RICHARD H. BRYAN
Governor

Copy

STATE OF NEVADA

DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES

DIVISION OF ENVIRONMENTAL PROTECTION
Capitol Complex
Carson City, Nevada 89710
(702) 885-4670

October 1, 1985

Mr. Robert L. Dent
Environmental Services Manager
Anaconda Minerals Company
555 17th Street
Denver, Colorado 80202

Certified Mail #P 264 098 625
Return Receipt Requested

RE: Anaconda Minerals Company, Weed Heights, Nevada

Dear Mr. Dent:

The enclosed Administrative Order, issued by the Administrator of the Division of Environmental Protection (DEP), pursuant to Nevada Revised Statutes (NRS) 445.317 and 445.324, requires compliance by the Anaconda Minerals Company with the items specified in the Order. The Order is based on the Finding of Violation issued by the DEP on November 23, 1982 and on subsequent sampling and groundwater results.

Any violation of the terms of this Order could subject Anaconda to an action for appropriate relief pursuant to NRS 445.327, NRS 445.331 or NRS 445.334.

I recognize, that as a result of our discussion with Company personnel on August 1, 1985, that it is the Company's position that the State does not have the authority under NRS 445 to issue the enclosed Order. While the State does not agree with your position, it is willing, in the spirit of cooperation to waive indefinitely the normal 30-day period for appeal of this Order provided that the Company undertakes compliance with the terms of the Order. If this occurs, we agree that the Company may raise at a later date, in an enforcement proceeding or otherwise, any defense it thinks it has to the issuance of this Order.

The Order issued by the DEP on November 23, 1982 has been complied with to our satisfaction. The present Order is a successor to the first and deals with implementation of the mitigation plan.

I look forward to continuing the same cooperative relationship with Anaconda that has characterized progress up to this point.

If you have any questions concerning this matter, please contact me at (702) 885-4670.

Sincerely,

L.H. Dodgion, P.E.
Administrator

Enclosures
cc: Roland Westergard
Joe Livak
Marta Adams
Nevada Environmental Commission
EPA, Region IX
Peter Haller
William G. Rogers

IN THE MATTER OF)
ANACONDA MINERALS COMPANY)
DENVER, COLORADO)

ORDER

The following order is issued this date pursuant to the powers and duties vested in the Director of the Department of Conservation and Natural Resources by Nevada Revised Statutes (NRS) Chapter 445.214, subsections 2 and 12, delegated to the Division of Environmental Protection pursuant to NRS Chapter 445.214 subsection 13, and in accordance with NRS Chapter 445.307, NRS 445.317 subsection 1 (a) and NRS 445.324.

On the basis of the Finding of Alleged Violation issued by the Division of Environmental Protection on November 23, 1982, and on the basis of subsequent sampling and groundwater monitoring results, the Administrator of the Division of Environmental Protection, pursuant to authority delegated to him by the Director, Department of Conservation and Natural Resources, has determined that Anaconda Minerals Company is in violation of NRS 445.221 for the unauthorized discharge of pollutants into waters of the State.

IT IS HEREBY ORDERED:

That Anaconda Minerals Company complete the following acts by the dates specified:

1. By December 31, 1985, Anaconda Minerals Company shall complete construction of an active pump-back interceptor well system and associated evaporation field for the Yerington property pursuant to plans and specifications which were submitted by the Company and approved by the State Division of Environmental Protection and shall, either directly or through an independent contractor, commence operation of the facility.

2. By September 30, 1986, Anaconda Minerals Company shall submit to the DEP an approvable plan for the continued operation of the above project. This plan shall include:
   (a) An operation and maintenance manual, including provisions for monitoring groundwater at the site on a scheduled basis; and
   (b) Incorporate the provisions for the continued operation, maintenance and monitoring of the constructed well system as set forth in Appendix 1.

   In the event Anaconda elects not to undertake the continued operation of the site beyond October of 1986, part (b) of the plan must provide for third party operation, maintenance and monitoring of the constructed well system, and must identify a funding system to be established by Anaconda. These provisions of the plan shall be implemented within three weeks after approval of the plan by the DEP.

DATED 10/1/85

L.H. Dodgion

L.H. Dodgion, Administrator
Division of Environmental Protection

APPENDIX 1

Technical Program
Stabilization of Contaminant Plume, Aquifer Cleanup, and Monitoring Program, Yerington Project, Nevada

The purpose of the program presented herein is to define the criteria for evaluation of the performance of the well barrier system in terms of stabilizing the contaminant plume seeping from the tailings ponds, and subsequent cleanup of the section of the aquifer affected by the seepage. Preventing the iron-rich ground water from inflowing into the irrigation ditch, an attendant effect of the pump barrier operation, has also been addressed.

The methods of ground water monitoring and criteria for evaluating the aquifer clean-up efforts will serve as a guide for calibration and operation of the well barrier system and will provide protection against further departure from ambient water quality and impairment of water rights.

BACKGROUND

In order to put the program in perspective, it is important to summarize the background of the issue of ground water contamination.

Site Description

The tailings ponds, assumed to be the source of the existing ground water contamination, were developed during the mining and milling of copper ore at Anaconda's Yerington project in Lyon County, Nevada. The site was in operation for the 25-year period between 1953 and 1978. During this time, sulfide ore tailings were deposited in the tailings ponds and acid brine from the oxide ore processing was deposited in evaporation ponds.

The site is underlain by semi-consolidated and unconsolidated alluvium and fan deposits. Ground water is encountered in this valley-fill material at depths ranging from one to ten feet below the ground surface. Ground water at the tailings site flows in a northwesterly direction at the rate of approximately 20 ft/yr.

Ground water discharges from the valley primarily at the surface via evapotranspiration, particularly in the marshlands to the north of the site (Huxel, 1969; AHA, 1983.)

Contaminant Nature and Contaminant Concentrations

Analysis of the ground water quality at the project site was initiated in 1976 by the United States Geological Survey (USGS). Water quality sampling and analyses from USGS, Applied Hydrology Associates, and Anaconda were used to assist in development of this program. Water quality data is available for 1978 through 1984.

Previous ground water quality monitoring was concentrated along the northern edge of the tailings disposal site. The locations of the ground water monitoring wells for the proposed monitoring program are shown in Figure 1.

Areal Extent of Contaminant Plume

Isoconcentration maps for iron, a reactive species; sulfate, a conservative species; and pH, a factor affecting concentration of iron in solution, were developed to examine the areal extent of the contaminant plume. These maps are shown in Figures 2, 3, and 4, respectively.

Inspection of these maps indicates that contamination tends to concentrate at two locations: Monitoring Wells USGS-2B to the north and D8AB-1 to the

south. The area located between well USGS-2B to the north and well D8AB-1 to the south will be termed "source" for the remainder of this discussion. Concentrations of the two selected contaminants are high at these locations with maximum values of 6,007 mg/l and 8,354 mg/l for iron, and 29,598 mg/l and 28,204 mg/l for sulfate. The actual location and extent of the source of contamination is not clearly defined because the available water quality data is only from areas at the perimeter of the tailings ponds.

Concentrations of the contaminants decline with distance from the source. Iron displays a more rapid decline than the sulfate because geochemical reactions with the soil retard migration. The acidity of the contaminated ground water (pH) also governs the concentration of iron and probably other metallic species. Low pH is evident in the immediate vicinity of the tailings where high concentrations of iron and sulfate are documented. Acidic neutralization is a function of distance from the tailings ponds and proximity to the surface (aeration).

Stratification of Ground Water Contamination

The contaminated ground water north of the tailings ponds shows distinct stratification of contaminant concentrations. The highest concentrations are encountered within the upper 40 feet of the aquifer and ground water quality improves greatly with depth. Figures 5, 6, and 7 illustrate this stratification and improved ground water quality with depth.

A possible explanation for the stratification of contaminant concentrations is the presence of an impermeable clay layer as well as the hydraulic stratification of the aquifer. The continuity of the clay layer has been demonstrated at a depth of about 40 feet for an area on the east side of the lined evaporation pond where contaminant concentrations are the highest. (See Figures 8 and 9 for plan view and vertical section showing the approximate location of the clay layer.) The presence of this layer under other portions of the site is possible.

This impermeable clay layer appears to create an effective barrier to the mixing of shallow and deep waters in those areas of previous investigation. Near the 4CB wells, sulfate and iron concentrations just above the clay were approximately 21,000 mg/l and 6,400 mg/l, respectively, while below the clay, sulfate levels had dropped to less than 2,000 mg/l and iron levels to 0.17 mg/l. Both contaminants exhibited this large decrease in concentration over a vertical distance of only about 10 feet.

Stratification of water quality, although of lesser contrast, also occurs regardless of the presence of the clay layer. Since the aquifer is layered with horizontal permeability up to 100 times higher than vertical permeability, the contaminated water tends to migrate horizontally along the more permeable layers. For example, the sulfate concentration in the shallow screened zone of D5AC-1 was in the range of 10,500 mg/l. However, in the deeper screened zone (10 feet deeper), the concentration dropped to around 2,600 mg/l, a fourfold decrease in concentration.

MONITORING PROGRAM

The objectives of this monitoring program are to document the performance of the well barrier system in terms of stabilization of the contaminant plume and aquifer cleanup. The intent of the efforts discussed in this section is to design a program of ground water monitoring which will take into account the following technical aspects: (1) the location of the source of contaminants as determined from available observation points, (2) the direction of the ground water flow, and (3) specifics of the hydrostratigraphy of the site, such as the presence of a clay layer and stratification of the aquifer. The frequency of sampling will vary according to the expected rate of change of concentration of contaminants in response to pumping. The network of monitoring points will utilize to a large extent wells already in place and previously monitored.

Location of Monitoring Wells

The network of ground water monitoring wells designated to produce information on performance of the well barrier system will consist of:

- One well, UW-1, to be installed upgradient of the presently identified source of contaminants. This well will allow verification (or dismissal) of the working hypothesis that the source of contaminants is located between wells USGS-2B to the north, and D8AB-1 to the south. This well will be drilled to the clay layer, or to an elevation corresponding to the depth of the clay layer at the location of well USGS-2B. The screen will be installed in the lower thirty percent of the saturated thickness of the aquifer. The proposed location of well selected for monitoring is shown in Figure 1.

- Two existing wells within the assumed area of the contaminant source. Data from these wells will provide information on possible dilution of contaminants which may result from ground water sweep in response to pumping. Wells which will be monitored are USGS-2B and D8AB-1.

- Three existing wells located downgradient of the contaminant source area. Data from these wells will provide information on stabilization of the contaminant plume and on the efficiency of cleanup of the aquifer downgradient of the well barrier. Wells selected for downgradient monitoring are D4BC-1, W5AB-2, and USGS 13.

- One downgradient well monitoring ambient ground water quality. The well selected for this purpose is Phipps domestic well.

- Two existing deep monitoring wells. These wells will provide data on ground water quality below the clay layer. The wells selected for monitoring the deep aquifer are W5AA-1 and W5AB-1.

Table 1 summarizes the information on depths from which samples are to be collected as well as the rationale for well selection.

In addition to collecting data from wells, the quantities and quality of water pumped from the wells will be monitored. Samples will be collected from the manual drain at well No. 4. This information will be used to correlate volumes of water pumped and changes in contaminant concentrations. This relationship is essential to predict the duration of aquifer clean-up efforts.

Monitored Contaminants

For the purpose of evaluating the performance of the well barrier system, the following contaminants are to be monitored in all monitoring points identified in Table 1:

Iron
Sulfate
pH

In additon to the above, water levels in all monitoring wells will be recorded at the time of sample collection.

Frequency of Monitoring

Four phases of monitoring efforts, each requiring different frequencies of sampling and analysis, are planned for the Yerington project.

Phase I

For the first year following activation of the well barrier system, ground water samples from all monitoring points will be collected quarterly.

During this one-year period, the changes in ground water quality in response to pumping are going to be the most pronounced. Quarterly monitoring will also allow for quantification of the influence of seasonal fluctuations on the concentration of contaminants, if any.

Phase II

After the first year of operation, the samples will be collected and analyzed semi-annually. The first set of samples will be collected in April-May when precipitation is highest. The second set will be collected and analyzed in October-November, i.e., during the months of lowest precipitation.

Phase III

If the concentrations of contaminants in the monitored wells are lowered to an acceptable level, the well barrier system will be turned off. For a one-year period after pumping ceases, the frequency of monitoring will be increased to quarterly readings. The purpose of the increased frequency of monitoring during this time period is to determine if the source of contaminants is still affecting the quality of ground water.

Phase IV

If stabilization has occurred as shown from the data collected in Phase III, then annual monitoring will take place for a period not to exceed five (5) years.

Sampling Technique

Samples from the monitoring wells and the pumping wells (from the manual drain at well No. 4) will be collected according to procedures described in the following EPA compendia:

1. "Procedure Manual for Groundwater Monitoring at Solid Waste Disposal Facilities," EPA SW-611, December 1, 1980.

DEFINITION OF END RESULTS

The activated well barrier is to meet two objectives:

1. Stabilization of the contaminant plume; and
2. Cleanup of the aquifer affected by seepage from the tailings.

Attendant to these objectives is the clean up of the irrigation ditch. The first objective may possibly be achieved within approximately one year after startup of the well barrier system. The second objective is a long-term process. The anticipated duration and achievable end results of the second objective will be determined when data on the performance of the well barrier system become available.

Stabilization of Contaminant Plume

The concentration of iron, sulfate, and pH in ground water will possibly be stabilized at background levels (Table 2) or lower within approximately one year of system operation startup. It is expected that concentrations of listed contaminants will show a declining trend soon after the system is activated.

The quarterly readings will be evaluated statistically against previous values. If statistically significant increases are observed in any monitoring point in three consecutive readings, the need for alteration to the pumping scheme will be evaluated.

Cleanup of the Aquifer Affected by Seepage from Tailings

The rate of reduction in contaminant concentrations is expected to be evident within one year after system startup. After one year, Anaconda will be in a position to determine a more realistic approach to the aquifer cleanup efforts.

For the purpose of discussion, preliminary end results may be established as follows:

1) Reduce the concentration of iron, sulfate, and pH in wells D4BC-1, W5AB-2, and USGS-13 to the EPA's secondary drinking water standards maximum concentration levels (SMCL). These concentrations, as determined in 40 CFR, Part 143, §43.3, are as follows:

Iron	-	0.3 mg/l
Sulfate	-	250 mg/l
pH	-	6.5-8.5

2) If the concentrations of contaminants show constant values within the levels identified above, the well barrier system will be turned off.

3) After the pumping is stopped, monitoring for iron, sulfate, and pH shall continue quarterly for one year. Should no statistically significant change be documented in wells D4BC-1, W5AB- , and USGS-13, the pumping program shall be terminated.

4) After termination of pumping, monitoring concentrations of iron, sulfate, and pH in all monitoring points upgradient, within, and downgradient of the contaminant source shall continue for a period not to exceed five (5) years.

5) Should no statistically significant increase in contaminant concentrations be observed within the monitoring period identified in point 4, Anaconda shall be released from further commitment to operate the well barrier system and monitoring program.

The aquifer clean-up criteria presented are conceputal only. However, these criteria depict the rationale which will be followed to elaborate the end results after 1 year of observation. In the event these criteria cannot be attained, Ananconda shall be permittted to propose revised criteria to the State for its consideration and review.

Cleanup of the Irrigation Ditch

Pumping in the barrier wells will lower the ground water table several feet at the irrigation ditch location. Exact information on the water table decline will be obtained during and after system startup. Ditch flow will be examined visually at the same time as ground water samples are collected for laboratory analyses.

REFERENCES

Anaconda, 1984, Attachment I, Iron Plume Study: Drill Hole Data Sheets and Water Quality Analysis Results.

Anaconda, 1984, Appendix A, Surface and Ground Water Sampling Field Forms.

Anaconda, 1984, Letter Report, "Water Quality Investigations and Mitigation Plan, Yerington Mine Site, Yerington, Nevada," 82 pgs.

Applied Hydrology Associates, 1985, "Water Quality Sampling and Well Testing, Yerington Mine Site, Yerington, Nevada, September, 1984," 116 pgs.

TABLE 1

Ground Water Monitoring Points

Sampling Point Designation	Depth of Sampling (ft)	Remarks
Upgradient Well		
UW-1	24-40	Well to be installed upgradient of contaminant source. Possibly used for ambient water quality monitoring.
Wells Within Area Of Assumed Source Of Contamination		
USGS-2B	28	This well shows highest concentration of contaminants at the northern edge of area of contaminant source. Changes in water quality will be indicative of cleanup of contaminant source.
D8AB-1	40	This well shows highest concentration of contaminants at the southern edge of the contaminant source area. Changes in water quality will be indicative of cleanup of contaminant source.
Wells Downstream of Assumed Source of Contamination		
D4BC-1	30	This well is located 1,200 feet downgradient of northern edge of contaminant source.
W5AB-1	38	Monitoring of this well will demonstrate if cleanup of sulfate north of the lined pond is taking place.
W5AB-2	20	Monitoring of this well will demonstrate if cleanup of sulfate north of the lined pond is taking place.
USGS-13	15	This well is furthest downgradient from the well barrier. Monitoring water quality in this well will supplement data from other points.
W5AA-1		

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