



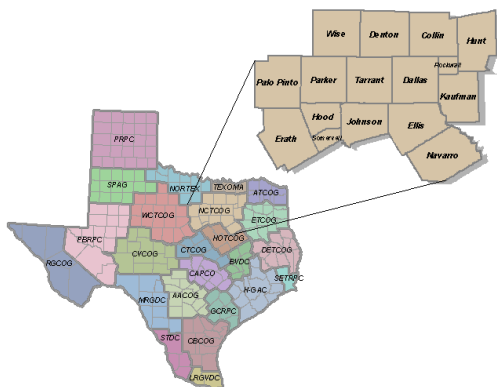
North Central Texas
Council of Governments



North Central Texas Floods May-June 2015



Credit: Dallas Morning News, Staff Photographer Nathan Hunsinger



About

The North Central Texas Council of Governments (NCTCOG) is a voluntary association of, by and for local governments, and was established to assist local governments in planning for common needs, cooperating for mutual benefit, and coordinating for sound regional development. NCTCOG's purpose is to strengthen both the individual and collective power of local governments and to help them recognize regional opportunities, eliminate unnecessary duplication, and make joint decisions.

NCTCOG serves a 16-county region of North Central Texas, which is centered around the two urban centers of Dallas and Fort Worth. NCTCOG has over 230 member governments including 16 counties, numerous cities, school districts, and special districts.

The Environment and Development Department of NCTCOG oversees the Trinity Common Vision program, a partnership that was initiated in 1989 between nine cities, three counties, special districts, and regional, state, and federal agencies to maintain a safe, clean, enjoyable, natural, and diverse Trinity River. This report, produced at the request of the Trinity Common Vision Partners, serves as an informational piece on the May-June 2015 floods and as a tool to achieve the higher goal of lessening flood impacts on our region.

Acknowledgements

This report was prepared on behalf of the Trinity River Common Vision Partners, listed below. Common Vision is a partnership that was initiated in 1989 between nine cities, three counties, special districts, and regional, state, and federal agencies to maintain a safe, clean, enjoyable, natural, and diverse Trinity River.

Trinity Common Vision Partners

Arlington

Carrollton

Coppell

Dallas

Farmers Branch

Fort Worth

Grand Prairie

Irving

Lewisville

Dallas County

Denton County

Tarrant County

Tarrant Regional Water District

Trinity River Authority of Texas



North Central Texas
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US Army Corps
of Engineers®



FEMA

Texas Water
Development Board

Contents

Figures and Tables	4
Abbreviations	5
Summary.....	6
Preceding Events	7
May-June 2015 Weather Events	8
Rivers and Lakes	11
Emergency Response.....	15
Damage Assessments and Aftermath	19
Outcomes	20
References	22



Figures and Tables

Figure 1	The 16 County North Central Texas Region.....	6
Figure 2	U.S. Drought Monitor for Texas February 24, 2015.....	7
Figure 3	Snowfall Accumulation for North Texas February 27, 2015	7
Figure 4	April 2015 Precipitation Percent of Average	7
Figure 5	Two Storm Systems Pass Through North Texas May 24-26, 2015	9
Figure 6	Storms moving into North Central Texas in the Overnight Hours of May 28-29	10
Figure 7	May 2015 Observed Precipitation and Percent of Normal Precipitation.....	10
Figure 8	Satellite Image and Total Rainfall From Tropical Storm Bill	10
Figure 9	The Trinity River System and Upper Trinity River System	11
Figure 10	Lake Levels and Releases from North Central Texas Flood Control Lakes	12-13
Figure 11	Flood Photos From The North Central Texas Region.....	15-17
Figure 12	American Red Cross May 2015 Texas Storm Response.....	18
Figure 13	FEMA Designated Counties Eligible For Assistance	19
Table 1	Historic Lake/River Crests in North Central Texas	14

Abbreviations

DMN	Dallas Morning News
FEMA	Federal Emergency Management Agency
iSPUW	Integrated Sensing and Prediction of Urban Water
iSWM	Integrated Stormwater Management
NCTCOG	North Central Texas Council of Governments
NDMC	National Drought Mitigation Center
NOAA	National Oceanic and Atmospheric Administration
NSF	National Science Foundation
NWS	National Weather Service
TXDPS	Texas Department of Public Safety
USACE	United States Army Corps of Engineers
UTA	University of Texas at Arlington
WGRFC	West Gulf River Forecast Center

Summary

The North Central Texas Council of Governments (NCTCOG) has compiled the following report on the May-June 2015 floods as not only an informational piece but as part of an ongoing effort to lessen impacts of floods on our region. With a current population estimated at 7 million, and projected to increase to more than 10 million by the year 2040, development is occurring at a dramatic pace.¹⁴ These population increases have a sizeable impact on our water resources and the ability for major waterways such as the Trinity River to store flood water. In recognition of this, NCTCOG partnered with the Fort Worth District of the United States Army Corps of Engineers (USACE) beginning in the 1980s, resulting in the creation of the Trinity River Common Vision (TCV) program. This initiative in part serves to ensure that the storage capacity of the Trinity River remains unaffected by all current and future development within the corridor boundaries. The Corridor Development Certificate (CDC) program underneath the TCV umbrella provides guidance and review through participating communities' development authority adopted by every member and the USACE to maintain the storage capacity and not allow for increases in flood water surface elevations or velocities.¹³ This initiative continues to be important not only because of population growth but also due to climate trends. According to Dr. Dong-Jun Seo of the University of Texas at Arlington (UTA), the region is experiencing a trend where it tends to rain more in a single event. "In North Texas, over the last 50 years or so, the rainfall amounts from heavy precipitation events have increased by 15 to 20 percent. If we hypothesize that the same trends will occur in the next 50 years, then we expect to see more extreme rainfall."³⁵ Increasing amounts of impervious surfaces brought on by development and continued urbanization further compound the issue. Continued diligence to develop along the Trinity River responsibly combined with knowledge of past flood events can help achieve the goal of lessening flood impacts.¹³

The spring 2015 floods in Texas are often referred to as the Memorial Day Floods. However, weather events in late winter and early spring of 2015 saturated the soil and set the stage for record flooding when several weather systems followed in May and June, delivering a devastating blow to much of Texas. Area lakes and the Trinity River system were overwhelmed with excess water, causing record and near record flooding.⁹ These events prompted the President of the United States to issue a major disaster declaration May 29. The Federal Emergency Management Agency (FEMA) later identified an incident period of May 4, 2015, to June 22, 2015.⁵

This report examines the timeline and impacts of these events specifically on the 16-county North Central Texas region. For a collection of over 200 photos and videos associated with these events, visit www.nctcog.org/envir/flooding.

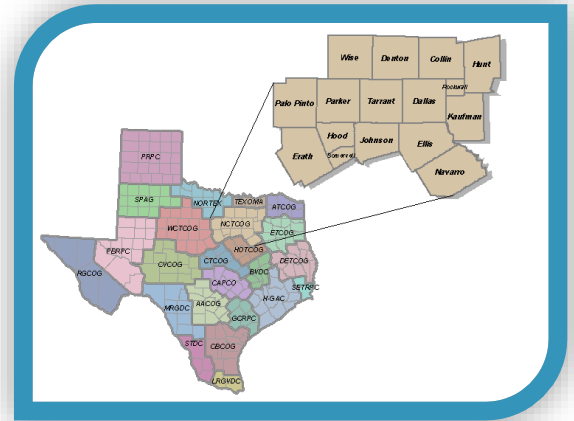


Figure 1. The 16 county North Central Texas Region. Credit: NCTCOG

Preceding Events

Lingering drought left area reservoirs low, with room for lake levels to increase significantly.^{8, 35} (Figure 2).

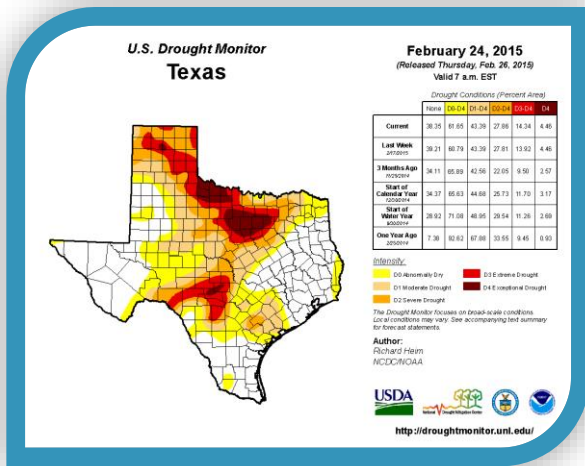


Figure 2. U.S. Drought Monitor for Texas February 24, 2015. Credit: NDMC

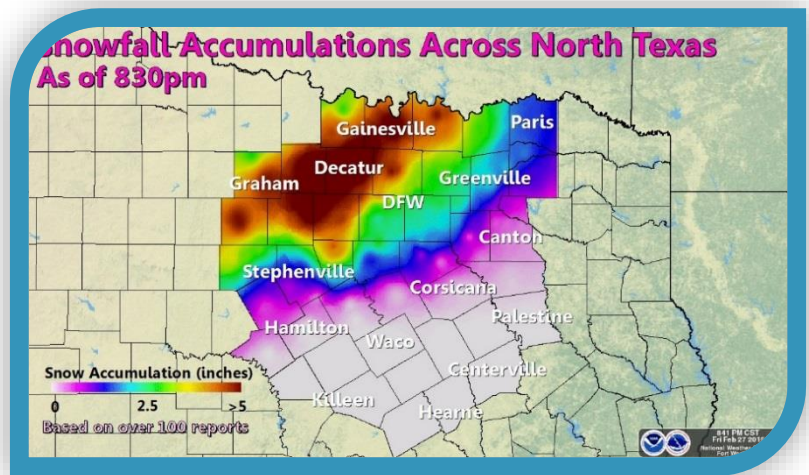


Figure 3. Snowfall Accumulation in North Texas on February 27, 2015. Credit: NOAA

That began to change through late winter and early spring 2015. On February 27, a snow event resulted in 4-7 inches of accumulation throughout the region, with the most snow falling in Wise County.¹⁹ (Figure 3).

On April 26th, a storm system stalled over the region, resulting in severe flash flooding in Johnson and Ellis counties that put three feet of water over Highway 67 southwest of Cleburne, one to two feet of water on rural roads, and forced several swift water rescues throughout the event. April precipitation totals in North Central Texas were 150-200% above average.¹⁷ (Figure 4).

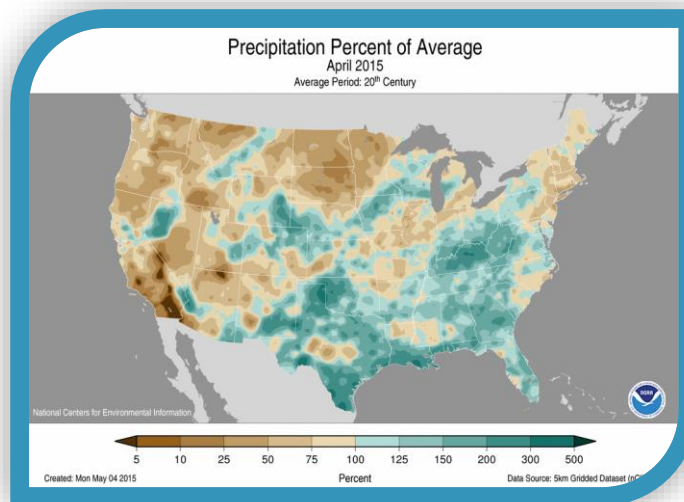


Figure 4. April 2015 Precipitation Percent of Average. Credit: NOAA

May-June 2015 Weather Events

The first major weather event of May was a line of supercell thunderstorms which tracked across the region May 7. Although the primary threat from these storms were tornadoes, two of which were confirmed in Denton and Wise counties, heavy rains continued to saturate the soil.⁹

Just one day later, the “Mother’s Day Weekend” storms produced several rounds of severe weather from May 8-10. Thirty reports of flash flooding were received by the National Weather Service Fort Worth Forecast Office. Sunday night was especially active when a storm producing a bow echo caused flash flooding in Navarro, Henderson, and Kaufman counties.⁹

Just over a week after the Mother’s Day storms, supercell thunderstorms again rolled through the region, primarily affecting areas west of I-35 and north of I-20. Numerous thunderstorms trained over Palo Pinto, Parker, and Wise counties, resulting in flash flooding and producing tornadoes and large hail.⁹

On May 23, the Memorial Day floods began. The first system began to build over Kansas and Oklahoma, and scattered storms began to appear around 3 p.m. May 23. By midnight, storms were covering the North Central Texas region in a swath that stretched from Mexico to Iowa. At 9 a.m. May 24, heavier rain hit the Dallas area as the storms pushed east. By 3 p.m. the same day, the line was moving out of Texas. However, at midnight May 25, storms once again began to build over Kansas and Oklahoma, developing over the region by midafternoon. During the early morning hours of May 26, this last round of storms finally left Texas.⁹ (Figure 5).

May 28-29 ushered in severe weather yet again, and continued to cause more flash flooding. Afterward, a brief drying trend finally gave North Central Texas a very short break.⁹ (Figure 6).

In the month of May, 37 trillion gallons of water fell across Texas. The NWS observed 16.96 inches of rain for May at Dallas-Fort Worth International Airport, which by far beat the old record in 1982 of 13.66 inches. It was the single wettest month in the Metroplex since 1942, narrowly missing a tie with the old record by 0.01 inches. Rainfall in the region was anywhere from 200-500 percent above normal for the month.⁹ (Figure 7).

Three weeks after the devastating and deadly Memorial Day floods, Tropical Storm Bill made landfall on the afternoon of June 16 on Matagorda Island. The storm was downgraded to a tropical depression as it made its way toward the North Central Texas region. The NWS issued a flash flood watch for June 16-18, anticipating 6-8 inches of rain. Once the storm passed, 5-10 inches of rain had fallen west and northwest of the metroplex, with Wise and Parker counties seeing the most rain of the North Central Texas region. The rest of the region experienced rainfall totals of about 2-4 inches.⁹ (Figure 8).



12:00 a.m. May 24



9:00 a.m. May 24



3:00 p.m. May 24



3:00 p.m. May 25



12:00 a.m. May 26

Figure 5. Two storm systems pass through Texas May 24-26, 2015.

Credit: San Antonio Express News

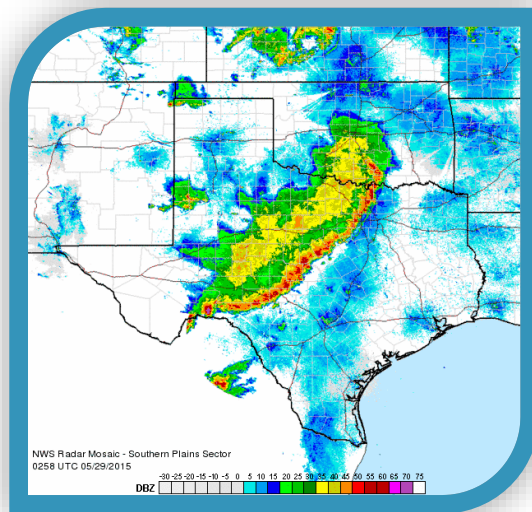


Figure 6. Storms moving into North Central Texas in the overnight hours of May 28-29. Credit: DMN

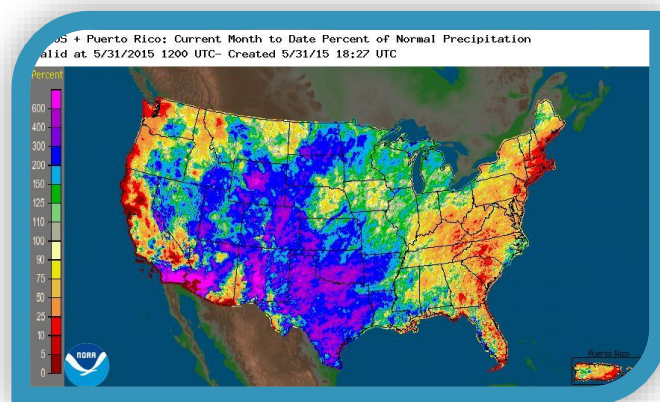
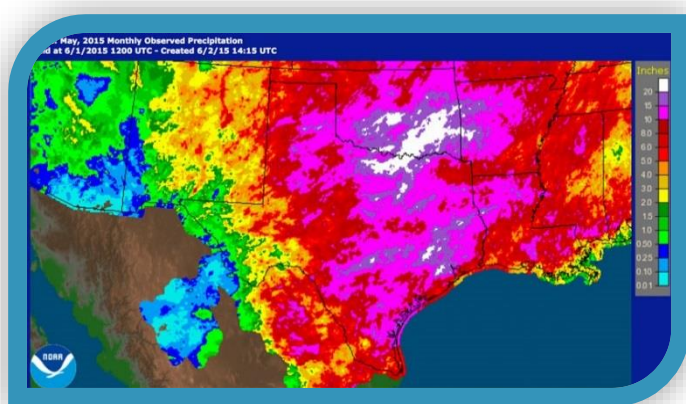


Figure 7. May 2015 observed precipitation (left) and percent of normal precipitation (right). Credit: NOAA

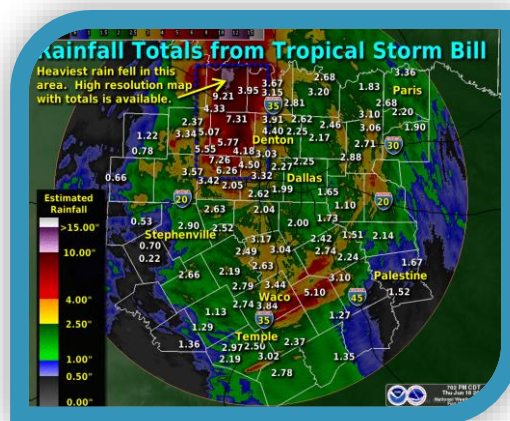
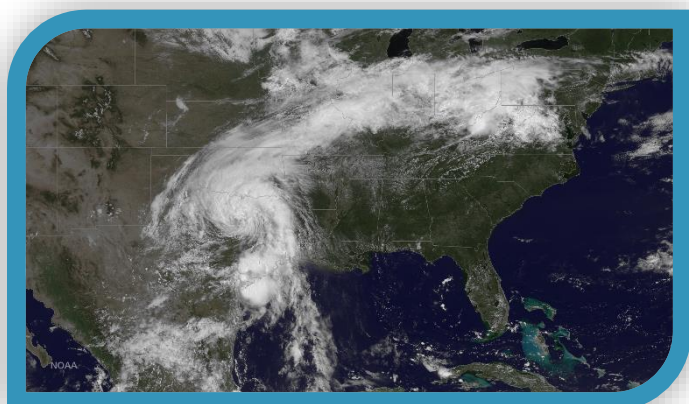


Figure 8. Satellite image (left) and total rainfall (right) from Tropical Storm Bill. Credit: IB Times (left) and iWeatherNet (right).

Rivers and Lakes

The effects of each flash flooding event were short lived. However, the cumulative effects of May rains, and later Tropical Storm Bill, hit area lakes and rivers hard. As Rocky Vaz of the Dallas Office of Emergency Management put it when interviewed by USA Today about the impacts of Tropical Storm Bill, “The rain itself is not as worrisome to us as what could happen two days after the rain has ended.”²⁸ As the lakes filled up, the USACE attempted to release water to prepare for the next flood event. The May 26, 2015, issue of the Dallas Morning News quoted Randy Cephus, spokesman for the USACE: “This flooding event has been so prolonged, the water is everywhere. So we’re filling up [the lakes and river], and we’re releasing water when we can. Any opportunity we get to release water, we’re doing it. Our reservoir control folks are monitoring this 24-7. But the problem is, we aren’t able to release water at the rate we’re refilling... For some areas, there might be some kind of flooding that takes place because of these releases. These lakes are part of a flood-reduction system. That doesn’t mean they can eliminate flooding.”³⁶

The USACE operates eight flood control reservoirs in the North Central Texas region. Figure 10 illustrates how dramatically the flood control reservoirs’ levels increased in a very short period of time, and the struggles the USACE faced with release amounts and timing. Despite several rounds of water releases, at the end of the incident period all eight reservoirs were still releasing water and had not returned to conservation pool levels.³¹

Flooding during the incident period was truly historic. As shown in Table 1, Joe Pool Reservoir reached its highest recorded level in May, breaking a 25 year old record. Several other reservoirs and rivers in the region fell short of breaking their all-time records by less than one inch. Of the 16 counties in the North Central Texas region, 14 have lake or river gauges, and of those, 10 counties’ gauges recorded historic crests that were their fifth highest or greater.²¹

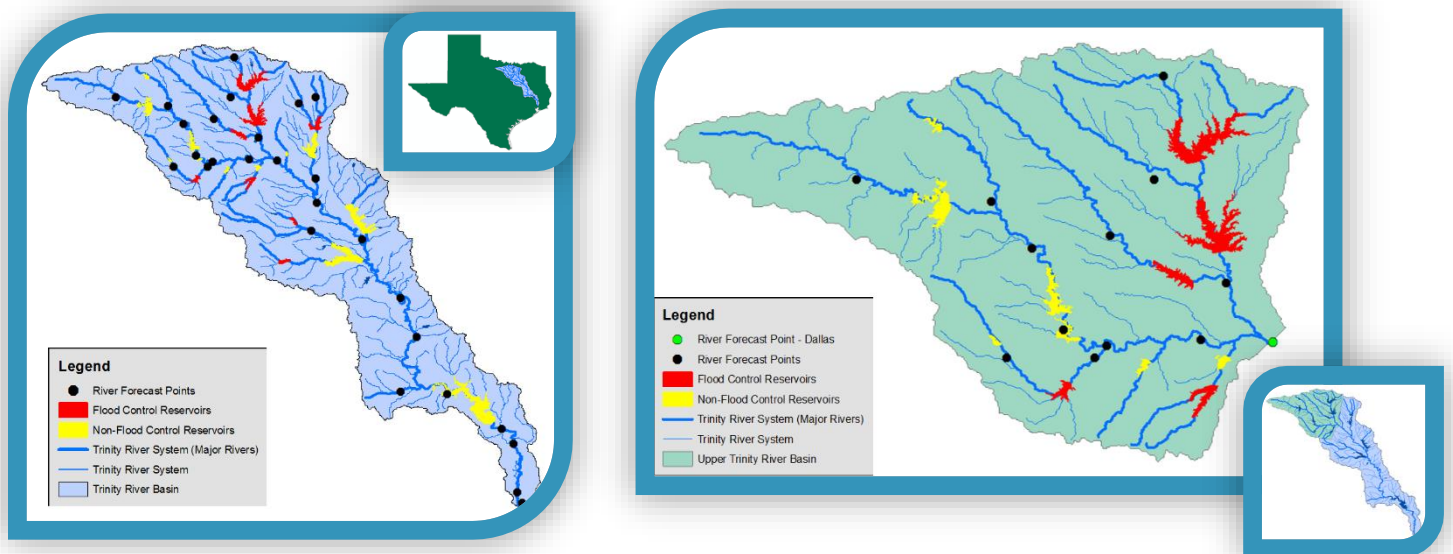
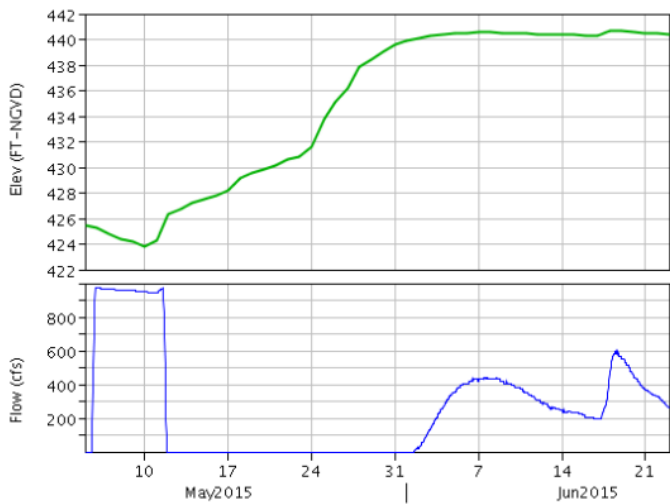


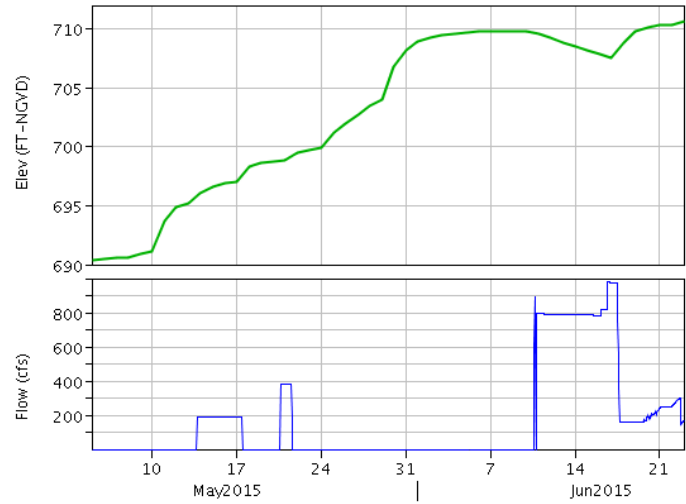
Figure 9. The Trinity River system (left) and the Upper Trinity River System (right).



Credit: Schultz, Western Gulf River Forecast Center 2015



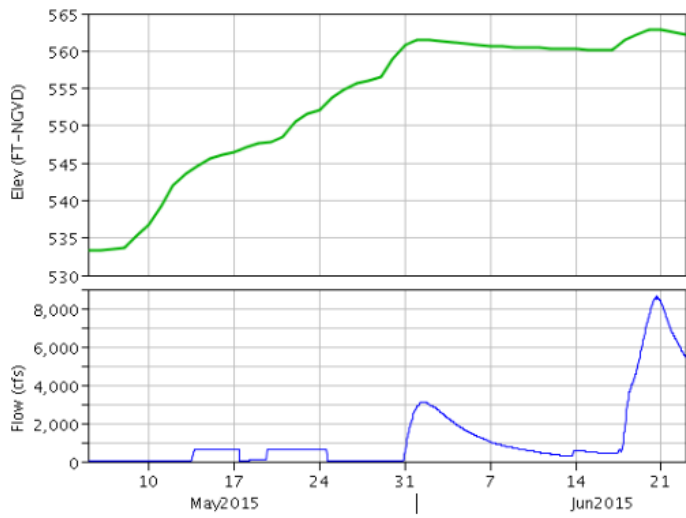

BDWT2 OBS ELEV
BDWT2 OBS TOT_REL




Bardwell Reservoir



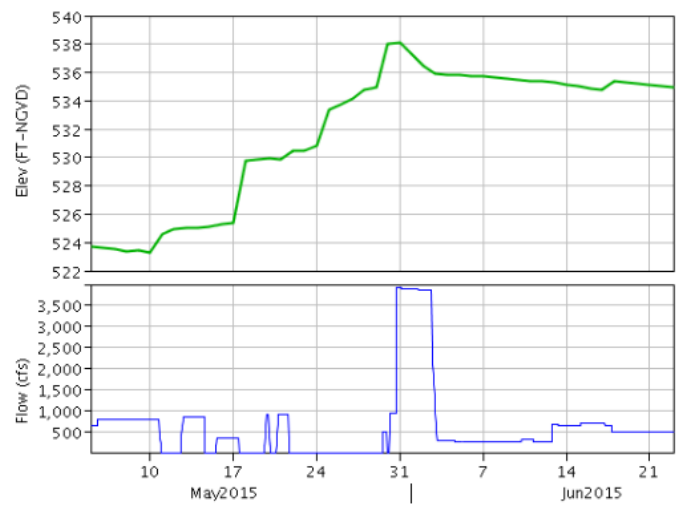

BNBT2 OBS ELEV
BNBT2 OBS TOT_REL




Benbrook Lake




GPVT2 OBS ELEV
GPVT2 OBS TOT_REL


Grapevine Lake

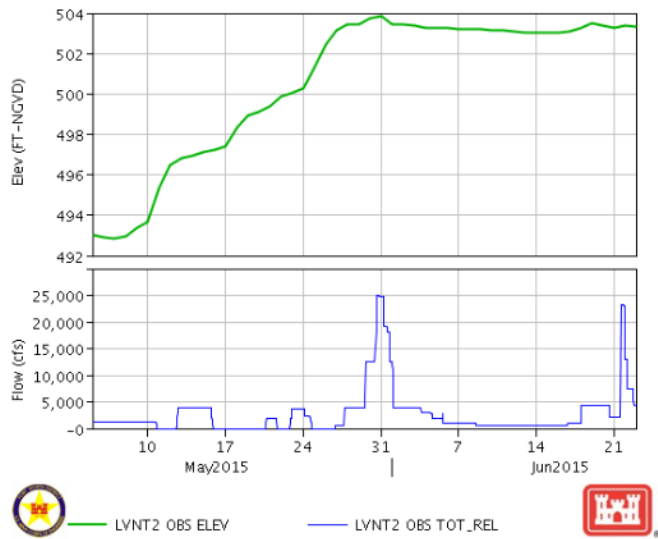



JPLT2 OBS ELEV
JPLT2 OBS TOT_REL


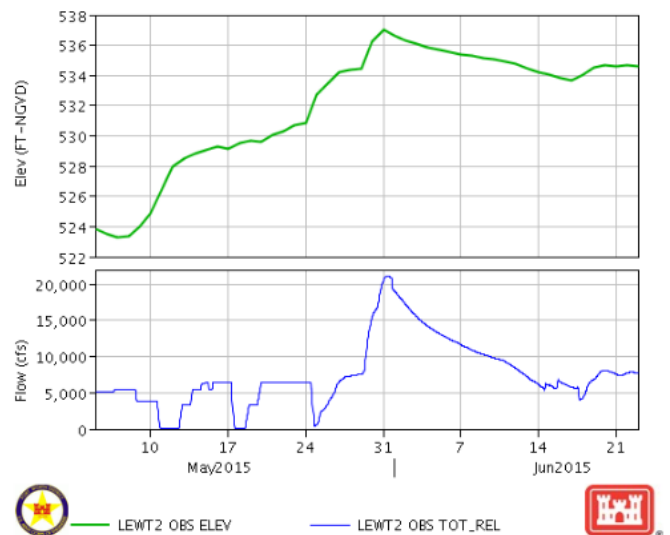
Joe Pool Lake*

Figure 10. Lake levels and releases from the eight USACE flood control lakes in the North Central Texas Region during the FEMA incident period from May 4, 2015, to June 22, 2015. Continued on next page.**

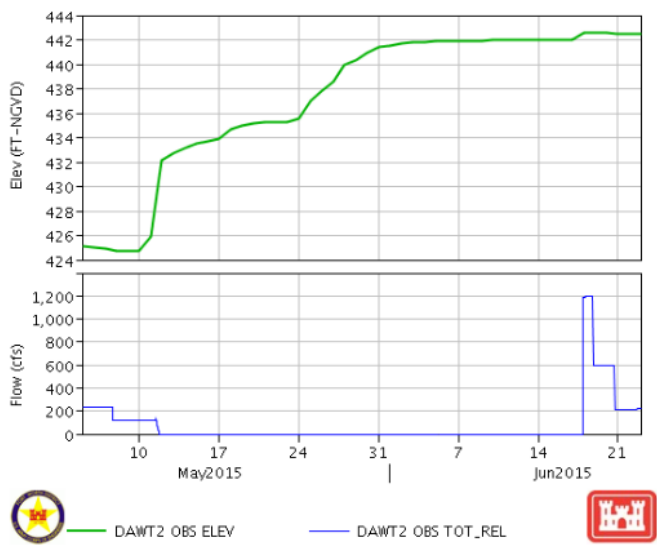




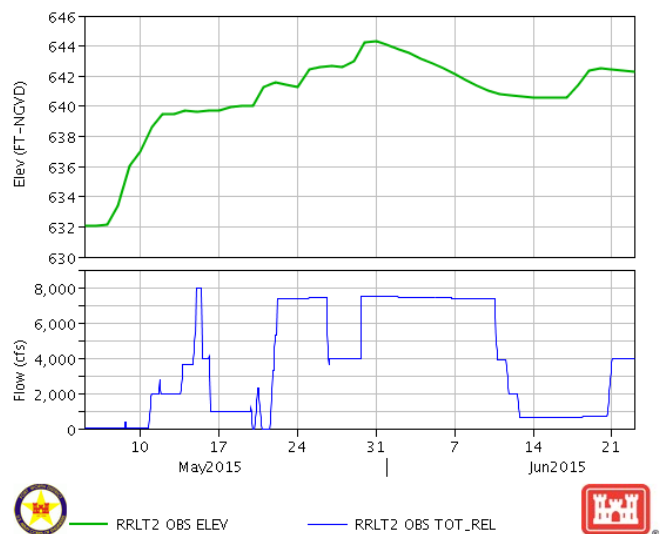
Lavon Lake



Lewisville Lake



Navarro Mills Lake



Ray Roberts Lake

Figure 10 (continued). Lake levels and releases from the eight USACE flood control lakes in the North Central Texas Region during the FEMA incident period from May 4, 2015, to June 22, 2015.

*The highest crest ever recorded for Joe Pool Lake occurred during the incident period of May 4, 2015 – June 22, 2015.

**Data obtained from the United States Army Corps of Engineers Fort Worth District Water Management Information website <http://www.swf-wc.usace.army.mil/cgi-bin/rcshtml.pl?page=Hydrologic>

Table 1. Historic lake/river crests with a ranking of 5th or higher in the North Central Texas Region during the incident period May 4, 2015 – June 22, 2015.*

NOAA Gauge	County	Stage (feet)	Date	Historic Ranking	Previous or Current Record feet and year
Joe Pool Lake	Dallas	538.11	05/30/2015	1	533.21 (1990)
East Fork Trinity near Crandall	Kaufman	23.94	06/01/2015	2	27.17 (1990)
Trinity River near Rosser	Kaufman	41.60	06/02/2015	2	41.80 (1938)
Sister Grove Creek near Blue Ridge	Collin	28.54	05/10/2015	2	32.50 (1982)
Big Sandy Creek near Bridgeport	Wise	15.05	06/18/2015	2	15.69 (1941)
Rowlette Creek near Sachse	Dallas	31.18	05/29/2015	2	35.40 (1942)
Lake Lavon	Collin	504.15	05/30/2015	2	504.93 (1990)
Ray Roberts Lake	Denton	644.41	05/31/2015	2	644.44 (1990)
Grapevine Lake	Tarrant	563.06	05/30/2015	2	563.50 (1981)
Lake Pat Cleburne	Cleburne	738.77	05/29/2015	2	738.91 (2007)
Lake Granbury	Hood	693.11	05/10/2015	2	693.60 (1977)
Elm Fork Trinity near Carrollton	Dallas	13.12	05/30/2015	4	19.00 (1908)
South Sabine Fork near Quinlan	Hunt	18.37	6/22/2015	5	21.00 (1902)
Squaw Creek Reservoir	Somervell	777.52	05/29/2015	5	779.41 (1991)

*Data obtained from the NOAA National Weather Service Advanced Hydrologic Prediction Service
<http://water.weather.gov/ahps>

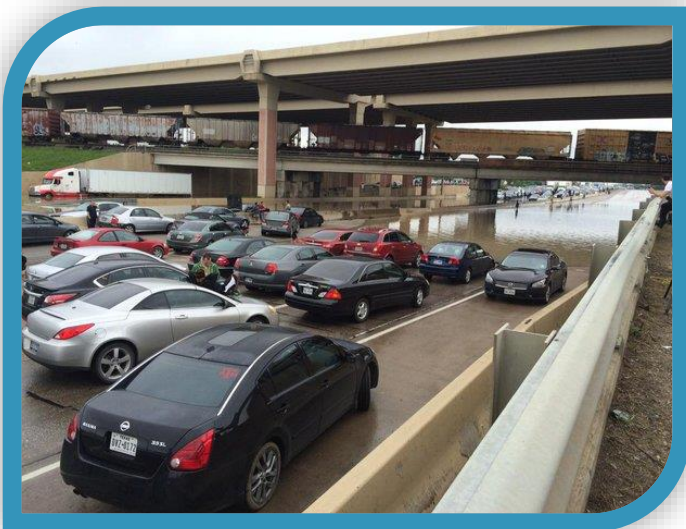
Emergency Response

Flooding and flash flooding during the multiple rain events kept city, county, flood control and water districts, and state emergency officials busy throughout the incident period.

As the May 24-26 storm systems tracked through Texas one after another, the NWS issued flash flood warnings throughout the North Central Texas region. By Sunday morning, about 6 inches of rain had fallen in Dallas, flooding multiple roads, including Highway 12 at I-30. Two deaths were reported by that time. Highway 360 in central Arlington had two feet of standing water.¹⁰

Johnson County was one of many hard-hit areas. On May 24, Johnson County officials performed six swift-water rescues from stranded and washed away vehicles and closed 15 roads. That day, the Fort Worth Star-Telegram quoted Jamie Moore, the Johnson County emergency management coordinator: “We are pretty worn out in Johnson County. There have been five major weather events in the past four weeks. That’s a remarkable number for any community, let alone Johnson County.” By May 29, 45 roads were closed, 30 people were evacuated from their homes when Buffalo Creek overflowed, 19 swift water rescues were performed, and the Texas National Guard was in the county assisting with rescue efforts.⁷

On May 26, the Texas National Guard rescued a family from a stranded car in a low water crossing near Granbury, Texas.¹² By mid-morning of May 29, Dallas Fire-Rescue reported they had received more than 270 calls for help for cars stranded in high water as well as 70 crashes. Over the entire region by this time, two people were dead and 13 were missing.¹⁰ The death toll reached three by the end of the incident period.¹⁹



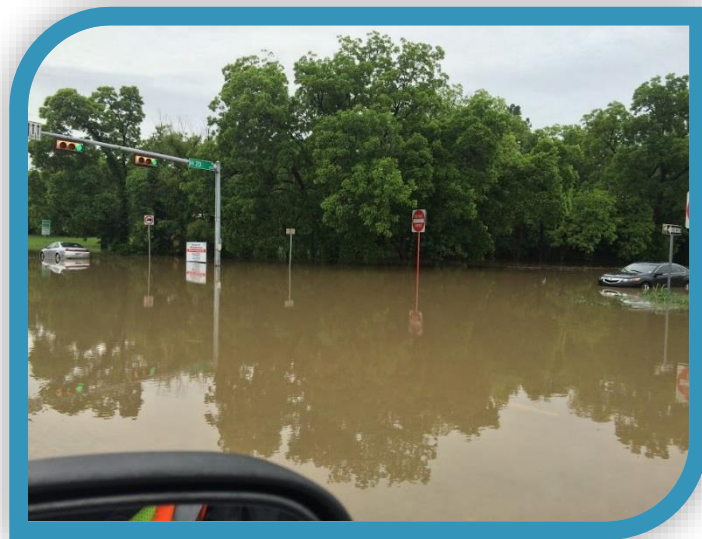
A. Loop 12 at I-30 flooding in Dallas, Texas, May 29, 2015
Credit: NBC 5 DFW News, Ellen Bryan



B. Loop 12 at I-30 flooding in Dallas, Texas, May 29, 2015
Credit: Dallas Morning News, Staff Photographer Smiley N. Pool



C. Walnut Creek in Mansfield, Texas, May 29, 2015
Credit: NBC 5 DFW News, Julie Fine



D. Carrier Parkway at I-20, Grand Prairie, Texas, May 17, 2015
NCTCOG Flood Photo Library

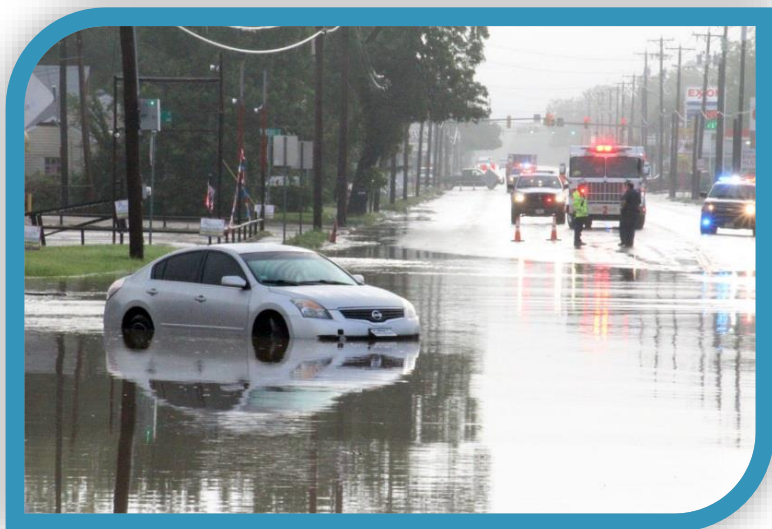


E. Celina, Texas, May 9, 2015
NCTCOG Flood Photo Library



F. The 111th Engineer Battalion of the Texas Army National Guard rescue three people from a small vehicle stuck in a low water crossing near Granbury, Texas, May 26, 2015.
Credit: U.S. Army 1st Lieutenant Max Perez





G. East Henderson Street in Cleburne, Texas, May 29, 2015
Credit: Cleburne Times Review, Matt Smith



H. Grapevine Lake Spillway, June 19, 2015
Credit: Brandon Barth, NCTCOG Flood Photo Library



I. FM 730 at the Trinity River, Wise County
Credit: Chad Davis, NCTCOG Photo Library



J. Rowlett Creek at Miller Road, Rowlett, Texas
Credit: Dennis Abraham, NCTCOG Flood Photo Library

Figure 11. Flood photos from the North Central Texas region.
Additional flood photos can be found at the NCTCOG Flood Photo Library:
www.nctcog.org/envir/flooding



Statewide emergency response was in full force during Memorial Day weekend. Texas Task Force 2 was staged in Dallas, Texas Department of Emergency Management deployed to Garland, and Texas Military Forces deployed 24 personnel as part of a Ground Transportation Package staged in Denton, Granbury, and Cleburne. The Texas Parks and Wildlife Department assisted local law enforcement by conducting search and rescue missions. The State Operations Center was operating at Level 1 (Emergency Conditions).³⁰

The American Red Cross also played a large part in emergency response by providing services to displaced flood victims. Throughout the state, they deployed over 2,100 workers and 45 emergency response vehicles. The Red Cross was present in all of the North Central Texas counties except for Rockwall and Somervell counties.¹ (Figure 12).

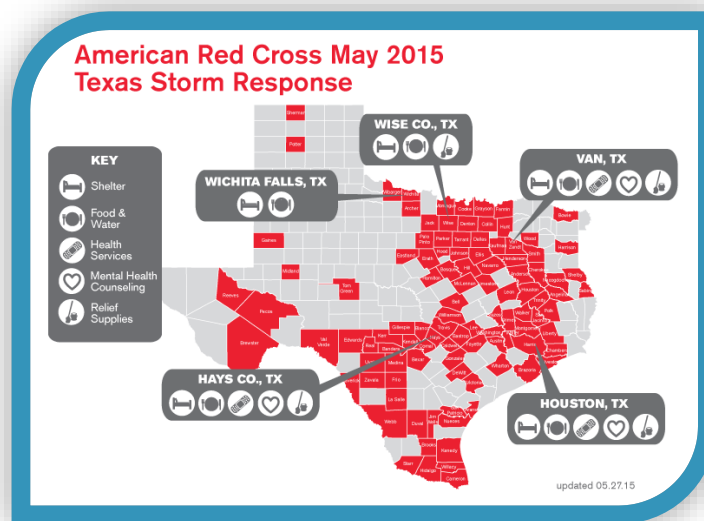


Figure 12. American Red Cross May 2015 Texas Storm Response. Credit: American Red Cross

Governor Greg Abbott first issued an Emergency Disaster Proclamation on May 11, but had to reissue the proclamation 7 additional times through June 22. It comprised 110 Texas counties for flash floods, floods, and tornadoes.²⁹ All North Central Texas counties were included in the proclamation except for Rockwall and Hunt counties. After the initial declaration, FEMA collaborated with the State of Texas to develop an operational management strategy for the massive scope of the disaster. Aside from a Joint Field Office in Austin and four mobile branch units, two operational branches were opened, one of which was in Denton. All counties in the NCTCOG service area were eligible for public assistance, individual assistance, or both, except for Collin, Hunt, and Rockwall counties.⁵ (Figure 13).

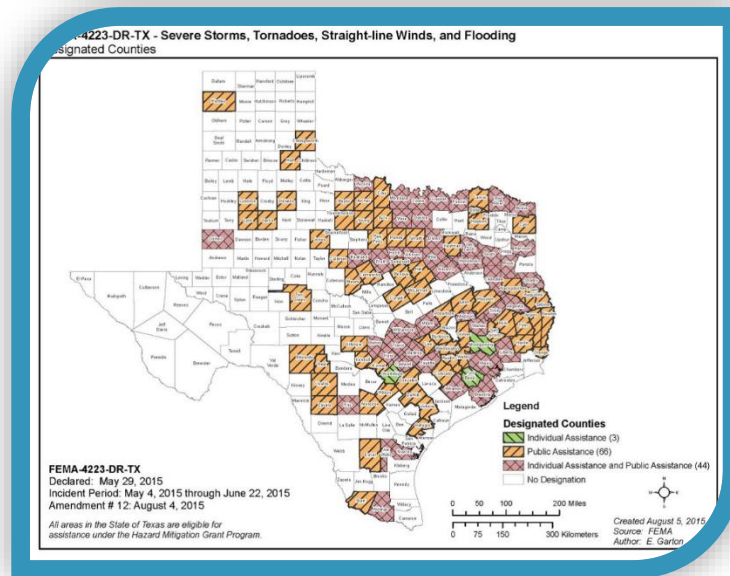


Figure 13. FEMA designated counties eligible for assistance for the incident period of May 4, 2015 through June 22, 2015. Credit: FEMA

Damage Assessments and the Aftermath

After the May storms were over, the damage estimates reported in the Dallas Morning News as of June 9 were staggering. The City of Dallas reported about \$50 million in storm damage to parks, roads, fire and police vehicles, and the cost of debris removal. The cities of Irving, Carrollton, and Grand Prairie and Kaufman County reported around \$2 million each. The city of Garland reported \$3.4 million, and Coppell reported \$869,000 for many of the same types of damages as well as to public utilities, buildings, and airports. The unincorporated areas of Dallas County estimated \$10,500 related to oil spill cleanup. The Mesquite municipal golf course sustained \$108,000 in damage.²²

As of December 15, 2015, FEMA received over 35,000 Individual Assistance registrations from all over Texas. They opened 53 centers throughout the state to assist the large number of people affected by the floods. The Small Business Administration approved over 1,850 Disaster Home and Personal Property loans totaling over \$76 million statewide.⁵

Overall, the Insurance Council of Texas estimated \$1 billion in total insured losses for the month of May, with vehicles accounting for about 25 percent of that total.²²

In light of the daunting damage estimates following the incident period, the USACE issued a news release in September of 2015 demonstrating the dollar amounts in damages saved by their flood risk reduction infrastructure. According to the document, while their reservoirs were put to the test with the record setting rainfall amounts, Grapevine Lake prevented \$1.2 billion in

damages, Lake Ray Roberts prevented \$2.5 billion in damages, and Lewisville Lake prevented \$2.4 billion in damages, for a total of \$6.7 billion. The USACE estimates these numbers by looking at the water level in place with the dam or levee, and where the water level would have reached if the flood reduction project had not been built.³²

Efforts Underway to Reduce Flood Impacts

Dr. Ralph Wurbs of Texas A&M Zachary Department of Civil Engineering said, “There is nothing unnatural about flooding. Most streams are going to get out of their banks every few years. It’s when people are there (in the flood’s path) that it becomes noticeable because of the damages.”³⁵

The May-June 2015 floods were devastating to the North Central Texas region, and many other parts of Texas. However, the overwhelming severity of the incident has prompted research into new ways to protect human life.

Dr. Sam Brody of Texas A&M University Department of Landscape Architecture and Urban Planning summarized it well when he said, “We have to think about being proactive, not reactive. We need to not try to recover from the flood but prevent the impact from the start.” As the focus turns further toward lessening flood impacts, the techniques for doing so have fallen on a few areas: early warning systems, regulating development, and partnerships between local governments.³⁵

A 5-year National Science Foundation (NSF) project with the NCTCOG and UTA is testing and developing an integrated flood warning system for the Metroplex with universities, governmental agencies, and private businesses. An important component of this system is the Collaborative Adaptive Sensing of the Atmosphere (CASA), a weather radar system that is smaller and faster-scanning than traditional radar. Combined with hydrologic and hydraulic modeling, CASA can help make faster and more accurate flooding predictions. The end goal of the project is for the system to be available to the public.³⁵

Another NSF-funded project contributing to the development of early warning systems is through the UTA and multiple governmental partners to create regional cyber infrastructure for observing and modeling urban water, called iSPUW, or Integrated Sensing and Prediction of Urban Water for Sustainable Cities. The vision also eventually involves gathering the public’s observations from social media and crowdsourcing. Their June 2015 workshop in the midst of the incident period highlighted the struggles the region was facing as well as victories and ongoing research.^{35, 6}

Crowdsourcing flood observations is also being explored by the National Weather Service West Gulf River Forecast Center. Their presentation at the iSPUW conference in June 2015 mentioned Twitter as a platform to utilize images and hashtags, but they particularly focused on a free smartphone app called mPing. According to the NOAA National Severe Storms Laboratory, mPing allows smartphone users to submit weather data anonymously, where it goes into a

database. Since radar cannot scan at the Earth's surface, the public observations allow NSSL to make the algorithms used to sort radar echoes more accurate.³³

A 4-year Trinity River Basin study, of which the USACE is the program lead, is underway. The Corps Water Management System is a nationwide effort to model over 200 watersheds, and the Trinity Basin was in the first group of basins to be selected for the effort. A major reason for conducting the study is to compensate for the uncertainty in historical gage records, improving technology that can improve public safety, decrease property damages, and could result in new flood risk technologies.³

The Trinity Common Vision Program and Corridor Development Certificate process continue to encourage intergovernmental collaboration to protect all citizens of the North Central Texas region. Not only do cities in the region have an effective and continually updated tool to decrease flood risk for their citizens, but they have access to expanded technical assistance from the USACE, stronger partnerships with other state and federal agencies, and they ultimately retain control over floodplain permitting decisions in their jurisdiction.¹³

The Integrated Stormwater Management (iSWM) program at NCTCOG, developed by over 60 communities in partnership with Freese and Nichols, Inc., focuses on regulating development and utilizing low impact development methods, design, and construction strategies to address flood mitigation and conveyance, water quality permit compliance, and streambank protection. When utilized within a community, the cumulative effects of this approach can serve as an effective flood prevention method and can be applied throughout an entire watershed, including within the redevelopment areas. Strategies like this are needed, particularly in urbanizing areas, to address the effects of the fast paced growth that is underway and that the North Central Texas region and others will continue to face for years to come.¹⁵

North Central Texas will face these challenges again and again, but if progressive efforts like these continue to be implemented, the region will be better prepared than ever before.

Conclusions

The May-June 2015 floods served as a reminder to our region that as we continue to grow and become further urbanized as an area, the activities and standards upheld within each of our member governments do have a cumulative effect. The storms of late May/early June 2015 hit heavily north of our region, and the storage available in our reservoirs that existed due to recent droughts played a key role in reducing damages that could have been much worse. Our communities should continue to consider adopting higher than FEMA minimum flood standards in order to protect themselves and their neighbors through their efforts toward flood prevention.

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