



# *American Society of Military Engineers Resiliency Workshop*

October 15, 2019  
Karen Keith, County Commissioner  
Tulsa County, District 2

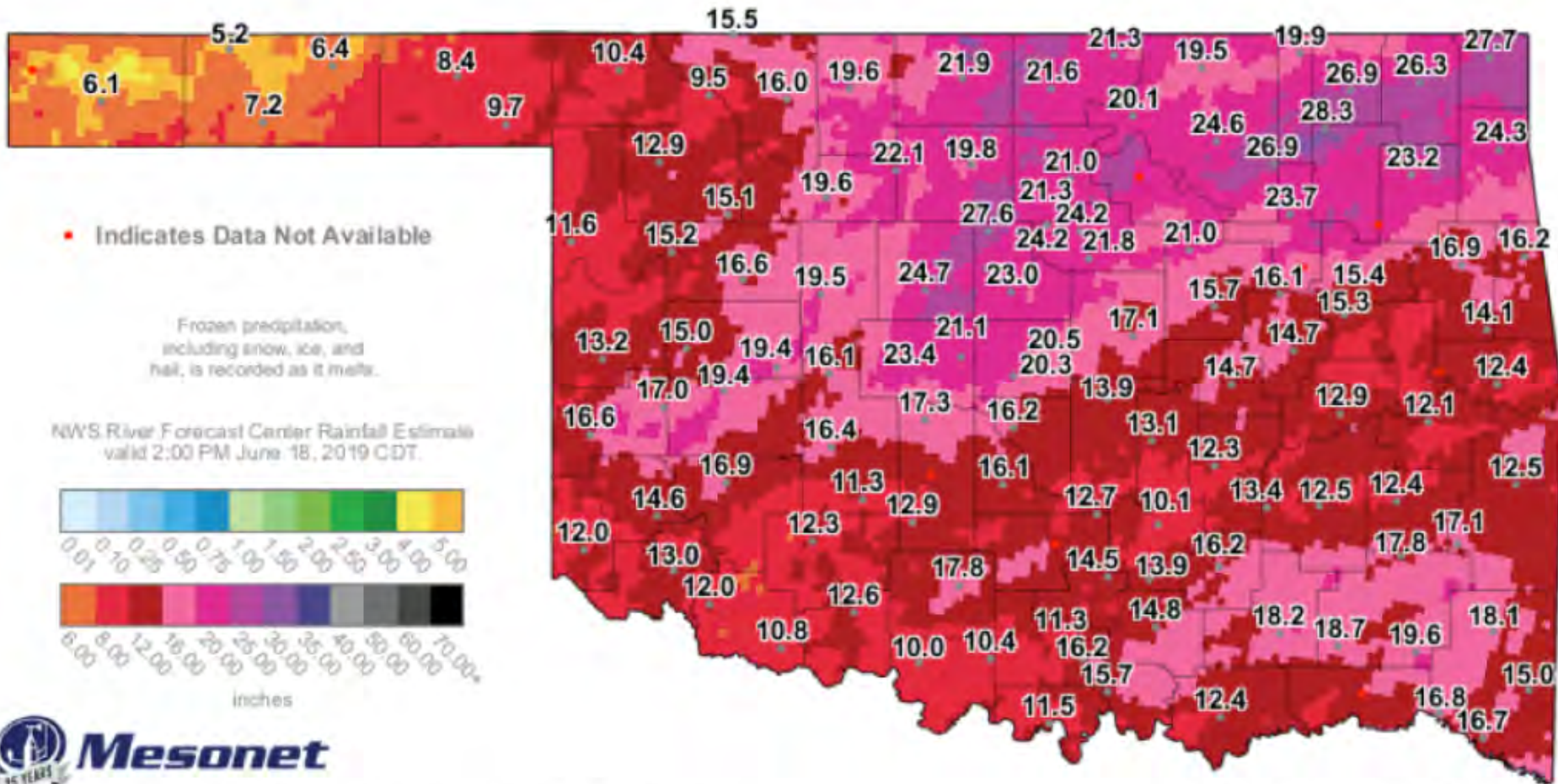


# FLOOD 2019





# RAINFALL ACCUMULATION MAP



60-Day Rainfall Accumulation (inches)

3:15 PM June 18, 2019 CDT  
Created 3:21:20 PM June 18, 2019 CDT © Copyright 2019



# MOVING HOMELESS FOLKS OFF OF THE LEVEE

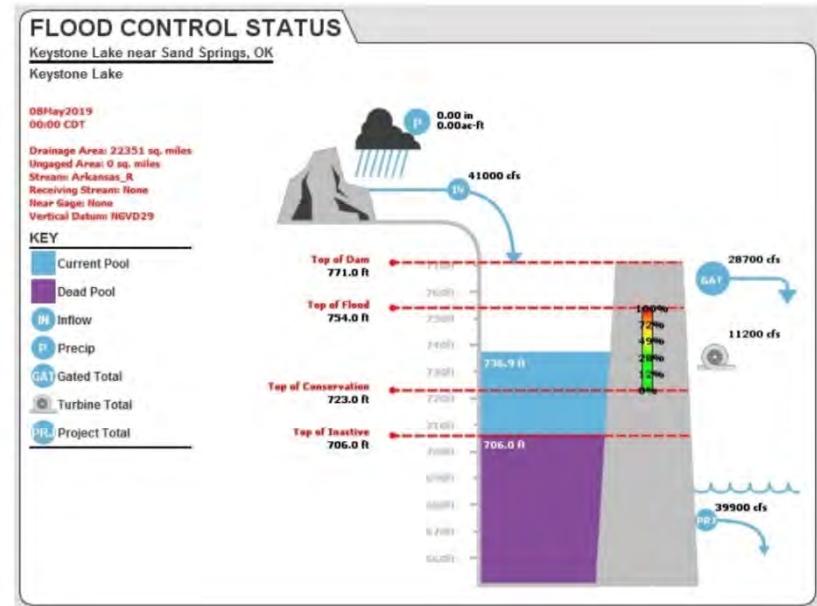




# FLOOD CONTROL STATS

Approximately 14 feet above normal

287,000 CFS



## Current Readings:

- 13.94 ft **ABOVE** normal
- Pool elevation is 736.94 feet on Wednesday 08May19 Time: 0100 hours.
- At this elevation the total amount of water stored in Keystone Lake is 809542 acre-feet.
- Reservoir release is 39896 cubic feet per second on Wednesday 08May19 Time: 0100 hours.
- Flood control pool is 33.46% full.
- Flood control pool storage filled is 377622 acre-feet which is equivalent to 0.32 inches of runoff over the entire drainage basin.
- Flood control pool storage empty is 751058 acre-feet which is equivalent to 0.63 inches of runoff over the entire drainage basin.



# FLOOD 2019

## Release from Keystone Dam



← From Here

To Here ↓



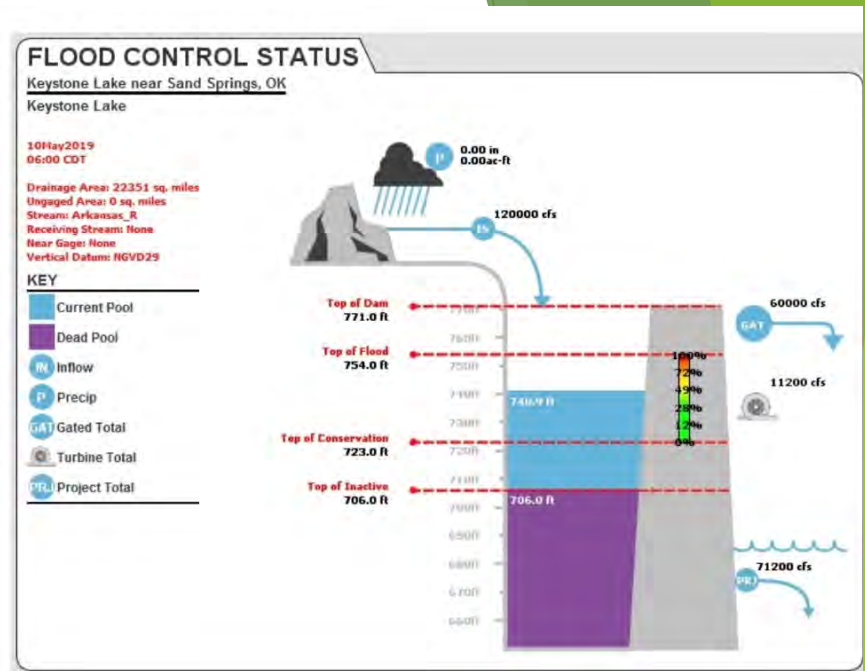
Water release amounts crept up many times resulting in too much water downstream.



# FLOOD CONTROL STATS

Approximately 18 feet above normal

60,000 CFS



## Current Readings:

- 17.92 ft **ABOVE** normal
- Pool elevation is 740.92 feet on Friday 10 May 19 Time: 0700 hours.
- At this elevation the total amount of water stored in Keystone Lake is 959080 acre-feet.
- Reservoir release is 71205 cubic feet per second on Friday 10 May 19 Time: 0700 hours.
- Flood control pool is 46.71% full.
- Flood control pool storage filled is 527160 acre-feet which is equivalent to 0.44 inches of runoff over the entire drainage basin.
- Flood control pool storage empty is 601520 acre-feet which is equivalent to 0.50 inches of runoff over the entire drainage basin.



# 21<sup>st</sup> STREET BRIDGE ALONG RIVERSIDE DRIVE







# RABBIT ROAD, SAND SPRINGS





# SAND BAG DETAIL





# FLOOD CONTROL STATS

## FLOOD CONTROL STATUS

Keystone Lake near Sand Springs, OK

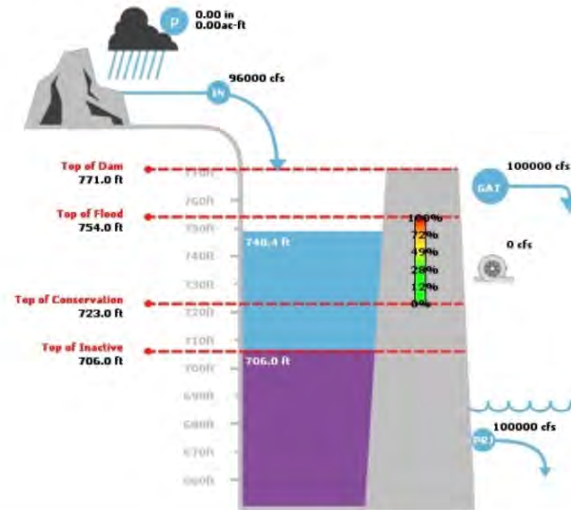
Keystone Lake

14May2019  
15:00 CDT

Drainage Area: 22351 sq. miles  
Un-gaged Area: 0 sq. miles  
Stream: Arkansas\_R  
Receiving Stream: None  
Near Gage: None  
Vertical Datum: NGVD29

### KEY

- Current Pool
- Dead Pool
- IH Inflow
- P Precip
- GAT Gated Total
- Turbine Total
- PLI Project Total



## Current Readings:

Approximately 26 feet above normal

100,000 CFS

- 25.35 ft **ABOVE** normal
- Pool elevation is 748.35 feet on Tuesday 14May19 Time: 2000 hours.
- At this elevation the total amount of water stored in Keystone Lake is [1276479](#) acre-feet.
- Reservoir release is 100128 cubic feet per second on Tuesday 14May19 Time: 2000 hours.
- Flood control pool is 74.83% full.
- Flood control pool storage filled is 844559 acre-feet which is equivalent to 0.71 inches of runoff over the entire drainage basin.
- Flood control pool storage empty is 284121 acre-feet which is equivalent to 0.24 inches of runoff over the entire drainage basin.



# RISING WATER “WATCH”

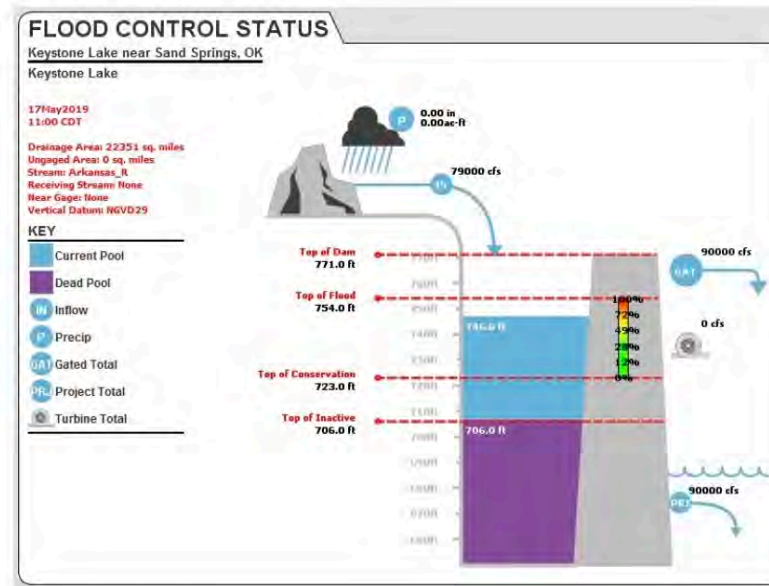


Blue Rose @ River Parks





# FLOOD CONTROL STATS



Approximately 24 feet above normal

## Current Readings:

- 23.58 ft **ABOVE** normal
- Pool elevation is 746.58 feet on Friday 17 May 19 Time: 1200 hours.
- At this elevation the total amount of water stored in Keystone Lake is [1195425](#) acre-feet.
- Reservoir release is 90018 cubic feet per second on Friday 17 May 19 Time: 1200 hours.
- Flood control pool is 67.65% full.
- Flood control pool storage filled is 763505 acre-feet which is equivalent to 0.64 inches of runoff over the entire drainage basin.
- Flood control pool storage empty is 365175 acre-feet which is equivalent to 0.31 inches of runoff over the entire drainage basin.



# EMERGENCY OPERATIONS CENTER (EOC)





# SEVERE WEATHER

## Tornado

### Warning

Valid from: Tue 21 May, 6:17 AM, CDT  
37 min remaining

#### Discussion

The National Weather Service in Tulsa has issued a  
\* Tornado Warning for...

Southwestern Rogers County in northeastern  
Oklahoma...

Northern Tulsa County in northeastern Oklahoma...

\* Until 700 AM CDT.

\* At 616 AM CDT, severe thunderstorms capable of  
producing a tornado

were located along a line extending from 2 miles  
southwest of Sand

Springs to Jenks Riverside Airport, moving northeast at  
55 mph.

HAZARD...Tornado.

SOURCE...Radar indicated rotation.

IMPACT...Flying debris will be dangerous to those  
caught without

shelter. Mobile homes will be damaged or destroyed.

Damage to roofs, windows, and vehicles will  
occur. Tree

damage is likely.

\* Locations in or near the path include...

Tulsa...

Broken Arrow...

Sand Springs...

Claremore...



# MEADOW VALLEY & FISHER CREEK



Sand Springs Police protected  
vacated neighborhoods





# TULSA BOYS HOME





# SANDY PARK APARTMENTS





# O'BRIEN PARK



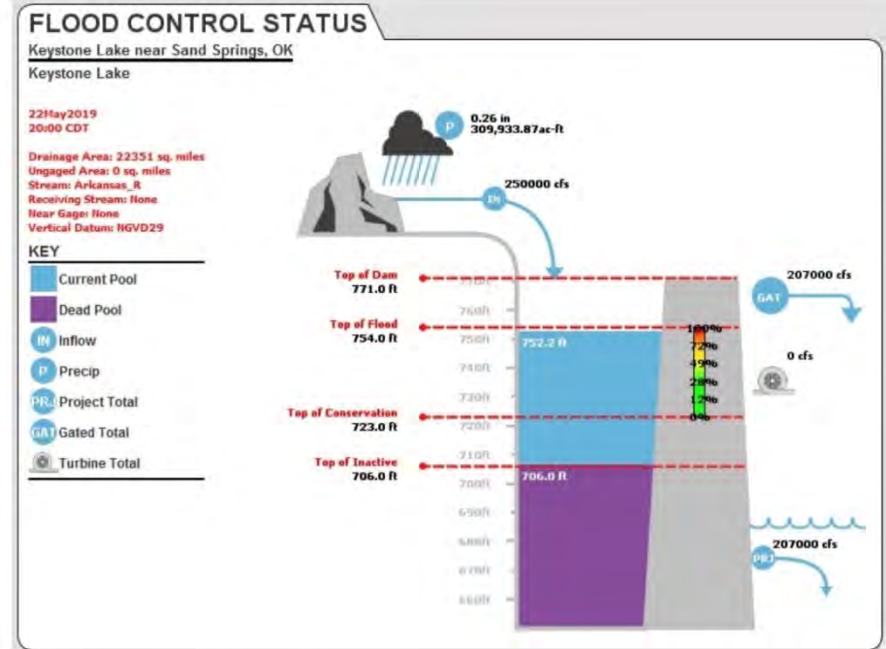
Tulsa County's O'Brien Park -almost underwater



# FLOOD CONTROL STATS

Approximately 30 feet above normal

207,000 CFS



## Current Readings:

- 29.18 ft **ABOVE** normal
- Pool elevation is 752.18 feet on Wednesday 22May19  
Time: 2000 hours.
- At this elevation the total amount of water stored in Keystone Lake is [1465223](#) acre-feet.
- Reservoir release is 206766 cubic feet per second on Wednesday 22May19 Time: 2000 hours.
- Flood control pool is 91.55% full.
- Flood control pool storage filled is [1033303](#) acre-feet which is equivalent to 0.87 inches of runoff over the entire drainage basin.
- Flood control pool storage empty is 95377 acre-feet which is equivalent to 0.08 inches of runoff over the



# KEYSTONE DAM

## Senator & Mrs. Lankford



Sen. & Mrs. Lankford and Com. Keith with Wade Anderson



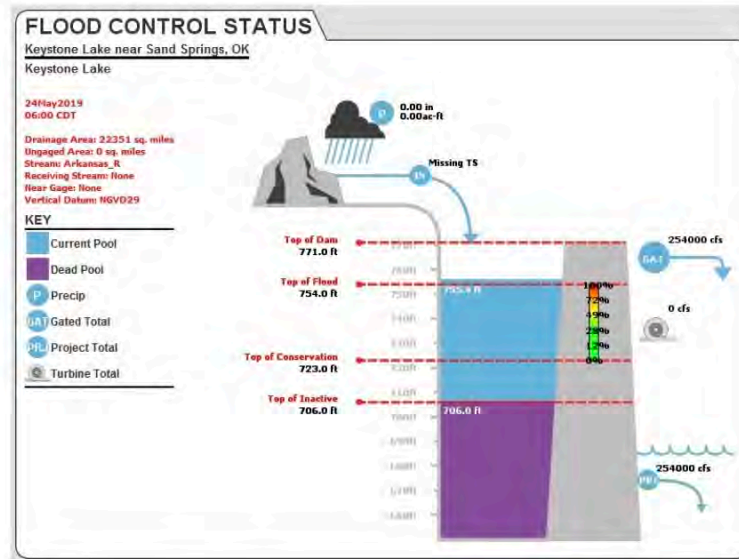
This IS an important gauge.



# FLOOD CONTROL STATS

Approximately 33 feet above normal

254,000 CFS

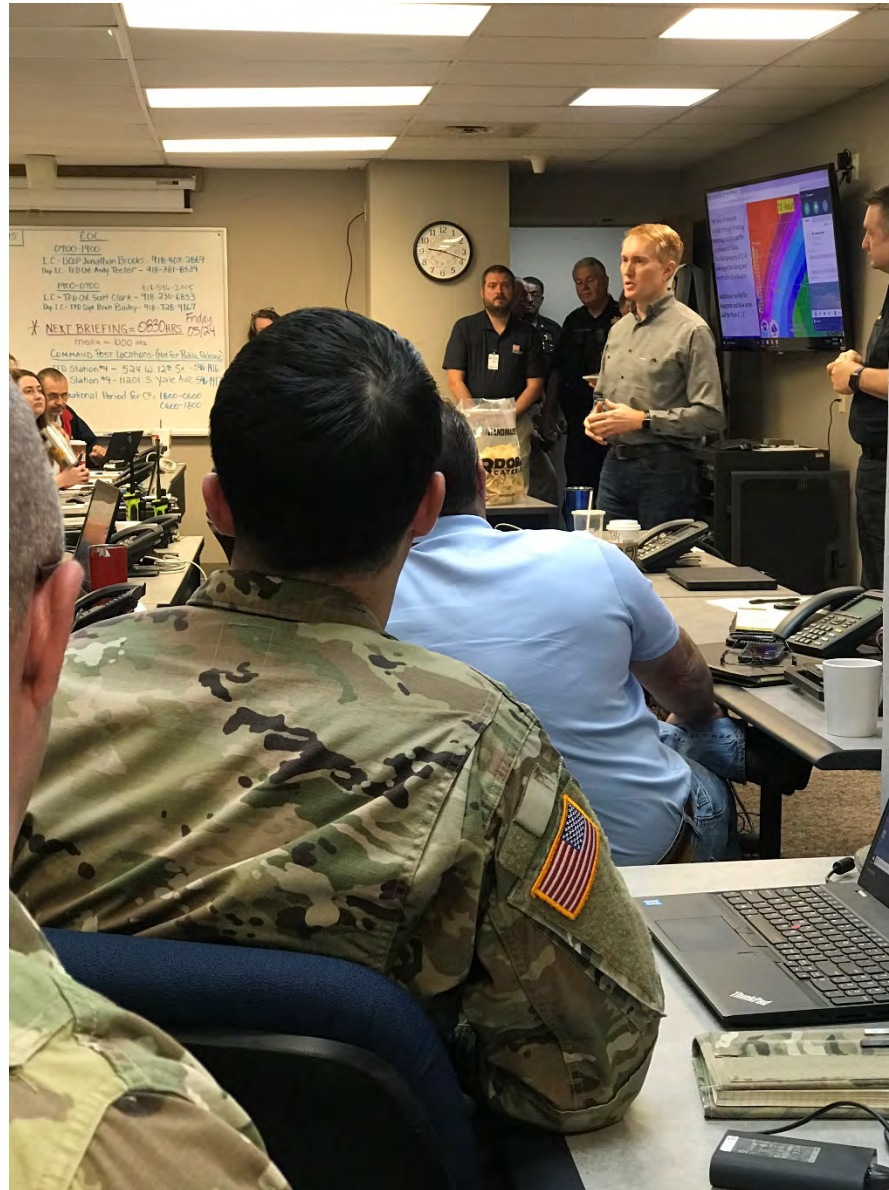


## Current Readings:

- 32.42 ft **ABOVE** normal
- Pool elevation is 755.42 feet on Friday 24May19 Time: 06:00 hours.
- At this elevation the total amount of water stored in Keystone Lake is [1637919](#) acre-feet.
- Reservoir release is 253971 cubic feet per second on Friday 24May19 Time: 06:00 hours.
- Flood control pool is 106.85% full.
- Flood control pool storage filled is [1205999](#) acre-feet which is equivalent to 1.01 inches of runoff over the entire drainage basin.
- Flood control pool storage empty is 0 acre-feet which is equivalent to 0.00 inches of runoff over the entire drainage basin.



# SENATOR LANKFORD @ EOC





# Candlestick Beach







# CHECKING FOR A LEVEE BREACH

6:40 AM



Service members with the National Guard and the Corps of Engineers work to fill sandbags behind a levee that was bubbling near West 67th Street and Charles Page Boulevard. TDM GILBERT/TUs a World



# CONGRESSMAN HERN ON THE LEVEE





# EFRAM WALKS THE LEVEE





# RESIDENTS COPING WITH THE WATER





# FLOOD 2019

## Charles Page Blvd Area



Brothers Don & Jon Comstock -  
Don lives in Mayfair Addition &  
had to relocate during flood.





# PAUL ZACHARY, CITY OF TULSA ENGINEER





# CASE COMMUNITY CENTER





# WALKING THE LEVEE







# RIVER SPIRIT CASINO



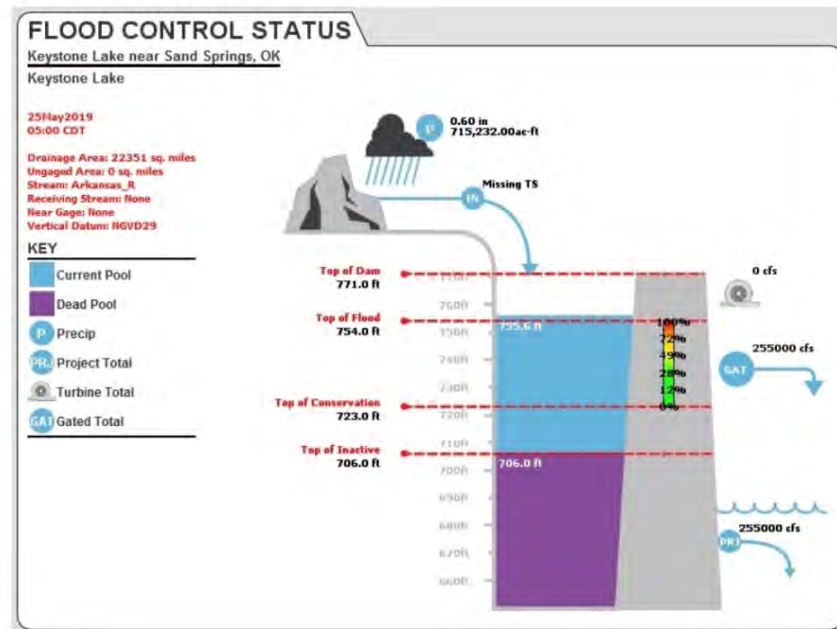


# CREEK NATION SUPPORTING RIVER SPIRIT CASINO





# FLOOD CONTROL STATS



Approximately 33 feet above normal

255,000 CFS

## Current Readings:

- 32.65 ft **ABOVE** normal
- Pool elevation is 755.65 feet on Saturday 25May19 Time: 0500 hours.
- At this elevation the total amount of water stored in Keystone Lake is [1650799](#) acre-feet.
- Reservoir release is 254943 cubic feet per second on Saturday 25May19 Time: 0400 hours.
- Flood control pool is 107.99% full.
- Flood control pool storage filled is [1218879](#) acre-feet which is equivalent to 1.02 inches of runoff over the entire drainage basin.
- Flood control pool storage empty is 0 acre-feet which is equivalent to 0.00 inches of runoff over the entire drainage basin.



# SANDBAGGING IN FULL FORCE



Had to build a road to help facilitate the work by the National Guard



# NATIONAL GUARD ON DUTY



Army Corps pumps assisted to get water back into the river



Levee Commissioner Kilpatrick with National Guard



# FLOOD CONCERNS

Abandoned  
Walker





# FLOOD CONCERNS

Concerns about the Refinery being flooded



University Towers  
in the background









# OKLAHOMA AQUARIUM, JENKS





# RESIDENTS MOVING OUT





# FLOOD-2019

## Town & Country



Many homes were affected throughout Tulsa County



# FLOOD 2019



From Water &  
Debris



To Clean Out &  
Down to Bare  
Studs





# FLOOD 2019

## Saving the Animals



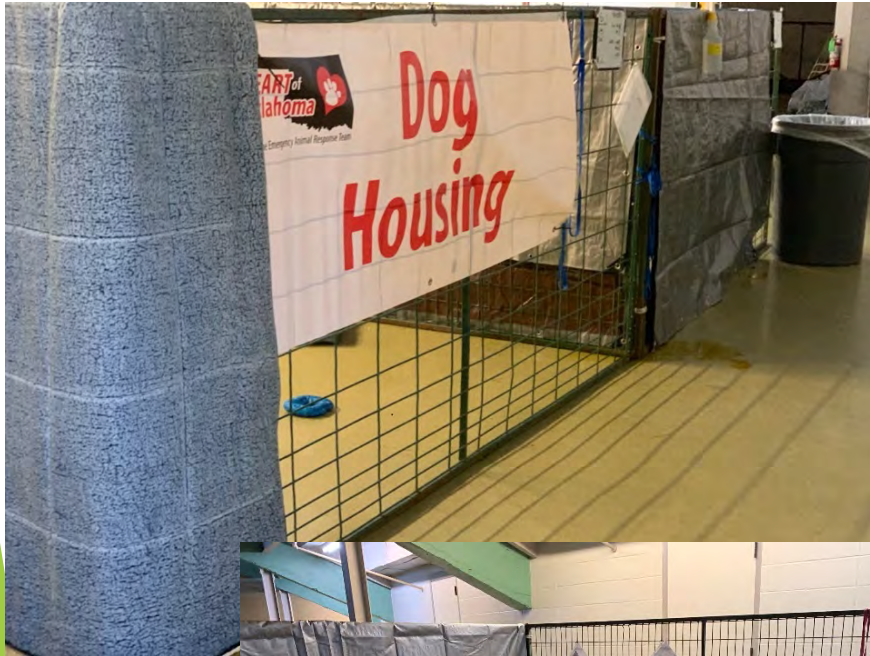
Undersheriff George Brown -  
rounding up animals





# FLOOD 2019

## Housing the Homeless Animals





# FLOOD 2019

## Fishing Anyone?





# HOME OWNERS SALVAGING GOODS, HAD TO BE RESCUED







# HOUSING STOCK





# CONGRESSMAN HERN ON THE WATER AGAIN





# JEREMY HERRINGTON, TOWN & COUNTRY RESIDENT



Though his house was impacted he still took the time to give tours and highlight his neighbor water issues.



# HOME OWNERS WITH NO INSURANCE



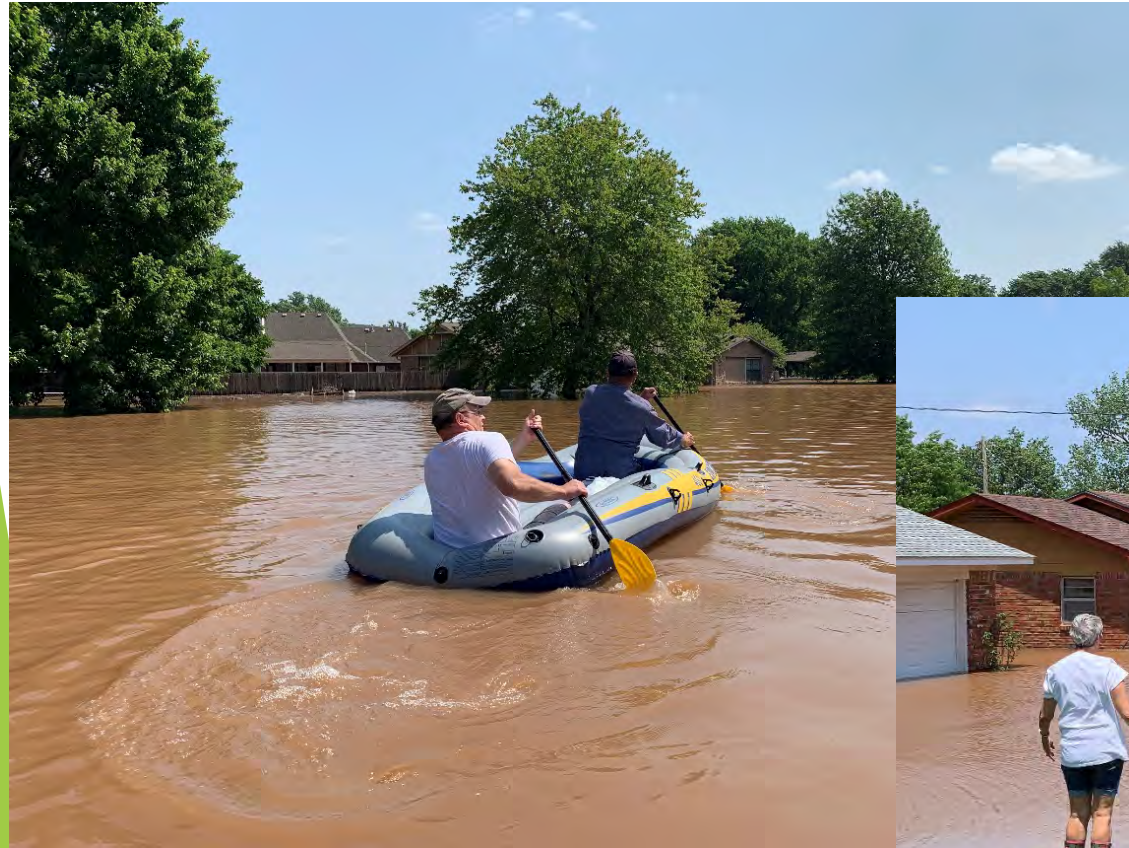


# JEREMY HERRINGTON, TOWN & COUNTRY RESIDENT





# HOME OWNERS SAVING POSSESSIONS





# WEBCO- ABOVE & BEYOND



Air conditioned, cleaned,  
well stocked facilities

Air condition trailer with  
cleaning supplies, food &  
water





# WEBCO EMPLOYEES- ABOVE & BEYOND





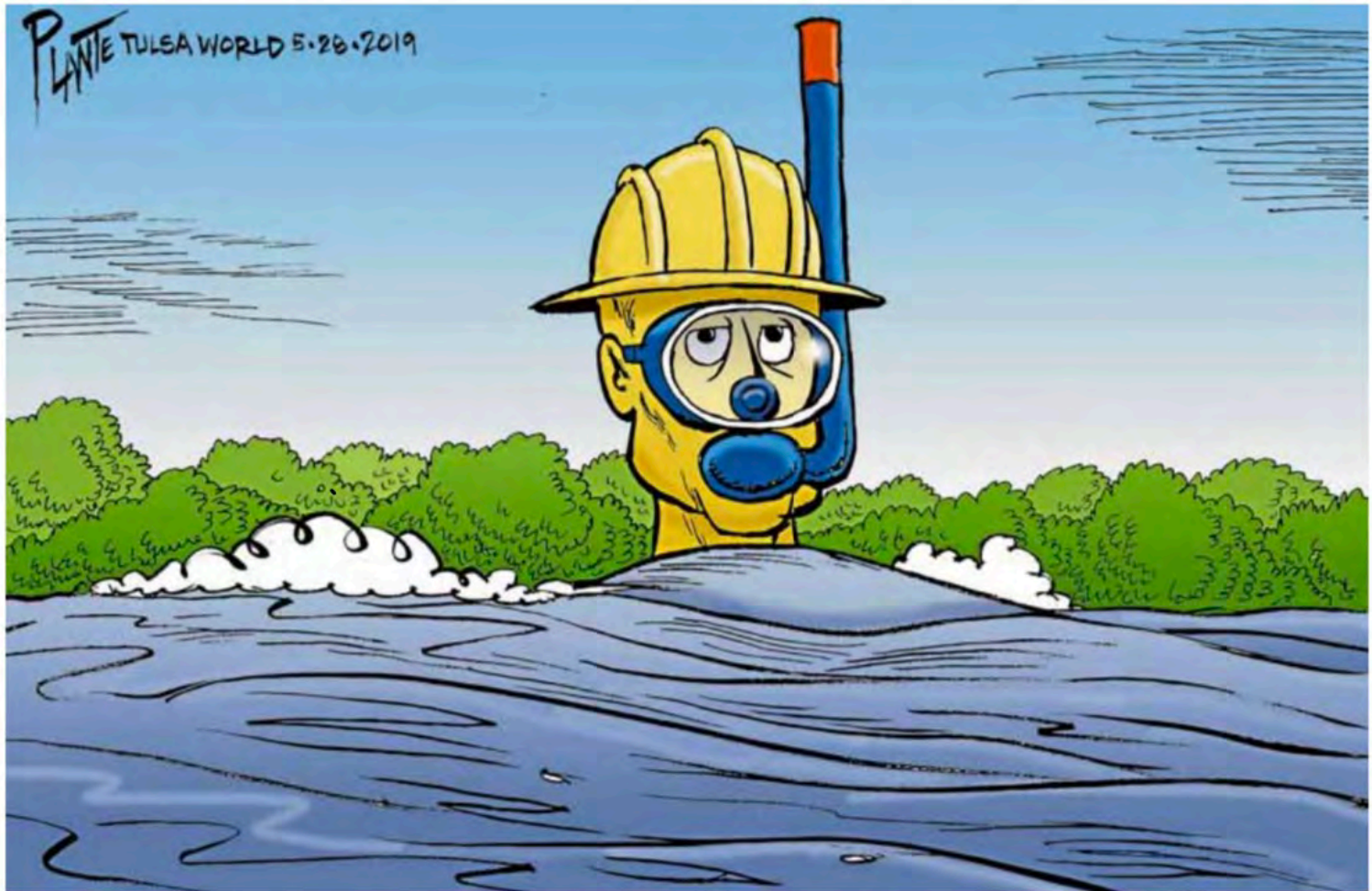


# ARK WRECKING





# GOLDEN DRILLER



Bruce Plante was at it again!



# CONGRESSMAN HERN & SHERIFF'S DEPUTIES





# SPREADING THE MESSAGE

## Tulsa World Newspaper Stories

### FEMA will pay maximum of about \$30,000, but average payout is about \$4,000

**By Kevin Canfield**

Tulsa World

Property owners seeking federal assistance to help rebuild their homes after last week's flooding should not expect all of their costs to be reimbursed, an official with FEMA said Friday.

Kent Clark, response division



in Houston help fill sandbags at ORU at a makeshift sandbag making operation in

#### Find shelter, assistance and supplies for storm and flood victims

Many agencies and businesses are offering help for storm and flood victims. Oklahoma residents seeking non-emergency disaster or health and human service information, please contact your local 2-1-1. Services are available 24 hours a day by dialing 2-1-1 from your home or cellular telephone. Please only call 911 for emergencies.

#### Free self storage from U-Haul

U-Haul Companies of Tulsa and Oklahoma City are making 18 facilities available for 30 days of free self-storage to Oklahomans affected by continued flooding across the state. People seeking additional information or needing to arrange 30 days free self-storage should contact the nearest participating U-Haul store location. Find locations at uhaul.com.

#### Tetanus shots

All Tulsa Health Department immunization clinics will offer tetanus shots at no cost to anyone affected by the weather events in Tulsa County. Visit [tulsa-health.org/vaccines](http://tulsa-health.org/vaccines) or call 918-582-9355 for hours and locations. Anyone who has sustained significant injuries is encouraged to seek medical attention from their primary care provider or urgent care. Many local pharmacies also offer tetanus shots.

#### Crisis cleanup

From now until June 14, several relief agencies are staffing a free hotline for muck-out, debris removal, and home cleanup from the recent statewide storms and flooding. This hotline will connect survivors with vetted relief agencies that will assist in debris cleanup and mucking out. All services are free, but service is not guaranteed due to the expected overwhelming need. The public may call 800-451-1954 to request help with storm and flooding related cleanup. Those requests will be shared with relief organizations at [crisiscleanup.org](http://crisiscleanup.org).

#### Free sand bags at ORU parking lot

The city of Tulsa is offering free bags of sand at the Oral Roberts University parking lot at 81st and South Lewis Avenue. The city has a machine capable of producing 40-pound sandbags at a rate of between 500 and 700 an hour at its West 23rd and South Jackson Avenue location.

#### Emergency housing assistance

Oklahoma Housing Finance Agency has emergency housing assistance available to Oklahoma families displaced by recent storms where their home has been left uninhabitable. OHFA provides grants of up to \$1,500 for temporary hotel accommodations and/or security or utility deposits for more permanent housing. To apply for assistance, call 405-419-8196 to leave a message on OHFA's housing hotline for the disaster housing grant.

#### Financial grants for veterans

Veterans who have been affected by the recent weather may be eligible for a financial grant, according to the Oklahoma Department of Veterans Affairs. Visit its website at [okvets.ok.gov](http://okvets.ok.gov) and click on the "get help" tab to find a service officer or location near you to assist. You can also call 918-781-7766 or 405-523-4000 to locate a service office or location near you.

#### Hotel discounts

WYPO HOTEL

### Neighbors help Tulsa



in the Wind River neighborhood near 121st and Delaware in Jenks. STEPHEN PINGRY



talks with friends trying to reach residents

today. It's still only up to about here," she said, hitting her boot closer to her ankle than her knee. "It won't get up into the apartment but we don't want to be stranded."

Many of the residents have already left, she said. "There are still some older residents here and it's them I'm concerned about mostly," she said. City of Bixby spokeswoman Jennifer Rush said the city would be updating its list of



# NEIGHBORHOOD MEETINGS

Broadway Baptist opened their doors.



Senator Lankford & Commissioner Keith



# NEIGHBORHOOD MEETINGS

Broadway Baptist opened their doors.



Insurance Commissioner Mulready



Teresa Tosh & Joseph Kralicek



# NEIGHBORHOOD MEETING

Sheriff Regalado

Mike Abate, Army Corps  
of Engineers (seated)





# CLEANING UP BEGINS







# CLEANING UP BEGINS





# INSPECTIONS BEGIN



3 FORECAST: PARTLY CLOUDY, HIGH: 87, LOW 64. A2 | TULSAWORLD.COM | \$2.00

FLOOD RECOVERY • County building inspections begin in Town and Country addition

## Waiting is the worst part



Teresa Tosh, director of county inspections, walks through the gutted living room of John Patterson's home in the Town and Country neighborhood west of Sand Springs during an inspection of the residence on Friday. JOSEPH RUSHMORE/for Tulsa World.



Bill Smith of the Oklahoma Flood Managers Association and Teresa Tosh, director of county inspections, survey homes in the flood-devastated Town and Country neighborhood west of Sand Springs on Friday.

JOSEPH RUSHMORE/for Tulsa World.



# FEMA ARRIVES





# DETERMINATION LETTERS

Angus Acres Baptist Church





# ANNIE VEST, MESCHEK & ASSOC.





# PACKED HOUSE





# FLOOD 2019 Disaster Relief Efforts



Spontaneous Volunteers & Groups Worked Tirelessly



# FLOOD 2019 Disaster Relief Efforts







# FLOOD 2019 Disaster Relief Efforts



**SUNDAY** JUNE 9, 2019  
**TULSA WORLD**  
 FORECAST: PARTLY SUNNY; HIGH 80, LOW 63. 4M | TULSAWORLD.COM | \$4.00

## THANK YOU

You responded to calls for help.  
 You walked miles of lanes... over and over.  
 You filled sand bags.  
 You wrestled goats.  
 You sheltered people, and their pets.  
 You stepped around downed power lines.  
 You waded deep into stinking, roiling water full of debris, snakes and sewage.  
 You did whatever it took.

You are the people who put others first: Volunteers, law enforcement, National Guard, local business, fire departments. And others who just showed up.

As flood waters rose, so did your determination. These are your communities. Your neighbors.

Today, we say thank you for being there when we needed you.

**INSIDE**  
 Read profiles about a few of those who stepped up when they were needed during recent storms. **A-11**

Three Photojournalists by Mike Emery, Jan Welch, Stephen Wagon, Mike Emery, David Johnson, Michael...



# HOMES UNDERWATER





# SO MANY HOMES UNDERWATER





# WHAT A WAY TO CATCH FISH





# FLOOD 2019

## Helping in Town & Country



VP Pence, Com. Keith  
& Joseph Kralicek



# BETO O'ROUKE, PRESIDENTIAL CANDIDATE



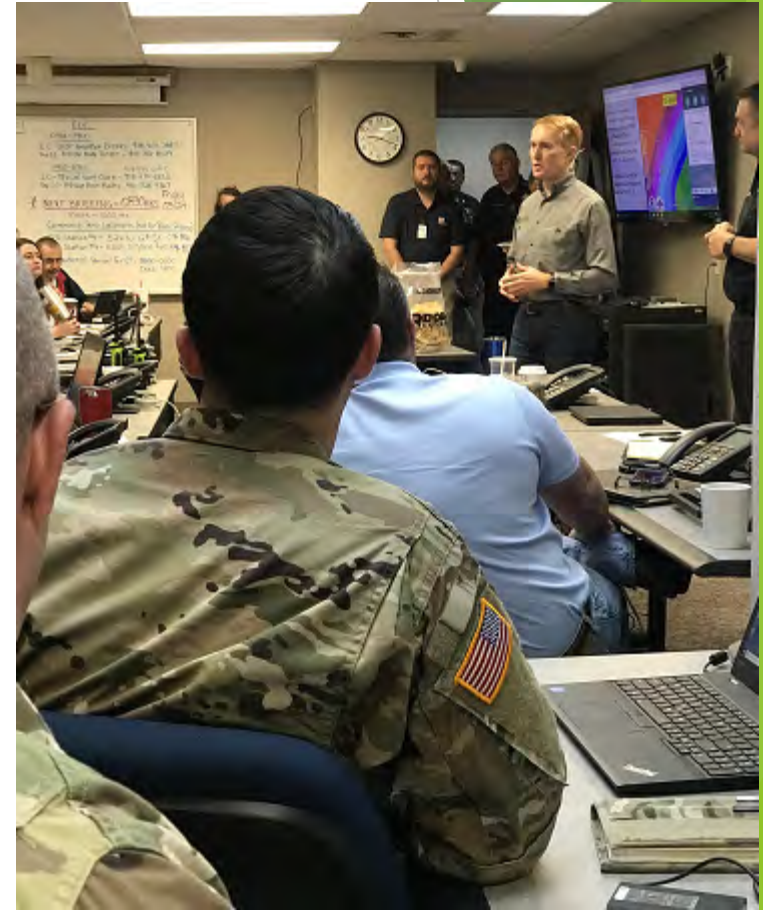


# FLOOD 2019

## Many Officials Assessing the Areas



Gov. Stitt & Levee,  
Com. Todd Kilpatrick, & Levee Crew



Senator Lankford in EOC  
Center



# FLOOD 2019

## Gov. Stitt Sent Guard & Equipment



Dropping  
3,000 lb.  
Sandbags







# IMPORTANT SUPPORT FROM THE ARMY CORPS OF ENGINEERS



Lt. Gen. Todd Semonite w/Todd  
Kilpatrick

ASA R.D. James & Brigadier General  
Owen with Todd Kilpatrick





# CONGRESSMAN LANKFORD'S VISIT TO THE LEVEE



Senator Lankford and his Team



# CONGRESSMEN SUPPORTING THE LEVEE



Congressman Mullin



Congressman Lucas



Congressman Hern & Com. Sallee

Levee Commissioner Kilpatrick explaining the upgrades needed for the Tulsa/West Tulsa Levee System.



# FLOOD 2019

## Guard Protecting the Neighborhoods



Patrolling the Levee System

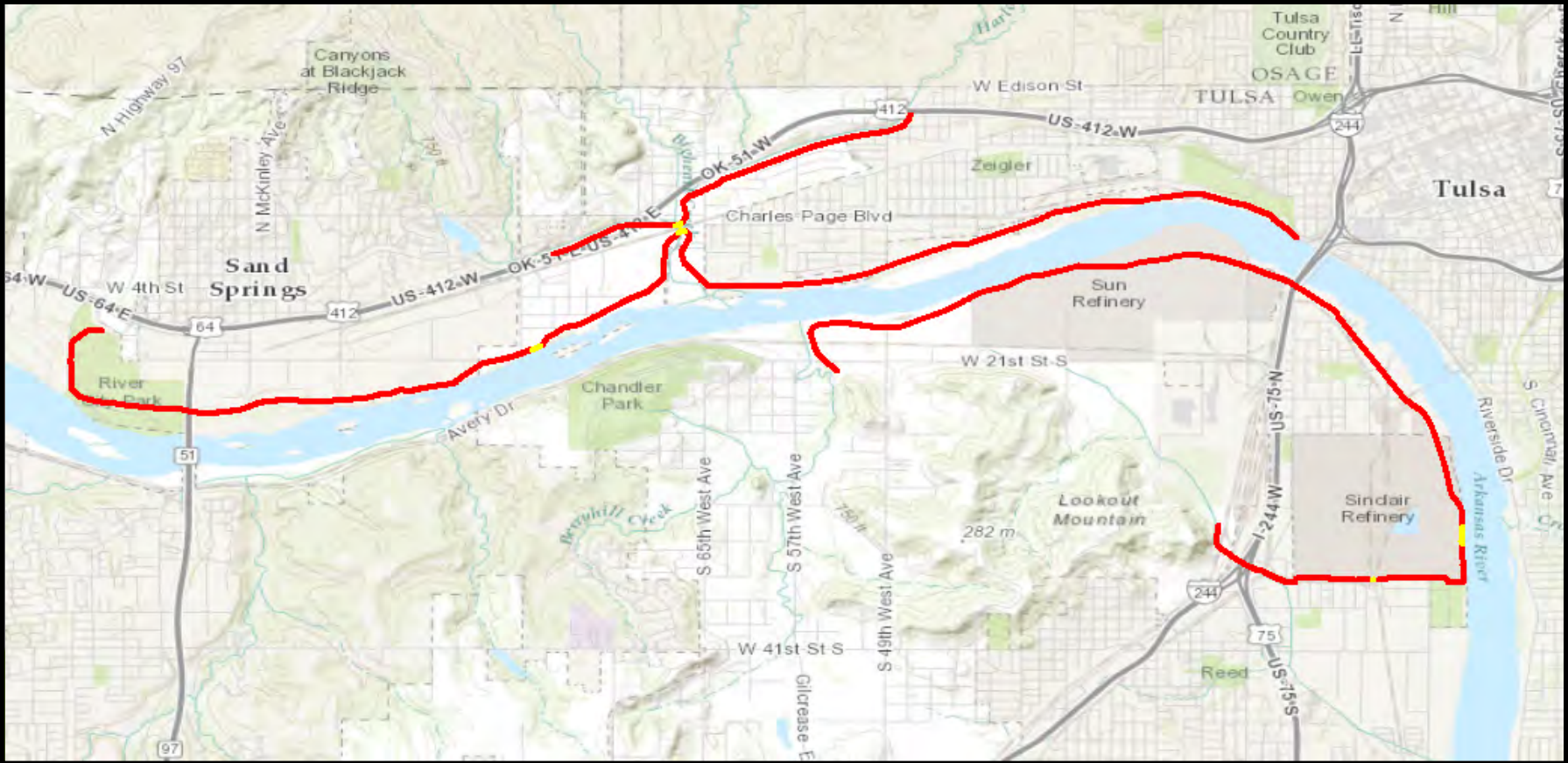




# LEVEE DISTRICT

## Tulsa-West Tulsa Levees

Arkansas River Corridor Feasibility Study  
Tulsa/West Levee Feasibility Study





# BUSINESS BEHIND THE LEVEE

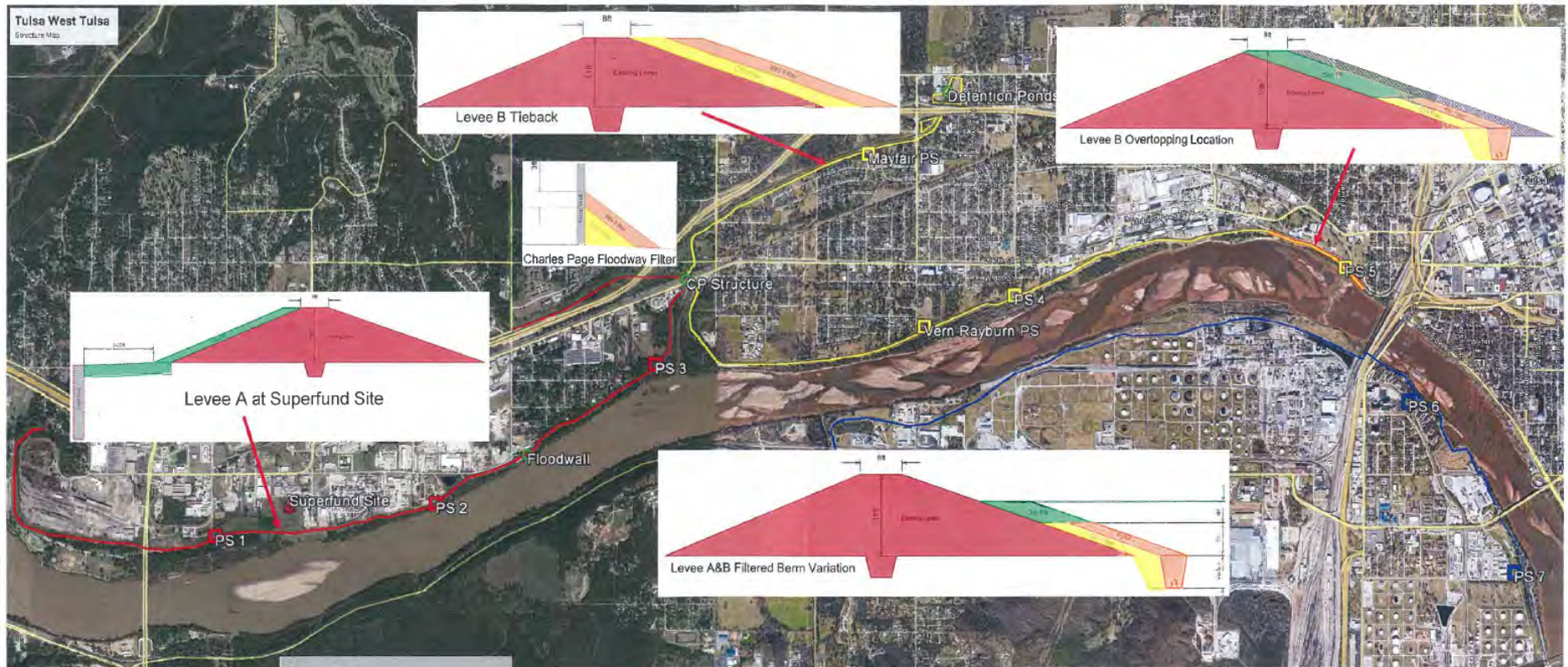




# LEVEE DISTRICT

## Tulsa West Tulsa Levees – Recommended TSP

Tulsa West Tulsa Levees Feasibility Study, Tulsa District, Southwestern Division



**Legend**

- █ Existing Levee
- █ Clay Fill
- █ C33 Filter
- █ #89 Filter
- Cutoff/Flood Wall
- ⬮ Levee A
- ⬮ Levee B
- ⬮ Levee C
- ⬮ Other Features
- ⬮ PS
- ⬮ PS
- ⬮ PS
- ⬮ Superfund Site

- **Recommended TSP – ALTERNATIVE 1E –**
  - Filtered berm with toe drain throughout Levee A and B, except a cutoff wall and landside impervious blanket at Superfund Site within Levee A for approx. 2,000 ft
  - Filtered berm at Floodway Structure and Levee B tieback
  - Detention Ponds at Levee B Tieback
  - Landside impervious blanket at Levee B for overtopping
  - Reconstruction of PS 1-7

**Total Cost: \$148M**



# TULSA WORLD CARTOON







# FLOOD 2019

tulsaworld.com

TULSA WORLD





# OTHER COUNTIES THROUGHOUT OK

Alfalpa County



Concrete Failure Low Water  
Crossing



Cross Drain Pipe Washed Out  
Into Field



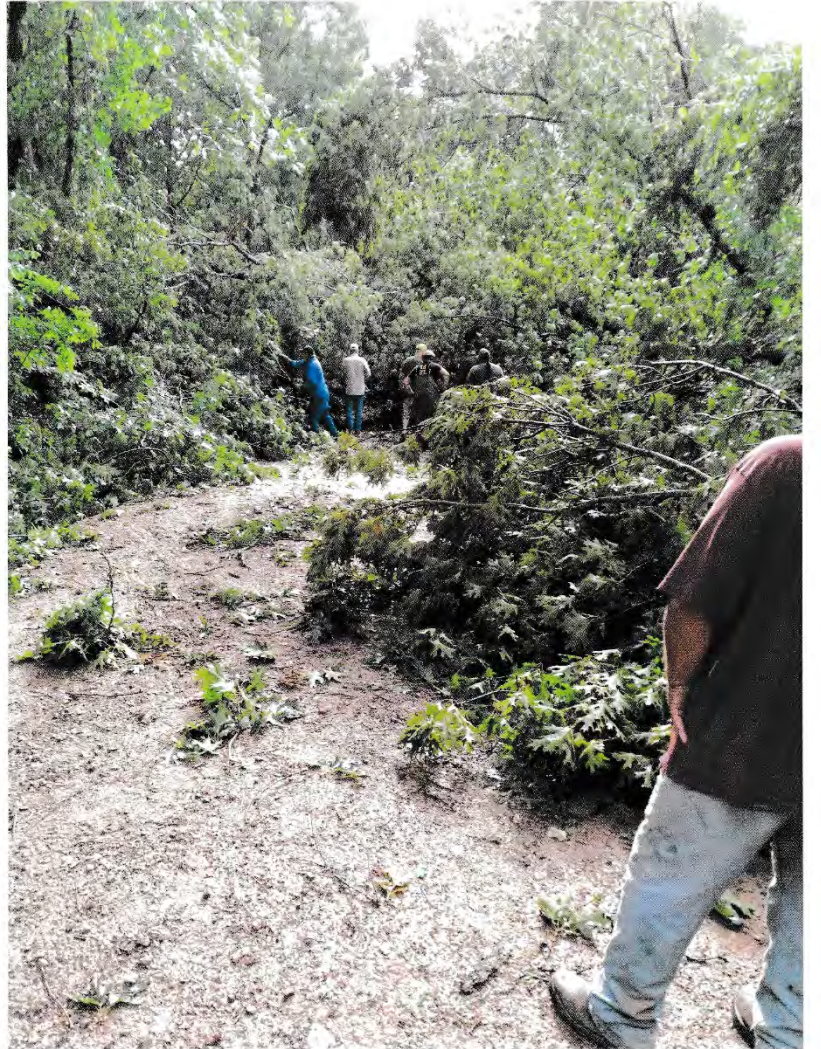
# OTHER COUNTIES

## Continued

### Atoka County



Cross Drain Failure



Trees Blocking the Road



# OTHER COUNTIES

## Continued

Beaver County



Erosion At Cross Drain Failure

Beaver County



Road Failure

Cleveland County





# OTHER COUNTIES

## Continued



Craig County



Creek County  
West 51<sup>st</sup>



Creek County W. 141<sup>st</sup> St



# OTHER COUNTIES Continued





# OTHER COUNTIES

## Continued

Lake Road



Hubbard Road @ Chikaskia River Bridge



Kay County



# OTHER COUNTIES Continued



Kingfisher County Cross Drain



Harper County Cross Drain



Kingfisher County Repairing  
Road - Note Leaning Power  
Poles





# OTHER COUNTIES

## Continued

### Noble County



**Cross Drain**





# OTHER COUNTIES

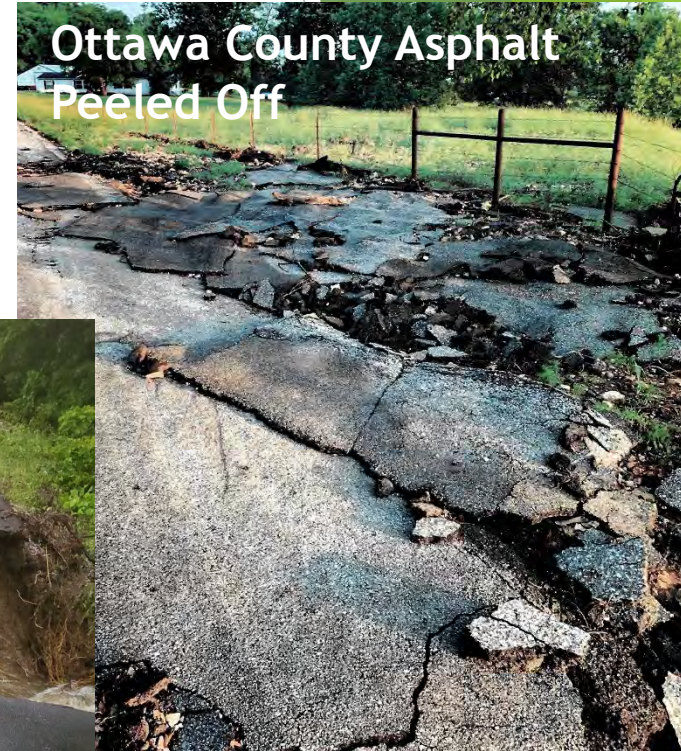
## Continued



Osage County Peeling  
Asphalt off of Pavement



Osage County Red  
Eagle Road Cross Drain

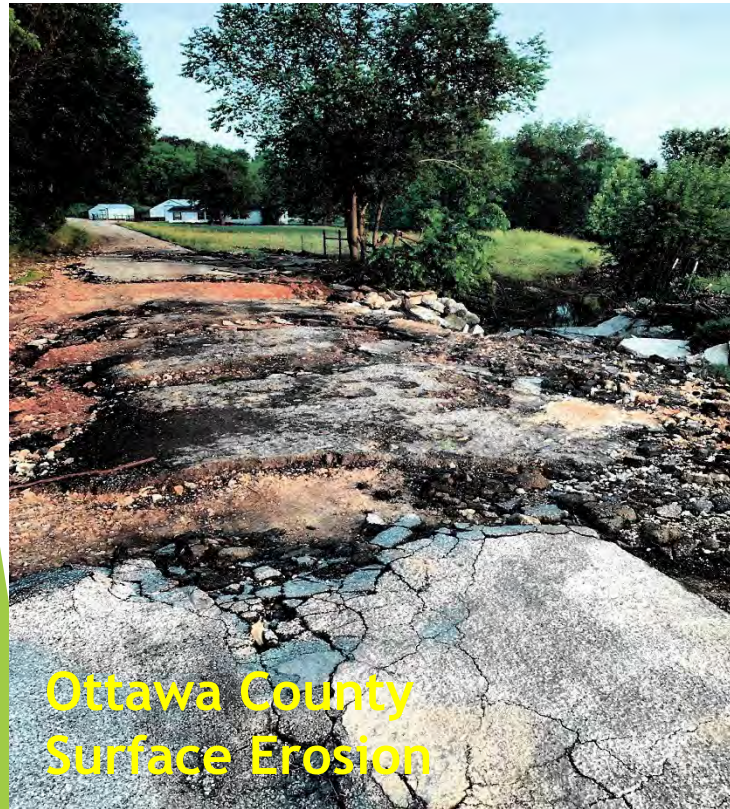


Ottawa County Asphalt  
Peeled Off

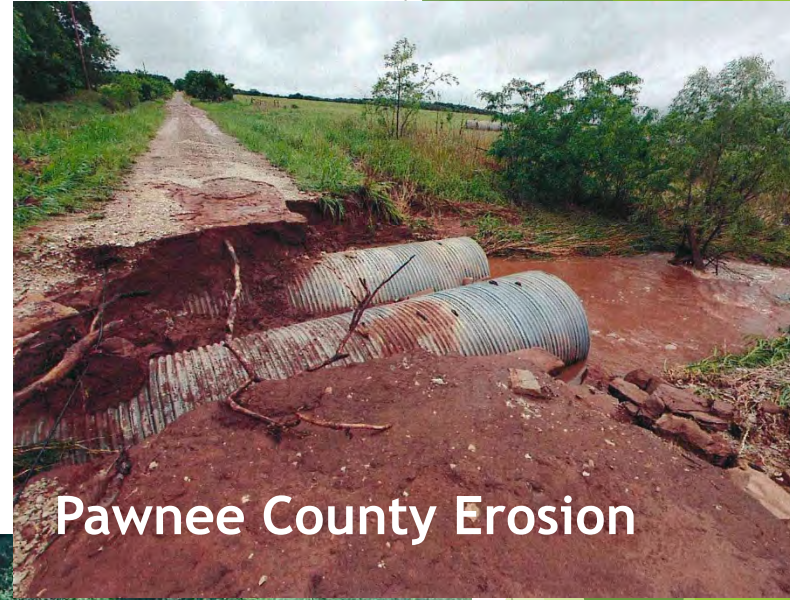


# OTHER COUNTIES

## Continued



Ottawa County  
Surface Erosion



Pawnee County Erosion



Pawnee County Cross Drain  
Pipe



# OTHER COUNTIES

## Continued



Payne County Flooding



# OTHER COUNTIES

## Continued

### Washington County



Debris on the Roadway

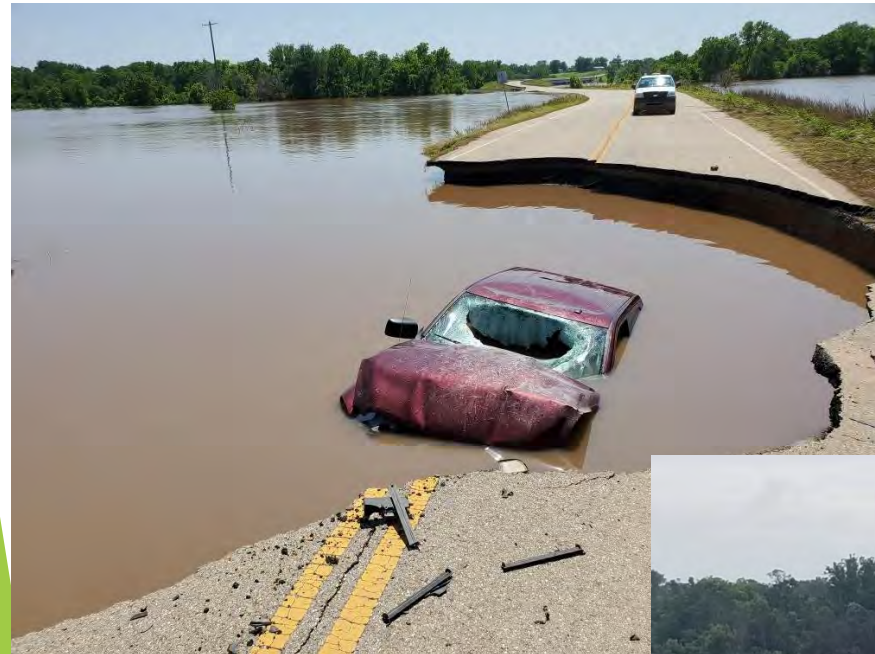
### Gravel Washed into the Ditch





# BRIDGES IMPACTED

Blackburn Bridge-Drove  
Around Barricades



Pawnee/Osage  
Counties Blackburn  
CIRB Funded Bridge  
in the Background  
Across the Arkansas  
River

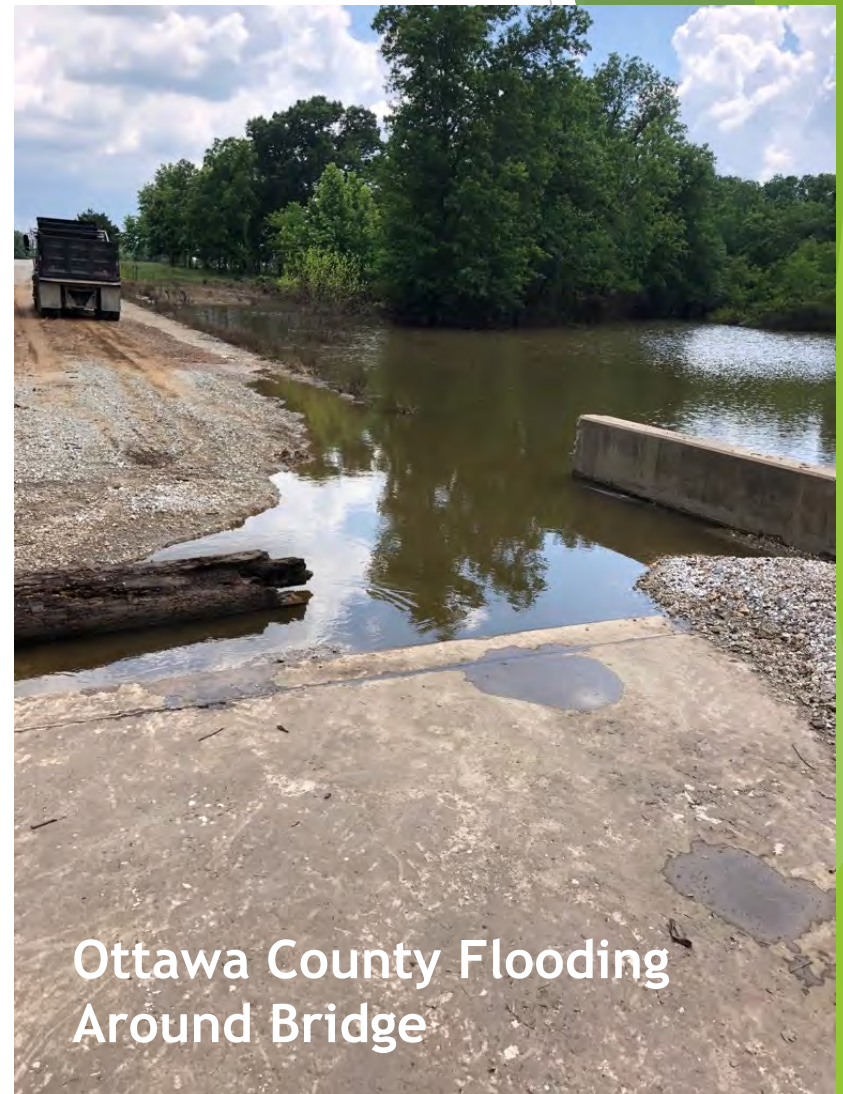




# BRIDGES IMPACTED

## Continued

Osage County, Debris Stacked  
Up on Bridge on Union Road



Ottawa County Flooding  
Around Bridge



# BRIDGES IMPACTED

## Continued



Grant County Bridge





# BRIDGES IMPACTED

## Continued

Oklahoma County CIRB Bridge Project on McArthur  
Handling the Flood Waters





# TOWN & COUNTRY TRAILER PARK





# PRESS CONFERENCE - EMERGENCY OPERATIONS CENTER

Mayor Bynum  
with City &  
County Officials





# PRESS CONFERENCE - EMERGENCY OPERATIONS CENTER

Senator Inhofe  
with City &  
County  
Officials





# PRESS CONFERENCE - EMERGENCY OPERATIONS CENTER

Senator  
Lankford with  
City & County  
Officials

