ARIZONA WATER RESOURCES
NEWS BULLETIN

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LANDSAT DATA USED TO INVENTORY MINED LANDS AND MONITOR HAZARDS

The Surface Mining Control and Reclamation Act of 1977 requires an inventory of hazardous mining areas within each state and periodic monitoring of active mines. In 1979 the Office of Surface Mining contracted with the University of Arizona Applied Remote Sensing Program (ARSP), Office of Arid Lands Studies, and the Mining and Geological Engineering Department for an evaluation of Landsat as a means for meeting these requirements. The objectives were to inventory mining activity in Arizona, where there are 41 active surface mines, and develop a mine-monitoring system, delineate mined lands with high-hazard potentials, and develop a training package for state agency personnel.

Nineteen Landsat computer compatible tapes were acquired, providing complete coverage of all the major active surface mines in Arizona. (Two mine areas, as seen by Landsat, are shown in Figures 1 and 2). These data were used to develop an initial statewide inventory of coal and copper mines and mine wastes using digital Landsat images.

Techniques for periodic monitoring of mining areas using multitemporal-classificaton and image-prediction were also developed. High-priority areas for future reclamation and present-day land-use planning based on environmental hazards were delineated with the aid of digital elevation and population-density data. Hazards in this case were based on the potential damage from a tailings dam failure and accompanying release of wastes, a situation that could contaminate groundwater and surface water in the area.

Statewide Inventory

Image signatures of mines were normalized to a consistent baseline by correcting signatures for changing sun angles, atmospheric conditions, and various local rock types to permit computer mapping of all copper mines in Arizona. ARSP also experimented with a simple color-slicing technique, which shows considerable potential for fast, efficient delineation of mines over large areas and in scenes acquired at different times.

Multitemporal Monitoring

With a series of seven Landsat scenes covering a seven-year period ARSP tested and compared several techniques for detecting and evaluating change over time for the large copper-mining complex located south of Tucson. Emphasis was on efficient, relatively inexpensive approaches.

With this series, ARSP also tested the accuracy of new techniques to predict future mine growth and reclamation progress. Image prediction appears to be a promising tool for management decision-making from both a mining and

Figure 1. Open pits and tailings ponds. Twin Buttes area copper mines, south of Tucson. *Approx. scale 1:400,000*

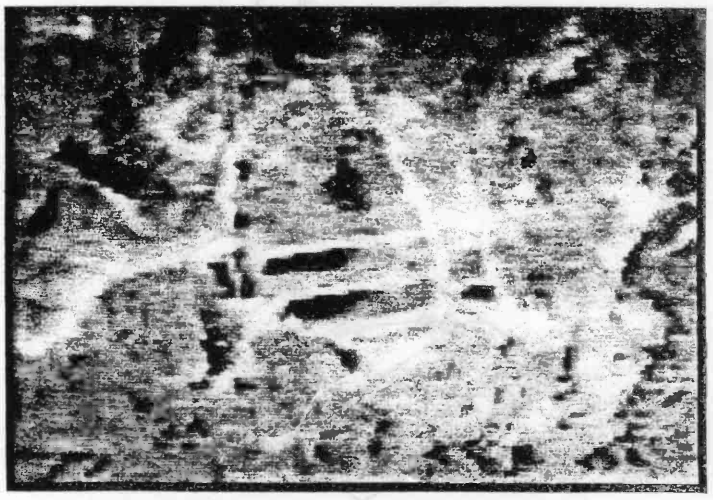

Figure 2. Morenci tailings ponds *Approx. scale 1:100,000*

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an environmental-protection standpoint. For example, with these techniques, managers should be able to predict the rate of progress of revegetation on reclamation programs. Also, prediction models should aid mine operators and government agencies in the development of public policy, such as land-use planning to reduce hazard and risk; in the enforcement of mine reclamation and land-use planning; and in litigation, with prediction data admissible as evidence.

Hazard and Risk Assessment

Delineating high-priority areas for future reclamation and present-day land-use planning was accomplished by modeling the risks and hazards of each mining area. Landsat classification maps and digital elevation and population-density data were used in the calculations. Hazard values were computed for 500-meter grid cells based upon the downslope proximity of cells to tailings ponds, the number of tailings ponds in the vicinity, and the mean annual rainfall at tailing-pond sites. Risk was computed by multiplying the population of a cell by the hazard value for that cell. If no people lived within the area represented by the cell, no risk was associated with it even though the hazard might have been high. Figures 3-5 give examples of hazard and risk maps for the Globe-Miami copper-mining area.

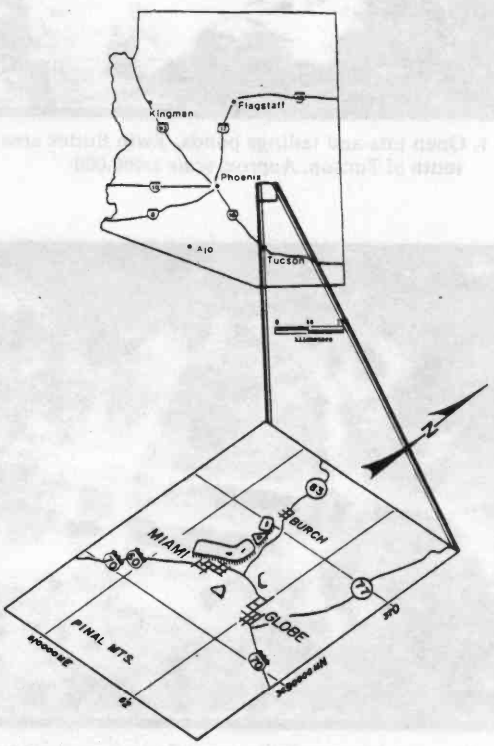

Figure 3. Location, Globe-Miami mining area

Hazard and risk values did not represent probabilities of tailings-dam failure or property loss. Their numerical values only had comparative meaning. Accordingly, these values were normalized with the Morenci mining area, which had more than twice the risk of any other mining area because of nearness of the population to tailings, a portion of Morenci even occupying an abandoned tailings pond. The lowest risk was associated with Bagdad, Arizona, where the low relief and sparse population gave Bagdad a low priority for reclamation or stabilization.

The intent in producing the hazard and risk maps was to provide a basis for planning for present-day land use and future reclamation. Hazard maps, depicting areas in which increases in population would increase risk, were not intended to imply specific areas were in imminent danger — rather that more attention should be paid to land-use planning in these areas and that studies should be conducted to assess actual hazard. Additional data may be incorporated into the hazard model data base, such as depth to groundwater to indicate potential for contamination by hazardous wastes.

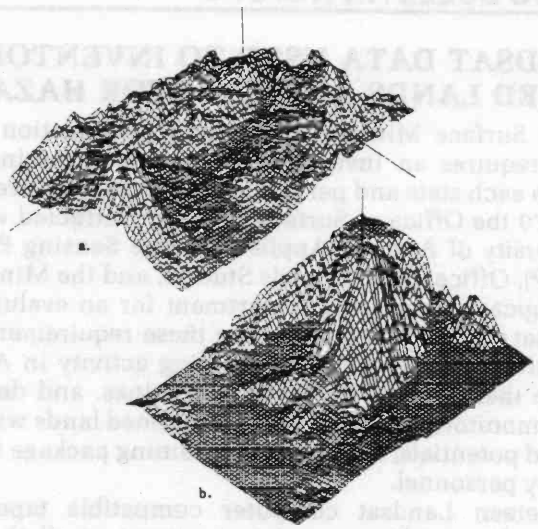

Figure 4. Topography (a) and hazard (b), Globe-Miami mining area.

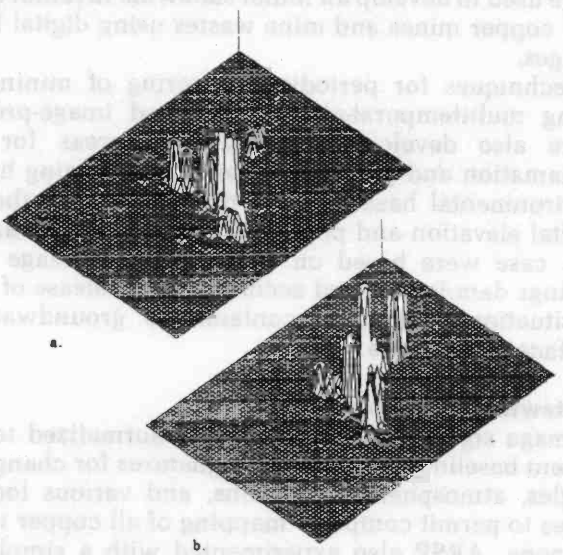

Figure 5. Population distribution (a) and risk (b) Globe-Miami mining area.

Training Program

To assist state agencies in monitoring mining areas, ARSP is currently designing a training package that includes a manual detailing procedures for processing and analyzing digital images on an operational level, videotape training courses in remote sensing and digital image processing and classification, and a guide for using

computer classification to map and monitor mining activities. The package could serve as a guideline for state programs to insure homogeneity in national mined-land reclamation, inventory, and monitoring programs.

The research project is discussed in detail in the final report *Inventory and Hazards Monitoring of Mined Lands Using Automated Processing of Satellite Imagery and Collateral Data* by C.E. Glass, R.A. Schowengerdt, and J.R. Carr. The report is available from the Applied Remote Sensing Program, Office of Arid Lands Studies, 845 N. Park Avenue, Tucson, Arizona 85719.

HEALTH SERVICES DEPARTMENT DEVELOPING UNDERGROUND INJECTION CONTROL PROGRAM

The Arizona Department of Health Services (ADHS), in consultation with the Department of Water Resources and Councils of Governments, is developing a state groundwater quality protection program. One element of the program is the Arizona Underground Injection Control (UIC) Program to regulate the underground disposal of fluids via injection wells. The regulations will govern injection well design, construction, operation, and abandonment.

The ADHS Bureau of Water Quality Control will hold public workshops in Flagstaff, Phoenix, Globe, and Tucson during the last week of July to permit public review of a program plan and preliminary draft of regulations. Formal public hearings on a final draft of regulations will be scheduled at a later date.

Copies of the preliminary draft UIC program plan and regulations are available on request by contacting Doris Evans, ADHS Bureau of Water Quality Control, Room 204, 1740 West Adams, Phoenix, Arizona 85007; telephone number, 602-255-1177. Questions regarding the proposed regulations should be directed to V.C. Danos at the same address and telephone number.

STATE WATER OFFICIALS ALARMED BY LACK OF APPLICATIONS FOR GRANDFATHERED RIGHTS

With less than two months left to file for grandfathered rights, Arizona Department of Water Resources (DWR) officials are concerned about the slow return of applications from property owners. Failure to file will result in the loss of rights to use groundwater.

About 35,000 applications were expected, but by the last week in June only 400 forms had been submitted. The deadline is September 14.

When the state legislature enacted the Groundwater Management Act in June 1980, it recognized that to achieve the goal of balancing the annual amount of groundwater withdrawn with that replenished, future uses would have to be curtailed. To protect existing users, the rights of persons who have historically used groundwater were "grandfathered in." These rights are needed only by residents of the Phoenix, Tucson, Pinal, and Prescott active management areas.

Homeowners and businesses that use wells with a pump capacity exceeding 35 gallons per minute to water an outdoor area larger than one acre must obtain a Type 2 grandfathered right to continue pumping groundwater. The right will equal the maximum amount of groundwater pumped in any one year of the five years preceeding June 12, 1980.

The Type 2 right is owned by the owner of the land; if the land is leased, the lessee may apply for the certificate on behalf of the owner. A Type 2 right allows one to use groundwater on or off the land for any purpose except irrigation.

In those instances where farmland was purchased and retired to provide the water supply for a specific non-agricultural use, a Type 1 grandfathered right may be obtained. It allows up to three acre-feet per acre of groundwater to be pumped for use on the property.

Residential customers of cities, private water companies and/or irrigation districts do not need grandfathered rights to continue using water delivered to them for non-irrigation purposes — household, watering yards, gardens, fruit trees.

Once the September 14 deadline has passed, the only way to obtain groundwater for non-agricultural uses inside the active management areas will be to purchase existing grandfathered rights or request a withdrawal permit. The DWR will grant permits on a limited basis if specific conditions are met. The general industrial use permit would allow groundwater to be used for shopping centers, parks, golf courses, commercial property landscaping and processing of agricultural products.

Applications and information are available at the Department of Water Resources office, 99 E. Virginia Avenue, Phoenix. The telephone number is 255-1546. (Toll free number: 1-800-352-5464). Persons may also obtain forms from the active management area offices in Prescott, Casa Grande and Tucson. The Department has stressed its willingness to assist people with questions. The filing fee is $20 and forms must be notarized.

The new groundwater code also requires anyone drilling a well to hire a driller licensed by the Department, to assure that wells are constructed properly in order to safeguard groundwater against contamination. Persons who want to drill an exempt well on their own property may not need to hire a driller if they can meet the well construction standards, but they must still file an "intent to drill" notice with the DWR. Development of a permanent, statewide registry of all wells is required by law.

DESIGNS, COSTS, AND BENEFITS FOR FLOOD CONTROL MEASURES TO BE PRESENTED BY CORPS OF ENGINEERS

In July and August, three special meetings of the eight-member Citizen Steering Committee will be held to review interim results of the Regional Flood Control Element of the U.S. Army Corps of Engineers' Tucson Urban Study. Members of that study's Citizen Advisory Committee and governmental representatives on the study's Multipurpose Technical Committee have been invited to attend. Preliminary findings will be presented by the Tucson Urban Study staff.

On September 11 and 12, all results will be presented to the general public in a special two-day open house, at a location to be announced. Special workshop discussions on specific watercourses will be scheduled for people interested in reviewing potential measures that would reduce flood damages along washes or watercourses in their neighborhoods or areas. Sessions will be announced for the Rillito River and its tributaries (Pantano Wash, Tanque Verde Creek, Agua Caliente Wash); Canada del Oro Wash and Santa Cruz River at Marana; Santa Cruz River at Green Valley; and Airport and Rodeo Washes.

PUBLICATIONS

Water Resources in the Sedona Area, Yavapai and Coconino Counties, Arizona is a report prepared by the U.S. Geological Survey and published recently as Arizona Water Commission Bulletin 11. The study evaluates the amount and quality of groundwater in the Sedona area and contains maps and tables showing the location and yield of wells, water-level depths and chemical analyses. The 37-page report is available at the Arizona Department of Water Resources, 99 East Virginia Avenue, Phoenix.

Groundwater Monitoring Review is a new journal to be published quarterly by the Water Well Journal Publishing Company. Articles will discuss current state-of-the-art skills and newly developed technology for monitoring groundwater quality. To subscribe, send a check for $16 to Groundwater Monitoring Review, 500 W. Wilson Bridge Road, Worthington, Ohio 43085.

Model of Time and Space Distribution of Rainfall in Arizona and New Mexico is a 27-page publicat describing a mathematical model developed to simul rainfall occurrence and amounts for ungaged watershe up to 150 km² and elevations between 300 and 2300 meters in Arizona and New Mexico. The model is a combination subroutine with alternative inputs and outputs. The model output can be used, for example, to simulate thunderstorm rainfall, which in turn can be used to predict the distribution and magnitude of peak discharges and runoff volumes for ungaged watersheds. The authors are H.B. Osborn, E.D. Shirley, D.R. Davis, and R.B. Koehler. The paper and programs can be obtained by writing to USDA-ARS, Southwest Rangeland Watershed Research Center, 442 E. 7th Street, Tucson, Arizona 85705.

CREAMS; A Field Scale Model for Chemicals, Runoff, and Erosion from Agricultural Management Systems, U.S.D.A. Conservation Research Report No. 26, is a 640-page publication describing in detail a mathematical model developed to evaluate nonpoint source pollution from field-sized areas. It consists of three components: hydrology, erosion/sedimentation, and chemistry, and includes model documentation, application, and selection of parameter values, and supporting documentation. CREAMS was edited by W.G. Knisel. Copies can be obtained by writing to the USDA-ARS Southwest Rangeland Watershed Research Center, 442 E. 7th Street, Tucson, Arizona 85705.

Field Manual for Research in Agricultural Hydrology: Agricultural Handbook 224 (revised, Feb. 1979) is a 550-page publication prepared to provide a complete set of techniques needed for initiation and maintenance of hydrologic research projects. These techniques were obtained by soliciting information from experts and adapting material described in current literature. Chapters 1-3 deal with precipitation, runoff, and climate. Chapters 4-6 discuss sedimentation, geology, and watershed characteristics and soil moisture. Coordinators were D.L. Brakensiek, H.B. Osborn, and W.J. Rawls. It is available through the Superintendent of Documents, U.S. vernment Printing Office, Washington, DC 20402.

Please address your news items or comments on the Project Bulletin to any of the editors:

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