Colorado Division of Water Resources

COLORADO DAM SAFETY BRANCH

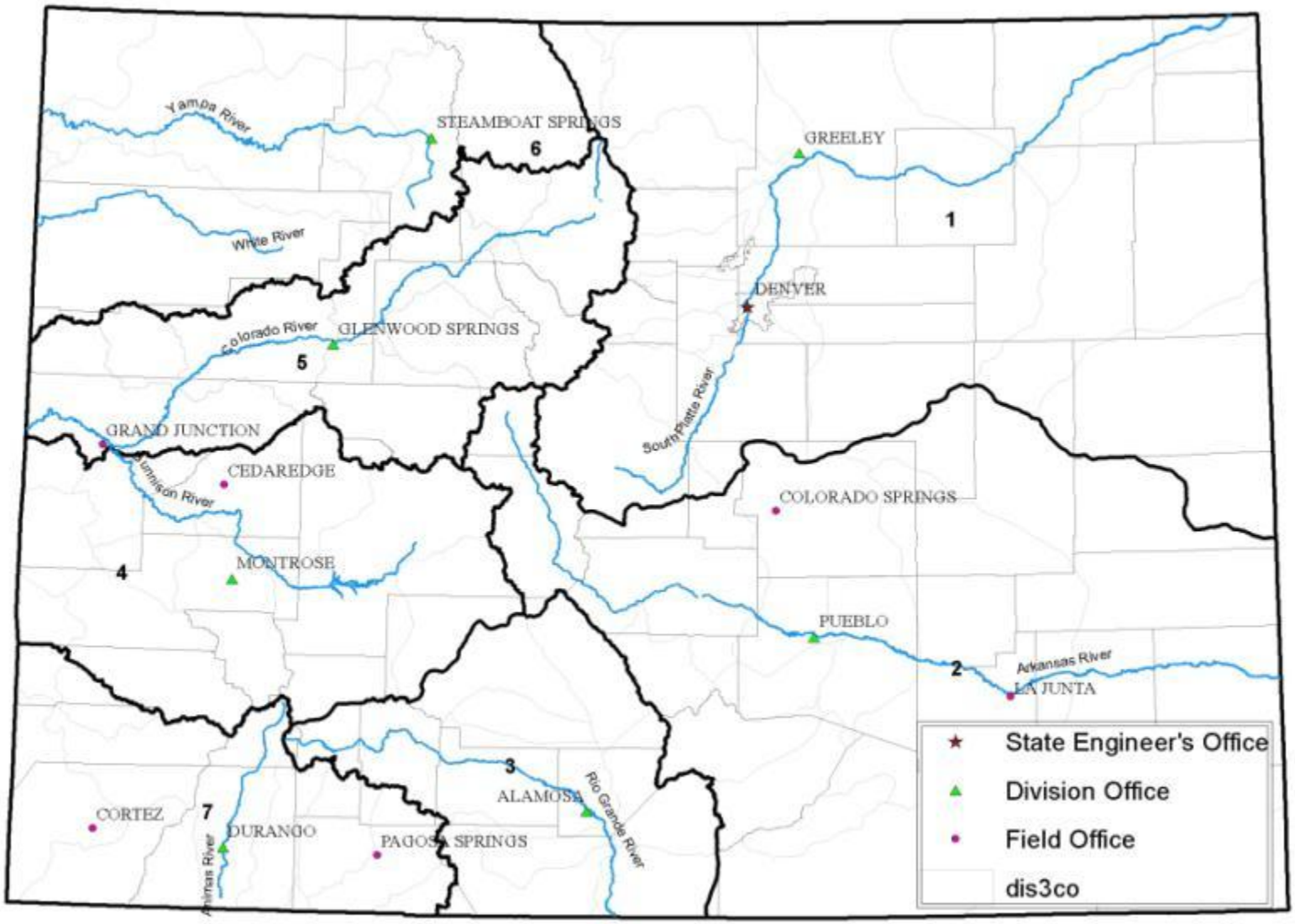
Dam Emergency Action Plans

2012 Irrigationists Symposium

March 15, 2012

John Batka & Jeremy Franz

Colorado's Water Divisions



Emergency Action Plans

- Colorado EAP Requirements
- Importance and Purpose of EAPs
- The Five Components of an EAP
- Resources Available
  - Preparation Guidance
  - Sample EAP / Template
- Emergency Remedial Actions
- Other EAP Topics
  - Exercises
  - Updates

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Colorado EAP Requirements

Rule 16.1 - Owners of High and Significant Hazard dams shall prepare and maintain an Emergency Action Plan. An EAP is a formal document that identifies potential emergency conditions at a dam and specifies preplanned immediate actions to prevent failure of the dam, reduce the potential for loss of life, and minimize property damage downstream

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Colorado EAP Requirements

Rule 16.4 – The owner shall review the EAP annually and update as necessary and appropriate. The updates shall be distributed to all parties shown on the distribution list.

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C.R.S. 37-87-108.5

If, in the opinion of the state engineer, conditions of any dam or reservoir are so dangerous to the health and safety of life or property as not to permit time for issuance and enforcement of an order relative to construction, modification, maintenance, or restriction of storage, or the dam is threatened by any large flood, the state engineer may immediately employ remedial measures necessary to protect such life and property.

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Liability for Dam Failures

C.R.S. 37-87-104: …no entity or person who owns, controls, or operates a water storage reservoir shall be held liable for any personal injury or property damage resulting from water escaping from that reservoir by overflow or as a result of the failure or partial failure of the structure or structures forming that reservoir **UNLESS** such failure or partial failure has been proximately caused by the **NEGLIGENCE** of that entity or person…

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Negligence

Conduct that falls below the standards of behavior established by law for the protection of others against unreasonable risk of harm.

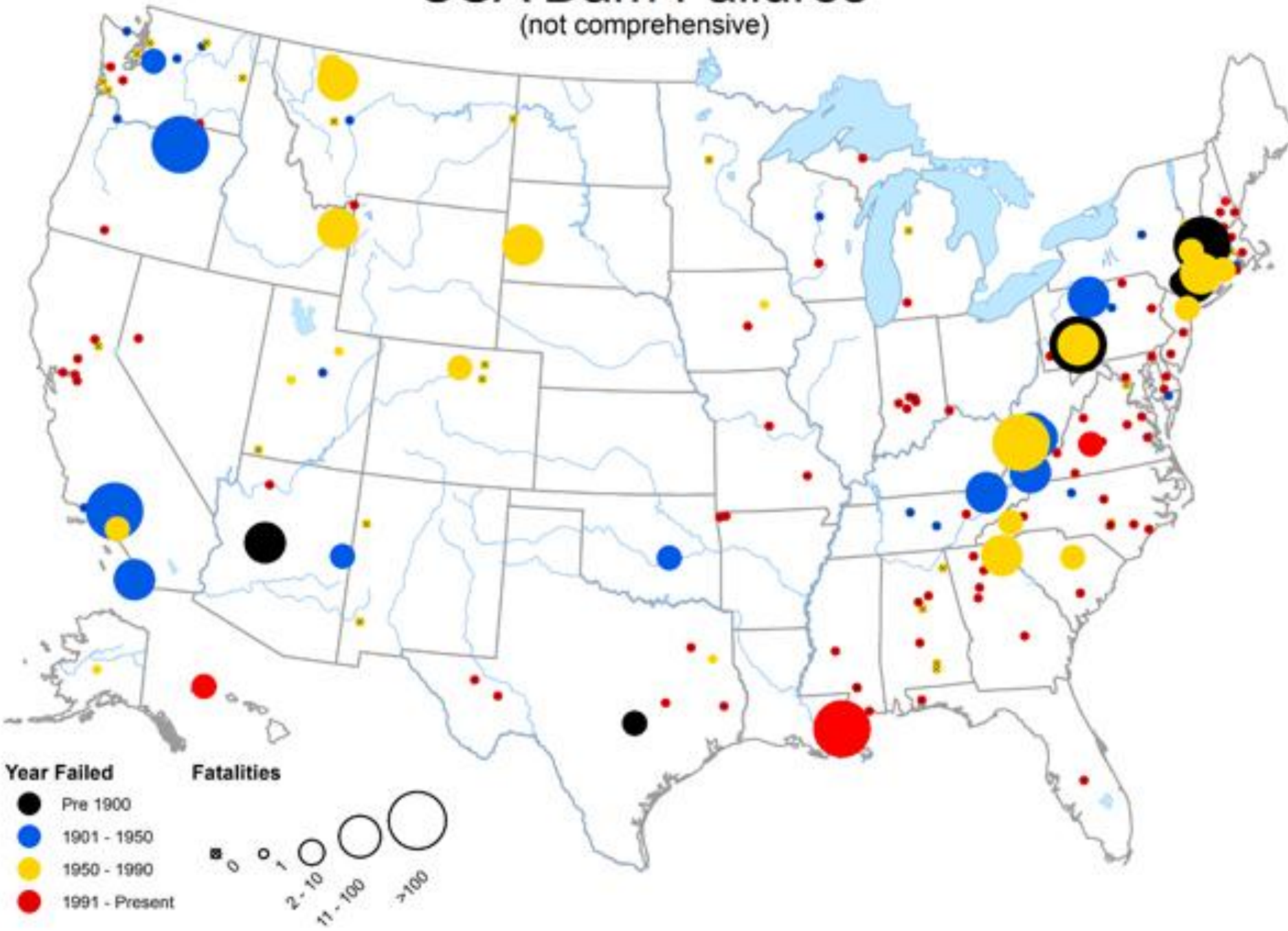
A person has acted negligently if he or she has departed from the conduct expected of a reasonably prudent person acting under similar circumstances

Importance of EAPS

- Dam Failures and Incidents Do Occur
  - Teton Dam, 1976 – 11 fatalaties
  - Laurel Run Dam, 1977 – 40 fatalities
  - Lawn Lake Dam, 1982 – 3 fatalaties
  - Tom Sauk Dam, 2005 – 0 fatalaties
  - Ka Loko Reservoir Dam, 2006 – 7 fatalities
- It will never happen to my dam…
- Those were all big dams… My dam is tiny in comparison

USA Dam Failures

(not comprehensive)



Importance of EAPs

Wayne Graham, Bureau of Reclamation

- Dam failures in US which caused at least one fatality
- 400 dam failures occurred from 1985 to 1998
- > 300 fatalities from dam failures from 1960 to 1998

Importance of EAPs

- The failure of large dams don't kill the most people - The failure of smaller dams do!
- 88% of fatalities due to dam failures were caused by dams that were less than 49 ft high
- 87% of fatalities due to dam failures were caused by dams that stored less than 1000 Ac-Ft
- Dam failures that have caused high fatality rates were those in which residences were destroyed and timely dam failure warnings were NOT issued.

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Importance of EAPs

- Focused early intervention helps to prevent an incident from spiraling out of control
- If an incident can't be averted, evacuation of those living in harms way must be a priority
- Hope for the best, but plan for the worst

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Importance of EAPs

EAPs Save Lives!

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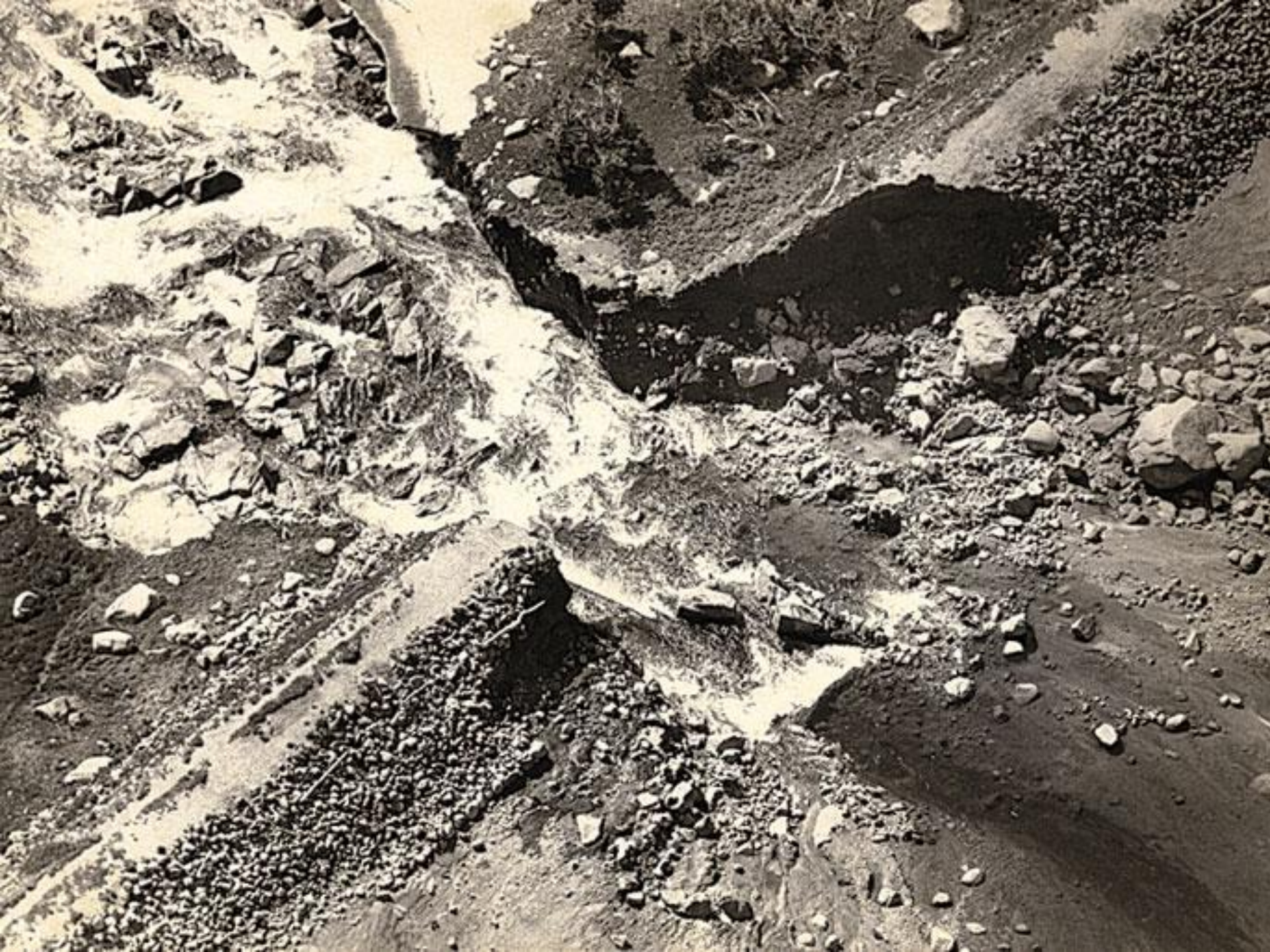

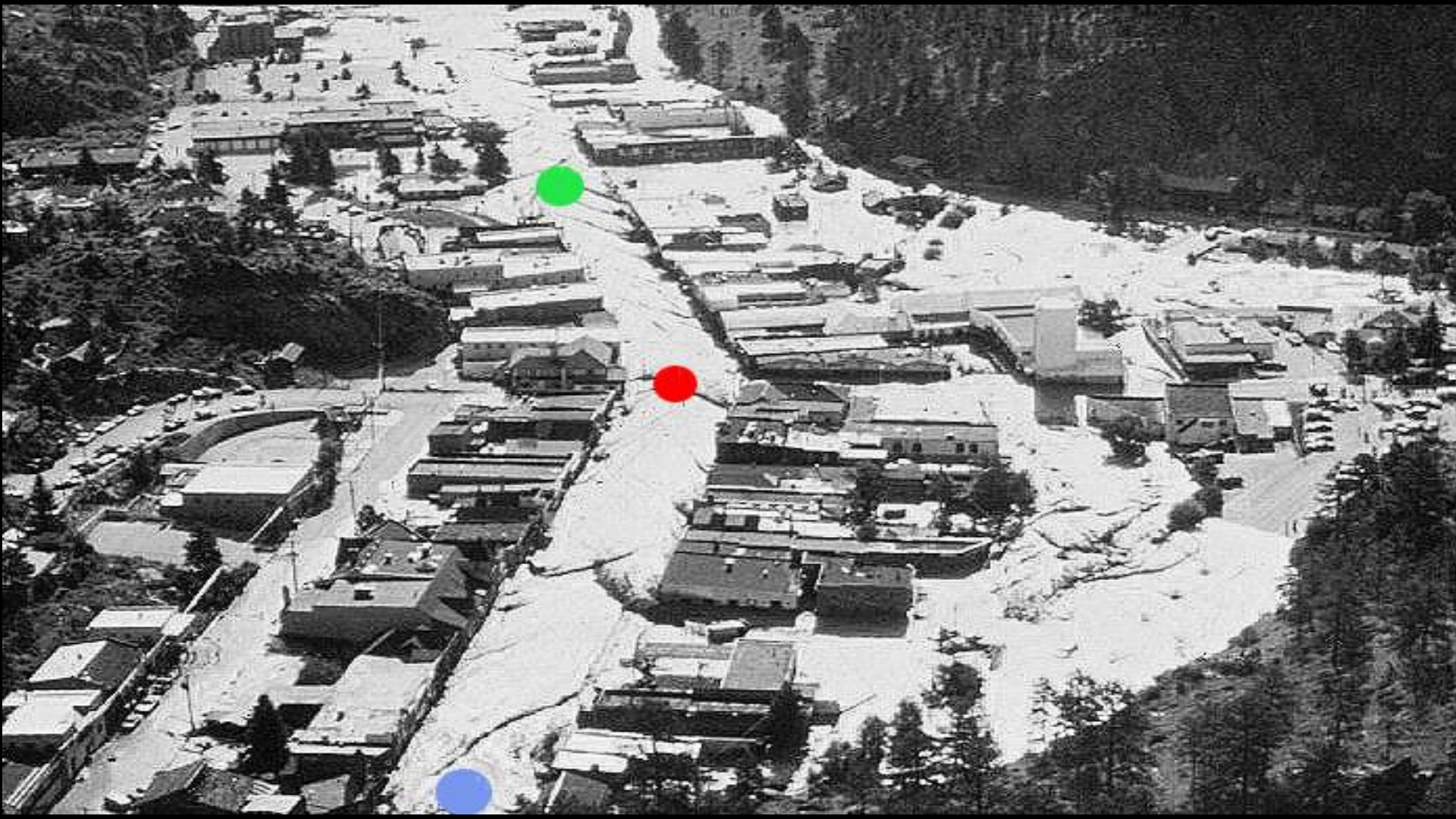

What do EAPs do?

- Provide an effective document that can be used by anybody
- Identify dam failure mechanisms early
- Outline measures to prevent the dam from failing
- Define conditions that require a response
- Provide clear direction for use during stressful situations

Purpose of EAPs

- Establish roles and responsibilities
- In the event of dam failure - prevent or at least minimize loss of life
- Get people out of harms way
- Be prepared and know what to do!
- Minimize property damage and environmental impacts if a dam failure is prevented

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10 Steps to Prepare/Maintain an EAP

1. Prepare Dam Breach Inundation Study and Field Reconnaissance
2. Prepare Inundation Maps with Flood Wave Arrival Times and Depths
3. Identify Emergency Situations and Actions
4. Identify and Meet with Involved Agencies
5. Identify Communication Methods – Primary and Backup

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10 Steps to Prepare/Maintain an EAP

6. Prepare Contact Charts Identifying Individuals, Phone Numbers and Order of Contact
7. Prepare Draft EAP
8. Distribute Draft EAP to Involved Agencies for Review/Comment
9. Revise EAP and Distribute Copies
10. Regularly Test, Review and Revise the EAP

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Roles and Responsibilities

- Dam Owner
- Local Emergency Manager
- Colorado Department of Emergency Management
- Dam Owner's Engineer
- State Dam Safety Engineer

The Five Steps of an EAP

1. Detection of an Unusual or Emergency Situation
2. Determine the Appropriate Emergency Level
3. Notification and Communication with First Responders
4. Outline Expected Actions
5. Termination of the Emergency Event

Step 1 - Detection of an Unusual or Emergency Situation

- What is Unusual?
  - Seepage?
  - Spillway Flows?
- What Constitutes an Emergency?
  - Bomb Threat?
  - Vandalism?

How are Emergencies Detected?

A. Instrumentation systems
B. Dam Tender observations
C. Observations by the general public
D. All of the above

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Step 2 – Determine the Appropriate Emergency Level

- Three Standard Levels
  1. Non-Emergency Incident
     - Unusual Event
     - Slowly Developing
     - Could Endanger Structural Integrity of Dam if not Mitigated
  2. Potential Dam Failure Situation, Rapidly Developing
  3. Urgent – Dam Failure is Imminent or in Progress
- Includes Example Scenarios of Each Emergency Level

Step 2 – Determine the Appropriate Emergency Level

Who is Responsible for Initiating an Emergency Action Plan?

A. The State Dam Safety Engineer
B. The Governor
C. The Local Emergency Manager
D. The Dam Owner

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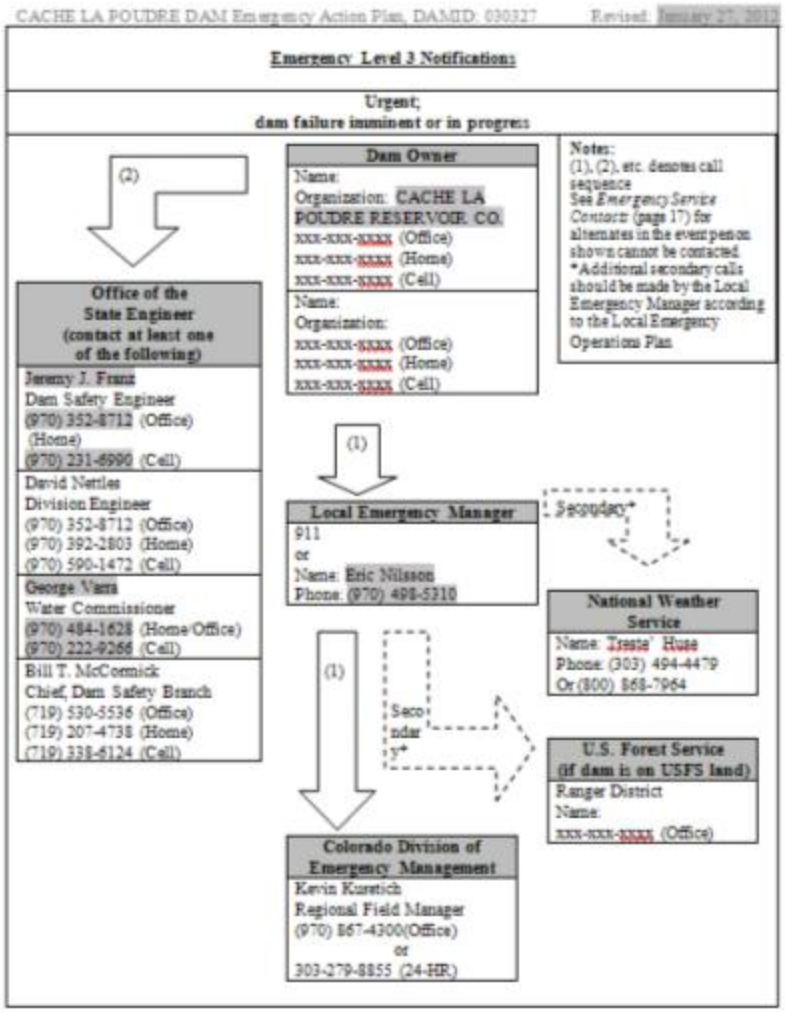
Example Emergency Levels

Event	Situation	Emergency Level
Seepage	New seepage areas in or near the dam	1
	New seepage areas with cloudy discharge or increasing flow rate	2
	Rapid flow rate increase with cloudy discharge from existing seepage area(s)	3
Security threat	Verified bomb threat that, if carried out, could result in damage to the dam	2
	Detonated bomb that has resulted in damage to the dam or appurtenances	3
Sabotage/ vandalism	Damage to dam or appurtenances with no impacts to the functioning of the dam	1
	Modification to the dam or appurtenances that could adversely impact the functioning of the dam	1
	Damage to dam or appurtenances that has resulted in seepage flow	2
	Damage to dam or appurtenances that has resulted in uncontrolled water release	3

Step 3 - Notification and Communication

- Communication Flow Chart
- Current Contact Information for all First Responders and Emergency Services
- Identifies Order of Contact Depending on the Emergency Level



How Should Communications Occur During a Dam Emergency?

A. By Telephone or Mobile Phone
B. By Radio
C. By All Communications Media Available
D. Through the News Media

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Step 4 - Expected Actions

- Identifies Actions to be Performed by the Dam Owner for each Emergency Level
- Identifies Emergency Remedial Actions that may be taken by the Dam Owner for Various Failure Modes

If a Dam Fails, Who is Responsible for Downstream Warning and Evacuation?

A. The Governor

B. The Sherriff

C. The Dam Owner

D. The Local High School Track Team

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If a Dam Fails, Who is Responsible for Downstream Warning and Evacuation?

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C. The Dam Owner

D. The Local High School Track Team

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What are the Dam Owner's Responsibilities During a Dam Safety Emergency?

A. Take Action to Prevent Dam Failure
B. Prayer
C. Keep All Parties Updated on the Status of the Event
D. All of the above

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A. Take Action to Prevent Dam Failure
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C. Keep All Parties Updated on the Status of the Event
D. All of the above

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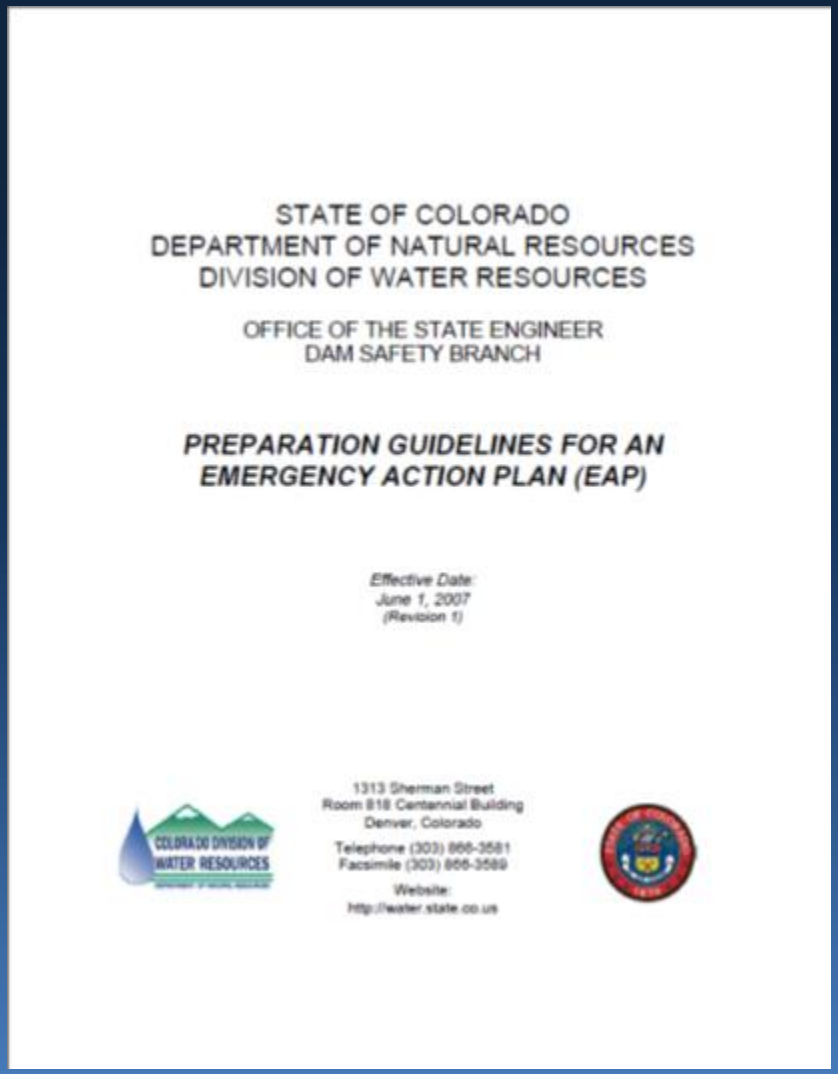
Step 5 – Termination

- Identifies Prerequisite Actions that must be Performed Prior to Event Termination
- Identifies Responsibility for Termination of the Emergency Event

Resources Available

- Preparation Guidance
- Sample EAP
- EAP Template
- Tabbed EAP Dividers



STATE OF COLORADO
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WATER RESOURCES

OFFICE OF THE STATE ENGINEER
DAM SAFETY BRANCH

PREPARATION GUIDELINES FOR AN EMERGENCY ACTION PLAN (EAP)

Effective Date:
June 1, 2007
(Revision 1)

COLORADO DIVISION OF WATER RESOURCES

1313 Sherman Street
Room 818 Centennial Building
Denver, Colorado
Telephone (303) 866-3581
Facsimile (303) 866-3589
Website:
http://water.state.co.us

Colorado Division of Water Resources

EAP Template

EMERGENCY ACTION PLAN (EAP)

WINDSOR #8 DAM

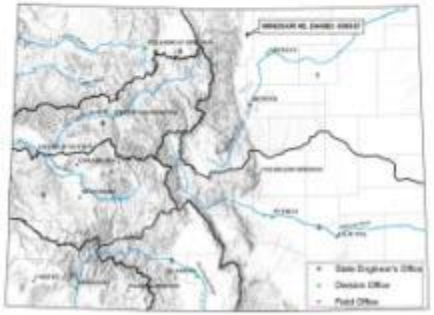
Larimer County, Colorado

HAZARD CLASSIFICATION: HIGH

State of Colorado DAMID: 030337 NATID (National Inventory of Dams): CO-00855

Water Division: 1 Water District: 3

Location Map:



Vicinity Map:

EAP Revision Date: _____

DESCRIPTION OF DAM

Dam Name:	WINDSOR #8
State of Colorado DAMID:	030337
NATID (Nat. Inventory of Dams):	CO-00855
Dam Owner:	WINDSOR RESERVOIR & CANAL CO.
Type of Dam:	RE
Hazard Classification:	High
County:	LARIMER
Location:	Section 18, Township 08N, Range 068W
	Latitude: 40.654999, Longitude: -105.04556
Nearest Town:	FORT COLLINS
Distance to Nearest Town:	3.0 (miles)
Name of Drainage, River, or Stream:	CACHE LA POUDRE RIVER
Year Constructed:	1903
Dam Height:	54.0 (feet)
Crest Length:	5200 (feet)
Crest Width:	14 (feet)
Drainage Basin Area:	1112 (acres)
Maximum Reservoir Surface Area:	392 (acres)
Reservoir Normal Capacity:	8993 (acre-feet)
Reservoir Maximum Capacity:	11031 (acre-feet)
Outlet Diameter:	54" REINFORCED CONCRETE PIPE (feet)
Outlet Type:	_____
Outlet Max. Discharge Capacity:	309 (cfs)
Emergency Spillway Type:	UCOND
Emergency Spillway Width:	9.4 (feet)
Spillway Freeboard:	5. (feet)
Maximum Spillway Capacity:	194 (cfs)

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Other EAP Requirements

- Inundation Mapping
  - High Hazard Dams – Flooding Extents, Velocities and Flood Wave Arrival Times
  - Significant Hazard Dams – Route of Flood Wave and Arrival Times
- Maintenance
  - Updating Names and Phone Numbers
  - Check all Information for Ongoing Relevance
- Testing/Exercising

EMERGENCY ACTION PLAN (EAP)

BLACK HOLLOW DAM

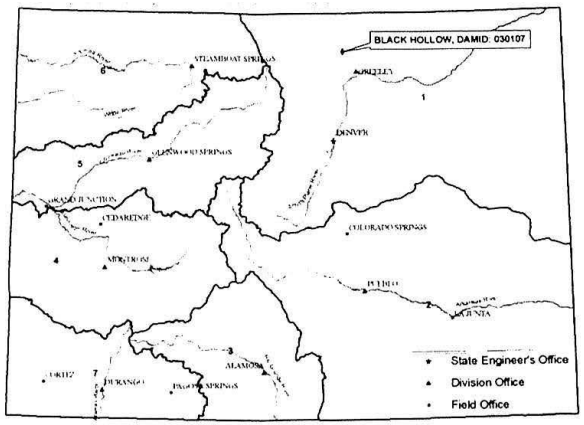
Weld County, Colorado

HAZARD CLASSIFICATION: HIGH

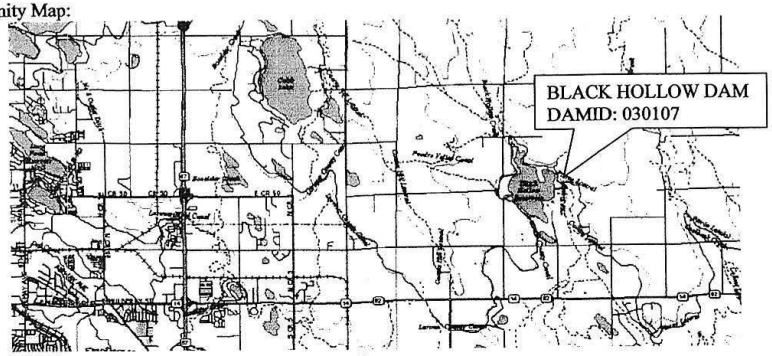
State of Colorado DAMID: 030107 NATID (National Inventory of Dams): CO-01157

Water Division: 1 Water District: 3

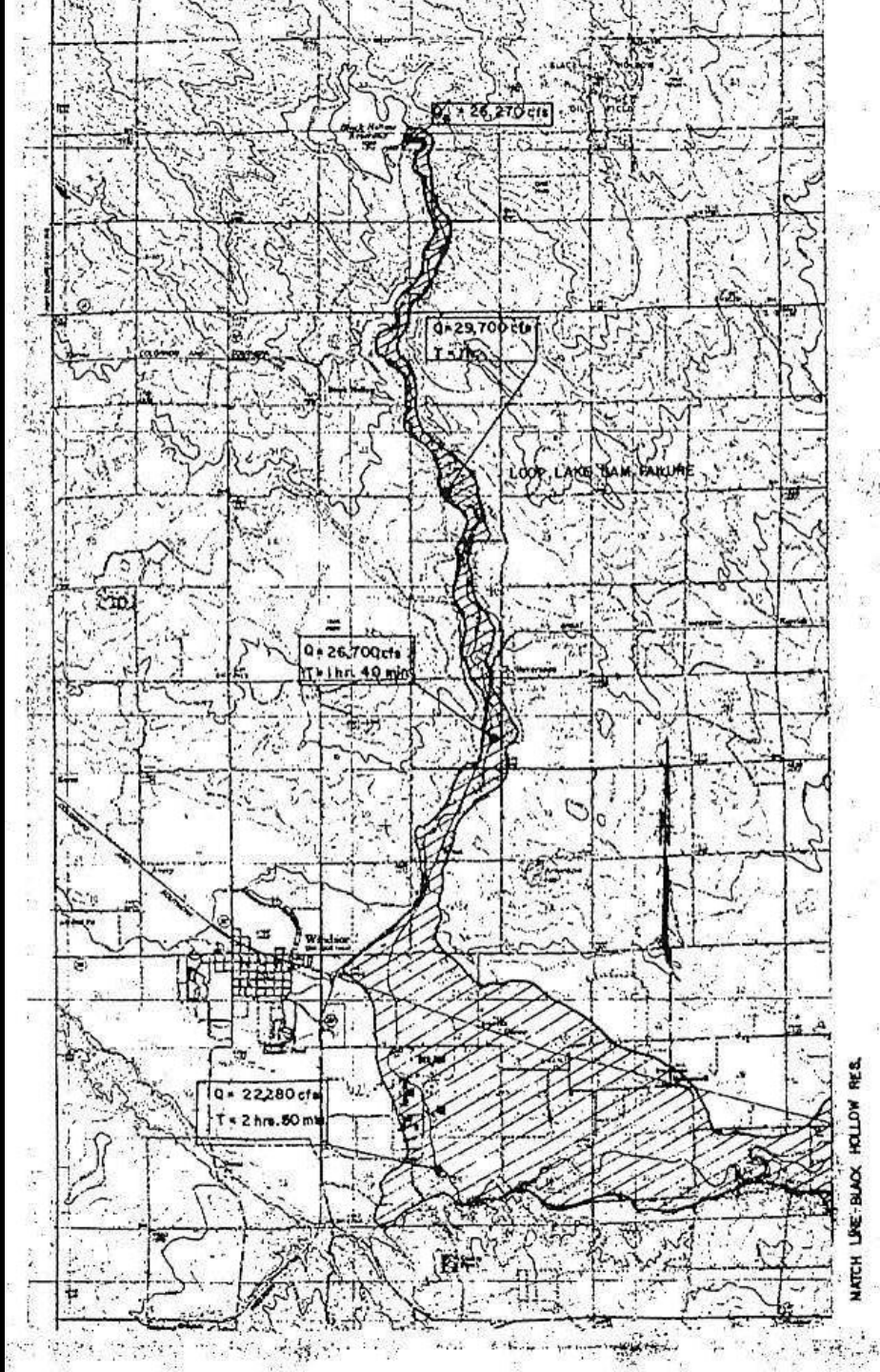
Location Map:



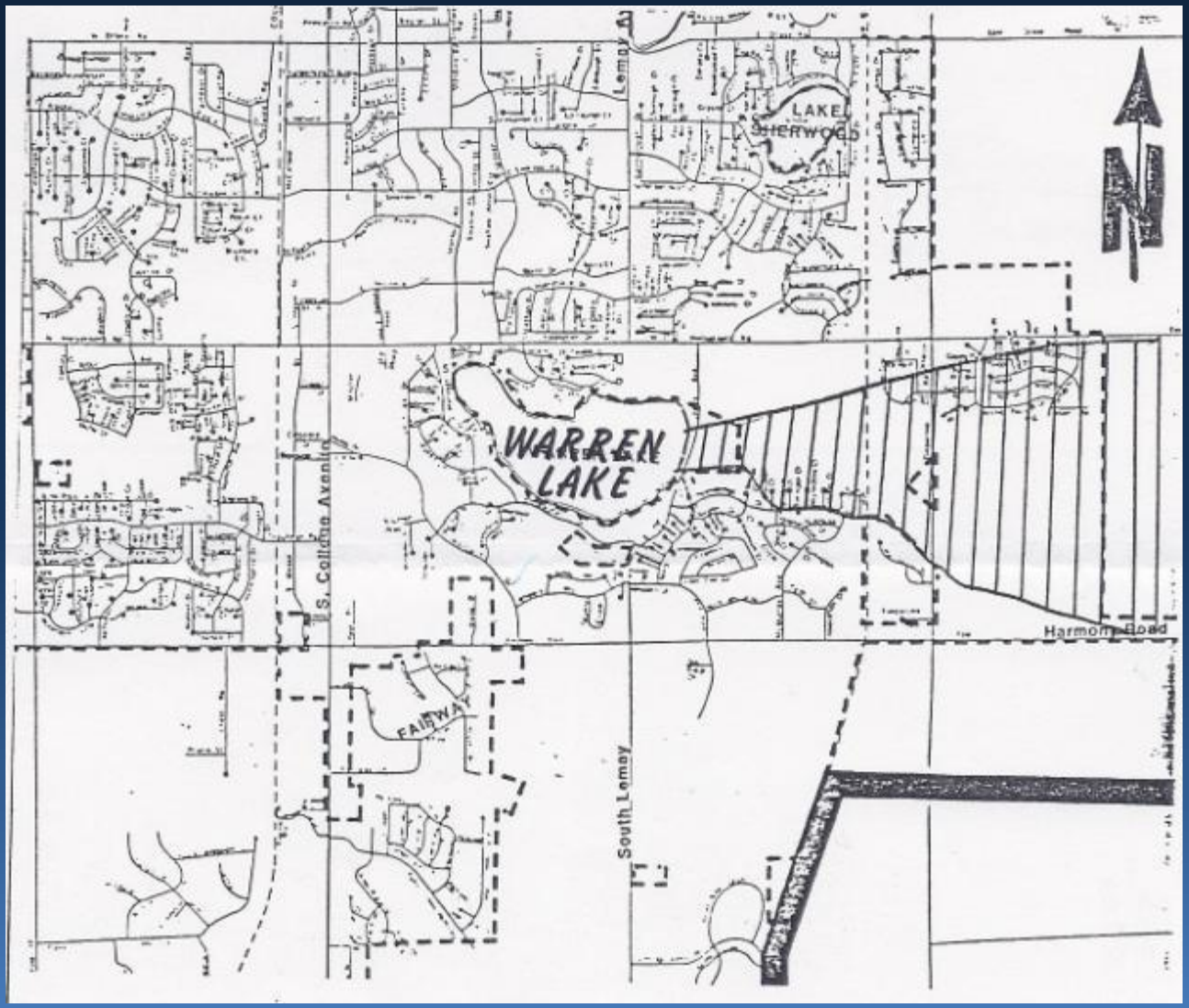
Vicinity Map:



EAP Revision Date: February 15, 2012



Inundation Mapping



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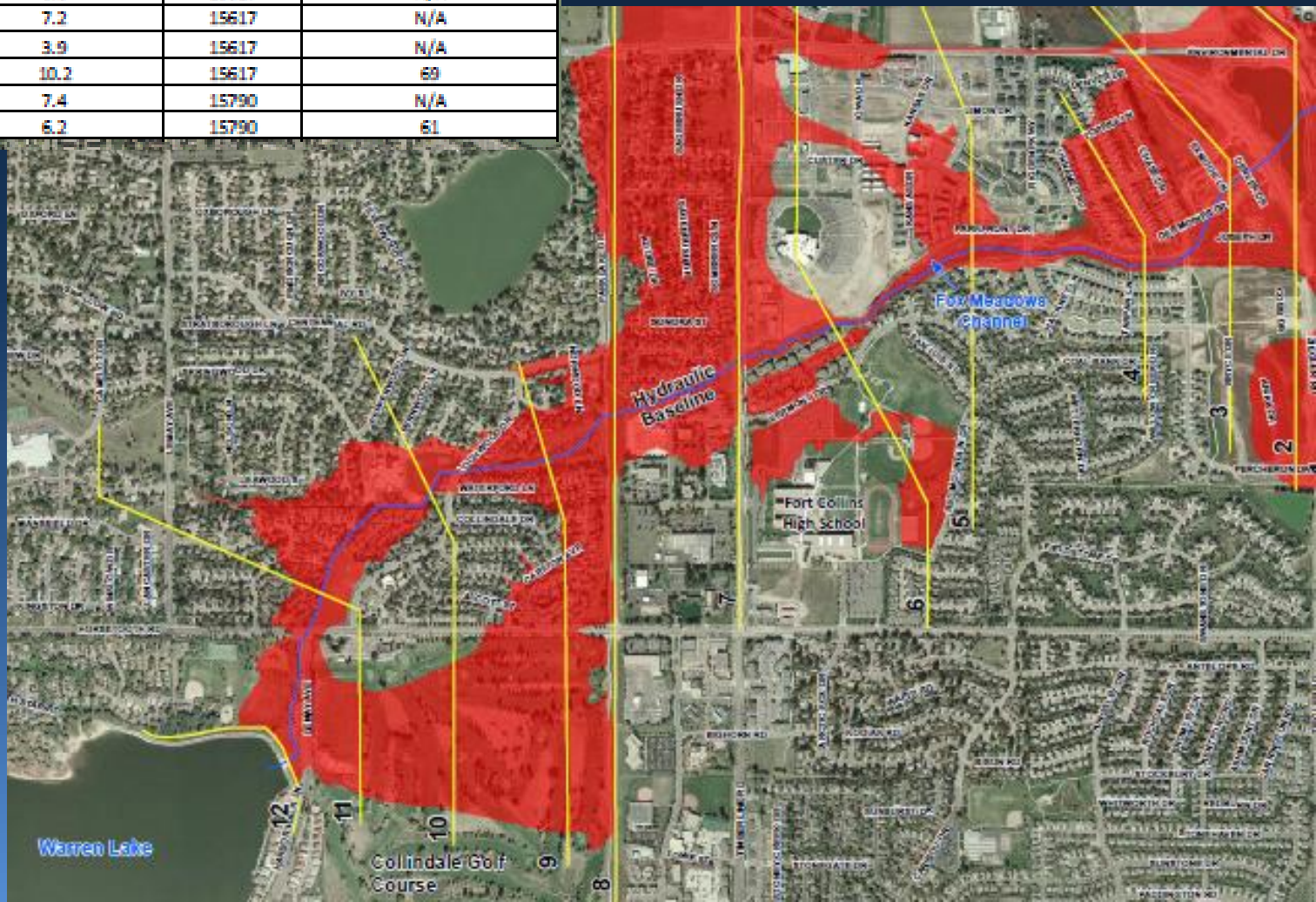
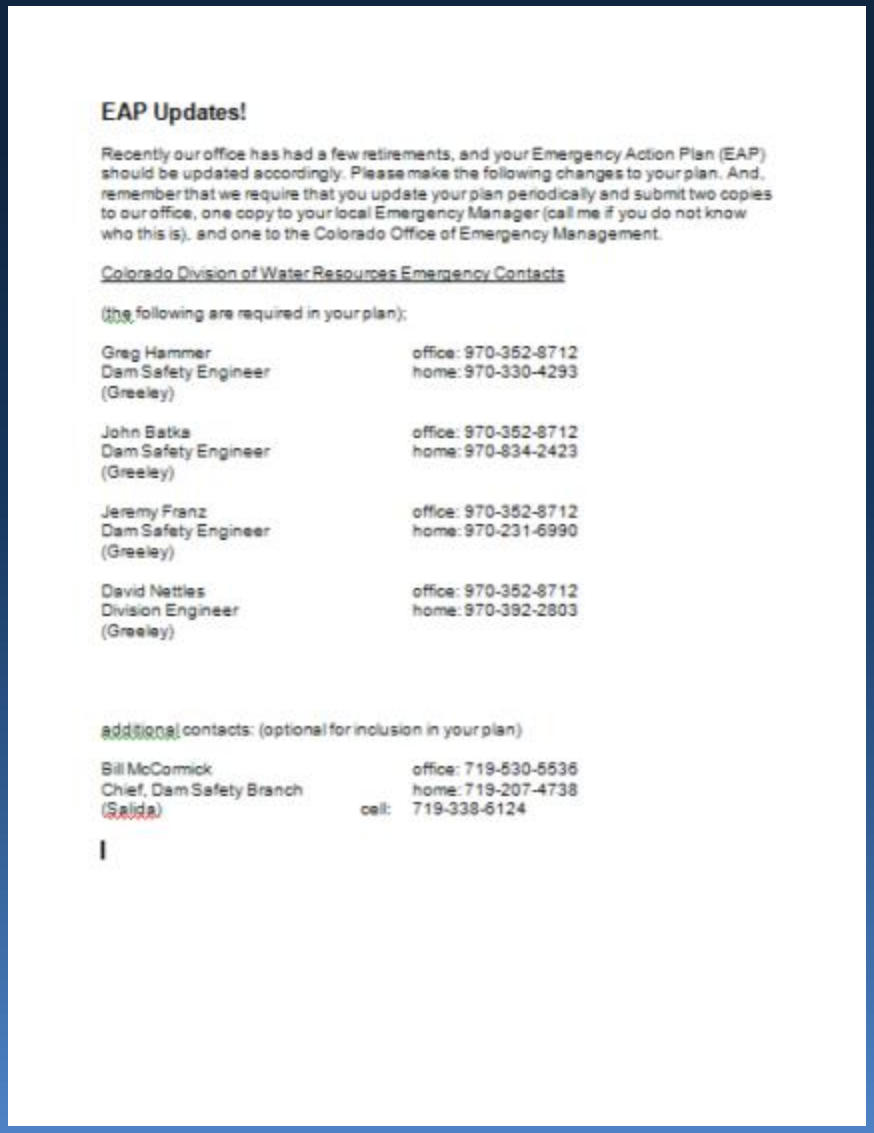
Inundation Mapping

Cross Section Number	Station	Maximum Velocity (fps)	Discharge (cfs)	Time to Peak Discharge (min)
1	104	7.4	15464	87
2	423	3.1	15484	N/A
3	1257	8.0	15484	N/A
4	2425	14.4	15484	83
5	4065	10.6	15548	N/A
6	5580	6.0	15548	76
7	6520	6.8	15617	N/A
8	7775	7.2	15617	N/A
9	8559	3.9	15617	N/A
10	9746	10.2	15617	69
11	11264	7.4	15790	N/A
12	12907	6.2	15790	61



Maintenance



EAP Updates!

Recently our office has had a few retirements, and your Emergency Action Plan (EAP) should be updated accordingly. Please make the following changes to your plan. And, remember that we require that you update your plan periodically and submit two copies to our office, one copy to your local Emergency Manager (call me if you do not know who this is), and one to the Colorado Office of Emergency Management.

Colorado Division of Water Resources Emergency Contacts

(the following are required in your plan):

Greg Hammer Dam Safety Engineer (Greeley)	office: 970-352-8712 home: 970-330-4293
John Batka Dam Safety Engineer (Greeley)	office: 970-352-8712 home: 970-834-2423
Jeremy Franz Dam Safety Engineer (Greeley)	office: 970-352-8712 home: 970-231-6990
David Nettles Division Engineer (Greeley)	office: 970-352-8712 home: 970-392-2803

additional contacts: (optional for inclusion in your plan)

Bill McCormick Chief, Dam Safety Branch (Salida)	office: 719-530-5536 home: 719-207-4738 cell: 719-338-6124

- EAPs are “Living Documents” that need frequent updates
- Contact Information Changes
- Exercise!!!

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Emergency Remedial Actions

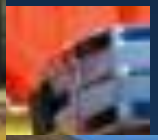
- Embankment Overtopping:
  - Open outlet
  - Sand bags on crest
  - Cover weakened areas of crest and downstream slope with:
    - riprap,
    - plastic sheeting, etc
    - to provide erosion resistance.

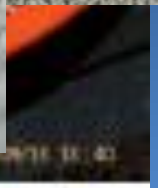
Emergency Remedial Actions

- Upstream Sinkhole (whirlpool):
  - Open outlet
  - If accessible, attempt to reduce flow by plugging entrance with
    - Hay bales,
    - Bentonite,
    - Soil or rock fill, or
    - Plastic sheeting

Emergency Remedial Actions

- Downstream Seepage/Sinkhole:
  - (
  - k :





Photograph 6-5 - Filter material

Emergency Remedial Actions

- Downstream Seepage/Sinkhole:
  - What if seepage pushes filter sand away?
    - Add gravel or riprap first to spread out flow and then continue building filter as described.
    - Build a berm or cofferdam to create a pond of water at the exit point to put hydraulic back pressure on the seepage

Emergency Remedial Actions

- Embankment Movement
  - Open outlet
  - Repair any settled areas of crest to restore freeboard
  - Add soil or rock buttress on toe area of downstream slope slides

Emergency Remedial Actions

- Planning:
  - EAP Current?
  - Knowledge of dam behavior and weather forecast?
  - Is outlet accessible and operable during emergency?
  - Is heavy equipment readily available?
  - Light plants if at night?
  - Materials stockpiled?
    - ASTM C-33 Filter Sand?
    - 2 to 3 inch minus drain gravel?
    - 8 to 12 inch graded riprap?
    - Sand bags, plastic sheeting?

Grant Opportunity

- DSB FEMA Inundation Mapping Grant Program
- CWCB Severance Tax Grant

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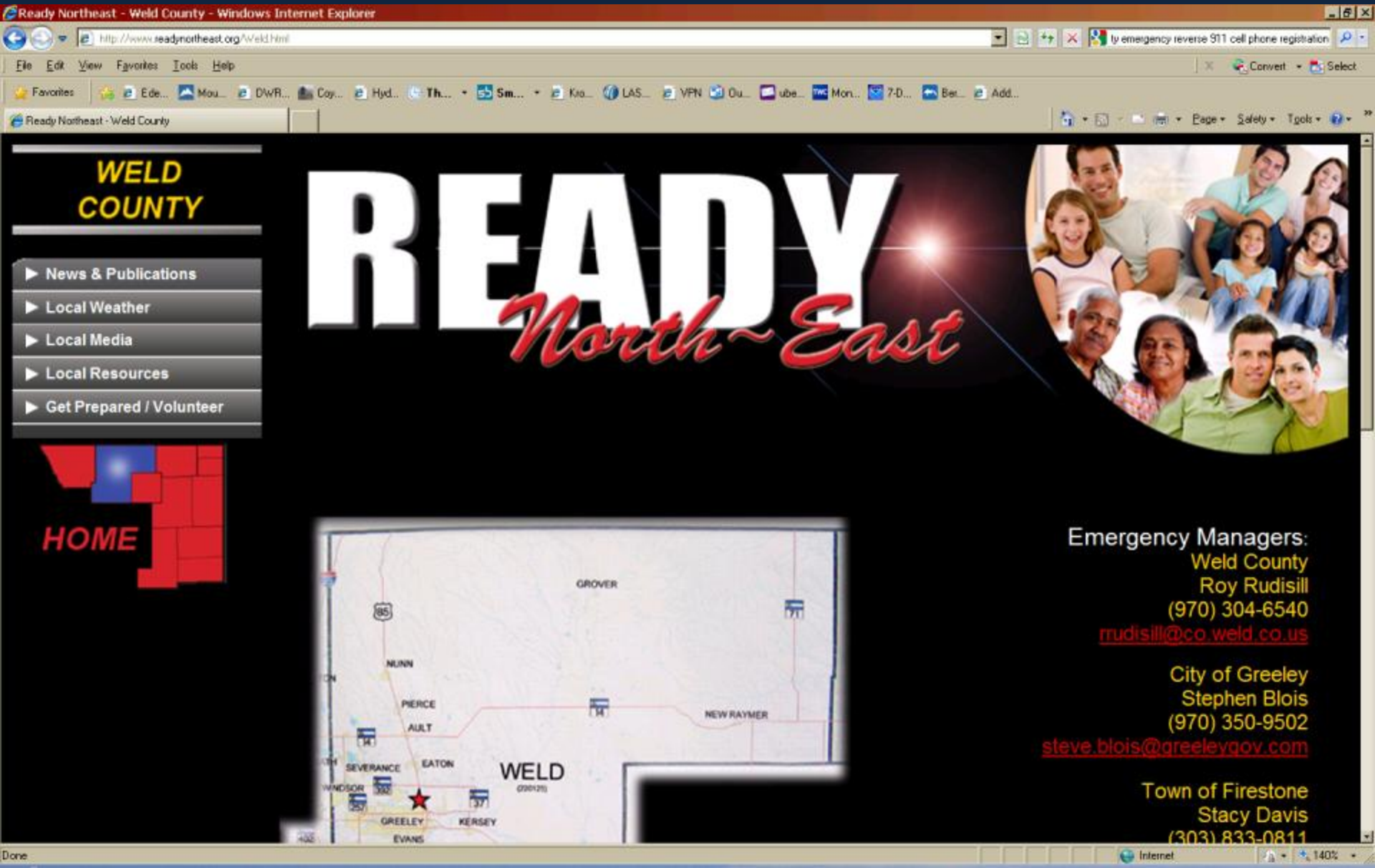
Reverse 911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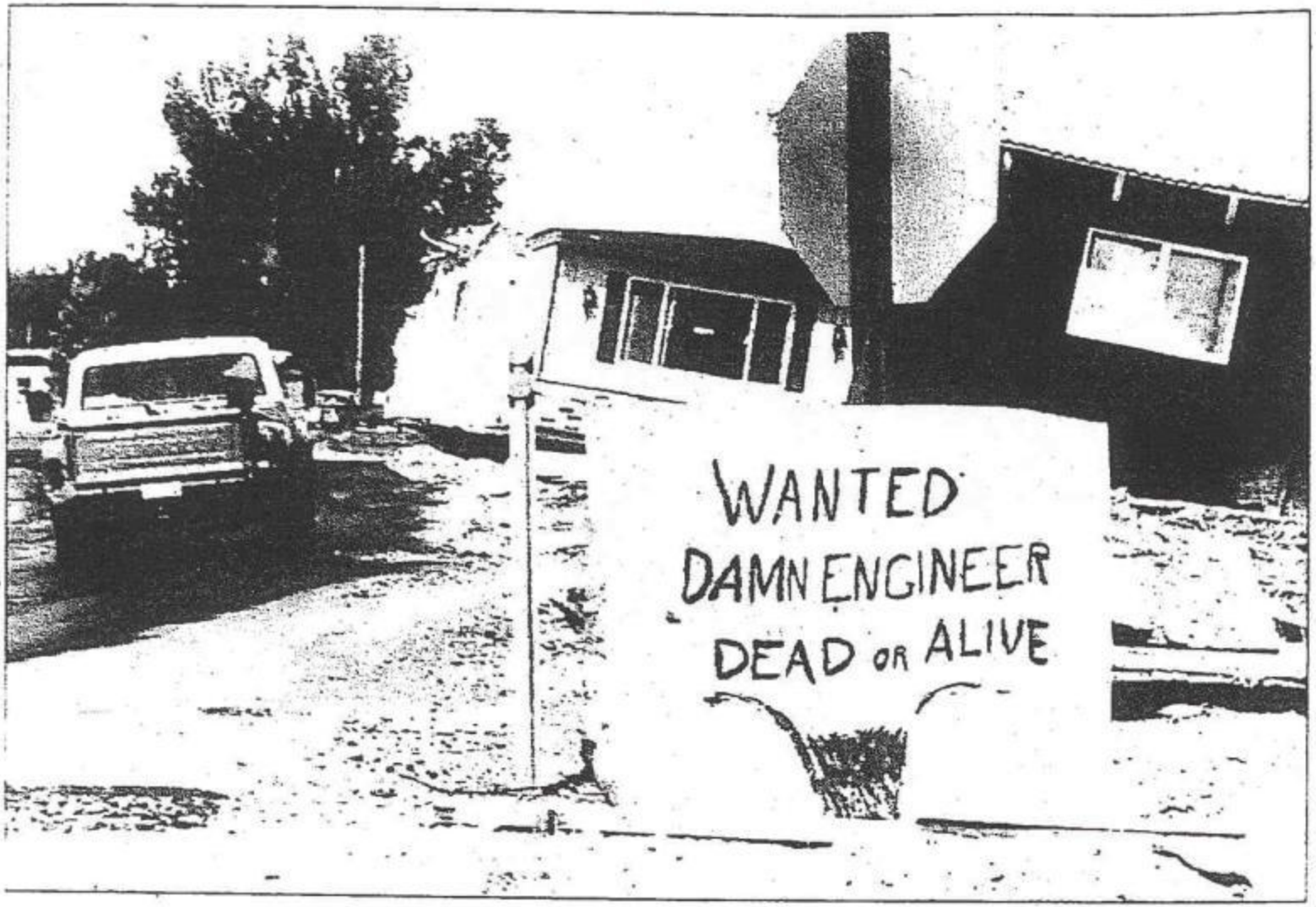
GROVER
NUNN
PIERCE
AULT
NEW RAYMER
SEVERANCE
EATON
WELD
GREELEY
KERSEY
EVANS
Emergency Managers:
Weld County
Roy Rudisill
(970) 304-6540
rrudisill@co.weld.co.us
City of Greeley
Stephen Blois
(970) 350-9502
steve.blois@greeleygov.com
Town of Firestone
Stacy Davis

Questions???

REGISTER Sunday, June 2, 1996



A sign expressing feelings concerning the Teton Dam was posted next to wrecked homes in Rexburg during cleanup efforts.

Post Register file photo