



## TECHNICAL NOTE

Mailing List 1

Filing Code 3042

Date Issued 5/70

Bureau of Land Management U.S. DEPARTMENT OF THE INTERIOR

Subject: Annotated Bibliography of Reclamation Literature  
Pertaining to Western U. S.

1. Armstrong, W. H., Establish Drought-Tolerant Plants by Direct Seeding. California Division of Highways, Department of Public Works, October 1968.

This is a review of the progress of research at the University of California (Davis) toward establishing drought-tolerant plants by direct seeding methods. Plant species are being evaluated for drought-tolerance, aggressiveness, insect and disease resistance and appearance. Seeding methods are being designed to make optimum use of natural conditions. Soil temperatures, moisture readings and plant survival are tabulated.

2. Beerbower, R. C., Jr., Maintenance of Refuse-Disposal Areas. Coal Age, February 1968, pp. 102-106.

Discusses planning, design and location of preparation plant, spoils and tailings area. Based on U. S. Steel's coal mining operation at Maple Creek Mine, Pennsylvania.

3. Bergoffen, Gene S., A Digest (of) Strip-Mine Reclamation. U. S. Department of Agriculture, Forest Service, 1962.

This is a review and summary of published reclamation literature through mid-1961. Most of the reclamation research up to that time was being carried out in the eastern U. S., but some of the results and conclusions are applicable in the western states. The coverage includes a discussion of the characteristics of spoils and the influences these have on revegetation, selection of plant species and methods of planting, potential uses of strip-mined lands, and mining methods used. The stringency and administration of state strip-mine reclamation legislation is reviewed.

4. Bingham, E. R., and Chabot, L. E., White Pine's Program.  
Mining Congress Journal, August 1968, pp. 29-32.

Discusses maintenance of environmental quality and reclamation of disturbed lands from total operational standpoint - mine, mill and smelter. Located in northern Michigan.

5. Brooks, David B., Strip Mine Reclamation and Economic Analysis.  
Natural Resources Journal, Volume 6, No. 1, January 1966.

The author suggests that a rational allocation of resources (value of minerals vs. social costs resulting from extraction) can be made based on benefit-cost analysis. Goals used are national productivity, cultural and aesthetic values, and local employment (redistribution of income).

6. Chapman, A. G., Effects of Spoil Grading on Tree Growth.  
Mining Congress Journal, August 1967, pp. 93-100.

Discusses effects of grading spoil banks as to compaction of materials and resulting effects on water absorption, erosion and plant survival. Emphasis is on clayey soils; test results of tree species, soil types and various types of grading are listed.

7. Coal Age, Strip Coal Mining, The Total-Benefit Industry, April 1966.

This brochure emphasizes the coal industry viewpoints: economic contributions of the industry to national needs, voluntary reclamation of mined areas, economic considerations of reclamation. Some of the uses of reclaimed lands include timber, wildlife habitat, agriculture, urban development, water storage and recreation sites.

8. Coal Age, P&M Reclamation - Forests, Lakes, Recreation Centers,  
October 1966, pp. 100-107.

Reviews techniques used and results obtained on reclamation at Pittsburgh and Midway Coal Company mines nationwide. The Edna Mine at Oak Creek, Colorado and the McKinley at Gallup, New Mexico are in the western U. S. Revegetation at the McKinley Mine started in 1962; plantings include red cedar, ponderosa pine and fescue grass. At the Edna, native grass, scrub trees, Russian olive and various grasses have been planted.

9. Coltharp, G. B.; Cook, C. Wayne; and Jensen, I. Bernard, Methods and Techniques for Seeding Roadway Cuts and Fills on Interstate Systems in Utah, Annual Project Report and Work Plan, Project No. 684, Agricultural Experiment Station.

This study was initiated in 1965 at various Interstate Highway locations throughout the State of Utah. Some of the topics covered are: effect of mulches and fertilizers on seedling establishment; effect of drill types on seedling establishment; species adaptability; use of pre-emergent and post-emergent herbicides in weed control for seedling establishment. Plots are identified and specific treatments discussed.

10. Dean, Karl C.; Havens, Richard; and Harper, Kimball T., Chemical and Vegetative Stabilization of a Nevada Copper Porphyry Mill Tailing. U. S. Department of the Interior, Bureau of Mines, R. I. 7261, May 1969.

Tests were made on stabilizing windblown tailings at McGill, Nevada. Legumes, winter wheat, wheatgrasses and wild rye were seeded and protected with a resinous adhesive chemical until sprouting. Annual precipitation is about eight inches, strong winds common and tails were slightly basic (pH 7.3 to 7.5). Fertilizer was used; no irrigation. Costs are estimated at about \$135 per acre and probably could be reduced.

11. Dean, Karl C.; and Havens, Richard; and Valdez, E. G.; Utilization and Stabilization of Solid Mineral Wastes. U. S. Department of the Interior, Bureau of Mines. Presentation at the 16th Ontario Industrial Waste Conference, Niagara Falls, Ontario, June 1969.

Authors briefly reviewed possible uses for solid wastes from mines, mills and smelters. Stabilization techniques by chemical, physical, vegetative and combined methods are discussed in detail. Salient features, advantages and problems with each method are reviewed. Cost estimates for chemical stabilization are given. Vegetation studies are reviewed, including effects of salinity and heavy metals. Interaction of fertilizers with heavy metals, possible modification of structure or pH of tailings and dewatering tailings were studied. The chemical-vegetative stabilization test at McGill is reviewed.

12. Gordon, I. M., Erosion Control at Hollinger Mine Tailing Site. Canadian Mining Journal, June 1969, pp. 46-49.

This discusses establishing a vegetative cover on mill tailings (pH 7.0-7.4) at Timmons, Ontario by the Hollinger Consolidated Gold Mines, Ltd. Fertilizer rates, seedings and grass species are listed. A novel aspect is use of sewage sludge on one area; highly successful. Scrub trees are planted as wind-break, and conifers will be planted in subsequent years for future timber.

13. Grubb, Hayes F., The Feasibility of Vegetating Mine Tailing at Climax, Colorado. Master's Thesis, Colorado State University, August 1965.

This study was made to determine the feasibility of establishing vegetation on the mill tailings at Climax. The site is at an elevation of 11,000 feet in central Colorado. Mean annual precipitation is about 23 inches, but the growing season is very short - the general environment is near alpine. The study included particle size distribution, cation exchange capacity, hydrogen ion activity, nutrients and trace minerals. Various plant species were tested in the greenhouse and field. It was determined that nutrients must be added, the pH raised and the surface stabilized for survival of vegetation.

14. Gwynn, Thomas A., Rehabilitation of the Lignite Areas of North Dakota Following Surface Mining. Knife River Coal Mining Company, Bismarck, North Dakota, April 1965.

See: Reclaiming Strip-Mined Land in North Dakota by Establishing Game Management Areas, January 1965.

15. Gwynn, Thomas A., Reclaiming Strip-Mined Land in North Dakota by Establishing Game Management Areas. Knife River Coal Mining Company, Bismarck, North Dakota, January 1965.

The author gives a review of strip mine problems and reclamation in North Dakota. The Knife River Coal Mining Company reclamation of its properties in North Dakota and Montana dates from 1963. Soil analyses and fertility tests of the soils were made. Wildlife habitat was selected as the optimum use of the mined lands. A wide variety of grasses, shrubs and trees were tested in diverse sites - 20,000 seedlings planted in 1964. Information is given on tree survival by site and species, recommended hand planting methods for trees, and effect of spoil bank grading.

16. Gwynn, Thomas A., Reclaiming Strip-Mined Land by Establishing Game Management Areas. Knife River Coal Mining Company, Bismarck, North Dakota, July 1966.

This is a follow-up report of work done by Knife River Coal Mining Company on properties in North Dakota and Montana. Over 156,000 seedlings were planted during 1965 at various sites. Preliminary observations were made on plant survival. Wildlife use is considerable. This program is compared with reclamation progress in other states.

17. Gwynn, Thomas A., An Improved Environment through Intelligent Mined-Land Reclamation. Paper presented at the SME Fall Meeting; Rocky Mountain Minerals Conference, Salt Lake City, Utah, September 19, 1969.

Summarizes recent legislation in field of mined-land reclamation, stressing that mining companies must cooperate in securing just, realistic reclamation laws.

18. Hafenrichter, A. L., et al., Grasses and Legumes for Soil Conservation in the Pacific Northwest and Great Basin States. U. S. Department of Agriculture, Soil Conservation Service Handbook 339, April 1968.

Experimental work on grasses and legumes over the past 32 years at various Soil Conservation Service plant material centers in Washington, Oregon, California, Nevada and Utah is summarized. Plants are grouped by rapid-developing short-lived grasses, saline- and alkali-tolerant, drought-resistant long-lived bunch and sod grasses, bluegrasses, five-leveled grasses and legumes. Characteristics, adaptability, uses and planting of each is discussed. Maps of the agricultural zones of each state are given.

19. Havens, Richard and Dean, Karl C., Chemical Stabilization of the Uranium Tailings at Tuba City, Arizona. U. S. Department of the Interior, Bureau of Mines RI 7288, August 1969.

Acid and basic uranium mill tailings at Tuba City, Arizona were stabilized against wind erosion by use of an elastomeric polymer on the dike areas and a calcium magnesium ligno-sulfate on the beach areas. Cost was \$335 per acre for the 34.5 acre tract. Details as to methods of application and cost breakdown are given.

20. Horton, Jerome S., Trees and Shrubs for Erosion Control in Southern California Mountains. California State Board of Forestry, Department of Natural Resources, 1949.

Discusses trees and shrubs that have proved adaptable to planting in eroding areas of the Southern California Mountains. It also briefly describes the different types of eroding areas, outlines conditions that restrict the choice of what and where to plant and suggests special precautions that are necessary to establish the selected species successfully. (Source: Al Thompson, Portland Service Center)

21. Jacoby, Pete W., Jr., Revegetation Studies on Coal Spoil Banks in Southwestern Wyoming. Master's Thesis, University of Wyoming, January 1968.

This was a second phase of study at the Sorensen Coal Mine following Lujan's work. Tests were made of crested and intermediate wheatgrasses, Russian wildrye, smooth brome grass and alsike clover on various ages of spoils. Treatment included mulch, jute net, snowfence, irrigation and combinations of these. Succession of native, invading and introduced plants was noted. Economic evaluation of the treatments is given.

22. Jacoby, Pete W., Jr., Revegetation Treatments for Stand Establishment on Coal Spoil Banks. Journal of Range Management, March 1969, Volume 22, No. 2, pp. 94-97.

See: Revegetation Studies on Coal Spoil Banks in Southwestern Wyoming.

This is a short summary of the research, results and conclusions.

23. Johnson, Craig, Practical Operating Procedures for Progressive Rehabilitation of Sand and Gravel Sites. National Sand and Gravel Association, Silver Spring, Maryland, 1966.

This is a general presentation of operating methods and reclamation of sand and gravel deposits. These are usually exploited in urban areas so the emphasis is on rather intensive development. Some application, especially of pre-mine planning suggestions, may be made to other mineral development in less populated areas. Equipment characteristics and recommendations are given.

24. Lujan, Leandro E., Revegetation of Strip-Mined Areas in Southwestern Wyoming. Master's Thesis, University of Wyoming, August 1966.

This study was made at the Sorensen Coal Mine testing native and introduced grasses, shrubs and trees (emphasis on latter) for survival in strip-mine spoil piles. Various combinations of irrigation, fertilization and site orientation were tried. Soil analyses, moisture content and some soil temperatures are given. The mean annual precipitation is about nine inches. Survival rates are given and evaluations made.

25. May, Morton, Mine Reclamation in the Western States. Mining Congress Journal, August 1967, pp. 101-105.

Reviews problems and research findings as to mined-land reclamation in the western United States. The major problems of this area are lack of moisture and selection of desirable plant species adaptable to revegetation of the area. Diversity of problems and need for study are emphasized.

26. Neumann, G. W., Tailings Disposal of No. 12 and No. 6 Concentrators at Brunswick Mining and Smelting Corporation, Ltd. Canadian Mining Journal, June 1969, p. 60.

Construction details are given for tailing storage and effluent settling ponds designed to avoid pollution of local streams. Soluble zinc and copper are removed by addition of lime to give a pH of 9.5+.

27. Peters, T. H., The Use of Vegetation to Stabilize Mine Tailings Areas at Copper Cliff. Presented at the annual meeting of the Mines Accident Prevention Association of Ontario, May 1969.

See: Young, C. A., The Use of Vegetation to Stabilize Mine Tailings at Copper Cliff. Canadian Mining Journal, June 1969, pp. 43-45.

28. Peterson, Howard B., and Monk, Ralph, Vegetation and Metal Toxicity in Relation to Mine and Mill Wastes. Utah State University (Logan) Utah Agricultural Experiment Station, Circular 148, September 1967.

This annotated bibliography of the literature relating to effects of metal toxicity on plants is indexed by specific elements found in mine, mill and smelter wastes.

29. Progress for Stabilization of Federal Aid Highways in New Mexico, 1965-1970: Project Report, New Mexico State Highway Department, 1969.

Stabilization seedings were made to reduce soil erosion on rights-of-way and to protect adjacent lands from siltation and pollution. Long fibre mulches, applied with asphalt, were most effective in stabilizing soil, reducing erosion and encouraging grass growth and survival on critical areas. Low cost methods, such as broadcast seeding with little or no bed preparation, were generally not successful. Competition by desirable species appeared to be the most effective and cheapest weed control. Natural revegetation of New Mexico roadsides normally takes three to five years on relatively stable areas with seed source from adjoining rangelands. During the five year period the State Highway Department had 19 stabilization seeding contracts. All were successful; results and costs are detailed.

30. Reilly, J. D., Planning Surface Mine Reclamation before Mining. Mining Congress Journal, November 1965, pp. 93-96.

Stresses need for pre-mine planning of reclamation. Considerations are economics, revegetation, erosion, water conservation and aesthetics. Potential land uses must be considered - recreation, forage, timber and urban development.

31. Schellie, Kenneth L. and Rogier, David L., Site Utilization and Rehabilitation Practices for Sand and Gravel Operations. National Sand and Gravel Association, Silver Spring, Maryland, 1963.

This is a guide for pre-planning the useful adaptation of land after extraction of minerals. Since it is concerned with sand and gravel operations, the emphasis is on the intensive land uses found in urban areas. However, some of the material is applicable to mining projects involving other minerals in less populated areas. The authors stress long-range pre-use planning to ensure legal availability of deposits and proper subsequent land use. Various land uses and site requirements of each are given. Site improvement practices - involving grading, soils and planting - are described.



32. Schellie, Kenneth L. and Bauer, Anthony M., Shaping the Land-Planned Use of Industrial Sand Deposits. National Industrial Sand Association, 1968.

The authors point up the need for preliminary site planning, before mining begins, to realize the highest potential use of the mined-land. Industrial sand deposits and the usual extractive processes are suggested. The planning procedure, plan elements and objectives are discussed.

33. Stark, N., Review of Highway Planting Information Appropriate to Nevada. University of Nevada, College of Agriculture, Bulletin No. B-7, 1966.

The ecological factors involved are briefly summarized. Criteria for various types of plantings are given: intensive-beautification, intermediate, nonintensive, erosion control and miscellaneous. The problems related to highway plantings are discussed; many of these are applicable to revegetation of any disturbed area. Weed control, need for seed information and sources, water and fertilizer requirements, various mulches and other special problems are considered. Highway planting programs of other states are reviewed. A detailed list of plants is given by vegetation zones. Soil and moisture requirements, insect and disease resistance, seed source and general characteristics of each plant are listed.

34. Sullivan, G. Don, Current Research Trends in Mined-Land Conservation and Utilization. Mining Engineering, March 1967, pp. 63-67.

A review of the research on mined-land reclamation currently underway by the coal industry. The work is centered principally in the eastern states with some interest and research starting in the Midwest, North Dakota and Wyoming. Areas of interest include revegetation, soil chemistry (spoils), hydrology and earth movement.

35. Thompson, Wesley W., Cover Establishment on Strip-Mined Area Using Two Rhizomatous Grass Species. Master's Thesis, University of Wyoming, January 1969.

This study at the Sorensen Coal Mine tested sprigging and sodding of two species of grasses in spoil piles. Species tested were Inland saltgrass (*Distichlis spicata* var *stricta*) and Western wheatgrass (*Agropyron smithii*). Comparisons were made of the grasses, the two planting methods, seasons of planting, influence of age of spoils, orientation of slope and influence of protection (snowfence). Soil analyses, moisture readings and soil temperatures were compiled. Survival rates are given and evaluations made.

36. U. S. Atomic Energy Commission. Erosion Control Uranium Mill Tailings Project, Monticello, Utah. RMP-3005, December 1963.

This project involved stabilization and revegetation of 40 acres of mill tailings at Monticello, Utah. Average annual precipitation is quoted at 14 inches. Tailings were graded, covered with rock, sand and topsoil. Both commercial fertilizer and manure were added and grasses seeded with rangeland drill. Some watering was done to germinate the spring seeding. Costs were quoted at \$190,000. Report lists seeding, soil analyses as to pH, radiation readings, fertilizer applied, material moved, equipment used and evaluation of reports.

37. U. S. Department of Agriculture. Restoring Surface-Mined Land. Miscellaneous Publication No. 1082, April 1968.

The extent of surface damage from mining is briefly reviewed. Tabulations are presented showing acreage of damaged land by commodity, mining method, state, ownership, age of mines, etc. Various aspects of the damage are considered - onsite and offsite effects. Accomplishments in reclamation, land treatment, research and legislation are reviewed.

38. U. S. Department of Health, Education and Welfare. Disposition and Control of Uranium Mill Tailings Piles in the Colorado River Basin. Federal Water Pollution Control Administration, March 1966.

This report is a survey of mill tailings at idle and active uranium mills in the Colorado River Basin - western Colorado, eastern Utah, northeast New Mexico and northwest Arizona. Long-range health hazard potential and possible pollution of groundwaters are considered. Treatment methods are recommended and costs estimated.

39. Waldbieser, William C., Development of Equipment for Cast Overburden Reclamation. Mining Congress Journal, July 1968, pp. 50 and 51.

Reviews the need for more economical equipment or methods for the reclamation phase of strip-mining operations. Discusses enlarged trenchers or backhoes, use of booster draglines and wheel excavators.

40. Young, C. A., The Use of Vegetation to Stabilize Mine Tailings Areas at Copper Cliff. Canadian Mining Journal, June 1969, pp. 43-45.

This article describes the methods International Nickel Company used to stabilize and secure vegetative cover on tailings at Copper Cliff, Ontario. Details as to preparation, seeding and fertilization are given. The tailings have a pH of 4.0. Grass has been established on over 500 acres.

41. 1968 Fiscal Year Annual Report, Highway Beautification. Los Lunas Plant Materials Center, New Mexico, 1968.

A total of 161 varieties or accessions of plants are being evaluated at the Los Lunas Plant Materials Center for use in roadside stabilization, beautification and conservation. Field evaluations will be made on many of these. Fertilizer tests have been made along Interstate 25. An excelsior soil retention blanket has proved successful in protecting ditch bottoms and berm areas from water erosion. Sites are listed, sample seeding instructions are given and test results of various species are discussed.

