

February, 2001

DIVISION OF WATER RESOURCES
Office of the State Engineer

People, Water and Stewardship

**Engineering, Technology,
and Investigations**

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2000 Annual Report

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Engineering, Technology, and Investigations

Executive Summary

The Engineering, Technology, and Investigations (ETI) organization is comprised of a multi-disciplined staff of engineers, geologists, hydrologists, technicians and support staff. We are an integral part of nearly every activity within the Division of Water Resources spanning a broad spectrum of technical and engineering responsibilities.

The key resource and critical component necessary for the accomplishment of all that is discussed in the following is the highly skilled, dedicated and innovative staff. An organization chart and staffing are provided as Exhibit A. Several of the Staff were recognized during 2000 for the outstanding performance and contribution to DWR's mission. Several staff participated in activities to foster teamwork in the accomplishment of DWR's mission, Thanks to all of the ETI staff.

The Dam Safety Branch also experienced a challenging and exciting 2000. A total of 798 inspections occurred in 2000. In spite of our best efforts in the dam safety program, we continue to experience serious incidents at dams. Dams experienced serious problems during 2000. The number of incidents involving dams is of concern. A review of the rules and regulations, evaluation of existing dams, and other procedures were initiated during 2000. The purpose of the review is to determine if modifications to the program are required to reduce the potential for dam failures and incidents. The State Engineer submitted an Annual Report on the Dam Safety Program to the Legislature November 1, 2000. The Colorado Dam Safety Program is among the best in the country. The highly skilled engineers and support staff responsible for the accomplishment of the Dam Safety Program continue to be recognized as exceptional assets to DWR and State of Colorado through their accomplishments and teamwork.

In addition, several federal grants were applied for and obtained through the National Dam Safety Program. These grant funds were used for technical training, improved software and equipment. The Federal Emergency Management Agency's Dam Safety Mitigation Directorate (FEMA), who

manage the National Dam Safety Program, sent us their applications for assistance grants for FY 2000-2002. They requested we submit a three-year plan which would be funded at \$85K+ a year if the funds are fully appropriated by Congress. Our three-year plan includes the continued advanced training in Dam Safety Engineering, which includes in-house training on risk analysis, engineering geology, hydrologic and hydraulic analysis, as well as needed training on software programs. Additional training for DWR staff and dam owners is also included, consistent with the DWR LRP.

The Modeling Branch, though small in number, continues to play an increasingly critical role in DWR activities. Brian Ahrens accepted the supervisory position in March. The staff continued efforts to revise and update data to the Hydrologic Institutional Model (HIM) for the Kansas v. Colorado litigation and Arkansas River Administration. Dale Straw was a welcome addition to the branch and is focused on HIM-Arkansas River issues. Jana Ash joined the staff in May and is an excellent addition, and is contributing through a variety of modeling and hydrographic project activities. Significant effort was expended on the management of the RGDSS and SPDSS development, Ray Bennett continues to demonstrate his excellent management and technical skills in coordinating with the Division Office and contractors on this important project. Although the summary of these activities is abbreviated, the effort and importance immense. The high level of skill and technical competence of the staff is the key to success in this area.

The Geotechnical Services Branch staff provide expert advise to both internal and external customers in the disciplines of geology, hydrogeology, engineering geology, geophysics, well construction and satellite assisted surveying (GPS). The Geotechnical Services Branch provides assistance to staff throughout the DWR. Special investigation projects included Arkansas Repayment Water Sources, Jefferson County Mountain Ground Water Study, Denver Basin Deep Core Hole, and a cooperative Denver Basin Mapping with USGS. Several support activities to the Board of Examiners were accomplished including evaluation of over 200 requests for variances from the Rules, development of a well observation program, and well completion report review. Other activities include technical support to the Ground Water Commission and Oil and Gas Commission.

The Hydrographic and Satellite Monitoring Branch is responsible for providing leadership and technical management and maintenance of the statewide network of stream gauges, stage/discharge relationships, stream flow records, and satellite-linked stream flow monitoring. Significant activities include the coordination with USGS and CWCB, conversion of the SMS, completion of the Hydrographic Manual, and organizational improvement. The 1999-2000 annual report on the Satellite-linked monitoring system was completed. The DWR hydrographic staff continues to be

dedicated to the improvement of data, information accessibility and increased effectiveness this cornerstone program.

Supporting the Board of Examiners for Water Well Construction and Pump installation Contractors has provided both great satisfaction and distress for the BOE staff team. The revision of the BOE Rules was completed though not without controversy. The revised Rules have an effective date of June 1, 2000. A great deal of the success is due to the excellent work by Dave McElhaney, Gina Antonio, along with Linda Bassi, Susan Schnieder and David Hayes of the Office of the Attorney General. Their knowledge, skills and dedication were and are greatly appreciated. Substantial education and outreach occurred during 2000, strengthening the protection of the groundwater resources and public safety. Of particular noteworthiness is the support by the Division staff of water commissioners, well commissioners and other support staff to the DWR-AG team in accomplishing the Board's objectives.

Significant accomplishment on the DWR Long range Plan was achieved by the ETI staff. Among the key areas was safety, dam safety, training, environment, partnership development and coordination with other entities. Specific accomplishments are provided in Exhibit F.

Dam Safety Program

The mission of Colorado's Dam Safety Program, is to prevent loss of life and property damage, determine the safe storage level and protect the state's water supplies, from the failure of dams, within the resources available. A staff of twelve trained, well-qualified engineers supports the Dam Safety Program. The program protects the public in relation to the design, construction, and operation of dams and reservoirs by working with dam owners and designers to achieve compliance with state dam safety statutes. A detailed annual report on all of the Dam Safety Program accomplishments and activities is provided to the Legislature each November.

The program includes the enforcement of a comprehensive set of regulations, policies, and procedures for the construction, operation, and maintenance of dams, and emergency preparedness. Determining the safe storage level and, if necessary, restricting the storage in the reservoir to the safe level provides for the public safety. The safe storage level is determined by the review and approval of engineered plans for the construction and repair of dams, and regular safety evaluations of existing dams and reservoirs by professional engineers.

The Dam Safety Program currently schedules an engineering inspection of Class 1 (high hazard) dams annually, Class 2 (significant hazard) dams biannually, and Class 3 (low hazard) dams every six years. A total of 798 inspections occurred in 2000. Inspections were slightly less this year than prior years due to John Blair's accident. Several of the staff assisted with the necessary dam inspections in Division 5 accomplishing the inspections of the critical dams. In accordance with a recommendation from the Dam Safety Audit, we have executed a Memorandum of Understanding with the Colorado Division of Wildlife (DOW), including approving their Dam Safety Engineer to inspect DOW Class 3 dams.

The determination of safe storage level has resulted in water storage restrictions at 190 reservoirs resulting in an estimated 131,600 AF of reduced storage. There were four (4) new dams for which design data was reviewed, thirty-two plans were submitted and reviewed for modifications, repairs, and enlargements. Four hydrology studies were reviewed and approved. Approximately \$6.5 million of construction was accomplished resulting in \$18,568 in fees collected.

We had four serious incidents at dams this year they ranged from failures of the outlet works to sinkholes in the reservoirs. The latter are evidence of piping erosion in the dam's foundation and or embankment. Because of this continuing occurrence of incidents at dams, we are seeking ways and means to

improve our program to reduce incidents. A summary of dam incidents from 1990 is provided in Exhibit B. One of the areas we will pursue is to better predict the performance of dams, or the risk of having an incident, using risk assessment tools like failure modes and consequences analysis. This will identify those dams that have a greater propensity for incidents, providing us with greater knowledge in order to take actions to minimize problems, thus improving public safety.

Federal Dam Safety Coordination

Since the dam safety program audit in 1998, and our reduction in participating in the routine inspection of federal dams, we have been pursuing the execution of Memorandums of Understanding (MOU) with the several federal agencies that own dams in Colorado. The purpose of the MOU's are to assure that we maintain communications and exchange of information related to the safety of the federally owned dams and thus the safety of the public. To date we have finalized the MOU with the US Bureau of Land Management and the US Air Force Academy. We are still working at finalizing the MOUs with the Bureau of Reclamation (revised), Army Corps of Engineers, and the Forest Service.

Extreme Precipitation Study

The State Engineer and the Colorado Water Conservation Board (CWCB) continued the process to study extreme precipitation in the mountainous areas of Colorado. The Phase I report was completed in May 1997 by the Department of Atmospheric Sciences, Colorado State University (CSU), and it contains a list of recommended extreme storms that will be used for modeling research, and can be used for site specific analysis of extreme events for project studies.

The Phase II and Phase III parts of the project were combined in 1998 and an Evaluation Committee (EC) awarded the contract to CSU. The principal scientists for CSU are Dr. William Cotton and Dr. Thomas McKee. The project will take about three years, with the completion date set for June 30, 2001. A volunteer Technical Review Group, which is made up of Mr. Jimmy Dudhia, National Center for Atmospheric Research; Dr. David Mathews and Mr. Louis Schriener, US Bureau of Reclamation; Mr. Stephen Spann, Consulting Engineer, are assisting us with the review of the project outcomes.

- CSU is presently in their 24th month of their proposed 30-month timetable. They have begun the simulation of historical flood events that were identified in the Phase I report after spending a lot of time calibrating the new model with the RAMS parallel cluster. They have produced four progress reports to date and the Technical Review Group (TRG) has met once during the initial stages. All of the progress reports have been reviewed by the TRG and comments sent to Dr. Cotton.

In his May 2000 report, Dr. Cotton reported that “the results are encouraging and suggest that while we cannot simulate the precise timing and location of a flood event, we can get close enough for extreme precipitation estimation”. In their December 2000 report, they state that they will perform additional analysis on the liquid/frozen versus elevation aspect of simulation, as well as perform depth-area-duration analysis from the model output. For a complete picture of the results of their research, you can visit their Web Page at rams.atmos.colostate.edu/precip-proj/index.html.

National Dam Safety Program Assistance Grants

The Water Resources Development Act of 1996, established the National Dam Safety Program (NDSP) under the Director of the Federal Emergency Management Agency (FEMA) as the coordinator of the Program. A primary goal of the program is to encourage the establishment and maintenance of effective State dam safety programs, and to provide financial assistance incentives to States that are moving towards improved safety of non-federal dams. Colorado applied for and received grants for federal fiscal years 1998, 1999, and 2000 in the amount of \$25,162, \$49,230, and \$85,4000 respectfully. The grants are to provide the dam safety engineering staff advanced training in dam safety engineering subjects, and to acquire computer hardware and software for the analysis of dam performance.

This year we have acquired the slope stability and seepage software package SLOPEW – SEEPW from GeoSlope International. In addition we purchased several digital cameras and field equipment, as well as a computer for our support staff. We will conduct training on Risk Based Decision Analysis in March 2001. These Activities comport with the Division’s Long Range Plan, as well as the Dam Safety Branch’s work plan goals and objectives. A copy of the NDSP work plan and Performance Reports are provided in Exhibit C.

Modeling Branch

The Modeling Branch provides technical expertise to the DWR through review, development, analysis and execution of complex hydrologic computer models. The branch consists of three highly skilled engineers that independently or as a team conduct investigation and analysis of computer models designed to simulate surface and ground water systems. The investigations and analysis are conducted to forecast streamflow, determine stream depletions due to pumping ground water, determine diversion requirements, transmission losses, evaporation losses, determine historic consumptive use, and general characteristics of stream regime. The staff provides expert advice to other agencies, provides expert testimony in water court, and recommends plans for water use and development within Colorado through the use of computer modeling.

The Modeling Branch welcomed 2 new people in Y2K. In May, Jana Ash joined the branch as an EIT2. Jana will actually split her work time 50% for the Modeling Branch and 50% for the Hydrographic Branch. Jana spent the bulk of her modeling time becoming familiar with the Glover stream depletion model developed by Dewayne Schroeder back in the days of DOS. The objective of her efforts was to bring the Glover program into the Windows environment in accordance with the Long-Range Plan. In addition, Jana improved her skills through participating in training on Microsoft Visual Basic and ArcView.

With the retirement of Dewayne Schroeder on January 1, 2000 Dale Straw was selected in July to fill Mr. Schroeder's vacant position and to begin working with the Hydrologic Institutional Model (HIM) in preparation for the upcoming trial on Compact compliance. However, the Modeling Branch did not actually enjoy Dale's presence in the Denver office until December because of his Arkansas River commitments.

HIM Model Upgrading and Updating

The HIM is being used in the U.S. Supreme Court case *Kansas v. Colorado* to quantify depletions to usable Stateline flows for the period 1986-1994 and the period 1995-1996 as ordered by the Special Master. During calendar year 2000, work was accomplished through a contract with Mr. Schroeder to continue with the tasks needed to prepare for the upcoming trial.

Mr. Schroeder completed modifications to versions of the HIM to incorporate the results of an irrigated acreage study by the Water Division 2 staff, to more accurately represent the hydrology of the Arkansas River including the

capacities of the Colorado canals, and to better represent the Arkansas River replacement plans that began operating in 1996. Once revisions and new data on irrigated acreage were added to the model, a recalibration was conducted. Additionally, new data was incorporated for the period 1997-1999 and further changes were made to represent the replacement plans implemented during the period 1997-1999. These revised models were used to test the adequacy of the replacement plans developed by well owners in Colorado to replace depletions to usable Stateline flows. Mr. Schroeder prepared an expert report summarizing his efforts in March and has continued, with Mr. Straw, to examine other areas of the HIM that may require modification. These include possible modifications to better predict the diversions by Colorado canals, to model the effects of bank and channel storage to attenuate streamflow, to model return flow interception for all ditches located below other ditches, to update unit response functions used to model the response to well pumping, and to evaluate better strategies for calibrating the model.

South Park Conjunctive Use Project

The Modeling Branch was heavily involved with the ground water model associated with the application for water rights of Park County Sportsmen's Ranch, Case No. 96CW14 in Division 1 Water court. The application is for the right to divert surface waters from the headwaters west and north of Boreas Pass and west of Kenosha Pass. The surface waters will be delivered by ditch and pipeline to recharge areas located on and near Sportsmen's Ranch. The recharged water will then be pumped from the South Park aquifers through a series of wells to meet the raw water demands of the City of Aurora.

The application raises a number of concerns including: 1) the fact that Colorado has not historically recognized the ability of an applicant to claim salvage credits derived from drying up preexisting natural vegetative cover on land not owned or controlled by the applicant; 2) the quantification of the amount of surface waters legally available to the applicant; 3) the ground water model developed to support the application is inaccurate and unreliable; and 4) the application will be impossible to administer as currently proposed.

Brian Ahrens spent 3 to 4 months reviewing and analyzing the ground water model and found that the model had insufficient data for conceptualization, aquifer parameter inputs, and more importantly, insufficient data to verify the results of the model. Brian was successful in producing exhibits, with the help of Jana, that clearly showed the model was continuously "calibrated" during the predictive runs. Brian, along with Glenn Graham and our Attorney Generals, Jennifer Gimbal, David Hayes, and Steve Simms, spent the bulk of July and August in Fairplay listening to 6 weeks of testimony by the ground water model developer as the applicant endeavored to build and continually resurrect it's case.

The applicant was unsuccessful in completing the case in chief and as a result the trial will be continued into 2001. The trial will continue for two weeks in February during which the applicant should complete their case in chief. The Water Court will then entertain arguments to dismiss based upon the applicant's inability meet the burden of proof. If the case is not dismissed, trial will continue in Fairplay during June, July, and August during which the opposition will put on their case.

Rio Grande Decision Support System Groundwater Model

Brian Ahrens spent the remainder of the year getting familiar with the San Luis groundwater model developed in 1990 for the AWDI trial because this model will be enhanced and incorporated in the Rio Grande Decision Support System (RGDSS). Also, it is anticipated that the enhanced version(s) of the model will be used in the promulgation of Rules and Regulations for new wells in the Valley.

Colorado Decision Support Systems

In cooperation with the Colorado Water Conservation Board, the modeling branch is involved in the management, development and maintenance of three decisions support systems; the South Platte Decision Support System (SPDSS), the Rio Grande Decision Support System (RGDSS) and the Colorado River Decision Support System (CRDSS).

SPDSS Progress in 2000

In calendar year 2000 a feasibility study was initiated in order to determine the users, components, cost and schedule for developing a decision support system for the South Platte River Basin (SPDSS). Following are key accomplishments:

- A consulting team consisting of experts in Ground Water, Surface Water, Consumptive Use and System Integration (GIS and database) was selected.
- A draft data collection report was prepared in order to initiate the development of irrigated acreage and aquifer data that require a significant lead-time.
- The comprehensive feasibility study was initiated.

RGDSS Progress in 2000

Calendar year 2000 was the second year of development for the Rio Grande Decision Support System (RGDSS). Following are key accomplishments:

Ground Water

Major accomplishments by the Ground Water Component in 2000 that are being performed for the State by HRS Water Consultants include:

- The first phase of a data-centered ground water modeling system that interacts with the State's database (HydroBase), geographic coverages (GIS) and other RGDSS planning tools was completed and applied to a steady state model.
- A steady state ground water model representing 19?? to 19?? was developed. Final calibration and documentation is expected to be completed early in 2001.
- The data collection program constructed and performed pumping tests on 12 new monitoring wells. Total well construction and testing for the project now includes 14 monitoring wells.

Surface Water

Major accomplishments by the Surface Water Component in 2000 that are being performed for the State by Hydrosphere Resource Consultants include:

- The State's surface water model, StateMod, was enhanced to include variable efficiency and soil moisture accounting and the Rio Grande compact.
- Historic calibration of StateMod on a monthly basis from 1950 to 1997 was completed. The model now includes 100% of the basin's consumptive use by explicitly modeling over 400 diversions, 2,500 wells, 12 reservoirs and 28 instream flows

Consumptive Use and Water Budget

Major accomplishments by the Consumptive Use and Water Budget Component in 2000 that are being performed for the State by Leonard Rice and AGRO Engineering include:

- The consumptive use model, StateCU, was enhanced to accommodate conditions required for the Rio Grande basin such as sprinkler irrigation, and conjunctive surface and ground water use.
- Application of the State's consumptive use model, StateCU, from 1950 to 1997 was completed and documented.
- Development of a water budget model, StateWB, was initiated.

Relational System Integration

Major accomplishments by the Relational System Integration Component in 2000 that are being performed for the State by Riverside Technology include:

- Enhancement of the surface water models graphical user interface to accommodate a daily time step and wells.
- Software enhancements to the data management interfaces (DMI's) that allow wells and daily data to be accessed from HydroBase and used by the systems models were initiated.
- An approach to distribute data via a CD was developed.

Spatial System Integration

Major accomplishments by the Spatial System Integration Component being performed for the State by HDR Engineering include:

- Eleven GIS coverages (maps) of the Valley were developed. These include a basemap that contains highways, water districts, counties, hydrography and a public land survey; location maps for stream gages, climate gages, diversion stations, reservoirs, and wells; and other coverages such as land use, precipitation, soils, solar radiation and topology.
- The development of water information sheets required to implement the Colorado Water Right Administration Tool was completed.

Other RGDSS Activities

Major accomplishments by Division 3 as part of RGDSS included:

- Refinement of the irrigated acreage and canal coverages to include 100% of the basin's irrigated lands and canals.
- Development of accurate location data for all key diversions using a Geographic Positioning System.
- A long term cooperative agreement to collect and publish water level data was agreed to with the Rio Grande Water Conservancy District.
- In cooperation with the USGS additional capability was developed for the ground water model Modflow to accommodate native evapotranspiration as a segmented function and drains with return flows.

CRDSS Progress in 2000

CRDSS development was completed in 2000. Major development and maintenance activities conducted in 2000 include the development of Data Extension for the Surface Water Model and a Consumptive Use model.

Data Extension for the Surface Water Model

The study period originally used to calibrate the Water Resource Planning Models was only 16 years (1975 to 1991). This relatively short time period was selected based on the availability of digitized diversion and reservoir records. To obtain a longer period of record with more extreme droughts and floods, historic records were extended and stochastic data is being developed. This enhancement was completed in 2000.

Maintenance Program

The CWCB and DWR completed their second year of maintenance on CDSS. Key achievements included hardware upgrades, a database refresh and enhanced product delivery using the Internet.

Geotechnical Services Branch

The Geotechnical Services Branch provides expertise in the disciplines of geology, hydrogeology, engineering geology, geophysics, well construction and satellite assisted surveying. The Branch includes three professional geologists, one professional engineer and one well drilling inspector. The branch primarily responds to requests by internal or external customers assisting in general investigations, ground water litigation, ground water data collection and reporting and technical assistance to the Board of Examiners and Groundwater Commission. The following is a summary of work done by the Geotechnical Services Branch in 2000.

By the Numbers

• Well construction variance requests reviewed	183
• Well completion reports reviewed	12,000
• Geophysical logs evaluated	120
• Geophysical log waivers reviewed	110
• Mined Land Reclamation plans reviewed	16
• Oil and Gas injection well proposals reviewed	14
• Well permit evaluation consultations	330
• Water levels measured	1,200
• Reports written	11
• Phone contacts and evaluations	325

General Investigations

- Denver Basin Deep Core Hole – The Geotechnical Services Section and Glenn Graham in particular remain involved with the Museum of Science and Nature concerning the data developed during the drilling of the core hole and the testing of the core. Information to be developed for the Division includes analysis of the aquifer characteristics in the finer sediments of the eastern part of the basin.
- Jefferson County Mountain Ground Water Study - Glenn Graham has worked with the county and the USGS on this project. A preliminary report has been submitted with the final report expected early in 2001. The focus is to determine the ground water yield of fractured aquifers.

- Coal Bed Methane – Work has been done in cooperation with the Oil and Gas Conservation Commission and the Department of Health to understand the hydrology of coal bed methane development and the implications to ground water production and availability.
- State Ground Water Atlas – Glenn Graham and George VanSlyke have been working with the Colorado Geological Survey and the Water Conservation Board to begin work on a state-wide ground water atlas that will not only describe the ground water of the state, but also link the descriptive material to actual ground water conditions such as water levels, geology and aquifer properties.
- Southern High Plains Study – Chuck Roberts worked closely with the Southern High Plains Ground Water Management District, the Water Conservation Board and McLaughlin Water Engineers to manage and develop the ground water study of the Southern High Plains basin. The report has been completed and the district is discussing Rule changes.

Ground Water Commission

- Monitoring of water levels in over 1500 wells covering almost 3/4 of the state are done annually and published by the Branch in a series 10 annual reports.
- George VanSlyke and Chuck Roberts gave technical presentations to the Plains-East Cheyenne and the Southern High Plains ground water management districts.
- Technical support for groundwater permit evaluations.

Board of Examiners

- Rules and Regulations. Dave McElhaney has spent the better part of the year working on the new Rules for the Board. The work culminated in the adoption of the revised rules in April of 2000.
- Well Completion Monitoring - Norm Hill checks all well completion and pump installation reports for compliance with standards for construction. Wells not adhering to the standards are referred for further action.
- Variances – Approximately 180 requests for variance from the well construction rules were processed during the year.

- Complaints and enforcement – we continue to handle dozens of complaints and enforcement actions each year.
- Additional information is provided in the Board of Examiners section.

Division Support

- Water Court - Glenn Graham spent most of the summer in Fairplay working on the City of Aurora, South Park case. Work was done on several other cases such as Beaver Brook, Pagosa Springs, and Oxley.
- GPS - Chuck Roberts continues as the in-house GPS expert answering questions of the field users and obtaining state-of-the-art equipment and software. Acquisition of personal mapping software for the division offices, Denver office, and all water commissioners was a major project for the year. Another is the on-going training of personnel in the use of GPS.
- Well Permitting and Subdivision Review Assistance - work continues on a daily basis with these activities. Several major errors in evaluating ground water availability were discovered by the Geotech staff. This resulted in the Geotechnical Services Branch reviewing the work of the permitting section along the margins of the Denver Basin. Additional training of engineers was done to explain the limitations and proper use of SB-5 materials.
- Chuck Roberts has been deeply involved with the Division Safety program and is the Division coordinator within the Departmental Safety Committee.
- Chuck Roberts again taught the class for the Well Tester Certification in the Arkansas Valley. This class takes considerable time and effort.
- Training was done for the Denver staff in “Use and Limitations of SB-5 materials” by George VanSlyke; the Denver Basin by Glenn Graham; and Metering of Wells by Chuck Roberts.
- Database conversions – Glenn Graham, George VanSlyke, and Chuck Roberts have all converted various databases to access. This was an involved process and consumed a lot of time and effort.

Hydrographic and Satellite Monitoring Branch

The Hydrographic and Satellite Monitoring Branch strives to provide accurate, high quality 'real time' stream flow data. The Branch also develops historic stream records in coordination with other state and federal entities and the water user community. Key staff record and check measurements, maintain equipment and improve the quantity and quality of data used to manage and administer water throughout the State of Colorado. An organizational plan was developed and approved in 1998 that improves long-term employee development, QA/QC program and coordination throughout DWR. Coordination with USGS and CWCB were improved through several staff level workshops.

A manual of hydrographic principles and practices was completed during the summer of 1999 and disseminated to all staff at the annual training conference held at Silver Creek in September. This manual clarifies the practices used for hydrographic work performed by DWR. It also provides a ready reference for all hydrographic staff.

The Annual Training Meeting was held at Silver Creek in late September. The meeting included GPS training by Chuck Roberts, an indirect streamflow measurement seminar by Joe Capesius from the USGS, and a presentation on the State Weed Program by Eric Lane from the Dept. of Agriculture. Also, work was done on the specifications for the hydrographic record program being developed by the IT staff.

A new project to develop a field tool for all staff to use for measurement notes, DCP data downloads, and DCP programming has begun. The work to develop the tool is being done by a team of students from a Software Engineering Class at Metro State University.

Satellite-Linked Monitoring System

The satellite-linked monitoring system (SMS) provides the Division of Water Resources, other state and federal entities, and the water user community with access to real-time and historic stream-flow data from gaging stations across the State of Colorado. These data and software systems provide for more

effective water rights administration, water resource management, computerized hydrologic record development, and flood warning.

The Satellite Monitoring System (SMS) allows the Division of Water Resources to collect, process, store, and distribute any kind of environmental data transmitted from remote locations. The data set of interest to the Division is the water level at rivers, streams, diversion structures, and reservoirs. The SMS converts these raw water level values into several "products" of use to various "clients". The "products" range from raw data passed on to other computer systems to the official Hydrographic Records of mean daily stream flows. Our "clients" include Division of Water Resources personnel and other water users wanting real-time administrative data, computer systems performing other analyses, and the varied user community of state and federal agencies, municipalities, canal companies, attorneys, and consulting engineers needing access to real-time and historic stream flow data.

The State Engineer's Office (SEO) began operating the SMS in 1985. The Colorado Water Resources and Power Development Authority provided initial funding for this project pursuant to Section 37-95-107(5), C.R.S. (1983), by enactment of Senate Joint Resolution No. 20. This system has become one of the most important and integral tools for the administration and management of Colorado's water resources, not only for the Division of Water Resources, but for the entire water user community.

Initially, the State of Colorado operated 150 remote gaging stations linked to the SMS. The Division of Water Resources now operates over 300 satellite gaging stations linked to the SMS. Federal agencies, water conservancy districts, municipalities, and private entities own other stations in Colorado and neighboring states. The Division collects and uses the data from 252 of these stations operated by others. The Colorado Water Conservation Board provided \$120,000 for the replacement of fifteen satellite installations with new electronic equipment and gaging station renovation.

Stream Flow Records

The Hydrographic and Satellite Monitoring Branch is also responsible for the development and publishing of annual stream flow records in accordance with USGS standards. The stream flow records are published in May of each year for the prior year stream flow. In May of 2000, a total of 216 stream flow records were published. This includes four records from the prior water year (1998) and four records for sites with combine the data from two or more gages.

Equipment Maintenance, Repair and Replacement

Substantial effort was invested in 2000 to maintain, repair and replace the equipment used to measure and transmit stream flow measurements. Some of the sites refurbished or replaced are: Rio Grande River at Wagonwheel Gap, Arkansas River near Nepesta, Culebra Creek near Chama and LaJara Creek near Capulin. Fifteen DCP's were replaced.

Board of Examiners for Water Well Construction and Pump Installation Contractors

In Article 91 of Title 37, the Colorado legislature created the State Board of Examiners of Water Well Construction and Pump Installation Contractors "under the division of water resources in the department of natural resources". The Board consists of five members, one of which is the State Engineer who has historically provided staff to support the activities of the Board and to assist the Board in the efficient and effective discharge of its duties and responsibilities. At present, there are two staff members devoted full-time, three to six others in the Denver office contribute part-time to supporting Board activities. In addition, numerous water commissioners and personnel in the Division offices provide invaluable assistance to the Denver staff in accomplishing the Board's objectives.

General Support

Primary activities of the support staff are focused in three general areas; complaints/enforcement actions, variances from the requirements of the Water Well Construction Rules, and well construction and pump installation contractor licensing activities. In addition to the primary functions, the Staff provides technical and professional assistance to the Board in the development of its revised Water Well Construction Rules. The Staff also reviews and presents to the Board new technology developed in the well construction industry, coordinates the activities of the Board with the objectives and requirements of the Division of Water Resources and other agencies, disseminates information to contractors, and provides education and general information concerning the Board's activities in a variety of public forums.

Licensing

The Board licensed a total of 343 contractors in 2000, including 18 new contractors (336 in 1999). The Board conducted 22 oral examinations for new licenses. Gina Antonio now coordinates all of the licensing activity.

Complaints and Enforcement Actions

Support staff for the Board of Examiners are solely responsible for the investigation of complaints that allege well construction or pump installation that violates the provisions of Article 91 of title 37, C.R.S., and/or the Water Well Construction Rules. In many instances, the staff in the Denver office enlists the assistance of field personnel to accomplish investigations by providing reports on observations at well sites or by determining property ownership. The staff's investigation often results in bringing the issues before the Board of Examiners for resolution, while others are resolved by staff actions authorized by the Board. The staff also conducts all "follow-up" actions to ensure that contractors and well owners are complying with Decision and Orders of the Board, including pursuing a judicial remedy if necessary. The staff works closely with the Attorney General's Office to accomplish these tasks.

New Complaints Investigated.....		101
Complaint Type: Construction violation.....	7	
Permit violation.....	73	
Unlicensed contractor.....	10	
No Work Report Filed.....	3	
Order to Fix or Plug	8	
 Complaints Resolved.....		63
1998/1999 complaints resolved in 2000.....	15	
2000 complaints resolved in 2000.....	48	
 Resolution/Action: Dismissed, withdrawn, discontinued, or otherwise resolved.....		13
Complied with Order.....		25
Court action (fines and fees).....		3
Letter of admonition/reprimand.....		4
Suspension/probation.....		4
Warning letters.....		8
Well construction accepted.....		6

The summary of Board's 2000 actions is presented in Exhibit D.

Education and Outreach

The Division of Water Resources and the Colorado Water Well Contractors Association with the assistance of several cosponsors have teamed up to provide a 1-day seminar on groundwater and wells. The seminar included presentations on basic information regarding groundwater resources, geology,

well construction, groundwater statutes and rules, well permitting, and groundwater administration. The meetings are informal and questions and discussion from the attendees are encouraged. The meetings have attracted a broad range of people including well construction contractors, pump installers, realtors, attorneys, water resource professionals, county planners, and private citizens. Additional information on the seminars can be obtained from the Division of water resources.

In addition, several informal meetings were held throughout the State with water well construction and pump installation contractors for education and general discussion on board and DWR activities. A web page was developed including an e-mail question section and several articles were provided to the CWWCA newsletter. BOE website @ <http://www.boe.state.co.us>.

Water Well Construction Rule's Revision

The Board and staff worked very diligently to improve the Rules and Regulations for Water Well Construction and Pump Installation. The intent of the revision of the Rules is to clarify the currently ambiguous rules, improve minimum construction standards, clarify environmental monitoring and observation well/hole minimum construction standards, improve the protection of the groundwater resource from contamination and protect public health.

The initial draft of the proposed revised Rules was developed with input from the Board, Licensed Contractors, Consulting Engineers and Geologists and others. The proposed revised rules were then sent to over 450 licensed contractors and interested parties to provide the opportunity for informal comments and proposed revisions. In addition, several informal meetings around the state were held to discuss the proposed revisions and obtain input to further improve the Rules. Input was gathered and a substantial number of thoughtful constructive suggestions resulted from these meetings.

The initial draft was revised and provided it to the Board in December 1998. The revised draft was discussed at the annual CWWCA meeting in January 1999, July 1999 and January 2000. Several proposed changes continue to be reviewed by the staff and contractors and interested parties. A final proposed draft was provided to the contractors and Board prior to the April 1999 Board meeting. The formal rulemaking process began in July 1999. However the formal hearings and Board deliberation was delayed to November 1999 and continued into early 2000. The Rules were adopted by the Board at it's April 2000 meeting and the effective date of the revised Rules is June 2000.

Several educational sessions were conducted by staff during 2000 to assist the contractors and DWR staff in understanding the revised Rules.



Well Observation Program

The well observation program summary is provided in Exhibit E.



Long Range Plan and Miscellaneous Activities

A summary of LRP activities is provided on Exhibit F.

The Annual Report for the DWR-DOW-WQCD MOU is provided on Exhibit G.

A copy of safety checklists and hazard analysis reports are provided on Exhibit H.

EXHIBITS

ENGINEERING, TECHNOLOGY AND INVESTIGATIONS ORGANIZATIONAL CHART

July 2000

Jack Byers
Assistant State Engineer
264
DWR Emergency Management Coordinator

Gina Antonio - Assistant

Dam Safety Unit

Alan Pearson
Professional Engineer III (168)

Mark Haynes
Prof. Engineer II (254)

Hydro & Satellite Monitoring

Jim McDanold
Professional Engineer III (191)

Dave Dzurovchin, Eng/Phys Sci Tech II (283)
Vacant, Telecom/Elec Spec III (429)

Modeling Unit

Brian Ahrens
Professional Engineer III (370)

Dale Straw, Professional Engineer III (259)
Jana Ash, Engineer-in-Training EIT II

CRDSS & RGDSS Project

Ray Bennett
Professional Engineer III (446)

GeoTech Services Unit

George VanSlyke
PSRS IV (251)

Chuck Roberts, Prof. Engineer III (253)
Glenn Graham, PSRS III (345)
Dave McElhaney, PSRS II (187)
Norm Hill, Eng/Phys Sci Tech I (288)

Board of Examiners

Jack Byers
Administrator



Table 1 Serious Incidents at Dams Since 1990

Date	Dam	Class	Location	Incident	EPP
06/25/90	Handy	1	Near Loveland, Larimer County	Sinkhole developed over the outlet.	Yes
04/09/92	Sanchez	1	Near San Luis, Costilla County	Muddy leakage, sinkholes on upstream slope.	Yes
05/07/92	Big Beaver	1	Near Meeker, Rio Blanco Co.	Sandboils at downstream toe.	Yes
05/13/93	Hughes	1	Near Genwood Springs, Garfield County	Erosion of emergency spillway during rapid snowmelt runoff	Yes
04/01/94	Aurora Rampart	2	Near Waterton, Jefferson County	Sudden increase in leakage, 30-50 gpm, below dam.	Yes
02/17/95	Homestake	1	Near Minturn, Eagle County	Outlet works operator bldg destroyed by snow avalanche	Yes
05/19/95	Vincent No.2	2	Near Palisade, Mesa County	Overtopped during Spring runoff due to spillway blocked with snow.	No
01/03/96	Standley Lake	1	Near Westminster, Jefferson County	Wind damage to riprap, eroding crest.	Yes
06/02/96	Sylvan	1	Near Parshall, Grand County	Slope stability failure of downstream slope	Yes
03/18/97	Durango Terminal	1	In Durango, LaPlata County	Sinkhole on upstream face.	Yes
05/29/97	Clear Lake	1	Near Georgetown, Clear Creek County	Piping incident related to grouted riprap upstream face.	Yes
05/30/97	Empire	1-2	Near Leadville, Lake County	An abandoned mining reservoir was being overtopped during Spring runoff. Failure was averted by Water Commissioner and help by inmates from Buena Vista.	No
05/02/98	Carl Smith	1	Near Hotchkiss, Delta County	Dam breached due to slope stability failure at right abutment. Significant damage to property. EPP not implemented due to unmanned location	Yes
08/19/98	Scholl	3	Near Kremmling, Grand County	Sinkholes in right abutment.	No
02/10/99	Spring Park	1	Near El Jebel, Eagle County	Developed sudden leakage from outlet works due to pipe joint separating near intake.	Yes
04/15/99	Jackson Lake	1	Near Goodrich, Morgan County	Concrete upstream facing failed during windstorm. EPP not implemented	Yes
05/06/99	Karval	3	At Karval, Lincoln County	Stability berm constructed in 1976 on downstream slope experienced a slide failure.	No

05/13/99	Oligarchy No.1	2	Near Longmont, Boulder County	Significant leakage related to rodent holes on dwnstrm slope	Yes
06/01/99	Elder	1	Near Ft. Collins, Larimer County	Developed sinkholes on crest of dam related to piping failure into outlet works.	Yes
06/08/99	Teller	2	On Fort Carson, Colorado Springs	Experienced longitudinal cracking on crest of dam.	Yes
07/21/99	Rist Benson	1	Near Loveland, Larimer County	Point source leakge from a rodent hole on downstream slope.	Yes
08/10/99	Occhiato No.1	3	Near Beulah, Pueblo County	Massive slide of downstream slope.	No
12/03/99	Woodland Park	2	At Woodland Park, Teller County	Uncontrolled leakage during first filling after repairs.	Yes
02/18/00	North Lake	1	Near Stonewall, Las Animas county	Experienced sudden increase in outflow from outlet pipe.	Yes
06/06/00	Grandby #11	2	On Grand Mesa near Cedaredge	Leakage and sinkholes in reservoir.	Yes



NDSP Proposed Work Plan FY 00, 01 & 02

Exhibit C

1. As stated in previous proposals, our goal has been to use the grant for advanced training in the area of dam safety and acquisition of computer equipment, office equipment, and field equipment in order to pursue our program goals. Under the expanded planning period, we will continue to provide staff training as planned in order to conduct detailed analysis of dam performance, and the appropriate acquisition of computer hardware and software. This performance area appears to be in accordance with Sub-Section (iv)(b) of the Basic Criteria, and Chapter III – Inspection, Section II of the Model State Dam Safety Program, November 1997.
2. In addition, we will plan for and conduct dam owner training in the areas of How to Inspect Dams and Emergency Preparedness. These would be scheduled workshops in the several divisions of the state, with emphasis on planning, preparation of plans, and conducting exercises of the plans. We would include our own division staff in this training in order for them to be able to assist in the safety observation of dams and reservoirs while they were doing their water administration work. We would conduct outreach programs, such as attending Natural Hazard Mitigation Council conferences to engage the emergency management community. This appears to be in the area of Sub-Section (ix) of the Basic Criteria.
3. We also intend to review and revise our Regulations for Dam Safety and Dam Construction, September 30, 1988, and the Policies and Procedures of our program. We have been soliciting comments from the dam engineering community, and we plan to hold public meetings throughout the state in order to reach the dam owner community. This appears to meet the Basic Criteria in Sub-Section (vii).

Below is an outline of the objectives for meeting the goals above:

1. Detailed Analysis

Staff Training

Attend Association of State Dam Safety Officials conferences and technical seminars. (Inspections, HEC programs, EAPs)
Hold in-house training on hydrology, engineering geology, and risk analysis(Failure mode and effects analysis), computer solutions, hazard classification, hydraulic structures, and structural design.
Attend training on safety in confined spaces.
Attend training on Hydrobase, and engineering software such as SLOPE W, BOSS RiverCad.
Staff participation in university courses on dam safety engineering.
Participation in dam safety related workshops offered by other organizations.
Purchase of technical references.

Equipment/Software(Purchases)

Digital Cameras, Global Positioning Systems
TV Inspection equipment for outlets
Geoslope SLOPE W and SEEP W, BOSS Int. RiverCAD, UTEXAS3
Air Testing equipment (Safety in confined spaces)
DeLORME 3D Topoquads
Office furniture
Vehicles

2. Dam Owner/Staff Training

Conduct workshops in each division of the state over the three-year period, using our Dam Owner Manual and Training Aids for Dam Safety (TADS) Modules, and our Emergency Preparedness Plan (EPP) guidelines. Use the FEMA guidelines for providing training on exercising plans in conjunction with the Colorado Office of Emergency Management and the Local Emergency Managers. We will participate in Colorado's Natural Hazard Mitigation workshops to engage the local emergency managers in promoting and requiring dam owners to prepare EPPs. The objectives are to get all EPPs up-to-date, and in conformance with a uniform guideline, and to train the owners/emergency managers to exercise their plans in order to maintain a good state of preparedness.

3. Review and Revision of Regulations/Policies

We have solicited comments on the regulations from the engineering community through the local professional engineering organizations. We plan to hold several staff meetings to review and prepare revisions to the rules. In addition, we will hold public meetings in the divisions of the state in order to obtain the dam owners input to the revisions of the rules and our policies. We will engage our Attorney General's Office to assist us in the interpretation of the statutes and preparation of the revised rules, as well as the hearings related to promulgating them.

We will review our policies in-house in order to bring them up-to-date, and coalesce the several letters and memos into a common form.

The performance measures related to the above are:

1. Completion of the training including the number of training seminars attended/conducted, attendance, cost, and an evaluation whether the training met our needs. The ultimate measure will be a reduction in the number of incidents occurring at dams, particularly failures.
2. The number of workshops conducted and attendance, and the increase in satisfactory EPPs being filed.
3. Completion of the revisions to the rules and policies in a reasonable time period, say 2002.

Fiscal Year 2000 National Dam Safety Program Grant- Interim Performance Report

Colorado – EMW-2000-GR-0121

Project Accomplishments

The DWR major objective is to improve our dam safety staff's abilities to do analysis of dam safety performance. This is accomplished by providing training to our Dam Safety Engineers in the technical arena of dam safety engineering. In the third year of our assistance grants, DWR continued to focus on technical training and associated software including upgrading our computer capabilities to enable the use of comprehensive software programs such as BOSS International's DAMBRK and Geo Slope's SEEPW and SLOPEW. As of January 2001, about 14% of the grant was expended for covering the costs for travel, lodging and per diem, registration fees, and support services for the staff to attend ASDSO Conferences and Technical Seminars, and in-house dam safety training meetings. This is consistent with a training plan that was developed by surveying the staff on their needs for training in relation to our goals, and scheduling their attendance at appropriate training events. By providing the kind of training that the staff has identified they need to perform the advanced analysis of the performance of dams; we feel we are improving our ability to assure the safe performance of dams under our jurisdiction. We intend to continue this in the next grant period. The general dam safety training acquired at ASDSO Conferences is considered to be an important area for all of our staff to take part in and learn about the state of the art of dam safety. Following is a list of the training/meetings that were attended during the period:

July 2000 – One engineer attended the USCOLD Annual Meeting and Special Session on Risk Assessment in Bellevue, WA.

September 2000 – Four engineers from the Dam Safety Branch attended the ASDSO Annual Conference in Providence, RI. Two of the engineers also attended the Technical Seminar on Slope Stability Analysis. One Design Review Engineer attended a weeklong workshop in Denver, CO on Roller Compacted Concrete.

December 2000 – Three Dam Safety Engineers attended the ASDSO Technical Seminar on Slope Stability Analysis in Denver, CO.

Future activities include:

A Dam Safety Branch meeting with two days training on risk assessment in March 2001. We have engaged Larry Von Thun, Consultant, and John Cyganiewicz, USBR to present the training.

Attending the ASDSO Western Region Conference in Anchorage, AK and Technical Seminar on Dam Failure Analysis.

Seven dam owner training sessions, one in each division.

About 4% of the grant was expended on the purchase of a Gateway computer for our support staff and a printer for Division 4. About 21% of the grant expenditures were spent on the purchase of software, Geo Slope's SEEPW and SLOPEW, and TopoQuad map software program.

The remaining 4% were expended on the purchase of equipment for the staff such as digital cameras, hand levels, and office furniture for the staff. It appears that digital cameras are very useful in the capture and editing of the pictures at dams, as well as storing and transmitting them to others via e-mail. All of the staff will eventually be equipped with digital cameras.

The staff is making great use of their new tools to analyze their dams, and they continue to make recommendations for improving our process using the power of the computer. We are proceeding with plans to implement risk assessment in our program and to provide training to dam owners.

Only about \$36,000 of our \$85,405 grant has been expended to date. We may need to request an extension for this grant beyond the May 11, 2001 end date.

Fiscal Year 1999 National Dam Safety Program Grant Final Performance Report

Colorado – EMW-1999-GR-0174

Project Accomplishments

DWR's major objective is to improve our dam safety staff's abilities to do analysis of dam safety performance. This is accomplished by providing training to our Dam Safety Engineers in the field of dam safety engineering. In the second year of our assistance grant, we continued the training of our dam safety staff. In addition, we upgraded our computer capabilities to enable the use of comprehensive software programs such as BOSS International's DAMBRK and RiverCad. About 39% of the grant was expended for covering the costs for consultant fees, travel, registration fees, and support services for the staff to attend ASDSO Conferences, Technical Seminars, and in-house dam safety training meetings. This is in accordance with a training plan that was developed by surveying the staff on their needs for training in relation to our goals, and scheduling their attendance at appropriate training events. The general dam safety training acquired at ASDSO Conferences is considered to be an important area for all of our staff to take part in and learn about the state of the art of dam safety. Following is a list of the training/meetings that were attended during the period:

October 1999 – Two staff members attended the ASDSO Annual Conference in St Louis, MO and the Technical Seminar on Risk Assessment.

January 2000 – We hired URS Griener - Woodward Clyde to train staff in advanced methods of slope stability and seepage analysis. Ten of the 12 members of the branch participated in the three days of training. A dam engineer from a sister agency, the Division of Wildlife, also participated. The branch also spent two days meeting to discuss the progress of our Long Range Plan, revisions to regulations, and plans for implementing risk assessment in our program.

March 2000 – The Dam Safety Branch (12 members) held a two-day meeting in Glenwood Springs to discuss and make recommendations for revisions to the Rules and Regulations for Dam Safety. A member of the Attorney General's Office also participated.

May 2000 – Two dam safety engineers attended the ASDSO Western Region Conference and Technical Seminar on Construction Inspection, in Portland, OR.

July 2000 – One engineer attended the USCOLD Annual Meeting and Special Session on Risk Assessment in Bellevue, WA. (Expenses covered by 2000 grant)

September 2000 – Four engineers from the Dam Safety Branch attended the ASDSO Annual Conference in Providence, RI. Two of the engineers also attended the Technical Seminar on Slope Stability Analysis. One Design Review Engineer attended a weeklong workshop in Denver, CO on Roller Compacted Concrete.

By providing the kind of training that the staff has identified they need to perform the advanced analysis of the performance of dams; we feel we have improved our ability to assure the safe performance of dams under our jurisdiction. We intend to continue this in the next grant period.

We also expended about 49% of the grant on the purchase of Gateway E-4200, 450 MHz, Pentium III computers with 8.45 GB hard drives, and 19-inch monitors for all 12 of the engineers in the branch. A Gateway laptop was also purchased for use in the branch. About 8% were spent on the purchase of software, such as the upgrade for BOSS Int. RiverCad 4.0, a TopoQuad map software program, and a riprap sizing software program.

The remaining 4% were expended on the purchase of equipment for the staff such as digital cameras, handlevels, and office furniture for the staff. It appears that digital cameras are very useful in the capture and editing of the pictures at dams, as well as storing and transmitting them to others via e-mail.

The staff is making great use of their new tools to analyze their dams, and they continue to make recommendations for improving our process using the power of the computer. We plan to purchase GEO-SLOPE'S SEEPW AND SLOPEW software with our 2000 grant funds, which will complete our suite of analytical tools. We are proceeding with plans to implement risk assessment in our program and to provide training to dam owners.

Fiscal Year 1998 National Dam Safety Program Grant Final Performance Report

Colorado – EMW-1998-GR-0270

Project Accomplishments

The proposal's major objective was to improve our dam safety staff's abilities to do analysis of dam safety performance. This was accomplished by providing training to our Dam Safety Engineers in the field of dam safety engineering. About 60% of the grant was expended for covering the costs for travel, registration fees, and support services for the staff to attend ASDSO Conferences and Technical Seminars, and in-house dam safety training meetings. A training plan was developed by surveying the staff on their needs for training in relation to our goals, and scheduling their attendance at appropriate training events. The general dam safety training acquired at ASDSO Conferences is considered to be an important area for all of our staff to take part in and learn about the state of the art of dam safety. Following is a list of the training/meetings that were attended during the period:

October 1998 – Five staff members attended the ASDSO Annual Conference in Las Vegas, NV, and the Technical Seminar on the NRCS SITES Program for the hydrologic/hydraulic evaluation of spillways.

November 1998 – The Dam Safety Branch(12 Members) held a two-day meeting in Denver to review and update our Long Range Plan, discuss revisions to the dam safety regulations, and make plans for improving the dam safety program with the NDSP Assistance Grant.

February 1999 – Three of the dam safety staff attended the ASDSO Western Region Technical Seminar on HEC-HMS in San Antonio, TX.

May 1999 – The Dam Safety Branch held a semi-annual meeting in Glenwood Springs. One day was spent discussing the proposed revisions to the regulations, and assigning tasks for drafting proposed revision/additions. Another day was spent discussing the policies of the branch and any revisions that appeared needed, especially any correlations that needed to be made in regard to revisions to the regulations.

June 1999 – Six staff members attended the ASDSO Western Region Conference in Phoenix, AZ, and the Technical Seminar on Filter and Drain Design.

October 1999 – Two staff members attended the ASDSO Conference in St Louis, MO, and the Technical Seminar on Risk analysis. Failure Modes and Effects Analysis is another area that we plan to use in our evaluation of dam performance. DWR plans to do more in-house training by hiring the technical seminar providers.

By providing the kind of training that the staff has identified they need to perform the advanced analysis of the performance of dams, we feel we have improved our ability to assure the safe

performance of dams under our jurisdiction. We intend to continue this in the next grant period, for we have just begun the effort we feel is required to accomplish our goals.

About 30% of the grant was spent on acquiring computer hardware and software for the staff. This was necessary in order to provide the tools to efficiently analyze problems, and conduct reviews of proposed designs. A major upgrade in computer power is planned to take advantage of several commercial programs like BOSS International's RiverCad/DAMBRK and GEOSLOPES stability/seepage programs.

The remaining 10% was expended on the purchase of equipment for the staff such as cameras, Global Positioning Systems units, outlet inspection gear, and maintenance of outlet inspection equipment. Some of the equipment, such as the GPS and digital cameras are being evaluated, and if deemed useful, will be acquired for all members of the branch with future grants.



STAFF SUMMARY

BOARD ACTION

2000

<u>MEETING</u>	<u>STIPULATIONS</u>	<u>PAPERS</u>	<u>HEARINGS</u>
February 1, 2000	0	0	0
April 4, 2000	0	0	1
June 6, 2000	4	0	0
August 1, 2000	0	0	0
October 3, 2000	1	0	0
December 5, 2000	2	0	0

Other Actions:

February 1, 2000

Complaints considered: 19 (17 continued; 2 new)
Authorized legal assistance: 3
Continue to investigate or follow up: 13
Monitor/delay action: 2
Dismiss/Close: 3

Board considered final alterations to the proposed Rules.

April 4, 2000

Complaints considered: 29 (13 continued; 16 new)
Authorized legal assistance: 6
Continue to investigate or follow up: 19
Monitor/Delay action: 2
Dismiss/Close: 4

Board adopted revised Rules.

A Default Judgment was entered in Case No. 00-BE-01.

The Board adopted the following policies:

2000-1; Policy on pump licenses

2000-2; Re-use of license numbers

2000-3; License requirements for gallery-type wells

Bulletin No. 2000- (use of GPS for well locations) was endorsed by the Board and the State Engineer.

An amendment addressing penalties was adopted for inclusion in the Complaint Process and Procedure.

June 6, 2000

Complaints considered: 36 (21 continued; 15 new)
Authorized legal assistance: 3
Continue to investigate or follow up: 20
Monitor/delay action: 3
Dismiss/Close: 10

Board considered requests for variance from the Rules submitted by Michael Keaton and Robert Goble. Both requests were denied.

Nancy Hood (well owner) addressed the Board and requested that her gallery-type well constructed by an unlicensed contractor be allowed to remain as constructed. Board granted the request.

Board reviewed its policies and Staff's recommendations to revoke some older polices and rewrite others. The Board concurred with the Staff's recommendations.

August 1, 2000

Complaints considered: 26 (19 continued; 7 new)
Authorized legal assistance: 2
Continue to investigate or follow up: 15
Monitor/delay action: 3
Dismiss/Close: 6

Board reviewed the information regarding a gallery-type well that was apparently constructed by an unlicensed contractor and directed the Staff address the matter with an Order to the well owner to provide evidence that well was constructed by licensed contractor or plug the well.

After review of re-written policies, the Board directed the Staff to modify the language in its policies regarding gravel pit exemptions and the use of fly ash additive.

October 3, 2000

Complaints considered: 44 (22 continued; 22 new)
Authorized legal assistance: 21
Continue to investigate or follow up: 18
Monitor/delay action: 2
Dismiss/Close: 3

Board reviewed re-written policies regarding gravel pit exemptions and the use of fly ash additive and adopted the re-written policies.

James Davis and Everett Jackson addressed the Board regarding a well that was apparently repaired by an unlicensed contractor. The Board accepted the well as adequately constructed but asked that the well owner have the well examined by a currently licensed contractor.

Board briefly discussed the need for statute changes and directed the Staff to begin a list of proposed statute changes for the Board's review.

December 5, 2000

Complaints considered: 73 (37 continued; 36 new)

Authorized legal assistance: 5

Continue to investigate or follow up: 50

Monitor/delay action: 3

Dismiss/Close: 15

The Board considered the construction of 8 wells based on the Licensed Contractor's Well Inspection Report submitted by the contractors. Of the wells considered, 1 was accepted with approval of a plan to modify the well (with conditions imposed by the Board), 4 were accepted as constructed, 1 was accepted with the repair plan approved on the condition that an acceptable water quality analysis was submitted, the construction of 1 well was not accepted, and consideration of 1 well was tabled to see if a Well Construction and Test Report could be obtained.

The Board was advised by Staff's legal council regarding the review and acceptance/denial of construction by unlicensed or unknown contractors.

The Board discussed the problem of zones of poor quality water (primarily in the lower Laramie Formation) not being grouted out by some contractors. To address the problem, the Board adopted Board Bulletin 2000-2.



Well observations performed by Division personnel during 2000. The program was implemented in March of 1999. Observations are shown by Division and month the inspection occurred.

WELL INSPECTIONS – 2000

<u>Div.</u>	<u>Jan.</u>	<u>Feb.</u>	<u>Mar.</u>	<u>Apr.</u>	<u>May</u>	<u>June</u>	<u>July</u>	<u>Aug.</u>	<u>Sept.</u>	<u>Oct.</u>	<u>Nov.</u>	<u>Dec.</u>	<u>TOTAL</u>
1	1	0	5	1	0	0	0	0	0	0	0	0	7
2	0	0	0	0	1	2	0	0	0	0	0	0	3
3	4	3	1	2	4	4	2	3	2	1	0	0	26
4	0	2	0	0	0	1	0	2	0	1	0	0	6
5	0	0	0	1	0	1	0	0	0	0	0	0	2
6	3	0	0	0	3	0	1	0	1	0	0	1	9
7	1	0	1	0	2	3	4	4	2	1	0	0	18
TOTAL	9	5	7	4	10	11	7	9	5	3	0	1	71

Construction Reports were received for just over 6200 wells during calendar year 2000. Seventy one inspections suggests that approximately 1.1% of the wells constructed are being inspected.



DWR Long Range Plan Tactic Status ASE/ETI

1.6; ASE-ETI contributed to overall environment via renovation of 6th floor conference room, and improved employee work conditions through computers, printers, safety and other support equipment and furniture.

1.7.4; Geotechnical Branch planned and initiated technical sessions, Modeling group offered a technical session originally planned for Spring '01 delayed until fall '01. Hydro manual development increased institutional knowledge transfer, many dam safety training and coordination meetings. Developed a transition plan November '00 for planned retirements in several technical areas to facilitate transfer of institutional knowledge. The BOE has been updating the Boards policies and documenting the procedures and improving the database.

2.6; The draft document was completed and provided to Steve Witte, Div. 2 on February 29, 2000 for completion of the Water Administration Section. After several reminders there has been no additional work on this tactic. The Draft was also provided to DSE for review and in March 00.

3.1.2; complete

3.1.4; complete, litigation ongoing

3.4.3; This Task is complete as of Jan 99, Republican River Compact support, the alluvium mapping was reviewed and report prepared. Additional information compiled as requested.

3.6.6; Update of RGDSS irrigated acreage, Plan for accomplishment not possible to implement, pilot project implemented Div 5 and IT. **The responsible person for accomplishment of this Tactic should be changed to IT Manager.**

2.2.2; The Hydrographic Branch is in the process of having a senior class at Metro State develop a software program to assist in field operations. Chuck Roberts continued to serve on the University of Southern Colorado's Academic/Curriculum Advisory Committee (This program has produced several Engineering Technology students who have become Hydrographers with DWR).

4.3.2; Plan developed 7/19/99, over 28 educational occurrences have been completed to date.

5.1.2; Initial activities completed, updates considered with annual review of the DNR Safety Manual which are to be completed (on or about Mar.1, 2001). This will be accomplished by way of specific references within the DNR Safety Manual to existing DWR Publications specifically addressing safety issues and guidelines for these groups

5.1.3; In addition to the first aid and survival kits, Vehicle Inspection forms were sent to Division Offices and the Denver Office (Nov. 22, 2000). Additionally the Sept. Hydrographer's Conference covered safety inspection forms and procedures for Cableway Measurement systems

5.1.4; Initial activities to identify content of safety (first aid) kit accomplished and phase 1 supply purchased either by division or ETI. Continued coordination with the divisions for identification of additional needs and strategy to purchase kits and additional survival gear as necessary for all state vehicles and private vehicles, which are used for state business to accomplish primary job functions. Anticipate completion in 2001. See attached report

Emergency/First Aid Kit distribution (60 distributed in Dec. 2000) and Survival Kit acquisition which will be completed as additional funds become available. Additionally Jana is in the process of coordinating CPR training Division-wide (targeted to be completed within 2001). This training will also accomplish the annual safety meeting requirement of Item **5.1.1**.

5.1.5; Hazard analysis checklists completed as planned. Item **5.1.5** requires that Site Hazard Analysis Checklists be developed for DWR job sites. This Objective/Tactic has technically been completed since August 11, 1999 when drafts of Hazard Checklist for Dam Safety, Field Operations, Hydrographers, and Office Personnel were sent to the Branch Chiefs/ Division Offices for review and feedback. There has been limited response and feedback on the forms from primarily Dam Safety branch and some Division Offices. The actual job site hazard analyses are to be completed by January of 2004. The drafts of the Checklists were forwarded under separate e-mail.

The field staff is supposed to be completing as sites are visited, survey of progress initiated Nov 2000.

5.2.1; The Dam Safety Program Plan is being utilized. Some delay in Rule revision due to workload impact by covering Division 5 and training for Div3/7 Dam Safety Engineers. In addition, a review of SE authorities and potential program modifications. A meeting was held in the spring of 2000 to discuss potential changes. Additional work is anticipated during 2001. All other activities are proceeding in a timely manner to accomplish the goals and objectives of the DSPP.

5.2.2; Grant and training funds applied for and secured.

5.2.3; Audit recommendations implemented.

5.2.4; See above, Work is progressing on Rule revision and assessment of program activities and statutory authorities. Risk assessment and development of a Risk Profiling procedure will have significant impact on rules revision. Additional work to continue through 2001 estimated completion is now fall 2002. **Revision of completion date requested.**

5.2.5; The dam observation training is scheduled to be completed in 2001. The Dam owner/operator training is being coordinated with CWCB and Insurance underwriters; four training sessions have been completed. Additional training is scheduled to occur through 2001 and 2002.

5.3.1; Rule revision completed June 2000.

5.3.2; Continuing activities with respect to water well construction and pump installation contractor education of revised Rules. This activity will continue for decades through CWWCA, newsletter articles, letters and seminars. In addition, the development and ongoing implementation of a training program for DWR staff and Water Well Contractors was accomplished in part by the *Introduction Water Well Meter Workshop* that I conducted for the entire staff in two sessions given August 24, 2000.

5.3.4; The well observation program was developed, training occurred and the program implemented. **The goal of the water commissioners accomplishing well observations on 5% of the constructed wells is not being met. The current annual accomplishment is around 1% and dropping rapidly. To be addressed in division 2001 spring meetings.**

5.4.4; Stream gaging program and data access is ongoing coordination with users. Note Stream gaging symposium and coordination with USGS, NRCS and CWCB.

5.4.2; Dependent on completion of SMS conversion. No activity at this time, work scheduled for 2002.

7.2.1 and 2; No activity to date. This goal, objective and tactics are presumed to be related to the development of Hydrobase and will proceed at the appropriate time. **The accomplishment date for these Tactics need revision.**

7.2.1 and 2; Completed as scheduled.

7.4.3; Completed as scheduled continued accomplishment coordinated with CWCB and DWR division offices.

7.4.4 and 5; Ongoing, evidence of success is the current CWCB Construction Fund Bill.



2000 Annual Report

MEMORANDUM OF UNDERSTANDING BETWEEN THE COLORADO DIVISION OF WATER RESOURCES COLORADO DIVISION OF WILDLIFE AND THE COLORADO WATER QUALITY CONTROL DIVISION

Introduction

The Division of Water Resources entered into a Memorandum of Understanding (MOU) with the Division of Wildlife and Water Quality Control Division in June 1998. The purpose of the MOU is to improve the communication and coordination between the three State agencies, water users and other interested parties. The prior MOU's has been a very valuable tool in improving our communication and coordination as well as avoiding unnecessary adverse impacts to the Aquatic ecosystem.

The agencies reviewed the effectiveness of the MOU on February 29, 2000. All three agencies reported that communication continues to improve. The MOU provides a framework to improve the communication, coordination and cooperation between the participating agencies regarding unusual, irregular or extraordinary water management activities. The sharing of water management information is to provide opportunities for the development of mutually beneficial, voluntary water management options to avoid or minimize, if possible, the negative impacts to fisheries and aquatic ecosystems or to protect the health and welfare of the public. The agencies agree to identify concerns and impacts associated with water management activities within the State of Colorado.

Through the identification of potential problems and timely sharing of water management information, the DWR, DOW, and WQCD agree to take reasonable action to identify options and opportunities to avoid or minimize, if possible, unnecessary impacts to fisheries and aquatic ecosystems due to water management practices. The agencies agree to be proactive in the education of dam owners, water right holders, and the general public regarding water management and possible concerns regarding negative impacts that may result and the possible actions that may be undertaken to avoid or minimize them.

The MOU does not, nor is it intended to, restrict or expand agency authorities, supersede, abrogate or impair lawful storage and legal uses of water rights in accordance with water court decrees and administrative rules and regulations. The agencies recognize the owners of water rights are entitled to certain lawful water management practices, the MOU is not intended, nor does it impose, any restrictions, perceived or actual on the lawful use of water rights.

The agency Division Directors and/or their representatives meet annually, by March 1 of each year, to review the effectiveness and progress of activities identified in the MOU. Several successful coordination events occurred during 2000 and are summarized herein.

General and Administrative Activities

The agency contact lists were revised to reflect personnel changes and inclusion of specific e-mail addresses. The DWR and WQCD agreed to meet later in the year to discuss discharge permit conditions and associated issues.

Ramah Dam

Improved coordination in 2000 with respect to outlet valve testing. No detrimental effects on the darter population.

De Weese Reservoir

Advance notice was provided by DWR regarding dam and outlet valve modification. Due to the coordination and joint consultation turbidity was minimized during construction.

Clear Creek Reservoir

A large-scale water sale by the Pueblo Board of Water Works resulted in a rapid lowering of the reservoir of approximately 12'. The rapid drawdown resulted in some fish loss. DWR was not aware of the water sale or rapid drawdown, DOW contacted the owners to discuss the problem and need for coordination.

Rio Grande, La Jara and Trujillo Meadows Reservoirs

Good coordination and notice on the repairs and water management. The frequent and extreme water fluctuations continue to create problems for fish management activities. The DOW and DWR representatives are encouraged to meet and discuss several water management options which may improve fishery management and water management.

Elkhead Reservoir

The escapement of fish from the reservoir due to the large release of water from the reservoir was of concern to the DOW. Improved coordination would have provided time to consider mitigation options.

Shoshone Dam

The modified diversion/bypass operations at Shoshone Dam were continued by Public Service Company (PSC) to enhance or better protect the aquatic ecosystem and/or angling capability of the Colorado River. PSC agreed to continue partial releases of water in excess of the power plant capacity through the lower gate. Additional coordination on these activities will continue.

Crystal River

DWR worked with DOW personnel on obtaining Augmentation water for a portion of DOW water rights on the Crystal River and also filling for irrigation rights to adjudicate their diversions on Garfield creek.

Strontia Springs Reservoir

Strontia Springs Reservoir located in Douglas and Jefferson Counties released sediment several times in the past year. The Buffalo Creek fire has caused a high level of sediment to move to the reservoir in the past two years. The Denver Water Board continues to implement the flushing program. Strontia Reservoir release plan was

approved May, 1998. The releases are needed to flush sediment accumulated behind reservoir due to Buffalo Creek fire and Denver gives notice prior to release to DOW. Denver has a standard protocol for notification and it is working well.

Griffith and Middle Griffith

The reservoirs were drained for dam safety and water administration purposes, their was good coordination between DOW and DWR. The resource was not damaged. Some public relations problems occurred and took considerable time and effort to resolve.

Overall, the MOU process is working well and is helping to find solutions to releases from dams and water management activities that may adversely impact water quality and wildlife.

Agency Contact: Jack G. Byers, Assistant State Engineer



Division Office Safety Coordinator Suggested Contacts and Focus

The proposed activities of the Division Office Safety Coordinator are outlined here, to generally describe the suggested involvement of the Division Office in the DWR Safety Program. Workplace safety is most effectively practiced at the site, accordingly local coordinators will be helpful in providing "in the Division Office" contacts for safety matters. A general safety awareness and unstructured, informal pursuit of safety within the Division will be the Safety Coordinator's charge. The areas of safety awareness are:

- 1) Equipment
 - Conduct periodic (semi-annual) safety checks of equipment and supplies, utilizing check lists of equipment and verifying they are in working order and/or stocked
 - Provides equipment needs lists to the Division Engineer and the DWR Safety Coordinator as need arises
 - Conduct vehicle safety check utilizing list provided by DWR and reporting to the DWR Coordinator semi-annually

- 2) Training
 - Cooperating with the DWR Coordinator in the logistics of providing annual safety training
 - Cooperating in meeting scheduling and coordination of topics
 - Provide new hires with safety manual access and provide updates of manual to personnel

- 3) Personnel
 - Help with Safety Training (providing information regarding manual, conveying information, requests and concerns)
 - Contact Person for all Division Office personnel
 - Accident Reporting information and forms
 - Hazard checklist - help with development and survey
 - Responsible charge of receiving, recording and transmitting safety concerns, hazards etc. to DWR - i.e. this is the person to whom safety issues are reported.

The DWR Safety Coordinator, with input from the Division Office coordinators, will be developing the safety checklists, and report forms for Equipment, Work site Hazards, and Training documentation.

DAILY VEHICLE SAFETY INSPECTION CHECKLIST

Of all aspects of driving conditions, you have direct control over only two: yourself and your vehicle. It is your responsibility to make sure your vehicle is in proper working condition. Use of this list may be critical to safety.

- 1. Brakes (Pedal Pressure)
- 2. Emergency Brake
- 3. Both Tail Lights
- 4. Windshield Wipers
- 5. Windshield Defroster
- 6. Horn
- 7. Mirrors (adjust before driving)
- 8. Turn Signals
- 9. Back-up Lights
- 10. Both Headlights (High & Low Beam)
- 11. Tires
 - Tread
 - Inflation
 - Spare
- 12. Brake Lights
- 13. Hazard Lights
- 14. Safety Belt
- 15. Fluid Levels
 - Gasoline
 - Oil
 - Power Steering
 - Power Brakes
 - Transmission
 - Windshield Washer
 - Coolant

Field Operations* - Hazard Checklist

(* Hydrographic, Dam Safety and Office Personnel use separate forms.)

This is intended as an initial screening device. It is not intended to be comprehensive, but only to identify categories of hazards specific to individual work environments which need further investigation. Does your Field workplace have areas or features that are basically safety hazards? An unchecked box indicates a potential hazard.

Machinery

- Guards are appropriate
- Emergency stops are clearly visible
- Noise emission is acceptable
- Allows operator to adopt a safe and comfortable working posture (arms not raised above shoulders frequently - not required to reach forward frequently)
- Any specific hazards related to Cable car equipment or operation?

Work surface

- Work height allows staff to adopt a safe and comfortable working posture waist-height if for most work - higher for precision work, eg using computers)

Floors

- Are not slippery
- Have an even surface
- Are maintained
- Are Dry
- Are structurally sound

Entrances/exits

- Are unobstructed
- Are well lit
- Have sound surfaces
- Have handrails if required

Passageways

- Are unobstructed
- Are well lit

Storage

- Is stable
- Has no exposed sharp edges
- Minimises double handling
- Allows space for movement and lifting equipment
- Allows staff to adopt safe, comfortable working postures (shelf heights for most lifting between knees and shoulders)

Chemicals, drugs, animals

- Material safety data sheets are supplied and displayed
- Hazardous chemicals and drugs securely stored
- Exposure guidelines for hazardous materials are adhered to
- Are there locations where there are hazardous exposure to harmful animals

Fire control

- Extinguishers are present, visible and maintained
- Smoking restrictions are observed
- Emergency numbers are displayed
- Alarms are tested

Waste control

- Bins are provided and emptied
- Spillages are cleaned
- Drains are cleared
- Pollution controls are operating

Ventilation, heating and cooling

- Are appropriate
- Are maintained

Electrical

- Lock out procedures are in place and followed
- Appropriate danger signs are posted
- Leads are off floor and well maintained
- Earth leakage circuit breakers are tested
- Start/stop controls are clearly visible

Amenities

Toilets and washing facilities are of adequate number, maintained and clean

Waste disposal

- Appropriate facilities for disposal of hazardous fluids are available
- Appropriate facilities for disposal, storage or transport of sharps are available
- Hazardous materials have been identified
- Staff know and follow documented procedures for disposal of hazardous materials

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Protective clothing

- Staff use appropriate protective clothing when working in exposed areas
- Staff use appropriate protective clothing/ equipment when working with hazardous materials

r7 materia

First aid

- Staff are familiar with emergency procedures
- First aid kits are appropriate, maintained and their location displayed

Water Safety

- Personal flotation devices are provided
- Personal flotation devices are used
- Water Commissioners or field personnel working over or near water are certified as satisfactory swimmers
- Adequate safety equipment is provided at structures or within vehicle used to get to site.

Hydrographic Section - Hazard Checklist

This is intended as an initial screening device. It is not intended to be comprehensive, but only to identify categories of hazards specific to individual work environments which need further investigation. Does your Field workplace have areas or features that are basically safety hazards? An unchecked box indicates a potential hazard.

Machinery

- Guards are appropriate
- Emergency stops are clearly visible
- Noise emission is acceptable
- Allows operator to adopt a safe and comfortable working posture (arms not raised above shoulders frequently - not required to reach forward frequently)
- Any specific hazards related to Cable car equipment or operation?

Work surface

- Work height allows staff to adopt a safe and comfortable working posture waist-height if for most work - higher for precision work, eg using computers)

Floors

- Are not slippery
- Have an even surface
- Are maintained
- Are Dry
- Are structurally sound

Entrances/exits

- Are unobstructed
- Are well lit
- Have sound surfaces
- Have handrails if required

Passageways

- Are unobstructed
- Are well lit

Storage

- Is stable
- Has no exposed sharp edges
- Minimises double handling
- Allows space for movement and lifting equipment
- Allows staff to adopt safe, comfortable working postures (shelf heights for most lifting between knees and shoulders)

Chemicals, drugs, animals

- Material safety data sheets are supplied and displayed
- Hazardous chemicals and drugs securely stored
- Exposure guidelines for hazardous materials are adhered to
- Are there locations where there are hazardous exposure to harmful animals

Fire control

- Extinguishers are present, visible and maintained
- Smoking restrictions are observed
- Emergency numbers are displayed
- Alarms are tested

Waste control

- Bins are provided and emptied
- Spillages are cleaned
- Drains are cleared
- Pollution controls are operating

Ventilation, heating and cooling

- Are appropriate
- Are maintained

Electrical

- Lock out procedures are in place and followed
- Appropriate danger signs are posted
- Leads are off floor and well maintained
- Earth leakage circuit breakers are tested
- Start/stop controls are clearly visible

Amenities

Toilets and washing facilities are of adequate number, maintained and clean

Waste disposal

- Appropriate facilities for disposal of hazardous fluids are available
- Appropriate facilities for disposal, storage or transport of sharps are available
- Hazardous materials have been identified
- Staff know and follow documented procedures for disposal of hazardous materials

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Protective clothing

- Staff use appropriate protective clothing when working in exposed areas
- Staff use appropriate protective clothing/ equipment when working with hazardous materials

r7 materia

First aid

- Staff are familiar with emergency procedures
- First aid kits are appropriate, maintained and their location displayed

Water Safety

- Personal flotation devices are provided
- Personal flotation devices are used
- Hydrographers certified as satisfactory swimmers
- Adequate safety equipment is provided at structures or within vehicle used to get to site.

Office Personnel - Hazard Checklist

This is intended as an initial screening device. It is not intended to be comprehensive, but only to identify categories of hazards specific to individual work environments which need further investigation. Does your Field workplace have areas or features that are basically safety hazards? An unchecked box indicates a potential hazard.

Machinery

- Guards are appropriate
- Emergency stops are clearly visible
- Noise emission is acceptable
- Allows operator to adopt a safe and comfortable working posture (arms not raised above shoulders frequently - not required to reach forward frequently)
- No specific hazards related to Office equipment or operation?

Work surface

- Work height allows staff to adopt a safe and comfortable working posture waist-height if for most work - higher for precision work, eg using computers)

Floors

- Are not slippery
- Have an even surface
- Are maintained
- Are Dry
- Are structurally sound

Entrances/exits

- Are unobstructed
- Are well lit
- Have sound surfaces
- Have handrails if required

Passageways

- Are unobstructed
- Are well lit

Storage

- Is stable
- Has no exposed sharp edges
- Minimises double handling
- Allows space for movement and lifting equipment
- Allows staff to adopt safe, comfortable working postures (shelf heights for most lifting between knees and shoulders)

Chemicals, drugs, irradiation

- Material safety data sheets are supplied and displayed
- Hazardous chemicals and drugs securely stored
- Exposure guidelines for hazardous materials are adhered to
- Are there no locations where there are hazardous exposures to harmful radiation

Fire control

- Extinguishers are present, visible and maintained
- Smoking restrictions are observed
- Emergency numbers are displayed
- Alarms are tested
- Fire Drills are conducted.

Waste control

- Bins are provided and emptied
- Spillages are cleaned
- Drains are cleared

- Pollution controls are operating

Ventilation, heating and cooling

- Are appropriate
- Are maintained

Electrical

- Lock out procedures are in place and followed
- Appropriate danger signs are posted
- Leads are off floor and well maintained
- Earth leakage circuit breakers are tested
- Start/stop controls are clearly visible

Amenities

- Toilets and washing facilities are of adequate number, maintained and clean

Waste disposal

- Appropriate facilities for disposal of hazardous fluids are available
- Appropriate facilities for disposal, storage or transport of sharps are available
- Hazardous materials have been identified
- Staff know and follow documented procedures for disposal of hazardous materials

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17

Protective clothing

- Staff use appropriate protective clothing when working in exposed areas
- Staff use appropriate protective clothing/ equipment when working with hazardous materials

r7 materia

First aid

- Staff are familiar with emergency procedures
- First aid kits are appropriate, maintained and their location displayed

Personal Safety - Office Violence

- Departmental Office Violence Policy is posted for inspection and review.
- Departmental "Observed Behaviour/Reasonable Suspicion Report" form is available to all employees.
- Emergency numbers, with guidelines for bomb or personal threat reporting.
- Off - hours security is satisfactory.

Dam Safety - Hazard Checklist

This is intended as an initial screening device. It is not to be comprehensive, but only to identify categories of hazards specific to individual work environments which need further investigation. Does your Field workplace have areas or features that are basically safety hazards? An unchecked box indicates a potential hazard.

Machinery

- Guards are appropriate
- Emergency stops are clearly visible
- Noise emission is acceptable
- Allows operator to adopt a safe and comfortable working posture (arms not raised above shoulders frequently - not required to reach forward frequently)

Work surface

- Work height allows staff to adopt a safe and comfortable working posture waist-height ifor most work - higher for precision work, eg. using computers)

Floors

- Are not slippery
- Have an even surface
- Are maintained
- Are dry
- Are Structurally sound

Entrances/exits

- Are unobstructed
- Are well lit
- Have sound surfaces
- Have handrails if required

Passageways

- Are unobstructed
- Are well lit
- Are free of confined space problems
- Are free of ingress and regress problems

Storage

- Is stable
- Has no exposed sharp edges
- Minimises double handling
- Allows space for movement and lifting equipment

- Allows staff to adopt safe, comfortable working postures (shelf heights for most lifting between knees and shoulders)

Chemicals and drugs

- Material safety data sheets are supplied and displayed
- Hazardous chemicals and drugs securely stored
- Exposure guidelines for hazardous materials are adhered to

Fire control

- Extinguishers are present, visible and maintained
- Smoking restrictions are observed
- Emergency numbers are displayed
- Alarms are tested

Waste control

- Bins are provided and emptied
- Spillages are cleaned
- Drains are cleared

- Pollution controls are operating

Ventilation, heating and cooling, Confined Spaces

- Confined space breathing apparatus is provided
- Confined spaces are identified with noticing procedure for all personnel before entry
- Confined spaces have emergency evacuation equipment, procedures, or passages.
- Confined spaces are reasonably safe, or reasonable measures taken to make them more safe
 - Are appropriate
 - Are maintained

Electrical

- Lock out procedures are in place and followed
- Appropriate danger signs are posted
- Leads are off floor and well maintained
- Earth leakage circuit breakers are tested
- Start/stop controls are clearly visible

Amenities

- Toilets and washing facilities are of adequate number, maintained and clean

Waste disposal

- Appropriate facilities for disposal of hazardous fluids are available
- Appropriate facilities for disposal, storage and transport of sharps are available
- Staff follow documented procedures for disposal of hazardous materials

Protective clothing

- Staff use appropriate protective clothing
- Staff use appropriate protective clothing/ equipment when working with hazardous materials

First aid

- Staff are familiar with emergency procedures
- First aid kits are appropriate, maintained and their location displayed

Water Safety

- Personal Flotation Devices are provided.
 - Personal Flotation Devices are used.
 - Dam Safety Inspectors are certified as being satisfactory swimmers.
 - Adequate safety equipment is provided at structure or within the vehicle used to get to site.
-