 T ALK CACO3 MG/L	00440 HCO3 ION HCO3 MG/L	00945 SULFATE SO4-TOT MG/L	00940 CHLORIDE TOTAL MG/L
92/05/04	1605	WATER		.05	.100K	.15C	.180	.080C	.23C	26	31	32	6

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00915 CALCIUM CA,DISS MG/L	00925 MGNSIUM MG,DISS MG/L	00930 SODIUM NA,DISS MG/L	00935 PTSSIUM K,DISS MG/L	00680 T ORG C C MG/L	01106 ALUMINUM AL,DISS UG/L	01000 ARSENIC AS,DISS UG/L	01005 BARIUM BA,DISS UG/L	01010 BERYLIUM BE,DISS UG/L	01020 BORON B,DISS UG/L
92/05/04	1605	WATER		14.0	3.0	9.00	2.00	5.0					

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01025 CADMIUM CD,DISS UG/L	01030 CHROMIUM CR,DISS UG/L	01035 COBALT CO,DISS UG/L	01040 COPPER CU,DISS UG/L	01046 IRON FE,DISS UG/L	01049 LEAD PB,DISS UG/L	82037 MG DISS MG UG/L	01056 MANGNESE MN,DISS UG/L	71900 MERCURY HG,TOTAL UG/L	01060 MOLY MO,DISS UG/L
92/05/04	1605	WATER										.5K	

REMARK CODES: C - calculated value, K - actual value is less than value shown, J - estimated value

SWCANC.TCLD20 SWCANCTCLD20 CLANTONDRAW
31 32 03.0 108 52 30.0 4
CLANTON DRAW AT GRAY RANCH HEADQUARTERS
35023 NEW MEXICO HIDALGO
21NMEX 920613 15040003
SURFACE SAMPLES 1547 METERS ELEVATION

Clanton Draw at Gray Ranch Headquarters

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00010 WATER TEMP CENT	00095 CNDUCTVY AT 25C MICROMHO	00300 DO MG/L	00400 PH SU	82079 TURBIDTY LAB NTU	70300 RESIDUE DISS-180 C MG/L	00530 RESIDUE TOT NFLT MG/L	00665 PHOS-TOT MG/L P	00900 TOT HARD CACO3 MG/L	00612 UN-IONZD NH3-N MG/L
92/05/04	1110	WATER		17.8	133	7.7	7.55	1.1	122	7	.220	42	0.002

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3+NH4- N TOTAL MG/L	00640 T INORG. NITROGEN MG/L N	00625 TOT KJEL N MG/L	00605 ORG N N MG/L	00600 TOTAL N N MG/L	00410 T ALK CACO3 MG/L	00440 HCO3 ION HCO3 MG/L	00945 SULFATE SO4-TOT MG/L	00940 CHLORIDE TOTAL MG/L
92/05/04	1110	WATER		.04K	.150	.19C	.570	.420C	.61C	41	50	12	5K

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00915 CALCIUM CA,DISS MG/L	00925 MGNSIUM MG,DISS MG/L	00930 SODIUM NA,DISS MG/L	00935 PTSSIUM K,DISS MG/L	00680 T ORG C C MG/L	01106 ALUMINUM AL,DISS UG/L	01000 ARSENIC AS,DISS UG/L	01005 BARIUM BA,DISS UG/L	01010 BERYLIUM BE,DISS UG/L	01020 BORON B,DISS UG/L
92/05/04	1110	WATER		12.0	3.0	5.00	3.00	10.0					

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01025 CADMIUM CD,DISS UG/L	01030 CHROMIUM CR,DISS UG/L	01035 COBALT CO,DISS UG/L	01040 COPPER CU,DISS UG/L	01046 IRON FE,DISS UG/L	01049 LEAD PB,DISS UG/L	82037 MG DISS MG UG/L	01056 MANGNESE MN,DISS UG/L	71900 MERCURY HG,TOTAL UG/L	01060 MOLY MO,DISS UG/L
92/05/04	1110	WATER										.5K	

REMARK CODES: C - calculated value, K - actual value is less than value shown, J - estimated value

SWCANC.TCLD20 SWCANCTCLD20 CLANTONDRAW
31 32 03.0 108 52 30.0 4
CLANTON DRAW AT GRAY RANCH HEADQUARTERS
35023 NEW MEXICO HIDALGO
21NMEX 920813 15040003
SURFACE SAMPLES 1547 METERS ELEVATION

Clanton Draw at Gray Ranch Headquarters

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	39330 ALDRIN TOT UG/L	39337 ALPHABHC TOTUG/L	39338 BETA BHC TOTUG/L	34259 DELTABHC TOTUG/L	39340 GAMMABHC LINDANE TOT.UG/L	39348 A-CHLRDN WHL SMPL UG/L	39810 G-CHLRDN WHL SMPL UG/L	39360 DDD WHL SMPL UG/L	39365 DDE WHL SMPL UG/L	39370 DDT WHL SMPL UG/L
92/05/04	1110	WATER		.100K	.100K	.100K	.100K	.100K	1.000K	1.00K	.100K	.100K	.100K

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	39380 DIELDRIN TOTUG/L	82623 ENDOSLFN -SO4 TOT REC UG/L	82624 ENDOSLFN BETA TOT REC UG/L	39388 ENDOSULN WHL SMPL UG/L	39390 ENDRIN TOT UG/L	82622 ENDRIN ALDH TOT REC UG/L	78008 ENDRIN KETONE UG/L	39700 HCB TOT UG/L	39410 HEPTCHLR TOTUG/L	39420 HPCHLREP TOTUG/L
92/05/04	1110	WATER		.100K	.2K	.1K	.100K	.100K	.2K	.20K	.160K	.100K	.100K

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	39480 MTHXYCLR WHL SMPL UG/L	39492 PCB-1232 TOTUG/L	39496 PCB-1242 TOTUG/L	39500 PCB-1248 TOTUG/L	39504 PCB-1254 TOTUG/L	39508 PCB-1260 TOTUG/L	39400 TOXAPHEN TOTUG/L
92/05/04	1110	WATER		1.000K	1.000K	1.000K	1.000K	2.000K	2.000K	2.000K

REMARK CODES: C - calculated value, K - actual value is less than value shown, J - estimated value

SWCANC.TCDC30 SWCANCTCDC30 CLOVERDALE
31 26 15.0 108 58 29.0 4
CLOVERDALE CREEK
35023 NEW MEXICO HIDALGO Cloverdale Creek
21NMEX 920613 15080303
SURFACE SAMPLES 1638 METERS ELEVATION

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00010 WATER TEMP CENT	00095 CNDUCTVY AT 25C MICROMHO	00300 DO MG/L	00400 PH SU	82079 TURBIDTY LAB NTU	70300 RESIDUE DISS-180 C MG/L	00530 RESIDUE TOT NFLT MG/L	00665 PHOS-TOT MG/L P	00900 TOT HARD CACO3 MG/L	00612 UN-IONZD NH3-N MG/L
92/05/04	1245	WATER		20.1	100	8.3	7.30	12.5	130	7	.090	31	<0.001

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3+NH4- N TOTAL MG/L	00640 T INORG. NITROGEN MG/L N	00625 TOT KJEL N MG/L	00605 ORG N N MG/L	00600 TOTAL N N MG/L	00410 T ALK CACO3 MG/L	00440 HCO3 ION HCO3 MG/L	00945 SULFATE SO4-TOT MG/L	00940 CHLORIDE TOTAL MG/L
92/05/04	1245	WATER		.04K	.100K	.14C	.150	.050C	.19C	20	25	19	5

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00915 CALCIUM CA,DISS MG/L	00925 MGNSIUM MG,DISS MG/L	00930 SODIUM NA,DISS MG/L	00935 PTSSIUM K,DISS MG/L	00680 T ORG C C MG/L	01106 ALUMINUM AL,DISS UG/L	01000 ARSENIC AS,DISS UG/L	01005 BARIUM BA,DISS UG/L	01010 BERYLIUM BE,DISS UG/L	01020 BORON B,DISS UG/L
92/05/04	1245	WATER		9.0	2.0	5.00	4.00	4.0					

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01025 CADMIUM CD,DISS UG/L	01030 CHROMIUM CR,DISS UG/L	01035 COBALT CO,DISS UG/L	01040 COPPER CU,DISS UG/L	01046 IRON FE,DISS UG/L	01049 LEAD PB,DISS UG/L	82037 MG DISS MG UG/L	01056 MANGNESE MN,DISS UG/L	71900 MERCURY HG,TOTAL UG/L	01060 MOLY MO,DISS UG/L
92/05/04	1245	WATER										.5K	

REMARK CODES: C - calculated value, K - actual value is less than value shown, J - estimated value

STORET RETRIEVAL DATE 93/03/01 PGM=RET PAGE: 5
LCRSSC.TSCC05 LCRSSCTSCC05 SKELETONCAN
31 35 12.0 109 00 45.0 4
SKELETON CANYON CREEK
35023 NEW MEXICO HIDALGO Skeleton Canyon Creek
21NMEX 920613 15040006
SURFACE SAMPLES 1507 METERS ELEVATION

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00010 WATER TEMP CENT	00095 CNDUCTVY AT 25C MICROMHO	00300 DO MG/L	00400 PH SU	82079 TURBIDTY LAB NTU	70300 RESIDUE DISS-180 C MG/L	00530 RESIDUE TOT NFLT MG/L	00665 PHOS-TOT MG/L P	00900 TOT HARD CACO3 MG/L	00612 UN-IONZD NH3-N MG/L
92/05/05	1100	WATER		22.0	108	7.0	7.53	5.4	122	3K	.090	43	<0.002

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3+NH4- N TOTAL MG/L	00640 T INORG. NITROGEN MG/L N	00625 TOT KJEL N MG/L	00605 ORG N N MG/L	00600 TOTAL N N MG/L	00410 T ALK CACO3 MG/L	00440 HCO3 ION HCO3 MG/L	00945 SULFATE SO4-TOT MG/L	00940 CHLORIDE TOTAL MG/L
92/05/05	1100	WATER		.04K	.100K	.14C	.220	.120C	.26C	25	30	17	5K

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00915 CALCIUM CA,DISS MG/L	00925 MGNSIUM MG,DISS MG/L	00930 SODIUM NA,DISS MG/L	00935 PTSSIUM K,DISS MG/L	00680 T ORG C C MG/L	01106 ALUMINUM AL,DISS UG/L	01000 ARSENIC AS,DISS UG/L	01005 BARIUM BA,DISS UG/L	01010 BERYLIUM BE,DISS UG/L	01020 BORON B,DISS UG/L
92/05/05	1100	WATER		14.0	2.0	3.00	4.00	8.0					

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01025 CADMIUM CD,DISS UG/L	01030 CHROMIUM CR,DISS UG/L	01035 COBALT CO,DISS UG/L	01040 COPPER CU,DISS UG/L	01046 IRON FE,DISS UG/L	01049 LEAD PB,DISS UG/L	82037 MG DISS MG UG/L	01056 MANGNESE MN,DISS UG/L	71900 MERCURY HG,TOTAL UG/L	01060 MOLY MO,DISS UG/L
92/05/05	1100	WATER										.5K	

REMARK CODES: C - calculated value, K - actual value is less than value shown, J - estimated value

INTENSIVE WATER QUALITY SURVEY OF THE GILA RIVER AND ITS TRIBUTARIES FROM THE CLIFF DWELLINGS DOWNSTREAM TO VIRDEN, CATRON, GRANT AND HIDALGO COUNTIES, NEW MEXICO, JUNE 1-3 AND AUGUST 5, 1992

Introduction

During the week of June 1, 1992, the Surveillance and Standards Section conducted a four-day intensive water quality survey of the Gila River from the cliff dwellings downstream to Virden, New Mexico, including the East, Middle and West forks. During the week additional samples were collected from Mangus and Sapillo creeks. Additional samples were collected from Turkey Creek on August 5, 1992. These streams are contained in water quality segments 2-501, 2-502 and 2-503.

Water Quality Standards

Water quality standards for the Gila River and its tributaries are set forth in sections 1-102, 2-501, 2-502, 2-503 and 3-101 of the New Mexico water quality standards (NMWQCC 1991). Designated uses for segment 2-501, which consists of the Gila River from the New Mexico-Arizona line upstream to Red Rock, are irrigation, limited warmwater fishery, livestock and wildlife watering and primary contact recreation. Designated uses for segment 2-502, which contains the Gila River from Red Rock upstream to Gila Hot Springs and perennial reaches of its tributaries below the town of Cliff, are industrial water supply, irrigation, livestock and wildlife watering, marginal coldwater fishery, primary contact recreation and warmwater fishery. Designated uses for segment 2-503, which includes the Gila River from Gila Hot Springs upstream to the headquarters and perennial reaches of its tributaries at or above the town of Cliff, are domestic water supply, high quality coldwater fishery, irrigation, livestock and wildlife watering and secondary contact recreation.

Methods

Water quality sampling methods were in accordance with the Quality Assurance Project Plan for Water Quality Management Programs (NMED 1991).

Sampling Stations

The names, STORET identification codes and locations of stations selected for this survey are given below. A map of the study area is presented in Fig. 2.

Station	STORET Code	Location
1	GRB501000505	Gila River at Virden.
2	GRB502001010	Gila River at Red Rock.
3	GRB502001515	Mangus Creek at Forest Road 809.
4	GRB502004020	Gila River at Gila.

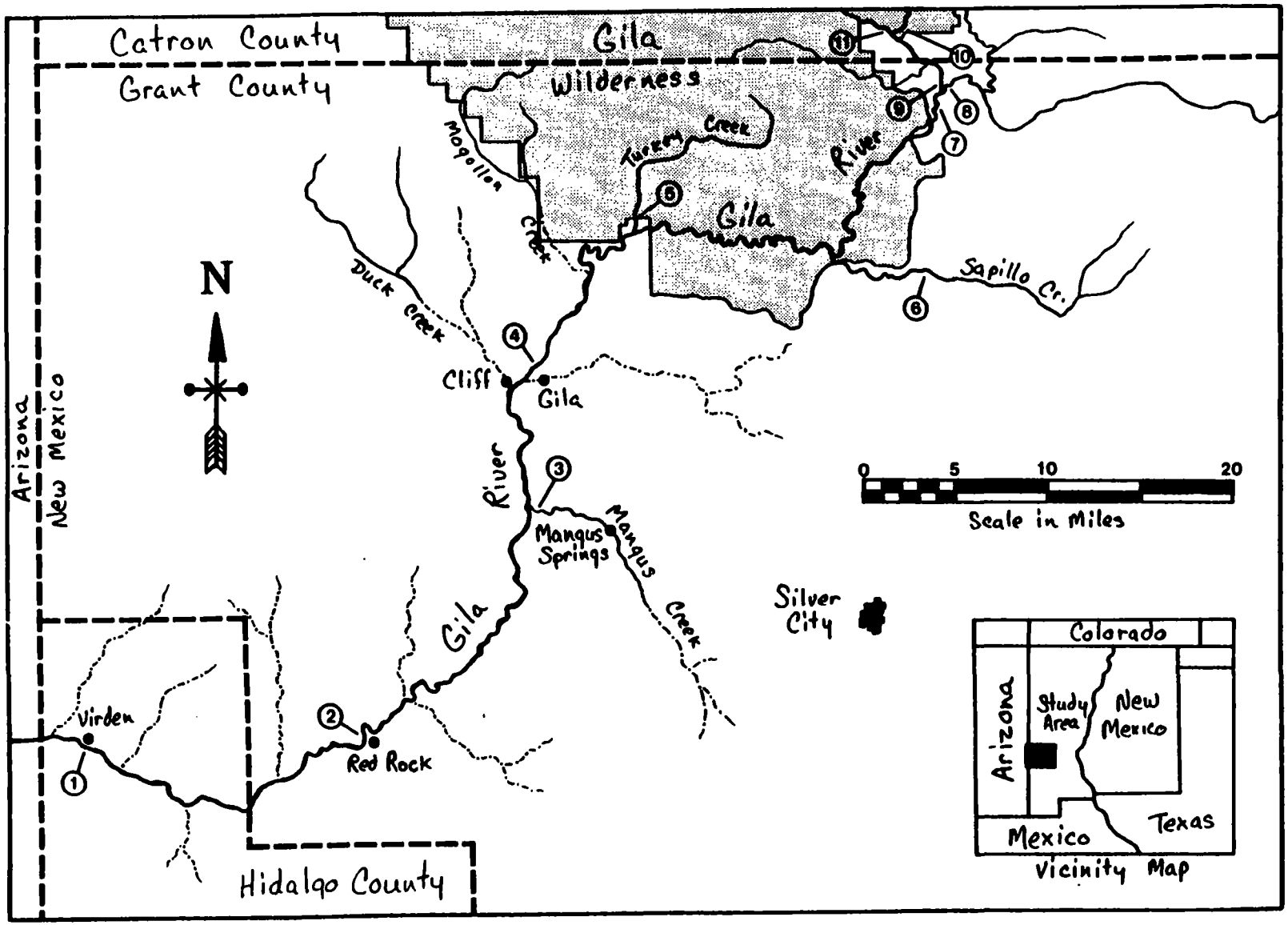

Figure 2. Map of sampling stations on the Gila River, including the East, Middle and West forks and on Mangus, Turkey and Sapillo creeks, 1992.

Station	STORET Code	Location
5	GRB503005505	Turkey Creek above Gila River at Forest Trail 155.
6	GRB503006530	Sapillo Creek at Highway 15.
7	GRB502007035	Gila River below East Fork of the Gila River.
8	GRB503007540	East Fork of the Gila River.
9	GRB502008055	Gila River below Gila Hot Springs.
10	GRB503009560	Middle Fork of the Gila River at mouth.
11	GRB503010570	West Fork of the Gila River above the Middle Fork of the Gila River.

Water Quality Assessment

Water quality data collected during this survey are available on STORET and can be retrieved using the selector A=21NMEX and the restrictor IS=923502. Parametric coverage and survey data are provided in Table 2.

During the period of June 1-4, 1992, stream discharges measured at the USGS gage on the Gila River near Gila were 668, 641, 553 and 490 ft^3/sec and those measured at the USGS gage on the Gila River near Red Rock were 855, 779, 673 and 557 ft^3/sec. Results of analyses for dissolved metals for this survey have not been received at the time this report was prepared.

The Gila River near Virden (station 1) was the only station during this intensive water quality survey located in water quality segment 2-501. The water here was warm, moderately alkaline and very turbid, with a relatively low level of dissolved oxygen. Nutrients were present in low to moderate amounts, as were most other chemical constituents. Samples for determination of organochlorine pesticide levels were collected at this station to ensure compliance with the water quality standards for chlordane. All results were less than the minimum quantification levels. Turbidity levels during both sampling trips exceeded the 25 NTU numeric standard for primary contact recreation, a designated use for this segment. The primary contact recreation use was only partially supported due to turbidity, which ranged from four to six times the standard. All other designated uses were attained.

The Gila River near Red Rock (station 2) was similar in most respects to the river at station 1. The water was moderately warm, alkaline and turbid with a higher dissolved oxygen content. Nutrients and most other chemical constituents were present at low to moderate levels except for total phosphorus, which was elevated. Samples for determination of organochlorine pesticide levels were collected at this station and all results were less than the minimum quantification levels. During two of the sampling runs turbidity levels exceeded the 25 NTU numeric standard for primary contact recreation, a designated use for this segment. This use was judged to be only partially supported while all other designated uses were attained.

Mangus Creek (station 3) was warm and moderately alkaline and turbid, with high levels of dissolved oxygen. Total phosphorus and most other chemical constituents were present in low to moderate amounts. Exceptions were nitrates/nitrites, total inorganic nitrogen and total nitrogen, which were present in very high levels. Water in sampling wells along Mangus Creek generally contain less than 1 mg/l nitrate, which suggests that much of the observed nitrate and other nitrogen species originate from surface sources (Twedt 1984). The most likely source was grazing cattle, which tend to concentrate near springs and seeps, common in the Mangus Creek watershed (Pierce 1987). One measurement for turbidity exceeded the 25 NTU numeric standard for primary contact recreation, a designated use for this segment. This exceedance is not considered to be significant and all other designated uses were attained.

The Gila River at Gila (station 4) was moderately warm and alkaline with moderate levels of dissolved oxygen and nutrients and high levels of turbidity. Nutrients and most other chemical constituents were present in low amounts. Turbidity levels during all three sampling trips exceeded the 25 NTU numeric standard for primary contact recreation, a designated use for this segment. This use was judged to be only partially attained. All other designated uses were attained.

Turkey Creek (station 5) can only be accessed by a trail that fords the main stem of the Gila River three times. Because of high flows in the Gila River during the week of June 1, access was not possible. Samples were collected from Turkey Creek on August 5, 1992, when the discharge of the Gila River near Gila was 60 ft^3/sec, compared to 668 ft^3/sec on June 1. The water in Turkey Creek was warm and moderately well oxygenated. Turbidity was very low as were nitrates, total phosphorus and most other chemical constituents. Exceptions were total Kjeldahl, organic and total nitrogen, which were high, possibly as a result of cattle grazing in the watershed. The temperature exceeded the numeric standard for segment 2-503, which indicates a partial impairment of the high quality coldwater fishery use, while all other designated uses were attained.

Sapillo Creek (station 6) was warm and slightly alkaline with moderate levels of dissolved oxygen and low levels of nutrients and most other chemical constituents. Two of the measured temperatures were above the standard of 20 C, which normally applies to segments designated for high quality coldwater fishery. There is a higher temperature standard of 32.2 C for Sapillo Creek and the East Fork of the Gila River. During two of the sampling runs turbidity was very low, while during the third run the turbidity greatly exceeded the segment standard of 10 NTU. This high reading indicates a partial impairment of the high quality coldwater fishery use, while all other designated uses were attained.

The Gila River below the East Fork (station 7) was moderately cool and clear and slightly alkaline with moderate levels of dissolved oxygen and nutrients. There were low levels of most other chemical constituents. There were no exceedances of the numeric or general standards and all designated uses were attained.

The East Fork of the Gila River (station 8) was cool to moderately warm and slightly alkaline with relatively high levels of dissolved oxygen. Turbidity

was very high during all three sampling runs. Total phosphorus and total organic carbon were also elevated, probably due to extensive grazing of cattle in the watershed. Most other chemical constituents were present in low to moderate levels. There were three exceedances of the numeric standard for turbidity, one for total phosphorus and one for total organic carbon. The measured total organic carbon level was 7.0 mg/l, as was the value for the QA replicate, while the standard for this segment is "less than 7.0 mg/l." These exceedances indicate a partial impairment of the high quality coldwater fishery use, while all other designated uses were attained.

The Gila River below the hot springs (station 9) was cool and slightly alkaline, with moderate levels of dissolved oxygen and turbidity. Most other chemical constituents were present in low to moderate amounts. Combined radium-226 and radium-228 was well below the numeric standard for livestock and wildlife watering. Samples for determination of organic contaminant levels were collected at this station and all results were less than the minimum quantification levels. There were no exceedances of the numeric or general standards and all designated uses were attained.

The Middle Fork of the Gila River (station 10) was cool, slightly alkaline and moderately well oxygenated. Turbidity and total phosphorus levels were high while levels of other nitrogen species and most other chemical constituents were low. The high phosphorus levels may reflect the composition of the soils in the watershed. All three turbidity readings exceeded the standard for segment 2-503, as did two of the three samples for total phosphorus. These exceedances represent a partial impairment of the high quality coldwater fishery use, while all other designated uses were attained.

The West Fork of the Gila River (station 11) was cool and moderately clear and alkaline with relatively high levels of dissolved oxygen. There were low levels of nutrients and most other chemical constituents. One turbidity level exceeded the standard for segment 2-503, however the exceedance was of such a low magnitude that no impairment of the high quality coldwater fishery use was deemed to have occurred. All other designated uses were attained.

Because of its remoteness and the difficulty of reaching Turkey Creek, an analysis of the macroinvertebrate community structure and habitat conditions was conducted. The results of this analysis are included in the report "Intensive water quality survey of the upper Gila River and its tributaries, Catron and Grant counties, New Mexico, August 3-4 and September 16, 1992" included in this volume.

Table 2. Water quality data collected from the Gila River and tributaries, June 1-3 and August 5, 1992.

STORET RETRIEVAL DATE 93/03/16 PGM=RET PAGE: 1
QRB501.000505 QRB501000505 LG1 GILA1
32 39 22.0 108 57 18.0 4
GILA RIVER NEAR VIRDEN AT NM HWY 92 BRIDGE
35023 NEW MEXICO HIDALGO
COLORADO RIVER 110400
GILA RIVER STATION 1 - GILA RIVER NEAR VIRDEN AT NM HWY 92 BRIDGE
21NMEX 870919 15040002
SURFACE SAMPLES 1152 METERS ELEVATION

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00010 WATER TEMP CENT	00095 CNDUCTVY AT 25C MICROMHO	00300 DO MG/L	00400 PH SU	82079 TURBIDTY LAB NTU	70300 RESIDUE DISS-180 C MG/L	00530 RESIDUE TOT NFLT MG/L	00665 PHOS-TOT MG/L P	00900 TOT HARD CACO3 MG/L	00612 UN-IONZD NH3-N MG/L
92/06/01	1635	WATER		21.0	185	7.6	8.28	121.0	163	181	.100	61	<0.008C
92/06/03	1350	WATER		23.4	185	7.2	8.25	100.0	160	172	.130	66	<0.008C

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3+NH4- N TOTAL MG/L	00640 T INORG. NITROGEN MG/L N	00625 TOT KJEL N MG/L	00605 ORG N N MG/L	00600 TOTAL N N MG/L	00410 T ALK CACO3 MG/L	00440 HCO3 ION HCO3 MG/L	00945 SULFATE SO4-TOT MG/L	00940 CHLORIDE TOTAL MG/L
92/06/01	1635	WATER		.14	.100K	.24C	.290	.190C	.43C	74	90	14	6
92/06/03	1350	WATER		.16	.100K	.26C	.390	.290C	.55C	79	96	15	6

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00915 CALCIUM CA,DISS MG/L	00925 MGNSIUM MG,DISS MG/L	00930 SODIUM NA,DISS MG/L	00935 PTSSIUM K,DISS MG/L	00680 T ORG C C MG/L	01106 ALUMINUM AL,DISS UG/L	01000 ARSENIC AS,DISS UG/L	01005 BARIUM BA,DISS UG/L	01010 BERYLIUM BE,DISS UG/L	01020 BORON B,DISS UG/L
92/06/01	1635	WATER		18.0	4.0	13.00	2.00	5.0K					
92/06/03	1350	WATER		20.0	4.0	13.00	2.00						

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01025 CADMIUM CD,DISS UG/L	01030 CHROMIUM CR,DISS UG/L	01035 COBALT CO,DISS UG/L	01040 COPPER CU,DISS UG/L	01046 IRON FE,DISS UG/L	01049 LEAD PB,DISS UG/L	82037 MG DISS MG UG/L	01056 MANGNESE MN,DISS UG/L	71900 MERCURY HG,TOTAL UG/L	01060 MOLY MO,DISS UG/L
92/06/01	1635	WATER										.5K	

REMARK CODES: C - calculated value, K - actual value is less than value shown, J - estimated value

STORET RETRIEVAL DATE 93/03/02 PGM=RET PAGE: 2
GRB501.000505 GRB501000505 LG1 GILA1
32 39 22.0 108 57 18.0 4
GILA RIVER NEAR VIRDEN AT NM HWY 92 BRIDGE
35023 NEW MEXICO HIDALGO
COLORADO RIVER 110400
GILA RIVER STATION 1 - GILA RIVER NEAR VIRDEN AT NM HWY 92 BRIDGE
21NMEX 870919 15040002
0000 FEET DEPTH 1152 METERS ELEVATION

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	39330 ALDRIN TOT UG/L	39337 ALPHABHC TOTUG/L	39338 BETA BHC TOTUG/L	34259 DELTABHC TOTUG/L	39340 GAMMABHC LINDANE TOT.UG/L	39348 A-CHLRDN WHL SMPL UG/L	39810 G-CHLRDN WHL SMPL UG/L	39360 DDD WHL SMPL UG/L	39365 DDE WHL SMPL UG/L	39370 DDT WHL SMPL UG/L
92/08/03	1350	WATER		.050K	.050K	.050K	.050K	.050K	.500K	.50K	.100K	.100K	.100K

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	39380 DIELDRIN TOTUG/L	82623 ENDOSLFN -SO4 TOT REC UG/L	82624 ENDOSLFN BETA TOT REC UG/L	39388 ENDOSULN WHL SMPL UG/L	39390 ENDRIN TOT UG/L	82622 ENDRIN ALDH TOT REC UG/L	78008 ENDRIN KETONE UG/L	39700 HCB TOT UG/L	39410 HEPTCHLR TOTUG/L	39420 HPCHLREP TOTUG/L
92/08/03	1350	WATER		.100K	.1K	.1K	.050K	.100K	.1K	.10K	.080K	.050K	.050K

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	39480 MTHXYCLR WHL SMPL UG/L	39492 PCB-1232 TOTUG/L	39496 PCB-1242 TOTUG/L	39500 PCB-1248 TOTUG/L	39504 PCB-1254 TOTUG/L	39508 PCB-1260 TOTUG/L	39400 TOXAPHEN TOTUG/L
92/08/03	1350	WATER		.500K	.500K	.500K	.500K	1.000K	1.000K	1.000K

REMARK CODES: C - calculated value, K - actual value is less than value shown, J - estimated value

GRB502.001010 GRB502001010 LQ2 GILA2
32 41 42.0 108 43 52.0 4
GILA RIVER AT RED ROCK
35017 NEW MEXICO GRANT
COLORADO RIVER 110400
GILA RIVER
21NMEX 870919 15040002
SURFACE SAMPLES 1242 METERS ELEVATION

STATION 2 - GILA RIVER AT RED ROCK

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00010 WATER TEMP CENT	00095 CNDUCTVY AT 25C MICROMHO	00300 DO MG/L	00400 PH SU	82079 TURBIDTY LAB NTU	70300 RESIDUE DISS-180 C MG/L	00530 RESIDUE TOT NFLT MG/L	00665 PHOS-TOT MG/L P	00900 TOT HARD CACO3 MG/L	00612 UN-IONZD NH3-N MG/L
92/06/01	1545	WATER		19.0	175	7.8	8.29	92.0	150	154	.090	61	<0.007C
92/06/02	0820	WATER		17.1	179	8.0	8.03	7.6	154	105	.260	59	<0.003C
92/06/03	1440	WATER		23.1	195	7.3	8.12	66.0	152	97	.100	61	<0.006C

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3+NH4- N TOTAL MG/L	00640 T INORG. NITROGEN MG/L N	00625 TOT KJEL N MG/L	00605 ORG N N MG/L	00600 TOTAL N N MG/L	00410 T ALK CACO3 MG/L	00440 HCO3 ION HCO3 MG/L	00945 SULFATE SO4-TOT MG/L	00940 CHLORIDE TOTAL MG/L
92/06/01	1545	WATER		.15	.100K	.25C	.370	.270C	.52C	68	83	14	6
92/06/02	0820	WATER		.15	.100K	.25C	.420	.320C	.57C	70	86	14	6
92/06/03	1440	WATER		.20	.100K	.30C	.350	.250C	.55C	75	91	15	6

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00915 CALCIUM CA,DISS MG/L	00925 MGNSIUM MG,DISS MG/L	00930 SODIUM NA,DISS MG/L	00935 PTSSIUM K,DISS MG/L	00680 T ORG C C MG/L	01106 ALUMINUM AL,DISS UG/L	01000 ARSENIC AS,DISS UG/L	01005 BARIUM BA,DISS UG/L	01010 BERYLIUM BE,DISS UG/L	01020 BORON B,DISS UG/L
92/06/01	1545	WATER		18.0	4.0	12.00	2.00	5.0					
92/06/02	0820	WATER		17.0	4.0	12.00	6.00						
92/06/03	1440	WATER		18.0	4.0	13.00	2.00						

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01025 CADMIUM CD,DISS UG/L	01030 CHROMIUM CR,DISS UG/L	01035 COBALT CO,DISS UG/L	01040 COPPER CU,DISS UG/L	01046 IRON FE,DISS UG/L	01049 LEAD PB,DISS UG/L	82037 MG DISS MG UG/L	01056 MANGNESE MN,DISS UG/L	71900 MERCURY HG,TOTAL UG/L	01060 MOLY MO,DISS UG/L
92/06/01	1545	WATER										.5K	

REMARK CODES: C - calculated value, K - actual value is less than value shown, J - estimated value

STORET RETRIEVAL DATE 93/03/02 PGM=RET PAGE: 4
GRB502.001010 GRB502001010 LQ2 GILA2
32 41 42.0 108 43 52.0 4
GILA RIVER AT RED ROCK
35017 NEW MEXICO GRANT
COLORADO RIVER 110400
GILA RIVER STATION 2 - GILA RIVER AT RED ROCK
21NWEX 870919 15040002
0000 FEET DEPTH 1242 METERS ELEVATION

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	39330 ALDRIN TOT UG/L	39337 ALPHABHC TOTUG/L	39338 BETA BHC TOTUG/L	34259 DELTABHC TOTUG/L	39340 GAMMABHC LINDANE TOT.UG/L	39348 A-CHLRDN WHL SMPL UG/L	39810 G-CHLRDN WHL SMPL UG/L	39360 DDD WHL SMPL UG/L	39365 DDE WHL SMPL UG/L	39370 DDT WHL SMPL UG/L
92/06/03	1440	WATER		.050K	.050K	.050K	.050K	.050K	.500K	.50K	.100K	.100K	.100K

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	39380 DIELDRIN TOTUG/L	82623 ENDOSLFN -SO4 TOT REC UG/L	82624 ENDOSLFN BETA TOT REC UG/L	39388 ENDOSULN WHL SMPL UG/L	39390 ENDRIN TOT UG/L	82622 ENDRIN ALDH TOT REC UG/L	78008 ENDRIN KETONE UG/L	39700 HCB TOT UG/L	39410 HEPTCHLR TOTUG/L	39420 HPCHLREP TOTUG/L
92/06/03	1440	WATER		.100K	.1K	.1K	.050K	.100K	.1K	.10K	.080K	.050K	.050K

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	39480 MTHXYCLR WHL SMPL UG/L	39492 PCB-1232 TOTUG/L	39496 PCB-1242 TOTUG/L	39500 PCB-1248 TOTUG/L	39504 PCB-1254 TOTUG/L	39508 PCB-1260 TOTUG/L	39400 TOXAPHEN TOTUG/L
92/06/03	1440	WATER		.500K	.500K	.500K	.500K	1.000K	1.000K	1.000K

REMARK CODES: C - calculated value, K - actual value is less than value shown, J - estimated value

GRB502.001515 GRB502001515 LG3 GILA3
32 51 39.0 108 35 08.0 4
MANGAS CREEK ABOVE GILA RIVER ON ROUTE 809
35017 NEW MEXICO GRANT
COLORADO RIVER 110400
GILA RIVER STATION 3 - MANGAS CREEK ABOVE GILA RIVER ON ROUTE 809
21NMEX 870919 15040002
SURFACE SAMPLES 1340 METERS ELEVATION

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00010 WATER TEMP CENT	00095 CNDUCTVY AT 25C MICROMHO	00300 DO MG/L	00400 PH SU	82079 TURBIDTY LAB NTU	70300 RESIDUE DISS-180 C MG/L	00530 RESIDUE TOT NFLT MG/L	00665 PHOS-TOT MG/L P	00900 TOT HARD CACO3 MG/L	00612 UN-IONZD NH3-N MG/L
92/06/01	1420	WATER		23.4	619	8.0	8.43	17.0	482	15	.010	247	<0.012C
92/06/02	0950	WATER		17.1	646	9.1	8.50	32.0	530	15	.030	341	<0.009C
92/06/02	0950	QA REPLICATE							568	23	.040	283	<0.010C
92/06/03	1600	WATER		27.9	575	8.4	8.52	15.0	402	6	.020	219	<0.019C

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3+NH4- N TOTAL MG/L	00640 T INORG. NITROGEN MG/L N	00625 TOT KJEL N MG/L	00605 ORG N N MG/L	00600 TOTAL N N MG/L	00410 T ALK CACO3 MG/L	00440 HCO3 ION HCO3 MG/L	00945 SULFATE SO4-TOT MG/L	00940 CHLORIDE TOTAL MG/L
92/06/01	1420	WATER		8.90	.100K	9.00C	.300	.200C	9.20C	137	164	133	15
92/06/02	0950	WATER		9.10	.100K	9.20C	.360	.260C	9.46C	180	220	134	15
92/06/02	0950	QA REPLICATE		9.10	.110	9.21C	.360	.260C	9.47C	180	220	133	16
92/06/03	1600	WATER		8.10	.100K	8.20C	.280	.180C	8.38C	112	137	135	16

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00915 CALCIUM CA,DISS MG/L	00925 MGNSIUM MG,DISS MG/L	00930 SODIUM NA,DISS MG/L	00935 PTSSIUM K,DISS MG/L	00680 T ORG C C MG/L	01106 ALUMINUM AL,DISS UG/L	01000 ARSENIC AS,DISS UG/L	01005 BARIUM BA,DISS UG/L	01010 BERYLIUM BE,DISS UG/L	01020 BORON B,DISS UG/L
92/06/01	1420	WATER		74.0	15.0	31.00	3.00	5.0K					
92/06/02	0950	WATER		112.0	15.0	32.00	3.00						
92/06/02	0950	QA REPLICATE		89.0	16.0	3.00	3.00						
92/06/03	1600	WATER		63.0	15.0	32.00	3.00						

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01025 CADMIUM CD,DISS UG/L	01030 CHROMIUM CR,DISS UG/L	01035 COBALT CO,DISS UG/L	01040 COPPER CU,DISS UG/L	01046 IRON FE,DISS UG/L	01049 LEAD PB,DISS UG/L	82037 MG DISS MG UG/L	01056 MANGNESE MN,DISS UG/L	71900 MERCURY HG,TOTAL UG/L	01060 MOLY MO,DISS UG/L
92/06/01	1420	WATER										.5K	

REMARK CODES: C - calculated value, K - actual value is less than value shown, J - estimated value

STORET RETRIEVAL DATE 93/03/16 PGM=RET PAGE: 6
QRB502.004020 QRB502004020 LG4 GILA5
32 58 10.0 108 35 09.0 4
GILA RIVER AT GILA
35017 NEW MEXICO GRANT
COLORADO RIVER 110400
GILA RIVER STATION 4 - GILA RIVER AT GILA
21NMEX 870919 15040002
SURFACE SAMPLES 1372 METERS ELEVATION

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00010 WATER TEMP CENT	00095 CNDUCTVY AT 25C MICROMHO	00300 DO MG/L	00400 PH SU	82079 TURBIDTY LAB NTU	70300 RESIDUE DISS-180 C MG/L	00530 RESIDUE TOT NFLT MG/L	00665 PHOS-TOT MG/L P	00900 TOT HARD CACO3 MG/L	00612 UN-IONZD NH3-N MG/L
92/06/01	1350	WATER		20.0	142	7.6	8.04	46.0	134	63	.070	45	0.004C
92/06/02	1030	WATER		16.6	146		7.99	40.9	132	37	.120	45	0.003C
92/06/03	1630	WATER		23.1	156	7.1		31.1	126	31	.090	47	

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3+NH4- N TOTAL MG/L	00640 T INORG. NITROGEN MG/L N	00625 TOT KJEL N MG/L	00605 ORG N N MG/L	00600 TOTAL N N MG/L	00410 T ALK CACO3 MG/L	00440 HCO3 ION HCO3 MG/L	00945 SULFATE SO4-TOT MG/L	00940 CHLORIDE TOTAL MG/L
92/06/01	1350	WATER		.12	.100	.22C	.420	.320C	.54C	52	64	13	56
92/06/02	1030	WATER		.13	.100	.23C	.360	.260C	.49C	55	67	12	6
92/06/03	1630	WATER		.07	.100K	.17C	.270	.170C	.34C	58	71	12	6

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00915 CALCIUM CA,DISS MG/L	00925 MGNSIUM MG,DISS MG/L	00930 SODIUM NA,DISS MG/L	00935 PTSSIUM K,DISS MG/L	00680 T ORG C C MG/L	01106 ALUMINUM AL,DISS UG/L	01000 ARSENIC AS,DISS UG/L	01005 BARIUM BA,DISS UG/L	01010 BERYLIUM BE,DISS UG/L	01020 BORON B,DISS UG/L
92/06/01	1350	WATER		13.0	3.0	9.00	2.00	5.0					
92/06/02	1030	WATER		13.0	3.0	10.00	2.00						
92/06/03	1630	WATER		14.0	3.0	11.00	2.00						

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01025 CADMIUM CD,DISS UG/L	01030 CHROMIUM CR,DISS UG/L	01035 COBALT CO,DISS UG/L	01040 COPPER CU,DISS UG/L	01046 IRON FE,DISS UG/L	01049 LEAD PB,DISS UG/L	82037 MG DISS MG UG/L	01056 MANGNESE MN,DISS UG/L	71900 MERCURY HG,TOTAL UG/L	01060 MOLY MO,DISS UG/L
92/06/01	1350	WATER										.5K	

REMARK CODES: C - calculated value, K - actual value is less than value shown, J - estimated value

GRB503,005505 GRB503005505 LG5
33 05 21.0 108 29 10.0 4
TURKEY CREEK ABOVE CONFLUENCE WITH GILA RIVER
35017 NEW MEXICO GRANT
COLORADO RIVER 110400
GILA RIVER
21NMEX 920912 15040001
SURFACE SAMPLES 1482 METERS ELEVATION

STATION 5 - TURKEY CREEK ABOVE CONFLUENCE WITH GILA RIVER

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00010 WATER TEMP CENT	00095 CNDUCTVY AT 25C MICROMHO	00300 DO MG/L	00400 PH SU	82079 TURBIDTY LAB NTU	70300 RESIDUE DISS-180 C MG/L	00530 RESIDUE TOT NFLT MG/L	00665 PHOS-TOT MG/L P	00900 TOT HARD CACO3 MG/L	00612 UN-IONZD NH3-N MG/L
92/08/05	1130	WATER		21.0	249	8.0	8.01	.5	182	3K	.010	37	0.005C

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3+NH4- N TOTAL MG/L	00640 T INORG. NITROGEN MG/L N	00625 TOT KJEL N MG/L	00605 ORG N N MG/L	00600 TOTAL N N MG/L	00410 T ALK CACO3 MG/L	00440 HCO3 ION HCO3 MG/L	00945 SULFATE SO4-TOT MG/L	00940 CHLORIDE TOTAL MG/L
92/08/05	1130	WATER		.04K	.120	.16C	1.590	1.470C	1.63C	68	83	34	5

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00915 CALCIUM CA,DISS MG/L	00925 MGNSIUM MG,DISS MG/L	00930 SODIUM NA,DISS MG/L	00935 PTSSIUM K,DISS MG/L	00680 T ORG C C MG/L	01106 ALUMINUM AL,DISS UG/L	01000 ARSENIC AS,DISS UG/L	01005 BARIUM BA,DISS UG/L	01010 BERYLIUM BE,DISS UG/L	01020 BORON B,DISS UG/L
92/08/05	1130	WATER		10.0	3.0	38.00	2.00	3.0					

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01025 CADMIUM CD,DISS UG/L	01030 CHROMIUM CR,DISS UG/L	01035 COBALT CO,DISS UG/L	01040 COPPER CU,DISS UG/L	01046 IRON FE,DISS UG/L	01049 LEAD PB,DISS UG/L	82037 MG DISS MG UG/L	01056 MANGNESE MN,DISS UG/L	71900 MERCURY HG,TOTAL UG/L	01060 MOLY MO,DISS UG/L
92/08/05	1130	WATER										.5K	

REMARK CODES: C - calculated value, K - actual value is less than value shown, J - estimated value

STORET RETRIEVAL DATE 93/03/16 PGM=RET PAGE: 8
GRB503.006530 GRB503006530 LG6 GILA7
33 02 26.0 108 13 02.0 4
SAPILLO CREEK AT NM HWY 15 BRIDGE
35017 NEW MEXICO GRANT
COLORADO RIVER 110400
GILA RIVER
21NMEX 870919 15040001
SURFACE SAMPLES 1777 FEET ELEVATION

STATION 6 - SAPILLO CREEK AT NM HIGHWAY 15 BRIDGE

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00010 WATER TEMP CENT	00095 CNDUCTVY AT 25C MICROMHO	00300 DO MG/L	00400 PH SU	82079 TURBIDTY LAB NTU	70300 RESIDUE DISS-180 C MG/L	00530 RESIDUE TOT NFLT MG/L	00665 PHOS-TOT MG/L P	00900 TOT HARD CACO3 MG/L	00612 UN-IONZD NH3-N MG/L
92/06/01	1200	WATER		21.4	266	7.4	8.20	3.1	194	3	.030	253	<0.006C
92/06/02	1320	WATER		22.4	269	7.5	8.36	39.0	190	3K	.020	119	<0.010C
92/06/03	0835	WATER		14.8	262	8.3	8.16	3.1	196	3K	.010	143	<0.004C

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3+NH4- N TOTAL MG/L	00640 T INORG. NITROGEN MG/L N	00625 TOT KJEL N MG/L	00605 ORG N N MG/L	00600 TOTAL N N MG/L	00410 T ALK CACO3 MG/L	00440 HCO3 ION HCO3 MG/L	00945 SULFATE SO4-TOT MG/L	00940 CHLORIDE TOTAL MG/L
92/06/01	1200	WATER		.05	.100K	.15C	.230	.130C	.28C	128	156	13	5K
92/06/02	1320	WATER		.04	.100K	.14C	.410	.310C	.45C	129	157	13	5K
92/06/03	0835	WATER		.06	.100K	.16C	.230	.130C	.29C	132	161	13	5K

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00915 CALCIUM CA,DISS MG/L	00925 MGNSIUM MG,DISS MG/L	00930 SODIUM NA,DISS MG/L	00935 PTSSIUM K,DISS MG/L	00680 T ORG C C MG/L	01106 ALUMINUM AL,DISS UG/L	01000 ARSENIC AS,DISS UG/L	01005 BARIUM BA,DISS UG/L	01010 BERYLIUM BE,DISS UG/L	01020 BORON B,DISS UG/L
92/06/01	1200	WATER		66.0	8.0	9.00	1.00	5.0					
92/06/02	1320	WATER		36.0	7.0	9.00	1.00						
92/06/03	0835	WATER		44.0	8.0	9.00	1.00						

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01025 CADMIUM CD,DISS UG/L	01030 CHROMIUM CR,DISS UG/L	01035 COBALT CO,DISS UG/L	01040 COPPER CU,DISS UG/L	01046 IRON FE,DISS UG/L	01049 LEAD PB,DISS UG/L	82037 MG DISS MG UG/L	01056 MANGNESE MN,DISS UG/L	71900 MERCURY HG,TOTAL UG/L	01060 MOLY MO,DISS UG/L
92/06/01	1200	WATER										.5K	

REMARK CODES: C - calculated value, K - actual value is less than value shown, J - estimated value

GRB502.007035 GRB502007035 LQ7 GILAB
33 10 46.0 108 12 22.0 4
GILA RIVER BELOW EAST FORK GILA RIVER
35017 NEW MEXICO GRANT
COLORADO RIVER 110400
GILA RIVER
21NMEX 870919 15040001
SURFACE SAMPLES 1690 METERS ELEVATION

STATION 7 - GILA RIVER BELOW EAST FORK GILA RIVER

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00010 WATER TEMP CENT	00095 CNDUCTVY AT 25C MICROMHO	00300 DO MG/L	00400 PH SU	82079 TURBIDTY LAB NTU	70300 RESIDUE DISS-180 C MG/L	00530 RESIDUE TOT NFLT MG/L	00665 PHOS-TOT MG/L P	00900 TOT HARD CACO3 MG/L	00612 UN-IONZD NH3-N MG/L
92/06/01	1100	WATER				7.9	7.91	22.0	108	16	.080	31	
92/06/02	1420	WATER		18.6	100	7.5	8.02	18.0	108	14	.060	92	0.004C
92/06/03	0930	WATER		14.4	101	8.1	8.01	15.1	106	11	.190	37	<0.003C

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3+NH4- N TOTAL MG/L	00640 T INORG. NITROGEN MG/L N	00625 TOT KJEL N MG/L	00605 ORG N N MG/L	00600 TOTAL N N MG/L	00410 T ALK CACO3 MG/L	00440 HCO3 ION HCO3 MG/L	00945 SULFATE SO4-TOT MG/L	00940 CHLORIDE TOTAL MG/L
92/06/01	1100	WATER		.05	.100K	.15C	.360	.260C	.41C	39	47	7	5K
92/06/02	1420	WATER		.05	.110	.16C	.480	.370C	.53C	39	47	8	5K
92/06/03	0930	WATER		.15	.100K	.25C	.260	.160C	.41C	40	49	8	5K

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00951 FLUORIDE F,TOTAL MG/L	00915 CALCIUM CA,DISS MG/L	00925 MGNSIUM MG,DISS MG/L	00930 SODIUM NA,DISS MG/L	00935 PTSSIUM K,DISS MG/L	00680 T ORG C C MG/L	01106 ALUMINUM AL,DISS UG/L	01000 ARSENIC AS,DISS UG/L	01005 BARIUM BA,DISS UG/L	01010 BERYLIUM BE,DISS UG/L
92/06/01	1100	WATER		.47	9.0	2.0	6.00	1.00	5.0				
92/06/02	1420	WATER			32.0	3.0	7.00	2.00					
92/06/03	0930	WATER			10.0	3.0	7.00	2.00					

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01020 BORON B,DISS UG/L	01025 CADMIUM CD,DISS UG/L	01030 CHROMIUM CR,DISS UG/L	01035 COBALT CO,DISS UG/L	01040 COPPER CU,DISS UG/L	01046 IRON FE,DISS UG/L	01049 LEAD PB,DISS UG/L	82037 MG DISS MG UG/L	01056 MANGNESE MN,DISS UG/L	71900 MERCURY HG,TOTAL UG/L
92/06/01	1100	WATER											.5K

REMARK CODES: C - calculated value, K - actual value is less than value shown, J - estimated value

GRB503.007540 GRB503007540 LGB GILA9
33 10 46.0 108 12 16.0 4
EAST FORK GILA RIVER BELOW BLACK CANYON
35017 NEW MEXICO GRANT
COLORADO RIVER 110400
GILA RIVER
21NMEX 870919 15040001
SURFACE SAMPLES 1692 METERS ELEVATION

STATION 8 - EAST FORK GILA RIVER BELOW BLACK CANYON

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00010 WATER TEMP CENT	00095 CNDUCTVY AT 25C MICROMHO	00300 DO MG/L	00400 PH SU	82079 TURBIDTY LAB NTU	70300 RESIDUE DISS-180 C MG/L	00530 RESIDUE TOT NFLT MG/L	00665 PHOS-TOT MG/L P	00900 TOT HARD CACO3 MG/L	00612 UN-IONZD NH3-N MG/L
92/06/01	1030	WATER		16.1	177	8.2	7.95	34.0	156	43	.090	59	<0.003C
92/06/01	1030	QA REPLICATE							162	42	.020	61	0.003C
92/06/02	1410	WATER		19.0	186	7.6	8.14	25.5	162	27	.200	81	0.005C
92/06/03	0910	WATER		15.4	188	8.1	8.01	22.1	162	27	.060	84	<0.003C

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3+NH4- N TOTAL MG/L	00640 T INORG. NITROGEN MG/L N	00625 TOT KJEL N MG/L	00605 ORG N N MG/L	00600 TOTAL N N MG/L	00410 T ALK CACO3 MG/L	00440 HCO3 ION HCO3 MG/L	00945 SULFATE SO4-TOT MG/L	00940 CHLORIDE TOTAL MG/L
92/06/01	1030	WATER		.12	.100K	.22K	.310	.210C	.43C	63	77	15	9
92/06/01	1030	QA REPLICATE		.12	.110	.23C	.420	.310C	.54C	64	77	15	9
92/06/02	1410	WATER		.12	.110	.23C	.440	.330C	.56C	63	77	14	9
92/06/03	0910	WATER		.13	.100K	.23C	.250	.150C	.38C	66	81	14	10

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00951 FLUORIDE F,TOTAL MG/L	00915 CALCIUM CA,DISS MG/L	00925 MGNSIUM MG,DISS MG/L	00930 SODIUM NA,DISS MG/L	00935 PTSSIUM K,DISS MG/L	00680 T ORG C C MG/L	01106 ALUMINUM AL,DISS UG/L	01000 ARSENIC AS,DISS UG/L	01005 BARIUM BA,DISS UG/L	01010 BERYLIUM BE,DISS UG/L
92/06/01	1030	WATER		1.21	17.0	4.0	14.00	4.00	7.0				
92/06/01	1030	QA REPLICATE		1.20	18.0	4.0	15.00	2.00	7.0				
92/06/02	1410	WATER			26.0	4.0	14.00	2.00					
92/06/03	0910	WATER			27.0	4.0	16.00	2.00					

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01020 BORON B,DISS UG/L	01025 CADMIUM CD,DISS UG/L	01030 CHROMIUM CR,DISS UG/L	01035 COBALT CO,DISS UG/L	01040 COPPER CU,DISS UG/L	01046 IRON FE,DISS UG/L	01049 LEAD PB,DISS UG/L	82037 MG DISS MG UG/L	01056 MANGNESE MN,DISS UG/L	71900 MERCURY HG,TOTAL UG/L
92/06/01	1030	WATER											.5K
92/06/01	1030	QA REPLICATE											.5K

REMARK CODES: C - calculated value, K - actual value is less than value shown, J - estimated value

GRB502.008055 GRB502008055 LG9 GILA10
33 10 48.0 108 12 20.0 4
GILA RIVER BELOW HOT SPRINGS
35017 NEW MEXICO GRANT
COLORADO RIVER 110400
GILA RIVER STATION 9 - GILA RIVER BELOW HOT SPRINGS
21NMEX 870919 15040001
SURFACE SAMPLES 1692 METERS ELEVATION

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00010 WATER TEMP CENT	00095 CNDUCTVY AT 25C MICROMHO	00300 DO MG/L	00400 PH SU	82079 TURBIDTY LAB NTU	70300 RESIDUE DISS-180 C MG/L	00530 RESIDUE TOT NFLT MG/L	00665 PHOS-TOT MG/L P	00900 TOT HARD CACO3 MG/L	00612 UN-IONZD NH3-N MG/L
92/06/01	1055	WATER				8.0	7.97	22.0	104	15	.010K	31	
92/06/02	1425	WATER		18.8	100	7.8	8.04	19.8	106	12	.200	102	<0.004C
92/06/03	0940	WATER		14.3	100	8.2	7.97	15.5	106	8	.010K	147	<0.002C

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3+NH4- N TOTAL MG/L	00640 T INORG. NITROGEN MG/L N	00625 TOT KJEL N MG/L	00605 ORG N N MG/L	00600 TOTAL N N MG/L	00410 T ALK CACO3 MG/L	00440 HCO3 ION HCO3 MG/L	00945 SULFATE SO4-TOT MG/L	00940 CHLORIDE TOTAL MG/L
92/06/01	1055	WATER		.04	.100K	.14C	.240	.140C	.28C	38	47	7	5K
92/06/02	1425	WATER		.04	.100K	.14C	.440	.340C	.48C	38	47	7	5K
92/06/03	0940	WATER		.07	.100K	.17C	.190	.090C	.26C	41	51	7	5K

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00951 FLUORIDE F,TOTAL MG/L	00915 CALCIUM CA,DISS MG/L	00925 MGNSIUM MG,DISS MG/L	00930 SODIUM NA,DISS MG/L	00935 PTSSIUM K,DISS MG/L	00680 T ORG C C MG/L	01106 ALUMINUM AL,DISS UG/L	01000 ARSENIC AS,DISS UG/L	01005 BARIUM BA,DISS UG/L	01010 BERYLIUM BE,DISS UG/L
92/06/01	1055	WATER		.30	9.0	2.0	5.00	3.00	5.0				
92/06/02	1425	WATER			36.0	3.0	6.00	2.00					
92/06/03	0940	WATER			54.0	3.0	6.00	2.00					

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01020 BORON B,DISS UG/L	01025 CADMIUM CD,DISS UG/L	01030 CHROMIUM CR,DISS UG/L	01035 COBALT CO,DISS UG/L	01040 COPPER CU,DISS UG/L	01046 IRON FE,DISS UG/L	01049 LEAD PB,DISS UG/L	82037 HG DISS HG UG/L	01056 MANGNESE MN,DISS UG/L	71900 MERCURY HG,TOTAL UG/L
92/06/01	1055	WATER											.5K

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01065 NICKEL NI,DISS UG/L	01145 SELENIUM SE,DISS UG/L	01140 SILICON SI,DISS UG/L	01075 SILVER AG,DISS UG/L	01080 STRONTUM SR,DISS UG/L	01100 TIN SN,DISS UG/L	01085 VANADIUM V,DISS UG/L	01090 ZINC ZN,DISS UG/L	11503 RA-226 + RA-228 PC/L	11504 RA-226 + 228 ERR PC/L
92/06/02	1425	WATER										1.2	.2

REMARK CODES: C - calculated value, K - actual value is less than value shown, J - estimated value

GRB502.008055 GRB502008055 LG9 GILA10
33 10 48.0 108 12 20.0 4
GILA RIVER BELOW HOT SPRINGS
35017 NEW MEXICO GRANT
COLORADO RIVER 110400
GILA RIVER

STATION 9 - GILA RIVER BELOW HOT SPRINGS

21NMEX 870919 15040001
0000 FEET DEPTH 1692 METERS ELEVATION

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	39330 ALDRIN TOT UG/L	39337 ALPHABHC TOTUG/L	39338 BETA BHC TOTUG/L	34259 DELTABHC TOTUG/L	39340 GAMMABHC LINDANE TOT.UG/L	39348 A-CHLRDN WHL SMPL UG/L	39810 G-CHLRDN WHL SMPL UG/L	39360 DDD WHL SMPL UG/L	39365 DDE WHL SMPL UG/L	39370 DDT WHL SMPL UG/L
92/08/03	0940	WATER		.050K	.050K	.050K	.050K	.050K	.500K	.50K	.100K	.100K	.100K

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	39380 DIELDRIN TOTUG/L	82623 ENDOSLFN -SO4 TOT REC UG/L	82624 ENDOSLFN BETA TOT REC UG/L	39388 ENDOSULN WHL SMPL UG/L	39390 ENDRIN TOT UG/L	82622 ENDRIN ALDH TOT REC UG/L	78008 ENDRIN KETONE UG/L	39700 HCB TOT UG/L	39410 HEPTCHLR TOTUG/L	39420 HPCHLREP TOTUG/L
92/08/03	0940	WATER		.100K	.1K	.1K	.050K	.100K	.1K	.10K	.080K	.050K	.050K

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	39480 MTHXYCLR WHL SMPL UG/L	39492 PCB-1232 TOTUG/L	39496 PCB-1242 TOTUG/L	39500 PCB-1248 TOTUG/L	39504 PCB-1254 TOTUG/L	39508 PCB-1260 TOTUG/L	39400 TOXAPHEN TOTUG/L
92/08/03	0940	WATER		.500K	.500K	.500K	.500K	1.000K	1.000K	1.000K

REMARK CODES: C - calculated value, K - actual value is less than value shown, J - estimated value

GRB503.009560 GRB503009560 LG10 GILA11
33 13 23.0 108 14 37.0 4
MIDDLE FORK GILA RIVER AT RANGER STATION
35003 NEW MEXICO CATRON
COLORADO RIVER 110400
GILA RIVER
21NMEX 870919 15040001
SURFACE SAMPLES 1725 METERS ELEVATION

STATION 10 - MIDDLE FORK GILA RIVER AT RANGER STATION

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00010 WATER TEMP CENT	00095 CNDUCTVY AT 25C MICROMHO	00300 DO MG/L	00400 PH SU	82079 TURBIDTY LAB NTU	70300 RESIDUE DISS-180 C MG/L	00530 RESIDUE TOT NFLT MG/L	00665 PHOS-TOT MG/L P	00900 TOT HARD CACO3 MG/L	00612 UN-IONZD NH3-N MG/L
92/06/01	0940	WATER		14.1	95	8.4	7.98	21.0	114	10	.780	82	0.003C
92/06/02	1520	WATER		18.9	100	7.6	8.00	19.0	118	5	.120	35	<0.004C
92/06/03	1010	WATER		15.2	98	8.1	7.86	16.0	110	6	.090	37	0.002C
92/06/03	1010	QA REPLICATE							114	6	.040	35	<0.002C

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3+NH4- N TOTAL MG/L	00640 T INORG. NITROGEN MG/L N	00625 TOT KJEL N MG/L	00605 ORG N N MG/L	00600 TOTAL N N MG/L	00410 T ALK CACO3 MG/L	00440 HCO3 ION HCO3 MG/L	00945 SULFATE SO4-TOT MG/L	00940 CHLORIDE TOTAL MG/L
92/06/01	0940	WATER		.04	.110	.15C	.320	.210C	.76C	38	47	7	5K
92/06/02	1520	WATER		.06	.100K	.16C	.380	.280C	.44C	38	46	8	5K
92/06/03	1010	WATER		.06	.110	.17C	.190	.080C	.25C	38	47	8	5K
92/06/03	1010	QA REPLICATE		.09	.100K	.19C	.420	.320C	.51C	38	47	8	5K

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00951 FLUORIDE F,TOTAL MG/L	00915 CALCIUM CA,DISS MG/L	00925 MGNSIUM MG,DISS MG/L	00930 SODIUM NA,DISS MG/L	00935 PTSSIUM K,DISS MG/L	00680 T ORG C C MG/L	01106 ALUMINUM AL,DISS UG/L	01000 ARSENIC AS,DISS UG/L	01005 BARIUM BA,DISS UG/L	01010 BERYLIUM BE,DISS UG/L
92/06/01	0940	WATER		.28	28.0	3.0	6.00	2.00	5.0				
92/06/02	1520	WATER			9.0	3.0	6.00	5.00					
92/06/03	1010	WATER			10.0	3.0	7.00	2.00					
92/06/03	1010	QA REPLICATE			9.0	3.0	6.00	2.00					

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01020 BORON B,DISS UG/L	01025 CADMIUM CD,DISS UG/L	01030 CHROMIUM CR,DISS UG/L	01035 COBALT CO,DISS UG/L	01040 COPPER CU,DISS UG/L	01046 IRON FE,DISS UG/L	01049 LEAD PB,DISS UG/L	82037 MG DISS MG UG/L	01056 MANGNESE MN,DISS UG/L	71900 MERCURY HG,TOTAL UG/L
92/06/01	0940	WATER											.5K
92/06/03	1010	QA REPLICATE											.5K

REMARK CODES: C - calculated value, K - actual value is less than value shown, J - estimated value

GRB503.010570 GRB503010570 LG11 GILA12
33 13 20.0 108 14 39.0 4
WEST FORK GILA RIVER ABOVE MIDDLE FORK GILA
35003 NEW MEXICO CATRON
COLORADO RIVER 110400
GILA RIVER STATION 11 - WEST FORK GILA RIVER ABOVE MIDDLE FORK GILA
21NMEX 870919 15040001
SURFACE SAMPLES 1725 METERS ELEVATION

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00010 WATER TEMP CENT	00095 CNDUCTVY AT 25C MICROMHO	00300 DO MG/L	00400 PH SU	82079 TURBIDTY LAB NTU	70300 RESIDUE DISS-180 C MG/L	00530 RESIDUE TOT NFLT MG/L	00665 PHOS-TOT MG/L P	00900 TOT HARD CACO3 MG/L	00612 UN-IONZD NH3-N MG/L
92/06/01	1005	WATER		13.0	74	8.5	8.06	11.2	88	5	.020	26	<0.003C
92/06/02	1455	WATER		18.1	79	7.0	8.01	8.5	88	3K	.050	28	<0.003C
92/06/03	1000	WATER		13.8	76	8.3	7.64	7.6	90	3K	.010K	31	<0.001C

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3+NH4- N TOTAL MG/L	00640 T INORG. NITROGEN MG/L N	00625 TOT KJEL N MG/L	00605 ORG N N MG/L	00600 TOTAL N N MG/L	00410 T ALK CACO3 MG/L	00440 HCO3 ION HCO3 MG/L	00945 SULFATE SO4-TOT MG/L	00940 CHLORIDE TOTAL MG/L
92/06/01	1005	WATER		.04K	.100K	.14C	.230	.130C	.27C	31	38	6	5K
92/06/02	1455	WATER		.17	.100K	.27C	.410	.310C	.58C	30	37	6	5K
92/06/03	1000	WATER		.04	.100K	.14C	.120	.020C	.16C	31	38	7	5K

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00951 FLUORIDE F,TOTAL MG/L	00915 CALCIUM CA,DISS MG/L	00925 MGNSIUM MG,DISS MG/L	00930 SODIUM NA,DISS MG/L	00935 PTSSIUM K,DISS MG/L	00680 T ORG C C MG/L	01106 ALUMINUM AL,DISS UG/L	01000 ARSENIC AS,DISS UG/L	01005 BARIUM BA,DISS UG/L	01010 BERYLIUM BE,DISS UG/L
92/06/01	1005	WATER		.16	7.0	2.0	4.00	1.00	5.0				
92/06/02	1455	WATER			8.0	2.0	4.00	1.00					
92/06/03	1000	WATER			9.0	2.0	5.00	1.00					

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01020 BORON B,DISS UG/L	01025 CADMIUM CD,DISS UG/L	01030 CHROMIUM CR,DISS UG/L	01035 COBALT CO,DISS UG/L	01040 COPPER CU,DISS UG/L	01046 IRON FE,DISS UG/L	01049 LEAD PB,DISS UG/L	82037 MG DISS MG UG/L	01056 MANGNESE MN,DISS UG/L	71900 MERCURY HG,TOTAL UG/L
92/06/01	1005	WATER											.5K

REMARK CODES: C - calculated value, K - actual value is less than value shown, J - estimated value

INTENSIVE WATER QUALITY SURVEY OF THE SAN FRANCISCO RIVER AND ITS TRIBUTARIES, CATRON AND GRANT COUNTIES, NEW MEXICO, JULY 13-16, 1992

Introduction

During the week of July 13, 1992, the Surveillance and Standards Section conducted a four-day intensive water quality survey of a 75-mile reach of the San Francisco River from upstream of Luna, New Mexico to the San Francisco hot springs. Additional samples were collected from Dillman, Centerfire, Mule, Tularosa, Trout and Whitewater creeks. The San Francisco River and its tributaries are contained in water quality segments 2-601, 2-602 and 2-603.

Water Quality Standards

Water quality standards for these watercourses are set forth in sections 1-102, 2-601, 2-602, 2-603 and 3-101 of the New Mexico water quality standards (NMWQCC 1991). Designated uses for segment 2-601, which contains the main stem of the San Francisco River from the New Mexico-Arizona line upstream to State Highway 12 at Reserve and the perennial reaches of Mule Creek, are irrigation, limited warmwater and marginal coldwater fishery, livestock and wildlife watering and secondary contact recreation. Designated uses for segment 2-602, which contains the main stem of the San Francisco River from State Highway 12 at Reserve upstream to the New Mexico-Arizona line, are coldwater fishery, irrigation, livestock and wildlife watering and primary contact recreation. Designated uses for segment 2-603, which contains all perennial reaches of tributaries to the San Francisco River at or above the Town of Glenwood, are domestic water supply, fish culture, high quality coldwater fishery, irrigation, livestock and wildlife watering and secondary contact recreation.

Methods

Water quality sampling methods were in accordance with the Quality Assurance Project Plan for Water Quality Management Programs (NMED 1991).

Sampling Stations

The names, STORET identification codes and locations of stations selected for this survey are given below. A map of the study area is presented in Fig. 3.

Station	STORET Code	Location
1	SFR602006040	San Francisco River above Luna.
2	SFR603005720	Dillman Creek at Forest Road 19 bridge.
3	SFR603005525	Trout Creek at Forest Road 19 bridge.
4	SFR603005315	Centerfire Creek at Forest Road 210 crossing.

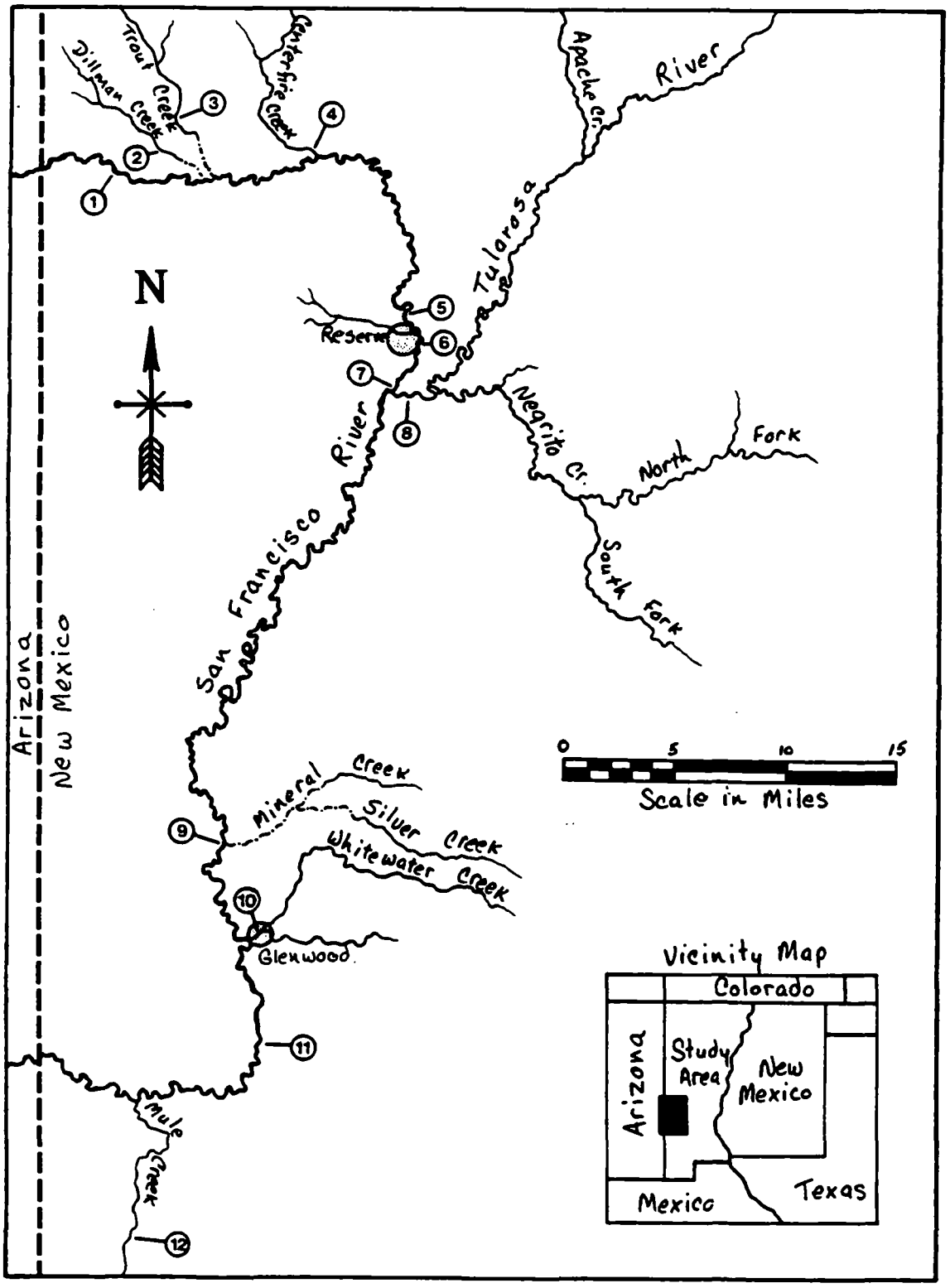

Figure 3. Sampling stations on the San Francisco River, the Tularosa River and Dillman, Trout, Centerfire, Whitewater and Mule creeks, 1992.

Station	STORET Code	Location
5	SFR602005035	San Francisco River above Reserve at State Highway 12.
6	SFR601004530	Reserve WWTF effluent discharge.
7	SFR601004520	San Francisco River below Reserve.
8	SFR603004025	Tularosa River above San Francisco River.
9	SFR601001515	San Francisco River at Alma.
10	SFR603001010	Whitewater Creek at Glenwood.
11	SFR601000505	San Francisco River at San Francisco hot springs.
12	SFR601000215	Mule Creek at State Highway 78.

Water Quality Assessment

Water quality data collected during this survey are available on STORET and can be retrieved using the selector A=21NMEX and the restrictor IS=923503. Parametric coverage and survey data are provided in Tables 3, 4 and 5.

During the period of July 13-16, 1992, stream discharges measured at the USGS gage on the San Francisco River near Reserve were 11, 10, 8.5 and 8.0 ft^3/sec and those measured at the USGS gage on the San Francisco River near Glenwood were 47, 42, 41 and 39 ft^3/sec. Results of analyses for dissolved metals for this survey have not been received at the time this report was prepared.

The San Francisco River above Luna (station 1) was warm, clear, well-oxygenated and somewhat alkaline. There were elevated levels of total phosphorus, nitrogen species including un-ionized ammonia and total organic carbon. Most other chemical constituents were present at low levels. There were exceedances of the numeric standards for water temperature, pH and un-ionized ammonia and exceedances of the general standard for plant nutrients. Plant nutrients were present in concentrations adequate to produce heavy growths of filamentous algae. The elevated phosphorus levels were noted in a previous study of the San Francisco River (Smolka 1987) and were attributed to non-point source pollution within the upper San Francisco watershed in the vicinity of Alpine, Arizona. The Arizona Department of Environmental Quality has been studying the problem since 1986. Samples for determination of organochlorine pesticide levels were collected at this station to ensure compliance with the water quality standards for chlordane. All results were less than the minimum quantification levels. The exceedances for temperature, pH and un-ionized ammonia indicate nonattainment of the coldwater fishery use and the presence of algae in concentrations which cause nuisance conditions indicate a partial impairment of the primary contact recreation use. All other designated uses were attained.

Dillman and Trout creeks (stations 2 and 3) were each sampled one time during this survey. Discharges were low and no surface flow from these streams entered the San Francisco River during the survey. Both creeks were cool, very clear and slightly alkaline with moderate dissolved oxygen levels. There were low levels of nutrients and most other chemical constituents. An exception was total phosphorus in Trout Creek, which exceeded the numeric standard. This indicates a partial impairment of the high quality coldwater fishery use in Trout Creek, while all other designated uses in Trout Creek and all designated uses in Dillman Creek were attained.

Centerfire Creek (station 4) was moderately warm to warm, moderately alkaline and very clear, with high levels of dissolved oxygen. There were low levels of nutrients and moderate levels of most other chemical constituents. All three measurements of conductivity exceeded the numeric standard for this segment as did one measurement for temperature, indicating a partial impairment of the high quality coldwater fishery use, while all other designated uses were attained.

The San Francisco River above and below Reserve (stations 5 and 7) was warm and moderately alkaline with high levels of dissolved oxygen. Turbidity was relatively low, except during one sampling run at station 7, when a bulldozer was operating upstream in the stream channel. Reading of 45 and 291 NTU were obtained within a period of ten minutes. There were moderate levels of nutrients and most other chemical constituents. There were no exceedances at either station and all designated uses were attained.

The Reserve wastewater treatment plant effluent (station 6) was warm and moderately turbid with very high levels of nutrients and total organic carbon and moderate levels of most other chemical constituents. There were low levels of BOD, non-filterable residue and fecal coliform bacteria. No visible foam or floating solids were detected. Total chlorine residual, measured by the colorimetric method (not approved by EPA), ranged from 0 to 0.07 mg/l, with one sample being above 0.011 mg/l. The NPDES permit for this facility specifies "no measurable chlorine" or 0.011 mg/l. The effluent from this facility did not reach the San Francisco river during the survey, but instead percolated into the sand and gravel well short of the stream channel. There were no detectable effects of this facility on the San Francisco River during the survey.

The Tularosa River upstream from its confluence with the San Francisco River (station 8) was warm, alkaline and clear, with high levels of dissolved oxygen and nutrients. There were exceedances of numeric standards for temperature, pH, total phosphorus and un-ionized ammonia. An intensive water quality survey of the Tularosa River conducted in 1990 attributed numerous violations of the water quality standards to irrigation and cattle grazing in the upper watershed (Smolka 1990). These exceedances indicate nonattainment of the high quality coldwater fishery use, while all other designated uses were attained.

The San Francisco River at Alma (station 9) was warm and moderately turbid and alkaline, with high levels of dissolved oxygen and low levels of nutrients and most other chemical constituents. There were no exceedances of numeric standards during the survey and all designated uses were attained.

Whitewater Creek at Glenwood (station 10) was cool, clear and slightly alkaline with high levels of dissolved oxygen and low levels of nutrients and most other chemical constituents. Samples for determination of organic contaminant levels were collected at this station and all results were less than the minimum quantification levels. There were no exceedances of numeric standards during the survey and all designated uses were attained.

The San Francisco River at the San Francisco hot springs (station 11) was warm and moderately alkaline and turbid. There were moderate levels of dissolved oxygen and low levels of nutrients and most other chemical constituents. The combined level of radium-226 and -228 (measured only at this station) was well below the numeric standard. Samples for determination of organic contaminant levels were collected at this station and all results were less than the minimum quantification levels. There were no exceedances of numeric standards during the survey and all designated uses were attained.

Mule Creek (station 12) was warm and very clear with low to moderate levels of dissolved oxygen, nutrients and most other chemical constituents. There were no exceedances of numeric standards during the survey and all designated uses were attained.

Biological Assessment

The San Francisco River at Luna (station 1) was selected as the reference station for habitat and biological assessments. Data from benthic sampling in 1987 were used as reference data to allow a separate assessment of the reference station based on temporal changes over the last five years.

Habitat conditions at station 1 in 1987 and 1992 were rated good to excellent. Habitat conditions at the two lower San Francisco River stations decreased in a downstream manner from supporting at station 5 above Reserve to non-supporting at station 7 below Reserve. The habitat conditions encountered at Centerfire Creek were also degraded and were considered to be only partially supporting compared to the reference.

The biological condition at station 1 was determined to be non-impaired and showed little change from 1987, except for a slight reduction in taxa and EPT numbers which could be related to sampling conditions. Analysis of the macroinvertebrate community at station 1 shows it to be healthy, diverse and composed of pollution-sensitive taxa. Biological conditions at the remaining three stations were slightly impaired when compared to the reference station. The macroinvertebrate communities at the two lower San Francisco River stations were characterized by reductions in both taxa and EPT numbers and a shift to a dominant taxa. The macroinvertebrate community at station 4 on Centerfire Creek showed only subtle reductions in most calculated metric values, accompanied by a major increase in the standing crop. The slightly impaired biological conditions at stations 5 and 7 on the San Francisco River are due to reductions in habitat quality and not water quality. The slightly impaired biological condition at station 4 on Centerfire Creek is primarily due to a reduction in habitat quality, but the increased standing crop apparently is due to an increase in nutrients from upstream activities, primarily ranching.

Table 3. Water quality data collected on the San Francisco River and tributaries, July 13-16, 1992.

STORET RETRIEVAL DATE 93/03/16 PGM=RET PAGE: 1
SFR602.006040 SFR602006040 SANFRAN005 SANFRAN1
33 49 06.0 108 59 23.0 4
SAN FRANCISCO RIVER ABOVE LUNA
35003 NEW MEXICO CATRON
COLORADO RIVER 110400
GILA RIVER STATION 1 - SAN FRANCISCO RIVER ABOVE LUNA
21NMEX 870919 15040004
0000 FEET DEPTH 2176 METERS ELEVATION

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00010 WATER TEMP CENT	00095 CNDUCTVY AT 25C MICROMHO	00300 DO MG/L	00400 PH SU	82079 TURBIDTY LAB NTU	70300 RESIDUE DISS-180 C MG/L	00530 RESIDUE TOT NFLT MG/L	00665 PHOS-TOT MG/L P	00900 TOT HARD CACO3 MG/L	00612 UN-IONIZD NH3-N MG/L
92/07/13	0915	WATER		13.1	243	8.4	8.40	2.7	198	3	.230	111	0.010C
92/07/14	1620	WATER		26.5	267	6.7	8.88	2.5	192	3	.200	129	0.039C
92/07/15	0900	WATER		13.9	266	8.2	8.38	2.4	189	3	1.140	119	0.007C

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3+NH4- N TOTAL MG/L	00640 T INORG. NITROGEN MG/L N	00625 TOT KJEL N MG/L	00605 ORG N N MG/L	00600 TOTAL N N MG/L	00410 T ALK CACO3 MG/L	00440 HCO3 ION HCO3 MG/L	00945 SULFATE SO4-TOT MG/L	00940 CHLORIDE TOTAL MG/L
92/07/13	0915	WATER		.11	.170	.28C	.450	.280C	.56C	143	175	7	5K
92/07/14	1620	WATER		.10	.120	.22C	.660	.540C	.76C				
92/07/15	0900	WATER		.12	.120	.24C	.540	.420C	.66C				

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00915 CALCIUM CA,DISS MG/L	00925 MGNSIUM MG,DISS MG/L	00930 SODIUM NA,DISS MG/L	00935 PTSSIUM K,DISS MG/L	00680 T ORG C C MG/L	01106 ALUMINUM AL,DISS UG/L	01000 ARSENIC AS,DISS UG/L	01005 BARIUM BA,DISS UG/L	01010 BERYLIUM BE,DISS UG/L	01020 BORON B,DISS UG/L
92/07/13	0915	WATER		28.0	10.0	16.00	1.00	8.0					

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01065 NICKEL NI,DISS UG/L	01145 SELENIUM SE,DISS UG/L	01140 SILICON SI,DISS UG/L	01075 SILVER AG,DISS UG/L	01080 STRONTUM SR,DISS UG/L	01100 TIN SN,DISS UG/L	01085 VANADIUM V,DISS UG/L	01090 ZINC ZN,DISS UG/L	50060 CHLORINE TOT RESD MG/L
92/07/15	0900	WATER										.00

REMARK CODES: C - calculated value, K - actual value is less than value shown, J - estimated value

SFR602.006040 SFR602006040 SANFRAN005 SANFRAN1
33 49 06.0 108 59 23.0 4
SAN FRANCISCO RIVER ABOVE LUNA
35003 NEW MEXICO CATRON
COLORADO RIVER 110400
GILA RIVER
21NMEX 870919 15040004
SURFACE SAMPLES 2176 METERS ELEVATION

STATION 1 - SAN FRANCISCO RIVER ABOVE LUNA

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	39330 ALDRIN TOT UG/L	39337 ALPHABHC TOTUG/L	39338 BETA BHC TOTUG/L	34259 DELTABHC TOTUG/L	39340 GAMMABHC LINDANE TOT.UG/L	39348 A-CHLRDN WHL SMPL UG/L	39810 G-CHLRDN WHL SMPL UG/L	39360 DDD WHL SMPL UG/L	39365 DDE WHL SMPL UG/L	39370 DDT WHL SMPL UG/L
92/07/15	0900	WATER		.050K	.050K	.050K	.050K	.050K	.500K	.50K	.100K	.100K	.100K

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	39380 DIELDRIN TOTUG/L	82623 ENDOSLFN -SO4 TOT REC UG/L	82624 ENDOSLFN BETA TOT REC UG/L	39388 ENDOSULN WHL SMPL UG/L	39390 ENDRIN TOT UG/L	82622 ENDRIN ALDH TOT REC UG/L	78008 ENDRIN KETONE UG/L	39700 HCB TOT UG/L	39410 HEPTCHLR TOTUG/L	39420 HPCHLREP TOTUG/L
92/07/15	0900	WATER		.100K	.1K	.1K	.050K	.100K	.1K	.10K	.080K	.050K	.050K

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	39480 MTHXYCLR WHL SMPL UG/L	39492 PCB-1232 TOTUG/L	39496 PCB-1242 TOTUG/L	39500 PCB-1248 TOTUG/L	39504 PCB-1254 TOTUG/L	39508 PCB-1260 TOTUG/L	39400 TOXAPHEN TOTUG/L
92/07/15	0900	WATER		.500K	.500K	.500K	.500K	1.000K	1.000K	1.000K

REMARK CODES: C - calculated value, K - actual value is less than value shown, J - estimated value

SFR603.005720 SFR603005720 SANFRAN2
33 49 49.0 108 57 19.0 4
DILLMAN CREEK AT FR19 BRIDGE
35003 NEW MEXICO CATRON
COLORADO RIVER 110400
GILA RIVER
21NMEX 920926 15040004
0000 FEET DEPTH 2177 METERS ELEVATION

STATION 2 - DILLMAN CREEK AT FOREST ROAD 19 BRIDGE

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00010 WATER TEMP CENT	00095 CNDUCTVY AT 25C MICROMHO	00300 DO MG/L	00400 PH SU	82079 TURBIDTY LAB NTU	70300 RESIDUE DISS-180 C MG/L	00530 RESIDUE TOT NFLT MG/L	00665 PHOS-TOT MG/L P	00900 TOT HARD CACO3 MG/L	00612 UN-IONZD NH3-N MG/L
92/07/13	1120	WATER		13.9	329	6.7	7.73	.6	238	3K	.070	162	0.001C

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3+NH4- N TOTAL MG/L	00640 T INORG. NITROGEN MG/L N	00625 TOT KJEL N MG/L	00605 ORG N N MG/L	00600 TOTAL N N MG/L	00410 T ALK CACO3 MG/L	00440 HCO3 ION HCO3 MG/L	00945 SULFATE SO4-TOT MG/L	00940 CHLORIDE TOTAL MG/L
92/07/13	1120	WATER		.11	.110	.22C	.200	.090C	.31C	179	219	11	5K

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00915 CALCIUM CA,DISS MG/L	00925 MGNSIUM MG,DISS MG/L	00930 SODIUM NA,DISS MG/L	00935 PTSSIUM K,DISS MG/L	00680 T ORG C C MG/L	01106 ALUMINUM AL,DISS UG/L	01000 ARSENIC AS,DISS UG/L	01005 BARIUM BA,DISS UG/L	01010 BERYLIUM BE,DISS UG/L	01020 BORON B,DISS UG/L
92/07/13	1120	WATER		45.0	12.0	21.00	1.00	5.0					

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01025 CADMIUM CD,DISS UG/L	01030 CHROMIUM CR,DISS UG/L	01035 COBALT CO,DISS UG/L	01040 COPPER CU,DISS UG/L	01046 IRON FE,DISS UG/L	01049 LEAD PB,DISS UG/L	82037 MG DISS MG UG/L	01056 MANGNESE MN,DISS UG/L	71900 MERCURY HG,TOTAL UG/L	01060 MOLY MO,DISS UG/L
92/07/13	1120	WATER										.5K	

REMARK CODES: C - calculated value, K - actual value is less than value shown, J - estimated value

SFR603.005525 SFR603005525 SANFRAN3
33 50 50.0 108 57 13.0 4
TROUT CREEK AT FR19 BRIDGE
35003 NEW MEXICO CATRON
COLORADO RIVER 110400
GILA RIVER
21NMEX 920926 15040004
0000 FEET DEPTH 2231 METERS ELEVATION

STATION 3 - TROUT CREEK AT FOREST ROAD 19 BRIDGE

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00010 WATER TEMP CENT	00095 CNDUCTVY AT 25C MICROMHO	00300 DO MG/L	00400 PH SU	82079 TURBIDTY LAB NTU	70300 RESIDUE DISS-180 C MG/L	00530 RESIDUE TOT NFLT MG/L	00665 PHOS-TOT MG/L P	00900 TOT HARD CACO3 MG/L	00612 UN-IONZD NH3-N MG/L
92/07/13	1005	WATER		14.3	287	8.2	8.08	1.0	204	3K	.190	121	0.005C

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3+NH4- N TOTAL MG/L	00640 T INORG. NITROGEN MG/L N	00625 TOT KJEL N MG/L	00605 ORG N N MG/L	00600 TOTAL N N MG/L	00410 T ALK CACO3 MG/L	00440 HCO3 ION HCO3 MG/L	00945 SULFATE SO4-TOT MG/L	00940 CHLORIDE TOTAL MG/L
92/07/13	1005	WATER		.08	.170	.25C	.190	.020C	.27C	154	187	6	5K

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00915 CALCIUM CA,DISS MG/L	00925 MGNSIUM MG,DISS MG/L	00930 SODIUM NA,DISS MG/L	00935 PTSSIUM K,DISS MG/L	00680 T ORG C C MG/L	01106 ALUMINUM AL,DISS UG/L	01000 ARSENIC AS,DISS UG/L	01005 BARIUM BA,DISS UG/L	01010 BERYLIUM BE,DISS UG/L	01020 BORON B,DISS UG/L
92/07/13	1005	WATER		32.0	10.0	16.00	1.00	5.0					

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01025 CADMIUM CD,DISS UG/L	01030 CHROMIUM CR,DISS UG/L	01035 COBALT CO,DISS UG/L	01040 COPPER CU,DISS UG/L	01046 IRON FE,DISS UG/L	01049 LEAD PB,DISS UG/L	82037 MG DISS MG UG/L	01056 MANGNESE MN,DISS UG/L	71900 MERCURY HG,TOTAL UG/L	01060 MOLY MO,DISS UG/L
92/07/13	1005	WATER										.5K	

REMARK CODES: C - calculated value, K - actual value is less than value shown, J - estimated value

SFR603.005315 SFR603005315 SANFRAN4
33 49 50.0 108 50 41.0 4
CENTERFIRE CREEK AT FR210 CROSSING
35003 NEW MEXICO CATRON
COLORADO RIVER 110400
GILA RIVER
21NMEX 920926 15040004
0000 FEET DEPTH 2033 METERS ELEVATION

STATION 4 - CENTERFIRE CREEK AT FOREST ROAD 210 CROSSING

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00010 WATER TEMP CENT	00095 CNDUCTVY AT 25C MICROMHO	00300 DO MG/L	00400 PH SU	82079 TURBIDTY LAB NTU	70300 RESIDUE DISS-180 C MG/L	00530 RESIDUE TOT NFLT MG/L	00665 PHOS-TOT MG/L P	00900 TOT HARD CACO3 MG/L	00612 UN-IONZD NH3-N MG/L
92/07/13	1045	WATER		16.9	490	8.7	8.54	.8	326	3K	.080	182	0.011C
92/07/14	1535	WATER		24.0	458	7.4	8.59	.9	312	4	.070	173	0.020C
92/07/15	1050	WATER		17.2	486	8.6	8.51	.7	338	3K	.070	190	<0.009C
92/07/15	1050	QA REPLICATE							340	3K	.080	180	0.009C

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3+NH4- N TOTAL MG/L	00640 T INORG. NITROGEN MG/L N	00625 TOT KJEL N MG/L	00605 ORG N N MG/L	00600 TOTAL N N MG/L	00410 T ALK CACO3 MG/L	00440 HCO3 ION HCO3 MG/L	00945 SULFATE SO4-TOT MG/L	00940 CHLORIDE TOTAL MG/L
92/07/13	1045	WATER		.08	.110	.18C	.130	.020C	.21C	274	326	13	8
92/07/14	1535	WATER		.11	.120	.23C	.380	.260C	.49C				
92/07/15	1050	WATER		.12	.100K	.22C	.100K	.000C	.22C				
92/07/15	1050	QA REPLICATE		.12	.100	.22C	.110	.010C	.23C				

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00915 CALCIUM CA,DISS MG/L	00925 MGNSIUM MG,DISS MG/L	00930 SODIUM NA,DISS MG/L	00935 PTSSIUM K,DISS MG/L	00680 T ORG C C MG/L	01106 ALUMINUM AL,DISS UG/L	01000 ARSENIC AS,DISS UG/L	01005 BARIUM BA,DISS UG/L	01010 BERYLIUM BE,DISS UG/L	01020 BORON B,DISS UG/L
92/07/13	1045	WATER		50.0	14.0	49.00	1.00	3.0					

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01025 CADMIUM CD,DISS UG/L	01030 CHROMIUM CR,DISS UG/L	01035 COBALT CO,DISS UG/L	01040 COPPER CU,DISS UG/L	01046 IRON FE,DISS UG/L	01049 LEAD PB,DISS UG/L	82037 MG DISS MG UG/L	01056 MANGNESE MN,DISS UG/L	71900 MERCURY HG,TOTAL UG/L	01060 MOLY MO,DISS UG/L
92/07/13	1045	WATER										.5K	

REMARK CODES: C - calculated value, K - actual value is less than value shown, J - estimated value

SFR602.005035 SFR602005035 SANFRAN5 USGS442680
33 44 12.0 108 46 14.0 4
SAN FRANCISCO RIVER ABOVE RESERVE AT HWY 12
35003 NEW MEXICO CATRON
COLORADO RIVER 110400
GILA RIVER STATION 5 - SAN FRANCISCO RIVER ABOVE RESERVE AT STATE HIGHWAY 12
21NMEX 870919 15040004
0000 FEET DEPTH 1753 METERS ELEVATION

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00010 WATER TEMP CENT	00095 CNDUCTVY AT 25C MICROMHO	00300 DO MG/L	00400 PH SU	82079 TURBIDTY LAB NTU	70300 RESIDUE DISS-180 C MG/L	00530 RESIDUE TOT NFLT MG/L	00665 PHOS-TOT MG/L P	00900 TOT HARD CACO3 MG/L	00612 UN-IONZD NH3-N MG/L
92/07/13	1205	WATER		22.4	366	8.2	8.58	8.3	244	15	.110	141	0.017C
92/07/14	1145	WATER		21.9	360	8.1	8.60	6.4	252	3K	.090	134	0.017C
92/07/15	1305	WATER		24.8	361	8.0	8.67	6.5	254	13	.110	137	0.023C

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3+NH4- N TOTAL MG/L	00640 T INORG. NITROGEN MG/L N	00625 TOT KJEL N MG/L	00605 ORG N N MG/L	00600 TOTAL N N MG/L	00410 T ALK CACO3 MG/L	00440 HCO3 ION HCO3 MG/L	00945 SULFATE SO4-TOT MG/L	00940 CHLORIDE TOTAL MG/L
92/07/13	1205	WATER		.14	.110	.25C	.240	.130C	.38C	195	235	11	5
92/07/14	1145	WATER		.11	.110	.22C	.270	.160C	.38C				
92/07/15	1305	WATER		.12	.110	.23C	.180	.070C	.30C				

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00915 CALCIUM CA,DISS MG/L	00925 MGNSIUM MG,DISS MG/L	00930 SODIUM NA,DISS MG/L	00935 PTSSIUM K,DISS MG/L	00680 T ORG C C MG/L	01106 ALUMINUM AL,DISS UG/L	01000 ARSENIC AS,DISS UG/L	01005 BARIUM BA,DISS UG/L	01010 BERYLIUM BE,DISS UG/L	01020 BORON B,DISS UG/L
92/07/13	1205	WATER		40.0	10.0	33.00	1.00	3.0					

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01025 CADMIUM CD,DISS UG/L	01030 CHROMIUM CR,DISS UG/L	01035 COBALT CO,DISS UG/L	01040 COPPER CU,DISS UG/L	01046 IRON FE,DISS UG/L	01049 LEAD PB,DISS UG/L	82037 MG DISS MG UG/L	01056 MANGNESE MN,DISS UG/L	71900 MERCURY HG,TOTAL UG/L	01060 MOLY MO,DISS UG/L
92/07/13	1205	WATER										.5K	

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01065 NICKEL NI,DISS UG/L	01145 SELENIUM SE,DISS UG/L	01080 STRONTUM SR,DISS UG/L	01100 TIN SN,DISS UG/L	01085 VANADIUM V,DISS UG/L	01090 ZINC ZN,DISS UG/L	50060 CHLORINE TOT RESD MG/L	31616 FEC COLI MFM-FCBR /100ML	00310 BOD 5 DAY MG/L
92/07/13	1205	WATER								.00		
92/07/14	1145	WATER								.00		
92/07/15	1305	WATER								.00		
92/07/16	0917	WATER									70J	4.0

REMARK CODES: C - calculated value, K - actual value is less than value shown, J - estimated value

SFR601.004530 SFR601004530 SANFRAN6 NM0024163
33 41 51.0 108 45 24.0 4
COMMUNITY OF RESERVE WWTP OUTFALL PIPE
35003 NEW MEXICO CATRON
COLORADO RIVER 110400
GILA RIVER
21NMEX 870926 15040004
SURFACE SAMPLES 1739 METERS ELEVATION

STATION 6 - COMMUNITY OF RESERVE WWTP OUTFALL PIPE

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00010 WATER TEMP CENT	00095 CNDUCTVY AT 25C MICROMHO	00400 PH SU	82079 TURBIDTY LAB NTU	70300 RESIDUE DISS-180 C MG/L	00530 RESIDUE TOT NFLT MG/L	00665 PHOS-TOT MG/L P	00900 TOT HARD CACO3 MG/L	00612 UN-IONZD NH3-N MG/L	00630 NO2&NO3 N-TOTAL MG/L
92/07/13	1350	WATER		21.5	738	7.63	7.4	568	10	3.030	187		16.10
92/07/14	1125	WATER		19.9	749	7.63	6.8	528	12	3.340	181		14.90
92/07/15	1320	WATER		20.5	698	7.62	9.2	558	15	.500	174		9.85

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00610 NH3+NH4-N TOTAL MG/L	00640 T INORG. NITROGEN MG/L N	00625 TOT KJEL N MG/L	00605 ORG N N MG/L	00600 TOTAL N N MG/L	00410 T ALK CACO3 MG/L	00440 HCO3 ION HCO3 MG/L	00945 SULFATE SO4-TOT MG/L	00940 CHLORIDE TOTAL MG/L	00915 CALCIUM CA,DISS MG/L
92/07/13	1350	WATER		.200	16.30C	2.910	2.710C	19.01C	210	256	40	43	55.0
92/07/14	1125	WATER		.160	15.06C	2.430	2.270C	17.33C					
92/07/15	1320	WATER		.220	10.07C	3.100	2.880C	12.95C					

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00925 MGNSIUM MG,DISS MG/L	00930 SODIUM NA,DISS MG/L	00935 PTSSIUM K,DISS MG/L	00680 T ORG C C MG/L	01106 ALUMINUM AL,DISS UG/L	01000 ARSENIC AS,DISS UG/L	01005 BARIUM BA,DISS UG/L	01010 BERYLIUM BE,DISS UG/L	01020 BORON B,DISS UG/L	01025 CADMIUM CD,DISS UG/L
92/07/13	1350	WATER		12.0	100.00	12.00	16.1						

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01030 CHROMIUM CR,DISS UG/L	01035 COBALT CO,DISS UG/L	01040 COPPER CU,DISS UG/L	01046 IRON FE,DISS UG/L	01049 LEAD PB,DISS UG/L	82037 MG DISS MG UG/L	01056 MANGNESE MN,DISS UG/L	71900 MERCURY HG,TOTAL UG/L	01060 MOLY MO,DISS UG/L	01065 NICKEL NI,DISS UG/L
92/07/13	1350	WATER									.5K		

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01145 SELENIUM SE,DISS UG/L	01080 STRONTUM SR,DISS UG/L	01100 TIN SN,DISS UG/L	01085 VANADIUM V,DISS UG/L	01090 ZINC ZN,DISS UG/L	50060 CHLORINE TOT RESD MG/L	31616 FEC COLI MFM-FCBR /100ML	00310 BOD 5 DAY MG/L
92/07/13	1350	WATER							.00		
92/07/14	1125	WATER							.00		
92/07/15	1320	WATER							.07		
92/07/16	0905	WATER								1K	3.0

REMARK CODES: C - calculated value, K - actual value is less than value shown, J - estimated value

SFR601.004520 SFR601004520 SANFRAN040 SANFRAN7
33 40 41.0 108 46 33.0 4
SAN FRANCISCO RIVER BELOW RESERVE
35003 NEW MEXICO CATRON
COLORADO RIVER 110400
GILA RIVER
21NMEX 870919 15040004
0000 FEET DEPTH 1732 METERS ELEVATION

STATION 7 - SAN FRANCISCO RIVER BELOW RESERVE

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00010 WATER TEMP CENT	00095 CNDUCTVY AT 25C MICROMHO	00300 DO MG/L	00400 PH SU	82079 TURBIDTY LAB NTU	70300 RESIDUE DISS-180 C MG/L	00530 RESIDUE TOT NFLT MG/L	00665 PHOS-TOT MG/L P	00900 TOT HARD CACO3 MG/L	00612 UN-IONZD NH3-N MG/L
92/07/13	1430	WATER		25.2	344	6.8	8.51	10.7	256	21	.130	151	0.017C
92/07/14	1100	WATER		19.8	381	7.8	8.41	45.0	262	33	.150	154	0.011C
92/07/14	1110	WATER						291.0					
92/07/15	1350	WATER		25.9	387	7.0	8.48	6.1	246	10	.110	159	0.017C

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3+NH4- N TOTAL MG/L	00640 T INORG. NITROGEN MG/L N	00625 TOT KJEL N MG/L	00605 ORG N N MG/L	00600 TOTAL N N MG/L	00410 T ALK CACO3 MG/L	00440 HCO3 ION HCO3 MG/L	00945 SULFATE SO4-TOT MG/L	00940 CHLORIDE TOTAL MG/L
92/07/13	1430	WATER		.10	.110	.21C	.210	.100C	.31C	203	245	11	6
92/07/14	1100	WATER		.14	.120	.26C	.300	.180C	.44C				
92/07/15	1350	WATER		.04K	.110	.15C	.170	.080C	.21C				

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00915 CALCIUM CA,DISS MG/L	00925 MGNSIUM MG,DISS MG/L	00930 SODIUM NA,DISS MG/L	00935 PTSSIUM K,DISS MG/L	00680 T ORG C C MG/L	01106 ALUMINUM AL,DISS UG/L	01000 ARSENIC AS,DISS UG/L	01005 BARIUM BA,DISS UG/L	01010 BERYLIUM BE,DISS UG/L	01020 BORON B,DISS UG/L
92/07/13	1430	WATER		44.0	10.0	33.00	1.00	3.0					

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01025 CADMIUM CD,DISS UG/L	01030 CHROMIUM CR,DISS UG/L	01035 COBALT CO,DISS UG/L	01040 COPPER CU,DISS UG/L	01046 IRON FE,DISS UG/L	01049 LEAD PB,DISS UG/L	82037 MG DISS MG UG/L	01056 MANGNESE MN,DISS UG/L	71900 MERCURY HG,TOTAL UG/L	01060 MOLY MO,DISS UG/L
92/07/13	1430	WATER										.5K	

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01065 NICKEL NI,DISS UG/L	01145 SELENIUM SE,DISS UG/L	01080 STRONTUM SR,DISS UG/L	01100 TIN SN,DISS UG/L	01085 VANADIUM V,DISS UG/L	01090 ZINC ZN,DISS UG/L	50060 CHLORINE TOT RESD MG/L	31616 FEC COLI MFM-FCBR /100ML	00310 BOD 5 DAY MG/L
92/07/13	1430	WATER								.00		
92/07/14	1100	WATER								.00		
92/07/15	1350	WATER								.00		
92/07/16	0858	WATER									90J	1.0

REMARK CODES: C - calculated value, K - actual value is less than value shown, J - estimated value

SFR603.004025 SFR603004025 TULAROSA095 SANFRAN8
33 40 40.0 108 46 10.0 4
TULAROSA RIVER ABOVE THE SAN FRANCISCO RIVER
35003 NEW MEXICO CATRON
COLORADO RIVER 110400
GILA RIVER STATION 8 - TULAROSA RIVER ABOVE THE SAN FRANCISCO RIVER
21NMEX 870919 15040004
0000 FEET DEPTH 1733 METERS ELEVATION

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00010 WATER TEMP CENT	00095 CNDUCTVY AT 25C MICROMHO	00300 DO MG/L	00400 PH SU	82079 TURBIDTY LAB NTU	70300 RESIDUE DISS-180 C MG/L	00530 RESIDUE TOT NFLT MG/L	00665 PHOS-TOT MG/L P	00900 TOT HARD CACO3 MG/L	00612 UN-IONZD NH3-N MG/L
92/07/13	1415	WATER		24.8	270	8.5	9.05	2.2	190	3K	.070	104	0.042C
92/07/14	1045	WATER		18.9	269	8.9	8.70	2.3	202	3	.200	107	0.017C
92/07/15	1405	WATER		25.5	262	8.7	9.08	2.2	176	3	.090	102	0.044C

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3+NH4- N TOTAL MG/L	00640 T INORG. NITROGEN MG/L N	00625 TOT KJEL N MG/L	00605 ORG N N MG/L	00600 TOTAL N N MG/L	00410 T ALK CACO3 MG/L	00440 HCO3 ION HCO3 MG/L	00945 SULFATE SO4-TOT MG/L	00940 CHLORIDE TOTAL MG/L
92/07/13	1415	WATER		.09	.110	.20C	1.280	1.170C	1.37C	135	155	10	5
92/07/14	1045	WATER		.12	.110	.23C	.240	.130C	.36C				
92/07/15	1405	WATER		.04K	.110	.15C	.260	.150C	.30C				

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00915 CALCIUM CA,DISS MG/L	00925 MGNSIUM MG,DISS MG/L	00930 SODIUM NA,DISS MG/L	00935 PTSSIUM K,DISS MG/L	00680 T ORG C C MG/L	01106 ALUMINUM AL,DISS UG/L	01000 ARSENIC AS,DISS UG/L	01005 BARIUM BA,DISS UG/L	01010 BERYLIUM BE,DISS UG/L	01020 BORON B,DISS UG/L
92/07/13	1415	WATER		27.0	9.0	21.00	3.00	3.0					

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01025 CADMIUM CD,DISS UG/L	01030 CHROMIUM CR,DISS UG/L	01035 COBALT CO,DISS UG/L	01040 COPPER CU,DISS UG/L	01046 IRON FE,DISS UG/L	01049 LEAD PB,DISS UG/L	82037 MG DISS MG UG/L	01056 MANGNESE MN,DISS UG/L	71900 MERCURY HG,TOTAL UG/L	01060 MOLY MO,DISS UG/L
92/07/13	1415	WATER										.5K	

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01065 NICKEL NI,DISS UG/L	01145 SELENIUM SE,DISS UG/L	01140 SILICON SI,DISS UG/L	01075 SILVER AG,DISS UG/L	01080 STRONTUM SR,DISS UG/L	01100 TIN SN,DISS UG/L	01085 VANADIUM V,DISS UG/L	01090 ZINC ZN,DISS UG/L	31616 FEC COLI MFM-FCBR /100ML
92/07/16	0855	WATER										10J

REMARK CODES: C - calculated value, K - actual value is less than value shown, J - estimated value

SFR601.001515 SFR601001515 SANFRAN9 USGS443000
33 22 05.0 108 54 35.0 4
SAN FRANCISCO RIVER AT ALMA
35003 NEW MEXICO CATRON
COLORADO RIVER 110400
GILA RIVER
21NMEX 870919 15040004
0000 FEET DEPTH 1476 METERS ELEVATION

STATION 9 - SAN FRANCISCO RIVER AT ALMA

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00010 WATER TEMP CENT	00095 CNDUCTVY AT 25C MICROMHO	00300 DO MG/L	00400 PH SU	82079 TURBIDTY LAB NTU	70300 RESIDUE DISS-180 C MG/L	00530 RESIDUE TOT NFLT MG/L	00665 PHOS-TOT MG/L P	00900 TOT HARD CACO3 MG/L	00612 UN-IONZD NH3-N MG/L
92/07/13	1535	WATER		31.0	342	7.2	8.69	14.3	240	24	.150	136	0.033C
92/07/14	0945	WATER		18.4	345	8.4	8.48	10.5	242	15	.130	141	0.011C
92/07/15	1510	WATER		31.5	334	7.4	8.79	8.7	240	10	.110	141	<0.035C
92/07/15	1510	QA REPLICATE							230	11	.090	131	<0.045C

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3+NH4- N TOTAL MG/L	00640 T INORG. NITROGEN MG/L N	00625 TOT KJEL N MG/L	00605 ORG N N MG/L	00600 TOTAL N N MG/L	00410 T ALK CACO3 MG/L	00440 HCO3 ION HCO3 MG/L	00945 SULFATE SO4-TOT MG/L	00940 CHLORIDE TOTAL MG/L
92/07/13	1535	WATER		.10	.110	.21C	.200	.090C	.30C	178	213	10	5
92/07/14	0945	WATER		.18	.110	.29C	.110	.000C	.29C				
92/07/15	1510	WATER		.04K	.100K	.14C	.170	.070C	.21C				
92/07/15	1510	QA REPLICATE		.04K	.110	.15C	.110	.000C	.15C				

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00915 CALCIUM CA,DISS MG/L	00925 MGNSIUM MG,DISS MG/L	00930 SODIUM NA,DISS MG/L	00935 PTSSIUM K,DISS MG/L	00680 T ORG C C MG/L	01106 ALUMINUM AL,DISS UG/L	01000 ARSENIC AS,DISS UG/L	01005 BARIUM BA,DISS UG/L	01010 BERYLIUM BE,DISS UG/L	01020 BORON B,DISS UG/L
92/07/13	1535	WATER		38.0	10.0	24.00	2.00	2.0					

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01025 CADMIUM CD,DISS UG/L	01030 CHROMIUM CR,DISS UG/L	01035 COBALT CO,DISS UG/L	01040 COPPER CU,DISS UG/L	01046 IRON FE,DISS UG/L	01049 LEAD PB,DISS UG/L	82037 MG DISS MG UG/L	01056 MANGNESE MN,DISS UG/L	71900 MERCURY HG,TOTAL UG/L	01060 MOLY MO,DISS UG/L
92/07/13	1535	WATER										.5K	

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01065 NICKEL NI,DISS UG/L	01145 SELENIUM SE,DISS UG/L	01140 SILICON SI,DISS UG/L	01075 SILVER AG,DISS UG/L	01080 STRONTUM SR,DISS UG/L	01100 TIN SN,DISS UG/L	01085 VANADIUM V,DISS UG/L	01090 ZINC ZN,DISS UG/L	31616 FEC COLI MFM-FCBR /100ML
92/07/16	0812	WATER										110J

REMARK CODES: C - calculated value, K - actual value is less than value shown, J - estimated value

SFR603.001010 SFR603001010 WWC098 SANFRAN10
33 18 57.0 108 52 57.0 4
WHITEWATER CREEK AT GLENWOOD
35003 NEW MEXICO CATRON
COLORADO RIVER 110400
GILA RIVER
21NMEX 870919 15040004
0000 FEET DEPTH 1437 METERS ELEVATION

STATION 10 - WHITEWATER CREEK AT GLENWOOD

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00010 WATER TEMP CENT	00095 CNDUCTVY AT 25C MICROMHO	00300 DO MG/L	00400 PH SU	82079 TURBIDTY LAB NTU	70300 RESIDUE DISS-180 C MG/L	00530 RESIDUE TOT NFLT MG/L	00665 PHOS-TOT MG/L P	00900 TOT HARD CACO3 MG/L	00612 UN-IONZD NH3-N MG/L
92/07/13	1600	WATER		19.0	114	7.9	8.08	5.2	94	8	.120	45	0.005C
92/07/14	0900	WATER		14.9	113	8.3	7.55	4.8	100	9	.070	45	0.001C
92/07/15	1530	WATER		18.9	110	8.2	8.07	4.8	104	6	.070	45	0.005C

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3+NH4- N TOTAL MG/L	00640 T INORG. NITROGEN MG/L N	00625 TOT KJEL N MG/L	00605 ORG N N MG/L	00600 TOTAL N N MG/L	00410 T ALK CACO3 MG/L	00440 HCO3 ION HCO3 MG/L	00945 SULFATE SO4-TOT MG/L	00940 CHLORIDE TOTAL MG/L
92/07/13	1600	WATER		.13	.110	.24C	.270	.160C	.40C	47	57	10	5K
92/07/14	0900	WATER		.17	.110	.28C	.180	.070C	.35C				
92/07/15	1530	WATER		.05	.120	.17C	.180	.060C	.23C				

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00915 CALCIUM CA,DISS MG/L	00925 MGNSIUM MG,DISS MG/L	00930 SODIUM NA,DISS MG/L	00935 PTSSIUM K,DISS MG/L	00680 T ORG C C MG/L	01106 ALUMINUM AL,DISS UG/L	01000 ARSENIC AS,DISS UG/L	01005 BARIUM BA,DISS UG/L	01010 BERYLIUM BE,DISS UG/L	01020 BORON B,DISS UG/L
92/07/13	1600	WATER		13.0	3.0	7.00	1.00	3.0					

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01025 CADMIUM CD,DISS UG/L	01030 CHROMIUM CR,DISS UG/L	01035 COBALT CO,DISS UG/L	01040 COPPER CU,DISS UG/L	01046 IRON FE,DISS UG/L	01049 LEAD PB,DISS UG/L	82037 MG DISS MG UG/L	01056 MANGNESE MN,DISS UG/L	71900 MERCURY HG,TOTAL UG/L	01060 MOLY MO,DISS UG/L
92/07/13	1600	WATER										.5K	

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01065 NICKEL NI,DISS UG/L	01145 SELENIUM SE,DISS UG/L	01140 SILICON SI,DISS UG/L	01075 SILVER AG,DISS UG/L	01080 STRONTUM SR,DISS UG/L	01100 TIN SN,DISS UG/L	01085 VANADIUM V,DISS UG/L	01090 ZINC ZN,DISS UG/L	31616 FEC COLI MFM-FCBR /100ML
92/07/16	0805	WATER										40J

REMARK CODES: C - calculated value, K - actual value is less than value shown, J - estimated value

SFR603.001010 SFR603001010 WWC098 SANFRAN10
33 18 57.0 108 52 57.0 4
WHITEWATER CREEK AT GLENWOOD
35003 NEW MEXICO CATRON
COLORADO RIVER 110400
GILA RIVER
21NMEX 870919 15040004
SURFACE SAMPLES 1437 METERS ELEVATION

STATION 10 - WHITEWATER CREEK AT GLENWOOD

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	39330 ALDRIN TOT UG/L	39337 ALPHABHC TOTUG/L	39338 BETA BHC TOTUG/L	34259 DELTABHC TOTUG/L	39340 GAMMABHC LINDANE TOT.UG/L	39348 A-CHLRDN WHL SMPL UG/L	39810 G-CHLRDN WHL SMPL UG/L	39360 DDD WHL SMPL UG/L	39365 DDE WHL SMPL UG/L	39370 DDT WHL SMPL UG/L
92/07/15	1530	WATER		.050K	.050K	.050K	.050K	.050K	.500K	.50K	.100K	.100K	.100K

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	39380 DIELDRIN TOTUG/L	82623 ENDOSLFN -SO4 TOT REC UG/L	82624 ENDOSLFN BETA TOT REC UG/L	39388 ENDOSULN WHL SMPL UG/L	39390 ENDRIN TOT UG/L	82622 ENDRIN ALDH TOT REC UG/L	78008 ENDRIN KETONE UG/L	39700 HCB TOT UG/L	39410 HEPTCHLR TOTUG/L	39420 HPCHLREP TOTUG/L
92/07/15	1530	WATER		.100K	.1K	.1K	.050K	.100K	.1K	.10K	.080K	.050K	.050K

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	39480 MTHXYCLR WHL SMPL UG/L	39492 PCB-1232 TOTUG/L	39496 PCB-1242 TOTUG/L	39500 PCB-1248 TOTUG/L	39504 PCB-1254 TOTUG/L	39508 PCB-1260 TOTUG/L	39400 TOXAPHEN TOTUG/L
92/07/15	1530	WATER		.500K	.500K	.500K	.500K	1.000K	1.000K	1.000K

REMARK CODES: C - calculated value, K - actual value is less than value shown, J - estimated value

SFR601.000505 SFR601000505 SANFRAN11 USGS444000
33 14 48.0 108 52 47.0 4
SAN FRANCISCO RIVER AT SAN FRANCISCO HOT SPRINGS
35003 NEW MEXICO CATRON
COLORADO RIVER 110400
GILA RIVER
21NMEX 870919 15040004
0000 FEET DEPTH 1390 METERS ELEVATION

STATION 11 - SAN FRANCISCO RIVER AT SAN FRANCISCO HOT SPRINGS

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00010 WATER TEMP CENT	00095 CNDUCTVY AT 25C MICROMHO	00300 DO MG/L	00400 PH SU	82079 TURBIDTY LAB NTU	70300 RESIDUE DISS-180 C MG/L	00530 RESIDUE TOT NFLT MG/L	00665 PHOS-TOT MG/L P	00900 TOT HARD CACO3 MG/L	00612 UN-IONZD NH3-N MG/L
92/07/13	1640	WATER		27.4	332	6.9	8.43	23.5	228	58	.200	124	0.018C
92/07/13	1640	QA REPLICATE							232	57	.150	129	0.018C
92/07/14	0810	WATER		16.1	331	7.9	8.11	18.2	230	34	.120	122	0.004C
92/07/15	1555	WATER		28.9	343	6.9	8.46	24.0	228	49	.180	117	0.021C

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3+NH4- N TOTAL MG/L	00640 T INORG. NITROGEN MG/L N	00625 TOT KJEL N MG/L	00605 ORG N N MG/L	00600 TOTAL N N MG/L	00410 T ALK CACO3 MG/L	00440 HCO3 ION HCO3 MG/L	00945 SULFATE SO4-TOT MG/L	00940 CHLORIDE TOTAL MG/L
92/07/13	1640	WATER		.21	.120	.33C	.290	.170C	.50C	147	179	11	14
92/07/13	1640	QA REPLICATE		.22	.120	.34C	.280	.160C	.50C	147	179	11	13
92/07/14	0810	WATER		.30	.110	.41C	.180	.070C	.48C				
92/07/15	1555	WATER		.08	.120	.20C	.220	.100C	.30C				

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00915 CALCIUM CA,DISS MG/L	00925 MGNSIUM MG,DISS MG/L	00930 SODIUM NA,DISS MG/L	00935 PTSSIUM K,DISS MG/L	00680 T ORG C C MG/L	01106 ALUMINUM AL,DISS UG/L	01000 ARSENIC AS,DISS UG/L	01005 BARIUM BA,DISS UG/L	01010 BERYLIUM BE,DISS UG/L	01020 BORON B,DISS UG/L
92/07/13	1640	WATER		35.0	9.0	27.00	3.00	3.0					
92/07/13	1640	QA REPLICATE		37.0	9.0	26.00	3.00	2.0					

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01145 SELENIUM SE,DISS UG/L	01140 SILICON SI,DISS UG/L	01075 SILVER AG,DISS UG/L	01080 STRONTUM SR,DISS UG/L	01100 TIN SN,DISS UG/L	01085 VANADIUM V,DISS UG/L	01090 ZINC ZN,DISS UG/L	31616 FEC COLI MFM-FCBR /100ML	11503 RA-226 + RA-228 PC/L	11504 RA-226 + 228 ERR PC/L
92/07/13	1640	WATER										3.4	1.4
92/07/16	0755	WATER									210		
92/07/16	0858	QA REPLICATE									60J		

REMARK CODES: C - calculated value, K - actual value is less than value shown, J - estimated value

SFR601.000505 SFR601000505 SANFRAN11 USGS444000
33 14 48.0 108 52 47.0 4
SAN FRANCISCO RIVER AT SAN FRANCISCO HOT SPRINGS
35003 NEW MEXICO CATRON
COLORADO RIVER 110400
GILA RIVER
21NMEX 870919 15040004
SURFACE SAMPLES 1390 METERS ELEVATION

STATION 11 - SAN FRANCISCO RIVER AT SAN FRANCISCO HOT SPRINGS

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	39330 ALDRIN TOT UG/L	39337 ALPHABHC TOTUG/L	39338 BETA BHC TOTUG/L	34259 DELTABHC TOTUG/L	39340 GAMMABHC LINDANE TOT.UG/L	39348 A-CHLRDN WHL SMPL UG/L	39810 G-CHLRDN WHL SMPL UG/L	39360 DDD WHL SMPL UG/L	39365 DDE WHL SMPL UG/L	39370 DDT WHL SMPL UG/L
92/07/15	1555	WATER		.050K	.050K	.050K	.050K	.050K	.500K	.50K	.100K	.100K	.100K

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	39380 DIELDRIN TOTUG/L	82623 ENDOSLFN -SO4 TOT REC UG/L	82624 ENDOSLFN BETA TOT REC UG/L	39388 ENDOSULN WHL SMPL UG/L	39390 ENDRIN TOT UG/L	82622 ENDRIN ALDH TOT REC UG/L	78008 ENDRIN KETONE UG/L	39700 HCB TOT UG/L	39410 HEPTCHLR TOTUG/L	39420 HPCHLREP TOTUG/L
92/07/15	1555	WATER		.100K	.1K	.1K	.050K	.100K	.1K	.10K	.080K	.050K	.050K

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	39480 MTHXYCLR WHL SMPL UG/L	39492 PCB-1232 TOTUG/L	39496 PCB-1242 TOTUG/L	39500 PCB-1248 TOTUG/L	39504 PCB-1254 TOTUG/L	39508 PCB-1260 TOTUG/L	39400 TOXAPHEN TOTUG/L
92/07/15	1555	WATER		.500K	.500K	.500K	.500K	1.000K	1.000K	1.000K

REMARK CODES: C - calculated value, K - actual value is less than value shown, J - estimated value

SFR601.000215 SFR601000215 MULE CR. 2 SANFRAN12
33 07 19.0 108 57 35.0 4
MULE CREEK AT NEW MEXICO HIGHWAY 78
35017 NEW MEXICO GRANT
COLORADO RIVER 110400
GILA RIVER
21NMEX 851207 15040004
0000 FEET DEPTH

STATION 12 - MULE CREEK AT NEW MEXICO HIGHWAY 78

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00010 WATER TEMP CENT	00095 CNDUCTVY AT 25C MICROMHO	00300 DO MG/L	00400 PH SU	82079 TURBIDTY LAB NTU	70300 RESIDUE DISS-180 C MG/L	00530 RESIDUE TOT NFLT MG/L	00665 PHOS-TOT MG/L P	00900 TOT HARD CACO3 MG/L	00612 UN-IONZD NH3-N MG/L
92/07/13	1710	WATER		22.1	243	7.2	8.06	.9	196	3K	.190	94	0.007C

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3+NH4- N TOTAL MG/L	00640 T INORG. NITROGEN MG/L N	00625 TOT KJEL N MG/L	00605 ORG N N MG/L	00600 TOTAL N N MG/L	00410 T ALK CACO3 MG/L	00440 HCO3 ION HCO3 MG/L	00945 SULFATE SO4-TOT MG/L	00940 CHLORIDE TOTAL MG/L
92/07/13	1710	WATER		.12	.130	.25C	.170	.040C	.29C	99	121	20	5K

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00915 CALCIUM CA,DISS MG/L	00925 MGNSIUM MG,DISS MG/L	00930 SODIUM NA,DISS MG/L	00935 PTSSIUM K,DISS MG/L	00680 T ORG C C MG/L	01106 ALUMINUM AL,DISS UG/L	01000 ARSENIC AS,DISS UG/L	01005 BARIUM BA,DISS UG/L	01010 BERYLIUM BE,DISS UG/L	01020 BORON B,DISS UG/L
92/07/13	1710	WATER		31.0	4.0	14.00	5.00						

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01025 CADMIUM CD,DISS UG/L	01030 CHROMIUM CR,DISS UG/L	01035 COBALT CO,DISS UG/L	01040 COPPER CU,DISS UG/L	01046 IRON FE,DISS UG/L	01049 LEAD PB,DISS UG/L	82037 MG DISS MG UG/L	01056 MANGNESE MN,DISS UG/L	71900 MERCURY HG,TOTAL UG/L	01060 MOLY MO,DISS UG/L
92/07/13	1710	WATER										.5K	

REMARK CODES: C - calculated value, K - actual value is less than value shown, J - estimated value

Table 4. MACROINVERTEBRATES COLLECTED FROM SAN FRANCISCO RIVER AND CENTERFIRE CREEK, JULY 1992.

TAXA	STATIONS 1 San Francisco at Luna	4 Centerfire Creek	5 San Francisco above Reserve	7 San Francisco below Reserve
PLECOPTERA - stoneflies				
Amphinemura sp.	17	-	-	-
EPHEMEROPTERA - mayflies				
Isonychia sp.	-	-	198	-
Baetis tricaudatus	312	369	215	
Baetis insignificans	-	1,888	284	187
Heptagenia sp.	119	40	-	-
Epeorus longimanus	51	-	-	-
Paraleptophlebia sp.	-	159	204	-
Thraulodes sp.	567	-	1,117	45
Tricorythodes sp.	153	493	266	397
Ephemerella inermis	-	51	261	91
TRICHOPTERA - caddisflies				
Atopsyche sp.	11	-	-	-
Glossosoma sp.	-	17	-	-
Hydropsyche venada	119	91	164	170
Stactobiella sp.	-	40	-	40
Helicopsyche borealis	159	11	-	-
DIPTERA - true flies				
Hexatoma A	-	-	6	6
Limonia sp.	17	-	6	-
Simuliidae	17	113	51	23
Chironomidae B	-	1,882	102	40
Chironomidae D	-	-	-	6
Diamesa sp.	-	1,015	-	-
Eukiefferiella sp.	-	57	-	-
Cricotopus sp.	147	187	40	-
Micropsectra sp.	-	-	23	-
Procladius sp.	23	17	6	-
Ceratopogonidae		125	6	-
Tabanidae	23	-	-	11
Oreogeton sp.	6	-	-	-
Limnophora sp.	-	181	-	-
ODONATA - damsel/dragonflies				
Argia sp.	-	6	-	-
HEMIPTERA - true bugs				
Ambrysus mormon	6	-	-	11
COLEOPTERA - beetles				
Helichus sp.	11	-	6	-
Peltodytes sp.	-	6	-	-
Dytiscidae	-	6	-	-
Zaitzevia parvula	11	28	164	28
Heterimnius corpulentus	57	-	-	-

Table 4. cont.

TAXA	STATIONS 1 San Francisco at Luna	4 Canterfire Creek	5 San Francisco above Reserve	7 San Francisco below Reserve
LEPIDOPTERA - moths				
Parargyractus kearfottalis	-	11	-	-
MOLLUSCA - snails/clams				
Physa sp.	-	45	-	-
ANNELIDA - segmented worms				
Erpobdell sp.	17	-	-	-
Naididae	-	17	-	79
PLATYHELMINTHES - flatworms				
Turbellaria	34	11	-	-
ARTHROPODA - other arthropods				
Hydracharina A - mites	6	-	-	6
Hydracharina B - mites	-	-	-	6
AMPHIPODA - scuds				
Hyalella azteca	-	153	-	6
Standing Crop (No./m^2)	1,883	7,019	3,119	1,152
Total Taxa	22	27	18	17
CTQ_d	75.5	89.8	77.6	91.9
Diversity Index	3.35	3.12	3.15	3.01

Table 5. RAPID BIOASSESSMENT (PROTOCOL III) OF THE SAN FRANCISCO RIVER AND CENTERFIRE CREEK, JULY 1992.

	STATIONS				
	Reference San Francisco at Luna (1987 data)	1 San Francisco at Luna	4 Centerfire Creek	5 Sanfrancisco above Reserve	7 San Francisco below Reserve
Calculated Value					
No. of Taxa	25	22	27	18	17
Standing Crop (#/m^2)	1,752	1,883	7,019	3,119	1,152
Biotic Index					
HBI	4.84	3.67	5.97	3.01	4.34
BCI (CTQ_d)	77	76	90	78	92
% Dominant Taxa	23	30	27	36	35
EPT Index	12	9	10	8	6
Community Loss	-	0.32	0.66	0.78	0.94
EPT/(Chironomids+EPT)	0.77	0.75	0.47	0.94	0.98
Scrapers/(C-F + Scrapers)	0.50	0.69	0.32	0.29	0.37
Shredders/Total	0.01	0.10	0.03	0.015	0.035
Percent of Reference					
No. of Taxa	100	88	108	72	68
Standing Crop (#/m^2)	100	107	400	178	66
Biotic Index					
HBI	100	132	81	160	112
BCI (CTQ_d)	100	101	85	99	84
% Dominant Taxa	23	30	27	36	35
EPT Index	100	75	83	66	50
Community Loss	-	0.32	0.66	0.78	0.94
EPT/(Chironomids+EPT)	-	97	61	122	127
Scrapers/(C-F + Scrapers)	-	138	64	58	74
Shredders/Total	-	1,000	300	150	350
Score					
No. of Taxa	6	6	6	4	4
Standing Crop (#/m^2)	6	6	0	4	4
Biotic Index					
HBI	6	6	4	6	6
BCI (CTQ_d)	6	6	4	6	4
% Dominant Taxa	4	4	4	2	2
EPT Index	6	2	4	0	0
Community Loss	6	6	4	4	4
EPT/(Chironomids+EPT)	6	6	4	6	6
Scrapers/(C-F + Scrapers)	6	6	6	6	6
Shredders/Total	6	6	6	6	6
Total	58	54	42	44	42
% of Reference	100	93	72	76	72
Biological Condition	Non-impaired	Non-impaired	Slightly impaired	Slightly impaired	Slightly impaired
Habitat Condition	149	149	103	120	77
% of Reference	100	100	69	81	52
Habitat Category	Good to Excellent	Comparable to Reference	Partially Supporting	Supporting	Non-Supporting

INTENSIVE WATER QUALITY SURVEY OF THE UPPER GILA RIVER AND ITS TRIBUTARIES, CATRON AND GRANT COUNTIES, NEW MEXICO, AUGUST 3-4 AND SEPTEMBER 16, 1992

Introduction

During the week of August 3, 1992, the Surveillance and Standards Section conducted a three-day intensive water quality survey of the East and Middle forks of the Gila River and their tributaries Black Canyon, Canyon, Diamond, Gilita, Iron, Snow, Taylor and Willow creeks. Additional samples were collected from Gilita and Willow creeks on September 16, 1992. These streams are contained in water quality segment 2-503.

Water Quality Standards

Water quality standards for the upper Gila River and its tributaries are set forth in sections 1-102, 2-503 and 3-101 of the New Mexico water quality standards (NMWQCC 1991). Designated uses for segment 2-503, which includes the Gila River from Gila Hot Springs upstream to the headwaters and perennial tributaries at or above the town of Cliff, are domestic water supply, high quality coldwater fishery, irrigation, livestock and wildlife watering and secondary contact recreation.

Methods

Water quality sampling methods were in accordance with the Quality Assurance Project Plan for Water Quality Management Programs (NMED 1991).

Sampling Stations

The names, STORET identification codes and locations of stations selected for this survey are given below. A map of the study area is presented in Fig. 4.

Station	STORET Code	Location
1	GRB503009590	Willow Creek at Ben Lilly Campground.
2	GRB503007545	Gilita Creek at Gilita Creek Campground.
3	GRB503009583	Snow Canyon Creek below Snow Lake.
4	GRB503009587	Gilita Creek above confluence with Snow Canyon Creek.
5	GRB503009580	Middle Fork of the Gila River below Gilita Creek.
6	GRB503009577	Iron Creek above confluence with the Middle Fork of the Gila River.
7	GRB503009575	Middle Fork of the Gila River below Iron Creek.

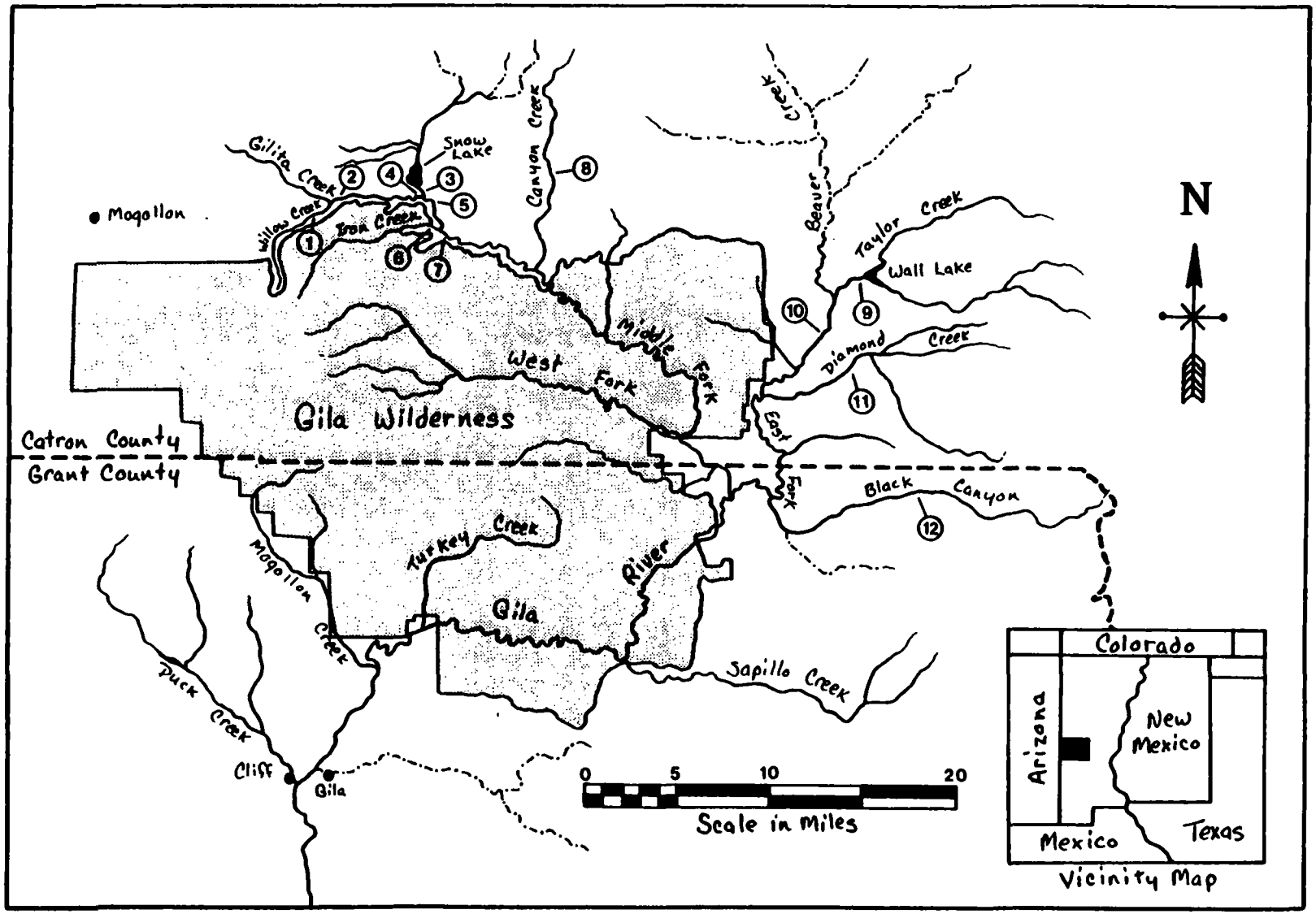

Figure 4. Map of sampling stations on the upper Gila River watershed, 1992.

Station	STORET Code	Location
8	GRB503009571	Canyon Creek at Forest Road 142.
9	GRB503007550	Taylor Creek below Wall Lake.
10	GRB503007547	East Fork of the Gila River below Taylor Creek.
11	GRB503007543	Diamond Creek at Forest Road 225.
12	GRB503009565	Black Canyon Creek at Highway 61 bridge.

Water Quality Assessment

Water quality data collected during this survey are available on STORET and can be retrieved using the selector A=21NMEX and the restrictor IS=923504. Parametric coverage and survey data are provided in Tables 6 through 9. Results of analyses for dissolved metals for this survey have not been received at the time this report was prepared.

The water at station 1 on Willow Creek was cool, clear and highly oxygenated with low to moderate levels of most chemical constituents and nutrients. Results of the initial samples collected on August 3, 1992, indicated a minor exceedance for total phosphorus. The analytical result for total phosphorus was 0.1 mg/l while the numeric standard for segment 2-503 states that phosphorus "shall be less than 0.1 mg/l." This station and station 2 were resampled on September 16, 1992, because the anion/cation samples collected during the earlier trip were accidentally destroyed at the laboratory. The total phosphorus level in the second sample was below the numeric standard. The total phosphorus exceedance is so minor that it does not indicate even a partial impairment of the high quality coldwater fishery use in August. All designated uses were attained.

Gilita Creek at station 2 was very similar to Willow Creek - cool, clear and highly oxygenated, with low to moderate levels of most chemical constituents and nutrients. During the initial sampling on August 3, the total phosphorus level for the sample and for the quality assurance replicate exceeded the numeric standard. The QA replicate for the August 3 sample had a very high reported level for total Kjeldahl nitrogen. Values for total organic nitrogen and total nitrogen, which are calculated from the total kjeldahl value, are also quite high. Since the original sample contained 0.18 mg/l for total Kjeldahl nitrogen, there was apparently a laboratory error in the reported QA sample value. The exceedance of the numeric standard for total phosphorus indicates a partial impairment of the high quality coldwater fishery use at that time while all other designated uses were attained.

Snow Canyon Creek downstream from Snow Lake (station 3) was warm and turbid with a low dissolved oxygen level, moderate to high levels of nutrients and low levels of most other chemical constituents. Exceptions were total dissolved solids and total suspended solids, which were quite high. There were exceedances of numeric standards for temperature, turbidity, total phosphorus and total organic carbon. The dissolved oxygen level was below the numeric standard for segment 2-503. This station was located 500 meters

downstream from the Snow Lake dam and the water, apparently discharged from the hypolimnion, was slow moving and muddy. The exceedances and the low dissolved oxygen indicate nonattainment of the high quality coldwater fishery use in this reach, while all other designated uses were attained.

Gilita Creek above the confluence with Snow Canyon Creek (station 4) was warm and clear with low to moderate levels of nutrients and low levels of other chemical constituents. The measured water temperature at this station exceeded the numeric standard and indicates a partial impairment of the high quality coldwater fishery use while all other designated uses were attained.

Station 5 was located on the Middle Fork of the Gila River, which is formed by the confluence of Gilita Creek and Snow Canyon Creek. The water at this station was warm and slightly turbid, with a low level of dissolved oxygen, low to moderate levels of nutrients and low levels of other chemical constituents. There were exceedances of the numeric standards for temperature and total phosphorus, which indicate a partial impairment of the high quality coldwater fishery use while all other designated uses were attained.

Iron Creek (station 6) is a tributary of the Middle Fork of the Gila River and is located completely within the Gila Wilderness. The water here was warm and clear with a relatively low level of dissolved oxygen and high levels of total phosphorus and un-ionized ammonia, reflecting the cattle grazing activity in the watershed. Other nutrients were present in low to moderate amounts and the other chemical constituents were present in low amounts. There were exceedances of numeric standards for temperature, total phosphorus and un-ionized ammonia, indicating nonattainment of the high quality coldwater fishery use while all other designated uses were attained.

Station 7 was on the Middle Fork of the Gila River downstream from its confluence with Iron Creek. The water here was warm and clear with a low dissolved oxygen level. There were moderate levels of nutrients and low levels of other chemical constituents. There was an exceedance of the numeric standard for temperature and the measured level of dissolved oxygen was 6.0 mg/l while the numeric standard for segment 2-503 states that "dissolved oxygen shall be greater than 6.0 mg/l." The exceedance of the temperature standard and the low level of dissolved oxygen indicate a partial impairment of the high quality coldwater fishery use while all other designated uses were attained.

Canyon Creek (station 8) was clear and moderately warm and alkaline, with a moderately high dissolved oxygen and low levels of nitrogen species and other chemical constituents. There was an exceedance of the numeric standard for total phosphorus, indicating a partial impairment of the high quality coldwater fishery use while all other designated uses were attained.

Station 9 was located on Taylor Creek just downstream from the Wall Lake dam. Wall Lake is a shallow, warm, eutrophic lake with heavy growths of macrophytes. The water in Taylor Creek was warm and moderately alkaline and turbid. there were moderate to high levels of nutrients and low to moderate levels of other chemical constituents. There were exceedances of the numeric standards for temperature and turbidity, indicating a partial impairment of the high quality coldwater fishery use while all other designated uses were attained.

Station 10 was located on the East Fork of the Gila River, which is formed by the confluence of Taylor and Beaver creeks. The water here was very warm, clear and alkaline with moderate levels of nutrients, dissolved oxygen and other chemical constituents. The measured water temperature was 28.2 C, the highest of any stream during this survey. The numeric standards for segment 2-503 specifically allows water temperatures in the East Fork to range as high as 32.2 C, while temperatures for the other Gila River tributaries sampled during this survey must be less than 20 C. There were exceedances of the numeric standards for pH and un-ionized ammonia, indicating nonattainment of the high quality coldwater fishery use while all other designated uses were attained.

Diamond Creek (station 11) was warm and clear with a moderately low level of dissolved oxygen. There were moderate to high levels of nutrients and low levels of other chemical constituents. There were exceedances of the numeric standards for temperature and total phosphorus, indicating nonattainment of the high quality coldwater fishery use while all other designated uses were attained. The sampling station on Diamond Creek was located downstream from the site of the previous year's forest fire in the upper watershed.

Black Canyon Creek (station 12) was warm, clear and somewhat alkaline, with a moderate level of dissolved oxygen and moderately high levels of nutrients and total organic carbon, which may reflect the cattle grazing activity in the watershed. There were low to moderate levels of other chemical constituents. There was a minor exceedance of the numeric standard for temperature (the standard states that the "temperature shall be less than 20 C," while the reading for this station was 20 C) and there was an exceedance of the numeric standard for total phosphorus, indicating a partial impairment of the high quality coldwater fishery use while all other designated uses were attained.

Biological Assessment

Two separate bioassessments were performed. One used a watershed reference station (Turkey creek) and the other used an ecoregion reference station (the San Francisco River above Luna). The San Francisco River above Luna is located in ecoregion 23, as are all of the sampled stations in this survey and Turkey Creek, but is not located in the same watershed.

Using Turkey Creek as the reference station, habitat conditions at each of the stations were rated good to excellent, except for the station on the East Fork. The habitat at this station was fair to poor, with a comparability index of 62 percent. The biological condition at the Turkey Creek reference station was good, as were biological conditions at Gilita Creek, Middle Fork and Iron Creek. These stations were considered to be non-impaired. Taylor Creek and the East Fork were slightly impaired, but for different reasons. Because the habitat at the Taylor Creek station was comparable to the reference, impairment of the macroinvertebrate community was due to reduced water quality. Taylor Creek, which drains Wall Lake, is highly eutrophic (Potter 1982) and the benthic community reflects this nutrient enrichment. Increases in both the standing crop and taxa richness, along with reductions in diversity and the EPT index substantiate an impairment due to reduced water quality. Large increases in the collector-filterer group (Simuliidae and *Hydropsyche*) and a reduction in the shredder group further point to nutrient-enriched water in Taylor Creek. The slight impairment of the macroinverte-

brate community at station 10 on the East Fork reflects the domination of this community by one taxa and a reduction in standing crop and species richness. This appears to be partially due to habitat impairment at the station, but also reflects a reduction in water quality. Taylor Creek becomes the East Fork after it joins with the much smaller Beaver Creek and these watercourses share water-quality problems.

An assessment of the same microbiological data using the San Francisco River reference station yielded similar results. This reference station was determined to be superior to the Turkey Creek station due to increased taxa numbers and a more pollution-sensitive benthic community. Compared to this improved reference station, each of the study stations scored slightly lower. Stations on the East Fork and Taylor Creek were again shown to be impaired for the same reasons. Gilita Creek was also found to be slightly impaired using this ecoregion reference station. Impairment here was shown by a small reduction in the percentage of EPT taxa and was probably due to a slight reduction in water quality. The other study stations and Turkey Creek were again shown to be non-impaired. The San Francisco River above Luna appears to be a valid reference station for the entire ecoregion and contains the highest quality benthic community found in this ecoregion to data.

Table 6. Water quality data collected from the upper Gila River watershed, August 3-4 and September 16, 1992.

STORET RETRIEVAL DATE 93/03/02 PGM=RET
GRB503.009590 GRB503009590 UG1
33 21 09.0 108 35 39.0 4
WILLOW CREEK AT BEN LILLY CAMPGROUND
35003 NEW MEXICO CATRON
COLORADO RIVER 110400
GILA RIVER STATION 1 - WILLOW CREEK AT BEN LILLY CAMPGROUND
21NMEX 920912 15040001
SURFACE SAMPLES 2441 METERS ELEVATION

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00010 WATER TEMP CENT	00095 CNDUCTVY AT 25C MICROMHO	00300 DO MG/L	00400 PH SU	82079 TURBIDTY LAB NTU	70300 RESIDUE DISS-180 C MG/L	00530 RESIDUE TOT NFLT MG/L	00665 PHOS-TOT MG/L P	00900 TOT HARD CACO3 MG/L	00612 UN-IONZD NH3-N MG/L
92/08/03	1000	WATER		13.1	59	7.8	7.98	2.2			.100		0.003C
92/09/16	1130	WATER		12.8	47	8.2	7.50	1.0	76	3K	.070	23	<0.001C

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3+NH4- N TOTAL MG/L	00640 T INORG. NITROGEN MG/L N	00625 TOT KJEL N MG/L	00605 ORG N N MG/L	00600 TOTAL N N MG/L	00410 T ALK CACO3 MG/L	00440 HCO3 ION HCO3 MG/L	00945 SULFATE SO4-TOT MG/L	00940 CHLORIDE TOTAL MG/L
92/08/03	1000	WATER		.04K	.120	.16C	.660	.540C	.70C				
92/09/16	1130	WATER		.10	.100K	.20C	.260	.160C	.36C	22	27	5K	5K

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00915 CALCIUM CA,DISS MG/L	00925 MGNSIUM MG,DISS MG/L	00930 SODIUM NA,DISS MG/L	00935 PTSSIUM K,DISS MG/L	00680 T ORG C C MG/L	01106 ALUMINUM AL,DISS UG/L	01000 ARSENIC AS,DISS UG/L	01005 BARIUM BA,DISS UG/L	01010 BERYLIUM BE,DISS UG/L	01020 BORON B,DISS UG/L
92/08/03	1000	WATER						2.0					
92/09/16	1130	WATER		6.0	2.0	3.00	2.00	2.0					

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01025 CADMIUM CD,DISS UG/L	01030 CHROMIUM CR,DISS UG/L	01035 COBALT CO,DISS UG/L	01040 COPPER CU,DISS UG/L	01046 IRON FE,DISS UG/L	01049 LEAD PB,DISS UG/L	82037 HG DISS HG UG/L	01056 MANGNESE MN,DISS UG/L	71900 MERCURY HG,TOTAL UG/L	01060 MOLY MO,DISS UG/L
92/08/03	1000	WATER										.5K	
92/09/16	1130	WATER										.5K	

REMARK CODES: C - calculated value, K - actual value is less than value shown, J - estimated value

GRB503.007545 GRB503007545 UG2
33 24 07.0 108 34 44.0 4
GILITA CREEK AT GILITA CREEK CAMPGROUND
35003 NEW MEXICO CATRON
COLORADO RIVER 110400
GILA RIVER
21NMEX 870919 15040001
SURFACE SAMPLES 2400 METERS ELEVATION

STATION 2 - GILITA CREEK AT GILITA CREEK CAMPGROUND

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00010 WATER TEMP CENT	00095 CNDUCTVY AT 25C MICROMHO	00300 DO MG/L	00400 PH SU	82079 TURBIDTY LAB NTU	70300 RESIDUE DISS-180 C MG/L	00530 RESIDUE TOT NFLT MG/L	00665 PHOS-TOT MG/L P	00900 TOT HARD CACO3 MG/L	00612 UN-IONZD NH3-N MG/L
92/08/03	1040	WATER		14.9	65	8.1	7.60	5.3			.140		0.001C
92/08/03	1040	QA REPLICATE									.140		0.001C
92/09/16	1220	WATER		14.8	59	8.0	7.46	2.8	76	3K	.060	26	0.001C
92/09/16	1220	QA REPLICATE							80	3K	.070	26	0.001C

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3+NH4- N TOTAL MG/L	00640 T INORG. NITROGEN MG/L N	00625 TOT KJEL N MG/L	00605 ORG N N MG/L	00600 TOTAL N N MG/L	00410 T ALK CACO3 MG/L	00440 HCO3 ION HCO3 MG/L	00945 SULFATE SO4-TOT MG/L	00940 CHLORIDE TOTAL MG/L
92/08/03	1040	WATER		.04K	.110	.15C	.180	.070C	.22C				
92/08/03	1040	QA REPLICATE		.04K	.120	.16C	1.150	1.030C	1.29C				
92/09/16	1220	WATER		.08	.190	.27C	.190	.000C	.27C	27	32	5K	5K
92/09/16	1220	QA REPLICATE		.11	.180	.29C	.240	.060C	.35C	27	32	5K	5K

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00915 CALCIUM CA,DISS MG/L	00925 MGNSIUM MG,DISS MG/L	00930 SODIUM NA,DISS MG/L	00935 PTSSIUM K,DISS MG/L	00680 T ORG C C MG/L	01108 ALUMINUM AL,DISS UG/L	01000 ARSENIC AS,DISS UG/L	01005 BARIUM BA,DISS UG/L	01010 BERYLIUM BE,DISS UG/L	01020 BORON B,DISS UG/L
92/08/03	1040	WATER						3.0					
92/08/03	1040	QA REPLICATE						3.0					
92/09/16	1220	WATER		7.0	2.0	3.00	2.00	3.0					
92/09/16	1220	QA REPLICATE		7.0	2.0	3.00	2.00	3.0					

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01025 CADMIUM CD,DISS UG/L	01030 CHROMIUM CR,DISS UG/L	01035 COBALT CO,DISS UG/L	01040 COPPER CU,DISS UG/L	01046 IRON FE,DISS UG/L	01049 LEAD PB,DISS UG/L	82037 MG DISS MG UG/L	01056 MANGNESE MN,DISS UG/L	71900 MERCURY HG,TOTAL UG/L	01060 MOLY MO,DISS UG/L
92/08/03	1040	WATER										.5K	
92/08/03	1040	QA REPLICATE										.5K	
92/09/16	1220	WATER										.5K	
92/09/16	1220	QA REPLICATE										.5K	

REMARK CODES: C - calculated value, K - actual value is less than value shown, J - estimated value

GRB503.009583 GRB503009583 UG3
33 24 52.0 108 36 55.0 4
SNOW CANYON CREEK BELOW SNOW LAKE
35003 NEW MEXICO CATRON
COLORADO RIVER 110400
GILA RIVER
21NMEX 920912 15040001
SURFACE SAMPLES 2216 METERS ELEVATION

STATION 3 - SNOW CANYON CREEK BELOW SNOW LAKE

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00010 WATER TEMP CENT	00095 CNDUCTVY AT 25C MICROMHO	00300 DO MG/L	00400 PH SU	82079 TURBIDTY LAB NTU	70300 RESIDUE DISS-180 C MG/L	00530 RESIDUE TOT NFLT MG/L	00665 PHOS-TOT MG/L P	00900 TOT HARD CACO3 MG/L	00612 UN-IONZD NH3-N MG/L
92/08/03	1950	WATER		23.1	126	5.6	7.84	40.1	124	105	.130	49	0.007C

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3+NH4- N TOTAL MG/L	00640 T INORG. NITROGEN MG/L N	00625 TOT KJEL N MG/L	00605 ORG N N MG/L	00600 TOTAL N N MG/L	00410 T ALK CACO3 MG/L	00440 HCO3 ION HCO3 MG/L	00945 SULFATE SO4-TOT MG/L	00940 CHLORIDE TOTAL MG/L
92/08/03	1950	WATER		.04K	.200	.24C	1.090	.890C	1.03C	48	59	8	5K

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00915 CALCIUM CA,DISS MG/L	00925 MGNSIUM MG,DISS MG/L	00930 SODIUM NA,DISS MG/L	00935 PTSSIUM K,DISS MG/L	00680 T ORG C C MG/L	01106 ALUMINUM AL,DISS UG/L	01000 ARSENIC AS,DISS UG/L	01005 BARIUM BA,DISS UG/L	01010 BERYLIUM BE,DISS UG/L	01020 BORON B,DISS UG/L
92/08/03	1950	WATER		13.0	4.0	5.00	4.00	8.0					

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01025 CADMIUM CD,DISS UG/L	01030 CHROMIUM CR,DISS UG/L	01035 COBALT CO,DISS UG/L	01040 COPPER CU,DISS UG/L	01046 IRON FE,DISS UG/L	01049 LEAD PB,DISS UG/L	82037 MG DISS MG UG/L	01056 MANGNESE MN,DISS UG/L	71900 MERCURY HG,TOTAL UG/L	01060 MOLY MO,DISS UG/L
92/08/03	1950	WATER										.5K	

REMARK CODES: C - calculated value, K - actual value is less than value shown, J - estimated value

GRB503.009587 GRB503009587 UG4
33 24 51.0 108 36 54.0 4
GILITA CREEK ABOVE CONF. WITH SNOW CANYON CREEK
35003 NEW MEXICO CATRON
COLORADO RIVER 110400
GILA RIVER
21NMEX 920912 15040001
SURFACE SAMPLES 2216 METERS ELEVATION

STATION 4 - GILITA CREEK ABOVE CONFLUENCE WITH SNOW CANYON CREEK

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00010 WATER TEMP CENT	00095 CNDUCTVY AT 25C MICROMHO	00300 DO MG/L	00400 PH SU	82079 TURBIDTY LAB NTU	70300 RESIDUE DISS-180 C MG/L	00530 RESIDUE TOT NFLT MG/L	00665 PHOS-TOT MG/L P	00900 TOT HARD CACO3 MG/L	00612 UN-IONZD NH3-N MG/L
92/08/03	1930	WATER		21.9	72		7.82	2.9	68	3K	.070	26	0.003C

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3+NH4- N TOTAL MG/L	00640 T INORG. NITROGEN MG/L N	00625 TOT KJEL N MG/L	00605 ORG N N MG/L	00600 TOTAL N N MG/L	00410 T ALK CACO3 MG/L	00440 HCO3 ION HCO3 MG/L	00945 SULFATE SO4-TOT MG/L	00940 CHLORIDE TOTAL MG/L
92/08/03	1930	WATER		.04K	.110	.15C	.600	.490C	.64C	31	38	5K	5K

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00915 CALCIUM CA,DISS MG/L	00925 MGNSIUM MG,DISS MG/L	00930 SODIUM NA,DISS MG/L	00935 PTSSIUM K,DISS MG/L	00680 T ORG C C MG/L	01106 ALUMINUM AL,DISS UG/L	01000 ARSENIC AS,DISS UG/L	01005 BARIUM BA,DISS UG/L	01010 BERYLIUM BE,DISS UG/L	01020 BORON B,DISS UG/L
92/08/03	1930	WATER		7.0	2.0	4.00	2.00	4.0					

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01025 CADMIUM CD,DISS UG/L	01030 CHROMIUM CR,DISS UG/L	01035 COBALT CO,DISS UG/L	01040 COPPER CU,DISS UG/L	01046 IRON FE,DISS UG/L	01049 LEAD PB,DISS UG/L	82037 MG DISS MG UG/L	01056 MANGNESE MN,DISS UG/L	71900 MERCURY HG,TOTAL UG/L	01060 MOLY MO,DISS UG/L
92/08/03	1930	WATER										.5K	

REMARK CODES: C - calculated value, K - actual value is less than value shown, J - estimated value

GRB503.009580 GRB503009580 UG5
33 24 52.0 108 38 51.0 4
MIDDLE FORK GILA RIVER BELOW GILITA CREEK
35003 NEW MEXICO CATRON
COLORADO RIVER 110400
GILA RIVER
21NMEX 920912 15040001
SURFACE SAMPLES 2215 METERS ELEVATION

STATION 5 - MIDDLE FORK OF THE GILA RIVER BELOW GILITA CREEK

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00010 WATER TEMP CENT	00095 CNDUCTVY AT 25C MICROMHO	00300 DO MG/L	00400 PH SU	82079 TURBIDTY LAB NTU	70300 RESIDUE DISS-180 C MG/L	00530 RESIDUE TOT NFLT MG/L	00665 PHOS-TOT MG/L P	00900 TOT HARD CACO3 MG/L	00612 UN-IONZD NH3-N MG/L
92/08/03	1900	WATER		22.4	86	6.5	7.78	5.4	82	9	.100	32	0.003C

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3+NH4- N TOTAL MG/L	00640 T INORG. NITROGEN MG/L N	00625 TOT KJEL N MG/L	00605 ORG N N MG/L	00600 TOTAL N N MG/L	00410 T ALK CACO3 MG/L	00440 HCO3 ION HCO3 MG/L	00945 SULFATE SO4-TOT MG/L	00940 CHLORIDE TOTAL MG/L
92/08/03	1900	WATER		.04K	.120	.16C	.670	.550C	.71C	36	44	5K	5K

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00915 CALCIUM CA,DISS MG/L	00925 MGNSIUM MG,DISS MG/L	00930 SODIUM NA,DISS MG/L	00935 PTSSIUM K,DISS MG/L	00680 T ORG C C MG/L	01106 ALUMINUM AL,DISS UG/L	01000 ARSENIC AS,DISS UG/L	01005 BARIUM BA,DISS UG/L	01010 BERYLIUM BE,DISS UG/L	01020 BORON B,DISS UG/L
92/08/03	1900	WATER		8.0	3.0	4.00	2.00	5.0					

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01025 CADMIUM CD,DISS UG/L	01030 CHROMIUM CR,DISS UG/L	01035 COBALT CO,DISS UG/L	01040 COPPER CU,DISS UG/L	01046 IRON FE,DISS UG/L	01049 LEAD PB,DISS UG/L	82037 MG DISS MG UG/L	01056 MANGNESE MN,DISS UG/L	71900 MERCURY HG,TOTAL UG/L	01060 MOLY MO,DISS UG/L
92/08/03	1900	WATER										.5K	

REMARK CODES: C - calculated value, K - actual value is less than value shown, J - estimated value

GRB503.009577 GRB503009577 UG6
33 23 16.0 108 36 02.0 4
IRON CREEK ABOVE CONFLUENCE WITH MIDDLE FORK
35003 NEW MEXICO CATRON
COLORADO RIVER 110400
GILA RIVER
21NMEX 920912 15040001
SURFACE SAMPLES 2150 METERS ELEVATION

STATION 6 - IRON CREEK ABOVE CONFLUENCE WITH THE MIDDLE FORK

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00010 WATER TEMP CENT	00095 CNDUCTVY AT 25C MICROMHO	00300 DO MG/L	00400 PH SU	82079 TURBIDTY LAB NTU	70300 RESIDUE DISS-180 C MG/L	00530 RESIDUE TOT NFLT MG/L	00665 PHOS-TOT MG/L P	00900 TOT HARD CACO3 MG/L	00612 UN-IONZD NH3-N MG/L
92/08/03	1550	WATER		26.0	80	6.9	8.61	1.1	70	3K	.930	35	0.022C

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3+NH4- N TOTAL MG/L	00640 T INORG. NITROGEN MG/L N	00625 TOT KJEL N MG/L	00605 ORG N N MG/L	00600 TOTAL N N MG/L	00410 T ALK CACO3 MG/L	00440 HCO3 ION HCO3 MG/L	00945 SULFATE SO4-TOT MG/L	00940 CHLORIDE TOTAL MG/L
92/08/03	1550	WATER		.04K	.110	.15C	.370	.260C	.41C	38	46	5K	5K

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00915 CALCIUM CA,DISS MG/L	00925 MGNSIUM MG,DISS MG/L	00930 SODIUM NA,DISS MG/L	00935 PTSSIUM K,DISS MG/L	00680 T ORG C C MG/L	01106 ALUMINUM AL,DISS UG/L	01000 ARSENIC AS,DISS UG/L	01005 BARIUM BA,DISS UG/L	01010 BERYLIUM BE,DISS UG/L	01020 BORON B,DISS UG/L
92/08/03	1550	WATER		9.0	3.0	4.00	2.00	2.0					

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01025 CADMIUM CD,DISS UG/L	01030 CHROMIUM CR,DISS UG/L	01035 COBALT CO,DISS UG/L	01040 COPPER CU,DISS UG/L	01046 IRON FE,DISS UG/L	01049 LEAD PB,DISS UG/L	82037 MG DISS MG UG/L	01056 MANGNESE MN,DISS UG/L	71900 MERCURY HG,TOTAL UG/L	01060 MOLY MO,DISS UG/L
92/08/03	1550	WATER										.5K	

REMARK CODES: C - calculated value, K - actual value is less than value shown, J - estimated value

GRB503.009575 GRB503009575 UG7
33 23 12.0 108 35 57.0 4
MIDDLE FORK GILA RIVER BELOW IRON CREEK
35003 NEW MEXICO CATRON
COLORADO RIVER 110400
GILA RIVER
21NMEX 920912 15040001
SURFACE SAMPLES 2147 METERS ELEVATION

STATION 7 - MIDDLE FORK OF THE GILA RIVER BELOW IRON CREEK

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00010 WATER TEMP CENT	00095 CNDUCTVY AT 25C MICROMHO	00300 DO MG/L	00400 PH SU	82079 TURBIDTY LAB NTU	70300 RESIDUE DISS-180 C MG/L	00530 RESIDUE TOT NFLT MG/L	00665 PHOS-TOT MG/L P	00900 TOT HARD CACO3 MG/L	00612 UN-IONZD NH3-N MG/L
92/08/03	1645	WATER		25.0	99	6.0	7.48	2.8	77	3K	.080	35	0.002C

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3+NH4- N TOTAL MG/L	00640 T INORG. NITROGEN MG/L N	00625 TOT KJEL N MG/L	00605 ORG N N MG/L	00600 TOTAL N N MG/L	00410 T ALK CACO3 MG/L	00440 HCO3 ION HCO3 MG/L	00945 SULFATE SO4-TOT MG/L	00940 CHLORIDE TOTAL MG/L
92/08/03	1645	WATER		.04K	.110	.15C	1.020	.910C	1.06C	39	48	5K	5K

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00915 CALCIUM CA,DISS MG/L	00925 MGNSIUM MG,DISS MG/L	00930 SODIUM NA,DISS MG/L	00935 PTSSIUM K,DISS MG/L	00680 T ORG C C MG/L	01106 ALUMINUM AL,DISS UG/L	01000 ARSENIC AS,DISS UG/L	01005 BARIUM BA,DISS UG/L	01010 BERYLIUM BE,DISS UG/L	01020 BORON B,DISS UG/L
92/08/03	1645	WATER		9.0	3.0	4.00	2.00	4.0					

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01025 CADMIUM CD,DISS UG/L	01030 CHROMIUM CR,DISS UG/L	01035 COBALT CO,DISS UG/L	01040 COPPER CU,DISS UG/L	01046 IRON FE,DISS UG/L	01049 LEAD PB,DISS UG/L	82037 MG DISS MG UG/L	01056 MANGNESE MN,DISS UG/L	71900 MERCURY HG,TOTAL UG/L	01060 MOLY MO,DISS UG/L
92/08/03	1645	WATER										.5K	

REMARK CODES: C - calculated value, K - actual value is less than value shown, J - estimated value

GRB503.009571 GRB503009571 UG8
33 25 22.0 108 22 04.0 4
CANYON CREEK AT FOREST ROAD 142
35003 NEW MEXICO CATRON
COLORADO RIVER 110400
GILA RIVER
21NMEX 920912 15040001
SURFACE SAMPLES 2286 METERS ELEVATION

STATION 8 - CANYON CREEK AT FOREST ROAD 142

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00010 WATER TEMP CENT	00095 CNDUCTVY AT 25C MICROMHO	00300 DO MG/L	00400 PH SU	82079 TURBIDTY LAB NTU	70300 RESIDUE DISS-180 C MG/L	00530 RESIDUE TOT NFLT MG/L	00665 PHOS-TOT MG/L P	00900 TOT HARD CACO3 MG/L	00612 UN-IONZD NH3-N MG/L
92/08/04	1015	WATER		19.3	187	8.3	8.59	2.4	132	3K	.270	83	0.014C

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3+NH4- N TOTAL MG/L	00640 T INORG. NITROGEN MG/L N	00625 TOT KJEL N MG/L	00605 ORG N N MG/L	00600 TOTAL N N MG/L	00410 T ALK CACO3 MG/L	00440 HCO3 ION HCO3 MG/L	00945 SULFATE SO4-TOT MG/L	00940 CHLORIDE TOTAL MG/L
92/08/04	1015	WATER		.04K	.110	.15C	.200	.090C	.24C	81	98	12	5K

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00915 CALCIUM CA,DISS MG/L	00925 MGNSIUM MG,DISS MG/L	00930 SODIUM NA,DISS MG/L	00935 PTSSIUM K,DISS MG/L	00680 T ORG C C MG/L	01106 ALUMINUM AL,DISS UG/L	01000 ARSENIC AS,DISS UG/L	01005 BARIUM BA,DISS UG/L	01010 BERYLIUM BE,DISS UG/L	01020 BORON B,DISS UG/L
92/08/04	1015	WATER		20.0	8.0	5.00	4.00	3.0					

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01025 CADMIUM CD,DISS UG/L	01030 CHROMIUM CR,DISS UG/L	01035 COBALT CO,DISS UG/L	01040 COPPER CU,DISS UG/L	01046 IRON FE,DISS UG/L	01049 LEAD PB,DISS UG/L	82037 MG DISS MG UG/L	01056 MANGNESE MN,DISS UG/L	71900 MERCURY HG,TOTAL UG/L	01060 MOLY MO,DISS UG/L
92/08/04	1015	WATER										.5K	

REMARK CODES: C - calculated value, K - actual value is less than value shown, J - estimated value

GRB503.007550 GRB503007550 UG9
33 21 01.0 108 04 47.0 4
TAYLOR CREEK BELOW WALL LAKE
35003 NEW MEXICO CATRON
COLORADO RIVER 110400
GILA RIVER
21NMEX 870919 15040001
SURFACE SAMPLES 1949 METERS ELEVATION

STATION 9 - TAYLOR CREEK BELOW WALL LAKE

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00010 WATER TEMP CENT	00095 CNDUCTVY AT 25C MICROMHO	00300 DO MG/L	00400 PH SU	82079 TURBIDTY LAB NTU	70300 RESIDUE DISS-180 C MG/L	00530 RESIDUE TOT NFLT MG/L	00665 PHOS-TOT MG/L P	00900 TOT HARD CACO3 MG/L	00612 UN-IONZD NH3-N MG/L
92/08/04	1300	WATER		22.8	188	7.2	8.28	10.7	136	30	.090	53	0.012C
92/08/04	1300	QA REPLICATE							142		.080	53	0.011C

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3+NH4- N TOTAL MG/L	00640 T INORG. NITROGEN MG/L N	00625 TOT KJEL N MG/L	00605 ORG N N MG/L	00600 TOTAL N N MG/L	00410 T ALK CACO3 MG/L	00440 HCO3 ION HCO3 MG/L	00945 SULFATE SO4-TOT MG/L	00940 CHLORIDE TOTAL MG/L
92/08/04	1300	WATER		.04K	.140	.18C	.810	.670C	.85C	70	85	10	6
92/08/04	1300	QA REPLICATE		.04K	.120	.16C	1.200	1.080C	1.24C	70	86	10	6

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00915 CALCIUM CA,DISS MG/L	00925 MGNSIUM MG,DISS MG/L	00930 SODIUM NA,DISS MG/L	00935 PTSSIUM K,DISS MG/L	00680 T ORG C C MG/L	01106 ALUMINUM AL,DISS UG/L	01000 ARSENIC AS,DISS UG/L	01005 BARIUM BA,DISS UG/L	01010 BERYLIUM BE,DISS UG/L	01020 BORON B,DISS UG/L
92/08/04	1300	WATER		18.0	2.0	18.00	1.00	6.0					
92/08/04	1300	WATER		18.0	2.0	19.00	2.00	6.0					

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01025 CADMIUM CD,DISS UG/L	01030 CHROMIUM CR,DISS UG/L	01035 COBALT CO,DISS UG/L	01040 COPPER CU,DISS UG/L	01046 IRON FE,DISS UG/L	01049 LEAD PB,DISS UG/L	82037 MG DISS MG UG/L	01056 MANGNESE MN,DISS UG/L	71900 MERCURY HG,TOTAL UG/L	01060 MOLY MO,DISS UG/L
92/08/04	1300	WATER										.5K	
92/08/04	1300	WATER										.5K	

REMARK CODES: C - calculated value, K - actual value is less than value shown, J - estimated value

GRB503.007547 GRB503007547 UG10
33 18 06.0 108 07 24.0 4
EAST FORK GILA RIVER BELOW TAYLOR CREEK
35003 NEW MEXICO CATRON
COLORADO RIVER 110400
GILA RIVER
21NMEX 920912 15040001
SURFACE SAMPLES 1876 METERS ELEVATION

STATION 10 - EAST FORK OF THE GILA RIVER BELOW TAYLOR CREEK

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00010 WATER TEMP CENT	00095 CNDUCTVY AT 25C MICROMHO	00300 DO MG/L	00400 PH SU	82079 TURBIDTY LAB NTU	70300 RESIDUE DISS-180 C MG/L	00530 RESIDUE TOT NFLT MG/L	00665 PHOS-TOT MG/L P	00900 TOT HARD CACO3 MG/L	00612 UN-IONZD NH3-N MG/L
92/08/04	1530	WATER		28.2	271	7.4	8.94	3.4	182	5	.020	72	0.046C

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3+NH4- N TOTAL MG/L	00640 T INORG. NITROGEN MG/L N	00625 TOT KJEL N MG/L	00605 ORG N N MG/L	00600 TOTAL N N MG/L	00410 T ALK CACO3 MG/L	00440 HCO3 ION HCO3 MG/L	00945 SULFATE SO4-TOT MG/L	00940 CHLORIDE TOTAL MG/L
92/08/04	1530	WATER		.06	.120	.18C	.920	.800C	.98C	86	105	13	17

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00915 CALCIUM CA,DISS MG/L	00925 MGNSIUM MG,DISS MG/L	00930 SODIUM NA,DISS MG/L	00935 PTSSIUM K,DISS MG/L	00680 T ORG C C MG/L	01106 ALUMINUM AL,DISS UG/L	01000 ARSENIC AS,DISS UG/L	01005 BARIUM BA,DISS UG/L	01010 BERYLIUM BE,DISS UG/L	01020 BORON B,DISS UG/L
92/08/04	1530	WATER		24.0	3.0	28.00	2.00	3.0					

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01025 CADMIUM CD,DISS UG/L	01030 CHROMIUM CR,DISS UG/L	01035 COBALT CO,DISS UG/L	01040 COPPER CU,DISS UG/L	01046 IRON FE,DISS UG/L	01049 LEAD PB,DISS UG/L	82037 MG DISS MG UG/L	01056 MANGNESE MN,DISS UG/L	71900 MERCURY HG,TOTAL UG/L	01060 MOLY MO,DISS UG/L
92/08/04	1530	WATER										.5K	

REMARK CODES: C - calculated value, K - actual value is less than value shown, J - estimated value

GRB503.007543 GRB503007543 UG11
33 17 21.0 108 04 33.0 4
DIAMOND CREEK AT FOREST ROAD 225
35003 NEW MEXICO CATRON
COLORADO RIVER 110400
GILA RIVER
21NMEX 920912 15040001
SURFACE SAMPLES 1949 METERS ELEVATION

STATION 11 - DIAMOND CREEK AT FOREST ROAD 225

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00010 WATER TEMP CENT	00095 CNDUCTVY AT 25C MICROMHO	00300 DO MG/L	00400 PH SU	82079 TURBIDTY LAB NTU	70300 RESIDUE DISS-180 C MG/L	00530 RESIDUE TOT NFLT MG/L	00665 PHOS-TOT MG/L P	00900 TOT HARD CACO3 MG/L	00612 UN-IONZD NH3-N MG/L
92/08/04	1635	WATER		22.5	140	7.0	7.61	3.4	120	3K	.160	55	0.002C

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3+NH4- N TOTAL MG/L	00640 T INORG. NITROGEN MG/L N	00625 TOT KJEL N MG/L	00605 ORG N N MG/L	00600 TOTAL N N MG/L	00410 T ALK CACO3 MG/L	00440 HCO3 ION HCO3 MG/L	00945 SULFATE SO4-TOT MG/L	00940 CHLORIDE TOTAL MG/L
92/08/04	1635	WATER		.04K	.120	.16C	.760	.640C	.80C	45	55	17	5K

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00915 CALCIUM CA,DISS MG/L	00925 MGNSIUM MG,DISS MG/L	00930 SODIUM NA,DISS MG/L	00935 PTSSIUM K,DISS MG/L	00680 T ORG C C MG/L	01106 ALUMINUM AL,DISS UG/L	01000 ARSENIC AS,DISS UG/L	01005 BARIUM BA,DISS UG/L	01010 BERYLIUM BE,DISS UG/L	01020 BORON B,DISS UG/L
92/08/04	1635	WATER		17.0	3.0	5.00	2.00	5.0					

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01025 CADMIUM CD,DISS UG/L	01030 CHROMIUM CR,DISS UG/L	01035 COBALT CO,DISS UG/L	01040 COPPER CU,DISS UG/L	01046 IRON FE,DISS UG/L	01049 LEAD PB,DISS UG/L	82037 MG DISS MG UG/L	01056 MANGNESE MN,DISS UG/L	71900 MERCURY HG,TOTAL UG/L	01060 MOLY MO,DISS UG/L
92/08/04	1635	WATER										.5K	

REMARK CODES: C - calculated value, K - actual value is less than value shown, J - estimated value

Table 7. cont.

TAXA	STATIONS (Reference) Turkey Creek	4 Gilita Creek	5 Middle Fork	6 Iron Creek	9 Taylor Creek	10 East Fork
MEGALOPTERA - dobson/alderflies						
Corydalus cornutus	34				6	
LEPIDOPTERA - moths						
Parargyractus kearfottalis	94	34	57	57	147	11
MOLLUSCA - snails/clams						
Lynmaea sp.					6	
Physa sp.	9				51	
Planorbidae					91	
Sphaeriidae					6	
ANNELIDA - segmented worms						
Lumbricidae					23	6
PLATYHELMINTHES - flatworms						
Turbellaria	9				652	6
ARTHROPODA - other arthropods						
Hydracharina A - mites				11	6	6
AMPHIPODA - scuds						
Hyalella azteca					11	
Standing Crop (No./m^2)	1,411	1,203	1,483	1,213	4,090	931
Total Taxa	23	16	21	20	27	19
CTQ_p	50	50	63	50	50	63
CTQ_d	88.4	83.4	79.3	80.8	98.2	86.6
BCI	56.5	59.9	79.5	61.9	50.9	72.7
Diversity Index	3.53	2.79	3.64	3.42	2.91	2.74

Table 8. RAPID BIOASSESSMENT (PROTOCOL III) OF UPPER GILA RIVER TRIBUTARIES, AUGUST 3-4, 1992.

	STATIONS					
	(Reference) Turkey Creek	4 Gilita Creek	5 Middle Fork	6 Iron Creek	9 Taylor Creek	10 East Fork
Calculated Value						
No. of Taxa	23	16	21	20	27	19
Standing Crop (#/m^2)	1,411	1,203	1,483	1,213	4,090	931
Biotic Index						
HBI	5.33	5.67	5.43	4.85	5.32	4.60
BCI (CTQ_d)	88	83	79	81	98	87
% Dominant Taxa	27	37	25	22	34	47
EPT Index	8	8	9	8	6	7
Community Loss	-	0.75	0.62	0.50	0.37	0.68
EPT/(Chironomids + EPT)	0.66	0.51	0.52	0.66	0.90	0.80
Scraper/(C-F + Scrapers)	0.70	0.98	0.85	0.98	0.06	0.79
Shredders/Total	0.07	0.20	0.11	0.03	0.004	0.01
Percent of Reference						
No. of Taxa	100	70	91	87	117	83
Standing Crop (#/m^2)	100	85	105	86	290	66
Biotic Index						
HBI	100	94	98	110	100	116
BCI (CTQ_d)	100	106	111	109	90	101
% Dominant Taxa	27	37	25	22	34	47
EPT Index	100	100	113	100	75	88
Community Loss	-	0.75	0.62	0.50	0.37	0.68
EPT/(Chironomids + EPT)	100	77	79	100	136	121
Scraper/(C-F + Scrapers)	100	140	121	140	9	113
Shredders/Total	100	286	157	43	6	14
Score						
No. of Taxa	6	4	6	6	6	4
Standing Crop (#/m^2)	6	6	6	6	0	6
Biotic Index						
HBI	6	6	6	6	6	6
BCI (CTQ_d)	6	6	6	6	6	6
% Dominant Taxa	4	2	4	4	2	0
EPT Index	6	6	6	6	2	4
Community Loss	6	4	4	4	6	4
EPT/(Chironomids + EPT)	6	6	6	6	4	6
Scraper/(C-F + Scrapers)	6	6	6	6	0	6
Shredders/Total	6	6	6	4	0	0
Total	58	52	56	54	32	42
% of Reference	100	90	97	93	55	72
Biological Condition	Non-Impaired	Non-Impaired	Non-Impaired	Non-Impaired	Slightly Impaired	Slightly Impaired
Habitat Condition	152	163	163	158	139	94
% of Reference	100	107	107	104	91	62
Habitat Category	Reference Good to Excellent	Comparable to Reference	Comparable to Reference	Supporting Reference	Comparable to Reference	Partially Supporting

Table 9. RAPID BIOASSESSMENT (PROTOCOL III) OF UPPER GILA RIVER TRIBUTARIES, AUGUST 3-4, 1992.

	STATIONS						
	(Reference) San Francisco River at Luna (1987 study)	4 Gilita Creek	5 Middle Fork	6 Iron Creek	9 Taylor Creek	10 East Fork	R Turkey Creek
Calculated Value							
No. of Taxa	25	16	21	20	27	19	23
Standing Crop (#/m^2)	1,752	1,203	1,485	1,213	4,090	931	1,411
Biotic Index							
HBI	4.84	5.67	5.43	4.85	5.32	4.60	5.33
BCI (CTQ_d)	77	83	79	81	98	87	88
% Dominant Taxa	23	37	25	22	34	47	27
EPT Index	12	8	9	8	6	7	8
Community Loss	-	0.56	0.71	0.65	0.44	0.79	0.52
EPT/(Chironomids + EPT)	0.77	0.51	0.52	0.66	0.90	0.80	0.66
Scraper/(C-F + Scrapers)	0.50	0.98	0.85	0.98	0.06	0.79	0.70
Shredders/Total	0.01	0.20	0.11	0.03	0.004	0.01	0.07
Percent of Reference							
No. of Taxa	100	64	84	80	108	76	92
Standing Crop (#/m^2)	100	69	85	69	233	53	81
Biotic Index							
HBI	100	85	89	100	91	105	91
BCI (CTQ_d)	100	93	97	95	79	89	88
% Dominant Taxa	23	37	25	22	34	47	27
EPT Index	100	67	75	67	50	58	67
Community Loss	-	0.56	0.71	0.65	0.44	0.79	0.52
EPT/(Chironomids + EPT)	-	66	68	94	117	104	86
Scraper/(C-F + Scrapers)	-	198	170	196	12	158	140
Shredders/Total	-	2,000	1,100	300	40	100	700
Score							
No. of Taxa	6	4	6	4	6	4	6
Standing Crop (#/m^2)	6	6	6	6	2	6	6
Biotic Index							
HBI	6	6	6	6	6	6	6
BCI (CTQ_d)	6	6	6	6	4	6	6
% Dominant Taxa	4	2	4	4	2	0	4
EPT Index	6	0	2	0	0	0	0
Community Loss	6	4	4	4	6	4	4
EPT/(Chironomids + EPT)	6	4	4	6	6	6	6
Scraper/(C-F + Scrapers)	6	6	6	6	0	6	6
Shredders/Total	6	6	6	6	4	6	6
Total	58	44	50	48	36	44	50
% of Reference	100	76	86	83	62	76	86
Biological Condition	Non-Impaired	Slightly Impaired	Non-Impaired	Non-Impaired	Slightly Impaired	Slightly Impaired	Non-Impaired
Habitat Condition	149	163	163	158	139	94	152
% of Reference	100	109	109	106	93	63	102
Habitat Category	Reference Good to Excellent	Comparable to Reference	Comparable to Reference	Comparable to Reference	Comparable to Reference	Partially Supporting	Comparable to Reference

SPECIAL WATER QUALITY SURVEY OF THE RIO HONDO, TAOS COUNTY, NEW MEXICO, FEBRUARY - DECEMBER, 1992

Introduction

During the period of February 19 through December 9, 1992, the Surveillance and Standards Section conducted a special water quality survey of the Rio Hondo from the Taos Ski Valley to its mouth at the Rio Grande. Land uses in the Rio Hondo watershed include recreation, ranching, farming and recreational community development. The Twining wastewater treatment plant is the only point source discharger into the Rio Hondo.

Water Quality Standards

Water quality standards for the Rio Hondo are set forth in sections 1-102, 2-120 and 3-101 of the New Mexico water quality standards (NMWQCC 1991). Designated uses for segment 2-120 are: domestic water supply, fish culture, high quality coldwater fishery, irrigation, livestock and wildlife watering and secondary contact recreation.

Methods

Water quality sampling methods were in accordance with the Quality Assurance Project Plan for Water Pollution Control Programs (NMED 1991). The benthic macroinvertebrate survey was performed by collecting three quantitative samples from each site using a modified Hess sampler. Samples were analyzed using EPA's Rapid Bioassessment Protocol III (Plafkin et al. 1989).

Sampling Stations

The names, STORET identification codes and locations of sites selected for this survey are given below. A map of the study area is presented in Fig. 5.

Station	STORET code	LOCATION
1	HON2	Lake Fork Creek above the Rio Hondo.
2	HON3	Rio Hondo above the Taos ski valley parking lot.
3	HON4	Rio Hondo above Twining WWTP.
4	HON8	Rio Hondo below Twining WWTP.
5	HON10	Rio Hondo at Italianos Canyon, 2.5 miles below Twining WWTP.
6	HON12	Rio Hondo at the USGS gage at the lower USFS boundary.

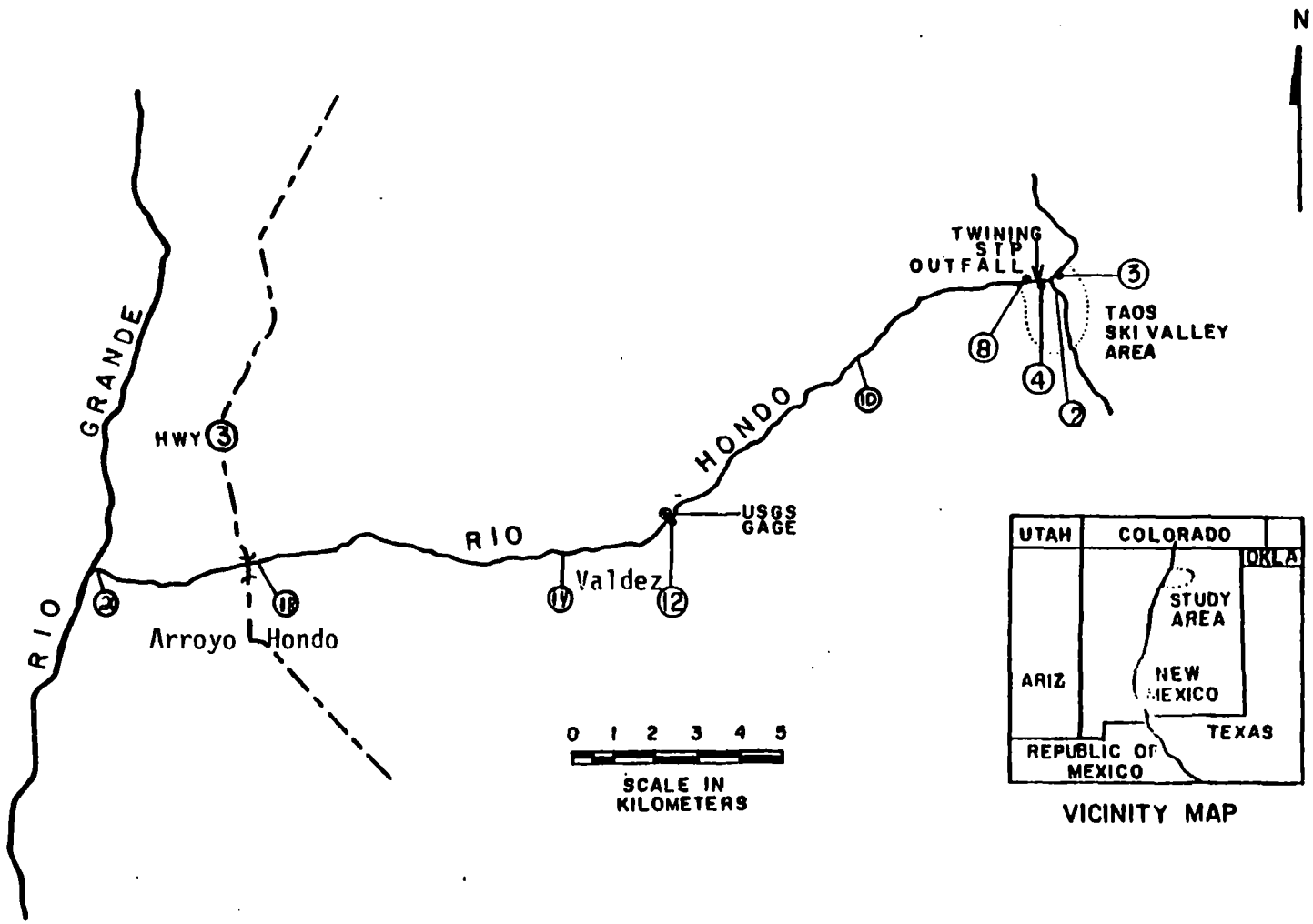

Figure 5. Location map of the Rio Hondo, Taos County, New Mexico.

7	HON14	Rio Hondo at lower Valdez bridge.
8	HON18	Rio Hondo at the highway 522 (3) bridge in Arroyo Hondo.
9	HON20	Rio Hondo above the Rio Grande.

Water Quality Assessment

Water quality data collected during the survey are available on STORET and can be retrieved using selector A=21NMEX and restrictor IS=923505. Parametric coverage and survey data are provided in Table 10. Streamflow on the Rio Hondo at HON12 (station 6) during the eleven monthly sampling dates, February through December, measured 11, 19, 52, 134, 91, 39, 30, 23, 16, 13 and 12 ft^3/sec, respectively.

The Rio Hondo was highly oxygenated and with few exceptions was clear, slightly alkaline and contained low amounts of chemical constituents. Water temperatures varied with the season and elevation from cold to cool, with some slightly warmer readings being noted during the summer months at the two lowest downstream stations.

There were ten exceedances of numeric water quality quality standards during the survey, nine occurred on the lower Rio Hondo below the USFS boundary. Seven of the exceedances were recorded at the lowest downstream station (HON20). There was one exceedance for total inorganic nitrogen at HON8 below the Twining wastewater treatment plant. There was one exceedance each for total phosphorus at HON14 and HON18. Exceedances at HON20 were as follows: total phosphorus, 2; temperature, 2; and un-ionized ammonia, 3. These data indicate a partial impairment of the high quality coldwater fishery use in the lower Rio Hondo valley.

The exceedances for phosphorus at all of the lower Rio Hondo stations were probably caused by the river's proximity to the communities of Valdez and Arroyo Hondo, and specifically to perturbations associated with livestock grazing, irrigation return flow, septic tank leach fields and other agricultural activities. Exceedances of the un-ionized ammonia standard at only the lower station can be attributed to a lack of canopy vegetation along the riparian strip, in turn contributing to increased primary productivity, elevated temperatures and pH. Increases in pH and water temperature would result in increased concentrations of un-ionized ammonia without additional inputs of total ammonia.

Although the upper Rio Hondo was relatively free of numeric stream standard exceedances, siltation of the stream bottom from parking lot runoff during the winter months was visually evident between HON3 and HON4, though turbidity measurements failed to detect such events. In addition, profuse growth of the golden brown alga Hydrurus carpeting the stream bottom below the Twining wastewater treatment plant during the late winter was also evident and was probably due to slight increases in nutrients. Both of these conditions, however, disappear from the upper valley after the ski season and after the

scouring effect of spring runoff. The data also indicate that the chemical quality of the Rio Hondo at HON12 is comparable to HON3 above the ski valley parking lot. Further, the increases in conductivity and TDS during the summer months below Valdez and Arroyo Hondo suggest that these communities may contribute importantly to numeric stream standard exceedances during the period when the ski valley is in the off-season.

Biological Assessment

Results of the benthic macroinvertebrate survey along with the analysis by Rapid Bioassessment (Protocol III) are listed in Tables 11 - 13 and Figs. 6 - 8. Since the Rio Hondo flows through two distinct ecoregions (21 and 22), separate assessments with different reference sites were performed for each ecoregion segment.

All of the upper Rio Hondo stations, HON3 through HON12, are located on US Forest Service land within ecoregion 21. Using station HON3 as the reference site, all sites were rated good to excellent with regard to habitat condition and each of the downstream study sites were assessed to be either comparable or supporting with respect to the reference site. An analysis of the benthic community at reference site 3 shows it to be healthy, diverse, and composed of numerous pollution sensitive taxa. With the exception of HON8, which is directly below the WWTP, all of the other downstream sites were rated non-impaired and contained many of the community attributes of HON3. Although HON4 was rated non-impaired, it did show a reduction in biological condition of 17% primarily due to siltation from the upper ski valley parking lot. HON8 however, was rated moderately impaired as reflected by increases in standing crop, HBI, and percent dominant taxa (40% Chironomidae: Diamesa sp.); all of which indicate nutrient enrichment. This conclusion is further supported by the confluent mats of the golden-brown (Chrysophyta) alga Hydrurus foetidus which is always present at this site during the winter ski season. This condition, however, is short lived both spatially and temporally as evidenced by the large reduction of this alga downstream during the winter months, and its absence at HON8 after the ski season. Further, the condition of the macroinvertebrate communities begins to return to reference conditions further downstream at HON10, and exceeds those qualities at HON12. This suggests that the influence of the Twining WWTP on both the chemical and biological quality of the upper Rio Hondo is minimal as the river leaves the Carson National Forest at HON12.

The lower Rio Hondo, located in ecoregion 22, flows primarily through private land contained within or adjacent to the rural communities of Valdez and Arroyo Hondo. Using HON14 as the reference site, all three lower sites were rated good with regard to habitat condition. The two downstream sites, HON18 and HON20, were assessed to be comparable with the reference site. An analysis of the macroinvertebrate community at reference site HON14 shows it to be healthy, diverse, and even non-impaired (Tables 12 and 13) when compared to upper reference site HON3. Although many of the taxa at this site were pollution sensitive, increases in both standing crop and the HBI index indicate that some light organic loading does occur within the community of Valdez. This trend of increased nutrient loading continues downstream at sites HON18 and HON20 within and below the community of Arroyo Hondo. The biological condition at HON18 and HON20 were identical in score and percentage

and were rated slightly impaired when compared to the reference site. The impairments to the biological quality of the lower Rio Hondo appear to be due primarily to non-point sources of pollutants within the community of Arroyo Hondo. In the lower valley, septic tank leach fields, livestock pasturing, reductions in flow due to irrigation diversions, irrigation return flow and riparian destruction appear to be additive in reducing water and habitat quality, thus having a negative impact on the macroinvertebrate communities in this reach.

Table 10. Water quality data collected on the Rio Hondo, February - December, 1992.

1
1STORET RETRIEVAL DATE 93/04/08 PGM=RET PAGE:
HON2 URG120026570
36 35 44.0 105 27 00.0 4
LAKE FORK CR AT MAIN LODGE BRIDGE
35055 NEW MEXICO TAOS
RIO GRANDE 120991
RIO HONDO /TYPA/AMBNT/STREAM
21NMEX 13020101025 0017.560 ON
0003 FEET DEPTH

0 DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00010 WATER TEMP CENT	00095 CNDUCTVY AT 25C MICROMHO	00300 DO MG/L	00400 PH SU	82079 TURBIDTY LAB NTU	00665 PHOS-TOT MG/L P	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3+NH4- N TOTAL MG/L	00640 T INORG. NITROGEN MG/L N	00625 TOT KJEL N MG/L
92/08/19	1035	WATER		5.5	111	9.7	8.1	.8	.01	.28	.10K	.38	.10K
92/09/23	1215	WATER		5.3	113	8.5	8.1	.8	.02	.35	.10K	.45K	.10K
92/10/21	1045	WATER		4.0	71	9.0	8.1	.6	.01	.42	.10	.52	.14
92/11/18	0945	WATER		2.5	117	9.5	7.7	.8	.01	.35	.10K	.45	.10K
92/12/09	0930	WATER		.0	120	10.3	7.8	.2	.01K	.40	.10K	.50C	.10K

0 DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00605 ORG N N MG/L	00600 TOTAL N N MG/L	00612 UN-IONZD NH3-N MG/L	70300 RESIDUE DISS-180 C MG/L	00530 RESIDUE TOT NFLT MG/L	00915 CALCIUM CA,DISS MG/L	00925 MGNSIUM MG,DISS MG/L	00935 PTSSIUM K,DISS MG/L	00930 SODIUM NA,DISS MG/L	00900 TOT HARD CACO3 MG/L
92/08/19	1035	WATER		.00	.38C	.002	82	3K	24.0	1.0	1.0	1.0	64.0
92/09/23	1215	WATER		.00	.45C	.002	86	3K	25.0	1.0	1.0	1.0	67.0
92/10/21	1045	WATER		.04C	.56C	.002	86	3K	25.0	2.0	1.0	2.0	71.0
92/11/18	0945	WATER		.00C	.45C	.001	86	3K	25.0	2.0	1.0	2.0	71.0
92/12/09	0930	WATER		.00C	.50C	.001	80	3K	25.0	2.0	2.0	2.0	71.0

0 DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00410 T ALK CACO3 MG/L	00440 HCO3 ION HCO3 MG/L	00946 SULFATE SO4-DISS MG/L	00940 CHLORIDE TOTAL MG/L	00680 T ORG C C MG/L	50060 CHLORINE TOT RESD MG/L	01106 ALUMINUM AL,DISS UG/L	01005 BARIUM BA,DISS UG/L	01010 BERYLIUM BE,DISS UG/L	01020 BORON B,DISS UG/L
92/08/19	1035	WATER		46.5	56.7	14.0	5K	1.0					
92/09/23	1215	WATER		48.8	58.8	35.8	5K	1.0					
92/10/21	1045	WATER		50.1	60.1	15.7	5K	2.0					
92/11/18	0945	WATER		53.9	65.7	15.0	5K	1.0K					
92/12/09	0930	WATER		54.3	66.2	14.7	5K	1.0K					

1STORET RETRIEVAL DATE 93/04/08 PGM=RET PAGE:
HON3 URG120026560
36 36 00.0 105 26 56.0 4
N FORK RIO HONDO ADJ TAOS SKI VALLEY PRKNG LOT
35055 NEW MEXICO TAOS
WESTERN GULF 120900
RIO GRANDE /TYPA/AMBNT/STREAM/BIO
21NMEX 800621 13020101025 0017.700 ON
0003 FEET DEPTH

0 DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00010 WATER TEMP CENT	00095 CNDUCTVY AT 25C MICROMHO	00300 DO MG/L	00400 PH SU	82079 TURBIDTY LAB NTU	00665 PHOS-TOT MG/L P	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3+NH4- N TOTAL MG/L	00640 T INORG. NITROGEN MG/L N	00625 TOT KJEL N MG/L
92/02/19	1000	WATER		1.3	103	9.8	8.3	.6	.02	.15	.16	.31	2.89
92/03/18	1000	WATER		1.2	102	9.8	8.2	1	.09	.15	.10K	.25	.10K
92/04/22	1000	WATER		1.7	117	9.2	8.2	.5	.06	.11	.10K	.21K	.10K
92/05/20	1100	WATER		5.0	77	9.5	8.3	4	.06	.06	.10	.16	.41
92/06/24	1100	WATER		6.5	112	8.7	8.0	.7	.01	.04	.10K	.14K	.10
92/07/22	1020	WATER		7.0	97	8.8	8.1	.5	.01	.08	.14	.22	.42
92/08/19	1025	WATER		7.2	129	8.8	8.1	.6	.02	.08	.10K	.18C	.17
92/09/23	1230	WATER		6.5	123	8.3	8.4	.2	.03	.07	.10K	.17C	.10
92/10/21	1100	WATER		4.2	127	9.2	8.2	.4	.01	.22	.10K	.32C	.15
92/11/18	1005	WATER		.5	122	9.7	8.1	.5	.01K	.15	.10K	.25C	.10K
92/12/09	0945	WATER		.0	128	9.9	8.0	.3	.01K	.14	.10K	.24C	.10K

0 DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00605 ORG N N MG/L	00600 TOTAL N N MG/L	00612 UN-IONZD NH3-N MG/L	70300 RESIDUE DISS-180 C MG/L	00530 RESIDUE TOT NFLT MG/L	00915 CALCIUM CA,DISS MG/L	00925 MGNSIUM MG,DISS MG/L	00935 PTSSIUM K,DISS MG/L	00930 SODIUM NA,DISS MG/L	00900 TOT HARD CACO3 MG/L
92/02/19	1000	WATER		2.73	3.04	.003	90	3K	23.0	5.0	1.0	2.0	78.0
92/03/18	1000	WATER		.00	.25	.001	93	4	23.0	5.0	1.0	2.0	78.0
92/04/22	1000	WATER		.00	.21	.001	80	1	31.0	5.0	1.0	1.0	98.0
92/05/20	1100	WATER		.31	.47C	.002	63	5	16.0	3.0	1.0	1.0K	52.0
92/06/24	1100	WATER		.00	.14K	.001	78	8	22.0	3.0	1.0	1.0	67.0
92/07/22	1020	WATER		.28	.50C	.003	78	3	24.0	4.0	1.0	2.0	76.0
92/08/19	1025	WATER		.07C	.25C	.002	94	3K	26.0	5.0	1.0	1.0	86.0
92/09/23	1230	WATER		.00C	.17C	.003	94	3K	25.0	5.0	1.0	1.0	83.0
92/10/21	1100	WATER		.05C	.37C	.002	88	3	24.0	5.0	4.0	5.0	81.0
92/11/18	1005	WATER		.00C	.25C	.001	92	3K	23.0	5.0	1.0	2.0	78.0
92/12/09	0945	WATER		.00C	.24C	.001	78	3K	23.0	5.0	2.0	2.0	78.0

HON3 URG120026560
36 36 00.0 105 26 56.0 4
N FORK RIO HONDO ADJ TAOS SKI VALLEY PRKNG LOT
35055 NEW MEXICO TAOS
WESTERN GULF 120900
RIO GRANDE /TYPA/AMBNT/STREAM/BIO
21NMEX 800821 13020101025 0017.700 ON
0003 FEET DEPTH

0 DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00410 T ALK CACO3 MG/L	00440 HCO3 ION HCO3 MG/L	00946 SULFATE SO4-DISS MG/L	00940 CHLORIDE TOTAL MG/L	00680 T ORG C C MG/L	50060 CHLORINE TOT RESD MG/L	01106 ALUMINUM AL,DISS UG/L	01005 BARIUM BA,DISS UG/L	01010 BERYLLIUM BE,DISS UG/L	01020 BORON B,DISS UG/L
92/02/19	1000	WATER		72.5	88.4	6.3	5K	5.0K					
92/03/18	1000	WATER		73.4	89.5	5.0K	5K	5.0K		100K	100K	100K	100K
92/04/22	1000	WATER		75.0	91.5	6.0	5K	1.0					
92/05/20	1100	WATER		56.2	68.6	5.0K	5K	5.0K					
92/06/24	1100	WATER		64.4	78.6	5.4	5K	1.0					
92/07/22	1020	WATER		74.0	90.0	5.0K	5K	1.0K					
92/08/19	1025	WATER		75.8	92.5	5.1	5K	2.0					
92/09/23	1230	WATER		76.8	92.2	5.6	5K	1.0					
92/10/21	1100	WATER		74.5	89.4	5.5	5K	1.0K					
92/11/18	1005	WATER		72.3	88.5	6.5	5K	1.0K					
92/12/09	0945	WATER		73.5	89.7	5.9	5K	1.0K					

0 DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01025 CADMIUM CD,DISS UG/L	01030 CHROMIUM CR,DISS UG/L	01035 COBALT CO,DISS UG/L	01040 COPPER CU,DISS UG/L	01046 IRON FE,DISS UG/L	01049 LEAD PB,DISS UG/L	01056 MANGNESE MN,DISS UG/L	01060 MOLY MO,DISS UG/L	01065 NICKEL NI,DISS UG/L	01140 SILICON SI,DISS UG/L
92/03/18	1000	WATER		1K	5K	50K	100K	200	5K	50K	100K	100K	3300

0 DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01075 SILVER AG,DISS UG/L	01080 STRONTUM SR,DISS UG/L	01100 TIN SN,DISS UG/L	01085 VANADIUM V,DISS UG/L	01090 ZINC ZN,DISS UG/L	01000 ARSENIC AS,DISS UG/L	01145 SELENIUM SE,DISS UG/L	71900 MERCURY HG,TOTAL UG/L	31616 FEC COLI MFM-FCBR /100ML
92/03/18	1000	WATER		100K	100K	100K	100K	100K	5K	5K	.5K	

1STORET RETRIEVAL DATE 93/04/08 PGM=RET PAGE:
HON4 URG120026555
36 35 47.0 105 27 13.0 4
RIO HONDO 50 YDS ABV STP
35055 NEW MEXICO TAOS
RIO GRANDE 120991
RIO HONDO /TYPA/AMBNT/STREAM/BIO
21NMEX 13020101025 0017.350 ON
0003 FEET DEPTH

0 DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00010 WATER TEMP CENT	00095 CNDUCTVY AT 25C MICROMHO	00300 DO MG/L	00400 PH SU	82079 TURBIDTY LAB NTU	00665 PHOS-TOT MG/L P	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3+NH4- N TOTAL MG/L	00640 T INORG. NITROGEN MG/L N	00625 TOT KJEL N MG/L
92/02/19	1030	WATER		1.0	104	9.6	8.4	2	.02	.28	.19	.47	1.13
92/03/18	1020	WATER		2.1	111	9.4	7.9	4	.01K	.25	.10K	.35	.10K
92/04/22	1010	WATER		2.5	120	9.2	7.8	3	.01K	.22	.10K	.32	.10K
92/05/20	1125	WATER		5.5	95	8.6	8.0	4	.01	.23	.10K	.33K	.28
92/06/24	1120	WATER		7.0	106	8.3	8.0	.7	.03	.29	.10K	.39K	.10K
92/07/22	1120	WATER		7.0	109	8.8	8.2	.7	.01K	.24	.14	.38	1.01
92/08/19	1100	WATER		6.5	123	8.9	8.2	1	.01	.21	.20	.41C	.25
92/09/23	1245	WATER		7.5	123	8.3	8.2	.9	.02	.25	.10K	.35C	.10K
92/10/21	1115	WATER		4.9	126	9.1	8.1	.5	.02	.40	.10K	.50C	.10K
92/11/18	1020	WATER		1.5	123	9.5	8.0	.6	.01K	.30	.10K	.40C	.10K
92/12/09	1005	WATER		.0	120	9.8	7.9	1	.01K	.37	.10K	.47C	.10K

0 DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00605 ORG N N MG/L	00600 TOTAL N N MG/L	00612 UN-IONZD NH3-N MG/L	70300 RESIDUE DISS-180 C MG/L	00530 RESIDUE TOT NFLT MG/L	00915 CALCIUM CA,DISS MG/L	00925 MGNSIUM MG,DISS MG/L	00935 PTSSIUM K,DISS MG/L	00930 SODIUM NA,DISS MG/L	00900 TOT HARD CACO3 MG/L
92/02/19	1030	WATER		.94	1.41	.004	62	3K	26.0	3.0	14.0	2.0	77.0
92/03/18	1020	WATER		.00	.35	.001	100	6	39.0	3.0	1.0	3.0	110.0
92/04/22	1010	WATER		.00	.32	.001	82	4	24.0	3.0	1.0	3.0	72.0
92/05/20	1125	WATER		.18	.51C	.001	82	4	27.0	2.0	4.0	1.0	76.0
92/06/24	1120	WATER		.00	.39C	.001	70	7	22.0	2.0	1.0	1.0	63.0
92/07/22	1120	WATER		.87	1.25C	.003	74	3K	22.0	2.0	1.0	1.0	63.0
92/08/19	1100	WATER		.04C	.45C	.004	84	3K	25.0	2.0	1.0	2.0	71.0
92/09/23	1245	WATER		.00C	.35C	.002	82	3K	25.0	2.0	1.0	2.0	71.0
92/10/21	1115	WATER		.00C	.50C	.002	92	3K	26.0	2.0	1.0	2.0	73.0
92/11/18	1020	WATER		.00C	.40C	.001	84	3	25.0	3.0	1.0	2.0	75.0
92/12/09	1005	WATER		.00C	.47C	.001	78	3K	24.0	2.0	2.0	2.0	68.0

1STORET RETRIEVAL DATE 93/04/08 PGM=RET PAGE:
HON4 URG120028555
36 35 47.0 105 27 13.0 4
RIO HONDO 50 YDS ABV STP
35055 NEW MEXICO TAOS
RIO GRANDE 120991
RIO HONDO /TYPA/AMBNT/STREAM/BIO
21NMEX 13020101025 0017.350 ON
0003 FEET DEPTH

0 DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00410 T ALK CACO3 MG/L	00440 HCO3 ION HCO3 MG/L	00946 SULFATE SO4-DISS MG/L	00940 CHLORIDE TOTAL MG/L	00680 T ORG C C MG/L	50060 CHLORINE TOT RESD MG/L	01106 ALUMINUM AL,DISS UG/L	01005 BARIUM BA,DISS UG/L	01010 BERYLLIUM BE,DISS UG/L	01020 BORON B,DISS UG/L
92/02/19	1030	WATER		60.6	73.9	10.9	5K	5.0K					
92/03/18	1020	WATER		65.0	79.3	8.7	7	5.0K		100K	100K	100K	100K
92/04/22	1010	WATER		60.2	73.4	11.3	6	2.0					
92/05/20	1125	WATER		51.2	62.5	8.1	5K	5.0K					
92/06/24	1120	WATER		46.2	56.4	11.6	5K	1.0					
92/07/22	1120	WATER		51.0	63.0	12.1	5K	1.0K					
92/08/19	1100	WATER		53.0	64.7	11.9	5K	2.0					
92/09/23	1245	WATER		55.3	66.3	13.2	5K	1.0					
92/10/21	1115	WATER		57.0	68.7	14.9	5	1.0K					
92/11/18	1020	WATER		60.6	73.9	12.2	5	1.0K					
92/12/09	1005	WATER		60.0	72.2	12.2	5	1.0K					

0 DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01025 CADMIUM CD,DISS UG/L	01030 CHROMIUM CR,DISS UG/L	01035 COBALT CO,DISS UG/L	01040 COPPER CU,DISS UG/L	01046 IRON FE,DISS UG/L	01049 LEAD PB,DISS UG/L	01056 MANGNESE MN,DISS UG/L	01060 MOLY MO,DISS UG/L	01065 NICKEL NI,DISS UG/L	01140 SILICON SI,DISS UG/L
92/03/18	1020	WATER		1K	5K	50K	100K	200	5K	50K	100K	100K	3100

0 DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01075 SILVER AG,DISS UG/L	01080 STRONTUM SR,DISS UG/L	01100 TIN SN,DISS UG/L	01085 VANADIUM V,DISS UG/L	01090 ZINC ZN,DISS UG/L	01000 ARSENIC AS,DISS UG/L	01145 SELENIUM SE,DISS UG/L	71900 MERCURY HG,TOTAL UG/L	31616 FEC COLI MFM-FCBR /100ML
92/03/18	1020	WATER		100K	100K	100K	100K	100K	5K	5K	.5K	

930113 0015 1 K

1STORET RETRIEVAL DATE 93/04/08 PGM=RET PAGE:
HONB URG120028550
36 35 45.0 105 27 20.0 4
RIO HONDO 300 YDS BLW STP
35055 NEW MEXICO TAOS
RIO GRANDE 120991
RIO HONDO /TYPA/AMBNT/STREAM/BIO
21NMEX 13020101025 0017.250 ON
0003 FEET DEPTH

0 DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00010 WATER TEMP CENT	00095 CNDUCTVY AT 25C MICROMHO	00300 DO MG/L	00400 PH SU	82079 TURBIDTY LAB NTU	00665 PHOS-TOT MG/L P	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3+NH4- N TOTAL MG/L	00640 T INORG. NITROGEN MG/L N	00625 TOT KJEL N MG/L
92/02/19	1045	WATER		1.0	115	10.0	8.2	3	.01	1.22	.14	1.36	.19
92/03/18	1040	WATER		1.8	119	9.7	8.0	8	.03	.42	.10K	.52	.10
92/04/22	1025	WATER		2.8	121	9.2	7.8	3	.01K	.26	.12	.38	.16
92/05/20	1135	WATER		6.0	97	9.2	7.9	4	.06	.84	.10K	.94C	.15
92/06/24	1155	WATER		7.8	108	8.3	8.1	1	.02	.32	.10K	.42	.10K
92/07/22	1135	WATER		8.0	111	8.4	8.2	.5	.01	.29	.14	.43	.65
92/08/19	1115	WATER		6.8	134	8.8	8.2	1	.01	.26	.10K	.36C	.10K
92/09/23	1300	WATER		7.1	133	8.0	8.2	.6	.01K	.30	.10K	.40C	.10K
92/10/21	1125	WATER		5.0	128	9.1	8.1	.6	.01K	.41	.10	.51C	.15
92/11/18	1030	WATER		1.3	115	9.7	7.7	.6	.01K	.32	.10K	.42C	.10K
92/12/09	1020	WATER		.0	131	9.9	7.7	2	.01K	.62	.10K	.72C	.10K

0 DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00605 ORG N N MG/L	00600 TOTAL N N MG/L	00612 UN-IONZD NH3-N MG/L	70300 RESIDUE DISS-180 C MG/L	00530 RESIDUE TOT NFLT MG/L	00915 CALCIUM CA,DISS MG/L	00925 MGNSIUM MG,DISS MG/L	00935 PTSSIUM K,DISS MG/L	00930 SODIUM NA,DISS MG/L	00900 TOT HARD CACO3 MG/L
92/02/19	1045	WATER		.05	1.41	.002	110	3K	34.0	3.0	12.0	7.0	97.0
92/03/18	1040	WATER		.00	.52	.001	108	6	26.0	3.0	1.0	5.0	77.0
92/04/22	1025	WATER		.04	.44	.001	92	2	26.0	3.0	1.0	4.0	77.0
92/05/20	1135	WATER		.05	.99C	.001	90	3	18.0	2.0	1.0	1.0	53.0
92/06/24	1155	WATER		.00	.42C	.002	78	9	21.0	2.0	1.0	1.0	61.0
92/07/22	1135	WATER		.51	.94C	.003	68	3	22.0	2.0	1.0	2.0	63.0
92/08/19	1115	WATER		.00C	.36C	.002	90	3K	25.0	2.0	1.0	2.0	71.0
92/09/23	1300	WATER		.00C	.40C	.002	85	3K	25.0	2.0	1.0	2.0	71.0
92/10/21	1125	WATER		.05C	.56C	.002	96	3	25.0	2.0	1.0	3.0	71.0
92/11/18	1030	WATER		.00C	.42C	.000	102	3K	25.0	3.0	1.0	2.0	75.0
92/12/09	1020	WATER		.00C	.72C	.000	86	3K	25.0	2.0	1.0K	1.0K	71.0

1STORET RETRIEVAL DATE 93/04/08 PGM=RET PAGE:
HONB URQ120026550
36 35 45.0 105 27 20.0 4
RIO HONDO 300 YDS BLW STP
35055 NEW MEXICO TAOS
RIO GRANDE 120991
RIO HONDO /TYPA/AMBNT/STREAM/BIO
21NMEX 13020101025 0017.250 ON
0003 FEET DEPTH

0 DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00410 T ALK CACO3 MG/L	00440 HCO3 ION HCO3 MG/L	00946 SULFATE SO4-DISS MG/L	00940 CHLORIDE TOTAL MG/L	00680 T ORG C C MG/L	50060 CHLORINE TOT RESD MG/L	01106 ALUMINUM AL,DISS UG/L	01005 BARIUM BA,DISS UG/L	01010 BERYLIUM BE,DISS UG/L	01020 BORON B,DISS UG/L
92/02/19	1045	WATER		61.2	74.7	15.4	6	5.0K					
92/03/18	1040	WATER		65.4	79.8	31.0	9	5.0K		100K	100K	100K	100K
92/04/22	1025	WATER		63.8	77.8	10.1	7	1.0					
92/05/20	1135	WATER		52.0	63.4	8.0	5K	5.0K					
92/06/24	1155	WATER		47.8	58.3	13.4	5K	1.0					
92/07/22	1135	WATER		52.0	64.0	12.2	5K	1.0K					
92/08/19	1115	WATER		54.7	66.8	12.0	5K	1.0					
92/09/23	1300	WATER		56.4	67.7	13.7	5K	2.0					
92/10/21	1125	WATER		57.4	68.9	13.9	5K	1.0K					
92/11/18	1030	WATER		60.3	73.6	12.5	5K	1.0K					
92/12/09	1020	WATER		60.7	74.1	13.9	5K	1.0K					

0 DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01025 CADMIUM CD,DISS UG/L	01030 CHROMIUM CR,DISS UG/L	01035 COBALT CO,DISS UG/L	01040 COPPER CU,DISS UG/L	01046 IRON FE,DISS UG/L	01049 LEAD PB,DISS UG/L	01056 MANGNESE MN,DISS UG/L	01060 MOLY MO,DISS UG/L	01065 NICKEL NI,DISS UG/L	01140 SILICON SI,DISS UG/L
92/03/18	1040	WATER		1K	5K	50K	100K	100K	5K	50K	100K	100K	3200

0 DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01075 SILVER AG,DISS UG/L	01080 STRONTUM SR,DISS UG/L	01100 TIN SN,DISS UG/L	01085 VANADIUM V,DISS UG/L	01090 ZINC ZN,DISS UG/L	01000 ARSENIC AS,DISS UG/L	01145 SELENIUM SE,DISS UG/L	71900 MERCURY HG,TOTAL UG/L	31616 FEC COLI MFM-FCBR /100ML
92/03/18	1040	WATER		100K	100	100K	100K	100K	5K	5K	.5K	

930113 0935 1 K

1STORET RETRIEVAL DATE 93/04/08 PGM=RET PAGE:
HON10 URG120026525 USGS08267500
36 35 06.0 105 29 39.0 4
RIO HONDO 2.4 MILES BLW STP
35055 NEW MEXICO TAOS
RIO GRANDE 120991
RIO HONDO /TYPA/AMBNT/STREAM/BIO
21NMEX 13020101025 0014.750 ON
0003 FEET DEPTH

0 DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00010 WATER TEMP CENT	00095 CNDUCTVY AT 25C MICROMHO	00300 DO MG/L	00400 PH SU	82079 TURBIDTY LAB NTU	00665 PHOS-TOT MG/L P	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3+NH4- N TOTAL MG/L	00640 T INORG. NITROGEN MG/L N	00625 TOT KJEL N MG/L
92/02/19	1100	WATER		1.0	101	10.2	8.5	4	.02	.78	.16	.94	.82
92/03/18	1100	WATER		2.3	134	9.9	8.0	3	.02	.64	.10K	.74	.10K
92/04/22	1055	WATER		3.0	112	9.2	7.8	4	.01	.20	.11	.31	.12
92/05/20	1210	WATER		7.0	88	8.8	8.0	5	.05	.23	.10K	.33C	.27
92/06/24	1220	WATER		8.8	106	8.5	8.3	1	.02	.28	.10K	.38	.10K
92/07/22	1155	WATER		9.0	112	8.2	8.3	1	.01K	.23	.14	.37	.79
92/08/19	1135	WATER		8.5	134	8.4	8.3	1	.03	.21	.10K	.31C	.12
92/09/23	1310	WATER		8.1	134	8.2	8.3	.6	.01K	.29	.10K	.39C	.18
92/10/21	1140	WATER		5.0	126	9.5	8.3	.5	.02	.44	.10K	.54C	.12
92/11/18	1040	WATER		1.0	126	9.9	7.7	.4	.01	.37	.10K	.47C	.10K
92/12/09	1045	WATER		.0	132	10.1	7.9	.9	.01	.44	.10K	.54C	.10K

0 DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00605 ORG N N MG/L	00600 TOTAL N N MG/L	00612 UN-IONZD NH3-N MG/L	70300 RESIDUE DISS-180 C MG/L	00530 RESIDUE TOT NFLT MG/L	00915 CALCIUM CA,DISS MG/L	00925 MGNSIUM MG,DISS MG/L	00935 PTSSIUM K,DISS MG/L	00930 SODIUM NA,DISS MG/L	00900 TOT HARD CACO3 MG/L
92/02/19	1100	WATER		.66	1.60	.004	123	3K	30.0	3.0	2.0	5.0	87.0
92/03/18	1100	WATER		.00	.74	.001	111	8	29.0	3.0	1.0	7.0	85.0
92/04/22	1055	WATER		.01	.32	.001	74	7	27.0	2.0	1.0	3.0	76.0
92/05/20	1210	WATER		.17	.50C	.001	85	4	18.0	2.0	4.0	2.0	53.0
92/06/24	1220	WATER		.00	.38C	.003	78	13	21.0	2.0	1.0	2.0	61.0
92/07/22	1155	WATER		.65	1.02C	.005	72	3	23.0	2.0	1.0	2.0	66.0
92/08/19	1135	WATER		.02C	.33C	.003	92	3K	26.0	2.0	1.0	2.0	73.0
92/09/23	1310	WATER		.08C	.47C	.003	90	3K	26.0	2.0	1.0	3.0	73.0
92/10/21	1140	WATER		.02C	.56C	.002	94	3K	27.0	2.0	1.0	3.0	76.0
92/11/18	1040	WATER		.00C	.47C	.000	96	3K	26.0	2.0	2.0	3.0	73.0
92/12/09	1045	WATER		.00C	.54C	.001	90	3K	26.0	2.0	2.0	3.0	73.0

1STORET RETRIEVAL DATE 93/04/08 PGM=RET PAGE:
HON10 URG120026525 USGS08267500
36 35 06.0 105 29 39.0 4
RIO HONDO 2.4 MILES BLW STP
35055 NEW MEXICO TAOS
RIO GRANDE 120991
RIO HONDO /TYPA/AMBNT/STREAM/BIO
21NMEX 13020101025 0014.750 ON
0003 FEET DEPTH

0 DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00410 T ALK CACO3 MG/L	00440 HCO3 ION HCO3 MG/L	00946 SULFATE SO4-DISS MG/L	00940 CHLORIDE TOTAL MG/L	00680 T ORG C C MG/L	50060 CHLORINE TOT RESD MG/L	01106 ALUMINUM AL,DISS UG/L	01005 BARIUM BA,DISS UG/L	01010 BERYLIUM BE,DISS UG/L	01020 BORON B,DISS UG/L
92/02/19	1100	WATER		62.2	75.9	13.9	6	5.0K					
92/03/18	1100	WATER		64.4	78.6	9.0	11	5.0K		100K	100K	100K	100K
92/04/22	1055	WATER		56.2	68.6	7.7	7	2.0					
92/05/20	1210	WATER		50.8	62.0	6.5	5K	5.0K					
92/06/24	1220	WATER		50.0	61.0	10.5	5K	1.0					
92/07/22	1155	WATER		56.0	68.0	10.9	5K	1.0K					
92/08/19	1135	WATER		58.3	71.7	10.6	5K	2.0					
92/09/23	1310	WATER		60.2	72.3	11.8	5K	1.0					
92/10/21	1140	WATER		61.5	73.9	32.9	5K	1.0					
92/11/18	1040	WATER		63.1	77.1	10.6	6	1.0K					
92/12/09	1045	WATER		63.5	77.5	11.3	5K	1.0K					

0 DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01025 CADMIUM CD,DISS UG/L	01030 CHROMIUM CR,DISS UG/L	01035 COBALT CO,DISS UG/L	01040 COPPER CU,DISS UG/L	01046 IRON FE,DISS UG/L	01049 LEAD PB,DISS UG/L	01056 MANGNESE MN,DISS UG/L	01060 MOLY MO,DISS UG/L	01065 NICKEL NI,DISS UG/L	01140 SILICON SI,DISS UG/L
92/03/18	1100	WATER		1K	5K	50K	100K	100K	5K	50K	100K	100K	3300

0 DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01075 SILVER AG,DISS UG/L	01080 STRONTUM SR,DISS UG/L	01100 TIN SN,DISS UG/L	01085 VANADIUM V,DISS UG/L	01090 ZINC ZN,DISS UG/L	01000 ARSENIC AS,DISS UG/L	01145 SELENIUM SE,DISS UG/L	71900 MERCURY HG,TOTAL UG/L	31616 FEC COLI MFM-FCBR /100ML
92/03/18	1100	WATER		100K	100	100K	100K	100K	5K	5K	.5K	

1STORET RETRIEVAL DATE 93/04/08 PGM=RET PAGE:
HON12 URG120026525 USGS08267500
36 32 30.0 105 33 22.0 4
RIO HONDO 1.5 MI ABV VALDEZ
35055 NEW MEXICO TAOS
RIO GRANDE 120991
RIO HONDO /TYPA/AMBNT/STREAM/BIO
21NMEX 13020101025 0009.780 ON
0002 FEET DEPTH

0 DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00010 WATER TEMP CENT	00095 CNDUCTVY AT 25C MICROMHO	00300 DO MG/L	00400 PH SU	82079 TURBIDTY LAB NTU	00665 PHOS-TOT MG/L P	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3+NH4- N TOTAL MG/L	00640 T INORG. NITROGEN MG/L N	00625 TOT KJEL N MG/L
92/02/19	1125	WATER		1.0	108	10.8	8.3	2	.05	.42	.14	.56	1.18
92/03/18	1120	WATER		2.2	127	9.7	8.0	2	.01K	.34	.10K	.44K	.12
92/04/22	1105	WATER		3.1	108	9.4	7.8	3	.04	.12	.11	.23	.12
92/05/20	1225	WATER		8.0	54	8.8	8.0	4	.04	.21	.16	.37C	.22
92/06/24	1240	WATER		9.5	105	8.3	7.9	2	.02	.21	.10K	.31	.10K
92/07/22	1225	WATER		9.9	117	6.9	8.2	.8	.02	.16	.14	.30	.47
92/08/19	1200	WATER		9.5	134	8.4	8.2	.9	.01	.15	.12	.27C	.19
92/09/23	1330	WATER		9.0	136	8.5	8.3	.5	.01	.20	.10K	.30C	.10K
92/10/21	1200	WATER		6.0	127	9.6	8.4	.4	.01K	.28	.10	.38C	.13
92/11/18	1055	WATER		1.5	128	9.9	7.7	.4	.01K	.27	.10K	.37C	.36
92/12/09	1105	WATER		.0	131	10.3	7.9	1	.01K	.36	.17	.53C	.26

0 DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00605 ORG N N MG/L	00600 TOTAL N N MG/L	00612 UN-IONZD NH3-N MG/L	70300 RESIDUE DISS-180 C MG/L	00530 RESIDUE TOT NFLT MG/L	00915 CALCIUM CA,DISS MG/L	00925 MGNSIUM MG,DISS MG/L	00935 PTSSIUM K,DISS MG/L	00930 SODIUM NA,DISS MG/L	00900 TOT HARD CACO3 MG/L
92/02/19	1125	WATER		1.04	1.60	.002	104	3K	63.0	3.0	1.0	5.0	170.0
92/03/18	1120	WATER		.02	.46	.001	104	6	26.0	3.0	1.0	6.0	77.0
92/04/22	1105	WATER		.01	.24	.001	80	3	19.0	2.0	1.0	3.0	56.0
92/05/20	1225	WATER		.06	.43C	.002	64	3	14.0	2.0	1.0	2.0	43.0
92/06/24	1240	WATER		.00	.31C	.004	74	3K	19.0	2.0	1.0	2.0	56.0
92/07/22	1225	WATER		.33	.66	.003	80	3	22.0	2.0	2.0	5.0	63.0
92/08/19	1200	WATER		.07C	.34C	.003	78	3	25.0	2.0	1.0	3.0	71.0
92/09/23	1330	WATER		.00C	.30C	.003	86	3K	24.0	2.0	1.0	3.0	68.0
92/10/21	1200	WATER		.03C	.41C	.003	96	3	24.0	2.0	1.0	2.0	68.0
92/11/18	1055	WATER		.26C	.63C	.000	96	3K	24.0	2.0	2.0	3.0	68.0
92/12/09	1105	WATER		.09C	.62C	.001	74	3K	24.0	2.0	2.0	3.0	68.0

1STORET RETRIEVAL DATE 93/04/08 PGM=RET PAGE:
HON12 URG120028525 USGS08267500
36 32 30.0 105 33 22.0 4
RIO HONDO 1.5 MI ABV VALDEZ
35055 NEW MEXICO TAOS
RIO GRANDE 120991
RIO HONDO /TYPA/AMBNT/STREAM/BIO
21NMEX 13020101025 0009.780 ON
0002 FEET DEPTH

0 DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00410 T ALK CACO3 MG/L	00440 HCO3 ION HCO3 MG/L	00946 SULFATE SO4-DISS MG/L	00940 CHLORIDE TOTAL MG/L	00680 T ORG C C MG/L	50060 CHLORINE TOT RESD MG/L	01106 ALUMINUM AL,DISS UG/L	01005 BARIUM BA,DISS UG/L	01010 BERYLLIUM BE,DISS UG/L	01020 BORON B,DISS UG/L
92/02/19	1125	WATER		58.6	71.7	14.5	9	5.0K					
92/03/18	1120	WATER		58.2	71.0	11.2	9	5.0K		100K	100K	100K	100K
92/04/22	1105	WATER		48.2	58.8	9.7	5K	3.0					
92/05/20	1225	WATER		39.6	48.3	8.0	5K	5.0K					
92/06/24	1240	WATER		44.8	54.7	10.4	5K	2.0					
92/07/22	1225	WATER		52.6	64.2	11.5	5K	1.0K					
92/08/19	1200	WATER		55.7	67.9	12.3	5K	2.0					
92/09/23	1330	WATER		57.4	68.9	12.5	5K	2.0					
92/10/21	1200	WATER		57.7	69.3	15.3	5K	1.0					
92/11/18	1055	WATER		57.0	69.9	13.4	5	1.0K					
92/12/09	1105	WATER		56.5	68.9	13.3	5K	5.0					

0 DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01025 CADMIUM CD,DISS UG/L	01030 CHROMIUM CR,DISS UG/L	01035 COBALT CO,DISS UG/L	01040 COPPER CU,DISS UG/L	01046 IRON FE,DISS UG/L	01049 LEAD PB,DISS UG/L	01056 MANGNESE MN,DISS UG/L	01060 MOLY MO,DISS UG/L	01065 NICKEL NI,DISS UG/L	01140 SILICON SI,DISS UG/L
92/03/18	1120	WATER		1K	5K	50K	100K	100K	5K	50K	100K	100K	3900

0 DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01075 SILVER AG,DISS UG/L	01080 STRONTUM SR,DISS UG/L	01100 TIN SN,DISS UG/L	01085 VANADIUM V,DISS UG/L	01090 ZINC ZN,DISS UG/L	01000 ARSENIC AS,DISS UG/L	01145 SELENIUM SE,DISS UG/L	71900 MERCURY HG,TOTAL UG/L	31616 FEC COLI MFM-FCBR /100ML
92/03/18	1120	WATER		100K	100	100K	100K	100K	5K	5K	.5K	1 K

930113 0955

1STORET RETRIEVAL DATE 93/04/08 PGM=RET PAGE:
HON14 URG120026520
36 31 58.0 105 35 00.0 4
RIO HONDO AT VALDEZ BRIDGE
35055 NEW MEXICO TAOS
RIO GRANDE 120991
RIO HONDO /TYPA/AMBNT/STREAM/BIO
21NMEX 13020101025 0007.730 ON
0002 FEET DEPTH

0 DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00010 WATER TEMP CENT	00095 CNDUCTVY AT 25C MICROMHO	00300 DO MG/L	00400 PH SU	82079 TURBIDTY LAB NTU	00665 PHOS-TOT MG/L P	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3+NH4- N TOTAL MG/L	00640 T INORG. NITROGEN MG/L N	00625 TOT KJEL N MG/L
92/02/19	1145	WATER		1.5	107	10.8	8.2	3	.01K	.36	.14	.50	.33
92/03/18	1140	WATER		3.2	121	9.7	7.8	8	.01K	.37	.13	.50	.14
92/04/22	1125	WATER		4.0	111	9.0	7.9	3	.08	.13	.12	.25	.18
92/05/20	1240	WATER		8.5	82	7.8	8.1	4	.03	.12	.10K	.22C	.36
92/06/24	1300	WATER		11.0	102	6.2	7.8	2	.10	.19	.10K	.29	.10K
92/07/22	1245	WATER		12.0	145	6.8	7.8	.6	.01	.12	.14	.26	.75
92/08/19	1215	WATER		13.2	164	7.7	7.9	2	.02	.10	.10K	.20C	.12
92/09/23	1345	WATER		10.5	162	8.4	8.0	.8	.01	.13	.10	.23C	.18
92/10/21	1210	WATER		8.0	147	9.3	8.2	1	.01	.21	.10K	.31	.15
92/11/18	1115	WATER		4.5	127	9.8	7.8	.7	.01	.19	.10K	.29	.10K
92/12/09	1130	WATER		1.3	136	10.1	7.9	.9	.01K	.33	.10K	.43C	.15

0 DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00605 ORG N N MG/L	00600 TOTAL N N MG/L	00612 UN-IONZD NH3-N MG/L	70300 RESIDUE DISS-180 C MG/L	00530 RESIDUE TOT NFLT MG/L	00915 CALCIUM CA,DISS MG/L	00925 MGNSIUM MG,DISS MG/L	00935 PTSSIUM K,DISS MG/L	00930 SODIUM NA,DISS MG/L	00900 TOT HARD CACO3 MG/L
92/02/19	1145	WATER		.19	.69	.002	132	4	97.0	4.0	1.0	4.0	259.0
92/03/18	1140	WATER		.01	.51	.001	108	6	25.0	3.0	1.0	6.0	75.0
92/04/22	1125	WATER		.06	.31	.001	86	5	20.0	2.0	1.0	3.0	58.0
92/05/20	1240	WATER		.26C	.48C	.002	68	4	14.0	2.0	4.0	2.0	43.0
92/06/24	1300	WATER		.00	.29C	.001	84	3K	36.0	2.0	1.0	2.0	98.0
92/07/22	1245	WATER		.61	.87	.002	46	3	26.0	3.0	1.0	3.0	77.0
92/08/19	1215	WATER		.02C	.22	.002	110	3	28.0	3.0	1.0	4.0	82.0
92/09/23	1345	WATER		.08C	.31C	.002	108	3K	27.0	3.0	1.0	4.0	80.0
92/10/21	1210	WATER		.05C	.36C	.002	94	3	26.0	3.0	2.0	3.0	77.0
92/11/18	1115	WATER		.00C	.29C	.001	108	3	26.0	3.0	1.0	4.0	77.0
92/12/09	1130	WATER		.05C	.48C	.001	86	3K	25.0	3.0	2.0	4.0	75.0

1STORET RETRIEVAL DATE 93/04/08 PGM=RET PAGE:
HON14 URG120028520
36 31 58.0 105 35 00.0 4
RIO HONDO AT VALDEZ BRIDGE
35055 NEW MEXICO TAOS
RIO GRANDE 120991
RIO HONDO /TYPA/AMBNT/STREAM/BIO
21NMEX 13020101025 0007.730 ON
0002 FEET DEPTH

0 DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00410 T ALK CACO3 MG/L	00440 HCO3 ION HCO3 MG/L	00946 SULFATE SO4-DISS MG/L	00940 CHLORIDE TOTAL MG/L	00680 T ORG C C MG/L	50060 CHLORINE TOT RESD MG/L	01106 ALUMINUM AL,DISS UG/L	01005 BARIUM BA,DISS UG/L	01010 BERYLLIUM BE,DISS UG/L	01020 BORON B,DISS UG/L
92/02/19	1145	WATER		61.6	71.2	14.5	9	5.0K					
92/03/18	1140	WATER		59.2	72.2	12.2	7	5.0K		100K	100K	100K	100K
92/04/22	1125	WATER		50.0	61.0	10.7	5	3.0					
92/05/20	1240	WATER		43.6	53.2	8.0	5K	5.0K					
92/06/24	1300	WATER		49.8	60.8	10.8	5K	2.0					
92/07/22	1245	WATER		65.4	79.8	12.4	5K	1.0					
92/08/19	1215	WATER		69.7	85.0	12.3	5K	3.0					
92/09/23	1345	WATER		65.8	78.9	13.3	5K	1.0					
92/10/21	1210	WATER		63.5	76.2	16.2	5K	1.0					
92/11/18	1115	WATER		62.1	75.9	14.2	5	1.0K					
92/12/09	1130	WATER		60.6	73.9	14.3	5K	1.0					

0 DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01025 CADMIUM CD,DISS UG/L	01030 CHROMIUM CR,DISS UG/L	01035 COBALT CO,DISS UG/L	01040 COPPER CU,DISS UG/L	01046 IRON FE,DISS UG/L	01049 LEAD PB,DISS UG/L	01056 MANGNESE MN,DISS UG/L	01060 MOLY MO,DISS UG/L	01065 NICKEL NI,DISS UG/L	01140 SILICON SI,DISS UG/L
92/03/18	1140	WATER		1K	5K	50K	100K	100K	5K	50K	100K	100K	4000

0 DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01075 SILVER AG,DISS UG/L	01080 STRONTUM SR,DISS UG/L	01100 TIN SN,DISS UG/L	01085 VANADIUM V,DISS UG/L	01090 ZINC ZN,DISS UG/L	01000 ARSENIC AS,DISS UG/L	01145 SELENIUM SE,DISS UG/L	71900 MERCURY HG,TOTAL UG/L	31616 FEC COLI MFM-FCBR /100ML
92/03/18	1140	WATER		100K	200	100K	100K	100K	5K	5K	.5K	

930113 1000 1 J

1STORET RETRIEVAL DATE 93/04/08 PGM=RET PAGE:
HON18 URG120026510
36 32 07.0 105 40 00.0 4
RIO HONDO AT HWY 3 BRIDGE
35055 NEW MEXICO TAOS
RIO GRANDE 120991
RIO HONDO /TYPA/AMBNT/STREAM/BIO
21NMEX 13020101025 0002.520 ON
0002 FEET DEPTH

0 DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00010 WATER TEMP CENT	00095 CNDUCTVY AT 25C MICROMHO	00300 DO MG/L	00400 PH SU	82079 TURBIDTY LAB NTU	00665 PHOS-TOT MG/L P	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3+NH4- N TOTAL MG/L	00640 T INORG. NITROGEN MG/L N	00625 TOT KJEL N MG/L
92/02/19	1205	WATER		1.0	125	11.0	8.2	5	.01K	.45	.18	.63	.34
92/03/18	1200	WATER		4.2	145	9.6	7.8	9	.10	.36	.10	.46	.19
92/04/22	1145	WATER		5.9	122	8.9	7.9	7	.06	.14	.11	.25	.23
92/05/20	1300	WATER		11.5	108	9.4	8.1	5	.01K	.14	.10K	.24C	.20
92/06/24	1315	WATER		13.5	135	8.7	8.0	2	.03	.17	.10K	.27	.10K
92/07/22	1310	WATER		19.0	230	6.9	8.0	.5	.01	.36	.14	.50	1.03
92/08/19	1235	WATER		18.8	256	7.3	8.0	.7	.03	.25	.20	.45C	.20
92/09/23	1410	WATER		15.9	225	7.8	8.1	1	.01	.24	.12	.46C	.24
92/10/21	1230	WATER		8.0	241	8.5	8.0	.7	.01	.21	.10	.31C	.41
92/11/18	1135	WATER		5.2	181	9.8	7.8	6	.01	.26	.10K	.36C	.10K
92/12/09	1215	WATER		1.1	145	10.5	7.5	4	.04	.44	.10K	.54C	.10K

0 DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00605 ORG N N MG/L	00600 TOTAL N N MG/L	00612 UN-IONZD NH3-N MG/L	70300 RESIDUE DISS-180 C MG/L	00530 RESIDUE TOT NFLT MG/L	00915 CALCIUM CA,DISS MG/L	00925 MGNSIUM MG,DISS MG/L	00935 PTSSIUM K,DISS MG/L	00930 SODIUM NA,DISS MG/L	00900 TOT HARD CACO3 MG/L
92/02/19	1205	WATER		.16	.79	.002	92	15	47.0	4.0	2.0	5.0	134.0
92/03/18	1200	WATER		.09	.55	.001	118	11	29.0	3.0	1.0	6.0	85.0
92/04/22	1145	WATER		.12	.37	.001	90	9	21.0	3.0	1.0	4.0	65.0
92/05/20	1300	WATER		.10C	.34C	.003	80	8	24.0	2.0	1.0	2.0	68.0
92/06/24	1315	WATER		.00	.27C	.002	90	3	22.0	3.0	1.0	3.0	67.0
92/07/22	1310	WATER		.89	1.39C	.005	136	3	39.0	5.0	1.0	2.0	118.0
92/08/19	1235	WATER		.00C	.45C	.007	160	22	44.0	5.0	2.0	6.0	130.0
92/09/23	1410	WATER		.12C	.58C	.004	140	4	38.0	5.0	2.0	5.0	115.0
92/10/21	1230	WATER		.31C	.62C	.002	154	3K	41.0	4.0	2.0	5.0	119.0
92/11/18	1135	WATER		.00C	.36C	.001	130	3K	32.0	4.0	2.0	5.0	96.0
92/12/09	1215	WATER		.00C	.54C	.000	98	8	28.0	3.0	2.0	4.0	82.0

1STORET RETRIEVAL DATE 93/04/08 PGM=RET PAGE:
HON18 URG120026510
36 32 07.0 105 40 00.0 4
RIO HONDO AT HWY 3 BRIDGE
35055 NEW MEXICO TAOS
RIO GRANDE 120991
RIO HONDO /TYPA/AMBNT/STREAM/BIO
21NMEX 13020101025 0002.520 ON
0002 FEET DEPTH

0 DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00410 T ALK CACO3 MG/L	00440 HCO3 ION HCO3 MG/L	00946 SULFATE SO4-DISS MG/L	00940 CHLORIDE TOTAL MG/L	00680 T ORG C C MG/L	50060 CHLORINE TOT RESD MG/L	01106 ALUMINUM AL,DISS UG/L	01005 BARIUM BA,DISS UG/L	01010 BERYLIUM BE,DISS UG/L	01020 BORON B,DISS UG/L
92/02/19	1205	WATER		70.4	85.9	14.4	5K	5.0K					
92/03/18	1200	WATER		65.8	80.3	12.0	9			100K	100K	100K	100K
92/04/22	1145	WATER		53.0	64.7	12.7	5K	3.0					
92/05/20	1300	WATER		50.8	62.0	9.0	5K	5.0K					
92/06/24	1315	WATER		58.6	70.8	11.1	5K	1.0					
92/07/22	1310	WATER		105.0	129.0	12.7	5K	2.0					
92/08/19	1235	WATER		120.0	146.0	11.8	5K	2.0					
92/09/23	1410	WATER		100.0	120.0	13.9	5K	3.0					
92/10/21	1230	WATER		105.0	126.0	16.4	5	3.0					
92/11/18	1135	WATER		83.0	102.0	18.3	5	1.0					
92/12/09	1215	WATER		71.4	87.1	14.7	5	1.0					

0 DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01025 CADMIUM CD,DISS UG/L	01030 CHROMIUM CR,DISS UG/L	01035 COBALT CO,DISS UG/L	01040 COPPER CU,DISS UG/L	01046 IRON FE,DISS UG/L	01049 LEAD PB,DISS UG/L	01056 MANGNESE MN,DISS UG/L	01060 MOLY MO,DISS UG/L	01065 NICKEL NI,DISS UG/L	01140 SILICON SI,DISS UG/L
92/03/18	1200	WATER		1K	5K	50K	100K	100K	5K	50K	100K	100K	4300

0 DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01075 SILVER AG,DISS UG/L	01080 STRONTUM SR,DISS UG/L	01100 TIN SN,DISS UG/L	01085 VANADIUM V,DISS UG/L	01090 ZINC ZN,DISS UG/L	01000 ARSENIC AS,DISS UG/L	01145 SELENIUM SE,DISS UG/L	71900 MERCURY HG,TOTAL UG/L	31616 FEC COLI MFM-FCBR /100ML
92/03/18	1200	WATER		100K	200	100K	100K	100K	5K	5K	.5K	

1STORET RETRIEVAL DATE 93/04/08 PGM=RET PAGE:
HON20 120026501
36 32 09.0 105 42 30.0 4
RIO HONDO AT RIO GRANDE CONFLUEN
35055 NEW MEXICO TAOS
RIO GRANDE 120991
RIO HONDO /TYPA/AMBNT/STREAM/BIO
21NMEX 13020101025 0000.140 ON
0002 FEET DEPTH

0 DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00010 WATER TEMP CENT	00095 CNDUCTVY AT 25C MICROMHO	00300 DO MG/L	00400 PH SU	82079 TURBIDTY LAB NTU	00665 PHOS-TOT MG/L P	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3+NH4- N TOTAL MG/L	00640 T INORG. NITROGEN MG/L N	00625 TOT KJEL N MG/L
92/02/19	1230	WATER		2.0	221	10.5	8.3	11	.01K	.56	.16	.72	.19
92/03/18	1220	WATER		6.3	188	9.5	8.3	9	.12	.45	.11	.56	.24
92/04/22	1200	WATER		6.8	154	9.0	8.0	5	.07	.21	.13	.34	.17
92/04/22	1200	WATER	QA REPLICATE						.02	.25	.11	.36	.33
92/05/20	1320	WATER		12.0	141	9.4	8.3	7	.03	.17	.10K	.27C	.39
92/05/20	1320	WATER	QA REPLICATE						.05	.16	.10K	.26	.35
92/06/24	1345	WATER		15.0	181	8.5	8.5	16	.12	.20	.10K	.30	.10K
92/06/24	1345	WATER	QA REPLICATE						.04	.20	.10K	.30	.17
92/07/22	1330	WATER		21.0	238	6.9	8.7	2	.03	.33	.15	.48	.61
92/07/22	1330	WATER	QA REPLICATE						.02	.32	.15	.47	.76
92/08/19	1315	WATER	QA REPLICATE						.02	.30	.17	.47	.17
92/08/19	1315	WATER		20.0	365	7.2	8.7	2	.03	.35	.22	.57C	.29
92/09/23	1430	WATER		18.0	324	8.0	8.8	2	.04	.29	.12	.41C	.20
92/09/23	1430	WATER	QA REPLICATE						.04	.39	.10K	.49C	.20
92/10/21	1250	WATER		12.0	315	9.0	8.6	3	.02	.41	.12	.53C	.17
92/10/21	1250	WATER	QA REPLICATE						.02	.40	.12	.52C	.19
92/11/18	1200	WATER		7.0	286	10.0	8.3	3	.01K	.51	.10K	.61C	.24

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RIO HONDO AT RIO GRANDE CONFLUEN
35055 NEW MEXICO TAOS
RIO GRANDE 120991
RIO HONDO /TYPA/AMBNT/STREAM/BIO
21NMEX 13020101025 0000.140 ON
0002 FEET DEPTH

0 DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00605 ORG N N MG/L	00600 TOTAL N N MG/L	00612 UN-IONZD NH3-N MG/L	70300 RESIDUE DISS-180 C MG/L	00530 RESIDUE TOT NFLT MG/L	00915 CALCIUM CA,DISS MG/L	00925 MGNSIUM MG,DISS MG/L	00935 PTSSIUM K,DISS MG/L	00930 SODIUM NA,DISS MG/L	00900 TOT HARD CACO3 MG/L
92/02/19	1230	WATER		.03	.75	.003	188	22	28.0	7.0	2.0	13.0	99.0
92/03/18	1220	WATER		.13	.69	.003	150	13	34.0	5.0	1.0	9.0	105.0
92/04/22	1200	WATER		.04	.38	.002	102	18	27.0	4.0	1.0	6.0	84.0
92/04/22	1200	WATER	QA REPLICATE	.22	.58	.002	105	16	29.0	4.0	1.0	6.0	89.0
92/05/20	1320	WATER		.29C	.56C	.004	102	10	35.0	3.0	1.0	4.0	100.0
92/05/20	1320	WATER	QA REPLICATE	.25	.51	.004	102	15	22.0	3.0	2.0	4.0	67.0
92/06/24	1345	WATER		.00	.30C	.008	122	26	30.0	4.0	1.0	2.0	91.0
92/06/24	1345	WATER	QA REPLICATE	.07	.37	.008	126	26	29.0	4.0	1.0	5.0	89.0
92/07/22	1330	WATER		.46	.94C	.026	220	3	52.0	9.0	2.0	15.0	167.0
92/07/22	1330	WATER	QA REPLICATE	.61	.14	.026	224	3	50.0	9.0	2.0	15.0	
92/08/19	1315	WATER	QA REPLICATE	.00	.47	.035	208	3	54.0	9.0	10.0	15.0	172.0
92/08/19	1315	WATER		.07C	.64C	.036	214	5	23.0	9.0	2.0	15.0	94.0
92/09/23	1430	WATER		.08C	.49C	.021	210	4	49.0	8.0	2.0	14.0	155.0
92/09/23	1430	WATER	QA REPLICATE	.00C	.49C	.017	210	3	48.0	8.0	2.0	14.0	153.0
92/10/21	1250	WATER		.05C	.58C	.009	204	4	45.0	8.0	2.0	14.0	145.0
92/10/21	1250	WATER	QA REPLICATE	.07C	.59C	.009	207	3	49.0	8.0	2.0	13.0	155.0
92/11/18	1200	WATER		.14C	.75C	.003	209	5	46.0	8.0	2.0	12.0	148.0

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RIO HONDO AT RIO GRANDE CONFLUEN
35055 NEW MEXICO TAOS
RIO GRANDE 120991
RIO HONDO /TYPA/AMBNT/STREAM/BIO
21NMEX 13020101025 0000.140 ON
0002 FEET DEPTH

0 DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00410 T ALK CACO3 MG/L	00440 HCO3 ION HCO3 MG/L	00946 SULFATE SO4-DISS MG/L	00940 CHLORIDE TOTAL MG/L	00680 T ORG C C MG/L	50060 CHLORINE TOT RESD MG/L	01106 ALUMINUM AL,DISS UG/L	01005 BARIUM BA,DISS UG/L	01010 BERYLLIUM BE,DISS UG/L	01020 BORON B,DISS UG/L
92/02/19	1230	WATER		128.0	156.0	22.7	6	5.0K					
92/03/18	1220	WATER		93.0	113.0	15.4	9			100K	100K	100K	100K
92/04/22	1200	WATER		70.0	85.4	16.4	5	3.0					
92/04/22	1200	WATER QA REPLICATE		70.4	85.9	13.8	6	5.0					
92/05/20	1320	WATER		65.4	79.8	10.8	5K	5.0K					
92/05/20	1320	WATER QA REPLICATE		65.6	80.0	10.7	5K	5.0K					
92/06/24	1345	WATER		81.4	99.3	12.9	5K	3.0					
92/06/24	1345	WATER QA REPLICATE		81.6	99.6	13.0	5K	3.0					
92/07/22	1330	WATER		168.0	205.0	20.0	6	3.0					
92/07/22	1330	WATER QA REPLICATE		168.0	205.0	19.0	6	3.0					
92/08/19	1315	WATER QA REPLICATE		167.0	230.0	19.3	5K	3.0					
92/08/19	1315	WATER		164.0	198.0	19.6	5K	5.0					
92/09/23	1430	WATER		150.0	180.0	21.4	6	4.0					
92/09/23	1430	WATER QA REPLICATE		149.0	179.0	21.6	6	4.0					
92/10/21	1250	WATER		145.0	174.0	24.9	5	2.0					
92/10/21	1250	WATER QA REPLICATE		146.0	175.0	25.2	5K	2.0					
92/11/18	1200	WATER		134.0	164.0	24.0	5	1.0K					

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1STORET RETRIEVAL DATE 93/04/08                    PGM=RET                                                    PAGE:
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RIO HONDO AT RIO GRANDE CONFLUEN
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RIO GRANDE                120991
RIO HONDO                                                          /TYPA/AMBNT/STREAM/BIO
21NMEX                        13020101025 0000.140 ON
0002 FEET DEPTH
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0 DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01025 CADMIUM CD,DISS UG/L	01030 CHROMIUM CR,DISS UG/L	01035 COBALT CO,DISS UG/L	01040 COPPER CU,DISS UG/L	01046 IRON FE,DISS UG/L	01049 LEAD PB,DISS UG/L	01056 MANGNESE MN,DISS UG/L	01060 MOLY MO,DISS UG/L	01065 NICKEL NI,DISS UG/L	01140 SILICON SI,DISS UG/L
92/03/18	1220	WATER		1K	5K	50K	100K	100K	5K	50K	100K	100K	5700

0 DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01075 SILVER AG,DISS UG/L	01080 STRONTUM SR,DISS UG/L	01100 TIN SN,DISS UG/L	01085 VANADIUM V,DISS UG/L	01090 ZINC ZN,DISS UG/L	01000 ARSENIC AS,DISS UG/L	01145 SELENIUM SE,DISS UG/L	71900 MERCURY HG,TOTAL UG/L	31616 FEC COLI MFM-FCBR /100ML
930113	1025											13 J
92/03/18	1220	WATER		100K	200	100K	100K	100K	5K	5K	.5K	

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1THAT'S ALL FOLKS
END OF DATA
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1STORET RETRIEVAL DATE 93/04/19 PGM=RET
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RIO HONDO AT RIO GRANDE CONFLUEN
35055 NEW MEXICO TAOS
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DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	39337 ALPHABHC TOTUG/L	39338 BETA BHC TOTUG/L	34259 DELTABHC TOTUG/L	39340 GAMMABHC LINDANE TOT.UG/L	39410 HEPTCHLR TOTUG/L	39330 ALDRIN TOT UG/L	39420 HPCHLREP TOTUG/L	39700 HCB TOT UG/L	39388 ENDOSULN WHL SMPL UG/L	39380 DIELDRIN TOTUG/L
92/08/19	1315	WATER		.05K	.05K	.05K	.05K	.05K	.05K	.05K	.08K	.05K	.1K

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	39390 ENDRIN TOT UG/L	82624 ENDOSLFN BETA TOT REC UG/L	39360 DDD WHL SMPL UG/L	82623 ENDOSLFN -SO4 TOT REC UG/L	39370 DDT WHL SMPL UG/L	39480 MTHXYCLR WHL SMPL UG/L	78008 ENDRIN KETONE UG/L	39348 A-CHLRDN WHL SMPL UG/L	39810 G-CHLRDN WHL SMPL UG/L	39400 TOXAPHEN TOTUG/L
92/08/19	1315	WATER		.1K	.1K	.01K	.1K	.1K	.05K	.1K	.5K	.5K	1.0K

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	39496 PCB-1242 TOTUG/L	39500 PCB-1248 TOTUG/L	39504 PCB-1254 TOTUG/L	39508 PCB-1260 TOTUG/L	39117 PHTHLATE ESTERS MG/L	82622 ENDRIN ALDH TOT REC UG/L	39492 PCB-1232 TOTUG/L	39365 DDE WHL SMPL UG/L	09503 RA-226 + 228 TOT PC/L	09504 RA-226+ 228 ERROR PC/L
92/08/19	1315	WATER		.5K	.5K	1.0K	1.0K		.01K	.5K	.1K		
92/07/22	1330	WATER										4.07	1.58

Table 11. Quantitative macroinvertebrate data collected at eight sampling sites on the Rio Hondo, April, 1992

Taxa	Station 3	4	8	10	12	14	18	20
PLECOPTERA – stoneflies								
Prostoia besametsa			153	255	170	68	23	23
Podmosta delicatula		6						
Zapada sp.	11	11		6	11			
Capniidae	28			91	102	68		
Taenionema sp.	249	221	51	284	17	11		
Leuctridae	45				6			
Pteronarcella badia					11	40	17	11
Megarcys signata	17	301	187	62	28			
Skwala americana								11
Cultus aestivalis	62	74	238	68	11	17		
Kogotus modestus	6	6						
Isoperla sp.				6		23	6	
Isoperla mormona								845
Chloroperlidae C	23	6		125				
Triznaka sp.				17	17	96	23	
Sweltsa sp.	11		9	45	28			
Hesperoperla pacifica	11					40	17	
EPHEMEROPTERA – mayflies								
Ameletus sp.				6				
Baetis insignificans	68	136	111					
Baetis tricaudatus				181	505	629	335	1310
Cinygmula sp.	51	45	9	6				
Rhithrogena robusta	295	102	34	6				
Rhithrogena hageni					318	238	210	6
Epeorus sp.	11	6		34	159	108	159	34
Paraleptophlebia sp.					11		51	
Drunella grandis						142	108	28
Drunella doddsi	23	352	170	232	51		23	
Ephemerella inermis	45	357	196	204	23			
Ephemerella infrequens	11	34	43	34	125	403	62	187
TRICHOPTERA – caddisflies								
Rhyacophila brunea cpx.	79			136	187	34	40	142
Rhyacophila iranda	74	51	17		6			
Rhyacophila valuma	57	40	85	244	96	51		
Rhyacophila coloradensis			34			62	17	
Rhyacophila hyalinata	17		9		11			
Glossosoma sp.	34	6						
Dolophilodes sortosa						6		
Hydropsyche venada					6	23	232	1032
Arctopsyche grandis				23		363		
Limnephilidae	6							159
Oligophlebodes sp.	28	136	26	352	181	748	17	
Psychoronia sp.					23	51		
Lepidostoma sp.								6
Brachycentrus sp.					17	45	11	
Brachycentrus americanus								488
Micrasema sp.	198	11		23	45	301	879	357
Helicopsyche borealis								408

Table 11. Continued

DIPTERA – true flies								
Hesperoconopa sp.							6	17
Antocha monticola							28	6
Dicranota sp.	57	68	26	34	23	57	28	23
Hexatoma sp. A					23	23	40	23
Tipula sp.								227
Pericoma sp.	17				51	255	11	17
Bibliocephala grandis	11				6			
Simuliidae	6			6	6	6		17
Diamesa sp.	23	45	1913	459	6	284	40	221
Brillia sp.	28	17	43	28	11	6		
Orthocladius sp.		51	706	641	11	465	23	811
Eukiefferiella sp.	6	17	111	51	17	6	23	136
Pagastia sp.			34	6		17	17	159
Rheocricotopus sp.	17		51	28				
Tvetnia sp.							6	23
Coryoneura sp.							6	
Macropelopia sp.	11							
Micropsectra sp.	130			23	45	11		
Paraphaenocladius sp.	17	11	43	11		11		
Microtendipes sp.							6	11
Ceratopogonidae			9		6	6		
Chelifera sp.	11	6	17			6		
Oreogeton sp.		6				34	6	
Hemerodromia sp.				6				
HEMIPTERA – true bugs								
Ambrysus mormon								6
COLEOPTERA – beetles								
Narpus sp.							11	
Heterlimnius corpulentus	17	6		11	28	28	261	652
LEPIDOPTERA – moths								
Parargyractis kearfottalis								181
MOLLUSCA – snails/clams								
Pelecypoda							6	
ANNELIDA – segmented worms								
Erpobdella sp.						6		
Naididae					17			
Lumbricidae	6						17	
PLATYHELMINTHES – flatworms								
Turbellaria	272	85	34	272	79	28	6	
ARTHROPODA – other arthropods								
Hydracarina A – mites					6		11	
AMPHIPODA –scuds								
Hyallela azteca							6	62
NEMATOMORPHA – Gordian worms								
Gordius sp.				6		17	6	
Standing Crop (No./m²)	2089	2213	4359	4022	2500	4833	2788	7639
Total Taxa	40	29	27	37	41	41	38	33
CTQ°	50	50	50	50	50	50	50	50
CTQ°	49.3	48.3	59.2	54	46.2	49.2	56.8	63.3
BCI	101.46	103.51	84.44	92.6	108.17	101.65	87.96	79.03
Diversity Index	4.37	3.85	3.09	4.17	4.22	4.19	3.69	3.86

Table 12. RAPID BIOASSESSMENT (PROTOCOL III) OF SIX SITES ON THE UPPER RIO HONDO, APRIL 2, 1992.

Metric	STATIONS 3 (reference)	4	8 (WWTP)	10	12 (<--21 Ecoregion Boundary)	14 (UBFS Boundary; 22-->)
Calculated Value						
No. of Taxa	40	29	27	37	41	41
Standing Crop (#/M^2)	2,089	2,213	4,359	4,022	2,500	4,833
Biotic Index						
HBI	2.42	2.18	5.93	3.90	2.20	3.65
BCI (CTQ_d)	49.3	48.3	59.2	54	46.2	51.5
% Dominant Taxa	14	16	44	16	20	15
EPT Index	25	19	16	23	26	23
Community Loss	--	0.48	0.67	0.35	0.34	0.46
EPT/(Chironomids + EPT)	0.86	0.93	0.32	0.66	0.96	0.82
Scraper/(C-F + Scrapers)	0.99	1.0	1.0	0.97	0.92	0.67
Shredders/Total	0.16	0.04	0.05	0.11	0.19	0.18
Percent of Reference						
No. of Taxa	100	73	68	93	103	103
Standing Crop (#/M^2)	100	106	209	193	120	231
Biotic Index						
HBI	100	111	41	62	110	66
BCI (CTQ_d)	100	102	83	91	107	96
% Dominant Taxa	14	16	44	16	20	15
EPT Index	100	76	64	92	104	92
Community Loss	--	0.48	0.67	0.35	0.34	0.46
EPT/(Chironomids + EPT)	100	108	37	77	112	95
Scraper/(C-F + Scrapers)	100	101	101	98	93	68
Shredders/Total	100	25	31	69	119	113
Score						
No. of Taxa	6	4	4	6	6	6
Standing Crop (#/M^2)	6	6	2	4	6	2
Biotic Index						
HBI	6	6	0	2	6	2
BCI (CTQ_d)	6	6	4	6	6	6
% Dominant Taxa	6	6	0	6	6	6
EPT Index	6	2	0	6	6	6
Community Loss	6	6	4	6	6	6
EPT/(Chironomids + EPT)	6	6	2	6	6	4
Scraper/(C-F + Scrapers)	6	6	6	6	6	6
Shredders/Total	6	2	2	6	6	6
Total	60	50	24	54	60	50
% of Reference	100	83	40	90	100	83
Biological Condition	Non-Impaired	Non-Impaired	Moderately Impaired	Non-Impaired	Non-Impaired	Non-Impaired*
Habitat Condition	139	147	150	108	155	126
% of Reference	100	106	108	78	112	91
Habitat Category	--	Comparable to Ref.	Comparable to Ref.	Supporting Reference	Comparable to Ref.	Comparable to Ref.

* Site is located in a different ecoregion

Table 13. RAPID BIOASSESSMENT (PROTOCOL III) OF THE LOWER RIO HONDO, APRIL 2, 1992.

Metric	STATIONS 14 (reference)	18	20
Calculated Value			
No. of Taxa	41	38	33
Standing Crop (#/M^2)	4,833	2,788	7,639
Biotic Index			
HBI	3.65	2.36	4.09
BCI (CTQ_d)	51.5	56.8	63.3
% Dominant Taxa	15	32	17
EPT Index	23	18	16
Community Loss	--	0.39	0.70
EPT/(Chironomids + EPT)	0.86	0.95	0.79
Scraper/(C-F + Scraper)	0.99	0.14	0.42
Shredders/Total	0.16	0.35	0.10
Percent of Reference			
No. of Taxa	100	93	80
Standing Crop (#/M^2)	100	58	158
Biotic Index			
HBI	100	155	89
BCI (CTQ_d)	100	91	81
% Dominant Taxa	15	32	17
EPT Index	100	78	70
Community Loss	--	0.39	0.70
EPT/(Chironomids + EPT)	100	110	92
Scraper/(C-F + Scraper)	100	14	42
Shredders/Total	100	219	63
Score			
No. of Taxa	6	6	4
Standing Crop (#/M^2)	6	6	4
Biotic Index			
HBI	6	6	6
BCI (CTQ_d)	6	6	4
% Dominant Taxa	6	2	6
EPT Index	6	2	2
Community Loss	6	6	4
EPT/(Chironomids + EPT)	6	6	6
Scraper/(C-F + Scraper)	6	0	4
Shredders/Total	6	6	6
Total	60	46	46
% of Reference	100	77	77
Biological Condition	Non-Impaired	Slightly Impaired	Slightly Impaired
Habitat Condition	126	114	142
% of Reference	100	90	113
Habitat Category	--	Comparable to Ref.	Comparable to Ref.

Rio Hondo Benthic Macroinvertebrates, April 1992

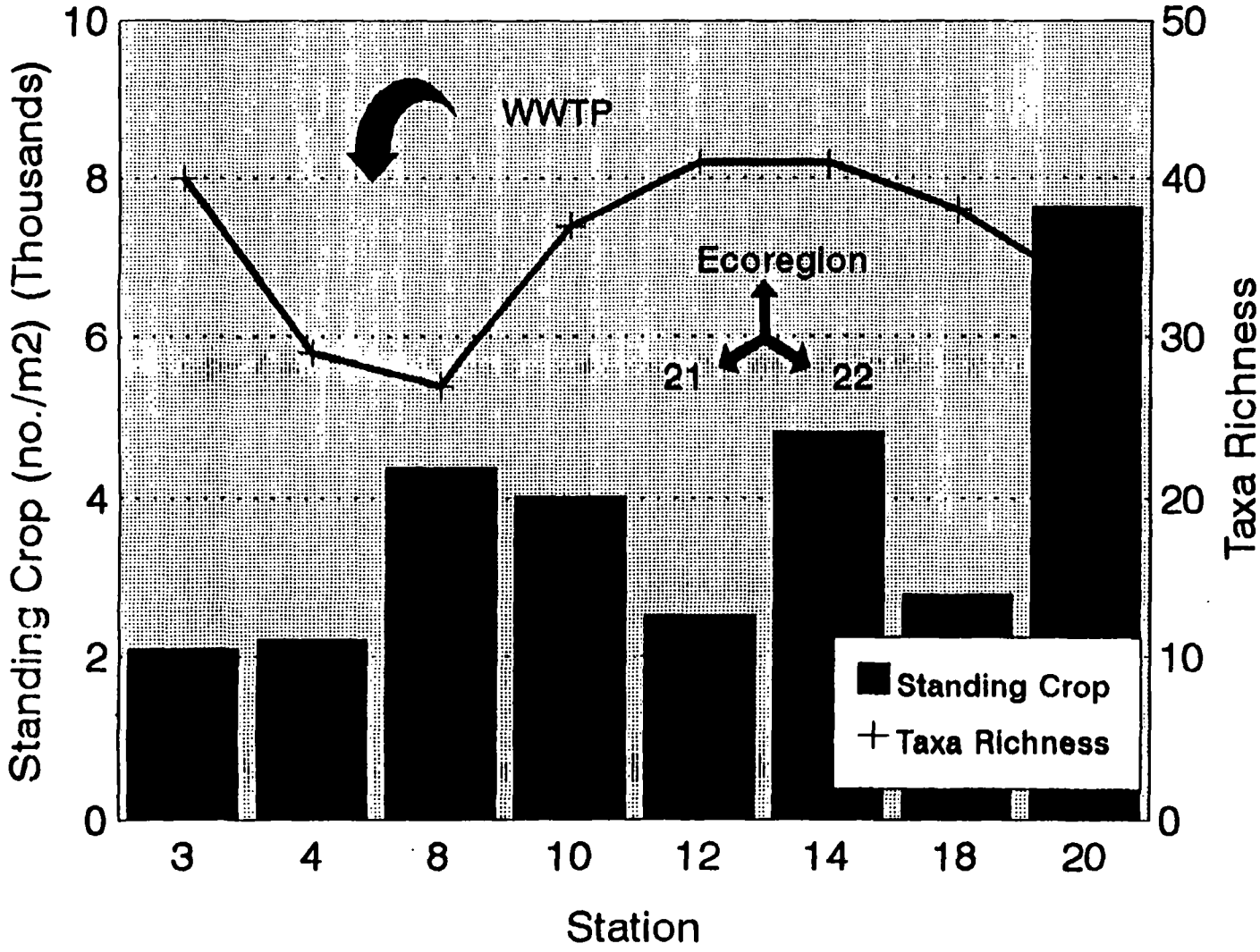

Figure 6. Standing crop and taxa richness of the benthic macroinvertebrate communities at eight sampling sites along the Rio Hondo, April, 1992.

Rio Hondo Benthic Macroinvertebrates, April 1992

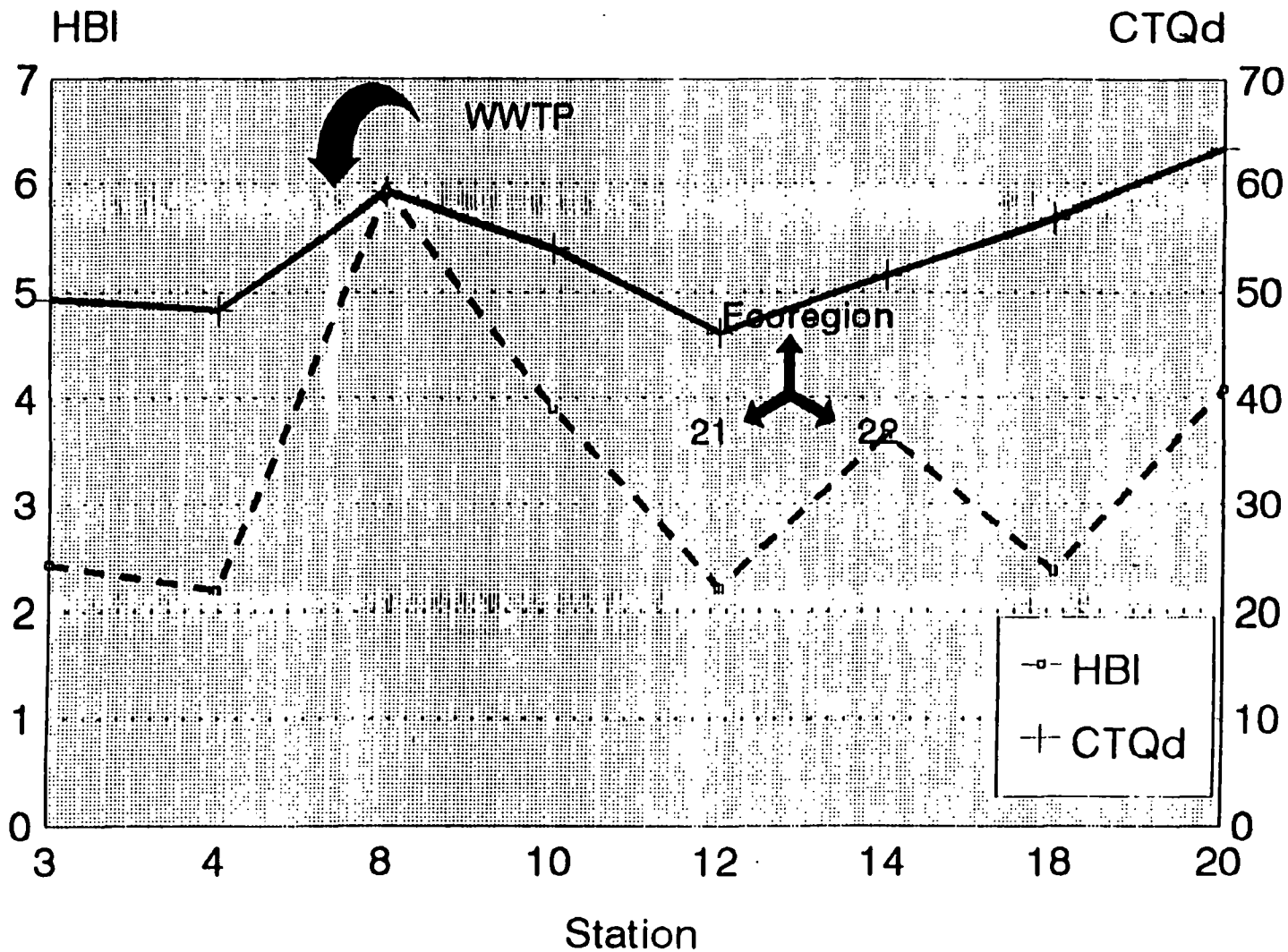

Figure 7. Benthic macroinvertebrate quality as represented by two different biotic indexes (HBI and CTQd(BCI))at eight Rio Hondo sites, April,1992.

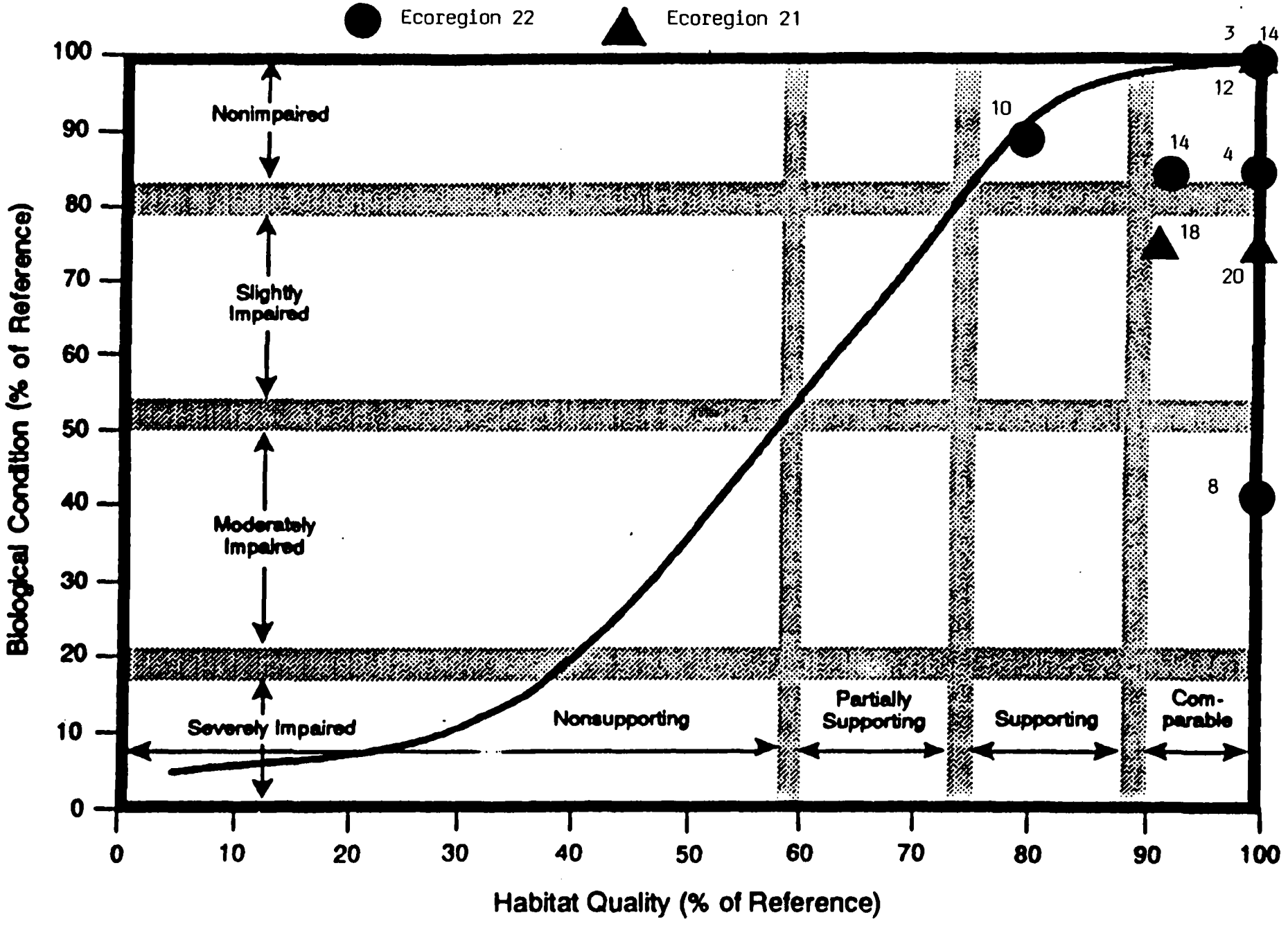

Figure 8—The relationship between habitat and biological condition. Rio Hondo, New Mexico.

SPECIAL WATER QUALITY SURVEY OF THE RED RIVER, TAOS COUNTY, NEW MEXICO, FEBRUARY - DECEMBER, 1992

Introduction

During the period of February 26 through December 16, 1992, the Surveillance and Standards Section conducted a special water quality survey of the Red River from the town of Red River to its mouth at the Rio Grande. Land uses in the Red River watershed include recreation, cattle ranching, farming, mining, fish culture, and community and recreational development. The Red River wastewater reclamation facility, the Red River fish hatchery, and Molycorp are the only point source dischargers into the Red River.

Water Quality Standards

Water quality standards for the Red River are set forth in sections 1-102, 2-119, 2-120, and 3-101 of the New Mexico water quality standards (NMWQCC 1991). Designated uses for segment 2-119 are: coldwater fishery, fish culture, irrigation, livestock and wildlife watering, and secondary contact recreation. Designated uses for segment 2-120 are: domestic water supply, high quality coldwater fishery, irrigation, fish culture, livestock and and wildlife watering, and secondary contact recreation.

Methods

Water quality sampling methods were in accordance with the Quality Assurance Project Plan for Water Pollution Control Programs (NMED 1991). The benthic macroinvertebrate survey was performed by collecting three quantitative samples from each site using a modified Hess sampler. Samples were analyzed using EPA's Rapid Bioassessment Protocol III (Plafkin et al. 1989).

Sampling Stations

The names, STORET identification codes and locations of sites selected for this survey are given below. A map of the study area is presented in Fig. 9.

Station	STORET code	Location
1	HRG22	Red River at Zwergle Dam site.
2	URG120.028069	Red River below Bitter Creek.
3	HRG23.1	Red River below the town of Red River and above the Red River WWTP.
4	HRG23.3	Red River below the Red River WWTP outfall at Elephant Rock campground.
5	URG120.028045	Red River at upper Molycorp boundary.

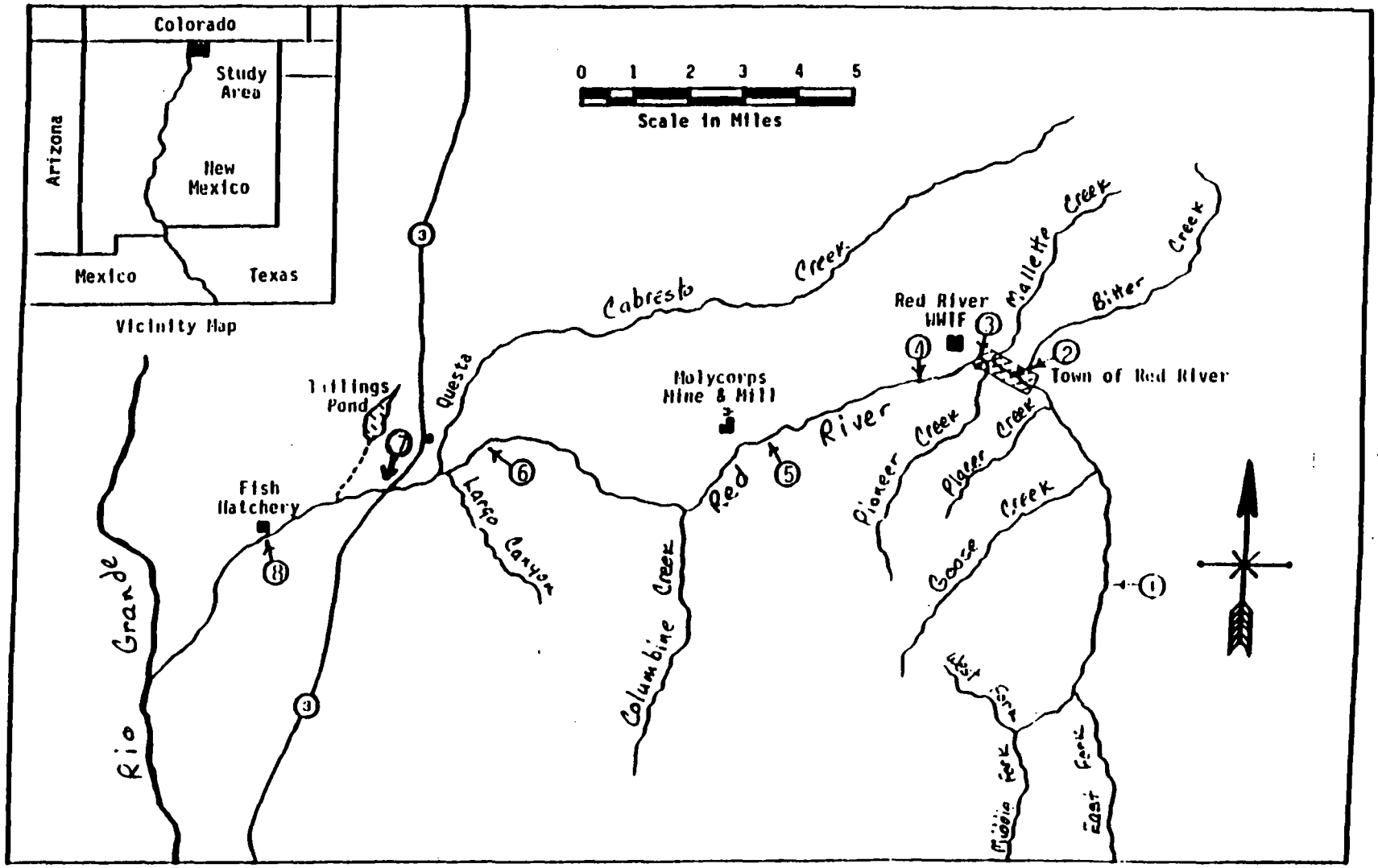

Figure 9. Location map of the Red River, Taos County, New Mexico.

6	HRG24	Red River above Questa at the USGS gage near the USFS office.
7	HRG25	Red River at the highway 522 (3) bridge in Questa.
8	HRG27	Red River below the Red River fish hatchery.

Water Quality Assessment

Water quality data collected during the survey are available on STORET and can be retrieved using selector A=21NMEX and restrictor IS=923506. Parametric coverage and survey data are provided in Table 14. Streamflow on the Red River at HRG24 (site 6) during the eleven monthly sampling dates, February through December, measured 23, 27, 135, 160, 103, 56, 53, 30, 25, 16, and 12 ft^3/sec, respectively.

During the survey, the Red River was highly oxygenated and with few exceptions was slightly alkaline and contained low amounts of dissolved chemical constituents which increased slightly in a downstream manner. Water temperatures varied with the season and elevation from cold to cool. Total non-filterable residue (TSS) and turbidity was elevated in that part of the river adjacent to the Molycorp facility during steady flow conditions. There were ten exceedances of numeric fisheries standards at two sampling sites downstream of the Molycorp mine and mill (sites 6 and 7). The exceedances were of either acute or chronic criteria as follows: two chronic exceedances for cadmium and four chronic and four acute exceedances for zinc. Dissolved aluminum was elevated at sites 2, 4, 5 and 8 during the sampling date in April. Although concentrations were above the chronic standard of 87 ug/l, compliance with this standard is assessed by averaging the analytical results of samples collected on each of four consecutive days. These data indicate an impairment of the coldwater fishery use in the middle Red River.

Biological Assessment

Results of the benthic macroinvertebrate survey and the analysis of these data using Rapid Bioassessment Protocol III are listed in Tables 15 through 18 and Figs. 10 through 12. Since the Red River flows through two ecoregions (21 and 22), separate assessments with different reference sites are performed for each reach.

The stream bottom and riparian habitats along the upper Red River (ecoregion 21) show a downstream pattern of decline in quality primarily due to channel alteration, loss of vegetation, and a reduction in available stream bottom substrate attributable to mineral deposition. These perturbations begin within the town of Red River and continue downstream to State Highway 522 (HRG25). Habitat conditions relative to the reference site are rated partially supporting along most of this stream reach.

Assessment of the macroinvertebrate community shows a dramatic downstream

decrease in overall community health from non-impaired within the town of Red River to moderately impaired below the Molycorp mine and mill complex. Major spatial changes to the community structure along this reach include a reduction in standing crop (33%-82%), a loss of taxa (35%-68%) and a decrease in the EPT index (35%-70%). These reductions can be further illustrated by the large change in diversity (3.64-1.18) and a community loss index of 2.40 at site 6 (Tables 15 and 16, Fig. 10).

The assessment of the lower Red River in ecoregion 22 appears to reflect conditions found upstream below the town of Red River. Since the lower Red River does not provide a suitable reference site, two sites on the lower Rio Hondo (HON14 and HON18) are used for comparison. Habitat conditions at site 7 are slightly degraded and are rated partially supporting while those below the fish hatchery (site 8) are somewhat improved and supporting in comparison to either of the Rio Hondo reference sites.

The biological condition at site 7 is rated moderately impaired and is similar to site 6 in ecoregion 21. A low standing crop and reduced taxa richness indicate that upstream conditions remain detrimental to the community at this site. By comparison, the community structure at site 8 is rated only slightly impaired due to increases in taxa, standing crop, diversity and EPT signaling a recovery process, probably due to increases in water quality and quantity from Cabresto Creek and springbrooks in this reach.

The present biological condition of the macroinvertebrate communities of the Red River is quite similar to those conditions found in surveys conducted in 1986 and 1988. In both of these surveys, standing crops and taxa richness were dramatically reduced in a downstream manner. These decreases began below the town of Red River, but were most pronounced between the Molycorp mine and mill complex and the USGS gage at the Questa Ranger Station (HRG24). In addition, data collected during the 1988 survey showed severe impairments to both the primary producers and the coldwater fishery in this reach.

The bioassessment scores from the present survey show that the macroinvertebrate communities between Bitter Creek (site 2) and the Molycorp mine and mill (site 5) are impaired primarily due to habitat quality, while the communities at the Questa Ranger Station (site 6) and State Highway 522 (site 7) are impaired due to reduced habitat and water quality. The results of this survey and the two previous surveys indicate that the middle Red River, in the reach between the town of Red River and State Highway 522, does not currently support the designated use of coldwater fishery, and probably has not supported this use since 1986.

Table 14. Water quality data collected on the Red River, February - December, 1992.

STORET RETRIEVAL DATE 93/04/23 PGM=RET PAGE:
HRG22 URG120028080 08264500
36 40 25.0 105 22 45.0 4
UPPER RED RIVER AT USGS GAGE
35055 NEW MEXICO TAOS
120991
/TYPA/AMBNT/STREAM/BIO
21NMEX 13020101028 0015.180 ON
0003 FEET DEPTH

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00010 WATER TEMP CENT	00095 CNDUCTVY AT 25C MICROMHO	00300 DO MG/L	00400 PH SU	82079 TURBIDTY LAB NTU	00665 PHOS-TOT MG/L P	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3+NH4- N TOTAL MG/L	00640 T INORG. NITROGEN MG/L N	00625 TOT KJEL N MG/L
92/02/26	1040	WATER		1.0	133	10.3	8.1	1	.01	.17	.10K	.27	.10K
92/03/25	1045	WATER		3.5	146	10.0	7.5	1	.02	.13	.10K	.23	.10K
92/04/29	1025	WATER		4.5	76	9.1	8.0	7	.01K	.10	.10K	.20K	.27
92/05/27	1020	WATER		6.0	108	9.0	8.1	5	.02	.08	.10K	.16C	.53
92/06/30	1100	WATER		7.3	99	8.9	8.1	2	.02	.14	.10K	.24C	.10K
92/07/29	1045	WATER		8.0	150	7.3	8.2	2	.01	.07	.14	.21C	1.08
92/08/26	1030	WATER		8.2	147	8.5	8.2	2	.02	.10	.10K	.20C	.22
92/09/30	0900	WATER		3.0	166	10.1	8.1	.8	.01K	.11	.12	.23C	.20
92/10/28	0810	WATER		3.1	161	10.2	7.9	.4	.01K	.12	.10K	.22C	.11
92/11/24	1030	WATER		.3	164	10.3	8.0	.3	.02	.15	.10K	.25C	.10K
92/12/16	0940	WATER		.0	157	10.5	8.0	.2	.01K	.26	.10K	.36C	.10K

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00605 ORG N N MG/L	00600 TOTAL N N MG/L	00612 UN-IONZD NH3-N MG/L	70300 RESIDUE DISS-180 C MG/L	00530 RESIDUE TOT NFLT MG/L	00915 CALCIUM CA,DISS MG/L	00925 MGNSIUM MG,DISS MG/L	00935 PTSSIUM K,DISS MG/L	00930 SODIUM NA,DISS MG/L	00900 TOT HARD CACO3 MG/L
92/02/26	1040	WATER		.00	.27	.001	122	3K	31.0	5.0	1.0	3.0	98.0
92/03/25	1045	WATER		.00	.23	.000	114	7	40.0	6.0	1.0	4.0	125.0
92/04/29	1025	WATER		.17	.37	.001	88	13	23.0	3.0	1.0	2.0	70.0
92/05/27	1020	WATER		.45C	.61C	.002	90	6	20.0	3.0	1.0	1.0	62.0
92/06/30	1100	WATER		.00C	.24C	.002	84	3	21.0	3.0	1.0	2.0	65.0
92/07/29	1045	WATER		.94C	1.15	.003	86	3	32.0	4.0	1.0	2.0	86.0
92/08/26	1030	WATER		.12C	.32C	.002	102	3K	30.0	4.0	1.0	2.0	91.0
92/09/30	0900	WATER		.08C	.31C	.002	106	3K	32.0	4.0	1.0	3.0	96.0
92/10/28	0810	WATER		.01C	.23C	.001	112	3K	33.0	5.0	1.0	3.0	103.0
92/11/24	1030	WATER		.00C	.25C	.001	126	3K	33.0	5.0	1.0	3.0	103.0
92/12/16	0940	WATER		.00C	.36C	.001	110	3K	31.0	5.0	2.0	3.0	98.0

REMARK CODES: C = calculated value, K = actual value is less than value shown, J = estimated value, * = WQ STANDARD VIOLATION

STORET RETRIEVAL DATE 93/04/23 PGM=RET PAGE:
HRG22 URG120028080 08264500
36 40 25.0 105 22 45.0 4
UPPER RED RIVER AT USGS GAGE
35055 NEW MEXICO TAOS
120991
/TYPA/AMBNT/STREAM/BIO
21NMEX 13020101028 0015.180 ON
0003 FEET DEPTH

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00410 T ALK CACO3 MG/L	00440 HCO3 ION HCO3 MG/L	00946 SULFATE SO4-DISS MG/L	00940 CHLORIDE TOTAL MG/L	00680 T ORG C C MG/L	01105 ALUMINUM Al Total UG/L	01106 ALUMINUM AL,DISS UG/L	01005 BARIUM BA,DISS UG/L	01010 BERYLIUM BE,DISS UG/L	01020 BORON B,DISS UG/L
92/02/26	1040	WATER		89.4	107.0	12.6	7		100	100K	100K	100K	100K
92/03/25	1045	WATER		91.0	111.0	9.8	5	5.0K	100	100K	100K	100K	100K
92/04/29	1025	WATER		84.6	79.1	8.2	5K	4.0	900	100K	100K	100K	100K
92/05/27	1020	WATER		57.4	70.0	7.8	5K	3.0					
92/06/30	1100	WATER		58.0	70.8	10.4	5K	1.0					
92/07/29	1045	WATER		71.6	87.4	11.9	5K	3.0					
92/08/26	1030	WATER		71.9	87.7	12.8	5K	1.0					
92/09/30	0900	WATER		87.0	104.0	22.2	5K	2.0K					
92/10/28	0810	WATER		86.6	106.0	11.9	5K	1.0					
92/11/24	1030	WATER		93.0	114.0	12.6	5K	3.0					
92/12/16	0940	WATER		87.4	106.7	11.9	5K	1.0					

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01025 CADMIUM CD,DISS UG/L	01030 CHROMIUM CR,DISS UG/L	01035 COBALT CO,DISS UG/L	01040 COPPER CU,DISS UG/L	01046 IRON FE,DISS UG/L	01049 LEAD PB,DISS UG/L	01056 MANGNESE MN,DISS UG/L	01060 MOLY MO,DISS UG/L	01065 NICKEL NI,DISS UG/L	01140 SILICON SI,DISS UG/L
92/02/26	1040	WATER		1K	5K	50K	100K	100K	5K	50K	100K	100K	3700
92/03/25	1045	WATER		1K	5K	50K	100K	100K	5K	50K	100K	100K	3900
92/04/29	1025	WATER		1K	5K	50K	100K	100K	5K	50K	100K	100K	3900

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01075 SILVER AG,DISS UG/L	01080 STRONTUM SR,DISS UG/L	01100 TIN SN,DISS UG/L	01085 VANADIUM V,DISS UG/L	01090 ZINC ZN,DISS UG/L	01000 ARSENIC AS,DISS UG/L	01145 SELENIUM SE,DISS UG/L	71900 MERCURY HG,TOTAL UG/L	31616 FEC COLI MFM-FCBR /100ML
92/02/26	1040	WATER		100K	200	100K	100K	100K	5K	5K	.5K	
92/03/25	1045	WATER		100K	200	100K	100K	100K	5K	5K	.5K	
92/04/29	1025	WATER		100K	100	100K	100K	100K	5K	5K	.5K	
93/01/27	0900	WATER										1J

STORET RETRIEVAL DATE 93/04/23 PGM=RET PAGE:
URG120.028069 URG120028069 HRG23.0
36 42 18.0 105 24 15.0 4
RED RIVER BELOW BITTER CREEK.
35055 NEW MEXICO TAOS
WESTERN GULF 120900
RIO GRANDE ABOVE PECOS RIVER /TYPA/AMBNT/STREAM/BIO
21NMEX 920808 13020101
0000 FEET DEPTH 2577 METERS ELEVATION
21M SOUT

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00010 WATER TEMP CENT	00095 CNDUCTVY AT 25C MICROMHO	00300 DO MG/L	00400 PH SU	82079 TURBIDTY LAB NTU	00665 PHOS-TOT MG/L P	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3+NH4- N TOTAL MG/L	00640 T INORG. NITROGEN MG/L N	00625 TOT KJEL N MG/L
92/02/26	1120	WATER		2.2	146	10.7	8.3	2	.07	.19	.10K	.29	.10K
92/03/25	1115	WATER		5.4	158	9.4	7.9	2	.02	.11	.10K	.21	.10K
92/04/29	1045	WATER		5.8	96	8.1	6.7	99	.34	.15	.10K	.25K	.50
92/05/27	1050	WATER		7.5	108	8.6	8.0	7	.06	.06	.10K	.16C	.31
92/06/30	1120	WATER		8.3	127	8.5	7.5	3	.02	.15	.10K	.25C	.20
92/07/29	1115	WATER		10.0	150	8.6	8.0	1	.01	.08	.10K	.18C	.10K
92/08/28	1050	WATER		10.0	150	8.0	8.1	1	.01K	.10	.10K	.20C	.10K
92/09/30	0925	WATER		5.0	170	8.7	7.5	.8	.01K	.11	.10K	.21C	.18
92/10/28	0825	WATER		3.7	171	8.8	7.3	.5	.02	.14	.10K	.24C	.10K
92/11/24	1055	WATER		.3	179	10.3	7.5	.6	.02	.16	.14	.30C	.22
92/12/16	1000	WATER		.0	172	10.5	7.3	1	.02	.24	.10K	.34C	.10K

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00605 ORG N N MG/L	00600 TOTAL N N MG/L	00612 UN-IONZD NH3-N MG/L	70300 RESIDUE DISS-180 C MG/L	00530 RESIDUE TOT NFLT MG/L	00915 CALCIUM CA,DISS MG/L	00925 MGNSIUM MG,DISS MG/L	00935 PTSSIUM K,DISS MG/L	00930 SODIUM NA,DISS MG/L	00900 TOT HARD CACO3 MG/L
92/02/26	1120	WATER		.00	.29	.002	126		38.0	5.0	1.0	3.0	115.0
92/03/25	1115	WATER		.00	.21	.001	124	4	30.0	5.0	1.0	3.0	96.0
92/04/29	1045	WATER		.40	.65	.000	78	202	15.0	3.0	1.0	3.0	60.0
92/05/27	1050	WATER		.21C	.37C	.002	100	9	18.0	3.0	1.0	2.0	57.0
92/06/30	1120	WATER		.10C	.35C	.001	90	5	22.0	3.0	1.0	2.0	67.0
92/07/29	1115	WATER		.00C	.18C	.002	94	3	29.0	4.0	1.0	3.0	89.0
92/08/28	1050	WATER		.00C	.20C	.002	102	3K	31.0	4.0	1.0	2.0	94.0
92/09/30	0925	WATER		.05C	.26C	.000	112	3	30.0	4.0	1.0	3.0	91.0
92/10/28	0825	WATER		.00C	.24C	.000	116	3K	32.0	5.0	2.0	4.0	100.0
92/11/24	1055	WATER		.08C	.38C	.000	134	3K	31.0	5.0	2.0	4.0	98.0
92/12/16	1000	WATER		.00C	.34C	.000	112	5	31.0	5.0	2.0	3.0	88.0

STORET RETRIEVAL DATE 93/04/23 PGM=RET PAGE:
URQ120.028069 URQ120028069 HRQ23.0
36 42 18.0 105 24 15.0 4
RED RIVER BELOW BITTER CREEK.
35055 NEW MEXICO TAOS
WESTERN GULF 120900
RIO GRANDE ABOVE PECOS RIVER /TYPA/AMBNT/STREAM/BIO
21NMEX 920608 13020101
0000 FEET DEPTH 2577 METERS ELEVATION
21N 8OUT

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00410 T ALK CACO3 MG/L	00440 HCO3 ION HCO3 MG/L	00946 SULFATE SO4-DISS MG/L	00940 CHLORIDE TOTAL MG/L	00680 T ORG C C MG/L	01105 ALUMINUM Al Total UG/L	01106 ALUMINUM AL,DISS UG/L	01005 BARIUM BA,DISS UG/L	01010 BERYLIUM BE,DISS UG/L	01020 BORON B,DISS UG/L
92/02/26	1120	WATER		85.6	99.3	15.2	8		200	100K	100K	100K	100K
92/03/25	1115	WATER		88.0	108.0	13.2	7	5.0K	100	100K	100K	100K	100K
92/04/29	1045	WATER		39.6	48.3	9.9	5	5.0	7000	600	100K	100K	100K
92/05/27	1050	WATER		50.4	61.5	9.7	5K	4.0					
92/06/30	1120	WATER		59.6	72.7	13.0	5K	2.0					
92/07/29	1115	WATER		72.8	88.8	12.4	5K	2.0					
92/08/26	1050	WATER		73.0	89.0	13.3	5K	1.0					
92/09/30	0925	WATER		84.2	102.0	15.8	5K	2.0					
92/10/28	0825	WATER		80.5	98.2	16.3	5	2.0					
92/11/24	1055	WATER		82.1	101.0	18.0	6	2.0					
92/12/16	1000	WATER		83.0	101.3	15.9	5K	1.0					

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01025 CADMIUM CD,DISS UG/L	01030 CHROMIUM CR,DISS UG/L	01035 COBALT CO,DISS UG/L	01040 COPPER CU,DISS UG/L	01046 IRON FE,DISS UG/L	01049 LEAD PB,DISS UG/L	01056 MANGNESE MN,DISS UG/L	01060 MOLY MO,DISS UG/L	01065 NICKEL NI,DISS UG/L	01140 SILICON SI,DISS UG/L
92/02/26	1120	WATER		1K	5K	50K	100K	100K	5K	50K	100K	100K	3700
92/03/25	1115	WATER		1K	5K	50K	100K	100K	5K	50K	100K	100K	4100
92/04/29	1045	WATER		1K	5K	50K	100K	300	5K	50K	100K	100K	5800

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01075 SILVER AG,DISS UG/L	01080 STRONTUM SR,DISS UG/L	01100 TIN SN,DISS UG/L	01085 VANADIUM V,DISS UG/L	01090 ZINC ZN,DISS UG/L	01000 ARSENIC AS,DISS UG/L	01145 SELENIUM SE,DISS UG/L	71900 MERCURY HG,TOTAL UG/L	31616 FEC COLI MFM FCBR /100ML
92/02/26	1120	WATER		100K	200	100K	100K	100K	5K	5K	.5K	
92/03/25	1115	WATER		100K	200	100K	100K	100K	5K	5K	.5K	
92/04/29	1045	WATER		100K	100	100K	100K	100K	5K	5K	.5K	

STORET RETRIEVAL DATE 93/04/23 PGM=RET PAGE:
HRG23.1 URG120028081
36 42 25.0 105 25 41.0 4
RED RIVER ABOVE RED RIVER LIFT STATION
35055 NEW MEXICO TAOS
WESTERN GULF 120900
RIO GRANDE /TYPA/AMBNT/STREAM/BIO
21NMEX 800607 13020101028 0010.780 ON
0003 FEET DEPTH

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00010 WATER TEMP CENT	00095 CNDUCTVY AT 25C MICROMHO	00300 DO MG/L	00400 PH SU	82079 TURBIDTY LAB NTU	00665 PHOS-TOT MG/L P	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3+NH4- N TOTAL MG/L	00640 T INORG. NITROGEN MG/L N	00625 TOT KJEL N MG/L
92/02/26	1145	WATER		3.3	185	10.5	7.9	2	.01K	.18	.10K	.28	.10K
92/03/25	1140	WATER		6.5	199	9.1	7.3	5	.04	.18	.16	.34	.18
92/04/29	1115	WATER		8.0	98	9.3	7.3	74	.17	.11	.12	.23	.52
92/05/27	1130	WATER		7.9	133	9.6	7.7	8	.04	.06	.10K	.16C	.39
92/06/30	1140	WATER		10.0	143	7.7	7.4	4	.03	.13	.10K	.23C	.10K
92/07/29	1130	WATER		8.2	200	7.2	7.8	3	.02	.10	.14	.24C	.15
92/08/26	1115	WATER		11.5	180	8.2	8.0	3	.01K	.09	.10K	.19C	.12
92/09/30	0940	WATER		5.2	211	9.4	7.6	.6	.01K	.11	.10K	.21C	.10K
92/10/28	0840	WATER		3.6	148	9.4	7.6	.6	.01	.11	.10K	.21C	.31
92/11/24	1115	WATER		.3	187	10.1	7.6	.9	.01	.15	.10	.25C	.10
92/12/16	1030	WATER		.0	204	10.6	7.4	.9	.03	.15	.10K	.25C	.10K

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00605 ORG N N MG/L	00600 TOTAL N N MG/L	00612 UN-IONZD NH3-N MG/L	70300 RESIDUE DISS-180 C MG/L	00530 RESIDUE TOT NFLT MG/L	00915 CALCIUM CA,DISS MG/L	00925 MGNSIUM MG,DISS MG/L	00935 PTSSIUM K,DISS MG/L	00930 SODIUM NA,DISS MG/L	00900 TOT HARD CACO3 MG/L
92/02/26	1145	WATER		.00	.28	.001	196	4	35.0	8.0	1.0	5.0	120.0
92/03/25	1140	WATER		.02	.36	.000	184	4	45.0	10.0	1.0	5.0	154.0
92/04/29	1115	WATER		.40	.63	.000	94	147	19.0	4.0	1.0	3.0	84.0
92/05/27	1130	WATER		.29C	.45C	.001	106	16	20.0	3.0	1.0	2.0	62.0
92/06/30	1140	WATER		.00C	.23C	.000	112	8	24.0	4.0	1.0	3.0	76.0
92/07/29	1130	WATER		.01C	.25C	.001	132	3	34.0	5.0	1.0	3.0	105.0
92/08/26	1115	WATER		.03C	.22C	.002	126	3	33.0	5.0	2.0	3.0	103.0
92/09/30	0940	WATER		.00C	.21C	.001	148	3K	46.0	7.0	1.0	4.0	144.0
92/10/28	0840	WATER		.21C	.42C	.000	160	3K	36.0	8.0	1.0	4.0	123.0
92/11/24	1115	WATER		.00C	.25C	.000	194	3K	36.0	9.0	2.0	5.0	127.0
92/12/16	1030	WATER		.00C	.25C	.000	150	10	35.0	8.0	2.0	5.0	120.0

STORET RETRIEVAL DATE 93/04/23 PGM=RET PAGE: HRG23.1
URG120028061/HRG23.1
36 42 25.0 105 25 41.0 4
RED RIVER ABOVE RED RIVER LIFT STATION
35055 NEW MEXICO TAOS
WESTERN GULF 120900
RIO GRANDE /TYPA/AMBNT/STREAM/BIO
21NMEX 800607 13020101028 0010.780 ON
0003 FEET DEPTH

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00410 T ALK CACO3 MG/L	00440 HCO3 ION HCO3 MG/L	00946 SULFATE SO4-DISS MG/L	00940 CHLORIDE TOTAL MG/L	00680 T ORG C C MG/L	01105 ALUMINUM Al Total UG/L	01106 ALUMINUM AL,DISS UG/L	01005 BARIUM BA,DISS UG/L	01010 BERYLIUM BE,DISS UG/L	01020 BORON B,DISS UG/L
92/02/26	1145	WATER		62.6	76.4	69.8	7		500	100K	100K	100K	100K
92/03/25	1140	WATER		69.2	84.4	55.2	7	5.0K					
92/04/29	1115	WATER		43.1	52.6	20.6	5K	4.0	900	100K	100K	100K	100K
92/05/27	1130	WATER		51.4	62.7	18.1	5K	5.0K					
92/06/30	1140	WATER		57.4	70.0	35.4	5K	1.0					
92/07/29	1130	WATER		65.2	79.5	34.8	5K	2.0					
92/08/26	1115	WATER		65.2	79.8	33.4	5K	1.0					
92/09/30	0940	WATER		70.6	85.0	55.1	9	2.0K					
92/10/28	0840	WATER		67.4	82.2	55.0	5K	2.0					
92/11/24	1115	WATER		61.0	74.5	71.3	5K	2.0					
92/12/16	1030	WATER		68.7	84.1	57.3	5K	1.0K					

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01025 CADMIUM CD,DISS UG/L	01030 CHROMIUM CR,DISS UG/L	01035 COBALT CO,DISS UG/L	01040 COPPER CU,DISS UG/L	01046 IRON FE,DISS UG/L	01049 LEAD PB,DISS UG/L	01056 MANGNESE MN,DISS UG/L	01060 MOLY MO,DISS UG/L	01065 NICKEL NI,DISS UG/L	01140 SILICON SI,DISS UG/L
92/02/26	1145	WATER		1K	5K	50K	100K	100K	5K	180	100K	100K	6000
92/03/25	1130	WATER		1K	5K	50K	100K	100	5K	190	100K	100K	6200
92/04/29	1115	WATER		1K	5K	50K	100K	100K	5K	50K	100K	100K	8700

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01075 SILVER AG,DISS UG/L	01080 STRONTUM SR,DISS UG/L	01100 TIN SN,DISS UG/L	01085 VANADIUM V,DISS UG/L	01090 ZINC ZN,DISS UG/L	01000 ARSENIC AS,DISS UG/L	01145 SELENIUM SE,DISS UG/L	71900 MERCURY HG,TOTAL UG/L	31616 FEC COLI MFM-FCBR /100ML
92/02/26	1145	WATER		100K	200	100K	100K	100K	5K	5K	.5K	
92/03/25	1130	WATER		100K	200	100K	100K	100K	5K	5K	.5K	
92/04/29	1115	WATER		100K	300	100K	100K	100K	5K	5K	.5K	
93/01/27	0915	WATER										1K

HRQ23.3 URQ120028055
36 42 28.0 105 26 14.0 4
RED RIVER 100M BLW RED RIVER STP OUTFALL
35055 NEW MEXICO TAOS
WESTERN GULF 120900
RIO GRANDE /TYPA/AMBNT/STREAM/BIO
21NMEX 800607 13020101028 0010.120 ON
0003 FEET DEPTH

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00010 WATER TEMP CENT	00095 CNDUCTVY AT 25C MICROMHO	00300 DO MG/L	00400 PH SU	82079 TURBIDTY LAB NTU	00665 PHOS-TOT MG/L P	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3+NH4- N TOTAL MG/L	00640 T INORG. NITROGEN MG/L N	00625 TOT KJEL N MG/L
92/02/26	1210	WATER		1.0	178	10.5	8.1	4	.01	.32	.10K	.42	.12
92/03/25	1150	WATER		5.5	209	9.6	7.7	6	.03	.40	.10K	.50	.10K
92/04/29	1130	WATER		7.8	120	9.3	7.7	82	.23	.14	.10K	.24K	.61
92/05/27	1150	WATER		8.0	134	9.4	7.8	10	.07	.11	.13	.24C	.34
92/06/30	1150	WATER		10.5	150	8.4	7.9	4	.03	.24	.11	.35C	.13
92/07/29	1145	WATER		8.2	212	8.4	8.2	2	.02	.23	.12	.35C	.12
92/08/26	1130	WATER		11.5	187	7.8	8.3	3	.02	.21	.22	.43C	.28
92/09/30	1000	WATER		5.0	227	9.7	7.8	3	.01	.29	.12	.41C	.12
92/10/28	0850	WATER		3.8	225	9.6	7.7	.5	.01	.26	.10K	.36C	.28
92/11/24	1130	WATER		.3	218	10.4	7.7	.9	.02	.31	.14	.45C	.15
92/12/16	1100	WATER		.0	200	10.5	7.5	1	.02	.80	.10	.90C	.10

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00605 ORG N N MG/L	00600 TOTAL N N MG/L	00612 UN-IONZD NH3-N MG/L	70300 RESIDUE DISS-180 C MG/L	00530 RESIDUE TOT NFLT MG/L	00915 CALCIUM CA,DISS MG/L	00925 MGNSIUM MG,DISS MG/L	00935 PTSSIUM K,DISS MG/L	00930 SODIUM NA,DISS MG/L	00900 TOT HARD CACO3 MG/L
92/02/26	1210	WATER		.02	.44	.001	193	6	35.0	8.0	2.0	5.0	120.0
92/03/25	1150	WATER		.00	.50	.001	198	7	35.0	88.0	2.0	6.0	120.0
92/04/29	1130	WATER		.50	.74	.001	106	128	19.0	4.0	1.0	3.0	64.0
92/05/27	1150	WATER		.21C	.45C	.001	106	9	19.0	4.0	3.0	2.0	64.0
92/06/30	1150	WATER		.02C	.37	.002	94	10	24.0	4.0	1.0	3.0	76.0
92/07/29	1145	WATER		.00	.35C	.003	126	3	33.0	6.0	1.0	4.0	107.0
92/08/26	1130	WATER		.08C	.49C	.011	130	3	33.0	6.0	1.0	4.0	107.0
92/09/30	1000	WATER		.00C	.41C	.001	166	4	35.0	7.0	2.0	5.0	116.0
92/10/28	0850	WATER		.18C	.54C	.001	170	3K	37.0	8.0	1.0	5.0	125.0
92/11/24	1130	WATER		.01C	.46C	.001	203	3	37.0	9.0	2.0	6.0	129.0
92/12/16	1100	WATER		.00C	.90C	.000	176	3	36.0	8.0	2.0	6.0	123.0

STORET RETRIEVAL DATE 93/04/23 PGM=RET PAGE:
HRG23.3 URG120028055
36 42 28.0 105 26 14.0 4
RED RIVER 100M BLW RED RIVER STP OUTFALL
35055 NEW MEXICO TAOS
WESTERN GULF 120900
RIO GRANDE /TYPA/AMBNT/STREAM/BIO
21NMEX 800807 13020101028 0010.120 ON
0003 FEET DEPTH

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00410 T ALK CACO3 MG/L	00440 HCO3 ION HCO3 MG/L	00946 SULFATE SO4-DISS MG/L	00940 CHLORIDE TOTAL MG/L	00680 T ORG C C MG/L	01105 ALUMINUM Al Total UG/L	01106 ALUMINUM AL,DISS UG/L	01005 BARIUM BA,DISS UG/L	01010 BERYLIUM BE,DISS UG/L	01020 BORON B,DISS UG/L
92/02/26	1210	WATER		59.6	72.7	75.2	7		700	100K	100K	100K	100K
92/03/25	1150	WATER		66.0	80.5	61.4	9	5.0K	800	100K	100K	100K	100K
92/04/29	1130	WATER		42.2	51.5	20.1	5K	5.0	5800	600	100K	100K	100K
92/05/27	1150	WATER		50.2	61.2	19.3	5K	3.0					
92/06/30	1150	WATER		56.2	68.6	29.4	5K	2.0					
92/07/29	1145	WATER		64.4	78.6	36.0	5K	2.0					
92/08/26	1130	WATER		64.1	78.2	38.1	5K	2.0					
92/09/30	1000	WATER		68.0	81.6	53.3	5K	2.0K					
92/10/28	0850	WATER		64.8	79.1	60.4	5K	1.0					
92/11/24	1130	WATER		62.4	76.2	74.9	5	1.0					
92/12/16	1100	WATER		64.5	78.6	66.3	5K	1.0					

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01025 CADMIUM CD,DISS UG/L	01030 CHROMIUM CR,DISS UG/L	01035 COBALT CO,DISS UG/L	01040 COPPER CU,DISS UG/L	01046 IRON FE,DISS UG/L	01049 LEAD PB,DISS UG/L	01056 MANGNESE MN,DISS UG/L	01060 MOLY MO,DISS UG/L	01065 NICKEL NI,DISS UG/L	01140 SILICON SI,DISS UG/L
92/02/26	1210	WATER		1K	5K	50K	100K	100K	5K	180	100K	100K	6400
92/03/25	1150	WATER		1K	5K	50K	100K	500	5K	200	100K	100K	6500
92/04/29	1130	WATER		1K	5K	50K	100K	300	5K	50K	100K	100K	6500

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01075 SILVER AG,DISS UG/L	01080 STRONTUM SR,DISS UG/L	01100 TIN SN,DISS UG/L	01085 VANADIUM V,DISS UG/L	01090 ZINC ZN,DISS UG/L	01000 ARSENIC AS,DISS UG/L	01145 SELENIUM SE,DISS UG/L	71900 MERCURY HG,TOTAL UG/L	31616 FEC COLI MFM-FCBR /100ML
92/02/26	1210	WATER		100K	200	100K	100K	100K	5K	5K	.5K	
92/03/25	1150	WATER		100K	200	100K	100K	100K	5K	5K	.5K	
92/04/29	1130	WATER		100K	100	100K	100K	100K	5K	5K	.5K	
93/01/27	0920	WATER										1J

URG120.028045 URG120028045
36 41 55.0 105 28 48.0 5
RED RIVER ABOVE MOLYCORPS BOUNDARY
35055 NEW MEXICO TAOS
WESTERN GULF 120900
UPPER RIO GRANDE ABOVE THE PECOS RIVER /TYPA/AMBNT/STREAM/BIO
21NMEX 881217 13020101
0000 FEET DEPTH 2490 TERS ELEVATION
21M SOUT

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00010 WATER TEMP CENT	00095 CNDUCTVY AT 25C MICROMHO	00300 DO MG/L	00400 PH SU	82079 TURBIDTY LAB NTU	00665 PHOS-TOT MG/L P	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3+NH4- N TOTAL MG/L	00640 T INORG. NITROGEN MG/L N	00625 TOT KJEL N MG/L
92/02/26	1230	WATER		2.1	217	10.1	8.0	4	.03	.29	.21	.50	.44
92/03/25	1205	WATER		5.0	242	9.8	7.7	14	.06	.38	.10K	.48	.10K
92/04/29	1145	WATER		7.2	133	8.9	7.5	87	.41	.12	.10K	.22	.50
92/05/27	1215	WATER		8.5	146	9.8	7.7	13	.01	.10	.10K	.20C	.39
92/06/30	1205	WATER		11.0	164	8.4	7.7	4	.02	.23	.10K	.33C	.10K
92/07/29	1200	WATER		12.0	227	8.5	8.1	4	.02	.04K	.15	.19C	.41
92/08/26	1145	WATER		12.0	204	8.0	8.1	6	.01	.19	.27	.46C	.46
92/09/30	1015	WATER		5.3	266	9.8	7.6	4	.01	.25	.10K	.35C	.10K
92/10/28	0905	WATER		3.9	255	9.7	7.3	1	.01	.23	.10K	.33C	.10K
92/11/24	1155	WATER		.1	255	10.5	7.5	6	.02	.36	.13	.49C	.15
92/12/16	1125	WATER		.2	228	10.6	7.5	5	.02	.41	.10K	.51C	.10K

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00605 ORG N N MG/L	00600 TOTAL N N MG/L	00612 UN-IONZD NH3-N MG/L	70300 RESIDUE DISS-180 C MG/L	00530 RESIDUE TOT NFLT MG/L	00915 CALCIUM CA,DISS MG/L	00925 MGNSIUM MG,DISS MG/L	00935 PTSSIUM K,DISS MG/L	00930 SODIUM NA,DISS MG/L	00900 TOT HARD CACO3 MG/L
92/02/26	1230	WATER		.23	.73	.002	232	6	50.0	10.0	2.0	6.0	166.0
92/03/25	1205	WATER		.00	.46	.001	230	20	41.0	10.0	2.0	6.0	144.0
92/04/29	1145	WATER		.40	.62	.000	108	206	21.0	4.0	1.0	3.0	69.0
92/05/27	1215	WATER		.29C	.49C	.001	118	16	20.0	4.0	1.0	2.0	66.0
92/06/30	1205	WATER		.00C	.33C	.001	118	7	26.0	5.0	1.0	3.0	86.0
92/07/29	1200	WATER		.26C	.45C	.004	146	6	34.0	7.0	1.0	4.0	114.0
92/08/26	1145	WATER		.21C	.67C	.007	145	9	37.0	7.0	2.0	4.0	121.0
92/09/30	1015	WATER		.00C	.35C	.001	190	8	41.0	8.0	2.0	5.0	135.0
92/10/28	0905	WATER		.00C	.33C	.000	196	8	39.0	9.0	2.0	5.0	134.0
92/11/24	1155	WATER		.02C	.51C	.000	246	6	42.0	10.0	2.0	7.0	146.0
92/12/16	1125	WATER		.00C	.51C	.000	204	8	40.0	10.0	2.0	6.0	141.0

STORET RETRIEVAL DATE 93/04/23 PGM=RET PAGE:
URG120.028045 URG120028045
36 41 55.0 105 28 40.0 5
RED RIVER ABOVE HOLYCORPS BOUNDARY
35055 NEW MEXICO TAOS
WESTERN GULF 120900
UPPER RIO GRANDE ABOVE THE PECOS RIVER /TYPA/AMBNT/STREAM/BIO
21NMEX 881217 13020101
0000 FEET DEPTH 2490 METERS ELEVATION
21M SOUT

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00410 T ALK CACO3 MG/L	00440 HCO3 ION HCO3 MG/L	00946 SULFATE SO4-DISS MG/L	00940 CHLORIDE TOTAL MG/L	00680 T ORG C C MG/L	01105 Aluminum Al Total UG/L	01106 ALUMINUM AL,DISS UG/L	01005 BARIUM BA,DISS UG/L	01010 BERYLIUM BE,DISS UG/L	01020 BORON B,DISS UG/L
92/02/26	1230	WATER		51.6	63.0	104.0	8		1300	100K	100K	100K	100K
92/03/25	1205	WATER		54.0	67.0	92.0	7	5.0K	1700	100K	100K	100K	100K
92/04/29	1145	WATER		41.5	50.6	27.2	5K	5.0	6800	100	100K	100K	100K
92/05/27	1215	WATER		51.6	63.2	25.9	5K	5.0K					
92/06/30	1205	WATER		44.6	54.7	34.2	5K	1.0					
92/07/29	1200	WATER		53.6	65.4	53.4	5K	1.0					
92/08/26	1145	WATER		59.1	72.1	51.8	5K	1.0					
92/09/30	1015	WATER		58.6	70.3	61.6	5K	1.0					
92/10/28	0905	WATER		55.0	67.1	90.9	5K	1.0					
92/11/24	1155	WATER		50.8	62.0	109.0	5	1.0					
92/12/16	1125	WATER		51.8	63.2	102.0	5K	1.0K					

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01025 CADMIUM CD,DISS UG/L	01030 CHROMIUM CR,DISS UG/L	01035 COBALT CO,DISS UG/L	01040 COPPER CU,DISS UG/L	01046 IRON FE,DISS UG/L	01049 LEAD PB,DISS UG/L	01056 MANGNESE MN,DISS UG/L	01060 MOLY MO,DISS UG/L	01065 NICKEL NI,DISS UG/L	01140 SILICON SI,DISS UG/L
92/02/26	1230	WATER		1K	5K	50K	100K	100K	5K	240	100K	100K	6400
92/03/25	1205	WATER		1K	5K	50K	100K	400	5K	300	100K	100K	6500
92/04/29	1145	WATER		1K	5K	50K	100K	100K	5K	50K	100K	100K	5800

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01075 SILVER AG,DISS UG/L	01080 STRONTUM SR,DISS UG/L	01100 TIN SN,DISS UG/L	01085 VANADIUM V,DISS UG/L	01090 ZINC ZN,DISS UG/L	01000 ARSENIC AS,DISS UG/L	01145 SELENIUM SE,DISS UG/L	71900 MERCURY HG,TOTAL UG/L	31616 FEC COLI MFM-FCBR /100ML
92/02/26	1230	WATER		100K	300	100K	100K	100K	5K	5K	.5K	
92/03/25	1205	WATER		100K	300	100K	100K	100K	5K	5K	.5K	
92/04/29	1145	WATER		100K	100	100K	100K	100K	5K	5K	.5K	

STORET RETRIEVAL DATE 93/04/23 PGM=RET PAGE:
HRG24 URG120028025 08265000
36 42 12.0 105 34 04.0 4
LOWER RED RIVER AT USGS GAGE
35055 NEW MEXICO TAOS
120891
/TYPA/AMBNT/STREAM/BIO
21NMEX 13020101028 0001.250 ON
0003 FEET DEPTH

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00010 WATER TEMP CENT	00095 CNDUCTVY AT 25C MICROMHO	00300 DO MG/L	00400 PH SU	82079 TURBIDTY LAB NTU	00665 PHOS-TOT MG/L P	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3+NH4- N TOTAL MG/L	00640 T INORG. NITROGEN MG/L N	00625 TOT KJEL N MG/L
92/02/26	1300	WATER		3.1	272	10.2	7.4	12	.04	.41	.15	.56	.15
92/03/25	1220	WATER		7.6	322	8.1	6.5	22	.10	.42	.10K	.52	.10K
92/04/29	1200	WATER		9.0	176	9.4	7.1	78	.24	.14	.10K	.24	.45
92/05/27	1235	WATER		6.5	186	9.6	7.4	19	.19	.17	.10K	.27C	.31
92/06/30	1225	WATER		11.9	218	8.3	6.6	6	.02	.30	.11	.41C	.20
92/07/29	1230	WATER		12.5	298	7.9	7.7	5	.01	.35	.17	.52C	.18
92/08/26	1205	WATER		13.5	266	7.7	7.8	11	.04	.25	.10K	.35C	.10
92/09/30	1040	WATER		7.2	371	9.1	7.1	7	.01	.48	.11	.59C	.17
92/10/28	0920	WATER		5.3	355	9.2	7.1	6	.01	.40	.10K	.50C	.10K
92/11/24	1215	WATER		.5	340	10.1	6.6	13	.02	.55	.10K	.65C	.10K
92/12/16	1155	WATER		.3	358	10.4	7.0	11	.16	.66	.10K	.76C	.10K

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00605 ORG N N MG/L	00600 TOTAL N N MG/L	00612 UN-IONZD NH3-N MG/L	70300 RESIDUE DISS-180 C MG/L	00530 RESIDUE TOT NFLT MG/L	00915 CALCIUM CA,DISS MG/L	00925 MGNSIUM MG,DISS MG/L	00935 PTSSIUM K,DISS MG/L	00930 SODIUM NA,DISS MG/L	00900 TOT HARD CACO3 MG/L
92/02/26	1300	WATER		.00	.56	.000	283	25	49.0	12.0	2.0	6.0	295.0
92/03/25	1220	WATER		.00	.52	.000	322	49	57.0	16.0	1.0	6.0	208.0
92/04/29	1200	WATER		.35	.59	.000	142	156	34.0	6.0	1.0	3.0	110.0
92/05/27	1235	WATER		.21C	.46C	.000	148	20	37.0	5.0	1.0	5.0	113.0
92/06/30	1225	WATER		.09C	.50C	.000	160	12	33.0	7.0	1.0	4.0	111.0
92/07/29	1230	WATER		.01C	.53C	.002	196	4	49.0	9.0	1.0	5.0	159.0
92/08/26	1205	WATER		.00C	.35C	.002	186	3K	46.0	9.0	1.0	4.0	152.0
92/09/30	1040	WATER		.06C	.65C	.000	256	13	49.0	11.0	2.0	6.0	166.0
92/10/28	0920	WATER		.00C	.50C	.000	280	16	56.0	13.0	2.0	6.0	193.0
92/11/24	1215	WATER		.00C	.65C	.000	333	33	61.0	15.0	2.0	7.0	214.0
92/12/16	1155	WATER		.00C	.76C	.000	340	24	61.0	14.0	2.0	7.0	210.0

STORET RETRIEVAL DATE 93/04/23 PGM=RET PAGE:
HRG24 URG120028025 08265000
36 42 12.0 105 34 04.0 4
LOWER RED RIVER AT USGS GAGE
35055 NEW MEXICO TAOS
120991
/TYPA/AMBNT/STREAM/BIO
21NMEX 13020101028 0001.250 ON
0003 FEET DEPTH

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00410 T ALK CACO3 MG/L	00440 HCO3 ION HCO3 MG/L	00946 SULFATE SO4-DISS MG/L	00940 CHLORIDE TOTAL MG/L	00680 T ORG C C MG/L	01105 ALUMINUM Al Total UG/L	01106 ALUMINUM AL,DISS UG/L	01005 BARIUM BA,DISS UG/L	01010 BERYLIUM BE,DISS UG/L	01020 BORON B,DISS UG/L
92/02/26	1300	WATER		30.6	37.3	166.0	9		5200	100K	100K	100K	100K
92/03/25	1220	WATER		18.4	22.4	175.0	7	5.0K	9000	100K	100K	100K	100K
92/04/29	1200	WATER		29.6	36.1	58.2	5K	4.0		100K	100K	100K	100K
92/05/27	1235	WATER		43.4	52.9	49.2	5K	5.0K					
92/06/30	1225	WATER		45.4	55.4	67.7	5K	1.0					
92/07/29	1230	WATER		48.6	59.3	98.8	5K	2.0					
92/08/26	1205	WATER		49.8	60.7	94.5	5K	2.0					
92/09/30	1040	WATER		42.5	51.3	142.0	5K	2.0K					
92/10/28	0920	WATER		34.9	43.0	162.0	6	1.0					
92/11/24	1215	WATER		21.5	26.6	205.0	7	1.0K					
92/12/16	1155	WATER		24.0	29.6	206.0	5	1.0					

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01025 CADMIUM CD,DISS UG/L	01030 CHROMIUM CR,DISS UG/L	01035 COBALT CO,DISS UG/L	01040 COPPER CU,DISS UG/L	01046 IRON FE,DISS UG/L	01049 LEAD PB,DISS UG/L	01056 MANGNESE MN,DISS UG/L	01060 MOLY MO,DISS UG/L	01065 NICKEL NI,DISS UG/L	01140 SILICON SI,DISS UG/L
92/02/26	1300	WATER		1	5K	50K	100K	100K	5K	1600	100K	100K	5400
92/03/25	1220	WATER		3 *	5K	50K	100K	200	5K	3000	100K	100K	8800
92/04/29	1200	WATER		1K	5K	50K	100K	100K	5K	760	100K	100K	5300

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01075 SILVER AG,DISS UG/L	01080 STRONTUM SR,DISS UG/L	01100 TIN SN,DISS UG/L	01085 VANADIUM V,DISS UG/L	01090 ZINC ZN,DISS UG/L	01000 ARSENIC AS,DISS UG/L	01145 SELENIUM SE,DISS UG/L	71900 MERCURY HG,TOTAL UG/L	31616 FEC COLI MFM-FCBR /100ML
92/02/26	1300	WATER		100K	300	100	100K	300 * *	5K	5K	.5K	
92/03/25	1220	WATER		100K	300	100K	100K	600 * *	5K	5K	.5K	
92/04/29	1200	WATER		100K	200	100K	100K	100K	5K	5K	.5K	
93/01/27	0935	WATER										1K

STORET RETRIEVAL DATE 93/04/23 PGM=RET PAGE:
HRG25 URG120028015 08266500
36 41 33.0 105 36 42.0 4
RED RIVER AT HWY 3 BRIDGE
35055 NEW MEXICO TAOS
NEW MEXICO 120900
WESTERN GULF RIO GRANDE /TYPA/AMBNT/STREAM/BIO
21NWEX 800807 13020101027 0006.160 ON
0003 FEET DEPTH

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00010 WATER TEMP CENT	00095 CNDUCTVY AT 25C MICROMHO	00300 DO MG/L	00400 PH SU	82079 TURBIDTY LAB NTU	00665 PHOS-TOT MG/L P	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3+NH4- N TOTAL MG/L	00640 T INORG. NITROGEN MG/L N	00625 TOT KJEL N MG/L
92/02/26	1325	WATER		3.5	257	10.2	7.5	11	.02	.34	.19	.53	.19
92/03/25	1240	WATER		7.8	269	9.2	7.1	25	.05	.32	.10K	.42	.10K
92/04/29	1215	WATER		8.6	179	8.9	7.3	60	.37	.16	.10K	.26	.46
92/05/27	1250	WATER		9.0	197	9.6	7.6	18	.04	.18	.10K	.28C	.35
92/06/30	1240	WATER		12.6	235	7.7	6.7	5	.02	.29	.10K	.39C	.15
92/07/29	1240	WATER		13.5	320	7.1	7.6	4	.01K	.31	.10K	.41C	.10K
92/08/26	1225	WATER		14.5	284	7.8	7.7	11	.02	.21	.10K	.31C	.10K
92/09/30	1100	WATER		6.3	356	6.6	7.3	6	.01K	.32	.12	.44C	.14
92/10/28	0935	WATER		6.5	364	8.9	7.3	6	.01	.34	.10K	.44C	.10K
92/11/24	1245	WATER		2.3	337	10.0	7.0	8	.02	.35	.10K	.45C	.10K
92/12/16	1215	WATER		.3	352	10.2	7.2	7	.01	.43	.10K	.53C	.10K

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00605 ORG N N MG/L	00600 TOTAL N N MG/L	00612 UN-IONZD NH3-N MG/L	70300 RESIDUE DISS-180 C MG/L	00530 RESIDUE TOT NFLT MG/L	00915 CALCIUM CA,DISS MG/L	00925 MGNSIUM MG,DISS MG/L	00935 PTSSIUM K,DISS MG/L	00930 SODIUM NA,DISS MG/L	00900 TOT HARD CACO3 MG/L
92/02/26	1325	WATER		.00	.53	.001	164	22	54.0	11.0	1.0	6.0	180.0
92/03/25	1240	WATER		.00	.42	.000	270	41	47.0	12.0	2.0	6.0	167.0
92/04/29	1215	WATER		.36	.62	.000	129	155	84.0	6.0	1.0	4.0	234.0
92/05/27	1250	WATER		.25C	.53C	.000	149	48	27.0	5.0	1.0	3.0	86.0
92/06/30	1240	WATER		.05C	.44C	.000	180	10	35.0	7.0	1.0	4.0	116.0
92/07/29	1240	WATER		.00C	.41C	.001	217	10	47.0	9.0	1.0	5.0	154.0
92/08/26	1225	WATER		.00C	.31C	.001	207	16	48.0	9.0	1.0	5.0	157.0
92/09/30	1100	WATER		.02C	.46C	.000	260	17	48.0	12.0	2.0	6.0	
92/10/28	0935	WATER		.00C	.44C	.000	280	12	55.0	12.0	2.0	6.0	187.0
92/11/24	1245	WATER		.00C	.45C	.000	288	16	45.0	10.0	2.0	6.0	154.0
92/12/16	1215	WATER		.00C	.53C	.000	296	15	55.0	12.0	2.0	6.0	187.0

STORET RETRIEVAL DATE 93/04/23 PGM=RET PAGE:
HRQ25 URQ120028015 08266500
36 41 33.0 105 36 42.0 4
RED RIVER AT HWY 3 BRIDGE
35055 NEW MEXICO TAOS
NEW MEXICO 120900
WESTERN GULF RIO GRANDE /TYPA/AMBNT/STREAM/BIO
21NMEX 800807 13020101027 0006.160 ON
0003 FEET DEPTH

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00410 T ALK CACO3 MG/L	00440 HCO3 ION HCO3 MG/L	00946 SULFATE SO4-DISS MG/L	00940 CHLORIDE TOTAL MG/L	00680 T ORG C C MG/L	01105 ALUMINUM Al Total UG/L	01106 ALUMINUM AL,DISS UG/L	01005 BARIUM BA,DISS UG/L	01010 BERYLIUM BE,DISS UG/L	01020 BORON B,DISS UG/L
92/02/26	1325	WATER		28.8	35.1	149.0	8		4600	100K	100K	100K	100K
92/03/25	1240	WATER		24.2	29.5	146.0	7	5.0K	7300	100K	100K	100K	100K
92/04/29	1215	WATER		31.2	38.1	55.6	5K	4.0	7700	100K	100K	100K	100K
92/05/27	1250	WATER		45.2	55.1	51.2	5	5.0K					
92/06/30	1240	WATER		48.4	59.0	71.5	5K	1.0					
92/07/29	1240	WATER		55.4	67.6	89.7	5K	1.0K					
92/08/26	1225	WATER		49.8	60.7	98.9	5K	1.0					
92/09/30	1100	WATER		41.4	49.6	145.0	5K	2.0K					
92/10/28	0935	WATER		40.1	48.9	158.0	5K	1.0K					
92/11/24	1245	WATER		33.6	41.5	157.0	6	1.0					
92/12/16	1215	WATER		28.4	34.7	172.0	5K	1.0					

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01025 CADMIUM CD,DISS UG/L	01030 CHROMIUM CR,DISS UG/L	01035 COBALT CO,DISS UG/L	01040 COPPER CU,DISS UG/L	01046 IRON FE,DISS UG/L	01049 LEAD PB,DISS UG/L	01056 MANGNESE MN,DISS UG/L	01060 MOLY MO,DISS UG/L	01065 NICKEL NI,DISS UG/L	01140 SILICON SI,DISS UG/L
92/02/26	1325	WATER		1	5K	50K	100K	100K	5K	1300	100K	100K	5300
92/03/25	1240	WATER		2 *	5K	50K	100K	100K	5K	2100	100K	100K	5600
92/04/29	1215	WATER		1K	5K	50K	100K	100K	5K	590	100K	100K	5200

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01075 SILVER AG,DISS UG/L	01080 STRONTUM SR,DISS UG/L	01100 TIN SN,DISS UG/L	01085 VANADIUM V,DISS UG/L	01090 ZINC ZN,DISS UG/L	01000 ARSENIC AS,DISS UG/L	01145 SELENIUM SE,DISS UG/L	71900 MERCURY HG,TOTAL UG/L	31616 FEC COLI MFM-FCBR /100ML
92/02/26	1325	WATER		100K	300	100K	100K	300 **	5K	5K	.5K	
92/03/25	1240	WATER		100K	300	100K	100K	400 **	5K	5K	.5K	
92/04/29	1215	WATER		100K	200	100K	100K	100K	5K	5K	.5K	
93/01/27	0945	WATER										9J

STORET RETRIEVAL DATE 93/04/23 PGM=RET PAGE:
HRG27 URG119027510 08266820
36 40 49.0 105 39 20.0 4
RED RIVER BELOW FISH HATCHERY
35055 NEW MEXICO TAOS
WESTERN GULF 120900
UPPER RIO GRANDE ABOVE PECOS RIVER /TYPA/AMBNT/STREAM/BIO
21NMEX 850427 13020101027 0003.340 ON
0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00010 WATER TEMP CENT	00095 CNDUCTVY AT 25C MICROMHO	00300 DO MG/L	00400 PH SU	82079 TURBIDTY LAB NTU	00665 PHOS-TOT MG/L P	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3+NH4- N TOTAL MG/L	00640 T INORG. NITROGEN MG/L N	00625 TOT KJEL N MG/L
92/02/26	1400	WATER		6.9	287	9.3	7.6	8	.04	.32	.21	.53	.21
92/02/26	1400	QC Replicate							.09	.32	.10K	.42	.10K
92/03/25	1300	WATER		10.0	255	8.8	7.3	14	.07	.35	.10K	.45	.10K
92/03/25	1300	QC replicate							.08	.36	.21	.57	.26
92/04/29	1235	WATER		10.3	193	9.0	7.5	73	.12	.16	.10	.26	.76
92/04/29	1235	QC Replicate							.17	.14	.10K	.24	.48
92/05/27	1300	WATER		10.0	215	8.8	7.5	20	.01	.18	.10K	.28C	.26
92/05/27	1300	QC Replicate							.09	.18	.10	.28	.40
92/06/30	1300	WATER		14.1	256	8.1	7.7	5	.02	.29	.11	.40C	.69
92/07/29	1300	WATER		14.0	320	7.2	7.9	4	.02	.35	.15	.50C	.22
92/07/29	1300	QC Replicate							.01	.33	.17	.50	.27
92/08/26	1245	WATER		15.0	324	7.9	8.0	11	.02	.21	.13	.34C	.20
92/08/26	1245	QC Replicate							.02	.22	.13	.35	.20
92/09/30	1130	WATER		10.9	397	8.6	7.6	4	.01	.31	.21	.52C	.25
92/10/28	1000	WATER		8.3	390	8.7	7.7	4	.01	.30	.10K	.40C	.26
92/10/28	1000	QC Replicate							.02	.30	.10	.40	.11
92/11/24	1310	WATER		6.5	312	9.8	7.3	4	.01	.31	.10K	.41C	.10K
92/11/24	1310	QC Replicate							.02	.31	.18	.49	.23
92/12/16	1230	WATER		4.7	394	10.1	7.4	5	.02	.44	.10K	.54C	.10K
92/12/16	1230	QC replicate							.01	.39	.10K	.54C	.10K

PAGE:

HRQ27 URQ119027510 08266820
36 40 49.0 105 39 20.0 4
RED RIVER BELOW FISH HATCHERY
35055 NEW MEXICO TAOS
WESTERN GULF 120900
UPPER RIO GRANDE ABOVE PECOS RIVER /TYPA/AMBNT/STREAM/BIO
21NMEX 850427 13020101027 0003.340 ON

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00605 ORG N N MG/L	00600 TOTAL N N MG/L	00612 UN-IONZD NH3-N MG/L	70300 RESIDUE DISS-180 C MG/L	00530 RESIDUE TOT NFLT MG/L	00915 CALCIUM CA,DISS MG/L	00925 MGNSIUM MG,DISS MG/L	00935 PTSSIUM K,DISS MG/L	00930 SODIUM NA,DISS MG/L	00900 TOT HARD CACO3 MG/L
92/02/26	1400	WATER		.00	.53	.000	290	14	45.0	10.0	2.0	14.0	154.0
92/02/26	1400	QC Replicate		.00	.42	.001	290	15	62.0	11.0	2.0	14.0	200.0
92/03/25	1300	WATER		.00	.45	.000	284	26	48.0	12.0	2.0	14.0	169.0
92/03/25	1300	QC Replicate		.06	.63	.001	276	27	47.0	12.0	2.0	13.0	167.0
92/04/29	1235	WATER		.66	.92	.001	150	132	28.0	6.0	1.0	5.0	96.0
92/04/29	1235	QC Replicate		.38	.62	.001	152	135	28.0	6.0	1.0	5.0	95.0
92/05/27	1300	WATER		.16C	.44C	.001	140	31	27.0	6.0	1.0	5.0	92.0
92/05/27	1300	QC Replicate		.30	.63	.001	159	29	28.0	6.0	4.0	5.0	95.0
92/06/30	1300	WATER		.58C	.98C	.001	202	9	39.0	8.0	6.0	7.0	130.0
92/07/29	1300	WATER		.07C	.57C	.004	234	7	53.0	10.0	2.0	11.0	174.0
92/07/29	1300	QC Replicate		.20	.70	.004	232	6	50.0	10.0	2.0	11.0	166.0
92/07/29	1300												
92/08/26	1245	WATER		.07C	.41C	.004	228	13	52.0	10.0	2.0	10.0	171.0
92/08/26	1245	QC Replicate		.07	.42	.004	230	13	52.0	10.0	2.0	10.0	171.0
92/09/30	1130	WATER		.04C	.56C	.002	274	9	49.0	11.0	2.0	14.0	168.0
92/10/28	1000	WATER		.15C	.55C	.001	284	8	53.0	12.0	2.0	14.0	182.0
92/10/28	1000	QC Replicate		.01	.41	.001	284	8	53.0	12.0	2.0	14.0	182.0
92/11/24	1310	WATER		.00C	.41C	.000	286	5	48.0	11.0	2.0	15.0	165.0
92/11/24	1310	QC Replicate		.05	.54	.002	284	5	48.0	11.0	2.0	15.0	165.0
92/12/16	1230	WATER		.00C	.54C	.000	296	6	51.0	11.0	2.0	15.0	173.0
92/12/16	1230	QC Replicate		.00C	.54C	.000	288	6	51.0	11.0	3.0	15.0	173.0

HRG27 URG119027510 08266820
RED RIVER BELOW FISH HATCHERY
35055 NEW MEXICO TAOS
WESTERN GULF 120900
UPPER RIO GRANDE ABOVE PECOS RIVER /TYPA/AMBNT/STREAM/BIO

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	00410 T ALK CACO3 MG/L	00440 HCO3 ION HCO3 MG/L	00946 SULFATE SO4-DISS MG/L	00940 CHLORIDE TOTAL MG/L	00680 T ORG C C MG/L	01105 ALUMINUM Al Total UG/L	01106 ALUMINUM AL,DISS UG/L	01005 BARIUM BA,DISS UG/L	01010 BERYLIUM BE,DISS UG/L	01020 BORON B,DISS UG/L
92/02/26	1400	WATER		50.0	61.0	137.0	7		3300	100K	100K	100K	100K
92/02/26	1400	QC Replicate		51.0	62.2	134.0	7						
									3400	100K	100K	100K	100K
92/03/25	1300	WATER		51.0	63.0	138.0	10	5.0K	4300	100K	100K	100K	100K
92/03/25	1300	QC Replicate		50.2	61.2	137.0	8	5.0K	4300	100K	100K	100K	100K
92/03/25	1300												
92/04/29	1235	WATER		35.6	43.4	60.8	5K	4.0	6700	200	100K	100K	100K
92/04/29	1235	QC Replicate		35.6	43.4	61.2	5K	8.0					
92/05/27	1300	WATER		49.2	60.0	59.0	5	5.0K					
92/05/27	1300	QC Replicate		49.4	60.3	59.0	5K	5.0K					
92/06/30	1300	WATER		54.8	66.9	79.4	5K	2.0					
92/07/29	1300	WATER		65.8	80.3	104.0	5	1.0					
92/07/29	1300	QC Replicate		65.8	80.3	105.0	5	2.0					
92/08/26	1245	WATER		60.6	74.0	124.0	5K	2.0					
92/08/26	1500	QC Replicate		60.5	74.3	106.0	5K	1.0					
92/09/30	1130	WATER		62.6	75.3	133.0	6	2.0					
92/10/28	1000	WATER		57.5	70.2	146.0	7	1.0					
92/10/28	1000	QC Replicate		57.5	70.2	146.0	7	1.0					
92/11/24	1310	WATER		60.1	73.3	137.0	7	2.0					
92/11/24	1310	QC Replicate		60.0	73.6	137.0	7	1.0K					
92/12/16	1230	WATER		54.9	66.9	150.0	7	1.0K					
92/12/16	1230	QC Replicate		57.3	69.9	151.0	7	1.0K					

STORET RETRIEVAL DATE 93/04/29 PGM=RET PAGE:
HRQ27 URG119027510 08266820
36 40 49.0 105 39 20.0 4
RED RIVER BELOW FISH HATCHERY
35055 NEW MEXICO TAOS
WESTERN GULF 120900
UPPER RIO GRANDE ABOVE PECOS RIVER /TYPA/AMBNT/STREAM/BIO
21NMEX 850427 13020101027 0003.340 ON
0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01025 CADMIUM CD,DISS UG/L	01030 CHROMIUM CR,DISS UG/L	01035 COBALT CO,DISS UG/L	01040 COPPER CU,DISS UG/L	01046 IRON FE,DISS UG/L	01049 LEAD PB,DISS UG/L	01056 MANGNESE MN,DISS UG/L	01060 MOLY MO,DISS UG/L	01065 NICKEL NI,DISS UG/L	01140 SILICON SI,DISS UG/L
92/02/26	1400	WATER		1K	5K	50K	100K	100K	5K	830	100K	100K	8400
92/02/26	1400	QC Replicate		1K	5K	50K	100K	5K		830	100K	100K	8400
92/03/25	1300	WATER		1K	5K	50K	100K	100K	5K	1400	100K	100K	8100
92/03/25	1300	QC Replicate		1K	5K	50K	100K	5K		1300	100K	100K	7700
92/04/29	1235	WATER		1K	5K	50K	100K	100K	5K	540	100K	100K	5800

DATE FROM TO	TIME OF DAY	MEDIUM	SMK OR DEPTH (FT)	01075 SILVER AG,DISS UG/L	01080 STRONTUM SR,DISS UG/L	01100 TIN SN,DISS UG/L	01085 VANADIUM V,DISS UG/L	01090 ZINC ZN,DISS UG/L	01000 ARSENIC AS,DISS UG/L	01145 SELENIUM SE,DISS UG/L	71900 MERCURY HG,TOTAL UG/L	31616 FEC COLI MFM-FCBR /100ML
92/02/26	1400	WATER		100K	300	100K	100K	100K	5K	5K	.5K	
92/02/26	1400	QC Replicate		100K	300	100K	100K	100	5K	5K	.5K	
92/03/25	1300	WATER		100K	300	100K	100K	100	5K	5K	.5K	
92/03/25	1300	QC Replicate		100K	300	100K	100K	100	5K	5K	.5K	
92/04/29	1235	WATER		100K	200	100K	100K	100K	5K	5K	.5K	
93/01/27	1000	WATER										1J

				39348 A-CHLRDN UG/L	39810 G-CHLRDN UG/L	11503 RA-226+ RA 228 PC/L	11504 RA-226+ RA-228 ERR PC/L
93/07/29	1300	Water				0.21	0.32
93/09/30	1130	Water		0.50K	0.50K		

Table 15. Quantitative macroinvertebrate data collected at nine sites along the Red River, April, 1992.

Taxa	Station 1	Above Bitter Creek *	2	3	4	5	6	7	8
PLECOPTERA – stoneflies									
Amphinemura sp.				11		17		6	
Prostoia besametsa			6						
Zapada sp.	108	96	57						
Pteronarcella badia			6	11	6				91
Perlodidae				11	11	6			6
Cultus aestivalis		11						6	
Isogenoides sp.	6								
Kogotus modestus	79	17	34						
Isoperla sp.	6								6
Sweltsa sp.	40	45	79	45	45			17	
Hesperoperla pacifica		11							
EPHEMEROPTERA – mayflies									
Baetis insignificans	420	249	289	57					
Baetis tricaudatus				249	442	176	17	164	266
Rhithrogena robusta				28	91		28		17
Rhithrogena hageni	255	147	187						
Epeorus longimanus	119	352	301	329	68	91	6		6
Drunella grandis		23	11	40	28	108	6	6	34
Drunella doddsi	23	17	28		6				
Ephemerella inermis	85	51	176	28					
Ephemerella infrequens	284	471	130		6			23	
TRICHOPTERA – caddisflies									
Rhyacophila brunea cpx.	187	45	6						
Rhyacophila iranda	6								28
Rhyacophila valuma	34								
Rhyacophila vernula	28								
Glossosoma sp.					6				6
Hydropsyche venada			11					11	11
Arctopsyche grandis	17	210	102	51	28	6		23	28
Oligophlebodes sp.	714	941	777	312	102	442			
Psychoronia sp.	11								
Brachycentrus americanus	6	108	153	516	482	635	403	227	403
Micrasema sp.	6	23					6		
DIPTERA – true flies									
Dicranota sp.		23	11	28					62
Hexatoma sp. A									
Tipula sp.	17		11						
Blephariceridae	6								
Simuliidae	51	17	11						
Diamesa sp.	23	17	102		57	68	6		
Eukiefferiella sp.	11	17	6	17		11			68
Tvetnia sp.		6	11	6	6				11
Chricotopus sp.	6	11	6	11		11		17	
Microtendipes sp.								6	119
Atherix pachypus	6	17			6		6	23	215
Chelifera sp.	6		6	17		17	6	6	
Hemerodromia sp.		6		6		6			

* No chemical data gathered at this site

Table 15. continued

COLEOPTERA – beetles									
Narpus sp.		6							
Heterlimnius corpulentus	159	136	34	62	11		6		40
PLATYHELMINTHES – flatworms									
Turbellaria	40	6							
ARTHROPODA – other arthropods									
Hydracarina A – mites	6								6
NEMATOMORPHA – Gordian worms									
Gordius sp.					6				
Standing Crop (No./m²)	2765	3090	2551	1835	1407	1594	490	535	1423
Total Taxa	31	29	26	20	18	13	10	13	19
CTQ_o	50	50	50	50	50	50	50	50	50
CTQ_d	45.6	45.3	46.6	48.6	41.1	51.7	46.2	50.1	53.5
BCI	109.7	110.5	107.3	102.8	113.5	96.7	108.2	99.8	93.5
Diversity Index	3.64	3.45	3.46	3.13	2.71	2.41	1.18	2.43	3.19

Table 16. RAPID BIOASSESSMENT (PROTOCOL III) OF UPPER RED RIVER, APRIL 10, 1992.

Metric	STATIONS 1 (reference)	2 Above Bitter Creek <—Town of Red River—>	3	4 WWTP	5 Molycorp	6 USFS Boundary Ecoregion <—21 | 22—>
Calculated Value						
No. of Taxa	31	29	26	20	18	13	10
Standing Crop (#/M^2)	2,765	3,090	2,551	1,835	1,407	1,594	490
Biotic Index							
HBI	2.55	2.48	2.61	2.14	2.48	2.59	1.26
BCI (CTQ_d)	46	45	47	49	44	52	46
% Dominant Taxa	26	30	30	28	34	40	82
EPT Index	20	17	17	13	13	8	6
Community Loss	-	0.31	0.42	0.90	1.17	1.77	2.40
EPT/(Chironomids + EPT)	0.98	0.98	0.95	0.98	0.95	0.94	0.99
Scraper/(C-F + Scrapers)	0.98	0.75	0.75	0.38	0.22	0.48	0.08
Shredders/Total	0.06	0.02	0.07	0.03	0.04	0.07	0.04
Percent of Reference							
No. of Taxa	100	94	84	65	58	42	32
Standing Crop (#/M^2)	100	112	92	66	51	58	18
Biotic Index							
HBI	100	103	98	119	103	98	202
BCI (CTQ_d)	100	102	98	94	105	88	100
% Dominant Taxa	26	30	30	28	34	40	82
EPT Index	100	85	85	65	65	40	30
Community Loss	-	0.31	0.42	0.90	1.17	1.77	2.40
EPT/(Chironomids + EPT)	-	100	97	100	97	96	101
Scraper/(C-F + Scrapers)	-	77	77	39	22	49	8
Shredders/Total	-	33	117	50	67	117	67
Score							
No. of Taxa	6	6	6	4	2	2	0
Standing Crop (#/M^2)	6	6	6	6	6	6	0
Biotic Index							
HBI	6	6	6	6	6	6	6
BCI (CTQ_d)	6	6	6	6	6	6	6
% Dominant Taxa	4	4	4	4	2	2	0
EPT Index	6	4	4	0	0	0	0
Community Loss	6	6	6	4	2	2	2
EPT/(Chironomids + EPT)	6	6	6	6	6	6	6
Scraper/(C-F + Scrapers)	6	6	6	4	2	4	0
Shredders/Total	6	2	6	4	6	6	6
Total	58	52	56	44	38	40	26
% of Reference	100	90	97	76	66	69	45
Biological Condition	Non-Impaired	Non-Impaired	Non-Impaired	Slightly Impaired	Slightly Impaired	Slightly Impaired	Moderately Impaired
Habitat Condition	153	113	113	92	103	92	92
% of Reference	-	74	74	60	67	60	60
Habitat Category	--	Supporting to Partially Supporting	Supporting to Partially Supporting	Partially Supporting	Partially Supporting	Partially Supporting	Partially Supporting

Table 17. RAPID BIOASSESSMENT (PROTOCOL III) OF THE LOWER RED RIVER, APRIL 10, 1992.

Metric	STATIONS HON14 (reference)	7 (HRG25)	8 (HRG27)
Calculated Value			
No. of Taxa	41	13	19
Standing Crop #/M^2	4,833	535	1,423
Biotic Index			
HBI	3.65	2.60	3.30
BCI (CTQ_d)	51.5	50	54
% Dominant Taxa	15	42	28
EPT Index	23	9	12
Community Loss	-	2.46	1.58
EPT/(Chironomids + EPT)	0.86	0.95	0.82
Scraper/(C-F + Scrapers)	0.99	0.02	0.07
Shredders/Total	0.16	0.04	0.11
Percent of Reference			
No. of Taxa	100	32	46
Standing Crop #/M^2	100	11	29
Biotic Index			
HBI	100	140	111
BCI (CTQ_d)	100	103	95
% Dominant Taxa	15	42	28
EPT Index	100	39	52
Community Loss	-	2.46	1.58
EPT/(Chironomids + EPT)	100	110	95
Scraper/(C-F + Scrapers)	100	2	7
Shredders/Total	100	25	69
Score			
No. of Taxa	6	0	2
Standing Crop #/M^2	6	0	2
Biotic Index			
HBI	6	6	6
BCI (CTQ_d)	6	6	6
% Dominant Taxa	6	0	4
EPT Index	6	0	0
Community Loss	6	2	2
EPT/(Chironomids + EPT)	6	6	6
Scraper/(C-F + Scrapers)	6	0	0
Shredders/Total	6	2	6
Total	60	22	34
% of Reference	100	37	57
Biological Condition	-	Moderately Impaired	Slightly Impaired
Habitat Condition	126	92	98
% of Reference	100	73	78
Habitat Category	-	Partially Supporting	Supporting

Table 18. RAPID BIOASSESSMENT (PROTOCOL III) OF THE LOWER RED RIVER, APRIL 10, 1992.

Metric	STATIONS		
	HON18 (reference)	7 (HRG25)	8 (HRG27)
Calculated Value			
No. of Taxa	38	13	19
Standing Crop #/M^2	2,788	535	1,423
Biotic Index			
HBI	2.36	2.60	3.30
BCI (CTQ_d)	57	50	54
% Dominant Taxa	32	42	28
EPT Index	18	9	12
Community Loss	-	2.46	1.32
EPT/(Chironomids + EPT)	0.95	0.95	0.82
Scraper/(C-F + Scrapers)	0.14	0.02	0.07
Shredders/Total	0.35	0.04	0.11
Percent of Reference			
No. of Taxa	100	34	50
Standing Crop #/M^2	100	19	51
Biotic Index			
HBI	100	91	72
BCI (CTQ_d)	100	114	106
% Dominant Taxa	32	42	28
EPT Index	100	50	67
Community Loss	-	2.46	1.32
EPT/(Chironomids + EPT)	100	100	86
Scraper/(C-F + Scrapers)	100	14	50
Shredders/Total	100	11	31
Score			
No. of Taxa	6	0	2
Standing Crop #/M^2	6	0	6
Biotic Index			
HBI	6	6	4
BCI (CTQ_d)	6	6	6
% Dominant Taxa	2	0	4
EPT Index	6	0	0
Community Loss	6	2	4
EPT/(Chironomids + EPT)	6	6	6
Scraper/(C-F + Scrapers)	6	0	4
Shredders/Total	6	0	2
Total	56	20	38
% of Reference	100	36	68
Biological Condition	-	Moderately Impaired	Slightly Impaired
Habitat Condition	114	92	98
% of Reference	100	81	86
Habitat Category	-	Supporting	Supporting

Red River Benthic Macroinvertebrates, April 1992

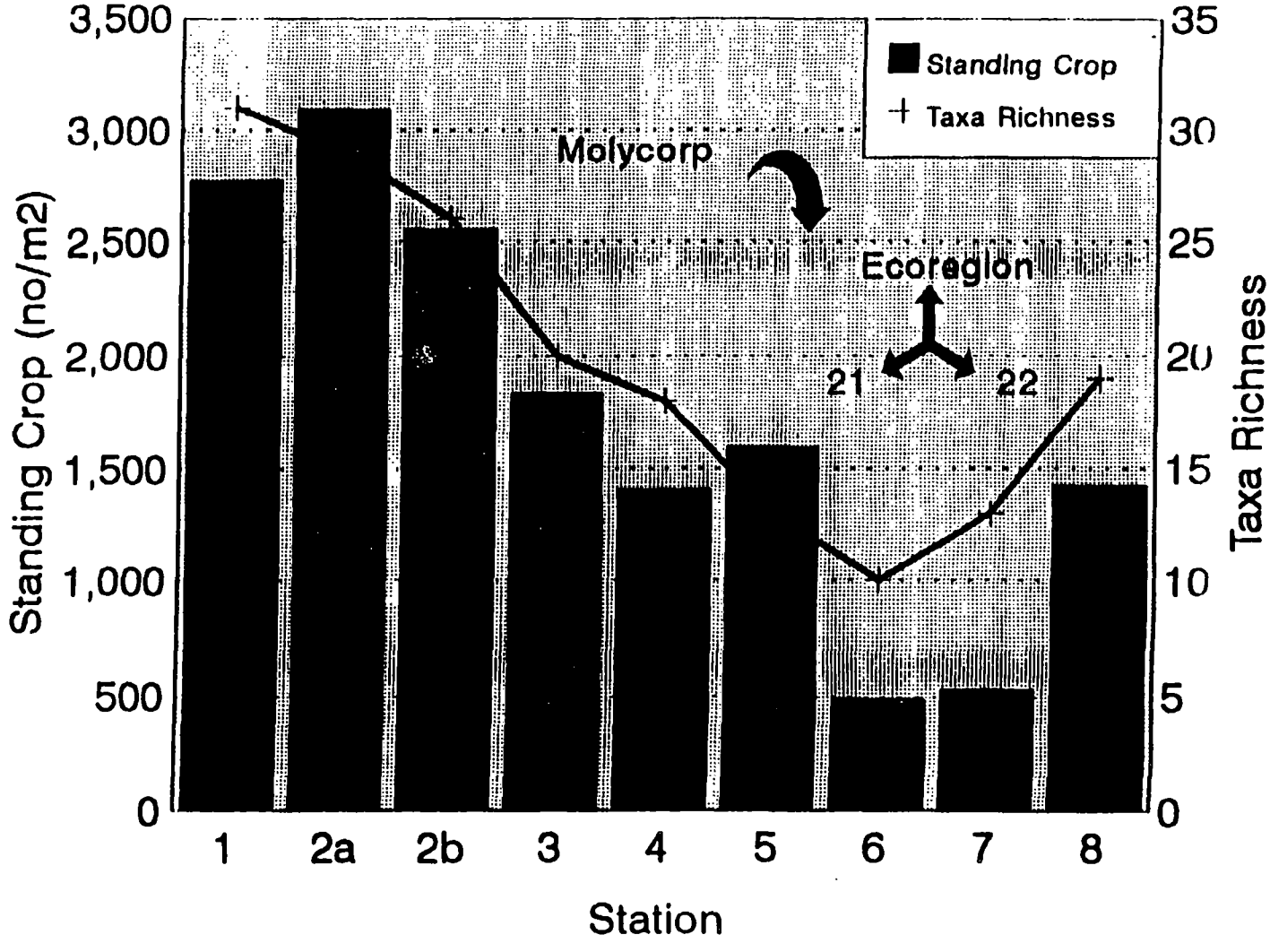

Figure 10. Standing crop and taxa richness of benthic macroinvertebrate communities collected at nine sites on the Red River, April, 1992.

Red River Benthic Macroinvertebrates, April 1992

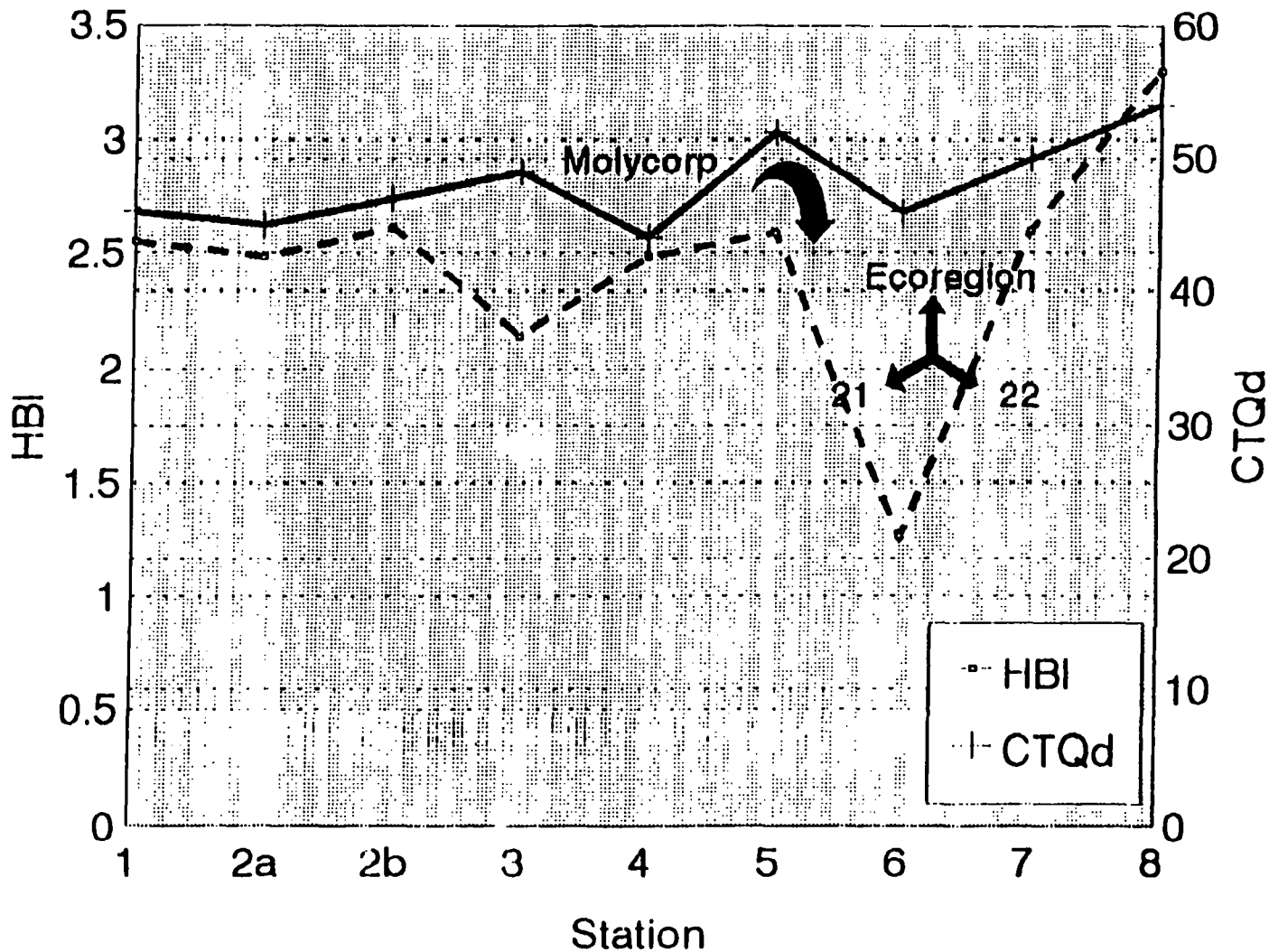

Figure 11. Benthic macroinvertebrate community quality as represented by two different biotic indexes at nine different sites on the Red River, April, 1992.

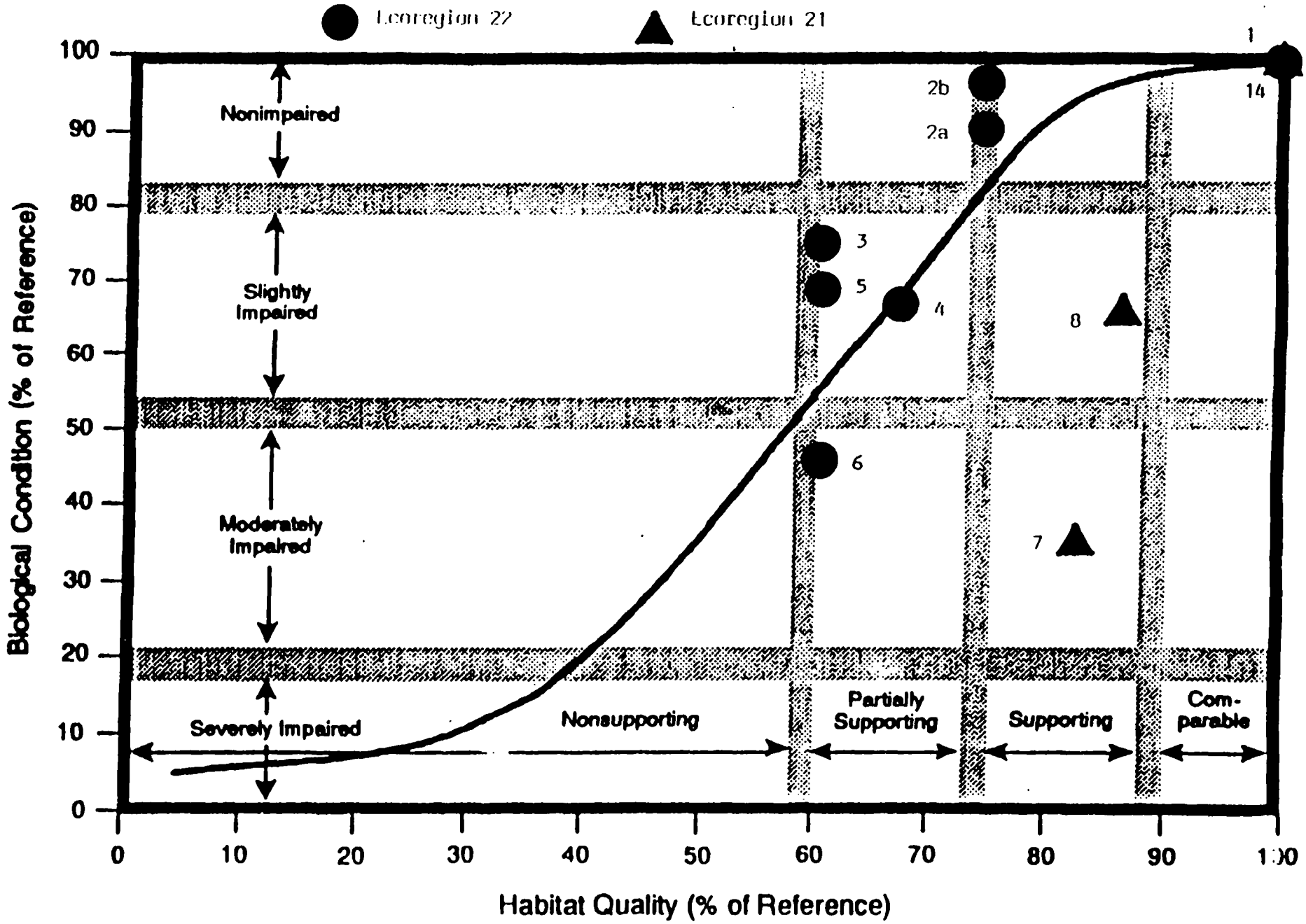

Figure 12. The relationship between habitat and biological condition. Red River, New Mexico.

REFERENCES

American Public Health Association. Standard methods for the examination of water and wastewater, latest edition.

Borland, P. United States Geological Survey, Subdistrict Albuquerque, New Mexico. Flow data recorded at USGS stations provided as requested. Personal communication.

Clark, I.G. 1987. Water in New Mexico, a history of its management and use. University of New Mexico Press.

Gabin, V.L., and L.E. Lesperance. 1977. New Mexico climatological data: precipitation, temperature, evaporation, and wind. Monthly and annual means 1850-1975. W. K. Summers and Associates.

Jacobi, G.Z. 1978. An inexpensive circular sampler for collecting benthic macroinvertebrates in streams. Arch. Hydrobiol. 83: 126-131.

Kunkel, K.E. 1984. Temperature and precipitation summaries for selected New Mexico locations. New Mexico Department of Agriculture.

Merritt, W., and K.W. Cummins. 1984. An introduction to the aquatic insects of North America, 2nd ed. Kendall/Hunt.

New Mexico Bureau of Mines and Mineral Resources. 1977. Mineral and water resources of New Mexico.

New Mexico Department of Game and Fish. 1988. Operation plan - aquatic management of New Mexico wildlife - 1987-1995.

New Mexico Environment Department. 1991. Intensive water quality stream surveys and lake water quality assessment surveys, 1990. EID/SWQ-91/1. 209 p.

New Mexico Environment Department. 1992. Quality assurance project plan for water quality management programs.

New Mexico Water Quality Control Commission. 1991. Water quality standards for interstate and intrastate streams in New Mexico. WQCC 91-1.

Palmer, C.M. 1977. Algae and water pollution. EPA-600/9-77-036.

Pennak, R.W. 1989. Freshwater invertebrates of the United States, 3rd. ed. Wiley.

Pierce, S.T. 1986. Reconnaissance survey of Mule Creek near the Town of Mule Creek, Grant County, NM, July 23-25, 1985. EID/SWQ-86/7. 21 p.

Pierce, S.T. 1987. Intensive water quality survey of the Gila River and its tributaries in Grant and Catron counties, NM, July 20-23, 1987. EID/SWQ-87/10. 69 p.

Plafkin, J.L., M.T. Barbour, K.D. Porter, S.K. Gross, and R.M. Hughes. 1989. Rapid bioassessment protocols for use in streams and rivers: benthic macroinvertebrates and fish. EPA/444/4-89-001.

Platts, W.S., W.F. Megahan, and G.W. Minshall. 1983. Methods for evaluating stream, riparian, and biotic conditions. U.S. Forest Service. INT-138.

Potter, D.U. 1982. New Mexico clean lakes program classification phase I final report. EID/WPC-82/4. 184 p.

Smolka, L.R., and D.F. Tague. 1986. Intensive survey of the Red River, Taos County, NM, August 18-21, 1986. EID/SWQ-86/22. 55 p.

Smolka, L.R. 1987. Intensive water quality survey of the San Francisco River and its tributaries in Catron County, NM, July 6-9, 1987. EID/SWQ-87/9. 41 p.

Smolka, L.R., and D.F. Tague. 1988. Intensive water quality survey of the middle Red River in Taos County, New Mexico, September 12 to October 25, 1988. EID/SWQ-88/8. 89 p.

Smolka, L.R. 1990. Intensive water quality survey of the Tularosa River and Apache and Negrito creeks in Catron County, New Mexico, July 9-13, 1990, p. 92-102. *In* Intensive water quality surveys and lake water quality assessment surveys, 1990. EID/SWQ-91/1. 209 p.

Tuan, Y., E.E. Everard, and J.C. Widdison. 1969. The climate of New Mexico. New Mexico State Planning Office.

Twedt, T.M., J.J. Messer, and Crist, L. 1984. Water quality study - upper Gila water supply project. Submitted to Bureau of Reclamation, Boulder City, Nevada, by Biowest Inc. Logan, Utah. 24 p.

United States Environmental Protection Agency. 1973. Biological field and laboratory methods for measuring the quality of surface waters and effluents. C.I. Weber [ed.]. EPA-670/4-73-001.

United States Environmental Protection Agency. 1985. Ambient water criteria for ammonia - 1984. EPA-440/5-85-001.

United States Environmental Protection Agency. Methods for chemical analysis of water and wastes. EPA-600/4-79-200 or latest edition.

Ward, H.B., and G.C. Whipple. 1959. Freshwater biology, 2nd ed., W.T. Edmonson [ed.]. Wiley.

Winget, R.N., and F.A. Mangum. 1979. Biotic condition index: integrated biological, physical, and chemical stream parameters for management. U.S. Forest Service.

State of New Mexico
ENVIRONMENT DEPARTMENT
Surface Water Quality Bureau
Harold Runnels Building
1190 St. Francis Drive, P.O. Box 26110
Santa Fe, New Mexico 87502
Telephone (505) 827-0187
Fax (505) 827-0160

GARY E. JOHNSON
GOVERNOR

PETER MAGGIORE
SECRETARY

PAUL R. RITZMA
DEPUTY SECRETARY

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July 25, 2000

Mr. Oscar Ramirez, Jr.
Acting Director
Water Quality Protection Division (6WQ)
U. S. Environmental Protection Agency
1445 Ross Avenue, Suite 1200
Dallas, Texas 75202-2733

Re: State Certification – Proposed NPDES Permit (NM0022306) – Molycorp, Inc.

Dear Mr. Ramirez:

Enclosed, please find the state certification for the following proposed NPDES permit:

Molycorp, Inc. -- Permit Number NM0022306

Comments are enclosed on separate sheets.

Sincerely,

James H. Davis, Ph.D.
Bureau Chief
Surface Water Quality Bureau

cc: (w/enclosures)
Mr. Benito Garcia, NMED District II, Santa Fe
Ms. Evelyn Rosborough, USEPA (6WQ-CA)
Ms. Marcy Leavitt, NMED GWQB
Mr. David R. Shoemaker via **Certified Mail (Z 434 828 532)**
General Manager
Molycorp, Inc.
P. O. Box 469
Questa, NM 87556-0469

Mr. Gregg Cooke, Regional Administrator
Environmental Protection Agency
1445 Ross Avenue
Dallas, TX 75202-2733

Date: July 25, 2000

STATE CERTIFICATION

RE: Molycorp, Inc.NPDES No. NM0022306

Dear Mr. Cooke:

The New Mexico Environment Department has examined the proposed NPDES permit above. The following conditions are necessary to assure compliance with the applicable provisions of the Clean Water Act Sections 208(e), 301, 302, 303, 306, and 307 and with appropriate requirements of State law. Compliance with the terms and conditions of the permit and this certification will provide reasonable assurance that the permitted activities will be conducted in a manner which will not violate applicable water quality standards, the water quality management plan or antidegradation policy.

The State of New Mexico

(X) certifies that the discharge will comply with the applicable provisions of Sections 208(e), 301, 302, 303, 306 and 307 of the Clean Water Act and with appropriate requirements of State law

( ) certifies that the discharge will comply with the applicable provisions of Sections 208(e), 301, 302, 303, 306 and 307 of the Clean Water Act and with appropriate requirements of State law upon inclusion of the following conditions in the permit (see attachments)

( ) denies certification for the reasons stated in the attachment

( ) waives its right to certify

In order to meet the requirements of State law, including water quality standards and appropriate basin plan as may be amended by the water quality management plan, each of the conditions cited in the draft permit and the State certification shall not be made less stringent.

The Department reserves the right to amend or revoke this certification if such action is necessary to ensure compliance with the State's water quality standards and water quality management plan.

Please contact Glenn Saums, (505) 827-2827, if you have any questions concerning this certification. Comments and conditions pertaining to this draft permit are attached.

Sincerely,

James H. Davis, Ph.D.
Bureau Chief
Surface Water Quality Bureau

Molycorp, Inc.
State Certification of the NPDES Permit
NM0022306
July 25, 2000

Conditions of Certification

There are no conditions of State certification.

Comments that are not Conditions of Certification

Comment #1 In the Fact Sheet, Part V., page 3, EPA included "secondary contact" in the list of the known uses of the receiving water(s). The list of "Designated Uses" for stream segment 2119 does not include "secondary contact" but does include "primary contact" (reference Subsection B of 20.6.1.2119 NMAC).

Comment #2 In the Fact Sheet, Part V., page 3, the State Water Quality Standards are referred to as "Water Quality Standards for Interstate and Intrastate Streams in New Mexico." (20 NMAC6.1, effective 2/15/00). The correct citation is "Standards for Interstate and Intrastate Surface Waters, 20.6.1 NMAC (2/23/2000)."

Comment #3 The Fact Sheet, Part VIII.C (B)(should probably be 2.) b, page 11 states, "[t]echnology based limits and monitoring requirements at Outfalls 004 and 005 are not proposed to be changed in the reissued permit." It appears, however that technology based limits for total cadmium, copper, zinc, lead, and mercury established in the previous permit have been changed in the reissued permit.

Comment #4 The Fact Sheet, Part VIII.D, page 13 states, "[t]he water collected by the interception systems may be pre-treated as necessary to insure the integrity of the tailings pipeline and then pumped into the tailings pipeline and sent to the tailings ponds located west of Questa or pumped to the mine for use as process water." SWQB comments that while pretreatment, if performed, may be necessary to insure the integrity of the pipeline, it may also be necessitated for other reasons beyond pipeline protection, for example meeting other applicable regulatory requirements of State law. SWQB further comments that introduction of such water collected by the interception systems into the tailings pipeline may require other state and/or federal approvals (e.g., the New Mexico Ground Water Discharge Permit pursuant to NM WQCC Regulations 20.6.2 NMAC).

Comment #5 The Fact Sheet, Part VIII.E.5.a, page 17 contains a quotation, "Surface waters of the State shall be free of toxic substances attributable to point or non-point discharge in amounts, concentrations or combinations which are toxic to fish or other aquatic organisms; ..." (NMWQS 1102.F)." The Fact Sheet's quotation is from outdated state water quality standards. The comparable revised and current version of the water quality standards reads "Surface waters of the State shall be free of toxic pollutants attributable to discharges in amounts, concentrations or combinations which affect the propagation of fish or which are toxic to fish or other aquatic organisms; ..." (Subsection F of 20.6.1.1105 NMAC)."

Comment #6 The Fact Sheet, Part XII (should be XI since there does not appear to be a Part IX.), page 22 lists segment 2-119. This should be 2119. In addition, this part states, "... the proposed permit contains limitations and conditions at Outfalls 001 and 002 ..."The proposed permit contains limitations and conditions at Outfalls 001, 002, 004, and 005.

Comment #7 The Proposed Permit, Part I.A., page 7 lists "Total Mercury (*1)" twice. NMED believes the second occurrence should be "Total Mercury (*2)."

Comment #8 The Proposed Permit, Part II.A., page 1 lists two springs (13 and 39) to be captured in french drain seepage interception systems, and a ground water withdrawal well installed to capture others. The rational for determining which springs to collect is unclear, particularly in respect to Spring 39. As described in the Proposed Permit, this spring is defined "as the seepage zone located on the north side of the Red River approximately 500 feet downstream of Thunder Bridge." This is not a commonly used reference point, except perhaps by Molycorp. For clarity, a description relative to a more common landmark should be used. If SWQB's understanding of the location of this spring is correct (adjacent to the river below Goathill Gulch), SWQB knows of no significant spring in this location.

Comment #9 The Proposed Permit, Part II.A, page 1 states, "[w]ater from the well shall be pumped to the mine or mill for use in operations." SWQB notes pumping this water to the mine or mill for use in operations may require other state and/or federal approvals (e.g., the New Mexico Ground Water Discharge Permit pursuant to NM WQCC Regulations 20.6.2 NMAC).

Comment #10 The Proposed Permit, Part II.A, page 1 specifies seepage interception systems for Springs 13 and 39 "...shall consist of a 400 foot long french drain...." SWQB suggests qualifying the length of the drain as a <u>minimum</u> of 400 feet.

Comment #11 The last sentence of the last paragraph in Part II, A of the Proposed Permit states "[t]his permit may be reopened if any significant discharge or seepage occurs." SWQB suggest EPA consider adding to the end of the sentence the phrase "... or if it is determined that existing seepage in other locations (e.g., Cabin Springs, etc.) is hydrologically connected to mine operations."

Comment #12 The Proposed Permit, Part II.H, page 7 states, "... or find seepage traceable to point source mine operations, this permit may be modified...." Although SWQB understands this statement to mean <u>any</u> seepage caused or impacted by mine operations, we suggest that EPA add the word "any", "additional," or other after find so that this statement is clearer. In addition, SWQB suggests that EPA replace the word "may" with "must" or "shall."

Comment #13 In Section VIII.E.6 (page 20-21) of the Fact Sheet regarding Water Quality Screening for EPA Human Health Protection Bioaccumulation Criteria, EPA states:

> *...the permitting sections will utilize the state assigned values for carcinogen risk factor and fish consumption rate. The EPA default assumptions for a 10^{-6} risk factor for carcinogens and a fish consumption rate of 6.5 g/day will be used in their absence.*

SWQB notes that while the New Mexico Water Quality Control Commission (WQCC) has not specifically addressed the issue of surface water quality standards for human health or established a risk factor for purposes of NPDES permits, the WQCC has routinely utilized a different risk factor when addressing human health concerns elsewhere. The first example is in the numeric criteria for "Domestic Water Supply" *Standards for Interstate and Intrastate Surface Waters,* [Subsection B of 20.6.1.3100 NMAC] which states in part:

> *[s]urface waters of the State designated for use as domestic water supplies shall not contain substances in concentrations that create a lifetime cancer risk of more than one cancer per 100,000* [or 10^{-5}] *exposed persons.*

The second example is in the WQCC's definition of "toxic pollutant" found in their *Ground and Surface Water Protection* Regulations [20.6.2.1101] which states in subsection TT:

> *...[a]ny water contaminant or combination of water contaminants in the list below creating a lifetime risk of more than one cancer per 100,000* [or 10^{-5}] *exposed persons is a toxic pollutant.*

Review of SWQB files on the issue also indicated that a January 25, 1989 letter from Mr. Myron O. Knudson, Director of the EPA's Water Management Division requested the NMED's comments on what risk level (10^{-4} thru 10^{-7}) the Department would support in NPDES permits in New Mexico. In responses dated February 9 and 17, 1989 (K. Sisneros to M. Knudson) the "one per 100,000 or 10^{-5} risk level was supported for the same reason as stated above regarding the WQCC's definition of toxic pollutant in their regulations.

According to instructions that accompany the 40 CFR 131.36 National Toxics Rule for human health criteria (footnote C of the table) the EPA's human health criteria number for arsenic utilized to evaluate this permit would change from 0.14 μg/l to 1.4 μg/l at the 10^{-5} risk level. Calculations by EPA in the Fact Sheet Appendices (page 10 step 4 EPA Human Health Criteria Screening) indicate that the "Potential In-stream Concentration" of 2.38 μg/l for arsenic would still exceed the revised criterion. Thus there would be no change in EPA's proposal to include monitoring in this permit as discussed further in the EPA Fact Sheet Appendices (page 17). Based upon the above precedent supporting the use of a one per 100,000 or 10^{-5} risk factor SWQB recommends that in the future EPA evaluate requirements for arsenic utilizing the revised criteria.

QUESTA MINE SITE
EXPERT REPORT BY IAN P.G. HUTCHISON

I, Ian P.G. Hutchison, Senior Vice President of TRC Environmental Solutions, Inc., have been retained to provide the following expert report in *Amigos Bravos and New Mexico Citizens for Clean Air vs. Molycorp, Inc.* (D.N.M. No. CIV 95-1497 [JP/DJS]).

1.0 SUMMARY OF QUALIFICATIONS

1.1 GENERAL QUALIFICATIONS

- Senior Vice President of TRC Environmental Solutions, Inc., with general responsibilities for mining environmental, and Superfund remediation projects.
- Over 25 years of experience in dealing with water quality issues at a large number of mining and industrial sites in the United States, Canada, South America and Africa.
- Ph.D. in Civil Engineering and Graduate Diploma (M.S. equivalent) in Hydraulic and Soil Mechanics from the University of the Witwatersrand, South Africa, and a B.S. in Civil Engineering from the University of Cape Town, South Africa.
- Experience on over 50 mining environmental projects throughout the United States, Canada, South America and Africa.
- Registered Professional Engineer in eight states, including New Mexico.
- Resume is provided in Attachment A.

1.2 PUBLICATIONS

- Senior editor and author of a textbook entitled "Mine Waste Management" published in 1992, Lewis Publishers.
- Other publications in the last 10 years include:
  - *Introduction to Evaluation, Design and Operation of Precious Metal Heap Leaching Projects*, Editor and Author of Chapter on "Surface Water Balance," 1988.
  - *Management for Hazardous Waste Liability at Mining Sites.* Colorado State University Symposium, January 1991.
  - *Summitville Mine - Remedial Alternatives Identification and Evaluation.* I.P. Hutchison, Michael L. Leonard, Sr. and David P. Cameron. Summitville Forum 95: A Forum held in Conjunction with Tailings and Mine 1995, Colorado State University, Fort Collins, Colorado, January 1995.

1.3 CASES IN THE LAST FOUR YEARS

- Involved as an expert witness and provided deposition or trial testimony on the following cases in the last four years:
  - *IMACC vs. Dorothy Myers Warburton, et al.*
  - *Penny Newman et al. versus State of California, Riverside County, et al.* regarding the Stringfellow site, California, 1993.

1.4 COMPENSATION

- My hourly rate is $160/hour.

2.0 SUMMARY OF OPINIONS

1. My major opinions deal with the diffuse nature of the sources of constituents, the seepage and ground water flow conditions at the mine site, and the surface water quality conditions in Red River. Naturally occurring alteration minerals occur within bedrock dispersed throughout the fractured bedrock area, are exposed on the surface in weathered bedrock (referred to as natural scar areas), and are dispersed within the colluvium and alluvium, and throughout most, but not all, of the excavated overburden pile material. Oxidization and weathering primarily of one of the minerals present, i.e., pyrite, can cause acidic conditions (i.e., low pH) and contribute dissolved constituents, which include a range of salts and metals, to surface or ground water flow that comes into contact with the weathered minerals. References in this report to "constituents" implies generally one or more substances from the range of salts and metals which typically include total dissolved solids (TDS), sulfate, aluminum, cadmium, copper, iron, manganese and zinc.

2. More specifically, my opinions are:
   - **Constituent Sources and Conveyances:** There are no discernible, confined and discrete conveyances of constituents from the overburden piles (also referred to as waste rock piles) to the Red River.
   - **Hydraulic Connection:** Conditions at the mine site are not well enough understood to determine whether there is a direct hydraulic connection between the overburden piles and Red River.

- **Red River Water Quality:** The available data does not support the conclusion that there has been a general reduction in the water quality of the Red River caused by mining activities between the mid-1960s and the mid-1990s.
- **Source of Constituents in Red River:** The available data does not allow for a determination of whether constituent loadings in Red River are derived from overburden piles, scar areas, or from alluvial deposits in tributary and Red River channels.

3. In addition to the above opinions, I have reviewed the plaintiff's expert reports and have provided comments on them.

4. The remaining sections of this report deal with the following topics:
   - 3.0 Basis for Major Opinions
   - 4.0 Summaries of Comments on Plaintiffs' Expert Reports

3.0 BASIS FOR MAJOR OPINIONS

3.1 CONSTITUENT SOURCES AND CONVEYANCES

1. There are no discernible, confined and discrete conveyances of constituents from the mine's overburden piles for the following reasons:
   - **Diffuse Sources:** Migration of water and constituents from and through the overburden piles is diffuse.
   - **Diffuse Flow Paths:** Migration of water and constituents through the alluvium and fractured bedrock, which underlie the overburden piles, is diffuse.
   - **Seepage Zones:** Migration of water and constituents into Red River, including the springs, which are actually seepage zones, is diffuse.

2. Each of these reasons is discussed in more detail below.

3.1.1 DIFFUSE SOURCES

1. The primary source of constituents in the overburden piles is the acid-generating minerals that are attached to the soil particles and boulders. Both water and oxygen are necessary to cause these minerals to oxidize or weather. This process can cause acidic conditions (i.e., low pH) and dissolves the constituents contained in the minerals. Infiltration of water during rainstorms and snowmelt migrates generally downward through the piles and dissolves the constituents. Infiltration is typically widespread over the surfaces of the piles; however, the rates of infiltration vary at different locations on the piles, depending on the surface slope and the amount of clay and silt present.

2. To the extent they represent potential sources of constituents, the overburden piles, therefore, are widespread diffuse seepage sources, with the amount of constituent loading varying within the source area.

3.1.2 DIFFUSE FLOW PATHS

1. Migration of water and constituents (or seepage) from the piles continues downward through the underlying unsaturated alluvium, natural hydrothermal scar areas, and/or fractured bedrock above the ground water table. Some lateral spreading may occur on lower permeability layers within the waste piles, or the underlying alluvium, or on low permeability bedrock surfaces. Migration of this widespread diffuse source therefore continues to be neither discernible, confined nor discrete. It is generally not discernible as it occurs as a subtle increase of moisture content on the surface of soil particles and in the large number of interconnected fractures that occur in bedrock. It is unbounded as it occurs over a widespread area, and finally, it is not discrete as it occurs in millions of pores and fractures in the soils and bedrock.

2. The alluvial material that occurs at the site is typically sandy, silty and sometimes clayey material. Ground water migration through these soils is diffuse, but rates of migration will vary locally depending on the soil types and composition.

3. After passing through the unsaturated zone, seepage from the overburden piles is mixed with ground water and then continues to migrate slowly through alluvium and fractured rock to deep bedrock below the Red River, to the Red River, or into the dewatered underground mine workings by the same diffuse flowpaths described above.

4. The geology of the area is complex, and a large number of faults and structural fractures have been identified at the site (SPRI, 1995). These include:
   - East-west trending low angle (relatively flat) faults and structural contacts dipping to the north;
   - High angle east-west, northeast and northwest trending faults;
   - Other high angle joints and fractures;
   - High and low angle fractures adjacent to magmatic intrusions.

   Typically, faults include zones of more permeable fractured rock as well as zones of low permeability rock where clayey materials can be present, where the fault zones "pinch out," or where faults are offset by younger faults cutting across older faults.

5. In addition to this largely random distribution of more permeable to less permeable zones formed by the faults described above, the bedrock between the faults is also highly fractured. Fractures occur at a large number of different orientations and typically have a large range of lengths and thicknesses. The intersection of these fractures and the faults causes the millions of migration pathways referred to in paragraph 1 above.

6. Ground water located in the fractured bedrock acts like water in a very large sponge, with a very large number of interconnected openings of varying size. Because of the random nature of the large number of faults and fractures in the bedrock, the rate of ground water migration can vary considerably from one area to the next.

7. Published ground water flow theories frequently treat flow through "fractured rock" as a diffuse flow through a continuum, which approximates flow through a porous medium (such as silt or sand) with increasing size of areas that are being analyzed. Due to the large size of

the mine facilities, and the mine site area, ground water migration could be analyzed as flow through porous media (Hubbert, 1956; Long et al., 1982; Hsieh et al., 1985).

8. As seepage containing dissolved constituents derived from the overburden piles migrates downgradient and away from the piles, the constituent concentrations are typically reduced by their contact with unmineralized alluvium and fractured bedrock, particularly if the alluvium or bedrock has the potential to neutralize acidic water. This process is referred to as attenuation and includes a combination of dilution, precipitation, adsorption and complexation. Metals are most susceptible to attenuation; however, salts can also be attenuated.

9. Furthermore, as ground water migrates through naturally acid-generating mineralized bedrock underlying the scars or alluvium that consists of eroded and redeposited scar material, additional salts and metals can be dissolved, leading to increased constituent concentrations.

10. It is evident that the concentration of constituents in ground water is not only a function of the source concentrations, but also the chemical interactions that occur within the ground water as it migrates through alluvial and fractured bedrock material. As a general rule, the further the ground water migrates from the original source of constituents, the less the constituent concentrations are dependent on that source, and the more they are dependent on the natural properties of the alluvium and fractured bedrock.

3.1.3 SEEPAGE ZONE

1. Referring to the seepage through the banks of the Red River as "springs" is inaccurate:

   "A spring is a concentrated discharge of ground water appearing at the ground surface as a current of flowing water. To be distinguished from springs are seepage zones, which include slower movement of ground water to the ground surface." (D.K. Todd, 1980)

2. It is more appropriate to use "seepage zones" to describe the areas along the banks of Red River, such as Capulin, Portal and Cabin Spring. This is based on my field observations and field mapping of seep areas conducted by GSi/water (GSi, 1997). It is also supported by Dr. Mink's expert report (Mink, 1997) and by deposition statements by both Dr. Mink and

Mr. Kelsey (Mink deposition, 1997; Kelsey deposition, 1997). These seepage zones have the appearance of wet soils or shallow fractured bedrock with water seeping out of the pore spaces at a varying rates throughout the seepage zone.

3.2 HYDRAULIC CONNECTION

1. Conditions at the mine site are not well enough understood to determine whether there is any direct hydraulic connection between the overburden piles and the Red River. It is virtually impossible to determine how much, if any, of the constituents emanating from the overburden piles migrate to the river, for the following reasons:
   - **Alternative Diffuse Migration Pathways:** There are several diffuse migration pathways for seepage derived from the overburden piles, including migration out of the general area in deep faults and fractures located well below the bed of the Red River and migration into the underground mine workings.
   - **Geochemical Processes:** The chemical reactions that take place as migration occurs alters the concentrations of the constituents and retards or eliminates the potential direct migration of constituents from the overburden piles to the Red River. As discussed below, this phenomenon is illustrated by the fact that the Red River reach along and closest to the largest overburden piles in the mine site area receives a lower mass TDS loading than river reaches adjacent to areas containing natural scars located close to the river, or adjacent to the town of Red River (Figure 6).
   - **Mixed Sources:** Because there are a large number of mining related sources (overburden piles) and nonmining related natural sources (scars, mineralized fractured bedrock, and mineralized alluvium) it is essentially impossible to distinguish whether any particular constituent loading to Red River is due to either natural or mine-related sources.

2. Each of the above reasons is discussed in more detail below.

3.2.1 ALTERNATIVE DIFFUSE PATHWAYS

1. As discussed above, the three potential diffuse migration pathways for seepage from the overburden piles include migration in deep bedrock faults and fractures to the west and below the Red River, migration into the underground mine, and shallow migration to the Red River.

2. While it is generally true that fractured bedrock permeability decreases with depth, the depths at which significant decreases occur vary from site to site. Evidence at the Questa Mine site indicates permeable bedrock occurs at considerable depths, and deep migration pathways are therefore very likely. This evidence includes:
   - During geologic time the area was subjected to extensive volcanism related to regional continental rifting. The major structural features, such as the high angle ring faults surrounding the caldera in which the mine is situated, are likely to be several thousands of feet deep. In addition, subsequent intrusions such as dikes and plutons derived from subterranean magma chambers and their associated fracturing, also extend to a great depth. The thickness of intra-caldera volcanic units are reported to range up to 10,000 feet in the Questa Caldera (SPRI, 1995), which would be the minimum depth of the above referenced high angle ring faults and subsequent intrusive structures. Figure 1 illustrates the typical structure for a caldera similar to the Questa caldera. Figure 2 shows the outline of the Questa caldera including the major faults that have been mapped or otherwise inferred in the area.
   - Water is observed by Molycorp personnel to seep into the deep underground mine workings through a large number of faults and fractures. The so-called "rain forest" occurs deep in the underground mine along the haulage drift at elevation 7,120 which is 600 to 700 feet below the level of the Red River and over 2,000 feet below the ground surface. Molycorp's underground mine mapping shows that extensive fracture systems are still present at this depth and represent a source of seepage into the mine (Molycorp, 1997).

3. As mentioned above, and as shown in Figure 3, the underground mine workings create a large drawdown cone in the ground water table which intercepts infiltration at the mine site, and seepage from the overburden piles. The interpretation in Figure 3 of the ground water levels in the mine area is the most reasonable given the available monitor well ground water level data; it also incorporates the Red River water levels. The mine's ground water capture zone estimated from these ground water contours is in general agreement with that determined by SPRI (SPRI, 1995, Figure 8) in that it shows capture extends from the Goathill Creek area in the west, to the area under the Sugar Shack, South Middle and Sulfur Gulch overburden piles to the east.

4. In my opinion the most realistic assessment of the average recharge from ground water in the mine area is SPRI's estimate of 0.66 cfs, or 295 gpm which is based on long term (1943 to 1955) base flow data for the general area between the Zwergle gauge upstream of Red River

and the Ranger Station gauge near Questa (SPRI, 1995, page B-6). It has been calculated for a mine site drainage/catchment area of approximately 3,200 acres, which includes portions of Capulin Canyon and Spring Gulch drainage areas that are outside of the projected capture zone for the mine. The other estimate presented in SPRI's report (SPRI) uses assumptions as to the amount of infiltration which appear to be too high, and which are not as reliable as the data-based estimate.

5. The SPRI estimate of average recharge is also appropriate for the 1980s to the 1990s. The average Red River flow at the Questa gauge was 48.6 cfs for the period 1943 to 1955, for which the above recharge estimate was performed. The flow during this period is close to the average flow at Questa during the 1980s and 1990s, i.e., 50.8 cfs for 1980 through 1993.

6. Correcting the SPRI's estimate for the area captured by the underground mine workings, which is approximately 2,300 acres (Attachment C), yields a ground water recharge rate of about 210 gpm.

7. Accounting for the increases in surface flows to the underground mine caused by the diversion of the upper portions of the Capulin Canyon and Goathill Creek Drainages (approximately 585 acres), and of surface water collecting in the open pit area (575 acres) yields approximately an additional 103 gpm (Attachment C, Table 1). This means that on the average, approximately 313 gpm, including the diversions and open pit, infiltrate in the underground mine's capture area.

8. Molycorp's reported equilibrium pumping rate from the underground workings is 270 gpm (Molycorp, 1997). To this amount should be added any seepage that occurs out of the mine through deep fractures. As the typical level of accuracy of these types of calculations is of the order of 20 percent, the over 270 gpm from the underground mine and the 313 gpm total infiltration may be treated as the same values. This indicates that virtually all the ground water flow in the mine's capture area is being pumped out of the area and does not migrate to Red River.

9. The estimated underground mine workings cone of depression captures seepage from the Capulin Canyon, Goathill Creek, and Sugar Shack West overburden piles, most of the western potions of the Sugar Shack South and Middle, and Sulfur/Spring Gulch piles and the open pit

overburden disposal piles (Figure 3). The only overburden that appears to be outside of the capture area is the Spring Gulch pile, and the limited eastern portions of the Sugar Shack South, Middle and Sulfur/Spring Gulch piles. The potential for seepage of constituents from the Spring Gulch overburden pile to Red River is very limited, based on evaluations and testing conducted by SRK, it contains black andesite, aplite and granite; *"These materials exhibit an average net neutralization potential. The average NP/AP ratio for black andesite and aplite/granite exceeds 3:1, indicating low acid producing potential."*

10. The potential for seepage of constituents from the Sulfur/Spring Gulch pile is also very limited because the eastern portion of this pile projected outside the underground mine capture zone, contains nonacid-generating black andesite and aplite/granite (SRK, 1995, page 33). Furthermore, the potential for seepage of constituents from this pile may be further reduced by the decline, which is a downward sloping tunnel that passes under the Sulfur/Spring Gulch pile and which could be intercepting ground water seepage from that pile. SRK in their report (SRK, 1995, page 29) indicate that ground water seepage occurs into the decline. Plaintiffs' expert Dr. Mink (Mink deposition, 1997, page 135) concurs that the decline may be dewatering ground water in the vicinity of monitoring well MMW-14 and -16, along the eastern edge of Sulfur/Spring Gulch pile.

11. The potential for seepage of constituents to Red River from the eastern portions of Sugar Shack South, Middle, and Sulfur/Spring Gulch piles is further reduced because the eastern faces of these piles have been covered with nonacid-generating black andesite and aplite/granite (SRK 1995, page 33).

3.2.2 GEOCHEMICAL PROCESSES

1. As previously mentioned, seepage containing constituent concentrations is subject to attenuation by the alluvium and fractured bedrock through which it migrates. Evidence that a significant amount of attenuation capacity exists in the fractured bedrock is the quality of the underground mine water. As discussed by SRK (SRK, 1995, page 27 and Table 1.4), the water pumped out of the mine is characterized by neutral pH, high TDS and sulfate and reduced metal concentrations, typical changes that occur during attenuation.

2. Further support for the presence of the natural attenuation capacity of the fractured bedrock is found in the inherent characteristics of the rocks in the area. The abundance of alkaline and calc-alkaline volcanic host rocks, such as aplite, latite, and dacite, and the added presence of natural carbonate alteration products in mineralized zones, provide natural neutralization capacity for migrating acidic water. Secondary alteration minerals, such as gypsum, provide additional neutralization capacity. The erosion and deposition of these materials in the valley fill alluvial deposits as cementation agents or detritus also provide neutralization capacity.

3. While SRK (SRK, 1995) indicates the alluvium has a limited neutralization potential, its samples were limited to three locations (Nos. 86, 88 and 94, Figure 3.3, SRK, 1995). Two of these samples (i.e., 86 and 88) could have been collected from alluvial material derived at least partly from the erosion of natural scar material. None of these samples are representative of the fractured bedrock under the overburden piles, which is where most of the seepage from these piles would go, nor are they representative of the alluvium along Red River.

3.2.3 MIXED SOURCES

1. As discussed above, there are a number of natural and mining related sources of constituents. They not only include the scar areas and overburden piles, but also generally mineralized acid-generating areas such as the lower Capulin Creek area (SRK, 1995), and alluvium derived from eroded scar material that has been deposited in the tributary creekbeds as well as the bed and banks of the Red River. Evidence for the presence of mineralized material in the creekbeds is also provided by some of the soil samples collected by SRK (Samples 10, 69, 70, 73, 87, HC6, and HC7; SRK, 1995). Furthermore, ground water in the alluvium south of Red River (i.e., on the opposite side of the river from the mine site) has a low pH (GSi, 1997), which provides more evidence of potential acid-generating mineralized material along the Red River.

2. The alluvium was placed in the creek and Red River beds over the past three million years, i.e., during the Quarternary Period. As this has been, and continues to be, an ongoing erosional/depositional process, new acid-generating mineralized material is continually being added, as the in-situ material oxidizes and slowly dissolves.

3.3 RED RIVER WATER QUALITY

3.3.1 INTRODUCTION

1. The reasons the available data does not support the conclusion that water quality in Red River has worsened between the 1960s and the 1990s due to mining activities are as follows:
   - **Climatic Trends:** The 1960s data was collected during a much drier period than the 1980s and 1990s information and cannot, therefore, be compared to the later data as constituent loadings to the river naturally increase during wetter periods.
   - **Reductions in Migration of Constituents:** Certain aspects of the Molycorp mining activities have resulted in reductions in the migration of constituents to the Red River.

   Each of these reasons are discussed in more detail below.

3.3.2 CLIMATIC TRENDS

1. As shown in Figures 4 and 5, both the precipitation and the flow in Red River have increased significantly from the 1960s through the 1990s. These graphs show the five-year moving average precipitation and runoff and therefore reflect the average annual accumulation over the previous five years. This approach is commonly used to establish trends in data; it makes these trends more visible by averaging out the extreme wet and dry years.

2. Figure 5 shows that average Red River flows have increased from approximately 30 cubic feet per second (cfs) in the 1960s and 1970s to 50 cfs in the 1980s and 1990s. As a result, the catchments adjacent to the river would have been a lot wetter in the 1980s and 1990s, thereby increasing the flushing of constituents into the river. Wetter conditions result in:
   - Higher rates of infiltration through the unsaturated soils and fractured bedrock containing weathered, mineralized material above the ground water table.
   - Higher ground water levels contacting more weathered mineralized material.
   - Increased ground water flow resulting in increased rates of constituent migration into the Red River.

3.3.3 REDUCTIONS IN MIGRATION OF CONSTITUENTS

1. Several of the mining and related activities result in reductions of constituent loads to the Red River. These include:
   - The dewatered underground mine workings which intercept a large proportion of the ground water flow towards the Red River as shown in Figure 3 (see discussion in Section 3.2.1).
   - The stormwater control systems prevent surface runoff contribution of both dissolved constituents and sediment into the Red River.
   - The diversions from Capulin Canyon to Goathill Creek reduce the constituent load in seepage for the upper portion of Capulin Canyon.
   - The subsidence area, intentionally created in the Goathill drainage, captures the surface runoff and seepage from the upper portion of Goathi.. Creek and conveys it to the underground workings.

However; how thick are the Piles?

3.4 SOURCE OF CONSTITUENTS IN RED RIVER

1. The available data do not allow for determination of whether constituent loadings in Red River are derived from overburden piles, natural scar areas, or from the alluvial deposits within the tributary and Red River channels. The reasons for this are that there are a large number of processes that determine whether constituents from the overburden piles actually migrate to Red River, most of which have not been characterized. These processes include : (1) the relative loadings of overburden piles and natural scar areas which determine what the potential proportion of source constituents are due to the overburden piles; (2) the migration pathways through the unsaturated zone and then through ground water; (3) the extent of geochemical changes that occur in seepage as it migrates through alluvium and fractured bedrock; (4) the extent to which the natural alluvial material, which contains mineralized material, impacts Red River water quality; and finally (5) the extent to which the Red River water itself chemically controls the constituent levels in the water.

2. The relative TDS loading from the bottom of an overburden pile, which is not indicative of what may reach the Red River, is different and possibly much lower than from natural scars because:
   - The overburden piles contain a very large proportion of gravel and boulder-sized material which typically only provide a fraction of the constituent load compared to finer-grained materials such as sands and silts, which are the predominant composition of the scar areas.

- The scar areas are more uniformly flushed by rainfall and infiltration as they contain more uniform material. Therefore, there is an increased potential to leach out more of the constituents than in the overburden piles. Infiltration through the overburden piles tends to be varied and most of the infiltration water typically only contacts a portion of the material, thereby reducing the mass of constituents that can be leached.

3. The laboratory shake tests conducted by SRK (SRK, 1995) are not representative of the relative loadings of overburden piles and scar areas. Plaintiffs' expert Dr. Williams has concurred with the conclusion that shake tests are not representative (Williams Deposition, 1997, page 130). Shake tests are not representative because:
   - Shake tests involve an agitated mixing of the material and water. This typically results in dissolved loads much higher than in nature where precipitation trickles over or through material.
   - Infiltration through overburden piles, while diffuse, varies significantly from one area to the next and may not reach all portions of the overburden material. This infiltration pattern further reduces loads for overburden piles and cannot be taken into account in shake tests.

4. While it is known that natural scars contribute significant loadings to Red River, without knowing the relative loading of overburden versus a scar it is not possible to calculate whether loadings to Red River have changed due to mining. While mining activities have increased the area of overburden that could potentially drain to Red River, they have also captured a substantial portion of the seepage emanating from both scar and overburden areas. In some areas overburden has been placed directly on scar material and the effect of this on the residual load from this combined area is also unknown.

5. As discussed in Section 3.1, potential flow pathways from the overburden piles are extremely large in number, variable in direction and generally difficult to impossible to define.

6. As discussed in Section 3.2 above, there are a range of geochemical changes that occur as the loading emanating from the bottom of an overburden pile migrates downward and laterally. These changes can potentially increase constituent concentration if the host material is acid-generating, or reduce concentrations if the host material has attenuative capacity.

4.0 COMMENTS ON PLAINTIFF'S EXPERT REPORTS

4.1 DIRECT HYDRAULIC CONNECTION

1. Plaintiffs' experts claim that there is direct hydraulic connection between the overburden piles and Red River, and that there are sufficiently well-understood preferential flow pathways for ground water movement from the overburden piles to Red River (Kelsey, 1997, *Opinion 1*; Mink, 1997, *Opinion 1*; and Williams, 1997, *Opinions 1 and 2*). However, no evidence is presented to support these opinions, and as outlined in Section 3.0, the evidence that is available supports the contrary conclusion, i.e., that there are no discernible, confined and discrete conveyances from the mine's overburden piles to Red River.

2. Plaintiffs' experts claim that because the Red River adjacent to the mine area is gaining, i.e., it receives recharge from the adjacent land areas, and because the overburden piles are located on that adjacent land area on permeable alluvium and bedrock, a direct hydraulic connection exists (Kelsey, Page 4; Mink, Page 7). The hypothesis stated simply indicates that ground <u>water</u> can migrate from higher ground to a lower area. It does not take into account the extremely complex geology (which has a very strong influence on the direction of migration of ground water); seepage collection; underground mine dewatering; or the complex chemical reactions that occur between ground water and the alluvium and fractured bedrock, which strongly influences to what extent <u>constituents</u> in the water migrate or are attenuated.

3. Plaintiffs' general claim that the Red River is gaining is an oversimplification and specific data I was able to locate shows that the opposite may be true for large portions of the Red River reach along the mine area. The 1988 evaluation completed by USGS (USGS, 1988) indicates that the reach between the mill down to 300 feet above the mouth of Columbine Creek, loses 1 cfs (approximately 450 gpm) of flow. Furthermore, the ground water level data presented in SPRI's report (SPRI, 1995, Figure 5) and collected by the mine in the ground water wells MMW-10A, B and C and -11 (Molycorp, 1997) shows there is a gradient away from the river into the bedrock under the Sugar Shack overburden pile, which is consistent with the Red River being a losing stream in this area.

4. The significance of the above losing river segment is that it occurs in the area where some of the largest overburden piles, i.e. Sugar Shack South, Middle and Sulphur Gulch, are located

relatively close to Red River. In areas where the river is recharging ground water under these piles, there would obviously be no potential for any constituent loading to the river from these overburden pile areas. To the extent these loses persist over time, they reduce the potential loads calculated for this reach shown in Figure 6 and discussed in Section 3.3, as these calculated loads assume this is a gaining reach.

5. Plaintiffs' expert makes the general assertions that because the overburden piles are in the recharge areas, and the seepage zones are in discharge areas, and because the primary aquifer systems within the mine area are sufficiently well understood, this represents a basis for finding a direct hydraulic connection between the overburden piles and the Red River (Kelsey, 1997, page 4). This general conclusion does not take into account all the site specific facts, such as those listed below:

- Plaintiffs' experts do not appear to take into account the important fact that before mining, the bedrock and the alluvium, including the alluvium in the tributary channels as well as Red River itself, all contained naturally mineralized material that had resulted in widespread ground and surface water impacts. SPRI accurately characterized this condition by stating: *"Naturally acidic waters have been in transit through the same system, excluding seepage barriers, for thousands of years as is evident from limonite-cemented alluvial and mudflow deposits."* (SPRI, 1995, page 6).
- The seepage zones referred to in the references cited (SRK, 1995, pages 11-12, and 21; SPRI, 1995, page 5; NMED, 1996, pages 16 and 33), include Capulin Canyon, Highway 38, Cabin and Portal. With the exception of Portal, these seepage zones are not located in close proximity to the overburden piles, or in downgradient areas, and it cannot therefore be concluded they are discharge areas for infiltration through overburden piles (see Figure 1.6, page 12, SRK, 1995).
  - The Capulin seepage zone is located approximately 5,000 feet (1 mile) downgradient from the closest mapped natural scar area and over 8,000 feet (1.5 miles) downgradient from the Capulin overburden pile. In any event, seepage from the Capulin overburden pile is intercepted and conveyed to the underground mine workings. The Capulin seepage zone is located in a fan delta deposit of alluvium which contains naturally occurring acid-generating mineralization. Thus, the fan delta deposit itself is the most likely source of constituents in the Capulin seepage zone.

- The Highway 38 seepage zone is located approximately 2,500 feet downgradient from a portion of the Sugar Shack West overburden pile.
- The Cabin seepage zone is located downgradient from a small natural drainage area. This zone is over 1,500 feet away from a large natural scar area and the Sugar Shack South overburden pile located in an adjacent drainage to the northeast.
- The Portal seepage zone is located 500 to 1,000 feet downgradient from the large natural scar area and Sugar Shack South overburden pile.
- The Sulphur Gulch seepage zone is located close to the toe of the Sulphur Gulch overburden pile, and less than 1,000 feet downgradient from a large natural scar area. While this zone is close to an overburden pile it has among the lowest constituent loadings of all the seepage zones on Red River (SRK, 1995, Table 1.4). For example, TDS and sulfate were measured to be 540 mg/l and 260 mg/l respectively. By comparison, values for water samples in Hansen Creek are much higher (SRK, 1995, Table 3.1). The measured TDS and sulfate concentrations are 2,620 mg/L and 1,544 mg/L respectively. This further demonstrates that the available data is not amenable to identifying specific sources to Red River.

• Mr. Kelsey's reference to overburden piles being placed over natural tributary channels which drain to Red River (SPRI, 1995, page B-3) is also not necessarily an indication that infiltration of water through the overburden piles would increase constituent loads to the river. All the tributaries that drain the mine area, i.e., Capulin Canyon and Goathill, Sulphur, Blind, and Spring Gulches, contain either naturally mineralized scars, or alluvial fan deposits derived from the erosion of scars, or both. The effect of this natural mineralization on the seepage water quality has not been characterized to the extent it is possible to indicate whether the overburden piles have had any impact on Red River water quality.

6. As discussed in Section 3.2, the complex nature of the seepage system, the chemical interaction between seepage, ground water and the alluvium or fractured bedrock, and the unpredictability of any connection between seepage from the overburden piles and the Red River, are highlighted by the fact that the major contributions of TDS, sulfate and metals to the Red River does not occur in the Red River reach (from the mill site to 300 feet above the mouth of Columbian Creek, Stations 7 to 10 in Figure 6) where over 50 percent (approximately 180 million tons) of the overburden piles are located along the Red River, or necessarily in areas where the scar areas are closest to the Red River (Table 1.1 and

Figure 1.2, SRK, 1995). The highest loads occur in Cabin seepage zone and in the Town of Red River, with the next higher in the Hansen Creek and Eagle Rock campground areas. Only one of these areas is within the mine site (Figure 6).

7. As further support for direct hydraulic connection, Dr. Mink (Mink, 1997, page 7) indicates that *"data show that water from mine wastes contains significantly greater concentrations of sulfate and metals (aluminum, iron, manganese, zinc, copper, cadmium) than water from scar areas."* However, no facts are provided to substantiate this statement. While water samples collected below the Capulin overburden pile (WS-CAP1 and WS-GC1) have high concentrations, it is not evident whether these are due to the upgradient overburden or the underlying scars (Figure 1.5, SRK, 1995). By contrast, the water samples collected on top of the Sugar Shack South overburden pile (WS-SS1 and WS-SS2) have very low concentrations, lower than the concentrations below the natural scars in the Hansen Creek area.

8. Dr. Williams uses water quality data and the fact that the same constituents occur in the overburden piles as in Red River, to conclude that there is direct hydraulic connection between the overburden piles and Red River (Williams 1997, page 7). This approach is too simplistic as it does not make adjustments for constituents that are added from naturally occurring mineralized material in the alluvium, in the creek and river beds, and in the fractured bedrock, nor does it account for the attenuation of the overburden pile derived constituents in these same materials. Dr. Williams furthermore also fails to point out (Williams, 1997, page 8) that most of the water samples collected downgradient from overburden piles could also be impacted by natural scar material located under and adjacent to these overburden piles.

9. Dr. Williams makes the statement that *"seepage flows laterally downhill along low hydraulic conductivity barriers at the base of the waste rock"* (Williams, 1997, page 4). This is not substantiated by any of the data. Dr. Williams provides no evidence of any such barriers, in fact the available information, which indicates that bedrock is highly fractured and faulted, suggest that such barriers are not present. It is not clear how an estimate of the relative amount of ground water flow intercepted by the underground mine working cone of depression can be attempted when Dr. Williams has made no attempt to estimate the size of the cone of depression.

10. Dr. Williams' claim (Williams, 1997, pages 8 and 9) that the timing of the appearance of the white precipitate in Red River verifies a hydraulic connection, has no factual basis. No reliable scientific data is provided to support the sudden appearance of new seeps and springs since mining started. For one, the premining data collection efforts were much less intense than those of the late 80s and 90s. To my knowledge, there is no documented systematic seep survey that characterizes seeps over time on a scientific basis. I have also not seen any evaluations of the appearance and disappearance of seeps that takes into account the effect of natural seep fluctuations. Any references therefore to finding new seeps and springs is likely due to a large number of nonmining related factors including more intensive observation of the river banks, different observational and seep characterization skills by the various parties involved, varying precipitation conditions causing increases or decreases in seepage flow rates prior to the observations, and varying snowmelt conditions.

11. Dr. Mink furthermore claims that seepage from Capulin Canyon overburden pile potentially contributes sulfate and metals to Red River (Mink, 1997, page 8). Even if a portion of the subsurface seepage from the Capulin Canyon overburden pile bypasses the seepage collection and diversion system, there is no evidence to indicate these constituents in this seepage reach Red River. There is a large expanse of alluvium and fractured bedrock, over 1-1/2 miles long below the overburden piles that not only contains naturally occurring mineralized material derived from scar erosion, but also contains attenuation capacity which would reduce naturally the seepage and reduce the metal concentrations. It is therefore, equally likely that the quality of seepage that does get into Red River is largely dependent on the chemical properties of these natural materials. In addition, a fault traverses along the upper portion of Capulin Canyon. It likely extends to great depth, also providing a deep migration pathway into the bedrock below the Red River.

4.2 PREFERENTIAL FLOW PATHWAYS

1. Mr. Kelsey's claims (Kelsey, 1997, page 7) that both perched ground water conditions and the presence of fractures and faults provide preferential pathways are unsubstantiated.

2. The perching conditions referenced by Mr. Kelsey (SPRI, page 6) are stated to be speculation by SPRI themselves: *"Perched water **can** form near the base of the waste rock dumps. Perched water **can** form in zones of fractured bedrock above the main water table and above clay intervals in the valley fill. Bedrock seeps, such as the seeps at Cabin Springs, near the river, **may** be from a perched bedrock zone."* Furthermore SPRI provides no evidence or any further discussion to confirm this speculation. Finally, in an alluvium-fractured bedrock system such as the one at the mine site, widespread perching generally does not occur. Because it consists of permeable alluvium overlying permeable fractured bedrock, the ground water it contains represents a single aquifer system which fills from the bottom up. As I indicated, isolated perched conditions can occur; however, their presence would have to be identified by data, not simply by speculation.

3. The faulting and fracturing referred to by Mr. Kelsey (SPRI, 1995, Figure 3, Pages 5 and B1; Plate 2: Geologic Map of the Questa Mine Area, and Plate 1: Geologic Map and Cross Sections of the Questa Mining District) does not support his opinion on preferred pathways.
   - Figure 3 (SPRI, 1995) simply shows a geologist's conceptual definition of some of the flat lying, east-west trending faults in the area. These lines do not connote flow pathways, but merely the location of faults that are typically irregular bands of sheared and fractured rock, and that can vary in thickness up to ten or hundreds of feet. They can also include areas where the fault zone is very thin and impermeable. Furthermore, between the indicated faults there are other known and unknown faults, and between the fault zones there is fractured bedrock. All of the above fractures can convey water in a diffuse but variable pattern.
   - The other SPRI references simply contain geologic descriptions of fault systems and do not indicate preferred pathways.

4.3 GROUND WATER MIGRATION CAPTURE BY THE UNDERGROUND MINE

1. Plaintiffs' witnesses also claim that the ground water cone of depression created by dewatering the underground mine does not capture a significant portion of the shallow ground water within the mine area (Mink, 1997, Opinion 2; Kelsey, 1997, page 4) due to perching of ground water and low permeability bedrock in the vicinity of the underground mine. The available data indicates the contrary, i.e.:
   - As previously discussed, the referenced SPRI statements of perching water under waste dumps and along the edge of the river

(SPRI, 1995, page 6) are speculative and no supporting evidence is provided. My experience at several mines with similar geologic conditions is that widespread perching typically does not occur.

- The referenced SPRI statements regarding potential perching in the alluvium between the Sugar Shack south overburden pile and Red River in the vicinity of Monitoring Wells MMW-10A, B and C have been misinterpreted (SPRI, 1995, page 12).
  - SPRI indicates its preferred explanation for the results of the pump test conducted in the MMW-10A well in this area is that the water was <u>not</u> perched (SPRI, 1995, page 13). I concur with SPRI's conclusion that there is merely a lower permeability zone in the area between the two well screens in MMW-10A and -C. This is also consistent with my ground water flow analysis outlined in Chapter 3.0 which accounts for such local heterogeneities.
  - It is generally not possible to have perched water develop in alluvial deposits adjacent to rivers as these deposits are usually totally saturated up to at least the water level in the river. The suspected perched zone was indicated to be below the river's water level (SPRI, 1995, page 12) which is implausible.
  - There is reference to another potentially localized perched ground water zone in the MMW-7 well area in the SPRI report (SPRI, 1995, page 11, and Figure 8) which is interpreted by SPRI not to have any effect on the amount of water captured by the underground mine workings. As shown in their Figure 8 (SPRI, 1995) and Figure 3 attached to this report, ground water under this potentially perched area can migrate into the underground workings if the water in MMW-7 is perched.

2. The other reasons the plaintiff's experts use to imply that seepage capture by the underground mine is not significant are unconvincing. In some cases, closer examination of the data referenced in the experts' citations actually substantiates the opposite, i.e., that capture is significant. Mr. Kelsey refers (Kelsey, 1997, page 6) to the SPRI reports (SPRI, 1995, page B-7) ... incorrect conclusion, and ignores basic data in the SPRI document that shows significant capture is being achieved.

   - Because the net accretion to Red River in the mine area was measured to be the same in 1988 as it was in 1965, in spite of mine dewatering from the new underground mine that took place from the mid 1970s onwards, SPRI concluded mine dewatering did not influence or intercept any accretion to the river (SPRI, 1995, page B-7). This conclusion ignores a very well established hydrologic principal, which is that net accretion to river segments continually changes with time as it depends predominantly on both the amount and the pattern of precipitation and temperature over

the previous weeks, months and even years. Therefore, using differences in the estimated accretion in two different periods to calculate how much water is being abstracted by a mine is meaningless and could result in a wide range of values.

- Reference to Figure 8 in the same report (SPRI, 1995) clearly shows that the underground mine had a significant capture zone extending from the east near Sulphur Gulch to the west, close to Goathill Gulch, and to the south close to Red River. This significant capture zone is consistent with my own assessment of the capture achieved by the underground mine (see Figure 3 of this report).
- Both SPRI (SPRI, 1995, page B-7) and by reference Mr. Kelsey incorrectly indicate that *"most of the ground water recharge to the river may have come from the upper part of the ground water system. In other words, the deep mine was not directly in the recharge zone."* Even though there may be different hydrologic units such as alluvium, shallow fractured bedrock, and deeper bedrock, there is generally only <u>one</u> ground water system at the site. With the exception of possible localized perched conditions at MMW-7 and potentially other isolated areas, the ground water in the mine site area is continuous. Therefore, creating a cone of depression in an area will capture all ground water flow that occurs within the capture zone. Ground water cannot, as plaintiffs' expert implies, migrate over the top of a several-hundred-foot-deep ground water depression. The effect of dewatering the mine has been measured as far away as approximately 5,000 feet at MMW-13.

3. Dr. Williams claims that because water levels in wells MMW-10A, B and C, and MMW-11 had not responded to mine dewatering, this indicated the capture zone of the mine was limited. Review of all the available information however (Molycorp, 1997) indicates there have been significant responses in the alluvium at MMW-10A, 9.22 feet drawdown, and MMW-10C, 8.66 feet and in shallow bedrock at MWW-10B, 9.18 feet, and MMW-11, 8.34 feet over the period May 1995 through February 1997. The lack of response in MMW-7 can be attributed to the anisotropic nature of fractured bedrock systems, i.e., directional permeability and storativity variations which will affect the time response of drawdown cone development on locally perched water conditions.

4.4 RED RIVER WATER QUALITY

1. Both Mr. Kelsey (Kelsey, 1997, Opinion 3) and Dr. Williams (Williams, 1997, Opinions 3 and 4) claim that the mine has worsened the water quality in the Red River. Mr. Kelsey's two main reasons are: (1) his theory on hydraulic connection, which as discussed in Section 3.1 is

not substantiated by the scientific data, and (2) the water quality data from the Red River. Dr. Williams attributes her opinion to the apparent increases in constituent loadings measured in Red River.

2. Dr. Williams claims that *"sulfate and metal loadings in the reach of the Red River adjacent to Molycorp Mine is more attributable to mining activities and emplacement of waste rock piles than to natural hydrothermal scars"* (Williams, 1997, Opinion 3, Page 5). The Red River water quality data relied on does not demonstrate that constituent loads to the Red River increased from 1966 to 1992 due to mining activities. As discussed in Section 3, there are other factors that cause changes to constituent loads to the Red River.

3. Mr. Kelsey has claimed that the Moly Tunnel *"caused the subsequent emergence of Portal Spring"* (Kelsey, 1997, Page 9). This statement is unsubstantiated, and the limited data that is available suggests that the "Moly Tunnel" does not likely represent a measurable source of seepage to Red River.

4. While the Moly Tunnel drained, the limited flow was reported to have been collected and reused in the mill (Dave Schoemaker Deposition, 1996). Flow in the tunnel is reported to have been derived from ground water inflow to the historic underground mine and precipitation recharge through the open pit, both of which are located at the upper end of the Tunnel. Once the new underground mine went into production (i.e., early 1980s), water no longer flowed out of the Tunnel, but was collected and drained down into the mine via a winze (i.e., a vertical shaft internal to the mine workings). Thus the volume of water Mr. Kelsey assumed would be accumulating behind the plug actually flowed down into and is collected in the underground workings. The Tunnel mouth was plugged in 1992 to avoid surface discharges in the event the winze became plugged (David Shoemaker Deposition, 1996).

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EXPERT REPORT BY IAN P.G. HUTCHISON
(Continued)

5. Recent inspections of the plug by Molycorp staff (Molycorp. 1997) indicate that there has been only a small (approximately two feet) of head behind the plug. The amount of standing water is relatively small and is not likely to cause any measurable increase of seepage to Red River. The effect of this small amount of water is that of a small surface pool of water located approximately 200 feet from the Red River.

Ian P.G. Hutchison

Dated: April 23, 1997

TABLE 1

CALCULATION OF TOTAL AVERAGE BASEFLOW AND RUNOFF FROM MINE AREA FOR PERIOD 1980 TO 1993

- Average Streamflow for Period 1943-1955 (Gauge near Questa): 48.6 cfs
- Average Streamflow for Period 1980-1993 (Gauge near Questa): 50.8 cfs
- Average Streamflows for Common Period 1943-1964 (22 years)
  - Gauge near Red River (19.1 square miles): 17.04 cfs
  - Gauge near Questa (113.0 square miles): 44.70 cfs

  Increase: 27.66 cfs over 93.9 square miles

  = 0.295 cfs/square mile
- Average Streamflow for Common Period 1963-1973 (11 years)
  - Gauge below Zwergle Dam (25.7 square miles): 17.27 cfs
  - Gauge near Questa (113.0 square miles): 32.10 cfs

  Increase: 14.83 cfs over 87.3 square miles

  = 0.170 cfs/square mile

Average Increase in Streamflow = (22 x 0.295 + 11 x 0.170)/33 = 0.253 cfs/square mile

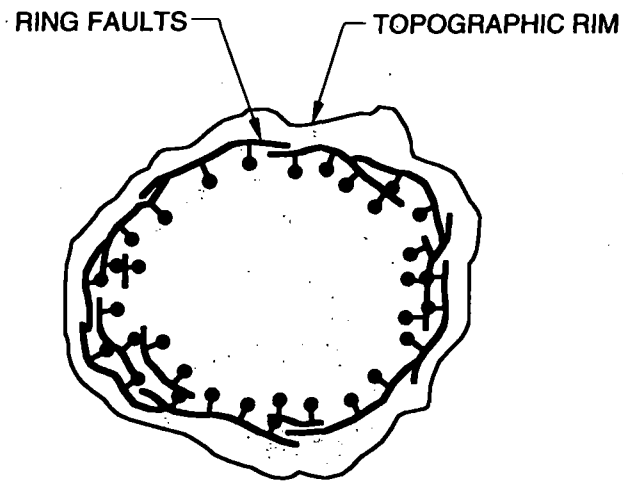
Amount of Base Flow (Recharge) Calculated by SPRI = 11.04/87.3 = 0.126 cfs/square mile

Amount of Surface Runoff Calculated by Differencing

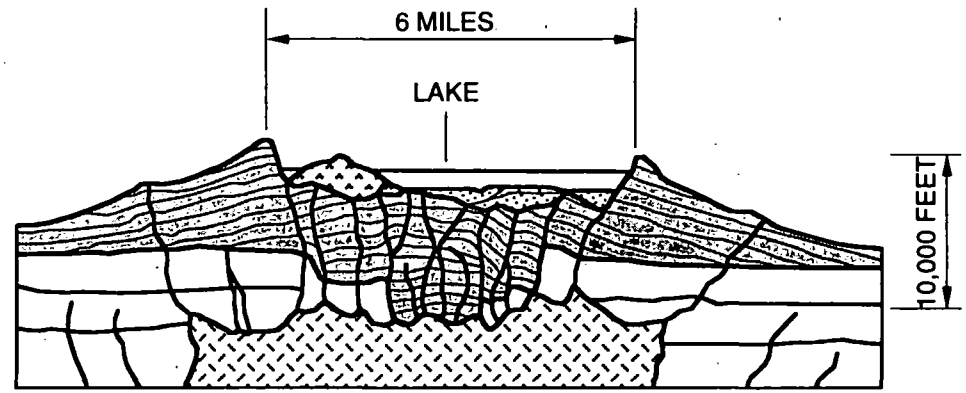
= 0.253 - 0.126
= 0.127 cfs/square mile

For 1.81 square miles (1,160 acres = 575 + 585)

= 0.230 cfs
= 103 gpm



PLAN



SECTION

FIGURE 1

CONCEPTUAL PRESENTATION OF FAULTING IN A TYPICAL CALDERA (BASED ON CRATER LAKE, OREGON TWISS AND MOORES, 1992)

TRC ENVIRONMENTAL SOLUTIONS, INC.

97-122EW-05 REV.04/23/97

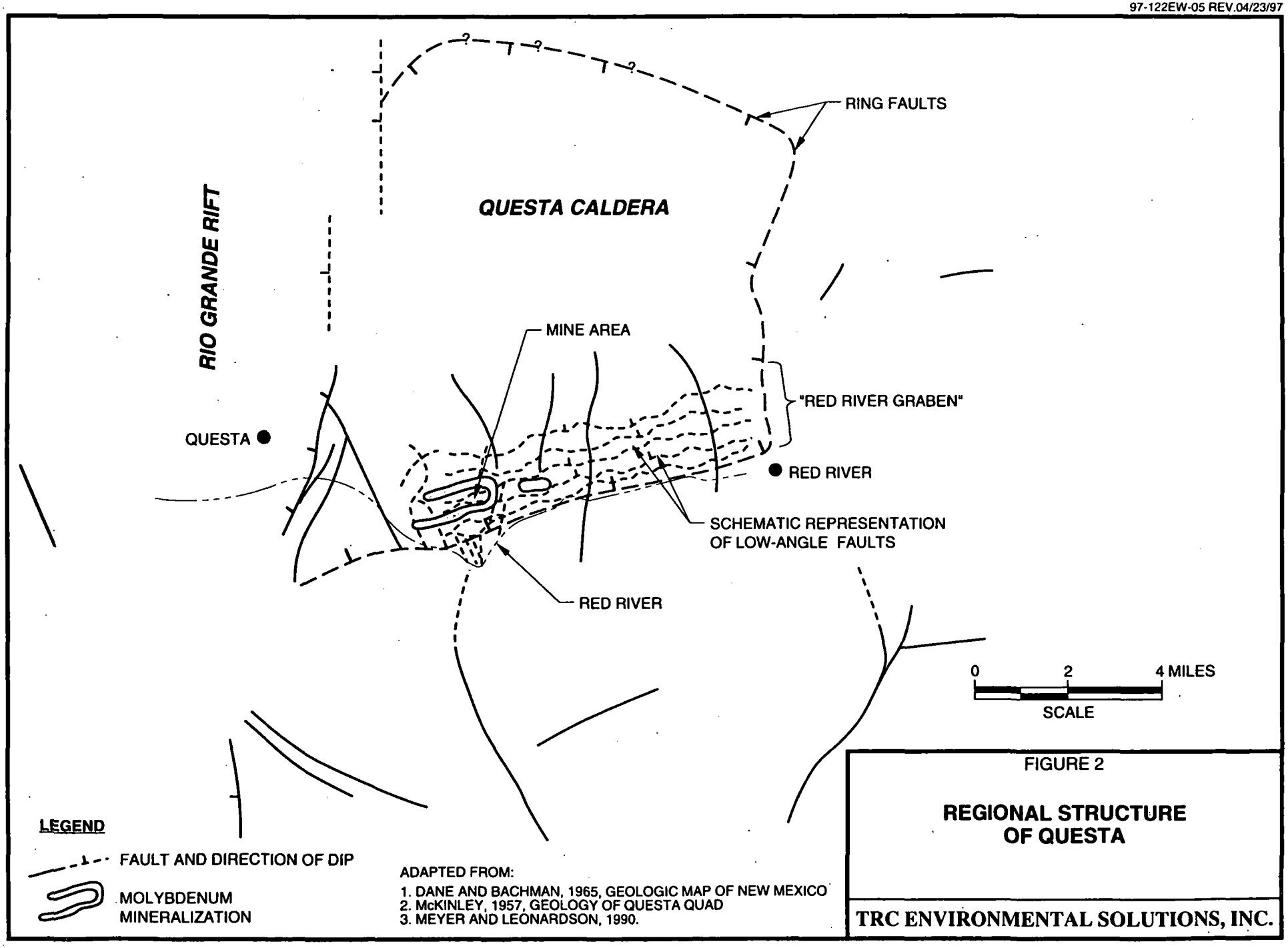
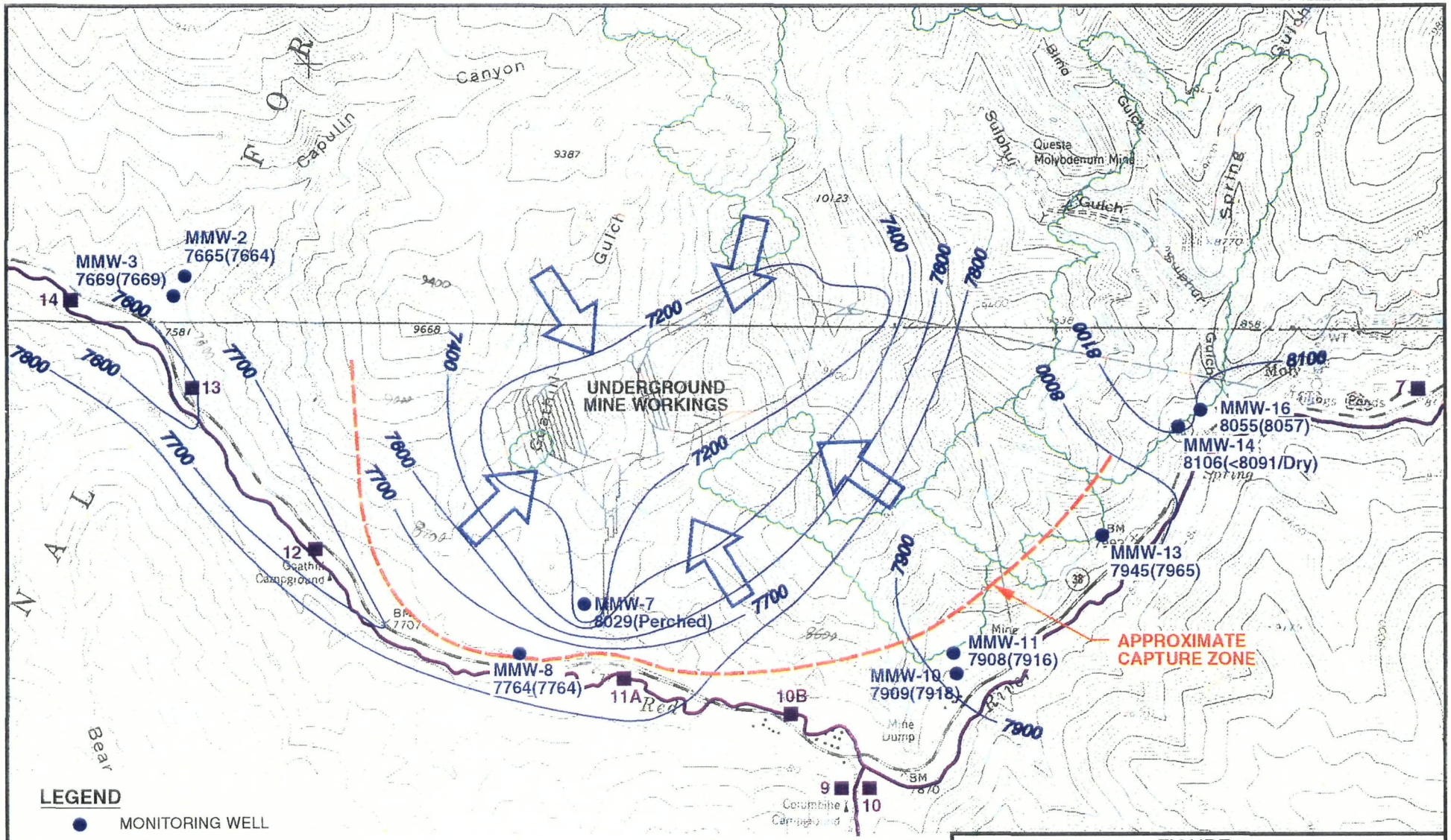


FIGURE 2

REGIONAL STRUCTURE OF QUESTA

TRC ENVIRONMENTAL SOLUTIONS, INC.

97-122EW-02 REV.4/21/97



LEGEND

- ● MONITORING WELL
- 7908 FEBRUARY 1997 ELEVATION
- (7916) JANUARY 1996 ELEVATION
- ■ RED RIVER SAMPLE LOCATION
- GROUND WATER FLOW DIRECTION
- OVERBURDEN DISPOSAL PILES (SRK, 1995)

0 2000 4000 FEET

SCALE

REFERENCE: U.S.G.S. TOPOGRAPHIC MAPS OF QUESTA AND RED RIVER, NEW MEXICO DATED 1963.

FIGURE 3

GROUND WATER CONE OF DEPRESSION CREATED BY DEWATERING OF THE UNDERGROUND MINE

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97-122EW-03 REV.04/21/97

FIGURE 4

FIVE YEAR MOVING AVERAGE PRECIPITATION AT RED RIVER

TRC ENVIRONMENTAL SOLUTIONS, INC.

97-122EW-04 REV.04/21/97

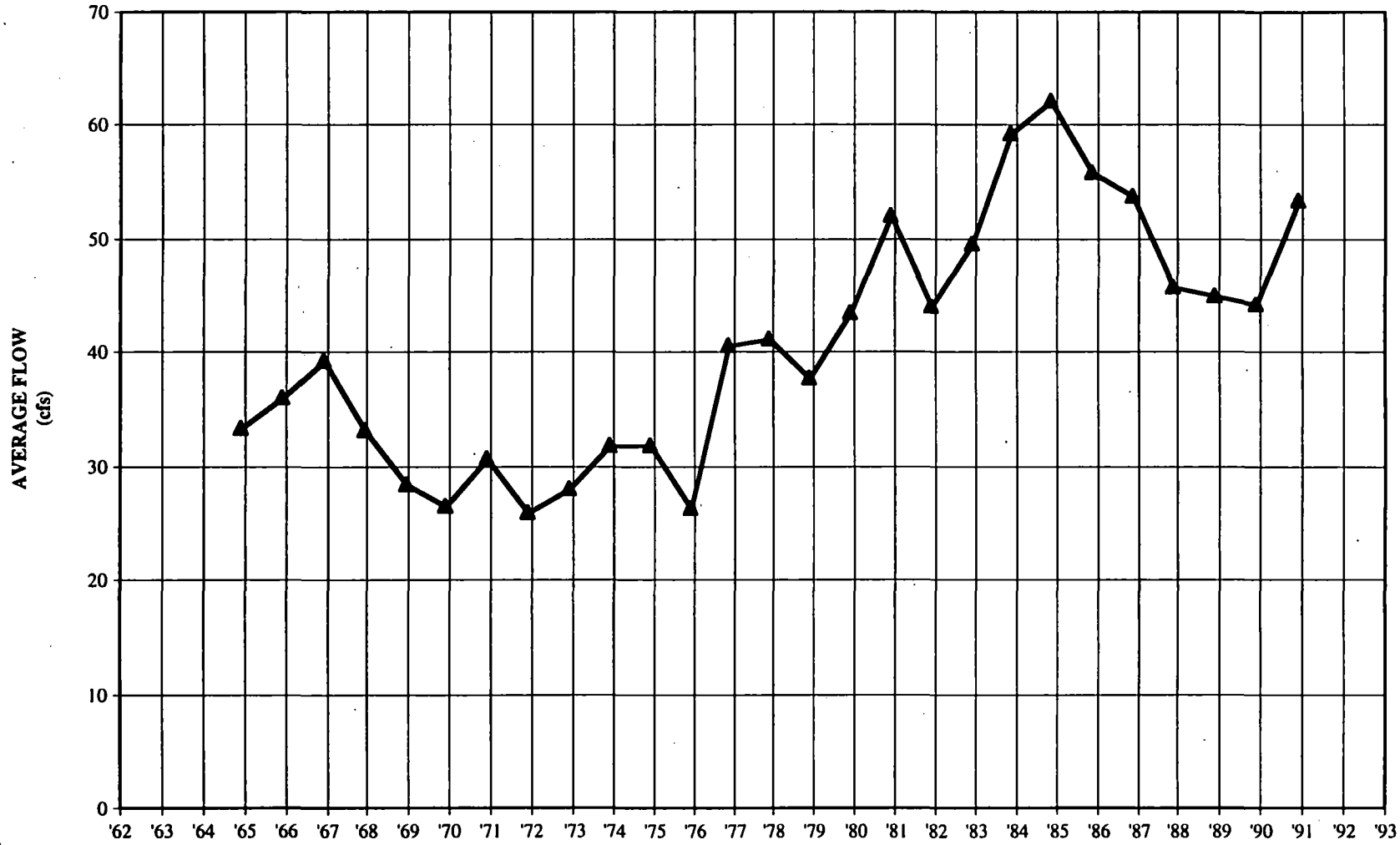
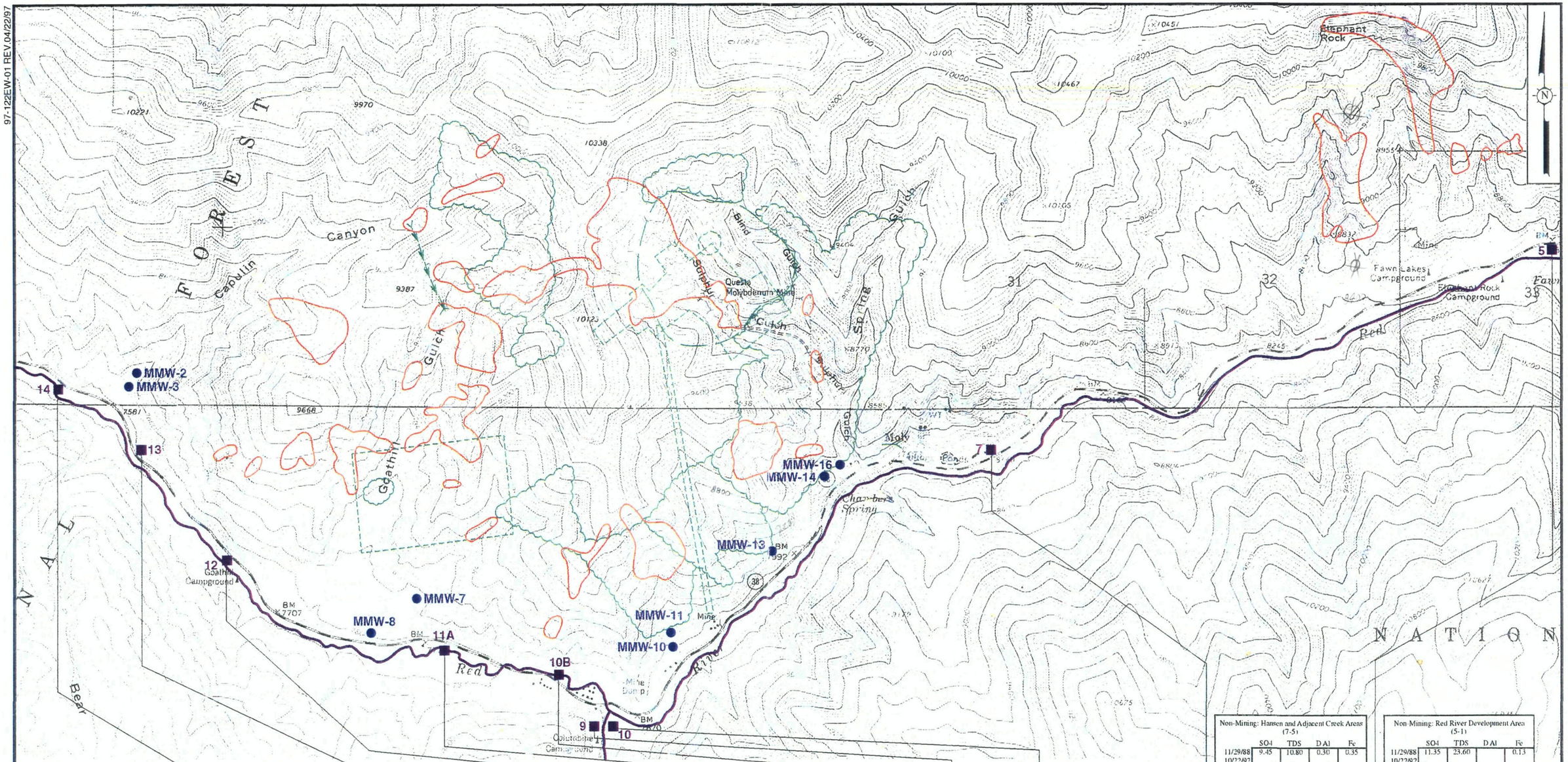


FIGURE 5

FIVE YEAR MOVING AVERAGE RED RIVER FLOW NEAR QUESTA

TRC ENVIRONMENTAL SOLUTIONS, INC.

97-122EW-01 REV.04/22/97



Non-Mining: Catchment Areas Downgradient from the Mine Site (17-14)	SO4	TDS	D Al	Fe
11/29/88	9.38	29.82	0.20	0.42
10/22/92	9.60	30.54	0.21	-0.06
2/16/93				
11/10/93	-2.46	0.69	0.29	1.29
2/11/94				
10/13/94	37.44	23.73	0.00	0.10
2/14/95	10.69	37.23	-0.01	0.06
11/9/95	4.21	-37.22	0.02	-1.74
2/26/96	5.51			
Average	10.63	14.13	0.12	0.01
Ranking:	6	6	3	6

Mining: Capulin Creek Area (14-13)	SO4	TDS	D Al	Fe
11/29/88	-2.79	-1.50	0.33	0.09
10/22/92	13.40	33.72	0.01	0.05
2/16/93	10.34	10.96	0.01	0.11
11/10/93	6.42	9.60	0.74	4.16
2/11/94	2.46	5.07	0.01	0.49
10/13/94	-2.24	5.53.	0.01	0.07
2/14/95	3.29	2.03	0.00	-0.56
11/9/95	-0.57	61.18	-0.02	1.69
2/26/96	11.87			
Average	4.69	15.82	0.14	0.76
Ranking:	8	4	2	1

Mining: Remainder of Catchment Area Adjacent to and West of Goathill Creek (13-12)	SO4	TDS	D Al	Fe
11/29/88	11.71	8.11	0.19	-0.10
10/22/92	-4.59	-14.64	-0.03	0.01
2/16/93	-2.78	0.38	0.00	0.01
11/10/93	0.18	21.46	0.14	-0.47
2/11/94	5.19	8.56	0.00	-0.62
10/13/94	6.21	0.46	0.00	0.02
2/14/95	2.51	1.53	0.00	0.62
11/9/95	6.09	15.79	0.01	0.08
2/26/96	0.19			
Average	2.75	-4.11	0.04	-0.06
Ranking:	9	9	6	8

Mining: Goathill Creek Area (12-11A)	SO4	TDS	D Al	Fe
11/29/88				
10/22/92				
2/16/93				
11/10/93	17.07	-0.40	-0.11	0.99
2/11/94				
10/13/94	19.27	22.53	0.01	-0.07
2/14/95	18.17	11.07	-0.05	0.46
11/9/95	13.35	25.71	0.01	-2.78
2/26/96	8.98			
Average	15.37	14.73	-0.04	-0.35
Ranking:	2	5	8	9

Mining: Remainder of Catchment Area Adjacent to and East of Goathill Creek (11A-10B)	SO4	TDS	D Al	Fe
11/29/88				
10/22/92				
2/16/93				
11/10/93	18.76	33.57	-0.13	0.10
2/11/94				
10/13/94	11.72	-4.73	0.00	0.02
2/14/95	2.95	-5.57	-0.10	0.08
11/9/95	5.86	1.65	0.02	2.31
2/26/96	-1.11			
Average	7.64	6.23	-0.05	0.63
Ranking:	7	8	9	2

Mining: Catchment Area opposite Columbia Creek (10B-10-9)	SO4	TDS	D Al	Fe
11/29/88	-35.95	-84.50	-0.72	-0.22
10/22/92	13.49	20.15	0.07	-0.04
2/16/93	15.92	36.07	0.06	-0.14
11/10/93	6.34	21.72	0.13	-0.03
2/11/94	12.97	22.37	0.05	0.28
10/13/94	34.24	30.65	0.08	0.00
2/14/95	17.10	14.18	0.08	-0.01
11/9/95	12.70	33.66	-0.03	0.35
2/26/96	29.00	0.00	0.00	0.00
Average	11.76	10.48	-0.03	0.02
Ranking:	4	7	7	5

Mining: Mill, Portal Spring, and the Spring Gulch, Sulfer Gulch, Middle and Sugar Shack South Overburden Disposal Pile Area (10-7)	SO4	TDS	D Al	Fe
11/29/88	13.07	21.98	0.10	-0.30
10/22/92	17.58	14.19	-0.09	-0.02
2/16/93	10.46	17.25	0.01	0.10
11/10/93	4.13	20.94	0.46	-0.09
2/11/94	16.41	21.39	0.01	0.20
10/13/94	12.33	19.15	0.10	-0.02
2/14/95	3.59	8.38	0.01	-0.06
11/9/95	13.18	13.67	0.00	0.10
2/26/96	6.61			
Average	10.82	17.12	0.07	-0.01
Ranking:	5	3	5	7

Non-Mining: Hansen and Adjacent Creek Areas (7-5)	SO4	TDS	D Al	Fe
11/29/88	9.45	10.80	0.30	0.35
10/22/92				
2/16/93				
11/10/93	8.61	26.01	0.37	-0.05
2/11/94				
10/13/94	20.05	22.69	0.02	0.12
2/14/95	14.99	18.26	0.01	-0.01
11/9/95	15.08	28.41	0.02	-0.05
2/26/96	16.09			
Average	14.04	21.23	0.14	0.07
Ranking:	3	2	1	4

Non-Mining: Red River Development Area (5-1)	SO4	TDS	D Al	Fe
11/29/88	11.35	23.60		0.13
10/22/92				
2/16/93				
11/10/93	28.39	50.27	0.09	0.22
2/11/94	19.87	36.94	0.09	0.18
10/13/94	32.51	63.65	0.11	0.08
2/14/95	24.79	53.86	0.02	0.11
11/9/95	24.56	42.38	0.03	0.17
2/26/96	27.00			
Average	24.06	45.12	0.07	0.15
Ranking:	1	1	4	3

LEGEND

- MONITORING WELL
- RED RIVER SAMPLE LOCATION
- UNDERGROUND MINE WORKINGS AND OPEN PIT
- SCAR AREAS (SRK, 1995)
- OVERBURDEN DISPOSAL PILES (SRK, 1995)
- ADIT

0 2000 4000 FEET
SCALE

REFERENCE: U.S.G.S. TOPOGRAPHIC MAPS OF QUESTA AND RED RIVER, NEW MEXICO DATED 1963.

FIGURE 6

INCREMENTAL SURFACE WATER LOADINGS (GM/SEC)

TRC ENVIRONMENTAL SOLUTIONS, INC.

ATTACHMENT A

Ian P. G. Hutchison

EDUCATION

B.S., Civil Engineering, University of Capetown, South Africa, 1967.
Graduate Diploma, Hydraulic and Soils Engineering, University of the Witwatersrand, South Africa, 1974.
Ph.D., Hydrology, University of the Witwatersrand, South Africa, 1976.

EXPERIENCE DETAIL

1989-Present: Senior Vice President, TRC Environmental Solutions, Inc.

- Expert witness for the following:
  - Stringfellow Superfund site, California (surface water-VOCs and metals) (Deposition and Trial Testimony 1987 through 1993).
  - Rancho California Airport site, California (ground water - hydrocarbons) (Deposition).
  - John Wayne Airport site, California (ground water - VOCs) (Expert Report, 1990).
  - Testimony to the County Supervisors on the Briggs Mine EIR, Inyo County, California (mine waste management). (Hearing Testimony, 1995).
  - Iron Mountain Mine site, California (acid drainage, metals) (Expert Review, 1994).
  - Hope Brook Gold Mine in Newfoundland, Canada (mine waste management, surface water). (Expert Report, 1995)
  - Confidential gold mine site in the southwestern United States (mine waste management, surface and ground water) (Expert Report, 1996).
  - Stanford Research Park Industrial Complex in Palo Alto, California (ground and surface VOCs) Expert Report, 1993).
  - Hattiesburg Wood Treatment Site, Mississippi (soil and ground water-wood treatment chemicals) (In progress 1995 - 1996).
  - Meyer's Drum Reprocessing Facilities (soil and ground water PCBs, Bunker C, metals and COCs) (Expert Report and Deposition, 1996).

- Project Director or Principal-in-Charge for the following remediation projects:
  - Site characterization and remedial design for the historic Pacific Coast Pipeline Refinery/Superfund site in Fillmore, California involving heavy and light hydrocarbon fuels. Remediation included soil vapor extraction and ground water pump and treat.
  - Site characterization and remedial design for the Purity Oil Recycling Facility Superfund site which is impacted by hydrocarbons and volatile organics (VOCs). Remedial technologies included soil vapor extraction, capping and ground water pump and treat.
  - Site characterization, risk assessments and remedial planning for the large operating Unocal refinery at Wilmington. Constituents of concern included hydrocarbons and lead. Remedial technologies included capping, soil excavation and treatment, and in-situ ground water treatment.

- Site characterization and remedial design, and record of decision (ROD) changes, for the J.H. Baxter Superfund site in northern California. Constituents of concern include dense nonaqueous phase liquids (DNAPLs); i.e., creosote, polychlorinated phenols (PCP), and metals including arsenic, chromium and zinc. Remedial elements included soil excavation, ex-situ biotreatment, onsite disposal in a RCRA-equivalent cell, in-situ biotreatment, slurry wall and limited ground water extraction and treatment.
- Site characterization, remedial design, and ROD changes for the Cabot Carbon/Koppers Superfund site (Wood Treatment Plant) in Gainesville, Florida involving creosote, PCP and metals. Remedial technologies included capping and "passive" slurry wall systems.
- Site characterization and remedial design, and construction oversight for the Feather River Wood Treatment site in Oroville, California which involves creosote, PCP and metals. Remediation included soil excavation and disposal in onsite RCRA-equivalent cells.
- Site characterization and remediation planning at the Vega Alta industrial site in Puerto Rico (VOCs). Remediation included selective ground water pump and treat.
- Site characterization and remediation planning at the Boricua Wood Treatment site in Puerto Rico (arsenic). Remedial technologies included soil excavation, offsite disposal and capping.
- Site characterization, remedial planning and design, and remediation construction at a mercury mine and processing facility in California. Technologies employed included building decontamination and demolition, soil excavation stabilization and offsite disposal, and buried drum location and removal.
- Remedial design for closure of tailings piles at the Shafter Silver Mine in Texas. Closure included regrading and capping.
- Assessment of closure liability and costs including conceptual designs and cost estimates for acid mine drainage control and treatment systems at mines in Colorado, Idaho and Nevada as part of a corporate acquisition. Closure technologies included physical, chemical and wetlands (biological) treatment, regrading and capping.
- Corrective action planning and design for a RCRA wood treatment facility in Montgomery, Alabama (constituents of concern include PAHs, PCP, metals and dioxins). Corrective action technologies include a "passive" slurry wall.
- Site characterization and interim measures implementation and evaluation at the Charleston Superfund site (wood treatment plan) in South Carolina. The technology tested involved NAPL removal well systems.

• Project Director or Principal-in-Charge for the following mining projects:
  - Development of closure plans for the Cactus Gold Heap Leach Mine in Lancaster, California. Closure elements included regrading and backfilling of pond areas.
  - Development of closure plans for wastewater ponds and tailing impoundments, tailings impoundment corrective actions, and ground water impact characterization for the Molycorp Mountain Pass rare earth mine, California. Characterization involved demonstration of limited seepage migration from tailings impoundment, and remedial/ closure technologies included a seepage interception well system, innovative cost-effective silty material caps for landfills and tailings ponds, and improvements to the wastewater treatment system (neutralization and settling).
  - Development of closure plans for an acidic waste rock disposal pile at the Homestake Mine, California. Closure technologies included short-term leachate collection and return systems and long-term control by encapsulation of the waste rock in clay cells.

- Development of closure plans and designs, and permitting of wastewater transfers at the Royal Mountain King Gold Mine, California. Operation of mine site during closure period. Technologies employed included RO treatment and solar evaporation of wastewater, regrading, soil and composite covers for tailings ponds and earthfill dam construction to contain pit lake levels.
- Planning and conceptual design of wastewater disposal systems for the Sonora Gold Mine, California. Systems permitted included land application on waste rock piles and blending and discharge under the NPDES program.
- Seepage evaluations, design of seepage control systems and a spill control dam at the Cerro Verde Mine in Peru.
- Briggs Gold Mine heap leach environmental impact report (EIR), California.
- Soledad Canyon gravel mine and site infrastructure design for TMC.
- Permitting of three copper mines and associated processing plants (heap leaching, SX/copper sulfate and EW facilities) in COREMA Region II (Atacama Desert) in Chile.
- Remediation designs and closure plan development for four lead/zinc/copper mines in the Peruvian Andes. Technologies included regrading, capping, underground mine sealing and wetlands treatment systems.
- Characterization and remedial planning for the control of acid drainage from historic mines in the Moche, Llaucano, and Parcoy River Basins in northern Peru.

• Regulatory development activities, including:
  - Senior editor and author of a 650-page textbook on mine waste management.
  - Preparation of industry "strawman" mine waste regulations for California.
  - Senior editor and reviewer of the Arizona BADCT mine waste regulations.
  - Presentation of testimony on mine waste management to State Hearing Boards in California.

• Senior Review Consultant on the following projects:
  - OII municipal/industrial landfill Superfund site in California (cover design, leachate collection and treatment and ground water characterization and remediation).
  - Site characterization and remedial planning at the closed Casmalia RCRA hazardous waste landfill site, California. Remediation includes ground water trench collection systems and capping.
  - Design of the B-18 hazardous waste disposal cell at Kettleman Hills, California.
  - Expansion plans for the McFarland-Delano Municipal Landfill, California.
  - Lead-zinc mining district Superfund site RI/FS in Kansas and Missouri (Jasper County and the Baxter Springs-Treece Superfund sites).
  - Development of a strategic RCRA compliance plan and designs for FMC's lithium production facility in Bessemer, North Carolina.
  - Site characterization and remedial planning including technology impracticability evaluations for Bristol Meyers' Weck Industrial site in North Carolina.
  - Site characterization and remedial design for two drum recycling facilities in Oakland and Emeryville, California (VOCs, PCB, heavy hydrocarbons and metals).
  - San Fernando Valley Superfund Site (Glendale Operable Unit) 5,000 gpm ground water remediation project.
  - Reassessment of proposed remedial ground water pumping at an industrial site in Ontario, California. Alternative proposed utilized natural attenuation to limit ground water extraction and treatment.
  - Characterization of waste rock for the Mule Canyon Mine in Nevada.

1981-1989: Managing Principal and Division Head, Water Engineering, Steffen Robertson and Kirsten

- Responsible for the U.S. operations of the company, including several hundred projects involving waste management, water pollution control, land use and air quality permitting, and open pit mining.
- Direct technical management of solid waste disposal, hazardous waste and hydrologic work carried out by the company.
- Project principal in charge of the design and construction of mine tailings and waste rock disposal facilities in Alaska, Washington, California, Colorado, Utah, and Nevada.
- Expert witness on the Stringfellow Superfund Site.
- Technical oversight on investigations carried out on the Boulder Marshall Municipal Waste Landfill Superfund site in Colorado.
- Technical expert review work on ground and surface water and soil pollution problems on mining Superfund sites including California Gulch, Colorado, and Galena, Kansas. Development of a comprehensive approach for the development of ARARs.
- Presentation of specialist technical evidence for ground and surface water contamination problems at mine sites in California and New Mexico.
- Supervision of regional hydrologic and water balance studies for the Rio Grande River basin.
- Embankment dam design and construction in California and Washington (fill dam heights of up to 400 feet).
- Project management of the design of 100-acre waste water disposal ponds in California.
- Testimony on water quality and waste management issues at the State and Regional Water Quality Control Boards in California.

1976-1981: Hydraulics Department Head/Project Engineer, Acres International

- Hydrologic and hydraulic engineering aspects of all projects conducted in the United States, and maintaining a staff team to undertake the work.
- Hydroelectric projects in New York, Maine, Vermont, and Alaska, including the Susitna River project in Alaska.
- Industrial process plants and tailings disposal systems in Ohio and Colorado.
- Streamwater quality studies in New York.
- FEMA flood plain mapping studies.
- The hydrologic and hydraulic engineering associated with a wide range of irrigation, navigation, hydroelectric, and industrial projects throughout Canada, the United States, and South America.

- Irrigation schemes in the Dominican Republic and Bolivia.
- Design and construction of three ports on the Amazon River in Peru.
- Design and construction of hydroelectric generating stations in Newfoundland, Ontario, and Alberta, Canada.
- Large-scale river basin water balance studies in Alberta, Canada.
- Regional flood studies for the province of New Brunswick, Canada.

1970-1976: Research Officer, Hydrological Research Unit, University of the Witwatersrand, Johannesburg, South Africa

- The development and application of river basin catchment, ground water, lake and estuary computer models for the evaluation of salinity control measures of the St. Lucia Lake system.
- Provided input to the update of national design flood manuals.
- Numerous consulting assignments involving the development of surface water supplies and implementation of flood control measures for projects in South Africa, Botswana, and Lesotho.
- Conducted graduate courses in computer modeling of surface water systems and water resources project economics.
- Conducted a study tour of the United States and Canada to review available technology for the modeling of flow and water quality of surface systems.

1968-1970: Engineer, Technical Computing Company, Johannesburg, South Africa

- Development and application of structural analysis computer software for the design of bridge decks and pile groups, and one-dimensional tidal propagation modeling in estuaries.

REGISTRATIONS

Professional Engineer in California and seven other states.

PROFESSIONAL AFFILIATIONS

American Society of Civil Engineers
American Water Resources Association
International Mine Water Association

TECHNICAL PUBLICATIONS

Author and presenter of more than 25 publications and seminar presentations on the subjects of waste management, hydrology, and regulatory development.

A Mathematical Model to Aid Management of Outflow from the Okavango Swamp, Botswana. Journal of Hydrology, Vol. 19, No. 2, June 1973.

The Okavango Delta - Ways of Evaluating the Economic and Environmental Impact of Mass Transport of Water. Presented at the 5th Quinquennial Convention of the South African Institution of Civil Engineering, South Africa, August 1973.

A Mathematical Sediment Model for a Sea Water Intake Basin. Presented at the Conference on Marine and Fresh Water Research in Southern Africa, Port Elizabeth, South Africa, July 1976.

Lake St. Lucia - Mathematical Modelling and Evaluation of Ameliorative Measures. The Civil Engineer in South Africa, Transactions of the South African Institution of Civil Engineering, South Africa, Vol. 19, No. 4, April 1977.

Lake St. Lucia - The Computer Points the Way. African Wildlife, Vol. 31, No. 2, April/May 1977.

Mathematical Modelling of Water Level and Salinity Regions in Some Southern African Lake and Estuary Systems. Presented at the Seventeenth Congress of the International Association for Hydraulic Research (IAHR), Baden-Baden, Federal Republic of Germany, August 1977.

Regional Flood Frequency Analysis for New Brunswick. Presented at the Canadian Hydrology Symposium: 77-Floods, in Edmonton, Alberta, Canada, August 1977.

A Systematic Approach to Flood Risk Mapping. Presented at the International Symposium on Risk and Reliability in Water Resources, in Waterloo, Ontario, Canada, June 1978.

Modelling the Water and Salt Balance in a Shallow Lake. Ecological Modelling, Vol. 4, 1978, pp. 21-235.

Aspects of Phosphogypsum Waste Disposal. Presented at the Seventh Annual Madison Waste Conference, Dept. of Engineering and Applied Science, University of Wisconsin-Extension, Madison, Sept. 11-12, 1984.

Cyanide Control Options - Lessons From Case Histories. Presented at the Tucson Cyanide Conference, December 1985.

Legal Allocation of Augmented Water Supply Due to Silvacultural Activity in the Upper Rio Grande River Basin. Fourth International Hydrology Symposium on "Multivariate Analysis of Hydrologic Process: Stochastic-Deterministic," Colorado State University, Fort Collins, Colorado, July 15-17, 1985.

Introduction to Evaluation, Design and Operation of Precious Metal Heap Leaching Projects, Editor and Author of Chapter on "Surface Water Balance," 1988.

Management for Hazardous Waste Liability at Mining Sites. Colorado State University Symposium, January 1991.

Mine Waste Management. Editors: I.P. Hutchison and R.D. Ellison. Lewis Publishers, Inc. 1992. pp. 652.

Summitville Mine - Remedial Alternatives Identification and Evaluation. I.P. Hutchison, Michael L. Leonard, Sr. and David P. Cameron. Summitville Forum 95: A Forum held in Conjunction with Tailings and Mine 1995, Colorado State University, Fort Collins, Colorado, January 1995.

P-Geo/Résumés/ExWi (3/97)

ATTACHMENT B

ATTACHMENT B: REFERENCES

GSi, 1997: GSi/water. *Ground Water Data* . Collected in 1996. 1997.

Hsieh et al., 1985: Hsieh, P.A. and Neuman, S.P., "Field Determination of the Three Dimensional Hydraulic Conductivity Tensor of Aniosotropic Media". *I, Theory: Water Resources Research*, v.21. pp. 1655-1665. 1985.

Hubbert, 1956: Hubbert, M.K., *Darcy's Law and the Field Equations of the Flow of Underground Fluids: Trans. America. Inst. Met. Engrs.*, v.207, pp. 222-239. 1956.

Kelsey Deposition, 1977: Kelsey, Richard K., P.E. Deposition. Taken by Richard E. Schwartz. April 7, 1997.

Kelsey, 1997: Kelsey, Richard K., P.E. *Expert Report*. March 14, 1997.

Long et al., 1982: Long, J.L.S., and others, "Porous Media Equivalents for Networks of Discontinuous Fractures", *Water Resources Research*, v.18, pp. 645-658. 1982.

Mink Deposition, 1997: Mink, Leland Leroy, Ph.D., P.G. Deposition. Taken by R. Timothy McCrum. April 8, 1997.

Mink, 1997: Mink, Leland Leroy, Ph.D., P.G. *Expert Report*. March 13, 1997.

Molycorp, 1997: Molycorp, Inc. Data provided by Molycorp, Questa. 1997.

Molycorp, Undated: Molycorp, Inc. *Stormwater Pollution Prevention Plan*. Undated.

Moores, 1993: Moores, Eldrige E. and Robert Twiss. *Structural Geology*. W.H. Freeman & Company, New York, 1993.

NMED, 1996: Slifer, Dennis. *Red River Groundwater Investigation*. New Mexico Environment Department Surface Water Quality Bureau. March 1996.

Shoemaker Deposition, 1997: Shoemaker, David. Deposition. Taken by Eric Ames. January 22, 1997.

SPRI, 1995: South Pass Resources Inc. *Progress Report on the Geology, Hydrogeology And Water Quality of the Mine Area* . Taos County, New Mexico, 1995.

SRK, 1995: Steffen, Robertson and Kirsten. *Questa Molybdenum Mine: Geochemical Assessment and Preliminary Closure Plan*. April 13, 1995.

USGS, 1988: USGS. *Rio Grande Basin: Red River Seepage Investigation*. 1988.

Vail, 1993: Vail Engineering, Inc. *Interim Study of the Acidic Drainage to the Middle Red River, Taos County, New Mexico.* July 9, 1993.

Williams Deposition, 1997: Williams, Barbara Cook, Ph.D., P.E. Deposition. Taken by Richard Schwartz. Volume I. April 8, 1997.

Williams, 1997: Williams, Barbara Cook, Ph.D., P.E. *Expert Report.* March 13, 1997.

Woodward-Clyde, 1995: Woodward-Clyde Consultants. *Red River Surface Water Investigation Report November 1995 Molycorp Questa Mine, Questa, New Mexico.* June 1996.

ATTACHMENT C

No. 99-2346

IN THE UNITED STATES COURT OF APPEALS
FOR THE TENTH CIRCUIT

AMIGOS BRAVOS, ET AL.
Plaintiffs - Appellants
v.
U.S. ENVIRONMENTAL PROTECTION AGENCY, ET AL.
Defendants - Appellees

Oral Argument is not Requested

On Appeal from the United States District Court
for the District of New Mexico
Don J. Svet, United States Magistrate Judge
D.C. No. Civ. 99-327 DJS/RLP

BRIEF FOR THE DEFENDANTS - APPELLEES

LOIS J. SCHIFFER
Assistant Attorney General

EVELYN YING
MELAINE WILLIAMS
KATHRYN E. KOVACS
U.S. Department of Justice
Environment & Natural Resources
Division, Appellate Section
P.O. Box 23795 l'Enfant Plaza

Washington, D.C. 20026

OF COUNSEL:

JOHN W. ZAVITZ
Assistant U.S. Attorney
Albuquerque, New Mexico

RICHARD T. WITT
U.S. Environmental Protection Agency
Station
Office of Regional Counsel

Dallas, Texas (202) 514-4010

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STATEMENT OF PRIOR OR RELATED APPEALS

In Amigos Bravos v. Molycorp, Inc., 166 F.3d 1220 (10th Cir. 1998), this Court affirmed the district court's dismissal of the plaintiffs' claims. In the case at bar, the district court held that this action is collaterally estopped by that earlier decision.

STATEMENT OF JURISDICTION

Amigos Bravos and New Mexico Citizens for Clean Air and Water ("Amigos Bravos") alleged subject matter jurisdiction in the district court based on 33 U.S.C. § 1365(a)(2). App. 64. The United States argued, *inter alia*, that the district court lacked jurisdiction. App. 80. The district court entered a final judgment on November 8, 1999, granting the United States' motion to dismiss on collateral estoppel grounds. App. 168. Jurisdiction in this Court is based on 28 U.S.C. § 1291. Amigos Bravos filed a notice of appeal on November 30, 1999 that was timely filed under Fed. R. App. P. 4(a)(1)(B).

STATEMENT OF THE ISSUES

1. Whether this action is barred by collateral estoppel.

2. Whether Amigos Bravos' Complaint failed to allege the violation of a nondiscretionary duty establishing jurisdiction under the Clean Water Act's citizen suit section.

3. Whether Amigos Bravos' notice of intent to sue was inadequate.

STATEMENT OF THE CASE

Molycorp operates a molybdenum mine in northern New Mexico adjacent to the Red River and holds a permit under the Clean Water Act's National

Pollutant Discharge Elimination System ("NPDES") to discharge certain pollutants from specified point sources. Amigos Bravos filed an action against Molycorp in 1995 alleging that Molycorp was discharging pollutants via underground seeps in violation of the Clean Water Act ("CWA"). App. 6. The district court granted Molycorp's motion for summary judgment and held that the action should have been filed in the Court of Appeals within 120 days of the issuance of Molycorp's NPDES permit. App. 18. This Court affirmed. App. 25.

Amigos Bravos then filed a citizen suit against the EPA alleging that the Administrator of the Environmental Protection Agency ("EPA") violated a nondiscretionary duty by not taking enforcement action against Molycorp for the same alleged discharges. App. 62. The district court granted the government's motion to dismiss, holding that this action was collaterally estopped by Amigos Bravos' prior action against Molycorp. App. 171. Amigos Bravos filed a timely notice of appeal. App. 176.

A. Statutory Background

The Clean Water Act was enacted "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters." 33 U.S.C. § 1251(a). To achieve this goal, Congress prohibited the "discharge" of any pollutant into

navigable waters except as authorized by specified sections of the Act. 33 U.S.C. §§ 1311(a). The CWA defines "discharge of a pollutant" to mean "any addition of any pollutant to navigable waters from any point source," 33 U.S.C. § 1362(12), and "pollutant" to mean "dredged spoil, solid waste * * * chemical wastes * * * industrial, municipal, and agricultural waste" and other material discharged into water, 33 U.S.C. § 1362(6). A "point source" is "any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure * * * from which pollutants are or may be discharged." 33 U.S.C. § 1362(14).

One of the sections that authorizes discharges to waters of the United States is section 402, which establishes the National Pollutant Discharge Elimination System ("NPDES"). 33 U.S.C. § 1342. The Administrator may issue NPDES permits that authorize the discharge of pollutants into the nation's waters under prescribed terms and conditions. 33 U.S.C. § 1342(a). If the permit-holder applies to renew an NPDES permit before it expires, 40 C.F.R. § 122.21(d)(2), the old permit remains effective and enforceable until a new permit is issued, 40 C.F.R. § 124.6. If the EPA tentatively decides to renew the permit, it issues a draft permit, giving public notice and allowing at least 30 days for public comments.

40 C.F.R. §§ 124.6; 124.8; 124.10(a)(1)(ii), (b); 124.56. Any interested person may submit comments and may request a public hearing. 40 C.F.R. § 124.11. After considering and responding to the public comments, 40 C.F.R. §§ 124.11, 124.17, the EPA makes a final decision to issue, deny, modify, revoke and reissue, or terminate the permit. 40 C.F.R. § 124.15. Any interested person may request an evidentiary hearing on the decision to issue or deny an NPDES permit within 30 days of the decision. 40 C.F.R. § 124.74(a). If the EPA denies the request, the person may appeal to the Environmental Appeals Board. 40 C.F.R. §§ 124.75(b); 124.91. If the Appeals Board denies review, the decision becomes final, 40 C.F.R. § 124.91(f)(1), and may be challenged by any interested person in the appropriate Court of Appeals within 120 days. 33 U.S.C. § 1369(b)(1)(F). See generally Amigos Bravos v. Molycorp, 166 F.3d 1220 (10th Cir. 1998) (Table).

In section 309 of the CWA, Congress prescribed the enforcement structure for achieving compliance with statute's requirements. 33 U.S.C. § 1319. When the EPA Administrator finds a violation of the CWA, including a violation of an NPDES permit, the agency has three options for correcting the violation. First, the EPA may issue an administrative order requiring compliance under section 309(a)(3). 33 U.S.C. § 1319(a)(3). Second, the EPA can initiate a civil action in a

United States District Court for appropriate relief, including monetary penalties under section 309(b). 33 U.S.C. § 1319(b). Third, the EPA may assess penalties in an administrative proceeding under section 309(g). 33 U.S.C. § 1319(g).

Private citizens may supplement the EPA's enforcement of the CWA by bringing an action against any person who violates the Act or against the Administrator "where there is alleged a failure of the Administrator to perform any act or duty under this chapter which is not discretionary with the Administrator." 33 U.S.C. § 1365(a). Citizens must notify the alleged violator and/or the Administrator of their intent to sue 60 days before filing the action. 33 U.S.C. § 1365(b)(1)(A), (b)(2). If the Administrator brings an enforcement action, any citizen suit against the alleged violator is barred. 33 U.S.C. § 1365(b)(1)(B).

B. <u>Prior Litigation</u>

The EPA issued Molycorp an NPDES permit in 1977 covering three point source discharges. App. 25. In December of 1992, Molycorp applied for a renewal of its NPDES permit. During the public comment period on the draft permit, the EPA received comments from the Land and Water Fund, suggesting that groundwater seepage from waste rock piles at the Molycorp mine site should be included in the NPDES permit. App. 27. The EPA added two point sources

and renewed the permit in September of 1993. The agency declined to include the groundwater discharges in the permit and responded to the Land and Water Fund's comments as follows:

> Response No. 9:
>
> While EPA understands the concern of these commenters for the possible impact of ground water seepage on the Red River, we do not agree that these are "point sources" under the NPDES permitting program. Ground water is regulated by the State through the [New Mexico Environment Department].
>
> We are familiar with the case law citation * * * which relates to EPA authority to require construction and control of surface discharges (proscribed "point sources" of pollution) in instances where the operator has not applied the proper control and construction to the sources. However, the issue of seepage of groundwater which may have infiltrated through porous soil is a different matter. We recommend that the commenters continue to pursue this issue through the [New Mexico Environment Department].

App. 27. No one sought administrative or judicial review of the EPA's decision to issue the NPDES permit without covering the groundwater discharges. Id.

Amigos Bravos filed a CWA citizen suit against Molycorp on December 8, 1995, alleging that waste rock piles at the Molycorp mine leach acid and metals into the groundwater, which eventually discharges into the Red River. App. 13 ¶ 18. Amigos Bravos alleged that the discharge of pollutants through the groundwater to the river without an NPDES permit violated the CWA. App. 16 ¶

27. The Complaint asked the court to declare that Molycorp violated the CWA by failing to obtain an NPDES permit; to enjoin Molycorp from discharging pollutants until it had obtained a permit; to order Molycorp to pay for environmental restoration; and to order Molycorp to pay the maximum civil penalties for violating the CWA. App. 16.

The district court, on September 11, 1997, granted Molycorp's motion for summary judgment. App. 23. Under 33 U.S.C. § 1369(b)(1), any challenge to the EPA's issuance or denial of an NPDES permit must be brought in the Court of Appeals within 120 days. The court held that "[a]t its core, plaintiffs' complaint attacks the EPA's decision to reissue Molycorp's NPDES permit without regulating groundwater seepage into the Red River. Under 33 U.S.C. § 1369(b)(1), this challenge should have been made in the Court of Appeals." App. 21. Amigos Bravos contended that they were not challenging EPA's decision to reissue Molycorp's NPDES permit, since the EPA had not considered the groundwater seepage when renewing Molycorp's permit. Id. To the contrary, the court held that the EPA "explicitly addressed this issue" and decided not to include the groundwater seepage in the permit because the agency did not believe that it constituted a "point source" that may be regulated under the CWA. App.

22.

This Court affirmed without oral argument in an unpublished opinion dated November 13, 1998. Amigos Bravos v. Molycorp, 166 F.3d 1220 (1998), App. 25. Since the groundwater seepage issue was raised in the public comments on the permit renewal, the Court found that Amigos Bravos could have challenged the EPA's decision not to regulate those discharges in a challenge to the permit itself. App. 28. "Having failed to do so, plaintiffs may not now use the vehicle of the CWA's citizen suit provisions to challenge Molycorp's discharge of pollutants from its rock waste piles without an NPDES permit." Id.

C. The Instant Litigation

By letter dated August 4, 1998, Amigos Bravos notified the EPA of its intent to sue for failure to perform nondiscretionary duties under the CWA. Supp. App. 1. The letter alleged that the EPA has a nondiscretionary duty to prohibit the discharge of unpermitted pollutants. Supp. App. 5. The letter also alleged that, under 33 U.S.C. § 1319(a)(1), the EPA must issue notices of violations to persons who violate state-issued CWA permits and that the EPA must "promptly require a permit for illegal discharges." Supp. App. 5-6. In addition, the letter requested termination or modification of Molycorp's NPDES permit to include the

discharges from the waste rock piles. Supp. App. 7.

On March 25, 1999, Amigos Bravos filed a Complaint against the EPA. App. 62. The Complaint alleged that the Red River is a "gaining stream" that gains volume from groundwater seeps and springs along its length, App. 67 ¶ 22, and that its water quality is currently degraded by acid and metals from groundwater discharges, App. 68 ¶ 24. The Complaint alleged that in 1965, Molycorp began open pit mining and deposited surface material in six waste rock dumps at Capulin Canyon, Goathill Gulch, Sugar Shack South, Sugar Shack West, Middle, and Spring and Supher Gulch. App. 69 ¶ 28. According to the Complaint, acidic groundwater leachate from these piles transports various metals through springs and seeps into the Red River. App. 69 ¶¶ 29-30.

The Complaint further alleged that on February 13, 1998, ten months before this Court issued its opinion in the prior litigation, David Abshire, a Geologist in EPA Region 6, issued a report entitled: "Report on Hydrological Connection Associated with Molycorp Mining Activity, Questa, New Mexico" [referred to herein as "Abshire Report"], App. 29, 70 ¶ 36. According to the Complaint, the Abshire Report concluded that:

> (a) discharges from Molycorp's waste rock dumps are hydrologically connected to the seepages into the Red River; (b) that the seepages

> are the primary and most incessant source for metals loading to the Red River; and (c) that a documented ground water hydrological connection between a source and surface water discharge is a "point source" requiring an NPDES permit under the Clean Water Act.

App. 71 ¶ 39.

Count I of the Complaint alleged that the EPA knows that Molycorp is illegally discharging pollutants from a point source without an NPDES permit and has "failed to fulfill [its] non-discretionary duty under the Clean Water Act to take enforcement action" by issuing a compliance order or filing a civil action against Molycorp under 33 U.S.C. § 1319(a)(3). App. 74 ¶¶ 54-56. Count I sought a declaration that the EPA has violated its nondiscretionary duty "to take enforcement action regarding a known, illegal discharge," and an order requiring the EPA to take enforcement action "by either issuing Molycorp a compliance order or bringing a civil action against Molycorp." App. 75 ¶¶ 1-2.

Count II of the Complaint alleged that the EPA has "failed to fulfill [its] non-discretionary duty under the Clean Water Act by failing to either issue an NPDES permit for Molycorp's illegal discharges from their waste rock dumps" under 33 U.S.C. § 1342, "or prohibit the illegal discharges" under 33 U.S.C. § 1311. App. 75 ¶¶ 59-60. Count II sought a declaration that the EPA has violated its nondiscretionary duties under 33 U.S.C. §§ 1311 and 1342, and an order

requiring the EPA to either issue an NPDES permit or prohibit the discharge of pollutants from Molycorp's waste rock piles. App. 75-76 ¶¶ 3-4.

On June 15, 1999, the EPA filed a motion to dismiss presenting several arguments. App. 80. First, the EPA argued that Amigos Bravos' action was barred by collateral estoppel, since it raised the same issues in its prior suit against Molycorp, and, as this Court held in that prior case, that the action should have been brought in the Court of Appeals within 120 days of the permit issuance. App. 86. Second, the EPA argued that the Complaint failed to state a claim since the agency's enforcement decisions are discretionary, not mandatory, and, therefore, cannot provide the basis for a CWA citizen suit. App. 88. Third, the EPA argued that the court lacked jurisdiction because Amigos Bravos' notice of intent to sue was inadequate. App. 93.

Amigos Bravos responded and filed a motion for summary judgment, App. 99, which the court held in abeyance pending the resolution of the government's motion to dismiss. CR 37. On November 8, 1999, the district court granted the EPA's motion, holding that Amigos Bravos' action is barred by collateral estoppel. App. 169. The court held that the issue in this case -- "the prohibition or permitting of groundwater seepage from the Molycorp mine waste rock piles into

the Red River" -- is identical to that raised in Amigos Bravos' prior action against Molycorp. App. 174. The court further held that Amigos Bravos had a full and fair opportunity to litigate that issue in the prior action. App. 175. Therefore, the court dismissed the Complaint with prejudice. Id.

On May 27, 2000, the EPA published notice of the availability of a new draft NPDES permit for Molycorp that generally prohibits the groundwater discharges that are at issue in this case. The draft permit specifically covers several of the seeps and requires monthly inspections to locate new seeps. The draft permit requires Molycorp to perform a field investigation and submit for EPA approval a plan to remedy point source discharges. The discharges must be remedied within two years of permit issuance. The draft permit also retains the EPA's discretion to revise the permit to address other seeps when they are sufficiently documented. The 60-day public comment period on the draft permit runs through July 27, 2000, and the EPA will hold a public hearing on July 13, 2000.

SUMMARY OF THE ARGUMENT

In Amigos Bravos' earlier case against Molycorp, this Court held that the Complaint challenged the EPA's decision to omit the groundwater discharges

from Molycorp's NPDES permit and, therefore, should have been filed under 33 U.S.C. § 1369(b)(1) in the court of appeals within 120 days of permit issuance. The district court in the case at bar properly held that the Complaint in this action raises an issue that is identical to that decided in the earlier case. Both Complaints allege that the groundwater discharges from Molycorp's waste rock piles without an NPDES permit violate the CWA, and both Complaints seek to have the discharges prohibited or permitted. Thus, this action is barred by collateral estoppel. Like the earlier case, this action should have been filed in the court of appeals within 120 days of permit issuance.

The facts that are of controlling significance here have not changed since this Court affirmed the dismissal of Amigos Bravos' first suit. Since the Abshire Report was written by a geologist who had no authority to make findings on behalf of the Administrator under section 309(a)(3), it has no legal significance here. Moreover, the Abshire Report merely compiled previously existing evidence that Molycorp was discharging pollutants from the waste rock piles through the groundwater to the Red River. Thus, the Abshire Report did not constitute new facts or changed circumstances and did not prevent collateral estoppel from barring this action.

Even if this Court determines that this case is not collaterally estopped, the district court's dismissal should be affirmed because Amigos Bravos failed to allege the violation of a nondiscretionary duty as is required to establish jurisdiction under the CWA citizen suit section, 33 U.S.C. § 1365(a)(2). The two courts of appeal that have addressed this issue have held that section 309(a)(3) does not impose any mandatory duty on the EPA to take enforcement action. Rather, the plain language, structure, and legislative history of the CWA indicate that the EPA's responsibilities to investigate, make findings, and bring enforcement actions under section 309(a)(3) are discretionary, as such duties normally are. Likewise, sections 301 and 402 impose no mandatory duties upon the EPA. In any event, the EPA fulfilled whatever duties it has under the CWA by issuing a draft permit that covers some of the groundwater discharges from the Molycorp site. The EPA has no duty to take enforcement action while the permit process is ongoing.

Finally, the district court lacked jurisdiction over Count I of the Complaint because Amigos Bravos' notice of intent to sue did not mention section 309(a)(3) and did not allege that the EPA has a nondiscretionary duty under that provision. The same is true of any allegations concerning section 301(e). Under 33 U.S.C. §

1365(b)(2), any case in which the notice of intent was not sufficient to enable the EPA to correct the violation before court involvement must be dismissed.

ARGUMENT

Standard of Review

This Court reviews conclusions of law de novo. State Insurance Fund v. Ace Transportation, Inc., 195 F.3d 561, 564 (10th Cir. 1999). The question of whether this action is barred by collateral estoppel is reviewed de novo, United States v. Rogers, 960 F.2d 1501, 1507 (10th Cir. 1992), as is the granting of the government's motion to dismiss under Fed. R. Civ. P. 12(b), Ordinance 59 Association v. Department of the Interior, 163 F.3d 1150, 1152 (10th Cir. 1999).

I. AMIGOS BRAVOS' COMPLAINT IS BARRED BY COLLATERAL ESTOPPEL.

Collateral estoppel forecloses relitigation of matters that have already been decided "when each of the following criteria have been met:"

> (1) the issue previously decided is identical with the one presented in the action in question, (2) the prior action has been finally adjudicated on the merits, (3) the party against whom the doctrine is invoked was a party or in privity with a party to the prior adjudication, and (4) the party against whom the doctrine is raised had a full and fair opportunity to litigate the issue in the prior action.

Rogers, 960 F.2d at 1508 (quoting Matter of Lombard, 739 F.2d 499 (10th Cir.

1984)), see also Murdock v. Ute Indian Tribe of Uintah, 975 F.2d 683, 686 (10th Cir. 1992). "The inquiry 'must be set in a practical frame and viewed with an eye to all the circumstances of the proceedings.'" Rogers, 960 F.2d at 1508 (quoting Ashe v. Swenson, 397 U.S. 436, 444 (1970)).

A change in the facts underlying a dispute may prevent an earlier decision from having preclusive effect. Taken to an extreme, however, this exception "could totally undermine the application of collateral estoppel. Rare would be the case in which counsel could not conjure up some factual element that had changed between adjudications." Scooper Dooper, Inc. v. Kraftco Corp., 494 F.2d 840, 846 (3d Cir. 1974). Therefore, only a change in facts that "were essential to the judgment and were 'of controlling significance'" can avoid the preclusive effect of a prior determination. EEOC v. American Airlines, Inc., 48 F.3d 164, 168 (5th Cir. 1995) (quoting Montana v. United States, 440 U.S. at 159 (1979)); see also United States v. Stauffer Chemical Co., 464 U.S. 165, 172 (1984) ("Any factual differences between the two cases * * * are of no legal significance whatever in resolving the issue presented in both cases."); Klein v. Commissioner of Internal Revenue, 880 F.2d 260, 263 (10th Cir. 1989) (holding no change in controlling facts precluded collateral estoppel); 18 Moore's Federal Practice § 132.02[2][e]

(3d ed.).

A. The issue raised in this case is identical to that decided in the earlier action.

Amigos Bravos contends that the first and fourth elements of collateral estoppel have not been met here. The issue raised in this case, they contend, is different from that raised in their prior suit against Molycorp. Amigos Bravos' contention, Br. 22-23, that they did not have a full and fair opportunity to litigate this issue in the prior action, however, is merely a restatement of their contention that the issue in this case was not litigated in that earlier action. In any event, the record reveals that Amigos Bravos participated fully in the prior litigation, and they make no allegations to the contrary.

The district court correctly held that the issue raised in this case is identical to that decided in the earlier litigation between Amigos Bravos and Molycorp. In their Complaint in the prior action, Amigos Bravos contended that the discharge of pollutants from the Molycorp waste rock piles via the groundwater to the Red River without an NPDES permit violated the CWA. App. 16 ¶ 27. In that case, the district court held that Amigos Bravos' Complaint challenged the EPA's decision to omit the groundwater discharges from Molycorp's NPDES permit. App. 21. In this case, Amigos Bravos again contended that the discharge of

pollutants from the waste rock piles without an NPDES permit violated the CWA. App. 73 ¶ 52. That contention is central to all of Amigos Bravos' claims in this action. Thus, according to this Court's opinion in the prior action, Amigos Bravos' Complaint again challenges the EPA's decision to omit those discharges from Molycorp's permit. The district court held correctly that the issue raised in both cases was "the prohibition or permitting of contaminated groundwater seepage from the Molycorp mine waste rock piles into the Red River." App. 174.

In the earlier action, Amigos Bravos asked the court to order Molycorp to cease discharging or obtain an NPDES permit. App. 16 ¶¶ 2. Likewise, in this case, Amigos Bravos asked the court to order the EPA to prohibit the discharges or issue Molycorp an NPDES permit. App. 76 ¶ 4. As the district court said:

> In the first action, Plaintiffs brought suit against Molycorp to compel it to stop the pollution or obtain a permit. In this action, Plaintiffs argue that the EPA is required to compel Molycorp to stop polluting or issue it a permit.

App. 174. Therefore, the district court was correct in concluding that "the ultimate question of whether the discharge of pollutants from the waste rock piles at the Molycorp mine into groundwater and thus the Red River must be stopped or subject to an NPDES permit, remains the same." Id.

Amigos Bravos contends that in the prior action, they sought to establish

that the seeps were point source discharges under the CWA. Now, they contend that the EPA agrees that the seeps are point source discharges and seek to force the EPA to take enforcement action. Br. 9. Both actions, however, challenged the EPA's decision not to include the seeps in Molycorp's NPDES permit. In the prior action, this Court held that because Amigos Bravos' Complaint attacked the EPA's decision to omit the discharges from the waste rock piles from Molycorp's NPDES permit, the case should have been filed under 33 U.S.C. § 1369(b)(1) in the Court of Appeals within 120 days of the issuance of the NPDES permit. App. 28. The Complaint here is identical in all material respects to that in the prior action. Therefore, Amigos Bravos should have filed in the Court of Appeals and is collaterally estopped from relitigating the issue that was decided in that earlier case.

B. The facts that were of controlling significance in the earlier litigation have not changed.

Like the legal claims, the facts alleged in the two Complaints are nearly identical. Compare App. 8 ¶ 8 with 65 ¶ 17; 9 ¶ 9 with 65 ¶ 18; 10-11 ¶¶ 11-15 with 67 ¶¶ 20-23; 12 ¶ 16-17 with 68 ¶¶ 25-27; 12 ¶ 18 with 69 ¶ 28-29; 13 ¶ 20 with 68 ¶ 24; 15 ¶ 23 with 70 ¶ 32; 15 ¶ 24 with 70 ¶ 33. Amigos Bravos contends that the Abshire Report is a new fact that makes the issue raised in this case

different from that decided in the prior litigation.[1] That report, however, has no legal significance here and, therefore, does not prevent the operation of collateral estoppel.

Amigos Bravos alleged in their Complaint that the Abshire Report constitutes a finding by the Administrator of a point source that triggers the EPA's duty to take enforcement action against Molycorp under CWA section 309(a)(3). App. 71, 73-75. The Abshire Report, however, was authored by a geologist in EPA Region 6, App. 29, who was not empowered to make findings on behalf of the Administrator under section 309(a)(3). The Administrator has delegated that authority to the Regional Administrators and the Assistant Administrator for Enforcement and Compliance Assurance, who may in turn re-delegate the authority to make findings to Division Directors. EPA Delegations Manual § 2-22. Since Abshire was not authorized to make findings under section 309, his report does not constitute a finding by the Administrator that would trigger any allegedly mandatory duty under the CWA. Thus, the Abshire Report has no legal significance in this case and does not prevent collateral estoppel from barring Amigos Bravos' claims.

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[1] As noted above, the Abshire Report came out approximately ten months before this Court's decision in the prior litigation.

Moreover, there was evidence at the time of the prior suit that Molycorp was discharging pollutants from the waste rock piles through the groundwater to the Red River. See App. 14 ¶ 21. The Abshire Report was not new evidence, but merely compiled the results of the numerous studies that had previously been conducted on the Red River near the Molycorp site. App. 30, 61; Supp. App. x; see also Supp. App. x (Slifer at 5-9). Among those studies was a report by Dennis Slifer of the New Mexico Environment Department, submitted to the EPA in March of 1996. Supp. App. x.[2] The Slifer Report documented that pollutants from the waste rock piles reached the Red River through groundwater seeps. Supp. App. x (1, 43-47, 66-67). Thus, the Abshire Report did not constitute changed circumstances or new facts so as to prevent collateral estoppel from barring this action.

II. AMIGOS BRAVOS' COMPLAINT FAILS TO ALLEGE JURISDICTION UNDER THE CITIZEN SUIT SECTION OF THE CWA, SINCE THE EPA'S ENFORCEMENT DECISIONS ARE DISCRETIONARY.

Even if the Court determines that this case is not barred by collateral estoppel, it should affirm the district court's dismissal since Amigos Bravos'

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[2] Amigos Bravos attached the Slifer Report as exhibit 2 to their motion for summary judgment, explaining that it "is heavily relied on and routinely cited by the EPA" in the Abshire Report. App. 110 n. 1; see also Supp. App. x.

Complaint failed to establish jurisdiction. "This court is not constrained by the trial court's conclusions, but may affirm the district court on any legal ground supported by the record, whether or not such ground was argued in the district court." State Insurance Fund, 195 F.3d at 564 (citations omitted).

Amigos Bravos' Complaint, App. 64, alleged jurisdiction based on the citizen suit section of the CWA, which grants the district courts jurisdiction over suits against the Administrator of the EPA "where there is alleged a failure of the Administrator to perform any act or duty under this chapter which is not discretionary with the Administrator." 33 U.S.C. § 1365(a)(2) (emphasis added).[3] The Complaint alleged that the Administrator violated her nondiscretionary duties 1) to either issue a compliance order or file a civil action under section 309(a)(3), 33 U.S.C. § 1319(a)(3), and 2) to either issue an NPDES permit under section 402, 33 U.S.C. § 1342, or prohibit Molycorp's allegedly illegal discharges under section 301, 33 U.S.C. § 1311. App. 74-75. In its motion to dismiss, the EPA argued that since its enforcement decisions are discretionary, the Complaint failed

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[3] Since the citizen suit section is a waiver of sovereign immunity, it must be read narrowly. Department of Energy v. Ohio, 503 U.S. 607, 615 (1992). If there is any doubt about whether the Administrator's duties under section 309(a)(3) are "not discretionary," those terms must be interpreted in favor of the government's immunity. Id.; cf. Monongahela Power Co. v. Reilly, 980 F.2d 272, 276 n. 3 (4th Cir. 1992) ("The term 'nondiscretionary' has been construed narrowly.").

to state a claim under the CWA citizen suit section. App. 88. In response, Amigos Bravos contended that 1) section 309(a)(3) "mandates enforcement against a known violator," and 2) sections 301 and 402, "when read together, do not give the EPA the discretion to exempt point sources from the requirements of the Act." App. 121. Since the district court held that Amigos Bravos' action was barred by collateral estoppel, it did not rule on this issue. App. 172.

A. Section 309(a)(3) of the CWA does not impose a mandatory duty on the EPA to take enforcement action.

Section 309(a)(3) of the CWA provides:

> Whenever on the basis of any information available to him the Administrator finds that any person is in violation of section 1311, 1312, 1316, 1317, 1318, 1328, or 1345 of this title, or is in violation of any permit condition or limitation implementing any of such sections in a permit issued under section 1342 of this title by him or by a State or in a permit issued under section 1344 of this title by a State, he shall issue an order requiring such person to comply with such section or requirement, or he shall bring a civil action in accordance with subsection (b) of this section.

33 U.S.C. § 1319(a)(3).

The two courts of appeals that have addressed the question have concluded that section 309(a)(3) does not require the Administrator to take enforcement action, but merely authorizes her to do so. See Dubois v. Thomas, 820 F.2d 943 (8th Cir. 1987); Sierra Club v. Train, 557 F.2d 485 (5th Cir. 1977), see also Cross

Timbers Concerned Citizens v. Saginaw, 991 F.Supp. 563,569 (N.D. Tex. 1997) (following Sierra Club v. Train); Caldwell v. Gurley Refining Co., 533 F.Supp. 252, 255-57 (E.D. Ark. 1982) (same). Courts of appeals that have addressed similar questions have likewise concluded that agency enforcement decisions are discretionary. See, e.g., Preserve Endangered Areas of Cobb's History, Inc. v. Corps of Engineers, 87 F.3d 1242, 1249 (11th Cir. 1996) (EPA Administrator's decision not to overrule Secretary of Army's determination on section 404 wetlands permit is discretionary); Laguna Gatuna, Inc. v. Browner, 58 F.3d 564, 566 (10th Cir. 1995) ("Judicial review of every unenforced compliance order would undermine the EPA's regulatory authority;" court lacked jurisdiction to review CWA compliance order); Harmon Cove Condo. Ass'n v. Marsh, 815 F.2d 949 (3d Cir. 1987) (Secretary of Army has discretion in enforcing CWA section 404); City of Seabrook v. Costle, 659 F.2d 1371, 1375 (5th Cir. 1981) (section 113(a) of Clean Air Act gives Administrator discretion in enforcement); State Water Control Bd. v. Train, 559 F.2d 921, 927 & n. 34 (4th Cir. 1977) (EPA has discretion to decline to prosecute municipalities that attempt in good faith but fail to meet effluent limitations deadlines).

1. The EPA has no mandatory duty to investigate and make findings.

The Eighth Circuit in Dubois, following the Fifth Circuit's decision in Sierra Club v. Train, 557 F.2d 485, held that "the duties imposed on [the EPA] by § 309(a)(3) are discretionary." 820 F.2d at 945. The plaintiffs in Dubois filed a citizen suit against the EPA, alleging that it failed to carry out its mandatory duty to enforce the CWA. The district court entered judgment in favor of the plaintiffs, and the Court of Appeals reversed. Id.

The court first addressed the EPA's duty to investigate and make findings under section 309(a)(3). The plain language of that section, the Court held, "makes no mention whatever of a duty to make findings, much less a duty to carry out an investigation of each and every citizen complaint." Dubois, 820 F.2d at 947. The court cited City of Seabrook v. Costle, 659 F.2d 1371, 1374 (5th Cir. 1981), in which the Fifth Circuit held that similar language in section 113 of the Clean Air Act[4] "does not impose a nondiscretionary duty [on the Administrator] to make a finding on every alleged violation." Id. at 1375; see also City of Yakima v. Surface Trans. Bd., 46 F.Supp.2d 1092, 1099-1100 (E.D.Wash. 1999) (same). Likewise, the Third Circuit in Harmon Cove held that similar language in section

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[4] Section 113 of the Clean Air Act, 42 U.S.C. § 7413, begins exactly the same as section 309(a)(3) of the CWA: "Whenever, on the basis of any information available to him, the Administrator finds that any person is in violation * * * ."

404 of the CWA[5] "imposes no duty on the Secretary [of the Army] to make a finding of violation." 815 F.2d at 953. Indeed, in their pleadings in the district court, Amigos Bravos conceded that "the EPA's duty to make a threshold determination as to whether there is a violation" is "a discretionary duty." App. 128.

The court in Dubois also held that the EPA's interpretation of section 309(a)(3) as giving the Administrator discretion in enforcement was consistent with Congress's intent in enacting the CWA.

> EPA could be compelled to expend its limited resources investigating multitudinous complaints, irrespective of the magnitude of their environmental significance. As a result, EPA would be unable to investigate efficiently and effectively those complaints that EPA, in its expertise, considers to be the most egregious violations of the [CWA]. Only if the Administrator has discretion to allocate its own resources can a rational enforcement approach be achieved.

820 F.2d at 948. The court in City of Seabrook also recognized that "enforcement agencies have only limited resources" and "are duty-bound to allocate those resources in the interest of the general public as they perceive it, not in the causes deemed most important by individual citizens." 659 F.2d at 1375; see also Sierra

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[5] Section 404 of the CWA, 33 U.S.C. § 1344, begins exactly the same as section 309(a)(3): "Whenever on the basis of any information available to him, the Secretary finds that any person is in violation * * * ."

Club v. Train, 557 F.2d at 490-91.[6]

Amigos Bravos alleged in their Complaint that the Abshire Report constituted a finding by the Administrator under section 309(a)(3) that Molycorp's groundwater discharges violated the CWA. App. 63 ¶¶ 7-9, 71 ¶¶ 39-40, 74 ¶¶ 54-56. As discussed above, however, since the Abshire Report was authored by a geologist who was not empowered to make findings under section 309(a)(3), it does not constitute a finding by the Administrator. Moreover, upon receipt of that report, the Administrator was under no obligation to make such a finding, as discussed above. Since there has been no finding of a violation, section 309(a)(3) has not been triggered. The plain language of section 309(a)(3) states that the Administrator need initiate enforcement action only when she finds a violation. Thus, the EPA is not obliged to take any enforcement action here.

2. The EPA has no mandatory duty to enforce the CWA.

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[6] Amigos Bravos argued in the district court that Dubois and Train are distinguishable because they are based on a concern about allocating scarce agency resources, but since the EPA has already investigated and found a violation here, that concern is not relevant in this case. App. 127. On the contrary, these policy concerns apply not only to investigations, but also to enforcement actions. Congress did not intend to require the Administrator to take enforcement action in every case, but rather intended for her to "reserve [her] authority for cases of paramount interest." Dubois, 820 F.2d at 950 (citing S. Rep. 92-414, at 64 (1971)).

Even if the Abshire Report constituted a finding of a violation under section 309(a)(3), the EPA still had no mandatory duty to take enforcement action against Molycorp. The court in Dubois recognized that the term "shall" generally indicates that the prescribed act is mandatory, but also recognized that "agency decisions which refuse enforcement generally are unsuitable for judicial review." Dubois, 820 F.2d at 948 (citing Heckler v. Chaney, 470 U.S. 821, 831 (1985)).[7] Thus, "when duties within the traditional realm of prosecutorial discretion are involved, the courts have not found this maxim [that "shall" normally imposes a

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[7] The Supreme Court in Heckler v. Chaney, held that the Food and Drug Administration has the discretion to decline to take enforcement actions with respect to drugs used to carry out the death penalty. 470 U.S. at 838. Similar to the CWA citizen suit section which allows challenges of nondiscretionary agency duties only, the Administrative Procedure Act, 5 U.S.C. § 701(a)(2), precludes judicial review of agency actions that are "committed to agency discretion by law." The Court in Heckler held that "an agency's decision not to prosecute or enforce * * * is a decision generally committed to an agency's absolute discretion," id. at 831, and "should be presumed immune from judicial review under § 701(a)(2)." Id. at 832. If the statute provides "guidelines" for the agency's exercise of its enforcement authority, "either by setting substantive priorities, or by otherwise circumscribing an agency's power to discriminate among issues or cases it will pursue," the presumption may be rebutted. Id. at 833. The Court held that the Act governing the FDA's enforcement did not provide sufficient guidelines to rebut the presumption that enforcement is discretionary. Id. at 838. Similarly, section 309(a)(3) of the CWA supplies no guidelines for enforcement, but rather commits enforcement entirely to the EPA's discretion; it does not set substantive priorities or otherwise limit the EPA's authority to decide which cases to pursue.

mandatory duty] controlling." City of Seabrook, 659 F.2d at 1374 n.3; Heckler, 470 U.S. at 1657-58; cf. Inmates of Attica Correctional Facility v. Rockefeller, 477 F.2d 375, 381 (2d Cir. 1973) (The mandatory nature of the word "required" * * * is insufficient to evince a broad Congressional purpose to bar the exercise of executive discretion.").

To interpret section 309(a)(3), the court in Dubois looked to the structure of the CWA. Section 309(b), to which section 309(a)(3) expressly refers, provides in part:

> The Administrator is authorized to commence a civil action for appropriate relief, including a permanent or temporary injunction, for any violation for which he is authorized to issue a compliance order under subsection (a) of this section.

33 U.S.C. § 1319(b) (emphasis added). The use of the term "authorized" indicates that the duties to issue compliance orders and commence civil actions are discretionary. Dubois, 820 F.2d at 949; see also Sierra Club v. Train, 557 F.2d at 490 ("Section 1319, especially subsection (b)'s statutory language "is authorized," clearly demonstrates the discretionary flavor of the statute."). Likewise, section 402(i), 33 U.S.C. § 1342(i), provides: "Nothing in this section shall be construed to limit the authority of the Administrator to take action pursuant to section 1319 of this title." (emphasis added). This text also indicates that section 309

authorizes the Administrator to take enforcement action, but does not mandate such action.

The citizen suit section itself also indicates that enforcement is discretionary. Section 505(a) allows citizens to file suit against alleged violators, as well as against the EPA for failure to perform a nondiscretionary duty. 33 U.S.C. § 1365(a). The Supreme Court in Gwaltney of Smithfield, Ltd. v. Chesapeake Bay Foundation, Inc., 484 U.S. 49 (1987), held that "the citizen suit is meant to supplement rather than to supplant governmental action." Id. at 60. Accordingly, section 505(b) bars citizen suits against alleged violators when the EPA is pursuing enforcement. 33 U.S.C. § 1365(b). If the EPA were required to take enforcement action in every case, then section 505(a)(1), which allows citizen suits against alleged violators, would be superfluous; the only viable citizen suits would be suits to force the EPA to take action. The government's ubiquitous enforcement would leave no room for supplementation in citizen suits. See Dubois, 820 F.2d at 949.

Finally, sections 301 and 402 provide the EPA another alternative for handling violations: issuing an NPDES permit. The Supreme Court in Weinberger v. Romero-Barcelo, 456 U.S. 305 (1982), found that under the CWA, discharges

that pose an imminent threat should be immediately enjoined. For other sorts of violations, the Court found that the Administrator is "authorize[d]" to bring enforcement action, but section 309(b) "makes clear that Congress did not anticipate that all discharges would be immediately enjoined." Id. at 317. The Court held that violations need not be enjoined immediately, but rather applying for an NPDES permit is sufficient to ensure compliance with the CWA. Id. at 315 ("The prohibition of the [CWA] against discharge of pollutants * * * can be overcome by the very permit the Navy was ordered to seek."). By the same token, the EPA is not required to bring enforcement actions for every violation, but may use the permit process to bring violators into compliance. The availability of this alternative demonstrates that the Administrator need not issue an abatement order or file suit in every case under section 309(a)(3). See Caldwell, 533 F.Supp. at 257. Thus, the structure of the CWA shows that enforcement is discretionary.

The legislative history of the CWA also shows that the Administrator's duty to take enforcement action under section 309(a)(3) is discretionary. According to the Conference Committee Report, the Senate version of the CWA "require[d] the Administrator * * * to issue a compliance order or to bring a civil action against the pollutor." The House version was "basically the same as the Senate bill except

They didn't apply for a permit for the seeps

that the Administrator is authorized rather than required to initiate civil actions or criminal proceedings;" and the Conference substitute adopted the House version. S. Conf. No. 92-1236, at 131-32 (1972), reprinted in Legis. Hist. 314-15 (emphasis added). The court in Dubois found that "even the Senate version of § 309(a)(3) did not require the Administrator to take enforcement action whenever a violation was found." 820 F.2d at 950. In particular, the Senate Report stated that "the Administrator may issue an order to comply or go to court against the violator." S. Rep. No. 92-414 , at 10 (1971), reprinted in Legis. Hist. 1428 (emphasis added); see also H.R. Rep. No. 92-911, at 114 (1972), reprinted in Legis. Hist. 801. The Senate Report also emphasized that the federal government's enforcement authority "should be used judiciously in those cases [which] deserve Federal action because of their national character, scope or seriousness," and that the Administrator should "reserve his authority for cases of paramount interest." S. Rep. No. 92-414, at 64 (1971), reprinted in Legis. Hist. 1428; see also Sierra Club v. Train, 557 F.2d at 489-90. Thus, the court in Dubois held that "the duties imposed on [the EPA] by § 309(a)(3) are discretionary," and the district court should have dismissed the claim against the EPA for lack of subject matter jurisdiction. Dubois, 820 F.2d at 951; accord Sierra Club v. Train,

557 F.2d at 491.

In opposing the EPA's motion to dismiss in the district court, App. 123-24, Amigos Bravos cited several district court cases holding that the EPA's CWA enforcement duties are nondiscretionary. See Greene v. Costle, 577 F.Supp. 1225 (W.D. Tenn. 1983), reversed, 1990 WL 152617 (W.D. Tenn. 1990), Supp. App. x;[8] United States v. Phelps Dodge Corp., 391 F.Supp. 1181 (D. Ariz. 1975);[9] South Carolina Wildlife Fed'n [SCWF] v. Alexander, 457 F.Supp. 118 (D.S.C. 1978); People of the State of Illinois v. Hoffman, 425 F.Supp. 71 (S.D. Ill. 1977). The continuing validity of these cases is questionable, since all of these cases were decided before the Supreme Court held that enforcement is presumed to be discretionary and immune from judicial review in Heckler v. Chaney, 470 U.S. at 831-32. In addition, all of these cases were decided before the Eighth Circuit's

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[8] The district court in Greene initially denied the EPA's motion to dismiss, holding that section 309(a)(3)'s duties are mandatory. 477 F.Supp. at 1227. However, the court later reversed itself and dismissed the case, based on the intervening decisions in Dubois and Heckler emphasizing the discretionary nature of enforcement. 1990 WL 152617 (W.D. Tenn. 1990), Supp. App. x.

[9] Phelps Dodge held only that the Administrator need not issue a civil abatement order before instituting criminal enforcement proceedings; any discussion beyond that was dicta. 391 F.Supp. at 1184; cf. U.S. v. Frezzo Bros., Inc., 602 F.2d 1123 (3d Cir. 1979), cert. denied, 444 U.S. 1074 (1980) (noting that Phelps Dodge held that the Administrator need not pursue civil enforcement before criminal).

decision in Dubois, which expressly declined to follow the district court's decisions in Greene, SCWF, and Hoffman. 820 F.2d at 946.[10]

Amigos Bravos also cited to several opinions in the district court that are not relevant here. In Natural Resources Defense Council v. Costle, 568 F.2d 1369 (D.C. Cir. 1977), which was decided before Heckler, the court held that the EPA exceeded its authority in promulgating regulations that exempted entire categories of point sources from the NPDES permit requirements. Id. at 1372. Contrary to Amigos Bravos' representation in the district court, App. 125, 136, the district court in Cross Timbers Concerned Citizens v. Saginaw, 991 F.Supp. 563 (N.D. Tex. 1997), held that it did not have jurisdiction under the CWA citizen suit section since "no mandatory EPA duty arises from the CWA to perform the specific actions for which Plaintiff requests declaratory and injunctive relief." Id.

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[10] A leading treatise on environmental law concluded:

> Although there is lower court authority to the contrary, the better view of section 309(a) is that enforcement is discretionary, in spite of the statute's use of the usually mandatory "shall" in describing EPA's response to a finding of noncompliance. Enforcement has nearly always been viewed as a matter of discretion on the part of law enforcement authorities, and even when the statute uses words like "shall," the better view is that enforcement is discretionary unless Congress has inserted a sanction for failure to act.

2 Law of Environmental Protection § 12.08[1][c] (2000).

at 570. In K.W. Thompson Tool Co., Inc. v. United States, 656 F.Supp. 1077 (D.N.H. 1987), the plaintiff claimed under the Federal Tort Claims Act ("FTCA") that the EPA abused the NPDES process by relying on false data and violated its own policies by criminally prosecuting the plaintiff while he was voluntarily attempting to complying with the CWA. Id. at 1080. The court held that it lacked jurisdiction since the challenged actions fell within the "discretionary function exception" to the FTCA. Id. at 1085. None of these cases held that the EPA has a mandatory duty to enforce the CWA under section 309(a)(3).

B. Sections 301 and 402 of the CWA do not impose mandatory duties on the EPA to take enforcement action.

Section 301 prohibits the discharge of pollutants into navigable waters except as authorized by specified sections of the CWA.

> Except as in compliance with this section and sections 1312, 1316, 1317, 1328, 1342, and 1344 of this title, the discharge of any pollutant by any person shall be unlawful.

comply

33 U.S.C. § 1311(a). Section 301 also provides:

> Effluent limitations established pursuant to this section or section 1312 of this title shall be applied to all point sources of discharge of pollutants in accordance with the provisions of this chapter.

33 U.S.C. § 1311(e). Section 402, 33 U.S.C. § 1342, is one of the sections that authorizes discharges. [footnote on other sections]

> (1) * * * the Administrator may, after opportunity for public hearing, issue a permit for the discharge of any pollutant, or combination of pollutants, notwithstanding section 1311(a) of this title * * * .

33 U.S.C. § 1342(a)(1).

The analysis set forth above with regard to enforcement under section 309(a)(3) is equally applicable here. The EPA's enforcement decisions under the CWA are discretionary. The plain language of these provisions reveals their discretionary nature. Sections 301(a) and (e) do not even mention the EPA, much less impose a mandatory duty upon the Administrator.[11] Section 301(a) is a prohibition directed at dischargers, and 301(e) is a general statement that effluent limitations apply to point source discharges. Section 402 expressly makes the EPA's duty to issue NPDES permits discretionary by using the term "may." See Bennett v. Panama Canal Co., 475 F.2d 1280, 1282 (D.C. Cir. 1973) ("Ordinarily 'may' is a permissive not a mandatory term."). Thus, the plain language of sections 301(a), 301(e), and 402 indicates that the EPA's duties thereunder are discretionary.

There is no indication in the Congressional reports that sections 301(a) and

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[11] Amigos Bravos did not allege in their Complaint that section 301(e) imposes a nondiscretionary duty on the EPA, but first raised this argument in their motion for summary judgment. App. 135. The Complaint referred only to section 301(a) in this regard. App. 74.

(e) were intended to impose upon the Administrator any nondiscretionary duty. See S. Conf. Rep. No. 92-1236, at 119-21 (1972), reprinted in Legis. Hist. 302-4; H. R. Rep. No. 92-911, at 100-104 (1972), reprinted in Legis. Hist. 787-91; S. Rep. No. 92-414, at 41-46 (1971), reprinted in Legis. Hist. 1459-64. The Conference Report states, however, that, in both the House and Senate versions, section 402 merely "authorizes" the Administrator to issue permits. S. Conf. Rep. No. 92-1236, at 138-39 (1972), reprinted in A Legislative History of the Water Pollution Control Act Amendments of 1972, at 321-22 (1973) [hereinafter "Legis. Hist."]. Thus, sections 301(a), 301(e), and 402 do not impose any nondiscretionary duties upon the EPA.

In support of its argument on Count II, Amigos Bravos relied in the district court upon NRDC v. Costle, 568 F.2d 1369. As pointed out above, that case is not relevant here. The issue in that case was whether the EPA has the authority to exempt entire categories of point sources from the NPDES permit requirements; the issue here is whether the EPA has a mandatory duty to enforce the CWA. The EPA's alleged failure to take enforcement action against Molycorp is not tantamount to exempting a class of discharges by regulation. Amigos Bravos also relied upon Cross Timbers, in which the district court held that it did not have

jurisdiction since section 301(e) does not impose a mandatory duty upon the EPA. 991 F.Supp. at 569.

In any event, the EPA did in fact take enforcement action here. As noted above, the EPA issued a draft NPDES permit that covers the groundwater discharges from the Molycorp site that are sufficiently documented to warrant regulation at this time. That action is sufficient to fulfill whatever duties the EPA has under the CWA. See Weinberger v. Romero-Barcelo, 456 U.S. 305, 315 (applying for an NPDES permit is sufficient to ensure compliance with the CWA). Molycorp's alleged discharges need not be enjoined while the permit process is proceeding. The Supreme Court's statement in Weinberger about the courts' discretion applies with equal force to the EPA.

> That the scheme as a whole contemplates the exercise of discretion and balancing of equities militates against the conclusion that Congress intended to deny courts their traditional equitable discretion in enforcing the statute.

Id. at 316. Thus, since the duties that Amigos Bravos alleged the EPA violated are discretionary, the Complaint failed to establish jurisdiction under the CWA citizen suit section.

III. THE DISTRICT COURT LACKED JURISDICTION BECAUSE AMIGOS BRAVOS' NOTICE OF INTENT TO SUE WAS INADEQUATE.

The CWA requires plaintiffs to give the EPA notice of intent to sue at least 60 days before filing a citizen suit. 33 U.S.C. § 1365(b)(2). This requirement is a "mandatory condition[] precedent to commencing suit" that must be strictly construed. New Mexico Citizens for Clean Air and Water v. Espanola Mercantile Co., 72 F.3d 830, 833 (10th Cir. 1996) (quoting Hallstrom v. Tillamook County, 493 U.S. 20, 31 (1989)). The EPA regulations implementing this provision require the notice to identify the provision of the CWA that creates the alleged nondiscretionary duty and to "describe with reasonable specificity the action taken or not taken by the Administrator which is alleged to constitute a failure to perform such act or duty." 40 C.F.R. § 135.3(b). The notice must give sufficient notice to enable the EPA to correct the alleged violation before a court becomes involved. New Mexico Citizens, 72 F.3d at 833. The court may not exercise its discretion, but must dismiss any case in which the notice of intent was inadequate. Id.

In their notice of intent to sue, Amigos Bravos first contended that "[t]he EPA has a nondiscretionary duty to prohibit the discharge of unpermitted pollutants," presumably under sections 301(a), 33 U.S.C. § 1311(a), and 402, 33 U.S.C. § 1342, of the CWA. Supp. App. 5. Second, they contended that the EPA

has a nondiscretionary duty under section 309(a)(1), 33 U.S.C. § 1319(a)(1), to issue a notice of violation to anyone who violates a permit issued by a state under an approved permit program. Supp. App. 5. Third, Amigos Bravos alleged that the EPA has a nondiscretionary duty "to promptly require a permit for illegal discharges." Supp. App. 6. The district court did not address this issue, since it held the action was barred by collateral estoppel. App. 172.

Amigos Bravos' notice of intent did not mention section 309(a)(3), 33 U.S.C. § 1319(a)(3), and did not allege that the EPA has a nondiscretionary duty to either issue a compliance order or bring a civil action against known violators under that section. The notice only alleged that the EPA must issue notices of violation to violators of state-issued permits under section 309(a)(1), 33 U.S.C. § 1319(a)(1), an allegation that Amigos Bravos did not include in their Complaint. Indeed, since the State of New Mexico does not have an approved CWA permit program, section 309(a)(1) cannot possibly be relevant in this case. Thus, the notice of intent did not give the EPA notice of the statutory provision or substance of Count I of Amigos Bravos' Complaint and did not, therefore, give the EPA sufficient information to correct the alleged violation. Accordingly, this Court is without jurisdiction to consider Count I.

Likewise, Amigos Bravos did not mention section 301(e), 33 U.S.C. § 1311(e) in their notice of intent, much less argue that the EPA has a nondiscretionary duty under that section. Rather, the notice contended only that Molycorp was violating section 301(a). Supp. App. 4. Moreover, as noted above, the Complaint did not cite section 301(e) or allege a nondiscretionary duty under that provision, but referred only to section 301(a). App. 74. Therefore, this Court is without jurisdiction to consider any argument concerning section 301(e).

CONCLUSION

For the foregoing reasons, the judgment of the district court should be affirmed.

Respectfully submitted,

LOIS J. SCHIFFER
Assistant Attorney General

EVELYN YING
MELAINE WILLIAMS
KATHRYN E. KOVACS
U.S. Department of Justice
Environment & Natural Resources
Division, Appellate Section
P.O. Box 23795 l'Enfant Plaza
Station

OF COUNSEL:

JOHN W. ZAVITZ
Assistant U.S. Attorney
Albuquerque, New Mexico

RICHARD T. WITT
U.S. Environmental Protection Agency

Office of Regional Counsel
Dallas, Texas

Washington, D.C. 20026
(202) 514-4010

June, 2000
90-5-1-4-05207/1

STATEMENT REGARDING ORAL ARGUMENT

The United States does not object to Amigos Bravos' suggestion that oral argument is not necessary in this case, but is available if the Court wishes to hear oral argument.

CERTIFICATE OF COMPLIANCE

Please complete one of the sections:

Section 1. Word count

As required by Fed. R. App. P. 32(a)(7)(C), I certify that this brief is proportionally spaced and contains _____ words.

Complete one of the following:

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I certify that the information on this form is true and correct to the best of my knowledge and belief formed after a reasonable inquiry.

_____

[Signature of attorney or pro se party]

ADDENDUM

Clean Water Act § 301, 33 U.S.C. § 1311

(a) Illegality of pollutant discharges except in compliance with law

Except as in compliance with this section and sections 1312, 1316, 1317, 1328, 1342, and 1344 of this title, the discharge of any pollutant by any person shall be unlawful.

* * *

(e) All point discharge source application of effluent limitations

Effluent limitations established pursuant to this section or section 1312 of this title shall be applied to all point sources of discharge of pollutants in accordance with the provisions of this chapter.

Clean Water Act § 309, 33 U.S.C. § 1319

(a) State enforcement; compliance orders

(1) Whenever, on the basis of any information available to him, the Administrator finds that any person is in violation of any condition or limitation which implements section 1311, 1312, 1316, 1317, 1318, 1328, or 1345 of this title in a permit issued by a State under an approved permit program under section 1342 or 1344 of this title, he shall proceed under his authority in paragraph (3) of this subsection or he shall notify the person in alleged violation and such State of such finding. If beyond the thirtieth day after the Administrator's notification the State has not commenced appropriate enforcement action, the Administrator shall issue an order requiring such person to comply with such condition or limitation or shall bring a civil action in accordance with subsection (b) of this section.

* * *

(3) Whenever on the basis of any information available to him the

Administrator finds that any person is in violation of section 1311, 1312, 1316, 1317, 1318, 1328, or 1345 of this title, or is in violation of any permit condition or limitation implementing any of such sections in a permit issued under section 1342 of this title by him or by a State or in a permit issued under section 1344 of this title by a State, he shall issue an order requiring such person to comply with such section or requirement, or he shall bring a civil action in accordance with subsection (b) of this section.

(b) Civil actions

The Administrator is authorized to commence a civil action for appropriate relief, including a permanent or temporary injunction, for any violation for which he is authorized to issue a compliance order under subsection (a) of this section. Any action under this subsection may be brought in the district court of the United States for the district in which the defendant is located or resides or is doing business, and such court shall have jurisdiction to restrain such violation and to require compliance. Notice of the commencement of such action shall be given immediately to the appropriate State.

Clean Water Act § 402, 33 U.S.C. § 1342

(a) Permits for discharge of pollutants

(1) Except as provided in sections 1328 and 1344 of this title, the Administrator may, after opportunity for public hearing, issue a permit for the discharge of any pollutant, or combination of pollutants, notwithstanding section 1311(a) of this title, upon condition that such discharge will meet either (A) all applicable requirements under sections 1311, 1312, 1316, 1317, 1318, and 1343 of this title, or (B) prior to the taking of necessary implementing actions relating to all such requirements, such conditions as the Administrator determines are necessary to carry out the provisions of this chapter.

* * *

(i) Federal enforcement not limited

Nothing in this section shall be construed to limit the authority of the Administrator to take action pursuant to section 1319 of this title.

Clean Water Act § 505, 33 U.S.C. § 1365

(a) Authorization; jurisdiction

Except as provided in subsection (b) of this section and section 1319(g)(6) of this title, any citizen may commence a civil action on his own behalf--

(1) against any person (including (i) the United States, and (ii) any other governmental instrumentality or agency to the extent permitted by the eleventh amendment to the Constitution) who is alleged to be in violation of (A) an effluent standard or limitation under this chapter or (B) an order issued by the Administrator or a State with respect to such a standard or limitation, or

(2) against the Administrator where there is alleged a failure of the Administrator to perform any act or duty under this chapter which is not discretionary with the Administrator.

The district courts shall have jurisdiction, without regard to the amount in controversy or the citizenship of the parties, to enforce such an effluent standard or limitation, or such an order, or to order the Administrator to perform such act or duty, as the case may be, and to apply any appropriate civil penalties under section 1319(d) of this title.

(b) Notice

No action may be commenced--

(1) under subsection (a)(1) of this section--

(A) prior to sixty days after the plaintiff has given notice of the

alleged violation (i) to the Administrator, (ii) to the State in which the alleged violation occurs, and (iii) to any alleged violator of the standard, limitation, or order, or

(B) if the Administrator or State has commenced and is diligently prosecuting a civil or criminal action in a court of the United States, or a State to require compliance with the standard, limitation, or order, but in any such action in a court of the United States any citizen may intervene as a matter of right.

(2) under subsection (a)(2) of this section prior to sixty days after the plaintiff has given notice of such action to the Administrator,

except that such action may be brought immediately after such notification in the case of an action under this section respecting a violation of sections 1316 and 1317(a) of this title. Notice under this subsection shall be given in such manner as the Administrator shall prescribe by regulation.

Clean Water Act § 509, 33 U.S.C. § 1369

(b) Review of Administrator's action; selection of court; fees

(1) Review of the Administrator's action (A) in promulgating any standard of performance under section 1316 of this title, (B) in making any determination pursuant to section 1316(b)(1)(C) of this title, (C) in promulgating any effluent standard, prohibition, or pretreatment standard under section 1317 of this title, (D) in making any determination as to a State permit program submitted under section 1342(b) of this title, (E) in approving or promulgating any effluent limitation or other limitation under section 1311, 1312, 1316, or 1345 of this title, (F) in issuing or denying any permit under section 1342 of this title, and (G) in promulgating any individual control strategy under section 1314(l) of this title, may be had by any interested person in the Circuit Court of Appeals of the United States for the Federal judicial district in which such person resides or transacts business which is directly affected by such action upon application by such person. Any such application shall be made

within 120 days from the date of such determination, approval, promulgation, issuance or denial, or after such date only if such application is based solely on grounds which arose after such 120th day.

(2) Action of the Administrator with respect to which review could have been obtained under paragraph (1) of this subsection shall not be subject to judicial review in any civil or criminal proceeding for enforcement.

40 C.F.R. § 135.3

* * *

(b) Failure to act. Notice regarding an alleged failure of the Administrator to perform any act or duty under the Act which is not discretionary with the Administrator shall identify the provision of the Act which requires such act or creates such duty, shall describe with reasonable specificity the action taken or not taken by the Administrator which is alleged to constitute a failure to perform such act or duty, and shall state the full name, address and telephone number of the person giving the notice.

(c) Identification of counsel. The notice shall state the name, address, and telephone number of the legal counsel, if any, representing the person giving the notice.

CERTIFICATE OF SERVICE

I hereby certify that on the ___ day of July, 2000, a copy of the foregoing was served by first class mail or Federal Express upon the following:

Matthew Bishop
Western Environmental Law Center
P.O. Box 1507
Taos, NM 87571

_____
Kathryn E. Kovacs, Attorney
U.S. Department of Justice
(202) 514-4010

VAIL ENGINEERING, INC.

PHONE: (505)
988-5575

1588 SAN MATEO LANE
SANTA FE, NEW MEXICO
87505

SPRING 13 & 39 PRELIMINARY DESIGN ANALYSIS:

Seepage containing high concentrations of acid rock drainage enters Red River at what is known as Spring 13, located several hundred feet upstream from the mouth of Capulin Canyon, and Spring 39 located about 500 feet downstream from Thunder Bridge at the west end of the Columbine Park area. This seepage results in increases in the metal and sulfate loadings in the river. During extreme low river flow periods, the seepage at Spring 13 adds considerably to the milky appearance of the waters downstream in the river to below the Ranger Station.

Ground Water Conditions

Spring 13 and Spring 39 are not isolated streams of water. These are seepage areas to the river of ground water flowing in a basin aquifer that extends at significant width and depth across the Red River Valley. This basin aquifer extends from below the Ranger Station to above the Town of Red River. The water table elevation in this aquifer is below the river elevation along extended reaches. At some locations the ground water table elevation is slightly above the river level and water seeps from the basin aquifer to the surface flow. Significant seepage areas are the river reaches through the Town of Red River and along the lower part of Columbine Park. Spring 39 is located in this latter reach. The ground water table in the vicinity of Spring 13 also is generally slightly above the river elevation which results in some seepage along this reach.

Above the mine area there are extensive areas of altered rock and numerous hydro-thermal scars. These areas and scars are predominantly along the north side of the river valley. These areas produce significant quantities of low pH acid rock drainage (ARD). Most of this drainage is to the basin aquifer below the river level. Most of the ARD appears to be concentrated in a plume flowing along the north side of the basin aquifer.

The Spring 13 area is located at the southwest base of Goat Hill. Goat Hill is composed of highly mineralized altered rock containing high concentration of pyrite. This results in the addition of ARD to the north side plume of the basin flow. This ARD increases the conductivity in the plume in the Spring 13 area to above 2000 μS/cm. Spring 13 includes a significant portion of this plume. Data from numerous river surveys indicate that the seepage from Capulin Canyon is minor and commensurate with the natural drainage that would be expected from the canyon area downstream of the Capulin capture system.

Seepage along the Spring 39 reach ranges up to 1700 μS/cm which is higher than that expected in the plume downstream of Thunder Bridge. If the high conductivities are the result of

accretions; the source has not been determined. There are no hydro-thermal scars, significant altered rock areas or waste piles in the near vicinity of Spring 39.

For the purpose of this report, Spring 13 is considered as the total of the ground water seepage flow along the north side of the river over a reach of about 400 feet in length. The seepage appears to be fairly well spread out over this reach with some localized areas of higher or lower seepage. These probably reflect variations in the elevations and gradients of both the surface and ground water flow and variations of hydraulic conductivity in the ground water aquifer along the river. Seepage is visible along the north river shore line and up the north bank in locations to an elevation of about one foot above the river level.

The quantity of seepage discharged to the river at Spring 13 is estimated based on the results of Molycorp's water quality surveys of Red River. Water samples are collected at least twice a year (from 1992 through 1999) from approximately 24 stations over the reach from above the Town of Red River to below the Ranger Station. Stream flow measurements at up to 16 Stations have been made coincidentally with the sampling. Water samples are collected at Station 13 (a few hundred feet above Spring 13) and at Station 13A (about 300 feet below Spring 13).

On March 14, 2000 the flow at Station 13 was measured at 17.63 CFS and the conductance was 374. The conductivity of the river water as 383 at Station 13A and the conductivity of Spring 13 discharge was 1888.

The flow of Spring 13 was calculated algebraically as follows:

(Flow Upstream x Conductance) + (Spring 13 Flow x Conductance) = (Downstream flow x Conductance)

(17.63 x 374) + (S13 CFS x 1888) = (17.63 +S13 CFS) x 383

Transposing:

(S13 CFS x 1888) = (17.63 x 383) - (17.63 x 374) + (S13 CFS x 383)

(S13 CFS x 1505) = 159

S13 = .1054 CFS = 47.3 GPM

Calculations using both conductance and SO_4 concentrations of other river surveys made during the past few years, indicated Spring 13 flows of similar magnitude.

PRIMARY DESIGN ALTERNATE

At this time the most favorable appearing seepage collection method appears to be the installation of a modified "French Drain" type system. Preliminary analysis indicates that a drain line installed at a depth of about two feet below the adjacent low water flow river level and about ten feet from the north shore line will be effective. The drain line would be perforated with small diameter holes drilled at spacing which will control the inflow to a rate of slightly more than the probable ground water seepage to the river. If the drain line inflow rate was not controlled there would be an excessive amount of inflow during high river flow periods.

Assuming that the Spring 13 seepage amounts to 50 gpm over a 400 foot reach; the average required inflow rate to the drain would be .125 gpm/feet. It appears desirable to maintain a minimum head above the orifice of 0.5 feet. Based on the standard orifice formula: Q cfs = C x Area sq. ft. x $(2\ gh)^{.5}$ and assuming an orifice coefficient of 0.61; 3/16 inch orifices at an average spacing of 2′ 3″ will be required. The river level during nominal high flow periods is approximately one foot above the level at low flow periods. At high flow periods the inflow rate would be approximately 1.5 times higher.

It is proposed to extend the Spring 13 drain line for about 800 feet farther west to collect the shallow seepage flow along the reach of the mouth of Capulin Canyon. It is believed that such seepage can be collected by installation of this section of the drain line along the old river channel. It is anticipated that an additional 50 gpm of seepage will be intercepted by this drain extension.

A similar drain line is proposed for the Spring 39 area. Additional exploratory work is required to determine the reach along the river where such a line would be beneficial. It presently appears that at least 400 feet of drain line will be required in this area.

In this area there is a large general discharge of the basin under flow to river surface flow. This precludes estimating the volume of high ARD seepage from the conductance gain along this river reach. Additional field investigations will therefore be required to determine the volume of the seepage flow that should be collected. It appears that the volume of high ARD seepage is somewhat less than at Spring 13. The collected water at Spring 39 will be pumped to either the tailing line or to the water supply line from Columbine Park to the mill.

ALTERNATE COLLECTION SYSTEM DESIGN

Interception of the seepage flow by several small shallow wells has also been considered. The number, spacing and distance from the river of the required wells is dependent on the hydrological properties of the aquifer. The principal advantage of the well system is that a nearly uniform ground water extraction rate would result. It is also probable that it would be necessary to extract a higher total amount of ground water to achieve the same effectiveness as the French Drain system.

ALTERNATIVES FOR DISPOSAL OF THE CAPTURED GROUND WATER INCLUDE:

(a) pumping the water to the tailings line

(b) installation of a new pipe line and pumpage of the collected water to the mine or mill area.

Tests must be made to determine if pumpage of the collected water to the tailings line will result in a pH in the tailings line that might be low enough to cause corrosion of the line or be in conflict with State regulations relative to discharges of such water to the tailing line or to

the tailings ponds. If low pH appears to be a problem it may be possible to neutralize the collected water with lime before pumpage to the tailings line.

At the Spring 13 area the pressure in the tailings line might vary from 50 psi or less to over 160 psi. A variable speed pump will therefore be required. The pump motor will be approximately 20 horse power.

ESSENTIAL FIELD INVESTIGATIONS

In order to make a final determination of the best and most effective alternative and the specific design details for such; a considerable amount of field investigation, and testing will be required. The proposed data collection work includes the following:

Proposed Ground Water Investigations

(a) Determine the elevations, direction of ground water flow and gradients in the vicinity of the Spring areas. It is probable that the water table elevation is at a fairly shallow depth in the area between the river and the steeply rising ground lying north of the highway. It is therefore proposed at each seepage area, to excavate with a back hoe, about 12 small pits to slightly below the water table. The water level in each pit will be accurately determined by instrument surveys. A vertical perforated pipe will be installed in pits during backfill operations so that the water levels can be monitored over a period of time. Tentative locations for most of the pits are shown on an attached drawing.

(b) Determine the hydrological characteristics of the shallow ground water aquifer. It is proposed to pump water from two or more of the shallow pits or from shallow wells in the vicinity. During the pumpage and water level recovery periods; the water levels at the pumped hole and in several nearly observation wells will be monitored to determine coefficients of hydraulic conductivity, aquifer storage coefficients and the extent and shape of the draw-down cone of depression. Water samples will also be collected and analyzed to determine variations in ARD concentrations.

(c) Determine the feasibility of a "french drain" type collection system and the detailed design factors related to such. It is proposed to excavate in the Spring 13 area, a trench to a depth of approximately 2 feet below the river level for a distance of about 100 feet parallel to and about 10 feet north of the river shoreline. (See attached drawing of proposed field investigations.)

Water inflow rates will be noted along the trench line. A four inch diameter plastic pipe will be laid along the trench bottom. The pipe will be perforated with the diameter and spacing of the perforations to be made as estimated for collection of an adequate and controlled amount of seepage flow into the line. Different hole diameters or spacing may be used along various sections of the trench length as indicated by possible variations in seepage rates into the trench or along the river shore line. The trench will then be back filled with clean gravel to a depth of about 18 inches over the pipe and with excavated soil to the natural ground line. The trench will be extended downstream about 100 feet on a fairly shallow grade to where it day lights out above

the surface so that the perforated collection line will be kept drained. The trench down stream of the perforated drain line will be backfilled to above the ground water level with clayey material.

Flow from the drain line will be measured over a period of time. Several observation wells at various distances out from each side of the drain line will be installed. The water levels in these will be monitored to observe changes of levels and gradients in the vicinity of the drain line. Seepage along the river in the vicinity of the drain line will be carefully noted prior to the excavation of the trench and monitored for some time thereafter. Prior to, during and following the drain trench installation, the conductivity of the river water upstream and downstream of the Spring 13 area will be measured frequently and a record of the river flow at the Ranger Station will be kept during this period. Final drain line location and design depth and size and spacing of perforations will be based on the results of the test drain line section.

PROJECT SCHEDULE

It is anticipated that a permit will be approved by the New Mexico Highway Department within the next few days so that the proposed field investigation can be conducted. Unless early snow melt flood flows occur, the field investigations can probably be completed by the end of April and final designs by the end of June. High river flows are expected from May through August or September. Construction can commence thereafter and should be completed by the end of November and before the usual period of milky river water and elevated ARD concentrations of the winter months.

NEW MILL WATER SUPPLY WELL

Molycorp is planning on developing a new well to augment the water supply for milling of ore and transportation of tailings. The well will be located at the west end of the area of waste rock piles which extend along the north side of the river basin between the mill area and Columbine Park. The well will be developed near the north edge of the valley underground water basin. It is anticipated that the well will intercept a substantial volume of the flow in the high ARD plume that flows from above the mine area down along the north side of the basin aquifer. This should substantially reduce the amount of ARD that is discharged from the underground basin into the river surface flow in the Columbine Park area. It is also anticipated that the well will result in a reduction in the ARD concentrations of the seepage farther downstream.

A permit from the State Engineer will be required to divert the ground waters by either well pumpage or a drain collection system and for discharge to either the river or the tailings line.

Respectfully Submitted:
VAIL ENGINEERING, INC.

Ralph E. Vail

Chief Engineer
NM PE & LS 2098

Molycorp Issue Paper

DATE: September 2, 1999

TOPIC: Issues involved in issuance of the NPDES permit for Molycorp

BACKGROUND: Molycorp operates a large molybdenum mine which is located in northen New Mexico approximately twenty miles north of Taos. The facility consists of tailings ponds located west of the town of Questa and the mine site located five miles east of Questa (see attached map). The Red River, which is located adjacent to the mine, has substantial water quality problems due to metals. Acidic seeps from the mine's waste rock piles are thought to contribute to the water quality problems.

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TECHNICAL CONCERNS:

- The seeps must have "direct hydrologic connections" to the waste rock piles to the river to be regulated under an NPDES permit. This has been used in other permits issued by Region 6 but has some weaknesses. EPA has not issued a policy statement.

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COMMUNITY CONCERNS: A citizens group, Amigos Bravos, has filed suit against EPA for failing to take enforcement action or regulate the seeps under an NPDES permit. There is much local interest in this permit. There has, however, been good cooperation between Amigos Bravos, Molycorp, and the State in gathering water quality data on the Red River. There are no direct Tribal issues. No Pueblos are adjacent or directly downstream and they have not expressed interest as yet. There are also no endangered species issues.

FUTURE/RECOMMENDED ACTIONS: We need to push Headquarters to write a policy statement on the "direct hydrologic connection" issue. Otherwise, we need to issue the permit and resolve the water quality issues.

CONTACT: Scott Wilson, 214-665-7511

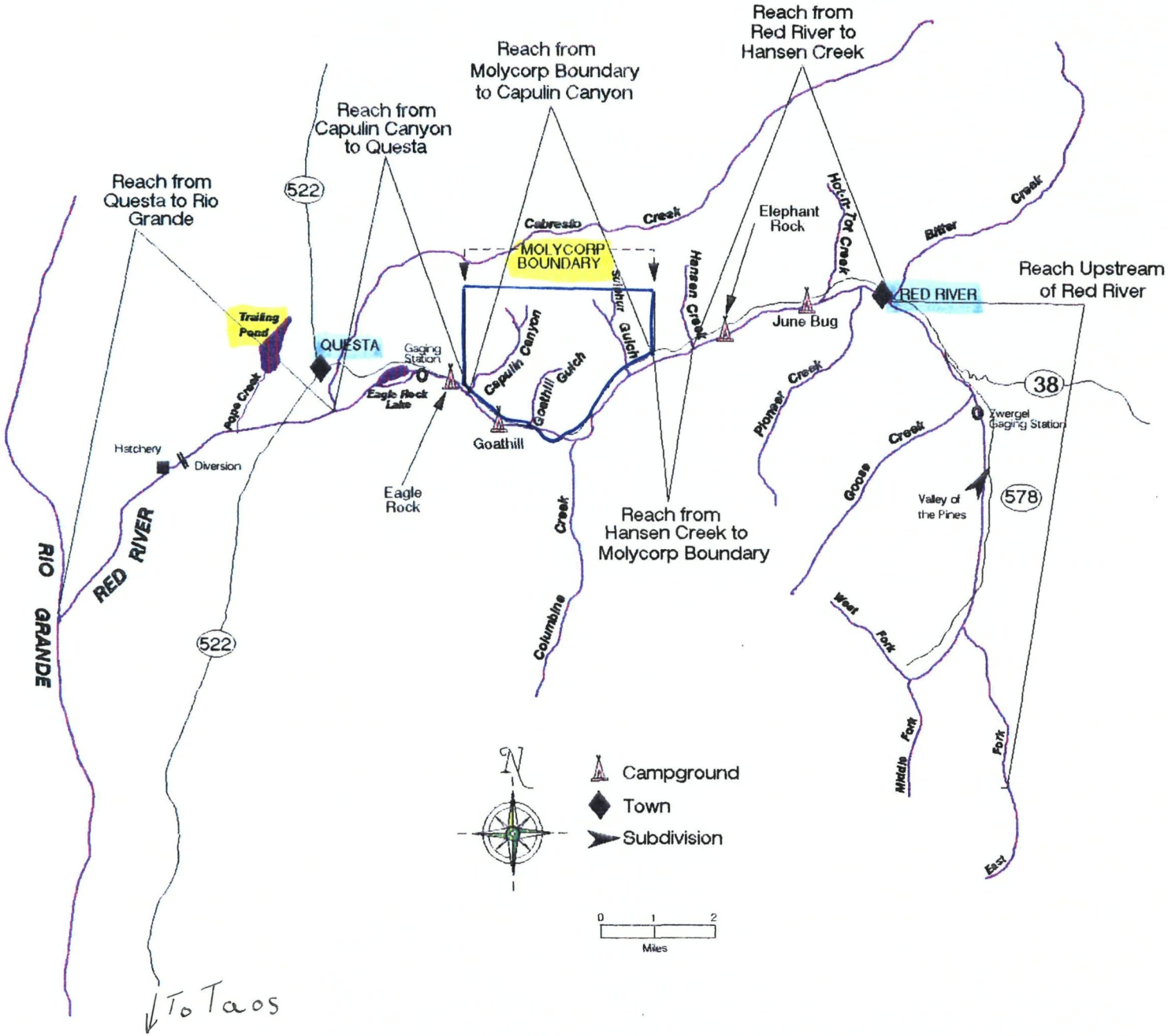

FIGURE 1: Red River Study Area with the six river reaches used in this report.

Technical Issue: Direct Hydrologic Connection

Molycorp Mine, Questa, New Mexico

Several Molycorp contractors have conducted studies at the mine site. All generally agree that the sulfide rich volcanic rock material "rhyolite" is most likely responsible for generating the highly acidic metal laden waters within the Red River watershed. This acidic metal laden water is called Acid Rock Drainage (ARD). The most common mechanism for the formation of ARD involves the oxidation and hydration of sulfide minerals (e.g., pyrite, or iron sulfide), resulting in the generation of sulfuric acid. The acidic waters then remove metals from the weathered rock material and delivers them to the river via ground or surface water flow.

Naturally occurring erosional scars, which are exposed rhyolitic volcanic flows; and Molycorp's Waste Rock Dumps (WRDs), which contain rhyolitic material, are the most probable sources of low pH and high metals discharge to the local watershed environment. Red River water quality and a localized concentration of acidic, high metals seeps indicate that the general area of the source is within the Molycorp property boundary. Geochemical analysis of erosional scar and WRD leachate indicates similar geochemical signatures. Monitor well ground water samples support a correlation between ground water chemistry and WRD and erosional scar leachate chemistry. USGS gage station data indicate ground water flow to the river. Although attenuation appears to be a factor for seep discharge, a correlation exists between seep and ground water quality. Therefore, verification has been adequately established to support a ground water hydrological connection between the two sources and Red River seep discharge. However, the percentage of constituent concentrations or discharge volume supplied by each probable source to a specific seep could not be determined using the available data. To attempt to determine these volumes and percentages would be impractical considering the geologic complexity of the area.

The Office of Inspector General (OIG) finalized a report entitled: "EPA Can Do More To Help Minimize Hardrock Mining Liabilities" on June 11, 1997. The OIG conducted this investigation in response to a request from Region 8 for an audit of the environmental and financial liabilities that could result from active hardrock mines. The OIG found that the low level of financial assurance requirements at mine sites may leave EPA in the position of assuming responsibility for cleanup of future abandoned hardrock mines under the Superfund Program. The EPA media-based program most often applied to hardrock mining is the CWA NPDES program, which calls for permits to limit the discharge of pollutants into U.S. waters. However, a serious limitation of the CWA is that it provides protection for surface waters only; ground water is not subject to regulation under the CWA.

The OIG investigation determined that the most serious environmental threat of current hardrock mining methods is the risk of acid mine drainage (i.e., ARD). Water and oxygen flowing over and through the metal-rich, sulfide rock exposed by mining activities can contaminate surface and ground waters and damage aquatic life. Predicting the probability and extent of acid mine drainage at a specific mine is difficult because drainage may not occur until long after active

mining ends. Reclamation may require water treatment in perpetuity. Although the OIG considered ARD as the most serious environmental threat; the OIG's investigation concentrated on mines which use the heap leaching method for the study.

Legal Issue: Citizens Suit

Amigos Bravos, et al. v. U.S. EPA (Molycorp Citizens Suit)

On March 25, 1999, Amigos Bravos and New Mexico Citizens for Clean Air and Water ("Plaintiffs"), two non-profit organizations dedicated to protecting New Mexico's water resources, filed a citizens suit against EPA under § 505 of the Clean Water Act, alleging that EPA has failed to perform non-discretionary duties under the Clean Water Act ("CWA") by 1) failing to take enforcement action either through the issuance of a compliance order or through a civil suit against Molycorp, Inc. ("Molycorp") for discharging pollutants into waters of the U.S. without a National Pollutant Discharge Elimination System (NPDES) permit, and 2) failing to either issue an NPDES permit for Molycorp's waste rock pile discharges or to prohibit such discharges pursuant to Section 301 of the Act.

Molycorp owns and operates a massive molybdenum mine on the banks of the Red River in New Mexico. Plaintiffs allege that pollutants leaching from Molycorp's waste rock piles are discharging to the Red River via a direct hydrologic groundwater connection and that these discharges are point sources requiring a NPDES permit.

On June 15, 1999, EPA filed a Motion to Dismiss contending 1) enforcement is a discretionary function under the CWA; 2) Plaintiffs were collaterally estopped by prior litigation on this same issue; and 3) Plaintiffs failed to provide proper notice under CWA §505. Plaintiffs filed a Response to EPA's Motion to Dismiss and a Motion for Summary Judgement on July 29, 1999. EPA's reply to Plaintiff's Response to EPA's Motion to Dismiss and to Plaintiff's Motion for Summary Judgment is due September 30, 1999.

ADDITIONAL BACKGROUND INFORMATION

In a 1993 NPDES permit action, EPA declined to impose effluent limitations on the discharges at issue, despite public comment raising the issue. In 1997, these same Plaintiffs filed a citizen suit against Molycorp contending Molycorp was discharging without a permit because Molycorp's 1993 permit did not authorize the overburden pile discharges. The District Court dismissed that case, essentially on the grounds that whether the overburden piles required a permit was an issue that should have been litigated in a challenge to EPA's permit action. Because it had not been, it could not be raised after the fact via a citizen's suit. The Tenth Circuit affirmed the District Court's decision. After its action against Molycorp was dismissed, Plaintiffs brought the instant action against EPA. Molycorp's 1993 permit is now up for renewal and the issue of whether the discharges from the overburden piles should be permitted is before EPA again.

Permit Issues

Molycorp's Molybdenum mine located near Questa, New Mexico is an extensive operation which began in the 1920's. Mining at the site has involved both surface and subterranean activities. Molycorp's current permit authorizes discharges from four outfalls. Two outfalls are located west of Questa at the tailings ponds. The other outfalls are for storm water discharges at the mine site. The storm water outfalls have never been used. Molycorp's NPDES permit has expired and a new permit is being drafted. The currently permitted discharges from the mine and tailings ponds are not expected to be controversial.

There are several seeps located adjacent to the mine site which are controversial and are presently the subject of a citizens suit. As their name describes, the seeps are areas along the stream where water is trickling into the Red River at a low rate. That water is highly acidic, often having a pH as low as 2.0, and contains high concentrations of metals. Although there are some natural seeps in the canyon, activities at the mine are thought to be responsible for the seeps located adjacent to the mine site. The seeps contribute to water quality problems in the Red River by their contribution of metals.

Since NPDES permit can only regulate point sources, the seeps can only be controlled if we can claim that they are point source discharges. This has been previously done in NPDES permits issued in Region 6 by determining that there is a "direct hydrologic connection" between the pollutant source and the receiving stream. The previous permit for Concentrated Animal Feeding Operations and the permit recently issued to US Liquids of Louisiana both contain requirements based on a direct hydrologic connection. A weakness to this approach was found in the Animal Feeding Operations model permit written by EPA Headquarters. The judge reviewing the model permit frowned on the direct hydrologic connection approach because EPA has not issued a policy statement. We should push Headquarters to develop such a policy statement so that this issue does not hurt our case in the event of a challenge.

Ecosystems/TMDL/Tribal Issues

Molycorp/ Red River issues from 6WP-EP

No Tribal concerns are expected on this issue. Tribal groundwater resources are not affected. After the confluence with the Red River, the Rio Grande flows approximately 12 miles before entering the Pueblo of Taos, which has partial jurisdiction over a 10 milestretch of the River. The state of New Mexico also has partial jurisdiction over this part of the Rio Grande. The Pueblo of Taos has jurisdiction over three separate tracts of land, one of which includes the Rio Grande. The Pueblo's traditional housing and tribal offices are located on the largest tract, which includes tributaries to the Rio Grande. The next Tribal jurisdiction (Pueblo of San Juan) is located approximately 30 miles south on the Rio Grande. EPA sends public notices of proposed NPDES permits in New Mexico to all Tribal leaders and environmental offices.

NMED has included the Red River from the mouth on the Rio Grande to Placer Creek in their 1998 303(d) list as Not Supporting water quality standards. The listing is for metals (Al, Cd, and Cu) at acute levels and for metals (Al, Zn) at chronic levels. The segment and numerous tributaries are also listed as not supported for stream bottom deposits. There are no T&E species issues for this reach. The state classifies this as a Class 1 (high) priority. This segment includes the MolyCorp mine area and the Town of Red River.

NMED is currently conducting intensive surface water sampling on this segment and its tributaries. The sampling design was developed through a consensus process that included NMED, NM Game and Fish, Amigos Bravos, MolyCorp., the Village of Red River, and the Red River Watershed Group. There are 42 sampling locations selected to characterize the mainstem, using sites, above and below known seeps or arroyos, and tributaries to the river. The sampling effort is being supported in part by a $100,000 104(b)(3) TMDL development grant awarded through R6. If the results of the sampling indicate that a TMDL is warranted NMED expects that it could be completed as early as spring 2000. This TMDL would most probably take a simple mass balance type approach.

6.3 Example Passive Systems at Metal Mines

Passive systems can be designed to treat runoff and seepage from waste rock dumps, tailings piles, and spent ore heaps, and drainage from adits and historic mine facilities. The technology was developed to treat acidic waters generated from abandoned coal mines in the eastern U.S. and has gained widespread acceptance for this application (more than 600 passive systems were constructed and operating in 1996; Gusek, 1998b). Metals levels in the low parts per million or high parts per billion range are typically achieved. At coal mines, acidic waters contain high concentrations of sulfate, aluminum, iron, and manganese, but few other metals. Only recently has passive treatment technology been used to treat acidic to neutral waters draining from metal mining sites. These technological applications are still under development. In addition to high concentrations of TDS and sulfate, metal mine waters may contain a variety of metals in moderate to high concentrations. The presence of numerous trace metals complicates the geochemical system design.

Several examples of the use of passive systems at mine sites is shown in Table E-2. In addition to the facilities shown in Table E-2, passive treatment is being employed at several other inactive or historic sites described in the references of the previous two sections. The mines in Table E-2 and referenced in the previous sections represent historic sites and ongoing remediation projects. The only active mine that EPA is aware of that is using passive treatment to meet NPDES permit effluent limits is the West Fork Mine in Missouri. Overall, a major challenge to using passive systems is maintaining system performance, at all times, and under all operating conditions. At present, passive systems appear to be a viable alternative only under limited conditions or when used in combination with other treatment approaches.

Table E-2. Example Passive Treatment Facilities at Metal Mines

Mine	Influent Characteristics	Passive Technologies Used	Effluent Characteristics
Wheal Jane, UK Underground Sn-Cu Inactive	3,500 gpm, pH = 3.8; Cd = 0.006 mg/L; Cu = 1.05 mg/L; Zn = 3.1 mg/L	Anaerobic cell → ALD → Aerobic Cell → Anaerobic Cell → Rock Filter	Not available.
West Fork, MO Underground Pb- Zn Active	1,200 gpm, pH = 7.9; Pb = 0.4 mg/L; Zn = 0.36 mg/L; Cu = 0.037 mg/L	Settling Pond → Anaerobic Cell → Rock Filter → Aeration Pond	pH = 7.2; Pb = 0.04 mg/L; Zn = 0.07 mg/L; Cu = <0.008 mg/L.
Ferris-Haggarty, WY Underground Cu Abandoned	20 to 480 gpm; pH = 4 to 7; Cu =2.0 to 6.5 mg/L; Significant seasonal variations.	Pilot Anaerobic Test Cell	pH = neutral; Cu = 0.05 mg/L.

Sources: Wheal Jane: Cambridge, 1995; West Fork: Gusek et al., 1998a; Ferris Haggarty: Reisinger and Gusek, 1998.

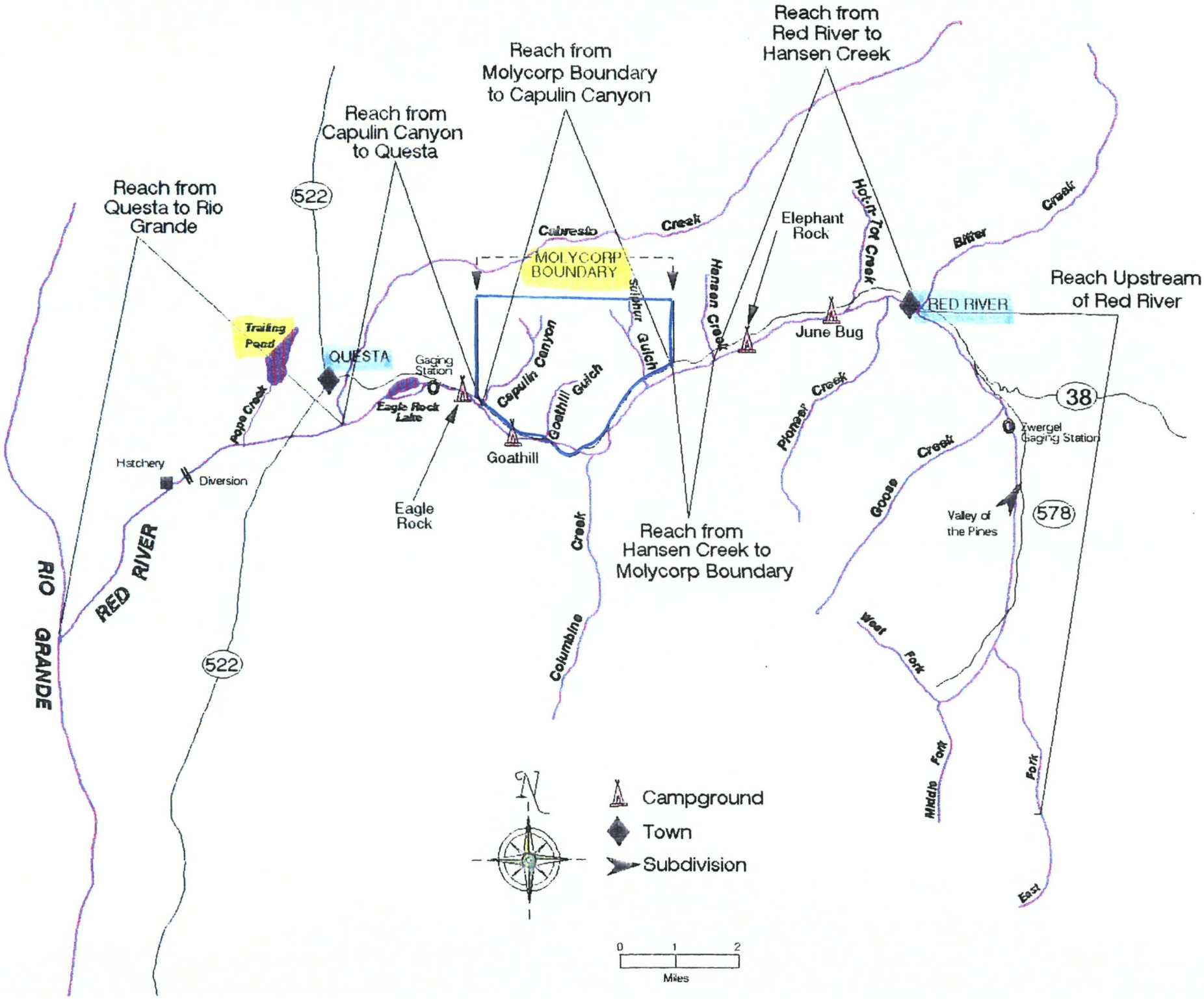

FIGURE 1: Red River Study Area with the six river reaches used in this report.

Molycorp Issue Paper

DATE: September 2, 1999

TOPIC: Issues involved in issuance of the NPDES permit for Molycorp

BACKGROUND: Molycorp operates a large molybdenum mine which is located in northen New Mexico approximately twenty miles north of Taos. The facility consists of tailings ponds located west of the town of Questa and the mine site located five miles east of Questa (see attached map). The Red River, which is located adjacent to the mine, has substantial water quality problems due to metals. Acidic seeps from the mine's waste rock piles are thought to contribute to the water quality problems.

CURRENT STATUS: The NPDES permits branch is working on reissuing Molycorp's permit. The existing permit authorizes several discharges from the mine's tailings ponds and from the mine site but does not address the seeps. Discharges from the seeps are planned to be controlled in the reissued permit. Water quality data are being gathered in the Red River to determine the causes of the problems and the extent to which seeps located near the mine affect the river.

TECHNICAL CONCERNS:

- The seeps must have "direct hydrologic connections" to the waste rock piles to the river to be regulated under an NPDES permit. This has been used in other permits issued by Region 6 but has some weaknesses. EPA has not issued a policy statement.

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FUTURE/RECOMMENDED ACTIONS: We need to push Headquarters to write a policy statement on the "direct hydrologic connection" issue. Otherwise, we need to issue the permit and resolve the water quality issues.

CONTACT: Scott Wilson, 214-665-7511

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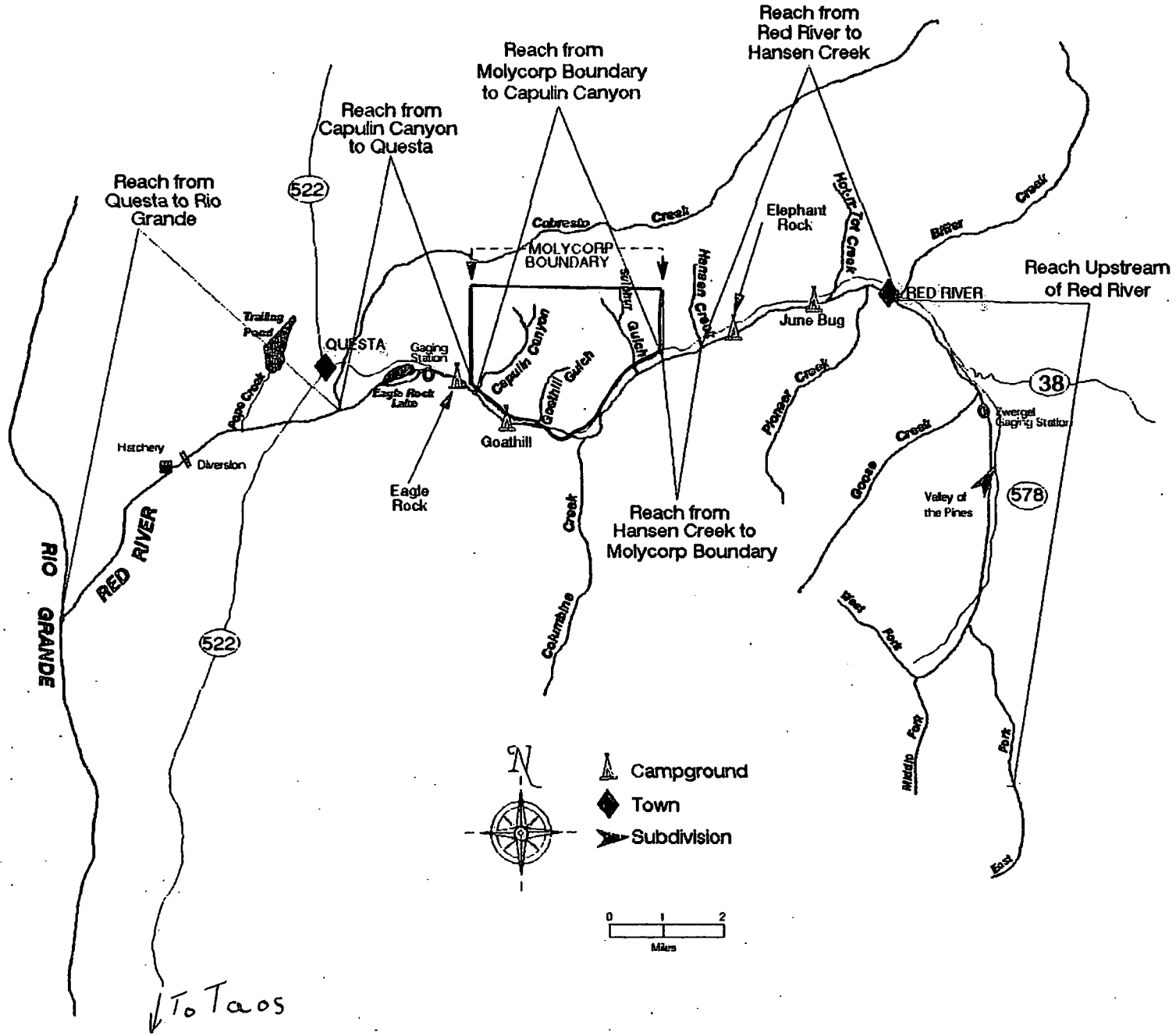

FIGURE 1: Red River Study Area with the six river reaches used in this report.

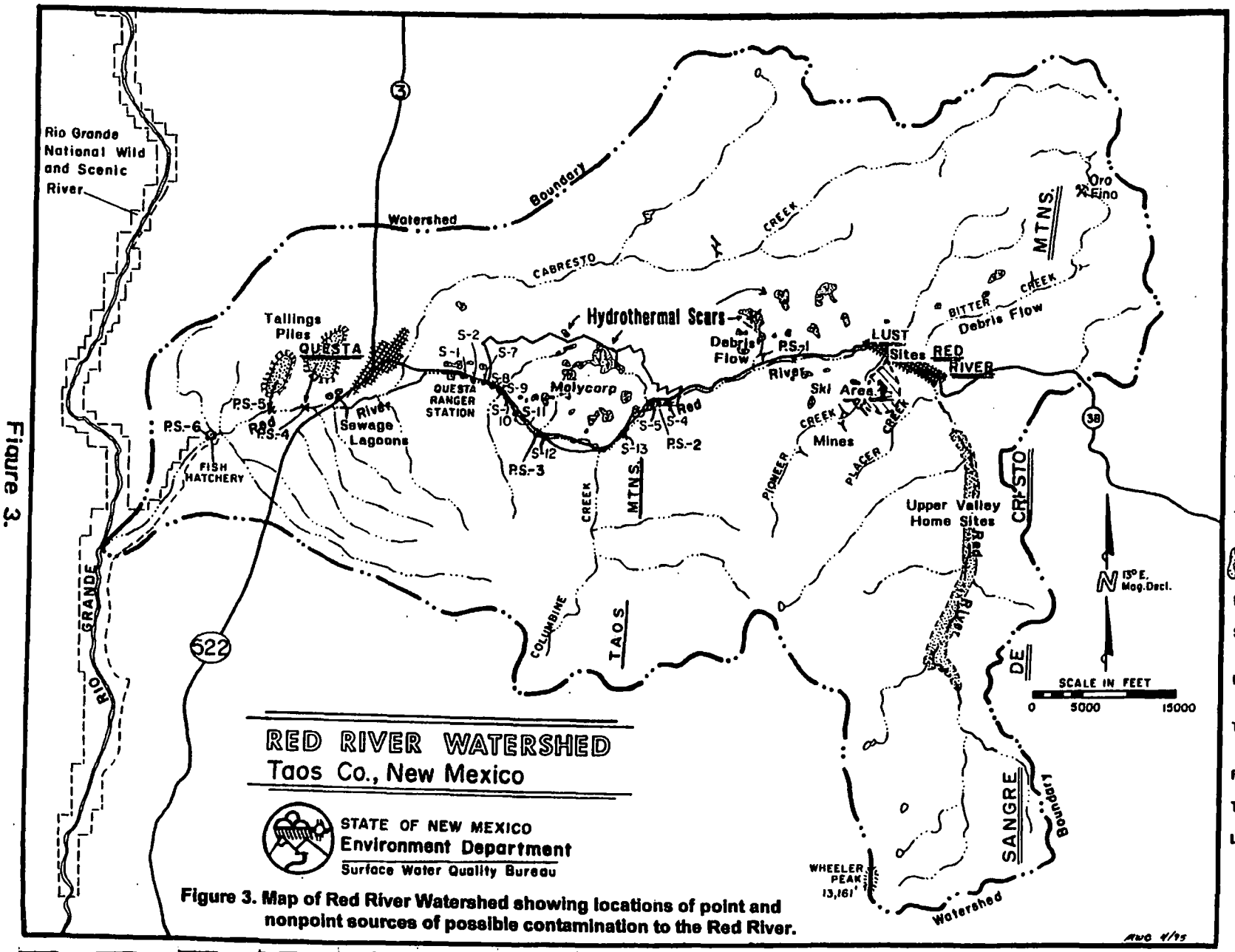

Figure 3. Map of Red River Watershed showing locations of point and nonpoint sources of possible contamination to the Red River.

Figure 3.

EXPLANATION

POINT SOURCE POLLUTION:

PS-1: Town of Red River Wastewater Treatment Plant

PS-2: Molycorp Mill Site Outfall #005

PS-3: Molycorp Mine, Goathill Gulch Outfall #004

PS-4: Molycorp East Tailings Pile Outfall #002

PS-5: Molycorp Pope Lake/W.Tailings Outfall #001

PS-6: Red River Fish Hatchery (NMDG&F)

NONPOINT SOURCE POLLUTION:

S-1 to S-13: Red River Groundwater Seeps (ARD)

Hydrothermally Altered Volcanic Rock Scars

Molycorp Mine

Scattered Abandoned Mine and Mill Sites (Esp. Pioneer and Bitter Creeks)

Upper RR Valley Home Sites: septic tanks, leach fields

Town of Red River: Leaking Underground Storage Tanks (LUST)

Red River Ski Area

Town of Questa Sewage Lagoons

Landslide/ Debris Flow Gravels and Sediments (Bitter, Hansen and Hotentot Creeks)

Figure 3.

CROWELL & MORING LLP
1001 PENNSYLVANIA AVENUE, N.W.
WASHINGTON, D.C. 20004-2595
(202) 624-2500
FACSIMILE (202) 628-5116

SUITE 1200
2010 MAIN STREET
IRVINE, CALIFORNIA 92614
(714) 263-8400
FACSIMILE (714) 263-8414

180 FLEET STREET
LONDON EC4A 2HD
44-171-413-0011
FACSIMILE 44-171-413-0333

RICHARD E. SCHWARTZ
(202) 624-2905
rschwartz@cromor.com

May 9, 1997

288:rls
89371.011

VIA FEDERAL EXPRESS

Mr. Sam Coleman
U.S. Environmental Protection Agency
Region 6
Suite 1200
1445 Ross Avenue
Dallas, TX 75202-2733

Re: Amigos Bravos et al. v. Molycorp, Inc.
(D.N.M. No. CIV 95-1497 JP/DJS)

Dear Mr. Coleman:

We represent Molycorp, Inc. in the above-captioned citizen's suit brought by two citizen groups, Amigos Bravos and New Mexico Citizens For Clean Air and Water, under the Clean Water Act. Molycorp operates the Questa molybdenum mine in Taos County, New Mexico. In this suit, the plaintiffs have alleged that certain discharges to ground water at the Questa mine require an NPDES permit. We understand that the plaintiffs recently contacted your office and made the same allegations.

EPA Region 6 has issued and reissued NPDES permits for this mine since 1977, most recently on October 15, 1993. The plaintiffs' allegations in the citizen suit are identical to allegations regarding alleged discharges to ground water raised by various public commenters (including the plaintiffs) before EPA Region 6 in Molycorp's last permit reissuance proceeding in 1993. EPA clearly rejected those allegations when it stated, in part:

> Various commenters have expressed concern with ground water seepage to the Red River and suggest that this ground water may be infiltrated from the mine and the tailings areas, in addition to natural sources....

> While EPA understands the concern of these commenters for the possible impact of ground water seepage on the Red River, we do not agree that these are "point sources" under the NPDES permitting program.

EPA, Response to Comments, NPDES Permit No. NM 0022306 (1993).

EPA can, of course, reevaluate these issues when Molycorp's permit comes up for renewal in 1998. In the meantime, we are concerned that the representatives of Amigos Bravos may be presenting a misleading portrayal of the facts. Accordingly, we are enclosing copies of the reports recently prepared by expert witnesses for Molycorp in the defense of the pending citizens' suit. The key conclusions of the enclosed reports are briefly set forth below.

The report by Dr. William Schafer, dated April 23, 1997, concludes:

> Based on these studies, changes in metal concentrations within a river system can be attributed to a number of factors including deposition in the stream bed, resuspension of previously deposited precipitates, adsorption onto bed sediments or dissolution from bed sediments. Consequently, changes in concentration in metals in the Red River cannot be reliably attributed to the Molycorp mine without proper consideration of these processes. When surface water data are properly interpreted, there is no indication that the Molycorp mine, currently, or at any time, has contributed metal loads to the Red River. [p. 16].

Another report, dated April, 1997, was prepared by biologists James Chadwick and Steve Canton of Chadwick Ecological Associates. It concludes as follows:

> The trends for both fish and benthic invertebrates indicate that the cumulative impacts of sediment from a number of sources, and possibly decreased water quality, substantially decrease the suitability of the Red River to sustain aquatic biota in the reaches upstream of the Molycorp Questa mine. This pattern was evident during both baseline [early 1960s] and present

> conditions. In the reaches of the Red River adjacent to the mine and downstream of Capulin Canyon, the suitability of the river to sustain aquatic biota does not improve. This pattern was established prior to open-pit mining during baseline conditions and continues to the present. The open pit mine and waste rock piles do not appear to have measurably impacted the suitability of the Red River to support aquatic biota. [p.66].

We suggest that you review Chadwick's figures which illustrate these findings, such as at pages 36, 40 and 63.

The report by Dr. Ian Hutchison, dated April 23, 1997, includes the following major opinions:

- **Constituent sources and conveyances:** There are no discernible, confined and discrete conveyances of constituents from the overburden piles (also referred to as waste rock piles) to the Red River.

- **Hydraulic connection:** Conditions at the mine site are not well enough understood to determine whether there is a direct hydraulic connection between the overburden piles and the Red River.

- **Red River Water Quality:** The available data does not support the conclusion that there has been a general reduction in the water quality of the Red river cause by mining activities between the mid-1960s and the mid-1990s.

- **Sources of constituents in Red River:** The available data does not allow for a determination of whether constituent loadings in Red River are derived from overburden piles, scar area, or from alluvial deposits in tributary and Red River channels. [pp. 2-3].

Finally, Mr. Richard Reavis, who has spent 18 years implementing the NPDES program with EPA (Region 9) and the State of Nevada, concludes in his report dated April 23, 1997, as follows:

> No unpermitted point sources of pollution as defined in 40 C.F.R. Sec. 122.2 exist at the Questa molybdenum mine (Molycorp mine)...The seepage zones that occur along the south boundary of the Molycorp property in the north bank of the Red River are unconfined seeps of groundwater that do not meet the definition of 40 C.F.R. Sec. 122.2, and must be considered non-point sources of pollution. [p. 2].

Please contact either of us if you have further questions regarding these matters.

Very truly yours,

Richard E. Schwartz
R. Timothy McCrum

Enclosures

cc: Mr. Jack Ferguson (w/o encs.)
Caroline Kirksey, Esq. (w/encs.)
Mr. Frederick Humke (w/encs.)

Molycorp Draft Permit

Summary

Discharges Continued from Existing Permit

Mine Site

- Two storm water discharges

  These have never been used but Molycorp wishes to have them in case of heavy rains

Tailings Ponds

- One discharge from the ground water interception system
- One discharge from the tailings water treatment system

New Proposed Requirements

- Prohibits the discharge of process related pollutants via hydrologic connection (Seeps)
- Includes Best Management Practices to prevent discharge

  Initial design consists of a 1200' and a 400' french drain

  Collected water will be pumped into the tailings pipeline or to the mill

- Molycorp will be required to investigate the ground water flow and refine the interception system design prior to installation
- The system must be approved by EPA

Molycorp Issue Paper

DATE: May 1, 2000

TOPIC: Issues involved in issuance of the NPDES permit for Molycorp

BACKGROUND: Molycorp operates a large molybdenum mine which is located in northen New Mexico approximately twenty miles north of Taos. The facility consists of tailings ponds located west of the town of Questa and the mine site located five miles east of Questa (see attached map). The Red River, which is located adjacent to the mine, has substantial water quality problems due to metals. Acidic seeps from the mine's waste rock piles are thought to contribute to those water quality problems.

CURRENT STATUS: The NPDES permits branch has drafted a permit for Molycorp. Existing discharges from the ground water capture system and treatment plant at the tailings ponds and storm water at the mine are proposed to be continued. Discharges from the seeps in the area of the mine site are proposed to be captured and pumped to the tailings ponds or used in the mill.

TECHNICAL CONCERNS:

- Best Management Practices which include several french drain collection systems have been agreed to by the permittee.
- The stream segment is listed for violating standards for Aluminum, Copper, Cadmium and Zinc. Also the narrative standard for bottom deposits.
- The permit will control acidic metal laden discharges to the Red River.
- Consistent with upcoming Superfund actions.

COMMUNITY CONCERNS: A citizens group, Amigos Bravos, has filed suit against EPA for failing to take enforcement action or regulate the seeps under an NPDES permit. There is much local interest in this permit. Superfund is on everyone's minds. There are no direct Tribal issues. No Pueblos are adjacent or directly downstream and they have not expressed interest as yet. There are also no endangered species issues.

FUTURE/RECOMMENDED ACTIONS: We are meeting with NMED on May 10 and Molycorp and the citizens group Amigos Bravos on May 11 to discuss the draft permit. Public Notice is expected to be May 27 and there will be a sixty day comment period. We will also schedule a public meeting to answer questions on the permit and a public hearing to take oral comments.

CONTACT: Scott Wilson, 214-665-7511

Scott

Cy: 6XA 6SF 6WQ 6WQ-P 6EN 6PD 6RC 6RA x2 6RD x2

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SANTA FE, NEW

GARY E. JOHNSON
GOVERNOR

April 1, 200

Gregg A. Cooke
Regional Administrator
United States Environmental Protection Agency
Region 6
1445 Ross Avenue
Dallas, Texas 75202-2733

Re: Inclusion of the Molycorp Mine Site, Questa New Mexico, on the National Priorities List

Dear Mr. Cooke:

I understand that the United States Environmental Protection Agency (EPA) is contemplating the addition of the Molycorp mine site in Questa, New Mexico to the National Priorities List (NPL) under section 105(a) (8) (B) of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), 42 U.S.C. § 9605 (a) (8) (B). EPA usually does not place a site on the NPL without the concurrence of the Governor of the affected State.

I hereby concur that EPA should place the Molycorp mine in Questa, New Mexico on the NPL for cleanup under CERCLA. During this process, I respectfully request that the work performed by Molycorp, Inc. pursuant to the New Mexico Mining Act and New Mexico Water Quality Act be recognized and accepted as part of the CERCLA process as applicable.

Sincerely,

Gary E Johnson

Gary E. Johnson
Governor of New Mexico

Received
APR 0 2000

cc: Pete Maggiore, Cabinet Secretary, NMED

State of New Mexico
ENVIRONMENT DEPARTMENT
ENVIRONMENTAL PROTECTION DIVISION
1190 St. Francis Drive, P.O. Box 26110
Santa Fe, New Mexico 87502-6110
Telephone (505) 827-2855
Fax (505) 827-2836

GARY E. JOHNSON
GOVERNOR

PETER MAGGIORE
SECRETARY

PAUL RITZMA
DEPUTY SECRETARY

DATE: April 3, 2000

TO: Mr. Gregg A. Cooke

FAX: 214-665-6648

Pages: 2

FROM: Governor Gary E. Johnson

Fax: 505-827-3026 Phone: 505-827-3000

COMMENTS:

FAX TRANSMISSION

Stenger

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 6
1445 ROSS AVENUE, SUITE 1200
DALLAS, TEXAS 75202-2733

SEP 17 1991

MEMORANDUM

SUBJECT: Determining the Need for Water Quality -Based Permit Effluent Limitations

FROM: Jack V. Ferguson
Chief
Permits Branch (6W-P)

TO: Addressees

The Permits Branch has developed a procedure for effluent data analysis that we will use in FY92 to determine when a water quality based permit limitation is necessary. Our regulations call for the imposition of a permit limit if there is a "reasonable potential" to exceed a water quality standard. The limited effluent data obtained with the permit application may not represent a complete picture of the actual range of pollutant concentrations.

Assessing the potential to cause a water quality violation is one of many points which need to be covered in water quality standard implementation documents. To date, the only state permitting implementation to address "reasonable potential" is that developed by the Texas Water Commission. The Permits Branch has worked up a sound and straightforward method that we will use in writing permits for the other states in Region 6, providing us with a workable alternative to the method described in the Technical Support Document for Toxics.

Our memorandum of January 3, 1991 described a statistical approach that would allow us to use a single piece of data or a small number of effluent measurements to estimate the upper range of concentrations that could be discharged and cause an exceedance of a standard. This procedure can be used to estimate the 95th percentile of an effluent data set, or the value that would be expected to exceed 95% of effluent concentrations in a discharge. The estimate of the 95th percentile is obtained by the following relationship:

pollutant concentration * 2.13 = 95th percentile pollutant concentration .

The procedure is based upon the relationship of the geometric mean to the 95th percentile in a lognormal distribution, assumes a constant coefficient of variance and is independent of the number of data points considered.

A single measurement of pollutant concentration or the geometric mean of multiple measurements may be used to estimate the upper range value. The upper range estimate of the pollutant is then used to calculate the concentration of that toxic parameter after dilution in the receiving stream. For example, if a permittee reported an effluent measurement of 4.0 ug/l of cadmium, the upper range of cadmium expected for that discharge would be estimated as 8.6 ug/l. The permit writer would determine if a discharge of 8.6 ug/l of cadmium would cause an exceedance of the applicable water quality criteria.

Our permit writers will begin using the above procedure in writing FY92 permits to examine the potential of a discharge to cause an excursion above a water quality standard. For Texas permits, reasonable potential to violate a standard will be assessed in the manner described in the TWC implementation policy. A permit limit will be imposed on Texas dischargers if the effluent pollutant concentration is within 85% of the allowable value. The permittee will measure and report that parameter if within 70% of the limit.

All of our states should address the "reasonable potential" of a discharge to cause excursions above water quality standards in an implementation document or their Continuing Planning Process. They may reference the method Region 6 has developed, or adopt something of equivalent stringency. We will consider pollutant levels within 90% of the standard to pose reasonable potential to cause a violation, at a minimum.

Accommodating the uncertainty in effluent data will be protective and will likely result in a higher number of permits containing water quality based limits. We believe our approach will provide the permit writers with a consistent, clean and equitable technique of implementing water quality standards. Please let met know if you have any questions on this. If your staff has questions on the underlying statistics, they may speak with Jane Watson of my staff at extension 7175.

Attachment

Addressees:

Roger Hartung
Chief
Enforcement Branch (6W-E)

Richard Hoppers
Chief
Water Quality Branch (6W-Q)

James Steibing
Chief
Surveillance Branch (6E-S)

Attachment

Region 6 Approach
Determining Reasonable Potential

Region 6 has developed a procedure to extrapolate limited datasets to better evaluate the potential for the higher effluent concentrations to exceed a State water quality standard. Our method yields an estimate of a selected upper percentile value. We believe that the most statistically valid estimate of an upper percentile value is a maximum likelihood estimator which is proportional to the population geometric mean. If one assumes the population of effluent concentrations to fit a lognormal distribution, this relationship is given by:

$$C_p = C_{mean} * \exp(Z_p * \sigma - 0.5 * \sigma^2)$$

where: Z_p = normal distribution factor at p^{th} percentile

$$\sigma^2 = \ln(CV^2 + 1)$$

To calculate the maximum likelihood estimator of the 95th percentile, the specific relationship becomes:

$$C_{95} = C_{mean} * \exp(1.645 * \sigma - 0.5 * \sigma^2)$$

if CV is assumed = 0.6,
$\sigma^2 = .307$

The ratio of the estimated 95th percentile value to the mean (C_{95}/C_{mean}) is calculated :

$$C_{95}/C_{mean} = 2.13$$

A single effluent value or the geometric mean of a group of values is multiplied by the ratio to yield the estimate of the 95th percentile value.

The following table shows the ratio of the upper percentile to the mean for the 90th, 95th, and 99th percentiles

Ratio of Upper Percentiles to Geometric Mean

Percentile	Z	C_{90}/C_{mean}
90	1.283	1.74
95	1.645	2.13
99	2.386	3.11

301(h) change

CALCULATIONS OF NEW MEXICO WATER QUALITY-BASED EFFLUENT LIMITATIONS

Calculations Specifications: Lotus Smartsuite 97 1-2-3

Prepared By: Isaac Chen

STEP 1: REFERENCE IMPLEMENTATION PROCEDURES
INPUT FACILITY AND RECEIVING STREAM DATA
INPUT RECEIVING STREAM POLLUTANT BACKGROUND CONCENTRATION DATA
LIST SOURCE OF DATA INPUT
INPUT EFFLUENT DATA

IMPLEMENTATION PROCEDURES

The water quality standards for Interstate and Intrastate streams of the State of New Mexico are implemented in this fact sheet using procedures established in the "Implementation Guidance for State of New Mexico Standards for Interstate and Intrastate streams", February 23, 2000.

FACILTY	DATA INPUT	
Permittee	Permittee	
NPDES Permit No.	NM0000000	
Outfall No.(s)	001	
Plant Effluent Flow (MGD)	0.35	For industrial and federal facility, use the highest monthly average flow
Plant Effluent Flow (cfs)	0.5425	for the past 24 months. For POTWs, use the design flow.

RECEIVING STREAM		DATA INPUT	
Receiving Stream Name		Stream	
Basin Name		Basin	
Waterbody Segment Code No.		Segment #	
Is a publicly owned lake or reservoir (enter "1" if yes, "0" if no)		0	
Are acute aquatic life criteria considered (1= yes, 0=no)		1	
Are chronic aquatic life criteria considered (1= yes, 0=no)		1	
Are domestic water supply criteria considered (1= yes, 0=no)		0	
Are irrigation water supply criteria considered (1= yes, 0=no)		1	
Livestock watering and wildlife habitat criteria applied to all streams			
USGS Flow Station		Station	
WQ Monitoring Station No.		NA	
Receiving Stream TSS (mg/l)		10	For intermittent stream, enter effluent TSS
Receiving Stream Hardness (mg/l as CaCOs)	RANGE: 0 - 400	127	For intermittent stream, enter effluent Hardness
Receiving Stream Critical Low Flow (4Q3) (cfs)		7.05	Enter "0" for intermittent stream and lake.
Avg. Water Temperature (C)		5	

pH (Avg)	7.72		
Fraction of stream allowed for mixing (F)	1	FQa=	7.05
(= 1, if stream morphology data is not available, or for intermittent stream, or pollutants have EPA human health criteria)			

SITE-SPECIFIC CRITERIA		
	Flow Limit (cfs)	100.000
	Chlorides (mg/l)	1.00E+100
	Sulfate (SO4) (mg/l)	1.00E+100
	Total Dissolved Solids	1.00E+100

DATA INPUT

Input pollutant geometric mean concentration as micro-gram per liter (ug/l or ppb) unless other unit is specified for the parameter. (Metals in "total" form)

Value below detection level which is smaller than the minimum quantification level will be counted as "0".
Value reported as "less than" but greater than MQL, the reported value is used.
Value below detection level and reported as "ND" will be counted as "0".

The following formular is used to calculate the Instream Waste Concentration (Cd)

Cd = [(F*Qa*Ca) + (Qe*2.13*Ce)] / (F*Qa + Qe)
Where:
Cd = Instream Waste Concentration
F = Fraction of stream allowed for mixing (see NM Implementation Guidance)
Ce = Reported concentration in effluent
Ca = Ambient stream concentration upstream of discharge
Qe = Plant effluent flow
Qa = Critical low flow of stream at discharge point expressed as the 4Q3

DATA SOURCES:

NPDES Application Form 2C dated 2/7/90.
Memo from Brian McGill to NPDES file dated 7/11/96
Letter from Brian McGill (Permittee) to Isaac Chen (EPA) dated 1/5/99, 1/6/99, and 1/19/99, respectively.
May enter "<" in column D or G if data was report as "less Than".

POLLUTANTS	<" Ambient Stream Conc. Ca (ug/l)	Ca > MQL?	<" Effluent Concentration Ce (ug/l)	Ce > MQL?	Instream Waste Concentration, Cd (ug/l) 2.13* Ce	100% 4Q3	F= 1 or less	MQL
Total Phenols (4AAP)	0	0	0	0	0	0	0	5
Aluminum (T)	3822	3822	70	70	149.1	3553.9118	3553.9118	100
Barium (T)	0	0	26	26	55.38	1.8577544	1.8577544	100

Boron (T)	0	0	0	0	0	0	0	100
Chlorine Residual (T)	0	0	0	0	0	0	0	100
Chlordane (T)	0	0	0	0	0	0	0	0.2
Cobalt (T)	2.6	2.6	0	0	0	2.4142246	2.4142246	50
Molybdenum (T)	0	0	100000	100000	213000	7145.2091	7145.2091	10
Nitrate (as N) (T) (mg/l)	0	0	140	140	298.2	10.003293	10.003293	0.1
Uranium (T)	0	0	0	0	0	0	0	
Radium-226+Radium 228 (pCi/l)	0	0	0.7	0.7	1.491	0.0500165	0.0500165	
Strontium-90 (pCi/l)	0	0	0	0	0	0	0	
Tritium (pCi/l)	0	0	0	0	0	0	0	
Gross Alpha (pCi/l)	0	0	31.7	31.7	67.521	2.2650313	2.2650313	
Vanadium	0	0	0	0	0	0	0	50
Antimony	0	0	2	2	4.26	0.1429042	0.1429042	60
Arsenic	0	0	100000	100000	213000	7145.2091	7145.2091	10
Beryllium	0	0	5	5	10.65	0.3572605	0.3572605	5
Cadmium	6	6	5	5	10.65	5.9285479	5.9285479	1
Chromium	0	0	10	10	21.3	0.7145209	0.7145209	10
Copper	50	50	20	20	42.6	47.856437	47.856437	10
Lead	0	0	10000	10000	21300	714.52091	714.52091	5
Mercury	0	0	100	100	213	7.1452091	7.1452091	0.2
Nickel	12	12	10	10	21.3	11.857096	11.857096	5
Selenium	0	0	5	5	10.65	0.3572605	0.3572605	5
Selenium (SO4 >500 mg/l)	0	0	5	5	10.65	0.3572605	0.3572605	5
Silver	0	0	2	2	4.26	0.1429042	0.1429042	2
Thalllium	0	0	2	2	4.26	0.1429042	0.1429042	10
Zinc	506	506	39	39	83.07	472.63187	472.63187	20
Cyanide (Amenable to chlorination)	0	0	40	40	85.2	2.8580836	2.8580836	20
Cyanide (T)	0	0	40	40	85.2	2.8580836	2.8580836	20
Arsenic, dissolved	NO DATA	NO DATA	NO DATA	NO DATA	0	0	0	10
Chromium, dissolved	NO DATA	NO DATA	NO DATA	NO DATA	0	0	0	10
Copper, dissolved	NO DATA	NO DATA	NO DATA	NO DATA	0	0	0	10
Lead, dissolved	NO DATA	NO DATA	NO DATA	NO DATA	0	0	0	5
Nickel, dissolved	NO DATA	NO DATA	NO DATA	NO DATA	0	0	0	5
Zinc, dissolved	NO DATA	NO DATA	NO DATA	NO DATA	0	0	0	20
Total DDT and metabolites	NO DATA	NO DATA	NO DATA	NO DATA	0	0	0	
Total PCBs	NO DATA	NO DATA	NO DATA	NO DATA	0	0	0	
Chlorides (mg/l)	NO DATA	NO DATA	NO DATA	NO DATA	0	0	0	
Sulfate (mg/l)	NO DATA	NO DATA	NO DATA	NO DATA	0	0	0	
Total Dissolved Solids (mg/l)	NO DATA	NO DATA	NO DATA	NO DATA	0	0	0	

STEP 2: CALCULATE HARDNESS DEPENDENT CRITERIA

CONVERT DISSOLVED METALS TO TOTAL FORM

This step calculate hardness dependent criteria, then convert these criteria from dissolved form to total form

The following formular is used to convert dissolved metals criteria to total form

Kp = Kpo * (TSS**a) — Kp = Linear partition coefficient; Kpo and a can be found in table below
C/Ct = 1/ (1 + Kp*TSS* 1.0E-6) — TSS = Total suspended solids concentration found in receiving stream (or in effluent for intermittent stream)
Total Metal Criteria (Ct) = Cr / (C/Ct) — C/Ct = Fraction of metal dissolved; and Cr = Dissolved criteria value

	Stream Linear Partition Coefficient				Lake Linear Partition Coefficient			
Metals	Kpo	alpha (a)	Kp	C/Ct	Kpo	alpha (a)	Kp	C/Ct
Arsenic	480000	-0.73	89380.183	0.5280384	480000	-0.73	89380.183	0.5280384
Chromium	3360000	-0.93	394765.58	0.2021159	2170000	-0.27	1165359	0.079029
Copper	1040000	-0.74	189248.89	0.345723	2850000	-0.9	358793.74	0.2179629
Lead	2800000	-0.8	443770.09	0.1839013	2040000	-0.53	602046.68	0.1424407
Nickel	490000	-0.57	131885.21	0.4312479	2210000	-0.76	384053.98	0.2065885
Zinc	1250000	-0.7	249407.79	0.2861985	3340000	-0.68	697824.91	0.1253408

The following formular is used to calculate hardness dependent criteria

			Dissolved WQC (ug/l)	Total Stream WQC (ug/l)	Total Lake WQC (ug/l)
Cadmium (D)	Acute	e(1.128[ln(hardness)]-3.6867)*CF	5.5249001		
	Chronic	e(0.7852[ln(hardness)]-2.715)*CF	2.670283		
Chromium (D)	Acute	e(0.819[ln(hardness)]+2.5736)	692.97174	3428.5857	8768.5803
	Chronic	e(0.819[ln(hardness)]+0.534)	90.142272	445.99293	1140.6234
Copper (D)	Acute	e(0.9422[ln(hardness)]-1.7408)	16.833872	48.691789	77.232753
	Chronic	e(0.8545[ln(hardness)]-1.7428)	10.985298	31.774853	50.399861
Lead (D)	Acute	e(1.273[ln(hardness)]-1.46)*CF	83.693904	455.10242	587.57027
	Chronic	e(1.273[ln(hardness)]-4.705)*CF	3.2614313	17.734688	22.89677
Nickel (D)	Acute	e(0.846[ln(hardness)]+2.253)	573.16995	1329.0963	2774.452
	Chronic	e(0.846[ln(hardness)]+0.0554)	63.661646	147.62194	308.15673
Zinc (D)	Acute	e(0.8473[ln(hardness)]+0.8618)	143.49206	501.37244	1144.8154
	Chronic	e(0.8473[ln(hardness)]+0.8699)	144.65907	505.45005	1154.1261
Silver (D)	Acute	e(1.72[ln(hardness)]-6.6825)	5.2043863		

STEP 3: SCAN POTENTIAL INSTREAM WASTE CONCENTRATIONS AGAINST WATER QUALITY CRITERIA AND ESTABLISH EFFLUENT LIMITATIONS FOR ALL APPLICABLE PARAMETERS

No limits are established if the receiving stream is not designated for the particular uses.
No limits are established if the potential instream waste concentrations are less than the chronic water quality criteria.
The most applicable stringent criteria are used to establish effluent limitations for a given parameter.
Water quality criteria apply at the end-of-pipe for acute aquatic life criteria and discharges to public lakes.
If background concentration exceeds the water quality criteria, water quality criteria apply. And "Need TMDL" shown to the next column of Avg. Mass
Monthly avg concentration = daily max. / 1.5.

TABLE OF NM WATER QUALITY STANDARDS
* For selenium and mercury, standards for wildlife habitat replace standards for livestock watering. Refer NMWQS for chlorine residual standards for wildlife habitat.

STREAM CRITERIA PARAMETERS	Potential Conc. ug/l (2.13*Ce)	IWC, (ug/l) 100% 4Q3 (Cd)	IWC (ug/l) F=1 or less	Livestock/ Wildlife Cr. ug/l	Irrigation Criteria ug/l	Domestic Criteria ug/l	Acute Fish Criteria ug/l	Chronic Fish Criteria ug/l
Aluminum (T)	149.1	3553.9118	3553.9118	5000	5000	1.00E+100	750	87
Barium (T)	55.38	1.8577544	1.8577544	1.00E+100	1.00E+100	2000	1.00E+100	1.00E+100
Boron (T)	0	0	0	5000	750	1.00E+100	1.00E+100	1.00E+100
Chlorine Residual (T)	0	0	0	11	1.00E+100	1.00E+100	19	11
Chlordane (T)	0	0	0	1.00E+100	1.00E+100	1.00E+100	2.4	0.0043
Cobalt (T)	0	2.4142246	2.4142246	1000	50	1.00E+100	1.00E+100	1.00E+100
Molydenum (T)	213000	7145.2091	7145.2091	1.00E+100	1000	1.00E+100	1.00E+100	1.00E+100
Nitrate (as N) (T) (mg/l)	298.2	10.003293	10.003293	1.00E+100	1.00E+100	10	1.00E+100	1.00E+100
Uranium (T)	0	0	0	1.00E+100	1.00E+100	5000	1.00E+100	1.00E+100
Radium-226+Radium 228 (pCi/l)	1.491	0.0500165	0.0500165	30	1.00E+100	5	1.00E+100	1.00E+100
Strontium-90 (pCi/l)	0	0	0	1.00E+100	1.00E+100	8	1.00E+100	1.00E+100
Tritium (pCi/l)	0	0	0	20000	1.00E+100	20000	1.00E+100	1.00E+100
Gross Alpha (pCi/l)	67.521	2.2650313	2.2650313	15	1.00E+100	15	1.00E+100	1.00E+100
Vanadium	0	0	0	100	100	1.00E+100	1.00E+100	1.00E+100
Antimony	4.26	0.1429042	0.1429042	1.00E+100	1.00E+100	6	1.00E+100	1.00E+100
Arsenic (T)	213000	7145.2091	7145.2091	378.76037	189.38018	94.690091	643.89262	284.07027
Beryllium	10.65	0.3572605	0.3572605	1.00E+100	1.00E+100	4	130	5.3
Cadmium	10.65	5.9285479	5.9285479	50	10	5	5.5249001	2.670283
Chromium (T)	21.3	0.7145209	0.7145209	4947.6558	494.76558	494.76558	3428.5857	445.99293
Copper (T)	42.6	47.856437	47.856437	1446.2444	578.49778	1.00E+100	48.691789	31.774853
Lead (T)	21300	714.52091	714.52091	543.77009	27188.505	271.88505	455.10242	17.734688
Mercury	213	7.1452091	7.1452091	0.77	1.00E+100	2	2.4	0.012
Nickel (T)	21.3	11.857096	11.857096	1.00E+100	1.00E+100	231.88521	1329.0963	147.62194
Selenium	10.65	0.3572605	0.3572605	5	130	50	20	5
Selenium (pres. of >500 mg/l SO4	10.65	0.3572605	0.3572605	1.00E+100	250	50	20	5

Silver	4.26	0.1429042	0.1429042	1.00E+100	1.00E+100	1.00E+100	5.2043863	1.00E+100
Thalllium	4.26	0.1429042	0.1429042	1.00E+100	1.00E+100	2	1.00E+100	1.00E+100
Zinc	83.07	472.63187	472.63187	87351.947	6988.1558	1.00E+100	501.37244	505.45005
Cyanide (Amenable to chlorination)	85.2	2.8580836	2.8580836	5.2	1.00E+100	200	22	5.2
Cyanide (T)	85.2	2.8580836	2.8580836	5.2	1.00E+100	200	22	5.2
Arsenic, dissolved	0	0	0	200	100	50	340	150
Chromium, dissolved	0	0	0	1000	100	100	692.97174	90.142272
Copper, dissolved	0	0	0	500	200	1.00E+100	16.833872	10.985298
Lead, dissolved	0	0	0	100	5000	50	83.693904	3.2614313
Nickel, dissolved	0	0	0	1.00E+100	1.00E+100	100	573.16995	63.661646
Zinc, dissolved	0	0	0	25000	2000	1.00E+100	143.49206	144.65907
Total DDT and metabolites	0	0	0	0.001	1.00E+100	1.00E+100	1.00E+100	1.00E+100
Total PCBs	0	0	0	0.014	1.00E+100	1.00E+100	1.00E+100	1.00E+100
Chlorides (mg/l)	0	0	0	1.00E+100	1.00E+100	1.00E+100	1.00E+100	1.00E+100
Sulfate (mg/l)	0	0	0	1.00E+100	1.00E+100	1.00E+100	1.00E+100	1.00E+100
Total Dissolved Solids (mg/l)	0	0	0	1.00E+100	1.00E+100	1.00E+100	1.00E+100	1.00E+100

APPLICABLE WATER QUALITY-BASED LIMITS

The following formular is used to calculate the allowable daily maximum effluent cincentration

Daily Max. Conc. = Cs + (Cs - Ca)(F*Qa/Qe)
Monthly Avg. Conc. = Daily Max. Conc. / 1.5

Where:
Cs = Applicable water quality standard
Ca = Ambient stream concentration
F = Fraction of stream allowed for mixing
Qe = Plant effluent flow
Qa = Criteria low flow (4Q3)

STREAM PARAMETERS	Livestock/ Wildlife Lim ug/l	Irrigation Limits ug/l	Domestic Limits ug/l	Acute Fish Limits ug/l	Chronic Fis Limits ug/l	Daily Max. ug/l	Daily Avg. ug/l	Max. Mass LBS/Day	Avg. Mass LBS/Day	Background Greater Than WQS
Aluminum (T)	No Limit	No Limit	No Limit	No Limit	87	87	58	0.253953	0.169302	Need TMDL
Barium (T)	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	
Boron (T)	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	
Chlorine Residual (T)	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	
Chlordane (T)	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	
Cobalt (T)	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	
Molydenum (T)	No Limit	13995.392	No Limit	No Limit	No Limit	13995.392	9330.2611	40.852548	27.235032	

Nitrate (as N) (T) (mg/l)	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	
Uranium (T)	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	
Radium-226+Radium 228 (pCi/l)	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	
Strontium-90 (pCi/l)	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	
Tritium (pCi/l)	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	
Gross Alpha (pCi/l)	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	
Vanadium	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	
Antimony	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	
Arsenic	5300.8997	2650.4498	No Limit	643.89262	3975.6748	643.89262	429.26175	1.8795226	1.253015	
Beryllium	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	
Cadmium	No Limit	No Limit	No Limit	5.5249001	2.670283	2.670283	1.7801887	0.0077946	0.0051964	Need TMDL
Chromium	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	
Copper	No Limit	No Limit	No Limit	No Limit	31.774853	31.774853	21.183236	0.0927508	0.0618339	Need TMDL
Lead	7610.2755	No Limit	No Limit	455.10242	248.2039	248.2039	165.46927	0.7245072	0.4830048	
Mercury	10.776452	No Limit	No Limit	2.4	0.1679447	0.1679447	0.1119631	0.0004902	0.0003268	
Nickel	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	
Selenium	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	
Selenium (pres. of >500 mg/l SO4	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	
Silver	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	
Thalllium	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	
Zinc	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	
Cyanide (Amenable to chlorination)	No Limit	No Limit	No Limit	22	No Limit	22	14.666667	0.064218	0.042812	
Cyanide (T)	No Limit	No Limit	No Limit	22	No Limit	22	14.666667	0.064218	0.042812	
Arsenic, dissolved	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	
Chromium, dissolved	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	
Copper, dissolved	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	
Lead, dissolved	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	
Nickel, dissolved	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	
Zinc, dissolved	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	
Total DDT and metabolites	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	
Total PCBs	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	
Chlorides (mg/l)	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	
Sulfate (mg/l)	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	
Total Dissolved Solids (mg/l)	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	

002 Tech Lim comparison

CALCULATIONS OF NEW MEXICO WATER QUALITY-BASED EFFLUENT LIMITATIONS

Calculations Specifications: Lotus Smartsuite 97 1-2-3

Prepared By: Isaac Chen

STEP 1: REFERENCE IMPLEMENTATION PROCEDURES
INPUT FACILITY AND RECEIVING STREAM DATA
INPUT RECEIVING STREAM POLLUTANT BACKGROUND CONCENTRATION DATA
LIST SOURCE OF DATA INPUT
INPUT EFFLUENT DATA

IMPLEMENTATION PROCEDURES

The water quality standards for Interstate and Intrastate streams of the State of New Mexico are implemented in this fact sheet using procedures established in the "Implementation Guidance for State of New Mexico Standards for Interstate and Intrastate streams", February 23, 2000.

FACILTY	DATA INPUT	
Permittee	Permittee	
NPDES Permit No.	NM0000000	
Outfall No.(s)	001	
Plant Effluent Flow (MGD)	0.35	For industrial and federal facility, use the highest monthly average flow
Plant Effluent Flow (cfs)	0.5425	for the past 24 months. For POTWs, use the design flow.

RECEIVING STREAM		DATA INPUT	
Receiving Stream Name		Stream	
Basin Name		Basin	
Waterbody Segment Code No.		Segment #	
Is a publicly owned lake or reservoir (enter "1" if yes, "0" if no)		0	
Are acute aquatic life criteria considered (1= yes, 0=no)		1	
Are chronic aquatic life criteria considered (1= yes, 0=no)		1	
Are domestic water supply criteria considered (1= yes, 0=no)		0	
Are irrigation water supply criteria considered (1= yes, 0=no)		1	
Livestock watering and wildlife habitat criteria applied to all streams			
USGS Flow Station		Station	
WQ Monitoring Station No.		NA	
Receiving Stream TSS (mg/l)		10	For intermittent stream, enter effluent TSS
Receiving Stream Hardness (mg/l as CaCOs)	RANGE: 0 - 400	127	For intermittent stream, enter effluent Hardness
Receiving Stream Critical Low Flow (4Q3) (cfs)		7.05	Enter "0" for intermittent stream and lake.
Avg. Water Temperature (C)		5	

pH (Avg)	7.72		
Fraction of stream allowed for mixing (F)	1	FQa=	7.05
(= 1, if stream morphology data is not available, or for intermittent stream, or pollutants have EPA human health criteria)			

SITE-SPECIFIC CRITERIA		
	Flow Limit (cfs)	100.000
	Chlorides (mg/l)	1.00E+100
	Sulfate (SO4) (mg/l)	1.00E+100
	Total Dissolved Solids	1.00E+100

DATA INPUT

Input pollutant geometric mean concentration as micro-gram per liter (ug/l or ppb) unless other unit is specified for the parameter. (Metals in "total" form)

Value below detection level which is smaller than the minimum quantification level will be counted as "0".
Value reported as "less than" but greater than MQL, the reported value is used.
Value below detection level and reported as "ND" will be counted as "0".

The following formular is used to calculate the Instream Waste Concentration (Cd)

Cd = [(F*Qa*Ca) + (Qe*2.13*Ce)] / (F*Qa + Qe)
Where:
Cd = Instream Waste Concentration
F = Fraction of stream allowed for mixing (see NM Implementation Guidance)
Ce = Reported concentration in effluent
Ca = Ambient stream concentration upstream of discharge
Qe = Plant effluent flow
Qa = Critical low flow of stream at discharge point expressed as the 4Q3

DATA SOURCES:

NPDES Application Form 2C dated 2/7/90.
Memo from Brian McGill to NPDES file dated 7/11/96
Letter from Brian McGill (Permittee) to Isaac Chen (EPA) dated 1/5/99, 1/6/99, and 1/19/99, respectively.
May enter "<" in column D or G if data was report as "less Than".

POLLUTANTS	<" Ambient Stream Conc. Ca (ug/l)	Ca > MQL?	<" Effluent Concentration Ce (ug/l)	Ce > MQL?	Instream Waste Concentration, Cd (ug/l) 2.13* Ce	100% 4Q3	F= 1 or less	MQL
Total Phenols (4AAP)	0	0	0	0	0	0	0	5
Aluminum (T)	3822	3822	70	70	149.1	3553.9118	3553.9118	100
Barium (T)	0	0	26	26	55.38	1.8577544	1.8577544	100

Boron (T)	0	0	0	0	0	0	0	100
Chlorine Residual (T)	0	0	0	0	0	0	0	100
Chlordane (T)	0	0	0	0	0	0	0	0.2
Cobalt (T)	2.6	2.6	0	0	0	2.4142246	2.4142246	50
Molybdenum (T)	0	0	100000	100000	213000	7145.2091	7145.2091	10
Nitrate (as N) (T) (mg/l)	0	0	140	140	298.2	10.003293	10.003293	0.1
Uranium (T)	0	0	0	0	0	0	0	
Radium-226+Radium 228 (pCi/l)	0	0	0.7	0.7	1.491	0.0500165	0.0500165	
Strontium-90 (pCi/l)	0	0	0	0	0	0	0	
Tritium (pCi/l)	0	0	0	0	0	0	0	
Gross Alpha (pCi/l)	0	0	31.7	31.7	67.521	2.2650313	2.2650313	
Vanadium	0	0	0	0	0	0	0	50
Antimony	0	0	2	2	4.26	0.1429042	0.1429042	60
Arsenic	0	0	100000	100000	213000	7145.2091	7145.2091	10
Beryllium	0	0	5	5	10.65	0.3572605	0.3572605	5
Cadmium	0	0	5	5	10.65	0.3572605	0.3572605	1
Chromium	0	0	10	10	21.3	0.7145209	0.7145209	10
Copper	3.5	3.5	20	20	42.6	4.6789595	4.6789595	10
Lead	0	0	10000	10000	21300	714.52091	714.52091	5
Mercury	0	0	100	100	213	7.1452091	7.1452091	0.2
Nickel	12	12	10	10	21.3	11.857096	11.857096	5
Selenium	0	0	5	5	10.65	0.3572605	0.3572605	5
Selenium (SO4 >500 mg/l)	0	0	5	5	10.65	0.3572605	0.3572605	5
Silver	0	0	2	2	4.26	0.1429042	0.1429042	2
Thalllium	0	0	2	2	4.26	0.1429042	0.1429042	10
Zinc	196	196	39	39	83.07	184.78202	184.78202	20
Cyanide (Amenable to chlorination)	0	0	40	40	85.2	2.8580836	2.8580836	20
Cyanide (T)	0	0	40	40	85.2	2.8580836	2.8580836	20
Arsenic, dissolved	NO DATA	NO DATA	NO DATA	NO DATA	0	0	0	10
Chromium, dissolved	NO DATA	NO DATA	NO DATA	NO DATA	0	0	0	10
Copper, dissolved	NO DATA	NO DATA	NO DATA	NO DATA	0	0	0	10
Lead, dissolved	NO DATA	NO DATA	NO DATA	NO DATA	0	0	0	5
Nickel, dissolved	NO DATA	NO DATA	NO DATA	NO DATA	0	0	0	5
Zinc, dissolved	NO DATA	NO DATA	NO DATA	NO DATA	0	0	0	20
Total DDT and metabolites	NO DATA	NO DATA	NO DATA	NO DATA	0	0	0	
Total PCBs	NO DATA	NO DATA	NO DATA	NO DATA	0	0	0	
Chlorides (mg/l)	NO DATA	NO DATA	NO DATA	NO DATA	0	0	0	
Sulfate (mg/l)	NO DATA	NO DATA	NO DATA	NO DATA	0	0	0	
Total Dissolved Solids (mg/l)	NO DATA	NO DATA	NO DATA	NO DATA	0	0	0	

STEP 2: CALCULATE HARDNESS DEPENDENT CRITERIA

CONVERT DISSOLVED METALS TO TOTAL FORM

This step calculate hardness dependent criteria, then convert these criteria from dissolved form to total form

The following formular is used to convert dissolved metals criteria to total form

Kp = Kpo * (TSS**a) — Kp = Linear partition coefficient; Kpo and a can be found in table below
C/Ct = 1/ (1 + Kp*TSS* 1.0E-6) — TSS = Total suspended solids concentration found in receiving stream (or in effluent for intermittent stream)
Total Metal Criteria (Ct) = Cr / (C/Ct) — C/Ct = Fraction of metal dissolved; and Cr = Dissolved criteria value

	Stream Linear Partition Coefficient				Lake Linear Partition Coefficient			
Metals	Kpo	alpha (a)	Kp	C/Ct	Kpo	alpha (a)	Kp	C/Ct
Arsenic	480000	-0.73	89380.183	0.5280384	480000	-0.73	89380.183	0.5280384
Chromium	3360000	-0.93	394765.58	0.2021159	2170000	-0.27	1165359	0.079029
Copper	1040000	-0.74	189248.89	0.345723	2850000	-0.9	358793.74	0.2179629
Lead	2800000	-0.8	443770.09	0.1839013	2040000	-0.53	602046.68	0.1424407
Nickel	490000	-0.57	131885.21	0.4312479	2210000	-0.76	384053.98	0.2065885
Zinc	1250000	-0.7	249407.79	0.2861985	3340000	-0.68	697824.91	0.1253408

The following formular is used to calculate hardness dependent criteria

			Dissolved WQC (ug/l)	Total Stream WQC (ug/l)	Total Lake WQC (ug/l)
Cadmium (D)	Acute	e(1.128[ln(hardness)]-3.6867)*CF	5.5249001		
	Chronic	e(0.7852[ln(hardness)]-2.715)*CF	2.670283		
Chromium (D)	Acute	e(0.819[ln(hardness)]+2.5736)	692.97174	3428.5857	8768.5803
	Chronic	e(0.819[ln(hardness)]+0.534)	90.142272	445.99293	1140.6234
Copper (D)	Acute	e(0.9422[ln(hardness)]-1.7408)	16.833872	48.691789	77.232753
	Chronic	e(0.8545[ln(hardness)]-1.7428)	10.985298	31.774853	50.399861
Lead (D)	Acute	e(1.273[ln(hardness)]-1.46)*CF	83.693904	455.10242	587.57027
	Chronic	e(1.273[ln(hardness)]-4.705)*CF	3.2614313	17.734688	22.89677
Nickel (D)	Acute	e(0.846[ln(hardness)]+2.253)	573.16995	1329.0963	2774.452
	Chronic	e(0.846[ln(hardness)]+0.0554)	63.661646	147.62194	308.15673
Zinc (D)	Acute	e(0.8473[ln(hardness)]+0.8618)	143.49206	501.37244	1144.8154
	Chronic	e(0.8473[ln(hardness)]+0.8699)	144.65907	505.45005	1154.1261
Silver (D)	Acute	e(1.72[ln(hardness)]-6.6825)	5.2043863		

STEP 3: SCAN POTENTIAL INSTREAM WASTE CONCENTRATIONS AGAINST WATER QUALITY CRITERIA AND ESTABLISH EFFLUENT LIMITATIONS FOR ALL APPLICABLE PARAMETERS

No limits are established if the receiving stream is not designated for the particular uses.
No limits are established if the potential instream waste concentrations are less than the chronic water quality criteria.
The most applicable stringent criteria are used to establish effluent limitations for a given parameter.
Water quality criteria apply at the end-of-pipe for acute aquatic life criteria and discharges to public lakes.
If background concentration exceeds the water quality criteria, water quality criteria apply. And "Need TMDL" shown to the next column of Avg. Mass
Monthly avg concentration = daily max. / 1.5.

TABLE OF NM WATER QUALITY STANDARDS
* For selenium and mercury, standards for wildlife habitat replace standards for livestock watering. Refer NMWQS for chlorine residual standards for wildlife habitat.

STREAM CRITERIA PARAMETERS	Potential Conc. ug/l (2.13*Ce)	IWC, (ug/l) 100% 4Q3 (Cd)	IWC (ug/l) F=1 or less	Livestock/ Wildlife Cr. ug/l	Irrigation Criteria ug/l	Domestic Criteria ug/l	Acute Fish Criteria ug/l	Chronic Fish Criteria ug/l
Aluminum (T)	149.1	3553.9118	3553.9118	5000	5000	1.00E+100	750	87
Barium (T)	55.38	1.8577544	1.8577544	1.00E+100	1.00E+100	2000	1.00E+100	1.00E+100
Boron (T)	0	0	0	5000	750	1.00E+100	1.00E+100	1.00E+100
Chlorine Residual (T)	0	0	0	11	1.00E+100	1.00E+100	19	11
Chlordane (T)	0	0	0	1.00E+100	1.00E+100	1.00E+100	2.4	0.0043
Cobalt (T)	0	2.4142246	2.4142246	1000	50	1.00E+100	1.00E+100	1.00E+100
Molydenum (T)	213000	7145.2091	7145.2091	1.00E+100	1000	1.00E+100	1.00E+100	1.00E+100
Nitrate (as N) (T) (mg/l)	298.2	10.003293	10.003293	1.00E+100	1.00E+100	10	1.00E+100	1.00E+100
Uranium (T)	0	0	0	1.00E+100	1.00E+100	5000	1.00E+100	1.00E+100
Radium-226+Radium 228 (pCi/l)	1.491	0.0500165	0.0500165	30	1.00E+100	5	1.00E+100	1.00E+100
Strontium-90 (pCi/l)	0	0	0	1.00E+100	1.00E+100	8	1.00E+100	1.00E+100
Tritium (pCi/l)	0	0	0	20000	1.00E+100	20000	1.00E+100	1.00E+100
Gross Alpha (pCi/l)	67.521	2.2650313	2.2650313	15	1.00E+100	15	1.00E+100	1.00E+100
Vanadium	0	0	0	100	100	1.00E+100	1.00E+100	1.00E+100
Antimony	4.26	0.1429042	0.1429042	1.00E+100	1.00E+100	6	1.00E+100	1.00E+100
Arsenic (T)	213000	7145.2091	7145.2091	378.76037	189.38018	94.690091	643.89262	284.07027
Beryllium	10.65	0.3572605	0.3572605	1.00E+100	1.00E+100	4	130	5.3
Cadmium	10.65	0.3572605	0.3572605	50	10	5	5.5249001	2.670283
Chromium (T)	21.3	0.7145209	0.7145209	4947.6558	494.76558	494.76558	3428.5857	445.99293
Copper (T)	42.6	4.6789595	4.6789595	1446.2444	578.49778	1.00E+100	48.691789	31.774853
Lead (T)	21300	714.52091	714.52091	543.77009	27188.505	271.88505	455:10242	17.734688
Mercury	213	7.1452091	7.1452091	0.77	1.00E+100	2	2.4	0.012
Nickel (T)	21.3	11.857096	11.857096	1.00E+100	1.00E+100	231.88521	1329.0963	147.62194
Selenium	10.65	0.3572605	0.3572605	5	130	50	20	5
Selenium (pres. of >500 mg/l SO4	10.65	0.3572605	0.3572605	1.00E+100	250	50	20	5

Silver	4.26	0.1429042	0.1429042	1.00E+100	1.00E+100	1.00E+100	5.2043863	1.00E+100
Thalllium	4.26	0.1429042	0.1429042	1.00E+100	1.00E+100	2	1.00E+100	1.00E+100
Zinc	83.07	184.78202	184.78202	87351.947	6988.1558	1.00E+100	501.37244	505.45005
Cyanide (Amenable to chlorination)	85.2	2.8580836	2.8580836	5.2	1.00E+100	200	22	5.2
Cyanide (T)	85.2	2.8580836	2.8580836	5.2	1.00E+100	200	22	5.2
Arsenic, dissolved	0	0	0	200	100	50	340	150
Chromium, dissolved	0	0	0	1000	100	100	692.97174	90.142272
Copper, dissolved	0	0	0	500	200	1.00E+100	16.833872	10.985298
Lead, dissolved	0	0	0	100	5000	50	83.693904	3.2614313
Nickel, dissolved	0	0	0	1.00E+100	1.00E+100	100	573.16995	63.661646
Zinc, dissolved	0	0	0	25000	2000	1.00E+100	143.49206	144.65907
Total DDT and metabolites	0	0	0	0.001	1.00E+100	1.00E+100	1.00E+100	1.00E+100
Total PCBs	0	0	0	0.014	1.00E+100	1.00E+100	1.00E+100	1.00E+100
Chlorides (mg/l)	0	0	0	1.00E+100	1.00E+100	1.00E+100	1.00E+100	1.00E+100
Sulfate (mg/l)	0	0	0	1.00E+100	1.00E+100	1.00E+100	1.00E+100	1.00E+100
Total Dissolved Solids (mg/l)	0	0	0	1.00E+100	1.00E+100	1.00E+100	1.00E+100	1.00E+100

APPLICABLE WATER QUALITY-BASED LIMITS

The following formular is used to calculate the allowable daily maximum effluent cincentration

Daily Max. Conc. = Cs + (Cs - Ca)(F*Qa/Qe)
Monthly Avg. Conc. = Daily Max. Conc. / 1.5

Where:
Cs = Applicable water quality standard
Ca = Ambient stream concentration
F = Fraction of stream allowed for mixing
Qe = Plant effluent flow
Qa = Criteria low flow (4Q3)

STREAM PARAMETERS	Livestock/ Wildlife Lim ug/l	Irrigation Limits ug/l	Domestic Limits ug/l	Acute Fish Limits ug/l	Chronic Fis Limits ug/l	Daily Max. ug/l	Daily Avg. ug/l	Max. Mass LBS/Day	Avg. Mass LBS/Day	Background Greater Than WQS
Aluminum (T)	No Limit	No Limit	No Limit	No Limit	87	87	58	0.253953	0.169302	Need TMDL
Barium (T)	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	
Boron (T)	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	
Chlorine Residual (T)	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	
Chlordane (T)	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	
Cobalt (T)	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	
Molydenum (T)	No Limit	13995.392	No Limit	No Limit	No Limit	13995.392	9330.2611	40.852548	27.235032	

Nitrate (as N) (T) (mg/l)	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit
Uranium (T)	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit
Radium-226+Radium 228 (pCi/l)	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit
Strontium-90 (pCi/l)	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit
Tritium (pCi/l)	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit
Gross Alpha (pCi/l)	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit
Vanadium	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit
Antimony	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit
Arsenic	5300.8997	2650.4498	No Limit	643.89262	3975.6748	643.89262	429.26175	1.8795226	1.253015
Beryllium	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit
Cadmium	No Limit	No Limit	No Limit	5.5249001	No Limit	5.5249001	3.6832667	0.0161272	0.0107515
Chromium	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit
Copper	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit
Lead	7610.2755	No Limit	No Limit	455.10242	248.2039	248.2039	165.46927	0.7245072	0.4830048
Mercury	10.776452	No Limit	No Limit	2.4	0.1679447	0.1679447	0.1119631	0.0004902	0.0003268
Nickel	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit
Selenium	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit
Selenium (pres. of >500 mg/l SO4	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit
Silver	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit
Thalllium	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit
Zinc	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit
Cyanide (Amenable to chlorination)	No Limit	No Limit	No Limit	22	No Limit	22	14.666667	0.064218	0.042812
Cyanide (T)	No Limit	No Limit	No Limit	22	No Limit	22	14.666667	0.064218	0.042812
Arsenic, dissolved	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit
Chromium, dissolved	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit
Copper, dissolved	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit
Lead, dissolved	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit
Nickel, dissolved	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit
Zinc, dissolved	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit
Total DDT and metabolites	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit
Total PCBs	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit
Chlorides (mg/l)	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit
Sulfate (mg/l)	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit
Total Dissolved Solids (mg/l)	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit

ADEQ Inventory No Permit No AZ0020516

AUTHORIZATION TO DISCHARGE UNDER THE
NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with the provisions of the Clean Water Act, as amended, (33 U.S.C. 1251 et seq, the "Act"),

Cyprus Miami Mining Corporation - Christmas Facilities
P.O. Box 4444
Claypool AZ 85532

is authorized to discharge from the following discharge point to an ephemeral tributary of ephemeral Dripping Springs Wash:

Outfall 002	Latitude: 33° 05' 24"N Longitude:110° 42' 36"W	Discharge to an ephemeral tributary of Dripping springs Wash

in accordance with effluent limitations, monitoring requirements and other conditions set forth herein, and in the attached EPA Region 9 "Standard Federal NPDES Permit Conditions," dated May 10, 1990.

This permit shall become effective on

This permit and the authorization to discharge shall expire at midnight, five (5) years after effective date

Signed this _____ day of _____

For the Regional Administrator

Alexis Strauss, Director
Water Division

A. DISCHARGE LIMITATIONS AND MONITORING REQUIREMENTS

1. The permitee is authorized to discharge from Outfall 002.

a. (i) Discharges from Outfall 002 shall be limited and monitored by the permittee as specified below:

EFFLUENT CHARACTERISTICS	DISCHARGE LIMITATIONS				MONITORING REQUIREMENTS	
	QUARTERLY AVERAGE		DAILY MAX		MEASUREMENT FREQUENCY	SAMPLE TYPE
FLOW - (MGD[1])					QUARTERLY[1]	DISCRETE
TOTAL SUSPENDED SOLID[2]	20	mg/l	30	mg/l	Quarterly	DISCRETE
CADMIUM[3,4,5]	3.4	ug/l	70	ug/l	Quarterly	DISCRETE
COPPER[3,4,5]	53	ug/l	89	ug/l	Quarterly	DISCRETE
LEAD[2,3,4]	39	ug/l	600	ug/l	Quarterly	DISCRETE
MERCURY[2,3,4]	1	ug/l	2	ug/l	Quarterly	DISCRETE
ZINC[2,3,4]	750	ug/l	1500	ug/l	Quarterly	DISCRETE
SULFIDES[2,4]			100	ug/l	Quarterly	DISCRETE
HARDNESS[6]					Quarterly	DISCRETE
pH	Not less than 6.5 nor greater than 9.0 standard units				Quarterly	DISCRETE

1 Estimates of flow volume, in millions of gallons per day (MGD), shall be reported for discharges from 002. There is no set flow limit at this time.

2 Technology-based limit.

3 All metals limits are to be analyzed for total recoverable metal and must be analyzed according to Methods for Chemical Analysis of Water Wastes (EPA 600/4-79-20, Revised 1983), paragraph 4.1.4 on page "Metals-6".

4 Method detection limits may be submitted in a separate report with the DMR. Where the discharge limitation is established at a level below the practical quantitation level, the discharge limitation shall be considered to be exceeded only if monitoring results exceed the practical quantitation level.

5 Discharge limitation calculated based on a hardness of 400 milligrams per liter as $CaCO_3$.

6 Total Hardness, in mg/l, as $CaCO_3$ shall be analyzed using methods in 40 CFR Part 136.

2. The permittee may elect to develop an EPA-approved site-specific relationship ("translator") between the phases of the metals as follows.

To initiate the translator study, permittee shall submit a study and monitoring plans to EPA and ADEQ to develop site-specific relationships between the dissolved and total recoverable phases for the following metals: zinc, copper, lead, mercury, and cadmium. This study plan shall incorporate components as specified in "The Metals Translator: Guidance for Calculating a Total Recoverable Permit Limit from a Dissolved Criterion" (EPA 823-B-96-007. June 1996). The study plan shall identify a schedule for submission of reports to EPA.

The permittee shall submit a final report that includes recommendations for the site-specific translator relationships and a request for permit modification based upon those recommendations. EPA will review the final report and notify the permittee of its decision to modify the permit within 30 days of receipt of the final report. The final report shall also describe: 1) whether compliance with the existing metals limits in A.1 can be achieved and 2) how changes resulting from the studies would satisfy A.A.C. R-18-11-107, Antidegradation.

The permittee may choose to conduct metals toxicity tests on waters with hardnesses spanning the range typifying the permittee's discharge, in order to determine the relationship between increasing levels of hardness and the toxicity of metals. Based on the results of these tests, the permittee may petition EPA to reopen and modify the discharge limitations for metals established in Sections A.1.a. that are based on a hardness of 400 mg/l.

3. The discharge shall be free from pollutants in amounts or combinations that:

a. Settle to form bottom deposits that inhibit or prohibit the habitation, growth or propagation of aquatic life or that impair recreational uses;

b. Cause objectionable odor in the area in which the navigable water is located;

c. Cause off-flavor in aquatic organisms or waterfowl;

d. Are toxic to humans, animals, plants or other organisms;

e. Cause the growth of algae or aquatic plants that inhibit or prohibit the habitation, growth or propagation of other aquatic life or that impair recreational uses;

f. Change the color of the navigable water from natural background levels of color;

g. The discharge shall be free from oil, grease and other pollutants that float as debris, foam, or scum; or that cause a film or iridescent appearance on the surface of the water; or that cause a deposit on a shoreline, bank or aquatic vegetation.

4. The facility shall report to the Regional Administrator and State Agency within 24 hours of becoming aware of any unauthorized discharge to the waters of the United States. Within 10 days the permittee shall submit to the Regional Administrator and State Agency the following information:

a. The description, source and cause of the discharge;

b. The date, time and duration of the discharge;

c. Actions taken to reduce, eliminate or prevent recurrence of the discharge;

d. The rainfall, in inches per day for each day which contributed to or caused the discharge;

e. Estimated volume and chemical characteristics of the discharge; and

5. Discharges (including discharges of "Mining Area Seeps" as defined in section C.2.a) shall not cause or contribute to a violation of Arizona Water Quality Standards.

6. Discharges authorized by the "NPDES General Permit for Storm Water

Discharges From Industrial Activities", 60 Fed. Reg. 50804 (Sept. 29, 1995), are not authorized by this permit.

B. MONITORING AND REPORTING

1. Reporting of Monitoring Results

a. Effluent monitoring results shall be reported on Discharge Monitoring Report (DMR) forms (EPA No. 3320-1) supplied by the Regional Administrator, to the extent that the results reported may be entered on the forms. The results of all monitoring required by this permit shall be submitted in such a format as to allow direct comparison with the limitations and requirements of this permit.

Unless otherwise specified, discharge flows shall be reported in terms of the average flow over each quarterly period and the maximum daily flow over that quarterly period. Each quarterly report is due by the 28th of the following month, i.e., the first quarter report is due by April 28. Duplicate signed copies of these, and all other reports required herein, shall be submitted to the Regional Administrator and the State at the following addresses:

Water Division
Environmental Protection Agency
Region IX, ATTN: WTR-7
75 Hawthorne Street
San Francisco, CA 94105
Telephone: (415) 744-1905

AZ Department of Environmental Quality
Water Quality Division
Surface Water Section
Enforcement Unit
3033 North Central Avenue
Phoenix, AZ 85012
Telephone: (602) 207-4620

b. Sample collection will be performed as stated in the QA Manual. The QA Manual shall include a discussion on the preservation and handling, preparation and analysis of samples as described in the most recent edition of 40 CFR 136.3, unless otherwise specified in this permit. For effluent analyses, the permittee shall utilize an

EPA-approved analytical method with a published Method Detection Limit (MDL, as defined in section B.4.g. of this permit) that is lower than the effluent limitations (or lower than water quality criteria applicable to the receiving water, listed in A.A.C. Title 18, Chapter 11, Article 1, for trace substances where monitoring is required but no effluent limitations have been established). If all published MDLs are higher than effluent limitations (or applicable criteria concentrations), the permittee shall utilize the EPA-approved analytical method with the lowest published MDL. In accordance with 40 CFR 122.45(c), effluent analyses for metals shall measure "total recoverable metal."

c. For the purpose of reporting, the permittee shall use the reporting threshold equivalent to the laboratory's MDL. As such, the permittee must utilize a standard calibration where the lowest standard point is equal to or less than the practical quantitation level (PQL), or, in the absence of a PQL, the minimum level (ML), as defined in section B.4.h. of this permit.

For analytical results between the laboratory's MDL and the PQL/ML, the permittee shall report No Discharge/No Data (Not Quantifiable) ["NODI(Q)"] on the DMR form. Analytical results below the laboratory's MDL shall be reported as No Discharge/No Data (Below Detection Level) ["NODI(B)"].

As an attachment to the DMR form, the permittee shall report for trace substances: the analytical result; the analytical method number or title, preparation and analytical procedure, and published MDL; the laboratory MDL, standard deviation(s) from the laboratory's MDL study (see 40 CFR Part 136, Appendix B), and the number of replicate analyses used to compute the laboratory's MDL (n); and PQL/ML.

When requested by EPA or ADEQ/ADHS, the permittee shall participate in the NPDES DMR-QA performance study and shall submit their study results to EPA or ADEQ/ADHS.

d. The permittee shall develop a Quality Assurance (QA) Manual/QA Plan. The purpose of the QA Manual is to assist in planning for the collection and analysis of samples and explaining data anomalies if they occur. As appropriate and applicable, the QA Manual

shall include the details enumerated below. The QA Manual shall be retained on the permittee's premises and be available for review by EPA or ADEQ/ADHS upon request. The permittee shall review its QA Manual annually and revise it when appropriate. Throughout all field sampling and laboratory analyses, the permittee shall use quality assurance/quality control (QA/QC) procedures as documented in their QA Manual.

(1) Project Management including roles and responsibilities of the participants; purpose of sample collection; matrix to be sampled; the analytes or compounds being measured; applicable technical, regulatory, or program-specific action criteria; personnel qualification requirements for collecting samples.

(2) Sample collection procedures; equipment used; the type and number of samples to be collected including QA/QC samples (i.e., background samples, duplicates, and equipment or field blanks); preservatives and holding times for the samples (see 40 CFR Part 136.3).

(3) Identification of the laboratory to be used to analyze the samples; provisions for any proficiency demonstration that will be required by the laboratory before or after contract award such as passing a performance evaluation sample; analytical method to be used; MDL and PQL/ML to be reported; required QC results to be reported (e.g., matrix spike recoveries, duplicate relative percent differences, blank contamination, laboratory control sample recoveries, surrogate spike recoveries, etc.) and acceptance criteria; and corrective actions to be taken by the permittee or the laboratory as a result of problems identified during QC checks.

(4) Discussion of how the permittee will perform data review and requirements for reporting of results to EPA or ADEQ to include resolving of data quality issues and identifying limitations on the use of the data.

2. <u>Monitoring and Records</u>

Records of monitoring information shall include:

a. Information identified in the attached Standard Conditions;

b. Preservatives used;

c. Laboratory/ies which performed the analyses;

d. Analytical techniques or methods used;

e. Any comments, case narrative or summary of results produced by the laboratory. These should identify and discuss QA/QC analyses performed concurrently during sample analyses and should specify whether they met project and 40 CFR Part 136 requirements. The summary of results must include information on initial and continuing calibration, surrogate analyses, blanks, duplicates, laboratory control samples, matrix spike and matrix spike duplicate results, sample receipt condition, holding times, and preservation;

f. Summary of data interpretation and any corrective action taken by the permittee; and

g. Effluent limitations for analytes/compounds being analyzed.

3. Twenty-Four Hour Reporting of Noncompliance

The permittee shall report any noncompliance which may endanger health or the environment. Any information shall be provided orally within 24 hours from the time the permittee becomes aware of the circumstances to the following persons or their offices:

CWA Compliance Office Chief
USEPA
(415) 744-1905

Water Quality Compliance Section Manager
ADEQ
(602) 207-4567.

If the permittee is unsuccessful in contacting the persons above, the permittee shall report by 9 a.m. on the first business day following the noncompliance. A written submission shall also be

provided within 5 days of the time the permittee becomes aware of the circumstances. The written submission shall contain a description of the noncompliance and its cause; the period of noncompliance, including dates and times, and, if the noncompliance has not been corrected, the time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance.

4. Definitions

a. The "daily maximum" concentration means the measurement made on any single discrete sample or composite sample.

b. The "daily maximum" mass limit means the total discharge by mass during any calendar day.

c. The "quarterly, monthly or weekly average" concentration, other than for fecal or total coliform bacteria, means the arithmetic mean of consecutive measurements made during a calendar quarterly, monthly or weekly period, respectively. The "quarterly, monthly or weekly average" concentration for fecal or total coliform bacteria means the geometric mean of measurements made during a quarterly, monthly or weekly period, respectively. The geometric mean is the nth root of the product of n numbers.

d. The "quarterly, monthly or weekly average" mass limitation means the total discharge by mass during a calendar quarterly, monthly or weekly period, respectively, divided by the number of days in the period that the facility was discharging. Where less than daily sampling is required by this permit, the quarterly, monthly or weekly average value shall be determined by the summation of all the measured discharges by mass divided by the number of days during the monthly or weekly period when the measurements were made.

e. A "discrete" sample means any individual sample collected in less than 15 minutes.

f. A "composite sample" means, for flow rate measurements, the arithmetic mean of no fewer than eight (8) individual measurements taken at equal intervals for eight (8) hours or for the duration of

discharge, whichever is shorter. A composite sample means, for other than flow rate measurement, a combination of eight (8) individual portions obtained at equal time intervals for eight (8) hours or for the duration of the discharge, whichever is shorter. The volume of each individual portion shall be directly proportional to the discharge flow rate at the time of sampling. The sampling period shall coincide with the period of maximum discharge flow.

g. The "method detection limit" (MDL) is the minimum concentration of an analyte that can be detected with 99% confidence that the analyte concentration is greater than zero, as defined by the specific laboratory method listed in 40 CFR Part 136. The procedure for determination of a laboratory MDL is in 40 CFR Part 136, Appendix B.

h. The "minimum level" (ML) is the concentration at which the entire analytical system must give a recognizable signal and acceptable calibration point. The ML is the concentration in a sample that is equivalent to the concentration of the lowest calibration standard analyzed by a specific analytical procedure, assuming that all of the method-specified sample weights, volumes, and processing steps have been followed (as defined in EPA's draft National Guidance for the Permitting, Monitoring, and Enforcement of Water Quality-Based Effluent Limitations Set Below Analytical Detection/Quantitative Levels, (March 22, 1994). Promulgated method-specified MLs are contained in 40 CFR Part 136, Appendix A and must be utilized if available. If a promulgated method-specific ML is not available, then an interim ML shall be calculated. The interim ML is equal to 3.18 times the promulgated method-specified MDL rounded to the nearest multiple of 1, 2, 5, 10, 20, 50, etc.

i. The "practical quantitation level" (PQL) is the lowest concentration of the analyte that can be reliably measured within specified limits of precision and accuracy during routine laboratory operating conditions [as defined in the Federal Register on July 8, 1987 (52 FR 25699)].

j. A "24-hour composite sample" means a time-proportioned mixture of not less than eight (8) discrete aliquots obtained at equal time intervals. Each aliquot shall be a grab sample of not less than

100 ml. Sample collection, preservation, and handling shall be performed as described in the most recent edition of 40 CFR Part 136.3 (Table II). Where collection, preservation and handling procedures are not outlined in 40 CFR Part 136.3, procedures outlined in the approved edition of Standard Methods for the Examination of Water and Wastewater shall be used.

C. BEST MANAGEMENT PRACTICES

1. BMP Plan

By six months from the effective date of this permit, the permittee shall submit to the Regional Administrator and State Agency a Best Management Practices (BMP) Plan for the facility as follows:

a. The BMP Plan shall include the name and location of the facility and a statement of the BMP policy and objective.

b. The permittee shall establish a BMP committee at the facility, the committee to include a manager qualified to certify the implementation of the BMP Plan. All construction plans enacted as a result of this BMP Plan shall be certified by an engineer who holds a degree in mining engineering or a Professional Engineer. The committee shall meet annually beginning on the effective date of this permit. Meeting notes shall be maintained at Cyprus Miami Mining Corporation's offices in Claypool, AZ, for review by EPA.

c. The permittee shall submit a detailed site map or maps including (1) the flow routing of all natural and constructed drainage channels including all bypass structures, (2) historic mine process areas, (3) storage impoundments, (4) locations of NPDES permitted discharge points, and (5) location of "mining area seeps" (as defined in section C.2.a), and (6) locations of seep inspection zones (as referenced in section C.1.d.(3)).

d. The permittee shall develop, update annually, and submit to the Regional Administrator and State Agency as part of the BMP Plan, and annually thereafter, the following information:

(1) A narrative description of the construction, design,

capacity and purpose of all NPDES related impoundments.

(2) A 1:500 scale map showing the delineations of all drainages and the flow routings of potential discharges from a 10-year, 24-hour storm event.

(3) Identification of seep inspection zones which are located around the downstream perimeter of large facilities such as tailings and waste rock heaps. These seep inspection zones include drainages at least 300 feet down stream of minor, and 1/4 mile downstream of the major drainage (below last impoundment) from the above facilities.

(4) Stormwater Containment Alternatives

(i) The permittee shall insure the ability to withstand or contain up to a 10-year, 24-hour storm event for existing and proposed NPDES water management facilities and shall develop best management practices for the operation of these facilities capable of insuring that Arizona Water Quality Standards are achieved.

(ii) In the alternative, the permittee may design and operate existing and proposed NPDES water management facilities such that they are capable of controlling precipitation from a 100-year, 24-hour storm event through pumping, containment, diversion, treatment or reuse, or some combination of these approaches.

(iii) In the alternative, the permittee may designate existing or proposed NPDES water management facilities as zero discharge. A zero discharge water management facility shall be capable of containing a peak stormwater flow event or handling through pumping, containment, treatment or reuse the maximum saturation event, whichever runoff volume is greater. The permittee shall evaluate the additional storage capacity necessary to meet containment requirements of this subsection for mine and process areas. The requirements of this subsection shall not apply to facilities regulated under Section 404 of the Clean Water Act.

e. The permittee shall use the above information to complete an overall assessment of the measures necessary at the facility to

prevent violations of effluent limitations and surface water quality standards as a result of discharges regulated by this permit. The assessment shall include the evaluation of controls such as expanding storm water storage capacity, water re-cycle and re-use capacity and/or water treatment. This assessment may conform to the requirements of Arizona's Aquifer Protection Permit program. The permittee shall base an individual facility's required capacity for containment or wastewater management on the 10-year, 24-hour storm event and from peak flow events. This assessment shall include an evaluation of the additional storage and conveyance capacity necessary to meet zero discharge requirements. The zero discharge requirements are not applicable to individual facilities regulated under Section 404 of the Clean Water Act.

f. The permittee shall submit an engineering plan including implementation schedules and final compliance dates for the measures identified in the assessment as being necessary to prevent unauthorized discharges and effluent limitation or surface water quality standards violations as a result of discharges regulated by this permit.

g. The permittee shall include in the BMP plan employee training procedures and implementation schedules as follows:

(1) Employee training in proper operating procedures, and

(2) Training for emergency spill response, related to NPDES facilities or Spill Prevention Control and Countermeasure (SPCC) Plans.

2. <u>Seeps</u>

By six months from the effective date of this permit, the permittee shall initiate the following Best Management Practices for seepage identification at the facility:

a. The permittee shall identify "mining area seeps" located on mine property. "Mining area seeps" are defined as meeting the following criteria:

(1) discharges as defined by the Clean Water Act to waters of the United States;

(2) has an observable and measurable flow of at least one gallon per minute upon discharge to waters of the U.S. or may otherwise potentially impact waters of the U.S. including accumulation of metal bearing salts;

(3) has continuous flow unrelated to storm events defined as being found to flow continuously 72 hours after a storm event; and

(4) is down-gradient or within 1/4 mile of inactive mining areas.

b. The permittee shall take an initial grab sample of any "mining area seeps" and analyze the sample for the parameters listed for Outfall 002. If the seep meets Arizona Water Quality Standards, the permittee shall sample the seep on a quarterly basis as described in section B.1 of the permit.

c. If the water flowing from the "mining area seeps" does not meet Arizona water quality standards, the permittee shall report the seep together with information listed in section A.4 of this permit and a response plan and compliance schedule.

3. Report

On a date within 18 months after the effective date of this permit, and annually thereafter, the permittee shall submit to the Regional Administrator and State Agency a report detailing compliance with the described Best Management Practices and the Best Management Practices Plan.

D. REOPENER PROVISIONS

1. This permit may be modified in accordance with the requirements set forth at 40 CFR Parts 122 and 124, to include appropriate conditions or limits to address demonstrated effluent toxicity based on newly available information where that information was not available at the time of permit issuance and would have justified the

application of different permit conditions at that time were it available.

2. This permit may be modified in accordance with the requirements set forth at 40 CFR Parts 122 and 124 to implement any EPA-approved new state water quality standards applicable to effluent toxicity, including any changes to Arizona's water quality standards that may stipulate the use of background hardness for receiving waters, or establish an upper limit to the hardness value used in the equations to calculate ambient water quality standards.

3. This permit may be modified in accordance with the requirements set forth at 40 CFR Parts 122 and 124 to implement any applicable EPA-approved new or amended state water quality standards, variances or designated uses.

4. The permitee shall notify EPA in the event that operations are restored at the Christmas Mine and the permit shall be modified in accordance with any changes to the operational status at the facility.

5. The permittee may petition EPA to reopen and modify this permit based on the results of the translator study (A.2.) and the hardness study (A.2.).

E. SPECIAL CONDITIONS

The permittee shall develop and implement a nutrient monitoring plan for waters discharged from Outfall 002. The nutrient monitoring plan shall be submitted for EPA approval no later than 90 days following issuance of this permit to:

Clean Water Act Standards
and Permits Office (WTR-5)
USEPA
75 Hawthorne St.
San Francisco, Ca 94105

The outfall shall be monitored quarterly for Total Nitrogen, Total Phosphorous, Turbidity and Chlorophyll a., and the results

submitted to the Clean Water Act Standards and Permits Office (WTR-5).

The sentence which CMMC seeks to be deleted has been revised in three respects: the term "seep" has been replaced with the phrase "Mining Area Seeps"; the phrase "and storm water

discharges associated with industrial activity as defined in 40 CFR 122.26(b)(14))" has been deleted; and, because of renumbering of the permit sections, the reference to section B.5.a has been changed to a reference to section C.2.a.

The Act's NPDES permit system regulates pollutants that enter waters of the United States through groundwater or by way of seeps. See, e.g.: *Williams Pipe Line Co. v. Bayer Corp.*, 964 F. Supp. 1300, 1319-20 (S.D. Iowa, 1997); *Friends of the Coast Fork v. County of Lane*, 1997 U.S. Dist. LEXIS 22705 (D. Ore. 1997); *Friends of Santa Fe County v. LAC Minerals, Inc.*, 892 F. Supp. 1333, 1357-58 (D.N.M.. 1995); *Washington Wilderness Coalition v. Hecla Mining Co.*, 870 F. Supp. 983, 990 (E.D. Wash. 1994); *Sierra Club v. Colorado Refining Co.*, 838 F. Supp. 1428, 1434 (D. Colo. 1993); and *U.S. v. Earth Sciences, Inc.*, 599 F.2d 368, 374 (10th Cir. 1979). See, Fact Sheet, pages 15 through 17.

Prohibiting the discharge of "mining area seeps" (as defined in the permit, see Permit, section C.2.a.) which cause or contribute to a violation of Arizona water quality standards is appropriate in the subject case. 40 CFR 122.44 requires that each NPDES permit include conditions meeting the following requirements when applicable:

> "(d) Water quality standards and State requirements: any requirements in addition to or more stringent than promulgated effluent limitations guidelines or standards under sections 301, 304, 306, 307, 318 and 405 of CWA necessary to:
>
> (1) Achieve water quality standards established under section 303 of the CWA, including State narrative criteria for water quality."

Precipitation may infiltrate through waste piles such as are found at the subject facility, resulting in seepage out the toe of waste piles. Drainage from the toe of waste piles, and discharge of impacted groundwater to streams and springs, is one of the primary means by which surface water is impacted from mine operations and wastes. Because of the unconsolidated and nonhomogeneous nature of waste rock and tailings at mining operations, water penetration can cause instability thus enhancing the formation of seeps containing high levels of various elements that could impact downslope sites. Prohibiting the discharge of "mining area seeps" which cause or contribute to a violation of Arizona water quality standards is appropriate in the subject case because it is needed to ensure that the applicable water quality standards are achieved. See, Fact Sheet pages 10 - 15.

Postmining stability and related hydrologic issues present both short- and long-term considerations for reclamation. Spotts, R., and Burrell, J.K., *Surface Water Quantity*, in *Environmental Effects of Mining*, in *Mining Environmental Handbook*, Marcus, Jerold J. (ed.), p.155 (1997). The parties involved in administering a reclaimed mine site need to provide inspection and maintenance as long as diversion and retention systems play a significant role in water and sediment management. *Id.*

In arid climates, migration of contaminants through mine waste facilities is often slow. *Project Monitoring*, in *Environmental Permitting*, in *Mining Environmental Handbook*, Marcus, Jerold J. (ed.), p.398 (1997). Hence, water quality impacts are not always detected during life-of-mine operations. *Id.* Key components of post closure monitoring should include surface and groundwater monitoring. *Id.*

Perpetual collection and treatment of acid drainage from a dump must be assumed. Kent, A., *Waste Rock Disposal Design*, in *Systems Design for Site Specific Environmental Protection*, in *Mining Environmental Handbook*, Marcus, Jerold J. (ed.), p.451 (1997). Decline in the rate of acid production in waste rock dumps is very slow and may accelerate rapidly if the cover is compromised. *Id.* Thus, care and maintenance of the cover system must be considered a very long-term requirement. *Id.*

The permit requires that, by six months from the effective date of the permit, the discharger shall initiate BMPs related to "mining area seeps". See, Permit, section C.2. Within six months from the effective date of the permit, the discharger is to identify "mining area seeps" located on the mine property. Permit, section C.2.a. As stated in Permit, para. C.2.a.:

> "Mining area seeps are defined as meeting the following criteria:
>
> (1) discharges as defined by the Clean Water Act to waters of the United States;
>
> (2) has an observable and measurable flow of at least one gallon permit miunute upon discharge to waters of the U.S. or may otherwise potentially impact waters of the U.S. including accumulation of metal bearing salts;
>
> (3) has continuous flow unrelated to storm events defined as being found to flow continuously 72 hours after a storm event; **and**
>
> (4) is down-gradient or within 1/4 mile of mine process areas." (Emphasis added.)

In order for a seep to be a "mining area seep", each of the four criteria must be met. Accordingly, a seep which is not a discharge as defined by the Clean Water Act is not a "mining area seep" in the context of the permit.

The requirement to identify and sample seeps under Permit, section C.2.a. and C.2.b. extends only to seeps which are discharges as defined by the Act. The requirement to prepare a response plan for a seep under section C.2.c. extends only to seeps which are discharges as defined by the Act and which do not meet Arizona water quality standards.

Whether a seep is a discharge as defined by the Act is to be determined by the applicable law regarding the Act's jurisdiction over such discharges. The Act protects water quality by prohibiting the discharge of any pollutant by any person into "navigable waters" except in accordance with a permit issued by EPA, the Corps of Engineers, or a State Government. See, CWA, secs. 301(a) and 502(12).[1] "The term 'navigable waters' means the waters of the United States, including the territorial seas." CWA, sec. 502(7).

In enacting the 1972 Amendments to the Federal Water Pollution Control Act, Congress intended to extend the Act's jurisdiction to the Constitutional limit. See, *Leslie Salt Co. v. Froehlke*, 578 F.2d 742, 755 (9th Cir. 1978). Accordingly, "the term 'navigable waters' within the meaning of the FWPCA is to be given the broadest possible constitutional interpretation under the Commerce Clause." *Id.*

"... Congress intended to create a very broad grant of jurisdiction in the Clean Water Act, extending to any aquatic features within the reach of the commerce clause power." *Leslie Salt Co. v. U.S.*, 896 F.2d 354, 357 (9th Cir. 1990), *cert. denied*, 498 U.S. 1126 (1991).

"Waters of the United States" is defined by regulation to include:

"(a) All waters which are currently used, were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of the tide;

(b) All interstate waters, including interstate "wetlands;"

(c) All other waters such as intrastate lakes, rivers, streams (including intermittent streams), mudflats, sandflats, "wetlands," sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds the use, degradation, or destruction of which would affect or could affect interstate or foreign commerce including any such waters:

(1) Which are or could be used by interstate or foreign travelers for recreational or other purposes;

(2) From which fish or shellfish are or could be taken and sold in interstate or foreign commerce; or

---

[1] The law was originally called the Federal Water Pollution Control Act Amendments of 1972. See, Pub. L. No. 92-500, 86 Stat. 816. The law became commonly known as the Clean Water Act, a name Congress recognized and added to the statute during passage of the 1977 Amendments to the Act. See, Clean Water Act of 1977, Pub. L. No. 95-217, 91 Stat. 1566 (1977).

Ground Water Quality, in *Environmental Effects of Mining*, in *Mining Environmental Handbook*, Marcus, Jerold J. (ed.), p.165 (1997).

If groundwater is contaminated as a result of mining operations, this contamination can affect human health and the environment when it emerges into the surface water system. Brown, A.,., *Ground Water Quality*, in *Technologies for Environmental Protection*, in *Mining Environmental Handbook*, Marcus, Jerold J. (ed.), p.254 (1997). The emerging water may contaminate surface water resources and plant life at the springs based on the emerging groundwater. *Id.* Several methods for remediating such contamination have been identified. *Id.* at 254-55.

In mining areas where the protective shield of vegetation is broken and the slopes are often times steepened, the balance between erosion and soil creation is upset, increasing runoff and erosion. Hassinger, B.W., *Erosion*, in *Environmental Effects of Mining*, in *Mining Environmental Handbook*, Marcus, Jerold J. (ed.), p.137 (1997). Overburden piles are frequently impacted by erosion at mining sites. *Id.* Fine tailings can be subject to severe erosion on steep slopes. *Id.*

Increased sediment production from active and abandoned mines sites is a common occurrence, except where effective sediment control measures are implemented and successful reclamation is achieved following cessation of mining. Moore, R.T., *Wildlife*, in *Environmental Effects of Mining*, in *Mining Environmental Handbook*, Marcus, Jerold J. (ed.), p.146 (1997).

Uncontrolled stormwater from land areas disturbed by mining often have considerable higher sediment loads than runoff from undisturbed watersheds. Johnson, S.W., *Surface Water Quality - Sediment*, in *Environmental Effects of Mining*, in *Mining Environmental Handbook*, Marcus, Jerold J. (ed.), p.149 (1997).

Strong soil contamination with trace metals in mining/smelting regions has been reported locally in numerous case studies. Dudka, S., *Environmental Impacts of Metal Ore Mining and Processing: A Review*, J. Environ. Qual. 26:590 (1997). The result of erosion is translocation of the metal-contaminated material and its dispersion over a bigger area.; leaching and washing of the metals from the studied soils is apparently facilitated by the low soil pH. *Id.*

Wind and water erosion and the associated environmental degradation are widespread problems related to tailing material. Dudka, S., *Environmental Impacts of Metal Ore Mining and Processing: A Review*, J. Environ. Qual. 26:590 (1997). Leaching of acidifying compounds from tailings leads to an acidification of adjacent soils. *Id.* Soils often undergo strong acidification in areas where metal ores are extracted and processed. *Id.* Metals present in the acidic soils becomes easily mobile and available for plants, and therefore, their leaching, plant uptake, and runoff from soils increase. *Id.*

5. By six months from the effective date of this permit, Asarco shall initiate the following Best Management Practices for seepage identification at the Asarco Ray Operations:

   a. Asarco shall identify process related seeps located on mine property. Process related seeps are defined as meeting the following criteria:

      I. discharges as defined by the Clean Water Act to waters of the United States;

      II. has an observable and measurable flow of at least one gallon per minute upon discharge to waters of the U.S.;

      III. has continuous flow unrelated to storm events defined as being found to flow continuously 72 hours after a storm event; and

      IV. is down-gradient or within 1/4 mile of mine process areas.

   b. Asarco shall take an initial grab sample of any process related seep and analyze the sample for the parameters listed for seeps in the ambient monitoring program. If the seep meets Arizona Water Quality Standards, Asarco shall sample the seep on a quarterly basis as described in section C.3 of the permit.

   c. If the water flowing from the seep does not meet Arizona water quality standards, Asarco shall report the seep together with information listed in section A.5 of this permit and a response plan and compliance schedule.

6. On a date within 18 months after the effective date of this permit, and annually thereafter, Asarco shall submit to the Regional Administrator and State Agency a report detailing compliance with the described Best Management Practices and the Best Management

Practices Plan.

EPA United States Environmental Protection Agency

Envirofacts Warehouse — Water Discharge Permits

Overview | Law | EXIT EPA | Query | Customized Query (NEW) | Model | Feedback | EF Home

PCS Query Results

Page No. 1

Consolidated facility information (from multiple EPA systems) was searched to select facilities

EPA REGION CODE: **9**
SIC CODE: **1021**
Results are based on data extracted on JAN-18-2000

Note: Click on the underlined CORPORATE LINK value for links to that company's environmental web pages. Click on the underlined MAPPING INFO value to obtain mapping information for the facility. Click on the underlined FACILITY ID value to view EPA Facility information for the facility. Click on the underlined NPDES value to view detailed reports on the facility.

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Facility Infor

NPDES ID	EPA FACILITY ID	FACILITY NAME	ADDRESS	COUNTY NAME
AZU000147	000008661896	3R MINE 3R MINE	SANTA CRUZ COUNTY, AZ	SANTA CRUZ
AZU000044	AZ0000308221	ALTA MINE - ASARCO	FLUX CANYON ROAD PATAGONIA, AZ 85624	SANTA CRUZ
AZ0000035	AZD008397184	ASARCO / RAY MINE	HWY 177 20 MI E OF HAYDEN HAYDEN, AZ 85235	GILA
AZ0020389	AZD001886654	BHP COPPER/SUPERIOR OPERATIONS	SMELTER TOWN NO 17 SUPERIOR, AZ 85273	PINAL
AZ0020419	000008873402	BHP/COPPER CITIES UNIT	3 MILES N OF MIAMI ON HWY 88 MIAMI, AZ 85539	GILA

AZ0020401	AZT000624379	BHP/PINTO VALLEY OPERATIONS	8 MILES W OF MIAMI ON HWY 60 MIAMI, AZ 85539	GILA
AZU000087	AZT000624379	BHP/PINTO VALLEY,MIAMI UNIT	HWY 60 MIAMI, AZ 85539	GILA
AZU000094	AZ0001267814	CARLOTA COPPER CO	PINTO VALLEY ROAD MIAMI, AZ 85539	GILA
AZ0024112	AZ0001267814	CARLOTA COPPER PROJECT	PINTO VALLEY ROAD MIAMI, AZ 85539	GILA
AZU000099	AZD983482373	CASA GRANDE MINE CYPRUS COPPER	HIGHWAY 15 CASA GRANDE, AZ 85222	PINAL
AZ0022268	AZD083717843	COPPER MINE, CYPRUS BAGDAD CO	HWY 95 BAGDAD, AZ 86321	YAVAPAI
AZU000102	AZD983482373	CYPRUS CASA GRANDE CORP	HWY 15 CASA GRANDE, AZ 85222	PINAL
AZU000048	000008662474	CYPRUS COPPER JOHNSON MINE	, AZ	
AZ0020508	AZD008398521	CYPRUS MIAMI MINING CORP	INSPIRATION AREA CLAYPOOL, AZ 85532	GILA
AZ0020516	AZD008398521	CYPRUS MIAMI MINING CORP	CHRISTMAS FACILITY CLAYPOOL, AZ 85532	GILA
AZU000101	AZD083717843	CYPRUS MINERALS	BAGDAD, AZ 86321	YAVAPAI
AZU000151	000008661934	CYPRUS MINING - ROD PLANT	PINAL COUNTY, AZ	PINAL
AZ0024309	000007539206	DOS POBRES/SAN JUAN MINE PROJ	RICHARD MOHR - MANAGER SAFFORD, AZ 85546	GRAHAM

AZU000093	AZ0000236299	GIBSON MINE	9 MILES W OF MIAMI MIAMI, AZ 85539	GILA
AZU000046	AZ0000308262	HARDSHELL MINE - ASARCO	FLUX CANYON ROAD PATAGONIA, AZ 85624	SANTA CRUZ
AZU000090	AZD008397127	HAYDEN SMELTER, ASARCO INC	640 ASARCO DRIVE HAYDEN, AZ 85235	GILA
AZU000045	AZ0000308270	HERMOSA MINE - ASARCO	FLUX CANYON ROAD PATAGONIA, AZ 85624	SANTA CRUZ
AZU000085	000008662474	JOHNSON MINE - ARIMETCO INT'L	, AZ	
AZU000004	AZD001886597	MAGMA COPPER - SAN MANUEL OPER	HWY 76 & MCNAB ROAD SAN MANUEL, AZ 85631	PINAL
AZU000053	AZD041456583	MINERAL PARK MINE CYPRUS COPPR	MINERAL PARK RD KINGMAN, AZ 86402	MOHAVE
AZU000042	AZT000623678	MISSION MINE - ASARCO	WEST PIMA MINE ROAD SAHUARITA, AZ 85629	PIMA
AZU000027	000008662690	NORANDA LAKESHORE MINE	PIMA COUNTY, AZ	PIMA
AZU000089	AZ0000309047	OLD DOMINION MINE MAGMA COPPER	US HWY 60 GLOBE, AZ 85501	GILA
AZU000086	000008662484	OLD RELIABLE MINE MAGMA COPPER	, AZ	
AZU000096	AZ0000309146	ORACLE RIDGE MINE	22 MI SE ORACLE ORACLE, AZ 85623	PINAL
AZU000005	AZD074489469	PHELPS DODGE MORENCI OPERATIONS	4521 US HWY 191 MORENCI, AZ 85540	GREENLE

AZ0022331	AZ0001109040	PHELPS DODGE CORP SAFFORD BRANCH	SAFFORD, AZ 85546	GRAHAM
AZU000172	AZD074489469	PHELPS DODGE E PLANT SITE WWTP	4521 US HWY 191 MORENCI, AZ 85540	GREENLE
AZU000002	AZD980817704	PHELPS DODGE, COPPER QUEEN	HWY 92 BISBEE, AZ 85603	COCHISE
AZ0022705	AZD074489469	PHELPS DODGE/MORENCI MINE	4521 US HIGHWAY 191 MORENCI, AZ 85540	GREENLE
AZU000095	AZ0001267764	PIONEER MINE WESTLINC MINING	HWY 77 GLOBE, AZ 85501	GILA
AZU000049	AZ0002015188	REYMERT MINE INSPIRATION COPPR	REYMERT - 3 MI S HWY60 SUPERIOR, AZ 85273	PINAL
AZU000162	AZ0001906205	SAN MANUEL MINE, BHP COPPER	200 S REDINGTON RD SAN MANUEL, AZ 85631	PINAL
AZU000043	000008662856	SIERRITA MINE - ASARCO	DUVAL MINE RD GREEN VALLEY, AZ 85622	PIMA
AZU000047	AZ8141190076	SIERRITA MINE, CYPRUS COPPER	DUVALL MINE ROAD GREEN VALLEY, AZ 85614	PIMA
AZU000001	AZD042370080	SILVER BELL MINE - ASARCO	25000 W AVRA VALLEY RD MARANA, AZ 85653	PIMA
AZU000088	000008661670	SOLITUDE TAILINGS MAGMA COPPER	PINE, AZ 85544	GILA
AZU000018	AZD983467754	TWIN BUTTES MINE ANAMAX MINING	TWIN BUTTES MINE SAHUARITA, AZ 85629	PIMA

AZU000092	000008661718	VAN DYKE MINE - ARIMETCO	YARNELL, AZ 85362	YAVAPAI
AZU000091	AZD980735682	ZONIA MINE, ZONIA CO INC	STATE ROUTE 1 KIRKLAND, AZ 86332	YAVAPAI
AZU000026	AZD980735682	ZONIA MINE, ZONIA COMPANY	STATE ROUTE 1 KIRKLAND, AZ 86332	YAVAPAI
CA0084166	CAD980736318	AFTERTHOUGHT MINE	SEC 10,11&15, T33N, R2W BELLA VISTA, CA 96008	SHASTA
CA0084212	000007133688	BULLY HILL & RISING STAR MINES	SQUAW CREEK ARM OF SHASTA LAK REDDING, CA 96001	SHASTA
CAU000158	000008657966	EBMUD PENN MINE	, CA	
CA0084221	000007133698	GREENHORN MINE	HWY 299W REDDING, CA 96001	SHASTA
CA0081108	CAD980498612	IMM ACID MINE DRAINAGE	IRON MOUNTAIN RD REDDING, CA 96001	SHASTA
CA0081876	CAD982391997	MAMMOTH,KEYSTONE,STOWELL ET AL	LITTLE BACKBONE & W SQUAW CRK REDDING, CA 96002	SHASTA
CA0084531	000008967984	WALKER MINE	E PLUMA CNTY 24MI N OF PORTOLA PLUMA CNTY, CA	PLUMAS

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Total Number of Facilities Displayed: 53

FAX TRANSMITTAL

OF PAGES 4 (INCLUDING COVER PAGE)

TO: Glenn Saums	FROM: Scott Wilson USEPA, REGION 6
	MAIL CODE: 6WQ-P
DEPT./AGENCY/BUSINESS NMED	PHONE# (214) 665-~~7170~~ 7511
FAX # 505 827 0160	FAX # (214) 665-2191

Taos County Species List

- Black-footed ferret, Mustela nigripes, E
- Fringed myotis, Myotis thysanodes, SC
- Long-eared myotis, Myotis evotis, SC
- Long-legged myotis, Myotis volans, SC
- New Mexican jumping mouse, Zapus hudsonius luteus, SC
- Occult little brown bat, Myotis lucifugus occultus, SC
- Pale Townsend's (=western) big-eared bat, Plecotus townsendii pallescens, SC
- Small-footed myotis, Myotis ciliolabrum, SC
- Southwestern otter, Lutra canadensis sonorae, SC
- Spotted bat, Euderma maculatum, SC
- Yuma myotis, Myotis yumanensis, SC
- ~~American peregrine falcon, Falco peregrinus anatum, E~~
- ~~Arctic peregrine falcon, Falco peregrinus tundrius, E (S/A)~~
- Baird's sparrow, Ammodramus bairdii, SC
- Bald eagle, Haliaeetus leucocephalus, T
- Ferruginous hawk, Buteo regalis, SC
- Harlequin duck, Histrionicus histrionicus, SC
- Loggerhead shrike, Lanius ludovicianus, SC
- Mexican spotted owl, Strix occidentalis lucida, T
- Mountain plover, Charadrius montanus, PT
- Northern goshawk, Accipiter gentilis, SC
- Southwestern willow flycatcher, Empidonax traillii extimus, E
- White-faced ibis, Plegadis chihi, SC
- Whooping crane, Grus americana, XN
- Yellow-billed cuckoo, Coccyzus americanus, SC
- Flathead chub, Platygobio (=Hybopsis) gracilis, SC
- Cockerell's striate disc (snail), Discus shemeki cockerelli, SC
- Sangre de Cristo peaclam, Pisidium sanguinichristi, SC
- New Mexico silverspot butterfly, Speyeria nokomis nitocris, SC
- Arizona willow, Salix arizonica, SC
- Chiricahua dock, Rumex orthoneurus, PT
- Ripley milk-vetch, Astragalus ripleyi, SC

Index

E	=	Endangered
PE	=	Proposed Endangered
PE w/CH	=	Proposed Endangered with critical habitat
T	=	Threatened
PT	=	Proposed Threatened
PT w/CH	=	Proposed Threatened with critical habitat
PCH	=	Proposed critical habitat
C	=	Candidate Species (taxa for which the Service has sufficient information to propose that they be added to list of endangered

		and threatened species, but the listing action has been precluded by other higher priority listing activities).
SC	=	Species of Concern (taxa for which further biological research and field study are needed to resolve their conservation status)
S/A	=	Similarity of Appearance
*	=	Introduced population
XN	=	Nonessential experimental

Eddy

Arizona black-tailed prairie dog, Cynomys ludovicianus arizonensis, SC
Big free-tailed bat, Nyctinomops macrotis (=Tadarida m., T. molossa), SC
Black-footed ferret, Mustela nigripes, E
Cave myotis, Myotis velifer, SC
Fringed myotis, Myotis thysanodes, SC
Gray-footed chipmunk, Tamias canipes, SC
Guadalupe southern pocket gopher, Thomomys umbrinus guadalupensis, SC
Long-legged myotis, Myotis volans, SC
Occult little brown bat, Myotis lucifugus occultus, SC
Pale Townsend's (=western) big-eared bat, Plecotus townsendii pallescens, SC
Pecos River muskrat, Ondatra zibethicus ripensis, SC
Small-footed myotis, Myotis ciliolabrum, SC
Swift fox, Vulpes velox, C
Yuma myotis, Myotis yumanensis, SC
American peregrine falcon, Falco peregrinus anatum, E
Arctic peregrine falcon, Falco peregrinus tundrius, E (S/A)
Baird's sparrow, Ammodramus bairdii, SC
Bald eagle, Haliaeetus leucocephalus, T
Black tern, Chlidonias niger, SC
Ferruginous hawk, Buteo regalis, SC
Interior least tern, Sterna antillarum, E
Loggerhead shrike, Lanius ludovicianus, SC
Mexican spotted owl, Strix occidentalis lucida, T
Northern aplomado falcon, Falco femoralis septentrionalis, E
Northern goshawk, Accipiter gentilis, SC
Western burrowing owl, Athene cunicularia hypugaea, SC
White-faced ibis, Plegadis chihi, SC
Lesser prairie chicken, Tympanuchus pallidicinctus, C
Yellow-billed cuckoo, Coccyzus americanus, SC
Blue sucker, Cycleptus elongatus, SC
Headwater catfish, Ictalurus lupus, SC
Pecos bluntnose shiner, Notropis simus pecosensis, T w/CH
Pecos gambusia, Gambusia nobilis, E
Pecos pupfish, Cyprinodon pecosensis, PE
Plains minnow, Hybognathus placitus*, SC
Rio Grande shiner, Notropis jemezanus, SC
Sand dune lizard, Sceloporus arenicolus, SC
Texas horned lizard, Phrynosoma cornutum, SC
limestone tiger beetle, Cicindela politula petrophila, SC
Mescalero Sands tiger beetle, Cicindela formosa rutilovirescens, SC
Mescalero Sands June beetle, Polyphylla mescalerensis, SC
Ovate vertigo (snail), Vertigo ovata, SC
Pecos springsnail, Pyrgulopsis pecosensis, SC
Texas hornshell (mussel), Popenaias popei, SC
Few-flowered jewelflower, Streptanthus sparsiflorus, SC
Glass Mountain coral-root, Hexalectris nitida, SC
Guadalupe rabbitbrush, Chrysothamnus nauseosus var. texemsis, SC

Gypsum wild-buckwheat, Eriogonum gypsophilum, T w/CH
Kuenzler hedgehog cactus, Echinocereus fendleri var. Kuenzleri, E
Lee pincushion cactus, Coryphantha sneedii var. leei, T
Mat leastdaisy, Chaetopappa hersheyi, SC
Tharp's blue-star, Amsonia tharpii, SC
Wright's water-willow, Justicia wrightii, SC

EPA Region VIII
FACT SHEET - SAN LUIS MINE
(2/3/99)

Battle Mountain Resources' San Luis Mine in south-central Colorado began to discharge from the embankment of the reclaimed backfilled pit to the Rito Seco Creek in late 1998 based upon information from the Costilla County Conservancy District (ground water discharge to surface water). Many residents of this very old Hispanic community opposed this new mine in 1990 because of the potential impacts to their community. Now that the mine is closed, it appears to be fulfilling their predictions.

There is a drinking water supply for the town of San Luis about 5 miles downstream in the Rito Seco alluvium. In checking with the Colorado Department of Public Health and Environment (CDPHE), violations of the arsenic MCL were found in 1994. Also another violation of the cyanide MCL was later negated because of possible contamination of the sample. The sampling and analyses are done by the mining company as a public service.

An EPA team doing sampling for mercury in a nearby area took a grab sample from the seep and had it analyzed for total metals. Very high levels of arsenic and other metals were detected. It was determined that due to the sampling and analysis methods, sampling results should only be used for screening not for enforcement purposes. CDPHE was given opportunity to inspect but did not. Therefore, an official NPDES inspection was conducted on June 15, 1999 by EPA. The agency found that the facility was discharging pollutants to the Rito Seco Creek without a discharge permit. Preliminary results show that pollutants were being discharged in excess of stream standards. Therefore, the CDPHE, the Colorado Department of Minerals and Geology State (DMG, the State mining permitting agency) and the mining company were notified and information was requested under Section 308. CDPHE issued a notice of violation and cease and desist order on August 20, 1999. In the State of Colorado the CDPHE sets water quality standards and implements the NPDES program, whereas the DMG is the implementing agency for "disturbances to the ... surface and ground water systems at mining sites" other than NPDES permits. As DMG is responsible for the protection of groundwater quality, on October 4, 1999 issued a letter suggesting that there is or may be a reasonable potential for degradation of water quality in the Rito Seco alluvial aquifer based upon violations of TDS, sulfate and manganese in the groundwater within monitoring wells.

The mine initially tried to pump and evaporate the water from the backfilled pit via "snow blowing" machines at a rate of approximately 500 gpm. The purpose was to lower the water level enough so that it wouldn't discharge directly to surface water. On August 26, 1999, the company requested a DMG permit revision for a temporary water treatment system, a nanofiltration system with chemical precipitation. Initially the company wanted to land-apply this effluent to fields farmed for alfalfa rather than obtain an NPDES permit. This plan was not pursued to our knowledge because of high metals uptake in the plants. They then tried to state that this water discharge should be covered under their stormwater permit. However, the stormwater permit had never been transferred from a previous mining company in the same area.

subject under the CWA, including "effluent limitations," water quality standards, standards of performance, toxic effluent standards or prohibitions, "best management practices," pretreatment standards, and "standards for sewage sludge use or disposal" under sections 301, 302, 303, 304, 306, 307, 308, 403 and 405 of CWA.

Application means the EPA standard national forms for applying for a permit, including any additions, revisions or modifications to the forms; or forms approved by EPA for use in "approved States," including any approved modifications or revisions.

Approved program or *approved State* means a State or interstate program which has been approved or authorized by EPA under part 123.

Average monthly discharge limitation means the highest allowable average of "daily discharges" over a calendar month, calculated as the sum of all "daily discharges" measured during a calendar month divided by the number of "daily discharges" measured during that month.

Average weekly discharge limitation means the highest allowable average of "daily discharges" over a calendar week, calculated as the sum of all "daily discharges" measured during a calendar week divided by the number of "daily discharges" measured during that week.

Best management practices ("BMPs") means schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of "waters of the United States." BMPs also include treatment requirements, operating procedures, and practices to control plant site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.

BMPs means "best management practices."

Class I sludge management facility means any POTW identified under 40 CFR 403.8(a) as being required to have an approved pretreatment program (including such POTWs located in a State that has elected to assume local program responsibilities pursuant to 40 CFR 403.10(e)) and any other treatment works treating domestic sewage classified as a Class I sludge management facility by the Regional Administrator, or, in the case of approved State programs, the Regional Administrator in conjunction with the State Director, because of the potential for its sludge use or disposal practices to adversely affect public health and the environment.

Contiguous zone means the entire zone established by the United States under Article 24 of the Convention on the Territorial Sea and the Contiguous Zone.

Continuous discharge means a "discharge" which occurs without interruption throughout the operating hours of the facility, except for infrequent shutdowns for maintenance, process changes, or other similar activities.

CWA means the Clean Water Act (formerly referred to as the Federal Water Pollution Control Act or Federal Water Pollution Control Act Amendments of 1972) Public Law 92–500, as amended by Public Law 95–217, Public Law 95–576, Public Law 96–483 and Public Law 97–117, 33 U.S.C. 1251 *et seq.*

CWA and regulations means the Clean Water Act (CWA) and applicable regulations promulgated thereunder. In the case of an approved State program, it includes State program requirements.

Daily discharge means the "discharge of a pollutant" measured during a calendar day or any 24-hour period that reasonably represents the calendar day for purposes of sampling. For pollutants with limitations expressed in units of mass, the "daily discharge" is calculated as the total mass of the pollutant discharged over the day. For pollutants with limitations expressed in other units of measurement, the "daily discharge" is calculated as the average measurement of the pollutant over the day.

Direct discharge means the "discharge of a pollutant."

Director means the Regional Administrator or the State Director, as the context requires, or an authorized representative. When there is no "approved State program," and there is an EPA administered program, "Director" means the Regional Administrator. When there is an approved State program, "Director" normally means the State Director. In some circumstances, however, EPA retains the authority to take certain actions even when there is an approved State program. (For example, when EPA has issued an NPDES permit prior to the approval of a State program, EPA may retain jurisdiction over that permit after program approval, see § 123.1.) In such cases, the term "Director" means the Regional Administrator and not the State Director.

Discharge when used without qualification means the "discharge of a pollutant."

Discharge of a pollutant means:

(a) Any addition of any "pollutant" or combination of pollutants to "waters of the United States" from any "point source," or

(b) Any addition of any pollutant or combination of pollutants to the waters of the "contiguous zone" or the ocean from any point source other than a vessel or other floating craft which is being used as a means of transportation.

This definition includes additions of pollutants into waters of the United States from: surface runoff which is collected or channelled by man; discharges through pipes, sewers, or other conveyances owned by a State, municipality, or other person which do not lead to a treatment works;

CROWELL & MORING LLP
1001 PENNSYLVANIA AVENUE, N.W.
WASHINGTON, D.C. 20004-2595
(202) 624-2500
FACSIMILE (202) 628-5116

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PERMITS BRANCH
6WQ-P

SUITE 1200
2010 MAIN STREET
IRVINE, CALIFORNIA 92614-7217
(949) 263-8400
FACSIMILE (949) 263-8414

180 FLEET STREET
LONDON EC4A 2HG
44-20-7413-0011
FACSIMILE 44-20-7413-0333

RICHARD E. SCHWARTZ
(202) 624-2905
rschwartz@cromor.com

June 22, 2000

300:res
89371.015

Mr. J. Scott Wilson
NPDES Permits Branch (6WQ-P)
U.S. Environmental Protection Agency
Region 6
1445 Ross Avenue
Dallas, Texas 75202-2733

Re: Molycorp, Inc., draft NPDES Permit No. NM0022306

Dear Mr. Wilson:

I am writing to confirm your telephone message to me of June 12, 2000, when you confirmed that the deadline for submitting comments on the above-referenced draft NPDES permit is July 26, 2000 (rather than 33 days from the date of the Notice).

Thank you very much for clearing up this ambiguity in the Notice.

Sincerely,

Rich Schwartz

Richard E. Schwartz

cc: Mr. David R. Shoemaker
John H. Pugh, Esq.

1727695

CROWELL & MORING LLP
1001 PENNSYLVANIA AVENUE, N.W.
WASHINGTON, D.C. 20004-2595

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Mr. J. Scott Wilson
NPDES Permits Branch (6WQ-P)
U.S. Environmental Protection Agency
Region 6
1445 Ross Avenue
Dallas, Texas 75202-2733

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5-2-84 Hemke

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VI
INTERFIRST TWO BUILDING, 1201 ELM STREET
DALLAS, TEXAS 75270

July 18, 1984

Mr. C.R. Sacrison
General Manager
Questa Division
P.O. Box 469
Questa, New Mexico 87556

Re: NPDES Permit No. NM0022306

Dear Mr. Sacrison:

This is to acknowledge receipt of your permit modification request dated June 29, 1984, for Union Molycorp.

It is possible that processing of your request may require time as modification requests are reviewed in accordance with Federal and State priorities for water pollution abatement. Also, please be advised that a request for permit modification does not relieve your obligation meet current permit requirements. Therefore, you must attempt to meet all permit requirements to the best of your ability.

Should additional information be required to complete processing of your request, you will be contacted.

Sincerely,

Jayne Watson

Jayne Watson, Chief
Permits Issuance Section (6W-PS)

5-2-84 Dunke

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

DATE: 7-11-84

SUBJECT: MODIFICATION REQUEST FOR AN ISSUED PERMIT

FROM: JENAIE SLAVEN, 6W-PS

TO: Sam Becker, 6W-PS

The referenced application and/or letter (see attached copy) has been submitted to this office requesting a modification to their existing NPDES permit, NM0022306.

Please return this form to 6W-PS initialing your desired course of action.

Name of Facility: Union Molycorp

____ From the information submitted, it would appear that a new pwemit should be written and issued independently from the previously issued permit. A new NPDES number should be assigned to this request.

____ The information received requesting a modification to the permit does not include enough information to make a determination. Please request additional information from permittee in the form of a Short Form A, B, C, or D, or Standard Form A or C. (Please circle appropriate form.)

X EPA staff will handle the request and modify the permit if necessary. Please refer to Dunke. (Optional)

____ EPA is in agreement with changing the permit. Send a copy of the request to the appropriate state agency for drafting of a new permit.

____ Send a copy of the request to the appropriate state agency to draft a new permit if the state agency determines that a change is warranted.

____ The request does not warrant a change to the permit. Please place in permit file for future reference.

Attachment(s)

Molycorp, Inc.

Questa Division
P. O. Box 469
Questa, New Mexico 87556
Telephone: (505) 586-0212

MR 2

union 76
MOLYCORP

June 29, 1984

Mr. Myron Knudson
Director, Water Management Div. (6W)
U.S. Environmental Protection Agency
Region VI
1201 Elm Street
Dallas, Texas 75270

Re: Molycorp/Questa
NPDES Permit NM0022306
Request for Modification

Dear Mr. Knudson:

The purpose of this letter is to request certain minor modifications to Molycorp's NPDES Permit for the Questa mine and milling facility. This request is being filed pursuant to 40 C.F.R. 122.63 and 40 C.F.R. 124.5. However, Region VI determines that this request must be considered under 40 C.F.R. 122.62, Molycorp consents to the consideration of this request on that basis.

The current NPDES Permit became effective on August 31, 1983. Though the permit was acceptable to Molycorp in almost all respects, there were a few points of disagreement. Consequently, Molycorp filed an Evidentiary Hearing Request on August 26, 1983. Molycorp received notice on June 11, 1984 that the Regional Administrator had denied the request, on the basis that the request did not set forth material issues of fact. Though Molycorp does not agree with the reasons for that decision, we are anxious to resolve the few remaining minor issues at the regional level without further delay. Accordingly, Molycorp is filing this request in the hope that it can be considered prior to the July 8, 1984 deadline to seek review of the Regional Administrator's June 8, 1984 denial. However, if that tight schedule cannot be met, Molycorp will make a protective filing with the Administrator.

RECEIVED
JUL 5 1984
6W-PS

The portions of the permit for which Molycorp requests modification, and the reasons therefore, are set out below.

1. Suspension of the molybdenum and manganese concentration Limitations for Outfall 002 When Outfall 001 is not Discharging O.K

Molybdenum limitations set forth in the development program of the existing permit were based on molybdenum loading to the Red River, calculated by dilution factors and irrigation use downstream. Compliance with molybdenum loading and concentration limitations is determined by a calculation based on the combined effects of Outfalls 001 and 002. This reasoning is retained in the new permit (Part 111.C.2).

Molycorp has recently completed a new ion exchange water treatment plant to remove molybdenum from water discharged through Outfall 001. The plant represents state of the art technology and is designed to remove sufficient quantities of molybdenum to comply with loading requirements and concentration limitations when calculated as stated in Part 111.C.2., when both Outfalls are discharging.

However, during normal operation, there will be times when there will be no discharge from Outfall 001. Under those circumstances, the flow weighted average reported for molybdenum would equal the total discharge from Outfall 002. This discharge will easily meet the loading limitations (25 pounds per day average), but not the limitations for concentrations (1.0 mg/l average). This situation commonly occurs during periods of construction on the tailings dams, and the result will be a situation similar to the recent mill shutdown. During such times, the seepage collected and discharged from Outfall 002 will continue, discharging less than ten pounds per day of molybdenum.

The molybdenum concentration limitations, as shown in the Stipulated Agreement on NPDES Permit NM0022306, June 16, 1977, Section IV.(2), were "based on Best Available Technology Economically Achievable as presently defined." BATEA is based on economics, and the concentration limitations are indeed economically achievable as calculated for combined Outfalls 001 and 002.

Outfall 002, when it represents the sole discharge from the operation, cannot economically meet the molybdenum concentration requirements for two reasons. First, the capital investment and operating expenses necessary to comply are not reasonable costs, and will have significant non-water quality impacts, particularly energy requirements. A description of the engineering aspects, costs and energy requirements is attached hereto as Exhibit 1.

Second, in order to treat the relatively low flows from Outfall 002 in the ion exchange treatment plant, Molycorp would be required to impound the water until sufficient quantity was collected to operate the treatment plant. Pumping costs to impound this water are included in Exhibit 1. At design flow, the treatment plant would operate approximately one hour per day to treat Outfall 002.

The treatment plant is designed for continuous flow and could practicably not be operated only one hour per day. The treatment plant operates most efficiently with continuous flow throughout a complete operating cycle before shutdown. An operating cycle is estimated to be four days at 4,000 gallons per minute, or larger periods of lesser flows down to a minimum of ±1,500 gallons per minute. Operating the plant on a short cycle could damage the ion exchange resin through osmotic shock and/or algae growth brought about by non-continuous operation. Severe osmotic shock or algae growth could destroy most of the resin, and thus render the plant inoperable to treat the significant flows from Outfall 001. Total replacement of resin would result in costs in excess of $0.5 million. The ion exchange resin is not a stock item with the manufacturer, but is made to order, requiring three to four months lead time. The end result could be a discharge of inadequately treated water if resin is destroyed more rapidly than anticipated.

In view of the environmental, engineering and economic risks associated with intermittent use of the ion exchange plant, Molycorp requests that the concentration limitations be suspended during periods of zero flow from Outfall 001. No impact on the receiving water will occur as the result of this change. The discharge from 002 does not change when 001 is not discharging. Total loadings to the Red River are much <u>lower</u> during such periods.

Manganese limits at 1.0 mg/l liter daily average a 1.5 mg/l liter daily maximum present no particular problem when 001 and 002 discharges are flow weighted. However, when only 002 is discharging, the daily average and maximum limits can be exceeded. Outfall 001 during 1984 (Outfall commenced in February) through May has averaged 0.42 mg/l liter manganese. Outfall 002 obviously picks up some manganese from the substrata since it was approximately 1.3 mg/l liter during the same period. It is requested that either the manganese limits be voided during periods when 001 is not discharging or that the daily average be brought up at least to the daily maximum limits of 1.5 mg/l liter.

2. <u>Molycorp Requests Suspension of the Arsenic Limitations Contained in Part I.A of the Permit for Two Years From the Date the Mill was Restarted (October 1985).</u>

EPA has included a discharge limitation of 0.5 mg/l daily average and 1.0 mg/l daily maximum in the permit, stating that "arsenic was present in significant levels in Outfall 001" in the analysis

submitted in the NPDES application. (See Response to Comments Issue No. 3) Molycorp notes that the analytical data submitted for arsenic was a single composite sample, as required by 40 C.F.R. 122.21 (g). Arsenic was not included as an effluent limitation in the existing permit, and Molycorp was given no indication that it would be added to the new permit. Consequently, very limited previous test work regarding arsenic has been conducted.

Since arsenic limitations were proposed in the draft permit, Molycorp began testing of the effect of the ion exchange pilot plant on arsenic solutions. There are no conclusive results from this limited test work to date. Because the mill was not operating for some time, it was impossible until recently to test the arsenic removal effect on the actual effluent. The results of monitoring performed since mill startup in October 1983 indicate arsenic levels in the effluent are 0.01 or less in both 001 and 002 Outfalls. These levels are at least an order of magnitude below the standards in the New Mexico Water Quality Control regulations for Human Health Standards (Section 3-103).

Sampling by EPA consultants conducted at two separate times, and by Molycorp consultants in 1970-72, indicates arsenic levels significantly below the levels detected in the sampling for the NPDES Permit application submitted to EPA in January 1982. On April 19, 1977, Calspan, an EPA consultant, collected monitoring samples pursuant to the Toxic Substances Control Act. Tailings pond effluent was analyzed for many constituents, including arsenic concentration, which was determined to be 0.005 mg/l. A copy of the results is attached as Exhibit 2.

In June 1970, Molycorp retained Thorne Ecological Institute to perform an environmental assessment of the Questa operation. The assessment included an extensive sampling program to define water quality aspects. Arsenic was included in the sampling program. Samples collected, which were analyzed for arsenic, showed concentrations below the detection limit of 0.02 parts per million. The arsenic concentrations were so consistently below detection limits that arsenic monitoring was dropped from the program. Excerpts from the final Thorne Report are attached as Exhibit 3.

Limited test work has been performed to date to determine the effect of the ion exchange treatment plant on arsenic. Molycorp needs additional time to define what arsenic limitations can be achieved by the plant. It is, however, reasonable to assume that the ion exchange plant will have some effect on arsenic levels which will then be below the "significant levels." As Molycorp noted in its comments on the draft permit, EPA expects arsenic contol to occur. (See 47 Fed. Reg. 54605.) Molycorp urges suspension of these limitations for two years to permit arsenic levels in the actual effluent to be adequately defined.

3. <u>Molycorp Requests Part 111.B of the Permit be Amended to Read as follows:</u> O.K. 1/ quarter for firmontoring

The term "composite sample" means a sample consisting of a minimum of two grab samples of effluents collected not less than four hours apart over a normal eight hour operating day and combined proportional to flow or a sample continuously collected proportional to flow over a normal eight hour operating day. All such samples shall be typical and representative of effluent generated during the period since the last sample was collected.

Sampling of Molycorp's effluent over the past six years pursuant to the previous permit was collected by obtaining a sample consisting of a minimum of two grab samples collected, not less than four hours apart over a normal eight hour operating day. Effluent from Outfall 001 is, in effect, a composite, since the wastewater is retained in a 50 acre-foot holding pond called Pope Lake. Retention time in the combined ponds is estimated to be at least ten days or more, sufficient time for mixing and stabilization of the water before discharge.

The definition of composite sampling (Part 11.B of the previous Permit) was carefully developed during discussions with EPA and EID regarding the conditions of that permit. It was determined that a two-part composite was an appropriate, representative sample of the effluent for two reasons. First, Outfalls 001 and 002 discharge water from impoundments with holding times of greater than 24 hours. Second, Molycorp environmental personnel work eight hours per day, five days per week and are best qualified to collect samples for compliance with the permit. Continuous samplers operate poorly in the harsh weather conditions experienced at the discharge locations, and samples must be manually composited by Environmental Department staff.

The four-part composite sample required in the new permit over a 24 hour operating day means that the sampling would be performed by the 24 hour tailings patrol. The position of tailings patrol is a union (hourly) position subject to shift rotation, bidding procedures and seniority. The weekly samples would be collected by a different group of samplers every week, depending upon the individuals on each shift. Variable sample quality could be experienced as a result. The samples, if collected by the tailings patrols, could be less representative under a four-part compositing scheme than under the previous sampling program under direct control of Molycorp environmental staff. The time of tailings patrol is best spent on surveillance of the tailings lines.

Because both Outfalls 001 and 002 discharge water from retention ponds with a retention period greater than 24 hours, and since EPA proposed that "a minimum of one grab sample will generally be sufficient to ensure a representative sample" from such impoundments

for permit application (See 47 FR 52076, November 18, 1982, EPA Proposal to Revise Consolidated Permit Regulations in Accordance with Settlement, Suspended NPDES Application Rules), the two-part composite sampling under the previous permit provides the most representative, consistent samples and should be the sampling required in the existing permit.

4. Molycorp Requests that Region VI Consider an Alternative Method for Biomonitoring, as Described Below

Section 308 of the Clean Water Act gives EPA the authority to require monitoring, including biomonitoring, as necessary, to carry out the objectives of the Clean Water Act. The objective of the Act is "to restore and maintain the chemical, physical and biological integrity of the Nation's water." (Section 101) In proposing the alternate method, Molycorp carefully considered that objective and believes that the alternate method provides a more valuable scientific tool with which to measure attainment of the goals of the Act.

In the comments on the new permit, Molycorp included a summary of biomonitoring results of a long-term comprehensive study of the Red River done by Dr. R. W. Pennak. Molycorp proposes the continuation of Dr. Pennak's research as an alternate method. Molycorp has taken the initiative, beginning in 1971, to determine the impact of its effluent on the receiving water. The study was conducted over 12 years and has included periods of inactivity of the mine and mill operations. Through Dr. Pennak's work, environmental scientists can compare the biological quality of the Red River during periods of operation and inactivity, and can compare the Red River with other mountain streams and determine not only toxicity of the effluent but its overall impact on the Red River and aquatic life.

While Molycorp understands EPA's need to develop a data base for toxic materials in effluent, we believe that the standard method proposed by EPA is a less effective means of developing a useful data base to determine the effects on the Red River of Molycorp's discharge. EPA has recognized the complexity of effluents and the synergistic effects between toxic substances in such effluents. Molycorp believes that using a simplistic biomonitoring method based on a non-indigenous organism does not (1) yield information which would be of value to EPA to determine synergistic effects of constituents, (2) apply to other operations or (3) provide insight into the toxicity of Molycorp's effluent in a reasonable context.

The proposed alternate method brings forth 12 years of collected data as a base, information regarding biological, physical and chemical data directly applicable to the quality of aquatic organisms found in the Red River. Molycorp's proposed alternate method reveals information of far more scientific value than Region VI's standardized method, which is not based on a specific receiving water. The

proposed alternate method is at least as expensive as EPA's standardized method and provides a more valuable measurement of the effect of any effluent.

5. Molycorp Requests that the pH limitations be Revised from 6.6 - 8.6 to 6.0 - 9.0 S.U. O.K.

Molycorp has requested that the State of New Mexico waive these requirements, and the State has agreed. The waiver documentation was provided to Region VI by our letter of October 31, 1983.

Thank you for your consideration of these requested modifications. We look forward to discussing them with you and your staff in the near future. Please call if you have any questions.

Sincerely,

C. R. Sacrison
General Manager

CRS/lm

EXHIBIT I

UNION P.O. BOX 469
QUESTA, NEW MEXICO 87556
MOLYCORP

INTEROFFICE CORRESPONDENCE

FROM: G. F. Eisebraun

DATE: August 22, 1983

TO: C. R. Sacrison

SUBJECT: RECYCLE PUMP SYSTEM FOR 002/003 OUTFALL — COST ESTIMATE

The following pump system provides for recycle of the ±300 GPM flow from the pipe junction of the 003/002 seeps below the Number 1 Dam to the Number 4 tailings pond area.

General:

1. Pipe route is 2000 feet with the intake at the 7280-foot elevation and the discharge at the 7530-foot elevation.

2. Pipe is six inch diameter schedule 40, of mild steel in 21-foot lengths, fitted with victaulic couplings.

3. Concrete works consists of a buried 3000-gallon collection tank, and pipe line foundations on 20-foot centers along the route.

4. Pumping operations would be controlled by automation at the pump site with all required monitoring data transmitted to the Molycorp mill control room.

5. Pump data follows:

a.	Total hydraulic head	268'
b.	PSIG at pump	116
c.	Brake horsepower required	25.5
d.	Pump horsepower at 1750 RPM	30
e.	Pump Stages	8
f.	Power to site (voltage)	230/460

g. Proposed pumps are equipped with 9LA bowls, WT1 weather enclosures, basked screens, 6-inch casing with one-inch drive line, 6 x 6 x 12 dish head, and six-inch discharge flanges rated at 125 PSI.

Project Cost Estimate:

Pumps (2 each w/one on standby)	$ 12,200
Pipe w/victaulic grooves @ $190/length	18,100
Couplings (Model 77 @ $16 each)	1,600
Earthwork (route preparation, tank excavating, etc.)	30,000
Concrete works (reinforced)	
Tank - 70 C.Y. Conc. @ $300/C.Y. installed	21,000
Pipe foundations - 100 each @ $200/each installed	20,000
230/460 V power - powerline (transformers, switch gear) 1200' @ $10/ft. installed	12,000
Instrumentation - site control/valving installed	5,000
- mill read out system (FMX-Mission)	8,000
	$127,900
Labor - pipeline and pump installation (5 man crew, 6 days @ $120/man day) (Rate 9 mechanic plus 20% fringe)	3,600
	$131,500
Design and field engineering @ 10% of Cost	13,200
	$144,700
Contingency @ 10%	14,500
ESTIMATED PROJECT COST	$159,200

Operating Cost:

Power - Electrical	$ 10,000
Maintenance, etc.	$ 10,000
ANNUAL COST	$ 20,000

xc: T. R. Thomas - Legal Dept.

EXHIBIT II

Calspan

17 October 1977

Ms. Obbey Davidson
Environmental Engineer
Molycorp
Questa, NM 87556

Dear Ms. Davidson:

Results of chemical analyses of water samples that we collected last spring on behalf of EPA at your facilities have recently become available. In accordance with previous agreements, EPA has authorized us to transmit the analytical results to you, with the proviso that they are to be treated as preliminary data. This is particularly important in those cases where some analyses (e.g., for asbestos) are to be repeated.

The enclosed copies of the analytical results are accompanied by one table showing the laboratory that performed the analysis and by another that lists the lowest detectable quantity of those constituents for which this number can be stated. When a target constituent is listed as "not detectable" in the record for your facility, its concentration was found to be less than the detection limit.

Thank you again for your cooperation and hospitality during this survey program. If you should have questions regarding this material, please contact me.

Very truly yours,

D.H. Bock

D.H. Bock

DHB:eb-32
Enclosure

SUMMARY DATA SHEET

Operation: Molycorp of America, Questa, New Mexico Date Visited: April 18-19, 1977

Sample-Site Description: Influent to tails pond

Calspan Sample No. W58-XI-FA-01A MC EPA Sample No. T002039 (17380)

Remarks: 24-hour composite

SUBSTANCE	CONCENTRATION	SUBSTANCE	CONCENTRATION
pH	7.40	1,3-dichlorobenzene	
total suspended solids	349,000	1,4-dichlorobenzene	
volatile suspended solids	41800	3,3'-dichlorobenzidine	
COD	1180	1,1-dichloroethylene	
TOC	19	1,2-trans-dichloroethylene	
radium 226 (total)	------	2,4-dichlorophenol	
radium 226 (dissolved)	------	1,2-dichloropropane	
antimony (total)	<100 µg/L	1,3-dichloropropylene (1,3-dichloropropene)	
arsenic (total)	10 µg/L		
beryllium (total)	130 µg/L	2,4-dimethylphenol	
cadmium (total)	13 µg/L	2,4-dinitrotoluene	
chromium (total)	8300 µg/L	2,6-dinitrotoluene	
copper (total)	10000 µg/L	1,2-diphenylhydrazine	
lead (total)	11000 µg/L	ethylbenzene	
mercury (total)	<0.5 µg/L	fluroanthene	
nickel (total)	3500 µg/L	4-chlorophenyl phenyl ether	
selenium (total)	40 µg/L	4-bromophenyl phenyl ether	
silver (total)	<250 µg/L	bis (2-chloroisopropyl) ether	
thallium (total)	<100 µg/L	bis (2-chloroethoxy) methane	
zinc (total)	13000 µg/L	methylene chloride (dichloromethane)	
asbestos (fibrous)		methyl chloride (chloromethane)	
cyanide (total)	<0.02	methyl bromide (bromomethane)	
phenol (total)	0.02	bromoform (tribromomethane)	
aldrin	NOT DETECTED	dichlorobromomethane	
dieldrin		trichlorofluoromethane	
chlordane (technical mixture and metabolites)		dichlorodifluororomethane	
		chlorodibromomethane	
4,4'-DDT		hexachlorobutadiene	
4,4'-DDE (p,p'-DDX)		hexachlorocyclopentadiene	
4,4'-DDD (p,p'-TDE)		isophorone	
α-endosulfan		naphthalene	
β-endosulfan		nitrobenzene	
endosulfan sulfate		2-nitrophenol	
endrin		4-nitrophenol	

FA - 01A MC

4,4'-DDT	NOT DETECTED		hexachlorobutadiene		
4,4'-DDE (p,p'-DDX)			hexachlorocyclopentadiene		
4,4'-DDD (p,p'-TDE)			isophorone		
α-endosulfan			napthalene		
β-endosulfan			nitrobenzene		
endosulfan sulfate			2-nitrophenol		
endrin			4-nitrophenol		
endrin aldehyde			2,4-dinitrophenol		
heptachlor			4,6-dinitro-o-cresol		
heptachlor epoxide			N-nitrosodimethylamine		
α-BHC			N-nitrosodiphenylamine		
β-BHC			N-nitrosodi-n-propylamine		
γ-BHC (lindane)			pentachlorophenol		
δ-BHC			phenol	Y	
PCB-1242 (Arochlor 1242)			bis (2-ethylhexyl) phthalate	100 µg/L	
PCB-1254 (Arochlor 1254)			butyl benzyl phthalate	not detected	believed to be
acenaphthene	not detected		di-n-butyl phthalate	15 µg/L	sampling
acrolein			diethyl phthalate	not detected	contamination
acrylonitrile			dimenthyl phthalate		
benzene			1,2-benzanthracene		
benzidine			benzo (a) pyrene (3,4-benzopyrene)		
carbon tetrachloride (tetrachloromethane)			3,4-benzofluoranthene		
			11,12-benzofluoranthene		
chlorobenzene			chrysene		
1,2,4-trichlorobenzene			acenaphthylene		
hexachlorobenzene			anthracene		
1,2-dichloroethane			1,12-benzoperylene		
1,1,1-trichloroethane			fluorene		
hexachloroethane			phenanthrene		
1,1-dichloroethane			1,2:5,6-dibenzanthracene		
1,1,2-trichloroethane			indeno (1,2,3-C,D) pyrene		
1,1,2,2-tetrachloroethane			pyrene		
chloroethane			2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD)		
bis (chloromethyl) ether					
bis (chloroethyl) ether			tetrachloroethylene		
2-chloroethyl vinyl ether (mixed)			toluene		
2-chloronaphthalene			trichloroethylene		
2,4,6-trichlorophenol			vinyl chloride	Y	
parachlorometa cresol			toxaphene		
chloroform (trichloromethane)					
2-chlorophenol					

SUMMARY DATA SHEET

Operation: Molycorp of America, Questa, New Mexico Date Visited: April 18-19, 1977

Sample-Site Description: Effluent from tails pond

Calspan Sample No. W58 - X1 - EA - 028 MC EPA Sample No. T002031 (17381)

Remarks: 24 - hour composite

SUBSTANCE	CONCENTRATION	SUBSTANCE	CONCENTRATION
pH	6.95	1,3-dichlorobenzene	not detected
total suspended solids	68	1,4-dichlorobenzene	
volatile suspended solids	4	3,3'-dichlorobenzidine	
COD	20	1,1-dichloroethylene	
TOC	7	1,2-trans-dichloroethylene	
radium 226 (total)	—	2,4-dichlorophenol	
radium 226 (dissolved)	—	1,2-dichloropropane	
antimony (total)	70 µg/L	1,3-dichloropropylene (1,3-dichloropropene)	
arsenic (total)	5 µg/L		
beryllium (total)	<20 µg/L	2,4-dimethylphenol	
cadmium (total)	<5 µg/L	2,4-dinitrotoluene	
chromium (total)	20 µg/L	2,6-dinitrotoluene	
copper (total)	270 µg/L	1,2-diphenylhydrazine	
lead (total)	<20 µg/L	ethylbenzene	
mercury (total)	<0.5 µg/L	fluroanthene	
nickel (total)	1400 µg/L	4-chlorophenyl phenyl ether	
selenium (total)	<5 µg/L	4-bromophenyl phenyl ether	
silver (total)	<250 µg/L	bis (2-chloroisopropyl) ether	
thallium (total)	<100 µg/L	bis (2-chloroethoxy) methane	
zinc (total)	5900 µg/L	methylene chloride (dichloromethane)	
asbestos (fibrous) total/chrysotile	$3.3 \cdot 10^{10}$/$2.0 \cdot 10^{9}$ fibers/liter	methyl chloride (chloromethane)	
cyanide (total)	<0.02	methyl bromide (bromomethane)	
phenol (total)	0.01	bromoform (tribromomethane)	
aldrin	NOT DETECTED	dichlorobromomethane	
dieldrin		trichlorofluoromethane	
chlordane (technical mixture and metabolites)		dichlorodifluoromethane	
		chlorodibromomethane	
4,4'-DDT		hexachlorobutadiene	
4,4'-DDE (p,p'-DDX)		hexachlorocyclopentadiene	
4,4'-DDD (p,p'-TDE)		isophorone	
α-endosulfan		napthalene	
β-endosulfan		nitrobenzene	
endosulfan sulfate		2-nitrophenol	
endrin		4-nitrophenol	

FA - 025 MC

technical mixture and metabolites)	not detected			
4,4'-DDT			hexachlorobutadiene	
4,4'-DDE (p,p'-DDX)			hexachlorocyclopentadiene	
4,4'-DDD (p,p'-TDE)			isophorone	
α-endosulfan			napthalene	
β-endosulfan			nitrobenzene	
endosulfan sulfate			2-nitrophenol	
endrin			4-nitrophenol	
endrin aldehyde			2,4-dinitrophenol	
heptachlor			4,6-dinitro-o-cresol	
heptachlor epoxide			N-nitrosodimethylamine	
α-BHC			N-nitrosodiphenylamine	
β-BHC			N-nitrosodi-n-propylamine	
γ-BHC (lindane)			pentachlorophenol	
δ-BHC			phenol	
PCB-1242 (Arochlor 1242)			bis (2-ethylhexyl) phthalate	
PCB-1254 (Arochlor 1254)			butyl benzyl phthalate	
acenaphthene	not detected		di-n-butyl phthalate	15 µg/l - from sample
acrolein			diethyl phthalate	not detected
acrylonitrile			dimenthyl phthalate	
benzene			1,2-benzanthracene	
benzidine			benzo (a) pyrene (3,4-benzopyrene)	
carbon tetrachloride (tetrachloromethane)			3,4-benzofluorathene	
			11,12-benzofluoranthene	
chlorobenzene			chrysene	
1,2,4-trichlorobenzene			acenaphthylene	
hexachlorobenzene			anthracene	
1,2-dichloroethane			1,12-benzoperylene	
1,1,1-trichloroethane			fluorene	
hexachloroethane			phenanthrene	
1,1-dichloroethane			1,2:5,6-dibenzanthracene	
1,1,2-trichloroethane			indeno (1,2,3-C,D) pyrene	
1,1,2,2-tetrachloroethane			pyrene	
chloroethane			2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD)	
bis (chloromethyl) ether				
bis (chloroethyl) ether			tetrachloroethylene	
2-chloroethyl vinyl ether (mixed)			toluene	
2-chloronaphthalene			trichloroethylene	
2,4,6-trichlorophenol			vinyl chloride	
parachlorometa cresol			toxaphene	
chloroform (trichloromethane)				
2-chlorophenol				

LOE Task XL

SUMMARY DATA SHEET

Operation: _____ Date Visited: _____

Sample-Site Description: Chemical Laboratory Listing for Analytical Work Performed

Calspan Sample No. _____ EPA Sample No. _____

Remarks: _____

SUBSTANCE	CONCENTRATION	SUBSTANCE	CONCENTRATION
pH	Calspan	1,3-dichlorobenzene	Gulf South Research Instit.
total suspended solids		1,4-dichlorobenzene	
volatile suspended solids		3,3'-dichlorobenzidine	
COD		1,1-dichloroethylene	
TOC		1,2-trans-dichloroethylene	
radium 226 (total)	Teledyne Isotopes	2,4-dichlorophenol	
radium 226 (dissolved)		1,2-dichloropropane	
antimony (total)	Calspan	1,3-dichloropropylene (1,3-dichloropropene)	
arsenic (total)			
beryllium (total)	EPA	2,4-dimethylphenol	
cadmium (total)	Calspan	2,4-dinitrotoluene	
chromium (total)		2,6-dinitrotoluene	
copper (total)		1,2-diphenylhydrazine	
lead (total)		ethylbenzene	
mercury (total)		fluroanthene	
nickel (total)		4-chlorophenyl phenyl ether	
selenium (total)		4-bromophenyl phenyl ether	
silver (total)		bis (2-chloroisopropyl) ether	
thallium (total)		bis (2-chloroethoxy) methane	
zinc (total)		methylene chloride (dichloromethane)	
asbestos (fibrous)		methyl chloride (chloromethane)	
cyanide (total)		methyl bromide (bromomethane)	
phenol (total)		bromoform (tribromomethane)	
aldrin		dichlorobromomethane	
dieldrin		trichlorofluoromethane	
chlordane (technical mixtures and metabolites)		dichlorodifluororomethane	
		chlorodibromomethane	
4,4'-DDT		hexachlorobutadiene	
4,4'-DDE (p,p'-DDX)		hexachlorocyclopentadiene	
4,4'-DDD (p,p'-TDE)		isophorone	
α-endosulfan		napthalene	
β-endosulfan		nitrobenzene	
endosulfan sulfate		2-nitrophenol	
endrin		4-nitrophenol	

4,4'-DDT			hexachlorobutadiene		
4,4'-DDE (p,p'-DDX)			hexachlorocyclopentadiene		
4.4'-DDD (p,p'-TDE)			isophorone		
α-endosulfan			napthalene		
β-endosulfan			nitrobenzene		
endosulfan sulfate			2-nitrophenol		
endrin			4-nitrophenol		
endrin aldehyde			2,4-dinitrophenol		
heptachlor			4,6-dinitro-o-cresol		
heptachlor epoxide			N-nitrosodimethylamine		
α-BHC			N-nitrosodiphenylamine		
β-BHC			N-nitrosodi-n-propylamine		
γ-BHC (lindane)			pentachlorophenol		
δ-BHC			phenol		
PCB-1242 (Arochlor 1242)			bis (2-ethylhexyl) phthalate		
PCB-1254 (Arochlor 1254)			butyl benzyl phthalate		
acenaphthene	Gulf South Research Inst.		di-n-butyl phthalate		
acrolein			diethyl phthalate		
acrylonitrile			dimenthyl phthalate		
benzene			1,2-benzanthracene		
benzidine			benzo (a) pyrene (3,4-benzopyrene)		
carbon tetrachloride (tetrachloromethane)			3,4- benzofluorathene		
			11,12-benzofluoranthene		
chlorobenzene			chrysene		
1,2,4-trichlorobenzene			acenaphthylene		
hexachlorobenzene			anthracene		
1,2-dichloroethane			1,12-benzoperylene		
1,1,1-trichloroethane			fluorene		
hexachloroethane			phenanthrene		
1,1-dichloroethane			1,2:5,6-dibenzanthracene		
1,1,2-trichloroethane			indeno (1,2,3-C,D) pyrene		
1,1,2,2-tetrachloroethane			pyrene		
chloroethane			2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD)		
bis (chloromethyl) ether					
bis (chloroethyl) ether			tetrachloroethylene		
2-chloroethyl vinyl ether (mixed)			toluene		
2-chloronaphthalene			trichloroethylene		
2,4,6-trichlorophenol			vinyl chloride		
parachlorometa cresol			toxaphene		
chloroform (trichloromethane)					
2-chlorophenol					

LOE Task XI

SUMMARY DATA SHEET

Operation:

Sample-Site Description:

Available Limits of Detection

Calspan Sample No.

EPA Sample No.

Remarks:

SUBSTANCE	CONCENTRATION	SUBSTANCE	CONCENTRATION
pH		1,3-dichlorobenzene	
total suspended solids	1 mg/L	1,4-dichlorobenzene	
volatile suspended solids	10 mg/L	3,3'-dichlorobenzidine	
COD	2 mg/L	1,1-dichloroethylene	0.50
TOC	1 mg/L	1,2-trans-dichloroethylene	0.35
radium 226 (total)	2 pCi/L	2,4-dichlorophenol	
radium 226 (dissolved)	2 pCi/L	1,2-dichloropropane	0.02
antimony (total)		1,3-dichloropropylene (1,3-dichloropropene)	0.35
arsenic (total)		2,4-dimethylphenol	0.40
beryllium (total)		2,4-dinitrotoluene	0.20
cadmium (total)		2,6-dinitrotoluene	0.75
chromium (total)		1,2-diphenylhydrazine	0.20
copper (total)		ethylbenzene	0.10
lead (total)		fluroanthene	0.20
mercury (total)		4-chlorophenyl phenyl ether	0.06
nickel (total)		4-bromophenyl phenyl ether	
selenium (total)		bis (2-chloroisopropyl) ether	
silver (total)		bis (2-chloroethoxy) methane	
thallium (total)		methylene chloride (dichloromethane)	0.08
zinc (total)		methyl chloride (chloromethane)	0.35
asbestos (fibrous)		methyl bromide (bromomethane)	0.08
cyanide (total)	0.02 mg/L	bromoform (tribromomethane)	0.40
phenol (total)	0.002 mg/L	dichlorobromomethane	0.05
aldrin	0.1 µg/L	trichlorofluoromethane	
dieldrin	0.5 µg/L	dichlorodifluororomethane	
chlordane (technical mixture and metabolites)	1 µg/L	chlorodibromomethane	
4,4'-DDT	1 µg/L	hexachlorobutadiene	0.08
4,4'-DDE (p,p'-DDX)	1 µg/L	hexachlorocyclopentadiene	
4,4'-DDD (p,p'-TDE)	1 µg/L	isophorone	
α-endosulfan	1 µg/L	napthalene	0.15
β-endosulfan	1 µg/L	nitrobenzene	0.85
endosulfan sulfate	1 µg/L	2-nitrophenol	
endrin	0.5 µg/L	4-nitrophenol	

4,4'-DDT	1 ug/L		hexachlorobutadiene	0.08
4,4'-DDE (p,p'-DDX)	1 ug/L		hexachlorocyclopentadiene	
4,4'-DDD (p,p'-TDE)	1 ug/L		isophorone	
α-endosulfan	1 ug/L		napthalene	0.15
β-endosulfan	1 ug/L		nitrobenzene	0.85
endosulfan sulfate	1 ug/L		2-nitrophenol	
endrin	0.5 ug/L		4-nitrophenol	
endrin aldehyde	0.5 ug/L		2,4-dinitrophenol	
heptachlor	0.1 ug/L		4,6-dinitro-o-cresol	
heptachlor epoxide	0.1 ug/L		N-nitrosodimethylamine	
α-BHC	0.1 ug/L		N-nitrosodiphenylamine	
β-BHC	0.1 ug/L		N-nitrosodi-n-propylamine	
γ-BHC (lindane)	0.1 ug/L		pentachlorophenol	ug/L
δ-BHC	0.1 ug/L		phenol	
PCB-1242 (Arochlor 1242)	1 ug/L		bis (2-ethylhexyl) phthalate	0.20
PCB-1254 (Arochlor 1254)	1 ug/L		butyl benzyl phthalate	0.25
acenaphthene	0.03		di-n-butyl phthalate	
acrolein			diethyl phthalate	0.20
acrylonitrile			dimenthyl phthalate	0.35
benzene	0.04		1,2-benzanthracene	0.05
benzidine			benzo (a) pyrene (3,4-benzopyrene)	
carbon tetrachloride (tetrachloromethane)	0.35		3,4-benzofluorathene	
			11,12-benzofluoranthene	
chlorobenzene	0.15		chrysene	0.20
1,2,4-trichlorobenzene			acenaphthylene	
hexachlorobenzene		ug/L	anthracene	0.05
1,2-dichloroethane	0.08		1,12-benzoperylene	
1,1,1-trichloroethane	0.15		fluorene	0.10
hexachloroethane			phenanthrene	
1,1-dichloroethane	0.15		1,2:5,6-dibenzanthracene	
1,1,2-trichloroethane	0.10		indeno (1,2,3-C,D) pyrene	
1,1,2,2-tetrachloroethane	0.90		pyrene	0.40
chloroethane			2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD)	
bis (chloromethyl) ether				
bis (chloroethyl) ether			tetrachloroethylene	1.10
2-chloroethyl vinyl ether (mixed)			toluene	0.35
2-chloronaphthalene			trichloroethylene	0.35
2,4,6-trichlorophenol			vinyl chloride	
parachlorometa cresol			toxaphene	
chloroform (trichloromethane)	0.05			
2-chlorophenol	1.00			

OLOGICAL
STITUTE
1400 Broadway
BOULDER, COLORADO 80302 (303) 443-[illegible]

EXHIBIT III

7325

FINAL REPORT ON ECOLOGICAL RESEARCH AND REHABILITATION

DONE FOR

THE MOLYBDENUM CORPORATION OF AMERICA

1970 - 1972

October 1972

STAFF
[illegible]
DIRECTORS
DR. BARLEIGH THOMPSON, II
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I. INTRODUCTION

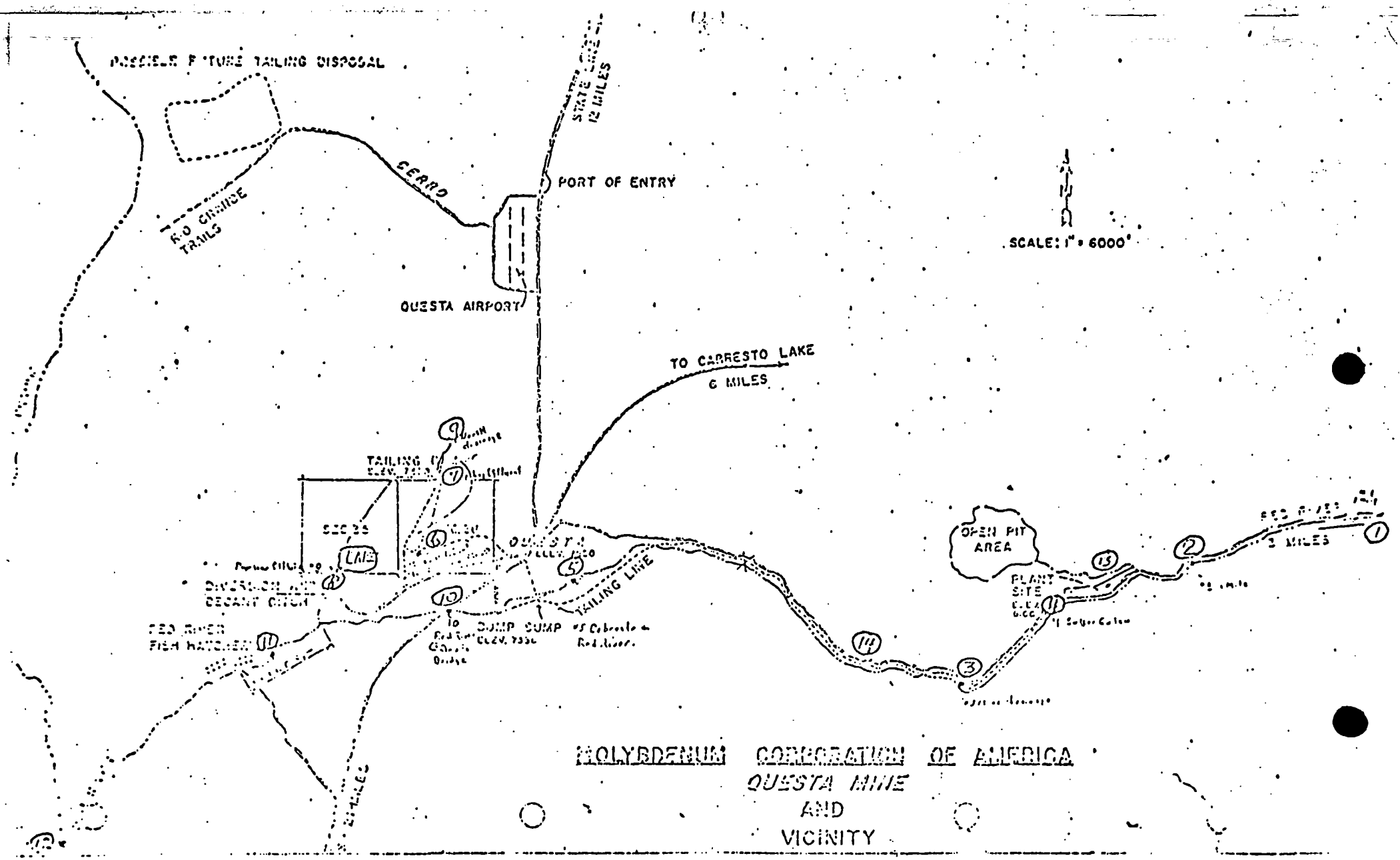
A. Background: In June of 1970, the Thorne Ecological Institute (TEI) was invited to send a professional ecologist to the Questa mine of the Molybdenum Corporation of America to make an assessment of the kinds of environmental problems that the mine was occasioning. In July Dr. Beatrice E. Willard, staff ecologist, visited the site and examined it thoroughly in the company of Mr. Colin Campbell, General Manager, and several of his associates. At that time, she was authorized to draw up a study plan for the company. August through October, three investigators were authorized to make reconnaissance of the area and draw up study proposals submitted to TEI. These were Dr. Wallace M. Johnson, plant ecologist of Ft. Collins, Dr. Robert W. Pannak, fresh water biologist of the University of Colorado, Boulder, and Dr. Cooper H. Wayman, water quality expert of G. W. Squared, Inc. in Golden. These men completed their work by November.

Dr. Willard took their plans and amalgamated them into a composite TEI proposal which she submitted to the company in early December, 1970. This proposal for ecological research and rehabilitation was reviewed by the company and approved in substance in April, 1971, when Thorne Ecological Institute was authorized to implement the proposed program. Implementation was done in two parts. The first part started in May, 1971 and went through October of 1971, after which an interim report would be submitted to the Company for its review and decision about how much of the second part was to be done. This interim report was submitted in late fall of 1971, and recommended some changes in the second phase. It was carried on during the spring and summer of 1972. The present report is a review of all data gathered during this 14-month period of research and rehabilitation activity at the Questa mine.

B. Approach: It is the policy of the Thorne Ecological Institute to make an initial reconnaissance of any environmental situation, then to select the very best possible investigators with special expertise in solving the types of problems found. This was done at the Questa site by selecting the above three-named men who have special expertise in the particular problems that were presented by the Questa mine. Secondly, TEI seeks to discover and use the ecological concepts and practices necessary for maintaining or recovering a high quality of environmental health in whatever situation it is requested to take part. Under no condition does the Thorne Ecological Institute solicit research. Its Guidelines and Criteria for accepting Applied Ecology projects are appended to this report.

II. METHODS

The selection of specific methods was left entirely to the investigators retained. In the case of the vegetation, Dr. Willard as a plant ecologist, had considerable input with Dr. Johnson on the methods and materials used in revegetating certain sites. The specific methods are described individually by the investigators in their particular sections of the report. It is important to recognize that standard scientific methods have been used in all cases. A characteristic of this method is to gather data, to analyze them, and to interpret them in an objective, scientific manner. In this way, it is hoped that environmental problems can be solved by use of ecological principles substantiated by facts gathered in the field, thus eliminating the emotional component so frequently connected to environmental problems today.


POSSIBLE FUTURE TAILING DISPOSAL
RIO GRANDE TRAILS
GERRO
STATE LINE 12 MILES
PORT OF ENTRY
QUESTA AIRPORT
SCALE: 1" = 6000'
TO CARRESTO LAKE
6 MILES
TAILING LINE
DIVERSION AND DECANT DITCH
RED RIVER FISH HATCHERY
DUMP
SUMP
OPEN PIT AREA
PLANT SITE
RED RIVER
3 MILES
MOLYBDENUM CORPORATION OF AMERICA
QUESTA MINE
AND
VICINITY

Spring 1972: All of the areas seeded to grass in August, 1971 were examined for general appearance in the spring. The seeding on the flood control dam looked very good at this time. The plants were robust and vigorous and approximately 4 inches tall. The stand was still spotty as was observed last fall. With the extreme droughty situation that existed, it may not fill in. The plants present now should be able to stand considerable drought, but moisture is needed for full establishment and development.

The seeding on the Sugar Shack berm is very good at the present time. The plants were robust, vigorous and about 3 inches tall. The stand is spotty as observed last fall. The seeding establishment was so good in places on the berm that it actually shows up green. It should be noted that quite a bit of grazing by deer has already taken place on the plants on the berm. Again, moisture is needed badly.

The seeding on the old mine dump is a failure as was anticipated. Only a very few weak, spindly seedlings were found and these mostly in areas where large quantities of mulch had accumulated. The disturbance of digging the tree holes and refilling them destroyed some of the seedlings that were present. However, there should be enough seed of grasses and other plants in soil hauled in that spots of quite luxuriant vegetation will develop. This may be all that is needed.

B. Water Quality: Within the time span of May, 1971 through July, 1972, the G. W. Squared Corporation of Golden, Colorado was retained as a water quality investigator by Thorne Ecological Institute of Boulder, Colorado, to assess water quality in the Red River and Rio Grande River near Questa, New Mexico.

The study consisted of a 17 mile stretch of the Red River approximately 3 miles east of the Moly Corp plant site to a point of confluence between the Red River and Rio Grande River. Sampling was also performed on the tailing pond and adjacent points of the Moly Corp settling pond area.

Sampling points were selected on a basis to represent possible background concentration best above the plant site (run-off before the mill site) and to represent points representative of run-off at sources contiguous to the mine property.

The attached map represents and identifies sampling points utilized in the report. Two ground water well samples (13, 14) were periodically taken to supply information with respect to effects of possible leaching of upper formations into ground water. The sample points on the map are identified as follows:

#1 Three miles above plant site

#2 One mile above plant site

#3 Mine drainage

#4 Sulphur Gulch

#5 Confluence of Cabresto Creek and Red River

#6 Influent to tailing pond

#7 Effluent from tailing pond

#8 Pope Lake (represents the Moly Corp discharge to Red River)

#9 North drainage

#10 Red River at Questa Bridge

#11 Fish Hatchery on Red River

#12 Confluence of Red River and Rio Grande River

#13 Moly Corp plant site well

#14 Columbine well near Cottonwood

1. Background

To the time of investigation only meager data are available on water quality aspects of the Red River. The Federal Water Pollution Control Administration (now EPA) carried out chemical, bacteriological and biological studies in November, 1965 (FWPCA, 1966). This study was continued in terms of additional biological studies on the Rio Grande and Red Rivers in October, 1966 in that portion of the river immediately above and below the mouth of the Red River (FWPCA, 1966). The most detailed report completed by a government agency consists of a water quality study during November, 1970 at seven stations along the Red River and at selected points to assess metals content in mine tailings (EPA, 1971).

The most detailed study with respect to water quality on the Red River is this report. This report describes a number of stations both above and below the plant site and reflects a reasonable approach to evaluate water quality on the Red River over nearly a continuous one-year span through sampling on a monthly basis. It is significant to point out that the data obtained in EPA, 1971 comprises a variety of sampling schemes, e.g. sampling at 2-hour intervals, and 8-hour and 24-hour sample composites. It is significant to note the similarity in results between the EPA investigation data obtained by grab samples * and data in this report which are based upon a systematic sampling program. The point of identification signifies that grab samples, if properly obtained, are equivalent to longer term composite samples. The latter are not always practical or economical on detailed water quality studies.

2. Characteristics of drainage area

An excellent and concise description of the drainage system of the Red River is found in the EPA Report. Because this description is apropos of this report, it is satisfactory to utilize it as a direct quote as follows (EPA 1971, p.5-6):

*grab sample: a totally haphazard sampling method with no schedule for sampling station defined.

"The drainage area of the Red River is mountaineous and ranges in elevation from 13,151 feet at Wheeler Peak to 6,500 at the confluence with the Rio Grande. Most of the area is forested except for that part above timberline and the area on both sides of State Highway 3 north of the river. Part of the area on each side of Highway 3 is irrigated for crops and pasture. The forested (sic) and rocky nature of most of the drainage basin produces fine material which contributes to the silt load of the stream. Landslides or construction activities may, however, contribute large quantities of silt from small areas.

The runoff from rainfall and snowmelt flows into the Red River via several small creeks with steep gradients. The distribution of summer rainfall and the slow melting of winter snows tend to prevent extremes of high or low flows in the river. The numerous springs and seeps tend to support a stable base flow throughout the year.

Total drainage area for the Red River is 190 square miles. Cabresto Creek, a major tributary to the Red River, has a drainage area of 36.3 square miles. The area is subject to a severe winter climate. Average mean rainfall is 21.22 inches (town of Red River). The average mean temperatures for the area is 39. 6° F (4° C). Elevation of the river bed varies from 8,600 feet (above town of Red River) to 7,100 feet near the Fish Hatchery."

3. Methods of chemical analysis

Either method 1 or method 2 (see Appendix 1) was employed for elemental analysis. A brief description of each method is given in the Appendix. The Appendix also states whether or not a different method from that of methods 1 or 2 was employed. Because the cyanide method employed may be deemed significant to future analysis, it is also given in Appendix 1.

A total of 80 samples were taken to a residue and studied by semi-quantitative analysis using the technique of emission spectrometry.

Temperature and dissolved oxygen (D.O.) were measured with the aid of a Yellow Springs Instrument D.O. meter. The in situ pH was determined with an Orion type specific ion electrode meter using a combination Ag-Ag Cl electrode system. Flow discharge measurements were made with a U.S.G.S. type flow-meter employing gear-agitations and amplified sound phones.

When the study was commenced in June, 1971, the following determinations were made on each sample:

suspended solids	chloride
hardness	cyanide
sulphate	chromium
nitrate	copper
phosphate	iron
barium	mercury
silver	maganese
arsenic	molybdenum
boron	nickel
coliform bacteria	lead
gross beta activity	cadmium
emission spec on residues	selenium
pH, D.O., temperature, flow discharge	zinc

However, after January, 1972 analyses were completed, it was concluded that a predictable trend was attained for certain determinations. Commencing with the February, 1972 sampling no analyses were made on barium, silver, arsenic, boron, cadmium, mercury, nickel, lead, chromium, gross beta activity or emission spectrographic analyses.

4. Water quality standards

With respect to effluent quality, New Mexico Regulation 4A (March 4, 1968) specifies that for a single sample the following limitations are imposed:

(1) Settleable Solids -- less than 1.0 ml/l
(2) Fecal Coliforms -- less than 500 per 100 ml
(3) pH -- between 6.6 and 8.6

In this study suspended solids and non-settleable solids were measured. The distinction should be made that settleable solids are measured on a volume/volume basis and suspended solids are based upon a mass/volume basis. Though the parameters are similar, they are not identical as a result of density differences, but corrections can be made when one knows the density of solids.

The other and most important regulation is New Mexico Number 6 (August, 1971), which states that a single sample must conform to the following:

As	0.05 mg/l or less
Ba	1.0 mg/l or less
B	0.75 mg/l or less
Cd	0.01 mg/l or less
Cr (total)	0.01 mg/l or less
Cu	0.05 mg/l or less
Pb	0.05 mg/l or less
Mn	0.1 mg/l or less
Hg	0.001 mg/l or less
Mo	0.01 mg/l or less
Ni	0.1 mg/l or less
Se	0.01 mg/l or less
Ag	0.05 mg/l or less
Zn	0.1 mg/l or less

Wayman would like to make one comment on these regulations. If the intent is to protect water quality and abate pollution, then why should community sewerage systems be given a license to exceed the copper concentration and zinc concentration by factors of 2 and 5, respectively, to wit:

> "provided that effluents from a community sewerage system may contain 0.1 mg/l copper and 0.5 mg/l zinc."

A very inte..ive and extensive report was prepared by Wayman in May, 1971 to evaluate criteria significant to New Mexico's Regulation No. 6. This report highlighted some of the inconsistencies and shortcomings in the type of criteria employed to establish standards in Regulation 6 in addition to providing background material on why a "single sample for regulatory purposes" should be criticized (Wayman, 1971).

Stream standards to be distinguished from effluent standards require that dissolved oxygen levels not be less than 6 mg/l for trout waters nor less than 5 mg/l for warm water fisheries. If the Red River constitutes a cold water fishery, then the stream standard would be 70° F. (21° C).

5. Results and discussion

Twelve sample points were selected to provide data on background (concentrations of elements) in the Red River above the Moly Corp plant and mine, to provide data on how the mine operation may exceed background concentrations, to provide information on concentrations of elements at various locations in the settling pond area, and to determine if the element concentration in the Rio Grande is substantially different from those in the Red River.

The sample points will be discussed in pairs or in combinations because of similar predictable behavior of these points or because of the manner in which the study was designed.

a) Sample Points 1,2

These two samples were selected to provide background information on the Red River above the Moly Corp plant and mine. The samples were approximately one and three miles above the plant site and should reflect natural concentrations of elements in the Red River without influence from a mechanical or man-made influences upon the river. In essence, these samples should indicate what happens as a result of the combination of stream run-off, baseflow (seepage on ground water), and from upstream leaching as distinguished from concentrations reaching the river from either mining and/or other activities prior to entrance onto the Moly Corp property and the Rio Grande.

Certain parameters analyzed were not plotted because these remained essentially constant throughout the sampling period and also because these elements were always below the heavy metal standards set by New Mexico Regulation Number 6. The actual concentrations of the various metals measured for these two points and all others were less than: (see page 17 for comparison with New Mexico standard)

Element	Concentration (ppm)
Ba	1.0
Ag	0.005
As	0.02
B	0.5
Cd	0.002
Hg	0.0001
Ni	0.005
Pb	0.005
Cr	0.01

The temperature range over the one year period ranged from 0° C in November, 1971 to 16° C in July, 1971. (see pertinent figures 1, 2). The EPA figure (large triangle) is about 2° C which is in reasonably good agreement with our data. These temperature data show about what the temperature range for a mountain stream is like over a period of a year. The data indicate further that the Red River above the Moly Corp plant is below stream standards for cold water fisheries.

The pH ranged from about 7.5 to a high of 8.4. It is significant to point out that this stream is somewhat on the basic side which is not uncommon for streams in this area. The high figure (8.4), also indicates that background nearly exceeds the standard imposed for effluent quality. The value of EPA of 7.3 for November, 1970 is substantially below our figures.. Our study employed very elegant instrumentation to eliminate streaming potentials and measurements were done in such a manner to reflect equilibrium readings. If the EPA measurements were not done in a similar manner, the values in their report may not represent equilibrium, which might explain the differences.

The D.O. measurements ranged from a low of 6 ppm to 11 ppm. The EPA value for November, 1970 was 12.1 which is in good agreement with our November, 1971 value of 10.8 ppm. The value of 6 ppm in April, 1972 is just about equivalent to the allowable stream standard for trout.

Coliform bacteria ranged from zero per 100 ml to a high of about 300 per 100 ml in October, 1971. The EPA value of 50 per 100 ml (November, 1970) is well in agreement with our values. Red River is currently below the value of 500 per 100 ml for effluent standards, but at least one measurement reflects a value that exceeds the stream standard of 200 per 100 ml for water used for body contact sports.

Suspended solids ranged from 0 to about 10 ppm. The data shown for these sample points indicates the value of 1 ml/l of settleable solids for effluent standards was exceeded for a significant portion of the sampling period.

One important thing should be indicated at this point. Samples were taken during high storm run-off above the plant on Red River and at the Ranger Station on Red River on September 30, 1971. The total solids contents of these samples were 6400 ppm and 7500 ppm, respectively. This indicates that uncontrollable natural conditions can temporarily cause problems on a stream which must be taken into consideration by regulatory agencies. A very significant and concommitant effect occurs during high run-off. Certain heavy metals concentrations also tend to increase. In this particular instance concentrations for cadmium, copper, magnanese, molybdenum (plant sample) and zinc would all have exceeded the heavy metal effluent standards indicating how background can easily fluctuate on a stream, due to natural conditions alone, and may cause serious and misleading consequences if a single sample were taken for regulatory purposes (see data Appendix 2).

The data for sulphate, phosphate, and nitrate are about what would be predictable as background for a mountain stream. The value for cyanide is also below the drinking water standard of 0.02 ppm. New Mexico has no stream or effluent standard for cyanide at the present time. The EPA data for suspended solids, sulphate, and nitrate was very similar to the data reported herein.

With respect to copper, the data indicate that the background value for copper does not presently exceed the effluent standard except during period of high run-off.

Iron was originally proposed at 0.3 ppm for Regulation 6, but never became part of that regulation. The background iron for this stream exceeds a value of 0.1 ppm for substantial amounts of time. The one reported EPA value for November, 1970 was greater than 0.1 ppm.

The regulation sets manganese at a value of 0.1 ppm. It is important to indicate that 7 of our samples were about equivalent or exceeded this standard. In addition, the value was significantly exceeded during high run-off.

The value for zinc ranged from about 0.02 to 0.1 ppm (one sample). Most of the time the stream was below the effluent standard set for the element.

The detailed results on sample 1 for Mo are as follows:

June 1971	.005 ppm
July "	.002 "
August "	.024 "
September "	.010 "
October "	.003 "
November "	.002 "
January 1972	.002 "
February "	.003 "
March "	.004 "
April "	.005 "

The effluent standard for Mo for this river has been set at 0.01 ppm. The above data indicate that there are times when the background concentration on the river can exceed the limit. Let us admit for purposes of a calculation that one background value for this stream could be as much as 0.024 ppm. This value is without significance unless the flow X concentration can be related because its the amount that is discharged and not just the concentration which alludes to a serious limitation

of concentration only as employed in effluent standards. The flow rate measured for the month of August, 1971 for the related Mo value was 12.5 CFS. The amount of Mo passing this point in one second is as follows:

$$12.5\ ft.^3 \times \frac{1728\ in.^3}{ft.^3} \times \frac{16.61\ cm^3}{in^3} \times \frac{1\ l}{1000\ cm^3} = 358.8\ l/sec.$$

$$358.8\ l/sec. \times 0.024\ mg/l = 8.61\ mg/sec.$$

$$8.61\ mg/sec. = 0.00861\ g/sec. \times 1\ \#/454\ oz.$$

$$= 1.95 \times 10^{-5}\ \#/sec.$$

Therefore, the background concentration may attain at least a value of 1.9×10^{-5} lb./sec. The regulation should allow a value of 7.9×10^{-6} lb./sec. for the flow rate, but does not consider flow x concentration. The lowest value observed for Mo during the sampling program was 0.002 ppm. If the same flow rate were applied to this value 1.6×10^{-6} lb./sec. of Mo would flow at this point. However, the actual flow rate measured was 7.8 CFS which give 1.0×10^{-6} lb/sec. Thus, the calculation shows that a setting of effluent standards by concentration alone is without merit. In reality, the numbers indicate that if the number of pounds is what we are concerned with, then if the flow rate decreases a higher concentration should be permitted in the effluent and vice-versa. This type of logic has been epitomized in a recent paper by Vogeli and King (1969), whereas the authors state on pages N3 and N5:

> "If natural conditions, including the rate of stream discharge, under which molybdenum arrives at the sampling point were to remain constant it would be possible to calculate an accurate total weight of molybdenum carried past the sampling point per minute, hour, day, and year. However, the natural conditions vary greatly, and the quantity of molybdenum in water changes. Only through constant monitoring of the molybdenum content in water and of stream discharge can accurate weight totals of molybdenum for unit time be determined."

b) Sample Points 3,4

These two points were selected to contrast the Red River above the plant (background), a point below the plant (Sulphur Gulch), and leaching of country rock with flow from an underground stream (point 3). Most of the data indicate that the temperature, pH, D.O., flow rate, coliform bacteria, suspended solids, sulphate, phosphate, cyanide, copper and iron contents between sample points 1, 2 and 4 are similar. These data indicate that mining and milling activities of the plant do not change the stream concentration, in its natural state. It is also significant to indicate the similarity in our results in contrast to the EPA data of November, 1970.

The curves do indicate a striking difference between natural background of the Red River and the leaching from underground streams which might reach the river and impair water quality. During the colder months of the year, the temperature of the underground water is markedly higher than temperatures of the Red River. Underground leaching in this case produces anomalous values (in contrast to background) for manganese (4 to 50 ppm), molybdenum (4 to 10 ppm), zinc (1 to 6 ppm), nitrate (1 to 20 ppm), and sulphate (1300 to 1600 ppm). These observations are important. It indicates that leakage from underground streams at even as low flow rates at these high concentrations, could significantly change the concentrations of contaminants in a surface stream due to natural causes. The reasons for these high values in sample point number 3 most likely are leaching of the ore and/or country rock. The high sulphate value probably results from dissolution of gypsum or anydrite.

c) Sample points 5,10

These two points were selected distant from the mining and milling operations along Red River to determine if a combination of mining activities and local man-made effects (essentially agricultural) would materially change the water quality from background.

The field measurements (Temperature, D.O., pH, and flow rate) are similar to those at sample points 1, 2, and 4. The exception is that the flow rate at point 10 is somewhat higher as a result of additional tributaries, e.g. Cabresto Creek. Coliform bacteria were extremely high for sample point 5 in September, 1971; this high value probably was the result of activity from cattle grazing nearby. These data are similar

to those of EPA with the exception of pH. Possible reasons for this discrepancy have been explained above.

Sample points 5 and 10 have nitrate values generally higher than background. Possibly the enhanced values may be the result of extensive use of fertilizers and cattle grazing in this area.

Sample point 10 contained a copper concentration of nearly 0.100 ppm in October, 1971 which would exceed the standard set forth in Regulation 6. Sample point number 5 contained excessive concentrations of manganese and zinc in November, 1971. These data indicate that at times the Red River may temporarily fluctuate in concentrations in heavy metals, even at points distantly removed from the effects of mining operations. These observations again taint with uncertainty the hazard of a single sample for regulatory purposes. The two sample identities of the EPA are similar in concentration to our data.

d) Sample points 13, 14

These two samples were taken to supply information with respect to possible leaching of upper formations by underground waters. Sampling of the wells was abandoned after October, 1971 because of higher priority attached to sample points 5 and 10 and because no significant change in trend with three sampling times.

The data indicate values predictable for ground-water in this type locale, with the exception of manganese and zinc in sample point 13. This is probably the result of underground leaching of the ore. Dissolved oxygen measurements were not made because samples were obtained by mechanical pumping which functioned as a sparger or aerator.

e) Sample points 6,7,8,9

These sample points represent what happens to tailing discharged effluent (sample point 8 for all practical purposes). A definitive analysis of these series of sample points indicates the potential for clarification by natural processes (flocculation - sedimentation) prior to discharge from Pope Lake into Red River.

The important sample point to consider is 8 because this is effluent quality. Temperature for this sample ranged from 0° C to 21° C, which does not exceed the temperature of 70° F (21° C) for the stream standard, but is just on the border line. The D.O. concentration never fell below the stream standard of 6.0 ppm for trout waters with the exception of one sample for June, 1971. Coliform bacteria for the sample was only slightly above or less than 100 per 100 ml which indicates that neither the effluent standard (500 per 100 ml) nor the stream standard of 200 per 100 ml was ever exceeded.

It is important to contrast sample points 6 and 8 for suspended solids. The suspended solids content of the influent ranged from 12 grams per liter to 680 grams per liter. In the early portion of the sampling program, sample 8 contained 4 to 5 mg/l at the point of discharge. These values for the effluent would exceed the effluent discharge standard for settleable solids of 1.0 ml/l. However, sampling from January, 1972 through April, 1972 indicated that the standard was just about being met at 1.0 ml/l. The suspended solids content should be carefully considered in the future so that the standard is not exceeded.

Nitrate and phosphate are two compounds believed to induce eutrophication (accelerated aging) of water. Though no stream or effluent standards are set for these compounds, values of 0.1 ppm and 1.0 ppm for phosphate and nitrate, respectively, should be considered. The level for phosphate is exceeded at times in North Drainage probably as a result of its content of domestic sewage. Sample point 8 also has phosphate concentrations of concern that should be carefully monitored in the future. The lowest concentration of nitrate in sample 8 during the study was 2.0 ppm. The observed concentrations are considered to be high and should be carefully checked in the future.

Cyanide does not seem to present any serious problem. There are no effluent standards or stream standards for this compound at the present time. However, the U. S. Public Health Drinking Water Standard is 0.02 ppm. The influent concentration contained as much as 1.0 ppm (June, 1971), but sample 8 was less than 0.02 ppm in all instances with the exception of August, 1971 (0.1 ppm) and October, 1971 (0.05 ppm). Cyanide probably finds its source from the flotation circuit where it is employed as a depressant. Low concentrations of cyanide are known to be toxic to fish (Nelson and Lysyj, 1971). This is particularly important at pH values less than 9.0 wherein HCN is formed. The EPA value for November, 1970 is in very good

agreement with our value measured in November, 1971.

Most heavy metals occur in the discharged effluent in insignificant amounts (same conclusion by EPA, 1971, p. 15) with the exception of Mo. Therefore, unless explained below, heavy metals contents in sample point 8 will presently meet the standards of Regulation 6.

The copper concentration in the influent since October, 1971 has been about 0.1 ppm. This value would exceed the 0.05 ppm for Regulation 6. However, the clarification process in the settling area reduces the influent concentration to values less than 0.05 ppm prior to discharge into the Red River. The EPA value in the tailing is nearly identical to our observations.

The iron concentration in sample point 8 for most of the sampling times was about 0.05 ppm, a very good value. As has been indicated before, no heavy metal standard was set for iron.

Regulation 6 sets manganese at 0.1 ppm or less. Concentrations of manganese in the influent for the most part were equal to or less than the standard. However, the manganese concentrations in the effluent (sample point 8) indicated that a substantial amount of time this standard is exceeded. The disparity between influent and effluent concentrations can most likely be attributed to the North Drainage leakage (see sample point 9). Apparently, this natural drainage may produce high concentrations. The one sample value by EPA is much lower than those found in the study though for the months of July, 1971 and September, 1971 our effluent values were less than those of the EPA study.

The data for sample 8 indicate that most values for zinc ranged from about 0.02 to 0.04 ppm which is consistent with the EPA value reported for November, 1970. These data place zinc below the standard in New Mexico Regulation 6.

The most serious problem with the discharged effluent to Red River is with Mo. New Mexico Regulation 6 sets an effluent standard of 0.1 ppm or less. Sample point 8 discharged a concentration of Mo ranging from about 1 to 2 ppm during the course of this study. Becuase of low discharge flows, only limited flows were measureable. An average value of about 2.0 CFS can be employed for purposes of this discussion. It is of interest to calculate the amount of Mo discharged to the Red River in contrast to the amount flowing past sample

points 1, 2 considered background. The calculation is made on the basis of at upper limit of 2.0 ppm Mo at a discharge rate of 2.0 CFS:

2.0 CFS = 57.4 l/sec.

57.4 l/sec. X 0.002 g/l = 0.1148 g/sec.

$$\frac{0.115 \text{ g/sec.}}{454 \text{ g/\#}} = 2.7 \times 10^{-4} \text{ \#/sec.}$$

or

$$2.7 \times 10^{-4} \text{ \#/sec. X } 86{,}400 \text{ sec./day} = 23.32 \text{ \# Mo/day}$$

At this flow rate, Regulation 6 would permit 1.2×10^{-6} #/Sec. or 0.103 #/day. Thus, the amount being discharged exceeds the regulation by about two orders of magnitude.

It was previously shown that the background concentration of Mo at sample points 1, 2 may attain a value of 1.9×10^{-5} #/sec. or 1.64 # Mo/day. It is difficult to see how this standard could ever be achieved when the background concentration in Red River itself may, at times, exceed the standard by more than one order of magnitude.

An important point possibly to be pursued is what amount in pounds per day can a body of water tolerate in a manner similar to setting pounds per day of allowable B.O.D. If this were done, then one could treat to an acceptable concentration and adjust flow rate to meet effluent standards. This logic would be a sensible and reasonable means for setting and/or meeting standards.

f) Sample points 11, 12

Sample point 11 was taken at the Fish Hatchery on the Red River. This sample would reflect any deleterious consequences that the discharged effluent from sample point 8 might have on the hatchery. Sample point 12 was taken at the confluence of the Red River and the Rio Grande, from June, 1971 through August, 1971. After that date it was not possible to get up and down the river bottom. The Rio Grande was then sampled above a point at its confluence with the Rio Hondo Creek, which is below Red River; this point gave a reasonable representation of the composition at the Red River - Rio Grande confluence.

Temperature ranged from about 5° C to about 21° C indicating that the Red River itself and its flow does not impair the stream standard of 21° C (cold water fishery). The EPA measured value of November, 1970 is nearly identical to our value.

The pH range was 7.5 to 8.5 and did not exceed either the stream standard or effluent standard of 6.6 to 8.6. The EPA was 7.0 in contrast to our measurements.

The C.O. content for trout waters was never below the 6.0 ppm except the June, 1971 measurement. The EPA measurement was very similar to our data.

The flow rate at sample point 11 ranged from 16.5 CFS to 23.5 CFS. One measurement by the EPA indicates a value of 45.55 CFS. This value exceeds our highest value by a factor of two. The difference most likely indicates their measurement was made at a deep and wide portion of the Red River.

Coliform bacteria at the Fish Hatchery (sample point 11) never exceeded 200 per 100 ml. This indicates that neither the effluent standard for stream standard was impaired. The data given for the Rio Grande at Rio Hondo show values from 860 to 4950 per 100 ml. These values considerably exceed the stream standard of 500 per 100 ml and are explicable on the basis of intense grazing activity in this area.

The concentrations of suspended solids, sulphate, and phosphate do not differ appreciably from background data and are in good agreement with the EPA data.

The results for nitrate exceed 1.0 ppm for much of the time period sampled. These data are substantially different from the EPA data. The high nitrate content at the Rio Grande (sample point 12) results from a combination of the high grazing activity and as a result of contamination from the Fish Hatchery itself as indicated by the EPA (ref. 3, p.4):

> "The State Fish Hatchery, located on the Red River some three or four stream miles above its mouth, is contributing to degradation of that portion of the stream, and consequently, to the Rio Grande. This degradation is increased when fish ponds are drained and cleaned for restocking. This discharge contains organics and solids and also has a fertilizing effect by the addition of nutrients."

The concentration of cyanide was less than 0.02 ppm in all instances indicating no pollution problem from sample point 8 (Red River) to as far down the Rio Grande at Rio Hondo.

No problems exist with heavy metals at either of these sample points with the exception of Mo and Mn. At sample point 11 the manganese effluent standard is exceeded by 0.04 ppm -- based on 12 samples, range 0.01 ppm to 0.04 ppm, mean 0.02 ppm -- probably as a result of natural stream contributions and in part at times from discharged effluent at sample point 8. As a result of dilution from the Rio Grande, the Mn standard is not exceeded.

The concentration of Mo at the Fish Hatchery ranged from about 0.04 ppm to 0.15 ppm which exceeds the effluent standards of 0.01 ppm. These values may be explainable from the natural background itself exceeding the standard and in part from the effluent at sample point 8. The EPA data on heavy metals is in reasonably good agreement with our data.

g) Other Analyses

Other analyses were made on the residues, but will not be discussed because there is nothing to add to the previous discussion already made on similar or identical elements.

Gross beta activity was also determined and is included in the tabulations. None of the samples analyzed approaches the value of 1000 picocuries per liter normally set by health authorities. The values usually were of the order of magnitude of ten picocuries per liter.

It is important to indicate that the EPA has classified all of its stations as biotically clean. On page 15, reference 3, it states that all stations along the Red River are considered clean based upon a numerical biotic index of 10 or more which classifies a station as clean. This would apparently indicate that effluent from sample point 8 has no impairment on stream biota.

6. Summary

This report summarizes a one year study of the measurement of various field parameters, the determination of various chemical constituents and coliform bacteria along the Red River from above the Moly Corp plant to the confluence of the Red River - Rio Grande to a point on the Rio Grande at the confluence with the Rio Hondo. The sampling program also assessed effects of underground leaching of the ore body.

The natural background concentration of the Red River at times will exceed the current effluent standard (Regulation 6) with respect to molybdenum and at other times be below the standard, suspended solids (settleable solids), and manganese.

Underground waters have a tendency to leach substantial amounts of Mo, Mn, nitrate and Zn and may contribute to pollution of the Red River from base flow considerations. The most serious problems are with Mo and Mn which were observed to discharge at concentrations as much as 10 ppm and 50 ppm, respectively.

The field measurements, with the exception of pH, coliform counts, and chemical analyses of this study are in good agreement with those reported by the EPA in their November, 1970 study (EPA, 1971).

With the exception of Mn and Mo, the discharged effluent (Pope Lake) into the Red River meets all current effluent regulations and stream standards. The suspended solids content is just about on the borderline of meeting effluent standards of 1 ml/l. The Mo concentration presently exceeds the allowable effluent standard by two magnitudes amounting to 23.32 pounds per day using an effluent concentration of 2.0 ppm at a flow rate of 2.0 CFS. The EPA report also indicates that heavy metals content is insignificant with the exception of Mo.

The EPA report indicates that the discharged effluent from Pope Lake maintains a "clean" condition on the Red River by not being less than 10 in Biotic index though a slight fertilization (mild pollution) effect is noted.

7. References

1. Federal Water Pollution Control Administration, U.S. Dept. of Interior. Jan. 1966. A Water Quality Survey, Red River of the Rio Grande, New Mexico, Project Report, Robert S. Kerr Water Research Center, S. Central Region, Ada, Oklahoma.

2. Federal Water Pollution Control Administration, U. S. Dept. of the Interior. Oct. - Nov. 1966. Biological Conditions in the Red River and Rio Grande, New Mexico, Project Report, Robert S. Kerr Water Research Center, S. Central Region, Ada, Oklahoma.

3. United States Environmental Protection Agency. Nov. 197[illegible]. A water quality survey of Red River and Rio Grande, New Mexico, Surveillance and Analysis Division, Region VI, Ada Facility Ada, Oklahoma.

4. Wayman, Cooper H. May, 1971. Considerations of water quality parameters pertinent to New Mexico's Regulation No. 6. Prepared for Molybdenum Corporation of America, Questa Branch, New Mexico.

5. Vogeli, P.T., Jr., and King, R.V. 1969. Occurrence and distribution of molybdenum in surface water of Colorado. U. S. Geological Survey Water-Supply Paper 1535-N. 32 p.

6. Nelson, K. and I. Lysyj. 1971. Analysis of water for molecular HCN. water pollution cont. Fed., J. 43: 739.

REPORT ON WATER ANALYSES
FOR SAMPLING OF JANUARY 15, 1972

Sample	Temp. °C	DO	pH	CFS	ROE	SS	Hardness
1	1.6	8.6	8.1	7.6	117	1	135
2	2.2	8.8	8.3	8.8	107	1	160
3	11.5	7.4	7.4	-	3180	3	1700
4	1.1	7.9	7.8	10.7	181	1	120
6	-	-	-	-	440	680[a]	215
7	1.5	5.8	7.6	-	1110	2	775
8	1.9	6.9	7.5	-	1260	1	715
9	2.6	7.4	8.2	-	1080	3	860
10	4.8	8.1	8.0	12.6	126	2	118
11	5.4	7.4	7.9	16.5	190	3	340
12	6.9	7.7	8.1	-	165	3	135

SS = suspended solids
[a] = total solids

Sample	Nitrate	Phosphate	Sulfate	Ag	As	B	Ba
1	0.4	<0.02	45	<0.005	<0.02	<0.1	<1
2	0.5	<0.02	125	<0.005	<0.02	<0.1	<1
3	17.6	<0.02	1530	<0.005	<0.02	<0.1	<1
4	0.3	<0.02	130	<0.005	<0.02	<0.1	<1
6	0.4	<0.02	300	<0.005	<0.02	<0.1	<1
7	5.8	<0.02	665	<0.005	<0.02	<0.1	<1
8	4.6	0.21	790	<0.005	<0.02	<0.1	<1
9	0.9	<0.02	640	<0.005	<0.02	<0.1	<1
10	1.5	<0.02	147	<0.005	<0.02	<0.1	<1
11	1.8	<0.02	226	<0.005	<0.02	<0.1	<1
12	2.4	0.05	91	<0.005	<0.02	<0.1	<1

Sample	Cd	Cl	CN	Cr	Cu	Fe	Hg
1	<0.005	1	<.01	<.01	<.02	.08	<.0001
2	<0.005	1	<.01	<.01	<.02	<.04	<.0001
3	0.005	8	<.01	<.01	.03	.05	<.0001
4	<0.005	1	<.01	<.01	<.02	<.04	<.0001
6	<0.005	1	<.01	<.01	.14	<.04	<.0001
7	<0.005	1	<.01	<.01	.03	<.04	<.0001
8	<0.005	2	<.01	<.01	<.02	<.04	<.0001
9	<0.005	1	<.01	<.01	<.02	<.04	<.0001
10	<0.005	1	<.01	<.01	<.02	<.04	<.0001
11	<0.005	3	<.01	<.01	<.02	<.04	<.0001
12	<0.005	4	<.01	<.01	<.02	.06	<.0001

Sample	Mn	Mo	Ni	Pb	Se	Zn	Coliform per 100/ml
1	.09	<.002	.008	<.005	<.005	.02	155
2	.25	.004	.007	<.005	<.005	.08	72
3	19.0	7.6	.050	<.005	<.005	5.6	41
4	.14	.003	.004	<.005	<.005	.05	170
6	.15	3.4	.073	<.005	<.005	.03	1
7	.40	1.8	.038	<.005	<.005	.05	18
8	.42	2.1	.029	<.005	<.005	.05	115
9	.36	.38	.018	<.005	<.005	.09	142
10	.28	.006	.015	<.005	<.005	.07	108
11	.18	.18	.010	<.005	<.005	.03	65
12	.06	.004	.024	<.005	<.005	.02	1860

Sample	Gross Beta Activity pC/l
1	3.1
2	6.9
3	19.0
4	4.4
6	6.2
7	10.8
8	4.9
9	12.8
10	1.6
11	6.1
12	11.9

Dwt. 2

SPECTROGRAPHIC WATER ANALYSES
(Values in ppm or % as indicated)

Element	1	2	3	4	6	8	11	12
Fe	0.1%	0.02%	0.02%	0.04%	0.8%	0.1%	0.07%	0.3%
Ca	18.0%	9.0%	17.0%	18.0%	12.0%	19.0%	18.0%	19.0%
Mg	3.0%	2.0%	1.5%	2.0%	3.0%	0.9%	2.4%	1.0%
Ag	<1	<1	<1	<1	<1	<1	<1	<1
As	<500	<500	<500	<500	<500	<500	<500	<500
B	15	<10	15	10	10	20	40	70
Ba	180	40	10	60	100	40	60	130
Be	<2	<2	20	<2	<2	<2	<2	<2
Bi	<10	<10	<10	<10	<10	<10	<10	<10
Cd	<50	<50	<50	<50	<50	<50	<50	<50
Co	<5	<5	20	<5	10	<5	<5	<5
Cr	<10	<10	50	<10	40	<10	<10	<10
Cu	60	40	60	10	140	10	10	20
Ga	<10	<10	<10	<10	<10	<10	<10	<10
Ge	<20	<20	<20	<20	<20	<20	<20	<20
La	20	40	20	30	20	20	20	20
Mn	900	1100	9500	600	800	900	300	200
Mo	<2	<2	850	6	1600	1100	800	600
Nb	<20	<20	<20	<20	<20	<20	<20	<20
Ni	<5	<5	<5	10	90	<5	10	30
Pb	<10	<10	60	<10	<10	<10	<10	<10

WESTERN ENVIRONMENTAL LAW CENTER
Grove Burnett
P.O. Box 1507
Taos, New Mexico 87571
(505) 751-1776
(505) 751-1775 Fax

Attorneys for Plaintiffs

UNITED STATES DISTRICT COURT

DISTRICT OF NEW MEXICO

AMIGOS BRAVOS, a nonprofit corporation, and NEW MEXICO CITIZENS FOR CLEAN AIR AND WATER, a nonprofit corporation,	)
Plaintiffs,	) PLAINTIFFS RULE 26 (a) (2) (B) EXPERT REPORT OF BARBARA C. WILLIAMS, Ph.D., P.E.
vs.	)
MOLYCORP, INC.	)
Defendant.	)

I, Barbara C. Williams, provide the following report as required by Fed. R. Civ. Pro. 26 (a) (2) (B) and the Court's March 17, 1997 disclosures.

A. SUMMARY OF QUALIFICATIONS

1. Qualifications of Witness

- Research scientist at the University of Idaho, performs research on mine waste management.
- Former research civil engineer with the US Bureau of Mines, with 10 years of mine waste research experience.
- Areas of expertise include groundwater hydrology, aqueous geochemistry, hydrogeology, multivariate statistics.
- Licensed Professional Engineer (PE); Civil.

- M.S. degree in Civil and Environmental Engineering. Ph.D. degree in Agricultural Engineering with concentration in Hydrology. Ph.D. dissertation topic: Aqueous Geochemistry of Ground Water in Mine Wastes.

2. List of Publications within past 10 years.

1. Williams, B.C., J.A. Riley, J.R. Montgomery, and J.A. Robinson. 1996. Hydrologic and Geophysical Studies at Midnite Mine, Wellpinit, WA: Summary of 1995 Field Season. US Bureau of Mines RI 9607. 34 pp.

2. Williams, B.C. and J.A. Riley. 1996. Hydraulic Characterization of Midnite Mine, Wellpinit, WA: Summary of 1994 Field Season. US Bureau of Mines RI 9606. 33 pp.

3. Stewart B.M., B.C. Williams, and R.H. Lambeth. 1995. Investigation of Acid Production, Leaching, and Transport of Dissolved Metals at an Abandoned Sulfide Tailings Impoundment: Monitoring and Physical Properties. US Bureau of Mines RI 9577. 82 pp.

4. Williams, B.C. and J.A. Riley. 1993. Midnite Uranium Mine - Hydrologic Research and Characterization *in* The Challenge of Integrating Diverse Perspectives in Reclamation, Proceedings, 10th National Meeting of Amer. Soc. of Surface Mining and Reclamation, Spokane, WA, May 1993, v. II, pp. 455-466.

5. Stewart, B.M., R.H. Lambeth and B.C. Williams. 1993. Factors Controlling the Release and Attenuation of Contaminants in a Sulfidic Tailings Impoundment *in* The Challenge of Integrating Diverse Perspectives in Reclamation, Proceedings, 10th National Meeting of Amer. Soc. of Surface Mining and Reclamation, Spokane, WA, May 1993, v. I, pp. 218-235.

6. Williams, B.C. 1992. Comparison of Multivariate Statistics and the Geochemical Code WATEQ4F for Water Quality Interpretation in Acidic Tailings. Ph.D. Dissertation, Univ. of Idaho, 164 pp.

7. Williams, B.C. 1992. Multivariate Statistical Analysis of Vadose and Saturated Zone Pore Waters of Sulfidic Mine Waste Tailings, *in* Emerging Process Technologies for a Cleaner Environment, Ed. S. Chander, Soc. for Min., Metall., and Explor., Chap. 10, pp. 63-70.

8. Williams, B.C. 1991. Statistical and Geochemical Analyses of Vadose and Saturated Pore Waters in Sulfidic Mine Waste Tailings *in* Proceedings, 4th International Mine Water Assoc. Congress, Ljubljana, Slovenia, v. 2, pp. 305-316.

9. Lambeth, R.H., B.M Stewart and B.C. Williams. 1991. An Investigation of Hydrogeochemical Mechanisms in an Abandoned Sulfide Tailings Impoundment and Underlying Aquifer *in* Proceedings, 2nd International Conference on the Abatement of Acidic Drainage, Tome [volume] 3, pp. 43-59.

10. Lambeth, R.H. and B.C. Williams. 1990. Linking Biological and Hydrogeochemical Mechanisms of Sediment Leaching *in* Biological Remediation of Contaminated Sediments, with Special Emphasis on the Great Lakes, Eds. C.T. Jafvert and J.E. Rogers. EPA/600/9-91/001, pp. 166-171.

11. Stewart, B.M., R.H. Lambeth and B.C. Williams. 1990. Effects of Pyritic Tailings in an Abandoned Impoundment on Downgradient Water Quality *in* Mining and Mineral Processing Wastes, Ed. Fiona M. Doyle, Soc. for Min., Metall., and Explor., pp. 133-142.

12. Williams, B.C., R.H. Lambeth and B.M. Stewart. 1989. Determining Heavy Metal Leaching and Transport from Abandoned Mine Wastes. Transactions, Preprint #89-25, Soc. for Min., Metall., and Explor. Annual Meeting, Las Vegas, NV, Feb. 1989.

3. Compensation

Hourly Rate is 75 $/hr.

4. Cases for which witness has testified in past 4 years.

None

B. SUMMARY OF OPINIONS

This Summary of Opinions relies in part upon specific documents in the published literature, public documents, or documents prepared by or on behalf of Molycorp. These documents are identified and cited in the Basis for Opinions, in the section below. This Opinion depends upon a site visit to the Molycorp Mine on December 17, 1996; review of scientific reports prepared by Molycorp's consultants; review of published geologic, hydrologic, and river sampling reports from about the Mine and the River by state and federal agencies; examination of water quality data from laboratory leach tests, seeps, the Red River, groundwater monitoring wells, water supply wells, and the underground mine; examination of water level data from monitor wells and the Red River; numerous maps and figures prepared by Molycorp or the State; other data; and experience acquired at other mine sites with similar hydrologic settings.

1. The hydrologic setting of the Molycorp Mine facilitates direct hydraulic connection(s) between the Molycorp waste rock piles and the Red River. The waste rock piles were not placed on liners. Rain and snowmelt infiltrate the waste rock piles. Stormwater runoff on and from some of the waste rock piles is collected in impoundments, whereupon it subsequently infiltrates. Seepage flows laterally downhill along low hydraulic conductivity barriers at the base of the waste rock until it enters the shallow alluvial and/or fractured bedrock aquifers. These flow paths may be within the saturated zone or perched above it. Seepage from most of the waste rock disposal areas is not collected in a seepage interception system. The natural groundwater gradients in the alluvial and bedrock aquifers are directed toward the river. Groundwater discharge to the Red River occurs through the shallow bedrock and alluvial aquifers by observed seeps and springs. The cone of depression in the deep bedrock that is created by the underground workings of the mine does not collect most of the groundwater from the shallow bedrock and alluvial aquifers. Groundwater elevations in wells between the waste rock disposal areas and the Red River show vertically upward directed gradients, indicating that groundwater recharges the river in this area. Other studies have shown that the Red River is a gaining stream in the vicinity of the Molycorp Mine. Therefore groundwater flows into the river over this reach of the Red River.

2. In consideration with the hydrologic evidence provided in Opinion 1, geochemical data and water quality data demonstrate a direct hydraulic connection between the Molycorp waste rock piles and seeps that flow into the Red River. The same dissolved constituents are observed to be leached from the waste rock, present in the groundwater upgradient of the Red River, and present in the seeps that discharge from groundwater to the Red River. Monitor wells installed in the shallow alluvial aquifer near the Portal Springs and the Capulin Springs exhibit water quality with chemical signatures that are similar to each of these springs, respectively. The timing of appearance of white

precipitates in the Red River in conjunction with Molycorp's open pit operation also verifies the direct hydraulic connection between the Molycorp waste rock piles and the Red River.

3. Sulfate and metal loading now exhibited in the reach of the Red River adjacent to the Molycorp Mine is more attributable to mining activities and emplacement of waste rock piles than to natural hydrothermal scars. The increase in loading exhibited over the years 1966 to 1992 is due overwhelmingly to mining and waste rock emplacement. Several hydrothermal scars on site have been removed or disturbed by mining activity so that the areal extent of natural scar material within the mine area has been reduced since the onset of mining. The episodic sediment loading to the Red River caused by erosion and landslides from hydrothermal scars within the Molycorp Mine area has been effectively eliminated by the storm water management activities. The surface area and volume of waste rock now exposed to weathering and leaching is greater than the area of hydrothermal scars in the mine area that was exposed to weathering and leaching before the open pit operation commenced. Total concentrations of sulfate, aluminum, copper, cadmium, iron, manganese, and zinc in drainage water from waste rock and disturbed areas are higher, on average, than drainage from hydrothermal scars. In summary, because the sulfate and metal loading to the reach of the Red River adjacent to the Molycorp Mine has increased over the period 1965 to 1993, and the portion of this load which can be attributed to undisturbed hydrothermal scar seepage and episodic sediment loading has decreased over the same time period, then nearly all of the increase in loading must be attributed to mine-influenced seepage and groundwater recharge to the Red River.

4. The sulfate and TDS concentrations in the reach of the Red River adjacent to the Molycorp Mine increased with time, during the period of 1965 to 1993. Fish populations were impacted severely during that time period. Metal and sulfate concentrations in this section of the Red River are higher than in upstream sections. The increase in impact upon the reach of the river adjacent to the Molycorp Mine over upstream reaches is dominated by the metals zinc and manganese; these metals are correlated more strongly to waste rock drainage than to hydrothermal scar drainage. The relatively high concentrations of zinc and manganese substantiates the aforementioned direct hydraulic connection between the Molycorp waste rock dumps and the Red River.

5. Without abatement, the Molycorp Mine will continue to discharge to the Red River acidic water containing dissolved sulfate and heavy metals. When it is exposed to air and water, the oxidizable sulfide in the waste rock piles produces sulfuric acid which dissolves metals. In the mixed volcanic waste rock, most of the neutralizing minerals have been consumed; however, a large volume of oxidizable sulfide remains. Sulfide oxidation will continue indefinitely. The natural soil and gravel deposits between the waste rock and the Red River have

little or no ability to neutralize the acid. Consequently the acid and metals that leach out of the waste rock migrate to the Red River with little or no attenuation.

C. BASIS FOR OPINIONS

1. The hydrologic setting of the Molycorp Mine facilitates direct hydraulic connection(s) between the Molycorp waste rock piles and the Red River. The waste rock piles were not placed on liners. Rain and snowmelt infiltrate the waste rock piles. Stormwater runoff on and from some of the waste rock piles is collected in impoundments (1012, p.11; 1040, p.79), whereupon it subsequently infiltrates. Numerous investigators, including Molycorp's consultants and technical staff from multiple state agencies, describe two principal and interconnected groundwater systems in the mine area. These are (a) a fractured bedrock aquifer and (b) an alluvium aquifer comprised of mudflow and valleyfill materials within the Red River and tributary drainages (1012, p. 11, p. 21; 1013, p. 5; 1017, p.10; 1021, p.67). Seepage flows laterally downhill along low hydraulic conductivity barriers at the base of the waste rock until it enters the shallow alluvial and/or fractured bedrock aquifer(s). These flow paths may be within the saturated zone or perched above it (1013, p. 6). Seepage from most of the waste rock disposal areas is not collected in a seepage interception system (1012, p. 38). The natural groundwater gradients in the alluvial and bedrock aquifers are directed toward the river (1013, p. 5). Groundwater discharge to the Red River occurs through the shallow bedrock and alluvial aquifers by observed seeps and springs. Because of the high permeability of alluvium and shallow fractured bedrock near the ground surface, relative to the low permeability of the deep bedrock in the vicinity of the underground mine, the cone of depression in the deep bedrock that is created by the underground workings does not collect most of the groundwater from the shallow bedrock and alluvial aquifers (1012, p. 21; 1013, p. B-7). Groundwater elevations in wells between the waste rock disposal areas and the Red River show vertically upward directed gradients (1013, pp. 8-11), indicating that groundwater recharges the river in this area. Other studies have shown that the Red River is a gaining stream in the vicinity of the Molycorp Mine (1017, p. 10; 1021, p.4, p.10). Therefore groundwater flows into the river over this reach of the Red River.

Seepage from waste rock piles and impoundments infiltrates until it encounters a low hydraulic conductivity barrier such as a perching zone in waste rock, a perching zone on hydrothermal scar material, and/or weathered bedrock. It follows these controlled pathways until it enters either the fractured bedrock aquifer or the alluvial mudflow/valleyfill aquifer (1012, p. 11; 1013, p. 6). Seepage from the Sugar Shack South, Middle and Spring and Sulphur Gulch waste rock piles is not controlled by a seepage collection system. (1012, p. 38). A portion of the seepage from the Capulin Canyon waste rock dump probably bypasses a seepage collection system constructed in that tributary (1012, p. 11).

Groundwater discharge to the Red River occurs through the shallow bedrock and alluvial aquifers by observed seeps and springs including the Portal Springs, Cabin Springs, and Capulin Springs. The cone of depression in the deep groundwater flow system that is created by the underground workings does not capture most of the groundwater from the shallow bedrock and alluvial aquifers (1012, p. 21; 1013, p. B-7). Water level data in the monitoring wells installed by Molycorp in 1994 had not responded to dewatering of the new underground mine in the first five months of monitoring (1013, p. B-7). Monitor wells MMW-2, MMW-3, MMW-10A, MMW-10B and MMW-10C had not responded to the dewatering in 5 months (1013, p.12); and water level changes in monitor wells MMW-8A, MMW-8B and MMW-11 were inconclusive. Only well MMW-13 appears to be in the cone of depression of the mine due to its low water elevation with respect to the river; however this well had not shown a drawdown response in the first five months of monitoring (1013, p.8). Even well MMW-7, which is between Shafts #1 and #2 of the underground workings, has a water level which is 550 feet above the cone of depression, suggesting that it is completed in a perched zone within bedrock (1013, p. 11). The lack of response among these wells indicates that the underground mine is dewatering deep bedrock that is not well-connected to the shallow aquifers which recharge the Red River. Water quality data support this conclusion. Only one documented sampling point in the underground workings, Decline Station 1000, shows contaminated water of low pH and similar quality to waste rock drainage (1012, Table 1.4; 1012, p. 13). Groundwater elevations in wells MMW-2, MMW-3, MMW-8A and 8B, MMW-10A, 10B, and 10C, and MMW-11, which are located between waste rock disposal areas and the Red River exhibit vertically upward directed gradients, (1013, p. 11, p. 8, and p. 9) indicating that they are in a groundwater discharge area, i.e. that groundwater recharges the river in the vicinity of these wells.

2. In consideration with the hydrologic evidence provided in Opinion 1, geochemical data and water quality data demonstrate a direct hydraulic connection between the Molycorp waste rock piles and seeps that flow into the Red River. The same dissolved constituents are observed to be leached from the waste rock, present in the groundwater upgradient of the Red River, and present in the seeps that discharge from groundwater to the Red River. Monitor wells installed in the shallow alluvial aquifer near the Portal Springs and the Capulin Springs exhibit water quality with chemical signatures that are similar to each of these springs, respectively. The timing of appearance of white precipitates in the Red River in conjunction with Molycorp's open pit operation also verifies the direct hydraulic connection between the Molycorp waste rock piles and the Red River.

The same dissolved constituents are observed to be leached from the waste rock, present in the groundwater upgradient of the Red River, and present in the seeps that discharge from groundwater to the Red River. Samples of water

temporarily impounded on waste rock piles (1012, p. 28) contain elevated dissolved concentrations of sulfate, aluminum (Al), iron (Fe), manganese (Mn), zinc (Zn), and other metals (1012, Table C1). These concentrations are elevated with respect to sample location WS-Cap2 (1012, Table C1), which is used as a background seep by Molycorp contractors (1012,Table 1.2, footnote). Groundwater monitoring wells downgradient of the waste rock piles contain concentrations of sulfate, aluminum, cadmium, copper, manganese and zinc that are higher, on average, than concentrations in water supply wells (1012, Table 1.4). Of the metals, manganese shows the largest concentration difference. Seeps downgradient from waste rock dumps that discharge into the Red River contain concentrations of dissolved sulfate, aluminum, copper, iron, manganese and zinc (1012, Table 1.4) that are elevated with respect to seep WS-Cap2 (1012, Table C1).

The similarity of water quality in the Portal Springs to water quality in monitor wells MMW-10A, 10B, and 10C indicates that they are in the same general flowpath to the river. Portal Springs #2 and #2a exhibit low pH (4.8-4.0), high Al (10.9-19.4 mg/L), high Mn (4.7-10.6 mg/L), and moderate Zn (1.3-2 mg/L) with respect to water supply wells in the area (1012, Table 1.4). The Portal Springs are downgradient from alluvial wells MMW-10A, and 10C. Well 10C is completed in the upper valley fill aquifer, immediately above a clay stratum which may act as a perching layer (1013, p.9). Well 10C exhibits low pH (4.7), high Al (31.1 mg/L), high Mn (16.3 mg/L), and moderate Zn (3.2 mg/L) with respect to water supply wells in the area (1012, Table 1.4). Well 10A is completed in the lower valley fill, immediately above bedrock, and analyses show low pH (5.8), high Al (33.4 mg/L), high Mn (13.1 mg/L), and moderate Zn (2.29 mg/L) with respect to water supply wells in the area (1012, Table 1.4). Several investigators have documented the similarity in water quality between the Portal Springs and shallow alluvial wells MMW-10A and 10C (1013, p. D-12; 1021, p. 49).

The Capulin Canyon Springs exhibit water quality with a similar geochemical signature to monitor well MMW-2. The Capulin Canyon Springs have low pH (3.4), high Al (43-157 mg/L), high Fe (10-36 mg/L), high Mn (15-55 mg/L), and high Zn (4-13 mg/L) with respect to water supply wells in the area (1012, Table 1.4). Monitor well MMW-2, which is completed in the Capulin Canyon valleyfill (1013, p. 11), has low pH (4.9), high Al (64 mg/L), high Fe (51 mg/L), high Mn (52 mg/L), and high Zn (9.5 mg/L) with respect to water supply wells in the area (1012, Table 1.4). Molycorp contractors also conclude that the Capulin Canyon seeps' water quality is closely aligned to the alluvial groundwater quality (1013, p. D-12).

The timing of appearance of the white precipitate in the Red River also verifies the hydraulic connection between the Molycorp waste rock piles and the Red River. Longtime area residents are reported to have noticed a change in color of

the Red River below Molycorp within a year or two after development of the open pit (1021, p.21). Commencement of open pit operations marked the first large-scale disposal of waste rock on the Molycorp Mine property. The emergence of a white precipitate in the river reflects a change in aluminum chemistry of the groundwater that flows into the river over time. Low pH (<4.5) water can carry more aluminum in solution than higher pH water. When low pH water mixes with higher pH water (in the approximate pH range 4.5 to 5.0), the aluminum precipitates out as aluminum hydroxide (1041, pp.54-55). The onset of white precipitate in the Red River adjacent to Molycorp marked the beginning of low pH, aluminum-laden recharge to the river. Capulin Springs, Portal Springs 2 and 2a, and the Cabin Springs all yield water of pH less than 5.2, and aluminum concentrations of 11-157 mg/L (1012, Table 1.4). When these seeps enter the Red River, which has pH values greater than 7.0, the aluminum precipitates as white aluminum hydroxide (1041, pp. 54-55; 1021, p.26).

3. Sulfate and metal loading now exhibited in the reach of the Red River adjacent to the Molycorp Mine is more attributable to mining activities and emplacement of waste rock piles than to natural hydrothermal scars. The increase in loading exhibited over the years 1966 to 1992 is due overwhelmingly to mining and waste rock emplacement. Several hydrothermal scars on site have been removed or disturbed by mining activity so that the areal extent of natural scar material within the mine area has been reduced since the onset of mining. The episodic sediment loading to the Red River caused by erosion and landslides from hydrothermal scars within the Molycorp Mine area has been effectively eliminated by the storm water management activities (1012, p.10). The surface area (1012, Fig. 1.4) and volume (1012, p. 29) of waste rock now exposed to weathering and leaching is greater than the area of hydrothermal scars in the mine area that was exposed to weathering and leaching before the open pit operation commenced. Total concentrations of sulfate, aluminum, copper, cadmium, iron, manganese, and zinc in drainage water from waste rock and disturbed areas are higher, on average, than drainage from hydrothermal scars. The constituents with the highest relative concentrations in waste drainage are sulfate, aluminum, manganese and zinc (1021, p. 50). In summary, because the sulfate and metal loading to the reach of the Red River adjacent to the Molycorp Mine has increased over the period 1966 to 1993, and the portion of this load which can be attributed to undisturbed hydrothermal scar seepage and episodic sediment loading has decreased over the same time period, then nearly all of the increase in loading must be attributed to mine-influenced seepage and groundwater recharge to the Red River.

The extent of natural scar area has been reduced subsequent to the onset of mining. The largest natural hydrothermal scar on the mine site was mostly removed by mining of the open pit, and the removed portion can no longer be considered as a partial source of the natural pollutant load being delivered to the River. Other hydrothermal scar areas have been disturbed by mining activities.

When compared with seeps that emanate from undisturbed scar material on the mine site, disturbed scar seeps contain higher concentrations of all measured constituents except iron (1012, Table 1.2). Hydrothermal scars that are buried under waste rock (a) were disturbed physically by heavy equipment and haul trucks during emplacement of waste rock, (b) were disturbed physically by the impact of dumped waste rock, and (c)are now degraded chemically by acid leachate from overlying waste rock. Leachate from overlying waste rock that contacts underlying scar material has the potential to leach the scar material more aggressively than did rain and snow before placement of the waste.

Pulse, or episodic, loading of sediments and dissolved sediments has been documented as a significant problem in the Red River (1021, pp. 13-14). Stormwater management activities by Molycorp Mine have effectively eliminated the episodic sediment loading to the Red River caused by erosion and by landslides that derive from hydrothermal scars within the Molycorp area (1012, p. 10).

The surface area and volume of waste rock now exposed to weathering and leaching is greater than the area of hydrothermal scars in the mine area that was exposed to weathering and leaching before the open pit operation commenced (1012, Fig. 1.4). The original area (acreage) of hydrothermal scar zones is less than the area of waste rock disposal areas (1012, Fig. 1.4). Aerial photos indicate that Molycorp documents may over-estimate the hydrothermal scar areas in Capulin Canyon (1015, p. 2). The comparison of pre-mining hydrothermal scar zones to waste rock disposal area is even more important if the scars covered less area than generally has been represented by Molycorp. Oxidation of natural hydrothermal scars is limited largely to the weathered surface, where freeze-thaw cycles and erosion gradually expose new mineral surfaces to oxidizing conditions (1012, p. 29). During open pit mining, huge volumes of waste rock are blasted, excavated and disposed. This sequence of events exposes a large volume of fresh mineral surface to oxidation in a short time frame. Blasting of unweathered material leaves a high permeability rock mix that enhances movement of oxygen and infiltrating water, thereby increasing the production and migration of acid and dissolved metals in waste rock drainage as compared to natural hydrothermal scar drainage (1012, p. 29). There are now an estimated 328,000,000 tons of waste rock disposed on the Molycorp mine site (1012, p. 4). Waste rock and disturbed area acreage is more than pre-mining hydraulic scar area; however, the total volume and surface area exposed to oxidation is many times greater than pre-mining scar volume.

X-ray florescence analysis of soils and mine wastes used in reactivity tests found higher levels of metals in mine wastes than in soils collected from erosional scars (1021, p. 13). Total concentrations of sulfate, aluminum, copper, cadmium, iron, manganese, and zinc in drainage water from waste rock and disturbed areas are higher, on average, than drainage from hydrothermal scars.

The constituents with the highest relative concentrations in waste drainage are sulfate, aluminum, manganese and zinc (1021, p. 50).

In summary, because the sulfate and metal loading to the reach of the Red River adjacent to the Molycorp Mine has increased over the period 1965 to 1993, and the portion of this load which can be attributed to undisturbed hydrothermal scar seepage and episodic sediment loading has decreased over the same time period, then nearly all of the increase in loading must be attributed to mine-influenced seepage and groundwater recharge to the Red River. State of New Mexico employees have noted that it is indefensible for Molycorp to attribute the majority of the present-day seep impact upon the Red River to hydrothermal scars (1043, p. 3).

4. The sulfate and TDS concentrations in the reach of the Red River adjacent to the Molycorp Mine increased with time, during the period of 1965 to 1993 (1012, Table 1.7). Fish populations were impacted severely during that time period. Metal and sulfate concentrations in this section of the Red River are higher than in upstream sections. The increase in impact upon the reach of the river adjacent to the Molycorp Mine over upstream reaches is dominated by the metals zinc and manganese; these metals are more strongly correlated to waste rock drainage than to hydrothermal scar drainage. The relatively high concentrations of zinc and manganese substantiate the aforementioned direct hydraulic connection between the Molycorp waste rock dumps and the Red River.

During the time period 1965 to 1993, dissolved sulfate concentrations increased from 51 to 128 mg/L (increase of 77 mg/L) at the Goat Hill Campground and from 64 to 129 mg/L (increase of 65 mg/L) at the Ranger Station (1012, Table 1.7). Stations upstream from the Molycorp Mine (above the town of Red River, below the town of Red River, and below Hansen Creek) exhibited smaller increases of sulfate concentration; the changes in values were 5 to 12 mg/L (change of 6 mg/L), from 20 to 41 mg/L (change of 21 mg/L), and from 47 to 71 mg/L (change of 24 mg/L), respectively. Total dissolved solids (TDS) decreased during the 27-year period at the three stations upstream of the Molycorp mine (from 133 to 80 mg/L; from 138 to 124 mg/L; from 165 to 164 mg/L). TDS increased at the subject stations adjacent to and downstream of the Molycorp Mine; from 172 to 220 mg/l at the Goat Hill Campground and from 188 to 262 mg/L at the Ranger Station. On the basis of sulfate and TDS data, sampling locations adjacent to and downstream of the Molycorp Mine exhibited a greater increase over the 27-year period than did upstream sampling locations. It is not possible to quantify accurately the increases in Fe and Zn concentrations because detection limits were so high in 1965 (1012, Table 1.7). Unfortunately, Mn and Al were not measured in 1965 (1042, Table V-1).

Fish populations in the Red River were impacted severely during the period 1960 to 1988 (1021, p.5). Opinion 3 above demonstrates that sulfate and metal loading to the Red River in the reach adjacent to the Molycorp mine is due predominantly to mining disturbance and waste rock disposal. State of New Mexico investigators propose that consideration of fish populations that existed in the early 1960's (1021, p. 68) constitutes another method of assessing the relatively large impact of the Molycorp Mine on the Red River. In this analysis fish population data from the 1960's are evaluated in light of the impact of hydrothermal scars that occurred naturally in the vicinity of the mine. The baseline load due to natural hydrothermal scars prior to open pit mining at the Molycorp Mine, although only poorly documented, was sufficiently low that a fishery existed. "During ...the late 1960's and early 1970's ... the New Mexico Department of Game and Fish discovered in the course of routine population studies that fish were conspicuously absent in the middle reach of the Red River where thriving populations had once existed. Fish census data for 1960 indicate that approximately 572 fish per mile were estimated in the river. The 1988 fish census found no fish in this same reach (1021, p. 5)." State investigators cite the advent of large-scale modern mining, and subsequent release of ARD seepage as having overwhelmed the river's natural buffering capacity, "resulting in the biologically impoverished condition that exists now (1021, p. 68)."

Metal and sulfate concentrations in the section of the River adjacent to the Molycorp Mine are elevated compared to the concentrations present immediately above the Molycorp boundary at Expanded Site Inspection (ESI) location #16 (1017, Fig 3, location 16). Using dissolved concentrations from location #16 as a baseline (1017, Fig 3, location 16), concentrations of zinc have been measured as 3 times higher in the Red River at Goathill Gulch (1017, Table 16). Zinc was 4 times higher than at the baseline, and manganese was more than 3 times higher in the Red River immediately downstream of Capulin Springs; sulfate concentrations increased by 1.6 times over the same interval (1017, Table 16). The relatively high concentrations of zinc and manganese further supports the existence of a direct hydraulic connection between the Molycorp waste rock dumps and the Red River because these two metals are correlated more strongly to waste rock than to hydrothermal scar drainage. Total concentrations of sulfate, aluminum, manganese and zinc in drainage water from waste rock and disturbed areas are higher, on average, than drainage from hydrothermal scars (1021, p. 50). The baseline concentrations at ESI location #16 includes the impact of the smaller mining operations upstream from the Molycorp Mine. None of these operations has been documented as singly or cumulatively impacting the Red River as much as the Molycorp Mine has been demonstrated to be impacted by the reach adjacent to the Mine (1021, p. 57).

5. Without abatement, the Molycorp Mine will continue to discharge to the Red River acidic water containing dissolved sulfate and heavy metals. When it is exposed to air and water, the oxidizable sulfide in the waste rock piles produces

sulfuric acid which dissolves metals. In the mixed volcanic waste rock, most of the neutralizing minerals have been consumed; however, a large volume of oxidizable sulfide remains (1012, p. 33). Sulfide oxidation will continue indefinitely (1012, p. 33). The natural soil and gravel deposits between the waste rock and the Red River have little or no ability to neutralize the acid (1012, p. 31). Consequently the acid and metals that leach out of the waste rock migrate to the Red River with little or no attenuation.

Sulfide oxidation of the waste rock disposed at the Molycorp mine will continue indefinitely. Mixed volcanic waste rock exhibits the potential for acid production (1012, p.36). Black andesite and aplite/granite waste rock are not acid-generators when tested alone, but they may be acid-generators at locations where they are combined with volcanic waste rock (1012, p. 32). Acid generation has been documented in the in-pit disposal area and in the Spring and Sulphur Gulch disposal areas even though they contain primarily black andesite and aplite/granite waste rock (1012, p. 31).

Based upon my experience with acid rock production in mine waste rock, the waste rock dumps at the Molycorp mine will continue to generate acid rock drainage for decades. Molycorp contractors note that the waste rock in Capulin Canyon has generated acid for 25 years, and that laboratory and field investigations indicate sufficient acid-generating potential to continue acid generation indefinitely (1012, p. 34).

Molycorp was requested by the State of New Mexico Environmental Improvement Division to evaluate the need for and location of interceptor wells and/or a pumpback system at the base of the waste rock piles (1010, p. 2; 1040, p. 176). Molycorp has investigated and is continuing to evaluate the need for pumpback systems upgradient of seeps and springs adjacent to the Molycorp Mine (1040, p. 176). These investigations have focused on groundwater flow paths between the waste rock dumps and the Red River. Data collected for these investigations (1013) have been used to support this basis for opinions, which demonstrates a direct hydraulic connection between the Molycorp Mine and the Red River.

Barbara C. Williams

Barbara C. Williams

Dated March 13, 1997

Barbara Cooke Williams, Ph.D., PE

Work
Idaho Water Resources Research Institute
106 Morrill Hall
University of Idaho, ID 83843
(208) 885-6429
(208) 885-6431

Home
P.O. Box 15
Viola, Idaho 83872-0015
Phone: (208) 875-0147
Fax, Voicemail: (208) 875-2372

EDUCATION

Ph.D. in Agricultural Engineering
University of Idaho
Moscow, Idaho - May 1992
Concentration: Aqueous Geochemistry of Ground Water in Mine Wastes
Minor Concentrations: Hydrogeology, Natural Resource Law

M.S. in Civil and Environmental Engineering
Cornell University
Ithaca, NY - August 1983
Concentration: Hydrology
Minor Concentration: Agricultural Engineering

B.S. in Engineering
Swarthmore College
Swarthmore, PA - June 1981
Concentration: Civil Engineering

WORK EXPERIENCE

Research Scientist, 5/96-present
Idaho Water Resources Research Institute
University of Idaho, Moscow, ID

Conducts research on hydrologic aspects of mine waste management, metal dissolution and transport, mine reclamation, and mine closure. Reviews data, reclamation scenarios and risk assessments. Advises government land managers on policy matters for site remediations.

CONSULTING EXPERIENCE

Civil Engineer, Hydrologist 2/96-present
EnviroSearch International, Boise, ID

Critically reviewed environmental impact documents prepared by an international mining company in support of their expanded mining operations abroad. Researched mining and milling archives to trace arsenic in metallurgical waste streams from the 1920's, in support of litigation.

Project Manager, Hydrologist, 5/88-5/89
Williams and Associates, Inc., Moscow, ID

Compiled a spatial relational database of ground water quality data at uranium mill sites for the U.S. Nuclear Regulatory Commission to facilitate data access and interpretation.

Independent Cartographer, July-August, 1978
Conservation Commission, Town of Bethel, CT

Prepared a wetlands map for the town of Bethel, CT using USGS quadrangle maps, and presented it to the public at a Conservation Commission Meeting.

PUBLICATIONS

1. Cooke, B.A. 1983. Experimental Determination of Unsaturated Flow Parameters and Their Spatial Variability. Master's Thesis, Cornell University, 169 pp.

2. Williams, B.C., R.H. Lambeth and B.M. Stewart. 1989. Determining Heavy Metal Leaching and Transport from Abandoned Mine Wastes. Transactions, Preprint #89-25, Soc. for Min., Metall., and Explor. Annual Meeting, Las Vegas, NV, Feb. 1989.

3. Stewart, B.M., R.H. Lambeth and B.C. Williams. 1990. Effects of Pyritic Tailings in an Abandoned Impoundment on Downgradient Water Quality *in* Mining and Mineral Processing Wastes, Ed. Fiona M. Doyle, Soc. for Min., Metall., and Explor., pp. 133-142.

4. Lambeth, R.H. and B.C. Williams. 1990. Linking Biological and Hydrogeochemical Mechanisms of Sediment Leaching *in* Biological Remediation of Contaminated Sediments, with Special Emphasis on the Great Lakes, Eds. C.T. Jafvert and J.E. Rogers. EPA/600/9-91/001, pp. 166-171.

5. Lambeth, R.H., B.M Stewart and B.C. Williams. 1991. An Investigation of Hydrogeochemical Mechanisms in an Abandoned Sulfide Tailings Impoundment and Underlying Aquifer *in* Proceedings, 2nd International Conference on the Abatement of Acidic Drainage, Tome [volume] 3, pp. 43-59.

6. Williams, B.C. 1991. Statistical and Geochemical Analyses of Vadose and Saturated Pore Waters in Sulfidic Mine Waste Tailings *in* Proceedings, 4th International Mine Water Assoc. Congress, Ljubljana, Slovenia, v. 2, pp. 305-316.

7. Williams, B.C. 1992. Multivariate Statistical Analysis of Vadose and Saturated Zone Pore Waters of Sulfidic Mine Waste Tailings, *in* Emerging Process Technologies for a Cleaner Environment, Ed. S. Chander, Soc. for Min., Metall., and Explor., Chap. 10, pp. 63-70.

8. Williams, B.C. 1992. Comparison of Multivariate Statistics and the Geochemical Code WATEQ4F for Water Quality Interpretation in Acidic Tailings. Ph.D. Dissertation, Univ. of Idaho, 164 pp.

9. Stewart, B.M., R.H. Lambeth and B.C. Williams. 1993. Factors Controlling the Release and Attenuation of Contaminants in a Sulfidic Tailings Impoundment *in* The Challenge of Integrating Diverse Perspectives in Reclamation, Proceedings, 10th National Meeting of Amer. Soc. of Surface Mining and Reclamation, Spokane, WA, May 1993, v. I, pp. 218-235.

10. Williams, B.C. and J.A. Riley. 1993. Midnite Uranium Mine - Hydrologic Research and Characterization *in* The Challenge of Integrating Diverse Perspectives in Reclamation, Proceedings, 10th National Meeting of Amer. Soc. of Surface Mining and Reclamation, Spokane, WA, May 1993, v. II, pp. 455-466.

11. Stewart B.M., B.C. Williams, and R.H. Lambeth. 1995. Investigation of Acid Production, Leaching, and Transport of Dissolved Metals at an Abandoned Sulfide Tailings Impoundment: Monitoring and Physical Properties. US Bureau of Mines RI 9577. 82 pp.

12. Williams, B.C. and J.A. Riley. 1996. Hydraulic Characterization of Midnite Mine, Wellpinit, WA: Summary of 1994 Field Season.. US Bureau of Mines RI 9606. 33 pp.

13. Williams, B.C., J.A. Riley, J.R. Montgomery, and J.A. Robinson. 1996. Hydrologic and Geophysical Studies at Midnite Mine, Wellpinit, WA: Summary of 1995 Field Season. US Bureau of Mines RI 9607. 34 pp.

ABSTRACTS AND PRESENTATIONS

1. Feb. 1989 - Presented "Determining Heavy Metal Leaching and Transport from Abandoned Mine Wastes" (see Publications, above) at Soc. for Min., Metall., and Explor. Annual Meeting, Las Vegas, NV.

2. Mar. 1989 - Presented "Heavy Metal Leaching and Transport from Abandoned Mine Wastes" at Hydrology Seminar, Univ. of Idaho.

3. Nov. 1989 - Presented "Oxidation of Pyrite in the Unsaturated and Saturated Zones of Copper/Gold Mine Tailings", at Agricultural Engineering Seminar, Univ. of Idaho.

4. Sept. 1991 - Presented "Statistical and Geochemical Analyses of Vadose and Saturated Pore Waters in Sulfidic Mine Waste Tailings" (see Publications, above) at 4th International Mine Water Assoc. Congress, Ljubljana, Slovenia.

5. Feb. 1992 - Presented "Multivariate Statistical Analysis of Vadose and Saturated Zone Pore Waters of Sulfidic Mine Waste Tailings" (see Publications, above) at Soc. for Min., Metall., and Explor. Annual Meeting, Phoenix, AZ.

6. May 1993 - Presented "Midnite Uranium Mine - Hydrologic Research and Characterization" (see Publications, above) at10th National Meeting of Amer. Soc. Of Surface Mining and Reclamation, Spokane, WA.

7. Dec. 1993 - Presented "Comparison of EPA's Toxicity Characteristic Leaching Procedure to Field Data" at Northwest Mining Assoc. Annual Meeting, Spokane, WA.

8. Mar. 1995 - Presented "Hydrologic Testing at the Midnite Mine" at Soc. Min. and Metallurg. Eng. Annual Meeting, Denver, CO.

9. Apr. 1995 - Presented "Hydrologic Testing at the Midnite Mine" at Hydrology Seminar, Univ. of Idaho.

10. Dec. 1995 - Presented "Geophysical Method for Tracing Groundwater Contamination at the Midnite Mine" at Northwest Mining Assoc. Annual Meeting, Spokane, WA.

SHORTCOURSE

Co-organizer and instructor of "Implications of Aqueous Geochemistry in Mine Reclamation" 2-day shortcourse, May 1993, taught in conjunction with the 10th National Meeting of the Amer. Soc. of Surface Mining and Reclamation, Spokane, WA.

JOURNAL REVIEWER/EDITOR

May 1989 - Symposium Chair for "Hydrogeologic and Hydrogeochemical Investigations for Waste Management", Geol. Soc. of Amer., Rocky Mountain Section, Spokane, WA.

May 1993 - Technically reviewed papers on hydrology and geochemistry of waste rock and tailings reclamation for 10th Annual Meeting, Amer. Soc. of Surface Min. and Reclamation, Spokane, WA. Also served on Conference Organizing Committee.

COMMUNITY OUTREACH

Mar. 1990 - Presented a workshop entitled "Cleaning up Groundwater Pollution" to three earth science classes at Salk Middle School, Spokane WA.

Nov. 1990 - Presented a workshop entitled "The Mining Cycle/Keeping Groundwater Clean" to an earth science class at Public School #51, Brooklyn, NY.

Nov. 1992 - Presented a dinner talk entitled "*Mining and the Environment*" to the *Lions Club*, Spokane, WA.

Nov. 1994 and Oct. 1993 - Participated in "Women in Engineering Panel Discussion" organized by Univ. of Idaho, College of Engineering.

Dec. 1994 and Dec. 1993 - Coordinated the Nat. Soc. of Prof. Eng. (NSPE) North Idaho Chapter's review of scholarship applications for high school students.

HONORS AND AWARDS

- Elon Huntington Hooker Fellowship in Hydraulics, 1982 (Cornell University).
- U.S. Bureau of Mines Research Team Innovation of the Year Award, 1990, in groundwater contamination control technology.
- Gamma Sigma Delta induction, Honor Society of Agriculture, 1990 (Univ. of Idaho).
- U.S. Bureau of Mines Performance Awards, 1991, 1992, 1993, 1994, 1995.
- U.S. Bureau of Mines Special Service Team Awards, 1992, 1993.

CERTIFICATION

Engineer-in-Training, State of PA
Professional Engineer, State of WA

PROFESSIONAL AFFILIATIONS

- Member - National Society of Professional Engineers (NSPE)
- Member - American Society of Surface Mining and Reclamation (ASSMR)
- Member - Society for Mining, Metallurgy and Exploration (SME)
- Member - Northwest Mining Association (NWMA)
- Past Member - American Geophysical Union (AGU)

WESTERN ENVIRONMENTAL LAW CENTER
Grove Burnett
P.O. Box 1507
Taos, New Mexico 87571
(505) 751-1776
(505) 751-1775 Fax

Attorneys for Plaintiffs

UNITED STATES DISTRICT COURT

DISTRICT OF NEW MEXICO

AMIGOS BRAVOS, a nonprofit corporation, and NEW MEXICO CITIZENS FOR CLEAN AIR AND WATER, a nonprofit corporation,	)	
Plaintiffs,	)	PLAINTIFFS RULE 26 (a) (2) (B) EXPERT REPORT OF RICHARD K. KELSEY, P.E.
vs.	)	
MOLYCORP, INC.	)	
Defendant.	)	

I, Richard K. Kelsey, Senior Vice-President, EnviroSearch International provide the following report as required by Fed. R. Civ. Pro. 26 (a) (2) (B) and the Court's March 17, 1997 disclosures.

A. SUMMARY OF QUALIFICATIONS

1. Qualifications of Witness

- Senior Vice President and Director of Hydrogeology and Remediation Services for EnviroSearch International.

- Registered Professional Engineer with thirteen years of professional environmental consulting experience in hydrology, hydrogeology, and environmental engineering at mining and industrially impacted sites.
- B.S. and M.S. in Agricultural Engineering with emphasis in surface water and groundwater hydrology.

2. Lists of Publications within past ten yrs.

   None

3. Compensation

   Hourly Rate is 100 $/hr

4. Cases witness has testified in past 4 years.

   None

B. SUMMARY OF OPINIONS

1. A direct hydraulic connection exists between the Molycorp waste rock piles and the Red River. The Red River is a gaining stream which drains the entire Red River watershed. The portion of the watershed drainage that contains the mine site is bounded by the Cabresto Creek drainage divide to the north and the Red River to the south (Exhibit 1). Surface water infiltration through the waste rock piles produces shallow groundwater recharge which is discharged primarily into the Red River with some infiltration captured by the cone of depression of the mine. Groundwater discharge into the Red River occurs through the shallow bedrock and alluvial aquifers by observed seeps and springs, including Portal springs, Cabin springs, Capulin springs and other springs adjacent to the Molycorp mine. Groundwater captured by the deep underground mine operation is discharged at the mill and piped to the tailings impoundment. The cone of depression created by the underground mine workings does not capture most of the groundwater from the shallow alluvial aquifer adjacent to the Red River or the shallow bedrock aquifer underlying the waste rock piles. Most, if not all, of the surface water infiltration through the waste rock adjacent to the river (Sugar Shack South, Middle and Sulphur Spring) is discharged through the alluvial and shallow bedrock aquifers into the Red River.

Local hydrologic conditions are present which enhance the connection between infiltration and leachate moving through the waste rock piles and the groundwater system which discharges into the Red River. The surface of the waste rock piles are located in a groundwater recharge zone whereas the springs and seeps along the Red River adjacent to the Molycorp mine site are located in a groundwater discharge zone. Several geologic and geohydrologic professionals have examined the groundwater system beneath the mine site. The prevailing aquifer conditions within the mine area are sufficiently understood to establish the basis for the hydrologic connection between the waste rock piles and the Red River.

2. Local geologic conditions are present which enhance the connection between infiltration and leachate moving through the waste rock piles and the groundwater system which discharges into the Red River. Geologic conditions beneath the Molycorp mine have been extensively studied. The prevailing geologic conditions that create preferential flow pathways for groundwater movement from the waste rock piles to the Red River are sufficiently well understood to constitute the basis for the hydraulic connection between the waste rock piles and the Red River.

3. The Molycorp mine has altered the natural local surface water and groundwater hydrology and water quality in the vicinity of the mine. Surface water infiltration and groundwater recharge have increased due to the placement of the waste rock piles in the watershed and tributary valleys of the Red River. Operations of the Molycorp mine have impacted the presence and behavior of seeps and springs along the Red River adjacent to the mine site. The Molycorp mine has had a significant impact on the water quality observed in the Red River.

C. BASIS FOR OPINIONS

This Summary of Opinions relies in part upon specific documents available through Molycorp and the public record; these documents are identified and cited in this Basis for Opinion.

1. A direct hydraulic connection exists between the Molycorp waste rock piles and the Red River. Numerous investigators have demonstrated that the Red River is a gaining stream which drains the entire Red River watershed (1013 pB-5; 1021 p4; 1017 p10; 1012 p1, p2; and 1040 p230). The portion of the watershed drainage containing the mine site is bounded by the Cabresto Creek drainage divide to the north and the Red River to the south (Exhibit 1; 1046, 1047). The waste rock piles are constructed immediately adjacent to the alluvial aquifer; they lie directly over the exposed bedrock (1013 Figure 5). Surface water infiltrates through the waste rock piles and produces shallow groundwater

recharge which is discharged primarily into the Red River; some infiltration may be captured by the cone of depression created by dewatering of the mine. Groundwater discharge into the Red River occurs through the shallow bedrock and alluvial aquifers via observed seeps and springs. These seeps and springs include Portal springs, Cabin springs, Capulin springs, and other springs adjacent to the Molycorp mine (1013 p5-6; pB-3, 1021 p16). Groundwater captured by the cone of depression created by dewatering the deep underground mine is discharged at the mill and piped to the tailings impoundment. Due to perching groundwater conditions near the surface, hydrologic boundaries within the drainages in the mine area, and low permeability bedrock in the vicinity of the underground mine, the cone of depression created by the underground mine workings does not capture a significant portion of the groundwater flowing through the shallow alluvial aquifer adjacent to the Red River or the shallow bedrock aquifer underlying the waste rock piles (1013 p6, p12). Most, if not all, of the surface water infiltration through the waste rock piles adjacent to the river is discharged through the alluvial and shallow bedrock aquifer into the Red River.

Local hydrologic conditions are present which enhance the hydraulic connection between infiltrating water, the leachate moving through the waste rock piles and the groundwater which discharges into the Red River. The surfaces of the waste rock piles are located in groundwater recharge zones whereas the springs and seeps along the Red River adjacent to the Molycorp mine site are located in groundwater discharge zones (1012 p21; 1013 pB3; 1017 p10; 1021 p4). The primary aquifer systems within the mine area are sufficiently well understood so as to establish the basis for the hydraulic connection between the waste rock piles and the Red River.

This opinion is based upon inspection of the mine site; review of numerous scientific reports prepared by Molycorp's consultants; review of published geologic and hydrologic reports from several state agencies; examination of water levels measured in the Red River and measured in groundwater monitoring wells; examination of pre-mine and post mine topographic maps; study of current configuration of the waste rock piles; depositions obtained from mine management personnel; interviews with multiple state employees familiar with the site; and on experience encountered with similar hydrologic conditions at other mine operations. The scientific reports from Molycorp's geohydrologic consultants and state agencies generally are consistent in describing the hydraulic connection between the waste rock dumps and the Red River. The scientific reports from Molycorp's geohydrologic consultants and state agencies consistently describe the waste rock piles as sources of inflow to the groundwater system. The reports also describe the seeps and springs adjacent to the mine as sources of discharge to the river (1012 p11-12, p21; 1013 p5; 1017 p10; p17-18; 1021 p16, p33). This hydraulic connection is consistent with conditions expected in this type of geographic, hydrologic and geologic setting. Examination of all factors and

information indicate a preponderance of evidence that a direct hydraulic connection exists between the waste rock piles and the Red River. Furthermore, no tangible evidence based on sound fundamental principles of hydrology and hydrogeology has been identified which can refute the hydraulic connection between the waste rock piles and the Red River.

The USGS topographic maps indicate that the Molycorp mine is contained within the Red River watershed boundary (1046, 1047, Exhibit 1). The orientation of the pre-mine topographic surface within the entire mine area is downhill towards the Red River and its tributaries (Exhibit 2). A number of seepage studies and hydrologic reports, including those performed and prepared by mine consultants and state and federal government agencies, demonstrate that the Red River is a gaining stream in the vicinity of the Molycorp mine area (1013 pB-5; 1021 p 4; 1017 p10). The Molycorp mine manager also has indicated that the Red River drains the entire watershed (1040 p230). The New Mexico Environment Department Surface Water Quality Bureau has indicated that "as a gaining stream, the Red River is recharged throughout the length of its main stem by groundwater, as documented by the US Geological Survey and the NM State Engineers Office." (1021 p 4).

Inflow to the watershed includes surface water infiltration (groundwater recharge) which is derived from precipitation on the slopes of the watershed and waste rock piles that neither evaporates nor is consumed by vegetation. Surface water runoff from the watershed and mine area into the Red River essentially is eliminated through storm water management practices employed by the mine (1012 p4, p20; 1034). Local surface water runoff within the watershed and on top of the waste rock piles infiltrates and recharges the underlying groundwater system. Outflow from the watershed includes groundwater captured by the cone of depression created by dewatering the mine operation. Groundwater not captured by mine operations discharges to the Red River through seeps and springs in the alluvial and bedrock aquifers. The Red River drains the entire watershed. A vertical upward hydraulic gradient is observed in monitoring wells adjacent to the Red River which, along with the observation of seeps and springs, indicates the area adjacent to the river is a groundwater discharge zone.

Numerous investigators, including Molycorp's geohydrologic consultants and technical staff from multiple state agencies describe two principal, and interconnected, groundwater systems in the mine area. These two aquifers are described as a shallow fractured bedrock aquifer and an overlying aquifer within the alluvium and valley-fill of the Red River and tributary drainages (1012 p17-18, p21; 1013 p5, p6; 1017 p10; 1021 p 67). The natural gradient in the alluvial aquifer slopes towards the Red River (1013 p5). The alluvial aquifer is recognized by Molycorp's' geohydrologic consultants and scientists from various state agencies as a transmissive hydraulic unit between the waste rock piles and the Red River (1013 pB3; 1017 p10). Molycorp's geohydrologic consultants have indicated "the primary hydrologic linkage between up-gradient sources and the river is the fan delta deposits at the mouths of tributary canyons at

Capulin Canyon and Sugar Shack South" (1013 p5). The alluvial aquifer is underlain by bedrock which limits vertical flow except in areas where fractures and faults create hydraulic preferential flow paths to the Red River. The majority of the waste rock piles are underlain by the shallow bedrock aquifer. Lower permeability bedrock is located at depth and acts as a hydrogeologic basement and a regional aquitard that limits deep circulation of groundwater (1013 pB7).

The underground mine extends into the deeper lower permeability bedrock. The cone of depression created by dewatering the underground mine workings does not extend across the entire mine site; the cone drains the area adjacent to the underground mine within the deep bedrock (1013 p6, pB7). The steep gradient believed to exist within the mines' cone of depression infers that the deep bedrock exhibits low permeability. The cone of depression does not collect a significant portion of the groundwater in the shallow aquifers which lie between the waste rock piles and the Red River (1013 pB7). The shortest path of least resistance for surface water infiltration through the waste rock piles adjacent to the river is through the shallow alluvial and bedrock aquifers into the Red River. Several groundwater monitoring wells in the area of the mine (MMW-2, MMW-3, MMW-7, MMW-8 and MMW-10) exhibit water adjacent levels above the levels in the Red River; therefore they are not significantly impacted by the cone of depression draining the mine. Groundwater in the shallow alluvial and bedrock aquifers that is not captured by the cone of depression discharges to the Red River.

2. Local geologic conditions are present which enhance the hydraulic connection between infiltration and leachate moving through the waste rock piles and the groundwater system which discharges into the Red River. Geologic conditions beneath the Molycorp mine have been studied extensively by numerous geologic professionals including mine geologists, consulting geohydrologists working for Molycorp and geologists working for the State of New Mexico Environmental Division (1012, 1013, 1017, 1021). The prevailing geologic conditions that create preferential flowpaths for groundwater flow from the waste rock piles to the Red River are understood sufficiently well to establish the basis for the hydraulic connection between the waste rock piles and the Red River.

This opinion is based upon a review of scientific hydrogeologic reports prepared by Molycorp's consultants; detailed examination of geologic maps prepared by Molycorp geologists; examination of geologic maps prepared by consulting geohydrologists; and upon review of published geologic and hydrologic reports from multiple state agencies. The scientific reports from Molycorp's' consultants and state agencies and geologic maps prepared by Molycorp consistently describe the geologic features that create preferential pathways for groundwater flow between the waste rock piles and the Red

that known geologic features are present which create preferential flow paths for leachate migration and for groundwater flow between the waste rock piles and the Red River.

In many areas, the fractured bedrock creates perched groundwater conditions which discharges into the Red River (1013 p6). The volcanic and sedimentary rock units, which underlie the alluvium and also are exposed at the pre-mine surface, are fractured and faulted north of the river (1013 Figure 3, p5, B1; 1037, 1038). The underlying shallow volcanic bedrock is a structurally controlled transmissive aquifer that exhibits highly variable hydraulic conductivity depending on the fracture orientation, fracture spacing, and the openness of the fracture spacing, below the water table (1013 pB-2). The fractures and faults in the shallow bedrock aquifer that create preferential flow paths to the Red River have been extensively mapped by Molycorp's consultants and mine geologists as well as technical professionals from state agencies. The fractured and faulted shallow bedrock aquifer exhibits preferential flow paths that transmit groundwater from the waste rock piles to the Red River. Geologic maps prepared by Molycorp's geologists identify faults immediately beneath the Middle and South Sugar Shack waste rock dumps which extend directly to Cabin springs (1037). Molycorp's consultants indicate that "Questa (Molycorp) geologist's mapped northeast-southwest and east-west trending Tertiary dike swarms that intersect in the area of the Cabin springs. The northeast-southwest swarm underlies the existing Middle and Sugar Shack South waste rock disposal areas. The presence of the dikes may be indicative of structurally controlled zones that hydraulically connect the foundation of Middle and Sugar Shack waste rock disposal areas, and the hydrothermal scars that underlie the waste rock disposal areas to the Cabin springs" (1012 p13). Several of these mapped structural features are shown on Exhibit 1 in relation to the waste rock piles. The deeper metamorphic and intrusive rocks form a hydrogeologic basement which constitutes a regional aquitard that exhibits low hydraulic conductivity, thereby limiting deep circulation of ground water (1013 pB-1). In addition, groundwater recovery from the underground mine workings (located within the deeper low permeability bedrock) is not sufficient to significantly affect the shallow fractured bedrock and alluvial aquifers.

3. The Molycorp mine has altered the natural local surface water and groundwater hydrology and water quality in the vicinity of the mine. Surface water infiltration and groundwater recharge have increased due to the placement of the waste rock piles in the watershed and tributary valleys of the Red River. Operations of the Molycorp mine have impacted the presence and behavior of seeps and springs along the Red River adjacent to the mine site. The Molycorp mine has had a significant impact on the water quality observed in the Red River.

This opinion is based upon review of surface water and groundwater scientific reports prepared by state and federal agencies, correlation of reported observations within the Red River to changes in operational procedures within the mine, examination of the

characteristics and configuration of the surface of the waste rock piles, expected and predictable responses in surface water infiltration due to the presence of the waste rock piles, and information obtained during deposition of the Molycorp mine manager. Examination of all factors and information indicates a preponderance of evidence that the Molycorp mine has impacted and altered the hydrology and the water quality of the Red River.

The presence of the mine and the configuration of the waste rock piles in some areas have increased surface water infiltration and groundwater recharge. Less evapotranspiration occurs from the bare rock surface of the waste rock piles than from the natural vegetative cover. The rubbly and uneven surface of the waste rock is more permeable than the surface of the natural collovium. Less runoff from the watershed occurs because the waste rock piles capture stormwater. More groundwater recharge occurs because more surface water infiltrates under the existing configuration of the mine surface than through the natural pre-mine drainage configuration.

Discharge of groundwater from the perched alluvial and fractured shallow bedrock aquifers through the seeps and springs adjacent to the Red River has increased due to the increase in groundwater recharge. The State of New Mexico Environmental Department/Surface Water Division documents "increased groundwater flow and discharge in the seeps and springs have been observed since the waste piles were placed in the mine. Analysis of data from USGS groundwater seepage investigations in 1965 and 1988 indicates that there was a significant (149%) increase in seepage rates (groundwater accretion) to the middle reach of the Red River near Molycorp in 1988 as compared to 1965. The Molycorp open pit mine was begun in 1965; by the time of the 1988 seepage investigation the pit had been in place for more than twenty years. The pit and associated waste-rock dumps enhance groundwater recharge and may be responsible for the documented increase in seepage rates, and changes in water quality." (1021 p67). This reported increase in seepage rates probably is an accurate interpretation given the increase in groundwater recharge and the presence of perched conditions beneath the waste rock piles.

Reported reductions in flow rates from the springs at Capulin Canyon adjacent to the Molycorp mine along the Red River probably have been due to interception of shallow groundwater below the waste rock piles in upper Capulin Canyon. According to Molycorp mine management, collection of shallow groundwater through the Capulin Canyon interception system reduced spring flows from Capulin springs adjacent to the Red River (1040 p213, p216). This observed reduction demonstrates the direct hydraulic connection between the waste rock piles and seepage observed at the river. Due to the collection at the interception system, less flow would occur through the shallow alluvial aquifer, however, deeper groundwater flow within the bedrock aquifer would not be significantly affected.

Based on the proximity of the Moly Tunnel outfall to the Portal springs and the Red River; and the sequence of events leading up to the emergence of the Portal spring,

evidence suggests that plugging of the Moly Tunnel in 1992 caused the subsequent emergence of Portal spring immediately downgradient along the Red River. Gravity drainage of groundwater out of the Moly Tunnel occurred prior to 1992. A bulkhead was placed in the Moly Tunnel in 1992 in order to stop discharge from the underground mine if the underground mine dewatering system failed. Placement of the bulkhead within the tunnel stopped the drainage out of the tunnel. Portal spring was observed for the first time in 1994 (1021 p43; 1040 p208). Water which formerly drained out of the tunnel probably flows through the fractured bedrock into alluvial aquifer and discharges at Portal spring which is immediately downgradient from the Moly tunnel bulkhead. Portal spring is outside the cone of influence associated with dewatering the old underground mine.

The State of New Mexico Environmental Division indicates that "The Red River watershed is one of the most severely impacted perennial stream system in regard to metal loading in New Mexico" (1021 p17). They further indicate that "Molycorp Mine is by far the most significant" of all the sources of contamination potentially impacting the Red River. Molycorp is by far the largest industrial operation within the Red River watershed. No mine in the Red River district produced more than a few hundred tons of ore, except the Memphis Mine on Bitter Creek, which produced 3500 tons of ore (1004 p376). Most of the activity in the district was development and exploration work. Molycorp produced over 328,000,000 tons of waste rock. Prior to open pit operations, the Red River was documented as a high quality stream. The presence of hydrothermal scars for thousands of years prior to the open pit operation apparently had little effect on the river, other than turn it red occasionally with sediment. Numerous water quality studies by state and federal agencies have documented significant deterioration of the Red River between 1966 and 1992, after the open pit began operation in 1965 (1017 p23, p24-25; 1021 p43-47). Summaries of these studies describe the condition of the Red River through time as follows: Water quality studies performed by the USDHEW in 1966 documented "the Red River as an "exceptional" high quality surface water resource". In November 1971, the United States Environmental Protection Agency concluded "the chemical quality of the Red River water remains very good...biological conditions in the river are good...and...occasional breaks in the [tailings] line are causing some degradation in stream quality and biota. During this same period of the late 1960's and early 1970's, however, the New Mexico Department of Game and Fish discovered in the course of routine population studies that fish were conspicuously absent in the middle reach of Red River where thriving populations had once existed. In 1982 the U.S. EPA conducted a "Site Specific Water Quality Assessment" of the Red River and found the stream to be substantially impaired from metal loading. The 1992 305(b) report listed an increased concentration in Red River in the vicinity of Molycorp Mine of several metals including Cd, Cu, Pb, Ag, and Zn. (1021 p7). The New Mexico Environmental Division further states that "during the surface water investigation performed by the State of New Mexico, water from groundwater seeps was observed emerging and entering Red River approximately one and a half miles below (southwest) Molycorp

mine. Along this same stretch of the Red River, manganese concentrations were greater than three times the concentrations detected upstream (NMED, Feb. 28, 1994, Table 6; Smolka and Tague, 1989). Fish census data of 1960 indicate that approximately 572 fish per mile were established in the river. The 1988 fish census found no fish in this same reach (NMDGF, November 29, 1988)." (1021, p9)

The preponderance of data suggest that the Molycorp mine has had a severely detrimental effect of the water quality of the Red River.

Richard K. Kelsey

Dated March 14, 1997

LIST OF DOCUMENTS
Moly Corp.

March 14, 1997

DOCUMENT NUMBER	DATE	DESCRIPTION
1004	1990	"Geology of the Red River District, Taos County, New Mexico" by Thomas T. Roberts, Gary A. Parkinson & Virginia T. McLemore in the New Mexico Geological Society Guidebook, 41st Field Conference, Southern Sangre de Cristo Mountains, New Mexico, 1990
1012	4/13/95	Questa Molybdenum Mine Geochemical Assessment. Prepared by Steffen Robertson and Kirsten (U.S.) Inc. for Molycorp Inc.
1013	4/21/95	Progress Report on the Geology, Hydrogeology, and Water Quality of the Mine Area Molycorp Facility, Taos County, New Mexico. Prepared by South Pass Resources, Inc./SPRI for Molycorp, Inc., Questa Division
1017	10/20/95	Expanded Site Inspection Report on Molycorp Inc., Questa Division, Taos County, New Mexico. Prepared by Stuart Kent, New Mexico Environment Department, Groundwater Protection and Remediation Bureau-Superfund Program
1021	3/96	Red River Groundwater Investigation, Final Report submitted to USEPA, Region VI, March, 1996 by Dennis Slifer, New Mexico Environment Department Surface Water Quality Bureau
1034	12/16/96	Letter from Geyza I. Orinczi, Environmental Manager, Molycorp, Inc., Questa Division to Mr. Richard E. Powell, New Mexico Environment Department Surface Water Qualilty Bureau re: Compliance Evaluation Inspection Report, Molycorp, Inc., NPDES Permit #NMR00A089, November 18, 1996
1036	undated	Geology of the Questa Mining District: Volcanic, Plutonic, Tectonic and Hydrothermal History by Jeff Meyer, Dept. of Geological Sciences, Univ. of Calif. at Santa Barbara, Robert Leonardson, Chief Geologist, Union/Molycorp
1037	undated	Plate 2 Geologic Map of the Questa Mine Area
1038	undated	Plate 1 Geologic Map and Cross Sections of the Questa Mining District
1040	1-22-97	David Shoemaker Deposition

RICHARD KELSEY, P.E.
Senior Vice President, Remediation Services, Director of Hydrogeology

M.S., Agricultural Engineering (Hydro/geotechnical), 1984 University of Idaho, Moscow, Idaho

B.S., Agricultural Engineering (Hydro/geotechnical), 1983 University of Idaho, Moscow, Idaho

Mr. Kelsey is a registered Professional Engineer with over 12 years of environmental consulting and litigation support experience including management of major client accounts involving complex multi-component remediation projects and providing comprehensive expert witness services. Mr. Kelsey also performs administrative management of the Hydrogeology and Remedial Engineering Departments, participates in corporate management as a member of the Board of Directors, and coordinates numerous domestic and international marketing initiatives.

Mr. Kelsey's primary responsibilities include: oversight of all technical staff in the Hydrogeology and Remedial Engineering departments at EnviroSearch, providing senior project support to all site characterization, remediation, and site closure projects; and allocating administrative and interdisciplinary staff resources to support project requirements. As client liaison, Mr. Kelsey has been involved with virtually every aspect of site remediation, hazardous waste management, and environmental compliance. He manages multi-component remedial feasibility studies and coordinates risk assessment activities at complex hazardous and non-hazardous waste sites. He has extensive experience in directing large technical teams of interdisciplinary personnel within the engineering, earth, and environmental sciences.

Additional technical responsibilities involve developing and reviewing workplans and work products associated with RI/FS and RFI activities conducted under CERCLA and RCRA including: sampling and analysis plans, data management plans, environmental data validation procedures, and preparation of data quality assessment and site characterization reports. He has conducted Remedial Investigations and RCRA Facility Investigations at several sites under state and federal compliance orders, and has a thorough working knowledge of related environmental regulations including SARA, TSCA, and the Clean Water Act. He also provides senior technical support in evaluating remedial alternatives and designs and implements soil and groundwater remediation systems at a wide variety of sites. Mr. Kelsey provides significant legal and litigation support for complex cases and participates in resolving diverse regulatory, legal and technical issues. As Program Manager for key accounts, Mr. Kelsey monitors all aspects of work product quality, project budgets, and schedules.

As Director of Hydrogeology/Remediation, Mr. Kelsey develops conceptual, analytical, and numerical models of hydrogeologic contaminant transport/distribution systems; characterizes the presence, persistence and mobility of organic contaminants complex hydrogeological settings; and evaluates alternative groundwater mitigation scenarios. He has implemented specific risk assessment modeling approaches in support of site closure at several sites contaminated with hydrocarbons, chlorinated solvents, heavy metals and radionuclides.

CERCLA/RCRA Remediation Experience

Mr. Kelsey has served as a Technical Advisor and Program Manager of over 50 soil and groundwater investigation and/or remediation projects involving facilities impacted by chlorinated solvents, radionuclides, petroleum products, pesticides, and heavy metals. As Senior Technical Advisor in Remediation Services, Mr. Kelsey has overseen the investigation and remediation of numerous sites impacted by petroleum compounds and manages several sites involving complex environmental conditions. He has developed and implemented several RI/FS workplans for federal NPL sites and prepared several Site Investigation Plans, Record of Investigation, Site Cleanup Plans, and Risk Assessments for sites regulated under a variety of regulatory programs in the State of Utah. Examples of Mr. Kelsey's specific project experience with remediation at hazardous waste sites includes:

Volvo GM RCRA Corrective Action - Project Manager in developing and implementing a RCRA Facility Investigation, and a RCRA Corrective Measures Study to cleanup soils and groundwater contaminated with heavy metals, solvents, petroleum compounds, radionuclides, mixed wastes, and industrial sludges. Site investigation activities included: extensive soil and groundwater characterization, defining aquifer parameters, implementation of pilot scale Soil Vapor Extraction and Air Sparging Tests and performance of insitu and exsitu treatability studies. Remedial design and implementation includes full scale application of bioventing, air sparging, and groundwater extraction systems as well as hazardous, radiological, and non-hazardous waste characterization, profiling, and disposal at licensed TSD's. Innovative waste segregation and volume reduction approaches developed by Mr. Kelsey resulted in over $1 million savings in disposal costs to the client and expedited cleanup of radiological wastes. Key aspects of the project included coordination of risk assessment activities to define cleanup objectives and standards as well as development and implementation of numerous Interim Site Management Plans resulting in significant cost savings and expedited site cleanup.

Program Manager Multiple Mine Sites in Idaho and Nevada - Mr. Kelsey is Program Manager for a multi-year multi-state contract with the US Forest Service to conduct CERCLA investigations and remedial evaluations of mine impacted sites in central Idaho and Nevada. Mr. Kelsey directed a multi-disciplinary field team to characterize metal concentrations in soil, sediment, surface water and groundwater from past and present mining activities at operating and abandoned mines in Idaho. He also directed an Engineering Evaluation/Cost Analysis (EE/CA) and remedial design for a Removal Action at an abandoned mine administered under CERCLA. Under Mr. Kelsey's direction, a multi-disciplinary project team conducted the EE/CA at the Buckskin National and McCormick Group Mine sites to address discharge of acid mine drainage, metals and cyanide in surface waters; stabilization of abandoned mine tailings; and cleanup of mercury contaminated soils. The scope of work includes a comprehensive analysis of removal and closure requirements and remedial alternatives, and design of the selected remedial action. The EE/CA satisfied environmental review and documentation requirements and provided a framework for evaluating and selecting alternative removal/closure technologies. The EE/CA was performed to satisfy the State of Nevada mine stabilization and federal EPA closure requirements.

Norton Aquifer Remediation - Mr. Kelsey acted as Technical Advisor in overseeing the development and implementation of a RCRA Facility Investigation, RCRA Corrective Measures Study and RCRA Corrective Action Plan to remediate a shallow aquifer contaminated with hexavalent and trivalent chromium. Site characterization included defining controlling hydrogeologic and geochemical parameters and a statistical analysis to determine background concentrations in soils and groundwater. The project included the design, construction, and operation of a multi-well groundwater extraction system and treatment plant to remove chrome from extracted groundwater prior to discharge to the local POTW. Risk assessment will be used to justify leaving residual contamination in place in support of site closure.

City of Midvale RI/FS Review - Project Manager in performing an independent review of all RI/FS activities conducted by the U.S. EPA for a mill tailings Superfund site. In support of a local citizens group for the City of Midvale, Mr. Kelsey managed a multidisciplinary independent review of the Remedial Investigation, Feasibility Study, and Risk Assessment for the Midvale Tailings Superfund site. The technical adequacy and thoroughness of the work performed by the EPA contractor was examined. Data deficiencies and inconsistencies in data interpretation were identified and an evaluation of the RI/FS methods and proposed Corrective Measures were performed.

Litigation Support Experience

Litigation support experience includes participating in strategic planning, preparation of expert testimony, formal expert witness training, preparation of technical and graphical work

products supporting deposition and trial, and critical review of opposition work products. Case specific experience is outlined below:

Shughart, Thomson and Kilroy/Joel Mosher - Mr. Kelsey provided expert witness services and directed a technical team of hydrogeologists and engineers in support of an insurance company refuting a 3 million dollar claim to recover remediation costs from a property impacted by a complex history of hydrocarbon releases. Mr. Kelsey participated in strategic case planning, directed review of all pertinent records, developed expert opinions, disclosure statements and products for deposition and trial, and critiqued oppositions work products. Technical support included developing alternative cleanup cost allocation approaches and identifying controlling hydrogeologic and site conditions affecting cleanup and assessing reasonableness of the remediation approach and associated costs. Settlement was reached in favor of our client during disclosure and deposition prior to trial which was significantly facilitated by the strength of the technical expert opinions provided.

Dunn and Dunn/Carl Ericson - On behalf of an insurance company, Mr. Kelsey provided senior oversight and peer review of opposition work products implicating release timing during specified periods of coverage. Mr. Kelsey directed a technical review team in critiquing the opposition groundwater flow and contaminant transport modeling suggesting incident timing and identified weaknesses in the oppositions deposition and overall modeling approach. Mr. Kelsey prepared a formal critique of the oppositions release timing analysis which was used to refute incident timing and implied coverage.

Beveridge and Diamond - Larry Bazel - In support of pending litigation for a Potentially Responsible Party (PRP), Mr. Kelsey evaluated the environmental conditions attributable to historical smelting and refining practices from an historical lead and precious metal refinery which operated in the late 1800's and early 1900's. A complex history of industrial usage including lead smelting, acid production, paint manufacturing, and vehicle maintenance is associated with the site involving several PRP's negotiating the allocation of cleanup costs. An examination of historical documents and metallurgical practices revealed the likely processes and character of the feedstocks and by-products from the historic smelter. The environmental impacts potentially attributable to the smelting operations were compared to the observed soil and groundwater contamination in order to accurately allocate the responsibility for cleanup.

Ballard Spahr Andrews & Ingersoll/Bill Prince - Mr. Kelsey has provided environmental and litigation support to Mr. Prince in a number of cases involving site assessment and remediation. Mr. Kelsey currently acts as Program Manager for a complex RCRA Corrective Action project (Volvo/GM) which is subject to significant review by opposition's counsel and technical consultant. While litigation is not pending, this project demonstrates an ongoing relationship with a key client in the legal community involving substantial remedial efforts. Other case support provided by EnviroSearch includes examination of oppositions work product and providing testimony during mediation proceedings and technical consultation on several cases involving alleged contamination by multiple parties.

Previous Employment

MK-Environmental Services, Boise, Idaho, Senior Hydrologist/ Hydrogeologist - Mr. Kelsey was responsible for design and implementation of hydrogeological and site characterization investigations, development and evaluation of remedial action and waste management alternatives, and environmental resource investigations.

Rocky Mountain Arsenal - Mr. Kelsey developed approximately one third of the expert testimony supporting a 2.8 billion dollar environmental claim against more than 200 insurance companies. To identify likely release timing and associated coverage, Mr. Kelsey developed and supervised a large scale groundwater flow and contaminant transport modeling program to identify and define the sources of pesticides and organic compounds in a complex hydrogeologic setting. He designed and implemented a comprehensive modeling approach considering all aspects of

development including the conceptual, analytical, and numerical modeling. Additionally, he supervised and coordinated the efforts of up to 20 engineers, soil chemists, hydrologists, hydrogeologists, and computer specialists in the development of regional and numerous local scale groundwater flow and contaminant transport models, including an evaluation of potential migration through the vadose zone. Mr. Kelsey also coordinated staff chemists performing plume dissection and chromatographic fingerprinting to relate contaminant sources to the associated soil and groundwater contamination.

Mr. Kelsey also participated in the identification, selection, and preparation of a nationally recognized expert witness as well as refuting opposing deposition and expert testimony. Mr. Kelsey participated in a formal training program for expert witnesses; developed and delivered technical presentations; served as liaison between the client, legal counsel, and support staff; and provided litigation support during the deposition process and trial.

Chemical manufacturing complex remediation, Beaumont, Texas - RCRA Corrective Measures Study/RCRA Corrective Action - Mr. Kelsey managed the identification and evaluation of cleanup alternatives to remediate LNAPLS and DNAPLS in groundwater including design and construction of a 32 well groundwater recovery and multi-component treatment plant for Dupont Beaumont Works chemical plant under the RCRA Corrective Action Program in the State of Texas. The project also included development of a system optimization and startup program as well as operation and maintenance plans.

As lead hydrologist, Mr. Kelsey was responsible for the design and implementation of a groundwater remediation program involving multiple sources of LNAPLS and DNAPLS in a complex hydrogeologic and contaminant distribution setting. He collected and analyzed hydrogeologic data for aquifer parameterization and hydraulic characterization, evaluated interaction between surface water and aquifer systems, and coordinated mathematical modeling and well field simulation studies to develop an efficient groundwater recovery system. He supervised the development and application of a three-dimensional numerical model (MODFLOW) to simulate the natural hydrogeologic system and predict the response of the multi-aquifer system to dewatering. He also characterized selected principal organic contaminants and evaluated their distribution and transport characteristics in relation to recovery and treatment system performance. Additionally, he interfaced with other engineering disciplines to develop final design drawings and construction plans.

Sand Springs Petrochemical Complex, Oklahoma - Mr. Kelsey developed and implemented CERCLA Remedial Investigation work plans and coordinated a large analytical laboratory testing program. He supervised a field investigation effort involving soil and waste sampling from numerous exploratory excavations and borings associated with multiple on-site sources. Additionally, he developed and implemented an automated data validation program, coordinated the development of an analytical data base, conducted statistical analysis of results, and prepared a data quality assessment and site characterization reports.

Usibelli Coal Mine, Alaska - Mr. Kelsey conducted a dewatering feasibility study to determine the potential for installing a groundwater extraction system to reduce inflow to the mine and stabilize the working slope and highwall. He performed hydrogeologic characterization, aquifer pump tests and analytical modeling to estimate groundwater flow rates and required well spacing associated with conceptual well flow characteristics and fracture flow patterns followed by recommending installation of horizontal collection drains at critical locations. He also assisted in the development of a surface water control plan and associated portions of the mine permit.

Pesticide manufacturing facility, Glacier Park Company, Washington - Mr. Kelsey developed and implemented a CERCLA Remedial Investigation plan to determine the presence and distribution of hazardous organic chemicals in soils and groundwater for a pesticide manufacturing facility in Washington. He performed a hydrogeological characterization, defined potential sources,

determined type and potential fate of chemicals of concern, sampled surface soils, and installed monitoring wells to define the distribution of contaminants and local hydrogeological regime. Mr. Kelsey established background water quality, and developed and evaluated remedial cleanup-containment alternatives.

Locomotive Remanufacturing Facility Remediation, Idaho - Mr. Kelsey performed characterization of the quality and treatability of industrial effluent containing organic and inorganic chemicals for this hazardous waste site in Idaho. He evaluated alternative treatment and/or disposal options, and initiated the disposal of wastewater through land application and on-site treatment by a portable carbon absorption train.

Training

Petroleum and Geological Engineering, Montana School of Mines

OSHA 29 CFR 1910.120 40-hour hazardous waste worker and site supervisory training

Computer Modeling of Groundwater Flow and Contaminant Transport Process short course, Butler University, International Groundwater Modeling Center

Certification

Professional Engineer - Utah and Idaho

Affiliations

National Water Well Association

National Groundwater Association

Association of Groundwater Scientists and Engineers

DKMR1195

WESTERN ENVIRONMENTAL LAW CENTER
Grove Burnett
P.O. Box 1507
Taos, New Mexico 87571
(505) 751-1776
(505) 751-1775 Fax

Attorneys for Plaintiffs

UNITED STATES DISTRICT COURT

DISTRICT OF NEW MEXICO

AMIGOS BRAVOS, a nonprofit corporation, and NEW MEXICO CITIZENS FOR CLEAN AIR AND WATER, a nonprofit corporation,	)
Plaintiffs,	) PLAINTIFFS RULE 26 (a) (2) (B) EXPERT REPORT OF LELAND LEROY MINK, Ph.D., PG
vs.	)
MOLYCORP, INC.	)
Defendant.	)

I, Leland L. Mink, provide the following report as required by Fed. R. Civ. Pro. 26 (a) (2) (B) and the Court's March 17, 1997 disclosures.

A. SUMMARY OF QUALIFICATIONS

1. QUALIFICATIONS OF WITNESS

- Director of the Idaho Water Resources Research Institute
- Co-director of the Center for Hazardous Waste Remediation
- Researcher and Professor of Hydrology at the University of Idaho

Menzies, A.J., Granadoes, E.E., Sanyal, S.K., Mink, L.L., Merida, L., 1990. An Integrated Test Program for the Definition of a High Temperature Geothermal Reservoir: A Case Study from the Zunil Geothermal Field, Guatemala, Geothermal Resources Council Transactions, Vol. 14, Part I, Hawaii.

Adams, M.C., Moore, J.N., White, L.D., Mink, L.L., Leiva, O., Ramirez, S., Anchissi, A.C., 1992. Fluid Recharge of the Zunil, Guatemala Geothermal System.

Freeman, K.M., Mink, L.L., 1993. Geographical Viability of Ground Water Geothermal Heat Pumps in the United States. Geothermal Resources Council: Utilities and Geothermal: An Emerging Partnership. 1993 Annual Meeting. Transactions, Volume 17. Burlingame, California.

Whitney, D.C., Mink, L.L., 1993. Agri-chemical Groundwater Quality Protection in Idaho: Management and Policies, Fourth National Conference on Pesticides Proceedings, Richmond, Virginia.

Foley, D., Mink, L., 1996. Geysers, Mudpots, Hotspings and a Lurking Volcano: Yellowstone National Park as a Dynamic Laboratory in Geologic Observation. Geologic Society of America Transactions, Denver, Colorado.

Mink, L.L., 1996. Headwater Watersheds: Using Yellowstone as an Outdoor Classroom for Watershed Training, Geologic Society of America Transactions, Denver, Colorado.

Mink, L.L., 1996. Idaho Mobile Outreach Pollution Prevention Program, ECO-Informa '96 Proceedings, Orlando, Florida.

2b. ADDITIONAL SELECTED PUBLICATIONS

Craig, M.R., Mink, L.L. 1985. An Analytical and Graphical Technique to Determine the spacing of Drainage Wicks for Pressure Relief in an Open Pit Coal Mine: Proceedings of the Second International Mine Water Congress, Granada, Spain, Vol. 1, No. 1, pp. 95-103.

Goldman, D., Allman, D.W., Mink, L.L. Oct. 1979. Data Collection and Evaluation of Combined Fractured and Porous Media Flow in a Fluid-Dominated Geothermal System: National Water Well Association, Oklahoma City, Oklahoma.

Williams, R.E., Mink, L.L. 1975. Settling Ponds as a Mining Wastewater Treatment Facility: Idaho Bureau of Mines & Geology, Pamphlet #164.

Norbeck, P.H., Williams, R.E., Mink, L.L. 1974. Ground Water Leaching of Jig Tailings Deposits in the Coeur d'Alene District of Northern Idaho: Water Resource Problems Related to Mining, American Water Resources Association.

Mink, L.L., et al. 1974. Mercury and Heavy Metal Contamination in the Jordan Creek Drainage Near Silver City, Owyhee County, Idaho: Proceedings of the 12 Annual Engineering Geology and Soils Symposium, Boise, ID.

Williams, R.E., Wallace, A.T., McNay, L.M., Mink, L.L. 1973. Renovation of Wastes by Mine Tailings Ponds: Mining Engineering, Vol. 25, No. 7.

Williams, R.E., Wallace, A.T., Mink, L.L. 1972. Effect of Early Day Mining Operations on Present Day Water Quality: Ground Water, Vol. 10, No. 1.

Mink, L.L., Kealy, C.D., Williams, R.E. 1972. Structural-Environmental Characteristics of Tailings Ponds: 10th Annual Engineering Geology and Soils Symposium, Moscow, Idaho.

3. COMPENSATION

Hourly rate is $125/hr

4. CASES IN WHICH WITNESS HAS TESTIFIED IN PAST 4 YEARS.

None

B. SUMMARY OF OPINIONS

The summary for opinions has been developed from documents available through Molycorp and various public sources. These sources are identified in the Basis for Opinions discussion. The opinion also has been formulated from observations during a tour of the Molycorp Mine area on December 17, 1996 and discussions during the site visit. In addition, reports from state and federal agencies, Molycorp consultants and available geologic maps and figures were considered.

Critical information obtained which solidified my professional opinion that a direct hydraulic connection exists between the waste rock piles and the Red River include:

a) The numerous citations in the literature including Molycorp documents and consultant reports that the potential for groundwater flow exists (see Basis for Opinions).
b) Geologic information (maps and reports) showing faults, dikes and alluvial material with adequate permeability to transmit water (see Opinion by Mr. Richard Kelsey).
c) Water quality and geochemistry information (see Opinion by Dr. Barbara Williams) that show geochemical evidence for direct hydraulic connection.
d) Hydrologic information including evidence for infiltration and recharge on waste rock piles, evidence of discharge through seeps, springs, and hydraulic data from monitoring wells within bedrock and alluvial material.

I. The geologic and hydrologic setting within the Molycorp Mine area provides for a direct and active hydraulic connection between the waste rock piles and the Red River. The permeable nature of the shallow unconsolidated alluvial material in the Red River Valley and lower areas of the tributary streams together with underlying fractured bedrock provides permeable material and pathways for shallow groundwater flow to discharge into the Red River adjacent to the Molycorp Mine. Waste rock piles overlying this natural alluvial/fractured bedrock are composed of broken rock and are permeable unless specifically capped with impermeable material. The waste rock piles at the Molycorp operation exhibit nearly flat to steeply sloping uncapped surfaces with drainage and water collection areas. Water infiltrating into the waste rock piles percolates downward to the shallow alluvial and/or fractured bedrock and then moves laterally to discharge areas along the Red River, the topographic low point in the Molycorp Mine area. Some bermed areas enhance ponding of water which disappears after a rain/snowmelt event indicating infiltration occurs through the waste rock piles.

2. Ground water is collected within the underground workings and used within the mill operation. The mill water is then discharged to the tailings impoundments outside of the active mine area. Hydrologic data indicate only a

small portion of the shallow ground water within the mine area is captured by the underground workings and is transported to the tailings impoundment. The remainder of the ground water moves toward the groundwater discharge area within the Red River Valley adjacent to the mine. Ground water was also collected by the Moly Tunnel prior to 1992. Subsequent plugging of the tunnel in 1992 has stopped the discharge but has resulted in infiltration of ground water into the fractured bedrock adjacent to the plug, creating a groundwater flow system moving through the fractured bedrock into shallow alluvium of the Red River Valley and discharging as springs into the Red River. These conclusions are evidenced by the recent formation of Portal Spring near the mouth of the Moly Tunnel in 1994.

C. BASIS FOR OPINIONS

1. Ground water in the unsaturated zone, in perched water zones, and in the saturated zone moves from recharge to discharge points. Sources of this water are both natural and mine-related: infiltration, surface run-off, and seepage from natural springs and mine-constructed waste-rock piles. The discharge points consist of the deep underground mine, the Red River, and (via slurry line) the Tailings Area ponds (1013, p. 5). The natural groundwater gradients are toward the Red River. The primary hydraulic linkage between up-gradient sources and the river is the fan delta deposits at the mouths of tributary canyons at Capulin Canyon and Sugar Shack South (1013, p. 5, Exhibit 1). Perched water can form near the base of the waste-rock dumps. Perched water can also form in zones of fractured bedrock above the main water table and above clay intervals in the valley fill. Bedrock seeps, such as the seeps at Cabin Springs near the river, may flow from a perched bedrock zone (1013, p.6).

The Tertiary volcanics and sedimentary rock units are highly fractured and faulted throughout the caldera block north of the river (1013, p. B-1). The Tertiary volcanic rock below the water table constitutes the aquifer in the area and has highly variable hydraulic conductivity depending on the fracture orientation, fracture spacing, and the openness of the fracture spacing (1013, p. B-2). Questa geologists mapped northeast-southwest and east-west trending tertiary dike swarms that intersect in the area of the Cabin Springs. These structures are evident in the geologic maps (1013, Figure A2; 1037). The northeast-southwest swarm underlies the existing Middle and /Sugar Shack South waste rock disposal areas. The presence of the dikes may be indicative of structurally controlled zones that hydraulically connect the foundation of Middle and /Sugar Shack waste rock disposal areas to the Cabin Springs (1012, p. 13).

Ground water in the shallow alluvial and upper fractured bedrock systems flows into the Red River. Seepage through the waste rock disposal areas and the shallow underlying colluvium and alluvium potentially contributes to the quality of springs and seeps that have been identified adjacent to the Red River

near the mine site (1012, p. 21). Potential paths of mine impacted drainage flow to the Red River include seepage and groundwater flow from the Capulin, Sugar Shack South, Middle and Spring and Sulphur Gulch waste rock disposal areas through alluvium and geologic structures possessing high hydraulic conductivity (1012, p. 11). A number of seepage studies have demonstrated that the Red River is a gaining stream in the vicinity of both the Molycorp tailings area and mine area(1021, p. 16). In the middle reach of the Red River (the reach from Questa to Red River, which includes the Molycorp mine area), seepage studies have documented accretion from ground water into Red River at average rates of 4 cfs(USGS Oct. 1988),(1021, p. 10) While some of the drainage reaches the Red River by overland flow (e. g. in Hansen Creek and Haut-n-Taut Creek), much infiltrates the colluvium and river channel alluvium and discharges to the Red River through seeps/springs. Many of these seeps have perennial flow, even during dry seasons. Therefore, an undetermined portion of the seep is likely attributable to ground water which recharges the river (1021, p. 27).

There are two principal, and interconnected, groundwater systems in the mine area: a fractured bedrock aquifer and an overlying aquifer within the alluvium and valley-fill of the Red River and tributary drainages. Water from all the new mine monitoring wells (Exhibit 2), as well as the seeps in the middle reach of the Red River, exceed New Mexico Groundwater standards for certain constituents: total dissolved solids, sulfate, fluoride, aluminum, iron, manganese, cobalt, copper, nickel, zinc, and cadmium (1021, p. 67). For both aquifers there is evidence for a release of these contaminants from Molycorp sources. Data show that water from mine wastes contains significantly greater concentrations of sulfate and metals (aluminum, iron, manganese, zinc, copper, cadmium) than water from scar areas. In comparing water quality of seeps located downgradient of Molycorp to seeps located at scars upgradient of the mine, a more than three-fold increase is shown for concentrations of iron, aluminum, copper, and manganese. Data for the fractured bedrock aquifer indicate a release of arsenic, cadmium, and copper that is partially attributable to Molycorp mine. Analysis of data from USGS groundwater seepage investigations in 1965 and 1988 indicates that there was a significant (149%) increase in seepage rates (groundwater accretion) to the middle reach of the Red River near Molycorp in 1988 as compared to 1965. The Molycorp open pit was begun in 1965; by the time of the 1988 seepage investigation the pit had been in place for more than twenty years. The pit and associated waste-rock dumps enhance groundwater recharge and may be responsible for the documented increase in seepage rates and changes in water quality (1021, p. 67).

Local drainage patterns have been altered as a result of mining and the implementation of Molycorp's surface water management and sediment collection system (1012, p. 4). Direct surface runoff from disturbed areas to the Red River does not occur under normal conditions. All significant areas of mine-affected drainages contain surface water and sediment impounding facilities (1012, pp.10, 11, and 20). In Goathill Gulch below the caved zone, surface

runoff is collected in surface impoundments. Surface flow in Capulin Canyon is also impounded and retained. Surface water discharges from waste rock disposal area adjacent to the Red River are contained in sediment collection ponds located at toes of waste rock disposal area (1012, p. 21). All watersheds within the mine disturbed area contain exposures of hydrothermal scar. These drainages are equipped with surface water and sediment collection facilities that prevent discharge of surface water and sediment from the mine disturbed area to the Red River (1012, p. 4).

The potential exists for a portion of the seepage from waste rock placed in Capulin Canyon to bypass the seepage collection and pump back system located in Capulin Creek. Seepage from the waste rock disposal area located adjacent to the Red River and from Upper Capulin Canyon potentially contributes sulfate and metals to the Red River (1012, p. 4).

Subsurface seepage from the new mine site, the mill site and the Sugar Shack South, Middle and Spring and Sulfur Gulch waste rock disposal areas are currently not controlled by Molycorp's seepage collection system. Acid generating materials in these areas have the potential to contribute sulfate and metal loads to the Red River (1012, p. 38).

The mine waste-rock dumps are recharged from snow melt and other precipitation events. Mine waste-rock dumps function as perched aquifers that discharge water to surface seeps and flows, to valley-fill sediments and to fractured bedrock (1013, p. B-3). Lack of storm water runoff from Goathill Gulch and Spring Gulch (Discharge points 004 and 005) since permits were issued in 1993 (1021, p. 3) indicate surface water diversions and impoundments potentially are resulting in increased recharge into the system.

A possible source is water from the waste-rock dumps infiltrating bedrock and/or valley-fill up-gradient from the wells (1013, p. D-3). While most of the leachate from the mine waste dumps and natural acidic run-on from scar areas is collected and purposely directed by Molycorp to ground water within the new underground mine, the numerous fracture systems in the vicinity of the mine (which are well documented in the geological literature) may provide an avenue for the collected waste water to reach the Red River. Several statements from a recent hydrogeological report suggest this possibility. The past rate of dewatering the mine, 0.55 cubic feet per second (cfs), is less that 40% of the estimated amount of water available to recharge (1.45 cfs) (1008, p. 8). Therefore, approximately 0.9 cfs is not collected by the mine. The report continues to state the fractures in the volcanics may provide an avenue for recharge to reach the Red River. Numerous geological reports mention that dominant structural features (fractures) in the mine area trend NNE to NE. These fractures would therefore direct ground water and seepage from the pit area west and southwest toward the concentration of acidic seeps along Red River near the mouth of Capulin Canyon. (1021, p. 22)

The water quality of well water (1021, Table 8) is best described in terms of specific areas where there may be linkages between sources (dumps,

bedrock, valley-fill) and sinks (river seeps). These areas are:

* Middle Waste-Rock Dump (MMW-13)
* Sugar Shack South Waste-Rock Dump (MMW-10A, -10C, and -11)
* Sugar Shack West Waste-Rock Dump (MMW-7, -8A, and -8B)
* Capulin Canyon (MMW-2 and -3)

These seeps were not noted until January 1993, despite numerous earlier river surveys (Molycorp 1994 communication). The immediate source of the springs is ground water seeping from the valley-fill aquifer exposed along the banks of the river (1013, p. D-3).

2. Seepage entering the 1000 foot station of the decline and draining to the underground workings contains elevated metal concentrations that suggest the waste dumps are the seepage sources (1012, p. 32). Inflow into the underground workings is very small compared with the surface and shallow alluvial and upper fractured bedrock groundwater flow quantities (1012, p. 18). The groundwater drawdown cone that has developed around the mine captures much of the groundwater flow in the low permeability bedrock (1012, p. 21).

However, Capulin Canyon appears to lie outside the zone of influence of dewatering cone of depression (1013, pp. 6 and 12). Monitor wells MMW -10A, 10B and 10C also were considered to be outside the cone and related to a water table at or very close to the elevation of the stream bed. This is evidenced by monitoring wells 2, 3, 10A, 10B and 10C not responding to five months of dewatering (1013, p. 12). This also suggests that the mine was de-watered from the deeper part of the groundwater flow system and did not appreciably, if at all, reduce accretion to the river from ground water. The explanation for this is that most of the ground water which recharges to the river may have come from the upper part of the groundwater system. SPRI (1008, 1013) concluded that the cone probably did not extend to the river. The stability of the water levels in the monitoring wells over the first 5 months after their installation, despite continuous dewatering of the underground mine, (several hundred feet decline over the same period), supports the interpretations that a steep cone of depression occurs over the mine and that the edge of the cone is north of the river (1013, p. B-7).

Leland L. Mink

Leland L. Mink

Dated March 13, 1997

Resume

LELAND L. MINK

Address:	217 Styner Moscow, Idaho 83843
Telephone:	(208) 882-9009 (home) (208) 885-6429 (work)
Birthdate:	March 6, 1940

CAREER SUMMARY

EDUCATION

1965	B.S.	Math/Science Education, Idaho State University, Pocatello, Idaho
1971	M.S.	Hydrology, *"Effect of Industrial and Domestic Effluents on the Water Quality of the Coeur d'Alene River Basin,"* University of Idaho, Moscow, Idaho
1973	Ph.D.	Geology, *"Evaluation of Settling Ponds as Treatment Devices For Mine Waste Water,"* University of Idaho, Moscow, Idaho

SHORT COURSES

1972-1973	Geothermal Resource Council Geothermal Exploration, Sacramento, California
1974	Montana State University Geothermal of Yellowstone Park, Bozeman, Montana
1977	Los Alamos Scientific Laboratory Reservoir Engineering, Los Alamos, New Mexico
1980	U.S. Government Effective Supervision Development, Portland, Oregon
1980	American Petroleum Institute Well Drilling Technology, Idaho Falls, Idaho (correspondence)
1981	U.S. Government Management Development, Phoenix, Arizona
1983	Geothermal Drilling, GRC, San Francisco, California
1986	Practical Aspects of Groundwater Modeling, Boise, Idaho

ADVANCED COURSES

1987	OSHA Hazardous Waste Site Operations Safety Training, MKE, Boise, Idaho
1989	Project Management Training, MKE, Boise, Idaho

Twenty years experience in performing and managing hydrological evaluations and management of hazardous and radioactive waste projects. Currently specializes in groundwater and geothermal resource evaluations and development. Conducts exploration activities aimed at potential development of groundwater and geothermal resources. Involved in environmental studies relating to groundwater contamination and migration of hazardous waste.

Experience in managing and conducting water quality studies, groundwater hydrology investigations, surface water hydrology investigations, and geochemistry analyses at several hazardous waste and environmentally sensitive sites. These include hazardous waste spills, landfill operations, urban runoff, agricultural runoff, mining operations and energy development projects. Involved in scoping the investigations, conducting the field data collection including drilling and sampling, performing data and laboratory analysis, and writing formal reports. Experience includes analytical and numerical modeling techniques for both groundwater and surface water studies.

Active management experience on hazardous waste projects has provided an in-depth understanding of environmental and regulatory policy, particularly related to RCRA and CERCLA. Experienced in providing technical support and expert testimony at public and professional meetings, congressional hearings, and court cases.

EXPERIENCE

09/64	Teaching Assistant, Department of Geology, Idaho State University, Pocatello, Idaho
02/65	2nd Lieutenant, Artillery Officer, 4th Division Artillery, Fort Lewis, Washington
09/65	1st Lieutenant, Forward Observer, 1st Air Cavalry, Viet Nam
11/66	1st Lieutenant, Escort Officer, Visitor's Bureau, Fort Sill, Oklahoma
02/71	Captain, U.S. Army Reserve, Moscow, Idaho
02/67	Junior High Math Instructor, Jerome School District #261, Jerome, Idaho
09/67	Junior High Math/Science Instructor, Douglas County School District, Zephyr Cove, Nevada
05/68	Field Assistant, Idaho Bureau of Mines and Geology, Moscow, Idaho
09/68	Teaching Assistant, Department of Geology, University of Idaho, Moscow, Idaho
09/69	Research Assistant, College of Mines, University of Idaho, Moscow, Idaho
01/72	Hydrogeologist, Idaho Bureau of Mines and Geology, Moscow, Idaho (Transferred in June, 1972 to Boise, Idaho, to set up a branch office at Boise State University)
	Administered branch office of Idaho Bureau of Mines and Geology at Boise. Conducted and published investigations relating to Idaho geology and hydrology. Worked with and advised the general public and local industries on geological and hydrological matters. Assisted the Idaho legislature and elected officials dealing with Idaho minerals, water, and land status. Involved with other State agencies conducting short courses. Performed teaching and research one-quarter time with Boise State University in the areas of groundwater hydrology and environmental sciences.
02/72	Associate Professor, Department of Geology Boise State University Boise, Idaho
	Instructed courses in groundwater geology, environmental geology, structural geology, fundamentals of geology, and advised 25 to 30 students. Principal investigator for research grants with the Corps of Engineers, ERDA (Energy Research and Development Agency), and NSF (National Science Foundation). Co-principal investigator for two grants with the University of Idaho and one with Idaho State University.
09/76	Research Geohydrologist, U.S. Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Las Vegas, Nevada

Managed grants and contracts involving development of ground and surface water monitoring systems. Provided technical expertise in planning and assisting research programs aimed at developing and improving methodology for ground and surface water monitoring. Reviewed technical reports of private industry and other governmental agencies. Served as the Monitoring Systems Analysis representative on working groups for the development of ground and surfacewater monitoring technology.

04/77 Program Manager, U.S. Department of Energy, Resource Exploration & Assessment Branch, Division of Geothermal Energy, Washington, D.C.

Worked with the Energy Research and Development Administration in forming and managing the resource assessment and reservoir engineering program within the Division of Geothermal Energy. Interfaced with high level federal and administrative and congressional personnel dealing with budget and programmatic matters. Established long-term program plans and guidelines for geothermal development. Formed and monitored programs with national laboratories, universities, and state agencies. Established liaison with other federal programs and agencies, and with the private sector involved in geothermal exploration and development. Managed major international cooperative geothermal programs with Italy and Mexico.

06/78 Physical Scientist, U.S. Department of Energy, Energy & Technology Division, Idaho Operations Office, Idaho Falls, Idaho

Served as the principal expert in hydrology for the Resource Definition Branch. Provided program management for geoscience, resource definition, and drilling programs. Responsible for the identification, location, and characterization of geothermal resources for the states west of the Mississippi. Responsible for planning and evaluating functions for the various program elements as well as being involved in interpreting, reporting, and distribution of the conclusions of these programs. Principal areas of activity involved exploration technology, geothermal resource characterization, and drilling these resources. Determined need and recommended new direction which helped accelerate commercial development of geothermal energy. Provided evaluation and technical direction of contractor cork developing new concepts or equipment.

06/79 Chief, Resource Definition Branch, U.S. Department of Energy, Energy & Technology Division, Idaho Operations Office, Idaho Falls, Idaho

Managed the Resource Definition Branch of the Office of Geothermal Energy. Involved supervision of a staff of two professional people and daily contact with personnel from DOE-HQ, subcontractors, national laboratories, foreign and domestic scientists, and the general public. Served as Technical Program Manager in a decentralized operation mode to DOE-HQ for the following national geoscience programs: Reservoir Engineering; Exploration Technology and Development; State Resource Assessment; and Industry-Cost Share Drilling Program. Duties included scoping, developing, and monitoring the technical aspects of these national programs and interfacing with DOE-HQ on major programmatic decisions. Served as the principal expert in hydrogeology and reservoir engineering for the energy Technology Division.

09/80 Chief, Geothermal Energy Branch, U.S. Department of Energy, Energy & Technology Division, Idaho Operations Office, Idaho Falls, Idaho

Managed the Geothermal Energy Branch which involved the direct supervision of four personnel. Responsible for the implementation, management, termination, and reporting of a variety of programs designed to stimulate the development of geothermal resources. Developed technology and the methods by which those resources were to be used as a viable energy source. Provided leadership and expert advice within the Department on a national and regional scale to other agencies and the general public for the total geothermal program. Emphasis was placed on those hydrothermal systems of the Western States and the Economical and environmentally acceptable approaches to developing those systems.

Coordinated the geothermal program managed through the Idaho Operations Office with other Branches such as Low-Head Hydro, Alcohol, Biomass, Municipal Waste, and Conservation. Served as a member of national committees or groups which formulated fundamental policies and determined national priorities for existing and required programs. Established new programs and evaluated existing research and development activities. Developed standards and guides for use in selecting, funding, and managing new activities.

Responsible for 13 major programs involving over 100 individual contracts with a combined annual budget in excess of 30 million dollars. These programs involved several major national projects such as exploration technology, geothermal drilling, reservoir engineering, DOD MX/RES Missile program, and Raft River 5mw. binary power plant.

12/81 Staff Hydrologist, Mining Group, Morrison-Knudsen Company, Inc., Boise, Idaho

Managed projects relating to hydrology, resource investigation, waste management, energy development, and environmental technology. Supervised projects involving geothermal resources, geohydrology, reservoir engineering,and mining hydrology, as well as environmental baseline studies, mine reclamation studies, alternative energy resource investigations, groundwater modeling, and acid mine drainage problems.

01/82 Instructor, Hydrogeology and Geothermal Geology, Boise State University, Boise, Idaho

11/83 Senior Design Project Engineer, Hydrology, Morrison-Knudsen Company, Inc., Boise, Idaho

Senior Manager on projects relating to hydrology, resource investigation, waste management, energy development, and environmental technology. Major emphasis on projects involving geothermal development, geohydrology, reservoir engineering, and mining hydrology, as well as hazardous waste remedial investigation and feasibility studies. Also responsible for projects relating to mine reclamation studies, alternative energy resource investigations, groundwater modeling, acid mine drainage problems, and hydrologic impacts of nuclear waste terminal storage. Has been involved in several groundwater development projects with wells ranging from 1,000 to over 4,000 feet deep.

01/86 Staff Design Project Engineer/Manager, Morrison-Knudsen Engineers, Inc. (Formerly Morrison-Knudsen Company, Inc.) Boise, Idaho

Managed projects relating to hydrology, resource investigation, waste management, energy development and environmental technology. Has supervised projects involving geothermal resources, geohydrology, reservoir engineering, and mining hydrology, as well as environmental baseline studies, mine reclamation studies, alternative energy resource investigations, ground water modeling, acid mine drainage problems, and hydrologic impacts of nuclear waste terminal storage.

01/88 Manager, Hydrology/Geosciences, Morrison-Knudsen Engineers, Inc.Boise, Idaho

Served as Manager of Hydrologic Services for MKE's Hazardous Waste and Environmental Division specializing in remedial investigations, site assessments, feasibility studies, and remedial action for hazardous waste sites. Project experience includes management of site investigation and assessment, feasibility studies, and regulatory analyses work for a confidential RCRA site in Idaho. Also managed cleanup activities at a Utah railroad maintenance and switchyard facility which included site inspection, remedial investigation, feasibility studies, and remedial action alternatives. Assessed geologic, hydrologic, and soil conditions to characterize the hydrological regime as a basis for remedial planning. Major projects include investigations and site assessments to study the impacts of mining activities on groundwater resources and surface water quality and quantity in Idaho, investigation of contamination of groundwater from various spill and disposal activities at

numerous hazardous waste sites, and assessment of groundwater impacts from a proposed high-level radioactive waste isolation facility. Has also been involved in several water well development and geothermal exploration projects for wells ranging from 1,000 to over 10,000 feet deep. Managed a major geothermal drilling and power development project in Guatemala.

1989-present — Director, Idaho Water and Energy Resources Research Institute, University of Idaho, Moscow, Idaho.

Directing activities of the Water and Energy Resources Research Institute including monitoring research projects, administering grants and contracts, and managing professional and technical staff. Responsibilities also include working with state and federal agencies, private industry, and other universities in performing water and energy investigations and research. Also serve as Co-Director for the Center for Hazardous Waste Remediation Research.

1995-1996 — President of the National Institutes for Water Resources (NIWR).

PROFESSIONAL MEETINGS

Stanford Reservoir Engineering Workshop, DOE Program, presentation, Stanford University, December, 1977

First Annual Mexico-U.S. Geothermal Conference, DOE Program, presentation, Cerro Prieto, Mexico, April, 1978

Geothermal Energy Short Course, Washington, D.C., May, 1978

Rocky Mountain Region Geothermal Energy Workshop, Salt Lake City, Utah, June, 1978

Geothermal Energy Demonstration Project, Opportunity Notice Technical Evaluation Committee Member, San Francisco, California, August, 1978

Cerro Prieto Conference, San Diego, California, September, 1978

First Invitational Well Testing Symposium, Lawrence Berkeley Laboratory, Berkeley, California, October, 1978

Stanford Reservoir Engineering Workshop, Session Chairman, Stanford University, Stanford, California, December, 1978

Mexican-U.S. Geothermal Agreement Meeting, Coordination Team Member, Mexicali, Mexico, January, 1979

Geothermal Resource Assessment Program Annual Meeting, Session Chairman, presentation, Salt Lake City, Utah, January, 1979

Second Mexico-U.S. Geothermal Conference, Mexicali, Mexico, April, 1979

Exploration Technology Development Task Force Review, Task Force member, Marina del Rey, California, May, 1979

Joint DOE-USGS Cascades Geothermal Project Review, Task Force member, Portland, Oregon, August, 1979

Mexican-U.S. Cerro Prieto Geothermal Project Meeting, Session Chairman, Mexicali, Mexico, October, 1979

Stanford Geothermal Reservoir Engineering Workshop, Session Chairman, Stanford, University, Stanford, California, December, 1979

National State Cooperative Resource Assessment Program Annual Meeting, Salt Lake City, Utah, January, 1980

Geothermal Rock Properties Program, Task Force Member, Salt Lake City, Utah, January, 1980

Phosphate Symposium, Pocatello, Idaho, March, 1980

Geothermal Resources Council Low Temperature Geothermal Development, Boise, Idaho, June, 1980

Geothermal Development Feasibility Studies Proposal Review Committee, member, San Francisco, California, June, 1980

Wood River Resource Association Geothermal Presentation, Sun Valley, Idaho, August, 1980

MX-RES Missile Geothermal Project Coordination, team member, Las Vegas, Nevada, August, 1980

Geothermal Resources Council Geothermal Energy for the 80's, Session Chairman, Salt Lake City, Utah, September, 1980

Rocky Mountain Geothermal Commercialization, presentation, Kalispell, Montana, September, 1980

Energy Security Act--Geothermal Drilling Loans, presentation, Seattle, Washington, September, 1980

U.S./DOE-Italy/ENEL International Geothermal Project, team member, Lawrence Berkeley Laboratory, October, 1980

MX-RES Missile Geothermal Project Implementation Plan, presentation, Washington, D.C., November, 1980

Geothermal Resources Council, Co-Chairman Geothermal Reservoir Engineering Session, Reno, Nevada, October, 1983

Geothermal Resources Council, Pacific Northwest Section, Geothermal Well Testing and Reservoir Engineering, presentation, Portland, Oregon, December, 1983

American Association of Petroleum Geologist Annual Convention, presentation of U.S. Geothermal Energy Status, San Antonio, Texas, May, 1984

American Association of Petroleum Geologists - Rocky Mountain Section Meeting, Geothermal Well Testing, presentation, Salt Lake City, Utah, August, 1984

City of Boise Geothermal Seminar, Idaho's Geothermal Potential, presentation, Boise, Idaho, March, 1984

Geological Society of America, Rocky Mountain Section, session co-chairman and conveyor, Boise, Idaho, April, 1985

American Institute of Mining Engineers Annual Meeting, Mine Dewatering, paper, St Louis, Missouri, July, 1985

International Mine Water Congress, Mine Dewatering Design, presentation, Granada, Spain, September, 1985

PROFESSIONAL ACTIVITIES

Expert Witness in Hydrogeology, State of Idaho, 1975

Coordinator and Instructor of Short School for Water and Wastewater Systems Operators, Boise State University, March, 1976

Affiliate Faculty - Hydrology University of Idaho, 1978-1982

Instructor for Yellowstone Institute Geothermal Systems, Yellowstone National Park, July-August, 1979 to present

Director of Workshop on Low-Temperature Geothermal Resources NWWA National Exposition, Oklahoma City, Oklahoma, October, 1979

Technical Assessment Committee, Boise Futures Foundation, Boise, Idaho, 1982

Geothermal Resources Council, Yellowstone Geothermal Tour, Tour Guide and Lecturer, June, 1984

EPSCOR Technical Committee Member, University of Idaho, Moscow, Idaho, 1985

Policy Advisory Committee Member, Idaho Water Resources Research Institute, University of Idaho Moscow, Idaho, 1985-1987

Geological Sciences Advisory Board, Boise State University, Boise, Idaho, 1986, 1987

Advisory Board, Idaho Geological Survey

Lawrence Berkley Laboratory Industry Review Panel on Geothermal Reservoir Technology, member

PROFESSIONAL ORGANIZATIONS

Geothermal Resource Council

Idaho Association of Professional Geologists

International Mine Water Association

National Water Well Association, Technical Division

Northwest Mining Association Sigma Gamma Epsilon

Society of Mining Engineers of AIME

OTHER ORGANIZATIONS

Boy Scouts of America

Idaho State Alumni Association

National Ski Patrol Association - Patrol Leader

University of Idaho Alumni Association

CERTIFICATIONS

OSHA Hazardous Waste Operator Certification

Advanced First-Aid and Emergency Care, American National Red Cross

Registered Professional Geologist - States of Idaho, Oregon, Virginia

Standard Secondary Teacher, State of Idaho

AWARDS

Certificate of Appreciation, Morrison-Knudsen Engineers, Inc., 1986

Outstanding Earth Scientist, Gamma Rho Chapter, Sigma Gamma Epsilon, 1974

PUBLICATIONS AND PRESENTATIONS

Mink, L.L., 1970. Analysis of an Aquatic Environment Receiving Domestic and Industrial Wastes: Conference on Trace Substances in Environmental Health. University of Missouri.

Mink, L.L., Williams, R.E., Wallace, A.T., Mar. 1971. Effect of Industrial and Domestic Effluents on the Water Quality of the Coeur d'Alene River Basin: Idaho Bureau of Mines & Geology, Pamphlet #149.

Mink, L. L., Kealy, C.D., Williams, R.E., April, 1972. Structural-Environmental Characteristics of TailingPonds: 10th Annual Engineering Geology and Soils Symposium, Moscow, Idaho.

Williams, R.E., Wallace, A.T., Mink, L.L., 1972. Effect of Early Day Mining Operations on Present Day Water Quality: Ground Water, Vol. 10, No. 1.

Mink, L. L. , April, 1973. In Lieu Lands--History and Selection: 11th Annual Engineering Geology and Soils Symposium, Pocatello, Idaho.

Williams, R.E., Wallace, A.T., McNay, L.M., Mink, L.L., July, 1973. Renovation of Wastes by Mine Tailings Ponds: Mining Engineering, Vol. 25, No. 7.

Mink, L.L., *et al.*, April, 1974. Mercury and Heavy Metal Contamination in the Jordan Creek Drainage Near Silver City, Owyhee County, Idaho: Proceedings of the 12th Annual Engineering Geology and Soils Symposium, Boise, Idaho.

Norbeck, P.H., Williams, R.E., Mink, L.L., June, 1974. Ground Water Leaching of Jig Tailings Deposits in the Coeur d'Alene District of Northern Idaho: Water Resource Problems Related to Mining, American Water Resources Association.

Mink, L.L., Wallace, A.T., April, 1975. Study on the Impact of Subsurface Sewage Disposal in the Ada-Canyon County Area of Southwest Idaho: Department of Army - Corps of Engineers.

Gilmore, C., Beck, S., Mink, L., *et al.*, Oct., 1975. User's Manual for the Selection and Management of Feedlot Sites and Land Disposal of Manure in Boise Valley, Idaho: Department of Army - Corps of Engineers.

Williams, R.E., Mink, L.L., Dec., 1975. Settling Ponds as a Mining Wastewater Treatment Facility: Idaho Bureau of Mines & Geology, Pamphlet #164.

Applegate, J.K., Donaldson, P.R., Mink, L.L., March, 1976. Geologic and Seismic Studies for the Boise Front, Idaho for Geothermal Resource Evaluation: Rocky Mountain Section of American Association of Petroleum Geologists and the Society of Economic Paleontologists and Mineralogists Annual Meeting.

Hollenbaugh, K.M., Donaldson, P.R., Applegate, J.K., Mink, L.L., Stoker, R.C., May, 1977. Boise Geothermal Project: Geothermal Resource Council Transactions, Vol. 1.

Mink, L.L., Graham, D.L., Oct., 1977. Geothermal Potential of the West Boise Area: U. S. Department of Energy National Engineering Laboratory, TREE 1162.

Prestwich, S.M., Mink, L.L., Sept., 1979. Snake River Plain Geothermal Exploration Well: Geothermal Resource Council Transactions, Vol. 3.

Goldman, D., Allman, D.W., Mink, L.L., Oct., 1979. Data Collection and Evaluation of Combined Fractured and Porous Media Flow in a Fluid-Dominated Geothermal System: National Water Well Association, Oklahoma City, Oklahoma.

Mink, L.L., May, 1981. Geothermal Potential of the Madison Aquifer System: Rocky Mountain Ground Water Conference, Laramie, Wyoming.

Mink, L.L., Molloy, M.W., Nov., 1981. National Geothermal Reservoir Engineering and Exploration Technology Program: New Zealand Geothermal Workshop, Auckland, New Zealand.

Mink, L.L., Lease, R.D., Nichols, C.R., May, 1982. The Raft River 5MW(e) Binary Project: International Conference on Geothermal Energy, Florence, Italy.

Mink, L.L., *et al.*, April, 1983. Utah State Prison Geothermal Project: Rocky Mountain Groundwater Conference, Boise, Idaho.

Craig, M.R., Mink, L.L., 1985. An Analytical and Graphical Technique to Determine the Spacing of Drainage Wicks For Pressure Relief in an Open Pit Coal Mine: Proceedings of the Second International Mine Water Congress, Granada, Spain, Vol. 1, No. 1, pp. 95-103.

Kunze, J.F., Richardson, A.S., Hollenbaugh, K. M., Nichols, C.R., Mink, L.L., May, 1985. Non-Electric Utilization Project: Proceedings of Second United Nations Geothermal Symposium.

Mink, L.L., Merida, L.F., Caicedo A., Oct., 1988. Zunil Geothermal Project An Update: Geothermal Resources Council Transactions, San Diego, California.

WESTERN ENVIRONMENTAL LAW CENTER
Grove Burnett
P.O. Box 1507
Taos, New Mexico 87571
(505) 751-1776
(505) 751-1775 Fax

Attorneys for Plaintiffs

UNITED STATES DISTRICT COURT

DISTRICT OF NEW MEXICO

AMIGOS BRAVOS, a nonprofit corporation, and NEW MEXICO CITIZENS FOR CLEAN AIR AND WATER, a nonprofit corporation,	
Plaintiffs,	PLAINTIFFS RULE 26 (a) (2) (B) EXPERT REPORT OF LELAND LEROY MINK, Ph.D., PG
vs.	
MOLYCORP, INC.	
Defendant.	

I, Leland L. Mink, provide the following report as required by Fed. R. Civ. Pro. 26 (a) (2) (B) and the Court's March 17, 1997 disclosures.

A. SUMMARY OF QUALIFICATIONS

1. QUALIFICATIONS OF WITNESS

- Director of the Idaho Water Resources Research Institute
- Co-director of the Center for Hazardous Waste Remediation
- Researcher and Professor of Hydrology at the University of Idaho

Menzies, A.J., Granadoes, E.E., Sanyal, S.K., Mink, L.L., Merida, L., 1990. An Integrated Test Program for the Definition of a High Temperature Geothermal Reservoir: A Case Study from the Zunil Geothermal Field, Guatemala, Geothermal Resources Council Transactions, Vol. 14, Part I, Hawaii.

Adams, M.C., Moore, J.N., White, L.D., Mink, L.L., Leiva, O., Ramirez, S., Anchissi, A.C., 1992. Fluid Recharge of the Zunil, Guatemala Geothermal System.

Freeman, K.M., Mink, L.L., 1993. Geographical Viability of Ground Water Geothermal Heat Pumps in the United States. Geothermal Resources Council: Utilities and Geothermal: An Emerging Partnership. 1993 Annual Meeting. Transactions, Volume 17. Burlingame, California.

Whitney, D.C., Mink, L.L., 1993. Agri-chemical Groundwater Quality Protection in Idaho: Management and Policies, Fourth National Conference on Pesticides Proceedings, Richmond, Virginia.

Foley, D., Mink, L., 1996. Geysers, Mudpots, Hotspings and a Lurking Volcano: Yellowstone National Park as a Dynamic Laboratory in Geologic Observation. Geologic Society of America Transactions, Denver, Colorado.

Mink, L.L., 1996. Headwater Watersheds: Using Yellowstone as an Outdoor Classroom for Watershed Training, Geologic Society of America Transactions, Denver, Colorado.

Mink, L.L., 1996. Idaho Mobile Outreach Pollution Prevention Program, ECO-Informa '96 Proceedings, Orlando, Florida.

2b. ADDITIONAL SELECTED PUBLICATIONS

Craig, M.R., Mink, L.L. 1985. An Analytical and Graphical Technique to Determine the spacing of Drainage Wicks for Pressure Relief in an Open Pit Coal Mine: Proceedings of the Second International Mine Water Congress, Granada, Spain, Vol. 1, No. 1, pp. 95-103.

Goldman, D., Allman, D.W., Mink, L.L. Oct. 1979. Data Collection and Evaluation of Combined Fractured and Porous Media Flow in a Fluid-Dominated Geothermal System: National Water Well Association, Oklahoma City, Oklahoma.

Williams, R.E., Mink, L.L. 1975. Settling Ponds as a Mining Wastewater Treatment Facility: Idaho Bureau of Mines & Geology, Pamphlet #164.

Norbeck, P.H., Williams, R.E., Mink, L.L. 1974. Ground Water Leaching of Jig Tailings Deposits in the Coeur d'Alene District of Northern Idaho: Water Resource Problems Related to Mining, American Water Resources Association.

Mink, L.L., et al. 1974. Mercury and Heavy Metal Contamination in the Jordan Creek Drainage Near Silver City, Owyhee County, Idaho: Proceedings of the 12 Annual Engineering Geology and Soils Symposium, Boise, ID.

Williams, R.E., Wallace, A.T., McNay, L.M., Mink, L.L. 1973. Renovation of Wastes by Mine Tailings Ponds: Mining Engineering, Vol. 25, No. 7.

Williams, R.E., Wallace, A.T., Mink, L.L. 1972. Effect of Early Day Mining Operations on Present Day Water Quality: Ground Water, Vol. 10, No. 1.

Mink, L.L., Kealy, C.D., Williams, R.E. 1972. Structural-Environmental Characteristics of Tailings Ponds: 10th Annual Engineering Geology and Soils Symposium, Moscow, Idaho.

3. COMPENSATION

Hourly rate is $125/hr

4. CASES IN WHICH WITNESS HAS TESTIFIED IN PAST 4 YEARS.

None

B. SUMMARY OF OPINIONS

The summary for opinions has been developed from documents available through Molycorp and various public sources. These sources are identified in the Basis for Opinions discussion. The opinion also has been formulated from observations during a tour of the Molycorp Mine area on December 17, 1996 and discussions during the site visit. In addition, reports from state and federal agencies, Molycorp consultants and available geologic maps and figures were considered.

Critical information obtained which solidified my professional opinion that a direct hydraulic connection exists between the waste rock piles and the Red River include:

a) The numerous citations in the literature including Molycorp documents and consultant reports that the potential for groundwater flow exists (see Basis for Opinions).
b) Geologic information (maps and reports) showing faults, dikes and alluvial material with adequate permeability to transmit water (see Opinion by Mr. Richard Kelsey).
c) Water quality and geochemistry information (see Opinion by Dr. Barbara Williams) that show geochemical evidence for direct hydraulic connection.
d) Hydrologic information including evidence for infiltration and recharge on waste rock piles, evidence of discharge through seeps, springs, and hydraulic data from monitoring wells within bedrock and alluvial material.

I. The geologic and hydrologic setting within the Molycorp Mine area provides for a direct and active hydraulic connection between the waste rock piles and the Red River. The permeable nature of the shallow unconsolidated alluvial material in the Red River Valley and lower areas of the tributary streams together with underlying fractured bedrock provides permeable material and pathways for shallow groundwater flow to discharge into the Red River adjacent to the Molycorp Mine. Waste rock piles overlying this natural alluvial/fractured bedrock are composed of broken rock and are permeable unless specifically capped with impermeable material. The waste rock piles at the Molycorp operation exhibit nearly flat to steeply sloping uncapped surfaces with drainage and water collection areas. Water infiltrating into the waste rock piles percolates downward to the shallow alluvial and/or fractured bedrock and then moves laterally to discharge areas along the Red River, the topographic low point in the Molycorp Mine area. Some bermed areas enhance ponding of water which disappears after a rain/snowmelt event indicating infiltration occurs through the waste rock piles.

2. Ground water is collected within the underground workings and used within the mill operation. The mill water is then discharged to the tailings impoundments outside of the active mine area. Hydrologic data indicate only a

small portion of the shallow ground water within the mine area is captured by the underground workings and is transported to the tailings impoundment. The remainder of the ground water moves toward the groundwater discharge area within the Red River Valley adjacent to the mine. Ground water was also collected by the Moly Tunnel prior to 1992. Subsequent plugging of the tunnel in 1992 has stopped the discharge but has resulted in infiltration of ground water into the fractured bedrock adjacent to the plug, creating a groundwater flow system moving through the fractured bedrock into shallow alluvium of the Red River Valley and discharging as springs into the Red River. These conclusions are evidenced by the recent formation of Portal Spring near the mouth of the Moly Tunnel in 1994.

C. BASIS FOR OPINIONS

1. Ground water in the unsaturated zone, in perched water zones, and in the saturated zone moves from recharge to discharge points. Sources of this water are both natural and mine-related: infiltration, surface run-off, and seepage from natural springs and mine-constructed waste-rock piles. The discharge points consist of the deep underground mine, the Red River, and (via slurry line) the Tailings Area ponds (1013, p. 5). The natural groundwater gradients are toward the Red River. The primary hydraulic linkage between up-gradient sources and the river is the fan delta deposits at the mouths of tributary canyons at Capulin Canyon and Sugar Shack South (1013, p. 5, Exhibit 1). Perched water can form near the base of the waste-rock dumps. Perched water can also form in zones of fractured bedrock above the main water table and above clay intervals in the valley fill. Bedrock seeps, such as the seeps at Cabin Springs near the river, may flow from a perched bedrock zone (1013, p.6).

The Tertiary volcanics and sedimentary rock units are highly fractured and faulted throughout the caldera block north of the river (1013, p. B-1). The Tertiary volcanic rock below the water table constitutes the aquifer in the area and has highly variable hydraulic conductivity depending on the fracture orientation, fracture spacing, and the openness of the fracture spacing (1013, p. B-2). Questa geologists mapped northeast-southwest and east-west trending tertiary dike swarms that intersect in the area of the Cabin Springs. These structures are evident in the geologic maps (1013, Figure A2; 1037). The northeast-southwest swarm underlies the existing Middle and /Sugar Shack South waste rock disposal areas. The presence of the dikes may be indicative of structurally controlled zones that hydraulically connect the foundation of Middle and /Sugar Shack waste rock disposal areas to the Cabin Springs (1012, p. 13).

Ground water in the shallow alluvial and upper fractured bedrock systems flows into the Red River. Seepage through the waste rock disposal areas and the shallow underlying colluvium and alluvium potentially contributes to the quality of springs and seeps that have been identified adjacent to the Red River

near the mine site (1012, p. 21). Potential paths of mine impacted drainage flow to the Red River include seepage and groundwater flow from the Capulin, Sugar Shack South, Middle and Spring and Sulphur Gulch waste rock disposal areas through alluvium and geologic structures possessing high hydraulic conductivity (1012, p. 11). A number of seepage studies have demonstrated that the Red River is a gaining stream in the vicinity of both the Molycorp tailings area and mine area(1021, p. 16). In the middle reach of the Red River (the reach from Questa to Red River, which includes the Molycorp mine area), seepage studies have documented accretion from ground water into Red River at average rates of 4 cfs(USGS Oct. 1988),(1021, p. 10) While some of the drainage reaches the Red River by overland flow (e. g. in Hansen Creek and Haut-n-Taut Creek), much infiltrates the colluvium and river channel alluvium and discharges to the Red River through seeps/springs. Many of these seeps have perennial flow, even during dry seasons. Therefore, an undetermined portion of the seep is likely attributable to ground water which recharges the river (1021, p. 27).

There are two principal, and interconnected, groundwater systems in the mine area: a fractured bedrock aquifer and an overlying aquifer within the alluvium and valley-fill of the Red River and tributary drainages. Water from all the new mine monitoring wells (Exhibit 2), as well as the seeps in the middle reach of the Red River, exceed New Mexico Groundwater standards for certain constituents: total dissolved solids, sulfate, fluoride, aluminum, iron, manganese, cobalt, copper, nickel, zinc, and cadmium (1021, p. 67). For both aquifers there is evidence for a release of these contaminants from Molycorp sources. Data show that water from mine wastes contains significantly greater concentrations of sulfate and metals (aluminum, iron, manganese, zinc, copper, cadmium) than water from scar areas. In comparing water quality of seeps located downgradient of Molycorp to seeps located at scars upgradient of the mine, a more than three-fold increase is shown for concentrations of iron, aluminum, copper, and manganese. Data for the fractured bedrock aquifer indicate a release of arsenic, cadmium, and copper that is partially attributable to Molycorp mine. Analysis of data from USGS groundwater seepage investigations in 1965 and 1988 indicates that there was a significant (149%) increase in seepage rates (groundwater accretion) to the middle reach of the Red River near Molycorp in 1988 as compared to 1965. The Molycorp open pit was begun in 1965; by the time of the 1988 seepage investigation the pit had been in place for more than twenty years. The pit and associated waste-rock dumps enhance groundwater recharge and may be responsible for the documented increase in seepage rates and changes in water quality (1021, p. 67).

Local drainage patterns have been altered as a result of mining and the implementation of Molycorp's surface water management and sediment collection system (1012, p. 4). Direct surface runoff from disturbed areas to the Red River does not occur under normal conditions. All significant areas of mine-affected drainages contain surface water and sediment impounding facilities (1012, pp.10, 11, and 20). In Goathill Gulch below the caved zone, surface

runoff is collected in surface impoundments. Surface flow in Capulin Canyon is also impounded and retained. Surface water discharges from waste rock disposal area adjacent to the Red River are contained in sediment collection ponds located at toes of waste rock disposal area (1012, p. 21). All watersheds within the mine disturbed area contain exposures of hydrothermal scar. These drainages are equipped with surface water and sediment collection facilities that prevent discharge of surface water and sediment from the mine disturbed area to the Red River (1012, p. 4).

The potential exists for a portion of the seepage from waste rock placed in Capulin Canyon to bypass the seepage collection and pump back system located in Capulin Creek. Seepage from the waste rock disposal area located adjacent to the Red River and from Upper Capulin Canyon potentially contributes sulfate and metals to the Red River (1012, p. 4).

Subsurface seepage from the new mine site, the mill site and the Sugar Shack South, Middle and Spring and Sulfur Gulch waste rock disposal areas are currently not controlled by Molycorp's seepage collection system. Acid generating materials in these areas have the potential to contribute sulfate and metal loads to the Red River (1012, p. 38).

The mine waste-rock dumps are recharged from snow melt and other precipitation events. Mine waste-rock dumps function as perched aquifers that discharge water to surface seeps and flows, to valley-fill sediments and to fractured bedrock (1013, p. B-3). Lack of storm water runoff from Goathill Gulch and Spring Gulch (Discharge points 004 and 005) since permits were issued in 1993 (1021, p. 3) indicate surface water diversions and impoundments potentially are resulting in increased recharge into the system.

A possible source is water from the waste-rock dumps infiltrating bedrock and/or valley-fill up-gradient from the wells (1013, p. D-3). While most of the leachate from the mine waste dumps and natural acidic run-on from scar areas is collected and purposely directed by Molycorp to ground water within the new underground mine, the numerous fracture systems in the vicinity of the mine (which are well documented in the geological literature) may provide an avenue for the collected waste water to reach the Red River. Several statements from a recent hydrogeological report suggest this possibility. The past rate of dewatering the mine, 0.55 cubic feet per second (cfs), is less that 40% of the estimated amount of water available to recharge (1.45 cfs) (1008, p. 8). Therefore, approximately 0.9 cfs is not collected by the mine. The report continues to state the fractures in the volcanics may provide an avenue for recharge to reach the Red River. Numerous geological reports mention that dominant structural features (fractures) in the mine area trend NNE to NE. These fractures would therefore direct ground water and seepage from the pit area west and southwest toward the concentration of acidic seeps along Red River near the mouth of Capulin Canyon. (1021, p. 22)

The water quality of well water (1021, Table 8) is best described in terms of specific areas where there may be linkages between sources (dumps,

bedrock, valley-fill) and sinks (river seeps). These areas are:

* Middle Waste-Rock Dump (MMW-13)
* Sugar Shack South Waste-Rock Dump (MMW-10A, -10C, and -11)
* Sugar Shack West Waste-Rock Dump (MMW-7, -8A, and -8B)
* Capulin Canyon (MMW-2 and -3)

These seeps were not noted until January 1993, despite numerous earlier river surveys (Molycorp 1994 communication). The immediate source of the springs is ground water seeping from the valley-fill aquifer exposed along the banks of the river (1013, p. D-3).

2. Seepage entering the 1000 foot station of the decline and draining to the underground workings contains elevated metal concentrations that suggest the waste dumps are the seepage sources (1012, p. 32). Inflow into the underground workings is very small compared with the surface and shallow alluvial and upper fractured bedrock groundwater flow quantities (1012, p. 18). The groundwater drawdown cone that has developed around the mine captures much of the groundwater flow in the low permeability bedrock (1012, p. 21).

However, Capulin Canyon appears to lie outside the zone of influence of dewatering cone of depression (1013, pp. 6 and 12). Monitor wells MMW -10A, 10B and 10C also were considered to be outside the cone and related to a water table at or very close to the elevation of the stream bed. This is evidenced by monitoring wells 2, 3, 10A, 10B and 10C not responding to five months of dewatering (1013, p. 12). This also suggests that the mine was de-watered from the deeper part of the groundwater flow system and did not appreciably, if at all, reduce accretion to the river from ground water. The explanation for this is that most of the ground water which recharges to the river may have come from the upper part of the groundwater system. SPRI (1008, 1013) concluded that the cone probably did not extend to the river. The stability of the water levels in the monitoring wells over the first 5 months after their installation, despite continuous dewatering of the underground mine, (several hundred feet decline over the same period), supports the interpretations that a steep cone of depression occurs over the mine and that the edge of the cone is north of the river (1013, p. B-7).

Leland L. Mink

Leland L. Mink

Dated March 13, 1997

Resume

LELAND L. MINK

Address:	217 Styner Moscow, Idaho 83843
Telephone:	(208) 882-9009 (home) (208) 885-6429 (work)
Birthdate:	March 6, 1940

CAREER SUMMARY

EDUCATION

1965	B.S.	Math/Science Education, Idaho State University, Pocatello, Idaho
1971	M.S.	Hydrology, *"Effect of Industrial and Domestic Effluents on the Water Quality of the Coeur d'Alene River Basin,"* University of Idaho, Moscow, Idaho
1973	Ph.D.	Geology, *"Evaluation of Settling Ponds as Treatment Devices For Mine Waste Water,"* University of Idaho, Moscow, Idaho

SHORT COURSES

1972-1973	Geothermal Resource Council Geothermal Exploration, Sacramento, California
1974	Montana State University Geothermal of Yellowstone Park, Bozeman, Montana
1977	Los Alamos Scientific Laboratory Reservoir Engineering, Los Alamos, New Mexico
1980	U.S. Government Effective Supervision Development, Portland, Oregon
1980	American Petroleum Institute Well Drilling Technology, Idaho Falls, Idaho (correspondence)
1981	U.S. Government Management Development, Phoenix, Arizona
1983	Geothermal Drilling, GRC, San Francisco, California
1986	Practical Aspects of Groundwater Modeling, Boise, Idaho

ADVANCED COURSES

1987	OSHA Hazardous Waste Site Operations Safety Training, MKE, Boise, Idaho
1989	Project Management Training, MKE, Boise, Idaho

Twenty years experience in performing and managing hydrological evaluations and management of hazardous and radioactive waste projects. Currently specializes in groundwater and geothermal resource evaluations and development. Conducts exploration activities aimed at potential development of groundwater and geothermal resources. Involved in environmental studies relating to groundwater contamination and migration of hazardous waste.

Experience in managing and conducting water quality studies, groundwater hydrology investigations, surface water hydrology investigations, and geochemistry analyses at several hazardous waste and environmentally sensitive sites. These include hazardous waste spills, landfill operations, urban runoff, agricultural runoff, mining operations and energy development projects. Involved in scoping the investigations, conducting the field data collection including drilling and sampling, performing data and laboratory analysis, and writing formal reports. Experience includes analytical and numerical modeling techniques for both groundwater and surface water studies.

Active management experience on hazardous waste projects has provided an in-depth understanding of environmental and regulatory policy, particularly related to RCRA and CERCLA. Experienced in providing technical support and expert testimony at public and professional meetings, congressional hearings, and court cases.

EXPERIENCE

09/64	Teaching Assistant, Department of Geology, Idaho State University, Pocatello, Idaho
02/65	2nd Lieutenant, Artillery Officer, 4th Division Artillery, Fort Lewis, Washington
09/65	1st Lieutenant, Forward Observer, 1st Air Cavalry, Viet Nam
11/66	1st Lieutenant, Escort Officer, Visitor's Bureau, Fort Sill, Oklahoma
02/71	Captain, U.S. Army Reserve, Moscow, Idaho
02/67	Junior High Math Instructor, Jerome School District #261, Jerome, Idaho
09/67	Junior High Math/Science Instructor, Douglas County School District, Zephyr Cove, Nevada
05/68	Field Assistant, Idaho Bureau of Mines and Geology, Moscow, Idaho
09/68	Teaching Assistant, Department of Geology, University of Idaho, Moscow, Idaho
09/69	Research Assistant, College of Mines, University of Idaho, Moscow, Idaho
01/72	Hydrogeologist, Idaho Bureau of Mines and Geology, Moscow, Idaho (Transferred in June, 1972 to Boise, Idaho, to set up a branch office at Boise State University)
	Administered branch office of Idaho Bureau of Mines and Geology at Boise. Conducted and published investigations relating to Idaho geology and hydrology. Worked with and advised the general public and local industries on geological and hydrological matters. Assisted the Idaho legislature and elected officials dealing with Idaho minerals, water, and land status. Involved with other State agencies conducting short courses. Performed teaching and research one-quarter time with Boise State University in the areas of groundwater hydrology and environmental sciences.
02/72	Associate Professor, Department of Geology Boise State University Boise, Idaho
	Instructed courses in groundwater geology, environmental geology, structural geology, fundamentals of geology, and advised 25 to 30 students. Principal investigator for research grants with the Corps of Engineers, ERDA (Energy Research and Development Agency), and NSF (National Science Foundation). Co-principal investigator for two grants with the University of Idaho and one with Idaho State University.
09/76	Research Geohydrologist, U.S. Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Las Vegas, Nevada

Managed grants and contracts involving development of ground and surface water monitoring systems. Provided technical expertise in planning and assisting research programs aimed at developing and improving methodology for ground and surface water monitoring. Reviewed technical reports of private industry and other governmental agencies. Served as the Monitoring Systems Analysis representative on working groups for the development of ground and surfacewater monitoring technology.

04/77 Program Manager, U.S. Department of Energy, Resource Exploration & Assessment Branch, Division of Geothermal Energy, Washington, D.C.

Worked with the Energy Research and Development Administration in forming and managing the resource assessment and reservoir engineering program within the Division of Geothermal Energy. Interfaced with high level federal and administrative and congressional personnel dealing with budget and programmatic matters. Established long-term program plans and guidelines for geothermal development. Formed and monitored programs with national laboratories, universities, and state agencies. Established liaison with other federal programs and agencies, and with the private sector involved in geothermal exploration and development. Managed major international cooperative geothermal programs with Italy and Mexico.

06/78 Physical Scientist, U.S. Department of Energy, Energy & Technology Division, Idaho Operations Office, Idaho Falls, Idaho

Served as the principal expert in hydrology for the Resource Definition Branch. Provided program management for geoscience, resource definition, and drilling programs. Responsible for the identification, location, and characterization of geothermal resources for the states west of the Mississippi. Responsible for planning and evaluating functions for the various program elements as well as being involved in interpreting, reporting, and distribution of the conclusions of these programs. Principal areas of activity involved exploration technology, geothermal resource characterization, and drilling these resources. Determined need and recommended new direction which helped accelerate commercial development of geothermal energy. Provided evaluation and technical direction of contractor cork developing new concepts or equipment.

06/79 Chief, Resource Definition Branch, U.S. Department of Energy, Energy & Technology Division, Idaho Operations Office, Idaho Falls, Idaho

Managed the Resource Definition Branch of the Office of Geothermal Energy. Involved supervision of a staff of two professional people and daily contact with personnel from DOE-HQ, subcontractors, national laboratories, foreign and domestic scientists, and the general public. Served as Technical Program Manager in a decentralized operation mode to DOE-HQ for the following national geoscience programs: Reservoir Engineering; Exploration Technology and Development; State Resource Assessment; and Industry-Cost Share Drilling Program. Duties included scoping, developing, and monitoring the technical aspects of these national programs and interfacing with DOE-HQ on major programmatic decisions. Served as the principal expert in hydrogeology and reservoir engineering for the energy Technology Division.

09/80 Chief, Geothermal Energy Branch, U.S. Department of Energy, Energy & Technology Division, Idaho Operations Office, Idaho Falls, Idaho

Managed the Geothermal Energy Branch which involved the direct supervision of four personnel. Responsible for the implementation, management, termination, and reporting of a variety of programs designed to stimulate the development of geothermal resources. Developed technology and the methods by which those resources were to be used as a viable energy source. Provided leadership and expert advice within the Department on a national and regional scale to other agencies and the general public for the total geothermal program. Emphasis was placed on those hydrothermal systems of the Western States and the Economical and environmentally acceptable approaches to developing those systems.

Coordinated the geothermal program managed through the Idaho Operations Office with other Branches such as Low-Head Hydro, Alcohol, Biomass, Municipal Waste, and Conservation. Served as a member of national committees or groups which formulated fundamental policies and determined national priorities for existing and required programs. Established new programs and evaluated existing research and development activities. Developed standards and guides for use in selecting, funding, and managing new activities.

Responsible for 13 major programs involving over 100 individual contracts with a combined annual budget in excess of 30 million dollars. These programs involved several major national projects such as exploration technology, geothermal drilling, reservoir engineering, DOD MX/RES Missile program, and Raft River 5mw. binary power plant.

12/81 Staff Hydrologist, Mining Group, Morrison-Knudsen Company, Inc., Boise, Idaho

Managed projects relating to hydrology, resource investigation, waste management, energy development, and environmental technology. Supervised projects involving geothermal resources, geohydrology, reservoir engineering,and mining hydrology, as well as environmental baseline studies, mine reclamation studies, alternative energy resource investigations, groundwater modeling, and acid mine drainage problems.

01/82 Instructor, Hydrogeology and Geothermal Geology, Boise State University, Boise, Idaho

11/83 Senior Design Project Engineer, Hydrology, Morrison-Knudsen Company, Inc., Boise, Idaho

Senior Manager on projects relating to hydrology, resource investigation, waste management, energy development, and environmental technology. Major emphasis on projects involving geothermal development, geohydrology, reservoir engineering, and mining hydrology, as well as hazardous waste remedial investigation and feasibility studies. Also responsible for projects relating to mine reclamation studies, alternative energy resource investigations, groundwater modeling, acid mine drainage problems, and hydrologic impacts of nuclear waste terminal storage. Has been involved in several groundwater development projects with wells ranging from 1,000 to over 4,000 feet deep.

01/86 Staff Design Project Engineer/Manager, Morrison-Knudsen Engineers, Inc. (Formerly Morrison-Knudsen Company, Inc.) Boise, Idaho

Managed projects relating to hydrology, resource investigation, waste management, energy development and environmental technology. Has supervised projects involving geothermal resources, geohydrology, reservoir engineering, and mining hydrology, as well as environmental baseline studies, mine reclamation studies, alternative energy resource investigations, ground water modeling, acid mine drainage problems, and hydrologic impacts of nuclear waste terminal storage.

01/88 Manager, Hydrology/Geosciences, Morrison-Knudsen Engineers, Inc.Boise, Idaho

Served as Manager of Hydrologic Services for MKE's Hazardous Waste and Environmental Division specializing in remedial investigations, site assessments, feasibility studies, and remedial action for hazardous waste sites. Project experience includes management of site investigation and assessment, feasibility studies, and regulatory analyses work for a confidential RCRA site in Idaho. Also managed cleanup activities at a Utah railroad maintenance and switchyard facility which included site inspection, remedial investigation, feasibility studies, and remedial action alternatives. Assessed geologic, hydrologic, and soil conditions to characterize the hydrological regime as a basis for remedial planning. Major projects include investigations and site assessments to study the impacts of mining activities on groundwater resources and surface water quality and quantity in Idaho, investigation of contamination of groundwater from various spill and disposal activities at

numerous hazardous waste sites, and assessment of groundwater impacts from a proposed high-level radioactive waste isolation facility. Has also been involved in several water well development and geothermal exploration projects for wells ranging from 1,000 to over 10,000 feet deep. Managed a major geothermal drilling and power development project in Guatemala.

1989-present — Director, Idaho Water and Energy Resources Research Institute, University of Idaho, Moscow, Idaho.

Directing activities of the Water and Energy Resources Research Institute including monitoring research projects, administering grants and contracts, and managing professional and technical staff. Responsibilities also include working with state and federal agencies, private industry, and other universities in performing water and energy investigations and research. Also serve as Co-Director for the Center for Hazardous Waste Remediation Research.

1995-1996 — President of the National Institutes for Water Resources (NIWR).

PROFESSIONAL MEETINGS

Stanford Reservoir Engineering Workshop, DOE Program, presentation, Stanford University, December, 1977

First Annual Mexico-U.S. Geothermal Conference, DOE Program, presentation, Cerro Prieto, Mexico, April, 1978

Geothermal Energy Short Course, Washington, D.C., May, 1978

Rocky Mountain Region Geothermal Energy Workshop, Salt Lake City, Utah, June, 1978

Geothermal Energy Demonstration Project, Opportunity Notice Technical Evaluation Committee Member, San Francisco, California, August, 1978

Cerro Prieto Conference, San Diego, California, September, 1978

First Invitational Well Testing Symposium, Lawrence Berkeley Laboratory, Berkeley, California, October, 1978

Stanford Reservoir Engineering Workshop, Session Chairman, Stanford University, Stanford, California, December, 1978

Mexican-U.S. Geothermal Agreement Meeting, Coordination Team Member, Mexicali, Mexico, January, 1979

Geothermal Resource Assessment Program Annual Meeting, Session Chairman, presentation, Salt Lake City, Utah, January, 1979

Second Mexico-U.S. Geothermal Conference, Mexicali, Mexico, April, 1979

Exploration Technology Development Task Force Review, Task Force member, Marina del Rey, California, May, 1979

Joint DOE-USGS Cascades Geothermal Project Review, Task Force member, Portland, Oregon, August, 1979

Mexican-U.S. Cerro Prieto Geothermal Project Meeting, Session Chairman, Mexicali, Mexico, October, 1979

Stanford Geothermal Reservoir Engineering Workshop, Session Chairman, Stanford, University, Stanford, California, December, 1979

National State Cooperative Resource Assessment Program Annual Meeting, Salt Lake City, Utah, January, 1980

Geothermal Rock Properties Program, Task Force Member, Salt Lake City, Utah, January, 1980

Phosphate Symposium, Pocatello, Idaho, March, 1980

Geothermal Resources Council Low Temperature Geothermal Development, Boise, Idaho, June, 1980

Geothermal Development Feasibility Studies Proposal Review Committee, member, San Francisco, California, June, 1980

Wood River Resource Association Geothermal Presentation, Sun Valley, Idaho, August, 1980

MX-RES Missile Geothermal Project Coordination, team member, Las Vegas, Nevada, August, 1980

Geothermal Resources Council Geothermal Energy for the 80's, Session Chairman, Salt Lake City, Utah, September, 1980

Rocky Mountain Geothermal Commercialization, presentation, Kalispell, Montana, September, 1980

Energy Security Act--Geothermal Drilling Loans, presentation, Seattle, Washington, September, 1980

U.S./DOE-Italy/ENEL International Geothermal Project, team member, Lawrence Berkeley Laboratory, October, 1980

MX-RES Missile Geothermal Project Implementation Plan, presentation, Washington, D.C., November, 1980

Geothermal Resources Council, Co-Chairman Geothermal Reservoir Engineering Session, Reno, Nevada, October, 1983

Geothermal Resources Council, Pacific Northwest Section, Geothermal Well Testing and Reservoir Engineering, presentation, Portland, Oregon, December, 1983

American Association of Petroleum Geologist Annual Convention, presentation of U.S. Geothermal Energy Status, San Antonio, Texas, May, 1984

American Association of Petroleum Geologists - Rocky Mountain Section Meeting, Geothermal Well Testing, presentation, Salt Lake City, Utah, August, 1984

City of Boise Geothermal Seminar, Idaho's Geothermal Potential, presentation, Boise, Idaho, March, 1984

Geological Society of America, Rocky Mountain Section, session co-chairman and conveyor, Boise, Idaho, April, 1985

American Institute of Mining Engineers Annual Meeting, Mine Dewatering, paper, St Louis, Missouri, July, 1985

International Mine Water Congress, Mine Dewatering Design, presentation, Granada, Spain, September, 1985

PROFESSIONAL ACTIVITIES

Expert Witness in Hydrogeology, State of Idaho, 1975

Coordinator and Instructor of Short School for Water and Wastewater Systems Operators, Boise State University, March, 1976

Affiliate Faculty - Hydrology University of Idaho, 1978-1982

Instructor for Yellowstone Institute Geothermal Systems, Yellowstone National Park, July-August, 1979 to present

Director of Workshop on Low-Temperature Geothermal Resources NWWA National Exposition, Oklahoma City, Oklahoma, October, 1979

Technical Assessment Committee, Boise Futures Foundation, Boise, Idaho, 1982

Geothermal Resources Council, Yellowstone Geothermal Tour, Tour Guide and Lecturer, June, 1984

EPSCOR Technical Committee Member, University of Idaho, Moscow, Idaho, 1985

Policy Advisory Committee Member, Idaho Water Resources Research Institute, University of Idaho Moscow, Idaho, 1985-1987

Geological Sciences Advisory Board, Boise State University, Boise, Idaho, 1986, 1987

Advisory Board, Idaho Geological Survey

Lawrence Berkley Laboratory Industry Review Panel on Geothermal Reservoir Technology, member

PROFESSIONAL ORGANIZATIONS

Geothermal Resource Council

Idaho Association of Professional Geologists

International Mine Water Association

National Water Well Association, Technical Division

Northwest Mining Association Sigma Gamma Epsilon

Society of Mining Engineers of AIME

OTHER ORGANIZATIONS

Boy Scouts of America

Idaho State Alumni Association

National Ski Patrol Association - Patrol Leader

University of Idaho Alumni Association

CERTIFICATIONS

OSHA Hazardous Waste Operator Certification

Advanced First-Aid and Emergency Care, American National Red Cross

Registered Professional Geologist - States of Idaho, Oregon, Virginia

Standard Secondary Teacher, State of Idaho

AWARDS

Certificate of Appreciation, Morrison-Knudsen Engineers, Inc., 1986

Outstanding Earth Scientist, Gamma Rho Chapter, Sigma Gamma Epsilon, 1974

PUBLICATIONS AND PRESENTATIONS

Mink, L.L., 1970. Analysis of an Aquatic Environment Receiving Domestic and Industrial Wastes: Conference on Trace Substances in Environmental Health, University of Missouri.

Mink, L.L., Williams, R.E., Wallace, A.T., Mar. 1971. Effect of Industrial and Domestic Effluents on the Water Quality of the Coeur d'Alene River Basin: Idaho Bureau of Mines & Geology, Pamphlet #149.

Mink, L. L., Kealy, C.D., Williams, R.E., April, 1972. Structural-Environmental Characteristics of TailingPonds: 10th Annual Engineering Geology and Soils Symposium, Moscow, Idaho.

Williams, R.E., Wallace, A.T., Mink, L.L., 1972. Effect of Early Day Mining Operations on Present Day Water Quality: Ground Water, Vol. 10, No. 1.

Mink, L. L. , April, 1973. In Lieu Lands--History and Selection: 11th Annual Engineering Geology and Soils Symposium, Pocatello, Idaho.

Williams, R.E., Wallace, A.T., McNay, L.M., Mink, L.L., July, 1973. Renovation of Wastes by Mine Tailings Ponds: Mining Engineering, Vol. 25, No. 7.

Mink, L.L., *et al.*, April, 1974. Mercury and Heavy Metal Contamination in the Jordan Creek Drainage Near Silver City, Owyhee County, Idaho: Proceedings of the 12th Annual Engineering Geology and Soils Symposium, Boise, Idaho.

Norbeck, P.H., Williams, R.E., Mink, L.L., June, 1974. Ground Water Leaching of Jig Tailings Deposits in the Coeur d'Alene District of Northern Idaho: Water Resource Problems Related to Mining, American Water Resources Association.

Mink, L.L., Wallace, A.T., April, 1975. Study on the Impact of Subsurface Sewage Disposal in the Ada-Canyon County Area of Southwest Idaho: Department of Army - Corps of Engineers.

Gilmore, C., Beck, S., Mink, L., *et al.*, Oct., 1975. User's Manual for the Selection and Management of Feedlot Sites and Land Disposal of Manure in Boise Valley, Idaho: Department of Army - Corps of Engineers.

Williams, R.E., Mink, L.L., Dec., 1975. Settling Ponds as a Mining Wastewater Treatment Facility: Idaho Bureau of Mines & Geology, Pamphlet #164.

Applegate, J.K., Donaldson, P.R., Mink, L.L., March, 1976. Geologic and Seismic Studies for the Boise Front, Idaho for Geothermal Resource Evaluation: Rocky Mountain Section of American Association of Petroleum Geologists and the Society of Economic Paleontologists and Mineralogists Annual Meeting.

Hollenbaugh, K.M., Donaldson, P.R., Applegate, J.K., Mink, L.L., Stoker, R.C., May, 1977. Boise Geothermal Project: Geothermal Resource Council Transactions, Vol. 1.

Mink, L.L., Graham, D.L., Oct., 1977. Geothermal Potential of the West Boise Area: U. S. Department of Energy National Engineering Laboratory, TREE 1162.

Prestwich, S.M., Mink, L.L., Sept., 1979. Snake River Plain Geothermal Exploration Well: Geothermal Resource Council Transactions, Vol. 3.

Goldman, D., Allman, D.W., Mink, L.L., Oct., 1979. Data Collection and Evaluation of Combined Fractured and Porous Media Flow in a Fluid-Dominated Geothermal System: National Water Well Association, Oklahoma City, Oklahoma.

Mink, L.L., May, 1981. Geothermal Potential of the Madison Aquifer System: Rocky Mountain Ground Water Conference, Laramie, Wyoming.

Mink, L.L., Molloy, M.W., Nov., 1981. National Geothermal Reservoir Engineering and Exploration Technology Program: New Zealand Geothermal Workshop, Auckland, New Zealand.

Mink, L.L., Lease, R.D., Nichols, C.R., May, 1982. The Raft River 5MW(e) Binary Project: International Conference on Geothermal Energy, Florence, Italy.

Mink, L.L., *et al.*, April, 1983. Utah State Prison Geothermal Project: Rocky Mountain Groundwater Conference, Boise, Idaho.

Craig, M.R., Mink, L.L., 1985. An Analytical and Graphical Technique to Determine the Spacing of Drainage Wicks For Pressure Relief in an Open Pit Coal Mine: Proceedings of the Second International Mine Water Congress, Granada, Spain, Vol. 1, No. 1, pp. 95-103.

Kunze, J.F., Richardson, A.S., Hollenbaugh, K. M., Nichols, C.R., Mink, L.L., May, 1985. Non-Electric Utilization Project: Proceedings of Second United Nations Geothermal Symposium.

Mink, L.L., Merida, L.F., Caicedo A., Oct., 1988. Zunil Geothermal Project An Update: Geothermal Resources Council Transactions, San Diego, California.

Permit file NM 22306

Western Environmental Law Center

1216 Lincoln Street • Eugene, Oregon 97401
503-485-2471 • FAX: 503-485-2457 • EMAIL: westernlaw@igc.org

Attorneys
Michael D. Axline*
John E. Bonine*
Marianne Dugan*
Deborah N. Mallander*
Charles M. Tebbutt†
* admitted in Oregon
† admitted in New York

Staff Scientist
Michael Wach

Development Director
Bonnie Souza

Office Manager
Kathy Cannon

Legal Assistant
Kari Kytola

TAOS OFFICE:
P.O. Box 1507
Taos, New Mexico 87571
505-751-0351
FAX: 505-751-1775
EMAIL: santafelaw@igc.org

Attorneys
Grove T. Burnett
Eric Ames
David Gomez
admitted in New Mexico

Office Manager
Linda M. Velarde

BY CERTIFIED MAIL

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SURFACE WATER QUALITY BUREAU

September 15, 1995

David R. Shoemaker
Vice President and Questa Mine Manager
Molycorp, Inc.
P.O. Box 469
Questa, New Mexico 87556

Re: Notice of Intent to File Citizen Suit

Our firm represents Amigos Bravos (c/o Brian Shields, Program Director, P.O. Box 238, Taos, NM 87571 (tel. 505-758-3874)), and New Mexico Citizens for Clean Air and Water (c/o Dr. John Bartlit, State Chairman, 113 Monte Rey Drive, Los Alamos, NM 87544 (tel. 505-672-9792)("the plaintiffs"). On their behalf, we hereby give you notice that the plaintiffs intend to file a citizen suit against Molycorp, Inc.("Molycorp"), pursuant to Section 505 of the Clean Water Act, 33 U.S.C. §1365.

The citizen suit will allege that Molycorp has violated and continues to violate the Clean Water Act by discharging acidic water and heavy metals, including but not limited to aluminum, cadmium, copper, chromium, cobalt, iron, molybdenum, manganese, nickel, lead, and zinc, from mine waste piles at the Questa Mine, either directly or indirectly through ground water, fissures and seeps, into the Red River. Molycorp has violated and continues to violate Section 301(a) of the Clean Water Act, 42 U.S.C. §1311(a), by not obtaining a permit for such discharges pursuant to Section 402 of the Clean Water Act, 42 U.S.C. §1342.

Be advised that the plaintiffs intend to initiate legal action against you at the close of the sixty day notice period to obtain prompt and complete enforcement of the Clean Water Act, as well as civil penalties to the statutory maximum of $25,000 per day of violation,

"Hear within ourselves the sound of the Earth crying." Vietnamese Zen Master Thich Nhat Hanh

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attorney and expert witness fees, costs, and such other relief as may be appropriate. This letter constitutes notice to you as required by Section 505(b) of the Clean Water Act, 33 U.S.C. §1365(b), to commence civil action authorized by Section 505 of the Clean Water Act, 33 U.S.C. §1365.

During the sixty day notice period, we will be available to discuss an amicable resolution of this matter. The plaintiffs seek a long-term solution to the discharge of acidic water and heavy metals from the mine waste piles. The Plaintiffs believe that such a solution, perhaps coupled with alternative environmental projects, would be preferrable to civil penalties.

Sincerely,

WESTERN ENVIRONMENTAL LAW CENTER

Grove T. Burnett
Eric Ames
P.O. Box 1507
Taos, New Mexico 87571
(505) 751-0351

Attorneys for Plaintiffs

cc by certified mail:

CT Corporation
Registered Agent for Molycorp, Inc.
119 East Marcy Street
Santa Fe, NM 87501

Carol Browner, Administrator
U.S. Environmental Protection Agency
401 M Street
Washington, D.C. 20460

Jane Sagimaw, Regional Administrator, Region VI
U.S. Environmental Protection Agency
1445 Ross Avenue
Suite 1200
Dallas, Texas 75202-2733

Janet Reno
Attorney General of the United States
U.S. Department of Justice
Washington, D.C. 20460

Mark Weidler, Secretary
Department of Environment
P.O. Box 26110
Santa Fe, New Mexico 87502

State of New Mexico
ENVIRONMENT DEPARTMENT
Harold Runnels Building
1190 St. Francis Drive, P.O. Box 26110
Santa Fe, New Mexico 87502
(505) 827-0187

GARY E. JOHNSON
GOVERNOR

MARK E. WEIDLER
SECRETARY

EDGAR T. THORNTON, III
DEPUTY SECRETARY

TELECOPIER TRANSMITTAL

DATE: 9/19/95 TIME: _____ PAGE: 1 OF 4

PLEASE DELIVER THE FOLLOWING PAGES TO:

TO: Brian Burgess

LOCATION: US EPA 6WQ-PI

TELEPHONE NUMBER: 214 665 7534

TELECOPIER NUMBER: 214 665 6490

FROM: Glenn Spears

LOCATION: NMED

TELEPHONE NUMBER: 505 827-2827

TELECOPIER NUMBER: 505 827-0160

COMMENTS:

CASE SUMMARIZATION

Discharges to ground water that are hydrologically connected to surface water.

The following are cases which have addressed the issue concerning ground water which is hydrologically connected to surface waters and have found that such discharges are subject to regulation by NPDES permit:

1. **U.S. v. Earth Sciences, Inc., 599 F.2d 368 (10th Cir. 1979).** This case involved application of the Act to a gold leaching process. In this case, the Tenth Circuit noted that the Clean Water Act is designed to regulate to the fullest extent possible sources emitting pollution into rivers, streams, and lakes. The court finally held that when mining activities release pollutants from a discernible conveyance, they are subject to NPDES regulation, as are all point sources,

2. **Sierra Club v. Abston Const. Co., Inc., 620 F.2d 41 (5th Cir. 1980).** This was a suit to enforce portions of the Clean Water Act against coal strip miners. It was held that point source of pollution may be present where miners design spoil piles from discarded overburden such that, during periods of precipitation, erosion of spoil pile walls results in discharges into a navigable body of water by means of ditches, gullies and other similar conveyances, even if the miners have done nothing beyond the mere collection of rocks and materials. The ultimate questions is whether the pollutants are discharged from "discernible, confined and discrete conveyances[s] either by gravitational or nongravitational means.

3. **Trustees for Alaska v. EPA, 749 F.2d 549 (9th Cir. 1984).** This case followed Earth Sciences and held that when mining activities release pollutants from a discernible conveyance, they are subject to NPDES regulation, as are all point sources.

4. **McClellan Ecological Seepage v. Weinberger, 707 F.Supp. 1182 (E.D. Cal. 1988).** It was alleged in this case that McClellan was violating section 301 of the Clean Water Act by discharging hazardous substances from its waste pits into ground water beneath the base without an NPDES permit. The court noted that the Act does not on its face indicate whether ground water constitutes "waters of the United States." The court concluded, however, that Congress did not require NPDES permits for discharges of pollutants to *isolated* ground water. However, the court held that permits *might be required for discharges to ground water that has a direct hydrological connection to surface waters that themselves constitute waters of the United States.* The court stated, "[I]t is also clear that Congress did mean to limit discharges of pollutants that could affect surface waters of the United States." Id at 1196. The court then allowed additional discovery in order to determine if there was a hydrological connection between the ground water that was beneath the waste pits and the surface waters that themselves constituted "navigable waters." If this connection could be shown, there would be a violation of the Clean Water Act.

5. **Quivera Mining Co. v. EPA, 765 F.2d 126 (10th Cir. 1985).** In this case, mining companies challenged the authority of the EPA under the Clean Water Act to regulate the discharge of pollutants from uranium mining and milling facilities into gullies or "arroyos." Neither of the arroyos at issue was navigable-in-fact; however, surface flow occasionally occurred at times of heavy rainfall, providing a surface connection with navigable waters independent of the underground flow. Additionally, it was noted that the waters of the arroyos soak into the earth's surface, become part of the underground aquifers, and after a lengthy period, perhaps centuries, the underground water moves toward eventual discharge into navigable waters. Id. at 129. Therefore, it was held that substantial evidence supported EPA's findings that the arroyos

were waters of the United States within the meaning of the Clean Water Act.

6. **Friends of Sakonnet v. Dutra, 738 F.Supp. 623 (D. Rhode Island 1990).** Septic system found to be a point source. This case adopts the holdings in Earth Sciences and Sierra Club v. Abston.

7. **Dague v. City of Burlington, 935 F.2d 1343 (2nd Cir. 1991).** The court found that a culvert running under a railroad at the boundary of a landfill connecting two portions of a marsh was a "point source" and held that the definition of a "point source" is to be broadly interpreted, citing Earth Sciences.

8. **Sierra Club v. Colorado Refining Co., 838 F.Supp. 1428 (D. Colo. 1993).** The court held that the Clean Water Act's preclusion of the discharge of any pollutant into "navigable waters" *includes discharges which reach "navigable waters" through ground water.* Since the defendant's discharges of pollutants into the soils and ground water beneath the refinery continued to make their way to navigable waters through the ground water, a cause of action was stated under the Clean Water Act. This case contains a very thorough discussion of the issue and of the cases underlying the court's decision.

9. **Washington Wilderness Coalition v. Hecla Mining Co., 870 F.Supp. 983 (E.D. Wash. 1994).** The court held that any pollutant which enters navigable waters, whether directly or through ground water is subject to regulation by NPDES permit. The court goes on to cite the Preamble, NPDES Permit Regulations for Storm Water Discharges, 55 Fed. Reg. 47990, 47997 (Nov. 16, 1990), and stated that the preamble explains EPA policy to require NPDES permits for discharges which may enter surface water via ground water, as well as those that enter directly. Id. at 990-991.

10. **Friends of Santa Fe County v. Lac Minerals, Civ. No. 94-0569 (New Mexico District Court 1995).** The Court held that a citizen suit plaintiff is entitled to present evidence at trial to prove the requisite hydrogeological connection. "Most courts...have held that hydrologically connected groundwaters are regulated waters of the Unites States."

In addition, EPA has repeatedly expressed its view that the Clean Water Act encompasses discharges to groundwaters that are hydrologically connected to surface waters of the United States. For example, EPA explained this interpretation when it promulgated regulations on storm water discharges. *See* Preamble, NPDES Permit Application Regulations for Storm Water Discharges, EPA Final Rule, 55 Fed. Reg. 47990, 47997 (Nov. 16, 1990). ([T]his rulemaking only addresses discharges to waters of the United States, consequently discharges to ground waters are not covered by this rulemaking (unless there is a hydrological connection between the ground water and nearby surface water body)").

EPA also interpreted the statute in this manner when it promulgated regulations governing discharges from concentrated animal feedlots. *See* NPDES General Permit and Reporting Requirements for Discharges from Concentrated Animal Feeding Operations, EPA Region 6 Public Notice of Final Permitting Decision, 58 Fed Reg. 7610, 7631 (Feb. 8, 1993) (feedlots required to obtain NPDES permit for discharges to ground water unless permittee can demonstrate lack of hydrologic connection to surface water).

EPA's statement of its position in connection with the promulgation of other recent

regulations is particularly instructive:

> Notwithstanding the strong language in the legislative history of the Clean Water Act to the effect that the Act does not grant EPA authority to regulate pollution of groundwaters, EPA and most courts addressing the issue have recognized that...the Act required NPDES permits for discharges to ground water where there is a direct hydrological connection between groundwaters and surface waters. In these situations, the affected groundwaters are not considered "waters of the United States" but discharges to them are regulated because such discharges are effectively discharges to the directly connected surface waters.

Amendments to the Water Quality Standards Regulations that Pertain to Standards on Indian Reservations, Final Rule, 56 Fed. Reg. 64,876, 64,892 (Dec. 12, 1991).

EPA has also taken the position in Court that the discharge of pollutants to groundwaters comes within the jurisdiction of the Clean Water Act. "EPA has repeatedly expressed its view that the CWA encompasses discharges to groundwaters that are hydrologically connected to waters of the United States.." *See:* Amicus Brief of the United States, *Village of Oconomowoc Lake v. Dayton-Hudson Corporation, No. 93-3380,* Seventh Circuit Court of Appeals.

WESTERN ENVIRONMENTAL LAW CENTER
Grove Burnett
P.O. Box 1507
Taos, New Mexico 87571
(505) 751-1776
(505) 751-1775 Fax

Attorneys for Plaintiffs

UNITED STATES DISTRICT COURT

DISTRICT OF NEW MEXICO

AMIGOS BRAVOS, a nonprofit corporation, and NEW MEXICO CITIZENS FOR CLEAN AIR AND WATER, a nonprofit corporation,	)	
Plaintiffs,	)	PLAINTIFFS RULE 26 (a) (2) (B) EXPERT REPORT OF RICHARD K. KELSEY, P.E.
vs.	)	
MOLYCORP, INC.	)	
Defendant.	)	

I, Richard K. Kelsey, Senior Vice-President, EnviroSearch International provide the following report as required by Fed. R. Civ. Pro. 26 (a) (2) (B) and the Court's March 17, 1997 disclosures.

A. SUMMARY OF QUALIFICATIONS

1. Qualifications of Witness

- Senior Vice President and Director of Hydrogeology and Remediation Services for EnviroSearch International.

- Registered Professional Engineer with thirteen years of professional environmental consulting experience in hydrology, hydrogeology, and environmental engineering at mining and industrially impacted sites.
- B.S. and M.S. in Agricultural Engineering with emphasis in surface water and groundwater hydrology.

2. Lists of Publications within past ten yrs.

   None

3. Compensation

   Hourly Rate is 100 $/hr

4. Cases witness has testified in past 4 years.

   None

B. SUMMARY OF OPINIONS

1. A direct hydraulic connection exists between the Molycorp waste rock piles and the Red River. The Red River is a gaining stream which drains the entire Red River watershed. The portion of the watershed drainage that contains the mine site is bounded by the Cabresto Creek drainage divide to the north and the Red River to the south (Exhibit 1). Surface water infiltration through the waste rock piles produces shallow groundwater recharge which is discharged primarily into the Red River with some infiltration captured by the cone of depression of the mine. Groundwater discharge into the Red River occurs through the shallow bedrock and alluvial aquifers by observed seeps and springs, including Portal springs, Cabin springs, Capulin springs and other springs adjacent to the Molycorp mine. Groundwater captured by the deep underground mine operation is discharged at the mill and piped to the tailings impoundment. The cone of depression created by the underground mine workings does not capture most of the groundwater from the shallow alluvial aquifer adjacent to the Red River or the shallow bedrock aquifer underlying the waste rock piles. Most, if not all, of the surface water infiltration through the waste rock adjacent to the river (Sugar Shack South, Middle and Sulphur Spring) is discharged through the alluvial and shallow bedrock aquifers into the Red River.

Local hydrologic conditions are present which enhance the connection between infiltration and leachate moving through the waste rock piles and the groundwater system which discharges into the Red River. The surface of the waste rock piles are located in a groundwater recharge zone whereas the springs and seeps along the Red River adjacent to the Molycorp mine site are located in a groundwater discharge zone. Several geologic and geohydrologic professionals have examined the groundwater system beneath the mine site. The prevailing aquifer conditions within the mine area are sufficiently understood to establish the basis for the hydrologic connection between the waste rock piles and the Red River.

2. Local geologic conditions are present which enhance the connection between infiltration and leachate moving through the waste rock piles and the groundwater system which discharges into the Red River. Geologic conditions beneath the Molycorp mine have been extensively studied. The prevailing geologic conditions that create preferential flow pathways for groundwater movement from the waste rock piles to the Red River are sufficiently well understood to constitute the basis for the hydraulic connection between the waste rock piles and the Red River.

3. The Molycorp mine has altered the natural local surface water and groundwater hydrology and water quality in the vicinity of the mine. Surface water infiltration and groundwater recharge have increased due to the placement of the waste rock piles in the watershed and tributary valleys of the Red River. Operations of the Molycorp mine have impacted the presence and behavior of seeps and springs along the Red River adjacent to the mine site. The Molycorp mine has had a significant impact on the water quality observed in the Red River.

C. BASIS FOR OPINIONS

This Summary of Opinions relies in part upon specific documents available through Molycorp and the public record; these documents are identified and cited in this Basis for Opinion.

1. A direct hydraulic connection exists between the Molycorp waste rock piles and the Red River. Numerous investigators have demonstrated that the Red River is a gaining stream which drains the entire Red River watershed (1013 pB-5; 1021 p4; 1017 p10; 1012 p1, p2; and 1040 p230). The portion of the watershed drainage containing the mine site is bounded by the Cabresto Creek drainage divide to the north and the Red River to the south (Exhibit 1; 1046, 1047). The waste rock piles are constructed immediately adjacent to the alluvial aquifer; they lie directly over the exposed bedrock (1013 Figure 5). Surface water infiltrates through the waste rock piles and produces shallow groundwater

recharge which is discharged primarily into the Red River; some infiltration may be captured by the cone of depression created by dewatering of the mine. Groundwater discharge into the Red River occurs through the shallow bedrock and alluvial aquifers via observed seeps and springs. These seeps and springs include Portal springs, Cabin springs, Capulin springs, and other springs adjacent to the Molycorp mine (1013 p5-6; pB-3, 1021 p16). Groundwater captured by the cone of depression created by dewatering the deep underground mine is discharged at the mill and piped to the tailings impoundment. Due to perching groundwater conditions near the surface, hydrologic boundaries within the drainages in the mine area, and low permeability bedrock in the vicinity of the underground mine, the cone of depression created by the underground mine workings does not capture a significant portion of the groundwater flowing through the shallow alluvial aquifer adjacent to the Red River or the shallow bedrock aquifer underlying the waste rock piles (1013 p6, p12). Most, if not all, of the surface water infiltration through the waste rock piles adjacent to the river is discharged through the alluvial and shallow bedrock aquifer into the Red River.

Local hydrologic conditions are present which enhance the hydraulic connection between infiltrating water, the leachate moving through the waste rock piles and the groundwater which discharges into the Red River. The surfaces of the waste rock piles are located in groundwater recharge zones whereas the springs and seeps along the Red River adjacent to the Molycorp mine site are located in groundwater discharge zones (1012 p21; 1013 pB3; 1017 p10; 1021 p4). The primary aquifer systems within the mine area are sufficiently well understood so as to establish the basis for the hydraulic connection between the waste rock piles and the Red River.

This opinion is based upon inspection of the mine site; review of numerous scientific reports prepared by Molycorp's consultants; review of published geologic and hydrologic reports from several state agencies; examination of water levels measured in the Red River and measured in groundwater monitoring wells; examination of pre-mine and post mine topographic maps; study of current configuration of the waste rock piles; depositions obtained from mine management personnel; interviews with multiple state employees familiar with the site; and on experience encountered with similar hydrologic conditions at other mine operations. The scientific reports from Molycorp's geohydrologic consultants and state agencies generally are consistent in describing the hydraulic connection between the waste rock dumps and the Red River. The scientific reports from Molycorp's geohydrologic consultants and state agencies consistently describe the waste rock piles as sources of inflow to the groundwater system. The reports also describe the seeps and springs adjacent to the mine as sources of discharge to the river (1012 p11-12, p21; 1013 p5; 1017 p10; p17-18; 1021 p16, p33). This hydraulic connection is consistent with conditions expected in this type of geographic, hydrologic and geologic setting. Examination of all factors and

information indicate a preponderance of evidence that a direct hydraulic connection exists between the waste rock piles and the Red River. Furthermore, no tangible evidence based on sound fundamental principles of hydrology and hydrogeology has been identified which can refute the hydraulic connection between the waste rock piles and the Red River.

The USGS topographic maps indicate that the Molycorp mine is contained within the Red River watershed boundary (1046, 1047, Exhibit 1). The orientation of the pre-mine topographic surface within the entire mine area is downhill towards the Red River and its tributaries (Exhibit 2). A number of seepage studies and hydrologic reports, including those performed and prepared by mine consultants and state and federal government agencies, demonstrate that the Red River is a gaining stream in the vicinity of the Molycorp mine area (1013 pB-5; 1021 p 4; 1017 p10). The Molycorp mine manager also has indicated that the Red River drains the entire watershed (1040 p230). The New Mexico Environment Department Surface Water Quality Bureau has indicated that "as a gaining stream, the Red River is recharged throughout the length of its main stem by groundwater, as documented by the US Geological Survey and the NM State Engineers Office." (1021 p 4).

Inflow to the watershed includes surface water infiltration (groundwater recharge) which is derived from precipitation on the slopes of the watershed and waste rock piles that neither evaporates nor is consumed by vegetation. Surface water runoff from the watershed and mine area into the Red River essentially is eliminated through storm water management practices employed by the mine (1012 p4, p20; 1034). Local surface water runoff within the watershed and on top of the waste rock piles infiltrates and recharges the underlying groundwater system. Outflow from the watershed includes groundwater captured by the cone of depression created by dewatering the mine operation. Groundwater not captured by mine operations discharges to the Red River through seeps and springs in the alluvial and bedrock aquifers. The Red River drains the entire watershed. A vertical upward hydraulic gradient is observed in monitoring wells adjacent to the Red River which, along with the observation of seeps and springs, indicates the area adjacent to the river is a groundwater discharge zone.

Numerous investigators, including Molycorp's geohydrologic consultants and technical staff from multiple state agencies describe two principal, and interconnected, groundwater systems in the mine area. These two aquifers are described as a shallow fractured bedrock aquifer and an overlying aquifer within the alluvium and valley-fill of the Red River and tributary drainages (1012 p17-18, p21; 1013 p5, p6; 1017 p10; 1021 p 67). The natural gradient in the alluvial aquifer slopes towards the Red River (1013 p5). The alluvial aquifer is recognized by Molycorp's' geohydrologic consultants and scientists from various state agencies as a transmissive hydraulic unit between the waste rock piles and the Red River (1013 pB3; 1017 p10). Molycorp's geohydrologic consultants have indicated "the primary hydrologic linkage between up-gradient sources and the river is the fan delta deposits at the mouths of tributary canyons at

Capulin Canyon and Sugar Shack South" (1013 p5). The alluvial aquifer is underlain by bedrock which limits vertical flow except in areas where fractures and faults create hydraulic preferential flow paths to the Red River. The majority of the waste rock piles are underlain by the shallow bedrock aquifer. Lower permeability bedrock is located at depth and acts as a hydrogeologic basement and a regional aquitard that limits deep circulation of groundwater (1013 pB7).

The underground mine extends into the deeper lower permeability bedrock. The cone of depression created by dewatering the underground mine workings does not extend across the entire mine site; the cone drains the area adjacent to the underground mine within the deep bedrock (1013 p6, pB7). The steep gradient believed to exist within the mines' cone of depression infers that the deep bedrock exhibits low permeability. The cone of depression does not collect a significant portion of the groundwater in the shallow aquifers which lie between the waste rock piles and the Red River (1013 pB7). The shortest path of least resistance for surface water infiltration through the waste rock piles adjacent to the river is through the shallow alluvial and bedrock aquifers into the Red River. Several groundwater monitoring wells in the area of the mine (MMW-2, MMW-3, MMW-7, MMW-8 and MMW-10) exhibit water adjacent levels above the levels in the Red River; therefore they are not significantly impacted by the cone of depression draining the mine. Groundwater in the shallow alluvial and bedrock aquifers that is not captured by the cone of depression discharges to the Red River.

2. Local geologic conditions are present which enhance the hydraulic connection between infiltration and leachate moving through the waste rock piles and the groundwater system which discharges into the Red River. Geologic conditions beneath the Molycorp mine have been studied extensively by numerous geologic professionals including mine geologists, consulting geohydrologists working for Molycorp and geologists working for the State of New Mexico Environmental Division (1012, 1013, 1017, 1021). The prevailing geologic conditions that create preferential flowpaths for groundwater flow from the waste rock piles to the Red River are understood sufficiently well to establish the basis for the hydraulic connection between the waste rock piles and the Red River.

This opinion is based upon a review of scientific hydrogeologic reports prepared by Molycorp's consultants; detailed examination of geologic maps prepared by Molycorp geologists; examination of geologic maps prepared by consulting geohydrologists; and upon review of published geologic and hydrologic reports from multiple state agencies. The scientific reports from Molycorp's' consultants and state agencies and geologic maps prepared by Molycorp consistently describe the geologic features that create preferential pathways for groundwater flow between the waste rock piles and the Red

that known geologic features are present which create preferential flow paths for leachate migration and for groundwater flow between the waste rock piles and the Red River.

In many areas, the fractured bedrock creates perched groundwater conditions which discharges into the Red River (1013 p6). The volcanic and sedimentary rock units, which underlie the alluvium and also are exposed at the pre-mine surface, are fractured and faulted north of the river (1013 Figure 3, p5, B1; 1037, 1038). The underlying shallow volcanic bedrock is a structurally controlled transmissive aquifer that exhibits highly variable hydraulic conductivity depending on the fracture orientation, fracture spacing, and the openness of the fracture spacing, below the water table (1013 pB-2). The fractures and faults in the shallow bedrock aquifer that create preferential flow paths to the Red River have been extensively mapped by Molycorp's consultants and mine geologists as well as technical professionals from state agencies. The fractured and faulted shallow bedrock aquifer exhibits preferential flow paths that transmit groundwater from the waste rock piles to the Red River. Geologic maps prepared by Molycorp's geologists identify faults immediately beneath the Middle and South Sugar Shack waste rock dumps which extend directly to Cabin springs (1037). Molycorp's consultants indicate that "Questa (Molycorp) geologist's mapped northeast-southwest and east-west trending Tertiary dike swarms that intersect in the area of the Cabin springs. The northeast-southwest swarm underlies the existing Middle and Sugar Shack South waste rock disposal areas. The presence of the dikes may be indicative of structurally controlled zones that hydraulically connect the foundation of Middle and Sugar Shack waste rock disposal areas, and the hydrothermal scars that underlie the waste rock disposal areas to the Cabin springs" (1012 p13). Several of these mapped structural features are shown on Exhibit 1 in relation to the waste rock piles. The deeper metamorphic and intrusive rocks form a hydrogeologic basement which constitutes a regional aquitard that exhibits low hydraulic conductivity, thereby limiting deep circulation of ground water (1013 pB-1). In addition, groundwater recovery from the underground mine workings (located within the deeper low permeability bedrock) is not sufficient to significantly affect the shallow fractured bedrock and alluvial aquifers.

3. The Molycorp mine has altered the natural local surface water and groundwater hydrology and water quality in the vicinity of the mine. Surface water infiltration and groundwater recharge have increased due to the placement of the waste rock piles in the watershed and tributary valleys of the Red River. Operations of the Molycorp mine have impacted the presence and behavior of seeps and springs along the Red River adjacent to the mine site. The Molycorp mine has had a significant impact on the water quality observed in the Red River.

This opinion is based upon review of surface water and groundwater scientific reports prepared by state and federal agencies, correlation of reported observations within the Red River to changes in operational procedures within the mine, examination of the

characteristics and configuration of the surface of the waste rock piles, expected and predictable responses in surface water infiltration due to the presence of the waste rock piles, and information obtained during deposition of the Molycorp mine manager. Examination of all factors and information indicates a preponderance of evidence that the Molycorp mine has impacted and altered the hydrology and the water quality of the Red River.

The presence of the mine and the configuration of the waste rock piles in some areas have increased surface water infiltration and groundwater recharge. Less evapotranspiration occurs from the bare rock surface of the waste rock piles than from the natural vegetative cover. The rubbly and uneven surface of the waste rock is more permeable than the surface of the natural collovium. Less runoff from the watershed occurs because the waste rock piles capture stormwater. More groundwater recharge occurs because more surface water infiltrates under the existing configuration of the mine surface than through the natural pre-mine drainage configuration.

Discharge of groundwater from the perched alluvial and fractured shallow bedrock aquifers through the seeps and springs adjacent to the Red River has increased due to the increase in groundwater recharge. The State of New Mexico Environmental Department/Surface Water Division documents "increased groundwater flow and discharge in the seeps and springs have been observed since the waste piles were placed in the mine. Analysis of data from USGS groundwater seepage investigations in 1965 and 1988 indicates that there was a significant (149%) increase in seepage rates (groundwater accretion) to the middle reach of the Red River near Molycorp in 1988 as compared to 1965. The Molycorp open pit mine was begun in 1965; by the time of the 1988 seepage investigation the pit had been in place for more than twenty years. The pit and associated waste-rock dumps enhance groundwater recharge and may be responsible for the documented increase in seepage rates, and changes in water quality." (1021 p67). This reported increase in seepage rates probably is an accurate interpretation given the increase in groundwater recharge and the presence of perched conditions beneath the waste rock piles.

Reported reductions in flow rates from the springs at Capulin Canyon adjacent to the Molycorp mine along the Red River probably have been due to interception of shallow groundwater below the waste rock piles in upper Capulin Canyon. According to Molycorp mine management, collection of shallow groundwater through the Capulin Canyon interception system reduced spring flows from Capulin springs adjacent to the Red River (1040 p213, p216). This observed reduction demonstrates the direct hydraulic connection between the waste rock piles and seepage observed at the river. Due to the collection at the interception system, less flow would occur through the shallow alluvial aquifer, however, deeper groundwater flow within the bedrock aquifer would not be significantly affected.

Based on the proximity of the Moly Tunnel outfall to the Portal springs and the Red River; and the sequence of events leading up to the emergence of the Portal spring,

evidence suggests that plugging of the Moly Tunnel in 1992 caused the subsequent emergence of Portal spring immediately downgradient along the Red River. Gravity drainage of groundwater out of the Moly Tunnel occurred prior to 1992. A bulkhead was placed in the Moly Tunnel in 1992 in order to stop discharge from the underground mine if the underground mine dewatering system failed. Placement of the bulkhead within the tunnel stopped the drainage out of the tunnel. Portal spring was observed for the first time in 1994 (1021 p43; 1040 p208). Water which formerly drained out of the tunnel probably flows through the fractured bedrock into alluvial aquifer and discharges at Portal spring which is immediately downgradient from the Moly tunnel bulkhead. Portal spring is outside the cone of influence associated with dewatering the old underground mine.

The State of New Mexico Environmental Division indicates that "The Red River watershed is one of the most severely impacted perennial stream system in regard to metal loading in New Mexico" (1021 p17). They further indicate that "Molycorp Mine is by far the most significant" of all the sources of contamination potentially impacting the Red River. Molycorp is by far the largest industrial operation within the Red River watershed. No mine in the Red River district produced more than a few hundred tons of ore, except the Memphis Mine on Bitter Creek, which produced 3500 tons of ore (1004 p376). Most of the activity in the district was development and exploration work. Molycorp produced over 328,000,000 tons of waste rock. Prior to open pit operations, the Red River was documented as a high quality stream. The presence of hydrothermal scars for thousands of years prior to the open pit operation apparently had little effect on the river, other than turn it red occasionally with sediment. Numerous water quality studies by state and federal agencies have documented significant deterioration of the Red River between 1966 and 1992, after the open pit began operation in 1965 (1017 p23, p24-25; 1021 p43-47). Summaries of these studies describe the condition of the Red River through time as follows: Water quality studies performed by the USDHEW in 1966 documented "the Red River as an "exceptional" high quality surface water resource". In November 1971, the United States Environmental Protection Agency concluded "the chemical quality of the Red River water remains very good...biological conditions in the river are good...and...occasional breaks in the [tailings] line are causing some degradation in stream quality and biota. During this same period of the late 1960's and early 1970's, however, the New Mexico Department of Game and Fish discovered in the course of routine population studies that fish were conspicuously absent in the middle reach of Red River where thriving populations had once existed. In 1982 the U.S. EPA conducted a "Site Specific Water Quality Assessment" of the Red River and found the stream to be substantially impaired from metal loading. The 1992 305(b) report listed an increased concentration in Red River in the vicinity of Molycorp Mine of several metals including Cd, Cu, Pb, Ag, and Zn. (1021 p7). The New Mexico Environmental Division further states that "during the surface water investigation performed by the State of New Mexico, water from groundwater seeps was observed emerging and entering Red River approximately one and a half miles below (southwest) Molycorp

mine. Along this same stretch of the Red River, manganese concentrations were greater than three times the concentrations detected upstream (NMED, Feb. 28, 1994, Table 6; Smolka and Tague, 1989). Fish census data of 1960 indicate that approximately 572 fish per mile were established in the river. The 1988 fish census found no fish in this same reach (NMDGF, November 29, 1988)." (1021, p9)

The preponderance of data suggest that the Molycorp mine has had a severely detrimental effect of the water quality of the Red River.

Richard K. Kelsey

Dated March 14, 1997

LIST OF DOCUMENTS
Moly Corp.

March 14, 1997

DOCUMENT NUMBER	DATE	DESCRIPTION
1004	1990	"Geology of the Red River District, Taos County, New Mexico" by Thomas T. Roberts, Gary A. Parkinson & Virginia T. McLemore in the New Mexico Geological Society Guidebook, 41st Field Conference, Southern Sangre de Cristo Mountains, New Mexico, 1990
1012	4/13/95	Questa Molybdenum Mine Geochemical Assessment. Prepared by Steffen Robertson and Kirsten (U.S.) Inc. for Molycorp Inc.
1013	4/21/95	Progress Report on the Geology, Hydrogeology, and Water Quality of the Mine Area Molycorp Facility, Taos County, New Mexico. Prepared by South Pass Resources, Inc./SPRI for Molycorp, Inc., Questa Division
1017	10/20/95	Expanded Site Inspection Report on Molycorp Inc., Questa Division, Taos County, New Mexico. Prepared by Stuart Kent, New Mexico Environment Department, Groundwater Protection and Remediation Bureau-Superfund Program
1021	3/96	Red River Groundwater Investigation, Final Report submitted to USEPA, Region VI, March, 1996 by Dennis Slifer, New Mexico Environment Department Surface Water Quality Bureau
1034	12/16/96	Letter from Geyza I. Orinczi, Environmental Manager, Molycorp, Inc., Questa Division to Mr. Richard E. Powell, New Mexico Environment Department Surface Water Qualilty Bureau re: Compliance Evaluation Inspection Report, Molycorp, Inc., NPDES Permit #NMR00A089, November 18, 1996
1036	undated	Geology of the Questa Mining District: Volcanic, Plutonic, Tectonic and Hydrothermal History by Jeff Meyer, Dept. of Geological Sciences, Univ. of Calif. at Santa Barbara, Robert Leonardson, Chief Geologist, Union/Molycorp
1037	undated	Plate 2 Geologic Map of the Questa Mine Area
1038	undated	Plate 1 Geologic Map and Cross Sections of the Questa Mining District
1040	1-22-97	David Shoemaker Deposition

RICHARD KELSEY, P.E.
Senior Vice President, Remediation Services, Director of Hydrogeology

M.S., Agricultural Engineering (Hydro/geotechnical), 1984 University of Idaho, Moscow, Idaho

B.S., Agricultural Engineering (Hydro/geotechnical), 1983 University of Idaho, Moscow, Idaho

Mr. Kelsey is a registered Professional Engineer with over 12 years of environmental consulting and litigation support experience including management of major client accounts involving complex multi-component remediation projects and providing comprehensive expert witness services. Mr. Kelsey also performs administrative management of the Hydrogeology and Remedial Engineering Departments, participates in corporate management as a member of the Board of Directors, and coordinates numerous domestic and international marketing initiatives.

Mr. Kelsey's primary responsibilities include: oversight of all technical staff in the Hydrogeology and Remedial Engineering departments at EnviroSearch, providing senior project support to all site characterization, remediation, and site closure projects; and allocating administrative and interdisciplinary staff resources to support project requirements. As client liaison, Mr. Kelsey has been involved with virtually every aspect of site remediation, hazardous waste management, and environmental compliance. He manages multi-component remedial feasibility studies and coordinates risk assessment activities at complex hazardous and non-hazardous waste sites. He has extensive experience in directing large technical teams of interdisciplinary personnel within the engineering, earth, and environmental sciences.

Additional technical responsibilities involve developing and reviewing workplans and work products associated with RI/FS and RFI activities conducted under CERCLA and RCRA including: sampling and analysis plans, data management plans, environmental data validation procedures, and preparation of data quality assessment and site characterization reports. He has conducted Remedial Investigations and RCRA Facility Investigations at several sites under state and federal compliance orders, and has a thorough working knowledge of related environmental regulations including SARA, TSCA, and the Clean Water Act. He also provides senior technical support in evaluating remedial alternatives and designs and implements soil and groundwater remediation systems at a wide variety of sites. Mr. Kelsey provides significant legal and litigation support for complex cases and participates in resolving diverse regulatory, legal and technical issues. As Program Manager for key accounts, Mr. Kelsey monitors all aspects of work product quality, project budgets, and schedules.

As Director of Hydrogeology/Remediation, Mr. Kelsey develops conceptual, analytical, and numerical models of hydrogeologic contaminant transport/distribution systems; characterizes the presence, persistence and mobility of organic contaminants complex hydrogeological settings; and evaluates alternative groundwater mitigation scenarios. He has implemented specific risk assessment modeling approaches in support of site closure at several sites contaminated with hydrocarbons, chlorinated solvents, heavy metals and radionuclides.

CERCLA/RCRA Remediation Experience

Mr. Kelsey has served as a Technical Advisor and Program Manager of over 50 soil and groundwater investigation and/or remediation projects involving facilities impacted by chlorinated solvents, radionuclides, petroleum products, pesticides, and heavy metals. As Senior Technical Advisor in Remediation Services, Mr. Kelsey has overseen the investigation and remediation of numerous sites impacted by petroleum compounds and manages several sites involving complex environmental conditions. He has developed and implemented several RI/FS workplans for federal NPL sites and prepared several Site Investigation Plans, Record of Investigation, Site Cleanup Plans, and Risk Assessments for sites regulated under a variety of regulatory programs in the State of Utah. Examples of Mr. Kelsey's specific project experience with remediation at hazardous waste sites includes:

Volvo GM RCRA Corrective Action - Project Manager in developing and implementing a RCRA Facility Investigation, and a RCRA Corrective Measures Study to cleanup soils and groundwater contaminated with heavy metals, solvents, petroleum compounds, radionuclides, mixed wastes, and industrial sludges. Site investigation activities included: extensive soil and groundwater characterization, defining aquifer parameters, implementation of pilot scale Soil Vapor Extraction and Air Sparging Tests and performance of insitu and exsitu treatability studies. Remedial design and implementation includes full scale application of bioventing, air sparging, and groundwater extraction systems as well as hazardous, radiological, and non-hazardous waste characterization, profiling, and disposal at licensed TSD's. Innovative waste segregation and volume reduction approaches developed by Mr. Kelsey resulted in over $1 million savings in disposal costs to the client and expedited cleanup of radiological wastes. Key aspects of the project included coordination of risk assessment activities to define cleanup objectives and standards as well as development and implementation of numerous Interim Site Management Plans resulting in significant cost savings and expedited site cleanup.

Program Manager Multiple Mine Sites in Idaho and Nevada - Mr. Kelsey is Program Manager for a multi-year multi-state contract with the US Forest Service to conduct CERCLA investigations and remedial evaluations of mine impacted sites in central Idaho and Nevada. Mr. Kelsey directed a multi-disciplinary field team to characterize metal concentrations in soil, sediment, surface water and groundwater from past and present mining activities at operating and abandoned mines in Idaho. He also directed an Engineering Evaluation/Cost Analysis (EE/CA) and remedial design for a Removal Action at an abandoned mine administered under CERCLA. Under Mr. Kelsey's direction, a multi-disciplinary project team conducted the EE/CA at the Buckskin National and McCormick Group Mine sites to address discharge of acid mine drainage, metals and cyanide in surface waters; stabilization of abandoned mine tailings; and cleanup of mercury contaminated soils. The scope of work includes a comprehensive analysis of removal and closure requirements and remedial alternatives, and design of the selected remedial action. The EE/CA satisfied environmental review and documentation requirements and provided a framework for evaluating and selecting alternative removal/closure technologies. The EE/CA was performed to satisfy the State of Nevada mine stabilization and federal EPA closure requirements.

Norton Aquifer Remediation - Mr. Kelsey acted as Technical Advisor in overseeing the development and implementation of a RCRA Facility Investigation, RCRA Corrective Measures Study and RCRA Corrective Action Plan to remediate a shallow aquifer contaminated with hexavalent and trivalent chromium. Site characterization included defining controlling hydrogeologic and geochemical parameters and a statistical analysis to determine background concentrations in soils and groundwater. The project included the design, construction, and operation of a multi-well groundwater extraction system and treatment plant to remove chrome from extracted groundwater prior to discharge to the local POTW. Risk assessment will be used to justify leaving residual contamination in place in support of site closure.

City of Midvale RI/FS Review - Project Manager in performing an independent review of all RI/FS activities conducted by the U.S. EPA for a mill tailings Superfund site. In support of a local citizens group for the City of Midvale, Mr. Kelsey managed a multidisciplinary independent review of the Remedial Investigation, Feasibility Study, and Risk Assessment for the Midvale Tailings Superfund site. The technical adequacy and thoroughness of the work performed by the EPA contractor was examined. Data deficiencies and inconsistencies in data interpretation were identified and an evaluation of the RI/FS methods and proposed Corrective Measures were performed.

Litigation Support Experience

Litigation support experience includes participating in strategic planning, preparation of expert testimony, formal expert witness training, preparation of technical and graphical work

products supporting deposition and trial, and critical review of opposition work products. Case specific experience is outlined below:

Shughart, Thomson and Kilroy/Joel Mosher - Mr. Kelsey provided expert witness services and directed a technical team of hydrogeologists and engineers in support of an insurance company refuting a 3 million dollar claim to recover remediation costs from a property impacted by a complex history of hydrocarbon releases. Mr. Kelsey participated in strategic case planning, directed review of all pertinent records, developed expert opinions, disclosure statements and products for deposition and trial, and critiqued oppositions work products. Technical support included developing alternative cleanup cost allocation approaches and identifying controlling hydrogeologic and site conditions affecting cleanup and assessing reasonableness of the remediation approach and associated costs. Settlement was reached in favor of our client during disclosure and deposition prior to trial which was significantly facilitated by the strength of the technical expert opinions provided.

Dunn and Dunn/Carl Ericson - On behalf of an insurance company, Mr. Kelsey provided senior oversight and peer review of opposition work products implicating release timing during specified periods of coverage. Mr. Kelsey directed a technical review team in critiquing the opposition groundwater flow and contaminant transport modeling suggesting incident timing and identified weaknesses in the oppositions deposition and overall modeling approach. Mr. Kelsey prepared a formal critique of the oppositions release timing analysis which was used to refute incident timing and implied coverage.

Beveridge and Diamond - Larry Bazel - In support of pending litigation for a Potentially Responsible Party (PRP), Mr. Kelsey evaluated the environmental conditions attributable to historical smelting and refining practices from an historical lead and precious metal refinery which operated in the late 1800's and early 1900's. A complex history of industrial usage including lead smelting, acid production, paint manufacturing, and vehicle maintenance is associated with the site involving several PRP's negotiating the allocation of cleanup costs. An examination of historical documents and metallurgical practices revealed the likely processes and character of the feedstocks and by-products from the historic smelter. The environmental impacts potentially attributable to the smelting operations were compared to the observed soil and groundwater contamination in order to accurately allocate the responsibility for cleanup.

Ballard Spahr Andrews & Ingersoll/Bill Prince - Mr. Kelsey has provided environmental and litigation support to Mr. Prince in a number of cases involving site assessment and remediation. Mr. Kelsey currently acts as Program Manager for a complex RCRA Corrective Action project (Volvo/GM) which is subject to significant review by opposition's counsel and technical consultant. While litigation is not pending, this project demonstrates an ongoing relationship with a key client in the legal community involving substantial remedial efforts. Other case support provided by EnviroSearch includes examination of oppositions work product and providing testimony during mediation proceedings and technical consultation on several cases involving alleged contamination by multiple parties.

Previous Employment

MK-Environmental Services, Boise, Idaho, Senior Hydrologist/ Hydrogeologist - Mr. Kelsey was responsible for design and implementation of hydrogeological and site characterization investigations, development and evaluation of remedial action and waste management alternatives, and environmental resource investigations.

Rocky Mountain Arsenal - Mr. Kelsey developed approximately one third of the expert testimony supporting a 2.8 billion dollar environmental claim against more than 200 insurance companies. To identify likely release timing and associated coverage, Mr. Kelsey developed and supervised a large scale groundwater flow and contaminant transport modeling program to identify and define the sources of pesticides and organic compounds in a complex hydrogeologic setting. He designed and implemented a comprehensive modeling approach considering all aspects of

development including the conceptual, analytical, and numerical modeling. Additionally, he supervised and coordinated the efforts of up to 20 engineers, soil chemists, hydrologists, hydrogeologists, and computer specialists in the development of regional and numerous local scale groundwater flow and contaminant transport models, including an evaluation of potential migration through the vadose zone. Mr. Kelsey also coordinated staff chemists performing plume dissection and chromatographic fingerprinting to relate contaminant sources to the associated soil and groundwater contamination.

Mr. Kelsey also participated in the identification, selection, and preparation of a nationally recognized expert witness as well as refuting opposing deposition and expert testimony. Mr. Kelsey participated in a formal training program for expert witnesses; developed and delivered technical presentations; served as liaison between the client, legal counsel, and support staff; and provided litigation support during the deposition process and trial.

Chemical manufacturing complex remediation, Beaumont, Texas - RCRA Corrective Measures Study/RCRA Corrective Action - Mr. Kelsey managed the identification and evaluation of cleanup alternatives to remediate LNAPLS and DNAPLS in groundwater including design and construction of a 32 well groundwater recovery and multi-component treatment plant for Dupont Beaumont Works chemical plant under the RCRA Corrective Action Program in the State of Texas. The project also included development of a system optimization and startup program as well as operation and maintenance plans.

As lead hydrologist, Mr. Kelsey was responsible for the design and implementation of a groundwater remediation program involving multiple sources of LNAPLS and DNAPLS in a complex hydrogeologic and contaminant distribution setting. He collected and analyzed hydrogeologic data for aquifer parameterization and hydraulic characterization, evaluated interaction between surface water and aquifer systems, and coordinated mathematical modeling and well field simulation studies to develop an efficient groundwater recovery system. He supervised the development and application of a three-dimensional numerical model (MODFLOW) to simulate the natural hydrogeologic system and predict the response of the multi-aquifer system to dewatering. He also characterized selected principal organic contaminants and evaluated their distribution and transport characteristics in relation to recovery and treatment system performance. Additionally, he interfaced with other engineering disciplines to develop final design drawings and construction plans.

Sand Springs Petrochemical Complex, Oklahoma - Mr. Kelsey developed and implemented CERCLA Remedial Investigation work plans and coordinated a large analytical laboratory testing program. He supervised a field investigation effort involving soil and waste sampling from numerous exploratory excavations and borings associated with multiple on-site sources. Additionally, he developed and implemented an automated data validation program, coordinated the development of an analytical data base, conducted statistical analysis of results, and prepared a data quality assessment and site characterization reports.

Usibelli Coal Mine, Alaska - Mr. Kelsey conducted a dewatering feasibility study to determine the potential for installing a groundwater extraction system to reduce inflow to the mine and stabilize the working slope and highwall. He performed hydrogeologic characterization, aquifer pump tests and analytical modeling to estimate groundwater flow rates and required well spacing associated with conceptual well flow characteristics and fracture flow patterns followed by recommending installation of horizontal collection drains at critical locations. He also assisted in the development of a surface water control plan and associated portions of the mine permit.

Pesticide manufacturing facility, Glacier Park Company, Washington - Mr. Kelsey developed and implemented a CERCLA Remedial Investigation plan to determine the presence and distribution of hazardous organic chemicals in soils and groundwater for a pesticide manufacturing facility in Washington. He performed a hydrogeological characterization, defined potential sources,

determined type and potential fate of chemicals of concern, sampled surface soils, and installed monitoring wells to define the distribution of contaminants and local hydrogeological regime. Mr. Kelsey established background water quality, and developed and evaluated remedial cleanup-containment alternatives.

Locomotive Remanufacturing Facility Remediation, Idaho - Mr. Kelsey performed characterization of the quality and treatability of industrial effluent containing organic and inorganic chemicals for this hazardous waste site in Idaho. He evaluated alternative treatment and/or disposal options, and initiated the disposal of wastewater through land application and on-site treatment by a portable carbon absorption train.

Training

Petroleum and Geological Engineering, Montana School of Mines

OSHA 29 CFR 1910.120 40-hour hazardous waste worker and site supervisory training

Computer Modeling of Groundwater Flow and Contaminant Transport Process short course, Butler University, International Groundwater Modeling Center

Certification

Professional Engineer - Utah and Idaho

Affiliations

National Water Well Association

National Groundwater Association

Association of Groundwater Scientists and Engineers

DKMR1186

...ering appeal state Supreme Court

The Public Service Company of New Mexico may take the controversial Ojo Line Extension all the way to the New Mexico Supreme Court.

On Monday, the three-member New Mexico Public Utility Commission unanimously rejected PNM's bid for permission to build the 50-mile power line through the allow the project to go forward. In so doing, it apparently ended one of Northern New Mexico's longest running environmental disputes.

But within two hours of the ruling, PNM spokesman Rick Brinneman said the utility giant may appeal the decision to the Supreme Court. Brinneman said PNM had two months to make a decision

Brinneman said that in making their decision about whether to appe e ruling, PNM officials would ...utinize the recommendation of hearing examiner Peter Springer that the PUC's decision is based on — particularly a section that lists alternatives to OLE that have been suggested by critics of the project.

has invested in the ... come to naught.

On Monday, Brin... company might "ea... lion or include the ... future rate case.

Springer said in ... ing issued in July ... failed to present c... dence that OLE wa...

THE SANTA FE NEW MEXICAN TUES NOV 21, 1995 pgs A1 + A3

Trying to save the 'dead' Red River

Photos by Laurent Gueste/For The New Mexican

State geologist Michael Coleman takes a reading for acidity where metals such as iron and manganese are seeping into the Red River.

Trenches catch acidic metals

By CATHERINE WALSH
For The New Mexican

QUESTA — Citing a desire to be "a good neighbor," Molycorp Inc. has teamed up with the state Environment Department and others in an effort to stop contaminated water from seeping into the Red River.

The mining company used its giant backhoe to dig four drainage trenches along the northern bank of the river near Capulin Canyon last month, said Dave Shoemaker, manager of Molycorp's molybdenum mine.

The company also has purchased several tons of limestone that was put into the trenches to leach out acidic fluids seeping into the river.

These limestone trenches were dug 13 to 15 feet deep, at or below the groundwater table. The trenches are part of a new technology that "neutralizes" water carrying acidic metals such as calcium and aluminum.

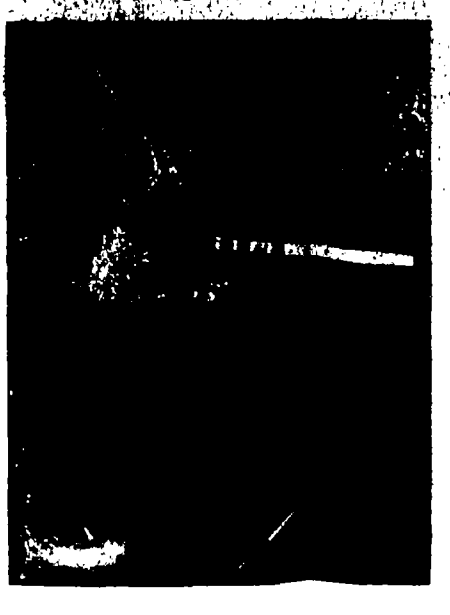
As water seeps through the limestone toward the river, the metals "drop out," Shoemaker said.

He said Molycorp's actions weren't motivated by accusations the company has turned the Red River into a dead river.

"We feel we don't have an impact on the river," he said. "We're controlling natural drainage (from the mine) and any problems we have are caught by interceptive barriers."

An environmental group in Taos said it holds Molycorp responsible for much of the pollu-

Please see RIVER, Page A-3



Test strips measure acidity at a seepage spot. Green algaes are not natural to the Red River and their presence is due to the high content of metals such as iron and manganese. The white deposit is calcium, aluminum and silica from the river fixed and crystallized by the metals of the seepage.

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New Mexican

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Already, De Republicans Mor ing about wha agreement mea House chief of st ta even suggestin necessarily bind seven-year time if that weren't sides could spe

Rangers at Bandelier National Monument issued a record number of citations last week, m to people who apparently decided the federal rnment shutdown was their chance to visit the monument without encountering cops or crowds.

"People were surprised we were working," Bandelier chief Ranger Carl Newman said.

Newman said park rangers and law enforcement officers issued 27 citations over the six-day period the park was closed. The National Park Service closed parks nationwide Tuesday and together with most other federal agencies furloughed all but the most essential workers during a standoff in budget negotiations.

During a comparable period, rangers could expect to issue only two or three citations for violations of park rules, Newman said.

"A lot of people seemed to look (at the monument closure) as an opportunity to go when no one else was there."

Newman said people ignored signs posted at all Bandelier trail heads and the monument entrance, then climbed over fences and gates. Some even let a personal best," Newman said, "but not a very pleasant experience."

Newman said that when confronted by rs, most trespassers were cooperative.

"There was no uppiness that I've heard about," he said. "Most people weren't frustrated with us — they understood we were doing our job."

At the Santa Fe National Cemetery, burials went on as scheduled last week, cemetery director Gloria Gomez said. When the full staff returned to the office Monday, Gomez said, "it was just the paperwork we were behind on. We can do that anytime."

It appeared Monday as if furloughed employees would get paid for their time off last week. That might make the furlough look like an "extra" paid vacation, but that's not the attitude most federal workers have, said Jerry Rogers, superintendent of the National Park Service Southwest Regional Office in Santa Fe.

Newman said some workers at Bandelier returned to work frustrated Monday. "There's a lot of dedicated folks here," he said. "They came in today and said, 'Jeez, I'm a week behind on this project.' "

RIVER

Continued from Page A-1

tion in the Red River.

But the group, Amigos Bravos, welcomed the mine's "wonderful gesture" of digging the trenches.

The first thing a visitor notices about the Red River a couple of miles east of Questa is the milky color of the water.

A closer look reveals a white glaze coating rocks in the stream.

But a check under dozens of these white rocks won't reveal any insect larvae clinging to the rocks. Few bugs live in this portion of the Red River.

There are almost no fish, as those stocked each year are either caught by fishermen or swim to the Rio Grande.

"Some people say this portion of the Red River is dead," said Michael Coleman, a geologist with the state Environment Department. "But we call it an impacted zone."

Standing above river's north bank Monday afternoon, Coleman pointed out a couple of rust-colored pools of water along the north edge of the river.

"That's seep water and these seeps are contaminated," he said.

Whether contamination is caused solely by water interacting with natural, hydrothermal clays in the area or by Molycorp's waste rock and tailings isn't clear, Coleman said.

"The mine could be a contributor," he said. "But water coming into contact with sulfides in the clay causes them to become loaded with (acidic) metals."

When acidic seep water "hits the river along the seep zones, it changes chemistry," Coleman said. The water drops calcium, aluminum and silica into the stream in a dissolved state that forms a paste, he said.

"The paste sort of cements the bottom of the stream and doesn't allow bugs to live," he said. "Bugs, of course, are necessary for fish survival."

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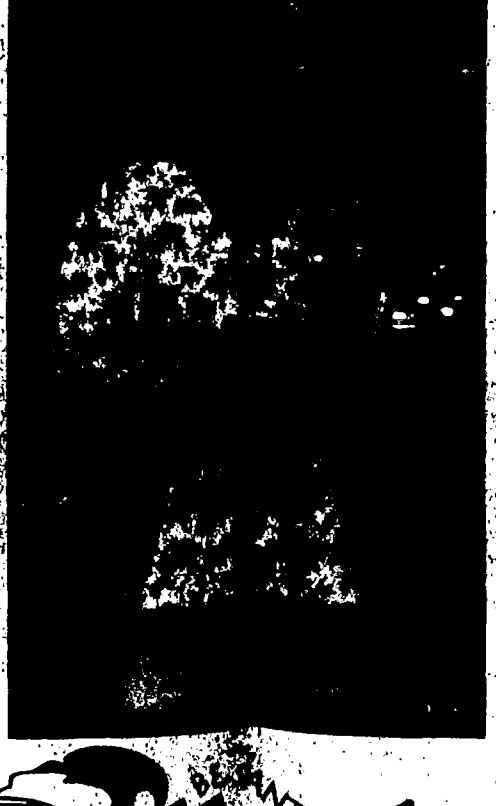

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Harold Runnels Building
1190 St. Francis Drive, P.O. Drawer 26110
Santa Fe, New Mexico 87502-0110
(505) 827-2855
Fax: (505) 827-2836

MARK E. WEIDLER
Secretary

EDGAR T. THORNTON, III
Deputy Secretary

FOR IMMEDIATE RELEASE

Contact Bill Williams, 827-2855

ENVIRONMENT DEPARTMENT PROTECTS RED RIVER

New Mexico Environment Department (NMED) staff members Michael Coleman, Dennis Slifer and Peter Monahan initiated a cooperative plan involving NMED, the Molycorp Questa Mine, the State Highway and Transportation Department (NMSHTD), the Questa Ranger District-Carson National Forest and the U.S. EPA.

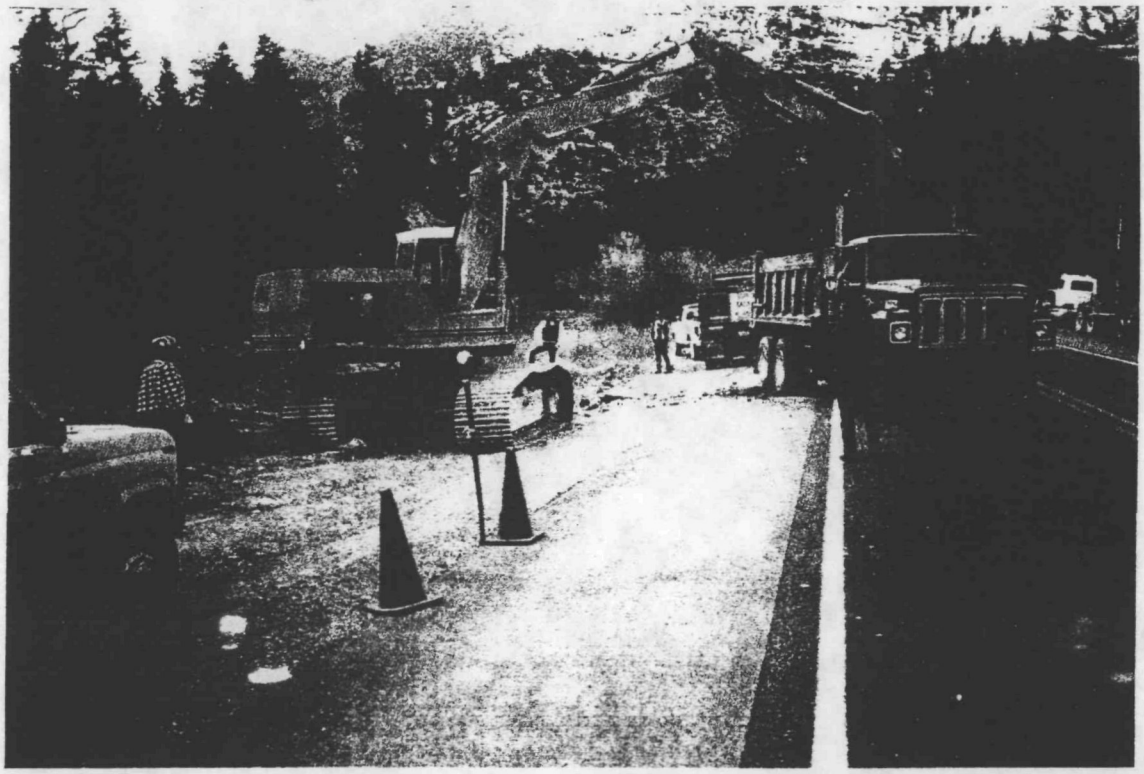
"The project involved the implementation of a relatively new technology: anoxic alkaline trenches acting as a passive treatment system to intercept and arrest acidic, metal-loaded groundwater or acid mine drainage," said Michael Coleman of NMED. "The project is situated along the Red River, between Questa and the town of Red River, Taos County."

"The impacted area was identified during our current EPA Grant project (Red River Groundwater Investigation. FY-92-A, 319(h))," said Dennis Slifer of NMED. "The objectives of the Grant project are to determine ground water and aquifer characteristics in order to identify, and ultimately eliminate, impairment of both the aquifer and the designated uses of the river. The alkaline trenches represent the Best Management Practice (BMP) which was selected to improve obvious water quality impairments: the perennial, steady state seepage of acid waters into the river, effects upon macroinvertibrate and fish populations and the overall negative impact on water quality."

"Trenches 25' to 70' long, 5' to 8' wide, and 13' to 15' deep were dug into the highway shoulder, adjacent to the north bank of the river," explained Peter Monahan of NMED. "Four segments, totaling 170 linear feet, were placed directly up grade from active seep areas, presently delivering a steady pH 3.4 to the stream. The trenches were half filled with limestone cobble, and a polyethylene mat vapor barrier was placed over the carbonates. The system is sealed by an overlying layer of bentonite clay and filled back to grade with clean soil. The areas were then leveled, seeded and covered with a chopped straw mulch."

"Molycorp covered the cost of the raw materials and provided a large track hoe and operator to dig the deep trenches," explained Ed Kelley, Water and Waste Management Division Director at NMED. "The Highway Department assigned a full crew with a smaller back hoe, a loader, dump trucks and traffic control. The Forest Service expedited all necessary NEPA clearance. The Environment Department costs were limited to staff time for planning and project oversite and a few minor supplies." Kelley is in charge of the division in which Coleman, Slifer and Monahan work.

"The project was a beautiful example of industry and State agencies working together in complete harmony towards a goal which could be of benefit to the entire state," said Bill Williams, Communications Director of NMED.



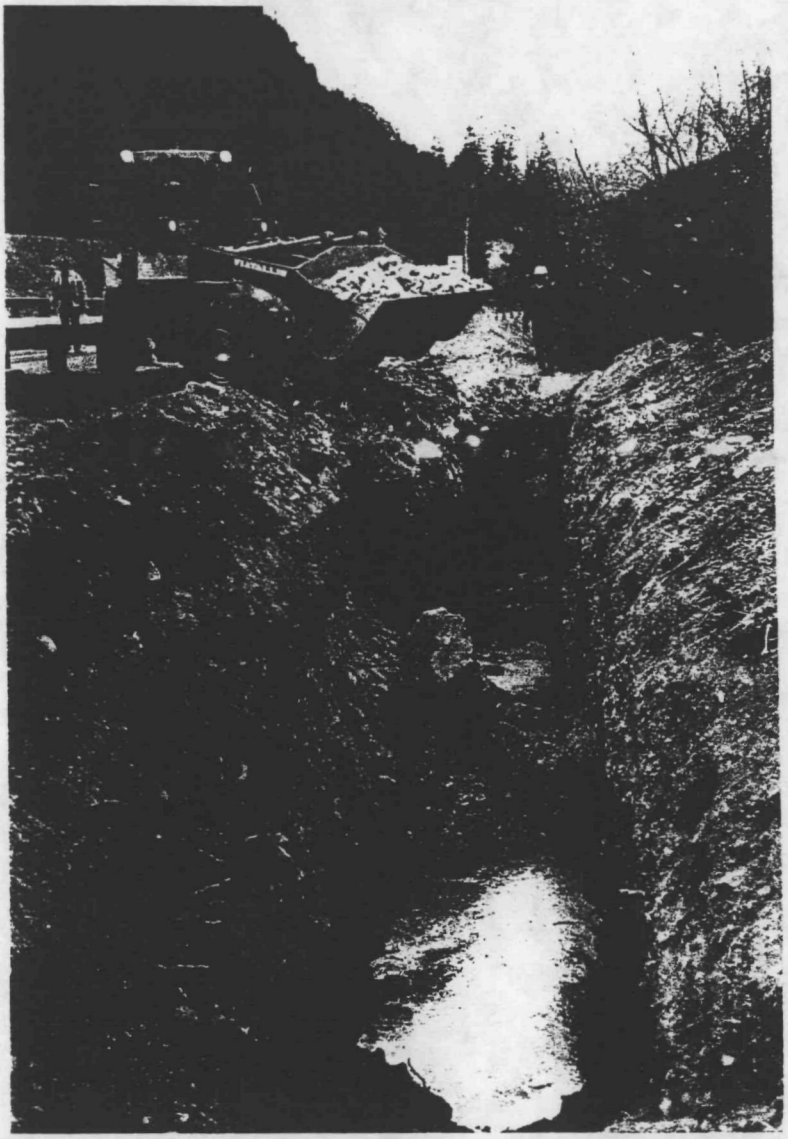


Photo Captions

Red River at Capulin Canyon:
Molycorp and N.M. Highway Department heavy equipment installing trenches along Highway 38, adjacent to Red River, Taos Co., New Mexico. Trenches are filled with limestone and clay. They intercept and neutralize acidic, metal-loaded ground water seeping into this stretch of the Red River. The process is known as "Anoxic Alkaline Drain Passive Treatment".

Filling trench with limestone cobble - note the accumulation of ground water in the trench. The water quality precisely matched the streamside seeps: pH of 3.6, conductivity of 1700 umhos.

Partially completed trench, with limestone layer, polyethylene vapor barrier and first load of bentonitic clay in place. a complete 3' layer of clay cap, and 2-3 ft. of clean fill dirt completed the trench.

15 November 1995

Submittal of abstract for the 1996 NM Conference on the Environment, March, 1996.

ABSTRACT: Alkaline Drain Treatment of Acidic Seeps on the Red River

Michael W. Coleman
Dennis W. Slifer
Surface Water Quality Bureau
Nonpoint Source Pollution Section
(505)827-0505

The New Mexico Environment Department (NMED) conducted a two-year water quality investigation, funded by a U.S. Environmental Protection Agency 319(h) Grant, along the Red River, Taos County. The project culminated in a cooperative field demonstration project to mitigate and prevent future impacts of highly acidic, metal loaded ground water seeps entering the Red River, near Questa. The NMED - Surface Water Quality Bureau, Nonpoint Source Pollution Section identified more than twenty sites where springs or perennial, steady state seeps deliver acid rock drainage via ground water in contact with sulfide-rich hydrothermal rock scar areas and historic or recent mine waste and processing piles within the watershed. The seeps have a direct effect on the physical and chemical water quality and designated uses of the waterway, including impacts on stream acidity , precipitation of calcium-aluminum precipitates, impairment of macroinvertibrate and fish habitat, and transport of a variety of dissolved and suspended heavy metals.

The field project involved the installation of selected Best Management Practices (BMPs) consisting of a series of anoxic alkaline drain passive treatment systems at a site along the Red River where several of the seeps are particularly active. One hundred seventy lateral feet (170') of trenches were dug below the local ground water level. The trenches were filled with limestone cobble, capped with a layer of clay, and reclaimed to road shoulder grade. Physical parameter and water chemistry monitoring is underway to measure an anticipated increase in pH levels and a corresponding decrease in the heavy metal content of the seeps. Favorable results may point the way to implementing this technology on several sites in this watershed, and around other abandoned mine or mill sites, or geologically active source areas throughout the state where acid rock drainage presents a pollution problem.

The project was a cooperative effort between NMED (project inception,design, coordination and followup monitoring), the Unocal Molycorp Questa Molybdenum Mine (donated materials, equipment. and labor), the State Highway and Transportation Department (labor, heavy equipment and safety crews) and the Questa Ranger District. Carson National Forest (permitting).

Molycorp Digs 4 Drainage Trenches

QUESTA — Molycorp has dug four drainage trenches along the northern bank of the Red River near Capulin Canyon to stop contaminated water from seeping in.

Dave Shoemaker, manager of the Molycorp molybdenum mine, also put several tons of limestone in the trenches last month to leach out acidic fluids and keep them from seeping into the river. As water drains through the limestone, the metals "drop out," he said.

A Taos environmental group said it holds Molycorp responsible for much of the pollution in the Red River. But the group, Amigos Bravos, welcomed the company's "wonderful gesture" of digging the trenches.

"We hope it's a sign that they are moving forward to clean up the Red River and providing jobs to do it," said Sawnie Morris, Amigos Bravos co-director.

ABQ. JOURNAL
11/22/95

"The demonstration project, if it proves to be successful, will have widespread application around abandoned or active mines or in natural geologic areas where acid rock drainage is occuring," added Williams.

NMED acquired over an hour and a half of video documenting the field operations and have plans to shoot additional scripted footage which will explain the watershed setting, BMP concept and expected results. NMED is planning to do a professional editing job with voiceover narration. NMED has a complete set of color slides and photos documenting the work. The NPS Section's newsletter, *Clearing The Waters*, is planning to feature the project in a future issue.

Still photos can be made available to print media by calling Michael Coleman at NMED.

-30-

Western Environmental Law Center

P.O. Box 1507 • Taos, New Mexico 87571
505-751-0351 • Fax: 505-751-1775 • taoslaw@laplaza.org

DEFENDING THE WEST

Attorneys
Grove Burnett*
David Gomez*
* admitted in New Mexico

Office Manager
Linda Velarde

Legal Assistant
Linda Gomez

EUGENE OFFICE:
1216 Lincoln Street
Eugene, OR 97401
541-485-2471
Fax: 541-485-2457
westernlaw@igc.org

Attorneys
Michael Axline*
John E. Bonine*
Marianne Dugan*
Charles Tebbutt*†
Elizabeth Mitchell*✦
* admitted in Oregon
† admitted in New York
✦ admitted in Colorado

Scientist
Michael Wach

Development Director
Deborah Mailander, J.D.

Office Manager
Kathy Cannon

Development Assistant
Kari Kytola

Legal Assistant
Rachel Thiesmeyer

Administrative Assistant
Marilyn Kemp

C. K.

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May 16, 1997

Mr. Sam Coleman 6EN
Director
Compliance Assurance and Enforcement Division
Environmental Protection Agency
1445 Ross Ave., Suite 1200
Dallas, TX 75201

Re: Clean Water Act violations from the waste rock piles at the Molycorp mine, Questa, New Mexico

Dear Mr. Coleman:

I write on behalf of Amigos Bravos and New Mexico Citizens for Clean Air & Water in connection with what we believe are serious violations of the Clean Water Act at Molycorp's molybdenum mine near Questa, New Mexico. As you know, this matter is currently the subject of a citizen suit in Federal Court in New Mexico captioned Amigos Bravos et al. vs. Molycorp, Inc., Civ. No. 95-1497 JP/DJS.

We respectfully request that EPA review this matter, especially the reports prepared by EnviroSearch Inc., to determine whether the agency should initiate appropriate enforcement action, including intervention in our civil action, and/or initiating a formal NPDES permitting process for the waste rock piles. We believe the facts of this case and the magnitude of the problem warrant EPA asserting jurisdiction over this source of pollution of the Red River.

I. Background

The Red River is a major tributary of the Rio Grande, which arises in the Taos range of the Sangre de Cristo Mountains in northern New Mexico. Until the late 1960s, water quality in the Red River watershed, including several tributaries with historic mining operations, was very good. In fact, until the late 1960s, the Red River watershed were considered a premier blue ribbon trout fishery.

The Molycorp mine is located four miles above Questa, New Mexico, and twelve miles above the confluence of the Red River and the Rio Grande. In 1964, Molycorp began open pit surface mining for molybdenum, a steel-hardening alloy.

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After the ore had been milled, the spent ore was pumped down the Red River through slurry pipelines to a tailings impoundment west of Questa. Since 1964, Molycorp has discharged 95 million tons of tailings into the Questa impoundment. It recently announced its intent to recommence operations this fall.

During the open pit surface mining, Molycorp removed *328 million tons of waste rock.* The waste rock was reduced to rubble, gravel, and fine particulates, greatly increasing the surface area exposed to weathering and alteration. Leachate from the waste rock is extremely acidic (average pH 2.8). The acidic water, or "acid mine drainage", dissolves and transports a wide range of metals in the waste rock, including iron, aluminum, cadmium, cobalt, chromium, copper, molybdenum, manganese, nickel, lead, and zinc.

Molycorp placed the waste rock in six piles at the mine site near the Red River. Some of the piles are located in narrow canyons which drain into the Red River. The natural ground water gradient at the Molycorp mine site and in these canyons is toward the Red River. As a result, water moves through the waste rock piles and leaches acid and metals into the ground water, which is then discharged through springs and seeps into the Red River.

Molycorp's open pit surface mining has adversely affected the Red River. Mine-related activities has severely disturbed approximately 3,200 acres of steep mountain terrain. In the 1980s, the slurry lines broke frequently, spilling thousands of tons of slurry into the Red River. The NMED has identified the acid drainage from the waste rock piles to be the most significant source of pollutants being discharged from the mine site into the Red River. For this reason, the NMED's 1994 water quality report to Congress stated that the Red River at Molycorp was *"biologically dead."* The report continued: "[F]or several miles at and below Molycorp, the sheer volume of steady-state metal-loaded drainage seeping out of *mine waste dumps* and the old underground workings overwhelms the river and *has rendered it dead for at least eight miles.*" (emphasis added).

Section 301 of the Clean Water Act prohibits the discharge by a point source of any pollutant into waters of the United States except as authorized by a National Pollutant Elimination Discharge System ("NPDES") permit. Molycorp has discharge and continues to discharge pollutants from the waste rock piles into waters of the United States without a NPDES permit. Molycorp is liable for civil penalties for these discharges.

II. EPA Should Assert Jurisdiction Under the Clean Water Act.

The factual and legal basis for our claim that Molycorp is violating the Clean Water Act is strong. Amigos Bravos and New Mexico Citizens have commissioned International EnviorSearch Inc. to conduct a comprehensive investigation of the waste rock piles at the Molycorp mine. EnviroSearch is an international consulting firm that has extensive expertise and experience in acid

mine drainage in the Western United States and worldwide. Their findings confirm that the waste rock piles are discharging pollutants into the ground water and that there is a direct hydrological connection between the ground water beneath the waste rock piles and the Red River.

A copy of the reports of International EnviroSearch of their investigation of the Molycorp mine site waste rock piles are enclosed.

In addition, the case law supports our position that the waste rock piles are point sources regulated under the Clean Water Act. The majority of courts that have addressed the issue have held that discharges to ground water that are hydrologically connected to surface water *must* obtain NPDES permits under the Clean Water Act. In the District for New Mexico, Judge Hansen has held that a citizen suit plaintiff is entitled to present evidence at trial to prove the requisite hydrogeological connection. *Friends of Santa Fe County et al. v. LAC Minerals, Civ. No. 94-0569.* (Relevant pages citing case law and a list of cases is attached.)

Molycorp's basic defense is that the waste rock piles are not point sources regulated under the Clean Water Act because the U.S. Environmental Protection Agency ("EPA") made a determination to that effect when it issued Molycorp's NPDES permit in 1993. There are several reasons why this "determination", as Molycorp terms it, has no merit and is not entitled to deference.

First, the EPA never made a factual "determination" that the rock piles are not point sources. The agency's "determination" was not a final agency action but simply a response to pubic comments on the proposed NPDES permit, which did not even cover the waste rock piles. This two-sentence response was not an informed analysis, but rather an unsupported conclusion, that related primarily to seepage from the tailings ponds--which is not at issue here. *EPA has never conducted an investigation of whether the waste rock piles are point sources.*

Second, it is clear that Molycorp's waste rock piles should be regulated under the Clean Water Act in accordance with EPA's own policy. EPA's policy, both regionally and nationally, has evolved substantially since 1993 and now clearly encompasses discharges to ground water which is hydrogeologically connected to surface water. EPA Region VI has required NPDES permits for concentrated livestock feeding operations which discharge to ground water which is hydrogeologically connected to surface water. Other regions, most notably EPA Region VIII, has issued several NPDES permits for such discharges. On the national level, EPA has taken the position in Court that the discharge of pollutants to groundwaters comes within the jurisdiction of the Clean Water Act, if hydrologically connected to waters of the United States. *See:* Amicus Brief of the United States, *Village of Oconomowoc Lake v. Dayton-Hudson Corporation, No. 93-3380,* Seventh Circuit Court of Appeals.

From the outset of this litigation, the plaintiffs have tried to engage Molycorp in

meaningful settlement discussions. Molycorp's posture toward settlement, however, has been erratic. Settlement negotiations broke down last fall after Molycorp refused to agree to any procedures for abatement of the pollution from the waste rock piles. The plaintiffs remain committed to achieving a settlement which abates Molycorp's pollution of the Red River from its waste rock piles and requires a remedial program to restore and ameliorate the environmental damage to the river.

We believe that such a settlement could be achieved if EPA becomes involved, initiates the permitting process, and notifies Molycorp that an NPDES application is required for its waste rock piles. This action would provide the framework for a settlement to be developed with EPA in the lead position.

We hope that you will review this matter and the materials we have provided, in particular the reports by International EnviroSearch. We firmly believe that EPA' participation and involvement will result in a settlement that will abate pollution and save the Red River.

I look forward to speaking to you soon.

Sincerely,

Grove T. Burnett
Director, Southwest Office
Western Environmental Law Center

cc: Fred Humke
Caroline Kirksey

No. 93-3380

U.S.C.A. - 7th Circuit
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IN THE UNITED STATES COURT OF APPEALS

FOR THE SEVENTH CIRCUIT

VILLAGE OF OCONOMOWOC LAKE,

Plaintiff-Appellant,

v.

DAYTON-HUDSON CORPORATION; GEORGE E. MEYER, Secretary; and the WISCONSIN DEPARTMENT OF NATURAL RESOURCES,

Defendants-Appellees.

ON APPEAL FROM THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF WISCONSIN
THE HONORABLE JOHN W. REYNOLDS, PRESIDING

BRIEF FOR THE UNITED STATES AS AMICUS CURIAE

LOIS J. SCHIFFER
Acting Assistant Attorney General

THOMAS PAUL SCHNEIDER
United States Attorney
Eastern District of Wisconsin

ELLEN J. DURKEE
CAROL ANNETTE PETSONK
Attorneys, Department of Justice
Washington D.C. 20530
(202) 514-7982

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IN THE UNITED STATES COURT OF APPEALS

FOR THE SEVENTH CIRCUIT

No. 93-3380

VILLAGE OF OCONOMOWOC LAKE,

Plaintiff-Appellant,

v.

DAYTON-HUDSON CORPORATION; GEORGE E. MEYER, Secretary; and the WISCONSIN DEPARTMENT OF NATURAL RESOURCES,

Defendants-Appellees.

ON APPEAL FROM THE UNITED STATES DISTRICT COURT FOR THE EASTERN DISTRICT OF WISCONSIN

BRIEF FOR THE UNITED STATES AS AMICUS CURIAE

OPINION BELOW

The unreported decision of the district court (Honorable John W. Reynolds, District Judge) was issued September 24, 1993.

SUBJECT MATTER JURISDICTION AND APPELLATE JURISDICTION

The complaint predicated the subject matter jurisdiction of the district court on 28 U.S.C. §§ 1331, 1361, 2201, and 2202; 33 U.S.C. § 1365; and 42 U.S.C. § 7604. (App. 8) The judgment entered on September 24, 1993 was final as to all issues and parties. (App. 7) The notice of appeal was filed on September 24, 1993. (App. 7) This Court's jurisdiction rests on 28 U.S.C. § 1291.

STATUTES INVOLVED

This appeal involves the Clean Water Act, 33 U.S.C. § 1251 et seq., and the Clean Air Act, 42 U.S.C. § 7401 et seq.

STATEMENT OF ISSUES

Pursuant to Rule 29 of the Federal Rules of Appellate Procedure and Rule 29 of this Court, the United States of America submits this memorandum on the following issues:

> (1) Whether the discharge of pollutants to groundwater, in certain circumstances, may be subject to the CWA prohibition against unpermitted point source discharges of pollutants to waters of the United States.
>
> (2) Whether State Implementation Plan (SIP) provisions, approved by EPA pursuant to Part D of the CAA, that regulate "indirect sources" of air pollution, are enforceable by citizens under CAA section 304(a)(3).

The United States has a direct interest in the development of the law regarding citizen enforcement under the CWA and CAA because citizens play a major role in the integrated federal-state-citizen enforcement scheme under these statutes. Moreover, the United States is concerned that district court's erroneous reasoning, if not corrected on appeal, could undermine federal enforcement of these laws. Accordingly, the United States requests that the judgment of the district court be reversed and the case remanded to that court for further proceedings.

STATEMENT OF THE CASE

Plaintiffs, Village of Oconomowoc Lake and Town of Summit, Wisconsin, brought suit on July 30, 1993, against the Dayton-Hudson Corporation, the Wisconsin Department of Natural Resources

and its Secretary, George E. Meyer, and the United States Environmental Protection Agency (EPA) and its Administrator and Regional Administrator, alleging that defendants had failed to obtain or issue permits required under the CWA and the CAA in connection with Dayton-Hudson's proposed construction of a merchandise distribution center for its Target Department store chain. The federal defendants were dropped from the litigation by stipulation of the parties on August 26, 1993.

The district court dismissed plaintiffs' CWA claim in an opinion issued September 24, 1993. The district court held that since plaintiffs had alleged that Dayton-Hudson's proposed facility would discharge pollutants to waters of the United States via groundwater, rather than directly to surface water, no National Pollution Discharge Elimination System (NPDES) permit could be required under the CWA. Village of Oconomowoc Lake et al. v. Dayton-Hudson et al., No. 93-C-0797, slip opinion at 7 (E.D. Wisc. Sept. 21, 1993).

The district court also dismissed plaintiffs' CAA claim. Plaintiffs had claimed that Dayton-Hudson was required to obtain a "major source" CAA permit for its facility under portions of the Wisconsin SIP regulating "indirect sources" of air pollution such as parking lots and other attractors of mobile source pollution. Plaintiffs had filed suit under a portion of the citizen suit provision of the CAA, section 304(a)(3) of the CAA, 42 U.S.C. § 7604(a)(3), which provides that citizens may bring suit against any person who proposes to construct or constructs

any new or modified major emitting facility without a permit "required under" specific parts of the CAA. The district court found that plaintiffs could not invoke Section 304(a)(3) because permits for indirect sources are not "required under" the CAA.

On September 24, 1993, the Village of Oconomowoc Lake appealed the district court's judgment. The case has been fully briefed by the parties. Oral argument is set for February 16, 1994.

STATEMENT OF FACTS

The statement of the facts is provided in the briefs of the parties.

RELATED CASES AND PROCEEDINGS

These are provided in the briefs of the parties.

STANDARD OF REVIEW

The standard of review is stated in the brief of the Appellant.

ARGUMENT

I.

DISCHARGES OF A POLLUTANT TO GROUNDWATER ARE WITHIN CWA JURISDICTION IN SPECIFIC CIRCUMSTANCES

A discharge of a pollutant to groundwater comes within Clean Water Act (CWA) jurisdiction where the discharge is tantamount to a discharge to waters of the United States. In such circumstances, under Sections 301(a) and 402 of the Clean Water Act (CWA), 33 U.S.C. §§ 1311(a) and 1342, a point source discharge of a pollutant to ground or to groundwater is subject to CWA regulation. Whether these circumstances exist in any

particular case is a question of fact. The lower court, however, erroneously assumed that as a matter of law, point source discharges to groundwater may never be subject to CWA permitting jurisdiction; on that basis, it dismissed plaintiffs' CWA claim.

Citizen suit plaintiffs "should have the opportunity to demonstrate through expert testimony that any seepage of pollutants ... into groundwater" is effectively a discharge into surface waters. See McClellan Ecological Seepage Situation (MESS) v. Cheney, 763 F. Supp. 431, 437 (E.D.Cal. 1989), appeals docketed, Nos. 91-16308, 91-16467 (9th Cir. Aug. 23, 1991). This Court should reverse the judgment of the district court on the CWA claim and remand the claim to the lower court for further examination of the factual circumstances.

A. The majority of cases recognize that discharges to groundwater may, in specified circumstances, come within Clean Water Act regulatory jurisdiction.

This Court has expressly recognized the possibility that point source discharges to groundwater may be subject to regulation under the CWA where the groundwater is hydrologically connected to surface waters. In the Inland Steel case, this Court stated that "the legal concept of navigable waters might include ground waters connected to surface waters -- though whether it does or not is an unresolved question." Inland Steel Co. v. EPA, 901 F.2d 1419, 1422 (7th Cir. 1990) (emphasis added).

The majority of courts have refused to rule out the possibility that discharges of pollutants to groundwater can come within the regulatory compass of the CWA. Most recently, in

Sierra Club v. Colorado Refining Company (CRC), 838 F. Supp. 1428 (D. Colo. 1993), plaintiffs alleged that pollutants discharged from a point source were entering surface waters via groundwater. The court found these allegations sufficient to withstand a motion to dismiss:

> I therefore find that Sierra Club's allegations that CRC has and continues to discharge pollutants into the soils and groundwater beneath the refinery which then make their way to Sand Creek through the groundwater state a cause of action under the Clean Water Act. Accordingly, I deny CRC's Rule 12(b)(6) motion to dismiss the first cause of action.

Sierra Club v. CRC, slip op. at 17-18.

Although Sierra Club v. CRC is, to our knowledge, the only case other than the present one to confront the question squarely in the context of a motion to dismiss, all but one of the other courts that have considered the issue have specifically held out the possibility that NPDES permits may be required in specific circumstances for discharges to groundwater where the groundwater is connected to waters of the United States. In Inland Steel, supra, this Court suggested that "a well that ended in such connected ground waters might be within the scope of the [Clean Water] Act." Id., 901 F.2d at 1423 (7th Cir. 1990) (citations omitted). Although the Court of Appeals for the Fifth Circuit has indicated that an NPDES permit is not required for discharges of pollutants into isolated groundwaters because those groundwaters are not waters of the United States, it "express[ed] no opinion" on what the result would be under the CWA if the contaminated groundwater migrated to navigable waters. Exxon v.

Train, 554 F.2d 1310, 1312 n. 1 (5th Cir. 1977). And in Kelley v. United States, No. 79-10199 (E.D. Mich. Oct. 28, 1980) ("Kelley I"), the district court found that wastes migrating from groundwater under an air base into nearby surface waters could fall within CWA jurisdiction. See Sierra Club v. CRC, supra, slip op. at 12 (discussing Kelley I).

In McClellan Ecological Seepage Situation v. Weinberger, 707 F. Supp. 1182, 1193-96 (E.D.Cal. 1988) ("MESS I"), the district court concluded that some discharges to groundwater could fall within the regulatory purview of the CWA if the groundwater is "naturally connected to surface waters that constitute 'navigable waters' under the Clean Water Act." 707 F. Supp. at 1196. In a later phase of the MESS litigation, after defendant presented testimony showing the "naturally connected" standard was not met, the court elaborated a more detailed standard, holding that the CWA encompasses discharges to groundwater where it is "reasonably foreseeable and temporally imminent" that the discharges will percolate to surface waters. MESS II, supra, 763 F. Supp. at 437.[1/]

1/ In New York v. United States, 620 F. Supp. 374 (E.D.N.Y. 1985), the court "decline[d] to reach defendants' argument as to the scope of section 301 [of the CWA] as applied to groundwaters, since it is clear that plaintiff has alleged that the pollutants threaten to contaminate [various creeks], all of which are indisputably navigable waters." Id. at 381. And, Quivira Mining Co. v. United States EPA, 765 F.2d 126, 129-130 (10th Cir. 1985), cert. denied, 474 U.S. 1055 (1986), affirmed EPA's decision that a CWA permit was required for discharges of pollutants into surface arroyos which, during storms, channelled rainwater both directly to navigable-in-fact streams and into underground aquifers that connected with such streams.

Only in Kelley v. United States, 618 F. Supp. 1103, 1106-7 (W.D. Mich. 1985) ("Kelley II") did a district court hold that CWA jurisdiction did not extend to the alleged release of toxic chemicals into groundwater that allegedly was migrating into a bay. The other authorities cited are better-reasoned than Kelley II and the court below. Thus, this Court should hold, as a matter of law, that discharges of pollutants to groundwaters may fall within the regulatory jurisdiction of the CWA, depending on the factual circumstances.

B. EPA's view is in accord with the majority of caselaw and is entitled to Chevron deference.

Section 402 of the CWA authorizes states to administer permit systems for the discharge of pollutants. "Discharge of a pollutant" is defined as any addition of pollutants "to navigable waters from a point source." 33 U.S.C. § 1362(12). The statute defines "navigable waters" as "waters of the United States." 33 U.S.C. § 1362(7). The CWA distinguishes between and refers separately to navigable waters and ground waters. See 33 U.S.C. §§ 1252(a), 1254(a)(5), 1256(e)(1).[2/] Thus, isolated groundwaters are not "navigable waters", and discharges to groundwaters per se are not covered by the CWA permitting scheme. The statute does not explicitly address, however, whether the prohibition on unpermitted discharges includes the addition of

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2/ The legislative history of the CWA also demonstrates that "Congress did not intend groundwater and navigable waters to be synonymous." McClellan Ecological Seepage Situation v. Weinberger, 707 F. Supp. 1182, 1194 (E.D.Cal. 1988) ("MESS I"); see also United States v. GAF Corporation, 389 F. Supp. 1379, 1383 (S.D. Tex. 1975).

pollutants to navigable waters from a point source through groundwater.

The legislative history is similarly inconclusive on this point. Congress specifically considered - and rejected - extension of the NPDES program to all groundwater.[3/] There is no evidence, however, that rejecting this extension, Congress intended to create a groundwater loophole through which discharges of pollutants could flow, unregulated, to surface water. The legislative debated coalesced around an amendment introduced by Representative Aspin, that would have extended CWA regulatory jurisdiction to all discharges to groundwater. A review of the debate illustrates that Congress was primarily concerned with the Aspin amendment's extension of CWA jurisdiction to groundwater per se, including isolated groundwater. For example, Rep. McClory, arguing in favor of the Aspin amendment, stated, "to consider that we are providing for the protection of the surface waters...and omitting from the strong provisions of this measure vast groundwater supplies--is to my mind unthinkable". 118 Cong. Rec. 10668 (1972) (remarks of Rep. McClory). Rep. Sisk objected to the Aspin Amendment because, in his view, "what they are attempting to do here is

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3/ See Exxon Corp., supra, 554 F.2d at 1326-1329 (reviewing legislative history); MESS I, 707 F. Supp. at 1194.

bring groundwater under the control of the EPA." 118 Cong. Rec. 10669 (1972) (remarks of Rep. Sisk).[4/]

Congress ultimately rejected the Aspin amendment. But there is no evidence that Congress intended to throw jurisdiction over affected surface waters out with the groundwater.

Since the plain language and legislative history do not answer definitively the precise question presented here, a reviewing court should defer to the views of the EPA, the agency charged with administering the CWA. See Chevron U.S.A. v. Natural Resources Defense Council, 467 U.S. 837, 842-844 (1984). EPA's interpretation of the CWA, including the jurisdictional limits of the NPDES requirements, are entitled to deference. Arkansas v. Oklahoma, 503 U.S. ___, 112 S. Ct. 1046, 1056 (1992). As recognized in Town of Norfolk v. United States Army Corps of Engineers, 968 F.2d 1438 (1st Cir. 1992), the determination

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4/ See also 118 Cong. Rec. 10668 (1972) (remarks of Rep. Harsha) ("[T]his amendment purports to require water-quality standards for groundwater"). Rep. Aspin himself was concerned not only with pollution of isolated groundwater, but with hydrologically connected groundwater as well:

> If we do not stop pollution of ground waters through seepage and other means, ground water gets into navigable waters, and to control only the navigable water and not the ground water makes no sense at all.

118 Cong. Rec. 10666 (1972) (remarks of Rep. Aspin). The tenor of the debate indicates, however, that the representatives were most concerned with application of the NPDES program to the nation's vast and isolated groundwater reserves. See generally Exxon v. Train, supra, 554 F.2d at 1326-1329 (reviewing legislative history); and see Mary Christina Wood, "Regulating Discharges into Groundwater: The Crucial Link in Pollution Control under the Clean Water Act," 12 Harv. Envtl. L. Rev. 569, 613-614 (1988).

whether a discharge to "waters of the United States" includes discharges to hydrologically connected groundwaters should be left in the first instance to the discretion of the EPA, "since such a determination ultimately involves an ecological judgment about the relationship between surface waters and groundwaters." Id., 968 F.2d at 1451 (citing United States v. Riverside Bayview Homes, Inc., 474 U.S. 121, 134 (1985) (deference should be given to administering agency's ecological judgment about the relationship between wetlands and adjacent surface waters)).

EPA has repeatedly expressed its view that the CWA encompasses discharges to groundwaters that are hydrologically connected to waters of the United States. For example, EPA explained this interpretation when it promulgated regulations on storm water discharges. See Preamble, NPDES Permit Application Regulations for Storm Water Discharges, EPA Final Rule, 55 Fed. Reg. 47990, 47997 (Nov. 16, 1990) ("[T]his rulemaking only addresses discharges to waters of the United States, consequently discharges to ground waters are not covered by this rulemaking (unless there is a hydrological connection between the ground water and a nearby surface water body)").[5/]

EPA also interpreted the statute in this way when it promulgated regulations governing discharges from animal feedlots. See NPDES General Permit and Reporting Requirements for Discharges from Concentrated Animal Feeding Operations, EPA

5/ See Natural Resources Defense Council v. EPA, 966 F.2d 1292 (9th Cir. 1992) (upholding rule, remanding on other grounds).

Region 6 Public Notice of Final Permitting Decision, 58 Fed. Reg. 7610, 7631 (Feb. 8, 1993) (feedlots required to obtain NPDES permit for discharges to groundwater unless permittee can demonstrate lack of hydrologic connection to surface water).

EPA's statement of its position in connection with the promulgation of other recent regulations is particularly instructive:

> Notwithstanding the strong language in the legislative history of the Clean Water Act to the effect that the Act does not grant EPA authority to regulate pollution of groundwaters, EPA and most courts addressing the issue have recognized that...the Act requires NPDES permits for discharges to groundwater where there is a direct hydrological connection between groundwaters and surface waters. In these situations, the affected groundwaters are not considered "waters of the United States" but discharges to them are regulated <u>because such discharges are effectively discharges to the directly connected surface waters.</u>"

Amendments to the Water Quality Standards Regulations that Pertain to Standards on Indian Reservations, Final Rule, 56 Fed. Reg. 64,876, 64,892 (Dec. 12, 1991) (emphasis added).

This Court should defer to EPA's scientific judgment in the complex area of groundwater-surface water relationships and hold that the discharge of pollutants to groundwaters may come within CWA jurisdiction, depending on the circumstances.

C. Discharges to groundwater come within CWA regulatory jurisdiction where there is a reasonably foreseeable direct hydrological connection between the groundwater and the surface waters in the proximity of the release, and a greater than de minimis quantity of pollutants reasonably is able to reach the surface water.

As noted above, a discharge to groundwater comes within the CWA's regulatory compass when the discharge is tantamount to a discharge to waters of the United States. This occurs when there is a reasonably foreseeable direct hydrological connection to waters of the United States in the proximity of the release, and a greater than de minimis quantity of the pollutant reasonably is able to reach the waters of the United States (provided that no other Federal statute directly addresses the activity causing the release).

It bears emphasizing that EPA does not take the position that groundwaters themselves are "waters of the United States" within the meaning of the CWA. Rather, the mere fact that groundwaters are not waters of the United States does not mean that discharges of pollutants to groundwaters can never be regulated discharges within the meaning of the CWA. Such discharges are regulated by the CWA where the discharge to groundwater is effectively a discharge to waters of the United States. Thus, where there is a reasonably ascertainable direct hydrological connection to surface waters in the proximity of a release of pollutants, and it is reasonably foreseeable that pollutants discharged into groundwater will reach surface waters in greater than de minimis quantities, CWA jurisdiction attaches

(provided, of course, that no other Federal statute directly regulates the release or the activity causing the release).

The United States recognizes that expert analysis of hydrological conditions may be required in order to determine whether this standard has been met. Precisely because such factual determinations may be required, it is inappropriate to dismiss a CWA complaint simply because the plaintiff alleges that pollutants will flow to waters of the United States via groundwater. Accordingly, the judgment of the district court should be reversed. The case should be remanded to the lower court for further factual examination to determine whether, under this standard, CWA jurisdiction is properly invoked.[6/]

II.

INDIRECT SOURCE PERMIT REQUIREMENTS APPROVED INTO STATE IMPLEMENTATION PLANS TO SATISFY REQUIREMENTS OF PART D OF THE CLEAN AIR ACT ARE ENFORCEABLE BY CITIZENS UNDER SECTION 304(A)(3) OF THAT ACT

The district court concluded that because defendant Dayton-Hudson's distribution center will cause air pollution only indirectly, and because EPA may not require states to include indirect source review programs in SIPs, EPA could not have

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6/ In this case, appellant seeks prospectively to prevent discharges to groundwater. The record indicates that the distribution center is still under construction, and the citizens have not alleged that any discharges to groundwater in violation of the CWA have occurred. Appellants have argued that the CWA does not provide a basis for prospective enforcement jurisdiction. On remand, after conducting the factual inquiry described above, the district court may need to consider whether the CWA affords a basis for prospective jurisdiction.

required Wisconsin to include in its SIP a program requiring the distribution center to obtain a permit. Village of Oconomowoc Lake v. Dayton-Hudson, slip op. at 4-5. The court held that Section 304(a)(3) of the CAA, 42 U.S.C. § 7604(a)(3), does not provide jurisdiction over citizen suits alleging a failure to issue or obtain a permit required under a SIP if the permit requirement is not specifically mandated under the CAA itself. Slip op. at 5-6.

Section 304(a)(3) of the CAA provides:

> Except as provided in subsection (b) of this section, any person may commence a civil action on his own behalf--* * * *
>
> > (3) against any person who proposes to construct or constructs any new or modified major emitting facility without a permit required under part C of subchapter I of this chapter (relating to significant deterioration of air quality) or part D of subchapter I of this chapter (relating to nonattainment) ...

42 U.S.C. § 7604(a)(3) (emphasis added). The district court reasoned that Section 304(a)(3)'s phrase, "required under", limits jurisdiction to challenges alleging violation of requirements to obtain a permit stated in the CAA itself.

The district court's conclusion is overly broad. The correct reading of Section 304(a)(3) is that citizen suits will lie to enforce all permit requirements approved by EPA into a SIP under Part D of Title I of the CAA. The court should have construed the Section 304(a)(3) reference to permits "required under..part D of subchapter I" to include permits required under

the implementation plan of a state by virtue of EPA's approval (or promulgation) of the plan pursuant to Part D.[7]

This construction is the one adopted by EPA, the agency charged with administering the CAA, in its regulations governing approval of SIPs. There, EPA takes the position that all provisions of an applicable SIP are federally enforceable, regardless of their provenance:

> (xiv) *Federally enforceable* means all limitations and conditions which are enforceable by the Administrator, including those requirements developed pursuant to 40 CFR parts 60 and 61, requirements within any applicable State implementation plan, any permit requirements established pursuant to 40 CFR 52.21 or under regulations approved pursuant to 40 CFR part 51, subpart I, including operating permits issued under an EPA-approved program that is incorporated into the State implementation plan and expressly requires adherence to any permit issued under such program.

40 CFR § 51.165(a)(1)(xiv) (emphasis added). Thus, EPA has authority to enforce all SIP provisions - including indirect source review requirements - approved by it under Part D, even though such requirements are not mandated by the CAA.

Interpreting the Section 304(a)(3) citizen suit provision to omit coverage of such requirements would strain the balance of the integrated statutory scheme of the CAA. It would also fail to recognize that, beyond a relatively small number of federally mandated specific requirements, Congress gave states broad

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7/ The statute, and the analysis in this brief, apply as well to permits required under Part C of subchapter I of the CAA, but Part C is not at issue in this case.

discretion to fashion appropriate air pollution control measures to meet their SIP obligations. See CAA Section 110 (a)(2)(A), 42 U.S.C. § 7410(a)(2)(A).

Moreover, such an interpretation would leave a significant hole in citizen enforcement, and require a reviewing court in every Section 304(a)(3) citizen suit to trace the pedigree of each SIP provision back to the parent CAA in order to determine whether the provision was mandated by the Act and thus could be enforced in federal court. There is no evidence in the statute or the legislative history to indicate that Congress intended such a strained result.

A. Caselaw supports the proposition that citizens may sue under CAA Section 304(a)(3) to enforce SIP indirect source provisions.

While there is no direct precedent addressing the precise question whether citizen suits under Section 304(a)(3) will lie to enforce indirect source review requirements contained in state plans approved by EPA under Part D, the tenor of the caselaw indicates that such suits should be allowed as part of the integrated CAA statutory scheme. Only one court of appeals has addressed the question, and it specifically saw some ambit for citizen enforcement. In Sierra Club v. Larson, 2 F.3d 462, 469 (1st Cir. 1993), the Court of Appeals held that Massachusetts SIP provisions on indirect sources can, in certain cases, be enforceable by citizen suit under Section 304(a)(3):

> "Of course, not every state-law restriction on a project is a matter of federal concern, but a state restriction that is part of a federally approved state implementation plan under the Clean Air Act may at

> least in some circumstances be within the purview of a citizens suit under 42 U.S.C. § 7604."

Sierra Club v. Larson, 2 F.3d at 469 (emphasis added) (construing section 304(a)(3)). The court did not decide the question definitively in Larson because the relevant provision of the state SIP had not yet been approved by EPA. Id. at 469-470.

In a number of other cases, courts have held that indirect source review provisions can constitute an "emissions standard or limitation" within the meaning of section 304(a)(1) of the CAA.[8/] While these cases are not dispositive of the issue on appeal, they do support the proposition that the CAA's integrated enforcement scheme allows for citizen enforcement of indirect source requirements approved into a SIP under Part D.[9/]

8/ See, e.g., Coalition Against Columbus Center v. City of New York, 967 F.2d 764, 771 (2d Cir. 1992); Citizens for a Better Environment v. Deukmejian, 731 F. Supp. 1448, 1454 (N.D. Cal. 1990); Delaware Valley Citizens Council v. Davis, 932 F.2d 256, 264-67 (3d Cir. 1991); American Lung Association v. Kean, 871 F.2d 319, 321-324 (3d Cir. 1989). CAA Section 304(a)(1) provides that any person may commence a civil action against any person who is "alleged to have violated...or to be in violation of (A) an emission standard or limitation under this chapter or (B) an order issued by the Administrator or a State with respect to such a standard or limitation." 42 U.S.C. § 7604(a)(1) (emphasis added).

9/ The citizen suit provisions of Section 304 parallel the federal enforcement authorities of Section 113. EPA's general SIP enforcement authority is contained in Section 113(a)(1) of the CAA, 42 U.S.C. § 7413(a)(1), which requires 30 days notice to the person alleged to be in violation before a suit may be filed. However, in recognition of the exigencies surrounding violations of new source permitting requirements, Section 113(a)(5) of the CAA, 42 U.S.C. § 7413(a)(5), allows the Administrator to bring suit without issuing a 30 day notice whenever a state fails to comply with new source permitting requirements. Similarly, Section 304(a)(1), 42 U.S.C. § 7604(a)(1), allows citizens to file suit regarding SIP violations only after giving 60 days

(continued...)

These cases are particularly important in view of the district court's misinterpretation of the distinction between Sections 304(a)(1) and 304(a)(3). The district court interpreted Section 304(a)(3) as having a narrower scope than Section 304(a)(1). The proper distinction between these provisions, however, relates not to the question whether a particular SIP provision is mandated by federal law, but whether EPA approved the SIP provision under the authority of the new source permitting requirements of Part D of the CAA.

B. The case should be remanded to the lower court for further determination regarding the Wisconsin SIP indirect source review provisions for emissions of NOx.

Appellee State of Wisconsin has raised the argument that the specific Wisconsin SIP provisions invoked by appellant have not yet been approved by EPA. It is true that the recent proposed SIP revisions submitted by the State of Wisconsin to EPA, Wis. Admin. Code § NR 408.02(21)(b)3. (1992), have not been approved by EPA, and thus cannot be enforced in a citizen suit. However, any existing SIP requirements for indirect source review are enforceable by citizens under Section 304(a)(3) if the requirements were approved by EPA under Part D. The record in this case is not sufficient to determine whether Wisconsin's indirect source review requirements were approved into its SIP

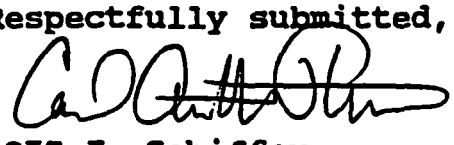
9/ (...continued)
advance notice to the Administrator, the affected state, and the alleged violator, see Section 304(b)(1)(A), 42 U.S.C. § 7604(b)(1)(A), while Section 304(b) in its entirety pointedly omits this advance notice requirement for suits brought under Section 304(a)(3). See 42 U.S.C. § 7604(b)(1)(A).

pursuant to Part D, and if so, whether they mandate permit distinctions between "major" and "minor" indirect sources of NOx. The United States therefore respectfully suggests that this Court remand the CAA claim to the lower court for it to make these determinations. While remand would entail some delay for review of an extensive administrative record that is nearly fifteen years old, the need for integrated enforcement of the CAA mandates that citizens be allowed under CAA Section 304(a)(3) to enforce all indirect source review requirements contained in a state's implementation plan. To hold otherwise would be to create an unwarranted gap in the CAA's comprehensive federal, state, and citizen enforcement scheme.

CONCLUSION

For the foregoing reasons, the judgment below should be reversed, and the case should be remanded to the district court.

Respectfully submitted,



LOIS J. Schiffer
Acting Assistant Attorney General

THOMAS PAUL SCHNEIDER
United States Attorney
Eastern District of Wisconsin

ELLEN J. DURKEE
CAROL ANNETTE PETSONK
Attorneys, Department of Justice
Washington D.C. 20530
(202) 514-7982

93-3380
February 14, 1994

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VIII
999 18th STREET - SUITE 500
DENVER, COLORADO 80202-2466

DEC 22 1993

Ref: 8WM-C

Dan Fraser, Chief
Water Quality Bureau
Montana Department of Health
& Environmental Sciences
Cogswell Building
Helena, Montana 57620

Re: NPDES Permit Issues
Hard Rock Mines

Dear Mr. Fraser:

This letter is in response to your request that EPA clarify its position on several key issues relating to the permitting of hard rock mines under Section 402 of the Clean Water Act (CWA). The following paragraphs explain EPA Region VIII's policy on the following issues: (1) point sources at hard rock mines; (1.a) historic mine adits; (1.b) ground water hydrologically connected to surface water; (2) regulation of historic mining areas; (3) storm water vs. traditional NPDES; and (4) maintaining water quality after mining.

1. <u>Point Sources at Hard Rock Mines</u>

1.a <u>Historic Adits</u>

Mine adits are quite clearly point sources as defined under Section 502(14) of the CWA, 33 U.S.C. § 1362(14). The CWA defines the term "point source" as any discernable confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, vessel or other floating craft from which pollutants are or may be discharged. Following this definition, discharges from mine adits at historic or active mines are point sources and are required to have an NPDES permit if pollutants are being discharged to waters of the United States. However, as discussed in paragraph 2 below, abandoned or long-term inactive mines have not been a top priority for permitting.

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1.b Ground Water Hydrologically Connected to Surface Water (including seeps)

For the past several years EPA, Region VIII, has been more closely evaluating NPDES compliance at mines. Although we found that substantial progress has been made in controlling surface water pollution from obvious discharge points, we still found serious water quality problems at some mines. Environmental data collected around these mining sites confirmed that the CWA goals of fishable and swimmable surface water were still not being achieved. In searching for this source of surface water pollution, EPA and the States found that pollutants from some mining sites are moving into the ground water and then into nearby surface water.

Upon determining that significant pollutants were being discharged from mines via ground water or less obvious points sources, EPA and the States began reevaluating mines. We found some mines had seeps or other ground water discharges to surface water which were not authorized in the facility's NPDES permit. There were also some mines without an NPDES permit which had claimed to be "non-discharging". However, upon inspection, these facilities were found to be discharging through seeps and water control structures. These facilities are now being required to obtain NPDES permits covering all outfalls including ground water discharges determined to be hydrologically connected to surface water.

As a result of these permit and enforcement actions, EPA has been reevaluating the definition of "point source" to require NPDES discharge permits for seeps and other less obvious discharges. It is therefore, EPA's position that seeps and other ground water discharges hydrologically connected to surface water from mines, either active or abandoned, are discharges from point sources and are subject to regulation through an NPDES permit. Current EPA policy, as augmented by several lawsuits, indicates that it is more the mine or the facility itself that is subject to NPDES regulations. Therefore, any seeps coming from identifiable sources of pollution (i.e., mine workings, land application sites, ponds, pits, etc.,) would need to be regulated by discharge permits. One important case is United States v. Earth Sciences, Inc., 599 F.2d 368 (10th Cir. 1979). This case concluded that the facility from which the contamination came was itself a point source. Another important court case is McClellan Ecological Seepage Situation v. Weinberger, 707 F.Supp. 1182 (E.D. Cal. 1988) where the court found that Congress intended to limit discharges of pollutants that could affect surface water and that NPDES permits could be required, where the ground water

is hydrologically connected to the surface water. Additionally, the preamble to the November 16, 1990 Storm Water Regulations states that EPA "intends to embrace the broadest possible definition of point source consistent with the legislative intent of the CWA." (55 Federal Register 47990, 47997/1, November 16, 1990.) The preamble also states that the requirements for point source dischargers are not applicable to the discharges to ground water unless there is a hydrological connection between the ground water and a nearby surface water. (See 55 Federal Register 47990, 47997/3.)

2. Historic Mining

Clearly, as discussed in 1.a above, discharges from abandoned mine adits are point sources which require a traditional (rather than a storm water) NPDES permit. However, Region VIII has not made these permits a high priority because of limited EPA and State resources. EPA's current permit writing practices and priorities incorporate historic mine drainage into NPDES permits for active mines if the active mine influences the pollution discharged from the historic area. In addition, if the active mine owns or has control over an adjacent historic mining area, the active mine must also apply for an NPDES permit to control the discharge from the inactive area. Factors which increase our priority for requiring NPDES permits at abandoned mines are: active exploration, construction, plans for re-mining, viable ownership, and water quality impacts. The enclosed table outlines the Region's priorities for writing permits and the basis for effluent limitations.

In Region VIII, there are several active mines which have permits for historic discharges. One example is Cripple Creek and Victor Gold (CCVG), which maintains the permit for the Carlton Tunnel (CO-0024562) in Colorado. This historic tunnel drains most of the Cripple Creek and Victor Mining District. CCVG is currently mining only on the surface. Although the company's operations do not seem to be affecting historic mine drainage, the Company must continue to comply with NPDES requirements because CCVG and its affiliates own or control most of the historic area. Further, the potential for connections between current and historic workings also necessitate a permit.

Region VIII has several permits that exclusively regulate drainage from abandoned mines, such as the Leadville Mine Drainage Tunnel owned by the Bureau of Reclamation (CO-0021717) and the site of the former Climax Urad Mine and Mill (CO-0041467). The Leadville Tunnel drains part of historic Leadville Mining District. The Urad site is a

previously reclaimed tailings area that Climax is remediating to collect ground water seeps and provide treatment to meet water quality based limits.

3. Storm Water v. "Traditional" NPDES

It is our position that any point source discharge of pollutants to waters of the United States, not directly associated with a precipitation or snow melt event, (i.e., dry weather flows), must be permitted under a "traditional" NPDES permit. This means that any dry weather flow from mine adits, seeps, french drains and culverts are mine drainage or process wastewater, and cannot be covered by a storm water permit. A "traditional" permit must be written for these discharges including both technology based and water quality standard based requirements where applicable. [Water diverted around the mine without contacting any disturbed area, and does not mix with mine or process water may not require an NPDES permit.] Also during wet weather flows, most of the areas at an active mine must be covered by "traditional" NPDES requirements because storm water was included in developing the effluent guidelines regulations. Only wet weather surface runoff from some ancillary areas of active mines and inactive areas would fall under the storm water program. It is also important to note that these discharges can be covered by storm water requirements only if they do not combine with "traditional" sources prior to discharge. Therefore, we recommend that the State combine both the storm water and traditional NPDES requirements into one permit at all active mines. There is too much overlap between storm water and dry weather flow, and active and inactive portions of the mine to write separate permits. We have attached the most recent version of the table (September 13, 1993) describing the applicability of storm water at mining sites.

4. Maintaining Water Quality (Financial Guarantee)

It is of increasing importance to financially guarantee compliance with environmental performance at all phases of the mining operation including post-closure. This has been mentioned by both Region VIII and EPA Headquarters' staff during discussions of environmental impact statements and NPDES permits for new mines. Clearly, the public's financial costs of Summitville is also a strong argument for financial guarantees. We think that this is an area where the State, through its mining program, has substantial regulatory ability. We will continue to look into this issue on a federal level, but we hope that the State will be able to resolve this problem through its authorities by requiring post-closure financial assurance.

If you wish to request a conference call to further discuss these issues or if you have any other comments please contact me.

Sincerely,

Max H. Dodson, Director
Water Management Division

Enclosure

cc: Kevin Keenan, MT
Tom Reed, MT
Crown Butte
Zortman
Greater Yellowstone Coalition
Fred Pehrson, UT
Sheila McClenathan, ND
Bob Shukle, CO
John Wagner, WY
Tim Tollefsrud, SD

backs from the sale of the securities. Indictment ¶¶ 2, 19, 24, and 25.

In light of these allegations, the indictment sufficiently alleges all of the elements of mail fraud necessary to sustain the indictment. The indictment need not specifically allege that Marchese breached his fiduciary duty to his customers. Moreover, the legal obligation to disclose such kickbacks to his customers is implied. Furthermore, Marchese's argument rests, at least in part, on factual questions which must be determined by the trier of fact and which are inappropriate to support a motion to dismiss i.e. whether Marchese and Sandberg breached their fiduciary duty to Power's customers and whether the kickbacks constituted material information such that Marchese and Sandberg had a duty to disclose this information.

[8] Marchese also argues that the indictment is defective because it fails to allege that his customers were injured by his receipt of "undisclosed fees". This argument lacks merit because a victim's actual loss as a result of a scheme is not an essential mail fraud element. *U.S. v. Stewart*, 872 F.2d 957, 960-61 (10th Cir.1989). Moreover, the indictment alleges that the kickbacks came from the sale of the securities. Indictment ¶ 25. Marchese further contends that the indictment fails to allege that the payment of "fees" were inimical to his customer's interests. In light of the other allegations in the indictment, this argument fails as well.

Marchese final argument is that the indictment is insufficient because it merely tracks statutory language without alleging particular elements of an offense. This argument is similarly without merit. Read as a whole, the indictment alleges each of the elements of mail fraud and sets forth the mail fraud scheme in sufficient detail. Indictment, ¶¶ 2, 19, 24, 25 and 39.

[9] Marchese's challenge to the sufficiency of the money laundering charges also fails. In *U.S. v. Alford*, 999 F.2d 818 (5th Cir.1993), as in this case, the court upheld an indictment where it tracked the language of the money laundering statute, identified the specified unlawful activity as mail and wire fraud, and described specific financial transactions associated with each count. *Id.* at 822-23. Because the indictment here contains similar detail, Marchese's motion to dismiss the indictment will be denied.

Accordingly, IT IS ORDERED THAT the defendants' motions to dismiss the indictment are DENIED.

SIERRA CLUB, a nonprofit corporation, Plaintiff,

v.

COLORADO REFINING COMPANY, a Colorado Corporation, Defendant.

Civ. A. No. 93-K-1713.

United States District Court, D. Colorado.

Dec. 8, 1993.

Plaintiff brought citizen suit pursuant to Clean Water Act, alleging that refinery illegally discharged pollutants into creek. Refinery moved to dismiss. The District Court, Kane, Senior District Judge, held that: (1) Clean Water Act's preclusion of discharge of any pollutant into "navigable waters" includes such discharge which reaches "navigable waters" through groundwater, and (2) where plaintiff did not exercise its rights under Colorado law to challenge stipulated order regarding National Pollution Discharge Elimination System (NPDES) effluent limit exceedances by refinery, it could not seek, by way of federal citizen suit, to supplant safeguard mechanisms contained within relevant state law.

Motion granted in part and denied in part.

1. Federal Civil Procedure ⇐1829

In ruling on motion to dismiss, whether for lack of subject matter jurisdiction or for failure to state cause of action, court must accept all factual allegations as true and must draw all reasonable inferences in favor of pleader. Fed.Rules Civ.Proc.Rule 12(b)(1, 6), 28 U.S.C.A.

2. Federal Civil Procedure ⇐1772, 1829

Claim should not be dismissed for lack of subject matter jurisdiction unless it appears beyond doubt that plaintiff can prove no set of facts which would entitle him to relief and all of plaintiff's pleadings must be liberally construed. Fed.Rules Civ.Proc. Rule 12(b)(1), 28 U.S.C.A.

3. Health and Environment ⇐25.15(3.2)

District court had jurisdiction over claim alleging unpermitted discharges of pollutants in violation of Clean Water Act. Federal Water Pollution Control Act Amendments of 1972, § 301(a), as amended, 33 U.S.C.A. § 1311(a).

4. Health and Environment ⇐25.7(4)

Clean Water Act's preclusion of discharge of any pollutant into "navigable waters" includes such discharge which reaches "navigable waters" through groundwater. Federal Water Pollution Control Act Amendments of 1972, § 101 et seq., as amended, 33 U.S.C.A. § 1251 et seq.

5. Health and Environment ⇐25.7(4)

Allegations that refinery discharged pollutants into soils and groundwater beneath refinery which then made their way to creek through groundwater stated cause of action under Clean Water Act; Act's preclusion of discharge of pollutant into navigable waters included such discharge which reached navigable waters through groundwater. Federal Water Pollution Control Act Amendments of 1972, § 101 et seq., as amended, 33 U.S.C.A. § 1251 et seq.

6. Health and Environment ⇐25.15(4.1)

Term "comparable state law" as used in Clean Water Act's provision stating that any violation for which state has issued final order not subject to further judicial review and violator has paid penalty assessed under "comparable state law" shall not be subject of citizen action for civil penalties does not mean that state's regulatory authority or processes must be identical to federal provisions. Federal Water Pollution Control Act Amendments of 1972, § 309(g)(6)(A)(iii), as amended, 33 U.S.C.A. § 1319(g)(6)(A)(iii).

See publication Words and Phrases for other judicial constructions and definitions.

7. United States ⇐91½

Citizen suits are proper only where governmental agency has failed to exercise its enforcement responsibility.

8. Health and Environment ⇐25.15(3.1)

Where plaintiff did not exercise its rights under Colorado law to challenge stipulated order regarding National Pollution Discharge Elimination System (NPDES) effluent limit exceedances by refinery, plaintiff could not seek, by way of federal citizen suit under Clean Water Act, to supplant safeguard mechanisms contained within relevant state law; although Colorado regulatory scheme did not mandate prior public notice of enforcement proceedings, scheme overall adequately protected public interest in enforcement actions, and plaintiff apparently received word of notice of violation issued by Colorado Department of Health to refinery and failed to take appropriate steps to voice its opinion. Federal Water Pollution Control Act Amendments of 1972, § 309(g)(6)(A)(iii), as amended, 33 U.S.C.A. § 1319(g)(6)(A)(iii).

Reed Zars, Denver, CO, for plaintiff.

Daniel Patterson, Holland & Hart, Denver, CO, for defendant.

MEMORANDUM OPINION AND ORDER

KANE, Senior District Judge.

This case is before me on a motion to dismiss filed by defendant Colorado Refining Company ("CRC"). Plaintiff Sierra Club asserts three causes of action. The first is for unpermitted discharges into Sand Creek in violation of Section 301 of the Clean Water Act, 33 U.S.C. § 1311(a) (1986); the second for discharges to Sand Creek in violation of CRC's National Pollution Discharge Elimination System ("NPDES") Permits and the

Clean Water Act, and the third for failure to determine the impact to Sand Creek of its noncomplying discharges in violation of the Clean Water Act. CRC moves to dismiss Sierra Club's first cause of action for lack of subject matter jurisdiction under Fed. R.Civ.P. 12(b)(1) and for failure to state a claim under Rule 12(b)(6) and to dismiss partially the second cause of action under Rule 12(b)(6) to the extent that the claim requests civil penalties for pre-April 1992 permit violations.

I. *Facts and Procedural Background*

This complaint was filed on August 12, 1993. No trial date has yet been set. Sierra Club brings this "citizen suit" pursuant to 33 U.S.C. § 1365(a)(1)(A)[1] and 28 U.S.C. § 1331[2], alleging that CRC has illegally discharged pollutants, in excess of permit limits, into Sand Creek from its refinery located in Adams County, Colorado, immediately to the south of the creek. Sierra Club further alleges that such discharge has and continues to degrade the water quality of Sand Creek and to diminish the fish populations downstream from the refinery.

It is undisputed that in April 1989, the Colorado Department of Health ("CDH") issued a Notice of Violation to CRC regarding NPDES effluent limit exceedances[3] between November 1988 and February 1989. In June 1989, CDH issued an Amended Notice of Violation to CRC regarding NPDES Total Suspended Solids exceedances from December 1988 through December 1989. In July 1992, CRC entered into an Agreement and Stipulated Order ("the stipulated order") with CDC regarding the aforementioned exceedances and additional exceedances which occurred through April 1992. In compliance with the penalty agreement, CRC paid penalties of $20,000 and waived its right to appeal in final settlement of any claims for penalties for exceedances which might be sought through April 1992.

II. *Standard for Motion to Dismiss*

[1, 2] Under Fed.R.Civ.P. 8(a), a plaintiff is required to offer a short and plain statement (1) of the grounds upon which the court's jurisdiction depends and (2) of the claim showing that the pleader is entitled to relief. In ruling on a motion to dismiss, whether on the ground of lack of jurisdiction over subject matter under Rule 12(b)(1) or for failure to state a cause of action under Rule 12(b)(6), the court must accept all factual allegations as true and must draw all reasonable inferences in favor of the pleader. *Scheuer v. Rhodes*, 416 U.S. 232, 236, 94 S.Ct. 1683, 1686, 40 L.Ed.2d 90 (1974). A claim should not be dismissed under Rule 12(b)(1) unless it appears beyond doubt that

1. This section provides in pertinent part:

Except as provided in subsection (b) of this section, any citizen may commence a civil action on his own behalf—

(1) against any person ... who is alleged to be in violation of (A) an effluent standard or limitation under this chapter ...

. . . . . .

The district courts shall have jurisdiction, without regard to the amount in controversy or the citizenship of the parties, to enforce such an effluent standard or limitation ... and to apply any appropriate civil penalties under section 1319(d) of this title.

In addition, 33 U.S.C. § 1319(d) provides in pertinent part:

Any person who violates section 1311, 1312, 1316, 1317, 1318, 1328, or 1345 of this title, or any permit condition or limitation implementing any of such sections in a permit issued under section 1342 of this title by the Administrator, or by a State, or in a permit issued under Section 1344 of this title by a State, ... shall be subject to a civil penalty not to exceed $10,000 per day of such violation.

2. This section provides: "The district courts shall have original jurisdiction of all civil actions arising under the Constitution, laws, or treatises of the United States."

3. I am reluctant to call "exceedance" a word at all. To use it invokes images of reverse peristalsis. Webster's International and the O.E.D. are predictably and mercifully silent in the matter. I don't know why a perfectly legitimate word such as "excess" cannot be used nor why a counterfeit flummery such as "exceedance" is coined. Nevertheless, the Congress of the United States has seen fit to use it in a statute (The Clean Air Act, see e.g. 42 U.S.C. §§ 7412(m)(5)(D), 7429(c), 7502(a)(2)(C)(ii)) and the briefs of the environmentalist cognoscenti are replete with its borborygmic ditter; it has even invaded the text of otherwise intelligent judicial opinions. If then, such is what litigants are disputing and Congress is legislating, I will use "exceedance(s)" in the faint hope that it conveys some meaning to anyone who might be interested. The disinterested reader, however, will need the assistance of this prolix footnote.

plaintiff can prove no set of facts which would entitle him to relief. *Id.; Swanson v. Bixler*, 750 F.2d 810, 813 (10th Cir.1984). All of the plaintiff's pleadings must be liberally construed. *Swanson*, 750 F.2d at 813.

III. *First Cause of Action for Violation of the Clean Water Act*

The Clean Water Act provides that "[e]xcept as in compliance with this section and sections 1312, 1316, 1317, 1328, 1342, and 1344 of this title, the discharge of any pollutant by any person shall be unlawful." 33 U.S.C. § 1311(a). The term "discharge of a pollutant" is defined as "any addition of any pollutant to navigable waters from any point source...." *Id.* § 1362(12). "Point source" is defined as "any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, ... from which pollutants may be discharged...." *Id.* § 1362(14). For the purpose of the Clean Water Act, the term "navigable waters" has been defined broadly as "the waters of the United States, including the territorial seas." *Id.* § 1362(7). Federal Courts have interpreted this directive broadly to include waters tributary to those which are navigable in fact. *Quivira Mining Co. v. United States EPA*, 765 F.2d 126, 129 (10th Cir.1985).

CRC argues that while the term "navigable waters" is construed broadly, Congress did not intend to include groundwater within its definition. CRC maintains that certain allegations in the complaint indicate that Sierra Club's first cause of action is totally founded on the discharge of pollutants by CRC into the soil and groundwater which then make their way into Sand Creek.

A. *Rule 12(b)(1) Challenge*

CRC argues that, since the Clean Water Act does not regulate the discharge of pollutants into groundwater, this court lacks subject matter jurisdiction over the first cause of action and that it fails to state a claim upon which relief may be granted. CRC relies on *United States v. GAF Corp.*, 389 F.Supp. 1379, 1381 n. 2 (S.D.Tex.1975). *GAF*, however stated that the interweaving of jurisdictional and substantive provisions of the Clean Water Act "has the effect of equating, *at least in this case*, a failure to state a claim with a lack of subject matter jurisdiction." *Id.* (emphasis added). The facts and jurisdictional allegations of *GAF* are distinguishable from those before me. There plaintiff's sole jurisdictional ground was 33 U.S.C. § 1319(b). Under that section, the Administrator of the Environmental Protection Agency ("EPA") is authorized to commence a civil action in federal court where the Administrator has previously found a violation under the Clean Water Act. Here, Sierra Club invokes jurisdiction for its "citizen suit" under 33 U.S.C. § 1365(a)(1)(A) which does not require a separate finding by the Administrator of the EPA before jurisdiction attaches. Therefore, the *GAF* equation of a failure to state a claim with a lack of subject matter jurisdiction is inapposite in this case.

[3] More relevant to the jurisdictional inquiry is the Supreme Court's holding that the assertion of a claim under a federal statute "alone is sufficient to empower the District Court to assume jurisdiction over the case and determine whether, in fact, the [statute] does provide the claimed rights." *Romero v. International Terminal Operating Co.*, 358 U.S. 354, 359, 79 S.Ct. 468, 473, 3 L.Ed.2d 368 (1959). Sierra Club alleges in support of its first cause of action that CRC is violating the Clean Water Act by discharging pollutants without a permit. Sierra Club has, therefore, asserted a claim under the Clean Water Act, 33 U.S.C. § 1365(a) which gives the district courts jurisdiction "to enforce ... an effluent standard or limitation ... and to apply any appropriate civil penalties." Section 1365(f) defines "effluent standard or limitation" to include an unlawful act under § 1311(a) which prohibits "the discharge of any pollutant" without a federal or state permit or in violation of the conditions of such permit. Thus, applying *Romero*, this court has jurisdiction over the first cause of action.

Sierra Club additionally invokes jurisdiction under 28 U.S.C. § 1331, which vests the district courts with original jurisdiction "over all civil actions arising under the Constitution, laws, or treaties of the United States."

Clearly, the first cause of action raises a federal question by alleging a violation of the Clean Water Act, a law of the United States.

For the reasons stated above, I deny CRC's motion to dismiss the first cause of action under Rule 12(b)(1) for lack of subject matter jurisdiction.

B. *Rule 12(b)(6) Challenge*

CRC maintains that, even accepting the allegations of the first cause of action as true, Sierra Club fails to state a claim upon which relief may be granted since the Clean Water Act does not regulate the discharge of pollutants into groundwater, even though such pollutants then migrate through the ground water into surface water which is subject to the Act. CRC points to certain allegations in the complaint which, it argues, indicate that the first cause of action is solely based on the contamination of groundwater which then enters Sand Creek. These include the allegations that "[a]s a result of oilspills, pipeline and tank leaks, and other releases at the refinery site, large quantities of petroleum and related compounds have entered, and continue to enter, the soils and groundwater beneath the refinery," (Compl. ¶¶ 11, 25, 26,) and that "[p]etroleum products and related compounds released in this manner are discharged with the groundwater into Sand Creek" through "underground paleochannels" and "seeps in the bank of the creek," (*Id.* ¶¶ 11, 27, 28). Sierra Club responds that the "complaint alleges in at least 25 separate paragraphs that defendant's pollutants are being discharged directly into Sand Creek," (Sierra Club's Opp'n. to Def's. Mot. to Dismiss at 10) and, that since Sand Creek is a tributary of the South Platte River, it is a "navigable water" within the meaning of the Clean Water Act.

While the complaint contains numerous allegations that CRC has discharged and continues to discharge petroleum products and related compounds from the refinery site into Sand Creek, it is unclear, however, whether Sierra Club is alleging that any of such discharges were made directly from the refinery into Sand Creek, as opposed to through the soil and groundwater. It is certain, however, that Sierra Club bases its first cause of action, at least in part, on discharges which reach Sand Creek through groundwater beneath the refinery. Therefore, I must decide whether the Clean Water Act's prohibition of the discharge of any pollutant into "navigable waters" encompasses discharges which reach "navigable waters" through groundwater.

A review of the case law addressing the regulation of groundwater under the Clean Water Act reveals that "isolated/nontributary groundwater," such as confined wells, has been unequivocally excluded from the Act by some courts. However, these cases and others do not preclude the act from applying to the regulation of "tributary groundwater," such as in the present case, which migrate from groundwater back into surface waters.

CRC relies on *Exxon Corp. v. Train*, 554 F.2d 1310, 1329 (5th Cir.1977) in support of its contention that the Clean Water Act does not require permits for discharges into groundwater. However, the *Exxon* court expressly limited its holding to nontributary groundwater:

> Specifically, EPA has not argued that the wastes disposed of into wells here do, or might, "migrate" from groundwaters back into surface waters that concededly are within its regulatory jurisdiction.... We mean to express no opinion on what the result would be if that were the state of facts.

Id. at 1312 n. 1. CRC also relies on *GAF*. The court in *GAF*, however, held that "[t]he disposal of chemical wastes into the underground waters *which have not been alleged to flow into or otherwise affect surface waters* does not constitute a 'discharge of a pollutant' within the meaning of § 1311(a)." 389 F.Supp. at 1383 (emphasis added). Furthermore, in *United States Steel Corp. v. Train*, 556 F.2d 822 (7th Cir.1977), the court highlighted the distinction between "tributary" and "nontributary" groundwater. Interpreting the Clean Water Act, it held that the EPA is authorized "to regulate the disposal of pollutants into deep wells, at least when the regulation is undertaken in conjunction with limitations on the permittee's discharges into surface waters." *Id.* at 852.

Only a few courts have confronted the precise question of whether tributary groundwater is subject to regulation under the Clean Water Act. In *Kelley v. United States*, No. 79-10199 (E.D.Mich. Oct. 28, 1980) ("*Kelley* I"), an unpublished opinion, the Attorney General of Michigan brought a citizen suit under the Clean Water Act against the United States, alleging the leakage of a toxic chemical into groundwater, which the federal government acknowledged travelled to a navigable lake. The court rejected the federal government's argument that *Exxon* excluded groundwater from regulation under the Clean Water Act, explaining that the Fifth Circuit in *Exxon* "concede[d] that wastes which migrate from groundwaters back into surface waters are within the EPA's regulatory jurisdiction." *Kelley ex rel. People of State of Michigan v. United States*, 618 F.Supp. 1103, 1106 (W.D.Michigan 1985) ("*Kelley* II") (citing *Kelley* I, slip op. at 2-3). By contrast, however *Kelley* II reached the opposite conclusion. There, toxic chemicals were allegedly released into the ground at a Coast Guard station. The pollutants contaminated the groundwater under the station, and the plume of contamination was migrating downgradient, eventually discharging into the East Arm of Grand Traverse Bay. The court held that the Clean Water Act did not extend federal authority to the regulation of groundwater contamination. *Id.* at 1107. It relied considerably on the opinion in *Exxon*, despite that court's distinction between tributary and nontributary groundwater.

To the contrary, the court in *McClellan Ecological Seepage Situation v. Weinberger*, 707 F.Supp. 1182 (E.D.Cal.1988), after reviewing the authorities including *Kelley* II, concluded that groundwater would fall within the regulatory purview of the Clean Water Act if it were established that such groundwater was "naturally connected to surface waters that constitute 'navigable waters' under the Clean Water Act." *Id.* at 1196. Likewise, in *New York v. United States*, 620 F.Supp. 374 (E.D.N.Y.1985) the court apparently assumed the applicability of the Clean Water Act to tributary groundwater. "We decline to reach defendants' argument as to the scope of section 301 [of the Federal Water Pollution Control Act, the equivalent of § 1311 of the Clean Water Act] as applied to groundwaters, since it is clear that plaintiff has alleged that the pollutants threaten to contaminate [named creeks], all of which are undisputably navigable waters." *Id.* at 381. More tentatively, the court in *Inland Steel Co. v. EPA* acknowledged that "the legal concept of navigable waters might include ground waters connected to surface waters—though whether it does or not is an unresolved question." 901 F.2d 1419, 1422 (7th Cir.1990).

On the other hand, the court in *Town of Norfolk v. United States Army Corps of Engineers*, while acknowledging differences in the opinions of various courts as to whether groundwater constitutes "waters of the United States" within the meaning of the Clean Water Act, held that deference should be given to the Corps' interpretation which limited the definition only to surface waters. 968 F.2d 1438, 1451 (1st Cir.1992).

In sum, case law conflicts as to whether "navigable waters" in the Clean Water Act encompass groundwater. Although there is little direct Tenth Circuit authority in this regard, the Sierra Club has cited two opinions which indicate that that circuit has placed a broad interpretation on the scope of the Clean Water Act. In *United States v. Earth Sciences, Inc.*, the court ruled that unpermitted leach mining waste escaping into the Rito Seco Creek through overflow of a reserve sump and through groundwater seeps violated the Clean Water Act which "was designed to regulate to the fullest extent possible those sources emitting pollution into rivers, streams and lakes." 599 F.2d 368, 373 (10th Cir.1979). Although the court was chiefly addressing the issue of whether "navigable waters" include waters such as the Rito Seco Creek, which are not navigable in fact, the observations made are nevertheless pertinent. As the court in *Earth Sciences* noted, "[i]t seems clear Congress intended to regulate discharges into every creek, stream, river or body of water that in any way may affect interstate commerce. Every court to discuss the issue has used a commerce power approach and agreed upon that interpretation." *Id.* at 375.

Likewise, in *Quivira*, 765 F.2d at 130, the court held that EPA had the authority under the Clean Water Act to issue NPDES permits regulating uranium mining company discharges into normally dry arroyos in New Mexico. The court reasoned that, although the arroyos were not navigable in fact, "surface flow occasionally occurs, at times of heavy rainfall, providing a surface connection with navigable waters independent of the underground flow. Additionally, the waters of the [arroyos] soak into the earth's surface, become part of the underground aquifers, and after a lengthy period, perhaps centuries, the underground water moves toward eventual discharge at Horace Springs or the Rio San Jose." *Id.* at 129. The *Quivira* court repeatedly stressed that "it was the clear intent of Congress to regulate waters of the United States to the fullest extent possible." *Id.* at 130.

[4, 5] These decisions leave little doubt that the Tenth Circuit has chosen to interpret the terminology of the Clean Water Act broadly to give full effect to Congress' declared goal and policy "to restore and maintain the chemical, physical and biological integrity of the Nation's waters." 33 U.S.C. § 1251(a).[4] With this in mind, I conclude that the Clean Water Act's preclusion of the discharge of any pollutant into "navigable waters" includes such discharge which reaches "navigable waters" through groundwater. I therefore find that Sierra Club's allegations that CRC has and continues to discharge pollutants into the soils and groundwater beneath the refinery which then make their way to Sand Creek through the groundwater state a cause of action under the Clean Water Act. Accordingly, I deny CRC's Rule 12(b)(6) motion to dismiss the first cause of action.

IV. *Second Cause of Action for Violation of NPDES Permits*

CDC argues that the second cause of action for violation of NPDES permits is jurisdictionally barred insofar as it seeks civil penalty relief for exceedances which occurred through April 1992. It is CDC's position that CDH's imposition of penalties with respect to such exceedances precludes Sierra Club's attempt to sue for the same underlying violations. CRC relies on the Clean Water Act's provision that:

> [A]ny violation—
>
> . . . .
>
> (iii) for which . . . the State has issued a final order not subject to further judicial review and the violator has paid a penalty assessed under this subsection or a comparable State Law, as the case may be,
>
> shall not be the subject of a [citizen action for civil penalties].

33 U.S.C. § 1319(g)(6)(A)(iii).

Sierra Club argues that the stipulated order was not commenced, prosecuted or issued pursuant to a state law that is "comparable" to the administrative penalty provisions of the Clean Water Act as required by the above provision. Therefore, Sierra Club asserts that it is not precluded from seeking further civil penalties to remedy the NPDES permit violations purportedly covered by the stipulated order.

There is no question that the stipulated order constitutes "a final order not subject to judicial review" issued by the State of Colorado and that CRC has paid an assessed penalty. The issue before me is whether the stipulated order was issued and the penalty was assessed under "comparable State law" within the meaning of this provision.

Sierra Club contends that Colorado law is not comparable because, unlike the Clean Water Act, it does not require public notice of enforcement proceedings, does not require an opportunity for public comment or provide participation rights to concerned citizens, and does not describe any factors to be considered in determining the appropriate penalty.

4. CRC argues that the legislative history of the Clean Water Act precludes the application of the Act to groundwater. Other commentators, who have conducted an in depth examination in this regard, do not agree that this legislative history is conclusive. *See* Mary C. Wood, *Regulating Discharges into Groundwater: The Crucial Link in Pollution Control under the Clean Water Act*, 12 Harv.Envtl.L.Rev. 569 (1988).

CRC responds that the Colorado Water Quality Control Act, Colo.Rev.Stat. § 25-8-302(1)(e) (1989)[5] and its implementing regulations 5 Colo.Code Regs. 1002-1 § 2.1.4(C)(1), (2) (1988)[6] mandated public notice of the state action taken against CRC. CRC states that notification that the State of Colorado had issued the Notice of Violation and Cease and Desist order to CRC on April 26, 1989 was given to recipients of a publication entitled "Water Quality Information" in June, 1989. CRC points out that the Sierra Club has been on the mailing list for the publication at all relevant times. Sierra Club does not allege that it did not receive this information.

Sierra Club counters that the Colorado Water Quality Control Act and related regulations do not require prior notice of, or meaningful opportunity to comment on, state penalty assessments in any way comparable to the relevant provisions of the Clean Water Act contained in 33 U.S.C. § 1319(g)(4)(A) (requiring the Administrator or Secretary to provide public notice of and reasonable opportunity to comment on proposed issuance of order.) CRC points out, however, that the Act does not require a public hearing to be conducted either before or after the issuance of a final order and that an interested party may only seek a hearing before the administrator if he/she took advantage of his/her opportunity to comment prior to the order. *See* 33 U.S.C. § 1319(g)(4)(B) and (C). Moreover, 33 U.S.C. § 1319(g)(8) provides for judicial review of a penalty assessment only at the instance of a person against whom the penalty was assessed or one who commented on the proposed assessment under 33 § 1319(g)(8).[7] Colorado law, on the other hand, allows "any person directly affected" by a final order to apply for a hearing or reconsideration of such order without the requirement of prior comment or receipt of notice under the implementing regulations. *See* Colo.Rev.Stat. § 25-8-403 ("During the time permitted for seeking judicial review of a final order . . . any party directly affected by such order . . . may apply . . . for a hearing or rehearing with respect to . . . such order. . . .") Similarly, Colorado law allows judicial review of "any final order" by "any person adversely affected or aggrieved." *See* Colo.Rev.Stat. § 25-8-404(1) ("Any final rule, order, or determination . . . shall be subject to judicial review in accordance with the provisions of this article and article 4 of title 24, C.R.S."); *Id.* § 24-4-106(4) ("any person adversely affected or aggrieved by any agency action may commence an action for judicial review in the district court within thirty days after such agency action becomes effective . . .")

[6] The term "comparable State law" as used in the Act does not mean that the state's regulatory authority or processes must be identical to the federal provisions. *Saboe v. State of Oregon*, 819 F.Supp. 914, 917 (D.Or.1993); *see also Sierra Club v. Port of Townsend Paper Corp.*, No. C87-316C, 1988 WL 160580, at *5-6 (W.D.Wash. May 2, 1988). A review of the administrative enforcement procedures under Colorado law and federal law reveals that, although the Colorado regulatory scheme does not mandate prior public notice of enforcement proceedings, overall, the scheme adequately protects the public interest in enforcement actions. *See North and South Rivers Water-*

5. This section provides in pertinent part: "The [water quality control] division shall: . . . (e) Maintain a mailing list of persons requesting notice of actions by the division . . . and notify persons on the list of such actions . . ."

6. These regulations provide in pertinent part:
Notice
1) All formal adjudicatory hearings of the [water quality control] Commission and the [water quality control] Division shall be preceded by written notice thereof in accordance with the requirements of this section.
2) Any person entitled to notice of a hearing, including the petitioners, those persons on the mailing list maintained by the [water quality control] Division pursuant to C.R.S., 25-8-302(1)(e), and any person requesting notice as to a particular matter, shall be given timely notice of the time, place, nature of the hearing, the legal authority and jurisdiction under which it is to be held, and the matters of fact and law asserted.

7. This section provides in pertinent part: "Any person against whom a civil penalty is assessed under this subsection or who commented on the proposed assessment of such penalty in accordance with paragraph (4) may obtain review of such assessment . . ."

shed Ass'n, Inc. v. Scituate, 949 F.2d 552, 556 n. 7 (1st Cir.1991.) (Construing similar state statutory scheme.)

It cannot be ignored that Sierra Club apparently received word of the Notice of Violation issued by the Colorado Department of Health to CRC in April 1989 and failed to take appropriate steps to voice its opinion. Furthermore, after the CRC entered the stipulated order in July 1992, Sierra Club did not avail itself of the relevant provisions of Colorado law to challenge such final order.

> [T]he citizen suit is meant to supplement rather than to supplant governmental action. The legislative history of the Act reinforces this view of the role of the citizen suit. The Senate Report noted that "[t]he Committee intends the great volume of enforcement actions [to] be brought by the State," and that citizen suits are proper only "if the Federal, State and local agencies fail to exercise their enforcement responsibility."

Gwaltney of Smithfield, Ltd. v. Chesapeake Bay Found., Inc., 484 U.S. 49, 60, 108 S.Ct. 376, 383, 98 L.Ed.2d 306 (1987) (citing S.Rep. No. 92-414, p. 64 (1971), reprinted in 2 A Legislative History of the Water Pollution Control Act Amendments of 1972, p. 1482 (1973)). To allow Sierra Club subsequently to voice its dissatisfaction with the stipulated order by resorting to a citizen suit under federal law would negate the Colorado law safeguards and would supplant rather than supplement the governmental action. This is contrary to the purpose of a citizen suit. *Id.*

Sierra Club further argues that the penalty against CRC was not assessed under comparable state law since Colorado law, unlike the Clean Water Act,[8] does not describe any factors to be considered in determining the appropriate penalty. CRC maintains, however, that Colorado has a policy for the assessment of civil penalties contained in published guidelines adopted in 1984 and titled "Guidance for Assessing Civil Penalties."[9] CRC attaches a copy of the guidelines (Def's.Ex. 2) which require that, in the assessment of civil penalties, consideration be taken of factors closely similar to those mandated by the Clean Water Act. Sierra Club asserts that said guidelines do not constitute enforceable law.[10] Further, that taking into account the number of violations addressed by the stipulated order, it is apparent that the guidelines were not followed in assessing the penalty amount of $20,000.

[7, 8] As discussed above, citizen suits are proper only where a governmental agency has failed to exercise its enforcement responsibility. *Gwaltney*, 484 U.S. at 62, 108 S.Ct. at 383. Sierra Club attempts to balkanize the applicable Colorado law and fails to recognize that, taken as a whole, Colorado law contains "an adequate mechanism for assessing civil penalties against polluters." *North and South Rivers Watershed Ass'n, Inc.*, 949 F.2d at 559 (Selya, J. concurring). Sierra Club's dissatisfaction with the amount of the civil penalty assessed under Colorado law does not prove otherwise. Again, Sierra Club did not exercise its rights under Colorado law to challenge the stipulated order. It cannot now seek, by way of a federal citizen suit, to supplant the safeguard mechanisms contained within the relevant state law.

For the aforesaid reasons, I find that the stipulated order was issued and the penalty was assessed under "comparable State law" within the meaning of the Clean Water Act. I therefore grant CRC's motion to dismiss partially the second cause of action under Rule 12(b)(6) to the extent that such claim seeks civil penalties for those pre-April 1992 NPDES permit violations covered by the stipulated order. Accordingly,

IT IS ORDERED THAT CRC's motion to dismiss Sierra Club's first cause of action is DENIED;

IT IS FURTHER ORDERED THAT CRC's motion to dismiss partially Sierra Club's second cause of Action to the extent that such claim seeks civil penalties for those pre-April 1992 NPDES permit violations covered by the stipulated order is GRANTED.

8. The Act provides that:

> In determining the amount of any penalty assessed under this subsection, the Administrator ... shall take into account the nature, circumstances, extent and gravity of the violation, or violations, and, with respect to the violator, ability to pay, any prior history of such violations, the degree of culpability, economic benefit or savings (if any) resulting from the violation, and such other matters as justice may require.

33 U.S.C. § 1319(g)(3).

9. The "Guidance for Assessing Civil Penalties" was superseded on May 1, 1993 by the Water Quality Control Division's "Civil Penalty Policy."

10. Sierra Club argues that CDH's "Guidance for Assessing Civil Penalties" was not published pursuant to the State Administrative Procedure Act of Colorado which provides: "No rule shall be relied upon or cited against any person unless, if adopted after May 1, 1959, it has been published and ... has been made available to the public in accordance with this section." Colo.Rev.Stat. § 24-4-103(10) (1989).

Ellen M. JENSEN, Plaintiff,

v.

JOHNSON COUNTY YOUTH BASEBALL LEAGUE, Defendant.

No. 93-2256-JWL.

United States District Court, D. Kansas.

Nov. 1, 1993.

Former employee brought action against youth baseball league alleging violation of Title VII sex discrimination provisions and Equal Pay Act. On defendant's motion to dismiss for lack of subject matter jurisdiction, the District Court, Lungstrum, J., held that: (1) motion to dismiss could be treated as motion for summary judgment; (2) defendant was not "employer" within meaning of Title VII; and (3) defendant was not an enterprise engaged in commerce or the production of goods for commerce for purposes of Equal Pay Act.

Motion granted.

1. Federal Courts ⟹34

Since federal courts have limited jurisdiction, there is a strong presumption against federal jurisdiction.

2. Federal Civil Procedure ⟹1742(1)

Court lacking subject matter jurisdiction must dismiss case at any stage of proceeding in which it becomes apparent that such jurisdiction is absent.

3. Federal Courts ⟹34

When jurisdiction of federal court is challenged, party invoking such jurisdiction bears burden of establishing its existence.

4. Federal Civil Procedure ⟹1834

Motion to dismiss for lack of subject matter jurisdiction is considered a "speaking motion" and can include references to evidence outside pleadings without converting motion to a Rule 56 summary judgment motion. Fed.Rules Civ.Proc.Rules 12(b)(1), 56, 28 U.S.C.A.

5. Federal Civil Procedure ⟹1832, 1833

Court has wide discretion to allow affidavits and other documents to resolve disputed jurisdictional facts under motion to dismiss for lack of subject matter jurisdiction. Fed. Rules Civ.Proc.Rule 12(b)(1), 28 U.S.C.A.

6. Federal Civil Procedure ⟹2533.1

As a general rule, a motion to dismiss for lack of subject matter jurisdiction should not be converted into a motion for summary judgment. Fed.Rules Civ.Proc.Rules 12(b)(1), 56, 28 U.S.C.A.

7. Federal Civil Procedure ⟹2533.1

Exception to general rule that motion to dismiss for lack of subject matter jurisdiction should not be converted to motion for summary judgment exists when jurisdictional question is meshed with merits of the case. Fed.Rules Civ.Proc.Rules 12(b)(1), 56, 28 U.S.C.A.

8. Federal Civil Procedure ⟹2533.1

For purpose of determining whether motion to dismiss for lack of subject matter jurisdiction should be converted to motion for summary judgment, jurisdictional question is intertwined with merits of case if subject matter jurisdiction is dependent on same

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 6
1445 ROSS AVENUE
DALLAS, TEXAS 75202-2733

May 6, 1997

Mr. Richard E. Schwartz
Attorney for Molycorp, Inc.
Crowell & Moring LLP
1001 Pennsylvania Avenue, N.W.
Washington, D.C. 20004-2595

Re: Molycorp, NPDES No. NM0022306

Dear Mr. Schwartz:

In response to your letter dated May 5, 1997, we have the following comments.

In the 1993 Response to Comments, it was the position of EPA Region 6 that percolation or infiltration from mine and tailings areas into groundwater did not constitute "point sources" under NPDES. However, we are aware that more recent U.S. District Court decisions are divided over this matter where "hydrologic connection" to surface waters is involved.

The only surface discharge sources from the mine areas which we considered in the 1993 reissuance in accordance with the application and our interpretation of other inputs are those associated with Outfalls 004 and 005. At that time we did not recognize and consider other surface discharges or surface seepage associated with mine wasterock piles. It was understood then that any other mine sources including the mine spoil piles percolated into groundwater. If other mine surface discharges or surface seeps exist, these would be "point sources" subject to the need for applications and permitting.

If I can add any further clarification, please contact me at voice (214) 665-7503 or FAX (214) 665-2191.

Sincerely,

Frederick O. Humke

Frederick O. Humke, P.E.
Environmental Engineer
Permits Branch (6WQ-PP)

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 6
1445 ROSS AVENUE
DALLAS, TEXAS 75202-2733

May 6, 1997

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 6
1445 ROSS AVENUE
DALLAS, TEXAS 75202-2733

May 6, 1997

Mr. Richard E. Schwartz
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Washington, D.C. 20004-2595

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Frederick O. Humke

Frederick O. Humke, P.E.
Environmental Engineer
Permits Branch (6WQ-PP)

CROWELL & MORING LLP
1001 PENNSYLVANIA AVENUE, N.W.
WASHINGTON, D.C. 20004-2595
(202) 624-2500
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FAX TELEPHONE NUMBER: (202) 628-5116

Date: 5/5/97

To: Fred Hunke

Firm: U.S. EPA, Region 6

Facsimile Telephone Number: ~~214~~ 972 615 - 2191

Total Number of Pages (*Includes Cover Sheet*): 14

From: Rich Schwartz

Message: Per our discussion. Thanks. Enclosed are copies of some of the comments EPA responded to regarding Issue No. 7 (groundwater segregs).

Hard Copy to Follow: (Yes) No

C&M Form #7

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 6
1445 ROSS AVENUE
DALLAS, TEXAS 75202-2733

CERTIFICATE
ACCOMPANYING COPIES
OF AGENCY RECORDS

40 CFR Section 2.406
[F.R.Civ.P. Rule 44]
[28 U.S.C. SECTION 1733]

AUTHENTICATION

I am the Chief of the Customer Service Branch, United States Environmental Protection Agency, Region 6, Dallas, Texas. In that position, I am the legal custodian, under the Regional Administrator, of those official records of the United States Environmental Protection Agency (EPA) which are in the custody of the Director of the Water Quality Protection Division. I attest that the 12 pages of documents to which this Authentication is attached are true and correct copies of the official records which are in the custody of the Water Quality Protection Division of the United States Environmental Protection Agency, Region 6, Dallas, Texas. The official records from which these documents were made consist of seven comments received by this office in response to proposed NPDES permit for MolyCorp, Inc. (NM0022306). The originals of these records are publicly-available information from the Customer Service Branch files in the Water Quality Protection Division Records Center.

2/13/97
Date

Jayne Fontenot
Jayne Fontenot, Chief
Customer Service Branch

CERTIFICATE

I am the Acting Regional Counsel of the Region 6 Office of the United States Environmental Protection Agency in Dallas, Texas. I have official duties within that office in Dallas, Texas, where the official records described above are kept. I certify that Jayne Fontenot, the person who signed the above Authentication, is the Chief of the Customer Service Branch, United States Environmental Protection Agency, Region 6, Dallas, Texas, and that in such position she has the legal custody, under the authority of the Regional Administrator, of the official Agency records described above. I certify that the signature above, of Jayne Fontenot, is genuine.

Witness my signature and the official seal of the United States Environmental Protection Agency .

Walter L. Sutton, Jr.
Walter L. Sutton, Jr.
Acting Regional Counsel

LAND AND WATER FUND

"Legal Aid For The Environment"

May 25, 1993

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4696 Overland Rd.
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Ms. Ellen Caldwell
Permits Branch (6W-PS)
U.S. EPA
1445 Ross Avenue
Dallas, TX 75202
Fax No. 214-655-6490

Post-it™ brand fax transmittal memo 7671	# of pages ▸ 12
To Fred Mirabiz	From Fred Hermann
Co. Molycorp	Co. EPA Reg. 6
Dept.	Phone # 214/655-2503
Fax # (575) 586-0611	Fax #

VIA FAX

Dear Ms. Caldwell:

I am writing on behalf of Concerned Citizens del Norte to comment on the proposed NPDES permit for Molycorp, Inc., No. NM0022306. Concerned Citizens del Norte is a grassroots group based in Questa, New Mexico, which has worked for many years on environmental problems caused by the nearby Molycorp mine and tailings facility. Thank you for extending our comment deadline to May 25.

COMMENTS REGARDING MINE DRAINAGE/STORMWATER RUNOFF

Most of our comments relate to the new outfalls 004 and 005, which are authorized to discharge "periodic mine drainage, including collected stormwater." We understand that Outfall 004 is to be located between the mine and mill site and the town of Questa (apparently in Goat Hill Gulch just above the river), while Outfall 005 is to be located at the mill site. Our comments are as follows:

Daily average loading limits. Discharges from outfalls 004 and 005 are subject to certain loading limits as part of Sum2, which aggregates the discharges from all four outfalls. These limits are expressed as daily averages. The use of a daily average limit appears inappropriate for Outfalls 004 and 005, since these points will primarily discharge stormwater and therefore will discharge at most a few days a month. By imposing only daily average limits, the permit would tend to allow highly toxic episodic discharges in otherwise dry months. Discharges from Outfalls 004 and 005 should also be subject to daily maximum loading limits.

Biomonitoring requirements. The permit requires Whole Effluent Toxicity Testing, but the specified test procedures do not seem to allow an accurate assessment of

2260 Baseline Road • Suite 200 • Boulder, Colorado 80302 • (303) 444-1188 • FAX (303) 786-8054

05/05/97 14:56 CROWELL & MORING → 214 665 2191 NO.919 P003/014

the toxicity of the effluent from Outfalls 004 and 005. First, the procedures call for a composite sample of effluent from all four outfalls. Such a composite sample is inappropriate, as several river miles separate Outfalls 004 and 005 from each other and from Outfalls 001 and 002. Moreover, while the permit language is not entirely clear on this point, it appears to allow the composite samples to be collected on days when Outfalls 004 and 005 are not discharging at all. The permit should require biomonitoring testing for individual samples of effluent from Outfalls 004 and 005.

Sum2 loading limitations. The permit contains no Sum2 loading limitations for certain metals which are the subject of concentration-based limits or Sum1 loading limits, such as copper, zinc, molybdenum and manganese. Past studies of the Red River have shown many of these metals to pose problems for the river's water quality and natural communities. The absence of such Sum2 limits reduces the permit's effectiveness in meeting the goals of the Clean Water Act and protecting the Red River.

Compliance deadline/reopener clause. The permit requires Molycorp only to report its Sum2 loadings until June 30, 1996. It is not clear why Molycorp is given three years to come into compliance with the final Sum2 limitations; we would support a shorter deadline. In addition, we believe the permit should contain a reopener clause providing for revision of the Sum2 limits based on Molycorp's monitoring report. Such a reopener clause seems particularly appropriate in this permit, since the existing data on Outfalls 004 and 005 appear to be scant.

COMMENTS REGARDING OUTFALLS 001 AND 002

Loading limits inflated by Outfall 001 flow. Except for molybdenum, the permit's daily average loading limitations for Sum1 "are calculated and limited at 00C [?] based on the daily average concentration and a daily average flow of 4.726 MGD." Thus, the permit assumes an average discharge from Outfall 001 of 4.29 MGD. In fact, Outfall 001 is unlikely to discharge at all during the life of this permit. It discharged only a few days over the past five years, and the mine was operating during most of that time. Now the mine is closed and is not expected to reopen soon, if ever. Thus, to base loading limits on an average Outfall 001 discharge of 4.29 MGD renders those limits largely meaningless. These inflated limits are especially troublesome with respect to manganese, for which the permit does not specify a concentration-based limit at Outfall 002.

Cadmium limit. The Sum1 loading limit for total cadmium, expressed as a daily average, is 2.00 pounds ~~per~~ day. The corresponding Sum2

Fig. 3

limit is 1.10 pounds per day. This must be a mistake. The Suml limit should be 1.10 pounds per day.

COMMENTS REGARDING ISSUES NOT ADDRESSED IN THE PROPOSED PERMIT

The permit does not address three potential sources of pollution to the Red River. None are typical point source discharges to surface water; rather, they involve the pollution of underground water sources which are, or may be, tributary to the Red River. Relevant case law indicates that these may be "point sources" subject to regulation under the NPDES program. These sources may pose greater problems and risks for surface water quality than for ground water.

Existing seeps below the mine. The Red River is constantly polluted by one or more springs or seeps on its north bank just below the Molycorp mine. The condition of the river, particularly the streambottom, worsens visibly in this area and stays bad for several miles; the seeps appear to be a major contributor to the degradation of the river. If, as seems likely, the water issuing from these seeps is draining from the Molycorp mine and spoils piles, then these seeps should be regulated under the NPDES program.

Filling of the deep underground workings. Molycorp has written in an August 10, 1992 letter to New Mexico Environment Secretary Judith Espinosa, that much of the water from the open pit and the spoils piles drains into the mine's upper underground workings. From there, the water drops through a "vertical drill hole" down to the deep underground workings which lie below the level of the river at that point. Molycorp has stated that if the water ever spills out from the underground workings it will be dealt with in accordance with the company's NPDES permit. This scenario raises two questions. First, does the proposed permit adequately address this possibility? Second, has EPA considered that the underground workings and the Red River may be hydrologically connected, and therefore that water from the underground workings could affect the river without reaching the surface?

Uncaptured tailings seepage. Over the years, seepage from the Molycorp tailings facility has contained high levels of solids and sulfates and varying levels of metals. A 1989 Report by Molycorp consultant Vail Engineering notes that a significant part of the Molycorp tailings seepage is not being collected by the existing system leading to Outfall 002. The same report also notes that the seepage appears to be affecting springs near the River. Thus, EPA should address the problem of uncollected seepage through this permit because of the possible affects of such seepage of surface water.

Pg. 3

Thank you for considering these comments.

Best regards,

Reed D. Benson
Staff attorney
Land and Water Fund of the Rockies

Attorneys for
Concerned Citizens del Norte
PO Box 1179
Questa, NM 87556
(505)586-1730

P.S. Along with these comments I am transmitting two additional sets of comments, one from Concerned Citizens del Norte themselves and one from Antonio Trujillo, a member of both Concerned Citizens del Norte and Amigos Bravos, a river protection group based in Taos.

Pg. 4

Fax Transmittal Memo 7672

Reed Benson
LAW Fund

Juan Hughes
CCdN
Questa NM
586-1241

Ms. Ellen Caldwell
Permits Branch (6W-PS)
U.S.EPA
1445 Ross Avenue
Dallas, TX 75202

Estimada Ms. Ross,

Please accept these comments on behalf of the Concerned Citizens Del Norte on the proposed NPDES permit for Molycorp, Inc., No. NM0022306. Concerned Citizens Del Norte is a community-based organization that has been monitoring the environmental degradation caused by the unregulated mining practices of Molycorp for the past 20 years.

While the fact that Molycorp is finally being required to apply for an NPDES permit on its discharges is a positive step, the current permit application does not cover all surface and groundwater discharges that we, as members of the affected community know exist. The Red River right at and below the mine site is biologiwally dead, we know this to be caused by seeps from the mine and all the slag tailings. The mine has pulled its underground pumps and is allowing its underground workings to flood, we know that in time this will seep into the Red River and because of the past mining explosions causing fractures will also contaminate Cabresto Creek our only remaining clean water source. The above two concerns are not addressed in the permit application.

Another major concern is the seepage fromthe mines tailings dump. Arecent court decision and settlement found the mine tailings responsible for contaminating groundwater beneath and around the dumps. We can show you where therwisesurface r off flowing from the tailings dump directly inob the Red River and acequias, our irrigation system. Again, neither of the above concerns are addressed in the permit application.

What the permit application does cover is totally unacceptable. It is incumbent for the EPA to measure the discharges by Molycorp accurately and effectively. By using the "daily average loading limits", you would be condoning inappropriate measures and systematic undercounting of contaminants. High levels of contaminants are discharged in storm runoff and not on a daily basis but by averaging on a daily basis this would bring down the levels released which we know to be excessive during runoff. On the use of Whole Effluent Testing, the use of composite samples from Outfalls miles from each other will result in diluted findings and are again, inappropriate. We request biomonitoring testing for individual samples from each Outfall. We also request that the final permit require loading limits for all the metals such as zinc, manganese, moly, lead, copper, etc., that are known to be dischar

We would appreciate a response to the above concerns and please apprise us of t scheduling of the public hearings.

Attentively,

Juan Hughes
Concerned Citizens Del Norte
P.O. Box 1179
Questa, NM 87556
Phone 505/586-1730/fax 586-1241

6W-P
page 335
Rev #(1)

AMIGOS BRAVOS, Box 238, Taos, NM 87571

FAX TRANSMITTAL

To: MS. ELLEN CALDWELL
PERMITS BRANCH
EPA - 6W-PS

Fax#: 214-655-6490

From: BRIAN SHIELDS

Fax#: (505) 758-3874

Date: 5/25/93

We only have one line for both phone and fax so when returning fax please call first.

Number of pages including cover sheet: 1

****

Dear Ms. Ellen Caldwell:

It has come to our attention today that Molycorp has made an application for NPDES permits at two new outfalls at their Goat Hill millsite. We were also informed that today is the deadline for comments.

Amigos Bravos has been in communication with EPA over the past five years concerning the Molycorp mine pollution of the Red River. So it came as a surprise that we had not been informed by EPA of this latest development. Amigos Bravos would like to study and submit comments on this permit application. We are requesting a copy of the NPDES draft permit and for an opportunity to offer our insights. *

Amigos Bravos is aware of the complexity of the issues involved and the need for the public to be fully informed of the stipulations and implications of the permit. We therefore ask, on behalf of our 600 members, that a public hearing be held in Questa on this NPDES permit.

Thank you for taking these two requests into consideration. Also, please make sure that we are included in whatever mailing list you have of organizations requesting to be kept informed of Molycorp actions.

Sincerely,

Brian Shields
Projects Director

* Fred/Bob -
Since this seems to be of strong interest, I would suggest letting him comment.

A Wilfred Rael
P.O. Box 603
Questa, New Mexico 87556

May 25, 1993

Re: Application to Discharge to Waters of the United States
NPDES Permit No. NM0022306
Draft Permit

Ms. Ellen Caldwell
Permits Branch (6W- PS)
U.S Environmental Protection Agency
1445 Ross Avenue
Dallas, Texas 75202-2733
(214) 655-7513

Dear Ms. Caldwell;

We appreciate your extending the time limit for submitting out comments till May 25, 1993. Thank you.

I have lived in Questa, New Mexico, in an area along the north bank of the Red River all my life. Currently, I own land and use waters from the Red River for irrigation. I was 15 years old when Moly Corp went from a small underground operation to an open pit mine in 1965. I witnessed many of the spills that occurred after the expansion began. I saw the Red River go from a beautiful mountain stream, full of life, to a polluted dead river. The water looks like it's discharged from a washing machine (Blue). According to many studies that have been performed by State and Federal Agencies, at least 8 miles of the Red River from MolyCorp to Lama Canyon is essentially a biologically dead reach. This dead zone of the Red River is due in greatest measure to continual metal loading from "steady state" seeps issuing from a number of locations along a 6 mile section of the middle reach beginning below the MolyCorp mill and persisting until about the Questa Ranger District. The mine claims that the goethermal scars on the mountain along the river are to blame for what has happened to the river. this is a joke! I strongly feel that the mine is to blame and they are using our state and federal agencies to get away with murder. If you were in my situation I am sure that you would feel the same way. If you studied the records and you investigated the problem further you would probably also draw the same conclusion.

MolyCorp Inc. is currently applying for permits for two new outfalls 004 and 005, EPA made an error in plane coordinates for outfall 004 [illegible] a point on the Rio Grande. There was also no description of these discharge points which made it very difficult to make an assessment of these permit application. It is good that EPA has reclassified use of the river to non-industrial use.

Due to the nature of the soils (very porous) between the mine and the Red River most of their discharges from the open pit mine (about 2 1/2 miles wide by 1/2 mile deep) flow into the Red River below the surface of the ground, they must be required to get these discharges permitted because, they created this collection system (open pit). The current NPDES application does not consider these discharges. The old underground workings are next to the Red River and below the open pit mine. This collection system that they developed as a result of the open pit mine seeps through these old workings and flows to the Red River and is not permitted.

The Clean Water Act prohibits the discharge of pollutants from any point source to the waters of the United States. It may be argued that the MolyCorp's open pit and approximately 5 square miles of disturbance are not "point sources". In Sierra Club v. Abston Construction Co., Inc., 620 F.2d 41 ((5th Cir. 1980), EPA argued that mining pits and collection ponds are point sources, and that seepage from such facilities constitutes a point source discharge. The court agreed. MolyCorp's NPDES permit does not include these discharges.

There is also a potential danger in the filling of the current underground workings because these polluted waters will seep into the Red River before they reach the surface.. This has not been properly addressed in this application.

The current application overestimates the flow from outfall 001 based on DMRs from the period of mine operation. There is little or no flow once the mine is inoperative (as now) this mistake allows unnecessary discharge under SUM1 limits for manganese and molybdenum. This have been two of the most significant pollutants from the mine; this is because there are no concentration based limits for these and an overestimate of flow from 001 gives the mine huge leeway to meet these mass limits. The same is true for cobalt, selenium, beryllium, silver, chlordane and chlorine which are picked up under SUM2. EPA should have concentration limits for all of these. The absence of such limits reduces the permit's effectiveness in meeting the goals of the Clean Water Act and protecting the Red River.

Draft permit provides for insufficient monitoring, discharges from outfalls 001 and 002, there should be daily monitoring for effluents that have concentration limits. Otherwise, episodic large releases of pollutants will not be accounted for, this compounds outfall 001's overestimation problem.

Draft permit whole effluent toxicity testing generally allows too much dilution of mixture for testing, a mixture of 36% should be used for most tests. The permit should require biomonitoring testing for individual samples of effluent from all outfalls. Composite sampling should not be done because there is a large distance between the outfalls.

Pg. 11

This permit requires MolyCorp only to report its Sum? loadings until June 30, 1996, it does not require compliance. Compliance should be required immediately.

Ms. Caldwell, we are confident that EPA will own up to it's responsibilities in protecting the Red River and the Rio Grande (Wild and Scenic Rivers as designated by Congress) from MolyCorp's discharges. The future of our children and our community is at stake here and we are depending on you for our protection.

On the basis of the above issues raised, I request a public hearing on MolyCorp's NPDES Permit No. NM0022306 Application.

Respectfully Submitted,

A. Wilfred Rael

A. Wilfred Rael

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 6
1445 ROSS AVENUE
DALLAS, TEXAS 75202-2733

CERTIFICATE
ACCOMPANYING COPIES
OF AGENCY RECORDS

40 CFR Section 2.406
[F.R.Civ.P. Rule 44]
[28 U.S.C. SECTION 1733]

AUTHENTICATION

I am the Chief of the Customer Service Branch, United States Environmental Protection Agency, Region 6, Dallas, Texas. In that position, I am the legal custodian, under the Regional Administrator, of those official records of the United States Environmental Protection Agency (EPA) which are in the custody of the Director of the Water Quality Protection Division. I attest that the 2 pages of documents to which this Authentication is attached are true and correct copies of the official records which are in the custody of the Water Quality Protection Division of the United States Environmental Protection Agency, Region 6, Dallas, Texas. The official records from which these documents were made consist of a letter dated May 25, 1993, from Penelope Rael to Ms. Ellen Caldwell regarding Permit No. NM0022306, MolyCorp, Inc. The originals of these records are publicly-available information from the Customer Service Branch files in the Water Quality Protection Division Records Center.

2/13/97
Date

Jayne Fontenot
Jayne Fontenot, Chief
Customer Service Branch

CERTIFICATE

I am the Acting Regional Counsel of the Region 6 Office of the United States Environmental Protection Agency in Dallas, Texas. I have official duties within that office in Dallas, Texas, where the official records described above are kept. I certify that Jayne Fontenot, the person who signed the above Authentication, is the Chief of the Customer Service Branch, United States Environmental Protection Agency, Region 6, Dallas, Texas, and that in such position she has the legal custody, under the authority of the Regional Administrator, of the official Agency records described above. I certify that the signature above, of Jayne Fontenot, is genuine.

Witness my signature and the official seal of the United States Environmental Protection Agency .

Walter L. Sutton, Jr.
Walter L. Sutton, Jr
Acting Regional Counsel

RECEIVED

JUN 02 1993

6W-PS

Penelope Rael
P.O. Box 603
Questa, New Mexico 87556

May 25, 1993

Re: Application to Discharge to Waters of the United States
NPDES Permit No. NM0022306
Draft Permit

Ms. Ellen Caldwell
Permits Branch (6W- PS)
U.S Environmental Protection Agency
1445 Ross Avenue
Dallas, Texas 75202-2733
(214) 655-7513

Dear Ms. Caldwell:

We appreciate your extending the time limit for submitting our comments until May 25, 1993. Thank you.

I have lived in Questa, New Mexico, in an area along the north bank of the Red River for the past 18 years. Currently, I own land and use waters from the Red River for irrigation.

According to many studies that have been performed by State and Federal Agencies, at least 8 miles of the Red River from MolyCorp to Lama Canyon is essentially a biologically dead reach. This dead zone of the Red River is due in greatest measure to continual metal loading from "steady state" seeps issuing from a number of locations along a 6 mile section of the middle reach beginning below the MolyCorp mill and persisting until about the Questa Ranger District.

MolyCorp Inc. is currently applying for permits for two new outfalls 004 and 005. EPA made an error in plane coordinates for outfall 004 giving a point on the Rio Grande. There was also no description of these discharge points which made it very difficult to make an assessment of these permit application. It is good that EPA has reclassified use of the river to non-industrial use.

Due to the nature of the soils (very porous) between the mine and the Red River most of their discharges from the open pit mine (about 2 1/2 miles wide by 1/2 mile deep) flow into the Red River below the surface of the ground. they must be required to get these discharges permitted because, they created this collection system (open pit). The current NPDES application does not consider these discharges. The old underground workings are next to the Red River and below the open pit mine. This collection system that they developed as a result of the open pit mine seeps through these old workings and flows to the Red River and is not permitted.

The Clean Water Act prohibits the discharge of pollutants from any point source to the waters of the United States. It may be argued that the MolyCorp s open pit and approximately 5 square miles of disturbance are not "point sources". In Sierra

Club v. Abston Construction Co., Inc., 620 F.2d 41 (5th Cir. 1980). EPA argued that mining pits and collection ponds are point sources, and that seepage from such facilities constitutes a point source discharge. The court agreed. MolyCorp's NPDES permit does not include these discharges.

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This permit requires MolyCorp only to report its Sum2 loadings until June 30, 1996. it does not require compliance. Compliance should be required immediately.

Ms. Caldwell, we are confident that EPA will own up to it's responsibilities in protecting the Red River and the Rio Grande (Wild and Scenic Rivers as designated by Congress) from MolyCorp's discharges. The future of our children and our community is at stake here and we are depending on you for our protection.

On the basis of the above issues raised. I request a public hearing on MolyCorp's NPDES Permit No. NM0022306 Application.

Respectfully Submitted.

Penelope Rael

Penelope Rael

FAX TRANSMITTAL

OF PAGES 5 (INCLUDING COVER PAGE)

TO: Rich Swartz	FROM: Fred Hunke
	MAIL CODE: 6WQ-PP
DEPT./AGENCY/BUSINESS Molycorp	PHONE# (214) 665-7503
FAX # (202) 628-5116	FAX # (214) 665-2191

This appears to be about tailings pond seepage into groundwater. Now we are talking about direct surface seepage from mine wasterock piles.

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This appears to be about tailings pond seepage into groundwater. Now we are talking about direct surface seepage from mine wasterock piles.

AMIGOS BRAVOS

Friends of the Wild Rivers

FAX TRANSMITTAL

To: **Dr. Oscar Ramirez** **Fax#: 214-665-7373**

From: **Brian Shields** **Fax#: (505) 758-7345**

Date: 4/21/97

Number of pages including cover sheet: 4

****

Dear Dr. Ramirez,

Attached is a copy of the letter we discussed sent by the New Mexico Environment Department to EPA requesting a determination regarding Molycorp's NPDES permit.

I am also enclosing a copy of an internal memo sent by Fred Humke concerning this issue.

I am sorry these letters are of poor quality but they are copies I had faxed to me this morning and their fax machine is obviously not working well. We obtained both of these letters from the EPA file when our attorney visited your office in January of this year.

Thank you for looking into this matter.

Sincerely,

Brian Shields
Executive Director

PO BOX 238 • TAOS, NEW MEXICO 87571
T. 505-758-3874 • F. 505-758-7345
email: bravos@taos.newmex.com

d.D.

State of New Mexico
ENVIRONMENT DEPARTMENT
Harold Runnels Building
1190 St. Francis Drive, P.O. Box 26110
Santa Fe, New Mexico 87502
(505) 827-0187

GARY E. JOHNSON
GOVERNOR

MARK [redacted]
EDGAR T. [redacted]
DEPUT[redacted]

January 30, 1996

1 - Permit/OD
2 - AO & AO
3 - DMR's
4 - Vio. Bur
5 - NCR
6 - Corres
7 - CRAS
Date
Clerk

Mr. Robert Murphy
Chief, Enforcement Branch
U.S. Environmental Protection Agency
1445 Ross Avenue
Dallas, Texas 75202-2733

Re: **Molycorp, Inc., NPDES Permit No. NM0022206**

Dear Mr. Murphy:

Recently staff of the New Mexico Environment Department S[redacted] Water Quality Bureau (SWQB) assigned to the New Mexico Mi[redacted] program began a review of Departmental files for the refe[redacted] facility. In this review, a September 24, 1993 report an[redacted] *Analysis of Tailings Pond Seepage Flow to the Red River at UNOCAL 76 Molycorp, Inc. Questa Division* by Molycorp's consultant Vail Engineering, Inc. was brought to the attention of the SWQB's Point Source Regulation Section. The report had been submitted to NMED's Ground Water Quality Bureau by Molycorp in support of their discussions on ground water quality impacts and permitting. A copy of the report is enclosed with this letter.

In this report, Molycorp has quantitatively identified subs[redacted] discharges of tailings leachate (volume & quality) to t[redacted] River. Please see the schematic diagram at end of the en[redacted] report labelled "Analysis of Accretions to Red River." [redacted] discharges are not permitted under the current NPDES permi[redacted] the best of our knowledge, Molycorp has never notified EPA o[redacted] discharges either through their NPDES permit application or [redacted] official correspondence. The current NPDES permit was [redacted] September 10, 1993. Given the time frames, and the fact m[redacted] the sample collections were in the Spring of 1993, it appear[redacted] Molycorp was aware of these discharges at the time the perm[redacted] being processed.

We understand there has been some judicial review[1] re[redacted] propriety of permitting situations where the pollutant[redacted] through ground water prior to entering a "water of the [redacted]

[1] e.g., Sierra Club v. Colorado Refining Co.; Was[redacted] Wilderness Coalition v. Hecla Mining Co.; McClellan Eco[redacted] Seepage Situation v. Defense Department; and Oconomowoc [redacted] Dayton Hudson Corp.

Mr. Robert Murphy
January 30, 1996
Page 2

States. We further understand that the issue, in terms of the cases, may not be fully resolved. However, we believe the situation at Molycorp is clear; the permittee has a professional engineer's report which firmly identifies and quantifies the discharge *vis a vis* the potential for discharge to a water of the United States which was an issue in other cases.

The Red River is classified in the New Mexico *Standards for Interstate and Intrastate Streams* [20 NMAC 6.1, §2119] with the following uses: coldwater fishery, fish culture, irrigation, livestock watering, wildlife habitat, and secondary contact. The discharges are also only a few miles above the portion of the Red River designated as a wild and scenic river by the U.S. Congress under the **Wild and Scenic Rivers Act**. Further, the Red River is included in the New Mexico §305(b) report's list of "Waterbodies with Designated Uses Partially or Not Fully Supported or with Threatened Designated or Attainable Uses" and is a "priority" reach on the New Mexico 1994-96 §303(d) list.

Based on the above, the NMED Surface Water Quality Bureau requests your review of this matter and determination of appropriate action. If you have any questions, please contact Glenn Saums of my staff at (505) 827-2827.

Sincerely,

Jim Piatt

Jim Piatt, Ph.D.
Chief
Surface Water Quality Bureau

Enclosure

cc (w/o enclosure):
Jack Ferguson, P.E., USEPA (6WQ-P)
Rip Harwood, NMED OGC
Marcy Leavitt, NMED GWQB

From : AMIGOS BRAVOS (505) 758-3874

From: Fred Humke
To: VICKERY-ROBERT
Date: Wednesday, February 7, 1996 9:37 am
Subject: Molycorp, NM0022306

With reference to the recent memo from Jim Piatt, dat 1/30/ this ground water issue has been periodically resurr d by t NMED. Refer to Item 9 of the 1993 Response to Commen (attached).

While I continue to believe that ground water seepage not a NPDES point source, I recommend that this be matter b ferred to enforcement for investigation. Dave Shoemaker, Min Manager at Molycorp, advised me today that the mine has reope the Western Environmental Law Center has filed suit again olycor with regard to the ground water matters; and the NMED ff is recommending that Molycorp be declared a superfund sit

As I have previously recommended, I suggest that fresh ight and intrapersonal skills be applied in terms of working th NMED.

Files: A:\NM22306.RTC

FAX TRANSMITTAL

OF PAGES 2 (INCLUDING COVER PAGE)

TO: Brian Shields	FROM: Fred Hiemke
	MAIL CODE: GWA-PP
DEPT./AGENCY/BUSINESS Bravos Amigos	PHONE# (214) 665-7503
FAX # (505) 758-7345	FAX # (214) 665-2191

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		TOTAL	0:01'17"	2		

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OF PAGES 2 (INCLUDING COVER PAGE)

TO: Brian Shields	FROM: Fred Humko
	MAIL CODE: GWQ-PP
DEPT./AGENCY/BUSINESS Bravos Amigos	PHONE# (214) 665-7503
FAX # (505) 758-7345	FAX # (214) 665-2191

Mike Rood - (303) 312-6132

1. Sierra Club vs. Colorado Refining Co.
1993 - Dist. Colo.
838 F. SUPP. 1428

2. more recent

Wash. Envr. vs. Hela Mining
Eastern Dist. of Wash. - 1994
CS94-233-FVS

3. Bunker Hill -
Idaho - Region 10
200 ft. long. fissure

WASH

WA mega
NAME (Hela Mining) date is 1994

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VIII
999 18th STREET - SUITE 500
DENVER, COLORADO 80202-2466

FAX

No. of Pages

TO: Fred Henke

FAX number: 214-665-2191

From: Mike Reed, NPDES Permits Team
8P2-W-P

Dept/Agency: Environmental Protection Agency

FAX number: 303-312-7084

Telephone: 312-6132

COMMENTS: Items

1. Dan Fraser letter, 12/22/93 (8 pages)
2. Garland letter, 2/6/95 (3 pages)
3. Wash. Wilderness Coal. v. Hecla, 10/21/94 (17 pages)
4. Max's declaration in New World 6/23/65 (2 pages)

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considering an appeal to state Supreme Court

The Public Service Company of New Mexico may take the controversial Ojo Line Extension all the way to the New Mexico Supreme Court.

On Monday, the three-member New Mexico Public Utility Commission unanimously rejected PNM's bid for permission to build the 50-mile power line through the

allow the project to go forward. In so doing, it apparently ended one of Northern New Mexico's longest running environmental disputes.

But within two hours of the ruling, PNM spokesman Rick Brinneman said the utility giant may appeal the decision to the Supreme Court. Brinneman said PNM had two months to make a decision

Brinneman said that in making their decision about whether to appeal the ruling, PNM officials would scrutinize the recommendation of hearing examiner Peter Springer that the PUC's decision is based on — particularly a section that lists alternatives to OLE that have been suggested by critics of the project.

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On Monday, Brin
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Springer said in
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THE SANTA FE NEW MEXICAN TUES NOV 21, 1995 pgs A1+A3

Trying to save the 'dead' Red River

Photo by Laura E. Owens/For The New Mexican

State geologist Michael Coleman takes a reading for acidity where metals such as iron and manganese are seeping into the Red River.

Trenches catch acidic metals

By CATHERINE WALSH
For The New Mexican

QUESTA — Citing a desire to be "a good neighbor," Molycorp Inc. has teamed up with the state Environment Department and others in an effort to stop contaminated water from seeping into the Red River.

The mining company used its giant backhoe to dig four drainage trenches along the northern bank of the river near Capulin Canyon last month, said Dave Shoemaker, manager of Molycorp's molybdenum mine.

The company also has purchased several tons of limestone that was put into the trenches to leach out acidic fluids seeping into the river.

These limestone trenches were dug 13 to 19 feet deep, at or below the groundwater table. The trenches are part of a new technology that "neutralizes" water carrying acidic metals such as calcium and aluminum.

As water seeps through the limestone toward the river, the metals "drop out," Shoemaker said.

He said Molycorp's actions weren't motivated by accusations the company has turned the Red River into a dead river.

"We feel we don't have an impact on the river," he said. "We're controlling natural drainage (from the mine) and any problems we have are caught by interceptive barriers."

An environmental group in Taos said it holds Molycorp responsible for much of the pollu-

Please see RIVER, Page A-3

Test strips measure acidity at a seepage spot. Green algae are not natural to the Red River and their presence is due to the high content of metals such as iron and manganese. The white deposit is calcium, aluminum and silica from the river fixed and crystallized by the metals of the seepage.

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Rangers at Bandelier National Monument issued a record number of citations last week, m[illegible] to people who apparently decided the federal [illegible]rnment shutdown was their chance to visit the monument without encountering cops or crowds.

"People were surprised we were working," Bandelier chief Ranger Carl Newman said.

Newman said park rangers and law enforcement officers issued 27 citations over the six-day period the park was closed. The National Park Service closed parks nationwide Tuesday and together with most other federal agencies furloughed all but the most essential workers during a standoff in budget negotiations.

During a comparable period, rangers could expect to issue only two or three citations for violations of park rules, Newman said.

"A lot of people seemed to look (at the monument closure) as an opportunity to go when no one else was there."

Newman said people ignored signs posted at all Bandelier trail heads and the monument entrance, then climbed over fences and gates. Some even let a personal pest," Newman said, "but not a very pleasant experience."

Newman said that when confronted by r[illegible]rs, most trespassers were cooperative.

"There was no uppiness that I've heard about," he said. "Most people weren't frustrated with us — they understood we were doing our job."

At the Santa Fe National Cemetery, burials went on as scheduled last week, cemetery director Gloria Gomez said. When the full staff returned to the office Monday, Gomez said, "it was just the paperwork we were behind on. We can do that anytime."

It appeared Monday as if furloughed employees would get paid for their time off last week. That might make the furlough look like an "extra" paid vacation, but that's not the attitude most federal workers have, said Jerry Rogers, superintendent of the National Park Service Southwest Regional Office in Santa Fe.

Newman said some workers at Bandelier returned to work frustrated Monday. "There's a lot of dedicated folks here," he said. "They came in today and said. 'Jeez, I'm a week behind on this project.' "

RIVER

Continued from Page A-1

tion in the Red River.

But the group, Amigos Bravos, welcomed the mine's "wonderful gesture" of digging the trenches.

The first thing a visitor notices about the Red River a couple of miles east of Questa is the milky color of the water.

A closer look reveals a white glaze coating rocks in the stream.

But a check under dozens of these white rocks won't reveal any insect larvae clinging to the rocks. Few bugs live in this portion of the Red River.

There are almost no fish, as those stocked each year are either caught by fishermen or swim to the Rio Grande.

"Some people say this portion of the Red River is dead," said Michael Coleman, a geologist with the state Environment Department. "But we call it an impacted zone."

Standing above river's north bank Monday afternoon, Coleman pointed out a couple of rust-colored pools of water along the north edge of the river.

"That's seep water and these seeps are contaminated," he said.

Whether contamination is caused solely by water interacting with natural, hydrothermal clays in the area or by Molycorp's waste rock and tailings isn't clear, Coleman said.

"The mine could be a contributor," he said. "But water coming into contact with sulfides in the clay causes them to become loaded with (acidic) metals."

When acidic seep water "hits the river along the seep zones, it changes chemistry," Coleman said. The water drops calcium, aluminum and silica into the stream in a dissolved state that forms a paste, he said.

"The paste sort of cements the bottom of the stream and doesn't allow bugs to live," he said. "Bugs, of course, are necessary for fish survival."

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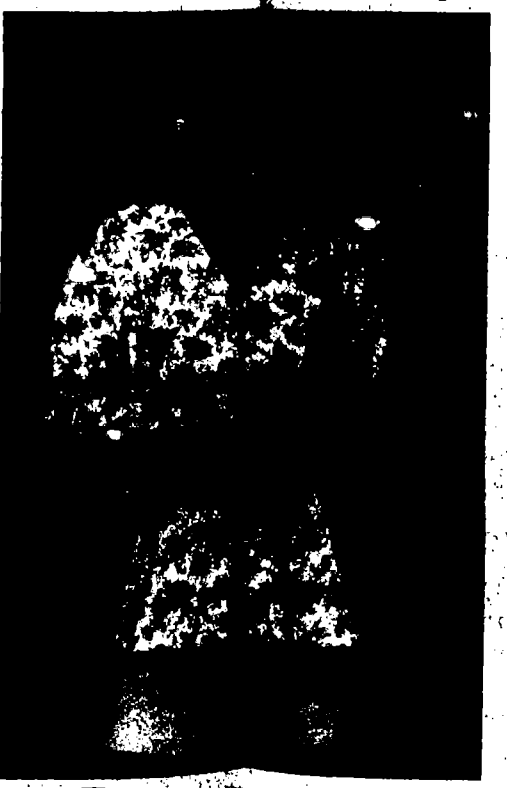

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Governor

State of New Mexico
ENVIRONMENT DEPARTMENT
Harold Runnels Building
1190 St. Francis Drive, P.O. Drawer 26110
Santa Fe, New Mexico 87502-0110
(505) 827-2855
Fax: (505) 827-2836

MARK E. WEIDLER
Secretary

EDGAR T. THORNTON, III
Deputy Secretary

FOR IMMEDIATE RELEASE

Contact Bill Williams, 827-2855

ENVIRONMENT DEPARTMENT PROTECTS RED RIVER

New Mexico Environment Department (NMED) staff members Michael Coleman, Dennis Slifer and Peter Monahan initiated a cooperative plan involving NMED, the Molycorp Questa Mine, the State Highway and Transportation Department (NMSHTD), the Questa Ranger District-Carson National Forest and the U.S. EPA.

"The project involved the implementation of a relatively new technology: anoxic alkaline trenches acting as a passive treatment system to intercept and arrest acidic, metal-loaded groundwater or acid mine drainage," said Michael Coleman of NMED. "The project is situated along the Red River, between Questa and the town of Red River, Taos County."

"The impacted area was identified during our current EPA Grant project (Red River Groundwater Investigation. FY-92-A, 319(h))," said Dennis Slifer of NMED. "The objectives of the Grant project are to determine ground water and aquifer characteristics in order to identify, and ultimately eliminate, impairment of both the aquifer and the designated uses of the river. The alkaline trenches represent the Best Management Practice (BMP) which was selected to improve obvious water quality impairments: the perennial, steady state seepage of acid waters into the river, effects upon macroinvertibrate and fish populations and the overall negative impact on water quality."

"Trenches 25' to 70' long, 5' to 8' wide, and 13' to 15' deep were dug into the highway shoulder, adjacent to the north bank of the river," explained Peter Monahan of NMED. "Four segments, totaling 170 linear feet, were placed directly up grade from active seep areas, presently delivering a steady pH 3.4 to the stream. The trenches were half filled with limestone cobble, and a polyethylene mat vapor barrier was placed over the carbonates. The system is sealed by an overlying layer of bentonite clay and filled back to grade with clean soil. The areas were then leveled, seeded and covered with a chopped straw mulch."

"Molycorp covered the cost of the raw materials and provided a large track hoe and operator to dig the deep trenches," explained Ed Kelley, Water and Waste Management Division Director at NMED. "The Highway Department assigned a full crew with a smaller back hoe, a loader, dump trucks and traffic control. The Forest Service expedited all necessary NEPA clearance. The Environment Department costs were limited to staff time for planning and project oversite and a few minor supplies." Kelley is in charge of the division in which Coleman, Slifer and Monahan work.

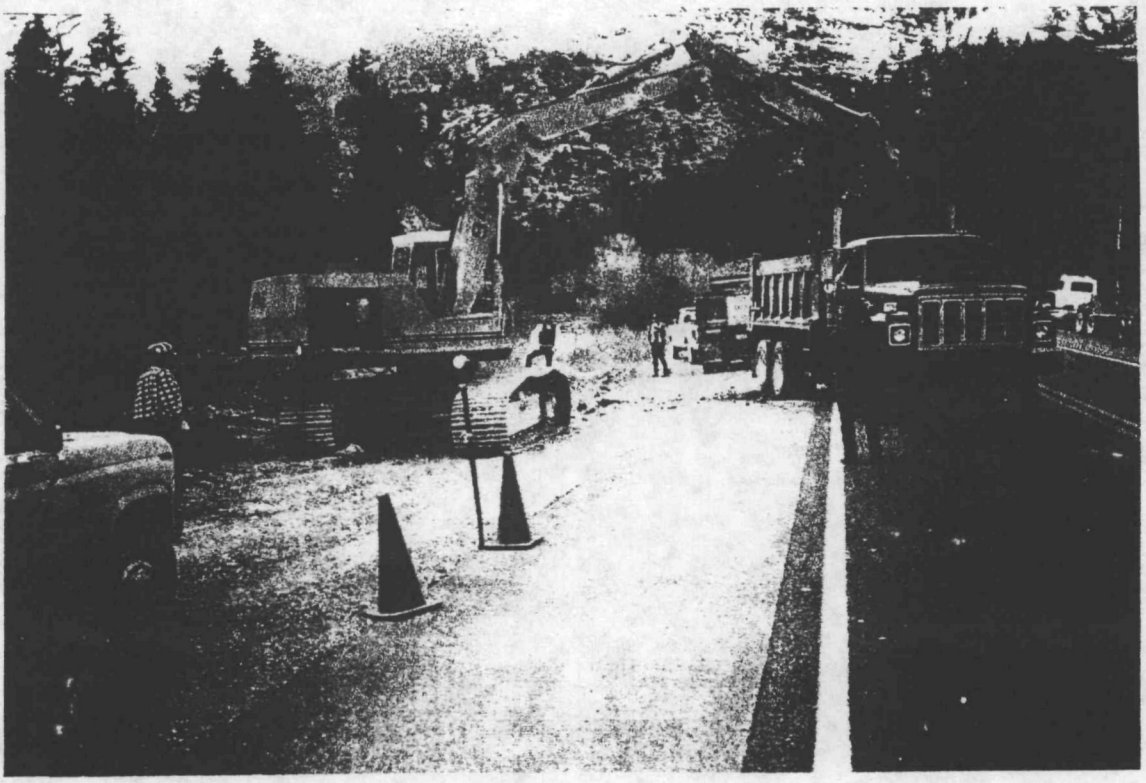
"The project was a beautiful example of industry and State agencies working together in complete harmony towards a goal which could be of benefit to the entire state," said Bill Williams, Communications Director of NMED.

"The demonstration project, if it proves to be successful, will have widespread application around abandoned or active mines or in natural geologic areas where acid rock drainage is occuring," added Williams.

NMED acquired over an hour and a half of video documenting the field operations and have plans to shoot additional scripted footage which will explain the watershed setting, BMP concept and expected results. NMED is planning to do a professional editing job with voiceover narration. NMED has a complete set of color slides and photos documenting the work. The NPS Section's newsletter, *Clearing The Waters*, is planning to feature the project in a future issue.

Still photos can be made available to print media by calling Michael Coleman at NMED.

-30-



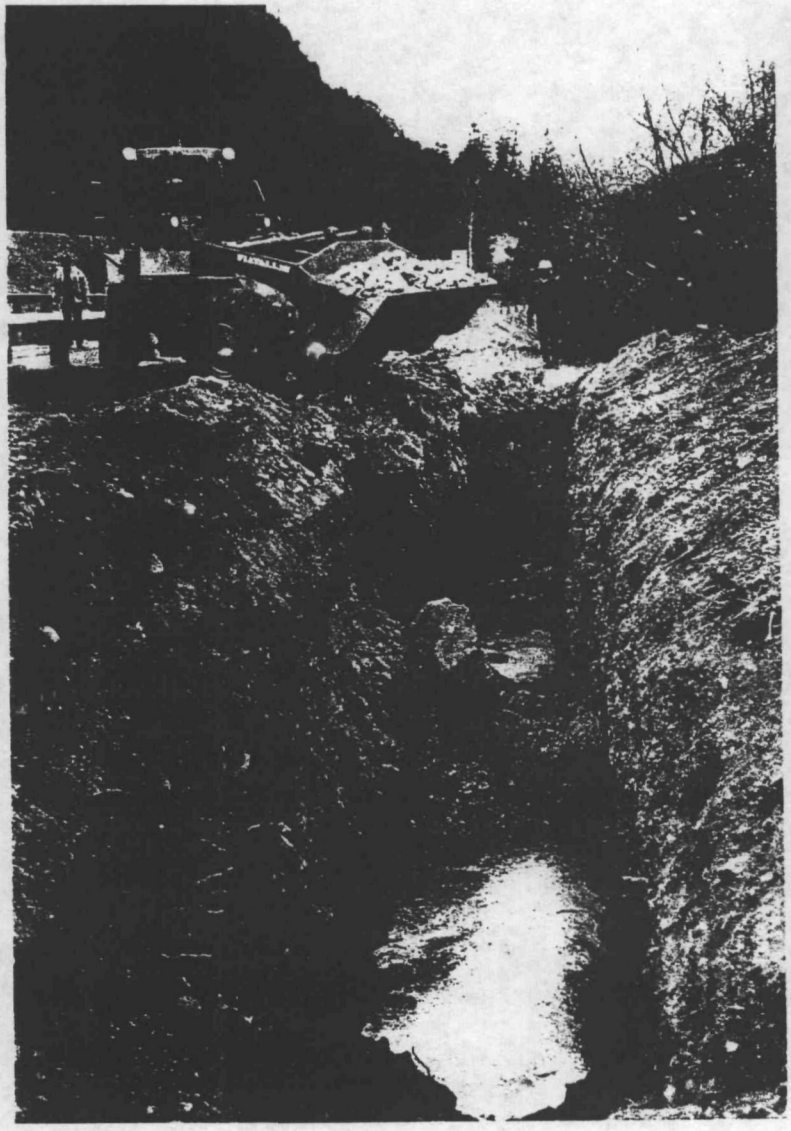


Photo Captions

Red River at Capulin Canyon:
Molycorp and N.M. Highway Department heavy equipment installing trenches along Highway 38, adjacent to Red River, Taos Co., New Mexico. Trenches are filled with limestone and clay. They intercept and neutralize acidic, metal-loaded ground water seeping into this stretch of the Red River. The process is known as "Anoxic alkaline Drain Passive Treatment".

Filling trench with limestone cobble - note the accumulation of ground water in the trench. The water quality precisely matched the streamside seeps: pH of 3.6, conductivity of 1700 umhos.

Partially completed trench, with limestone layer, polyethylene vapor barrier and first load of bentonitic clay in place. a complete 3' layer of clay cap, and 2-3 ft. of clean fill dirt completed the trench.

15 November 1995

Submittal of abstract for the 1996 NM Conference on the Environment, March, 1996.

ABSTRACT: Alkaline Drain Treatment of Acidic Seeps on the Red River

Michael W. Coleman
Dennis W. Slifer
Surface Water Quality Bureau
Nonpoint Source Pollution Section
(505)827-0505

The New Mexico Environment Department (NMED) conducted a two-year water quality investigation, funded by a U.S. Environmental Protection Agency 319(h) Grant, along the Red River, Taos County. The project culminated in a cooperative field demonstration project to mitigate and prevent future impacts of highly acidic, metal loaded ground water seeps entering the Red River, near Questa. The NMED - Surface Water Quality Bureau, Nonpoint Source Pollution Section identified more than twenty sites where springs or perennial, steady state seeps deliver acid rock drainage via ground water in contact with sulfide-rich hydrothermal rock scar areas and historic or recent mine waste and processing piles within the watershed. The seeps have a direct effect on the physical and chemical water quality and designated uses of the waterway, including impacts on stream acidity , precipitation of calcium-aluminum precipitates, impairment of macroinvertibrate and fish habitat, and transport of a variety of dissolved and suspended heavy metals.

The field project involved the installation of selected Best Management Practices (BMPs) consisting of a series of anoxic alkaline drain passive treatment systems at a site along the Red River where several of the seeps are particularly active. One hundred seventy lateral feet (170') of trenches were dug below the local ground water level. The trenches were filled with limestone cobble, capped with a layer of clay, and reclaimed to road shoulder grade. Physical parameter and water chemistry monitoring is underway to measure an anticipated increase in pH levels and a corresponding decrease in the heavy metal content of the seeps. Favorable results may point the way to implementing this technology on several sites in this watershed, and around other abandoned mine or mill sites, or geologically active source areas throughout the state where acid rock drainage presents a pollution problem.

The project was a cooperative effort between NMED (project inception,design, coordination and followup monitoring), the Unocal Molycorp Questa Molybdenum Mine (donated materials, equipment, and labor), the State Highway and Transportation Department (labor, heavy equipment and safety crews) and the Questa Ranger District, Carson National Forest (permitting).

Molycorp Digs 4 Drainage Trenches

QUESTA — Molycorp has dug four drainage trenches along the northern bank of the Red River near Capulin Canyon to stop contaminated water from seeping in.

Dave Shoemaker, manager of the Molycorp molybdenum mine, also put several tons of limestone in the trenches last month to leach out acidic fluids and keep them from seeping into the river. As water drains through the limestone, the metals "drop out," he said.

A Taos environmental group said it holds Molycorp responsible for much of the pollution in the Red River. But the group, Amigos Bravos, welcomed the company's "wonderful gesture" of digging the trenches.

"We hope it's a sign that they are moving forward to clean up the Red River and providing jobs to do it," said Sawnie Morris, Amigos Bravos co-director.

ABQ. JOURNAL
11/22/95

DECLARATION OF MAX H. DODSON

I, Max H. Dodson, do hereby declare as follows:

1. I am the Director of the Water Management Division of Region VIII of the United States Environmental Protection Agency. As the Director, I am responsible for the enforcement of the federal Clean Water Act (CWA) in Montana, among other states. My responsibilities encompass oversight and approval of various aspects of the Montana program, including the establishment of state water quality standards and the issuance of permits under Section 402 of the CWA, 33 U.S.C. Section 1342.

2. I have been to the New World Mining District in Park County, Montana, just north of Cooke City, Montana, on at least two occasions, in 1993 and 1994. The purpose of my visits was to gain first-hand knowledge regarding the proposed New World mine and to view areas of potential environmental impact from the proposed mine. Based on these visits and on my dealings with EPA staff members who have been involved in several regulatory processes pertaining to the New World Mining District, I have learned about the site and its water quality and permitting issues.

3. During my visits to the New World Mining District, I have seen the Glengarry Adit, a historic adit located at the headwaters of Fisher Creek. I have observed discharges from the Glengarry Adit into the headwaters of Fisher Creek. The evidence of iron precipitates at the mouth of the adit and in the streambed of Fisher Creek indicates that acid mine drainage is flowing from the adit and that pollutants are being discharged from the adit into Fisher Creek.

4. In addition to the Glengarry Adit, I also have observed waste piles and open pits in mine-disturbed areas at the New World Mining district that are exposed to runoff of snow melt and rainwater.

5. It is EPA's position that mine adits such as the Glengarry Adit are clearly point sources as defined under Section 502(14) of the CWA, 33 U.S.C. Section 1362(14) and that the discharges from the Glengarry Adit are required by the CWA to have an NPDES permit.

6. It is EPA's position that discharges from seeps and springs degraded by mining or from open pits or waste piles from mining must be covered by an NPDES permit. Those discharges that occur continuously as "dry weather" discharges, rather than only because of precipitation or snowmelt, require a "traditional" NPDES permit.

7. Some discharges of pollutants from inactive areas of the New World Mining District are required to be covered by a stormwater discharge permit. NPDES permits are required for stormwater runoff that comes into contact with any overburden

(defined in 40 CFR Section 122.26(b)(10)), raw material, intermediate products, finished products, or waste products on active or inactive mining sites. If stormwater runoff contributes substantially to water quality degradation, an individual, rather than a general, stormwater permit is appropriate.

8. EPA maintains that any point source discharge of pollutants into waters of the United States at any active or inactive mining site must be permitted under an NPDES permit. When the discharge is not directly associated with precipitation or snow melt (i.e., any dry weather flow), it must be covered by a "traditional" NPDES permit rather than a stormwater permit. It is my understanding that the Glengarry Adit has a constant flow that is not directly associated with storms; therefore, it should be covered by a "traditional" NPDES permit rather than merely by a stormwater NPDES permit.

9. Due to resource limitations, EPA Region VIII and Montana have not yet issued NPDES permits or obtained NPDES permit applications for every point source discharge on lands disturbed by past mining. There are an estimated 200,000 to 600,000 such sites nationwide. EPA's priorities in issuing permits for this large group of discharges relate to the degree of water quality degradation attributable to these sources, the presence or absence of an identifiable owner or operator, and the feasibility of treatment or controls. In my opinion, the discharge from the Glengarry Adit is a relatively high priority for permitting and consequent controls.

I declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct to the best of my knowledge, information, and belief.

Executed this 23rd day of June, 1995.

Max H Dodson

Max H. Dodson, Director
Water Quality Division

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VIII
999 18th STREET - SUITE 500
DENVER, COLORADO 80202-2466

FEB 6 1995

Ref: 8WM-C

William L. Garland, Administrator
Water Quality Division
Wyoming Department of Environmental Quality
Herschler Building
122 West 25th Street
Cheyenne, Wyoming 82002

Re: The Applicability of CWA to Pollutant Discharges Entering Surface Waters via Groundwater and the Texaco Casper Refinery

Dear Mr. Garland:

On December 22, 1993, in a letter to Montana Department of Health and Environmental Sciences (with a copy to you), EPA addressed the permitting of hard rock mines under Section 402 of the Clean Water Act (CWA). This letter addresses the issue of discharges of pollutants from petroleum refineries, to waters of the U.S. via tributary groundwater and the implications of these discharges under the CWA. In the case of the Texaco Refinery in Casper, the EPA RCRA Program has begun to address this issue as part of the overall site remediation. However, as with the Texaco facility, seeps may be subject to other substantive legal requirements. EPA would like to use this opportunity to discuss the issues of; 1) seeps as point sources at industrial facilities; 2) tributary groundwater; and 3) compliance expectations as it pertains to the NPDES program.

1. <u>Seeps as Point Sources</u>

The CWA defines the term "point source" as any discernible confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, vessel or other floating craft from which pollutants are or may be discharged. It is EPA's position that seeps and other less obvious discharges are "point sources" that require NPDES discharge permits.

Upon determining that significant pollutants are being discharged from seeps via groundwater or less obvious point sources, EPA began reevaluating these seeps in reference to SUPERFUND/RCRA cleanups. We found that some facilities have had seeps or other groundwater discharges to surface water which were not authorized by any NPDES permit. There were also some facilities without an NPDES permit which had claimed to be "non-discharging." However, these facilities

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have been found to be discharging pollutants to surface waters via seeps and leakage from wastewater treatment containment and/or control structures. These facilities are being required to cease discharge of pollutants or obtain NPDES permits covering all outfalls, including groundwater discharges determined to be hydrologically connected to surface water.

2. Tributary Groundwater

It is EPA's position that seeps and other groundwater discharges hydrologically connected to surface water (tributary groundwater), from identifiable sources, are discharges from point sources and are subject to regulation through an NPDES permit. Current EPA policy, in line with the decisions of several recent court cases, indicates that the facility itself is subject to NPDES regulations. Therefore, any seeps coming from identifiable sources of pollution would need to be regulated by discharge permits.

One important case is United States v. Earth Sciences, Inc., 599 F. 2d 368 (10th Cir. 1979). This case concluded that the facility from which the contamination came was itself a point source. Another is McClellan Ecological Seepage Situation v. Weinberger, 707 F. Supp. 1182 (E.D. Cal. 1988) where the court found that Congress intended to limit discharges of pollutants that could affect surface water, and that NPDES permits could be required where the groundwater is hydrologically connected to the surface water. Likewise, in Sierra Club v. Colorado Refining Company, 838 F. Supp. 1428 (D. Colo. 1993), where pollutants migrated through the groundwater into surface water, the Court concluded that the Clean Water Act's prohibition of the discharge of any pollutant into "navigable waters" includes such discharge which reaches "navigable waters" through groundwater. The most recent case, Washington Wilderness Coalition v. Hecla Mining Co. (Wash. Oct., 1994), follows the above cases. In so doing, the court cited the December 22, 1993, letter as persuasive.

Additionally, the preamble to the November 16, 1990, Storm Water Regulations states that EPA "intends to embrace the broadest possible definition of point source consistent with the legislative intent of the CWA." (55 Federal Register 47990, 47997/1, November 16, 1990.) The preamble also states that the requirements for point source discharges are not applicable to the discharges to groundwater unless there is a hydrological connection between the groundwater and a nearby surface water. (See 55 Federal Register 47990, 47997/3.)

3. <u>Compliance with CWA/Injunctive Relief</u>

Section 301 of the CWA makes it unlawful to discharge pollutants to navigable waters from any point source except in compliance with named sections, one of which is Section 402. This Section provides for the issuance of an NPDES permit to authorize such discharges. In the case of petroleum refinery seeps, the release/discharge of pollutants to waters of the U.S. would have to be terminated or permitted. EPA envisions that immediate action would be taken to terminate the tributary flow to surface waters by employing a virtually impermeable barrier by structural and/or mechanical means when such point source discharges are identified. Recovered contaminated waters would have to be treated to a technology based standard or, if water quality standards required greater levels of protection, a stricter water quality based limit prior to discharge at an outfall approved in an NPDES permit.

If you wish to discuss these issues or if you have comments, please contact me.

Sincerely,

Max H. Dodson
Director
Water Management Division

cc: Fred Pehrson, UT
Gary Bracht, ND
Bob Shukle, CO
Steve Pilcher, MT
John Wagner, WY
Tim Tollefsrud, SD

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FILED IN THE
U.S. DISTRICT COURT
EASTERN DISTRICT OF WASHINGTON
OCT 21 1994
JAMES R. LARSEN, CLERK
DEPUTY

COPY

UNITED STATES DISTRICT COURT
EASTERN DISTRICT OF WASHINGTON

MELANIE PALLMAN
294-1386

WASHINGTON WILDERNESS COALITION, a Washington Corporation, OKANOGAN HIGHLANDS ALLIANCE, a Washington corporation, and ATLANTIC STATES LEGAL FOUNDATION, INC.,

Plaintiffs,

vs.

HECLA MINING COMPANY, a Delaware Corporation,

Defendant.

NO. CS-94-233-FVS

ORDER DENYING DEFENDANT'S MOTION TO DISMISS PLAINTIFFS' CAUSE OF ACTION UNDER THE CLEAN WATER ACT

BEFORE THE COURT is Defendant's motion to Dismiss Plaintiffs' First Cause of Action, which arises under Section 301 of the Clean Water Act, 33 U.S.C. § 1311 ("CWA"). (Ct. Rec. 9). Plaintiffs are represented by Michael Axline, Deborah Mailander and local counsel Richard Smith; Mark Wielga, Elizabeth Temkin and local counsel B. Mark Hausman represent Defendant. Having reviewed the record and considered the arguments of counsel, the Court enters this Order to memorialize its ruling denying defendant's motion.

Background

This case concerns Hecla Mining Company's Republic, Washington facility, which is a placer mine for gold and silver ore. In extracting gold and silver from ore, raw material is processed in a

liquid solution containing cyanide and other chemical agents. This generates a significant amount of wastewater, which Hecla, pursuant to a state waste discharge permit[1], pumps from its mill into a 38 acre tailings impoundment ("Aspen Pond").

Plaintiffs' complaint alleges three sources of water pollution: (1) the Aspen Tailing Pond; (2) Tailing pond #1; and (3) Tailing pond #2. The Aspen Tailing Pond was allegedly constructed without an impermeable line. Plaintiffs allege that some chemicals and heavy metals bypass a water collection system installed by Hecla, and seep through the pond into waters of the United States.

Tailing ponds #1 and #2 are filled with dirt, and are no longer used in mining operations. Plaintiffs allege that inactive tailings in the ponds "seep and leach" contaminated waste water, some of which is intercepted and pumped into the Aspen pond, but some of which escapes and enters the waters of the United States.

In their first cause of action, Plaintiffs claim that Hecla is violating Section 301 of the CWA, by discharging pollutants into navigable waters without a National Pollutant Discharge Elimination System ("NPDES") permit. Plaintiffs' second cause of action, not the subject of the instant motion, is for CERCLA violations.

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[1] The state permit should not be confused with the NPDES permit required by the CWA for discharges from a point source into navigable waters. See 33 U.S.C. § 1342. The State permit merely authorizes Hecla to "discharge mill tailings, seepage return, and mine drainage to the Aspen tailings impoundment", subject to certain effluent limitations. See permit, (Ct. Rec 1, ex. C).

Standards

Hecla moves to dismiss the CWA claim on two grounds: (1) lack of subject matter jurisdiction, and (2) failure to state a claim. Fed.R.Civ.P. 12 (b)(1) & (6). In challenging subject matter jurisdiction, Hecla suggests that a citizens suit is not authorized under the CWA to enforce state water quality standards, which operate in lieu of federal standards in Washington. Hecla further questions the sufficiency of Plaintiffs' allegations of pollution from a "point source" into "navigable waters" of the United States.

When ruling on a motion to dismiss, whether for lack of subject matter jurisdiction or for failure to state a claim, the court accepts all factual allegations as true and draws all reasonable inferences in favor of Plaintiffs. Sheuer v. Rhodes, 416 U.S. 232, 236, 94 S.Ct. 1683, 1686 (1972). The complaint will not be dismissed unless it appears to a certainty that Plaintiffs can prove no set of facts which would entitle them to relief. Elias v. Connett, 908 F.2d 521 (9th Cir. 1990).

Discussion

1. subject matter jurisdiction

Federal jurisdiction over citizens suits to enforce the CWA is grounded in Section 505, which authorizes private litigation "(1) against any person . . . who is alleged to be in violation of (A) an effluent standard or limitation under this chapter." 33 U.S.C. § 1365 (a) (1). Hecla argues that Plaintiffs have not shown violation of an "effluent limitation", since they challenge Hecla's failure to obtain

a limitation-setting permit in the first place. Hecla further asserts that citizens suits under the CWA are not authorized when a state NPDES permit process operates in lieu of the EPA-administered process.

Hecla's first argument has no support in the language of the CWA. Section 1365 (f) defines "effluent limitation" to include "an unlawful act under subsection (a) of section 1311." Section 1311 (a), in turn, makes it unlawful to discharge any pollutant except in compliance with the NPDES permit required in Section 1342. Thus, a citizens suit to enforce an "effluent limitation" can be based on allegations that the defendant is discharging without an NPDES permit. Plaintiffs cite several cases in which citizens have brought suit to require the issuance of a permit. E.g. Sierra Club v. Abston Constr. Co., Inc., 620 F.2d 41 (5th Cir. 1980); United States v. Earth Sciences, Inc., 599 F.2d 368, 370 (10th Cir. 1979); Hawaii's Thousand Friends v. Honolulu, 806 F.Supp. 225, 229 (D.Hawaii 1992). The only court to address the question directly concluded: "obtaining a permit is itself an important effluent limitation, and private attorneys general may enforce that limitation via citizens suits." Hudson River Fishermen's Ass'n v. Westchester Cty., 686 F.Supp 1044, 1050 (S.D.N.Y. 1988).

Hecla suggests that the Ninth Circuit would limit the scope of citizens suits to enforcement of permit limitations. Citing Northwest Environmental Advocates (NWEA) v. Portland, 11 F.3d 900 (9th Cir. 1994). In NWEA, the court noted that "effluent limitations" are "end-of-pipe limitations and permit violations", and that citizens suits are not authorized to establish general water quality standards. Id.

at 902. The court did not suggest that a permit must be in place before a citizens suit may be brought; rather, it distinguished between suits to enforce discharge limitations that would be the subject of a permit and those to enforce general water quality standards. There is no question in this case that Plaintiffs' challenge is to discharge limitations subject to NPDES permit. This clearly falls within the jurisdictional sweep of the CWA.

Hecla's second argument is that the CWA does not provide jurisdiction for citizens suits when a state NPDES permit program operates in lieu of the federal program. This argument is based on 33 U.S.C. § 1342 (c), which suspends the issuance of federal NPDES permits once a state permit program acceptable to EPA is in place. Washington has had an EPA-approved permit program since 1973. See 39 Fed. Reg 26,061 (July 16, 1974).

The courts addressing whether citizens suit are available in a state with its own permit process are divided on the issue. Some hold that private suits are not authorized, on the theory that federal enforcement is suspended entirely by a state permit program. E.g. City of Heath, Ohio v. Ashland Oil, Inc., 834 F.Supp. 971 (D.Ohio 1993) (no citizen suit under similar RCRA state permit program) (citing Dague v. City of Burlington, 935 F.2d 1343, 1353 (2d Cir. 1991)); Thompson v. Thomas, 680 F.Supp. 1 (D.D.C. 1987). These cases treat federal and state programs as separate universes, and conclude that citizens suits are authorized only under a state provision.

Other courts emphasize the unity of purpose behind state and federal CWA programs, and hold that citizens may enforce effluent limitations regardless of whether the EPA or a state agency issues the NPDES permits. E.g. Lutz v. Chromatex, Inc., 725 F.Supp. 258, 261 (M.D.Pa. 1989); United States v. Hooker Chem. & Plastics, 749 F.2d 968 (2d Cir. 1984); McClellan Ecological Seepage Situation ("MESS") v. Weinberger, 707 F.Supp. 1182, 1190-91 (E.D.Cal. 1988). This conclusion is suggested by the definition of "effluent limitation" in section 1362 (11), which includes "any restriction established by a state or the [EPA] Administrator."

With respect to identical state enforcement provisions of the Resource Conservation and Recovery Act ("RCRA"), the EPA itself has taken the position that citizen's suits may be brought in states that have received authority to operate permit programs in lieu of the federal program. Lutz v. Chromatex, Inc., 725 F.Supp. 258, 261 (M.D.Pa. 1989) (citing EPA statement in 45 Fed. Reg. 85015 (Dec. 24, 1980). MESS points out that state permit programs are essentially part of federal law, since they must be approved by the EPA, and must comport with stringent federal requirements. 707 F.Supp. at 1190-91; see also, 40 C.F.R. 122.1 et seq. (setting forth program criteria for NPDES permits, applicable to both EPA and state administered programs). Several mandatory federal standards are expressly recognized as "effluent limitations" in the citizens suit provision of the CWA. 33 U.S.C. § 1365 (f) (referencing standards in 33 U.S.C. §§ 1311, 1312, 1316, 1317, 1343; 33 U.S.C. § 1342 (b)(1)(A)).

Hecla asserts that the state program for issuance of NPDES permits is intended to supplant all other methods of CWA enforcement. The court is not persuaded. Section 1342 (c), which suspends the federal permit program upon approval of a state program, simply guarantees that the state will be the sole entity issuing NPDES permits. The EPA retains full authority to carry out its other duties under the CWA, and to supervise state programs to ensure compliance with federal guidelines. As to private action, the CWA generally authorizes citizens suits unless the responsible government agency has commenced proceedings for the same purpose; in that case, citizens are guaranteed a right to intervene in the government action. See Hooker Chemicals, 968 F.2d at 978; 40 C.F.R. § 25.1 et seq..

Nothing in the language or structure of the CWA suggests that citizens suits are incompatible with state administration of the NPDES permit program. Indeed, it would be bad policy to remove a key component of private enforcement from the CWA simply because the EPA has approved a state permit program in lieu of the federal bureaucracy. Accordingly, the court is persuaded by the line of authority holding that citizens suits may proceed in states administering their own NPDES permit program. Hecla's motion to dismiss for lack of subject matter jurisdiction is denied.

2. Failure to State a claim.

The CWA makes it unlawful for any person or entity to "discharge any pollutant" without an NPDES permit. 33 U.S.C. § 1311 (a) & § 1342 (a). "Discharge of any pollutant" is defined as "any addition of any

pollutant to navigable waters from a point source." 33 U.S.C. § 1362 (12) (a) (emphasis added). Hecla argues that plaintiffs have not stated a claim under the CWA, because the mining runoff at issue does not flow from a "point source", and does not enter "navigable waters."

(a) "point source."

Section 1362(14) defines "point source" as:

> any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged.

A nonpoint source is anything else. Idaho v. Hanna Mining Co., 699 F.Supp 827, 832 (D.Id. 1987), aff'd, 882 F.2d 392 (1988).

Hecla argues that its tailings ponds are not point sources, but merely "areas of low topography into which mine tailing from mineral processing activities have been deposited and through which water may percolate." (A's memo at 13). Noting that a point source is usually a pipe or a ditch, Hecla points out that here we are dealing here with a 38 acre man-made pond.

Initially, it is clear that the size of the pond is not relevant to determining whether or not it is a point source. As plaintiffs explain, it would be irrational to conclude that the bigger the source of pollution, the less likely it is to be a "source" under the CWA. Cases cited by defendants support the conclusion that man-made ponds, designed to receive tailings, are "conveyances" or "containers" under the definitions in the clean water act. See United States v. Earth Sciences, Inc., 599 F.2d 368, 370 (10th Cir. 1979) (system of sump

pumps, ditches, and hoses is "point source"); Appalachian Power Co. v. Train, 545 F.2d 1352, 1373 (4th Cir. 1976) (distinguishing point sources from "unchanneled and uncollected surface waters"); Consolidated Coal Co. v. Costle, 604 F.2d 239, 249 (4th Cir. 1979) (point sources include slurry ponds, drainage ponds, and coal refuse piles); Trustees for Alaska v. E.P.A., 749 F.2d 549, 557-58 (9th Cir. 1984) (adopting Earth Sciences interpretation of point source to apply to placer mine). To similar effect is Abston Constr., where the Fifth Circuit noted: "gravity flow (from rain or runoff water) . . . may be part of a point source discharge if the miner at least initially collected or channeled the water and other materials"). Sierra Club v. Abston Const. Co., 620 F.2d 41 (5th Cir. 1980); see also, Committee to Save Mokelumne River v. East Bay Util., 13 F.3d 305, 308 (9th Cir. 1993) (holding that an NPDES permit is required for "surface runoff that is collected or channelled" into a Mine Run Dam Reservoir).

These cases make clear that the touchstone for finding a point source is the ability to identify a discrete facility from which pollutants have escaped. Particularly persuasive is the reasoning of the Earth Sciences court, adopted by the Ninth Circuit in Trustees for Alaska. 599 F.2d at 370[2]. There, the court noted that "point source"

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[2] Both Earth Sciences and Trustees for Alaska involved placer mining operations similar to Hecla's Republic facility. In Earth Sciences, unusually large spring runoffs caused an overflow of a sump pump system, resulting in discharges of pollutants into a nearby creek. In Trustees for Alaska, discharge water was released from a sluice box, which the Ninth Circuit concluded was a "confined channel" under the statutory definition of point source. Like the tailing ponds at Hecla's facility, sumps and sluice boxes are designed to gather the

must be interpreted broadly to effectuate the remedial purposes of the CWA. 599 F.2d at 373. The non-point source designation is limited to uncollected runoff water from, for example, oil and gasoline on a highway, which is difficult to ascribe to a single polluter. Trustees for Alaska, 749 F.2d at 558. Discharges from a pond or refuse pile can easily be traced to their source. Thus, even though runoff may be caused by rainfall or snow melt percolating through a pond or refuse pile, the discharge is from a point source because the pond or pile acts to collect and channel contaminated water. Id. at 374.

It appears that EPA agrees with the Earth Sciences analysis. The preamble to EPA's NPDES Permit Application Regulations for Storm Water Discharges, 55 Fed. Reg. 47990 (Nov. 16, 1990), states that the agency "intends to embrace the broadest possible definition of point source consistent with the legislative intent of the CWA." (See π's opposition memo, appendix A at 3). Accordingly, the federal regulations define "discharge of a pollutant" to include "surface runoff which is collected or channeled by man." 40 C.F.R. 122.2. In a letter from EPA region VIII, "point sources" is defined to include "any seeps coming from identifiable sources of pollution (i.e., mine workings, land application sites, ponds, pits, etc.). Defendants correctly note that the EPA statements from Region VIII are not authoritative. See Village of Oconomowoc Lake v. Dayton Hudson Corp., __ F.3d ___, 1994 WL 192793 (May 18, 1994). Nonetheless, they are

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sodium cyanide-sodium hydroxide water solution used to extract gold and silver from ore.

persuasive, as they reflect a view which was endorsed by the Ninth Circuit in Trustees for Alaska.

Even if it is not certain that the ponds in this case are similar enough to those in other cases to constitute a point source under the CWA, dismissal would be premature. Several courts note that the question whether a discharge occurred from a point source is fact-laden; the court must consider evidence of the "precise nature" of the Defendant's facility. See Abston Const. Co., 620 F.2d at 47; Hanna Mining, 699 F.Supp. at 832; Concerned Area Residents v. Southview Farm, 834 F.Supp. 1410, 1417 (W.D.N.Y. 1993). Thus, at this stage in the proceedings, plaintiffs' allegations are sufficient to establish that Hecla's tailings ponds are point sources within the meaning of the CWA.

(b) "Navigable Waters"

Hecla next argues that Plaintiffs merely allege discharge to groundwater, which is not part of the "navigable waters" of the United States. In fact, the complaint does allege that polluted wastewater from the Hecla mine enters surface waters, including Eureka creek and Mud Lake[3]. (Complaint at 7). The connection to groundwater is Plaintiffs' acknowledgement that a large volume of discharge "seeps

[3] In a side-note, Plaintiffs also suggest that the tailings ponds themselves constitute "navigable waters." (P's brief at 11). This is wrong. The EPA definition of navigable waters includes only "natural" ponds, as opposed to manmade collection systems. Besides, it is illogical for plaintiffs to maintain that the tailings ponds can be both a "point source" of discharge and "navigable water." See Oconomowoc Lake, 24 F.2d at 963.

and leaks" from the ponds into the soil and groundwater, and thereafter into the surface waters. Given this indirect path of discharge, the court must decide whether the Clean Water Act's prohibition of the discharge of any pollutant into "navigable waters" encompasses discharges which migrate through groundwater.

The Clean Water Act generously defines "navigable waters" as "waters of the United States." 33 U.S.C. § 1362 (7). Given the Act's purpose to regulate as fully as possible all sources of water pollution, the Supreme Court recognized that "the term navigable is of little import." United States v. Riverside Bayview Homes, Inc., 474 U.S. 121, 133 (1985). To the extent permitted under the Constitution, Congress intended "navigable waters" to embrace virtually "every creek, stream, river or body of water that in any way may affect interstate commerce." Quivira Min. Co. v. E.P.A., 765 F.2d 126, 129 (10th Cir. 1985); accord Leslie Salt Co. v. Froehlke, 578 F.2d 742, 755 (9th Cir. 1978).

Nonetheless, Congress did not intend to include isolated groundwater as part of the "navigable waters." The language and structure of the Act make this clear. First, the CWA consistently refers to "navigable waters and ground waters" in those portions of the Act dealing with EPA program development as well as the study of water pollution. E.g. 33 U.S.C. § 1252 (a), § 1254 (a) (5), & § 1256 (e) (1). In the provisions for water quality standards and discharge permitting, on the other hand, only the phrase "navigable waters" is used. E.g. 33 U.S.C. § 1312 (a), § 1342 (a) (4). If the terms were

synonymous, it would not be necessary for Congress to make distinct references to groundwater and navigable water.

More importantly, the legislative history of the CWA demonstrates that Congress did not intend that discharges to isolated groundwater be subject to permit requirements. The Report of the Senate Committee on Public Works that accompanied the bill stated:

> Because the jurisdiction regarding groundwaters is so complex and varied from State to State, the Committee did not adopt this recommendation (to approve groundwater standards). The Committee recognizes the essential link between ground and surface waters and the artificial nature of any distinction.

S.Rep.No. 414, 92d Cong., 1st Sess. 73 (1971), U.S. Code Cong. & Admin. News 1972, pp. 3668, 3739, *reprinted in* 2 Congressional Research Service of the Library of Congress, A Legislative History of the Water Pollution Control Act Amendments of 1972, 93d Cong., 1st Sess., at 1491 (Comm. Print 1973) (hereinafter "Leg.Hist."). Congress rejected an amendment offered by Senator Aspin to "bring groundwater into the subject of the bill." 118 Cong. Rec. 10,669 (1972), 1 Leg. Hist. 597. (See Remarks of Sen. Aspin). Congress's main concern was expressed by Representative Harsha: "We do not have the knowledge or the technology to devise water-quality standards for ground water; we do not as yet know how to do that." 1 Leg.Hist. 594 (remarks of Rep. Harsha).[4]

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[4] Plaintiffs read too much into the comments of Representatives Clausen and Dingell during debate on the 1972 amendment. See 1 Leg.Hist. 590-92. While the comments reflect an understanding that the Aspin amendment would bring ground water within the "enforcement provisions relating to the standards" of the CWA, they do not draw a distinction, as plaintiffs suggest, between "enforcement standards" and

Guided by the legislative history, courts that have considered the issue agree that "waters of the United States" do not include "isolated/nontributary groundwater." See, Exxon Corp. v. Train, 554 F.2d 1310 (5th Cir. 1977); United States v. GAF Corp., 389 F.Supp. 1379 (S.D. Tx. 1975). They are split, however, on the present question of whether tributary groundwater, which is naturally connected to surface water, is subject to CWA regulation.

On the one hand are published decisions which hold that Congress intended regulation of "discharges of pollutants that could affect surface waters of the United States." McClellan (MESS), 707 F.Supp at 1196 (E.D. Cal. 1196); Sierra Club v. Colorado Refining Co., 838 F.Supp. 1428 (D.Colo. 1993)("discharge of any pollutant into 'navigable waters' includes such discharge which reaches 'navigable waters' through groundwater"). On the other hand are those courts which conclude that the possibility of a hydrological connection between ground and surface waters is insufficient to justify CWA regulation. Oconomowoc Lake, 24 F.3d 962 (7th Cir. 1994)[5]; Kelley v.

"permitting." To the contrary, the Representatives opposed the amendment precisely because they understood it to extend to ground water "the types of controls that are required for navigable water." 1 Leg.Hist. 591. The Ninth Circuit recently recognized that a feature of the 1972 amendments was to shift the focus of the CWA away from water quality enforcement standards toward permit limitations. Northwest Environmental Advocates (NWEA), 11 F.3d at 909-10. Thus, it would be natural for the language of "enforcement standards" and of "permitting" to overlap.

[5] Curiously, Oconomowoc Lake makes no reference to the Seventh Circuit decision in United States Steel Corp v. Train, 556 F.2d 822, 852 (7th Cir. 1977), which held that the EPA is

United States, 618 F.Supp. 1103 (W.D.Mich. 1985). One court, rather than sorting through the conflicting authorities, deferred to an agency interpretation excluding groundwater from coverage under the CWA. Town of Norfolk v. Corps of Engineers, 968 F.2d 1432, 1450 (1st Cir. 1992).

After reviewing the authorities, this court comes down on the side of MESS and Colorado Refining. The logic of these cases is compelling: since the goal of the CWA is to protect the quality of surface waters, any pollutant which enters such waters, whether directly or through groundwater, is subject to regulation by NPDES permit. Applying effluent limitations to tributary groundwater does not change nature of CWA monitoring. As MESS explains, Plaintiffs must still demonstrate that pollutants from a point source affect surface waters of the United States. 707 F.Supp. at 1196. It is not sufficient to allege groundwater pollution, and then to assert a general hydrological connection between all waters. Rather, pollutants must be traced from their source to surface waters, in order to come within the purview of the CWA. Id.

This approach to groundwater pollution has been favorably acknowledged by EPA on at least one occasion. Preamble, NPDES Permit Regulations for Storm Water Discharges, 55 Fed. Reg. 47990, 47997 (Nov. 16, 1990). Citing to MESS and Exxon, EPA stated that rulemaking in 40 C.F.R. parts 122, 123, and 124, does not apply to groundwater,

---

authorized to regulate tributary groundwater, "at least when the regulation is undertaken in conjunction with limitations on the permittee's discharges into surface waters."

"unless there is a hydrological connection between the ground water and a nearby surface water body." Id. The court in Oconomowoc Lake dismissed the EPA statements as a "collateral reference to a problem." 28 F.2d at 966. It appears to this court, however, that the preamble explains EPA's policy to require NPDES permits for discharges which may enter surface water via groundwater, as well as those that enter directly.

Plaintiffs' complaint alleges a hydrological connection between seepage into groundwater and the nearby surface waters of Eureka creek and Mud lake. Taking the allegation as true, the complaint is thus sufficient to support a claim under the CWA.

Conclusion

Hecla's Motion to Dismiss must be denied. The Court has subject matter jurisdiction over citizens suits to require issuance of a NPDES permit through state CWA administration. The tailings ponds are "point sources", since they collect and channel contaminated water into a discrete conveyance. Plaintiffs allege discharge into "navigable waters", by describing pollution which migrates from ground waters beneath the tailings ponds into surface waters of the United States.

IT IS HEREBY ORDERED: Defendant's Motion to Dismiss Plaintiffs' First Cause of Action (Ct. Rec. 9) is DENIED.

IT IS SO ORDERED. The Clerk is hereby directed to enter this Order and furnish copies to counsel.

DATED this 20 day of October 1994.

Fred Van Sickle

FRED VAN SICKLE
United States District Judge

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 6
1445 ROSS AVENUE, SUITE 1200
DALLAS, TX 75202-2733

Permit File
NM 22306
P/C

JUN 26 1997

MEMORANDUM

SUBJECT: Molycorp Molybdenum Mine - Questa, NM
Contaminated Groundwater Discharges

FROM: Robert V. Murphy, Chief
Water Enforcement Branch (6EN-W)

TO: Jack V. Ferguson, Chief
NPDES Permits Branch (6WQ-P)

The attached May 16, 1997, submittal from the Western Environmental Law Center requests EPA enforcement review of information pertaining to contaminated groundwater discharges to the Red River resulting from Molycorp's mining operations at Questa, NM.

During the comment period for Molycorp's 1993 NPDES permit, various commenters expressed concern with groundwater seepage to the Red River from both mine and tailings areas. In the Region's Response to Comments, Final Permit Decision (Response No. 9), EPA stated that "...we do not agree that these [seepage discharges] are 'point sources' under the NPDES permitting program."

In light of determinations made in the administrative record for Molycorp's NPDES permit, 6EN-W does not feel it would be appropriate to initiate enforcement actions for these discharges. We are forwarding the attached information for your review, as the submittal specifically requests a determination of whether the EPA should initiate a formal NPDES permitting process for waste rock pile seepage discharges.

Attachment

RECEIVED
JUN 30 1997
6WQ-PO

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	MAIL CODE: GWB-PP
DEPT./AGENCY/BUSINESS Molycorp	PHONE# (214) 665-7503
FAX # (203) 628-5116	FAX # (214) 665-2191

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FAX TRANSMITTAL

OF PAGES 2 (INCLUDING COVER PAGE)

TO: Rich Schwartz	FROM: Fred Humke MAIL CODE: 6WQ-PP
DEPT./AGENCY/BUSINESS Molycorp	PHONE# (214)665-7503
FAX # (202)628-5116	FAX # (214)665-2191

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 6
1445 ROSS AVENUE
DALLAS, TEXAS 75202-2733

May 6, 1997

Mr. Richard E. Schwartz
Attorney for Molycorp, Inc.
Crowell & Moring LLP
1001 Pennsylvania Avenue, N.W.
Washington, D.C. 20004-2595

Re: Molycorp, NPDES No. NM0022306

Dear Mr. Schwartz:

In response to your letter dated May 5, 1997, we have the following comments.

In the 1993 Response to Comments, it was the position of EPA Region 6 that percolation or infiltration from mine and tailings areas into groundwater did not constitute "point sources" under NPDES. However, we are aware that more recent U.S. District Court decisions are divided over this matter where "hydrologic connection" to surface waters is involved.

The only surface discharge sources from the mine areas which we considered in the 1993 reissuance in accordance with the application and our interpretation of other inputs are those associated with Outfalls 004 and 005. At that time we did not recognize and consider other surface discharges or surface seepage associated with mine wasterock piles. It was understood then that any other mine sources including the mine spoil piles percolated into groundwater. If other mine surface discharges or surface seeps exist, these would be "point sources" subject to the need for applications and permitting.

If I can add any further clarification, please contact me at voice (214) 665-7503 or FAX (214) 665-2191.

Sincerely,

Frederick O. Humke

Frederick O. Humke, P.E.
Environmental Engineer
Permits Branch (6WQ-PP)

FAX TRANSMITTAL

OF PAGES 2 (INCLUDING COVER PAGE)

TO: Grove Burnett	FROM: Fred Humke
	MAIL CODE: GWR-PP
DEPT./AGENCY/BUSINESS Molycorp	PHONE# (214) 665-7503
FAX # (505) 751-1775	FAX # (214) 665-2191

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FAX TRANSMITTAL

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 6
1445 ROSS AVENUE
DALLAS, TEXAS 75202-2733

April 30, 1997

Mr. Brian Shields
Executive Director
Amigos Bravos
P.O. Box 238
Taos, New Mexico 87671

Dear Mr. Shields:

This letter is in response to your FAX of April 21, 1997, to Dr. Oscar Ramirez, Deputy Director of the Water Quality Management Division of the EPA Region 6 office relative to Molycorp, near Questa, New Mexico. You further explained to me the specific issue in our telephone conversation of April 29, 1997.

A review of the record shows that in the permit reissuance dated September 10, 1993, EPA did not consider discharges or seepages associated with mine wasterock piles. You have indicated that these discharges are essentially discrete sources. Issue No. 9 of the associated Response to Comments was concerned with a different and more complex matter related to possible infiltration to existing groundwater sources primarily associated with the tailings areas although possibly to a much lesser extent also associated with the mine.

We hope that this clarifies the matter. If you have further questions, please contact me at (214) 665-7503.

Sincerely,

Frederick O. Humke, P.E.
Environmental Engineer
Permits Branch (6WQ-P)

CONCURRENCES

FHUMKE	JWATSON	CKIRKSEY	JFERGUSON	ORAMIREZ
6WQ-PP	6WQ-PP	6RC-C	6WQ-P	6WQ

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Sincerely,

Frederick O. Humke, P.E.
Environmental Engineer
Permits Branch (6WQ-P)

From: Fred Humke
To: WATSON-JANE
Date: Monday, April 28, 1997 9:43 am
Subject: Molycorp, NM0022306

Caroline recommends that we do not respond at this time to Brian Shields (Amigos Bravos). She has been discussing the matter with OGC and other headquarters and there are some questions involved. Furthermore, last week she was contacted by Grove Burnett, who is the attorney for the current suit by Bravos Amigos. Grove informed her that Molycorp has moved for dismissal based on our 1993 Response to Comments. Grove also has attempted to contact me. Caroline also recommends that at this time we do not discuss the matter with Grove unless we have her involved.

I recommend that we soon meet with Caroline on this matter.

CC: R6DAL01.R6TOXLAN.KIRKSEY-CAROLINE