

**STATE ENGINEER'S
EIGHTEENTH ANNUAL REPORT
TO
THE COLORADO GENERAL ASSEMBLY
ON**

**DAM SAFETY
FOR
FY 01-02**

January 2003

Prepared by

**COLORADO DIVISION OF WATER RESOURCES
OFFICE OF THE STATE ENGINEER**

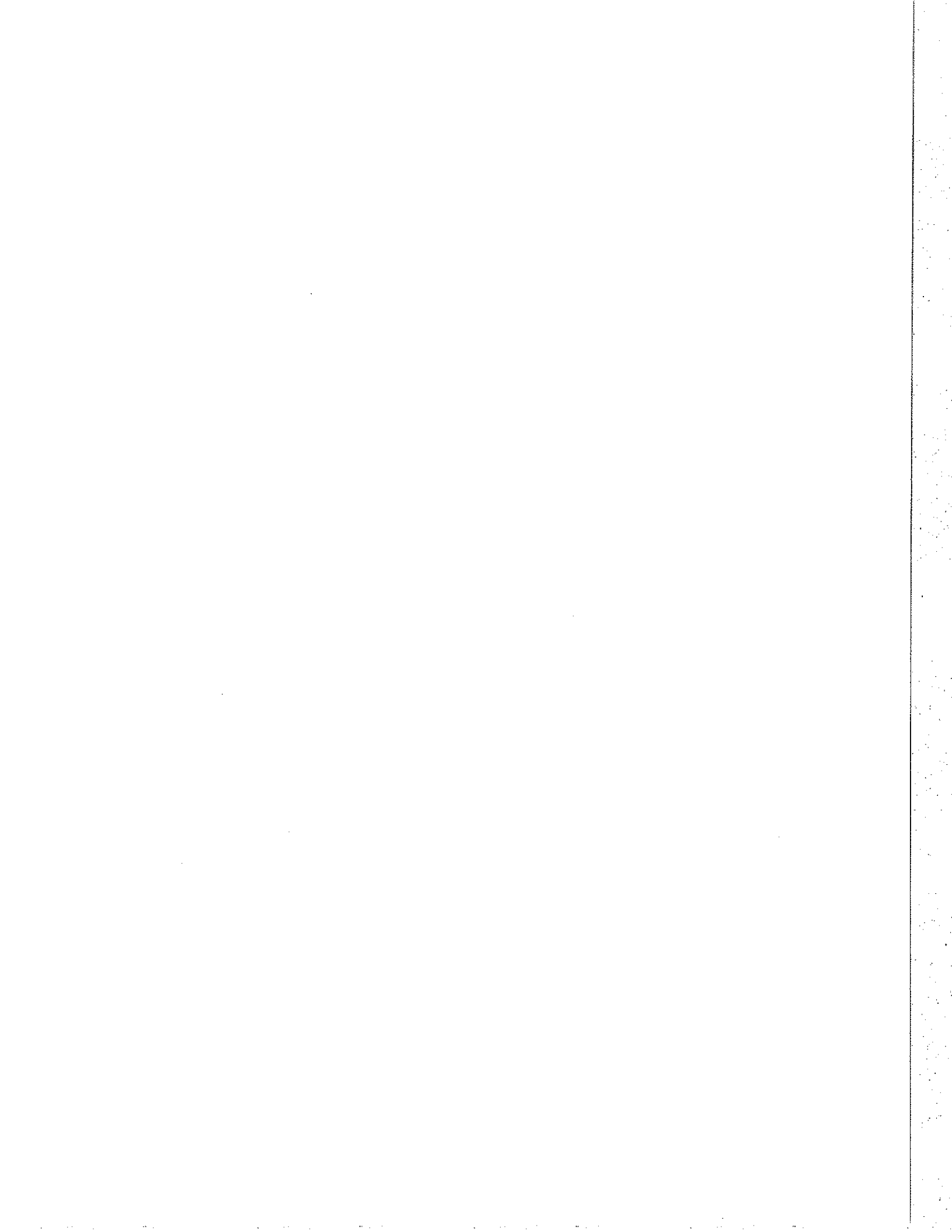
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EXECUTIVE SUMMARY

The Colorado Division of Water Resources' Dam Safety Branch's objective is to prevent property damage and the loss of life, while protecting the loss of water supplies due to the failure of dams in Colorado. The Dam Safety Program includes the enforcement of a comprehensive set of regulations, policies, and procedures for the design, construction, and maintenance of dams; the safe operation of reservoirs; and emergency preparedness planning.

The Dam Safety Program is managed by the State Engineer in accordance with Title 37, Article 87 of C.R.S. (2001 Supp.) and the Livestock Water Tank Act, Title 35, Article 49 of C.R.S. (2001 Supp.), as amended. The program is implemented by the State Engineer through the Dam Safety Branch and the Division Engineer's offices. The Branch currently consists of a branch chief, dam safety engineers, and design review engineers. Currently, the program oversees a total of about 2,900 dams in Colorado with 1,861 dams of jurisdictional size. Of these, about 1,737 are non-federal dams. Of the non-federal dams, approximately 572, or about one-third of the total non-federal dams in Colorado, are classified as dams that, in the event of a failure, would be expected to cause loss of life and/or significant property damage to a significant portion of the state's population.

For FY 01-02, the Dam Safety Program achieved a great number of goals and objectives in the design review and inspection of dams for the determination of safe water storage levels. Although dam safety incidents were reported this year, because of our program, these incidents resulted in reduced consequences with no loss of life or significant property damage. This is attributed to the increased awareness and responsibility of the dam owners for their dams - including emergency preparedness planning - and to the enforcement of the regulations, policies, and procedures by our office. Emergency preparedness for incidents at dams that jeopardize the public safety, including the failure of dams, has become an integral part of dam safety programs across the nation. Colorado has been actively involved in this area since 1981. Approximately 111 new and updated emergency preparedness plans were reviewed during the fiscal year.

During FY 01-02, the State Engineer's Office approved plans for three new dams and thirty-one plans for alteration, modification, or enlargement. Twelve separate hydrology studies were also approved for determination of the inflow design flood for spillway design. The estimated cost of construction for the submitted plans was over \$49 million.

The statutes specify that a safety inspection for the determination of the safe water storage level must include the review of previous inspection reports and drawings, site inspection of the dam, spillways, outlet facilities, seepage control and measurement system, and permanent monument or monitoring installations. During FY 01-02, a total of 639 safety inspections and 128 construction inspections were conducted for a total of 767 inspections. In addition, 158 follow-up inspections were performed. At the conclusion of the reporting period, there were 193 dams restricted from full storage due to various structural deficiencies such as significant leakage, cracking and sliding of embankments, and inadequate spillways. Total storage restricted was 130,086 acre-feet. The restrictions provide risk reduction for the public and environment until the problems are corrected.

The Dam Safety Branch continues to use risk-based tools to help evaluate and prioritize the jurisdictional dams in Colorado in order to more efficiently and effectively use program resources.

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1.0 INTRODUCTION

1.1 Program Mission

The mission of the Dam Safety Program is to prevent property damage and the loss of life, while protecting the loss of water supplies due to the failure of dams in Colorado through the effective and efficient use of available resources. The program includes the enforcement of a comprehensive set of regulations, policies, and procedures for the design, construction, and maintenance of dams; the safe operation of reservoirs; and emergency preparedness planning. In the event a dam is found to be unsafe, the risk of adverse consequences due to failure of the dam is reduced by restricting the storage in the reservoir to a safe level. The safe storage levels are 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 licensed professional engineers.

The program is managed by the State Engineer in accordance with Title 37, Article 87 of C.R.S. (2001 Supp.) and the Livestock Water Tank Act, Title 35, Article 49 of C.R.S. (2001 Supp.), as amended. The "Rules and Regulations for Dam Safety and Dam Construction" and "Standard Specifications for Livestock Water Tanks and Erosion Control Dams" establish the procedures and requirements of the State Engineer in the implementation of these statutes.

1.2 Report Purpose

This report is submitted in compliance with Section 37-87-114.4 of C.R.S. (2001 Supp.) concerning the dam safety activities of the State Engineer and the Colorado Division of Water Resources relating to Sections 37-87-105 to 37-87-114 of C.R.S. (2001 Supp.).

2.0 PROGRAM OVERVIEW

2.1 Goals and Objectives

The Dam Safety Program, although responsible for the approximately 2,900 dams within the state, concentrates on "jurisdictional" dams and reservoirs as defined in Section 37-87-105 of C.R.S. (2001 Supp.). Jurisdictional dams are dams that are greater than ten feet high as measured at the spillway, twenty acres or more in surface area, or 100 acre-feet or more in capacity at the high water line. Further, dams are classified as to estimated downstream consequences as a result of failure of the dam in the absence of flooding conditions as follows:

Dam Classification	Description
1	Loss of human life is expected in the event of failure of the dam.
2	Significant damage is expected to occur, but no loss of human life is expected in the event of failure of the dam.
3	Loss of human life is not expected and damage to structures and public facilities is not expected in the event of failure of the dam.
4	No loss of human life is expected and damage will occur only to the dam owner's property in the event of failure of the dam.

Identified goals of the program are as follows:

1. In order to protect the public, the Dam Safety Branch shall determine the amount of water that is safe to impound in reservoirs of the state.
2. In order to protect the public from failure of dams, the Dam Safety Branch shall review and recommend approval of plans and specification for the construction, modification, and repairs of dams, in accordance with the Rules and Regulations for Dam Safety and Dam Construction, implemented on September 30, 1988.
3. To reduce the risk of dam failure and adverse consequences and to more efficiently and effectively use the available resources within the program, the Dam Safety Branch shall implement and utilize a risk-based approach to prioritize the jurisdictional dams within the program.
4. In order to improve the functions of the Branch and to meet the public information needs, the Dam Safety Branch shall maintain a data information system.
5. In order to improve the technical proficiency of the Branch, the Division of Water Resources shall provide training and professional development of the Branch personnel.
6. In order to improve the Dam Safety Program, to participate in the development of national policies on dam safety, and to take advantage of the continuing education and information available, the state shall be a full voting member of the Association of State Dam Safety Officials (ASDSO).

2.2 Organization

The Dam Safety Program is executed by the State Engineer through the Dam Safety Branch and the Division Engineer's offices. The Branch currently consists of a branch chief, dam safety engineers, and design review engineers. The dam safety engineers are responsible for the program in their geographic area. The dam safety review engineers and branch chief are located in Denver. A summary of the Branch organization and personnel is included in Appendix A.

Interagency coordination occurs as necessary. A Memorandum of Understanding has been executed with the Division of Wildlife (DOW) regarding the responsibilities of each agency in carrying out the safety inspection of DOW dams. The DOW is making safety inspections of their Class 3 (low hazard) dams.

The Colorado Water Conservation Board (CWCB) makes its construction fund available to assist owners with the repair of their dams. We closely coordinate the review and approval and final acceptance of these dams with the CWCB.

2.3 Roles and Responsibilities

The branch chief has program-wide responsibility for formulating the goals of the program, recommending policies for implementation of the regulations, preparing procedures for carrying out the policies, providing technical guidelines for conduct of the work, communication, training, and coordination. The branch chief directly supervises the Design Review and Construction Inspection Unit activities.

The dam safety engineers' principal duties are to:

1. respond to emergency situations;
2. conduct safety inspections of existing dams;
3. review the adequacy of spillways under the rules;
4. enforce the requirement for emergency planning;
5. assist dam owner in developing their Emergency Preparedness Plans (EPP);
6. provide design review and construction inspection of repairs and alternations when necessary; and
7. investigate complaints on the safety of dams.

Dam safety engineers also investigate the construction of dams in violation of Section 37-87-105 (1) and (4) of C.R.S. (2001 Supp.) and conduct training on the inspection of dams for Division personnel, dam owners, interested agencies, engineers, and the public. In addition, they review and approve Livestock Watertank and Erosion Control Dam applications and do other related work as assigned.

The design review engineers' principal duties are to review the plans and specifications for the construction, alteration, modification, repair, and enlargement of reservoirs or dams in accordance with Section 37-87-105 of C.R.S. (2001 Supp.). This involves a comprehensive engineering review of the plans and specifications to assure that a safe design has been developed and to inspect the construction of the dam. The engineers assist the Department of Health in the technical evaluation of tailing impoundments through a Memorandum of Understanding, participate in the state's joint review process with the Department of Natural Resources, provide technical assistance to the Division Engineers' offices on dam safety, and perform other related work as assigned.

2.3 Summary of Colorado Dams

Table 1 summarizes the distribution of dams by division, ownership, and hazard class in Colorado. Currently, the program oversees a total of about 3,600 dams within Colorado. Of these, 1,861 are considered jurisdictional dams, of which about 1,737 are non-federal dams. Of the non-federal dams, approximately 572, or about one-third of the total non-federal dams in Colorado, are classified as dams that, in the event of a failure, would be expected to cause loss of life and/or significant property damage.

2.4 ASCE Report Card on Dam Safety

2.4.1 General - Recently, the American Society of Civil Engineers (ASCE) spearheaded an effort to evaluate or "grade" the condition of the nations aging infrastructure. This has included buildings, highways, bridges, and dams, among other infrastructure features. In Colorado, this effort has been guided under the Colorado Section of ASCE, Government and Public Affairs Committee (GPAC).

Within the GPAC, a Dam Safety Advisory Board was formed in the spring of 2002 to evaluate Colorado's dams. This advisory board consisted of members from federal agencies (U.S. Bureau of Reclamation and Army Corps of Engineers), state agencies (Division of Water Resources and Colorado Water Conservation Board), and representation from private industry.

2.4.2 Categories and Grading Criteria - The following general criteria for grading was established by the GPAC for all infrastructure categories:

- (1) condition and performance indices;
- (2) need vs. capacity; and
- (3) funding vs. need.

The Dam Safety Advisory Board reached a consensus on the specific definitions that would be considered for each of these three criteria under the dam safety category. Each criterion was assigned equal weight (33 1/3 percent) to compute the composite grade. The grading criteria are defined as follows:

Criterion 1: Condition Index

The condition index criterion characterizes the *physical condition* of dams in Colorado. Condition index scales are shown on the table below. This scale is based on the Colorado Division of Water Resources categories that are more compatible with our inspection criteria.

Condition Index Scales

Grade	Condition Description
A or B	Satisfactory: The safety inspection indicates no conditions that appear to threaten the safety of the dam and the dam is expected to perform satisfactorily under all design loading conditions.
C	Conditionally Satisfactory: The safety inspection indicates symptoms of structural distress (seepage, evidence of major displacements, etc.) that, if conditions worsen, could lead to failure of the dam. Essential monitoring, inspection, and maintenance must be performed as a requirement for continued full storage.
D	Unsatisfactory: The safety inspection indicates definite signs of hydrologic inadequacy or structural distress (excessive seepage, cracks, slides, sinkholes, severe deterioration, etc.) that could lead to failure of the dam if operated at full storage.

Criterion 2: Need versus Capacity (Manpower and Assets)

This criterion, as defined by the advisory board, pertains to the adequacy of the *dam safety programs* that operate in Colorado.

With regard to dam safety programs, the "need" is for adequate dam safety inspections, monitoring, record keeping, and emergency preparedness plans at federal, state, and local levels. The advisory board attempted to define a "grade" for the dam safety programs that considers the technical

adequacy of the programs, and their current capacity in regard to manpower and assets such as number of inspectors and support staff, available tools, and possibly other considerations.

Criterion 3: Funding versus Need

The advisory board chose to define this criterion on the basis of funding needed for *dam rehabilitation* to bring deficient facilities up to current dam safety standards.

2.4.3 Composite Grades - Only high hazard, or Class 1, dams were considered in the condition index evaluation. By the Colorado Division of Water Resources, a Class 1 dam is a dam for which loss of human life is expected in the event of failure.

Composite grades were developed by each of the three agencies for high hazard dams under their jurisdiction: (1) Colorado Division of Water Resources (includes state, local governments, private, utilities, and some federal dam owners), (2) Department of the Interior (includes dams owned and operated by U.S. Bureau of Reclamation and U.S. Forest Service), (3) U.S. Army Corps of Engineers dams. The following point scale was assigned to compute the grades: A=4, B=3, C=2, D=1, F=0.

Once composite grades for dams from each agency were developed, a weighted average grade for all dams based on number of dams under each sector in the high hazard (Class 1) classification was computed. The overall composite grade for Colorado dam safety was computed by weighting the composite grades for each agency according to the ratio of the number of high hazard dams under their jurisdiction to the total number of high hazard dams in the state. An overall composite grade of approximately 2.6 (B-) was calculated using this method.

2.4.4 Conclusions and Recommendations - Preliminary conclusions of the study include:

1. At the time of the study, there were 192 dams in all hazard categories, and 32 high hazard dams, on the Colorado Division of Water Resources "restricted list" of dams that are not allowed to operate at full reservoir storage capacity. Seventeen of Colorado's high hazard dams were considered unsatisfactory, meaning that the dam safety inspections indicated definite signs of hydrologic inadequacy or structural distress that could lead to failure of these dams if they are operated at full storage capacity. An additional 92 high hazard dams were categorized as conditionally satisfactory, meaning that the safety inspections revealed symptoms of structural distress such as excessive seepage, evidence of major displacements, etc., that could lead to failure of the dam if conditions worsen.
2. The Colorado Division of Water Resources' Dam Safety Program is recognized as one of the best state dam safety programs in the nation. The state has been able to acquire and maintain a solid group of experienced professionals, and has adequate statutes, regulations, policies, and procedures to implement and carry out the program. However, there remains a number of areas where improvements are needed, including the eventual filling of key personnel vacancies within the program, equipment needs, and the strengthening of a number of existing statutes.
3. Approximately half of the dams on the Colorado Division of Water Resources "restricted list" have been on that list for ten years or longer. This is interpreted to reflect the lack of funding to make repairs or upgrades needed to remove the restrictions. Colorado has no state grant programs for these projects. Loans are available for local government and

private projects through the Colorado Water Conservation Board, but these loans are underutilized because dam owners are unwilling or unable to take on even these low interest debts. Another possible funding source for bondable entities is through the bond authority of the Colorado Water and Power Development Authority. With the ongoing, nearly unprecedented drought, Colorado's water supply issues have come into sharp focus. Several 2002 drought-related news reports and articles have highlighted the need to repair and rehabilitate existing dams and reservoirs that cannot be filled to capacity because of structural flaws.

The advisory board is still in the process of drafting their preliminary conclusions and recommendations of the study. A final report is anticipated to be released in early- to mid-2003.

3.0 PROGRAM ACCOMPLISHMENTS

3.1 General

The effectiveness of a program can be demonstrated by producing a positive result or accomplishment. For fiscal year 2001-2002, the Dam Safety Program achieved a great number of goals and objectives in the design review and inspection of dams. Although dam safety incidents were reported this year, because of our program, these incidents resulted in reduced consequences with no loss of life or significant property damage. This is attributed to the increased awareness of the dam owners to be responsible for their dams, including emergency preparedness planning, and to the enforcement of the regulations, policies, and procedures by our office.

As is typical, a number of dams experienced serious problems during the period, including:

1. Tarryall Dam, a Class 1 structure, experienced cracking of the concrete dam in the right gravity section. A review of stability analyses under normal and flood loading conditions led to a reservoir restriction and order to repair the dam.
2. Fruita Dam No. 1, a Class 2 structure, experienced a slide on the downstream slope of the dam. Engineering evaluations were performed and temporary repairs have been completed.
3. Mariano Dam, a Class 1 structure, experienced cracking on the downstream slope near the dam crest. Engineering evaluations have recently been completed.
4. Clear Lake Dam, a Class 1 structure, experienced a sinkhole on the upstream slope of the embankment. The sinkhole was discovered during a Federal Energy Regulatory Commission (FERC) inspection. Engineering evaluations are currently underway.
5. May Ranch Dam, a non-jurisdictional dam, experienced serious seepage along the downstream groin. Investigations revealed internal erosion and piping of embankment materials. The reservoir was drawn down to a safe level and repairs are underway.

At the conclusion of the reporting period, there were 193 dams restricted from full storage due to various structural deficiencies such as significant leakage, cracking and sliding of embankments, and inadequate spillways. Total storage restricted was 130,086 acre-feet. The restrictions provide risk

reduction for the public and environment until the problems are corrected. The owners are responsible for following the restricted operating levels and the restrictions are enforced by the Division Engineers. A list of currently restricted reservoirs is included in Appendix B. In the event that conditions of any dam or reservoir are so unsafe as to not permit the time to issue or enforce a restriction, or a dam is threatened by a large flood, the State Engineer may immediately employ remedial measures to protect the public safety. An emergency dam repair cash fund is provided under the CWCB construction fund per Section 37-87-122.5 (Supp. 2001).

With the passage of the National Dam Safety Program Act (NDSP), PL 104-303 and its subsequent funding, Colorado has applied for and received assistance grants each year since 1998. An additional grant was approved for 2002. These funds are being used to provide advanced training to the Dam Safety Branch personnel in the field of dam safety and risk analysis. Additional training is provided under the technical seminar provisions of the Act. The grant funds are also used to acquire emergency communication equipment, upgrade computers, and purchase engineering computer software programs and other equipment. Future grants may be available each year under the Act, subject to appropriations.

3.2 Approval of Plans and Specifications

During FY 01-02, the State Engineer's Office received plans for three new dams and 31 plans for alteration, modification, or enlargement. Twelve separate hydrology studies were also submitted for determination of the inflow design flood for spillway design. The estimated cost of construction for the submitted plans was \$49,131,041 and \$34,105 was collected for the examination and filing of the submitted plans.

Thirty-four sets of plans and specifications for construction and twelve hydrology studies were approved by the State Engineer during FY 01-02, as listed in Appendix C. In order to expedite the approval of repair plans for dams, the division dam safety engineers review plans and specifications and perform the construction inspections on selected projects. In addition, five third-party reviews of the plans and specifications were performed in FY 01-02. This enables the owners to repair or construct their dams sooner by shortening the review time. The State Engineer provides review and approval of plans and specifications performed by third parties.

Upon completion of construction, the owner's design engineer submits copies of the "AS-CONSTRUCTED" plans showing any changes made during construction. These plans are reviewed by the engineer who monitored the construction for completeness before being accepted for filing. The superseded plans are disposed and the "AS-CONSTRUCTED" plans serve as the public record as required by the statutes.

Section 37-87-114.5 of C.R.S. (2001 Supp.) exempts certain structures from the State Engineer's approval. These are structures not designed or operated for the purposes of storing water, mill tailing impoundments permitted under Article 32 or Article 33 of title 34 of C.R.S. (Minerals or Coal Mines), uranium mill tailing and liquid impoundment structures permitted under Article 11 of Title 25 of C.R.S., siltation structures permitted under Article 33 of Title 34 of C.R.S. (Coal Mines), and structures that only store water below the natural surface of the ground.

Owners of small dams that do not fall under the jurisdiction of the State Engineer are required to submit a Notice of Intent to Construct a Nonjurisdictional Water Impoundment Structure to the State Engineer prior to beginning construction under Section 37-87-125 of C.R.S. (2001 Supp.).

3.3 Safety Inspections and Construction Observations

The statutes specify that a dam safety inspection must include the review of previous inspection reports and drawings, site inspection of the dam, spillways, outlet facilities, seepage control and measurement system, and permanent monument or monitoring installations. The dam safety inspection also includes an evaluation of the adequacy of the spillway to pass the appropriate sized flood for the dams' size and hazard class, to make an evaluation of the dam's hazard classification and whether it has changed, and to assess the adequacy of the Emergency Preparedness Plan for the dam. The internal inspection of the outlet works and an evaluation of instrumentation has also been added to the workload as required by the regulations. The hydrologic evaluation of spillways on dams located above elevation 7,500 feet has been postponed, pending the completion of a study of extreme precipitation by the State Engineer and the CWCB as discussed in Section 4.1 of this report.

The findings of the dam safety inspection are documented in a report that rates the conditions observed of the several components of the dam and reservoir. The overall conditions are rated as satisfactory, conditionally satisfactory, or unsatisfactory (unsafe) for full storage and a recommendation is made for the safe storage level by the dam safety engineer. An order is prepared for the State Engineer's signature restricting storage in the reservoir until the deficiency is corrected. The report also identifies the several repair and maintenance items that the owner should take care of and any engineering and monitoring requirements that are deemed necessary to assure the safety of the dam. A copy of the Engineers Inspection Report is included in Appendix D.

Procedures have been implemented to begin reporting incidents and the findings of dam safety inspections where orders have been issued to make modifications for safety reasons. Incidents are reported to the Center for the Performance of Dams at Stanford University, in Palo Alto, California. This is a national program that has been developed by the Association of State Dam Safety Officials and the Federal Emergency Management Agency for the accumulation of data for the improvement of design and safety evaluations of dams nationwide. Dam incident reports were submitted for the dam incidents reported in the state during this fiscal year.

Orders to repair or maintain the dam usually require the re-inspection of the dam in order to verify that the work has been done in an acceptable manner. Re-inspections also occur to assure follow-up of the State Engineer's orders or as requested by the owner. If the dam safety inspection finds that the overall conditions are unsafe, an order is written by the State Engineer restricting the storage of the reservoir to a safe level. Restriction letters are accompanied by orders to rehabilitate the dam to make it safe for full storage or to breach the dam. In the event the owner fails to comply with an order to make the dam safe, a breach order is issued to remove the hazard created by the dam and reservoir. If the findings are conditionally satisfactory, full storage is recommended contingent on appropriate monitoring being provided by the owner.

Construction inspections are important to assure that the approved plans are being followed and to assure changed conditions during construction does not jeopardize the safety of the design. The site visits are preceded by a review of the file and history of performance, coordination with the owner, division staff, and other interested parties so they may take part in the inspection.

The dam safety engineers collectively conduct about 600 to 800 dam safety and construction inspections each year. Jurisdictional dams identified for inspection in accordance with the policies of the State Engineer are assigned to the dam safety engineers in each division. The number of

inspections to be performed is related to the number of dams in each division and their hazard class. Included in these numbers is the annual inspection of all Class 1, one-half of the Class 2, and about one-sixth of the Class 3 dams. Inspection of federal dams for nonroutine inspections is integrated with these schedules. Subsequent follow-up and problem solving meetings with dam owners result in additional inspections each year.

In order to track potential problems that could develop at Class 3 dams, the dam safety engineers assign dams to be observed by the division's water commissioners and they file an observation report. The report is reviewed and then furnished to the owner for their information and to implement any recommendations for repair and maintenance. A copy of the Water Commissioner Dam Observation Report form is included in Appendix E.

During FY 01-02, a total of approximately 639 safety inspections and approximately 128 construction inspections were conducted for a total of 767 inspections. In addition, approximately 158 follow-up inspections were made. The safety inspections included 213 Class 1 (High hazard), 189 Class 2 (Significant hazard), 223 Class 3 (Low hazard), and 5 Class 4 (No hazard) dams. More dam inspections were performed in FY 01-02 than in FY 00-01. For inspections of federally-owned and FERC-regulated dams that the State Engineer's Office does not participate in, the reports prepared by the federal agencies are received and reviewed.

3.4 Staff Training

A critical element in the Dam Safety Program is the continued training of our personnel to maintain a high level of technical competency, to keep up with changing technology, to develop additional management and communication skills, and to keep abreast of changes in the development of dam safety programs across the country. The following training opportunities were achieved this fiscal year:

1. ASDSO Annual Conference, Dam Safety 2001, Salt Lake City (attended by four dam safety engineers and one design review engineer);
2. ASDSO Regional Technical Seminar, Earthquake Engineering for Small Dams (attended by one dam safety engineer);
3. ASDSO Technical Seminar, Plant and Animal Penetrations of Embankment Dams, Salt Lake City (attended by one dam safety engineer and one design review engineer);
4. Federal Emergency Management Agency, Responding to Dam Safety Emergencies, Emmitsburg, MD (attended by the Deputy State Engineer);
5. HEC-RAS Hydrology modeling seminar by Dr. Arthur Miller, Penn State University, Denver (attended by seven dam safety engineers and one design review engineer);
6. U.S. Society on Dams Annual Meeting, The Future of Dams and Their Reservoirs, Denver (attended by one dam safety engineer and one design review engineer);
7. Federal Emergency Management Agency, HEC-HMS software training, Emmitsburg, MD (attended by one dam safety engineer);

8. Slope stability and seepage software training, GEO-SLOPE International, Calgary, Alberta, Canada (attended by one design review engineer); and
9. Embankment dam presentation by Dr. Ralph Peck, Denver (attended by one dam safety engineer).

3.5 Emergency Preparedness Plans

Emergency preparedness for incidents at dams that jeopardize the public safety, including the failure of dams, has become an integral part of dam safety programs across the nation. All the federal dam owning/regulating agencies and most states require that plans be formulated in order to detect incidents at dams, give adequate warning, and maintain preparedness for the eventual failure or misoperation of dams. Colorado has been actively involved in this area since 1981, ultimately requiring that Emergency Preparedness Plans (EPP) be prepared for High and Significant Hazard dams as part of the regulations for dam safety adopted in September 1988. Although all high hazard dams have such a plan, much work is still needed to update, maintain, and exercise the plans annually. Approximately 111 EPP's were reviewed during the fiscal year.

Approximately 98 percent of the significant hazard dams have plans on file. The owners of significant hazard dams that do not have a plan have been notified of the requirement to prepare them. The dam safety engineers in the Divisions continue to assist dam owners in the preparation of their EPP's. In some cases, we have prepared the plans for the owners. This will continue to be enforced during the following year of inspections. We also participate in a variety of emergency exercises in coordination with federal, state, and local emergency managers.

3.6 Security Issues

Awareness of security issues surrounding the nation's infrastructure has increased following the events of September 11, 2001. Dams are an integral part of the nation's, and this state's, critical infrastructure. Through training and correspondence with others practicing in dam safety, personnel from the Dam Safety Branch have gained an understanding of the need to have security assessments performed for critical dams in the state. The division's personnel have emphasized to owners of dams the importance of performing these security assessments for their structures. As a minimum, these assessments should include a thorough evaluation of the potential threats, consequences, vulnerability, and responses associated with their structures. The performance of security assessments and continued security updates by owners of dams will continue to be emphasized by the Dam Safety Branch.

3.7 Dam Safety Management System

The dams database (DAMS), formerly maintained using dBASE IV, has been updated and upgraded this fiscal year to MS Access. While the main database is kept on a computer server in Denver, the dam safety engineers can access and update the data for their divisions through modem connections. The Dam Safety Branch's capability to maintain the database and analyze dams was enhanced by the receipt of computer hardware and software for the Denver office and the division offices under the auspices of the national Dam Safety Program Assistance grants. The addition of e-mail and Internet services has improved our ability to maintain and share our database materially. This system is used

to update the National Inventory of Dams (NATDAM or NID) periodically when requested by the US Army Corps of Engineers.

3.8 Publications/Internet

As a service to dam owners, the Dam Safety Branch makes available, at no cost, a brochure on the construction and operation of dams in Colorado. It contains general information on requirements for approval of plans, water rights, financing, liability, insurance, Emergency Preparedness Plans, statutes, publications, and Division Engineer and Water Court addresses. A "Dam Safety Manual" is also available at a reasonable cost that instructs dam owners on the safety inspections of their dams. Guidelines for preparing EPP's and a Project Review Guide for submitting plans for approval are provided at no cost.

In addition, the Regulations, Project Review Guide, application forms, sample plans, Livestock and Erosion Control Dam Permits, and Notice to Construct a Nonjurisdictional Impoundment Structure are available on the Dam Safety Web page at <http://water.state.co.us/damsafety/dams.asp>.

3.9 Risk-Based Approach

Colorado has relied on an inspection/standards based program for over 20 years to assure the safety of dams in the state. While inspection activities are necessary and provide a basis for dam inventories, evaluation of hazard classifications, and site conditions at dams, too many serious incidents and even failures of dams in Colorado are still occurring. After attending an ASDSO workshop in 1999 on risk assessment, dam safety engineers decided to explore ways to include risk assessment in the Dam Safety Program as a tool for identifying potential failure modes at existing dam and to focus resources at the dams having the greatest risk of failure and significant consequences.

A pilot project was implemented to train staff and evaluate Failure Modes and Consequence Evaluations (FMCE). Simultaneously, an evaluation began of the U. S. Bureau of Reclamation's Risk Based Profiling System (RBPS). It is an indexing method for ranking dams in accordance with weighted failure modes and consequences. RBPS could be used to create a list of dams to do a more detailed FMCE.

A subset of risk analysis, FMCE, is simplified by qualitatively, rather than quantitatively, estimating the likelihood of adverse consequences from loads on dams (static, hydrologic, and seismic). It includes a comprehensive review of the engineering data, operation, performance history, and record of design construction, as well as information related to the consequences of failure and planned emergency procedures, by a team of experts in dam safety. The teams use an "expert elicitation" process to develop an understanding of the most significant failure modes, consequences, and any risk reductions that can be implemented with respect to a dam. One session was conducted in 2000 and four have been conducted for this fiscal year. The 2000 and 2001 sessions have proven to be very successful and the process shows promise for further implementation in the program.

A review of the RBPS was performed on a number of dams to evaluate the effectiveness of the procedure. In fact, several of the dam safety engineers have ranked many of the dams in their geographic area using this tool. The RBPS results provide a relative ranking of dams that should receive more attention, and in some cases, less attention, in the program. As discussed in Section 4.2

below, based on initial reviews, an agreement was executed with the Bureau of Reclamation for adapting this system for the state. An Intergovernmental Agreement with the Bureau of Reclamation was issued to revise their RBPS based on program needs.

3.10 IPA

The Dam Safety Branch Chief for 20 years, Mr. Alan Pearson, retired in May 2002. However, due to the current funding status and budgetary limitations, it has not been possible to fill this critical leadership position. Therefore, other funding options were explored to fill this position on a temporary basis. Through some unique resources and abilities, the Deputy State Engineer was able to investigate, request, and obtain approval for an Intergovernmental Personnel Act (IPA) agreement with the Department of the Interior, Bureau of Reclamation, for an individual to provide technical leadership necessary to serve as the Branch Chief. The IPA agreement is valid for up to two years, at the state's discretion, and the Bureau of Reclamation will fund 100 percent of the employee's salary and benefits. The Bureau of Reclamation employee will provide knowledge of the Bureau of Reclamation's efforts to implement risk-based dam safety decision-making processes as attempts are made to implement such processes in the Dam Safety Program.

A highly qualified individual, Mr. Douglas Boyer, was selected in mid-October 2002 and began serving as Branch Chief on November 3, 2002. Mr. Boyer has over 17 years of experience in the investigation, evaluation, analysis, design, and construction of embankment and concrete dams. He has an undergraduate degree in geology and a graduate degree in civil engineering. He has been the principal investigator and/or designer for a number of embankment and concrete dams, including the 275-foot-high Ridges Basin Dam, currently under construction in Colorado. Mr. Boyer has authored or co-authored more than 15 technical papers and has been an invited speaker at university classes, dam safety training courses, and international seminars.

4.0 SPECIAL STUDIES

4.1 Extreme Precipitation Study

The State Engineer and the Colorado Water Conservation Board (CWCB) continued the process during the period to study extreme precipitation in the mountainous areas of Colorado. A volunteer committee of meteorologists, hydrologists, engineers, federal and state agencies, and private entities assisted in the preparation of the technical portions of the request for proposal. The Department of Atmospheric Science at CSU was selected to develop a new method of estimating extreme precipitation and to develop concepts of how extreme precipitation varies with elevation in Colorado.

A technical review group is assisting the Dam Safety Branch in reviewing the progress of the research. The members of the group are Mr. Jimmy Dudhia, National Center for Atmospheric Research; Mr. Louis Schreiner and Mr. David Mathews, U.S. Bureau of Reclamation; and Mr. Stephen Spann, consultant. The results of this new study should provide a more accurate portrayal of the maximum estimated precipitation in the mountainous areas and should save millions of dollars in the construction of spillways for dams.

The draft final report was submitted on July 29, 2002. The technical review group will be meeting in early 2003 to discuss the conclusions and recommendations of the report.

4.2 Risk Based Profiling System

The Dam Safety Branch continued their efforts in using risk-based tools to help evaluate and rank the jurisdictional dams in Colorado in order to more efficiently and effectively use program resources. One tool that has shown promise is the Risk Based Profiling System (RBPS) as developed by the Bureau of Reclamation. The Bureau of Reclamation has been using this tool for a number of years for similar purposes with much success. Based on understanding of the system and initial reviews, an agreement was executed with the Bureau of Reclamation for adapting this system for the state. An Intergovernmental Agreement with the Bureau of Reclamation was issued to revise their RBPS based on program needs. It is the Branch's goal that, by the end of the next fiscal year, a modified RBPS is in place that is fully functional and effective at focusing resources where they are most needed.

5.0 COORDINATION WITH NATIONAL DAM SAFETY PROGRAMS

5.1 Association of State Dam Safety Officials

All of the dam safety engineers in the Dam Safety Branch are members of the Association of State Dam Safety Officials (ASDSO) and actively participate in its programs, presenting papers and serving on task groups and committees. The purpose of ASDSO is to provide a forum for the exchange of ideas and experiences on dam safety issues, foster interstate cooperation, provide information and assistance to dam safety programs, provide representation of state interests before Congress and federal agencies for dam safety, and to improve the efficiency and effectiveness of state dam safety programs. Mr. Jack Byers, Deputy State Engineer, is the state's representative to the ASDSO.

5.2 Federal Dam Safety Programs

5.2.1 General - Routine inspections of federal dams by Dam Safety Engineers have been curtailed in accordance with a legislative audit recommendation. The Branch, however, will participate in the evaluation of the safety of some federal dams for special issues and performance problem evaluations, in accordance with the procedure for obtaining approval to participate in these inspections. Less than about 80 hours were spent this fiscal year participating in these safety inspections at a cost of less than \$3,600.

5.2.2 Memoranda of Understanding - Memorandums of Understanding (MOU) have been executed with the U.S. Bureau of Reclamation, the U.S. Bureau of Land Management, and the Air Force Academy (AFA) relating to dam safety activities in Colorado. They provide for the exchange of safety related information of dams under each agency's jurisdiction. A MOU is also being updated with the U.S. Forest Service, Rocky Mountain Region, to provide coordination of mutual responsibilities for dam safety and their Travel Management Plan for the National Forests. This is necessary to provide access to private dams located within the forests. MOU's are being pursued with the other federal agencies such as the U.S. Army Corps of Engineers and the Federal Energy Regulatory Commission to assure that the dams under their jurisdiction are being maintained in a safe condition and to coordinate activities and exchange of information and data.

5.2.3 Federal Energy Regulatory Commission - The Branch makes safety inspections of dams that are also regulated by the Federal Energy Regulatory Commission (FERC). In accordance with an agreement with them, they notify the Dam Safety Branch of their schedules and invite the Branch to participate in their inspections. They also furnish copies of their reports for Branch records. The FERC is notified of any safety problems that have been identified based on safety inspections, when requested by them. The Branch has curtailed participation in FERC regulated dams in accordance with the audit, but in accordance with the procedures for approval, spent about 12 hours on inspections to evaluate specific performance or maintenance issues, at a cost of less than about \$540.

6.0 FISCAL RESPONSIBILITY

6.1 Use of Appropriated Funds

Dam safety personal service expenditures for the fiscal year 2001-02 were \$1,047,398. Total operating and travel expenditures were approximately \$54,192.

6.2 Receipt of Funds Generated by Filing Fees

Fees collected by the State Engineer and deposited in the General Fund for dam safety amounted to \$34,105.22 for filing plans and specifications during the period.

7.0 ENFORCEMENT ORDERS AND PROCEEDINGS

No enforcement orders on dam safety were issued during the period.

8.0 LEGISLATION

No legislation affecting dam safety was enacted during the period.

9.0 SUMMARY OF FY 02-03 PROGRAM GOALS

In addition to yearly program goals of inspections and design reviews, the following are additional program goals for FY 02-03:

1. Develop procedures for conducting independent third party reviews of plans and specifications for dam construction.
2. Review and provide comments to CSU on the extreme precipitation study.
3. Fully implement the modified Risk Based Profiling System.
4. Review and update current policy documents.
5. Review current rules and regulations.
6. Update the long range Dam Safety Plan.
7. Improve coordination and communication of personnel within the program and Division Offices.

TABLE 1 - DISTRIBUTION OF DAMS BY IRRIGATION DIVISION/CLASS

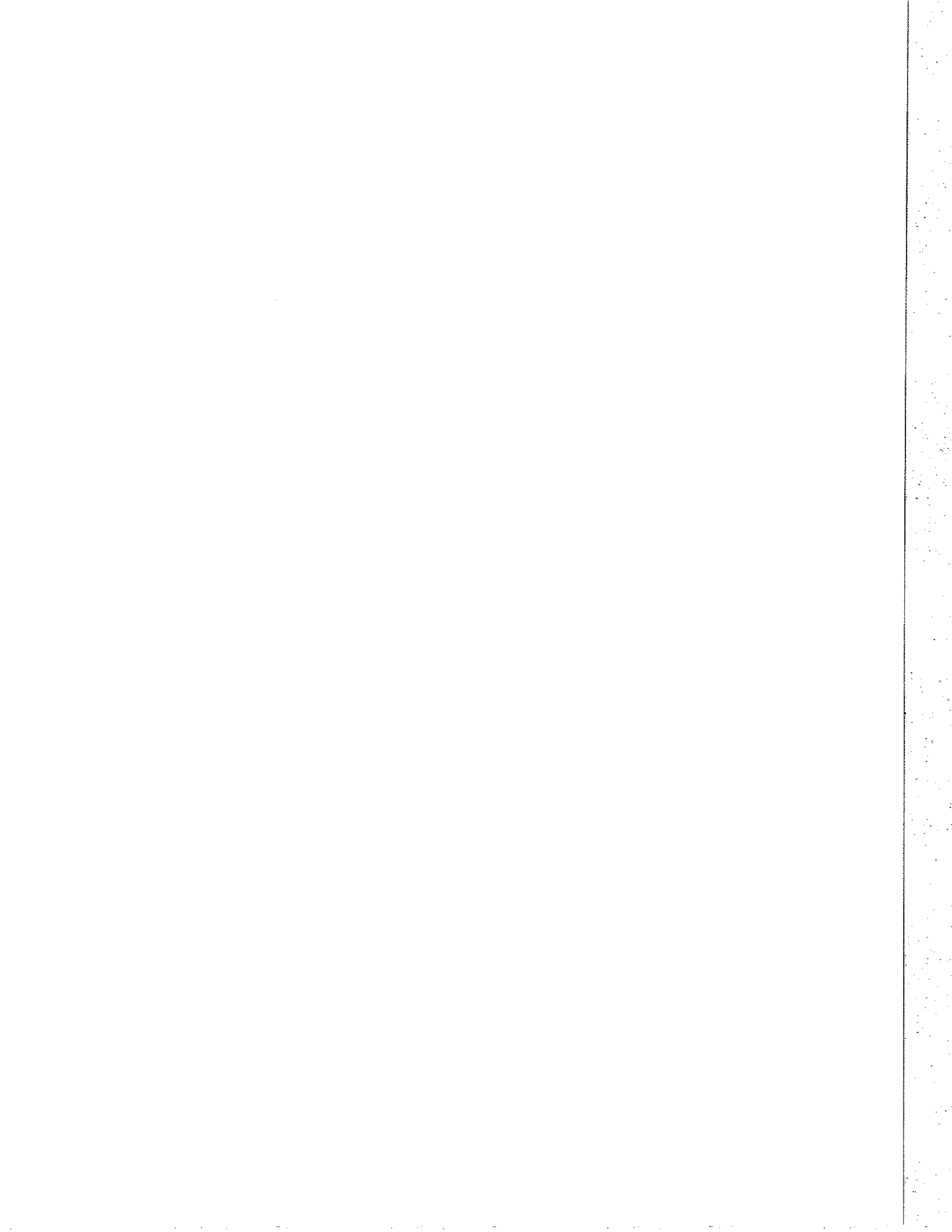
HAZARD	DIVISION	NONFEDERAL	FEDERAL	TOTAL
Class 1	1	136	14	150
Class 2	1	123	8	131
Class 3	1	430	12	442
Class 4	1	36	9	45
Class 1	2	41	6	47
Class 2	2	49	3	52
Class 3	2	98	11	109
Class 4	2	101	4	105
Class 1	3	9	1	10
Class 2	3	13	0	13
Class 3	3	26	4	30
Class 4	3	19	0	19
Class 1	4	31	10	41
Class 2	4	37	0	37
Class 3	4	147	6	153
Class 4	4	5	3	8
Class 1	5	33	7	40
Class 2	5	43	1	44
Class 3	5	117	9	126
Class 4	5	17	0	17
Class 1	6	13	0	13
Class 2	6	13	1	14
Class 3	6	107	9	116
Class 4	6	11	0	11
Class 1	7	13	4	17
Class 2	7	18	1	19
Class 3	7	44	1	45
Class 4	7	7	0	7
TOTALS		1737	124	1861

Class 1 - Loss of human life is expected in the event of failure of the dam, while the reservoir is at the high water line.

Class 2 - Significant damage to improved property is expected in the event of failure of the dam while the reservoir is at the high water line, but no loss of life is expected.

Class 3 - Loss of human life is not expected, and damage to improved property is expected to be small in the event of failure of the dam while the reservoir is at the high water line.

Class 4 - Loss of human life is not expected, and damage will only occur to the dam owner's property in the event of failure of the dam while the reservoir is at the high water line.

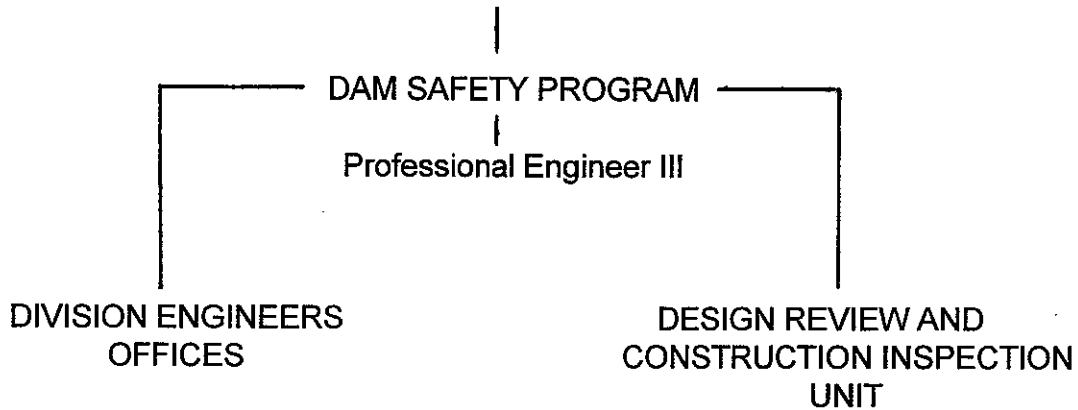


APPENDIX A
DAM SAFETY BRANCH ORGANIZATION
AND PERSONNEL

APPENDIX A

DAM SAFETY BRANCH

**ASSISTANT STATE ENGINEER
ENGINEERING, TECHNOLOGY, AND INVESTIGATIONS**



**DIVISION 1
4 - Professional Engineer II**

**DIVISION 2
2 - Professional Engineer II**

**DIVISION 3-7
Professional Engineer II**

**DIVISION 4
Professional Engineer II**

**DIVISION 5
Professional Engineer II**

**DIVISION 6
Professional Engineer II**

1 - Professional Engineer II

DAM SAFETY BRANCH PERSONNEL

NAME	TITLE	RESPONSIBILITY
<u>Denver Office</u>		
Alan Pearson ¹	Professional Engineer III	Chief, Dam Safety Branch
Mark Haynes	Professional Engineer II	Design Review/Construction Inspect.
<u>Division Offices</u>		
Michael Cola	Professional Engineer II	Dam Safety Engineer, Division 1
James Dubler	Professional Engineer II	Dam Safety Engineer, Division 1
Gregory Hammer	Professional Engineer II	Dam Safety Engineer, Division 1
Dennis Miller	Professional Engineer II	Dam Safety Engineer, Division 1
Michael Graber	Professional Engineer II	Dam Safety Engineer, Division 2
Garrett Jackson	Professional Engineer II	Dam Safety Engineer, Division 2 ²
Brett Nordby	Professional Engineer II	Dam Safety Engineer, Division 3/7
James Norfleet	Professional Engineer II	Dam Safety Engineer, Division 4
John Blair	Professional Engineer II	Dam Safety Engineer, Division 5
Vacant ¹	Professional Engineer II	Dam Safety Engineer, Division 6

Notes:

¹Retired during fiscal year, position not filled by the end of the fiscal year

²One-half time Dam Safety Engineer, one-half time Design Review Engineer

APPENDIX B
RESERVOIR RESTRICTION LIST

STATE OF COLORADO --- DAM SAFETY BRANCH
LISTING OF DAMS UNDER STORAGE RESTRICTION ORDERS

FOR 1

DAMID	Haz. Class	Dam Name	Restricted Reservoir Level	Reason for Restriction	Gage Ht.	Action Date	Act. Type	Volume
010104	3	ADAMS & BUNKER #3	6.0 CREST	INADEQUATE FREEBOARD, SEEPAGE	0	5/22/1975	C	150
010115	2	BIJOU #2 DAM #1	GH 16 FT.	SCARPING OF U/S FACE, NO EMER SPWY, SEEPAGE	16	6/1/1993	C	1700
010132	3	J.B. COOKE	3.0 CREST	FREEBOARD	0	5/6/1998	R	0
010138	3	DOVER	10.0 FT. CREST	POOR CONDITION	29	6/27/1996	I	60
010210	1	EMPIRE (OUTLET EMBANKMENT)	GH 29 FT.	ABSENCE OF SPILLWAY	0	3/7/1985	R	2779
010419	3	D.A. LORD #4	2.0 SPILLWAY	INADEQUATE SPILLWAY	0	9/19/1980	C	400
010505	2	PROSPECT	GH 35.5.	QUESTIONABLE SLOPE STABILITY	35.5	8/31/1988	C	600
010506	1	RIVERSIDE	GH 33.55 FT.	PREVENT OVERFILLING OF RESERVOIR	33.5	5/9/1984	I	2500
010611	3	BRAMKAMP	9.0 CREST	SCARPING/EROSION OF U/S SLOPE	0	12/5/1990	I	320
010612	3	NO NAME 1-1 #1	10 FT. CREST	SCOUR OF D/S SLOPE DUE TO FAILURE OF OUTLET	0	11/2/2000	I	100
010709	3	JOLLY JOHN	NO STORAGE	SCOUR HOLE FROM OUTLET	0	10/27/2000	I	297
010716	3	HOWARDS LAKE	3.0 FT. SPILLWAY	EROSION OF DAM AND CREST	0	6/3/1998	I	50
020109	3	BRIGHT VIEW #1	7.0 CREST	INOP. OUTLET, INADEQUATE FREEBOARD	0	9/30/1985	I	17
020113	3	CARLIN	5.0 CREST	NO SPILLWAY	0	7/29/1986	C	0
020115	3	LOWER CHURCH LAKE	3.0 FT CREST	INADEQUATE SPILLWAY	0	6/22/1999	I	0
020119	3	COLE	NO STORAGE	POOR CONDITION	0	6/30/1994	I	95
020123	2	EAST LAKE #1	NO STORAGE	INADEQUATE SPILLWAY, POOR CONDITION	0	3/19/1992	I	125
020125	2	EAST LAKE #2	NO STORAGE	POOR CONDITION	0	3/19/1992	I	198
020314	3	NORTH STAR	3.0 CREST		0	10/17/1991	I	30
020322	2	SIGNAL #1	5.0 CREST	CONCENTRATED SPG AREAS&QUESTIONABLE COND OF OUTLET	0	6/21/1993	R	60
020325	1	SMITH IRRIGATION	NO STORAGE	PREVENT STORAGE	0	9/21/2000	I	264
020327	2	RANKIN RESERVOIR	NO STORAGE	POOR CONDITION	0	7/12/1995	I	44
020333	3	THOMPSON	5.0 CREST	INADEQUATE FREEBOARD, GENERALLY POOR CONDITION	0	10/7/1987	R	30
020411	2	NISSEN #2	1.75 SPILLWAY	LACK OF FREEBOARD	0	9/11/1995	I	50
020606	3	MOWER	3 Feet below Lowest Point of Dam Crest	Inadequate Spillway and Freeboard	0	5/22/2002	I	8
020615	3	HAVANA STREET DAM	NO STORAGE	NO SPILLWAY	0	6/17/1987	C	0
020634	3	VOGEL POND	3.0 FT. CREST	NO SPILLWAY	0	11/4/1996	I	0
030107	1	BLACK HOLLOW	4.2 FT. SPILLWAY	INADEQUATE SPILLWAY	31	10/22/1997	I	999
030108	3	BOX ELDER #2	3.0 FT. SPILLWAY	EXCESSIVE SEEPAGE	6.5	8/8/1989	I	49
030122	2	CURTIS LAKE	GH 10 FT.	CREST, SLOPE, EXT. SEEP. AREA BELOW D/S TOE	10	7/2/1985	I	397
030128	3	DRY CREEK	GH 11.5 FT.	OUTLET DETERIORATION, SEEPAGE, INAD SW SINKHOLES	11.5	1/17/1996	R	150
030131	1	ELDER	2.0 FT. SPILLWAY		0	4/26/1999	I	500
030138	2	GRAY #3	NO STORAGE	SINKHOLE OVER OUTLET	0	5/27/1997	I	100
030214	3	LAW, JOHN	3.0 CREST	INADEQUATE SPILLWAY AND FREEBOARD	11	6/22/1987	C	45
030220	3	MATTINGLY	2.0 FT. SPILLWAY	EROSION/3-5 FT. SCARP ON U/S FACE	0	10/23/1997	I	99
030225	3	MOUNTAIN SUPPLY #1	10 FT. CREST	POOR CONDITION	5	11/5/1997	I	500

STATE OF COLORADO --- DAM SAFETY BRANCH
LISTING OF DAMS UNDER STORAGE RESTRICTION ORDERS

FOR 1

DAMID	Haz. Class	Dam Name	Restricted Reservoir Level	Reason for Restriction	Gage Ht.	Action Date	Act. Type	Volume
030226	3	MOUNTAIN SUPPLY # 2	10 FT. CREST	POOR CONDITION	5	11/5/1997	I	300
030227	3	MOUNTAIN SUPPLY # 6	3.0 CREST	NO SPILLWAY	0	10/19/2000	C	120
030229	3	MOUNTAIN SUPPLY # 8	NO STORAGE	POOR CONDITION	0	10/3/1978	I	643
030236	2	NORTH POUDDRE # 1	7.0 CREST	SEEP @ HIGHER STGE. LEVELS/COND. OF UP SLOPE	9	10/17/1988	R	365
030301	2	NORTH POUDDRE # 4	GH 17 FT.	POOR U/S FACE, GENERAL CONDITION	17	4/17/1984	R	562
030509	3	GEIST	5.0 CREST	INADEQUATE SPILLWAY	6.7	6/18/1998	C	58
030512	3	RIST CANYON	3.0 CREST	SEEPAGE, INADEQUATE SPILLWAY	0	4/19/1983	I	33
040123	2	FAIRPORT	6.0 SPILLWAY	POOR CONDITION	8	6/22/1987	R	30
040211	2	RYAN GULCH		INADEQUATE SPILLWAY, LEAKAGE	27.6	2/12/1997	R	40
040213	2	SOUTH SIDE	8.0 CREST	DAM UNSAFE FOR ORIG. STOR. AMT.	8	7/7/1978	I	105
040237	3	WESTERDOLL LAKE	8.5 CREST	POOR CONDITION	0	3/30/1992	I	9
045234	3	IDE AND STARBIRD #1	3.0 CREST	POOR MN. ERODED U/S FACE, QUES. SPILLWAY	0	7/3/1985	I	0
050101	2	AKERS & TARR	7.0 CREST OCT. 1 - APRIL 1	SLIDE ON D/S SLOPE, SPGE. IN AREA OF ABAND OTL	0	3/23/1989	R	34
050132	3	HIGHLAND	3.0 BELOW TOP OF CONCRETE WALL AT OUTLET	NO SPILLWAY	0	11/26/1990	R	0
050206	3	KNOTH	NO STORAGE	NEVER COMPLETED DAM	0	12/24/1985	I	204
050212	3	LITTLE GEM	10.0 CREST	EROSION ON U/S SLOPE & CRST. TREES ON U/S SLOPE	0	10/11/1985	I	60
050230	2	OLIGARCHY #1	restricted to gage height 26.0	point source seep from rodent hole	26	5/20/1989	I	200
050301	3	STEELE BROTHERS #1	4.0 SPILLWAY	SAT. EMBKMT.;INOP. O'S.;INAD. FBD.;SPWY.REPAIR	0	12/1/1987	I	34
050302	3	STEELE BROTHERS #2	3.0 SPILLWAY	TOTAL REHABILITATION REQUIRED	0	11/23/1987	I	14
050304	3	SWEDE	5.0 CREST	EMBANKMENT SEEPAGE & INADEQUATE FREEBOARD	0	11/14/1986	I	75
050308	2	UNION	GH 28.0	spillway design based on GH=28.0	28	12/6/1977	C	0
060115	2	ERIE	3.0 CREST	INSUFFICIENT FREEBOARD	12	6/2/1986	I	29
060122	4	GREEN LAKE NO. 1	3.0 CREST	SEEPAGE, NO SPILLWAY	0	10/12/1984	I	30
060124	4	GREEN LAKE NO. 3	3.0 CREST	LEAKS, INADEQUATE SPILLWAY FREEBOARD	0	10/8/1984	I	60
060202	3	MCKAY LAKE - EAST DAM	GH 11 FT.	INAD. FREEBOARD, SEEPAGE	11	9/1/1995	I	90
060204	3	MESA	NO STORAGE	POOR COND	4	6/28/2000	I	100
060208	3	PRINCE NO. 1	7.25 CREST	LEAKAGE	4	7/7/1994	I	32
060212	3	SECTION 19	4.0 CREST	NO SPILLWAY	0	7/24/1984	I	10
060306	3	VARSITY POND	1 FT. SPILLWAY	SEEPAGE/SPILLWAY	0	8/31/1999	I	1
060314	3	HODGSON-HARRIS	6.0 CREST	POOR CONDITION	0	11/14/1995	I	60
060323	3	PETERSON LAKE	3.0 FT. CREST	INSUFFICIENT FREEBOARD	0	10/4/2001	I	1
070111	1	IDAHO SPRINGS	8.0 CREST	SEEPAGE, SETTLEMENT & REPAIRS REQD. ON SPWY.	22	2/27/2002	R	19
070113	3	LOWER CHINNS		SINKHOLES	110	11/24/1999	I	60
070126	2	DEWEY NO. 1	3.0 CREST(NW)	POOR CONDITION	0	11/19/1990	I	15
070201	1	KALCEVIC	11.0 CREST	ERODED UPSTREAM SLOPE	0	2/10/1983	I	43

STATE OF COLORADO --- DAM SAFETY BRANCH
LISTING OF DAMS UNDER STORAGE RESTRICTION ORDERS

FOR 1

DAMID	Haz. Class	Dam Name	Restricted Reservoir Level	Reason for Restriction	Gage Ht.	Action Date	Act. Type	Volume
070202	3	KELLY	3.0 CREST	NO SPILLWAY, SEEPAGE	0	12/5/1986	I	30
075311	1	SMITH	1.0 SPILLWAY	NO SPILLWAY, SEEPAGE	0	1/26/2000	R	100
080101	3	ALLIS	15.0 CREST	SLOUGHING, SEEPAGE	0	8/25/1992	R	50
080105	3	BAIRD #1	7.0 CREST	SEVERE BEAVER ACTIVITY, PLUGGED OUTLET	0	1/8/1990	I	25
080110	4	CANTRILL	NO STORAGE	NO SPILLWAY, INOPERABLE OUTLET	0	10/22/1987	I	37
080218	3	LAMBERT	8.0 CREST	COMPLETELY REHABILITATE THE DAM	0	7/9/1984	I	50
080306	3	WAKEMAN	NO STORAGE	SPILLWAY EROSION	0	10/17/1994	I	110
080321	4	QUICK	NO STORAGE	NO SPILLWAY, INOPERABLE OUTLET	0	10/22/1987	I	64
080327	1	SKEEL	2.0 FT. SPILLWAY	POOR CONDITION	0	4/2/1997	R	10
080422	3	RAINBOW FALLS #5	9.0 CREST	INADEQUATE SPILLWAY	0	9/11/1985	I	25
080424	3	GERLITS	NO STORAGE	DAM PARTIALLY BREACHED DUE TO OVERTOPPING.	0	11/13/1984	I	10
090115	2	HARRIMAN	GH 19 FT.	EXCESSIVE SEEPAGE	19	11/12/1992	R	300
090138	4	HAYSTACK #1	NO STORAGE	SPILLWAY UNDERMINED	0	5/8/1987	I	3
090204	1	WILLOW SPRINGS #1	1.0 SPILLWAY	EROSION OF US FACE	13.5	9/14/2000	R	10
095223	2	KENDRICK	5.0 CREST	NO SPILLWAY	0	1/8/1999	I	0
230102	1	ANTERO	GH 18 FT.	STAB. BERM CONST. & NEW INSTR. MONITORING	18	2/4/1986	R	5100
230208	1	TARRYALL	5 FEET SPILLWAY	CRACK IN DAM	0	7/25/2001	I	500
230308	3	MOUNTAIN	4.0 CREST	INSUFFICIENT FREEBOARD, SEEPAGE AT TOE	0	11/6/1985	I	3
230310	3	STOCKING POND	NO STORAGE	INADEQUATE SPILLWAY	0	6/13/1988	I	10
230311	3	SUN	5.0 CREST	SEEPAGE-RESTRICT 0.8' BELOW CREST	0	12/31/1984	R	6
230312	3	WIND	5.5 CREST	SATURATED D/S SLOPE	0	9/20/1985	C	3
480101	3	JOHNSON	4.0 CREST(3.0 CREST IRR. SEASON)	EROS. ON U/S FACE, IMPROPER FB., SEEP/D/S TOE	0	7/18/1984	C	68
640104	1	JULESBURG #4	GH 24 FT. FOR 90 DAYS, THEN GH 23 FT.	CONDITION OF OUTLET, EXCESSIVE SEEPAGE	24	5/2/1995	R	6964
640108	1	PREWITT	GH 26.5 FT.	NO SPWY & EXCESSIVE SEEPAGE	26.5	8/23/1990	I	2531
650121	3	DUCK	4.0 SPILLWAY	NARROW CREST, STEEP SLOPES	0	3/23/1987	I	15
650123	3	HANSHAW	5.0 CREST	SEEPAGE, SLIDE	0	7/7/1987	I	20

VOLUME OF STORAGE WATER LOST DUE TO RESTRICTION FOR DIVISION 1 32196 AF

TOTAL NUMBER OF DAMS AFFECTED: 97 DAMS

STATE OF COLORADO --- DAM SAFETY BRANCH
LISTING OF DAMS UNDER STORAGE RESTRICTION ORDERS

FOR 2

DAMID	Haz. Class	Dam Name	Restricted Reservoir Level	Reason for Restriction	Gage Ht.	Action Date	Act. Type	Volume
100123	3	A. MC CRAY	5.0 FT SPILLWAY	INSTABILITY	0	4/13/1988	I	10
100128	1	FOUNTAIN VALLEY NO 2	1.5 FEET SPILLWAY	HYDROLOGIC INADEQUATE SPILLWAY	0	6/11/2001	I	345
100131	3	GARDEN OF THE GODS GOLF COURSE	3.0 CREST	NO SPILLWAY	0	5/31/1988	I	0
100205	3	KEETON LAKE	10.0 FT. SPILLWAY	EROSION OF SPILLWAY, LEAKAGE, PIPING	0	8/8/1997	I	10
100214	2	MONUMENT LAKE	3.0 SPILLWAY	UNSAT. SPILLWAY CONDITION	0	3/22/2001	C	150
100215	N	MODERN WOODMEN OF AMER. #2	NO STORAGE	INADEQUATE SPILLWAY, POOR REPAIR	0	8/12/1983	R	85
100235	2	PROSPECT LAKE	3.5 CREST	NO SPWY., OTLT OPERABILITY QUESTIONABLE	0	5/31/1988	I	0
100309	3	VALLEY NO. 1	15.0 CREST	INOPERABLE OUTLET & BLOCKED SPILLWAY	0	12/27/1984	I	50
100402	2	VALLEY NO. 2	NO STORAGE	INOPERABLE OUTLET, OBSTRUCTED SPILLWAY	0	9/21/2000	I	185
110106	3	EVANS GULCH	3.0 CREST	INSUFFICIENT FREEBOARD	0	2/2/1985	R	2
120136	3	PARK CENTER L & W #2	8.8 CREST	SLIDE ON DOWNSTREAM SLOPE	0	1/4/1989	R	11
120202	3	PARK CENTER L & W #10	GH 7 FT.	EXTENSIVE CRACKING ON THE CREST	7	10/2/1974	I	48
120218	2	VICTOR #2	8.0 CREST	EXTENSIVE CRACKING ALONG EMBANKMENT	23	6/11/1984	I	17
150116	3	OCCHIATO #1	10 FEET CREST	SLIDE	0	9/16/1999	I	3
160108	1	CUCHARAS #5	GH 100 FT.	POOR OVERALL CON. EMBKMT. HISTY. MVMNT.	100	7/21/1988	R	33000
160135	4	CLARK #1	8.0 CREST	ERODED UPSTREAM SLOPE	0	2/16/1994	R	80
160218	1	MARTIN LAKE	5.0 CREST	NO SPILLWAY	0	2/18/1983	I	1200
170118	3	CUDAHY #1	5.0 FT. BELOW DAM CREST	INADEQUATE FREEBOARD AND INOPERABLE OUTLET	0	7/15/1985	I	900
170217	3	SWINK #1	5.0 CREST	IN DISREPAIR, ABANDONED	0	4/24/1986	I	500
170218	3	SWINK #2	5.0 CREST	IN DISREPAIR, ABANDONED	0	4/24/1986	I	600
170219	3	SWINK #5	5.0 CREST	IN DISREPAIR, ABANDONED	0	4/24/1986	I	750
170220	3	SWINK #6	5.0 CREST	IN DISREPAIR, ABANDONED	0	4/24/1986	I	650
170222	3	TIMPAS #3	10.0 CREST	IN DISREPAIR, ABANDONED	0	4/21/1986	I	500
180206	2	APISHAPA	22.0 CREST	SPILLWAY, OUTLET SILTED IN	0	2/18/1994	I	260
180207	3	SEVEN LAKES	7.0 CREST	DILAPIDATED CONDITION OF DAM	0	5/6/1987	I	1200
190114	3	MODEL	3.0 FT SPILLWAY	POOR COND	0	6/28/2000	I	1000
670218	2	NEE-NOSHE	GH 20 FT.	SAND BOILS IN OUTLET CHANNEL	23.5	6/22/1999	R	6392
670236	1	TWO BUTTES	VOLUME OF STORAGE WATER LOST DUE TO RESTRICTION FOR DIVISION	HYDRAULICALLY INADEQUATE SPILLWAY	20	1/24/1983	I	31465
TOTAL NUMBER OF DAMS AFFECTED:								28 DAMS

STATE OF COLORADO --- DAM SAFETY BRANCH
 LISTING OF DAMS UNDER STORAGE RESTRICTION ORDERS

FOR 3

DAMID	Haz. Class	Dam Name	Restricted Reservoir Level	Reason for Restriction	Gage Ht.	Action Date	Act. Type	Volume
200110	1	CONTINENTAL	GH 64.5	LEAKAGE	64.5	8/1/1995	R	7679
210102	1	TERRACE	7.0 SPILLWAY	DETERIORATED SPILLWAY	117	7/18/1984	I	2000
VOLUME OF STORAGE WATER LOST DUE TO RESTRICTION FOR DIVISION				3	9679 AF		TOTAL NUMBER OF DAMS AFFECTED:	
							2 DAMS	

STATE OF COLORADO -- DAM SAFETY BRANCH
LISTING OF DAMS UNDER STORAGE RESTRICTION ORDERS

FOR 4

DAMID	Haz. Class	Dam Name	Restricted Reservoir Level	Reason for Restriction	Gage Ht.	Action Date	Act. Type	Volume
400103	3	ARCH SLOUGH	DAM WAS ABANDONED,BUT CAN STILL HOLD WATER	POOR CONDITION	0	12/12/1985	I	66
400112	2	BIG BATTLEMENT	GH 8 FT.	SINKHOLES ON EMBANKMENT	8	9/24/1991	R	750
400135	1	CEDAR MESA	10.0 FT. SPILLWAY	SEEPAGE	24.5	7/14/1999	I	380
400212	3	CYPHER #1	4.0 CREST	INADEQUATE FREEBOARD, OUTLET INOPERABLE	0	10/13/1988	I	10
400306	2	GRANBY #12	GH 17 FT.	D/S FACE SLIDE DUE TO SEEPAGE	17	10/15/1987	R	0
400307	2	GRANBY #5-11	5.0 SPILLWAY (PROVISIONAL DURING WINTER)	SEEPAGE	18	3/1/2001	R	500
400318	1	HOTEL LAKE	NO STORAGE	WEAKENED CONDITIONS!	0	1/14/2002	I	549
400330	3	KNOX	FULL STORAGE FROM 4/1 TO 8/15 IF MONITORED	EXCESSIVE SEEPAGE AT TOE AND ON	17	1/8/1988	R	0
400405	3	LONE STAR #1	30.0 CREST	CRACKS ON CREST, UNAPPROVED PLANS, POOR CONSTR	0	7/31/1996	R	0
400411	3	MILITARY PARK	10.0 SPILLWAY,	PIPING	10	9/7/2000	I	150
400413	2	MONUMENT	FILL/MONITORING PLAN IN PLACE	CRACKS ON DAM AND LEFT ABUTMENT SLIDE	33.5	4/29/1993	I	175
400434	3	PITCAIRNE #1	5.5 FT. SPILLWAY	BEAVER DENS ON US FACE	0	8/2/2000	I	50
400522	3	TODD	10.0 CREST	6' ELEVATION DIFF ALONG CREST WITH NO SPILLWAY	0	10/19/1984	I	112
400524	3	TRIO	8.0 SPILLWAY	SLIDE ON DOWNSTREAM SLOPE	14	1/11/1989	I	75
400601	3	HARRY WHITE #2	5.0 CREST	POOR OUTLET VALVE,LACK OF FREEBOARD,MAINTENANC	0	8/9/1991	I	30
400619	3	LONE STAR #2	10.0 CREST	CONSTRUCTION WITHOUT APPROVED PLANS & SPECS	0	6/2/1988	C	0
400705	3	WEBSTER #1	NO STORAGE	POORLY CONSTRUCTED	0	5/6/1987	C	15
400707	3	WEBSTER #3	NO STORAGE	POORLY CONSTRUCTED	0	5/6/1987	C	15
410201	3	COFFEY RESERVOIR	NO STORAGE	GENERAL POOR CONDITION CONST. WO/APP. PLANS	0	7/21/1988	C	90
410202	3	MOCK #1	9.0 CREST(AFTER 60 DAYS FULL)	BUILT WITHOUT APPROVED PLANS & SEEPAGE	0	4/26/1989	R	0
420116	2	FRUITA #1	20 FT. CREST	SLIDE ON DOWNSTREAM SLOPE	0	8/12/1998	I	100
420119	3	G.H. AND S. #2	NO STORAGE	NARROW CREST, STEEP SLOPES, POOR OUTLET	0	8/26/1992	R	29
420120	2	GRAND MESA #1	8 FT. SPILLWAY	OUTLET WORKS FAILURE	12	12/21/2000	I	300
420123	3	GRAND MESA #9	3.4 FT SPILLWAY	OUTLET WORKS PROBLEMS	8	12/21/2000	I	100
420135	3	REEDER	8.0 CREST	SEEP. ON D/S SURFACE NUMEROUS LARGE TREES	0	8/26/1985	R	96
590113	2	MERIDIAN LAKE PARK #1	2.0 SPILLWAY (PRIN SPWY LOWERED)	SEVERE EROSION OF THE EMERGENCY SPILLWAY	0	6/4/1987	I	10
600105	3	BLUE LAKE #1	5.0 FEET SPILLWAY	POOR CONDITION	0	11/21/2001	I	100
600117	3	NUCLA DOMESTIC	NO STORAGE	POOR CONDITION	0	11/21/2001	I	50
600118	3	PAXTON	2.5 SPILLWAY	SEEPAGE	0	8/8/1988	R	100
600126	3	CUSHMAN	6.0 CREST	OUTLET-INOP. SPWY-INAD. EMB. SEEPS	0	7/29/1975	I	36
600127	1	PRIEST	3.0 CREST	INSUFFICIENT FREEBOARD	0	9/16/1985	I	25

STATE OF COLORADO --- DAM SAFETY BRANCH
 LISTING OF DAMS UNDER STORAGE RESTRICTION ORDERS

FOR 4

DAMID	Haz. Dam Name Class	Restricted Reservoir Level	Reason for Restriction	Gage Ht.	Action Date	Act. Type	Volume
	VOLUME OF STORAGE WATER LOST DUE TO RESTRICTION FOR DIVISION	4	3913 AF			31 DAMS	TOTAL NUMBER OF DAMS AFFECTED:

STATE OF COLORADO -- DAM SAFETY BRANCH
 LISTING OF DAMS UNDER STORAGE RESTRICTION ORDERS

FOR 5

DAMID	Haz. Class	Dam Name	Restricted Reservoir Level	Reason for Restriction	Gage Ht.	Action Date	Act. Type	Volume
370116	3	G G LOWER	4.0 CREST	INADEQ FRBD., STABILITY OF DOWNSTREAM SLOPE	0	12/14/1992	R	6
370205	3	FORIER #3	NO STORAGE	ILLEGAL DAM /INADEQUATE SPILLWAY	0	11/9/1995	I	2
380207	2	WARREN LAKE #3	NO STORAGE	INADEQUATE SPILLWAY	0	11/1/1995	I	27
380212	2	FLANNERY	1.0 FT SPILLWAY	SPILLWAY EROSION	0	9/17/2001	I	20
380217	2	CHRISTINE LAKE	3.5 FT CREST	NO SPILLWAY	0	5/4/2001	I	10
450101	3	BATTLEMENT #2	NO STORAGE	INADEQUATE SPILLWAY	0	9/18/1995	I	23
450102	3	BATTLEMENT #1	NO STORAGE	POOR CONDITION OF OUTLET	0	10/1/1990	C	70
500113	2	MATHESON	ELEVATION OF SINKHOLES	SINKHOLES	0	9/26/2000	I	500
500126	3	MILK CREEK	15.0 CREST (AUG 1 THRU MAY 1)	EXCESSIVE LEAKAGE	0	5/10/1991	R	56
510104	2	DALE	ORDER TO BREACH BY 01/15/97	OUTLET DISTRESS, SLOUGHING AT OUTLET	0	12/20/1996	R	39
510114	2	LITTLE KING RANCH	10.0 SPILLWAY	EXCESSIVE SEEPAGE	41	3/7/1978	C	439
510124	2	SCHOLL	NO STORAGE	SINKHOLES	0	8/2/2001	I	51
510125	1	SYLVAN	14.0 CREST	SLIDE ON DOWNSTREAM SLOPE	0	7/8/1998	R	650
510129	N	ROCK CREEK	NO STORAGE	DAM BREACHED BY OWNER BUT WANTS TO REPAIR	0	6/28/1989	C	66
530119	3	KELLY	5.0 CREST	SPILLWAY EROSION	0	9/20/1985	C	0
530125	3	NEWTON GULCH	20.0 CREST	EXCESSIVE SEEPAGE THROUGH ABUTMENTS	17	7/20/1990	I	465
530129	3	STERNER	RELAX 5/1-8/15, 3.0 SPILLWAY	UNCONTROLLED LEAKAGE	0	8/2/1995	R	71
720117	3	CARPENTER	NO STORAGE	PIPING HOLE	0	8/23/1994	I	27
720126	3	CURRIER #2	5.0 SPILLWAY	SLIDE ON HILL ABOVE SPILLWAY, BACKCUTTING	0	5/24/1995	I	100
VOLUME OF STORAGE WATER LOST DUE TO RESTRICTION FOR DIVISION 5 2622 AF								
TOTAL NUMBER OF DAMS AFFECTED: 19 DAMS								

STATE OF COLORADO -- DAM SAFETY BRANCH
 LISTING OF DAMS UNDER STORAGE RESTRICTION ORDERS

FOR 6

DAMID	Haz. Class	Dam Name	Restricted Reservoir Level	Reason for Restriction	Gage Ht.	Action Date	Act. Type	Volume
430205	3	BAXTER	5.0 FT. SPILLWAY	SEEPAGE, EROSION OF U/S FACE		11/13/1997	I	30
430212	3	WILSON #3	3.0 SPILLWAY	INOPERABLE OUTLET, INAD SPWY		9/30/1989	I	10
440106	3	BISKUP	5.0 SPILLWAY	DILAPIDATED CONDITION		8/19/1987	C	55
440120	3	DRESCHER	8.0 SPILLWAY	SEEPAGE & INSTABILITY		8/1/1988	R	159
440124	3	ELLGEN #2	NO STORAGE	POOR OUTLET CONDITION		5/30/1986	I	60
440213	3	FLATTOP	5.0 FT CREST MAIN DAM	BREACHED, BEAVER DAMS, FREEBOARD		8/2/1999	I	50
540103	3	MARTIN GULL	NO STORAGE	U/S SLOPE FAILURE		10/25/2000	I	250
560107	3	BASSET #2	NO STORAGE	ILLEGAL DAM, POOR CONDITION		8/21/2001	I	54
570114	3	LAKE EMRICH	15.0 CREST	SLIDES ON DOWNSTREAM SLOPE		8/30/1988	C	330
580304	2	UPPER SPRING CREEK	5.0 FT SPILLWAY	SEEPAGE, INADEQUATE SPILLWAY, EROSION		7/14/1999	I	10
VOLUME OF STORAGE WATER LOST DUE TO RESTRICTION FOR DIVISION				6	1008 AF			10 DAMS
								TOTAL NUMBER OF DAMS AFFECTED:

STATE OF COLORADO -- DAM SAFETY BRANCH
 LISTING OF DAMS UNDER STORAGE RESTRICTION ORDERS

FOR 7

DAMID	Haz. Class	Dam Name	Restricted Reservoir Level	Reason for Restriction	Gage Ht.	Action Date	Act. Type	Volume
340101	2	BAUER LAKE #1	3.0 SPILLWAY	SATURATION HIGH ON EMBANKMENT	0	8/27/1984	R	144
340106	3	HURST	NO STORAGE	OUTLET FAILURE	0	3/29/1999	I	35
340119	3	J. O. SPENCER	NO STORAGE	INOPERABLE OUTLET	0	5/8/2000	I	16
340203	1	SUMMIT	NOT TO EXCEED 1.1' BELOW SPILL FOR > 3 WEEKS	EXCESSIVE SEEPAGE	23.6	6/3/1998	R	579
770103	2	SPENCE	NO STORAGE	OUTLET PIPE BLOCKAGE	0	6/19/2001	I	441
780111	2	PINON LAKE	3 FEET SPILLWAY	POOR CONDITION	0	7/27/2001	I	40
VOLUME OF STORAGE WATER LOST DUE TO RESTRICTION FOR DIVISION 7 1255 AF								
TOTAL NUMBER OF DAMS AFFECTED: 6 DAMS								

APPENDIX C

APPROVED PLANS AND SPECIFICATIONS LIST

**APPROVED PLANS AND SPECIFICATIONS FOR NEW DAMS AND ALTERATIONS,
ENLARGEMENTS, OR REPAIRS OF EXISTING DAMS**

NAME	DAMID	C-NO	CONST TYPE	APPROVAL	USE
STILLWATER	080444	C-1785A	MODIFICATION	7/19/2001	RECREATION
SMITH IRRIGATION	020325	C-1052A	MODIFICATION	7/30/2001	IRRIGATION
PITCH MINE WASTEWATER	280110	C-1585B	REPAIR	8/2/2001	DOMESTIC
JACKSON LAKE	010227	C-1813	REPAIR	8/10/2001	IRRIGATION
BURG	630103	C-1289X	MODIFICATION	8/27/2001	IRRIGATION
G.H. AND S. #2	420119	C-342A	REPAIR	8/27/2001	IRRIGATION
BOEHMER	120105	C-1815	REPAIR	10/16/2001	DOMESTIC
JOHNSTON	095220	C-1397B	REPAIR	10/16/2001	IRRIGATION
WYMAN	440218	C-1817	REPAIR	10/18/2001	IRRIGATION
BLUNN	070302	C-1520B	REPAIR	10/29/2001	DOMESTIC
MC LELLAN	080225	C-1025D	REPAIR	10/29/2001	DOMESTIC
MARTIN CULL	540103	C-0694A	REPAIR	11/8/2001	IRRIGATION
SOUTH SUBURBAN	100213	C-0255B	REPAIR	11/8/2001	DOMESTIC
IDAHO SPRINGS	070111	C-1514C	REPAIR	11/8/2001	DOMESTIC
BELLVUE WATER TREATMENT	030525	C-1820	MODIFICATION	12/3/2001	
HIWAN NO. 6	090122	C-1065A	MODIFICATION	12/3/2001	IRRIGATION
FRUITA NO.1	420116		BREACH	12/3/2001	DOMESTIC
LEFT HAND VALLEY	050210	C-0635B	MODIFICATION	12/26/2001	IRRIGATION
GREAT WESTERN	020212	C-857G	MODIFICATION	1/25/2002	DOMESTIC
CEDAR MESA	400135	C-1419C	MODIFICATION	2/27/2002	IRRIGATION
MILTON LAKE	020304	C-1471E	MODIFICATION	2/27/2002	IRRIGATION
VOGEL POND	020634	C-1822	MODIFICATION	3/29/2002	FIRE PROTECTION
MEADOWVIEW	09__B	C-1800	NEW	3/29/2002	
BARTON PORTER	450106	C-0718B	MODIFICATION	4/23/2002	IRRIGATION
PETERSON LAKE	060323	C-1823	REPAIR	4/26/2002	DOMESTIC
STANDLEY LAKE	020326	C-1070H	REPAIR	5/2/2002	IRRIGATION
MONUMENT LAKE	190115	C-0202A	MODIFICATION	5/13/2002	DOMESTIC
ANNEX #8	030103	C-1821	REPAIR	5/13/2002	IRRIGATION
NEE-NOSHE	670218	C-1819	REPAIR	5/13/2002	IRRIGATION
JUNIATA	420128	C-0661C	MODIFICATION	5/23/2002	DOMESTIC
CLIFTON RAW WATER POND	720420	C-1786X	NEW	5/27/2002	
SUNNYSIDE RANCH	600134	C-1824	NEW	6/18/2002	
PINERY	080230	C-1282A	REPAIR	6/25/2002	DOMESTIC
DILLON	360104	C-0930F	REPAIR	6/27/2002	RECREATION

APPENDIX D

ENGINEERS INSPECTION REPORT FORM

ENGINEERS INSPECTION REPORT

OFFICE OF THE STATE ENGINEER-DIVISION OF WATER RESOURCES - DAM SAFETY BRANCH
1313 Sherman Street, Room 818, Denver, CO 80203, (303) 866-3581

DAM NAME _____ W. DIV. _____ W. DIST. _____ DATE OF INSPECTION ____/____/____

DAM ID _____ FILE NO. C- _____ FOREST I.D. _____ DATE OF LAST INSPECTION ____/____/____

OWNER NAME _____ OWNER PHONE _____

ADDRESS _____ ZIP CODE _____

CONTACT NAME _____ CONTACT PHONE _____

CLASS _____ CAPACITY _____ AF SURFACE AREA _____ AC. HEIGHT _____ FT. CREST LENGTH _____ FT. CREST WIDTH _____ FT.

CURRENT RESTRICTION (NO) (YES) LEVEL _____ EPP ON FILE (NO) (YES) SPWY WIDTH _____ FT. FBD. _____ FT. Z _____

INSPECTION PARTY REPRESENTING _____

DIRECTIONS: MARK AN X FOR CONDITIONS FOUND AND UNDERLINE WORDS THAT APPLY. GIVE LOCATION AND EXTENT WITH NUMBER REFERENCE I.E. (25) ALL ALONG SLOPE. OR SHOW IT ON SKETCH.

FIELD CONDITIONS OBSERVED

WATER LEVEL - BELOW DAM CREST _____ FT. BELOW SPILLWAY _____ FT. GAGE ROD _____

GROUND MOISTURE CONDITION: DRY _____ WET _____ SNOWCOVER _____ OTHER _____

UPSTREAM SLOPE

PROBLEMS NOTED: (0) NONE (1) RIPRAP - MISSING, SPARSE, DISPLACED, WEATHERED (2) WAVE EROSION-WITH SCARPS

(3) CRACKS-WITH DISPLACEMENT (4) SINKHOLE (5) APPEARS TOO STEEP (6) DEPRESSIONS OR BULGES (7) SLIDES

(8) CONCRETE FACING-HOLES, CRACKS, DISPLACED, UNDERMINED (9) OTHER _____

Comments: _____

CREST

PROBLEMS NOTED: (10) NONE (11) RUTS OR PUDDLES (12) EROSION (13) CRACKS - WITH DISPLACEMENT (14) SINKHOLES

(15) NOT WIDE ENOUGH (16) LOW AREA (17) MISALIGNMENT (18) INADEQUATE SURFACE DRAINAGE

(19) OTHER _____

Comments: _____

DOWNSTREAM SLOPE

PROBLEMS NOTED: (20) NONE (21) LIVESTOCK DAMAGE (22) EROSION OR GULLIES (23) CRACKS - WITH DISPLACEMENT (24) SINKHOLE

(25) APPEARS TOO STEEP (26) DEPRESSION OR BULGES (27) SLIDE (28) SOFT AREAS (29) OTHER _____

Comments: _____

SEEPAGE

PROBLEMS NOTED: (30) NONE (31) SATURATED EMBANKMENT AREA (32) SEEPAGE EXITS ON EMBANKMENT

(33) SEEPAGE EXITS AT POINT SOURCE (34) SEEPAGE AREA AT TOE (35) FLOW ADJACENT TO OUTLET (36) SEEPAGE INCREASED/MUDDY

DRAIN OUTFALLS SEEN No Yes (37) FLOW INCREASED/MUDDY (38) DRAIN DRY/OBSTRUCTED

(39) OTHER _____ Show location of drains on sketch and indicate amount and quality of discharge.

Comments: _____

OUTLET

PROBLEMS NOTED: (40) NONE (41) NO OUTLET FOUND (42) POOR OPERATING ACCESS (43) INOPERABLE

(44) UPSTREAM OR DOWNSTREAM STRUCTURE DETERIORATED (45) OUTLET NOT OPERATED DURING INSPECTION

INTERIOR INSPECTED (120) NO (121) YES (46) CONDUIT DETERIORATED OR COLLAPSED (47) JOINTS DISPLACED (48) VALVE LEAKAGE

(49) OTHER _____

Comments: _____

SPILLWAY

PROBLEMS NOTED: (50) NONE (51) NO EMERGENCY SPILLWAY FOUND (52) EROSION-WITH BACKCUTTING (53) CRACK - WITH DISPLACEMENT

(54) APPEARS TO BE STRUCTURALLY INADEQUATE (55) APPEARS TOO SMALL (56) INADEQUATE FREEBOARD (57) FLOW OBSTRUCTED

(58) CONCRETE DETERIORATED/UNDERMINED (59) OTHER _____

Comments: _____

Conditions Observed		
GOOD	ACCEPTABLE	POOR
UPSTREAM SLOPE		
GOOD	ACCEPTABLE	POOR
CREST		
GOOD	ACCEPTABLE	POOR
DOWNSTREAM SLOPE		
GOOD	ACCEPTABLE	POOR
SEEPAGE		
GOOD	ACCEPTABLE	POOR
OUTLET		
GOOD	ACCEPTABLE	POOR
SPILLWAY		

See Guidelines on Back of this Sheet

MONITORING

EXISTING INSTRUMENTATION FOUND (110) NONE (111) GAGE ROD (112) PIEZOMETERS (113) SEEPAGE WEIRS/FLUMES

(114) SURVEY MONUMENTS (115) OTHER _____

MONITORING OF INSTRUMENTATION: (116) NO (117) YES PERIODIC INSPECTIONS BY: (118) OWNER (119) ENGINEER

Comments: _____

GOOD	ACCEPTABLE	POOR
------	------------	------

MAINTENANCE AND REPAIR

PROBLEMS NOTED: (60) NONE (61) ACCESS ROAD NEEDS MAINTENANCE (62) CATTLE DAMAGE

(63) BRUSH ON UPSTREAM SLOPE, CREST, DOWNSTREAM SLOPE, TOE (64) TREES ON UPSTREAM SLOPE, CREST, DOWNSTREAM SLOPE, TOE

(65) RODENT ACTIVITY ON UPSTREAM SLOPE, CREST, DOWNSTREAM SLOPE, TOE (66) DETERIORATED CONCRETE-FACING, OUTLET, SPILLWAY

(67) GATE AND OPERATING MECHANISM NEED MAINTENANCE (68) OTHER _____

Comments: _____

GOOD	ACCEPTABLE	POOR
------	------------	------

OVERALL CONDITIONS

REMARKS: _____

Based on this Safety Inspection and recent file review, the overall condition is determined to be:

71 SATISFACTORY 72 CONDITIONALLY SATISFACTORY 73 UNSATISFACTORY

OVERALL CONDITIONS

ITEMS REQUIRING ACTION BY OWNER TO IMPROVE THE SAFETY OF THE DAM

The State Engineer, by providing this dam safety inspection report, does not assume responsibility for any unsafe condition of the subject dam. The sole responsibility for the safety of this dam rests with the reservoir owner or operator, who should take every step necessary to prevent damages caused by leakage or overflow of water from the reservoir or floods resulting from a failure of the dam.

MAINTENANCE - MINOR REPAIR - MONITORING

(80) PROVIDE ADDITIONAL RIPRAP: _____

(81) LUBRICATE AND OPERATE OUTLET GATES THROUGH FULL CYCLE: _____

(82) CLEAR TREES AND/OR BRUSH FROM: _____

(83) INITIATE RODENT CONTROL PROGRAM AND PROPERLY BACKFILL EXISTING HOLES: _____

(84) GRADE CREST TO A UNIFORM ELEVATION WITH DRAINAGE TO THE UPSTREAM SLOPE: _____

(85) PROVIDE SURFACE DRAINAGE FOR: _____

(86) MONITOR: _____

(87) DEVELOP AND SUBMIT AN EMERGENCY PREPAREDNESS PLAN: _____

(88) OTHER: _____

(89) OTHER: _____

ENGINEERING - EMPLOY AN ENGINEER EXPERIENCED IN DESIGN AND CONSTRUCTION OF DAMS TO: (Plans & Specification must be approved by State Engineer prior to construction.)

(90) PREPARE PLANS AND SPECIFICATIONS FOR THE REHABILITATION OF THE DAM: _____

(91) PREPARE AS-BUILT DRAWINGS OF: _____

(92) PERFORM A GEOTECHNICAL INVESTIGATION TO EVALUATE THE STABILITY OF THE DAM: _____

(93) PERFORM A HYDROLOGIC STUDY TO DETERMINE REQUIRED SPILLWAY SIZE: _____

(94) PREPARE PLANS AND SPECIFICATIONS FOR AN ADEQUATE SPILLWAY: _____

(95) SET UP A MONITORING SYSTEM INCLUDING WORK SHEETS, REDUCED DATA AND GRAPHED RESULTS: _____

(96) PERFORM AN INTERNAL INSPECTION OF THE OUTLET: _____

(97) OTHER: _____

(98) OTHER: _____

(99) OTHER: _____

SAFE STORAGE LEVEL RECOMMENDED AS A RESULT OF THIS INSPECTION

(101) FULL STORAGE

(102) CONDITIONAL FULL STORAGE RESTRICTED LEVEL

(103) RECOMMENDED RESTRICTION OFFICIAL ORDER TO FOLLOW

_____ FT. BELOW DAMS CREST
 _____ FT. BELOW SPILLWAY CREST
 _____ FT. GAGE HEIGHT
 _____ NO STORAGE-MAINTAIN OUTLET FULLY OPEN

REASON FOR RESTRICTION: _____

ACTIONS REQUIRED FOR CONDITIONAL FULL STORAGE OR CONTINUED STORAGE AT THE RESTRICTED LEVEL: _____

GUIDELINES FOR DETERMINING CONDITIONS

CONDITIONS OBSERVED - APPLIES TO UPSTREAM SLOPE, CREST, DOWNSTREAM SLOPE, OUTLET, SPILLWAY

GOOD	ACCEPTABLE	POOR
In general, this part of the structure has a near new appearance, and conditions observed in this area do not appear to threaten the safety of the dam.	Although general cross-section is maintained, surfaces may be irregular, eroded, rutted, spalled; or otherwise not in new condition. Conditions in this area do not currently appear to threaten the safety of the dam.	Conditions observed in this area appear to threaten the safety of the dam.

CONDITIONS OBSERVED - APPLIES TO SEEPAGE

GOOD	ACCEPTABLE	POOR
No evidence of uncontrolled seepage. No unexplained increase in flows from designed drains. All seepage is clear. Seepage conditions do not appear to threaten the safety of the dam.	Some seepage exists at areas other than the drain outfalls, or other designed drains. No unexplained increase in seepage. All seepage is clear. Seepage conditions observed do not currently appear to threaten the safety of the dam.	Seepage conditions observed appear to threaten the safety of the dam. Examples: 1) Designed drain or seepage flows have increased without increase in reservoir level. 2) Drain or seepage flows contain sediment, i.e., muddy water or particles in jar samples. 3) Widespread seepage, concentrated seepage or ponding appears to threaten the safety of the dam.

CONDITIONS OBSERVED - APPLIES TO MONITORING

GOOD	ACCEPTABLE	POOR
Monitoring includes movement surveys and leakage measurements for all dams, and piezometer readings for Class I dams. Instrumentation is in reliable, working condition. A plan for monitoring the instrumentation and analyzing results by the owner's engineer is in effect. Periodic inspections by owner's engineer.	Monitoring includes movement surveys and leakage measurements for Class I & II dams; leakage measurements for Class III dams. Instrumentation is in serviceable condition. A plan for monitoring instrumentation is in effect by owner. Periodic inspections by owner or representative. OR, NO MONITORING REQUIRED.	All instrumentation and monitoring described under "ACCEPTABLE" here for each class of dam, are not provided, or required periodic readings are not being made, or unexplained changes in readings are not reacted to by the owner.

CONDITIONS OBSERVED - APPLIES TO MAINTENANCE AND REPAIR

GOOD	ACCEPTABLE	POOR
Dam appears to receive effective on-going maintenance and repair, and only a few minor items may need to be addressed.	Dam appears to receive maintenance, but some maintenance items need to be addressed. No major repairs are required.	Dam does not appear to receive adequate maintenance. One or more items needing maintenance or repair has begun to threaten the safety of the dam.

OVERALL CONDITIONS

SATISFACTORY	CONDITIONALLY SATISFACTORY	UNSATISFACTORY
The safety inspection indicates no conditions that appear to threaten the safety of the dam, and the dam is expected to perform satisfactorily under all design loading conditions. Most of the required monitoring is being performed.	The safety inspection indicates symptoms of possible structural distress (seepage, evidence of minor displacements, etc.), which, if conditions worsen, could lead to the failure of the dam. Essential monitoring, inspection, and maintenance must be performed as a requirement for continued full or reduced storage in the reservoir.	The safety inspection indicates definite signs of structural distress (excessive seepage, cracks, slides, sinkholes, severe deterioration, etc.), which could lead to the failure of the dam if the reservoir is used to full capacity. The dam is judged unsafe for full storage of water.

SAFE STORAGE LEVEL

FULL STORAGE	CONDITIONAL FULL STORAGE	RESTRICTION
Dam may be used to full capacity with no conditions attached.	Dam may be used to full storage if certain monitoring, maintenance, or operational conditions are met.	Dam may not be used to full capacity, but must be operated at some reduced level in the interest of public safety.

CLASSIFICATION OF DAMS

CLASS I	CLASS II	CLASS III
Class I - Loss of human life is expected in the event of failure of the dam, while the reservoir is at the high water line.	Class II - Significant damage to improved property is expected in the event of failure of the dam while the reservoir is at the high water line, but no loss of human life is expected.	Class III - Loss of human life is not expected, and damage to improved property is expected to be small, in the event of failure of the dam while the reservoir is at high water line.

APPENDIX E

WATER COMMISSIONER DAM OBSERVATION REPORT FORM

WATER COMMISSIONER • DAM OBSERVATION REPORT • OFFICE OF THE STATE ENGINEER

DAM NAME _____ W. DIV. _____ W. DIST. _____ DATE OF INSPECTION ____/____/____

DAM ID _____ FILE NO. C _____ FOREST ID. _____ DATE OF LAST INSPECTION ____/____/____

OWNER NAME _____ OWNER PHONE _____

ADDRESS _____ ZIP CODE _____

CONTACT NAME _____ CONTACT PHONE _____

CLASS _____ CAPACITY _____ AF SURFACE AREA _____ AC. HEIGHT _____ FT. CREST LENGTH _____ FT. CREST WIDTH _____ FT.

CURRENT RESTRICTION (NO) (YES) LEVEL _____ EPP ON FILE (NO) (YES) SPWY WIDTH _____ FT. FBD. _____ FT. Z _____

FIELD CONDITIONS OBSERVED WATER LEVEL: BELOW DAM CREST _____ FT., BELOW SPILLWAY _____ FT., GAGE ROD READING _____

GROUND MOISTURE CONDITION: DRY _____ WET _____ SNOWCOVER _____ OTHER _____

DIRECTIONS: MARK AN X FOR CONDITIONS FOUND AND UNDERLINE WORDS THAT APPLY.

SLOPE	PROBLEMS NOTED: <input type="checkbox"/> (0) NONE <input type="checkbox"/> (1) RIPRAP - MISSING, SPARSE, DISPLACED, WEATHERED <input type="checkbox"/> (2) WAVE EROSION-WITH SCARPS <input type="checkbox"/> (3) CRACKS-WITH DISPLACEMENT <input type="checkbox"/> (4) SINKHOLE <input type="checkbox"/> (5) APPEARS TOO STEEP <input type="checkbox"/> (6) DEPRESSIONS OR BULGES <input type="checkbox"/> (7) SLIDES <input type="checkbox"/> (8) CONCRETE FACING-HOLES, CRACKS, DISPLACED, UNDERMINED <input type="checkbox"/> (9) OTHER _____	Conditions Observed		
		GOOD	ACCEPTABLE	POOR
CREST	PROBLEMS NOTED: <input type="checkbox"/> (10) NONE <input type="checkbox"/> (11) RUTS OR PUDDLES <input type="checkbox"/> (12) EROSION <input type="checkbox"/> (13) CRACKS - WITH DISPLACEMENT <input type="checkbox"/> (14) SINKHOLES <input type="checkbox"/> (15) NOT WIDE ENOUGH <input type="checkbox"/> (16) LOW AREA <input type="checkbox"/> (17) MISALIGNMENT <input type="checkbox"/> (18) IMPROPER SURFACE DRAINAGE <input type="checkbox"/> (19) OTHER _____	GOOD	ACCEPTABLE	POOR
SLOPE	PROBLEMS NOTED: <input type="checkbox"/> (20) NONE <input type="checkbox"/> (21) LIVESTOCK DAMAGE, <input type="checkbox"/> (22) EROSION OR GULLIES, <input type="checkbox"/> (23) CRACKS - WITH DISPLACEMENT <input type="checkbox"/> (24) SINKHOLE <input type="checkbox"/> (25) APPEARS TOO STEEP <input type="checkbox"/> (26) DEPRESSION OR BULGES <input type="checkbox"/> (27) SLIDE <input type="checkbox"/> (28) SOFT AREAS <input type="checkbox"/> (29) OTHER _____	GOOD	ACCEPTABLE	POOR
SEEPAGE	PROBLEMS NOTED: <input type="checkbox"/> (30) NONE <input type="checkbox"/> (31) SATURATED EMBANKMENT AREA <input type="checkbox"/> (32) SEEPAGE EXITS ON EMBANKMENT <input type="checkbox"/> (33) SEEPAGE EXITS AT POINT SOURCE <input type="checkbox"/> (34) SEEPAGE AREA AT TOE <input type="checkbox"/> (35) FLOW ADJACENT TO OUTLET <input type="checkbox"/> (36) SEEPAGE INCREASED/MUDDY DRAIN OUTFALLS SEEN <input type="checkbox"/> No <input type="checkbox"/> Yes <input type="checkbox"/> (37) FLOW INCREASED/MUDDY <input type="checkbox"/> (38) DRAIN DRY/OBSTRUCTED <input type="checkbox"/> (39) OTHER _____	GOOD	ACCEPTABLE	POOR
OUTLET	PROBLEMS NOTED: <input type="checkbox"/> (40) NONE <input type="checkbox"/> (41) NO OUTLET FOUND <input type="checkbox"/> (42) POOR OPERATING ACCESS <input type="checkbox"/> (43) INOPERABLE <input type="checkbox"/> (44) UPSTREAM OR DOWNSTREAM STRUCTURE DETERIORATED <input type="checkbox"/> (45) OUTLET NOT OPERATED DURING INSPECTION INTERIOR INSPECTED <input type="checkbox"/> (120) NO <input type="checkbox"/> (121) YES <input type="checkbox"/> (46) CONDUIT DETERIORATED OR COLLAPSED <input type="checkbox"/> (47) JOINTS DISPLACED <input type="checkbox"/> (48) VALVE LEAKAGE <input type="checkbox"/> (49) OTHER _____	GOOD	ACCEPTABLE	POOR
SPILLWAY	PROBLEMS NOTED: <input type="checkbox"/> (50) NONE <input type="checkbox"/> (51) NO EMERGENCY SPILLWAY FOUND <input type="checkbox"/> (52) EROSION-WITH BACKCUTTING <input type="checkbox"/> (53) CRACK - WITH DISPLACEMENT <input type="checkbox"/> (54) APPEARS TO BE STRUCTURALLY INADEQUATE <input type="checkbox"/> (55) APPEARS TOO SMALL <input type="checkbox"/> (56) INADEQUATE FREEBOARD <input type="checkbox"/> (57) FLOW OBSTRUCTED <input type="checkbox"/> (58) CONCRETE DETERIORATED/UNDERMINED <input type="checkbox"/> (59) OTHER _____	GOOD	ACCEPTABLE	POOR
MAINTENANCE	PROBLEMS NOTED: <input type="checkbox"/> (60) NONE <input type="checkbox"/> (61) ACCESS ROAD NEEDS MAINTENANCE <input type="checkbox"/> (62) CATTLE DAMAGE <input type="checkbox"/> (63) BRUSH ON UPSTREAM SLOPE, CREST, DOWNSTREAM SLOPE, TOE <input type="checkbox"/> (64) TREES ON UPSTREAM SLOPE, CREST, DOWNSTREAM SLOPE, TOE <input type="checkbox"/> (65) RODENT ACTIVITY ON UPSTREAM SLOPE, CREST, DOWNSTREAM SLOPE, TOE <input type="checkbox"/> (66) DETERIORATED CONCRETE-FACING, OUTLET, SPILLWAY <input type="checkbox"/> (67) GATE AND OPERATING MECHANISM NEED MAINTENANCE <input type="checkbox"/> (68) OTHER _____	GOOD	ACCEPTABLE	POOR

See Guidelines on Back of this Sheet

DIRECTIONS: ENTER PROBLEM NUMBER () THEN LOCATION DIMENSIONS, DEGREE, ETC.

LOCATION OF PROBLEMS & COMMENTS: _____

- MAINTENANCE - MINOR REPAIR - MONITORING - ACTION REQUIRED OF OWNER TO IMPROVE THE SAFETY OF THE DAM.**
- (80) PROVIDE ADDITIONAL RIPRAP: _____
 - (81) LUBRICATE AND OPERATE OUTLET-GATES THROUGH FULL-CYCLE: _____
 - (82) CLEAR TREES AND/OR BRUSH FROM: _____
 - (83) INITIATE RODENT CONTROL PROGRAM AND PROPERLY BACKFILL EXISTING HOLES: _____
 - (84) GRADE CREST TO A UNIFORM ELEVATION WITH DRAINAGE TO THE UPSTREAM SLOPE: _____
 - (85) PROVIDE SURFACE DRAINAGE FOR: _____
 - (86) MONITOR: _____
 - (88) OTHER: _____
 - (89) OTHER: _____

DAM REQUIRES INSPECTION BY A FIELD ENGINEER FIELD DIMENSIONS SHOWN ON BACK

The State Engineer, by providing this dam safety observation report, does not assume responsibility for any unsafe condition of the subject dam. The sole responsibility for the safety of this dam rests with the reservoir owner or operator, who should take every step necessary to prevent damages caused by leakage or overflow of waters from the reservoir or floods resulting from a failure of the dam.