PAST MINING ACTIVITIES AND WATER QUALITY IN THE LYNX CREEK WATERSHED

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ABSTRACT

Lynx Lake Watershed consists of approximately 13,600 acres of the Agua Fria drainage. About 13 percent of the area is patented mining claims (mainly copper) with numerous mining shafts, waste dumps, and mill tailings. Lynx Creek itself was once mined for gold and the creek bed still shows the scars of the dredging operations. Drainage from the numerous old mining sites show a certain extent of toxic mineral and sediment pollution of the water resources in the area. Lynx Creek carries runoff which is slightly acidic in nature and has a high concentration of copper, manganese, iron, zinc, and sulfates. The Sheldon Mine complex is considered one of the major sources of pollution to the lake. Aquatic life and recreation potential of the watershed is greatly reduced by the water pollution problem. The pollutants from the abandoned mine sites enter into Lynx Lake, a trout fisheries lake, which was created by damming the creek in 1962 by the Arizona Game and Fish Department. The Sheldon Tailings pond was rehabilitated during the summer of 1975 as part of a reclamation study and demonstration project that is currently in progress and being sponsored by SEAM (Surface Environment and Mining). The study is being conducted cooperatively by the School of Renewable Resources, University of Arizona, and the Prescott National Forest. An excellent vegetative cover is established on the site and studies are being conducted to measure the beneficial effects of the reclamation on water quality.

SEAM (SURFACE ENVIRONMENT AND MINING)
SHeldon Mine Complex Reclamation Project

The Sheldon Mine Complex is located approximately eight miles southeast of Prescott, Arizona. It is in the Lynx Lake Watershed which consists of approximately 13,600 acres of the Agua Fria Drainage. The surface geology of the watershed is relatively complex with much intermixing of Bradshaw granite and Yavapai schist. Soil depths vary from 10 to greater than 40 inches. The watershed is bordered on three sides by steep mountain peaks and ridges with elevation ranges of 7,950 feet at Mount Davis to 5,500 feet at the spillway of the lake. Vegetation of the watershed varies from mixed conifer at the higher elevations to ponderosa pine and chaparral at the lower elevations. Average annual precipitation is about 23 inches and ranges from 9 to 29 inches.

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Gold was discovered in Lynx Creek in 1863. Numerous claims were located and recorded. Initially, the claims were for placer beds in the creeks and gulches. However, as minerals were discovered in lodes and ledges on the hillsides, lode claims were also located. Mining activities died down as the placer beds were exhausted and did not start again until improved mining techniques such as dredging and hydraulic mining were introduced to the area.

A number of underground mines were operated on and off until 1952. The Sheldon Mine was the largest in the area. It had a 1,300 foot deep inclined shaft with six drift levels, the deepest was at 1,250 feet and the uppermost at 150 feet from the surface. It is estimated that there are about five miles of drifts in the underground workings of this mine.

These mining activities have caused significant deterioration in water quality within and downstream from the mining sites. Mine drainage includes water flowing from underground mine shafts, surface runoff or seepage from mining dumps. Drainage from the numerous old mining sites shows a certain extent of toxic mineral and sediment pollution of the water resources in the area. The pollutants in the form of dissolved, suspended, or other solid mineral wastes and debris, enter into the stream or ground water. Aquatic life and recreational potential of the watershed is greatly reduced by the water pollution problem from the abandoned mines. The pollutants from the abandoned mines enter into the Lynx Lake which is located six miles southeast of Prescott. Lynx Lake, a trout fisheries lake, was created by a dam built in 1962 by the Arizona Game and Fish Department. The lake is 55 surface acres in size with the storage capacity of 1,500 acre feet of water. The lake is stocked with catchable trout due to the inability of the fish to reproduce.

The average yearly flow of sediment into the lake is 3,200 cubic yards. The sediment is slightly acidic in nature and has high concentrations of copper, manganese, iron, zinc, and sulfates. The Sheldon Mine Complex is considered one of the major sources of pollution.

1. Prescott National Forest, U.S.D.A., Forest Service
2. School of Renewable Natural Resources, University of Arizona
Many efforts to reclaim the Sheldon Mine Complex were proposed but never accomplished due to financial and land ownership problems. However, it was suggested that an effective vegetative cover on the site would not only enhance the aesthetics but would also reduce toxic mineral and sediment pollution into the creek.

The Forest Service is a land management agency that manages surface resources on over 187 million acres of National Forests and Grasslands, much of which are underlain with coal, phosphate and other minerals. Removing these, particularly by surface mining, would have a drastic effect on the resources such as soil, water, timber, wildlife, forage, and recreation.

The increasing need to direct additional attention toward mineral related problems made it necessary to coordinate Forest Service efforts with others involved in mining and reclamation. The Forest Service formed SEAM (Surface Environment and Mining) in 1972 to coordinate interagency reclamation efforts.

Basically, SEAM is an on-the-ground problem solving program planned to encompass the major mining regions of the nation, but initially concentrated in the West where there is a high interest in new mining development. The SEAM program has four basic objectives:

1. Determine the impacts of mining.
2. Develop criteria and techniques to minimize the impacts.
3. Evaluate concepts, practices or techniques in the field.
4. Develop recommendations and disseminate findings.

Currently, projects are being conducted in ten western states for the purpose of providing technical information and assistance to land managers and mining companies on the latest reclamation techniques. These projects are cooperative efforts involving ten universities, seven research work units and three research stations, plus individual states, mining companies, and other federal agencies.

It was under the SEAM program that it was possible to reclaim the Sheldon Mine Tailings Dump. This dump was formed by the waste from the mill working the ore that came out of the Sheldon Mine. The ore waste was pumped to the tailings dump through large wooden pipes. The project is being conducted through the coordinated efforts of the Forest Service and the School of Renewable Natural Resources, University of Arizona at Tucson. The project is aimed at reclaiming some of the abandoned mine spoils in the Lynx Creek watershed and monitoring of water quality in the creek to evaluate the effectiveness of the reclamation measures. Reclamation of the Sheldon Mine Tailings pond consisted of regrading the area to stable slope conditions, top dressing it with 15 tons of crushed lime per acre and six to eight inches of topsoil. Lime and soil top dressing treatments were necessary to provide a suitable growing media and also to help isolate and protect the surface media from upward movement of high acidity water. Prior to treatment, the pH values of the surface spoils material ranged from 2.0 to 2.5. Six samples taken 2 inches below the spoils material in late March 1976 had pH values ranging from 4.0 to 4.4 with an average of 4.26.

The face of the regraded tailings pond was hydrosseeded using a combination of wood fiber and a petroleum based emulsion. The emulsion was added as a binder. The rate of hydromulch application was 1,500 to 2,000 pounds per acre. The seed mixture was applied at a rate of 16 pounds per acre. The mixture consisted of Ranger Alfalfa, Black Medic, Pubescent Wheatgrass, Perennial Ryegrass, Common Vetch, Weeping Lovegrass, Hard Fescue, Lehman Lovegrass and Orchard Grass.

A diversion ditch was constructed along the upper edge of the tailings pond to divert runoff water from the upslope area. A contour trench was constructed on the face of the regraded slope.

The results up to date have been encouraging. An excellent vegetation cover was established within four to five weeks of seeding. Runoff and sediment control on the regraded tailings pond seemed quite effective. Some problems did occur in the diversion ditch. The gabion dropstructures failed and some very minor rilling also took place. The proper erosion control and maintenance measures have been performed since completion of the project.

Plans are presently being made to reclaim the overburden dump of the Sheldon Mine site. It is going to be a complex project due to land ownership patterns adjacent to the dump and the lack of information on the structural soundness of the waste dump. The latter is the most important and has to be determined before heavy equipment is allowed on the site.

In conclusion, we hope that the methodology and technological experience gained from the reclamation projects will provide invaluable information for reclaiming abandoned mining sites within the Ponderosa Pine Ecosystem.
REFERENCES CITED

Follett, Robert H. and Wilson, Jerry C. 1969. Pollution of Lynx Lake By Drainage From the Sheldon Mine; Arizona State Department of Health Services, Division of Water Pollution Control.
