Directory of Mine Waste Characterization and Drainage Quality Contacts in Western Governors' Association Member States



Minnesota Department of Natural Resources Division of Minerals

September 1991

Directory of Mine Waste Characterization and Drainage Quality Contacts in Western Governors' Association

Member States

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PREFACE

Contained within this directory are contacts with access to information on metal mine waste characterization, metal mine drainage quality, and drainage quality prediction for each of the twenty-one Western Governors' Association (WGA) member states.

Each state was contacted and asked to provide names, addresses, phone numbers of people with access to information on ten topics relevant to mine waste characterization and drainage quality. The request, in the form of a questionnaire, was sent to WGA contacts as well as other people in associated departments and the information received was compiled. Ten questions listed for each state are followed by the contacts used to get the information requested. When necessary, an explanatory paragraph precedes the contact list. In some cases, supplemental information such as a mine or reference list is placed in appendices.

Listed below are the ten topics used to solicit the information contained herein for each state.

- 1. Metal mines list.
- 2. Mine waste disposal list.
- 3. Mine geology and/or processing methods descriptions.
- 4. Mine waste composition/drainage quality data.
- 5. Summaries of data on mine waste composition/drainage quality.
- 6. Drainage quality predictive test list.
- 7. Summary of predictive test results.
- 8. Description of mine waste samples available for testing.
- 9. Mine waste samples.
- 10. Any publications or other information on mine drainage quality.

The compilation of this directory was funded by the United States Environmental Protection Agency through the Western Governors' Association.

ALASKA MINE WASTE DRAINAGE QUALITY CONTACTS

1. Metal mines list

A comprehensive listing of current or historic mining is not available from any one source. A new Alaska reclamation law scheduled to go into effect October 1991 will work toward one comprehensive listing of active mines across the state, regardless of land classification. This law will be administered by the Alaska Department of Natural Resources.

Department of Natural Resources Division of Mining P.O. Box 107016 Anchorage, AK 99510-7016 Sam Dunaway (907/762-2171) Acting Director FAX (907/563-1853)

The various land managers that will have information on mining activity under their jurisdictions are:

U. S. Forest Service P.O. Box 21628 Juneau, AK 99802 Roger W. Griffin (907/586-7867) Group Leader, Minerals and Geology FAX (907/586-7843)

U. S. Bureau of Land Management 222 West 7th Avenue #13 Anchorage, AK 99513-7599 John Santora (907/271-3343) Chief, Minerals Section FAX (907/272-2249)

Alaska Department of Natural Resources Division of Mining P.O. Box 107016 Anchorage, AK 99510-7016 Judd Peterson (907/762-2160) Chief, Permitting and Field Operations FAX (907/563-1853) Although extensive studies have not been conducted on abandoned mines in the state, some information is available from the U. S. Department of the Interior, Bureau of Mines.

United States Department of the Interior Bureau of Mines Alaska Field Operations Center 201 East 9th Avenue, Suite 101 Anchorage, AK 99501 Donald P. Blasko (907/271-2455) Director FAX (907/277-8734)

2. Mine waste disposal facilities list

Information on mine waste disposal facilities is available from the Department of Environmental Conservation.

Department of Environmental Conservation 3220 Hospital Drive P.O. Box 0 Juneau, AK 99811-1800 John A. Sandor (907/465-2600) Commissioner FAX (907/465-2617)

The structural stability of tailings impoundments is a responsibility of the Department of Natural Resources, Division of Land and Water Management.

Alaska Department of Natural Resources Division of Land and Water Management 3601 C Street, Suite 814 Frontier Building P.O. Box 107005 Anchorage, AK 99510-7005 Gary Gustafson (907/762-2692) Director FAX (907/762-2529)

3. Mine geology and/or processing methods descriptions

For information on these subjects contact the Division of Geological and Geophysical Surveys; or the U. S. Department of the Interior, Bureau of Mines (see #1). The Department of Commerce and Economic Development is the source to contact for the annual mining activity report.

Department of Natural Resources Division of Geological and Geophysical Surveys 794 University Avenue Fairbanks, AK 99709-3645 Thomas Smith (907/451-2760) Acting Director FAX (907/479-4779)

Department of Commerce and Economic Development 1001 Noble Street, Suite 360 Fairbanks, AK 99701 Richard (Dick) Swainbank (907/452-7464) Development Specialist, Mining and Minerals FAX (907/456-8173)

4. Mine waste composition/drainage quality data

Alaska has complex land ownership including vast regions of state, federal, and private lands. The state and federal lands are divided into large blocks of various land classifications including federal wilderness areas, state and federal conservation units, parks, forests, Bureau of Land Management lands, state lands, and numerous other categories of state and federal lands. Historically, at one time or another mining has taken place on most of these lands across the state. Each land manager has the responsibility of keeping track of mining on lands under his/her jurisdiction.

Certain environmental management agencies have been given some jurisdiction and permitting authority over most metal mining operations, regardless of the land classification and surface land manager. With regard to mine discharge quality and receiving stream water quality the following agencies have jurisdiction:

> Alaska Department of Environmental Conservation P.O. Box 32420 Juneau, AK 99803 Deena Henkins (907/465-2653) Chief, Wastewater and Treatment Section FAX (907/789-6762) Doug Redburn (907/465-2653) Chief, Water Quality Management FAX (907/789-6762)

U. S. Environmental Protection Agency 222 West 7th Avenue #19 Anchorage, AK 99513 Mr. C. D. Robinson, Jr. (907/271-5083) Chief, Field Operations Section FAX (907/271-3424)

5. Summaries of data on mine waste composition/drainage quality

The Department of Environmental Conservation (see #2) publishes the Annual Mining Report which contains information on the impact of mine waste drainage.

Additional information regarding stream water quality and groundwater data from sources near mines is available in publicized form from the Publications Section of the Division of Geologic and Geophysical Surveys.

Department of Natural Resources Division of Geological and Geophysical Surveys Publications Section 749 University Avenue Fairbanks, AK 99709-3654 Joyce Outten (907/474-7147) Publications Technician FAX (907/479-4779)

6. Drainage quality predictive test list

No Alaska agency has compiled a predictive test list.

7. Summary of predictive test results

The results of predictive tests within the state have not been summarized.

8. Description of mine waste samples available for testing

The state does not keep a library of mine waste samples available for testing. Descriptions of mine waste samples may be available from the individual mines (see #1 for list of mines).

9. Mine waste samples.

See #8. Contact individual mines for information on obtaining mine waste samples.

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10. Any publications or other information on mine drainage quality

A list of publications is contained in Appendix 1.

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ARIZONA MINE WASTE COMPOSITION AND DRAINAGE QUALITY CONTACTS

Beyond the standards required by the Bureau of Land Management and the Forest Service, the Arizona Department of Environmental Quality (ADEQ) regulates all potential discharges to groundwater including mine wastes under the Aquifer Protection Permit (APP) Program. The APP Program requires mines to utilize the Best Available Demonstrated Control Technology (BADCT) to control discharges to groundwater to the maximum extent practical. The BADCT required will vary by type of waste, although an attainment of no discharge is required where practical. Mines must also demonstrate that current Aquifer Water Quality Standards (currently equivalent to the Federal MCLs) will be maintained at a point of compliance no farther than 750 feet downgradient from the waste disposal area. A facility may use site specific conditions as a component of their control technology if it can be demonstrated that the site conditions will reduce discharge equivalent to that of using an optimum BADCT. Groundwater monitoring is usually required with alert levels set on the mobile inorganic (indicator) parameters, such as sulfate. APPs require the closure and post-closure of mining activities to the extent that any reasonable probability of further discharge and/or of violating AWQS is eliminated. This normally includes permanent isolation or neutralization of the mining wastes and a period of post-closure groundwater monitoring.

New mines are required to obtain APPs prior to commencing operations. Existing mines, including the major copper mines, are being asked to submit applications on a time frame relative to their position on a priority point list. Major modifications to a mine's disposal or operational practices are deemed to be new facilities.

1. Metal mines list

The Department of Mines and Mineral Resources annually publishes the Directory of Active Mines in Arizona, which includes a listing of active mines within the state. A database known as the Arizona Mineral Industry Location System (AzMILS) is updated on a continuous basis by the Department of Mines and Mineral Resources and includes data on mine names, commodities, topographic quadrangle location, and location by legal description. There is currently no list of the estimated 10,000 to 40,000 abandoned mines. Some information concerning them, specifically historical backgrounds, may be obtained through the Department of Mines and Mineral Resources.

> Department of Mines and Mineral Resources Mineral Building - State Fair Grounds 1826 West McDowell Road Phoenix, AZ 85004 Leroy Kissinger (602/255-3791)

Both State and Federal Mine Inspection agencies have lists of currently operating mines.

Mine Safety and Health Administration 3221 North 16th Street Phoenix, AZ 85016 (602/640-2030)

Office of State Mine Inspector 4th Floor, Capitol Tower 1700 West Washington Phoenix, AZ 85007 (602/542-5971) FAX (602/542-5335)

2. Mine waste disposal list

The ADEQ has Notices of Disposal (NODs) or permits for all mining facilities in the state. Existing facilities not yet permitted have submitted NODs which generally describe the activities occurring at each mine including waste types and disposal.

> Arizona Department of Environmental Quality Water Permits Unit Room 202 2005 North Central Avenue P.O. Box 600 Phoenix, AZ 85001-0600 Abigail Myers (602/257-6825) FAX (602/257-6873)

The State Mine Inspectors Office has an active and abandoned mine inventory. Some analyses of tailings are also kept in their files.

> Office of State Mine Inspector 4th Floor, Capitol Tower 1700 West Washington Phoenix, AZ 85007 Doug Martin (602/542-5971) State Mine Inspector FAX (602/542-5335)

A description of mine waste disposal facilities at specific mines may be acquired by contacting the mines directly or by contacting the State and Federal Mine

Inspectors (see #1).

3. Mine geology and/or processing methods descriptions

The base metal mines generally utilize two processing methods: flotation concentration with smelting; and acid heap leach with solvent extraction/electrowinning. Currently there are also one active and two pilot in-situ acid leach projects. Precious metal mines utilize heap or vat leaching methods (cyanide, bromide, thiourea) and/or flotation concentration. For further information, contact the individual mines, the Department of Mines and Mineral Resources (see #1), the Office of the State Mine Inspector (see #2), the ADEQ (see #2), or the following:

> Arizona Geological Survey 845 North Park Avenue, Room 100 Tucson, AZ 85719 Larry D. Fellows (602/882-4795) FAX (602/628-5106)

The Department of Mines and Mineral Resources has limited information on mine geology and processing methods and reports that more detailed information may be procured from the mines directly (see #1 for information on contacting either the Department of Mines and Mineral Resources or the individual mines). The State Land Department can also provide limited information on mine geology and processing methods.

State Land Department Department of Natural Resources 1616 West Adams Phoenix, AZ 85007 Michael Rice (602/542-4628) Geologist FAX (602/542-2590)

Additionally, the State and Federal Mine Inspection Agencies (see #1) have information on processing methods at operating mines.

Limited geological information may be found at the following:

Department of Geology and Mineral Technology University of Arizona Tucson, AZ 85721 (602/621-2211) FAX (602/621-2672)

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4. Mine waste composition/drainage quality data

The Department of Mines and Mineral Resources (see #1) has publications on file (open-file reports, circulars, and maps) which provide information on government agencies that address mining related questions (see #10).

See also ADEQ and Office of the State Mine Inspector (see #2).

5. Summaries of data on mine waste composition/drainage quality

See ADEQ and Office of the State Mine Inspector (see #2).

6. Drainage quality predictive test list

See ADEQ and Office of the State Mine Inspector (see #2).

Much of the attention directed toward abandoned mines deals with procedures to prevent people from falling into them. Few resources have been applied to sampling or testing mine tailings or waste dumps.

7. Summary of predictive test results

See ADEQ and Office of the State Mine Inspector (see #2).

8. Description of mine waste samples available for testing

Information on the types of mine waste samples available for testing is most readily obtained from the Arizona Mining Association.

Arizona Mining Association 2702 North 3rd Street Suite 2015 Phoenix, AZ 85004 Dave Ridinger (602/266-4416) President FAX (602/266-4418)

See also ADEQ and Office of the State Mine Inspector (see #2).

9. Mine waste samples

See #8.

10. Any publications or other information on mine drainage quality

Numerous articles relate to mine drainage and are cited below.

Arizona Department of Mines and Mineral Resources. 1989. C5: Data concerning mining related state and federal agencies, 1989. AZ Dept. of Mines and Mineral Resources. Phoenix, AZ.

. 1989. C23: Federal agencies concerned with mining and mineral resources in Arizona, 1989. AZ Dept. of Mines and Mineral Resources. Phoenix, AZ.

. 1989. C24: State agencies concerned with mining and mineral resources in Arizona, 1989. AZ Dept. of Mines and Mineral Resources. Phoenix, AZ.

. 1989. C25: County agencies concerned with mining and mineral resources in Arizona, 1989. AZ Dept. of Mines and Mineral Resources. Phoenix, AZ.

_____. 1991. Directory of active mines in Arizona, 1991. AZ Dept. on Mines and Mineral Resources. Phoenix, AZ. 16 p.

_____. 1991. List of available publications. AZ Dept. of Mines and Mineral Resources. Phoenix, AZ. 5 p.

. 1989. M89-1: Active mines map. AZ Dept. of Mines and Mineral Resources. Phoenix, AZ.

Bain, Diane. 1990. OFR90-5: Publications of the Department of Mines and Mineral Resources from 1939 to 1990. AZ Dept. of Mines and Minerals. Phoenix, AZ. 15 p.

. 1987. C14: Reference material list-Phoenix office. AZ Dept. of Mines and Minerals. Phoenix, AZ.

Niemuth, N. J. 1990. C29: Arizona mining update. AZ Dept. of Mines and Mineral Resources. Phoenix, AZ.

Phillips, K. A. 1985. C10: Services and help from the Arizona Department of Mines and Mineral Resources. AZ Dept. of Mines and Mineral Resources. Phoenix, AZ. Two additional articles related mining in Arizona are found in the following book:

Lootens, D.J., Greenslade, W.M., and Barker J.M. 1991. Environmental Management for the 1900's. Proceedings of the Symposium on Environmental Management for the 1990's, Society for Mining, Metallurgy, and Exploration Inc. Denver, CO, February 25-28.

The two articles are entitled:

- Arizona's Aquifer Protection Permit Regulations and Some Implications for the Mining Industry by A.A. Myers and M.A. Milczarek, p. 7.
- Controls on Acid Water Migration in the Pinal Creek Alluvial Aquifer, Globe-Miami Mining District, Arizona by J.R. Norris, G.R. Walter, and T.A. Conto, p. 157.

CALIFORNIA MINE WASTE DRAINAGE QUALITY CONTACTS

1. Metal mines list

At least two lists of mines are currently being developed. John Rapp at the Division of Mines and Geology compiled the "Rapp file", which lists all active mines and some abandoned mines in the state. Barry Montoya of the Central Valley Regional Water Quality Control Board was also compiling a list of abandoned mines in the central valley region.

Department of Conservation Division of Mining and Geology P.O. Box 2980 Sacramento, CA 95812-2980 John Rapp (916/322-3119) Senior Geologist FAX (916/327-1853) or (916/324-1396)

Central Valley Water Quality Control Board Region 5 3443 Routier Road Sacramento, CA 95827-3098 Barry Montoya (916/361-5692) Sanitary Engineer Associate FAX (916/361-5686)

2. Mine waste disposal facilities list

As a general rule, mine waste is discharged on site. Consequently, the active mine list (see #1) should answer this question.

Additionally, lists of mine waste disposal facilities may be derived from the databases of all regulated facilities maintained by the nine Regional Water Quality Control Boards in the state:

North Coast Region (Region 1) 1440 Guerneville Road Santa Rosa, CA 95403 John Hannum (707/576-2220) Senior Water Resource Control Engineer Dave Evans (707/576-2220) FAX (707/523-0135) San Francisco Bay Region (Region 2) 1800 Harrison Street Suite 700 Oakland, CA 94612 Steven R. Ritchie (415/464-1255) Executive Officer FAX (415/464-1380)

Central Coast Region (Region 3) 1102A Laurel Lane San Luis Obispo, CA 93401 William R. Leonard (805/548-3147) Executive Officer FAX (805/543-0397)

Los Angeles Region (Region 4) 101 Centre Plaza Drive Monterey Park, CA 91754-2156 Robert P. Ghirelli (213/266-7500) Executive Officer FAX (213/266-7600)

Central Valley Region (Region 5) 3443 Routier Road Sacramento, CA 95827-3098 William H. Crooks (916/361-5600) Executive Officer FAX (916/361-5686)

Lahontan Region (Region 6) 2092 Lake Tahoe Boulevard P.O. Box 9428 South Lake Tahoe, CA 95731-2428 Harold J. Singer (916/544-3481) Executive Officer FAX (916/544-2271)

Colorado River Basin Region (Region 7) 73-271 Highway 111 Suite 21 Palm Desert, CA 92260 Philip Gruenberg (619/346-7491) Executive Officer FAX (619/341-6820) Santa Ana Region (Region 8) 6809 Indiana Avenue Suite 200 Riverside, CA 92506 Gerard J. Thibeault (714/782-4130) Executive Officer FAX (714/781-6288)

San Diego Region (Region 9) 9771 Clairemont Mesa Boulevard Suite B San Diego, CA 92124 Ladin H. Delaney (619/265-5114) Executive Officer FAX (619/571-6972)

3. Mine geology and/or processing method descriptions

In general these descriptions can be found in the report of waste discharge filed by the mining companies pursuant to Chapter 15 regulations. Accessing these reports involves querying the Regional Water Quality Control Boards (see #2) because the reports are not centrally filed.

Additional data in the form of geological maps and general geological information is available from the Division of Mining and Geology. Another possible source of information is the Mineral Resources Developmental Program administered by the Division of Mines and Geology.

> Department of Conservation Division of Mining and Geology 650 Bercut Drive Sacramento, CA 95814-0131 Information Office (916/445-5716)

> Mineral Resources Development Program 650 Bercut Drive Sacramento, CA 95814 John Alfors (916/323-7696) Supervising Geologist FAX (916/327-1853)

4. Mine waste composition/ drainage quality data

Metal mines are usually permitted by the nine Regional Water Quality Control

Board offices (see #2). These offices, however, usually do not have dedicated staff to work on mining because work is assigned on a county-by-county basis. Questions about a particular mine can be directed to the Executive Officer of the appropriate Regional Water Quality Control Board who then can identify the staff person assigned to that mine.

Additionally, the State Water Resources Control Board recently completed several special projects directed at mining. Information on the reports which summarize the results of these projects may be obtained from the individuals identified below.

State Water Resources Control Board Division of Clean Water Programs 2014 T Street Sacramento, CA 95814 Bud Eagle (916/739-4194) Attenuation Study Charlene Herbst (916/739-4196) Mining Waste Study Rick Humphreys (916/739-4254) AMD Testing Methods

5. Summaries of data on mine waste composition/drainage quality

See #4.

A useful publication is listed below:

Marshack, Jon B., February 1991. A compilation of Water Quality Goals. Regional Water Quality Control Board, Central Valley Region, Sacramento, CA.

6. Drainage quality predictive test list

See #4. There is no state-wide testing protocol; consequently, a variety of tests are used. Approval of a test proposed by the project proponent is usually based on the permit writer's familiarity with the test.

A recent publication, listed below, by the University of California at Davis pertains to vadose zone contaminant transport:

University of California, Davis, 1990. A review of the state of the art: Predicting contaminant transport in the vadose zone. Prepared for the California State Water Resources Control Board by the Department of Land, Air, and Water Resources at the University of California, Davis, CA. 19 p.

One other recent publication is referenced as follows:

Humphreys, Richard D. 1990. Report to the Legislation on Acid-Generation Potential Tests. 90-18CWP, Dec. 1990. Water Resources Control Board, Division of Clean Water Programs.

7. Summary of predictive test results

There is no centrally located, uniformly formatted AMD test results data base at the State Water Resources Control Board, Regional Water Quality Control Boards, nor at the Division of Mines and Geology.

8. Description of mine waste samples available for testing

Descriptions of mine waste samples are in the Report of Waste Discharge filed by the project proponent pursuant to Chapter 15 regulations (see #3).

9. Mine waste samples

Generally, it appears to be easiest to obtain samples through correspondence with the mining companies. The individuals identified below have, at times, been able to obtain samples.

> State Water Resources Control Board Division of Clean Water Programs 2014 T Street Sacramento, CA 95814 Rick Humphreys (916/739-4254) FAX (916/739-2300)

> North Coast Regional Board 1440 Guerneville Road Santa Rosa, CA 95403 Dave Evans (707/576-2220) FAX (707/523-0135)

Central Valley Regional Board (Sacramento) 3443 Routier Road Sacramento, CA 95827-3098 Steve Bond (916/361-5728) FAX (916/361-5686)

10. Any publications of other information on mine drainage quality

A catalog of currently available publications may be obtained from the Department of Conservation, Division of Mines and Geology (see #3):

California Department of Conservation, Division of Mines and Geology, 1990. List of available publications. California Department of Conservation, Division of Mines and Geology, Sacramento, CA. 46p.

The following reference is an extensive study of mine wastes and has a lengthy bibliography:

University of California at Berkeley, July 1, 1988. Mining Waste Study. Prepared for California State Legislature. 402 pages.

One additional article is referenced below:

Rapp, John, May 1991. The California Paradox. Mining Engineering Vol. 43 No. 5 p. 549-550.

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COLORADO MINE WASTE DRAINAGE QUALITY CONTACTS

1. Metal mines list

Most information dealing with mine waste composition and drainage quality, including a metal mines list, can be obtained through the following office:

Colorado Department of Natural Resources Mined Land Reclamation Division 1313 Sherman Street, Room 215 Denver, CO 80203 Dan Hernandez (303/866-3567) Senior Reclamation Specialist FAX (303/832-8106)

2. Mine waste disposal facilities list

See #1.

3. Mine geology and/or processing methods descriptions

For mine geology and processing methods contact:

Colorado Department of Natural Resources Mined Land Reclamation Division 1313 Sherman Street, Room 215 Denver, CO 80203 Dan Hernandez (303/866-3567) FAX (303/832-8106)

For mine geology contact:

Colorado Department of Natural Resources Colorado Geological Survey 1313 Sherman Street, Room 715 Denver, CO 80203 John Rold (303/866-2611) Director FAX (303/866-2115)

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4. Mine waste composition/drainage quality data

For mine waste composition contact the Mined Land Reclamation Division (see #3).

For state water quality data and standards contact:

Colorado Department of Health Water Quality Control Division 4210 East 11th Avenue Denver, CO 80220-3716 Greg Parsons (303/331-4756) FAX (303/322-9076)

5. Summaries of data on mine waste composition/drainage quality

Information on this topic can be obtained from the Mined Land Reclamation Division (see #3).

6. Drainage quality predictive test list

Tests are conducted to determine acid generating potential within waste, neutralization potential for cyanide operations, and discharge water quality. See #1 for contact. See Appendix 2 for a list of sampling parameters.

> Acid generating potential tests: total sulfur peroxide oxidizable humidity cell neutralization potential for cyanide operations: column leach test (site specific) discharge water quality

7. Summary of predictive test results

Colorado Department of Natural Resources Mined Land Reclamation Division 1313 Sherman Street, Room 215 Denver, CO 80203 Dan Hernandez (303/866-3567) FAX (303/832-8106)

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8. Description of predictive test results

See #7.

9. Mine waste samples

See #7.

10. Any publications or other information on mine drainage quality

Select study reports, dated 1989-1990, are available on individual stream segments in Colorado. Contact Greg Parsons (see #4).

Listed below are four relevant references.

Colorado Non-Point source Assessment Report, October, 1990.

USGS Circular 21. Moran-Wentz, 1972.

USGS Circular 25. Moran-Wentz, 1972.

Lewis, Steven, 1987. An Evaluation of Mining Related Pollution in Colorado Streams. Colorado School of Mines Research Institute, Golden, Colorado.

FLORIDA MINE WASTE DRAINAGE QUALITY CONTACTS

There is no metal mining in Florida, but there is a great deal of phosphate mining. In addition, there is also limestone, sand, clay, heavy minerals, and fill dirt mining. Hundreds of individual mines exist in the state.

1. Metal mines list

A list of the mines in the state is available from the following office.

Department of Natural Resources Bureau of Mine Reclamation 2051 East Dirac Drive Tallahassee, FL 32310 Joseph Bakker (904/488-8217) FAX (904/488-1254)

2. Mine waste disposal facilities

Mines deposit the wastes on site. It is advisable to contact the Bureau of Mine Reclamation (see #1) for assistance in reaching an individual mine.

3. Mine geology and/or processing methods descriptions

For information on mine geology contact the following.

Bureau of Geology 903 West Tennessee Street Tallahassee, FL 32304 Walt Schmidt (904/488-4191) FAX (904/488-8086)

The mines are grouped into councils according to the type of mine. For assistance in reaching the correct organization, contact the Bureau of Mine Reclamation (see #1).

4. Mine waste composition/drainage quality data

For this information, the Bureau of Mine Reclamation (see #1) and the following contact are suggested:

Department of Environmental Regulation (DER) Industrial Waste Section 2600 Blair Stone Road Tallahassee, FL 32399-2400 Phil Coram (904/488-4522) Administrator FAX (904/487-3618)

5. Summaries of mine waste composition/drainage quality

There is not a great deal of summary data, but the Bureau of Mine Reclamation (see #1) can provide what there is. Additional data may be contained in the following.

- 1. Department of Environmental Regulation applications for new mines,
- 2. Development of Regional Impact applications submitted to local planning agencies, and
- 3. Environmental impact statements prepared for new mining operations and submitted to the EPA.

6. Drainage quality predictive test list

Leachate quality predictive tests may be included in the references listed above (see #5). This type of predictive work is usually performed at the request of the Department of Environmental Regulation (DER) by consultants hired by the facility. The contact at the DER is Phil Coram (see #4). The following consultants have performed this type of testing in the past.

Ardman and Associates 8008 South Orange Avenue Orlando, FL 32859-3860 (407/855-3860) FAX (407/859-8121)

Environmental Science and Engineering P.O. Box ESE Gainsville, FL 32602-3053 (904/332-3318) FAX (904/332-0507) Bromwell and Carrier P.O. Box 5467 Lakeland, FL 33807 (813/646-8591) FAX (813/644-5920)

See Appendix 3 for a list of predictive tests.

7. Summary of predictive tests results

See #6.

8. Descriptions of mine waste samples available for testing

Most mines have samples available for testing. Since there are so many mines, the Bureau of Mine Reclamation (see #1) can facilitate in finding mines with samples available.

9. Mine waste samples

See #8.

10. Any publications or other information on mine drainage quality

The following is an excellent source of information for phosphate mining and related water quality as well as general information on mining and tailings.

Florida Institute of Phosphate Research 1855 West Main Street Bartow, FL 33830 Betty Faye Stidman (813/534-7160) Librarian FAX (813/534-7165)

The following article is a general one referring to managing tailings.

Ritcey, Gordon M., 1989. <u>Tailings Management:Problems and</u> <u>Solutions in the Mining Industry</u>. Elsevier Science Publishing B. V., Amsterdam.

The following articles are also useful.

<u>Control of Ground Water Contamination from Phosphogypsum</u> <u>Disposal Sites.</u> Ardman and Associates, 1980. Effects of Three Phosphate Industrial Sites on Ground Water Quality in Central Florida from 1970 to 1980. U.S. Department of the Interior.

These are the U. S. Geological Survey Offices in Florida.

District Office Suite 3015 227 North Bronough Street Tallahassee, FL 32301 (904/681-7620)

Miami Subdistrict Office 9100 NW 36th Street, Suite 106-107 Miami, FL 33178 (305/594-0655)

Orlando Subdistrict Office 224 West Center Street, Suite 1006 Altamonte Springs, FL 32714 (407/648-6191)

Tampa Subdistrict Office 4710 Eisenhower Boulevard, Suite B-5 Tampa, FL 33634 (813/228-2124)

Ocala QW Service Unit 207 NW 2nd Street, Room 222 Ocala, FL 32670 (904/629-8931)

Fort Meyer Field Headquarters 3745 Broadway, Suite 301 Fort Meyers, FL 33901 (813/334-7787)

Jacksonville Field Headquarters 3728 Phillips Highway, Suite 222 Jacksonville, FL 32207 (904/398-2121) Sarasota Field Headquarters 243 Field End Road Sarasota, FL 34240 (813/371-0821)

Stuart Field Headquarters 6552 SE Federal Highway Stuart, FL 33494 (407/286-6299)

IDAHO MINE WASTE DRAINAGE QUALITY CONTACTS

1. Metal mines list

The Idaho Department of Lands solicits recommendations from other state regulatory agencies on mineland reclamation, approves reclamation plans, and enforces reclamation compliance. They also keep a data base on the operating surface and placer mines in the state.

> Idaho Department of Lands 1215 West State Street Boise, ID 83720 Tom Markland (208/334-0232) FAX (208/334-2339)

A list of all operating mines in the state is available through the US Department of Labor in Denver.

U.S. Department of Labor Mine Safety and Health Technology P.O. Box 25367 Denver, CO 80225 Richard L. Smith (303/231-5445) FAX (303/231-5599)

For abandoned mines in the state:

United States Department of the Interior Bureau of Mines Western Field Operations Center East 360 3rd Avenue Spokane, WA 99202-1413 Jim Ridenour (509/353-2695) FAX (509/439-2661)

The USDA Forest Service and the U.S. Bureau of Land Management (BLM) deal with permitting and environmental review for proposed mines and have some information concerning abandoned mines on Federal lands. For the USDA Forest Service, these tasks are typically handled on the Forest or District levels of their management structure. The National Forests in Idaho lie primarily in two USDA Forest Service Regions. Region 1 lies north of the Salmon River and contains the Clearwater, Idaho Panhandle, Bitterroot, and Nez Perce National Forests. Region 4 lies south of the Salmon River and contains the Boise, Challis, Caribou Payette, Salmon, Sawtooth, and Targhee National Forests. Gene Farmer of Region 4 mentioned that many of the more severe mine waste drainages are generated by mines which have long been abandoned. Since many of these mines are in remote areas, and pose little threat to human health, they have been essentially ignored. He also mentioned that he was unaware of any listing of mining operations on USDA Forest Service land.

> USDA Forest Service Region 1 P.O. Box 7669 Missoula, MT 59807 Norman Yogerst (406/329-3634) FAX (406/329-3347)

USDA Forest Service Region 4 324 25th Street Ogden, UT 84401 Gene Farmer (801/625-5271) FAX (801/625-5127)

Ben Albrechtsen (801/625-5154)

Boise National Forest 1750 Front Street Boise, ID 83702 Wayne Patton (208/364-4100) FAX (208/364-4111)

Caribou National Forest 250 S. 4th Avenue Suite 294 Federal Building Pocatello, ID 83201 Jeff Gabardi (208/236-7500) Mining Engineer FAX (208/236-7503)

Challis National Forest P.O. Box 404 Federal Building Challis, ID 83226 Bill Savage (208/879-2285) FAX (208/879-5242)

Payette National Forest 106 West Park McCall, ID 83638	on	(208/634-0700)			
Kurt Nels	FAX	(208/634-1428)			
Salmon National Forest P.O. Box 729					
James W.	Baker	(208/756-2215)			
	FAX	(208/756-5151)			
Sawtooth National Forest 2647 Kimberly Road Twin Falls, ID 83301-7976					
Jerry L. C	Freen	(208/678-0430)			
BLM Idaho State Office 3380 Americana Terrac Boise, ID 83706	e e				
Terry Mal	ley	(208/334-1447)			
Clearwater National Forest Supervisor's Office 12730 Highway 12 Orofino, ID 83544					
Pam Bow	en FAX	(208/476-4541) (208/476-0129)			
Idaho Panhandle National Forest Supervisor's Office 1201 Ironwood Drive Coeur d' Alene ID					
Roger Mi	nnich FAX	(208/765-7223) (208/765-7307)			
Nez Perce National For Supervisor's Office Route 2, Box 475	est				
Grangeville, ID 05550					

rangeville, ID 83530		
Ihor Mereszcza	ık	(208/983-1950)
	FAX	(208/983-1553)

2. Mine waste disposal facilities list

Information on mine waste disposal facilities is available from the Division of Environmental Quality.

Department of Health and Welfare Division of Environmental Quality Water Quality Bureau 1410 North Hilton Boise, ID 83706 Irene Nautch (208/334-5860) FAX (208/334-0417)

The structural stability of tailings impoundments is a responsibility of the Department of Water Resources.

Idaho Department of Water Resources Dam Safety Section 1301 Orchard Street Statehouse Mail Boise, ID 83720 Dave Hollingshead (208/327-7957) FAX (208/327-7866)

For mines proposed on Federal lands, the Forest Service or BLM is often the lead agency, addressing structural concerns of waste rock dumps. They also work with abandoned mines on Federal lands (see #1).

3. Mine geology and/or processing methods descriptions

For mine geology contact the following.

Idaho Geological Survey University of Idaho Morrill Hall 332 Moscow, ID 83843 Earl Bennett (208/885-7991) FAX (208/885-5826)

For processing methods contact the office listed below.

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United States Department of the Interior Bureau of Mines Western Field Operations Center East 360 3rd Avenue Spokane, WA 99202-1413 Rod Minarik (509/353-2720) FAX (509/353-2661)

4. Mine waste composition/drainage quality data

Idaho has limited data on mine waste composition collected by the state.

Data on mine discharge quality and receiving stream water quality are filed by the five regional field offices of the Department of Health and Welfare (see #2) and the contacts for the five field offices are:

Division of Environmental Quality Boise Field Office 1410 North Hilton Street Boise, ID 83706 Craig Shepard (208/334-0550) FAX (208/334-0576)

Division of Environmental Quality Coeur d'Alene Field Office 2110 Ironwood Parkway Coeur d'Alene, ID 83814 Ed Tulloch (208/667-3524) FAX (208/667-4869)

Division of Environmental Quality Lewiston Field Office 1118 F Street Lewiston, ID 83501 Hudson Mann (208/799-3430) FAX (208/799-3350)

Division of Environmental Quality Pocatello Field Office 224 South Arthur Street Pocatello, ID 83204 Walt Poole (208/236-6160) FAX (208/236-6168) Division of Environmental Quality Twin Falls Field Office P.O. Box 1626 Twin Falls, ID 83303 Mike McMasters (208/736-2190) FAX (208/736-2194)

5. Summaries of data on mine waste composition/drainage quality

The Division of Environmental Quality (see #2) has two summaries which contain information on impacts of mine drainage in the state: 305(b) Reports (as required by Section 305(b) of the Clean Water Act) and a Non-point Source Management Plan Report. As mentioned in #4, limited data are collected on mine waste composition and mine waste drainage quality.

6. Drainage quality predictive test list

The Division of Environmental Quality (see #2) has some information on predictive tests used by mining companies in the state.

7. Summary of predictive test results

The results of predictive tests used in the state have not been summarized.

8. Description of mine waste samples available for testing

The Division of Environmental Quality (see #2) and the U.S. Forest Service or BLM (see #1) could provide information on mine wastes which could be sampled.

9. Mine waste samples

Contact Irene Nautch for information on obtaining mine waste samples (see #2).

10. Any publications or other information on mine drainage quality

The Idaho Department of Lands (see #1) is working on a handbook describing Best Management Practices for mining operations.

A state task force chaired by Tom Markland (see #1) is working on an informational pamphlet describing the state mine permitting process.

The Bunker Hill Mine, mill, and smelter is a Superfund site which is located on private land in Kellogg, Idaho which lies in the Coeur d'Alene area of the Idaho panhandle. This Superfund site is administered by the EPA Region 10 office in Seattle, WA.

Extensive study has been conducted in the state on water quality impacts of mining in the Coeur d'Alene area, and a bibliography on the area has been compiled:

Savage, Nancy L., May 1986. A Topical Review of Environmental Studies in the Coeur d'Alene River-Lake System. Idaho Water Resources Research Institute, University of Idaho, Moscow, Idaho, May, 1986.
MICHIGAN MINE WASTE DRAINAGE QUALITY CONTACTS

1. Metal mines list

A list of active and abandoned mines is available from the following office:

Michigan Department of Natural Resources Geological Survey Division P.O. Box 30028 Lansing, MI 48909 Robert Reed (517/334-6907) FAX (517/334-6038)

The following publication, to be published soon, describes the history, geology, and production of metal mines in Michigan. Contact the author for information regarding publication:

Reed, Robert C. Economic Geology and History of Metallic Minerals in the Northern Peninsula of Michigan. Geological Society of America.

This publication includes annual shipments through 1950 for each mine, maps showing location, a brief historical sketch of each property, and other data:

Lake Superior Iron Ore Association, 1952. Lake Superior Iron Ores. Second Edition, Cleveland, Ohio, 334 pages.

This publication lists all iron mines (about 250) in Michigan with recorded shipments through 1974. Mines are listed by range and/or district:

Reed, R.C., 1975. One Thousand Million Tons. Michigan Geological Survey Circular 12, 12 pages.

This publication lists all native copper mines in Michigan with recorded production through 1925. It includes about 110 properties and has 52 plates. It includes all except for the Iroquois, Kingston, and White Pine:

Butler, B.S. and Burbank, W.S., 1929. The Copper Deposits of Michigan. U.S. Geological Society Professional Paper 144, 237 pages.

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The following publication includes an update of production through 1977, maps of major mines, and other data:

Wilband, J.T., 1978. The Copper Resources of Northern Michigan. U.S. Bureau of Mines, 66 pages.

2. Mine waste disposal facilities

The waste is deposited on site. Contacting the individual mining company is the best option for this information.

Those mines which beneficiated, pelletized, or milled rock products include:

<u>Iron Mines</u>	
Ohio	- Cleveland Cliffs, Marquette County
Humboldt	- Cleveland Cliffs, Marquette County
Republic	- Cleveland Cliffs, Marquette County
Empire	- Cleveland Cliffs, Marquette County
Tilden	- Cleveland Cliffs, Marquette County
Groveland	- Hanna Mining, Dickenson County

<u>Copper Mines</u> White Pine - Copper Range Company, Ontonagon County

In addition, there are tailings piles from native copper mines located in Torch Lake, Portage Lake Ship Canal, Lake Superior, and Keweenaw Bay. These areas are discussed in the three volume report on, "Recovery of Copper from Michigan Stamp Sands" prepared by Michigan Technological University.

3. Mine geology and/or processing methods descriptions

The Geological Survey Division (see #1) is the suggested contact for mine geology. Robert Reed has been involved in the taxation of metal mines since 1952. The Division has maps of most iron, copper, and the Ropes gold mine submitted for tax purposes.

Included in Appendix 4 is a list of U.S. Geological Survey Professional Papers which describe mine geology.

For native copper processing methods, the following publication has a fairly extensive reference list and bibliography. A few of these references are listed in Appendix 4.

Babcock, L.L. and Spiroff, K., July, 1970. Recovery of Copper from Michigan Stamp Sands, Volume 1. Project R-182, 26011 and 18182, Institute of Mineral Research, Michigan Technological University, Houghton, Michigan. For processing methods at White Pine contact:

Copper Range Company P.O. Box 100 White Pine, MI 49971 Ronald Woody (906/885-5111) Mill Superintendent Kenton Sutliff (906/885-5111) Smelter and Refinery Superintendent FAX (906/885-5437)

For processing methods at Empire and Tilden Mines contact:

Cleveland Cliffs, Inc. 504 Spruce Street Ishpeming, MI (906/486-9941) FAX (906/486-4322)

4. Mine waste composition/drainage quality data

Surface water quality permits (NPDES permits) for metal operations can be obtained from:

Michigan Department of Natural Resources SWQD-Permits P.O. Box 30028 Lansing, MI 48909 Peter Ostlund (517/335-4116) FAX (517/373-9958)

Contacting Copper Range Company and Cleveland Cliffs, Inc. (addresses above in #3) is another source.

The following contact is involved in mine reclamation research.

Michigan Technological University Department of Forestry Houghton, MI 49931 Steve Shetron (906/487-2454) FAX (906/487-2915)

For historical information on quality discharge and effects in streams and lakes contact the following:

Michigan Department of Natural Resources SWQD-GLEAS P.O. Box 30028 Lansing, MI 48909 Elwin Evans (517/335-4182) FAX (517/373-9958)

5. Summaries of data on mine waste composition/drainage quality

See #4.

6. Drainage quality predictive test list

This information is available from the mining companies directly and from the following.

Michigan DNR SWQD Permits P.O. Box 30028 Lansing, MI 48909 Peter Ostlund (517/335-4116) FAX (517/373-9958)

7. Summary of predictive test results.

See #6.

8. Description of mine waste samples available for testing.

Contacting the mining companies directly is the best route for obtaining sample information.

9. Mine waste samples.

See #8.

10. Any publications or other information on mine drainage quality

A number of studies have been conducted to determine if there have been any adverse affects on the Torch Lake region from the mining activity in the area. Some studies are referenced here.

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- Leddy, Dr, David G. et al, August, 1986. Torch Lake Study: A Project Completion Report for the Michigan DNR. Michigan Technological University, Houghton, MI.
- Ransome, Lorraine, S., July 1990. Torch Lake Remedial Investigation/Feasibility Study, Houghton County, Michigan: Volume 1A Final Work Plan, Revision 2. U.S. EPA Contract 68-W8-0093. Donohue and Associates, Inc.
- Torch Lake Remedial Action Plan. Michigan Department of Natural Resources, Surface Water Quality Division. Submitted to ITC, October, 1987.
- Wright, T., D. Leddy, B. Brandt, and T. Virnig, 1973. Water Quality Alteration of Torch Lake, Michigan by Copper Leach Liquor. In: <u>Proceedings 16th Conference Great Lakes Res.</u> pages 329-344.

A study was conducted for the Iron River District on the problems in that region. This is referenced here.

> Johnson, Allan M. and Frantti, Gordon, April, 1978. Study of Mine Subsidence and Acid Water Drainage in the Iron River Valley, Iron County, Michigan. Michigan Technological University, Houghton, MI.

The Michigan Geological Survey financed a program called the Iron County Survey which was conducted by Michigan Tech. This was a study of acid mine water drainage and subsidence of iron mines in Iron County. This resulted in a number of reports. Some of these are referenced in Appendix 4. For further information contact the following office.

> Michigan Technological University Department of Mining Engineering Houghton, MI 49931 Allan Johnson (906/487-2814) FAX (906/487-2943)

The Mine Reclamation Act #92, Public Act 1970 as amended deals with open pit mines.

MINNESOTA MINE WASTE DRAINAGE QUALITY CONTACTS

1. Metal mines list

The Mineral Resources Research Center at the University of Minnesota annually publishes the Minnesota Mining Directory, which lists current mining activities within the state. This directory presents lists of active mines, exhausted mines, mining companies, mine fee owners, and exploration companies.

> Mineral Resources Research Center. 1989. Minnesota Mining Direct ory: 1989. Rodney J. Lipp (ed.) Mineral Resources Research Center, University of Minnesota, Minneapolis, MN. 266 p.

Mineral Resources Research Center University of Minnesota 56 E. River Rd. Minneapolis, MN 55455 Rodney Lipp (612/625-3344) Scientist FAX (612/625-1882)

In addition, the Minnesota Department of Natural Resources, Division of Minerals, keeps a list of all mines within Minnesota. The Minnesota Pollution Control Agency, which issues, monitors, and enforces N.P.D.E.S. permits also has a listing of mines.

Minnesota Department of Natural Resources Minerals Division Mineral Lease Operations 1525 3rd Ave. E. P.O. Box 567 Hibbing, MN 55746 Dick Hemmersbaugh (218/262-6767) Manager of Lease Operations FAX (218/263-5420)

Minnesota Pollution Control Agency Environmental Analysis Office 520 Lafayette Rd. St. Paul, MN 55155 Bill Lynott (612/296-7794) Resource Development Coordinator FAX (612/297-1456) Minnesota Pollution Control Agency Water Quality Division Industrial Section 520 Lafayette Rd. St. Paul, MN 55155 Jim Strudell (612/296-7238) Pollution Control Specialist Dick Clark (612/296-8828) Hydrogeologist Gene Soderbeck (612/296-8280) Supervisor, Enforcement FAX (612/297-1456)

Natural Resources Research Institute 5013 Miller Trunk Highway Duluth, MN 55811 Steve Hauck (218/720-4273) Senior Scientist Mark Severson (218/720-4239) Scientist FAX (218/720-4219)

United States Bureau of Mines Twin Cities Research Center 5629 Minnehaha Ave. S. Minneapolis, MN 55417 Wanda West (612/725-4535) FAX (612/789-4526)

2. Mine waste disposal facilities list

The Department of Natural Resources, Division of Minerals, Mineland Reclamation section, is responsible for the reclamation of mining waste in Minnesota. The Minnesota Pollution Control Agency (see #1) also compiles data on mine waste.

> Department of Natural Resources Minerals Division Mineland Reclamation 1525 3rd Ave. E. Hibbing, MN 55746 Steve Dewar (218/262-6767) Mineland Reclamation Field Supervisor FAX (218/263-5420)

3. Mine geology and/or processing methods descriptions

Information on mine geology can be obtained through the Minnesota Geological Survey. Various personnel at the University of Minnesota and the Department of Natural Resources can provide data on mine processing methods in addition to mine geology.

Mine geology:

Department of Natural Resources Minerals Division 1525 3rd Ave. E. Hibbing, MN 55746 Jim Sellner (218/262-6767) Senior Engineer FAX (218/263-5420)

Mine geology and general geology of Minnesota:

Department of Geology and Geophysics 108 Pillsbury Hall University of Minnesota Minneapolis, MN 55455 Sam Sawkins (612/624-6302) Professor FAX (612/625-3819)

Department of Civil and Mineral Engineering 122 Civil and Mineral Engineering Bldg. 500 Pillsbury Dr. S.E. Minneapolis, MN 55455-0220 Randal J. Barnes (612/625-5828) Assistant Professor Steve Crouch (612/625-4080) Professor, Department Head Charles Fairhurst (612/625-1869) Professor FAX (612/624-0293) Minnesota Geological Survey 2642 University Ave. St. Paul, MN 55114 G.B. Morrey (612/627-4780) Assoc. Director and Chief Geologist FAX (612/627-4778)

Natural Resources Research Institute 5013 Miller Trunk Highway Duluth, MN 55811 Steve Hauck (218/720-4273) Senior Scientist Mark Severson (218/720-4239) Scientist FAX (218/720-4219)

Mineral processing methods:

Department of Natural Resources Minerals Division 1525 3rd Ave. E. Hibbing, MN 55746 Dave Englund (218/262-6767) Senior Engineer FAX (218/263-5420)

Mineral Resources Research Center University of Minnesota 56 E. River Rd. Minneapolis, MN 55455 Iwao Iwasaki (612/625-0312) Professor FAX (612/625-1882)

In 1988, the Department of Natural Resources and the Pollution Control Agency collaborated on a simulation project which produced three reports, one of which examines the minerals processing industry:

Minnesota Pollution Control Agency. 1989. The Nonferrous Mining and Processing Industry: A Review of Literature and Other Information. Minnesota Pollution Control Agency, St. Paul, MN. 224 p. plus appendices.

4. Mine waste composition/drainage quality data

The Department of Natural Resources, Mineland Reclamation Section, is responsible for the rehabilitation of mined land and has information on the composition of, and drainage from sulfide-bearing rock at the Dunka mining site. Data on water quality at the Dunka site may also be found in the Discharge Monitoring Reports received by the Minnesota Pollution Control Agency (see #1), which are required under the N.P.D.E.S. permits. Enforcement of water quality standards is the responsibility of the M.P.C.A.

> Department of Natural Resources Minerals Division Mineland Reclamation 500 Lafayette Rd. St. Paul, MN 55155-4045 Paul Eger (612/296-9549) Principal Engineer Kim Lapakko (612/296-1358) Senior Engineer FAX (612/296-5939)

The Division of Minerals has also published several reports on studies at this site (see Appendix 8 for citations), which address :

- 1. waste rock dump drainage quality and quantity,
- 2. transport of dissolved components present in mine waste drainage, and
- 3. drainage impact on water quality in Bob Bay, and Birch Lake.

5. Summaries of data on mine waste composition/drainage quality

Publications which address topics including mine waste composition and/or mine waste drainage quality data for Minnesota are summarized in the following publication which is available from the Division of Minerals (see #4).

Nonferrous Metal Mining Research Summary: Impact, Mitigation, and Prediction (Minnesota Department of Natural Resources, 1990).

6. Drainage quality predictive test list

Various types of predictive tests for mine waste drainage quality have been used by the Department of Natural Resources (see #4). These tests include acid-base accounting, ambient temperature wet-dry cycling (Lapakko, 1988; Lapakko, 1990),

and batch reactor and column tests (Lapakko, 1980; Lapakko and Eger, 1980). In addition, test dumps and operational dumps have been monitored (Eger and Lapakko, 1985).

7. Summary of predictive test results

Information on predictive testing is presented in publications mentioned in #6 and in the publication cited in #5.

8. Description of mine waste samples available for testing

Mine waste samples from the Biwabik Iron Formation, Duluth Gabbro, and Virginia Formation hornfels are available for testing from the Minnesota Department of Natural Resources, Mineland Reclamation Section (see #4).

9. Mine waste samples

See #8.

10. Any publications or other information on mine drainage quality

In 1988, the Department of Natural Resources and the Pollution Control Agency collaborated on a simulation project which produced three reports dealing with mine waste related issues:

E. K. Lehmann and Associates, Inc., Minnesota Department of Natural Resources, Minnesota Pollution Control Agency, and the Project Environment Foundation. 1989. The Report on the Mining Simulation Project. Minnesota Department of Natural Resources, St. Paul, MN. 90 p.

. 1989. Appendices to the Final Report: Nonferrous Mineral Project. Department of Natural Resources, St. Paul, MN.

Minnesota Pollution Control Agency. 1989. The Nonferrous Mining and Processing Industry: A Review of Literature and Other Information. Minnesota Pollution Control Agency, St. Paul, MN. 224 p. plus appendices.

A list of publications is contained in Appendix 5.

MISSOURI MINE WASTE DRAINAGE QUALITY CONTACTS

1. Metal mines list

All of the active mining is in the southeast region of the state. Lists of active, inactive, and abandoned mines are contained in Appendix 6. This list was supplied by:

Missouri Department of Natural Resources (MDNR) Division of Environmental Quality (DEQ) Southeast Regional Office 948 Lester Street P.O. Box 1420 Poplar Bluff, MO 63901 John E. Hill (314/785-0832) Professional Engineer FAX (314/785-2599)

Additional information about inactive and abandoned mines can be obtained by contacting the following office.

U. S. Geological Survey Branch of Resource Analysis Mail Stop 984 345 Middlefield Road Menlo Park, CA 94025 Don Huber (415/329-5358) FAX (415/329-5110)

2. Mine waste disposal facilities list

Each mine maintains its own tailings piles for the waste rock. Contacting the individual mines for further information is advised. In addition, the Waste Management Program at the MDNR has some information.

Missouri Department of Natural Resources Division of Environmental Quality Waste Management Program 205 Jefferson Street Jefferson, MO 65102 Nicholas Di Pasquale (314/785-0832) Director FAX (314/751-7869)

3. Mine geology and/or processing methods list

Partially due to the regulation of tailings dams, information for mine geology is available from the Division of Geology and Land Survey (DGLS) of the MDNR.

Missouri Department of Natural Resources Division of Geology and Land Survey Box 250 Rolla, MO 65401 Mike McFarland (314/368-2100) FAX (314/368-2111)

A reference which provides geologic setting, ore deposit type, and a discussion of production in the Viburnum Trend is:

Wharton, Heyward B., et al, 1975. Guidebook to the Geology and Ore Deposits of Selected Mines in the Viburnum Trend, Missouri. MDNR, Geologic Survey Rep. Inv. 58, 60.

4. Mine waste composition/drainage quality

Within the MDNR, the Southeast Regional Office (SERO) in Poplar Bluff is the contact for metallic mineral waste and water quality information, for both the active mines in the southeast and the inactive mines in the southwest.

Southeast Regional Office 948 Lester Street P.O. Box 1420 Poplar Bluff, MO 63901 Jim Burris (314/785-0832) FAX (314/785-2599)

Additional information regarding mining in the southwest region can be obtained from:

Southwest Regional Office 1155 Cherokee Street Springfield, MO 65807 John Nixon (417/895-6950) FAX (417/895-6954)

5. Summaries of data on mine waste composition/drainage quality

An investigation of the Joplin area was made by the USGS in 1976, referenced as follows:

Barks, James A, August, 1977. Effects of Abandoned Lead and Zinc Mines and Tailings Piles on Water Quality in the Joplin Area, Missouri. USGS Water-Resources Investigations 77-75.

6. Drainage quality predictive test list

This information is also available at the MDNR.

Missouri Department Natural Resources Division of Environmental Quality Water Pollution Control Program 205 Jefferson Street Jefferson, MO 65102 Charles Steiferman Robert Hentges John Howland (314/785-0832) FAX (314/751-9396)

7. Summary of predictive tests

See #6.

8. Descriptions of mine waste samples available for testing

This would be best obtained directly through the mining companies themselves. MDNR would be able to assist if necessary.

9. Mine waste samples.

See #8.

10. Any publications or other information on mine drainage quality

The following is a list of other sources on the above topics:

Missouri Water Resources Center University of Missouri - Columbia Engineering Complex, Room 55A Columbia, MO 65211 Dr. Thomas E. Cleavenger (314/882-7564) Director

FAX (314/882-4784)

University of Missouri - Rolla Life Sciences Department 105 Schrenk Hall Rolla, MO 65401-0249 Dr. Nord L. Gale (314/341-4862) FAX (314/341-4821)

University of Missouri - Rolla Department of Geological Engineering Rolla, MO 65401 Dr. Don L. Warner (314/341-4867) FAX (314/341-4192)

U. S. Bureau of Land Management 901 Pine Street Rolla, Mo 65401 (314/364-0203) FAX (314/364-0498)

U. S. Bureau of Mines Rolla Research Center P.O. Box 280 1300 Bishop Avenue Rolla, MO 65401 Richard Sandburg Director FAX

(314/364-3169)

(314/364-3169) ext. 220

U.S. Geological Survey 1400 Independence Road Mail Stop 200 Rolla, MO 65401 Brenda Smith (314/341-0830) FAX (314/341-0805) U.S. Fish and Wildlife Service National Fisheries Containment Research Center Route 2 4200 New Haven Road Columbia, MO 65201 (314/875-5399) FAX (314/876-1896)

MONTANA MINE WASTE DRAINAGE QUALITY CONTACTS

1. Metal mines list

For active mines in the state:

Department of State Lands Hardrock Bureau 1625 11th Avenue Helena, MT 59620 Sandi Olsen (406/444-2074) FAX (406/444-2684)

Montana College of Mineral Science and Technology Montana Bureau of Mines and Geology Butte, MT Harold James (406/496-4175) FAX (406/496-4133)

For an inventory of abandoned mines in the state:

Department of State Lands Abandoned Mine Reclamation Bureau 1625 11th Avenue Helena, MT 59620 John Koerth (406/444-2074) Stu Levit (406/444-2074) FAX (406/444-2684)

2. Mine waste disposal facilities list

The Hardrock Bureau and the Abandoned Mine Reclamation Bureau (see #1) can provide information on this topic.

3. Mine geology and/or processing methods list

The Hardrock Bureau and the Montana Bureau of Mines and Geology (see #1) are useful contacts.

4. Mine waste composition/drainage quality data

In addition to the Hardrock Bureau and the Abandoned Mine Reclamation Bureau (see #1), the following three contacts can be of assistance.

Department of State Lands Coal Bureau 1625 11th Avenue Helena, MT 59620 Bonnie Lovelace (406/444-2074) FAX (406/444-2684)

Department of Health & Environmental Science Solid and Hazardous Waste Bureau Cogswell Building, Capitol Station Helena, MT 59620 Duane Robertson (406/444-2544)

FAX (406/444-1499)

Department of Health and Environmental Science Water Quality Bureau Cogswell Building, Room A-206 Helena, MT 59620 Dan Fraser (406/444-2406) FAX (406/444-1374)

5. Summaries of data on mine waste composition/drainage quality

For active mines contact the Hardrock Bureau (see #1), the Water Quality Bureau (see #4), and the Solid and Hazardous Waste Bureau (see #4).

For abandoned mines contact the Abandoned Mine Reclamation Bureau (see #1). The inventory of abandoned mine sites includes drainage flow, pH, specific conductance, and the primary and secondary basins in which the mine in located. As mentioned in the Bureau objectives (see #1) the first concern is safety, although compliance with NEPA requirements is also a concern.

6. Drainage quality predictive test list

Acid-Base Characterization: Tests are conducted to determine the initial acid generation potential and to verify the acid generating status throughout the mine life. Tests recommended by the "Draft Acid Rock Drainage Technical Guide, Volumes I and II" are used. The Technical Guides were prepared for the British Columbia Acid Mine Drainage Task Force by Steffen, Robertson, and Kirsten (B.C.) Inc.

> Steffen, Robertson, and Kirsten (BC, Inc.), Volume I 1989, Volume II 1990. Draft acid rock drainage technical guide. British Columbia Acid Mine Drainage Task Force.

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Photocopies of the out of print draft and further information can be obtained from the following office:

Department of State Lands Hardrock Bureau 1625 11th Avenue Helena, MT 59620 Patrick Plantenberg (406/444-2074) FAX (406/444-2648)

Cyanide operations: Tests are conducted for cyanide operations including column leach tests for heap neutralization and drainage water quality prediction. Tests are also conducted on soil attenuation for land application and disposal of detoxified process water. For more information contact the following.

> Department of State Lands Hardrock Bureau 1625 11th Avenue Helena, MT 59620 Scott Spano (406/444-2074) FAX (406/444-1923)

Recently Scientific Applications International Corporation reviewed the Hardrock Bureau (see #1) files and is compiling a summary of mine waste characterization and water quality data for the EPA. Contact is the following:

Scientific Applications International Corporation 8400 Westpark Drive McLean, VA 22102 Ingrid Rosencrantz (703/821-4300)

For this information contact the Hardrock Bureau (see #1) and the Water Quality Bureau (see #4).

7. Summary of predictive test results

There are no summaries presently available.

8. Description of mine waste samples available for testing

The Hardrock Bureau of the Department of State Lands (see #1) has information on mine waste descriptions, as such information is included in permit applications.

9. Mine waste samples

Mine waste samples can be obtained directly from the mines (see #1 for mine list contacts).

10. Any publications or other information on mine drainage quality

The following citation relates to water quality.

Montana Department of Health and Environmental Sciences. 1990. Montana Water Quality 1990: The Montana 305(b) Report. Montana Department of Health and Environmental Sciences, Environmental Sciences Division, Water Quality Bureau, Helena, Montana. 21 p. plus appendix.

The next reference deals with permitting.

Williams, R. David, Plantenburg, Patrick. 1990. Permitting mines with reactive waste - a Montana primer. Presented at the joint sessions of the Northern Rocky Mountain Water Congress/Mineral and Hazardous Waste Processing Symposium, Butte, Montana. October 1-5, 1990. 8 p.

Mary Beth Linder provided a great deal of the information in this compilation and could be contacted for additional information.

Department of State Lands 1625 11th Avenue Helena, MT 59620 Mary Beth Linder (406/444-2074) Administrative Officer FAX (406/444-2648)

NEVADA MINE WASTE DRAINAGE QUALITY CONTACTS

1. Metal mines list

A list of metal mines in Nevada may be obtained from the Bureau of Mining Regulation and Reclamation, the Department of Minerals, and the Division of Mine Inspection. The Nevada Bureau of Mines and Geology annually publishes a mining bulletin which includes a listing of active metal mines within the state.

> Nevada Division of Environmental Protection Bureau of Mining Regulation and Reclamation 123 West Nye Lane Carson City, NV 89710 Thomas J. Fronapfel (702/687-4670) Bureau Chief FAX (702/885-0868)

> Department of Minerals 400 West King Street, Suite 106 Carson City, NV 89710 Russell A. Fields (702/687-5050) Director FAX (702/687-3957)

> Division of Mine Inspection 1380 South Curry Street Capitol Complex Carson City, NV 89710 Norton Pickett (702/687-5243) State Mine Inspector FAX (702/687-6305)

> Nevada Bureau of Mines and Geology University of Nevada Mail Stop 178 Reno, NV 89557-0088 Ronald H. Hess (702/784-6691) Geologic Information Specialist FAX (702/784-1709)

2. Mine waste disposal facilities list

No such list exists, but the list of metal mines in #1 includes those with disposal

sites. Furthermore, Nevada has an industry comprised of private facilities which reprocess or perform secondary recovery of gold mining wastes. For more information concerning these facilities, contact the Bureau of Mining Regulation and Reclamation and the Department of Minerals (see #1).

3. Mine geology and/or processing methods descriptions

The Nevada Bureau of Mines and Geology has limited information on mine geology and processing methods, which is restricted to descriptions provided by the individual mines. Additional data may be found in the mining bulletin published by the Bureau of Mines and Geology. The Department of Minerals may also be able to furnish information (see #1 for all of the above). Information on processing methods is available from the Chemical and Metallurgical Engineering Department at the University of Nevada and the United States Bureau of Mines.

> Chemical and Metallurgical Engineering Department Mackay School of Mines University of Nevada - Reno Reno, NV 89557 Jim Hendrix (702/784-6115) FAX (702/784-1766)

United States Bureau of Mines Reno Research Center 1605 Evans Avenue Reno, NV 89512-2295 Tom Carnahan (702/784-5391) Research Supervisor FAX (702/784-5699)

4. Mine waste composition and drainage quality data

Nevada Division of Environmental Protection Bureau of Mining Regulation and Reclamation 123 West Nye Lane Carson City, NV 89710 Thomas J. Fronapfel (702/687-4670) P.E., Bureau Chief FAX (702/885-0868) Nevada Bureau of Mines and Geology University of Nevada Mail Stop 178 Reno, NV 89557-0088 Ronald H. Hess (702/784-6691) Geologic Information Specialist FAX (702/784-1709)

5. Summaries of data on mine waste composition/drainage quality

The United States Bureau of Mines annually publishes a summary of research with which they were involved during the preceding fiscal year (see #10). Areas of research examined by the U.S. Bureau of Mines include control of mine drainage and liquid wastes, and solid waste management and subsidence.

6. Drainage quality predictive test list

See Appendix 7 and Appendix 8. Tom Fronapfel of the Bureau of Mining Regulation and Reclamation (see #1) who provided the material in the appendices, may be able to provide information concerning drainage quality predictive tests in greater detail.

7. Summary of predictive test results

No summaries of predictive test results currently exist.

8. Description of mine waste samples available for testing

Contact individual mining facilities within the state for information regarding mine waste samples. Tom Carnahan of the United States Bureau of Mines (see #3) states that his organization can act as an agent to assist people in contacting the individual mines.

9. Mine waste samples

Same as #8.

10. Any publications or other information on mine drainage quality

These publications are available from the USBM as mentioned in #5.

Nevada Bureau of Mines and Geology. 1990. Major mines of Nevada 1989. Nevada Bureau of mines and Geology. Reno, Nevada. 28 p.

1990. Publications. Nevada Bureau of Mines and Geology. Reno, Nevada. 28 p.

United States Bureau of Mines, Reno Research Center. 1990. Reno Research Center research program, fiscal year 1990. United States Bureau of Mines. Washington, D.C. 45p.

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NEW MEXICO MINE WASTE DRAINAGE QUALITY CONTACTS

1. Metal mines list

The Mining and Minerals Division (MMD) of the Energy, Minerals and Natural Resources Department requires registration and annual reporting of all mining and milling operations including sand, gravel, and stone. Mines and mills are listed in "Mines and Mills in New Mexico" an annually updated directory (with map) compiled from MMD records of registered operations. Metal operations are indicated by commodity. Contacts, addresses, location descriptions, and other information are provided. The directory is available from the following two offices.

> Energy, Minerals, and Natural Resources Department Mining and Minerals Division Mine Registration and Geological Services 2040 South Pacheco Street Santa Fe, NM 87505 Kay Hatton (505/827-5923)

> > FAX (505/827-7195)

Bureau of Mines and Mineral Resources Campus Station New Mexico Tech Socorro, NM 87801 James Barker (505/835-5410) FAX (505/835-6333)

For abandoned mines in New Mexico:

Energy, Minerals, and Natural Resources Department Mining and Minerals Division Abandoned Mine Land Bureau 2040 South Pacheco Street Santa Fe, NM 78505 Denise Gallegos (505/827-5963)

The USDA Forest Service (USFS) and the U.S. Bureau of Land Management (BLM) deal with permitting and environmental review for proposed mines and have some information regarding abandoned mines on Federal lands. For the USFS, these tasks are typically handled on the Forest or District levels of their management structure. National Forests include, from north to south, the Carson, Santa Fe, Cibola, Lincoln, and Gila. Most metal mining occurs in the Gila National Forest in the southwestern part of the state. The Southwest Regional

Office of the USFS is located in Albuquerque and administers both New Mexico and Arizona.

U.S. Forest Service Regional Office		
517 Gold Avenue, S.W.		
Albuquerque, NM 87102		
David F. Jolly	(505/842-3300)	
FAX	(505/842-3800)	
Carson National Forest P.O. Box 558		
Taos, NM 78571		
Andy Lindquist FAX	(505/758-6200) (505/758-6207)	
Santa Fe National Forest		
P.O. Box 1689		
Santa Fe, NM 8/504	(505/000 6040)	
FAX	(505/984-3182)	
	(303/301 3102)	
Cibola National Forest		
2113 Osuna Road, N.E., Suite A		
Albuquerque, NM 87113	· · · · · · · · · · · · · · · · · · ·	
Phil Smith	(505/761-4650)	
FAX	(505/761-4663)	
Lincoln National Forest		
Federal Building		
11th and New York		
Alamogordo, NM 88310	(505 405 (000)	
	(505/43/-6030)	
FAX	(505/434-7218)	
Gila National Forest		
2610 North Silver		
Silver City, NM 88061		
Menard Rost	(505/388-8201)	
ГАХ	(JUJ/J88-83JY)	

The BLM maintains three district offices in New Mexico, all administered from the State Office in Santa Fe. Mining activity occurs throughout all three districts with metals concentrated in the Las Cruces District (southwestern New Mexico) and

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potash mining located in the Roswell District (southwestern New Mexico).

Bureau of Land Management New Mexico Office P.O. Box 1449 435 Montano NE Santa Fe, NM 87107 Bob Dale (505/761-4505) FAX (505/988-6030)

Bureau of Land Management Las Cruces District Office 1800 Marquez Las Cruces, NM 88005 Jim Fox (505/525-8228)

Bureau of Land Management Roswell District Office P.O. Box 1397 Roswell, NM 88201-1397 Francis Cherry (505/624-1790)

2. Mine waste disposal facilities list

Information on mine waste disposal is available from the following office.

New Mexico Environment Department (NMED) Water and Waste Management Division 1190 St. Francis Drive, P.O. Box 26110 Harold Runnels Building Santa Fe, NM 87502 Kathleen Sisneros (505/827-2850) FAX (505/827-2836)

Structural stability of impoundments is the responsibility of the Office of State Engineer.

Office of State Engineer Bataan Memorial Building, Room 101 P.O. Box 25102 Santa Fe, NM 87504-5102 Eluid Martinez (505/827-6120) For mines proposed on Federal lands, the USFS or the BLM are often the lead agencies (see #1). The BLM also works with abandoned mines and the various Indian pueblos and nations.

For uranium mill tailings and reclamation, contact the following.

U.S. Nuclear Regulatory Commission Region IV Uranium Recovery Field Office P.O. Box 25325 Denver, CO 80225 Dale Smith (303/236-2805)

3. Mine geology and/or processing methods descriptions

For this information, the following two contacts at New Mexico Tech are suggested.

New Mexico Bureau of Mines and Mineral Resources Campus Station New Mexico Tech Socorro, NM 87801 Charles Chapin (505/835-5302) Department on Mining, Environmental, and Geological Engineering

New Mexico Tech Campus Station Socorro, NM 87801 Cathy Aimone-Martin (505/835-5345)

4. Mine waste composition/drainage quality data

The MMD (address listed in #1, contact: Doug Bland) publishes a document entitled, "State Permit Requirements for Development of Energy and Mineral Resources in New Mexico."

Information on mine waste composition and drainage quality for mines and mills subject to regulatory requirements may be obtained from the NMED (see #2).

All state agency contacts concerned with extractive industry permitting and regulations are listed by media regulated, including but not restricted to:

New Mexico Environment Department Water and Waste Management Division 1190 St. Francis Drive, P.O. Box 26110 Harold Runnels Building Santa Fe, NM 87502 Ernie Rebuck (505/827-2900) Groundwater Bureau Glen Saums (505/827-2827) Surface Water Quality Bureau

5. Summaries of data on mine waste composition/drainage quality

The NMED (formerly the EID) has published a summary document on uranium entitled "Water Quality Data for Discharges from New Mexico Uranium Mines and Mills." Information may be obtained from the following.

New Mexico Environment Department Water and Waste Management Division 190 St. Francis Drive, P.O. Box 26110 Harold Runnels Building Santa Fe, NM 87502 Maxine Goad (505/827-2908) FAX (505/827-2836)

6. Drainage quality predictive test list

See #3.

7. Summary of predictive test results

Summaries on predictive test results may be obtained from the NMED (see #2). New Mexico Tech (see #3) maintains files on Superfund sites.

8. Description of mine waste samples available for testing

New Mexico Tech, USFS, BLM, and NMED can provide information on mine waste sites which have been or could be sampled (see #1, #3, and #4).

9. Mine waste samples

For information about samples and/or actual samples, contact the Department of Mining, Environmental, and Geological Engineering (see #3) for information or consult individual operators ("Mines and Mills in New Mexico," see #1).

10. Any publications or other information on mine drainage quality

The NMED (see #4 and #5) and the Bureau of Mines and Mineral Resources at N.M. Tech (see #3) can provide information on their available technical publications and open-file reports.

W.J. Stone of New Mexico Bureau of Mines and Mineral Resources has published a report entitled "Selected Papers on Water Quality and Pollution in New Mexico," 1984 (Hydrologic Report 7).

NORTH CAROLINA MINE WASTE DRAINAGE QUALITY CONTACTS

Currently, North Carolina has a fair amount of sand, gravel, and crushed stone mining, but has little metal mining. Metallic metal mining has been done in the past, but no mines have been operating during the past twenty years. There is, however, a potential for renewed small scale gold mining. For a list of mining statistics, available from the Land Quality Section (see #1), see Appendix 9.

1. Metal mines list

As stated in The Mining Act of 1971, mines of more than one acre must be permitted and monitored. Water quality (and possibly landfill permits) are subsequently required. The following office handles the permitting for mines, and maintains a detailed listing of mines, company contacts, addresses, and phone numbers.

> North Carolina Department of Environmental, Health, and Natural Resources Land Quality Section P.O. Box 27687 Raleigh, NC 27611 Tracy Davis (919/733-4574) Mining Specialist FAX (919/733-2622)

There are no lists of abandoned mines because permitting was not required previous to 1971. It is not known exactly how many there are or where they are located. Study is getting underway to isolate and determine if and how bad any drainage problems are from these abandoned mines.

2. Mine waste disposal facilities list

About ninety percent of the mines remove the waste to a landfill. Approximately ten percent dump on site by special permits. Contact the Land Quality Section (see #1) for further information.

3. Mine geology and/or processing methods at mines

Listed on the mine files associated with the permitting process are descriptions of mine location. These files are available at the Land Quality Section (see #1).

Contacting the company directly is the best source for information about the processing methods.

4. Mine waste composition/drainage quality

The Water Quality Section permits any discharge off-site and any water which remains on site. They also have limited information regarding abandoned mines and could supply additional leads.

> North Carolina Department of Environmental, Health, and Natural Resources Water Quality Section P.O. Box 27687 Raleigh, NC 27611 Beth McGee (919/733-5083) Environmental Engineer FAX (919/733-9919)

5. Summaries on data on mine waste composition/drainage quality

See #4.

6. List of drainage quality predictive tests

There is no predictive testing performed.

7. Summary of predictive tests

See #6.

8. Descriptions of mine waste samples available for testing

Contacting the company itself is the best source for this information.

9. Mine waste samples

See #8.

10. Any publications or other information on mine drainage quality

No additional information was available.

OREGON MINE WASTE DRAINAGE QUALITY CONTACTS

1. Metal mines list

The Department of Environmental Quality can provide a list of mines which discharge water or use chemical processes to extract ore. This list would include any active mines of significant size within the state. A mine list can also be produced by the Department of Geology and Mineral Industries. The Forest Service can be contacted for a list of mines located on lands which they administer.

> Department of Environmental Quality Water Quality Division Industrial Waste Section 811 Southwest 6th Portland, OR 97204 Jerry Turnbaugh (503/229-5374) FAX (503/229-6124)

Department of Geology and Mineral Industries Mined Land Reclamation 1534 Queen Avenue S.E. Albany, OR 97321 Alan Throop (503/967-2039) Reclamationist FAX (503/967-5905)

U.S.D.A. Forest Service Locatable Minerals Section P.O. Box 3623 Portland, OR 97208-3623 Reb Bennett (503/326-2921) Regional Mining Engineer FAX (503/326-3096)

2. Mine waste disposal facilities list

The Department of Environmental Quality can provide a list of selected mines which store their mine wastes on site. A list can also be produced by the Department of Geology and Mineral Industries. Contact the Forest Service for a list of disposal facilities on lands which they administer (see #1 for all of the above).

3. Mine geology and/or processing methods descriptions

Mine geology and processing method information is available for the mines which are listed with the Department of Environmental Quality (see #1). This information is required on the permit applications which the mines must file with the Department. Additional information is available from the Department of Geology and Mineral Industries (see #1).

4. Mine waste composition/drainage quality data

The Department of Environmental Quality has mine waste composition/drainage quality data for all mines which discharge water or use chemical processes to extract ore (see #1).

5. Summaries of data on mine waste composition/drainage quality

Data on mine waste composition and mine waste drainage quality is available from the Department of Environmental Quality (see #1), although no informational summaries exist at the current time.

6. Drainage quality predictive test list

A list of tests being used to predict mine waste drainage quality can be obtained from the Department of Environmental Quality (see #1).

7. Summary of predictive test results

The Department of Environmental Quality (see #1) has information on the results of predictive tests, although the tests have not been summarized at the current time.

8. Description of mine waste samples available for testing

The Department of Environmental Quality (see #1) has descriptions of mine waste composition available from the mine permits on file. These permits contain information on waste composition from analyses performed by the individual mines. In addition, the Department of Geology and Mineral Industries can provide this information (see #1).

9. Mine waste samples

Samples of mine wastes may be obtained through the Department of Geology and Mineral Industries or by contacting the individual mines directly (see #1).

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10. Any publications or other information on mine drainage quality

The following reference deals with the Lakeview Uranium Site.

U.S. Department of Energy. 1985. Environmental assessment of remedial action at the Lakeview Uranium Mill Tailings Site Lakeview, Oregon. U.S. Department of Energy, U.M.T.R.A. Project Office, Albuquerque Operations Office, Albuquerque, New Mexico. Volume 1 - text, Volume 2 - appendices.

SOUTH CAROLINA MINE WASTE DRAINAGE QUALITY CONTACTS

1. Metal mines

This list, as well as much of the information below, can be obtained through the following office.

South Carolina Land Resources Commission 2221 Devine Street, Suite 222 Columbia, SC 29205 Craig Kennedy (803/734-9100) Assitant Director FAX (803/734-9200)

Appendix 10 contains an informative summary of the four metal mines in the state.

2. Mine waste disposal facilities list

As the waste is deposited on site, this information may be obtained by directly contacting the mines.

3. Mine geology and/or processing methods descriptions

For both geology and processing descriptions see the contact for #1. The individual mines may also be of assistance.

4. Mine waste composition/drainage quality

There is limited data available, which the Land Resources Commission (see #1) would be able to locate.

5. Summaries of data on mine waste composition/drainage quality

See #4.

6. Drainage quality predictive test list

In general, the state requires testing of rock for acid generation potential as part of the application process. The tests are the acid/base accounting and the humidity cell. Additionally, the companies are testing for acid potential throughout the operation to detect "hot" areas so that acid producing rock can be disposed of properly. Information relating to predictive testing is available from the office listed below, which is responsible for permitting.
South Carolina Department of Health and Environmental Control 2600 Bull Street Columbia, SC 29201 Birgit McDade (803/734-5300) Engineer FAX (803/734-5246)

7. Summary of predictive tests

See #6.

8. Descriptions of mine waste samples available for testing

In the past, samples have been obtained from the Haile and the Ridgeway Mines. This was handled through the Land Resources Commission (see #1), they can be contacted for more information.

9. Mine waste samples

See #8.

10. Any publications or other information on mine drainage quality

No additional information was available.

SOUTH DAKOTA MINE WASTE DRAINAGE QUALITY CONTACTS

1. Metal mines list

This information is available from the following office.

Department of Environment and Natural Resources Exploration and Mining Program 523 East Capitol Pierre, SD 57501 Tom Durkin (605/773-4201) Hydrologist Mike Cepak (605/773-4201) Natural Resources Engineer FAX (605/773-6035)

2. Mine waste disposal facilities list

This information is available from the following office.

Department of Environment and Natural Resources Exploration and Mining Program 523 East Capitol Pierre, SD 57501 Tom Durkin (605/773-4201) Hydrologist FAX (605/773-6035)

3. Mine geology and/or processing methods descriptions

Contacting the mining industry geologists is the best source for information about mine geology.

Homestake Mining Corporation P.O. Box 875 Lead, SD 57754 Phil Barnes (605/584-4780) Environmental Director FAX (605/584-4590)

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Brohm Miming Corporation P.O. Box 485 Deadwood, SD 57732 Rod MacLeod (605/578-2107) Senior Geologist FAX (605/578-1709)

Wharf Resources P.O. Box 446 Deadwood, SD 57732 Jim Lessard (605/584-1441) Chief Geologist FAX (605/584-3730)

Bond Gold Richmond Hill P.O. Box 892 Lead, SD 57754 Todd Duex (605/584-1210) Chief Geologist FAX (605/584-3210)

The Golden Reward Mining Company P.O. Box 888 Lead, SD 57754 Carl Emmanuel (605/584-2010) Chief Geologist FAX (605/584-2572)

The contacts for processing methods are at the Exploration and Mining Program (see #1).

4. Mine waste composition/drainage quality

For this category contact Exploration and Mining Program (see #2) and the following office.

U.S. Forest Service 460 Main Street Deadwood, SD 57732 Don Murray (605/578-2744) Mineral Specialist The following are relevant publications on acid mine drainage. The first citation contains two volumes, both in draft stage and out of print. The final drafts are due to be published in one year. Photocopies and further information can be obtained from the Montana Department of State Lands, Hardrock Bureau.

Department of State Lands Hardrock Bureau 1625 11th Avenue Helena, MT 59620 Patrick Plantenberg (406/444-2074) FAX (406/444-2648)

Steffen, Robertson, and Kirsten (BC, Inc.), Volume I 1989, Volume II 1990. Draft acid rock drainage technical guide. British Columbia Acid Mine Drainage Task Force.

Coastech Research, Inc. Investigation of predictive techniques for acid mine drainage.

5. Summaries of data on mine waste composition/drainage quality

See #2.

6. Drainage quality predictive test list

The two reports cited in #4 are useful in this category as is the Exploration and Mining Program (see #1).

7. Summary of predictive test results

See the two offices in #4.

8. Descriptions of mine waste samples available for testing

Contacting the mining industry geologists listed in #3 is advised. In addition, see #7.

9. Mine waste samples

Again, contacting the mining industry geologists listed in #3 is advised.

10. Any publications or other information on mine drainage quality

Information from Water Quality Files is available from the Exploration and Mining Program at the Department of Environment and Natural Resources upon request (see #2 for telephone number and address).

Much information is available on the Gilt Edge project area in the Black Hills National Forest near Deadwood. The following are some papers pertaining to this.

> Geology and Soils: Literature Review of the Gilt Edge Project Area. August 26, 1988. EnecoTech, Inc. Denver, CO. Project Number 189-005.

- Plan of Operations: Gilt Edge Expansion Project. June, 1990. Brohm Mining Corporation, Deadwood, SD.
- Study Plan for an Environmental Impact Statement for the Proposed Gilt Edge Expansion Project. September, 1989. ENSR Consulting and Engineering, Fort Collins, CO, Document Number 1063-001.

The following paper is related to gold mining in the Black Hills.

Durkin, T. V., 1990. Neutralization of spent ore from cyanide heap leach gold mine facilities in the Black Hills of South Dakota:
Current practices and requirements. In: Proceedings of the 4th Annual Reg. Conference on Precious Metals and the Environment, held by AIME, Lead, South Dakota, September, 1990.

TEXAS MINE WASTE DRAINAGE QUALITY CONTACTS

1. Metal mines list

There is little metal mining in the state and some surface mining. The following is a contact for surface mining.

Railroad Commission P.O. Drawer 12967 Capital Station Austin, TX 78711-2967 Patrick Martinets (512/463-6900) Special Project Director FAX (512/463-7161)

2. Mine waste disposal facilities list

The overburden is disposed of at the site, while the tailings are deposited at the processing site, usually close to the mine itself. Contact the mines directly for this information.

3. Mine geology and/or processing methods descriptions

Information regarding this topic can be found by contacting the following.

Bureau of Economic Geology University of Texas at Austin University Station, Box X Austin, TX 78713-7508 Chris Henry (512/471-1534) Senior Research Scientist FAX (512/471-0140)

The following two references deal with the geology of the Uranium Province in southern portion of the state.

Galloway, William E., Finley, R. J., and Henry, C. D. April, 1979.
South Texas Uranium Province: Geologic Perspective. Guidebook
18. Bureau of Economic Geology, University of Texas at Austin.

Eargle, D. H., Hinds, G. W., and Weeks, A, M., 1973. Uranium Geology and Mines, South Texas. Guidebook 12. Bureau of Economic Geology, University of Texas at Austin. This reference has some geology of beryllium deposits along with a thorough discussion of the mineralogy:

 Torma, A. E. and Gundiler, I. H., 1988. <u>Precious and Rare Metal</u> <u>Technologies.</u> Rubin, et al. Mineralogy of Beryllium Deposits near Sierra Blanca, Texas. Elsevier, Amsterdam, p. 601-614.

Two other papers address trace elements associated with uranium deposits in the south.

- Henry, C. D. and Kapadia, R. R., 1980. Trace Elements in Soils of the South Texas Uranium District: Concentrations, Origin, and Environmental Significance. Bureau of Economic Geology, University of Texas at Austin.
- Henry, C. D., March 1983. Trace and Potentially Toxic Elements Associated with Uranium Deposits in South Texas. Project Summary, U. S. EPA. EPA-600/S7-83-005.

One final paper addresses ground water in the Oakville Sandstone.

Henry, Chris, et al, 1982. Geochemistry of Ground Water in the Oakville Sandstone: A Major Aquifer and Uranium Host of the Texas Coastal Plain. Bureau of Economic Geology, University of Texas at Austin.

4. Mine waste composition/drainage quality

For information relating to solution mining, contact the following.

Texas Water Commission 8900 Shoal Creek Austin, TX 78757 Dale Kohler (512/371-6322) FAX (512/371

For information regarding any other type of mining contact:

Texas Railroad Commission P.O. Drawer 12967 Capital Station Austin, TX 78711-2967 Patrick Martinets (512/463-6900) Special Project Director FAX (512/463-7161)

5. Summaries of data on mine waste composition/drainage quality

The contacts for this information are the same as #4 above.

6. Drainage quality predictive test list

Predictive testing is performed on ash disposed of at the mine sites and on the overburden. Contact the following for information concerning these tests.

Texas Railroad Commission P.O. Drawer 12967 Capital Station Austin, TX 78711-2967 Paul Askanesy (512/463-6900) Chemist FAX (512/463-7161)

7. Summary of predictive tests

See #6.

8. Descriptions of mine waste samples available for testing

Contact the mining company directly for samples (see #1).

9. Mine waste samples

See #8.

10. Any publications or other information on mine drainage quality

No additional information was available.

1. Metal mines list

The Division of Oil, Gas and Mining can provide a list of the metal mines which they currently have on file.

Utah Department of Natural Resources Division of Oil, Gas, and Mining 355 West North Temple 3 Triad Center, Suite 350 Salt Lake City, UT 84116 D. Wayne Hedburg (801/538-5340) Permit Supervisor- Minerals FAX (801/359-3940)

2. Mine waste disposal facilities list

See #1.

3. Mine geology and/or processing methods descriptions

The Utah Geological and Mineral Survey is a good source for mining related geologic information. Contact the Division of Oil, Gas, and Mining (see #1), the Design Evaluation Section, and Groundwater Section for specific information on mine geology and processing methods.

Utah Geological and Mineral Survey 606 Blackhawk Way Salt Lake City, UT 84108 Information (801/467-7970) FAX (801/467-4070)

Department of Health Division of Environmental Health Bureau of Water Pollution Control Design Evaluation Section 288 North 1460 West P.O. Box 16690 Salt Lake City, UT 84116-0690 Kiran Bhayani (801/538-6146) Environmental Engineer FAX (801/538-6016) Department of Health Division of Environmental Health Bureau of Water Pollution Control Groundwater Protection Section 288 North 1460 West P.O. Box 16690 Salt Lake City, UT 84116-0690 Larry Mize (801/538-6146) FAX (801/538-6016)

4. Mine waste composition and drainage quality data.

The Design Evaluation Section (see address and contact below) has limited data on the mine waste composition/drainage quality relationship, due largely to the arid climate in areas of current mineral production. Much of the information it does have is not compiled in a readily accessible format. The Section would be willing to provide more detailed information on project-specific requests.

Drainage quality data, state water quality standards:

Department of Health Division of Environmental Health Bureau of Water Pollution Control Design Evaluation Section 288 North 1460 West P. O. Box 16690 Salt Lake City, UT 84116-0690 David Wham (801/538-6121) FAX (801/538-6016)

Department of Health Division of Environmental Health Bureau of Water Pollution Control Water Quality Management Section P. O. Box 16690 Salt Lake City, UT 84116 Mike Reichert (801/538-6146) FAX (801/538-6016) Mine waste composition:

Department of Health Division of Environmental Health Bureau of Water Pollution Control Design Evaluation Section P. O. Box 16690 Salt Lake City, UT 84116-0690 Kiran Bhayani (801/538-6146) Environmental Engineer FAX (801/538-6016)

Groundwater quality data/mine waste composition:

Department of Health Division of Environmental Health Bureau of Water Pollution Control Groundwater Protection Section P. O. Box 16690 Salt Lake City, UT 84116-0690 Larry Mize (801/538-6151) FAX (801/538-6016)

Water quality data and mine waste composition information as it pertains to NPDES permits:

Bureau of Water Pollution Control Permitting and Compliance Section P. O. Box 16690 Salt Lake City, UT 84116-0690 Don Hilden (801/538-6146) FAX (801/538-6016)

Mine waste composition and water quality data:

Division of Oil, Gas and Mining Minerals Reclamation Program 3 Triad Center, Suite 350 Salt Lake City, UT 84116 D. Wayne Hedberg (801/538-5340) FAX (801/359-3940) General mine waste composition and water quality information on abandoned mines:

Division of Oil, Gas and Mining Abandoned Mine Lands Program 3 Traid Center, Suite 350 Salt Lake City, UT 84116 Mary Ann Wright (801/538-5340) FAX (801/359-3940)

Geologic information:

Utah Geological and Mineral Survey 606 Blackhawk Way Salt Lake City, UT 84108 Information (801/581-6831) FAX (801/467-4070)

5. Summaries of data on mine waste composition/drainage quality

Specific information regarding mine waste composition and mine waste drainage quality may obtained by contacting the Division of Oil, Gas, and Mining (see #1). Additionally, the Design Evaluation, Groundwater Protection, and Permitting and Compliance Sections of the Bureau of Water Pollution Control (see #4) may be contacted for specific information on mine waste composition.

6. Drainage quality predictive test list

Acid-base accounting EP toxicity Column leach Total constituent analysis

7. Summary of predictive test results

Contact the Division of Oil, Gas and Mining (see #1) and the Bureau of Water Pollution Control (see #4) for results on specific projects.

8. Description of mine waste samples available for testing

See #7.

9. Mine waste samples

See #7.

10. Any publications or other information on mine drainage quality

No additional information was available.

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WASHINGTON MINE WASTE DRAINAGE QUALITY CONTACTS

1. Metal mines list

A list of metal mines is available from the Department of Natural Resources.

Department of Natural Resources Division of Geology and Earth Resources Mail Stop PY-12 Olympia, WA 98504 Bill Lingley (206/459-6372) Regulatory Programs Manager FAX (206/459-6380)

2. Mine waste disposal facilities list

Information contained in permits issued by the DNR (see #1) will be available through them.

The Department of Ecology will have information on county issued limited purpose landfill permits which may apply.

Department of Ecology Solid and Hazardous Waste Program Mail Stop PV-11 Olympia, WA 98504 Guy J. Gregory (206/459-6865) Hydrogeologist FAX (206/438-7484)

3. Mine geology and/or processing method descriptions

Descriptions of mine geology and the general geology of Washington are available from the Department of Natural Resources, Division of Geology and Earth Resources (see #1).

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4. Mine waste composition/drainage quality data

Department of Ecology Solid and Hazardous Waste Program Mail Stop PV-11 Olympia, WA 98504 Guy J. Gregory (206/459-6865) Hydrogeologist FAX (206/438-7484)

The Bureau of Mines can provide various information on mine wastes and mine waste drainage.

United States Department of the Interior Bureau of Mines Western Field Operations Center East 360 3rd Avenue Spokane, WA 99202-1413 Mine Geotechnical Section (509/484-1610) FAX (509/353-2652)

5. Summaries of data on mine waste composition/drainage quality

Summaries are not compiled as of this date.

6. Drainage quality predictive test list

According to Guy Gregory in the Department of Ecology (see #4), there is "no standardized modeling for such materials, as both individual deposits and local climatological conditions vary widely. Recent EIS documentation filed with the Department of Ecology included no such testing."

7. Summary of predictive test results

No results are available (see #6).

8. Description of mine waste samples available for testing

Contact the mine itself for information on this topic.

9. Mine waste samples

See #8.

10. Any publications or other information on mine drainage quality

Information on publications available from the U.S.D.I. Bureau of Mines can be obtained by contacting the library at its research center in Spokane (see #4).

WISCONSIN MINE WASTE DRAINAGE QUALITY CONTACTS

1. Metal mines list

The Department of Natural Resources has a list of five permitted mines which are currently not in operation. Hundreds of small lead-zinc mines were operated in the southwestern part of the state from the 1830's through 1978, before current permitting laws came into effect. Also, prior to the promulgation of comprehensive mining laws, numerous deep, underground, iron mines were operated in northern Wisconsin. Consequently, a comprehensive list of abandoned mines does not exist. A decision on a proposal by the Flambeau Mining Company, a Kennecott subsidiary, for a copper-gold mine near Ladysmith, Wisconsin, is expected early in 1991. It is likely that the decision will be appealed.

> Department of Natural Resources Box 7921 Madison, WI 53707 Larry Lynch (608/267-7553) Hydrogeologist FAX (608/267-2768)

2. Mine waste disposal facilities list

At present there is only one licensed mine waste disposal facility within the state of Wisconsin. Information regarding this facility can be obtained from the Department of Natural Resources (see #1).

3. Mine geology and/or processing methods descriptions

The Department of Natural Resources can access, although not in summary form, information concerning mine geology and processing methods from files they have on specific mines (see #1). The Wisconsin Geological and Natural History Survey may be able to provide additional material on specific mines and can answer questions pertaining to regional geology.

Wisconsin Geological and Natural History Survey 3817 Mineral Point Road Madison, WI 53705 Tom Evans (608/262-1705) Mineral Resources FAX (608/262-8086)

4. Mine waste composition/drainage quality data.

For this information, see the contact listed in #1.

5. Summaries of data on mine waste composition/drainage quality

Although no summaries currently exist, the Department of Natural Resources can provide ground water quality and leachate information (see #1).

6. Drainage quality predictive test list

A standard list of drainage quality predictive tests is not used. Companies are notified of the parameters to be examined and are permitted to use any testing method they find applicable, subject to DNR approval.

7. Summary of predictive test results

Information on predictive test results can be obtained from the Department of Natural Resources (see #1), however, it has not been summarized at present.

8. Description of mine waste samples available for testing

Information on mine waste samples from the five permitted, currently nonoperating mines in Wisconsin is available from the Department of Natural Resources (see #1).

9. Mine waste samples

See #8.

10. Any publications or other information on mine drainage quality

Colorado School of Mines Research Institute. 1982. Study on characterization of Crandon Mill tailings. Prepared for Exxon Minerals Company by Colorado School of Mines Research Institute, Golden, Colorado. 132 p. plus appendices.

Division of Applied Biology, B.C. Research. 1981. Assessment of the acidproducing characteristics of Crandon Hanging Wall material of varying sulfur content. Prepared for Exxon Minerals Company by Division of Applied Biology, B.C. Research, Vancouver, British Columbia. 34 p. plus appendices.

- Division of Extractive Metallurgy, B.C. Research. 1982. Waste characterization studies of typical waste rocks from the Crandon Mineral Deposit. Division of Extractive Metallurgy, B.C. Research, Vancouver, British Columbia. 93 p. plus appendices.
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- Heyl, Allen V., Agnew, Allen F., Lyons, Erwin J., Behre, Charles H. 1959. The geology of the Upper Mississippi Valley zinc-lead district. United States Geological Survey, Denver, Colorado. 310 p.
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- Mercando, Larry. 1987. Flambeau project; Ladysmith, Wisconsin summary. Flambeau Mining Company, Ladysmith, Wisconsin. 4 p.
- Mullens, Thomas E. 1964. Geology of the Cuba City, New Diggings, and Shullsburg Quadrangles, Wisconsin and Illinois: United States Geological Survey Bulletin 1123-H. United States Geological Survey, Washington, D.C., and Wisconsin Geological and Natural History Survey, Madison, Wisconsin. 95 p.
- Toran, L., Bradbury, K. R. 1986. Hydrogeologic and geochemical evolution of contaminated groundwater near abandoned mines. Technical Completion Report, Project Number G-878-03. 34 p.

WYOMING MINE WASTE DRAINAGE QUALITY CONTACTS

Wyoming has a variety of metal resources which have been utilized for the past two centuries. Iron, gold, copper, uranium, and trona have all been the focus of mining activity, with the attendant mine wastes being produced. Wyoming has experienced limited water quality problems attributable to mine waste, in part a result of Wyoming's semi-arid climate; some mining areas receive 15 inches or less of precipitation annually.

1. Metal mines list

Previously, there have been two iron mining facilities, both of which shut down approximately ten years ago and are in the process of closure. Around the turn of the century copper mining activities took place near Encampment with the associated generation of mining wastes. The Department of Environmental Quality, Abandoned Mine Land (AML) program has reclaimed much of this disturbance. Scattered placer and lode gold mining and milling activity has also taken place. For all intents and purposes this activity ceased by the 1930's, with much of the intrusion having been reclaimed by the AML program. Several pulses of uranium mining activity have taken place since 1950, the last of which occurred during the 1970's. This was predominantly surface mining with only a few underground operations. Large quantities of waste rock and uranium tailings have resulted from these operations, affecting large areas of the Southern Powder River Basin, the Shirley Basin, the Gas Hills, and the Crooks Gap Area. Some uranium production still occurs, but this is primarily from in situ operations in the Southern Powder River Basin. Many of the rest are in various stages of closure.

The Land Quality Division of the Department of Environmental Quality can provide a list of mine permits which they catalogue by mineral type.

> Department of Environmental Quality Land Quality Division Herschler Building 122 West 25th Street Cheyenne, WY 82002 Richard A. Chancellor (307/777-7756) Engineering Supervisor FAX (307/634-0799)

The Wyoming Geological Survey does not keep a listing of mines, but such information can be derived from their publications and mineral files.

Wyoming Geological Survey Box 3008 University Station Laramie, WY 82071 Information (307/766-2286) FAX (307/766-2605)

2. Mine waste disposal facilities list

Mine waste in Wyoming is contained on site, with no separate handling facilities. Several uranium mines, however, have approval to receive uranium waste from other mines. Consequently, the mine list in #1 should answer this question.

3. Mine geology and/or processing method descriptions

Information on mine geology may be obtained from the Wyoming Geological Survey. In addition, the mine permits on file with the Land Quality Division contain descriptions of mine geology and processing methods. They are unable to provide a compiled list, but their Records Specialist could assist anyone interested in researching their records.

> Wyoming Geological Survey Box 3008 University Station Laramie, WY 82071 Dan Hausel (307/766-2286) Deputy Director, Head of Metals and Precious Minerals Division Ray Harris (307/766-2286) Head of Industrial Minerals and Uranium Division FAX (307/766-2605)

Department of Environmental Quality Land Quality Division Herschler Building 122 West 25th Street Cheyenne, WY 82002 Ramona Christensen (307/777-7756) Records Specialist FAX (307/634-0799)

4. Mine waste composition/drainage quality data

Information concerning mine waste composition may be acquired from the Wyoming Geological Survey (see #3).

Mine drainage quality data is obtainable from the Water Quality Division.

Department of Environmental Quality Water Quality Division Herschler Building 4 West Cheyenne, WY 82002 John Wagner (307/777-7781) Technical Support Supervisor FAX (307/777-5973)

5. Summaries of data on mine waste composition/drainage quality

Groundwater contamination from tailings leachate has occurred in the uranium mining areas, however, these tailings are not subject to RCRA regulation. Some information suggests acid production and metal contamination exists in pyritic uranium waste rock which has been backfilled into mine pits.

Each permit to mine issued by the Division of Land Quality (see #1) contains information on any waste generated.

No data summaries on mine waste drainage quality currently exist.

6. Drainage quality predictive test list

John Wagner of the Water Quality Division (see #4) has identified one drainage quality predictive test known as SEDIMONT, which is used to predict sediment. Additional information can be obtained from the Land Quality Division. Most of the water quality predictive tests have been concerned with coal mine related waste rock, where various leaching tests have been used. These tests include batch tests, column leach tests, and in the future, the ASTM sequential batch extraction procedure. Department of Environmental Quality Land Quality Division Herschler Building 122 West 25th Street Cheyenne, WY 82002 Mark Moxley (307/332-3047) Supervisor, District II FAX (307/332-7726) Christine West (307/777-6772) Chief Hydrologist FAX (307/634-0799)

7. Summary of predictive test results

No summaries of predictive test results are currently available, although Christine West of the Land Quality Division (see #6) may be able to provide a generalization.

8. Description of mine waste samples available for testing

Contacting the mines directly is the best source for mine waste descriptions (see #1 for a list of mines). Similar information, although not categorically described, is contained within the mineral files of the Wyoming Geological Survey (see #1). Mark Moxley of the Land Quality Division (see #6) can also provide information on obtaining descriptions of mine waste.

9. Mine waste samples

Mine waste samples may be obtained by contacting the mines directly (see #1 for list of mines). Additionally, the Wyoming Geological Survey (see #3) can provide information on procuring mine waste samples, as can Mark Moxley of the Land Quality Division (see #6).

10. Any publications or other information on mine drainage quality

Mark Moxley and Christine West of the Land Quality Division may be able to provide additional information concerning publications or other data on mine drainage quality.

The following is a compiled bibliography.

Geological Survey of Wyoming. 1991. Publications available from the Geological Survey of Wyoming. Geological Survey of Wyoming, Laramie, Wyoming. 46 p. APPENDICES

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- Bainbridge, K., 1979. Evaluation of wastewater treatment practices employed at Alaskan gold placer mining operations. Prepared for U.S. Environmental Protection Agency, Effluent Guidelines Division by Calspan Advanced Technology Center, Buffalo, NY, 44 pp.
- Bjerklie, D.M., and J.D. LaPerriere, 1985. Gold-mining effects on stream hydrology and water quality, Circle quadrangle, Alaska. Water Resources Bulletin, Vol. 21, No. 2, pp. 235-243.
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- Mack, S., 1985. Placer mining water quality monitoring program, 1984. Unpublished data, Alaska Department of Natural Resources, Division of Geologic and Geophysical Surveys, Fairbanks, Alaska, 30 pp.
- Parks, B., and R.J. Madison, 1985. Estimation of selected flow and water quality characteristics of Alaskan streams. U.S. Geological Survey Water-Resources Investigations Report 84-4247, 64 pp.
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- R&M Consultants, Inc., 1982. Placer mining wastewater settling pond demonstration project. Prepared for Alaska Department of Environmental Conservation by R&M Consultants, Inc., Fairbanks, Alaska, 60 pp. + Appendices.
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- Simmons, R.C., 1984. Effects of placer mining sedimentation on Arctic grayling of interior Alaska. M.S. Thesis, University of Alaska, Fairbanks, Alaska, 75 pp.

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- Wilson, F.H., and D.B. Hawkins, 1978. Arsenic in streams, stream sediments, and ground water, Fairbanks area, Alaska. Environmental Geology, Vol. 2, No. 4, pp. 195-202.
- Yost, T.B., 1982. Initial decision on remand. Docket No. X-WP-76-30C in the matter of National Pollutant Discharge Elimination System Permits for Alaska P Placer Miners. U.S. Environmental Protection Agency, Washington, D.C., 21 pp.

APPENDIX 2 COLORADO: LIST OF SAMPLING PARAMETERS

Acid-Base Potential EC pH Total Dissolved Solids Total Suspended Solids

Bicarbonate Calcium Chloride Magnesium Nitrate Potassium Sodium Sulfate Aluminum Antimony Arsenic Cadmium Chromium Copper Iron Lead Manganese Mercury Molybdenum Nickel Selenium Silver Zinc

Free Cyanide Total Cyanide Thiocyanaie Weak Acid Dissociable Cyanide

All testing should be done in accordance with Colorado Department of Health, Water Quality Control Commission Regulations.

APPENDIX 3 FLORIDA: INFORMATION ON PREDICTIVE TESTING

Predictive Testing

- 1. Vertical and horizontal permeability of phosphogypsum, clay liners, and soil
- 2. Predictive groundwater modeling to determine quantity and quality of leachate
- 3. Ion exchange capacity of soil and pore water and prediction of metal and ion attenuation in soil
- 4. Chemical analyses on waste material for metals, organics, and radioactive materials to predict mobility
- 5. Chemical analyses in sand tailings water for volatile organics as a part of a mine's ground water monitoring plan to determine potential impact to ground water

APPENDIX 4 MICHIGAN: SUPPLEMENTAL REFERENCE LIST

Professional Papers on Mining Geology from Question 3

Geology of central Dickenson County, Michigan

Geology of the Marquette and Sands quadrangle, Marquette, Michigan

Geology of the Menominee iron-bearing district Dickenson County, Michigan and Florence and Marinette Counties, Wisconsin.

Geology and ore deposits of the Iron River - Crystal Falls District, Iron County, Michigan.

Geology of the Florence Area, Wisconsin and Michigan.

Bedrock geology and ore deposits of the Palmer quadrangle, Marquette County, Michigan.

Geology of the Neguanee quadrangle, Marquette County, Michigan.

References for Processing Methods from Question 3

Benedict, C.H., 1955. Lake Superior Milling Practice. The Michigan Technological University Press, Houghton, 137 pages.

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<u>References from the Iron County Survey from Question 10</u>

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APPENDIX 5 MINNESOTA: REFERENCES

Eger, A. P., Antonson, D., Udoh, F., 1990a. Stockpile Capping Report. MN Dep. Nat. Resour., Div. of Minerals. St. Paul, Minnesota. 47p.

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Eger, A. P., Lapakko, K. A. 1980a. Leaching and chemical transport at the Erie Mining Company Dunka Site: A data summary, 1976-1979. MN Dep. Nat. Resour., Div. of Minerals, St. Paul, MN. 117 p. plus appendices.

. 1980b. Transport of chemical constituents present in mining runoff through a creek system. MN Dep. Nat. Resour., Div. of Minerals, St. Paul, MN. 47 p. plus appendices.

. 1980c. Environmental leaching of Duluth Gabbro under laboratory and field conditions: Oxidative dissolution of metal sulfide and silicate minerals. MN Dep. Nat. Resour., Div. of Minerals, St. Paul, MN. 340 p.

. 1981. The leaching and reclamation of low-grade mineralized stockpiles. P. 157-166. In Proc. 1981 Symposium on Surface Mining Hydrology, Sedimentology and Reclamation. Lexington, KY.

. 1985. Heavy metals study progress report on the field leaching and reclamation program: 1977-1983. MN Dep. Nat. Resour., Div. of Minerals, St. Paul, MN. 53 p. plus appendices.

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Eger, A. P., Lapakko, K. A., Otterson, P. 1980. Trace metal uptake by peat: Interaction of a white cedar bog and mining stockpile leachate. P. 542-547. <u>In</u> Proc. of the 6th International Peat Congress. Duluth, MN. Aug. 17-23, 1980.

Eger, A. P., Lapakko, K. A., Weir, A. 1980a. Heavy metals study: 1979 progress report on the field leaching and reclamation program, and the removal of metals from stockpile runoff by peat and tailings. MN Dep. Nat. Resour., Div. of Minerals, St. Paul, MN. 95 p. plus appendices.

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APPENDIX 6 MISSOURI: LIST OF MINES

ACTIVE MINES

Mine	Company	Address	<u>Activity</u>
Sweetwater Mine	ASARCO	Route 1, Box 202C Bunker, MO 63629	Underground Lead Mine
West Fork Mine	ASARCO	(same as above)	Underground Lead Mine
Magmont Mine	Comico American	Bixby, MO 65439	Underground Lead Mine
Buick Mine	The Doe Run Co.	11885 Lackland Rd. Suite 500 St. Louis, MO 63146	Underground Lead Mine
Brushy Creek	The Doe Run Co.	(same as above)	Underground Lead Mine
Casteel Mine	The Doe Run Co.	(same as above)	Underground Lead Mine
Fletcher Mine	The Doe Run Co.	(same as above)	Underground Lead Mine
Viburnum #28 and 29	The Doe Run Co.	(same as above)	Underground Lead Mine
Pea Ridge Iron Mine	The Pea Ridge Iron Ore Co.	H.C. 65 Sullivan, MO 63080	Underground Iron Mine

The 1988 Missouri Minerals Yearbook, by the U.S. Department of Interior Bureau of Mines, reported estimated ore reserves for the Doe Run, ASARCO, and Comico Mines as 74, 35, and 4 million tons, respectively. The Comico Mine is expected to close in the next two or three years. About 90 million tons of iron ore reserves were reported for the Pea Ridge Mine.

These mines are all located in the Viburnum Trend.

INACTIVE/ABANDONED MINES

Iron County:

Annapolis Lead Mine Pilot Knob Pellot Company Mine

Madison County: Park City Mine Madison Mine Copper Mine Catherine Mine

> Mine La Motte Higdon Mine

St. Francois County: Bonne Terre County Elvis Mine Leadwood Mine Federal Mine, St. Joe State Park Desloge Mine Doe Run Mine Unnamed Mine, U.S. Survey 3092 Iron Mountain Iron Mine Valles Mine

Washington County: Indian Creek Mine

This is a partial listing which includes the major inactive and abandoned mines. Additional information may be obtained by contacting one of the mines directly. A list including minor mines can obtained through the USGS, Branch of Resource Analysis (see #1).

APPENDIX 7 NEVADA: WASTE ROCK AND OVERBURDEN EVALUATION

Waste rock and overburden shall be evaluated for its potential to release pollutants and its acid generation potential.

SAMPLE COLLECTION

In order for this evaluation to be meaningful, the sample material must be representative of the entire range of material deposited in a waste dump. The following factors must be considered in establishing a representative sampling program.

- a. Lithological variation.
- b. Mineralogical variation.
- c. Extent of "sulfide" mineralization.
- d. Color variation.
- e. Degree of fracturing.
- f. Degree of oxidation.
- g. Extent of secondary mineralization.

Drill core samples collected during initial ore body definition may be used for initial material characterization. During active mining, samples can be collected from those materials that have been sent to the assay lab. All or a portion of those materials that have been determined to be waste should be saved and representatively composited during the quarter for on-going evaluations. Samples shall also be collected of those materials that are determined to be waste without having to be assayed.

EVALUATION PROCEDURE

- I. Collect a representative sample and submit a synopsis of the sampling procedures used.
- II. The potential to release pollutants shall be evaluated by the Meteoric Water Mobility Procedure.
- III. The potential for acid generation shall be evaluated in accordance with the following testing procedures:

A. Static Testing - Acid/Base Accounting or equivalent

1. Determine neutralization potential (NP). Add a known amount of HCL, heat sample, and titrate with NaOH to ph7, (convert to tons of CaCO/1000 tons).

APPENDIX 7 (con't)

2. Determine acidification potential by alternative I or II.

Alternative I

a) Determine total sulfur content by LECO furnace. All sulfur is assumed to be acid generating (convert to tons of CaCO/1000 tons).

Compare results to NP. If NP exceeds this value by 20% evaluations can stop, material is considered non-acid generating; if less than 20% continue with Alternative I(b) analysis.

b) Determine total sulfide sulfur content accordance with procedures described in <u>Standard Methods of Chemical Analyses</u>, or other equivalent procedure. Compare this value to NP. If NP exceed this value by 20% evaluations can stop, material is considered non acid generating; if less than 20% initiate kinetic testing.

Alternative II

a) Determine peroxide oxidizable sulphur. Compare this value to NP. If NP exceeds this value by 100% evaluations may stop, material is considered non-acid generating; if less than 100%, initiate kinetic testing.

3. For facilities in active operation, if results of static testing shows the material is acid generating, the Division must be notified and kinetic testing initiated within 10 days.

B. Kinetic Testing

Kinetic testing shall be conducted in accordance with one of the procedures identified in Attachment I.

IV. If kinetic testing confirms acid generation potential, site specific conditions and characteristics shall be evaluated and containment/neutralization methods proposed to the Division for approval.

APPENDIX 8 NEVADA: <u>METEORIC WATER MOBILITY PROCEDURE</u>

Collect a representative sample of the material. The minimum sample size for this procedure is 5 kilograms. If the material to be sampled has particle sizes greater than 5 centimeters, sufficient material must be classified to provide 5 kilograms of sample with maximum particle size less than 5 centimeters. This classified sample is placed in an extraction device which allows the sample to be continuously wetted by circulation of the synthetic meteoric water (lixiviant). The volume of the synthetic meteoric water must be equal in weight to the weight of the classified sample plus the additional volume necessary to saturate the sample. The lixiviant is circulated, agitated, or mixed for 24 hours, continuously wetting the full laboratory grade water whose hydrogen ion activity (pH) has been adjusted to between pH 5.5 and 7.0 with reagent grade nitric acid before charging it to the extraction device. No further adjustment of the pH during extraction is required. One hour after ceasing to circulate, a sample of the lixiviant is decanted and prepared for analysis. Analysis shall be performed for the constituents listed at the end of this procedure. Elements for which a standard has been established shall have a lower level of quantification equal to or less than that standard.

The extraction device can be a packed column with a small recycle reservoir or bottle roll or large barrel fitted with internal circulation/agitation or equivalent.

The information to be recorded and reported is:

- 1. The procedure used to collect a representative sample;
- 2. The adjusted pH of original lixiviant;
- 3. The final pH of fluid after mixing;
- 4. Percentage of sample passing 200 mesh;
- 5. Total weight of solid sample;
- 6. Moisture required to saturate sample;
- 7. Time of contact in extraction device;
- 8. Synopsis of the technique and equipment used to leach sample, i.e., column, batch, etc.; and

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9. Results of the analysis of the lixiviant after ending the extraction (*when appropriate).

Alkalinity	Gallium	Scandium	
Aluminum	Iron	Selenium	
Antimony	Lead	Silver	
Arsenic	Lithium	Sodium	
Barium	Magnesium	Strontium	
Beryllium	Manganese	Sulfate	
Bismuth	Mercury	Thallium	
Cadmium	Molybdenum	Tin	
Calcium	Nickel	Titanium	
Chloride	Nitrate	Total Diss	
		Solid	
Chromium	р Н	Vanadium	
Cobalt	Phosphorus	*WAD CN	
Copper	Potassium	Zinc	
Fluoride			

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APPENDIX 9 NORTH CAROLINA: 1989 MINING REPORT FOR INACTIVE AND ACTIVE MINES'

Commodity	no. of permits	net acres disturbed in 1989	tot. acres recl/rec in 1989**	tot. acres affected & unreclaimed	est. of tot. acres permitted
clay/shale	64	5	51	1780	9504
crushed stone	129	120	457	7320	26792
dimension stone	23	0	6	231	1377
feldspar	5	0	11	189	487
gemstone	15	0	5	62	233
lithium	2	0	22	622	988
mica	8	0	6	349	948
olivine	9	0	9	92	523
other	15	3	19	125	499
peat	3	0	7949	197	3745
pyrophyllite	7	1	3	119	649
phosphate	2	140	0	8400	13420
sand/gravel	491	167	399	5846	18081
gold	3	31	0	51	173
TOTALS	776	467	8937	25383	77419

* approximate figures** does not reflect reclamation in progress

APPENDIX 10

SOUTH CAROLINA: MINE LIST AND BRIEF DESCRIPTION

The information which follows was received from Craig Kennedy of the Land Resources Commission. The four metal mines, which all mine gold, are outlined briefly. All four sites lie in the Carolina Slate Belt that is composed of volcanics and metasediments with zones of alteration. The ore is predominantly siltstones clastics that have undergone hydrothermal alteration.

Piedmont Mining Company Haile Mine

Haile is a heap leaching operation that stacks the ore on HPDE lined dedicated pads. The ore is mined from the predominantly oxidized zone of the ore body and is processed by crushing, agglomeration with cement, and stacked on the pad with a radial stacker.

There are three waste rock disposal sites for the Haile operation for run of mine wastes. All drainage is routed through an NPDES outfall prior to discharge. There is little analytical data of drainage quality from the one waste pile prior to treatment before discharge. The three waste rock dumps are scheduled to be back filled into mined open pits as part of the reclamation plan.

Kennecott Ridgeway Mining Company Ridgeway Mining Company Ridgeway Mine

Ridgeway is a cyanide leach operation which leaches the ore with the Carbon in Leach process. Leaching takes place in tanks with the leached out ore pumped and disposed of in a lined tailings impoundment.

The waste rock from the mine is predominantly being used to construct tailings impoundment. At present, there is little if any history on drainage analysis.

Brewer Gold Company Brewer Mine

Brewer is a heap leaching operation that stacks the ore on HPDE lined dedicated pads. The ore is mined from the predominantly oxidized zone of the ore body and is processed by crushing, agglomeration with cement, and stacked on the pad with a radial stacker.

A-20

There is only one waste rock disposal site for the Brewer mine for run of mine waste. All drainage is routed through an NPDES outfall prior to discharge.

Gwalia (USA) Ltd. Barite Hill Mine

Barite Hill mine is a heap leaching operation that will stack ore on an on/off leach pad that is designed to leach the ore, rinse the ore, and remove ore off the pad. The rinsed ore has a solid waste disposal site that must collect runoff from the disposed leached ore if the leachate cannot meet NPDES standards.

At present, the Barite Hill is just beginning mining operations. There are three waste disposal sites planned for this operation. As would be expected, there has not been any waste rock placed in the disposal areas.