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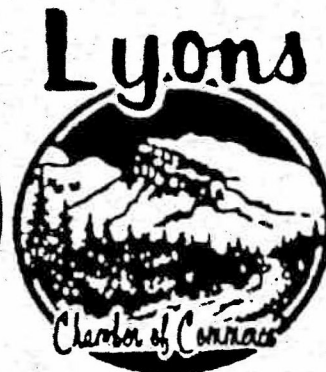
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TOWN OF LYONS, COLORADO



Flood Hazard Mitigation Plan

The August 10, 1994 Flood

Governor Roy Romer

**Town of Lyons, Colorado
Colorado Department of Local Affairs
Division of Local Government
Office of Emergency Management**

August 1994

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Town of Lyons, Colorado

and

Colorado Office of Emergency Management

prepared by

**Cynthia A. Defnet
Office of Emergency Management
Intern Program
August 1994**

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Lyons Town Council

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Special recognition goes to the field personnel of these departments that responded to the August 10, 1994 flood.

The Lyons Public Works Crew

Lyons Fire Fighters

The Town's Building Inspector

Town Administration

Boulder County Sheriff's Department

Local Insurance Agents

State Highway Department

All Emergency Assistance that responded from surrounding towns.

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Introduction

PURPOSE AND SCOPE

Flooding continues to threaten those residents of Colorado located in the eastern foothills of the Rocky Mountains. The citizens of Lyons, Colorado, along with other surrounding mountain communities have experienced quick onset and long term flooding since the first settlers reached the area in the mid 1800s.

The most recent flash flood episode in Lyons occurred on the night of Aug. 10, 1994, approximately 15 years since the last flood in the area. This flood resulted in costly property damage to both public and private sectors of town, not to mention, disruption in the lives of Lyons residents.

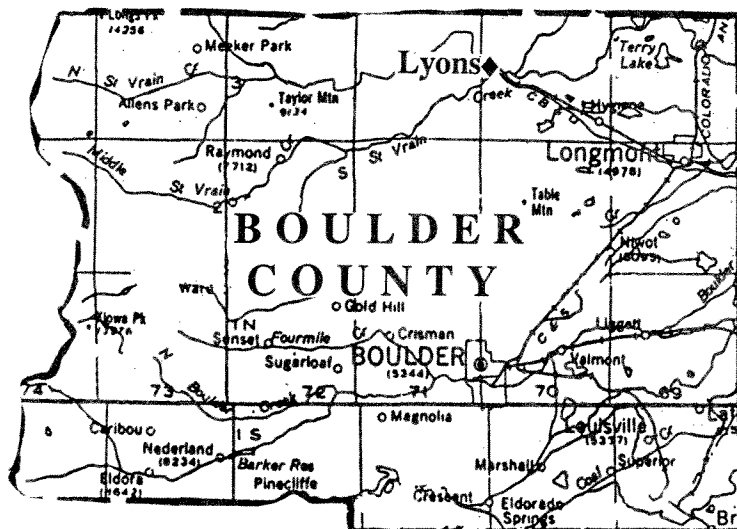
This report is an effort to record and evaluate the events of the flood. It is structured to create a general awareness of the hazards associated with living in a floodplain and will provide prevention tactics, mitigation practices and ideas to lessen flood risk and vulnerability. In cooperation with Boulder County emergency officials and Lyons town officials, the Office of Emergency Management hopes to provide:

- ◇ a practical flood reference guide for home and business owners;
- ◇ a reference for local government to compare current floods against historical floods;

- ◇ an accurate recording of the actual flooding event, which activities were successful and which were not.

This report will begin with a brief geographical description of the Lyons area followed by a complete summary of the flood including who was involved and what was accomplished. Finally, this report will conclude with suggestions for future mitigation and prevention steps which may be implemented by home and business owners or local government.

COMMUNITY PROFILE



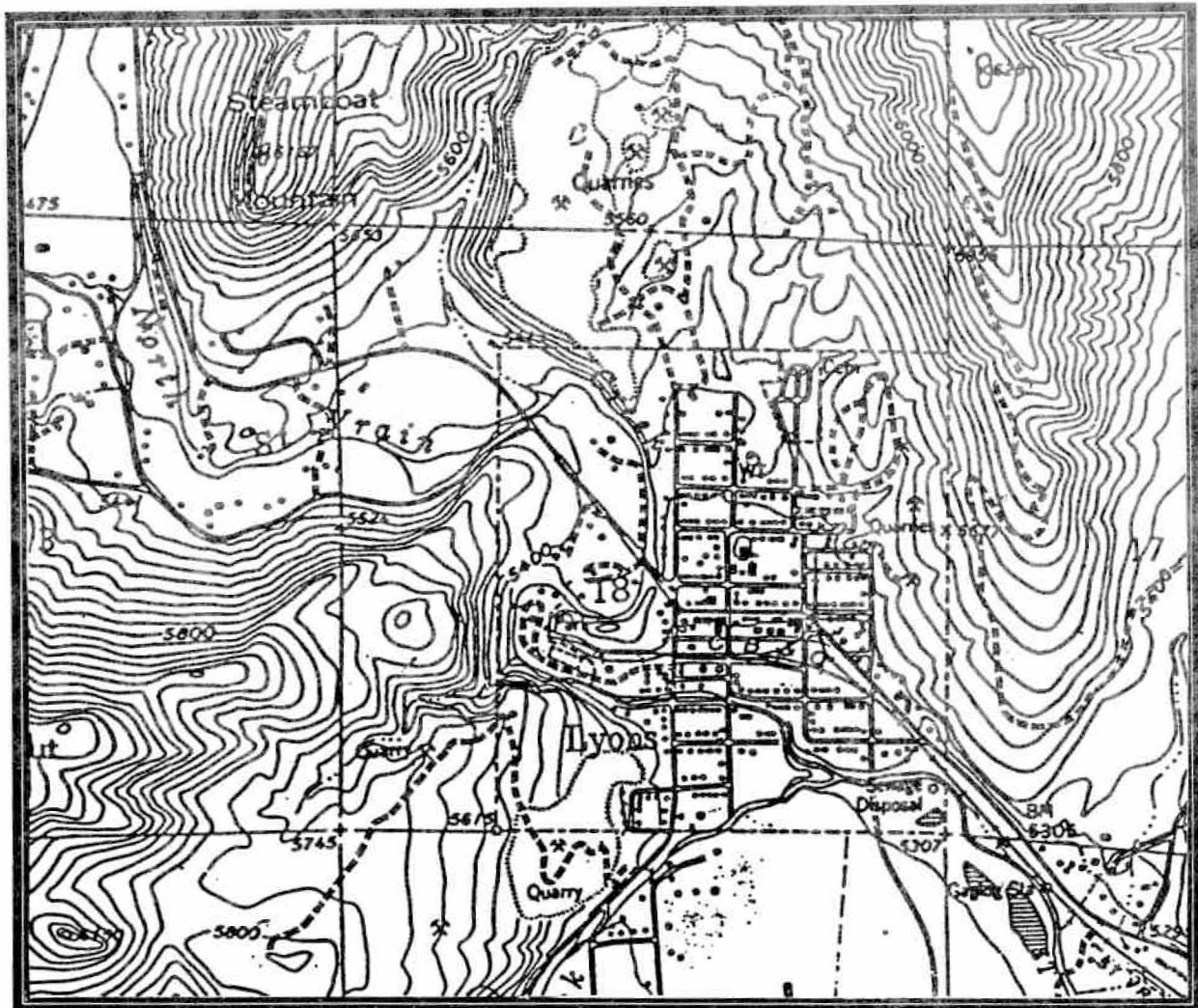
Map of Boulder County and location of Lyons.

Lyons is located in north-central Colorado, just northwest of Boulder and 10 miles west of Longmont. The town lies in the bottom of a tea cup valley surrounded by

LYONS COLORADO FLOOD HAZARD MITIGATION PLAN

steep, red sandstone mountains, and is positioned below the North and South Saint Vrain river canyons. The North and South St. Vrain creeks meet towards the south end of town to form the St. Vrain River basin eventually emptying into the South Platte river in eastern Colorado. The peak run-off months are between May and September. Precipitation in the mountains west of Lyons is approximated at 17 inches per year.

Many of the 1,227 residents (1990, U.S. Census Bureau) are employed outside the community and commute to nearby cities, characterizing Lyons as a bedroom community. However, farming and ranching still play a large role in the local economy. Several residents are employed at the largest industry in town, Martin Marietta Cement - Western Division. Most of the current construction in the area is residential.



Taken from the Lyons quadrangle: Map of Lyons with surrounding landscape and elevation

Flood Risk and Vulnerability

LYONS FLOOD HISTORY

Lyons' residents have experienced floods since the area was first settled in the early 1860s. Floodplains were undefined at that time, so many settlers unknowingly located themselves in floodplains for quick and easy access to water supplies.

One contributing factor to historical and current flooding in Lyons is the location and development of buildings surrounding the North and South St. Vrain creeks. A majority of the town is situated in the FEMA 100-year floodplain, meaning this area has a one percent chance of a flood equaling or exceeding any historical flood in any given year. This means those houses located in close proximity to water are at risk for encountering flood. The floods that threaten Lyons occur in a 10 - 25 year cycle ranging from quick onset to prolonged water accumulation.

Lyons geographical location also contributes to flooding in this area. Lyons lies in a valley with steep sloping foothills which is a prime location for severe runoff conditions. These foothills act as cloud collection pockets for storm systems trapping and holding storms in the valley. In addition, the semi-arid climate, which combines sparse vegetation with intense rainstorms and prolonged snowmelt, contribute to flood risk in this area.

Information taken from the United States Army Corps of Engineers indicates a number of significant floods occurred in

1864, 1876, 1894, 1919, 1941, 1949, 1951, 1957, and in 1969. The most intense flood experienced by Lyons was May 31, 1894, which, at an estimated peak discharge of 9,800 cubic feet per second, washed away 20 homes.



1957 Flood - Railroad washout near Lyons.



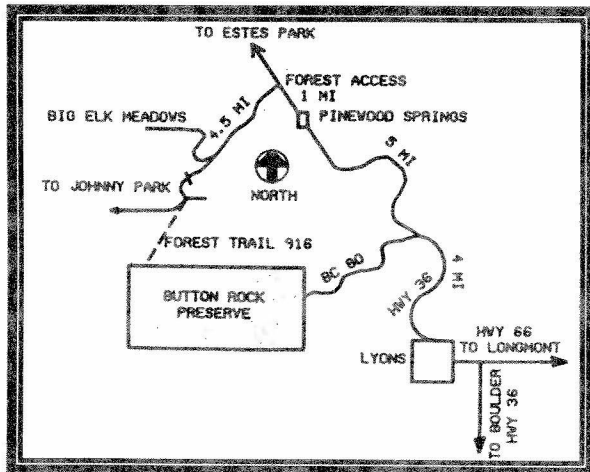
Lyons, Colorado - May 7, 1969.

Also, Lyons' rise in population has led to an increase in land pressures (more people and structures per sq. mile), and floodplain encroachment (more structures being built in floodplain areas). People continue to build structures close to water supplies for esthetic beauty, convenience and crop

irrigation which may prove to be a costly endeavor due to the frequency of floods in this area.

OTHER POTENTIAL FLOOD HAZARDS

In addition to severe weather conditions, other factors threaten the community. Located above the town, lies Button Rock Dam which retains Ralph Price Reservoir, the City of Longmont's water supply. The North St. Vrain creek, which is a spill-off water-way for this reservoir, leads directly towards the town.



Button Rock Dam and Reservoir enclosed in Button Rock Preserve (elevation 6,400 ft.) with regards to Lyons (elevation 5,000 ft.)

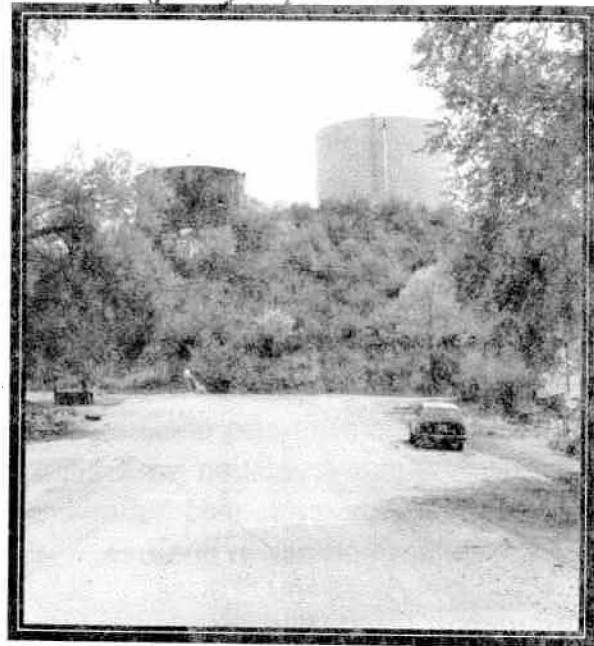
The dam stands 210 ft. high and has a capacity to hold 16,084 acre ft. of water. This high-hazard, earthen dam has a crest width of 30 ft., base width of 1,030 ft. and is 925 ft. in length. It is classified as a class-1, high-hazard dam due to its composition (rock and mud) and elevated position with respect to Lyons and other nearby towns. The dam, in conjunction with the people and structures located

below, produce a *high risk - high vulnerability* situation. If this dam failed Lyons and other surrounding towns would be devastated by flood waters.

Water storage tanks pose another danger. On the corner of Fourth and Reese streets are the town's two water tanks which sit on an elevated landform. The tanks impose increased flood risk to neighboring properties making property owners more susceptible to flood loss and damage. Floods from water tanks can be just as damaging and dangerous as riverine floods or rainfall floods.

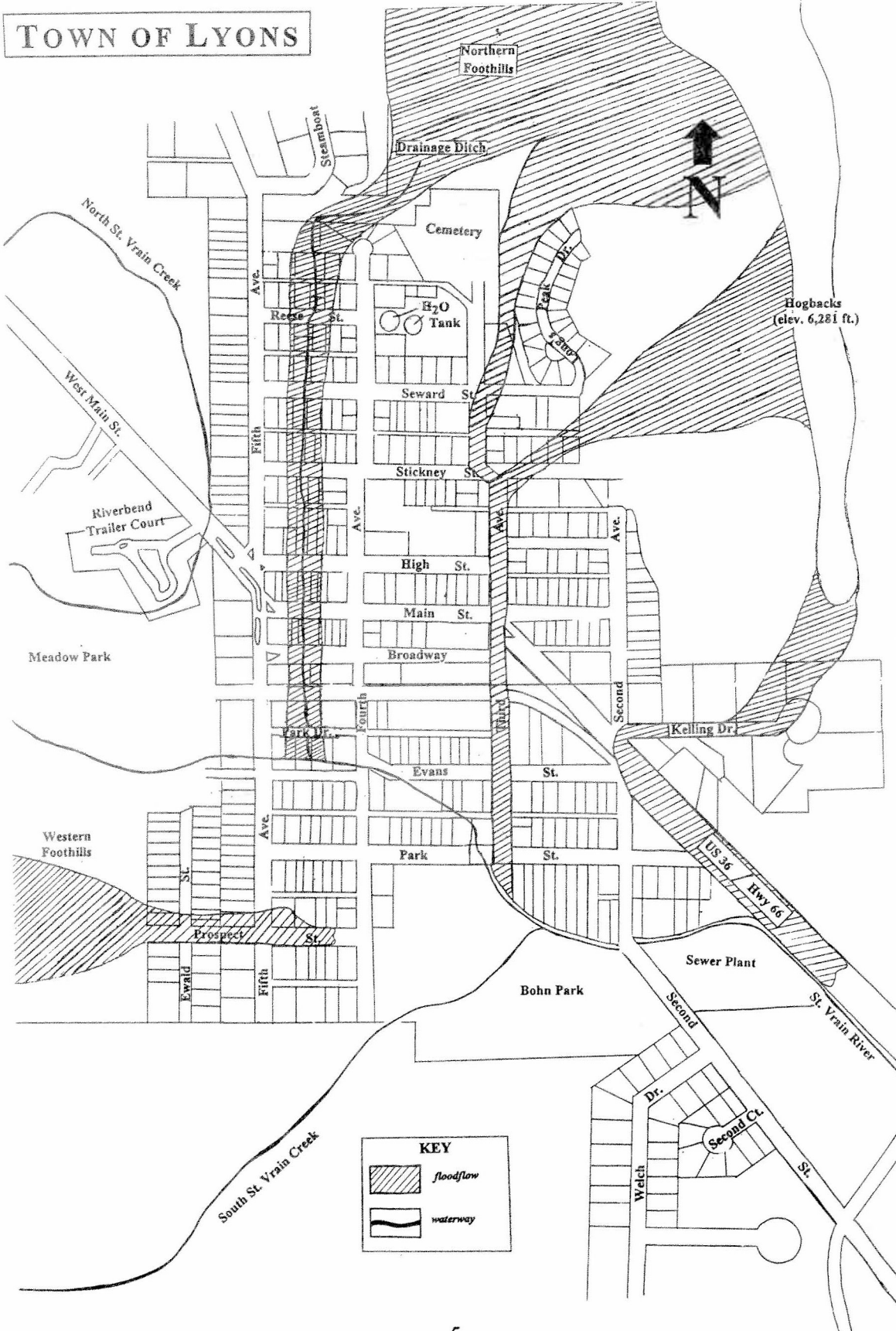
Overall, flood risk and vulnerability increase:

- ◇ *as the amount and location of stored water supplies increase;*
- ◇ *as population and development increase;*
- ◇ *as water paths continue to be altered;*
- ◇ *as people continue to live in and develop in designated floodplain areas.*



Lyons's water supply tanks located on the corner of Fourth and Reese Street.

LYONS COLORADO FLOOD HAZARD MITIGATION PLAN





Flood waters caused erosion to Prospect St., west of town.



The northern section of the drainage ditch overgrown with vegetation.



Underground drainage pipe filled with sediment and debris.

The August 10, 1994 Lyons Flood

THE EVENT

On the night of Aug. 10, 1994, a storm cell hovered over Lyons. At approximately 10:15 p.m., the town was inundated with rainfall accompanied by high winds of close to 100 miles an hour. An estimated three inches of rain fell in the Lyons vicinity within 30 minutes. The town's drainage system, unable to manage such large quantities of water, backed-up spilling over its banks, causing an urban flash flood.

The flood waters originated from the foothills located to the north, east and west of town. Water flowed in a steady stream on most north - south streets. High winds brought down tree limbs damaging cars, yards and homes. A newly framed house located in Eagle Canyon, just west of town, collapsed as a result of the strong winds. Lightning struck a service line at a home knocking out electricity at about 10:13 p.m.; it was three hours before power was restored. Fortunately there were no deaths or injuries.

The hardest hit area of town was between Evans Street and north of Reese Street. The town's drainage system, *the ditch*, runs through this vicinity carrying runoff water from the northern foothills south through a residential area and then flows into the North St. Vrain Creek. This manmade ditch is built of red sandstone found in the surrounding foothills. It is roughly four and a half feet in width and about three to

three and a half feet deep and is generally empty from October to May. During peak runoff and snowmelt months (May - September), there is usually a steady flow of about six inches of water in the ditch.

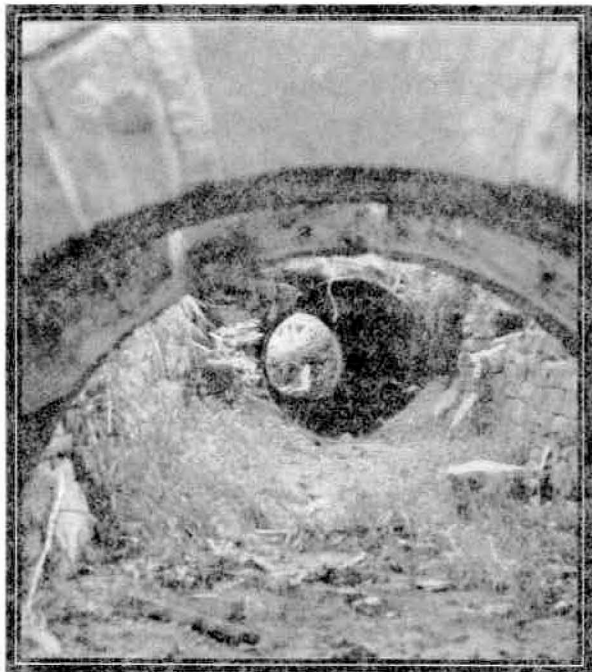


Lyons drainage ditch: photo taken at property on Reese Street.

Factors that Contributed to the Flood

Over the years, parts of the ditch have been re-routed or covered for landscaping or to build roads while some parts remain above ground and visible. The ditch was not designed for flood and is capable of carrying only minimal amounts of water. Most of the underground pipes, being smaller than the upstream water channels, are unable to transport water as fast as the upstream channels themselves. This causes water to back-up and spill over the banks during rainstorms or high runoff.

Next, the ditch was not sufficiently maintained. Sediment and debris accumulated in underground pipes which confined the water space even more. Lastly, the banks of the ditch were completely eroded in some places causing huge pools of water to form on private property.



Looking through underground drainage pipes.

The ditch is currently owned by property owners living adjacent to the ditch; these property owners are also responsible for its maintenance. The town is currently attempting to gain responsibility for maintenance of the ditch through an easement or law but for now, the town government is not responsible for cleaning or clearing this waterway at any time.

The flood also created significant erosion problems throughout town. Steep grades increased floodwater speed eroding structural foundations, lawns, roads, private

drives and accumulating water and debris in basements. Upstream alterations to the natural water flow paths compounded damage to downstream properties. Alterations included: the building of roads and structures; removal of natural vegetation; and the changing of slopes by shifting, removing or adding dirt, rocks, or landscape to pre-existing landforms resulting in the transportation of dirt, gravel, trees, mud, and fences from upstream to downstream properties. Alterations impede and redirect natural water flow paths often causing increased flood damage.

FLOOD RESPONSE EFFORTS

Lyons Fire Protection District

The Boulder County Emergency Operations Center (EOC) dispatched fire crews to Lyons shortly after the onset of the flood. They set up an Incident Command Post (ICP) at the Lyons Elementary School which is the highest point in town. From there, they carried out the initial flood response and maintained open lines of communication with the other organizations involved. They managed and facilitated the evacuation of families and residents from an area surrounding a house on Ewald Street as a result of a gas leak. The evacuation went well, 40 residents were directed to Lyons Elementary for shelter.

Fire crews had problems keeping evacuated residents from returning to their homes. An hour later the fire department had contained the gas leak and the initial

threat was under control. By that time most residents had already returned home.

Public Works

Public Works crews labored during and after the storm examining power lines throughout town to ensure safety when power was restored. They also monitored water and sewer lines for leaks or breaks. During the flood, a few sewer lids popped off allowing water to enter the city's drainage system, fortunately the water pipes remained unharmed. For weeks, crews continued to clear debris from streets and waterways.

Boulder County Sheriff's Department

The sheriff's department controlled curious onlookers and responded to emergency calls during the flood. Officers were responsible for closing highways 7 and 36 and helped redirect traffic away from the town. Town Hall, which houses government offices, the Boulder County Sheriff's Department (in Lyons) and the Office of Public Works, flooded, however this did not jeopardize the flood response effort.

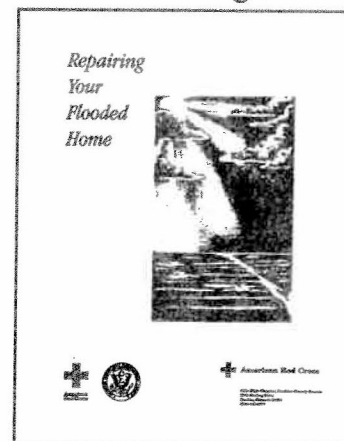
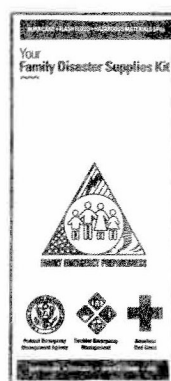
Boulder County American Red Cross

The Boulder County EOC called the Boulder County American Red Cross (ARC) to the flood scene. Eight Disaster Action Team (DAT) volunteers responded to the call. They arrived at Lyons elementary shortly after the flood with disaster shelter equipment and case work information. The American Red Cross has

an agreement with the St. Vrain School District which states:

In the event of an emergency, school buildings may be used as shelters.

By the time the American Red Cross arrived at the planned location for the disaster shelter, the 40 evacuated residents had already returned home so a shelter was not needed. A few days later the ARC conducted independent damage assessments of private property and distributed a flood information booklet *Repairing Your Flooded Home*, (ARC) and a brochure, *Your Family Disaster Supplies Kit*, (ARC, FEMA), both shown below. Most of the flooding that occurred was 1 - 3 inches of water in basements - which the ARC considers to be minor damage.



At the Flood Mitigation Workshop, held 8 days after the flood, the ARC provided emotional and financial support for victims in need. No casework was done as most residents used their own resources (family, friends, neighbors, etc.) to cope with structural and emotional damages from the flood.

Lyons Town Government

A meeting was held at the Lyons Town Hall on Aug. 12, to discuss possible options to assist flood victims with property damage. Present at this meeting were representatives from the state Office of Emergency Management, Boulder County Office of Emergency Management, the state Department of Local Affairs, Lyons Town Administration, and the American Red Cross.

Costs of damage to public roads and streets were estimated. Due to the nature of the damage, no requests for state or federal disaster declarations were made. It was decided that the town would be responsible for the costs of public damages. Damage estimates for private property were not available at this time.

Boulder County and State Offices of Emergency Management supplied a small grant to the Lyons town government. With this grant, the town investigated feasible solutions for the town's drainage system.

Farmer's Housing Administration

The Farmer's Housing Administration offered financial support through two types of disaster-related loans, the 502 and 504. Loans were made available to property owners sustaining damage to structures or contents during this non-declared disaster.

The 502 loan is a low-interest loan marked at eight percent interest and to qualify, income must be at or below Farmer's Housing Administration's *Low Income*

Limit which is approximately \$39,000 for a family of four (the limits vary for families of other sizes). Loans are allotted based on amount of damage and income resources available; repayment is contingent upon income.

The 504 loan offers property owners up to \$15,000 and is available to low income families. Also, property owners over the age of 62 may qualify for up to \$5,000 in grant monies. Qualifications for the 504 loans and grants are based on the amount of damage sustained and available income resources.

DAMAGE ASSESSMENT

Damage was assessed in the days and weeks following the flood event. Private property damage was comprised of three main types:

- 1.) *flooding of homes located in low-lying, floodplain areas, or areas close to the town's drainage system;*
- 2.) *downstream flooding caused by upstream alterations to the natural water paths;*
- 3.) *and erosion of structures built in the direct path of flowing water.*

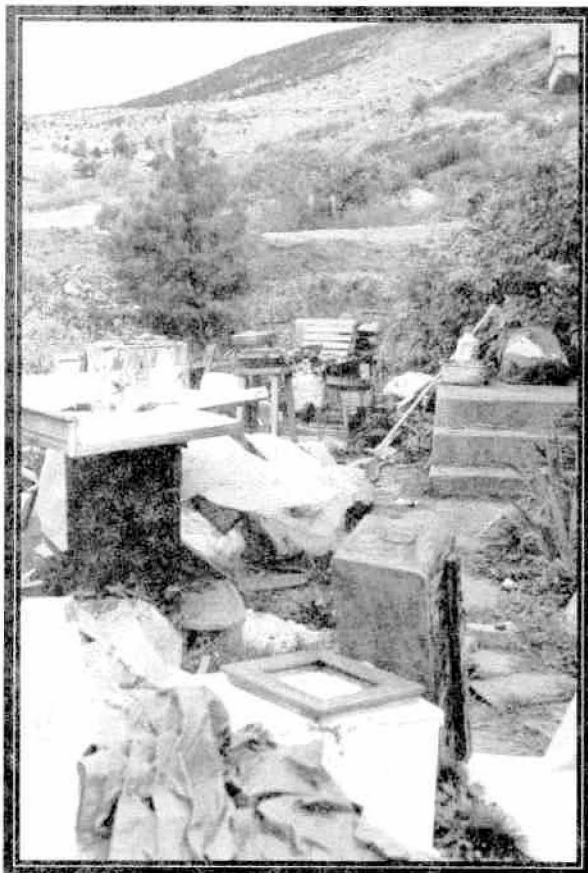
Damage cost estimates for the private sector (home and business owners) were estimated at \$213,000. Sixty-nine percent of the damage sustained was structural damage and 31 percent was damage to contents.

**Frequency Distribution Table for
Damage Assessment**

Cost of Damage	Damage to Structures	Damage to Contents	Total % of Damage per Cost Unit
Under \$1,000	11%	17%	28%
\$1,000 - \$2,500	21%	8%	29%
\$2,500 - \$5,000	16%	3%	19%
\$5,000 - \$10,000	21%	3%	24%
Above \$10,000	0	0	0
Total	69%	31%	100%



A trash dumpster stationed streetside by flooded properties.



These mud covered and water soaked belongings were recovered from a flooded basement on Fourth St.

Homes located in close proximity to the drainage ditch sustained a majority of the property damage. Residents faced mud and water filled basements, eroded and debris covered lawns, exposed foundations, and lost fences. One resident reported nearly six feet of mud and water in the basement of his home. A few homes suffered damage to electrical outlets, damage to or destruction of furnaces, water heaters, washers and dryers and other personal items stored in basements.

There are four basic ways flood waters find their way into a basement - according to the *Home and Business Guide for the Mitigation of Flooded Basements*, (OEM, June, 1993).

**The Four Ways of Water
Entry Into Basements:**

- *Through a drainage system's sump;*
- *the backing up of sewer lines beneath the house;*
- *seepage through cracks in the walls and floor;*
- *over the surface or the ground through windows and doorways.*

Damage estimates to public property, which includes road maintenance and labor wages, reached approximately \$65,000. In some places water eroded the streets from below causing extreme rippling or bubbling, as a result, parts of the road were carried off by flowing water. City crews began resurfacing these roads within a week of the event.



This was one of many roads in town that suffered erosional damage from flood waters.

The clean up and recovery stages of this flood will continue for months. Overall, a majority of this costly damage may be avoided in future floods through proper mitigation, preparedness and education which should always be a priority.

TIPS TO REMEMBER BEFORE THE NEXT FLOOD

- *Alterations to natural water flow paths causes flooding to downstream properties.*
- *Organization and the defining of certain public and governmental responsibilities should be decided before the next disaster occurs.*
- *It is important that public officials encourage proper public education and enhance local mitigation, preparedness, response and recovery efforts.*
- *Property owners need to start planning and flood-proofing now, before the next flood episode.*

These tips promote a philosophy of long term awareness for city administrators and the general community. With public awareness and education in mind, a community can achieve and maintain a sustainable and safe environment.

Prevention and Mitigation Activities in Lyons and Boulder County

BOULDER COUNTY/CITY OFFICE OF EMERGENCY MANAGEMENT

Forecasting and Warning

The Boulder County Office of Emergency Management supervises and operates the Boulder County Emergency Operation Center (EOC). The Boulder County EOC is located in the city of Boulder and is the County's "eye" for weather watch. This center is equipped with a number of highly technological weather monitoring systems that aid in storm detection, monitor stream gauge readings, execute warning systems and monitor temperatures at different elevations within Boulder County. These weather monitoring systems include NEXT RAD, STORRM and ALERT. Soon, testing will begin on a new program that is currently being developed by the National Oceanic and Atmospheric Association (NOAA) for the National Weather Service.

The Boulder County EOC acts as the main communications center for Boulder County. After 5 p.m. daily, all 911 calls from Lyons are directed to the EOC. On Aug. 10, 911 calls reporting flood conditions began to come in at 10:15 p.m. At that time, a designated flood-mode tone was dispatched to fire and police radio frequencies. Organizations began response efforts immediately.

Effective communications were reported between the Lyons sheriff's office, Lyons Fire Protection District, and Lyons Office of Public Works which illustrates the importance of inter-agency communications and a well organized warning system during a disaster.

Many Boulder County OEM personnel participate in the Multi-Agency Coordinating System (MACS), a policy making group with representatives from state, local, non-profit, public and private sectors throughout the area. Representatives meet every month to discuss possible threats, hazards, or disasters that might occur within the county. They then map out disaster support plans and determine what actions will be taken, when, and by whom during an emergency. MACS has successfully promoted open lines of communications between agencies managing disastrous event. Boulder County OEM organizes and participates in simulated, emergency exercises to test the effectiveness and to allow for adjustments or alterations of Boulder County's current flood plan. There are several participating agencies, primarily emergency services organizations.

FLOOD MITIGATION WORKSHOP

The Office of Emergency Management (OEM) organized and presented a Flood Mitigation Workshop on Aug. 18, at the

LYONS COLORADO FLOOD HAZARD MITIGATION PLAN

Lyons Elementary School. Architects, drainage design engineers, county/city planners, and emergency management representatives were present to offer advice and expertise on flood mitigation.

Workshop Objectives

The main objectives for this workshop were:

- ❖ to provide guidance and information to Lyons residents on flood-proofing homes and businesses;
- ❖ to assist the client in determining possibilities for mitigation that would best work for them.

Flood Mitigation Workshop for Town of Lyons Flood Victims
Sponsored by:
Colorado Department of Local Affairs - Division of Local Government
Office of Emergency Management (OEM) - Colorado Association of Stormwater & Floodplain Management
Boulder Office of Emergency Preparedness - American Red Cross Mt. High Chapter
Town of Lyons Officials
Thursday, August 18, 1994
Lyons Elementary School, 4th and High Street - Lyons, Colorado
6:00 P.M. to 9:00 P.M.

REGISTRATION

Name _____
Address of flooded property _____
Phone Number _____

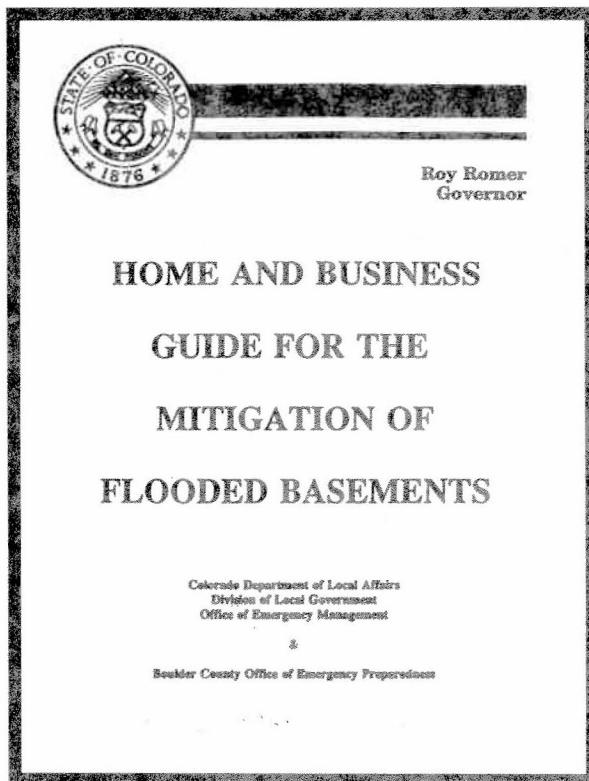
1. Before this flood, did you know your property could have been flooded?
() Yes () No
2. Did you have flood insurance?
() Yes () No
3. How high did the water get?
() In yard only
() Water kept out of house by sandbagging, sewer valve or other protective measure
() In basement: less than 2 feet
() In basement: over 2 feet
() In crawl space
() Over first floor: less than 2 feet
() Over first floor: over 2 feet
() Other _____

What was the approximate amount of damage?

	Structure	Contents
None	()	()
Under \$1,000	()	()
\$1,000 - \$2,500	()	()
\$2,500 - \$5,000	()	()
\$5,000 - \$10,000	()	()
Over \$10,000	()	()

Mitigation 5

Damage Survey/Registration



Each flood victim met with a team of four professionals and filled out flood damage surveys/registrations allowing workshop employees to better understand the types of damage sustained. Victims were also encouraged to draw pictures of their damage to assist the workshop personnel in grasping the problem.

Each workshop station provided 2 handouts, *Home and Business Guide for the Mitigation of Flooded Basements* and *Tips for Hazard Mitigation. Flood Damage Control*, (FEMA, April, 1993). Both give a good, basic and in-depth knowledge of flood mitigation practices. Standpipes and glass bricks were displayed for visual examples of what each looked like and how each operated. OEM also presented a flood model of a basement with a sump pump and standpipe. With this, OEM was able to

demonstrate exactly how a sump pump and stand pipe can help to minimize flood waters.

People attending the workshop were in search of ways to prevent future flooding; few were in search of compensation for losses. The workshop personnel were told not to *dictate* mitigation ideas to the clients but instead, let the client choose the mitigation practice that would best suit their lifestyle. When a client begins to take responsibility for the situation, they also begin to develop a self-help awareness - they begin to find ways to help themselves, instead of relying on others for help.

OEM also made follow up visits for residents that were unable to attend the workshop. These people were given information on low-interest loans and ideas for mitigation. Overall the workshop personnel accomplished their objectives and were able to get mitigation information circulating through the community. It was left up to the town to implement and use this information to their benefit.

On Sept. 9, a second meeting determined which mitigation tactics could be used for specific flood areas in town. A mitigation solution was offered for each major location:

North-Central Lyons (near *the ditch*):

How can the impact of future floods be lessened?

Mitigation Solution: Suggestions were made to build a retention pond above the

north end of town, to retain runoff waters draining from Steamboat Mountain (northwest of town). This land is currently owned by a private developer and it is unknown at this time what approach the town will take to implement the retention pond.

Eastern Lyons (below eastern hogback - see map pg. 5):

How can the impact of future floods be lessened?

Mitigation Solution: Due to the landscape and location of underground pipes, redesigning and replanning would be too cost prohibitive for the local economy. The solution for private property damage was individual household mitigation (see section on structural mitigation). The solution offered for public damage was reconstructing streets into an inverse crown shape (pictured below). This directs water away from the gutters and road-side properties to the center of the streets. Possible funding sources are still under consideration at this time.

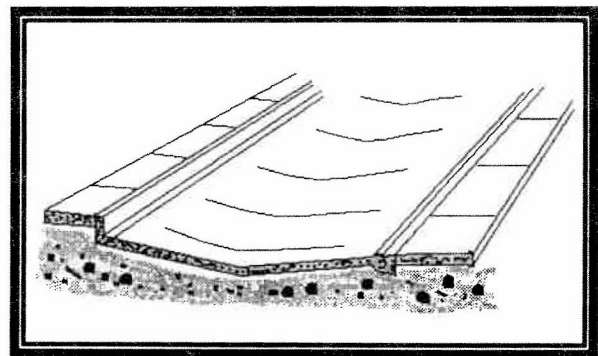


Illustration of Inverse Crown

THE NATIONAL CIVILIAN COMMUNITY CORPS (NCCC)

What is the NCCC?

The National Civilian Community Corps (NCCC) is a community service organization that offers community service work to young Americans in exchange for educational and financial awards. The NCCC focuses on projects relating to the environment, education, public safety, and human needs. It is one of several community services offered through President Clinton's AmeriCorps Program.

The NCCC's Involvement in Lyons



NCCC workers cleaning ditch in front of flooded property.

On Oct. 7, OEM met at Lyons town hall with the town administrator and three representatives from the NCCC. A verbal proposal was presented asking for NCCC's assistance in Lyons. This proposal was quickly accepted. The assistance given by

the NCCC would be in the form of structural mitigation to damaged properties.

Right of Entry Agreement
Town of Lyons Flood Mitigation Project

I (We) _____
the owner(s) of the property commonly identified at _____

Street (Attach legal description if available) _____ City or Town _____

Boulder County, State of Colorado, and the National Civilian Community Corps, do hereby grant and give freely and without coercion whatsoever, the right of access, entry, and use of and to said property to the Town of Lyons, Boulder County, State of Colorado, and the National Civilian Community Corps their agencies, contractors, and subcontractors thereof, for the purpose of inspecting, removing and clearing any and all storm-generated debris of whatever nature from the above described property as may be necessary in the accomplishment of the foregoing. Also included in this agreement are certain flood mitigation techniques to be undertaken by the Town of Lyons, Boulder County, State of Colorado, their agencies, and the National Civilian Community Corps, contractors, and subcontractors, to lessen the effects of future flooding to my property. These mitigation techniques have worked for others in a similar situation, however, I (We) understand these mitigation techniques may not prevent future flood damages.

The undersigned agrees and warrants to hold harmless the Town of Lyons, Boulder County, State of Colorado, their agencies, and the National Civilian Community Corps, contractors, and subcontractors, for any damage of any type, whatsoever, either to the above property or persons situated thereon and hereby releases, discharge, and waive any and all action, either legal or equitable which might arise out of any use or activities on the above described property.

I(We) have not and will not receive any compensation for debris removal from any other source including private insurance, or any other public assistance program. For the considerations and purposes set herein, I hereby set my hand and seal the ____ Day of _____, 199__.

(Witness) _____ (Owner/Owners)

(Owner/Owners)

(Current Address) _____ (Current Telephone Number)

Note: This agreement must be completed prior to entry on private property for the purposes of conducting emergency or disaster work.

AmeriCorp/Colorado OEM
Flood Mitigation Project

SITE PROFILE

NAME: _____

ADDRESS: _____

PHONE: _____

PROJECT DESCRIPTION: _____

MATERIALS NEEDED/TIME REQUIRED: _____

COST ESTIMATION: _____

SURVEYOR: _____

Homeowner permission was needed for conducting site profiles in order to determine the mitigation needed for each property. OEM provided flood information packets containing *Right of Entry Agreement Forms* (which allowed OEM employees to enter a premises) and *Site Profile Forms* (which were used to record observations and make suggestions for mitigation).

On Oct. 15, representatives from the ARC, OEM and the Boulder County Sheriff's Department organized and presented, to the flood victims, a general overview of the NCCC program and the various types of structural mitigation that could be done. The information packets were also handed out at this time. It was stressed that the NCCC's work would be at no charge to property owners and agreement of participation would be decided independently by the owners.



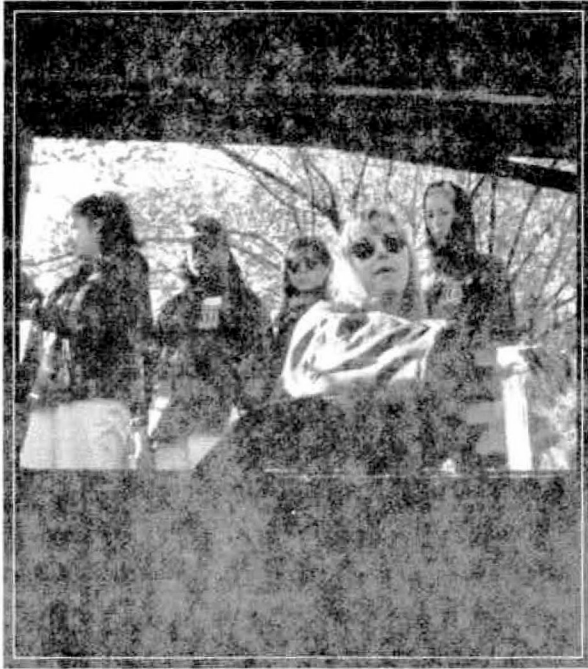
Working days always began with a project plan and discussion.

Structural Mitigation

OEM began conducting site profiles. A list of materials and equipment, along with time and cost estimates was prepared for each property surveyed. Any costs incurred during this project would be absorbed by OEM with funds from the University of Colorado, Colorado Springs, Center for Community Development and Design. The Department of Local Affairs and Division of Local Government would supply required resources and technical expertise needed during this project.

After site profiles were summarized, OEM determined the following mitigation efforts were needed at the various sites:

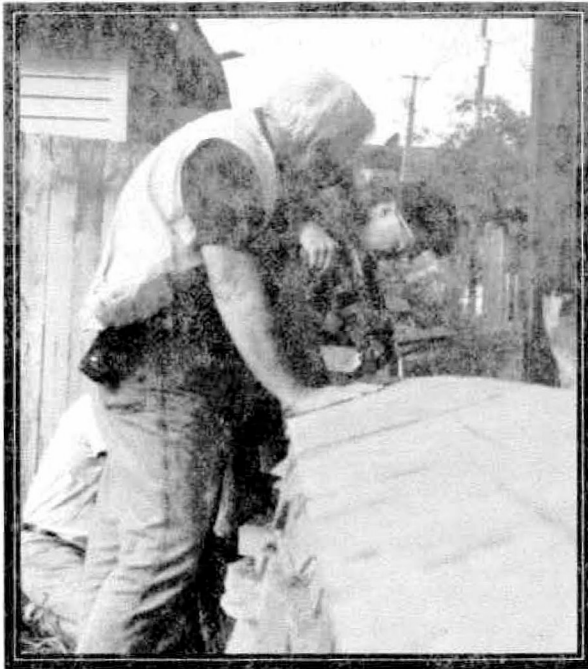
- ▶ Glass block and brick installation in basement windows.
- ▶ Flood wall construction around ground level doors and windows
- ▶ Removing mud and debris from the town's drainage ditch (Reese St. only).
- ▶ Building berms to divert water flow.
- ▶ Alteration of slope to redirect water flow away from property.
- ▶ Rebuild border of drainage ditch (Reese St. Property).
- ▶ Installation of track closures.



NCCC and OEM workers cementing glass blocks into a basement window frame.

structural work performed. The NCCC workers supplied picks and shovels and OEM provided glass blocks, cement, lumber, wheel barrels, saws and drills.

Aside from bad weather delaying the time schedule, everything ran smoothly. The work team demonstrated great commitment, enthusiasm and cooperation. With this project, a bond was created between OEM and the NCCC, as well as between a federal community service program and the town of Lyons. It also gave the NCCC a high profile within the Lyons community which may be looked upon as an example for future NCCC services.



OEM and NCCC workers constructing a floodwall.

The work began on Oct. 25, and was completed on Nov. 10. A team of 12 NCCC workers was provided. OEM appointed an employee to monitor the

Resources for Flood Mitigation

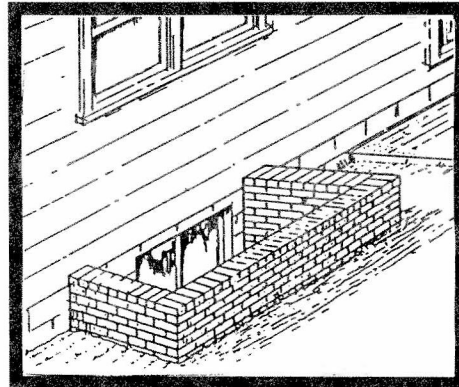
STRUCTURAL MODIFICATIONS

Structural modifications (the implementation of mitigation fixtures to buildings or property) offer numerous mitigation options that are both affordable and simple to construct. Home and/or property owners are encouraged to use structural modifications to divert water away from their premises. Temporary and permanent fixtures are the two main types of structural modifications; examples of both include: flood walls, berms, track closures (hinged or unhinged), flood barriers, structural sealing and others.

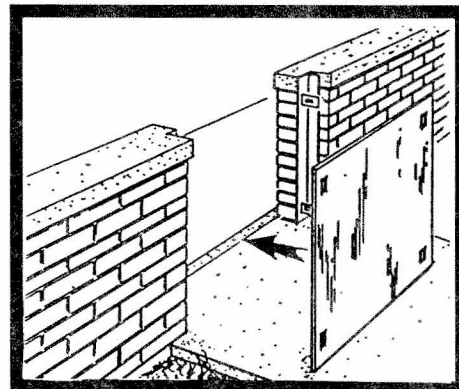
Temporary and Permanent Fixtures

Temporary fixtures may be removed and stored easily between floods. Track closures are some of the most common temporary fixtures. It is important to remember, though, that temporary fixtures rely heavily on flood warning time. Many floods are quick onset and sometimes not enough time is given to put the closures in place. In this sense, permanent fixtures may prove more effective in that they don't have to be physically placed during the threat of a flood.

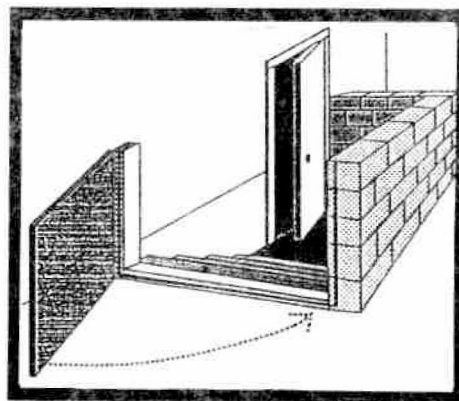
Permanent fixtures, such as mini-walls, may be a very effective mitigation tool. Placement of mini-walls around the perimeter of a property, around an outside basement entrance or bordering a basement window well, is extremely effective for diverting water away from a structure.



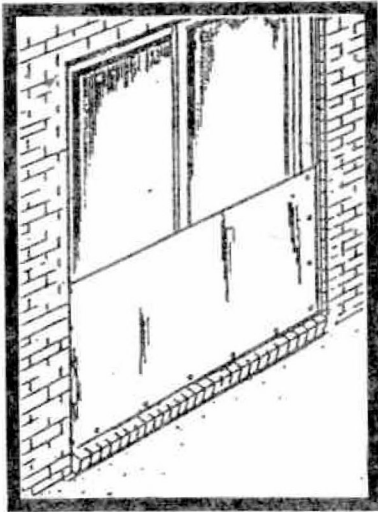
Floodwall around a basement window



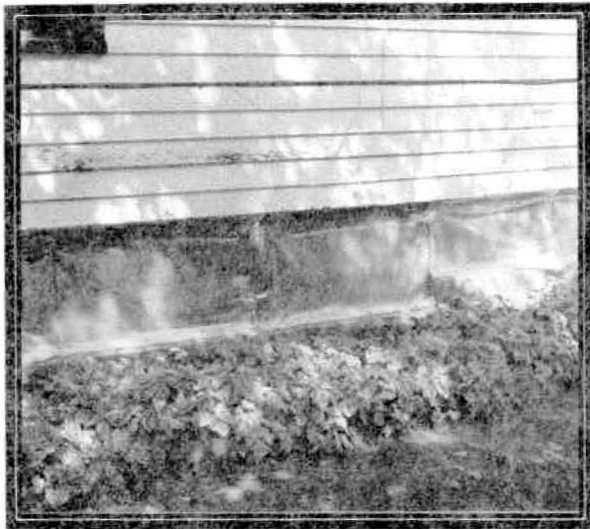
Bolt on Flood shield.



Floodwall and gasketed gate to a door that is below grade.



Removable window cover.



Windows covered in plastic: a result of flood waters breaking through basement windows.

Retrofitting

Retrofitting, another form of structural modification, allows existing buildings to be structurally altered so that they may be considered safe under current building codes. Retrofitting usually involves the application of proper engineering design, construction and alterations are usually made to the skeletal structure of the building and are on a much larger scale.

FLOOD INSURANCE

The National Flood Insurance Program (NFIP) was developed in the late 1960s by the U.S. Government to discourage floodplain use and to encourage communities to take part in proper land use programs. The NFIP offers money saving incentives to those who purchase flood insurance and take part in mitigation of their properties.

One local insurance agent in Lyons reported only one inquiry about insurance following the Aug. 10, flood. The following are recommendations a local government may use for increasing participation in the National Flood Insurance Program (*Flood Hazard Mitigation Plan, City of Cañon City, August 1993*):

- 1.) Determine which buildings are located in the FEMA-specified 100 year floodplain.
- 2.) Contact building owners in the FEMA-specified 100 year floodplain through the mail, personal visits or telephone calls. Educate citizens on the benefits of flood insurance. Encourage them to buy flood insurance within six months. Inform them that a follow up study will be made in six months.
- 3.) After six months, if interest and cooperation is low, decide what further actions may be taken to encourage a new interest.
- 4.) Map the boundaries of the recent flood and enact any regulations that may exist requiring flood insurance within that area. Make sure that it is understood that these regulations will be strongly upheld.
- 5.) Implement a mass flood awareness campaign aimed at all of Lyons residents on the benefits of flood insurance.

PLANNING

Zoning

Zoning is the process of dividing an area of land into districts or zones, and placing certain development and land use restrictions on these areas. It is a means by which the development and growth of a community may be controlled.

Benefits of Zoning

-
- Zoning conserves and promotes proper development of natural resources.
 - Zoning helps to prevent property depreciation, protects against natural and technological disasters.
 - Zoning prevents overcrowding and unnecessary land pressures associated with over-development and over population.
 - Zoning promotes safe living within the community.
-

Zoning is an important, if not critical, tool for successful mitigation against any type of disaster. By implementing height, weight, bulk, and design limitations, as well as penalties for development within designated areas, an environmentally safe and stable community may be achieved.

Recommended Steps for Zoning

- **Map use and size of existing buildings; this should include height, bulk, lot size and lot depth.**

- **Assess current property values if not already done.**
- **Map all new buildings erected within the last five years.**
- **Map topography, surface drainage, soil types and subsurface drainage conditions.**
- **Designate floodplain areas, fault lines, and all waterways.**
- **Classify streets and roads, listing their present and future anticipated traffic volumes, transportation lines, accident spots and parking facilities.**
- **Collect the number, distribution, migration characteristics, and age composition of the population.**
- **Define the economic base of the community.**
- **Based on the information gathered, design a feasible zoning plan that promotes a safe environment and discourages any misuse of land.**

Implementation of zoning ordinances should be structured so all adjacent properties are under similar restrictions to avoid conflict between patrons that have adjacent properties. High hazard areas, such as floodplains, may eventually be converted into recreational parks, parking lots, agricultural land, or wildlife sanctuaries, which all lessen risk associated with flood.

Land Use Planning

Land use planning encourages people to avoid hazardous zones. There are four basic aspects of land use planning:

Public Acquisition - is government ownership of potentially hazardous land

within communities. This allows local government to decide what is built within hazard areas. Many towns choose to build recreational parks, parking lots, or nature sanctuaries within hazardous areas.

Land Zoning - is the implementation of laws and ordinances to regulate hazardous zones. This allows public control over hazardous areas through voting.

Public Education - accomplished through community preparedness exercises and mitigation information. By getting a community involved, they learn to take a *pro-active* approach to disastrous situations instead of a *reactive* approach.

Financial Incentives - discourage the use of hazardous areas by offering cost saving incentives to those who mitigate. One plan is the National Flood Insurance Program (NFIP), which offers incentives for participation in community preparedness, structural modifications and other mitigation practices for private properties.

Overall land use planning offers efficient mitigation against flood damage and prohibits damage-creating encroachments within hazardous areas - such as a floodplain - and encourages an educated approach to proper use of the land.

COLORADO OFFICE OF EMERGENCY MANAGEMENT

Colorado's Office of Emergency Management will continue to convey information and guidance on hazard mitigation throughout Colorado using

community preparedness programs, disaster recovery information, and public education. Working with local community governments allows OEM to inform and prepare these communities for future disasters.



OEM staff and interns discussing plans for a future project.

OEM continues hazard research while working with the Colorado National Hazards Mitigation Council and continues to expand knowledge of hazards common to the cultural and geographical landscape of Colorado.

References

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Flood Plain Information, Upper St. Vrain Creek, Boulder County Colorado, United States Army Corp. of Engineers, September 1972, Vol. 4, pp. 11-16.

Flood Hazard Mitigation Plan, City of Canon City, "The August 12, 1991 Flood," City of Canon City and Colorado Office of Emergency Management, August 1993.

Flood Insurance Study, Boulder County, Colorado: Unincorporated Areas, Federal Emergency Management Agency, May 1990, Vol. 1-5.

Hazard Mitigation, Flood Damage Control, Federal Emergency Management Agency, 1993.

Home and Business Guide for the Mitigation of Flooded Basements, Division of Local Government, Division of Local Affairs and Colorado Office of Emergency Management, 1993.

Repairing Your Flooded Home, American Red Cross, ARC 4477, Federal Emergency Management Agency, FEMA 234, August 1992.

The Old Lyons Recorder, August 18, 1994.

Your Family Disaster Supplies Kit, American Red Cross, ARC 4463, Boulder Emergency Management, Federal Emergency Management Agency, FEMA L - 189.

Appendix A

In the Event of a Flood: Tips to Minimize Loss of Life and Property

The following tips are from the Federal Emergency Management Agency / Federal Insurance Administration National Flood Insurance Program and should be used as suggested guidelines for action before, during, and after a flood.

STEPS TO TAKE TODAY

- Make an itemized list of personal property, including furnishings, clothing, valuables and take photographs of your home inside and out. These items will assist an adjuster in settling claims and will help prove uninsured losses, which may be tax deductible.
- Learn the safest route from your home or place of business to high, safe ground if you should have to evacuate in a hurry.
- Keep a portable radio, emergency cooking equipment, and flashlights in working order.
- Persons who live in frequently flooded areas should keep on hand materials such as sandbags, plywood, plastic sheeting, and lumber which can be used to protect private property. Remember, sandbags should not be stacked directly against the outer walls of a building, since, when wet, the bags may create added pressure on the foundation.
- Call your local Red Cross for a copy of "Your Family Disaster Supplies Kit." brochure.
- Buy flood insurance. You should contact your property/casualty agent or broker about eligibility for flood insurance, which is offered through the National Flood Insurance Program. Generally, there is a thirty day waiting period for this policy to become effective, so don't wait to apply.
- Keep your insurance policies and a list of personal property in a safe place, such as a safety-deposit box.
- Know the name and location of the agent(s) who insured the policies.

WHEN THE FLOOD COMES

The safety of your family is the most important consideration. Since flood-

waters can rise very rapidly, you should be prepared to evacuate before the water level reaches your property.

- Keep a battery-powered radio tuned to a local station, and follow all emergency instructions.
- If you're caught in the house by suddenly rising waters, move to the second floor and, if necessary, to the roof. Take warm clothing, a flashlight, and portable radio with you. Then wait for help...don't try to swim to safety. Rescue teams will be looking for you.
- When outside the house, remember..... **FLOODS ARE DECEPTIVE.** Try to avoid flooded areas, and don't attempt to walk or drive through flood waters that are more than knee deep.

If, and only if, time permits . . . there are several precautionary steps that can be taken.

- Turn off all utilities at the main power switch and close the main gas valve if evacuation appears necessary. Do not touch any electrical equipment.
- Move valuable, personal items such as papers, furs, jewelry, clothing, and other contents to upper floors or higher elevations.
- Fill bathtubs, sinks and jugs with clean water in case regular supplies

are contaminated. You can sanitize these items by first rinsing with bleach.

- Board up windows or protect them with storm shutters or tape to prevent flying glass.
- Bring outdoor possessions inside the house or tie them down securely. This includes lawn furniture, garbage cans, tools, signs, and other movable objects that might be swept away or hurled about.

If it is safe to evacuate by car, you should consider doing the following:

- Stock the car with non-perishable foods (like canned goods), a plastic container of water, blankets, first aid kit, flashlights, dry clothing, and any special medication needed by your family.
- Keep the gas tank at least half full since gasoline pumps will not be working if the electricity has been cut off.
- Do not drive where water is over the roads. Parts of the roads may already be washed out.
- If your car stalls in a flooded area, abandon it as soon as possible. Flood waters can rise rapidly and sweep a car (and its occupants) away. Many deaths have resulted from attempts to move stalled vehicles.

AFTER THE FLOOD

If your home, apartment or business has suffered flood damage, immediately call the agent or broker who handles your flood insurance policy. The agent will then submit a loss form to the National Flood Insurance Program. An adjuster will be assigned to inspect your property as soon as possible.

- Prior to entering a building, check for structural damage. Make sure it is not in danger of collapsing. Turn off any outside gas lines at the meter or tank, and let the house air for several minutes to remove foul odors or escaping gas.
- Upon entering the building, do not use open flame as a source of light since gas may still be trapped inside; a battery-operated flashlight is ideal.
- Watch for electrical shorts or live wires before making certain that the main power switch is turned off. Do not turn on any lights or appliances until an electrician has checked the system for short circuits.
- Cover broken windows and holes in the roof or walls to prevent further weather damage.
- Proceed with immediate cleanup measures to prevent any health hazards. Perishable items which pose a health problem should be listed and photographed before discarding. Throw out fresh food and previously opened medicines that have come in contact with flood waters.
- Water for drinking and food preparation should be boiled vigorously for ten minutes (until the public water system has been declared safe). Another method of disinfecting is to mix 1/2 teaspoon of liquid commercial bleach with 2-1/2 gallons of water...let stand for five minutes before using. The flat taste can be removed by pouring the water from one container to another or adding a pinch of salt. In an emergency, water may be obtained by draining a hot water tank or melting ice cubes.
- Refrigerators, sofas, and other hard goods should be hosed off and kept for the adjuster's inspection. A good deodorizer when cleaning major kitchen appliances is to add one teaspoon of baking soda to a quart of water. Any partially damaged items should be dried and aired; the adjuster will make recommendations as to their repair or disposal. Take pictures of the damage done to your building and contents.
- Take all wooden furniture outdoors, but keep it out of direct sunlight to prevent warping. A garage or car port is a good place for drying. Remove drawers and other moving

parts as soon as possible, but do not pry open swollen drawers from the front. Instead, remove the backing and push the drawers out.

- Shovel out mud while it is still moist to give walls and floors a chance to dry. Once plastered walls have dried, brush off loose dirt. Wash with a mild soap solution and rinse with clean water; always start at the bottom and work up. Ceilings are done last. Special attention at this early stage should also be paid to cleaning out heating and plumbing systems.
- Mildew can be removed from dry wood with a solution of 4 to 6 tablespoons of tri-sodium phosphate (TSP), 1 cup liquid chlorine bleach, and 1 gallon water.
- Clean metal at once then wipe with a kerosene-soaked cloth. A light coat of oil will prevent iron from rusting. Scour all utensils, and, if necessary, use fine steel wool on unpolished surfaces. Aluminum may be brightened by scrubbing with a solution of vinegar, cream of tartar, and hot water.
- Quickly separate all laundry items to avoid running colors. Clothing or household fabrics should be allowed to dry (slowly, away from direct heat) before brushing off loose dirt. If you cannot get to a professional cleaner, rinse the items in lukewarm water to remove lodged soil. Then

wash with mild detergent; rinse and dry in sunlight.

- Flooded basements should be drained and cleaned as soon as possible. However, structural damage can occur by pumping out the water too quickly. After the flood waters around your property have subsided, begin draining the basement in stages, about 1/3 of the water volume each day.

Appendix B

Sources of Assistance

The following agencies can provide advice or assistance before, during, or after a flood.

EMERGENCY MANAGEMENT

Lyons Town Hall
432 5th Ave.
Lyons, CO 80540
(303) 823-6622

Lyons Fire Protection District
PO Box 695
Lyons, CO 80540-0695
(303) 823-6611

Boulder County
Emergency Management
1805 33rd Street
Boulder, CO 80301
(303) 441-3390

Colorado Office of Emergency
Management
15075 S. Golden Rd., Bldg 120
Golden, CO 80401-3979
(303) 273-1622

FLOOD MITIGATION/CONTROL INFORMATION

Colorado Water Conservation Board
1313 Sherman St. Rm 720
Denver, CO 80203
(303) 866-3441

FLOOD INSURANCE

Local Insurance Agents
Your Town or County
Federal Emergency Management Agency

Federal Insurance Administration
Washington, D.C. 20472
(202)646-2780
1-800-638-6620

VICTIM ASSISTANCE

American Red Cross
Boulder County Branch
5378 Sterling Dr.
Boulder, CO 80301
(303) 442-0577