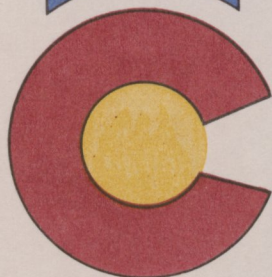




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STATE ENGINEER'S
SIXTH ANNUAL REPORT TO THE
COLORADO GENERAL ASSEMBLY ON
DAM SAFETY FOR
F.Y. 88-89

November 1, 1989

OFFICE OF THE STATE ENGINEER
DIVISION OF WATER RESOURCES



Jeris A. Danielson
State Engineer

ROY ROMER
Governor



JERIS A. DANIELSON
State Engineer

OFFICE OF THE STATE ENGINEER
DIVISION OF WATER RESOURCES

1313 Sherman Street-Room 818
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October 23, 1989

The Honorable Roy Romer
Governor, State of Colorado
State Capitol Building
Denver, Colorado

The Honorable Ted Strickland
President of the Senate
Colorado State Senate
Denver, Colorado

The Honorable Bev Bledsoe
Speaker of the House
Colorado House of Representatives
Denver, Colorado

Gentlemen:

Pursuant to Section 37-87-114.4, C.R.S. 1973 (1987 Supp.), I am pleased to transmit the enclosed report describing the activities of the State Engineer with respect to dam safety in Colorado for fiscal year 1988-1989.

Colorado's dam safety program has matured as a result of resources made available by the General Assembly and as a result of increased awareness by dam owners of their responsibilities. This awareness has been gained by informing the owner through public meetings and seminars on dam safety issues.

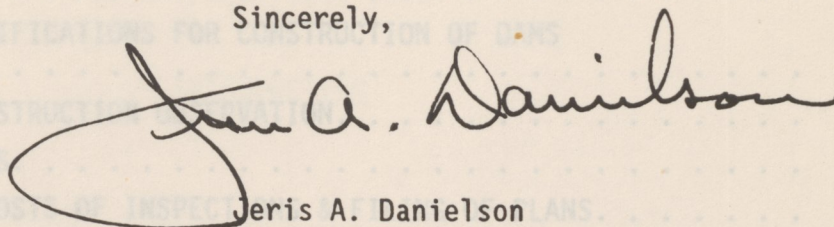
I believe our dam safety program can be improved by continued education of dam owners and the public, additional staffing (1.0 FTE) to support the dam safety data management system, additional funds (\$5,000) for training of our professional staff, and additional funds (\$30,000) for rental of "All-Terrain Vehicles" and a helicopter for efficient access to remote areas as described in detail in the report.

I have taken steps to decentralize the dam inspection program by moving field engineers from Denver to Glenwood Springs, Montrose, and Durango, and will be moving field engineers to Steamboat Springs and Pueblo this winter. This will permit inspections at less cost and will enhance the program.

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If you have any questions or would like additional information, please feel free to call upon me at any time.

Sincerely,



Jeris A. Danielson
State Engineer

JAD/AEP:jmg/5619I

Enclosure (a/s)

cc: Senate Majority Leader Jeffrey M. Wells
Senate Minority Leader Larry Trujillo
House Majority Leader Chris Paulson
House Minority Leader Ruth Wright
Senator Tilman Bishop, Chairman
Senate Agriculture Committee
Representative Scott McInnis, Chairman
House Agriculture Committee
Senator Mike Bird, Chairman, Joint Budget Committee
Senator Robert DeNier, Joint Budget Committee
Senator James Rizzuto, Joint Budget Committee
Representative Elwood Gillis, Joint Budget Committee
Representative Richard R. Bond, Joint Budget Committee
Representative Tony Grampas, Joint Budget Committee

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STATE ENGINEER'S SIXTH ANNUAL REPORT
TO THE
GENERAL ASSEMBLY
ON
DAM SAFETY
FOR
FISCAL YEAR 1988-1989

INTRODUCTION

Statutory Provisions

Colorado's Dam Safety Program is administered by the State Engineer in accordance with Title 37, Article 87, of C.R.S. (1973)(1988 Supp.), and the Livestock Water Tank Act, Title 35, Article 49 of C.R.S. (1973), as amended. 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 for administration of these statutes.

This report is submitted in compliance with Section 37-87-114.4, C.R.S. (1988 Supp.) concerning the activities of the State Engineer and the Division of Water Resources relating to Section 37-87-105 to 27-87-114, C.R.S. (1973)(1988 Supp.).

Organization

Implementation of the Dam Safety Program is done by the State Engineer through the Dam Safety Branch.

The Branch is organized into three Units, two being Field Engineering Units (FEU) and the other, the Design Review and Construction Inspection Unit (DRCIU). Each Unit is led by a Supervising Water Resource Engineer. (See Appendix A for tables and charts for the personnel and organization of the Branch.)

The Field Engineering Units' principal duties are to conduct safety evaluations of existing dams (SEED),¹ design review and construction inspection of repairs², and investigation of complaints on the safety of dams.³ They investigate the construction of dams in violation of Section 37-87-105(1) and (4), C.R.S. (1973) (1988 Supp.), assist the Department of Health in the inspection of tailing dams, and conduct training on the inspection of dams for division personnel, dam owners, interested agencies, engineers, and the public. They also do other related work as assigned.

¹Per Section 37-87-107, C.R.S. (1973)(1988 Supp.)

²Per Section 37-87-105(4), C.R.S. (1973)(1988 Supp.)

³Per Section 37-87-109, C.R.S. (1973)

The Design Review and Construction Inspection Unit's 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, C.R.S. (1973)(1988 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 work. It processes the Livestock Water Tank and Erosion Control Dam applications per Section 35-49-101 through 116, C.R.S. (1973) and Section 37-87-122, C.R.S. (1973). The Unit assists the Department of Health in the technical evaluation of tailing impoundments through a "Memorandum to Understanding," and participates in the state's "Joint Review Process" with the Department of Natural Resources. They also do other related work as assigned.

Goals and Objectives of the Program

The primary goal of the State Engineer with respect to dam safety is to provide maximum public safety against dam failures within the resources of his office. Towards this goal, the resources are directed at the safety inspection of each Class I and Class II hazard nonfederal dam and reservoir on an annual basis, and the safety inspection of each Class III hazard nonfederal dam and reservoir on a five year basis. The program concentrates on "jurisdictional" dams and reservoirs as defined in Section 27-87-105, C.R.S. (1973)(1988 Supp.) which are greater than ten feet high at the spillway, or greater than twenty acres in surface area at the high water line, or greater than 100 acre-feet in capacity at the high water line. Because of their non-hazardous situation, Class IV dams are not inspected regularly, but observed for changes in hazard class periodically.

Safety inspections are made of U.S. Bureau of Reclamation and U.S. Corps of Engineers dams on a cooperative basis, their safety inspections being carried out in accordance with the "Federal Guidelines for Dam Safety." Arrangements are made with other federal agencies for the safety inspection of their dams by the Bureau of Reclamation, the Corps of Engineers, their own forces, consulting engineers, or by the State Engineer. When other than State Engineer personnel conduct the safety inspections, the agencies submit the findings/recommendations and follow-up to the State Engineer in order to assure the safety of these dams. A Memorandum of Understanding has been formulated with the Bureau of Reclamation relating to dam safety activities in Colorado. It provides for the exchange of safety-related information of dams under each agency's jurisdiction.

A related objective is the inspection of construction for compliance with approved plans, and to assure that plans are adequate for the site conditions. Inspections are made of the foundation, outlet works, spillways, and final construction as a minimum. Interim inspections are made as necessary.

An adjunct to the inspection objectives, but an important element of the dam safety program, is the goal to have each owner of Class I and Class II hazard dams prepare an Emergency Preparedness Plan to combat any incident which would jeopardize the safety of the dams, and to give warning to appropriate emergency preparedness agencies/officials so they may mobilize their plans for mitigating the consequences of dam-break flooding. An inundation map is required for Class I dams.

The following Table 1 shows the ownership of jurisdictional dams in Colorado by owner; and Table 2 shows the distribution of dams in the state by Water Division and hazard rating.

TABLE 1

JURISDICTIONAL¹ DAM OWNERSHIP STATUS
IN COLORADO

HAZARD RATING	TYPE OF OWNER				TOTAL
	FEDERAL	STATE	OTHER GOVT.	PRIVATE	
Class I	38	12	76	130	256
Class II	11	22	76	209	318
Class III	43	33	136	952	1164
Class IV	<u>8</u>	<u>0</u>	<u>0</u>	<u>4</u>	<u>12</u>
TOTAL	100	67	288	1295	1750

¹Greater than ten feet high to spillway, or twenty acres in surface area at the high water line, or 100 acre-feet in capacity at the high water line.

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 the high water line.

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

TABLE 2

DISTRIBUTION OF DAMS BY IRRIGATION DIVISION/CLASS

<u>DIVISION</u>	<u>NONFEDERAL</u>				<u>FEDERAL</u>				<u>TOTAL</u>			
	<u>I</u>	<u>II</u>	<u>III</u>	<u>IV</u>	<u>I</u>	<u>II</u>	<u>III</u>	<u>IV</u>	<u>I</u>	<u>II</u>	<u>III</u>	<u>IV</u>
1	114	127	453	1	13	6	9	8	127	133	462	9
2	32	52	196	0	5	3	8	0	37	55	204	0
3	9	15	35	1	1	0	5	0	10	15	40	1
4	21	39	169	0	8	0	7	0	29	39	176	0
5	20	42	121	0	7	0	9	0	27	42	130	0
6	11	15	104	1	0	2	4	0	11	17	108	1
7	<u>11</u>	<u>17</u>	<u>43</u>	<u>1</u>	<u>4</u>	<u>0</u>	<u>1</u>	<u>0</u>	<u>15</u>	<u>17</u>	<u>44</u>	<u>1</u>
	218	307	1121	4	38	11	43	8	256	318	1164	12
TOTALS			1650				100				1750	

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 the high water line.

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

APPROVAL OF PLANS AND SPECIFICATIONS FOR CONSTRUCTION OF DAMS AND RESERVOIRS

During FY 88-89, the State Engineer received plans for four new dams, and 38 plans for alteration, modification, repair, or enlargement. Seven change orders to previously approved plans were also reviewed and all were approved within the time frame. Twelve separate hydrology/hazard studies were also approved for determination of the inflow design flood for spillway design or hazard classifications. Estimated cost of construction for the submitted plans was \$15,377,488.00. Three thousand one hundred and ninety three dollars (\$3,193.00) was collected for the examination and filing of the submitted plans.

Twenty-nine sets of plans and specifications were approved by the State Engineer for construction during FY 88-89. (See Appendix B for lists of dams which were approved by Water Division/District, and use.) In order to expedite the approval of repair plans for dams, the State Engineer has modified the approval process for these type of plans by delaying the filing requirements until the end of construction and approving the work by letter. This enables the owners to repair their dams sooner by shortening the review time. Since these types of repairs are usually simple procedures, they do not require the same detail as plans for new dams.

Three special studies associated with dams were also performed, including geotechnical reports, feasibility reports, subdivision plans, and requests from the Department of Health and Division of Mined Land Reclamation.

Upon completion of construction, the owner's engineer submits copies of the "AS-CONSTRUCTED" plans showing the 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 of and the "AS-CONSTRUCTED" plans serve as the public record as provided by the statutes.

In order to provide for the quality control of the design review work, the supervisor reviews the work, design review memoranda, and construction inspection of the unit. The supervisor also provides expert guidance to the unit, as well as the field engineers when they are involved with design and construction.

Section 37-87-114.5, C.R.S., (1988 Supp.) exempts certain structures from the State Engineer's approval. They are, structures not designed or operated for the purpose of storing water, mill tailing impoundments permitted under Article 32 or 33 of Title 34, C.R.S. (Minerals or Coal Mines), uranium mill tailing and liquid impoundment structures permitted under Article 11 of Title 25, C.R.S. siltation structures permitted under Article 33 of Title 34, C.R.S. (Coal Mines), and structures which store water only below the natural surface of the ground.

In order to prevent administrative problems arising from the construction of small dams which do not fall under the jurisdiction of the State Engineer's review and approval, Section 37-87-125, C.R.S. (1988 Supp.) requires that a

Notice of Intent to Construct a Nonjurisdictional Water Impoundment Structure must be submitted to the State Engineer prior to beginning construction. The State Engineer has developed a form for submitting the notice, which is directed to the Division Engineer of the Division that the impoundment is located in for processing. The notification also served to address any dam safety issues which are evident.

SAFETY INSPECTIONS AND CONSTRUCTION OBSERVATION

Scheduling

Jurisdictional dams identified for inspection in accordance with the objectives of the State Engineer are assigned to the field engineers on a geographic and hazard related basis. The field engineers each schedule the inspection of approximately 85 separate dams each "inspection season," which begins about April 1 and ends about November 1. Subsequent follow-up and problem solving results in additional inspections each year. Within the planned schedules are the inclusion of all the Class I and Class II hazard dams, and approximately one-fifth of the Class III ones. Inspection of federal dams are integrated with these schedules. The State Engineer has executed a Memorandum of Understanding (MOU) with the Regional Forester, Rocky Mountain Region, USDA Forest Service, concerning the statutory obligations each has in regard to the administration and safety of dams on National Forest lands in Colorado. The Memorandum of Understanding provides for the exchange of information, assuring access to dams (e.g. wilderness areas), scheduling of the inspection of forest service dams, and the joint review for approval of plans and specifications: During 1988, the State Engineer also executed an MOU with the Bureau of Reclamation (Upper Colorado Region and Great Plains Region). The MOU provides for the exchange of information at an annual meeting; or when requested on Reclamation dams, and non-federal dams which may affect Reclamation dams; the observation of the construction at Reclamation dams; the notification of emergency conditions at mutually affected dams; and the access to technical expertise when requested. The Field Engineering Units, therefore, collectively conduct about 900 safety inspections on an "inspection season" basis, which is equivalent to a fiscal year in the amount planned.

In order to track potential problems which could develop at Class III dams between their five year engineered inspections, the Division's water commissioners are assigned lists of Class III dams to observe and to fill out a report. The report is submitted to the Branch for review, and a copy is furnished to the owner for their information and to implement any recommendations for maintenance and repair. A copy of the WATER COMMISSIONER DAM OBSERVATION REPORT is in Appendix C.

Scope

A safety inspection involves more than must a visit to the dam. The site visit is preceded by a review of the file and history of performance, and coordination with the owner, division staff, and other interested parties so they may take part in the inspection. (The statute specifies that a safety inspection 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.)

A safety inspection also includes an evaluation of the adequacy of the spillway to pass the appropriate magnitude flood for the dam's size and hazard class, to make an evaluation of the dam's hazard classification and whether it has been affected, and to assess the several emergency preparedness plans for the dam.

The findings of the inspection are documented on a report form which 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 on the safe storage level. The report also enumerates the several repair and maintenance items which the owner must attend to, and specifies the several engineering and monitoring requirements necessary to assure the safety of the dam. (A copy of the ENGINEERS INSPECTION REPORT is in Appendix D.)

In order to assure the quality control of the safety inspections of several hundred reports generated each year, the supervisors of the field engineering units review the findings and conclusions of each report. They also provide guidance and direction on problems and questions that the field engineers have.

An invoice for the cost of the inspection is also prepared in accordance with the provisions of the statutes, the payment being due within thirty days of receipt by the owner.

If the safety inspection finds that the overall conditions are unsafe, an order is written by the State Engineer restricting the storage in the reservoir to a safe level. If the findings are conditionally satisfactory, full storage is recommended contingent upon appropriate monitoring provisions being provided by the owner. Restriction orders are accompanied by orders to rehabilitate the dam to make it safe for full storage, or to breach the dam.

Orders to repair or maintain the dam usually require the reinspection of the dam in order to verify that the work has been done in a workmanlike manner. Reinspections normally occur to assure follow-up of the State Engineer's orders, or by request from the owner.

In the event the owner fails to comply with an order to make a dam safe, a breach order is issued to remove the hazard created by the dam and reservoir. This subject will be covered in more detail later in this report under RESULTS OF SAFETY INSPECTIONS AND ENFORCEMENT ORDERS AND PROCEEDINGS, where the Attorney General is requested to commence proceedings against owners refusing to obey the written orders of the State Engineer.

Number of Inspections

During FY 88-89, a total of 957 safety inspections were conducted (and 100 construction inspections) for a total of 1057. This included 248 safety inspections of Class I hazard dams, 336 safety inspections of Class II hazard dams, 369 safety inspections of Class III hazard dams, and four safety inspections of Class IV hazard dams (including federal dams). The objective of inspecting all Class I and Class II hazard dams on an annual basis is an "inspection season" objective versus a fiscal year one. This objective was reached for "inspection season" 1988, with the assistance of the field unit supervisors, and is expected for 1989.

Assistance to Dam Owners

During the year the field engineers had several occasions to assist dam owners in the repair and maintenance of their dams. Following are examples of the assistance provided.

1. In Rio Blanco County, a hydrology study was performed for Larson #2 dam in order to determine the size of a spillway. It was lowered one foot.
2. In Las Animas County, an interim hydrology study was done for Apishipa dam in order to make the dam able to pass the 100 year flood pending upgrade to 50 percent of the Probable Maximum Flood (PMF) as required by the regulations.
3. In Grand County, assisted the engineer with hydrologic portion of the spillway flood for Parsons dam. Also assisted the owner of the Phenev dam in the sizing of the spillway for the 100 year flood.
4. In Mesa County, assisted the owner of Coon Creek #4 dam in the modification of their dam to non-jurisdictional size.
5. In Weld County, advised the owner of Rockwell Dam in the placement of riprap which allowed the removal of a restriction.
6. In Delta County, assisted with emergency repairs to Weir and Johnson Reservoir after the outlet collapsed. Assisted the owners of Hale Reservoir in the repairs to holes in dam; provided hydrology study for Dowdy Reservoir.
7. In Montrose County, provided assistance on spillway design for Chippeta Lakes.
8. In Archuleta County, assisted engineer in the repairs to Thomas Reservoir.
9. In La Plata County, met with owner on proposed Wilson Gulch Dams, and assisted engineer for Amber Dam with design of repairs, and provided owner with assistance in field to improve dams' safety.
10. In Mineral County, provided owner with directions for repairing dam and sizing the spillway.

Results of Safety Inspections

The 957 safety inspections resulted in the issuance of 19 restriction orders due to unsafe conditions during FY 88-89. Fifty former restrictions were removed, and 13 revised.

As of June 30, 1989, there were a total of 245 restriction orders in effect. The following tables show the cause for restriction by category and hazard class in Table 3, and by category and Irrigation Division in Table 4.

TABLE 3

CAUSE FOR RESTRICTION BY CATEGORY/HAZARD¹

HAZARD	A		B		C		D		TOTAL	
CLASS I	10	(-9) ²	3	(0)	10	(-17)	5	(0)	28	(-10)
CLASS II	17	(-15)	25	(-22)	11	(-15)	5	(-50)	58	(-23)
CLASS III	<u>62</u>	<u>(-9)</u>	<u>69</u>	<u>(0)</u>	<u>13</u>	<u>(-38)</u>	<u>15</u>	<u>(0)</u>	<u>159</u>	<u>(-8)</u>
TOTAL	89	(-10)	97	(-7)	34	(-26)	25	(-17)	245 ³	(-12)

TABLE 4

CAUSE FOR RESTRICTIONS BY CATEGORY/IRRIGATION DIVISION

DIVISION	CATEGORY					TOTAL	NO. OF NONFEDERAL DAMS
	A	B	C	D			
1	42	39	17	13		111	695
2	13	22	6	3		44	280
3	4	1	0	0		5	60
4	9	11	5	3		28	229
5	14	15	4	1		34	183
6	6	5	1	3		15	131
7	<u>1</u>	<u>4</u>	<u>1</u>	<u>2</u>		<u>8</u>	<u>72</u>
TOTAL	89	97	34	25		245 ³	1650

A - Inadequate Spillway/Freeboard

B - Structural Problem (Deteriorated appurtenances, cracking, erosion, scarps, sinkholes, deteriorated riprap, etc.)

C - Leakage/Piping Conditions

D - Stability (Slides, saturated slopes)

¹In effect as of June 10, 1989²(%) change from FY 87-88³All nonfederal dams

The approximate amount of storage lost due to restrictions is 183,058 acre-feet. The number of restrictions has been reduced, reflecting the repairs the owners are making to their dams, or breaching. A list of the storage restrictions by name, former Water District, amount of restriction, date reason, hazard rating, and approximate storage lost is contained in Appendix E.

The greatest problems causing the unsafe conditions according to the tables are inadequate spillway capacity, insufficient freeboard (freeboard is the vertical distance between the bottom of the spillway and the crest of the dam), and structural deficiencies. As a single category, inadequate spillway capacity represents almost half of these deficiencies; it being judged by hydrologic standards related to a dam's "hazard" to the flood plain. The State Engineer's hydrologic requirements for spillway flood capacity range from the 100-year flood to the Probable Maximum Flood (PMF); any spillway capacity less than the PMF requiring demonstration that the overtopping failure of the dam will be insignificant on the floodplain. The number of leakage and piping problems decreased materially for all classes of dams. There were significant decreases in other categories as well, such as structural problems with Class I hazard dams, and stability problems with Class I and Class II dams.

With inadequate spillways identified as a frequent deficiency concerning the safety of dams in Colorado, a large number of orders issued by the State Engineer to dam owners is the need to repair and enlarge spillways. For "inspection season" 1988, all dams were being evaluated for hydrologic adequacy in accordance with the following. All dams must pass a 100-year flood with one foot of residual freeboard. For Class I and Class II hazard dams that cannot do this, the dam is restricted to a level that can handle the 100-year event, and an order issued to upgrade the spillway (to the PMF, if needed). For low hazard dams that cannot pass the 50-year flood, the dam is restricted to handle the 50-year event, and an order issued to upgrade the spillway (to at least the 100-year event). If a low hazard dam will pass the 50-year event, but not the 100-year event, an order is issued to upgrade the spillway to the 100-year event. In each case, the owner has the alternative to partially or fully breach the dam. For "inspection season" 1989, the spillways are being evaluated in accordance with the regulations adopted September 30, 1988.

In cases where the restriction orders cannot be enforced during flooding due to inadequate outlet capacity, and the owner has not complied with the orders to rehabilitate the dam, orders are issued to partially breach the dam by cutting the spillway down to the restricted level. The work must be done under the supervision of a registered professional engineer, and the spillway must be able to pass the 100-year flood.

In the event the owner does not comply with any of the above orders, another order is issued to completely breach the dam. The breach must be of sufficient width to pass abnormal flood flows without surcharging the reservoir basin by passing the 100-year event at less than five feet of depth.

Following is a list of dams which were breached during FY 88-89:

<u>NAME</u>	<u>COUNTY</u>	<u>DIV/DIST</u>	<u>DESCRIPTION</u>
Rudolph	Grand	5/50	Total breach, 15-foot bottom width.
Willow Creek	Eagle	5/37	Spillway lowered two feet.

USE OF APPROPRIATED FUNDS

The legislature, for FY 88-89, budgeted \$802,789.00 for dam safety personnel services. The Division of Water Resources allocated \$36,735.00 for both operating costs and for travel and subsistence to the Dam Safety Branch.

Dam Safety personal services expenditures for the fiscal year were \$804,524.00. Total operating and travel and subsistence expenditures were \$32,695.00. (No capital expenditures were made during the fiscal year.) In order to more effectively and efficiently administer the program, the State Engineer has transferred three field engineers to the Division offices in Glenwood Springs, Montrose, and Durango. The engineer in Durango also supports the program in the Alamosa Division office. Besides realizing a savings of approximately two thousand dollars in travel costs to administer the program in these areas, another benefit being achieved is availability to the dam owners to assist them with the maintenance and repair of their dams.

Although the initial assignment in Division Four had an inauspicious beginning, both dam owners and State Representative Margaret Masson have commented favorably on the conduct of the field engineers' performance and the greater understanding and cooperation realized by having the field engineers working out of the division.

Unfortunately, the loss of an FTE in 1988 is beginning to affect the ability to transfer other field engineers due to excess workload for the remaining field engineers on the east slope. The majority of dams exist on the east slope, especially class I and II hazard dams.

Whenever possible, the members of the Dam Safety Branch are provided or given administrative leave to take training. Several members have attended meetings of the Association of Dam Safety Officials, taken university courses, the state's Supervisory Certificate Program, and computer-related courses. Funds for these, however, must be gleaned from the operating budget, because there is no cost center for training. The funds saved by decentralization have been used to assist training.

RECEIPTS GENERATED FOR COSTS OF INSPECTION AND FILING OF PLANS

Fees collected by the State Engineer and deposited in the General Fund for dam safety were \$44,424.60 for safety inspections and construction observation, and \$3,193.04 for filing plans and inspections during the period. Invoices totaling \$49,743.29 were issued for safety inspections during the period.

RULES AND REGULATIONS

Upon completion of the final draft of regulations in 1988, public meetings were held in Delta, Alamosa, and Denver to receive input on the proposed rules. The proposed fiscal impact statement was filed with the Office of Regulatory Reform, and the notice of the hearing on the rule making was published in the Colorado Register. A prehearing conference was held on March 25, 1988, and the hearings were held from April 13 to 18, 1988. Substantial revisions were made to the rules based upon testimony from the hearings. The revisions were transmitted

to the parties to the hearings on August 1, 1988, with final comments due by August 15, 1988. Several additional revisions were made, and the rules were adopted on August 26, 1988. They were published in the September 10, 1988 issue of the Colorado Register and became effective on September 30, 1988.

The new regulations have reduced the size requirements for spillways by relating them to the dam's size and hazard class (lesser requirements for smaller dams). The cost for determining spillway adequacy should be less in most cases, and the cost of the spillways themselves should be less without jeopardizing the public safety.

In order to safeguard life, health, and property, the design and construction of dams must be done by professional engineers who are certified to practice in accordance with the laws regulating professional engineers. The regulations require the use of engineers for the design and construction of dams where they constitute a significant hazard to life and property; the requirements for assuring safe design and construction, however, vary with the size and hazard class of the dam. For Class III and IV hazard dams, the dam owners will be able to repair their dams themselves with assistance from the State Engineer.

The regulations also provide for the safety inspection of dams by the owner's engineer, where it is more expedient and beneficial to the owner. The manner in which fees are collected for safety inspections of dams was revised to lessen the daily charge to owners of dams who have more than one of their dams inspected the same day.

ENFORCEMENT ORDERS AND PROCEEDINGS

During the fiscal year, the State Engineer was involved in enforcement proceedings under Section 37-87-114, C.R.S. (1973)(1988 Supp.). Following is a brief description of the case.

Oberon No. 1 Dam

Oberon No. 1 Dam is located in Section 3, Township 3S, Range 69W, in the vicinity of 68th Avenue and Independence Street, Arvada, Colorado. It is a thirty-foot high, 54-acre-foot, Class II hazard dam.

On July 8, 1985, an order was written by the State Engineer to the dam owner to provide an acceptable spillway or breach the dam. On January 21, 1987, the Urban Drainage and Flood Control District communicated their interest, along with the City of Arvada and Jefferson County, in modifying the dam to conform with a master plan of improvements for Hays Lake (aka Oberon No. 1), and the contiguous flood plain. The plan was previously approved by the State Engineer, which would alter the dam to nonjurisdictional size and eliminate the hazard.

Subsequent attempts to accomplish the alteration by the several parties was unsuccessful due to the Oberon Water Company failing to participate in the joint venture within the prescribed time (several extensions were granted from 1985 to 1988). On April 1, 1988, the dam owner was notified of the State Engineer's intent to proceed with legal action to enforce his order. The case, No. 89CV460, Division 7, is pending in District Court, Jefferson County, Colorado.

EMERGENCY PREPAREDNESS PLANS

During the National Dam Safety Program's inspection and Phase I findings/recommendations on Class I hazard dams, the preparation and maintenance of plans to combat incidents at dams, and to give warning to the floodplain area downstream, became a common recommendation of the reviewing professional engineers. At the conclusion of the National Dam Safety Program in 1981, the State Engineer requested that all owners of Class I hazard dams prepare emergency preparedness plans and provided a guideline for them to follow.

As of August 25, 1989, a total of 136 plans for Class I hazard dams have been filed with the State Engineer out of the 256 federal and nonfederal Class I hazard dams on file. Of the 136, twenty-eight are for federal dams, primarily of the Bureau of Reclamation. In addition, plans have been submitted for thirty-four moderate hazard dams (three federal), and twenty-two low hazard dams (one federal). During FY 89-90, the State Engineer plans to return comments on submitted EPP's to the owners for updating, and to request the balance of the Class I hazard dam owners and the Class II hazard dam owners to prepare plans and file them with the State Engineer in accordance with the regulations. The owners will also be requested to coordinate with the Division of Disaster Emergency Services and local disaster coordinators.

DAM SAFETY DATA BASE MANAGEMENT SYSTEM

During FY 88-89, the Dam Safety Branch continued to enter data and make corrections to the data base, primarily being done by the several field engineers and a secretary. The FOCUS data base management software was acquired and installed in late June 1986. It is being tested to learn its features and capabilities. Part of the data base (VS-300) was transferred to a dBase III format in the Branch's personal computer in order to prepare reports and print the headings for our inspections forms.

EFFECTIVENESS OF PROGRAM

As expressed by the goals and objectives of the State Engineer, the program's effectiveness can be measured by the prevention of dam failures. No failures occurred during the period of the report. Another example of the effectiveness of the Dam Safety Program is shown in the tables of causes for restriction and the restriction list in the appendix. The identification of the unsafe conditions at the several dams and reservoirs and the subsequent restrictions to safe storage levels prevented inevitable failures of these structures and the costly consequences thereof. The enforcement of the State Engineer's orders also plays a role in assuring the effectiveness of the program. The combination of the State Engineer's safety inspection, restrictions, Emergency Preparedness Plans, and programs to make the dam owners more knowledgeable about the safe operation and maintenance of their dams through the State Engineer's "Dam Safety Manual," makes Colorado's Dam Safety Program one of the most effective in the United States.

In order to make dam owners aware of the value of designing, constructing, and maintaining safe dams, the State Engineer's Office sponsored a dam safety workshop in Denver, Colorado, on March 14, 1989. About three hundred participants received valuable information from engineers and dam owners on the

safe design of dams and their appurtenances, and the safe operation and maintenance of their dams. In August of 1988, the Dam Safety Branch, and the Division Engineer in Division 4, conducted a tour of dams on the Grand Mesa for members of the Joint Budget Committee. Based on their comments, a letter was sent to all dam owners explaining the purpose of the regulations for dams, and to communicate the important changes that occurred which benefit dam owners. In order to provide general information to dam owners and the public, a brochure has been produced on the construction and operation of dams in Colorado. It contains information on the types of dams regulated by the State Engineer, application requirements, safety inspections, notice to construct impoundment structures, water rights, financing, liability and insurance, and emergency preparedness planning. It is available free of cost.

Most of the members of the Dam Safety Branch are members of the Association of State Dam Safety Officials (ASDSO) and actively participates in its program. 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 state dam safety programs; provide representation of the state interests before Congress and federal agencies for dam safety; and improve efficiency and effectiveness of state dam safety programs.

The State Engineer is presently the president of the association and has been an officer and founding participant since 1984, when Colorado hosted the organizing meeting.

The chief of the branch has been serving on the Technical Activities Committee of a program for developing training in dam safety. This is a joint effort of the ASDSO and the federal dam building agencies. It is used in order to provide low cost training to states, and others associated with dams, in order to increase the safety of dams nationwide.

LEGISLATION

No new legislation was enacted except that the initial budget bill included a reduction of two FTE for the Dam Safety program as adopted by the Joint Budget Committee. The positions were restored to the budget before the bill was enacted by the legislature.

RECOMMENDED LEGISLATION

Program Funding

Increased funding is recommended for several areas of the Dam Safety Program in order to maintain and improve it. One area is increased full-time employees (FTE). With the transfer of the dams data base to the DNR WANG VS-300 computer (and the intent to place as much relevant data as possible into the system), in order to produce comprehensive management and report data, there is a need for an FTE to support the data base, the Branch, and to achieve its objectives.

Rapid changes occur in the field of dam safety engineering and related disciplines. New designs of dams (and rehabilitation of dams) are utilizing new material whose behavior and properties are unknown to the staff, and several conferences are held

throughout the country with the object of sharing knowledge and experience in the field of dam safety. It is proposed to establish a training plan to send our dam safety engineers to these training programs in order to maintain a knowledge of the state-of-the-art of dam safety. The estimated first year's cost for such a program would be about \$5,000.

Another area is the rental of "All-Terrain Vehicles (ATV's) and helicopters to allow fast and efficient access to many dams in remote areas. It is proposed to reserve about one-fourth of the helicopter time for emergency use. Estimated first year's cost for this program is \$30,000.

AEP/jmg/56211

Superv. Water Resource Eng. Steve Spann Chief, Design Review Unit

Senior Water Resource Eng. Louis DeGrave Design Review/Const. Insp.
Senior Water Resource Eng. Dennis Miller Design Review/Const. Insp.

Superv. Water Resource Eng. Gary Berta Chief, Field Eng. Unit - 1

Senior Water Resource Eng. Chin Lee Field Engineering Unit - 1
Senior Water Resource Eng. Michael Cole Field Engineering Unit - 1

Water Resource Eng. C. John Blair Field Engineering Unit - 1
Water Resource Eng. C. John Blair Field Engineering Unit - 1

CONSTRUCTION INSPECTION UNIT
Sup. Water Resource Eng. John Blair Field Engineering Unit - 1

Senior Water Resource Eng. Jim Norfluet Field Engineering Unit - 2
Senior Water Resource Eng. William McIntyre Field Engineering Unit - 2

Senior Water Resource Eng. Gregg Moser Field Engineering Unit - 2
Senior Water Resource Eng. Sally Lewis Field Engineering Unit - 2

Senior Water Resource Eng. Frank Kugel Field Engineering Unit - 2

Word Processing Operator
SR. WATER RESOURCE ENGINEER
SR. WATER RESOURCE ENGINEER

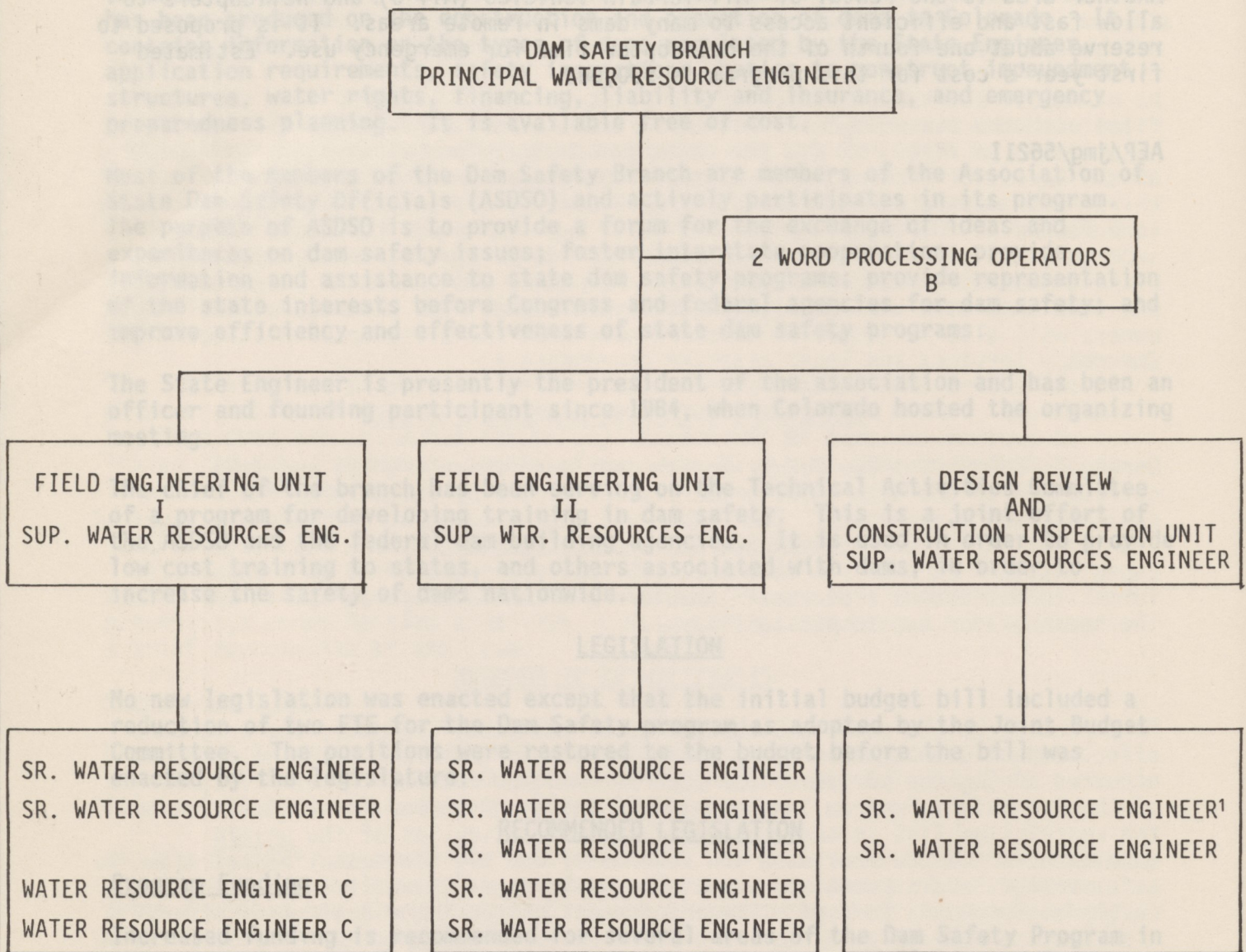
SR. WATER RESOURCE ENGINEER
SR. WATER RESOURCE ENGINEER
SR. WATER RESOURCE ENGINEER

SR. WATER RESOURCE ENGINEER
SR. WATER RESOURCE ENGINEER
SR. WATER RESOURCE ENGINEER

*Field Engineer position being used for Design Review and Construction Inspection
*Field Engineer position being used for Design Review and Construction Inspection

APPENDIX A

PERSONNEL DAM SAFETY BRANCH



¹Field engineer position being used for design review and construction inspection

APPENDIX A
PERSONNEL
DAM SAFETY BRANCH

<u>TITLE</u>	<u>NAME</u>	<u>AREA OF</u>
Principal Water Resource Eng.	Alan Pearson	Chief, Dam Safety Branch
Superv. Water Resource Eng.	Steve Spann	Chief, Design Review Unit
Senior Water Resource Eng.	Louis DeGrave	Design Review/Const. Insp. ¹
Senior Water Resource Eng.	Dennis Miller	Design Review/Const. Insp.
Superv. Water Resource Eng.	Gary Barta	Chief, Field Eng. Unit - 1
Senior Water Resource Eng.	Chin Lee	Field Engineering Unit - 1
Senior Water Resource Eng.	Michael Cola	Field Engineering Unit - 1
Water Resource Eng. C	John Blair	Field Engineering Unit - 1
Water Resource Eng. C	Gregory Kasel	Field Engineering Unit - 1
Superv. Water Resource Eng.	John Van Sciver	Chief, Field Eng. Unit - 2
Senior Water Resource Eng.	Jim Norfleet	Field Engineering Unit - 2
Senior Water Resource Eng.	William McIntyre	Field Engineering Unit - 2
Senior Water Resource Eng.	Gregg Hammer	Field Engineering Unit - 2
Senior Water Resource Eng.	Sally Lewis	Field Engineering Unit - 2
Senior Water Resource Eng.	Frank Kugel	Field Engineering Unit - 2
Word Processing Operator B	Rolynda Bain	Typing, Word Processing, Maintain File System
Word Processing Operator B	Chris Fredrich	Typing, Word Processing, Maintain File System

¹Field Engineer position being used for Design Review and Construction Inspection.

APPENDIX B

APPROVED PLANS AND SPECIFICATIONS FOR NEW DAMS OR OLD DAMS NOT PREVIOUSLY APPROVED

<u>NAME</u>	<u>DIVISION/ DISTRICT</u>	<u>"C" No. ¹</u>	<u>USE</u>	<u>DATE</u>
Copeland	1/07		DOM/IND	05/31/89
Davis	1/05	C-1688	IRR	08/12/88
Dixon Canyon	1/03	C-1695	IRR	02/24/89
Fait	6/58	C-1684	IRR/FISH	08/22/88
Harriman	1/09	C-1689	MUN	10/17/88
Ish #3	1/04		IRR	08/31/88
Lake Loveland	1/04	C-1686	IRR	09/01/88
Langholen	5/51	C-1696	IRR	03/13/89
Lone Cabin	4/40	C-1683	IRR/STK	07/28/88
Louisville #1	1/06	C-1699	MUN	04/10/89
Rainbow Lake	2/11	C-1687	IRR/REC	09/21/88
Regan Lake	3/20	C-1685	IRR	08/22/88
S. Lazy U.	3/20	C-1692	REC/FISH	10/12/88

¹Filing system for approved plans (C-1651). Assigned to new dams and existing dams without previously approved plans which are being altered, enlarged, or repaired.

APPENDIX B (continued)

APPROVED PLANS AND SPECIFICATIONS FOR ALTERATIONS,
ENLARGEMENTS, OR REPAIR OF EXISTING DAMS

<u>NAME</u>	<u>DIVISION/ DISTRICT</u>	<u>"C" No.²</u>	<u>USE</u>	<u>DATE</u>
Beaver Brook #2	1/07	LTR	MUN/IRR	06/19/89
Clarks Lake	1/03	C-897A	IRR	09/19/88
Doughty	4/40	C-1420A	IRR/DOM	07/22/88
Gobbo #3	4/42	C-1377A	IRR/DOM/STK	07/22/88
Goose Lake	1/06	C-1639A	MUN	06/26/89
Humphreys	3/20	C-168C	IRR	10/11/88
Julesburg #2	1/64	C-43C	IRR	09/30/88
Long Lake	6/58	C-828A	MUN	09/06/88
Lower Long Lake	1/07	C-1460B	MUN	10/24/88
Maple Grove	1/07	C-757E	DOM/MUN	08/11/88
Marston	1/09	C-970C	MUN	05/23/89
Silver Lake	1/06	C-781C	MUN	06/26/89
Taylor Draw	6/43	C-1612A	IRR/MUN	05/05/89
Trout Lake	4/60	C-675C	HYDR/REC	09/01/88
Weir and Johnson	4/40	C-1433A	REC/IRR	07/29/88
Worster Reservoir	1/03	C-56A	IRR	09/14/88

²Filing system for approved plans (C-1008A). Letters denote revisions to previously approved plans.

NOTE: Includes AS-CONSTRUCTED plans which were prepared after sketch plans or emergency action were completed.

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 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 _____

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.

		Conditions Observed		
		GOOD	ACCEPTABLE	POOR
UPSTREAM 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 _____			
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 _____			
DOWNSTREAM 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 _____			
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 ___ No ___ Yes <input type="checkbox"/> (37) FLOW INCREASED/MUDDY <input type="checkbox"/> (38) DRAIN DRY/OBSTRUCTED <input type="checkbox"/> (39) OTHER _____			
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 _____			
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 _____			
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 _____			

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.

APPENDIX D

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 <input type="checkbox"/> (NO) <input type="checkbox"/> (YES) LEVEL _____		EPP ON FILE <input type="checkbox"/> (NO) <input type="checkbox"/> (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	CREST	DOWNSTREAM SLOPE	SEEPAGE	OUTLET	SPILLWAY	Conditions Observed		
							GOOD	ACCEPTABLE	POOR
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 _____ Comments: _____	<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) INADEQUATE SURFACE DRAINAGE <input type="checkbox"/> (19) OTHER _____ Comments: _____	<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 _____ Comments: _____	<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 ____ No ____ Yes <input type="checkbox"/> (37) FLOW INCREASED/MUDDY <input type="checkbox"/> (38) DRAIN DRY/OBSTRUCTED <input type="checkbox"/> (39) OTHER _____ Show location of drains on sketch and indicate amount and quality of discharge. Comments: _____	<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 _____ Comments: _____	<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 _____ Comments: _____	GOOD	ACCEPTABLE	POOR
							GOOD	ACCEPTABLE	POOR

See Guidelines on Back of this Sheet

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 D

DAM NAME: _____

DAM I.D.: _____

DATE: ____/____/____

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

MONITORING

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

MAINTENANCE AND REPAIRS

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

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
- ☐ (103) RECOMMENDED RESTRICTION
- RESTRICTED LEVEL
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: _____

Engineer's
Signature _____

INSPECTED BY _____

Owner's
Signature _____

OWNER/OWNER'S REPRESENTATIVE _____

DATE: ____/____/____

APPENDIX E
DAM SAFETY BRANCH
CURRENT RESTRICTIONS¹

JUNE 30, 1989

DIVISION ONE

NAME	DIST.	AMOUNT	DATE	REASON	HAZARD CLASS	APPROX. STG. LOST ACRE-Feet
Adams & Bunker #3	01	6' below crest	05/22/75	Inadequate freeboard, high seepage	3	150
Adrian Pond	04	8' below crest	12/03/86	No spillway	3	18
Akers & Tarr	05	7' below crest Oct. 1 to April 1 Full storage April to Oct. 1	03/23/89	Slide on downstream slope and seepage in area of abandoned outlet	2	34
Allis	08	11.5' below crest	05/03/85	Spillway prone to erosion	2	80
Angel Lake	03	5' below crest	09/06/88	Poor condition E. concrete wall		50
Antero	23	G.H. 18'	02/04/86	Stab. berm const. & new instrumen. monitoring	1	5,100
Badding/Croke 12 West	07	11' below embank- ment crest	12/30/83	Lack of maint. & repair; no serv. spwy.; no invest. of seepage situation, no EPP	1	751
Beaver Brook #2	07	3' below crest	09/02/88	Spillway too small	1	6
Beaver Brook #3	07	4' below spwy.	09/02/88	Inadequate freeboard	2	20
Beaver Brook #3A	07	15' below crest	06/22/87	Seepage high on embankment	1	48
Beaver Park	05	5' below spwy.	11/08/84	Inadequate spillway	1	570
Bergen East	10'	below crest	04/30/84	Cracks in crest; inadequate spillway	1	209
Bijou #2	01	G.H. 15'	05/16/83	Erosion on upstream slope	2	470
Bluebird	05	No storage	11/21/74	Poor condition	2	966
Box Elder #3	03	5' below outlet	10/10/84	No emergency spillway	3	150
Bright View #1	02	7' below crest	09/30/85	Inoperable outlet, inadequate frbd.	3	17
Camp Shoshoni	06	3' below crest	08/08/88	Inadequate freeboard	3	4
Cantrill	08	G.H. 0'	10/22/87	No spillway, inoperable outlet	3	64
Carlin	02	5' below crest	07/29/86	No spillway	3	0
Carmody	09	3' below crest	04/30/84	No spillway	2	0
Chambers	03	No storage above G.H. 45' more than 30 days	11/22/78	Excessive seepage over gage 45	1	0
**Clarks Lake	03	G.H. 5'	06/29/89	Poor condition	2	338
						9,045.0

¹Total Storage Lost - 183,058.50

*Restrictions imposed this month

**Restrictions removed this month (date)

+Revised existing restrictions

Division One (cont.)

<u>NAME</u>	<u>DIST.</u>	<u>AMOUNT</u>	<u>DATE</u>	<u>REASON</u>	<u>HAZARD CLASS</u>	<u>APPROX. STG. LOST ACRE-FEET</u>
+Clennon	05	Zero	06/12/89	Poor condition of embankment, sink-hole above outlet on d/s slope	2	120
Comanche	03	G.H. 25'	07/24/87	Sand boils in outlet discharge channel & inadequate spillway	1	340
Cooke	01	5' below crest	03/20/74	Deteriorated conditions	3	75
Croke #12 East	07	4' below emerg. spwy.	06/01/84	Leakage from outlet pipe, sinkholes & depressions above outlet pipe	2	44
Crystal	05	5' below crest at outlet	04/17/85	Excessive seep. erosion of u/s slope, no spwy., brush, trees, and slough areas on d/s slope	2	50
Curtis	03	G.H. 10'	07/02/85	Irr. narrow crst, eroded unprotected u/s slope, exten. seep. area below d/s toe.	2	173
D. A. Lord #4	01	2' below prin. spwy	02/10/76	Inadequate spillway & seepage	3	400
**Davis 1, 2, 3	80	4' below crest	06/16/89	Inadequate emergency spillways	3	10
Derby	02	14.5' below crest	02/05/85	Inadequate Spillway	2	400
Divide	05	5' crest	07/13/88	No spillway, generally poor condition	3	130
Dixon Canyon	03	6' below crest	04/13/84	Erosion of u/s slope, sliding of d/s slope, lack of maintenance	2	195
Dry Creek	03	6' below crest	03/27/84	Outlet deter., u/s face erosion seep. d/s slope cracking	3	125
Duck	65	4' below spwy.	03/23/87	Narrow crest, steep slopes	3	15
Empire	01	No storage above G.H. 29'	07/09/84	Excess seepage and no spillway	1	6,000
Erie	06	3' below crest	06/02/86	Insufficient freeboard	2	29
Fairport	04	6' below spwy.	06/22/87	Poor condition	3	30
Florissant	23	No storage	05/21/73	Spillway failed; dam breached	3	20
Foothills	05	G.H. 41'	05/20/86	Excessive leakage	1	450
Geist/aka/B-22	03	5' below crest	01/27/84	Erosion, seep., inad. spwy. no acceptable outlet	3	57.5
Gerlits	08	No storage	11/13/84	Dam partially breached due to overtopping	3	10
Gray #3	03	2' below spwy.	03/11/83	Severe erosion u/s slope	2	200
Green Lake #1	06	3.' below crest	10/12/84	Seepage, no spillway	3	30
Green Lake #3	06	3' below crest	10/08/84	Leaks, inadequate spwy. freeboard	3	60
Hanshaw	65	5' below crest	07/07/87	Seepage, slide	3	20
Havana Street	02	No storage	01/02/87	No spillway	3	75
Henry	02	No storage	01/02/87	Piping into outlet, no spillway	3	100

9,158.5

Division One (cont.)

<u>NAME</u>	<u>DIST.</u>	<u>AMOUNT</u>	<u>DATE</u>	<u>REASON</u>	<u>HAZARD CLASS</u>	<u>APPROX. STG. LOST ACRE- FEET</u>
Hoder	08	4' spillway	04/27/89	Spillway channel erosion	3	20
Hourglass	03	31.0'	08/20/87	Excessive seepage	1	259
Idaho Springs	07	9' below crest	10/06/87	Seepage, settlement, and repairs required on spillway	2	59
Ide & Starbird #1	05	3' below crest	07/03/85	Poor maintenance, eroded u/s face questionable spillway	2	
John Law	03	3' below crest 11' gage height	06/22/87	Inadequate freeboard & spillway	3	45
Johnson/aka Hohnholtz #3	48	5' below crest	07/24/86	Erosion on u/s face, lack of proper freeboard, seepage along d/s toe.	3	88
Julesburg	64	G.H. 23'	06/13/88	Seepge at toe dam #2	1	6000
Kalcevic	07	11' below crest	02/10/83	Sloughing on upstream slope	1	69
Kelly	07	3' below crest	12/05/86	No spwy, inad. outlet construction	3	30
Knoth	05	Zero storage	12/24/85	Never completed dam	3	204
Lake Loveland	04	8' below crest	06/27/85	Deteriorated outlet, no spillway	1	1,000
Lambert	08	8' below crest	07/09/84	Large slide, abandoned outlet	3	50
Leyden	07	8' below crest	05/29/74	Inadequate spillway, unstable embankment	2	207
Lilly Lake	04	3.5' below crest	10/09/85	Spillway too small	2	5
Little Gem	05	10' below crest	10/11/85	Erosion on u/s slope & crest & trees on u/s slope	3	60
Louisville #1	06	5.5' below crest	06/28/85	Excessive seepage This is a seasonal restriction between the months of 10/1 & 4/30	2	
Lower Cochran	09	4.5' below crest	05/22/86	Poor condition of upstream slope	4	2
Lower Long Lake	07	5' below crest	06/22/85	Poor condition of upstream face and crest, no spillway	4	52
McLain	23	3' below crest	07/07/87	Slip on upstream slope	3	6
Magnusun #1	23	8' below crest	12/04/85	Provide adequate freeboard	3	18
Mountain	23	4' below crest	11/06/85	Insufficient freebd., seepage @ toe	3	3
Mountain Supply #8	03	No storage	10/03/78	Poor condition	3	643
North Poudre #1	03	7' below crest	10/17/88	Seepage at higher storage levels, the condition of the upstream slope and the deteriorated condition of the outlet conduit.	2	106
North Poudre #2	03	G.H. 18'	05/15/84	Concentrated seep, questions concerning abandoned outlet	1	985
North Poudre #4	03	G.H. 17'	04/25/84	Poor u/s face, general condition	2	265
North Poudre #5	03	5.5' below spwy.	12/12/78	Seepage instability	1	2,375

12,551.0

Division One (cont.)

<u>NAME</u>	<u>DIST.</u>	<u>AMOUNT</u>	<u>DATE</u>	<u>REASON</u>	<u>HAZARD CLASS</u>	<u>APPROX. STG. LOST ACRE-FEET</u>
North Poudre #6	03	G.H. 0	05/08/89	Deteriorated outlet, potential piping, no spillway, poor overall condition	1	9,968
North Poudre #17	03	15' below crest after repaired	07/15/83	Poor condition, outlet	2	600
Oberon #1 (Lower) aka/ Hays Lake	07	No storage	06/08/85	Inadequate spwy., inoperable & disintegrating outlets.	2	54
Ohio Lake	02	5' below crest	05/14/84	Erosion on u/s slope, rodent activity, lack of maintenance	2	0
Park Creek #2	03	8' below crest	10/03/84	Generally poor condition, seepage	2	10
Pear	05	No storage	11/21/74	Poor condition	3	420
Pennock Creek/aka/ Twin Lakes	03	Zero storage	01/22/86	Deteriorated outlet, etc.	2	278
Peterson	03	12.6' below principal spwy.	08/16/82	Excessive uplift at toe	1	246
Prospect	01	G.H. 15.5'	04/15/80	Post-failure monitor; cracking on d/s slope	2	720
Quick	08	G.H. Zero	10/22/87	No spillway, inoperable outlet	3	37
Rainbow Falls #5	08	9' below crest	09/11/85	Inadequate spillway	3	25
Richards	02	6' below crest	12/22/83	Erosion, narrow crest, seepage, plugged outlet, etc.	3	140
*Rist Benson	04	11.5'	06/15/89	Concentrated seepage	2	62
Rist Canyon	03	3' below crest	04/19/83	Poor condition	3	30
Rist George	04	G.H. 8.0'	07/18/85	Dilapidated condition, no spwy.	2	200
Riverside	01	G.H. 33.55'	05/09/84	Prevent overfilling of reservoir	1	0
Ryan Gulch	04	8' below crest	02/15/78	Inadequate spillway and leakage	2	217
Sandbeach	05	No storage	02/07/83	Poor condition	2	297
Section 19 Res.	06	4' below crest	07/24/84	No spillway	4	10
Signal #1	02	10' below crest	05/25/84	Concentrated seepage areas and questionable condition of outlet	3	100
Southside	04	8' below crest	07/07/78	Inadequate spillway	2	144
Steele Bros. #1	05	4' below spwy.	12/01/87	Sat. embankment; inoperable outlets; unknown cond. of n. outlet & adj. seep.; inad. frbd.; lack of erosion protection in spillway	3	34
Steele Bros. #2	05	3' below spwy.	11/23/87	Total rehabilitation required	3	14
Storm	02	5' below crest	11/07/84	Inadequate cross-section, low areas on crest	3	10
Stocking Pond	23	Zero Storage	06/13/88	Inadequate spillway	3	10
Sun Lake	23	8' below crest	06/20/83	Provide adequate freeboard	3	1

13,627.0

Division One (cont.)

<u>NAME</u>	<u>DIST.</u>	<u>AMOUNT</u>	<u>DATE</u>	<u>REASON</u>	<u>HAZARD CLASS</u>	<u>APPROX. STG. LOST ACRE-FEET</u>
Swede	05	5' below crest	11/14/86	Embankment seepage & inadequate freeboard	3	75
Swift	05	7' crest	12/09/88	Piping failure at outlet headwall	3	20
Thompson	02	5' below crest	10/07/87	Inadequate freeboard, generally poor condition	3	30
Tony White	08	10' below crest	05/18/84	Dam breached through spillway	3	112
Tucker Lake	07	6' below crest	06/08/87	Inadequate spillway	1	70
Twin Lakes Res.	03	Gage-height 0	01/22/86	Deteriorated outlet		278
Wadley #1	02	8 below crest	06/13/85	Poor condition of dam	3	50
Wadley #2	02	7 below crest	06/17/85	Poor condition of dam	3	140
Waterpoint	02	No storage	06/19/86	Poor condition of spillway	3	10
W. Cherry Crk #11	08	G.H. 72.8'	08/01/88	Illegal storage in flood control dam.	3	5
Wind	23	5.5' below crest	09/20/85	Saturated downstream slope	3	3
Woodland Park	08	20' below crest	05/21/83	Poor condition/inadequate spillway	1	40
						<hr/> 833.0

Division One Total

45,214.5

Revised existing restriction
Restrictions removed this month (date)
Restrictions imposed this month

**DAM SAFETY BRANCH
CURRENT RESTRICTIONS**

JUNE 30, 1989

DIVISION TWO

<u>NAME</u>	<u>DIST.</u>	<u>AMOUNT</u>	<u>DATE</u>	<u>REASON</u>	<u>HAZARD CLASS</u>	<u>APPROX. STG. LOST ACRE-Feet</u>
Browning & Reese #1	17	Zero storage	12/28/87	Generally poor condition; inoperable outlet	3	383
Browning & Reese #2	17	Zero storage	12/28/87	Generally poor condition; inoperable outlet	3	100
Calahan	10	8' below crest	12/06/84	Saturated downstream slope	3	180
*Clark #1	16	4.0 foot crest	06/07/89	Eroded upstream slope	2	20
Cottonwood #1	67	7' crest	12/20/88	Poor condition	3	20
Cripple Creek #3	12	3' below crest	06/27/86	Inadequate spillway	3	112
Cucharas #5	16	G.H. 100'	07/21/88	Poor overall condition of the embankment & history of movement	1	35,000
Evans Gulch	11	3' below crest	02/02/85	Insufficient freeboard	3	2
Evans Gulch #2	11	1.5' below spwy.	09/14/84	Insufficient freeboard	2	39
Gagliardi, Mike	19	Zero storage	10/21/87	Large animal holes in u/s slope	3	75
Garden of the Gods	10	3' crest	05/31/88	No spillway	3	
Holita	16	3' below crest	06/02/77	Inadequate freeboard, slip on d/s slope	3	189
Horse Creek & Black Draw	17	5' below crest	04/24/86	In disrepair, abandoned	3	112
Lake Chipita	10	5' below crest	12/12/84	Provide adequate freeboard	3	5
Lake Dorothy	19	23' below crest	08/12/88	Seepage and stability	3	200
Lake Henry	17	7' below crest	07/15/87	Seepage on east dam	2	2,659
Lolita #3	17	5' below crest	08/12/85	Inoperable outlet, uneven crest	3	700
Martin Lake	16	5' below crest	02/18/83	No spillway, poor condition of outlet	1	412
Mill Lake	16	9' below crest	02/16/83	Inadequate spillway, poor condition	3	40
Modern Woodmen of America #2	10	No storage	08/12/83	Spillway obstructed	3	85
Monument	10	3' below spwy.	04/23/85	Unsat. Spillway condition	2	150
Nee-Noshe	67	5' with	01/17/83	Sandboils	2	7,392
Orlando #2	16	G.H. 22.5', 4' spwy	07/24/84	Cracks on downstream slope	3	750
Park Center L&W#2	12	8.8' dam crest	01/04/89	Slide on downstream slope	3	11
						48,636.0

*Restrictions imposed this month
 **Restrictions removed this month (date)
 +Revised existing restrictions

Division Two (cont.)

Division Two Total

76,139.0

**DAM SAFETY BRANCH
CURRENT RESTRICTIONS**

JUNE 30, 1989

DIVISION THREE

<u>NAME</u>	<u>DIST.</u>	<u>AMOUNT</u>	<u>DATE</u>	<u>REASON</u>	<u>HAZARD CLASS</u>	<u>APPROX. STG. LOST ACRE-FEET</u>
Eastdale #1	24	G.H. 18' (12' below crest) 11/1 - 7/31 G.H. 15' (15' below crest) 8/1 - 10/31	08/21/87	Upstream slope erosion, seepage	3	1,700
Forbes Park	35	2.5' spwy.	07/19/85	Inadequate spillway	3	45
Lost Lake #2	20	3.5' below crest	08/14/87	Cracking, inadequate freeboard, rusted outlet	3	80
Mountain Home	35	G.H. 87.5'	09/16/82	Inadequate spillway	1	15,000
Terrace	21	7' below spwy.	07/18/84	Inadequate spillway	1	2,000
<hr/>						18,825.0
Division Three Total						18,825.0

*Restrictions imposed this month

**Restrictions removed this month (date)

+Revised existing restrictions

**DAM SAFETY BRANCH
CURRENT RESTRICTIONS**

JUNE 30, 1989

DIVISION FOUR

<u>NAME</u>	<u>DIST.</u>	<u>AMOUNT</u>	<u>DATE</u>	<u>REASON</u>	<u>HAZARD CLASS</u>	<u>APPROX. STG. LOST ACRE-FEET</u>
Alta #1	60	5' below crest	08/18/76	Inadequate spillway	4	20
Alta #3	60	5' below crest	09/16/85	Provide sufficient freeboard	4	10
Arch Slough	40	G.H. Zero	12/12/85	Poor condition, reservoir abandoned	3	66
Beaver	40	10' below spwy.	07/07/87	Excessive seepage	1	300
Big Battlement	40	5' gage-height	03/21/89	Sinkholes	3	750
Coffey	41	Zero storage	07/21/88	General poor condition	3	90
Cushman Lake	60	6' below crest	07/29/75	Provide sufficient freeboard	3	6
Cypers #1	40	4' below crest	10/13/88	Inadequate freeboard, outlet inoperable	3	10
Doughty	40	5' below spwy.	10/23/86	Seepage adjacent to outlet	3	21
Duwall #1	73	16' below crest	05/22/85	Poor condition, no outlet	3	15
Fullmoon	68	3' below crest	11/27/85	Maintain minimum freeboard	3	
Granby #11	40	4' below spwy.	10/15/87	Seepage	2	72
Granby #12	40	G.H. 17'	10/15/87	Seepage	2	98
Grand Mesa No. 1	42	3' below crest	01/27/88	Inadequate freeboard	3	48
Hale	40	5' below crest	09/17/85	Sinkholes	3	15
Knox	40	G.H. 17'	01/08/88	Seepage on embankment revision until 8/15/87	3	135
Little Giant #1	40	6' crest, G.H. 10.5'	06/06/88	Poor outlet, inadequate spillway.	3	
Lone Cabin	40	3' below spwy.	01/07/86	Slide on downstream slope	3	40
Lone Star #1	40	10' below crest	04/12/85	Constructed without approved plans and specifications	3	
Meridian Lake Park #1	59	2' below spwy.	06/04/87	Severe erosion of the spillway	3	10
Mock #1	41	9' below crest	04/26/89	60 days storage allowed above restriction	3	20
Monument	40	10' below spwy.	07/08/87	Cracks in left abutment	2	225
Priest Lake	60	3' below crest	09/16/85	Insufficient freeboard	3	25
Reeder	42	8' below crest	08/14/85	Insufficient freeboard Seepage, trees	3	96

2,072.0

*Restrictions imposed this month

**Restrictions removed this month (date)

+Revised existing restrictions

Division Four (cont.)

<u>NAME</u>	<u>DIST.</u>	<u>AMOUNT</u>	<u>DATE</u>	<u>REASON</u>	<u>HAZARD CLASS</u>	<u>APPROX. STG. LOST ACRE-FEET</u>
Todd	40	10' below crest	10/19/84	6' elevation difference along crest with no spillway	3	112
Trio	40	8' spillway	01/11/89	Slide on downstream slope	3	
Waterbug	40	6' below spwy.	11/10/86	Poor condition, slip on u/s slope, d/s outlet valve	3	65
Womack #2 & #3	40	4' below crest	11/13/87	Inadequate cross-section	3	23
						<u>200.0</u>
				Division Four Total		2,272.0

*Restrictions imposed this month
*Restrictions removed this month (date)
*Revised existing restrictions

**DAM SAFETY BRANCH
CURRENT RESTRICTIONS**

JUNE 30, 1989

DIVISION FIVE

<u>NAME</u>	<u>DIST.</u>	<u>AMOUNT</u>	<u>DATE</u>	<u>REASON</u>	<u>HAZARD CLASS</u>	<u>APPROX. STG. LOST ACRE-FEET</u>
Battlement #2	45	Zero storage	11/05/85	Damaged outlet	3	70
Big Beaver	72	10' below crest	11/17/87	Sinkholes in right embankment	3	96
Bull Basin #1	72	10' below crest	11/23/87	Spillway flows impinge on embankment toe	3	80
Bull Creek #3	72	Zero Storage Maintain Outlet Fully Open	11/23/87	Sinkhole on u/s slope	3	59
Carpenter	72	G.H. zero	11/07/86	Sinkhole, seepage	3	34
Coon Creek #1	72	8' below spwy.	09/24/87	Inadequate spillway	2	475
Coon Creek #3	72	5' below crest	09/29/87	Outlet deteriorated	3	30
Coon Creek #4	72	No storage	09/16/86	Poor condition	3	9
Currier #2	72	Zero Storage	10/16/87	Land slides into spillway	3	222
Dale	51	15.5' below crest	07/06/87	Outlet distress, sloughing at outlet	3	
Dale #2	51	5' below crest	07/05/85	Insufficient freeboard	3	15
Fruita Settling Basin #2	72	Zero storage	11/23/87	Poor condition	3	38
G. G. Lower	37	No storage	02/14/86	Inadequate freeboard	3	37
G. G. Upper	37	No storage	02/14/86	Inadequate frbd. & questionable stability of d/s slope	3	30
Harris	39	6' below spwy.	11/27/85	Undersized spillway	2	50
Jones	52	5' below p. spwy.	10/23/85	Outlet disrepair, seepage on embmnt.	2	35
Kelly Dam	53	5' below crest	09/20/85	Insufficient freeboard	3	100
Langholen	51	4' below spwy.	06/28/85	Inadequate spillway	3	60
Little King Ranch	51	9.8' below spwy. G.H. 41'	03/07/78	Excessive leakage	2	180
Mesa Lake #2	72	Zero	05/30/89	Sinkhole on upstream slope	3	25
Michaelson	72	G.H. Zero	10/21/87		3	88
Milk Creek	50	20' below crest except between 5/1/89 & 7/31/89 when filling is allowed.	02/18/89	Excessive seepage on embankment	3	60

1,793.0

*Restrictions imposed this month
 **Restrictions removed this month (date)
 +Revised existing restrictions

Division Five (cont.)

<u>NAME</u>	<u>DIST.</u>	<u>AMOUNT</u>	<u>DATE</u>	<u>REASON</u>	<u>HAZARD CLASS</u>	<u>APPROX. STG. LOST ACRE-FEET</u>
Newton Gulch	53	20' below crest	07/03/75	Abutment piping failure	3	400
Noeker	37	5' below crest	10/10/84	Badger holes down into crest	3	65
Parkerson	72	No storage	09/24/87	Improper construction	3	10
Parsons	50	Zero Storage	11/28/86	Inadequate spwy. sagging crest, abutment slides at spwy.	3	27
*Pheney	51	5' below crest	06/21/89	No spillway, extensive seepage	3	100
Rapid Creek #1	72	6' below crest	09/27/88	Inoperable outlet, erosion on u/s slope & excessive seepage	2	130
Rapid Creek #2	72	6' below crest	09/21/88	Inadequate freeboard & abandoned old outlet	2	245
Rifle Valley	39	5' below crest	02/14/77	No spillway, outlet, inoperable	2	49
Rock Creek	51	15' below crest	08/25/88	Inadequate spillway, poor embankmnt.	3	125
Ruby Lee	72	No storage	01/23/87	Inadequate spillway, poor condition	3	367
Scholl	51	22' below crest	11/28/86	Sinkholes in abutment	3	250
Sylvan	51	5' below crest	09/30/85	Erosion on u/s slope & seepage above outlet	2	130
Y-T Reservoir	72	6' below crest	09/24/87	Extensive historic seepage, inadequate spillway	3	40

1,938.0

Division Five Total

3,731.0

Restrictions imposed this month
Restrictions removed this month (date)
Revised existing restrictions

**DAM SAFETY BRANCH
CURRENT RESTRICTIONS**

JUNE 30, 1989

DIVISION SIX

<u>NAME</u>	<u>DIST.</u>	<u>AMOUNT</u>	<u>DATE</u>	<u>REASON</u>	<u>HAZARD CLASS</u>	<u>APPROX. STG. LOST ACRE-FEET</u>
Anderson	44	6' below crest	06/06/86	Blocked spillway	3	60
Bar-Bee	58	1' below spwy.	11/17/87	Spillway erosion	3	6
Basin	57	13' below crest	09/17/85	Dam is breached	3	200
Biskup Dam	44	5' below spwy.	08/19/86	Inadequate spillway, slide, poor condition	3	45
Bunker	44	5' below crest	09/24/87	Poor condition, no spillway	3	60
Clayton	47	5' below spwy.	04/16/87	Seepage on d/s face	3	60
D D & E Wise	44	5' below spwy.	09/02/88	Slope appears too steep	2	200
Drescher	44	1' below spwy.	09/22/87	Cracks in crest and spillway backcutting	3	30
Ellgen #2	44	No storage	05/30/86	Poor outlet condition	3	60
Elk Lake	54	5' below crest	09/12/85	Spillway obstructed, poor maint.	2	40
Lake Emrich	57	15' below crest	08/30/88	Slide on d/s face	3	250
Lake Gloria	43	5' below crest	12/29/87	Illegal dam w/o plans & specs.; inad. frbd.; questionable spwy.	3	7
Pole Mountain	47	No storage	03/30/83	Slide, upstream slope	2	1,905
Sullivan Dam	44	8' below crest.	09/01/88	Inadequate spillway	3	25

2,948.0

Division Six Total

2,948.0

*Restrictions imposed this month

**Restrictions removed this month (date)

+Revised existing restrictions

The major changes which have occurred are:

1. Established four classes of dams, Class 1, 2, 3, and 4, rather than three as previously utilized. The Class 4 dam is a dam for which no loss of human life is expected, and which damage will occur only to the dam owner's property. No state field engineer inspection of Class 4 dams. Class 4 dams are occasionally checked by the water commissioner and are inspected by a field engineer only if a complaint is received. There is no fee for these inspections.

(Previously, Class 4 dams were considered to be Class 3 dams and inspected and invoiced every five years.)

**DAM SAFETY BRANCH
CURRENT RESTRICTIONS**

JUNE 30, 1989

DIVISION SEVEN

<u>NAME</u>	<u>DIST.</u>	<u>AMOUNT</u>	<u>DATE</u>	<u>REASON</u>	<u>HAZARD CLASS</u>	<u>APPROX. STG. LOST ACRE-FEET</u>
Bauer #1	34	3' below spwy. for 45 days or 5' below spwy.	08/27/84	Saturation high on embankment	2	144
Big Pine	71	2' below spwy.	08/12/85	Steepness of d/s slope around outlet and seepage and sloughing from abutment left of outlet	2	70
Caballo Lake	31	2' below spwy.	07/29/86	Leakage along outlet; inadequate spillway	3	8
Charles Lemon	30	G.H. 8.5	03/07/86	Poor condition - restriction is to top of principle spwy. pipe	3	15
Henry's Dam	46	Zero Storage	04/07/89	Constructed without approved plans	3	
Highland Mary	30	11' below crest	09/12/85	Inoperable outlet, partially breached condition of dam	3	60
J. O. Spencer	34	5' below spwy.		Poor condition	3	13
Short	30	No storage. Outlet full open.	11/13/86	Inadequate spwy.; erosion on u/s face; current rest. results in about 3 AF of dead storage below invert of outlet	3	40
Division Seven Total						350.0

*Restrictions imposed this month
 **Restrictions removed this month (date)
 +Revised existing restrictions

ROY ROMER
Governor



JERIS A. DANIELSON
State Engineer

OFFICE OF THE STATE ENGINEER
DIVISION OF WATER RESOURCES

1313 Sherman Street-Room 818
Denver, Colorado 80203
(303) 866-3581

January 27, 1989

Dear Dam Owner:

With the adoption of new regulations for dam safety and dam construction, which became effective on September 30, 1988, this letter is being provided to inform you of the major provisions of the regulations, their implementation, and how they represent changes to the dam safety program, which improve its efficiency, and benefit dam owners.

The purpose of the rules are to provide for the safety of dams by establishing reasonable standards and to create a public record for reviewing the performance of dams. They apply to applications for review and approval of plans for construction, alteration, modification, repair, enlargement, and removal of dams and reservoirs, quality assurance of construction, acceptance of construction, nonjurisdictional dams, safety inspections, owner responsibilities, emergency preparedness plans, fees, and restriction of recreational facilities within reservoirs. Structures not designed or operated for the purpose of impounding water, mill tailing impoundments, solution process impoundments and siltation structures permitted by the Mined Land Reclamation Division, uranium mill tailing impoundments permitted by the Department of Health, and structures which store water only below the lowest point of the natural ground are exempt from the regulations. In addition, general maintenance, ordinary repairs, and emergency actions not impairing the safety of the dam may be done without the prior approval of the State Engineer. The rules cover these subjects in detail.

The major changes which have occurred are:

1. Established four classes of dams, Class 1, 2, 3, and 4, rather than three as previously utilized. The Class 4 dam is a dam for which no loss of human life is expected, and which damage will occur only to the dam owners property. No state field engineer inspection of Class 4 dams. Class 4 dams are occasionally checked by the water commissioner and are inspected by a field engineer only if a complaint is received. There is no fee for these inspections.

(Previously, Class 4 dams were considered to be Class 3 dams and inspected and invoiced once every five years.)

2. Spillway requirements reduced for existing dams. Rule 6 of the 1988 rules and regulations have dramatically reduced spillway requirements by 25% and 50% of previous requirements. All sizes and classes of existing dams benefit from this reduction.

(As an example, previous policy required existing Class 1 and Class 2 dams to pass 100% of the flood caused by the Probable Maximum Precipitation. The new rules reduced this to 75% for existing Class 1 and 50% for existing Class 2 dams.)

3. Private engineer not required for repairs to Class 4 dams and for simple repairs to minor and small Class 3 dams. The owner or his contractor may develop the repair plan, which will be reviewed quickly by our field engineer. The field engineer will inspect the dam and provide engineering assistance.

(Previously, full plans and specifications, signed by a registered professional engineer, were required prior to repair of any size or class jurisdictional dam.)

4. Invoicing Costs Reduced. We charge a maximum of \$125 per day for a single owner, with local travel cost and actual inspection time as the only billed items. We also schedule as many of an owner's dams as we can in the same day to minimize invoiced costs.

(Previously, inspections were invoiced at a maximum of \$125 per dam.)

5. Quicker response on design reviews. The field engineer will assist in determining a cost-effective solution to dam safety problems. He or she will also review the repair plan (often within 30 days) so construction can proceed with minimal delay. This represents office policy and is included within the field engineer's performance plan.

6. Inspection reports provided at the dam or mailed to the owner within 30 days. Special situations may take a little longer, but the field engineer will always try to discuss inspection results with the owner at the dam, or later by phone. This represents office policy and is included within the field engineer's performance plan.

(Previously, it occasionally took up to six months to finalize the report and send it to the dam owner.)

7. Better communication with dam owners. The field engineer will always try to schedule the inspection with the dam owner and invite him or her to attend at a mutually agreed upon time. The field engineer will explain inspection findings at the dam, or later by phone if necessary. Also, with the relocation of field engineers to Durango, Montrose, and Glenwood Springs, west slope dam owners now have a local representative to call on for assistance. Maintaining good communication represents office policy and is included within the field engineer's performance plan.

(Previously, dam owners were not always present during the inspection or felt they had not local representative to call.)

8. Follow-up inspections provided without charge. The field engineer will reinspect the dam at the owner's request to discuss repairs needed or to review work completed by the owner. There is no fee for this follow-up work. This represents office policy and is included within the field engineer's performance plan.

(Previously, the owner was invoiced for follow-up inspections.)

9. Training provided at no cost. Members of the Dam Safety Branch will provide dam safety training to dam owners and other interested persons. Training may include classroom as well as "on the dam" instruction. The state of Colorado "Dam Safety Manual" is available at a cost of \$8. Providing training is a matter of office policy.

(Prior to 1982, training was limited to "on the dam" training of state water commissioners.)

Some of the things we are doing with regard to implementing the rules are:

1. Developing a Design Review Manual containing the requirements for filing plans for approval by the State Engineer.

2. Providing application forms for filing plans and specifications, and a form for notifying the State Engineer of the intent to construct a nonjurisdictional dam.

3. During 1989, we will be assessing the adequacy of existing spillways for Class 1 (high hazard) dams in accordance with Rule 6.A.(4). Class 2 dams will be assessed the following year. We will be screening the spillways for potential incremental damage analysis possibilities and notifying the owners.

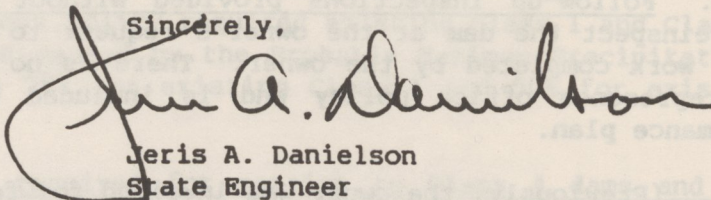
4. We will begin assessing the adequacy of outlets in accordance with Rule 15.A starting January 1, 1989. Class 1 and Class 2 dams must receive an internal inspection, unless waived in accordance with the rule, once every ten years. The owners will be responsible for facilitating the inspections by dewatering the outlet and access areas, providing a safe environment by ventilation, providing lighting and any other equipment necessary to safely accomplish the inspection.

5. We will be implementing the requirement for Emergency Preparedness Plans in 1989. Dam owners will be given up to one year to develop a plan for Class 1 dams after their safety inspection, and Class 2 dams two years. You will, however, be encouraged to develop them as quickly as possible.

6. And, finally, we will begin rating the adequacy of instrumentation, monitoring of dams, and maintenance in accordance with Rules 15.B., 15.C, and 15.D.

Copies of the rules are available from the State Engineer's office for \$3.00. They may be obtained from our Records Section, Division of Water Resources, Room 818, 1313 Sherman Street, Denver, CO 80203.

Sincerely,



Jeris A. Danielson
State Engineer

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