

VALUE OF URBAN DRAINAGE PLANNING AND FLOOD HAZARD REDUCTION PROJECTS IN THE 2013 FLOOD

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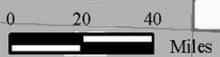
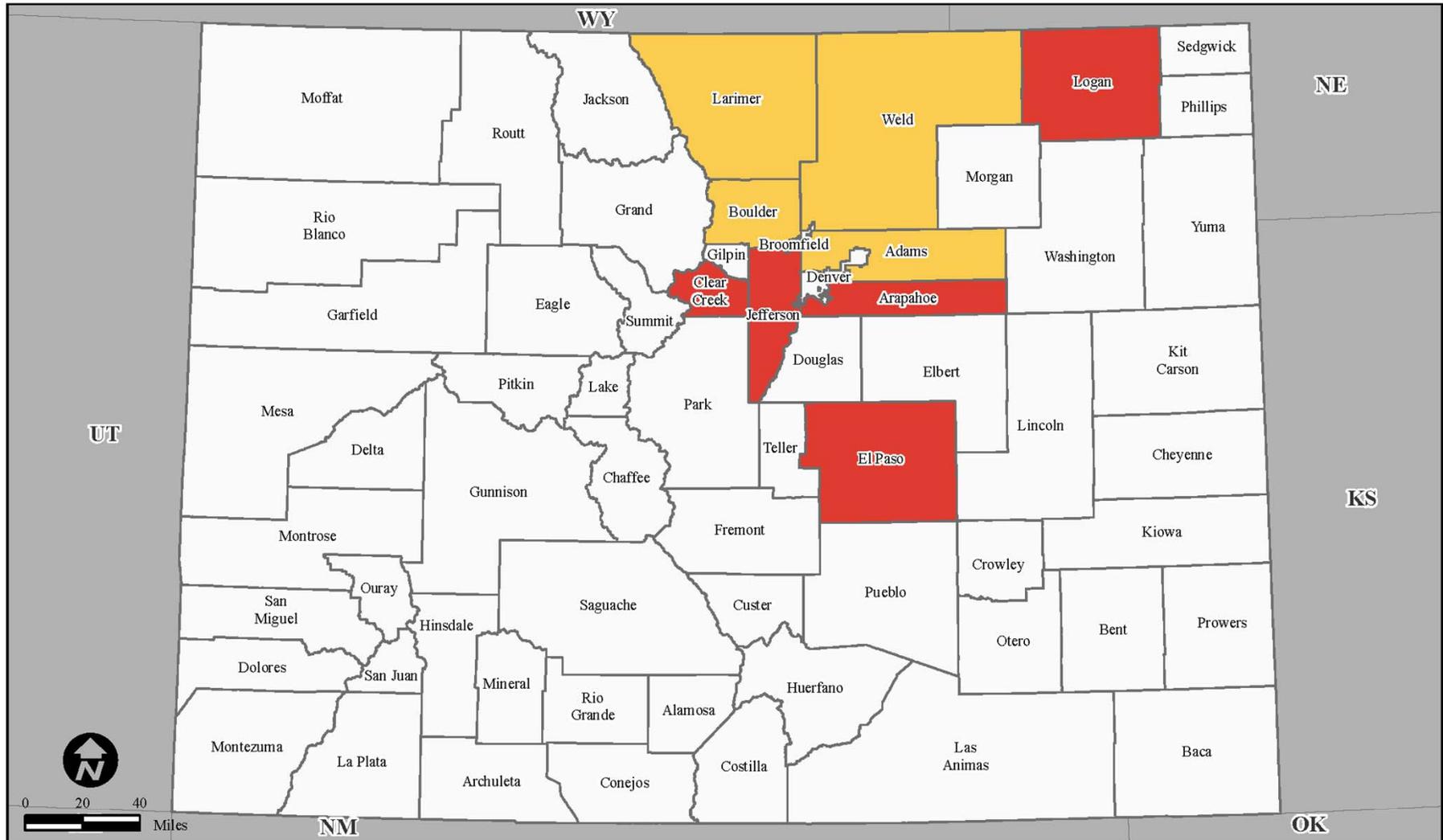
October 11, 2013

Water Resources Review Committee



Photos from Boulder Daily Camera Archive

FEMA-4145-DR, Colorado Disaster Declaration as of 09/20/2013



Location Map



Designated Counties

- No Designation
- Individual Assistance
- Individual Assistance and Public Assistance (Categories A and B)

All counties in the State of Colorado are eligible to apply for assistance under the Hazard Mitigation Grant Program.



FEMA
 MSB-OCIO-AEES
 Enterprise Geospatial
 Information Services (EGIS)
 09/20/13 - 2:04 PM EST

*Source: Disaster Federal Registry Notice
 Amendment No. 3: 09/20/2013*

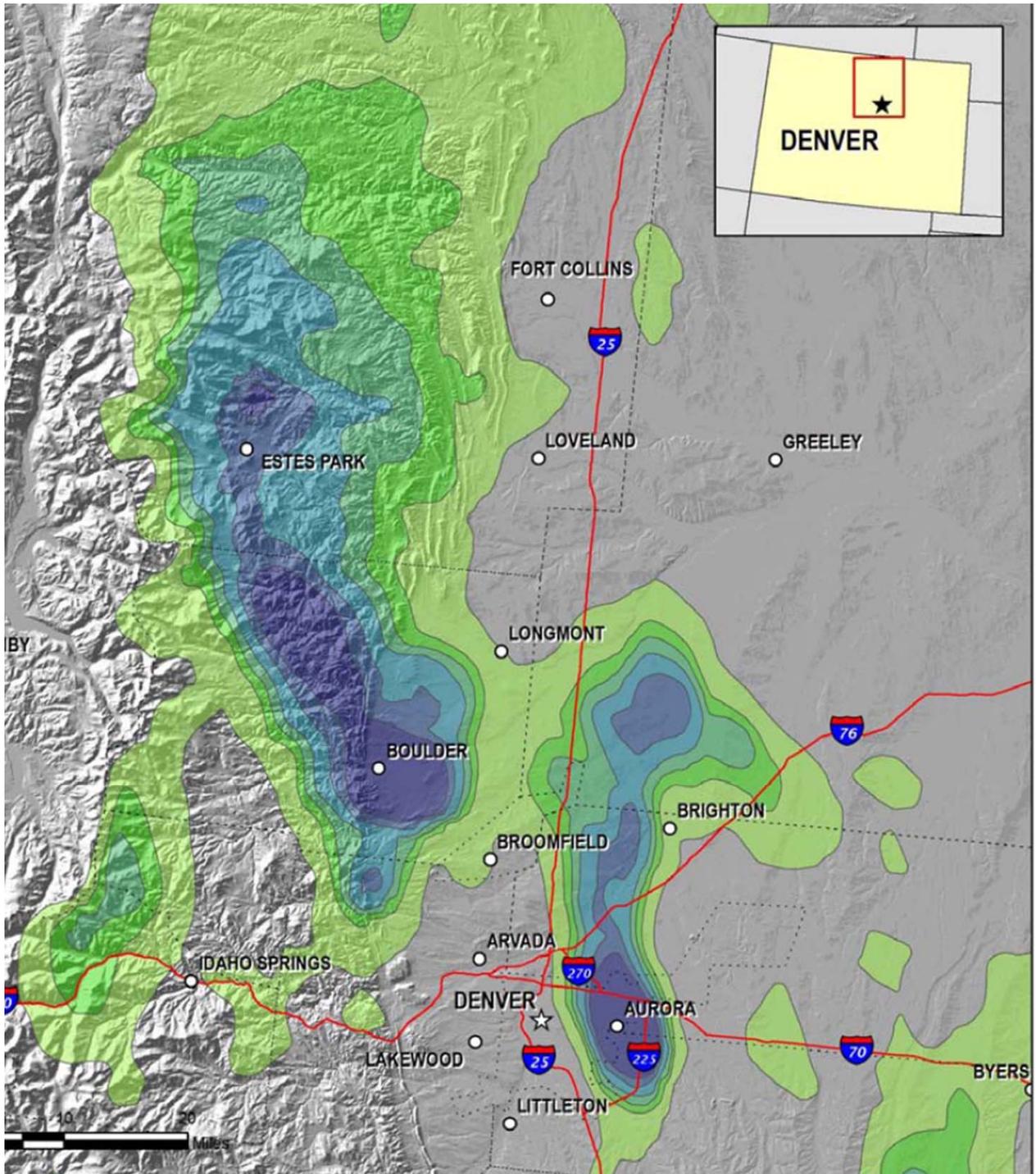
The High Costs Of Colorado's High Water, By The Numbers

The flooding that roared through communities and canyons across Colorado's Front Range is being blamed for:

- ❑ As many as eight deaths.
- ❑ Damaging or destroying 19,000 homes.
- ❑ Causing up to \$500 million worth of damage to roads and highways.

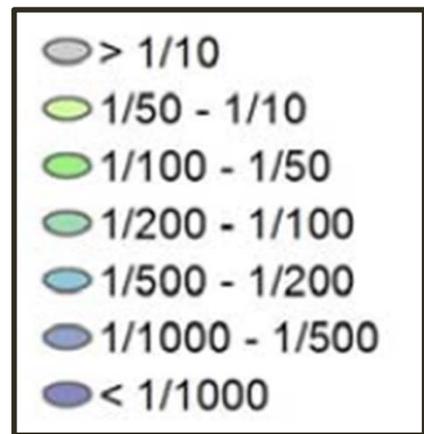
Source: *NPR.org*





Record Rainfall (NOAA/NWS)

24-Hour "Worst Case" Exceedence Probabilities

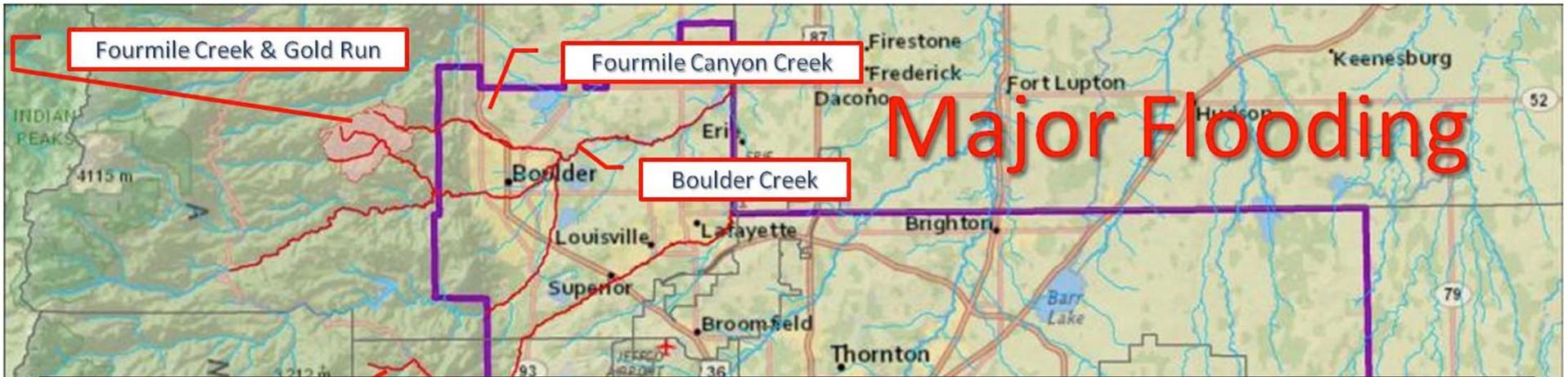


Record Runoff?

GAGE	2013 PEAK (preliminary)	NEW RECORD	PREVIOUS/CURRENT RECORD	COMMENT
Bear Creek at Morrison	9.1'	No?	9.2' on 9/1/1938	
Clear Creek at Golden	6.8'; 1550 cfs	No	2370 cfs on 7/10/1983	
Boulder Creek at Boulder	8.2'; 5,000 cfs	No	~11,000 cfs on 5/30/1894	1894 estimated
St. Vrain Creek at Lyons	>8.8'	Yes?	8.1'; 10,500 cfs on 6/22/1941	Gage destroyed 2013
N. Fork Big Thompson R., Drake	10.2'	Yes	9.3' on 7/31/1976	
Big Thompson, Canyon Mouth	>8.2'	Maybe	~19.9'; ~31,000 cfs on 7/31/76	Gage destroyed 2013 and 1976
Poudre R. at Ft. Collins	10.8'; 8420 cfs	Yes?	10.5'; 7,710 cfs on 4/30/1999	Gaged since 1975
S. Platte R. near Fort Morgan	24.7'; 50,600 cfs	No	83,700 cfs on 5/31/1935	

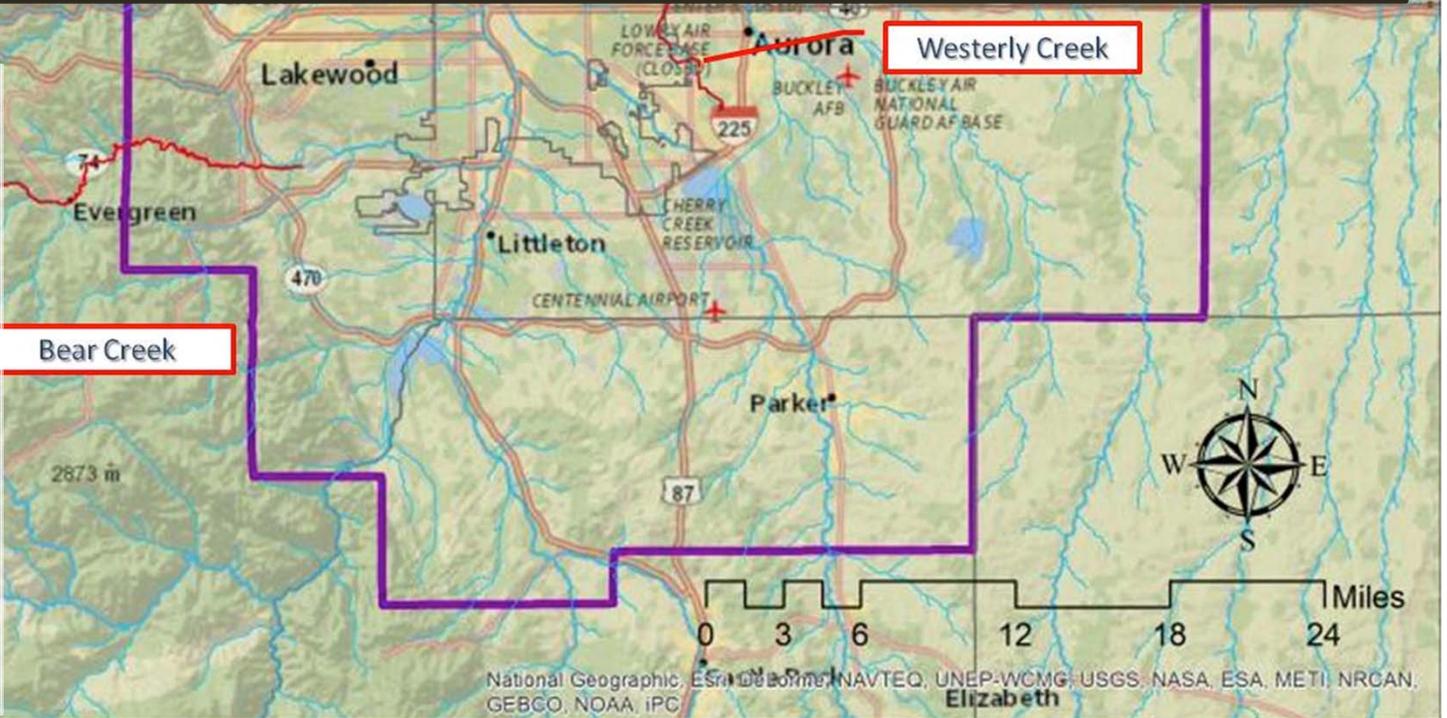
Preliminary flood peaks from selected gages on Front Range drainages affected by flooding, September 2013, compared with previous flood peaks. (Data: USGS, Colorado DWR, UDFCD)

Source: Severe Flooding on the Colorado Front Range September 2013. A Preliminary Assessment from the CIRES Western Water Assessment at the University of Colorado, NOAA ESRL Physical Science Division, and the CSU Colorado Climate Center.

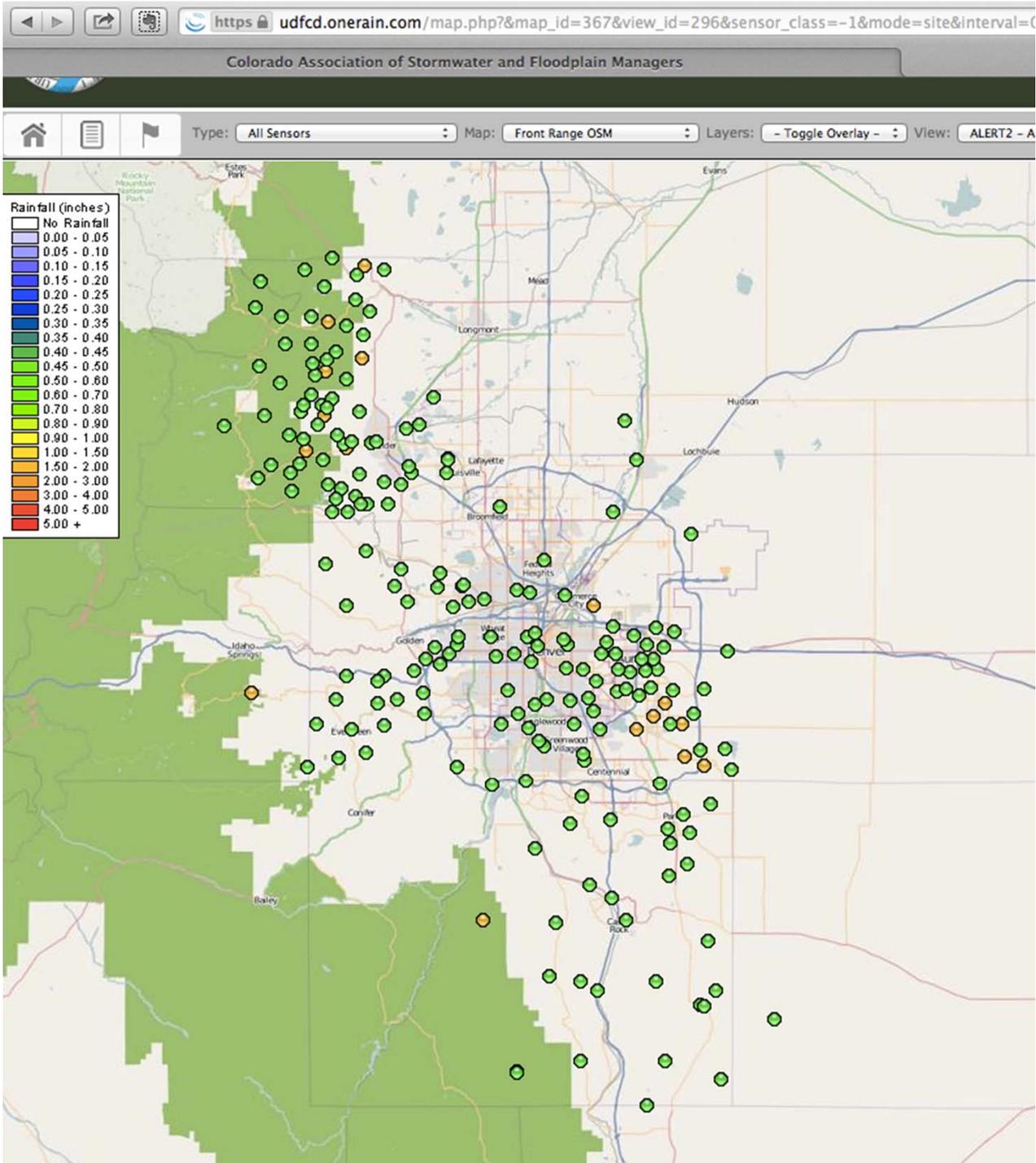


The Urban Drainage and Flood Control District works with local governments to address multi-jurisdictional drainage and flood control challenges in order to protect people, property, and the environment.

**UDFCD
Boundary
& Areas
of Major
Flooding**



National Geographic, Esri, DeLorme, NAVTEQ, UNEP-WCMG, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, IPC
Elizabeth



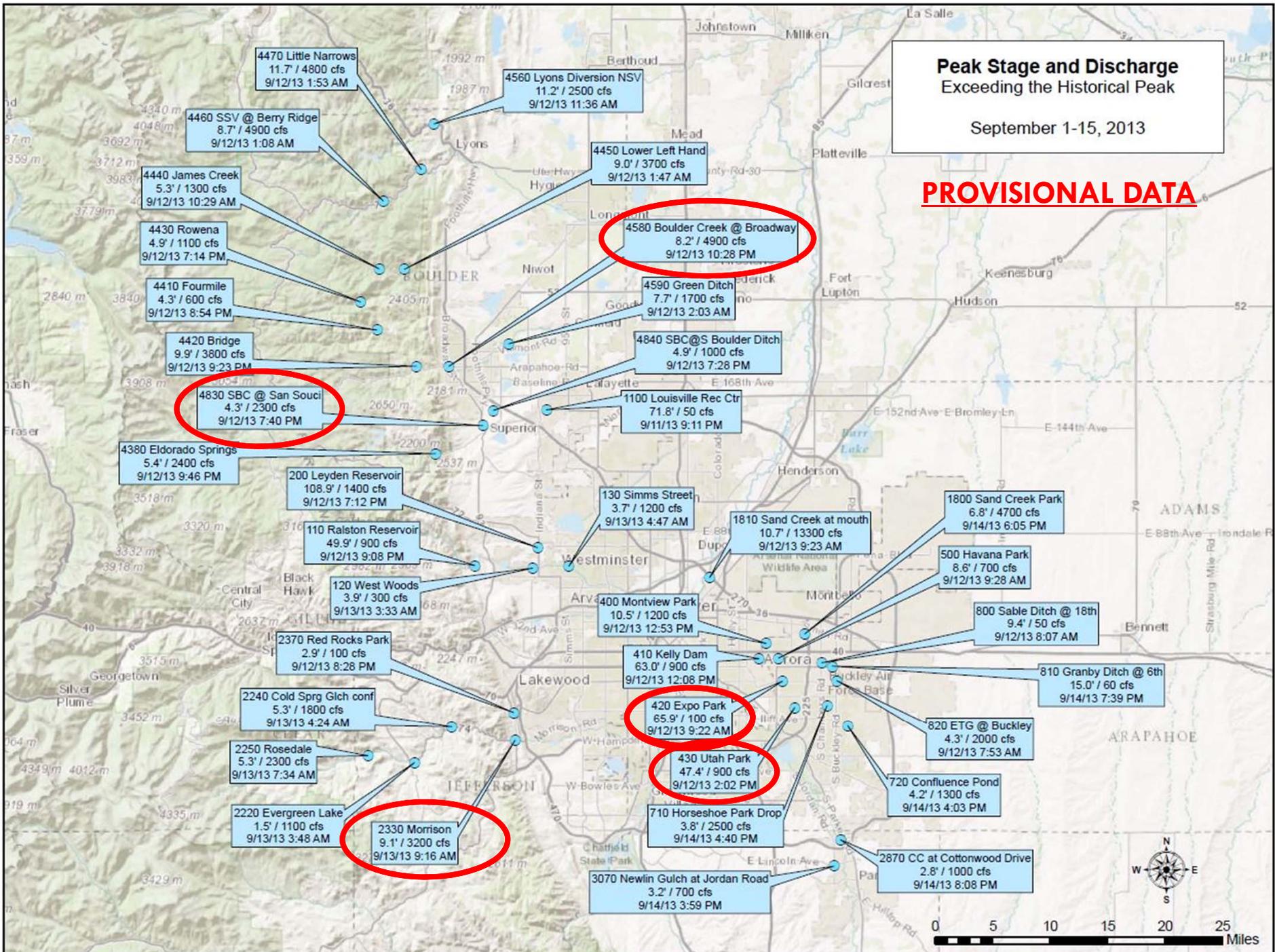
UDFCD ALERT SYSTEM

PRECIPITATION &
FLOW

**Peak Stage and Discharge
Exceeding the Historical Peak**

September 1-15, 2013

PROVISIONAL DATA





Expo & Utah Park—Westerly Creek

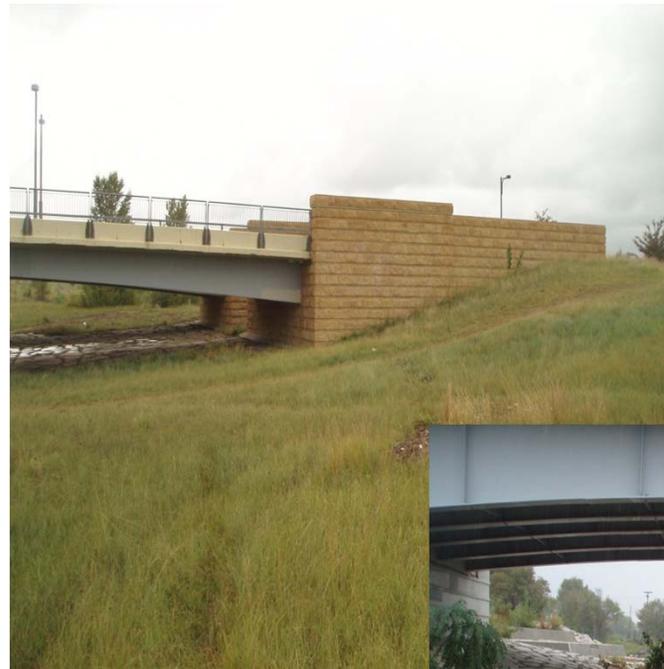
Aurora, Colorado

Westerly Creek

Area creeks and canals were still at or over capacity on September 14th, but city officials said there appeared to be no widespread flooding caused from creeks jumping the banks.



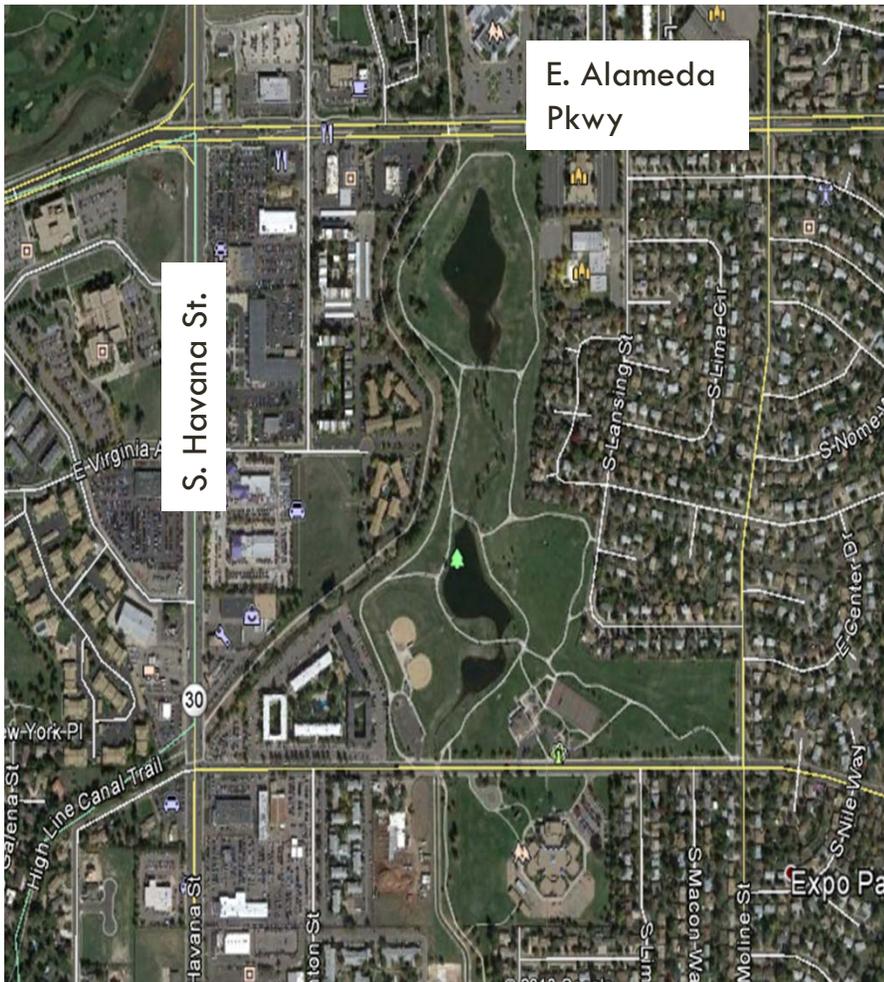
During rain and flooding.



After rain and flooding.



Westerly Creek Regional Detention Facility – Exposition Park



- Designed in 1971
- Improvements designed in 1999
- Provides 225 acre-feet of storage during the 100-year storm



Westerly Creek Regional Detention Facility – Exposition Park



The city estimates that Aurora received the same amount of rain in a week that it gets in an entire year, although it did little damage to infrastructure and property.



Aurora's two "saving graces" were Expo Park and Utah Park, which experienced severe overflow but still detained much of the water, Aurora Water spokesman Greg Baker said.



"That was water that wasn't going into people's homes." Greg Baker, Aurora Water Spokesperson.

Westerly Creek Regional Detention Facility – Utah Park



During flooding, water in Utah Park reached a peak depth of about 12-feet.

- Constructed in 2009
- Project consisted of:
 - Relocating the existing detention pond
 - Re-design of the existing drainage path
 - Re-grade topography to improve overall stormwater detention capacity
- Provides 250 acre-feet of storage

Westerly Creek Regional Detention Facility – Utah Park



A redesign of the water storage system at Aurora's Utah Park helped save surrounding homes during harsh flooding in the area Sept. 12-13, said Aurora Parks, Recreation and Open Space.



"The park performed as it was designed to perform and provided excellent protection."
--John Sawatzke, Principle Landscape Architect at Aurora Parks, Recreation and Open Space.

Westerly Creek Flood Quotes

“We came out of this very well, and I know it’s hard to believe with all the water,” said Aurora Water spokesman Greg Baker, but our system moved the water as fast and as best as it could, and did an excellent job of it.”

–Greg Baker, City of Aurora Spokesperson.

“All the water that could have gone into those neighborhoods and done significant damage to those homes was diverted to Utah Park,” said. “We are really proud that it’s doing its job and saving those homes from rising water in the area.”

--Sherri-Jo Stowell, spokesperson for Aurora Parks, Recreation and Open Space.



Bear Creek Lake Park

Lakewood, Colorado

Bear Creek Lake Park



Bear Creek Lake Park

Photo by David Mallory, UDFCD



Flood Facts—Bear Creek Lake Park

- Lake rose to ~ 50 feet above normal water level.
- Area of inundation increased from 110 acres to 1200 acres.
- Repairs to park estimated in neighborhood of \$300,000—
This is not unexpected.

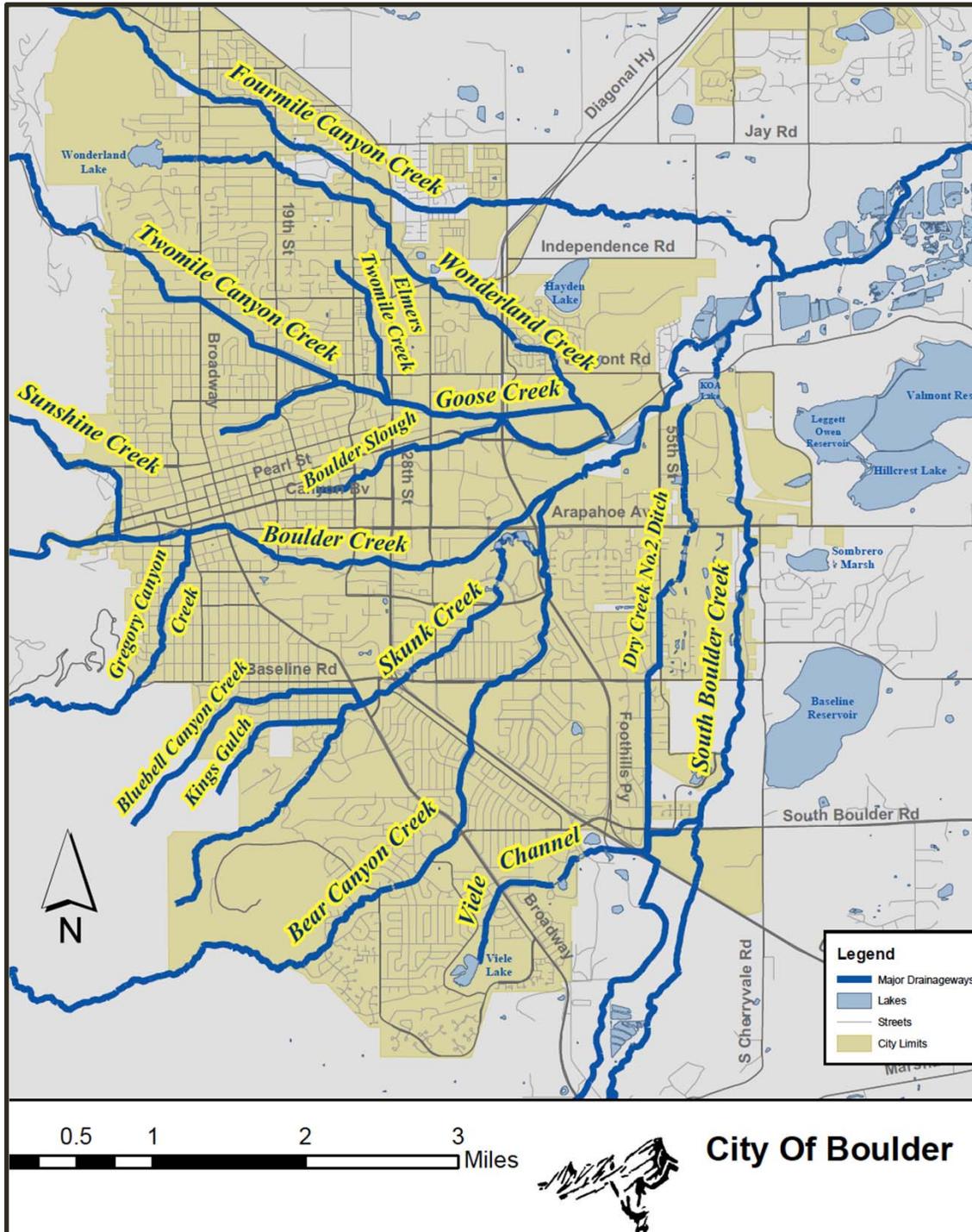
“A lot of people are fascinated to see it working as it was supposed to work & seeing that it actually worked.” – Drew Sprafke, Lakewood Regional Park Supervisor.

“It was a Godsend. If it hadn't stored that water, we'd probably been at least damaged a lot.” --Dave Humbargar, resident of subdivision downstream of lake.



City of Boulder

Selected examples of flooding & drainage
infrastructure



City of Boulder Major Drainage- ways

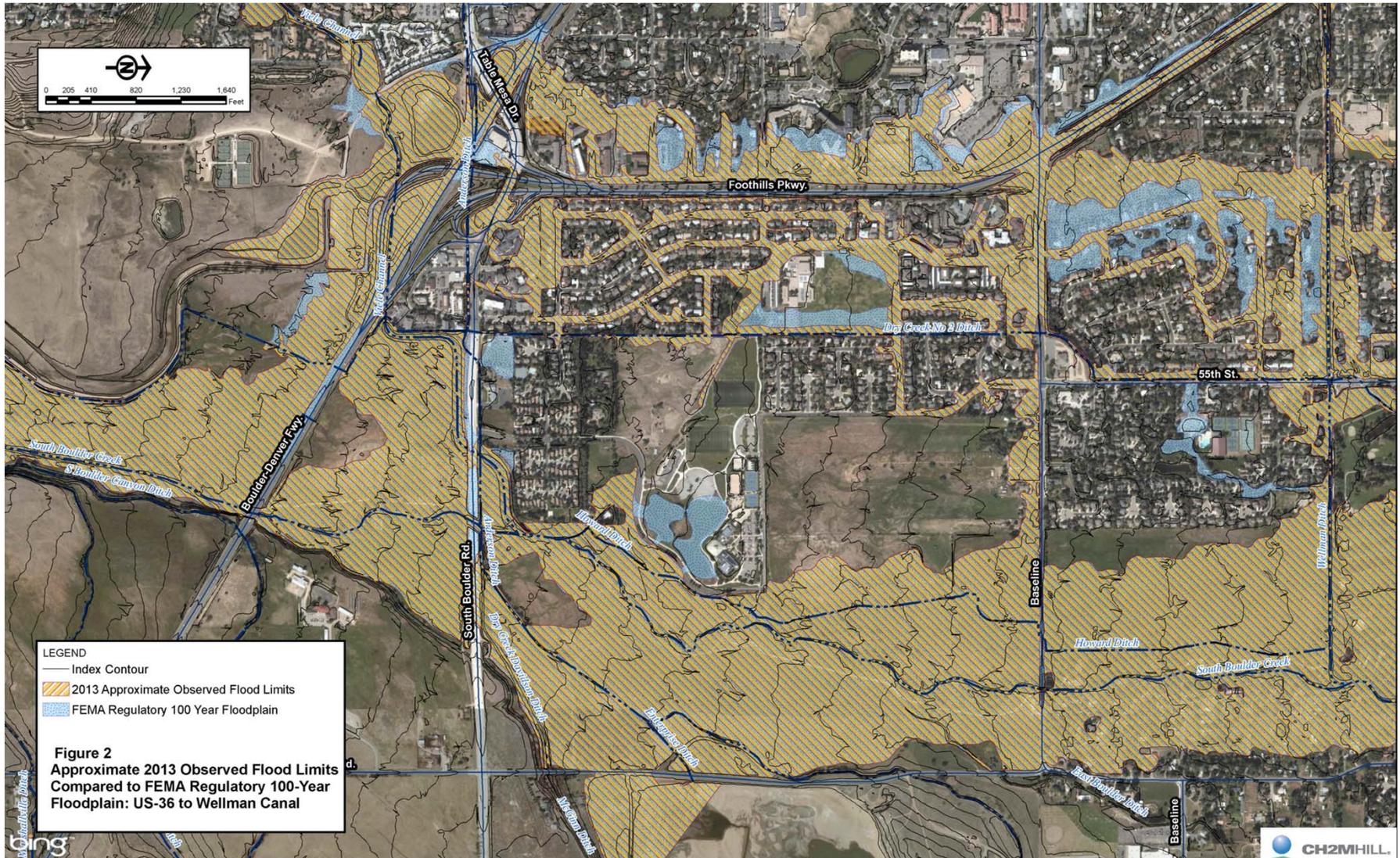
Urban Flooding

Photos from Boulder Daily Camera Archive



South Boulder Creek Floodplain

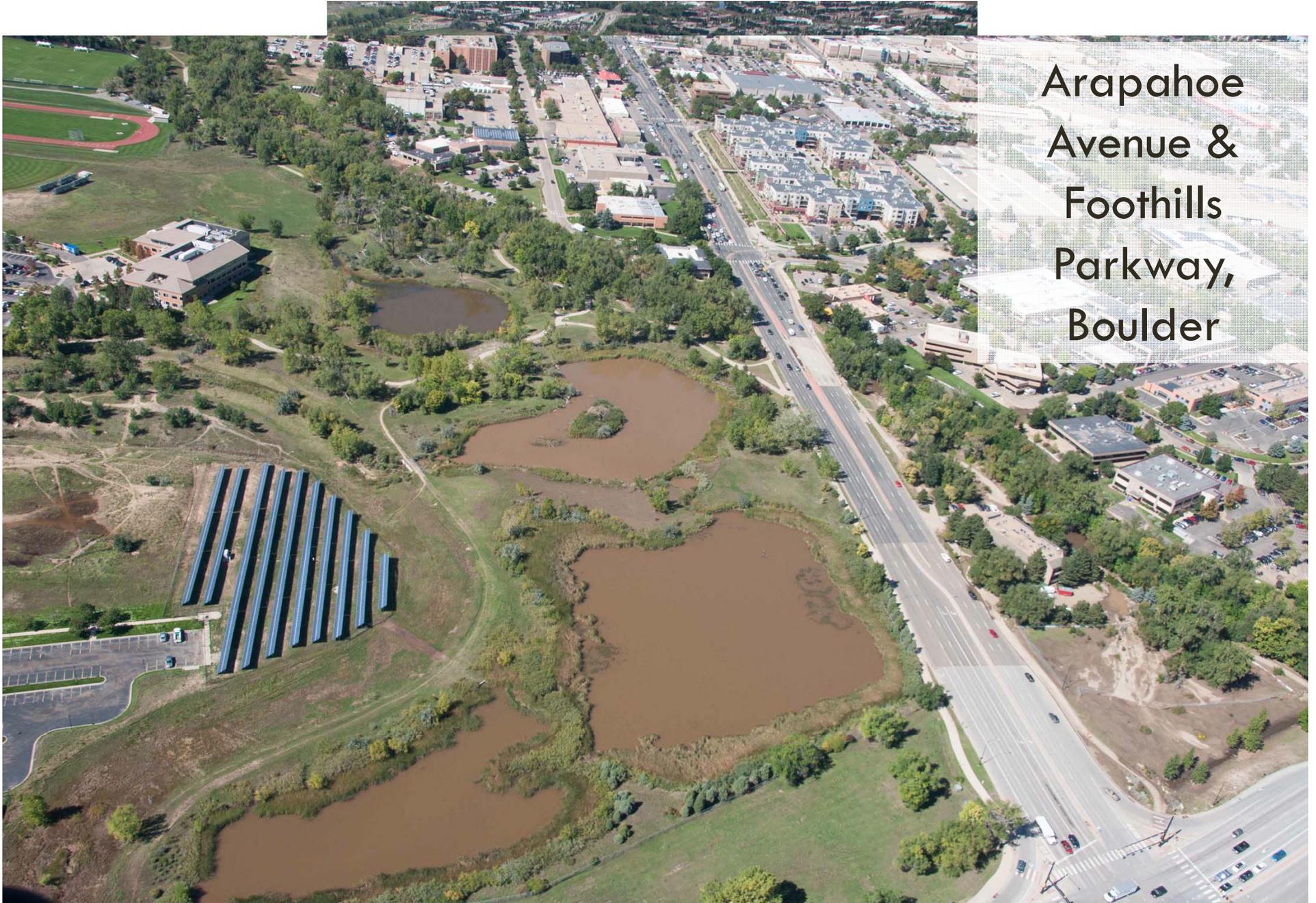
Image from City of Boulder, prepared by CH2M-Hill



Boulder Creek at 95th Street

Photo by David Mallory, UDFCD





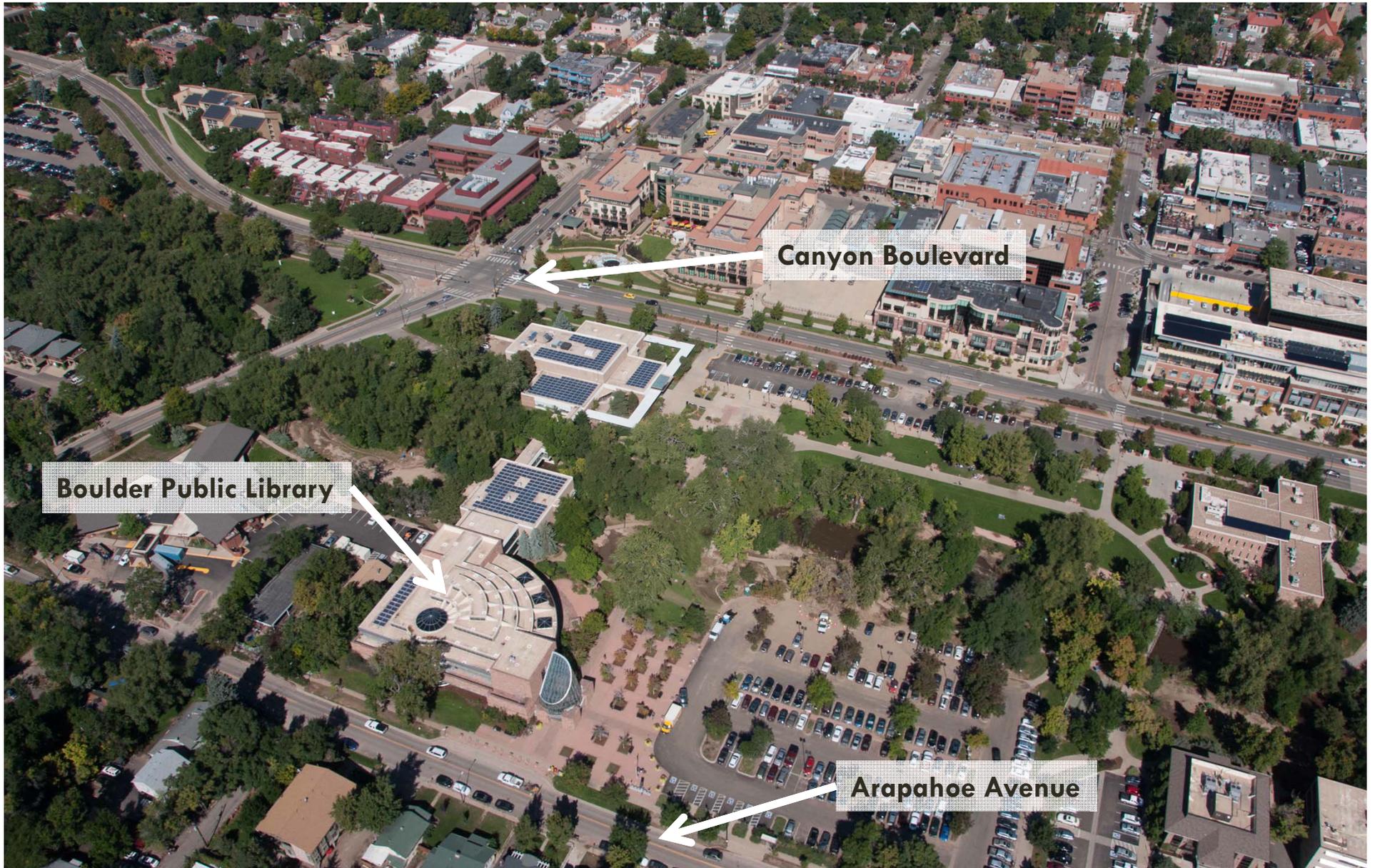
Arapahoe
Avenue &
Foothills
Parkway,
Boulder

Photos by David
Mallory, UDFCD



Boulder Creek in Vicinity of Library

Photo by David Mallory, UDFCD





Lessons Learned



- Extreme rainfall and large floods have occurred in the past and will occur again in the future.
- Flooding and related damages are not confined to the regulatory 100-year floodplain.
- Protection of critical facilities beyond 100-year limits is important for public safety and welfare.
- Floodplain preservation is a wise policy.

Lessons Learned

- Drainage infrastructure that is designed to appropriate criteria, constructed to a high standard and regularly maintained significantly reduces damages from flooding & protects the public.
- Flood warning systems save lives.
- Expect debris, especially in mountainous areas.
- Streams have a natural tendency to move over time.

Questions & Discussion



"Floods are 'acts of God,' but flood losses are largely acts of man."

--Gilbert White 1945. *Human Adjustment to Floods*. University of Chicago Department of Geography Research Paper No. 29.

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Urban Drainage Principles



- Drainage is a regional phenomenon that does not respect the boundaries between government jurisdictions or between properties.
- Every urban area has an initial and a major drainage system, whether or not they are actually planned and designed.
- Runoff routing is primarily a space allocation problem.
- Planning and design of stormwater drainage systems generally should not be based on the premise that problems can be transferred.

Urban Drainage Principles



- An urban storm drainage strategy should be a multi-objective and multi-means effort.
- The stormwater management system should receive regular maintenance.
- Floodplains need to be preserved whenever feasible and practicable.
- Reserve sufficient right-of-way to permit lateral channel movement whenever the floodplain is contained within a narrow natural channel.