# Cleaning up Coal Creek

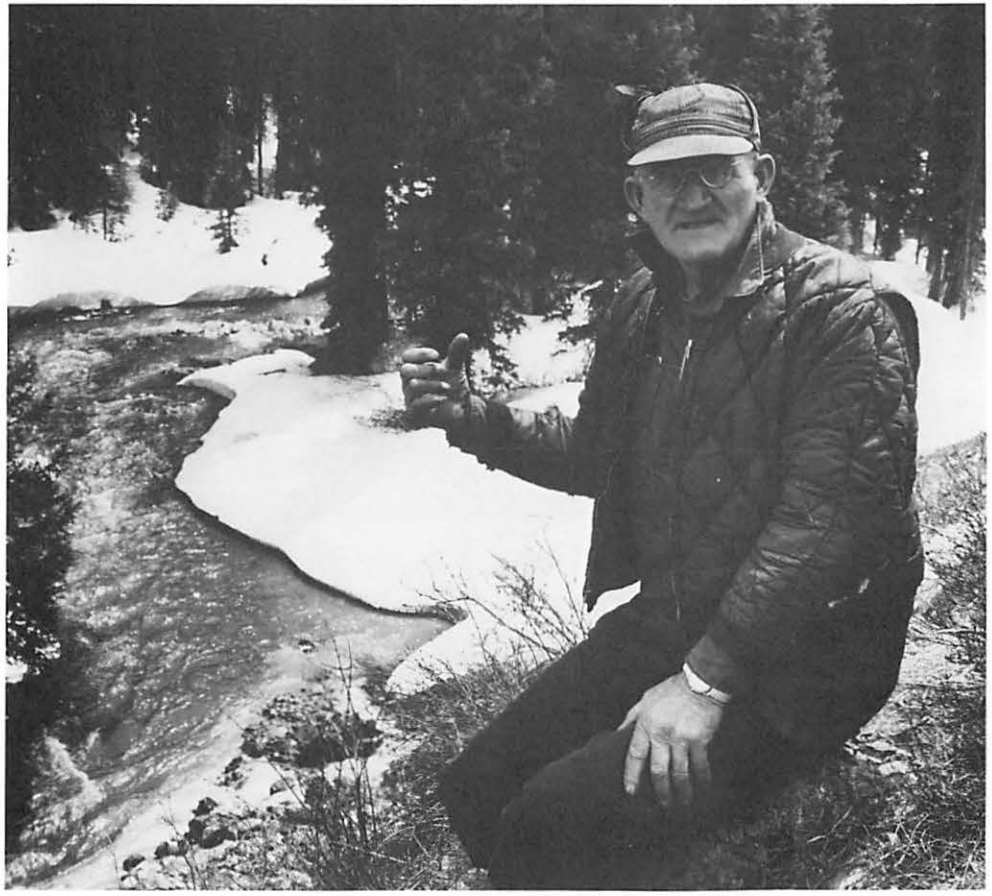
MOUNT EMMONS

AMAX INC.

Coal Creek can come back to life, with fish once more in residence, after a major restoration job. The project, already underway, is expected to take less than three years to complete. It is a major commitment by AMAX Inc. as the company explores the possibility of opening a molybdenum mine at Mt. Emmons near Crested Butte, Colo.

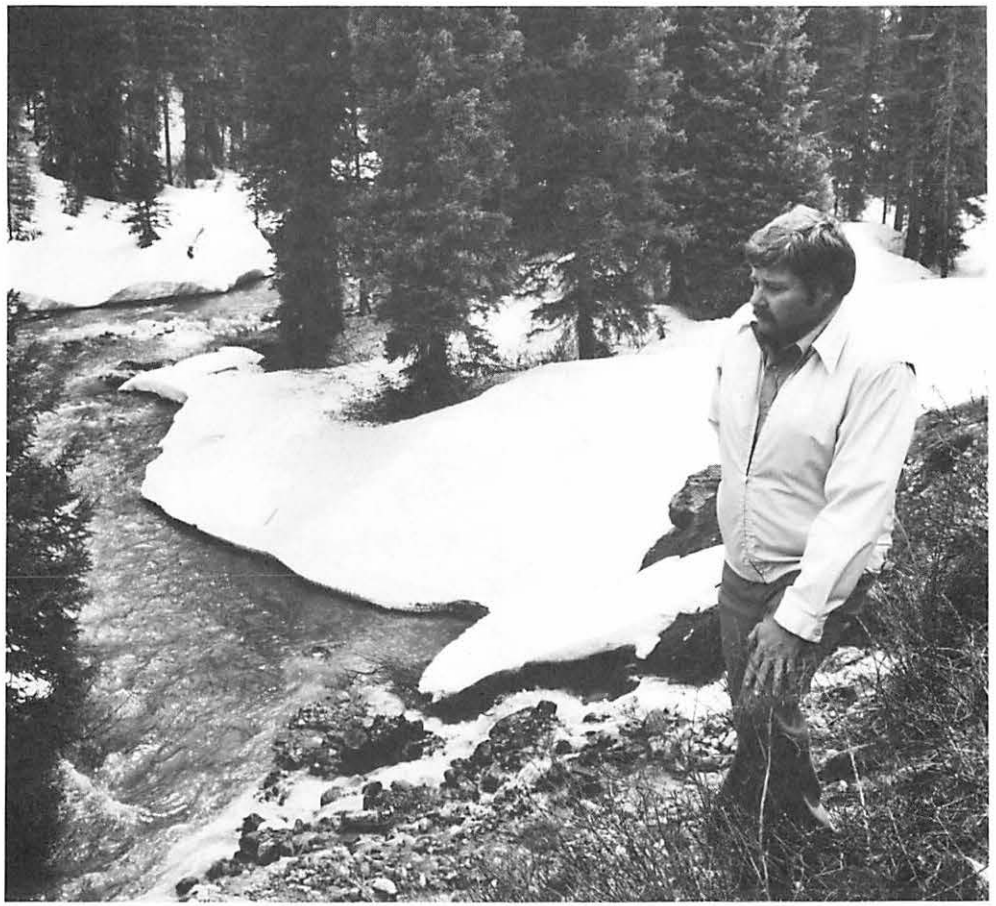
**"We used to fish the creek. You could catch all the trout you wanted: rainbow, native, eastern, German brown. During the depression in 1931, we'd go out in the creek and get fish for dinner. We used to catch fish right where I live. My cousin caught a two-pounder in front of city hall about 40 years back... In the winter, when the creek was down, fish used to stay in beaver ponds. There always were fish."**

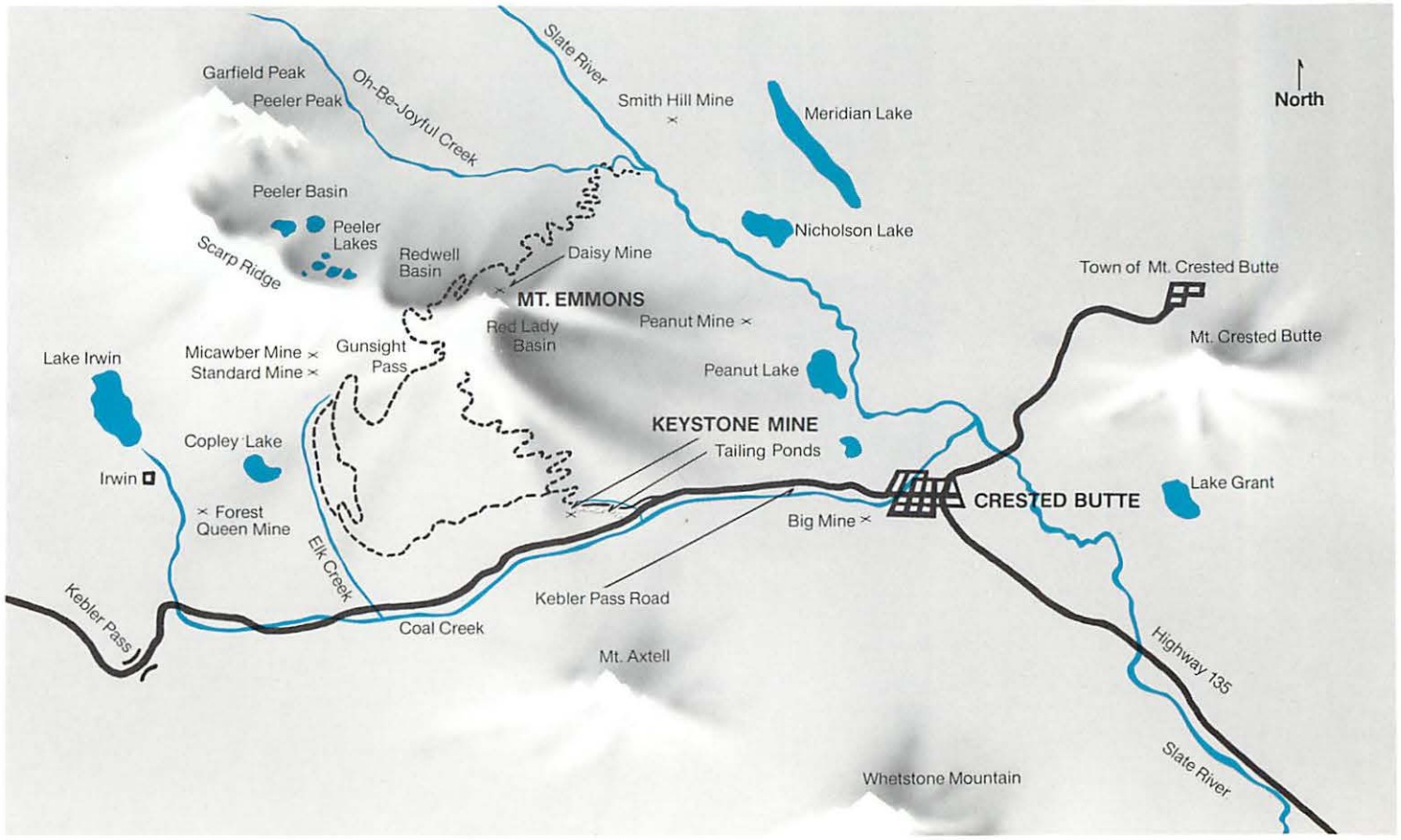
Tony Verzuh was born in Crested Butte in 1912. He has lived there all his life and taken part in almost every aspect of community activity. He has worked for the telephone company and the coal mines. He has served on the city council and as sheriff. Verzuh is now a contractor and rancher.



**"When AMAX acquired the Keystone Mine, it inherited a pollution problem that had become critical for the residents of Crested Butte. Immediate action was taken to alleviate the risk to the town water supply, but Coal Creek is still a seriously polluted stream. AMAX is undertaking a major cleanup program to improve the quality of water discharged from the mine property. These efforts will aid in revitalizing Coal Creek as a fishery."**

Ralph Barnett became AMAX project manager at Mt. Emmons in October, 1977. He has been with the company for 23 years as a mining engineer and manager. Most recently he was general superintendent of the Climax Mine, a molybdenum mining and milling operation near Leadville, Colo.




Garfield Peak
Peeler Peak
Oh-Be-Joyful Creek
Slate River
Smith Hill Mine
Meridian Lake
North
Peeler Basin
Peeler Lakes
Nicholson Lake
Scarp Ridge
Redwell Basin
Daisy Mine
Town of Mt. Crested Butte
MT. EMMONS
Red Lady Basin
Peanut Mine
Mt. Crested Butte
Lake Irwin
Micawber Mine
Standard Mine
Gunsight Pass
Peanut Lake
KEYSTONE MINE
Tailing Ponds
Copley Lake
Irwin
Lake Grant
Forest Queen Mine
CRESTED BUTTE
Big Mine
Elk Creek
Kebler Pass
Kebler Pass Road
Coal Creek
Mt. Axtell
Highway 135
Slate River
Whetstone Mountain

## Coal Creek

Originating 10 miles west of Crested Butte in the Elk Mountains, Coal Creek drains almost 21 square miles of mountainous terrain, including the south face of 12,414-foot Mt. Emmons. For almost a century, mining activities at Mt. Emmons have affected the waters draining into Coal Creek.

The mountain, just west of Crested Butte and 110 airline miles southwest of Denver, is the site of Keystone Mine. Early records are sketchy, but they show numerous mining concerns operated the property off and on since 1880. The Keystone produced some gold, silver, copper, lead and zinc. In 1955, operators built a mill to process ores from the Keystone, Micawber and Daisy Mines. With the mill came the need for tailing ponds to dispose of mine wastes.

Over the years, waters draining from Mt. Emmons have washed high concentrations of zinc, lead, cadmium, manganese, iron and copper from the mine and tailing ponds into Coal Creek. These soluble metals have poisoned the creek for fish and the organisms they feed on.

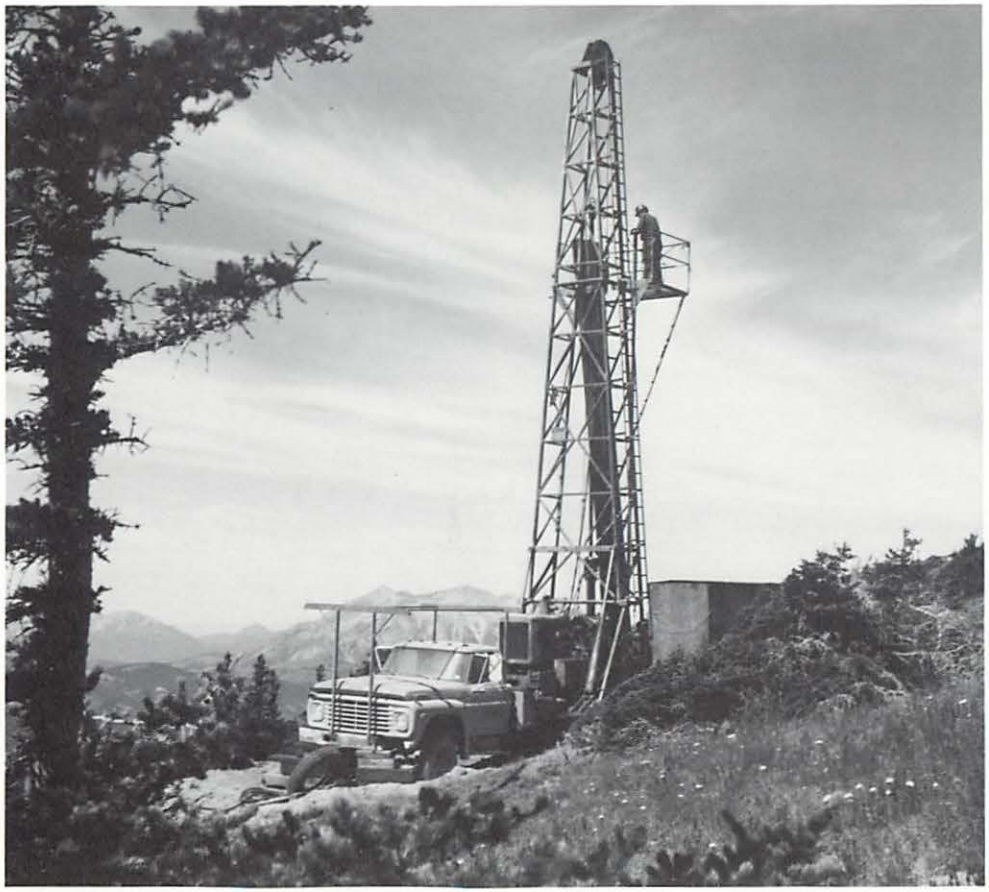
Government agencies took action in 1975 when the dam on the lowest of four tailing ponds gave way, dumping wastes into the creek above the Crested Butte water supply.

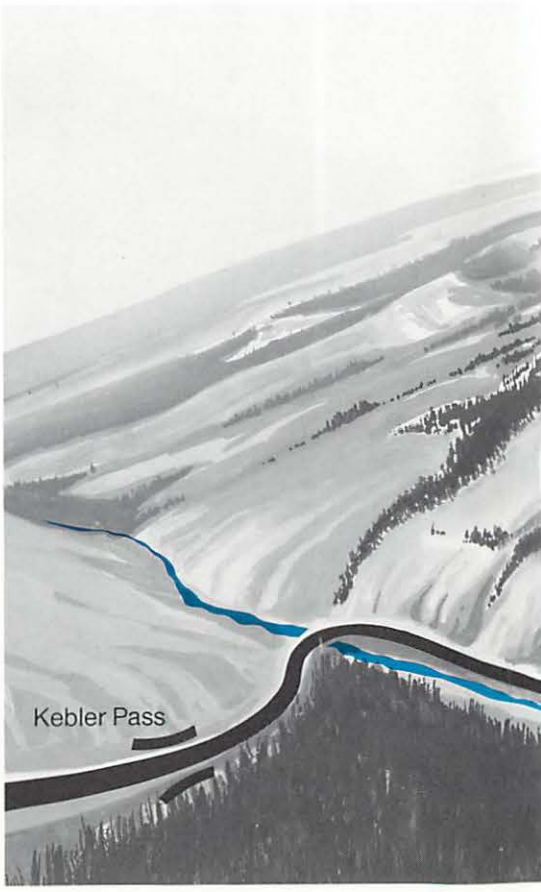
The Colorado Department of Health filed a cease and desist order against the company that owned the property at the time of the spill. The order called for remedial action and stabilization of the tailing areas to prevent another spill. The Environmental Protection Agency filed suit to seek damages and a maximum penalty of $40,000.

## Mt. Emmons

When AMAX Inc. acquired the Keystone Mine property at Mt. Emmons in 1977, it accepted responsibility for stabilizing the tailing dams and cleaning up Coal Creek.

The property was purchased after exploration and test drilling during a three-year period indicated a significant body of molybdenum ore may exist. AMAX is hopeful that evaluation of the Mt. Emmons deposit and concurrent studies of environmental and socio-





economic impacts will justify mine development in the 1980s.

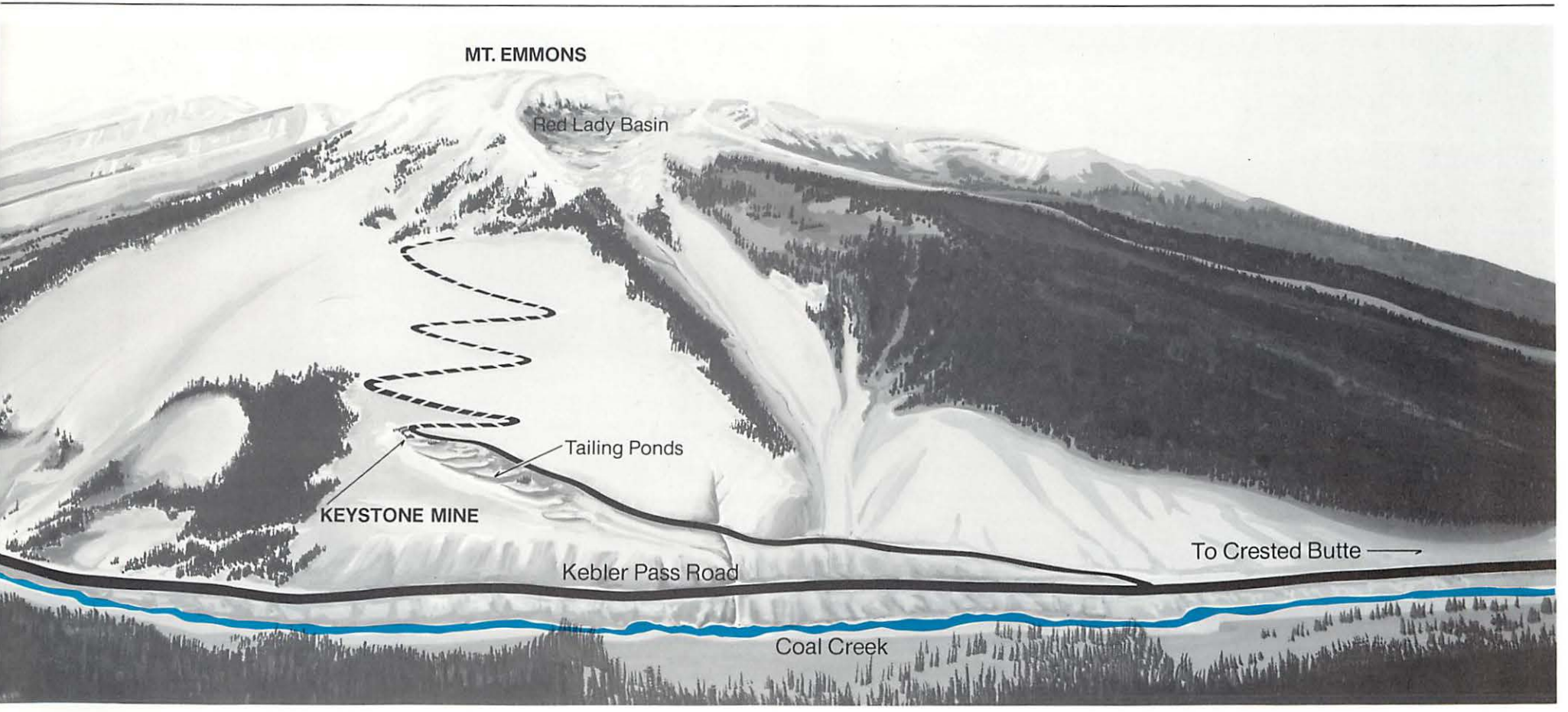
The company must further define the quality, size and uniformity of the deposit and evaluate several areas for possible location of mine and mill facilities. Underground and surface drilling as well as metallurgical testing will decide whether the molybdenum ore at Mt. Emmons can help supply the increasing world demand for this versatile metal.

Molybdenum, a silver-gray metallic element nearly as heavy as lead, is used mainly in the steel and iron industries. It has a high melting point – 2,000 degrees higher than that of steel – and adds strength and corrosion resistance to the metals. These properties make it extremely useful in the manufacture of tool steels, stainless steels and arctic pipelines. It is also an essential component in many organic and inorganic compounds used as catalysts, lubricants, corrosion-inhibiting paint pigments and flame retardants.

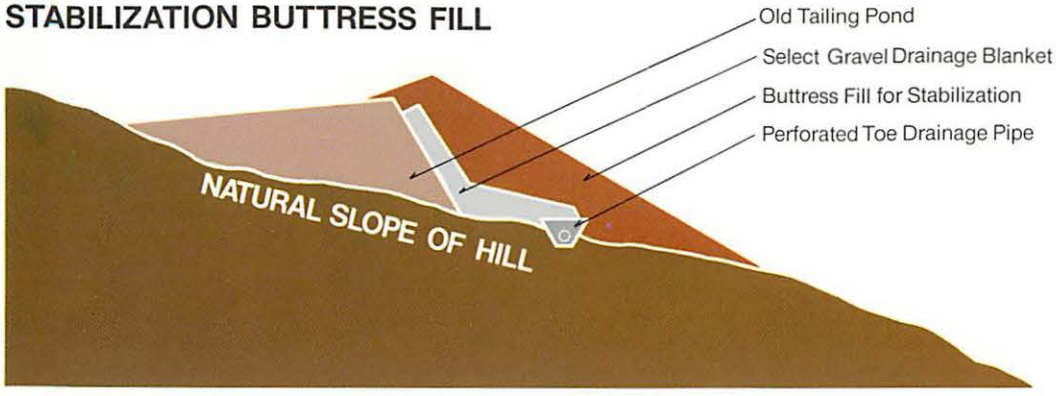
The United States produces about two thirds of the world supply of molybdenum, and most of that comes from Colorado. The ore deposit at Mt. Emmons may be another Colorado source. AMAX expects test drilling and feasibility studies to take at least two years.

During that time, a number of issues must be resolved, including an assessment of environmental impacts and how they can best be handled.

The first environmental problems that had to be dealt with when AMAX obtained the property were stabilization of the tailing ponds and the reclamation of Coal Creek.

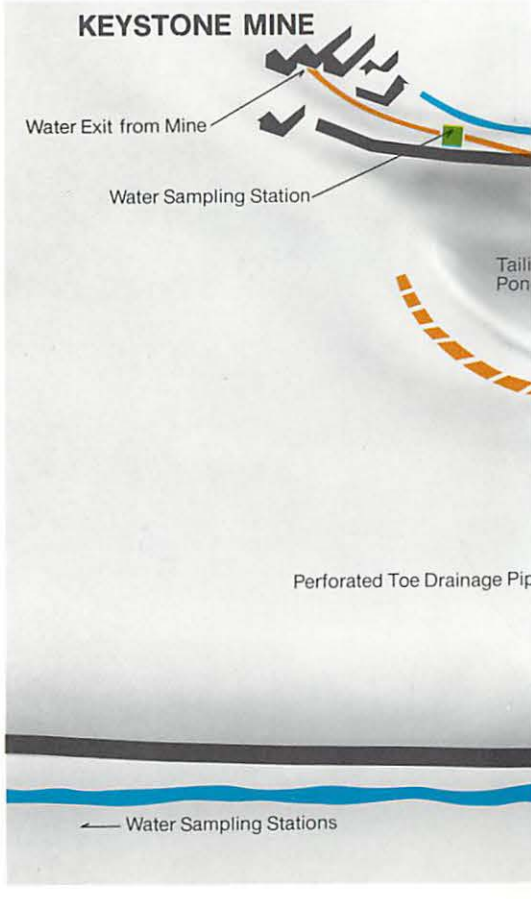


## Corrective Action




Investigations by AMAX specialists and their consultants showed the existing tailing dams were extremely unstable and immediate corrective action was necessary.

Specially selected gravel and soil were brought in to fortify the dams. Starting at the toe or base, engineers built a gravel drain blanket up the face of each dam. Perforated pipe was placed at the base of the gravel drain blanket to collect seepage and direct



it to a central retention pond.

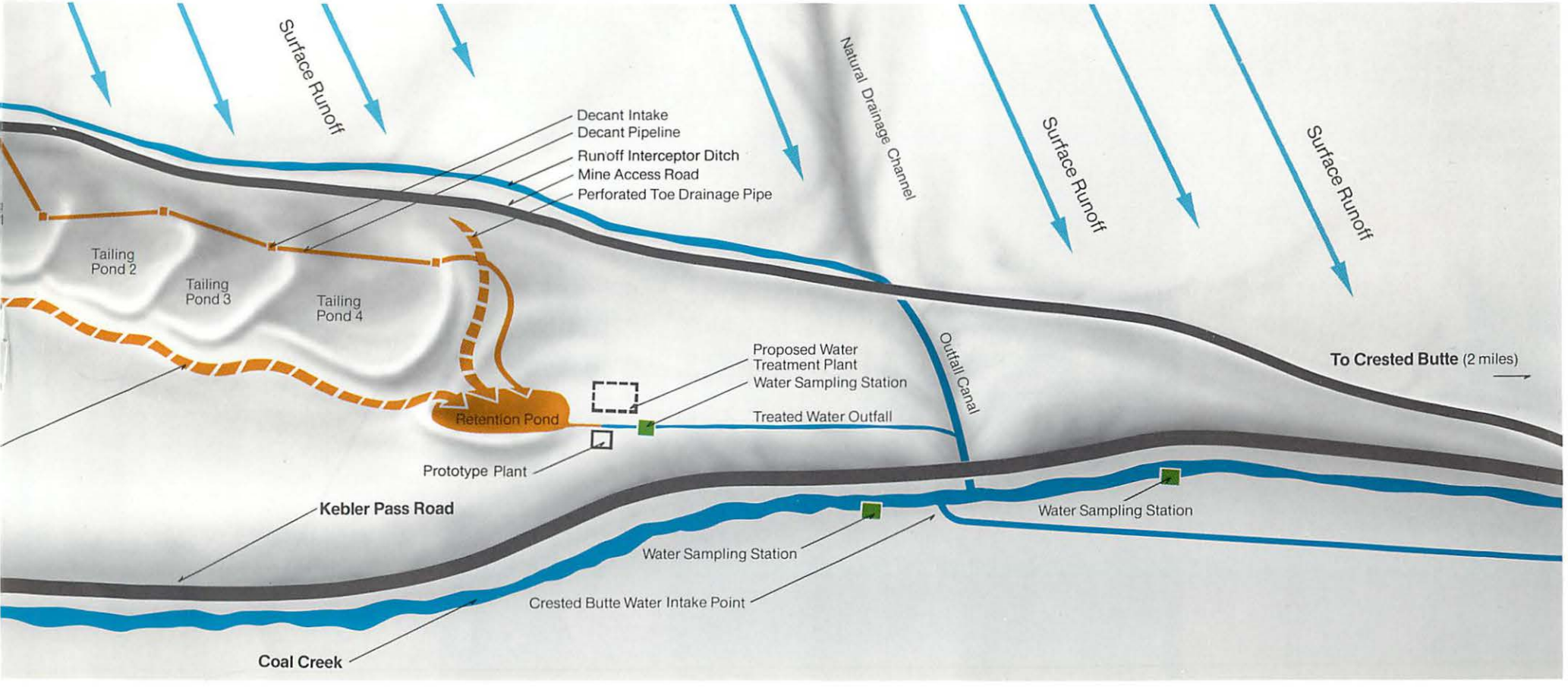
Earth was compacted over the gravel to form a buttress fill along the dam faces. Planting the embankment with grass is designed to keep rains and snow melt from eroding the dam faces and make the area more aesthetically pleasing.

To drain the surface of the tailing area, it was graded to slope toward collection points. Drain pipes, or decant lines, were installed to collect the water from these points and carry it to the retention pond.

To intercept surface runoff before it joins mine and tailing water, a drainage ditch and channel were routed around the pond to Coal Creek.

Finally, water running through the mine had to be collected. Construction of a ditch and placement of a pipeline to the retention pond completed the almost $1 million stabilization and collection project.

With all the mine-affected water directed to a central area, company engineers and environmental specialists began collecting data on the quality and quantity of water that must be treated.

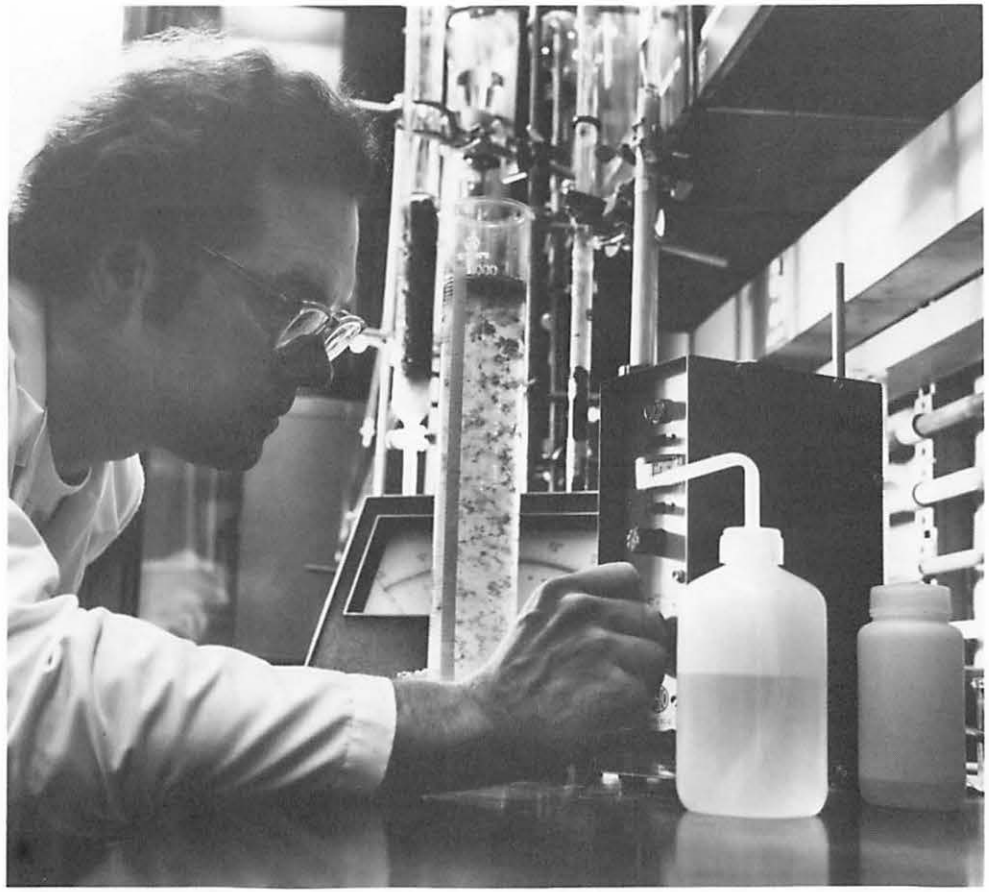


## Research

Working with the Water Quality Division of the Colorado State Department of Health and the U.S. Environmental Protection Agency, AMAX is determining the best treatment method for the mine-affected waters.

The first task is to evaluate the existing situation. AMAX researchers are taking weekly samples of water coming from the mine, that being discharged from the retention pond and creek samples from above and below the retention pond discharge point. A number of analyses are being done on each sample. They show what the water contains. Laboratory analyses of the mine water and retention pond samples have shown very high concentrations of heavy metals.

Analyses of creek samples show what effect these heavy metals are having on Coal Creek. Although water flow in Coal Creek differs throughout the year and from year to year, data collected by AMAX in March-April, 1978 are comparable to results obtained by the state in March, 1973. The only significant variation is the amount of zinc found upstream from the point where mine waters flow into Coal Creek. At this location, AMAX data show higher concentrations of zinc than do the state's 1973 figures. Further study is required to determine causes for the variation, but AMAX data may reflect the residual impact of the tailing failure in 1975 and the formerly uncollected seepage from the tailing area.



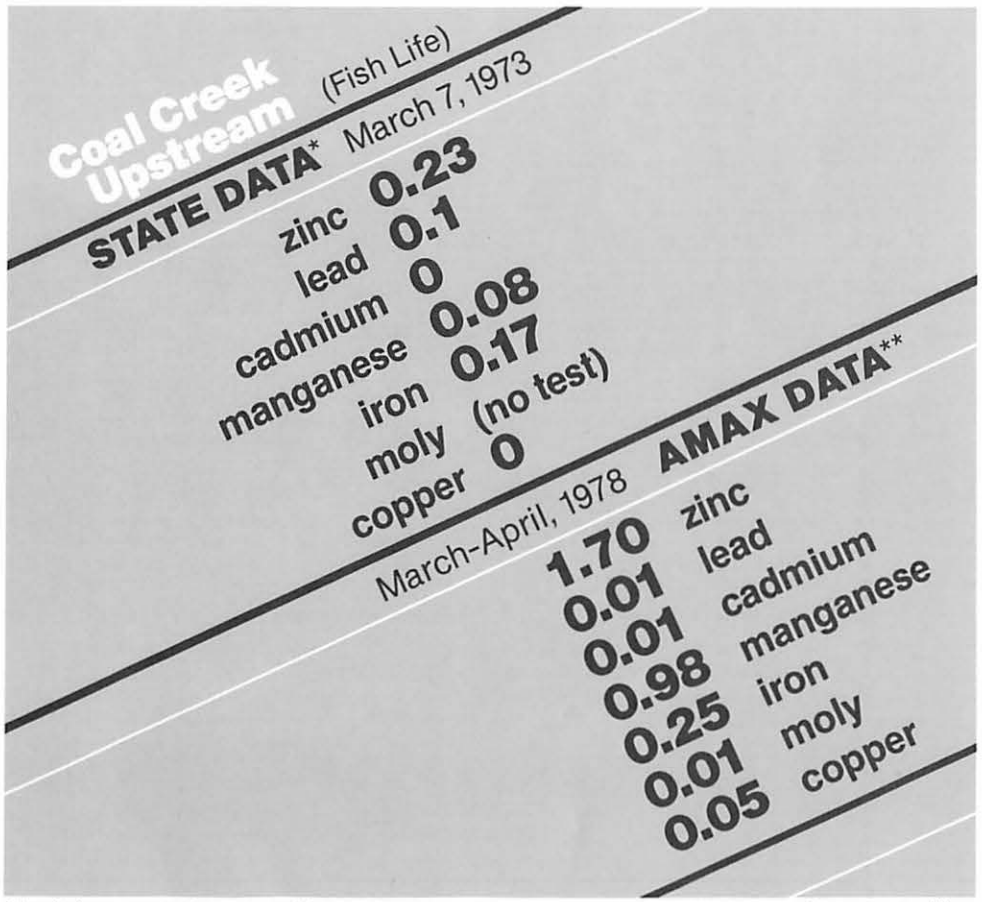
A second area being studied is the amount of water that needs treating. AMAX has installed gaging stations at the mine and retention pond to measure water flows throughout the year. Flow information is also being developed on Coal Creek.

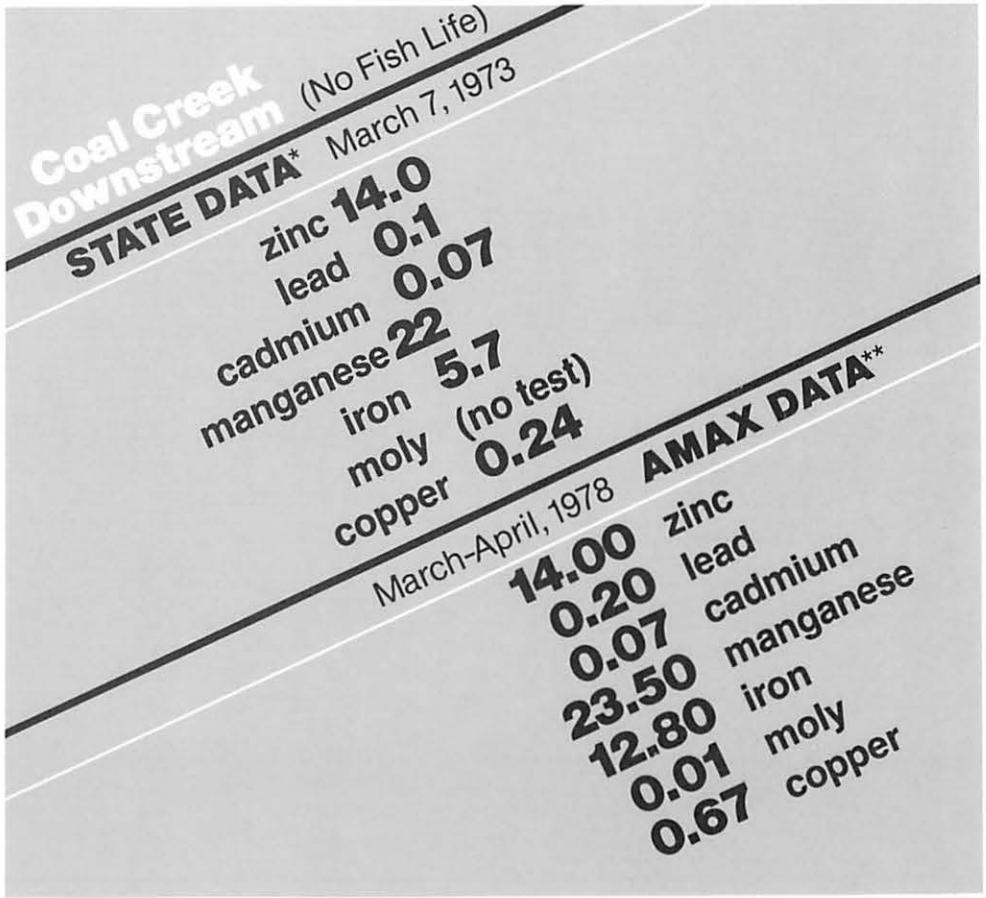
Besides the amount of water that needs treating, scientists and engineers need more information about the Mt. Emmons drainage area. To get this information, hydrological studies will help identify the sources and amounts of underground and surface waters in and near the mine.

By the fall of 1978 AMAX engineers will have installed and will be testing a prototype treatment facility near the retention pond. The system being tested is one that proved successful in removing heavy metals at the company's Climax Mine near Leadville, Colo.

The test facility, a scaled-down version of the Swift Lectroclear water treatment system, processes about 10 gallons of water per minute.

Concurrent with these activities, AMAX scientists are reviewing disposal methods for the sludge, or sediment, removed from the water. Some half dozen methods are possible, but not all are feasible or environmentally acceptable. Disposition of heavy metal sludge, however, is an integral part of the total problem.




*Results from one sample, expressed in parts per million. **Averages from three samples, expressed in parts per million.

## Water Treatment

Studies now underway will provide information needed to design the full-scale treatment facility required to end the Keystone drainage contamination of Coal Creek.

Engineers must know how bad the water is, what it contains and how much must be treated before they can design an adequate facility.

Hydrological studies showing the sources of water in the area will provide information that may allow engineers to redirect certain flows. By establishing how much and where water exists, engineers may be able to reduce the amount that must be treated.

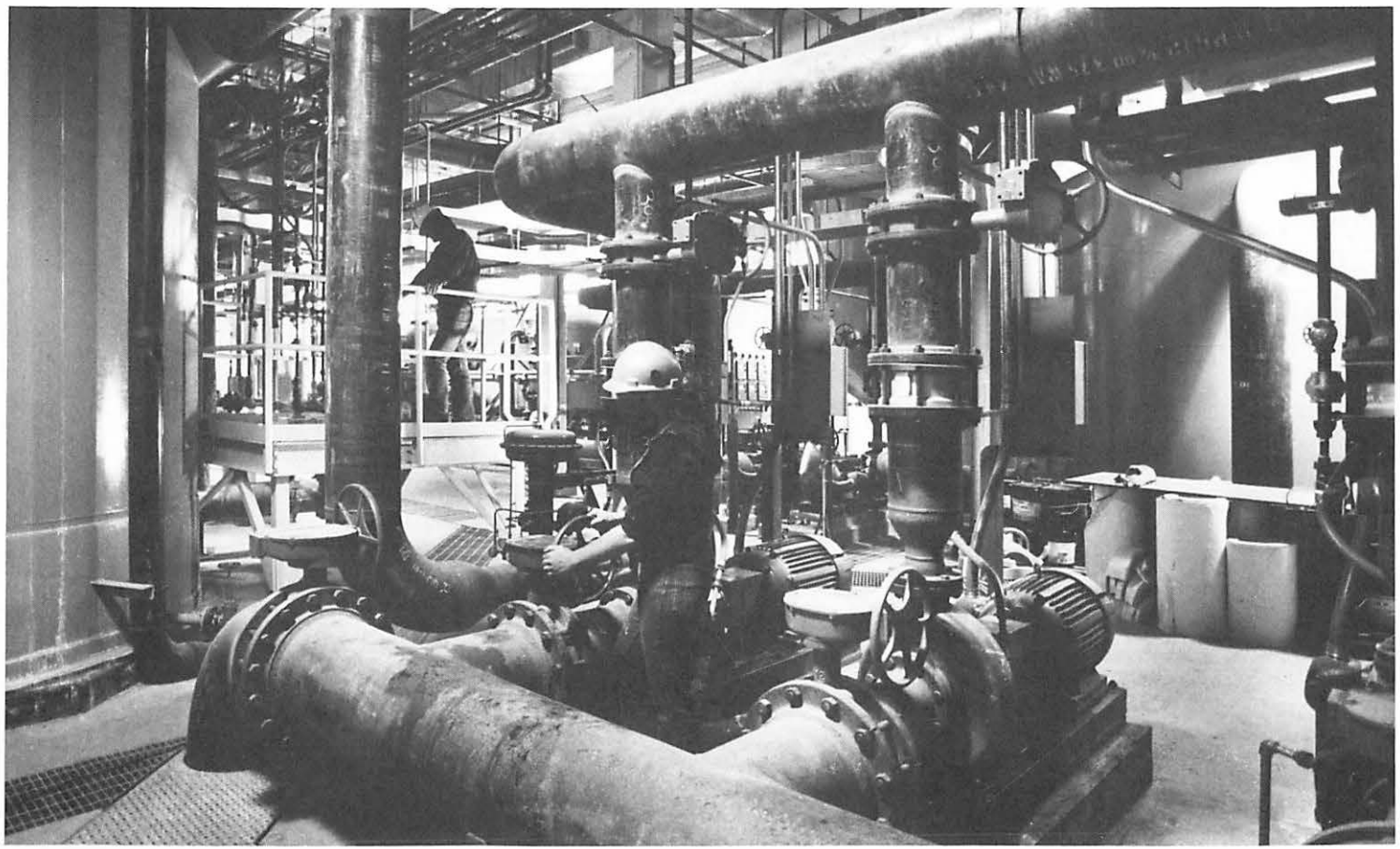
Even before these studies are completed, engineers will install drainage pipes in the mine to route water out of the tunnel, thus minimizing its contact with potential metal contaminants.

The prototype treatment facility will test

the effectiveness of the Swift Lectroclear system. A full-scale plant is now being used successfully to treat water at the Climax Mine. Technologically, a similar plant should be able to handle the polluted water at Mt. Emmons, although some differences in the treatment chemistry may be necessary.

The treatment process first involves the addition of lime or other alkaline material to facilitate the conversion of the heavy metals in solution into insoluble precipitates. A flocculent material is then added to this mixture to induce the insoluble precipitates to combine. The precipitates are floated to the surface as a light, fluffy mass by microbubbles of electrolytically generated oxygen and hydrogen. The mass or sludge is then skimmed off, the water subjected as necessary to further heavy metals removal and the treated water discharged.

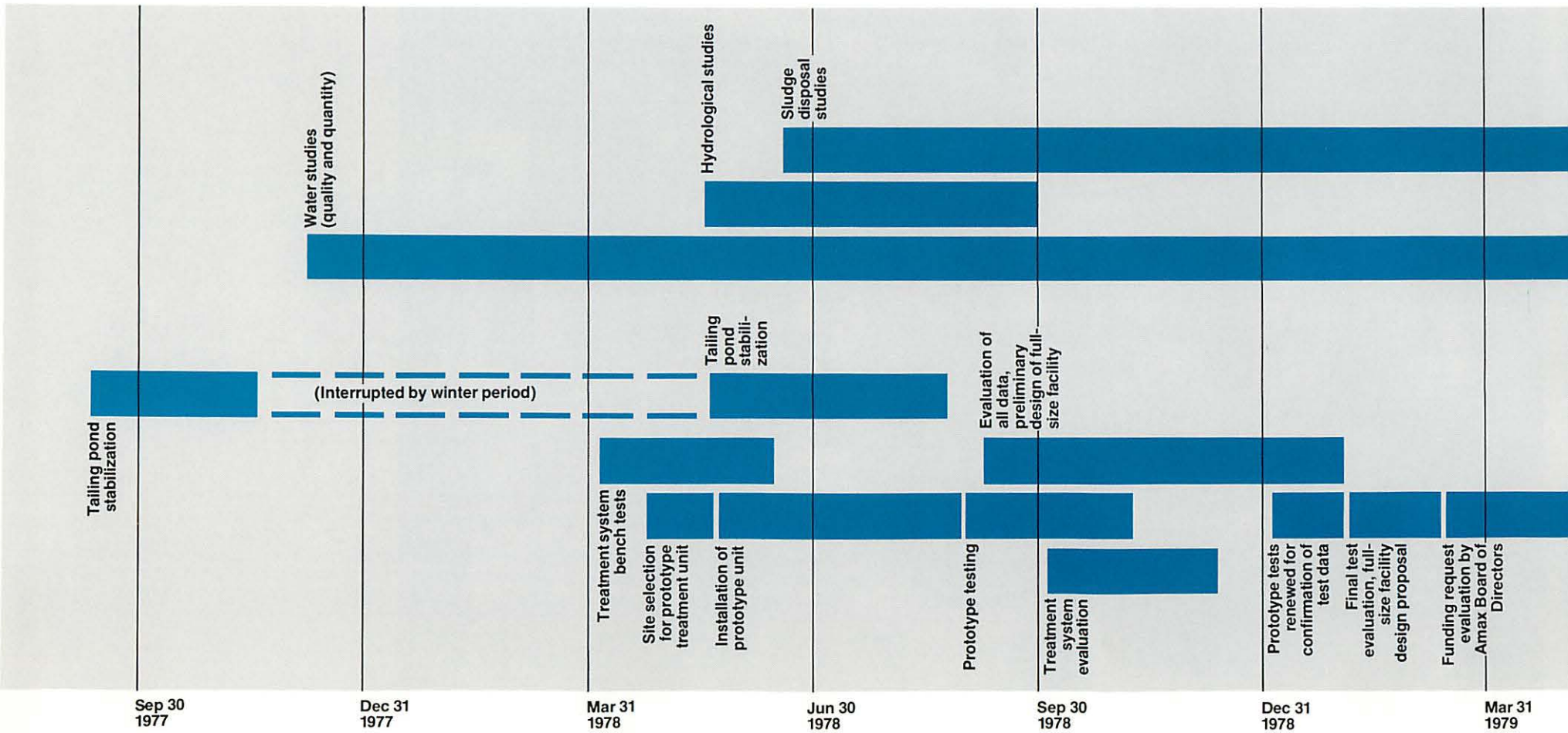
Besides testing the effectiveness of the Lectroclear system on Keystone Mine effluent, the prototype studies will identify the characteristics of the sludge and with this information, engineers can determine an environmentally acceptable disposal method.



## Timetable

Although time consuming, the chemical, physical, hydrological and sludge disposal studies are necessary in order to find the best method for solving the pollution problem from Keystone Mine. Temporary measures or those predicated on insufficient data could prove unreliable for the long term.

With the tailing dams stabilized and further deterioration of the creek unlikely, AMAX scientists and engineers are implementing a two-year



research and design program.

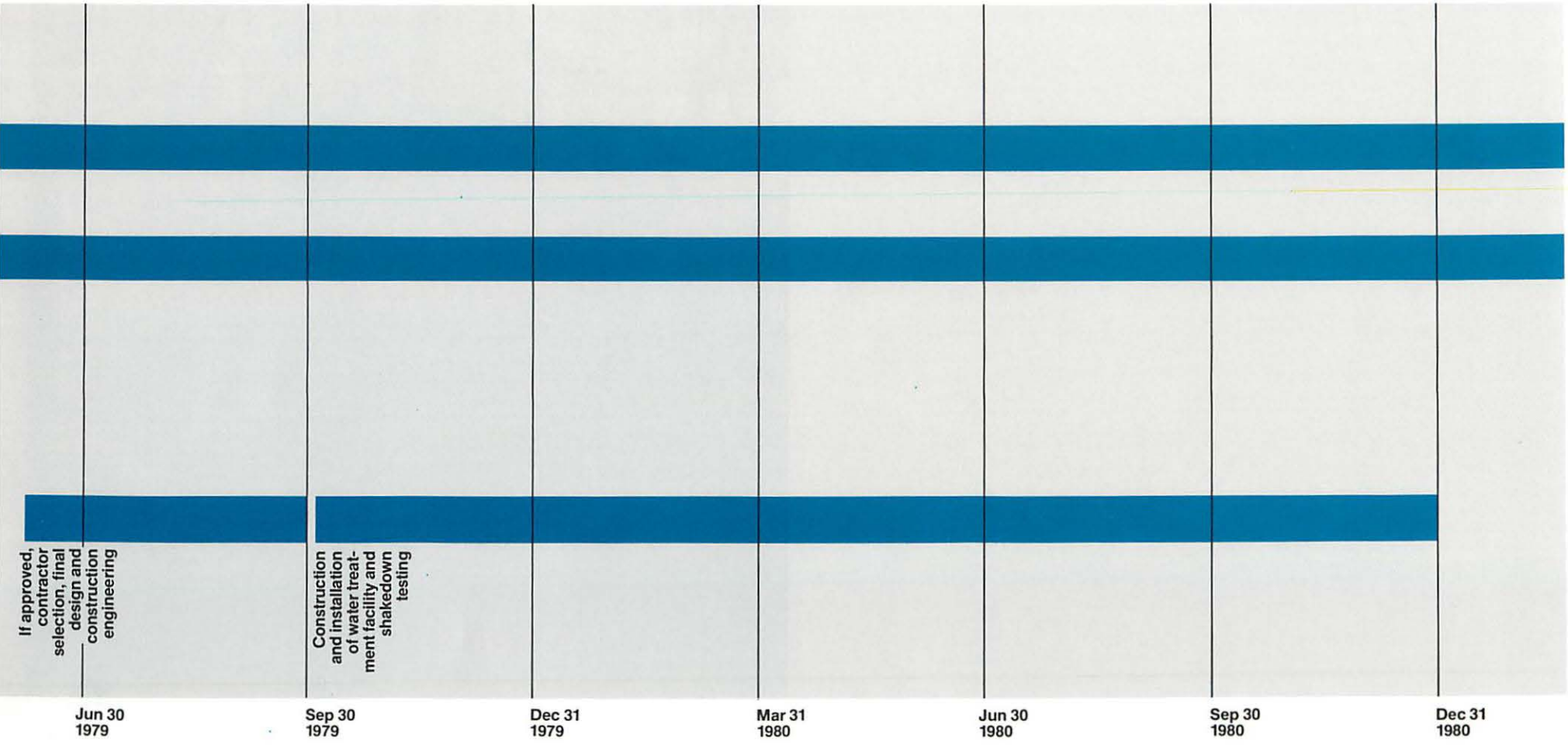
The schedule includes a 12-month study period of water characteristics and seasonal flow variations. The 12-month period, while not necessarily representative of long-term average or extreme conditions, should provide sufficient information on mine drainage and stream flow to allow rainfall and snow melt correlations. Hydrological studies will be done concurrently.

Installation of a test treatment facility will also occur during this period. Actual testing is scheduled to begin in the fall of 1978 and continue through early 1979.

Design of the full-scale pollution abatement facility will take about six months. It will include structural plans and specifications for water treatment, sludge disposal and flow reduction.

Allowing time for approvals by regulatory agencies and selection of a contractor, construction could begin in the fall of 1979. It will be completed and the facility fully operational by the end of 1980.

The costs for this program are estimated at $2 million.



**AMAX is committed to the people of Colorado to help maintain the air, water and natural environment that make the good life here what it is. Believing mining activities need not adversely affect people downstream, AMAX has pledged the cleanup of mine waters entering Coal Creek.**

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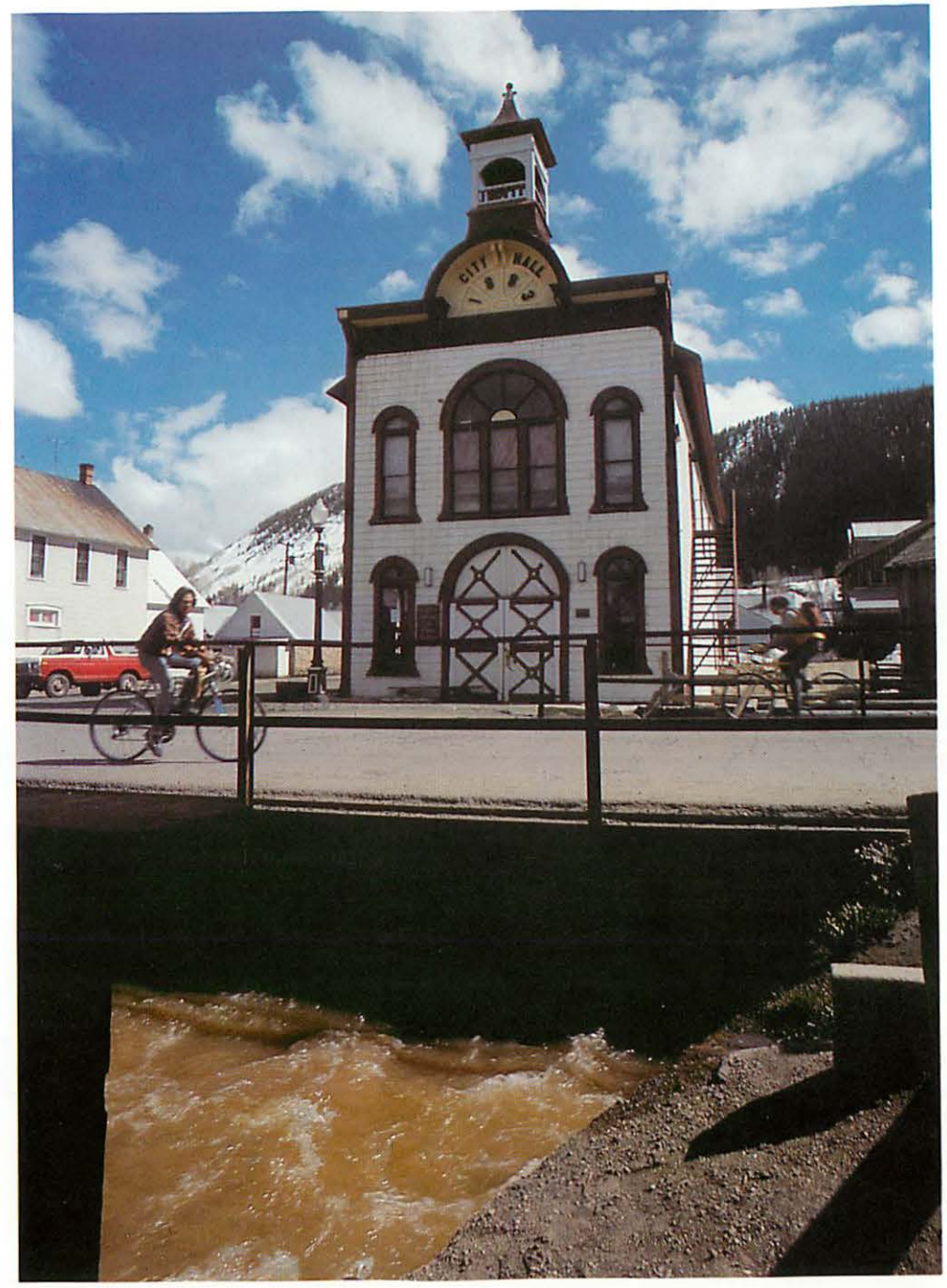

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