FLOOD EARLY WARNING SYSTEM OF THE UPPER MEDINA RIVER WATER SHED OF BANDERA COUNTY, TEXAS ANNUAL PROGRESS REPORT FY-2024

Final Medina River FEWS, A.P.R.-2024-005

USGS Stream Gage (No. 0817887350) at Patterson Rd. Medina, TX

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Acronyms

(APR)	Annual Progress Report
(BCRAGD)	Bandera County River Authority and Groundwater District
(cfs)	Cubic Feet per Second
(cfsm)	Cubic Feet per Second per Square Mile
(DCP)	Data Collection Platform
(EOC)	Emergency Operations Center
(FEWS)	Flood Early Warning System
(FIMP)	Flood Inundation Mapping Program
(FIMS)	Flood Inundation Maps
(FSM)	Flood Science Manager
(GHT)	Water Surface Stage – Gage Height
(GOES)	Geostationary Operational Environmental Satellite
(HEC-RAS)	Hydrologic Engineering Center-River Analysis System
(Lidar)	Light detection and ranging
(NAVD 88)	North American Vertical Datum of 1988
(NRA)	Nueces River Authority
(NWIS)	National Water Information Center
(NWS-AHPS)	National Weather Service - Advanced Hydrologic Prediction Service
(RFPG)	Regional Flood Planning Group
(Rv)	River
(SIR)	USGS Scientific Investigations Report
(TWDB)	Texas Water Development Board
(USACE)	U.S. Army Corps of Engineers
(USGS)	United State Geological Survey
(WY)	United States Geological Survey Water Year

Abstract

Floods are the leading cause of natural disaster losses in the United States. Although loss of life to floods during the past half century have declined, in part because of improved warning systems. Economic losses have continued to rise with increased urbanization in flood hazard areas throughout the nation (U.S. Geological Survey, 2006).

On June 1, 2016, the Bandera County River Authority and Groundwater District, (BCRAGD) applied for, and received, a 50/50 cost shared funding grant from the Texas Water Development Board, (TWDB) for a total project cost of $530,300.00, to contract with the U.S. Geological Survey (USGS) for development of a flood warning tool set for the Medina River, Bandera County, Texas. A contract agreement was approved and signed by both agencies, (TWDB and BCRAGD) on August 25, 2016.

A Hydrologic Engineering Center-River Analysis System (HEC-RAS) model, was utilized by the USGS to apply data from existing streamflow-gaging stations, including two newly installed 'stage only' streamflow-gaging stations with rainfall monitors along the headwaters of the North and West Prongs of the Medina River. A flood atlas, consisting of a library of flood-inundation maps for a range of streamflow conditions, was developed and were included on the USGS Flood Inundation Mapping Program (FIMP) website at: https://pubs.usgs.gov/sir/2019/5067/sir20195067.pdf . The Flood Inundation Maps (FIMS) depict estimates of the areal extent and depth of flooding corresponding to selected water levels (stages) at the USGS streamflow-gaging station 08178880 Medina River at Bandera, Texas. **(Figure 1)**

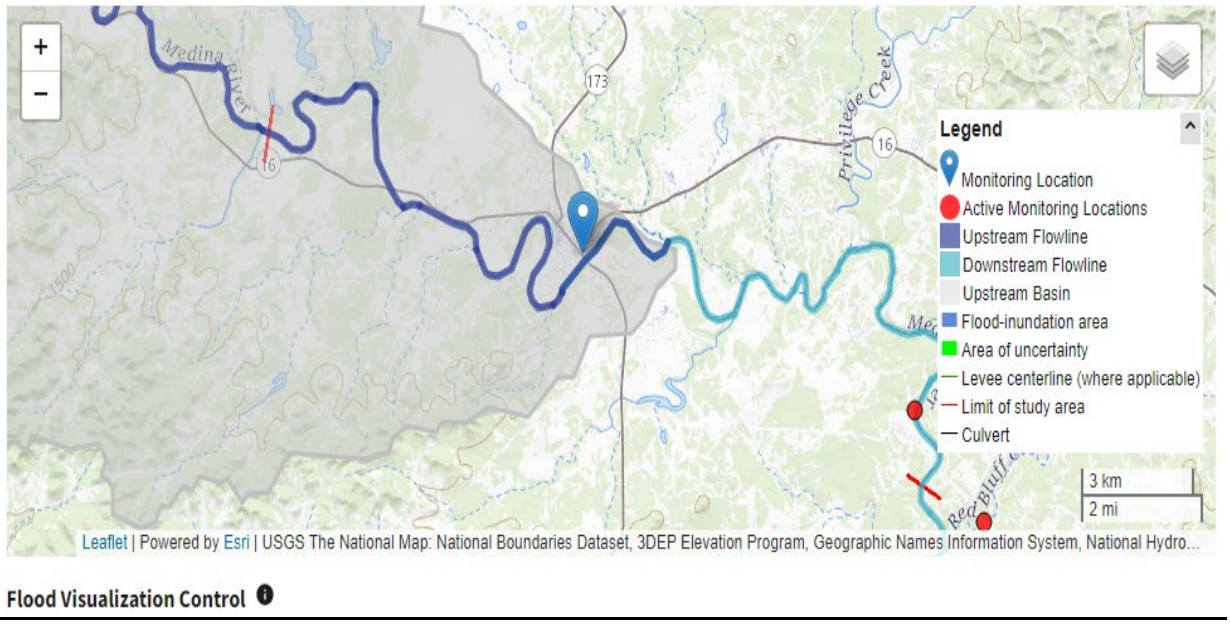


Figure 1 – Medina River Flood Early Warning System, Flood Visualization Control – interactive map

The study area encompassed a 23-mile reach of the Medina River from the confluence of Winans Creek to English Crossing Road above Medina Lake **(Figure 2) (Table 1)**.

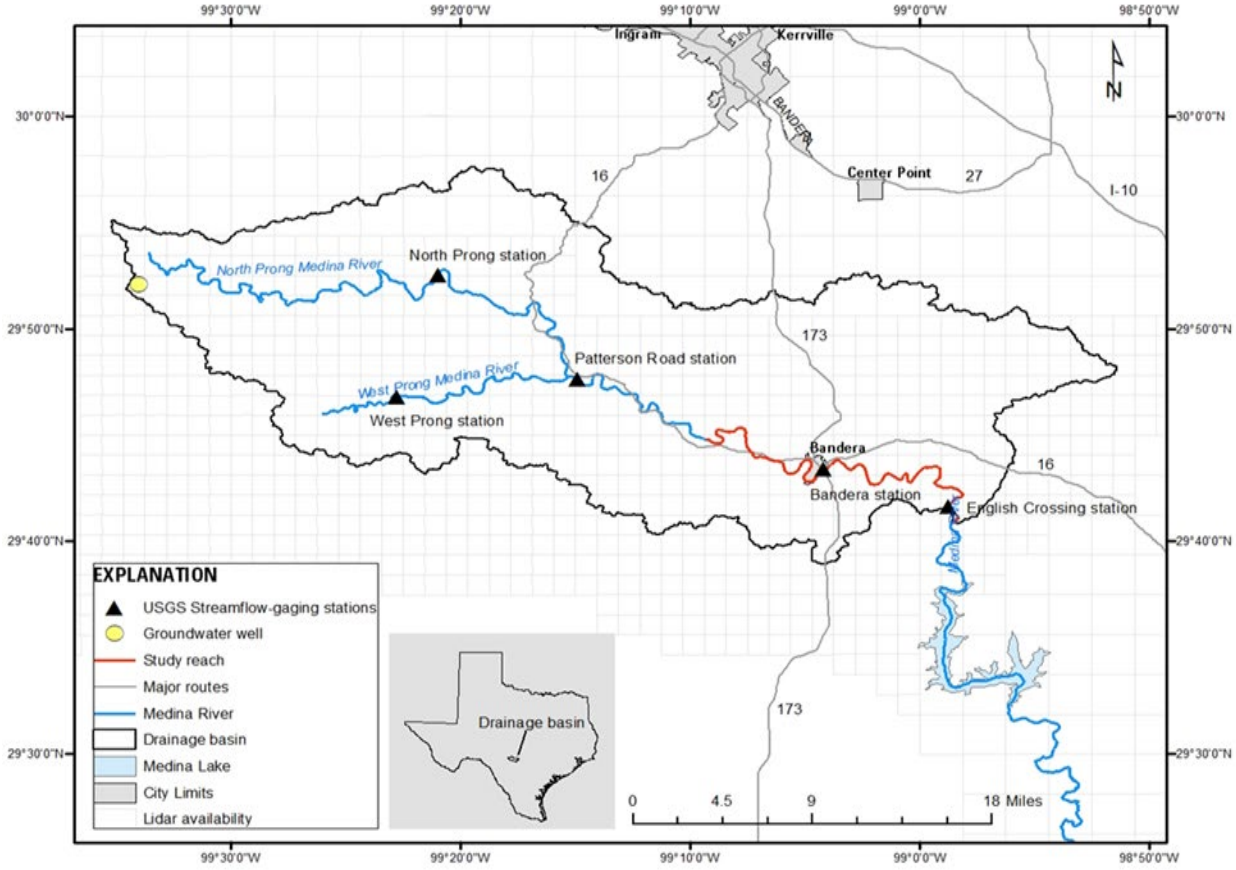


Figure 2 – Study area map with the USGS FEWS streamflow-gaging stations

Table 1 – U.S. Geological Survey streamflow-gaging stations in the study area includes a 23-river mile reach of the Medina River

Station number	Station name	Latitude and longitude	Data collected	Period of data collection	Changes made
0817887350	Medina River at Patterson Road at Medina, Texas.	29.79389, -99.2486	Discharge Gage height Precipitation	November 2, 2011–present November 2, 2011–present January 6, 2019–present	Added precip.
08178880	Medina River at Bandera, Texas.	29.72384, -99.0700	Discharge Gage height	October 20, 1982-present October 20, 1982–present	Period of record revised 9/14/22
08178980	Medina River above English Crossing near Pipe Creek, Texas.	29.69439, -98.9793	Discharge Gage height Precipitation	May 10, 2017–present May 10, 2017–present January 6, 2019–present	Added precip.
08178861	North Prong Medina River at Brewington Creek near Medina, Texas.	29.87533, -99.3488	Gage height Precipitation	October 12, 2017–present January 6, 2019–present	Added precip.
08178871	West Prong Medina River at Carpenter Creek Road near Medina, Texas.	29.78014, -99.3793	Gage height Precipitation	August 3, 2017–present January 6, 2019–present	Added precip.

On July 23rd, 2024, there was a brief and intense occurrence of approximately six (6) inches of rainfall within a short period of time within the Medina Rv watershed. The Medina Rv FEWS data was reviewed by BCRAGD and identified two (2) potential highwater peak ghts to occur at the USGS stream-gage, number 08178880 located at the Highway-173 bridge.

A 3 ½ to 4-hour river flow travel time was considered for the first water surface peak to reach the Bandera Hwy-173 bridge. A thorough review of the FEWS data including an eye on field reconnaissance confirming an anticipated secondary peak to meet or exceed an initial ght peak at the Bandera Hwy–173 location. The suspected secondary rise in stage was a rare occurrence, contributed by many locations such as fields, pastures, road ditch drains, and culverts that were flowing with rainfall run-off, including several overtopped and or breached small ponds located in the upper watershed of the Medina Rv. Observed flows were East of Hwy-16 at Medina, Tx and below the Medina Rv at Patterson Road USGS, FEWS stream gage number 0817887350 and were not accessibly recorded by the USGS stream-gage. This information was communicated to Bandera EOC, resulting in a first response flood warning awareness action for the Medina River at Hwy-173 bridge, Bandera Tx. **(Figure 3, Figure 4)**.

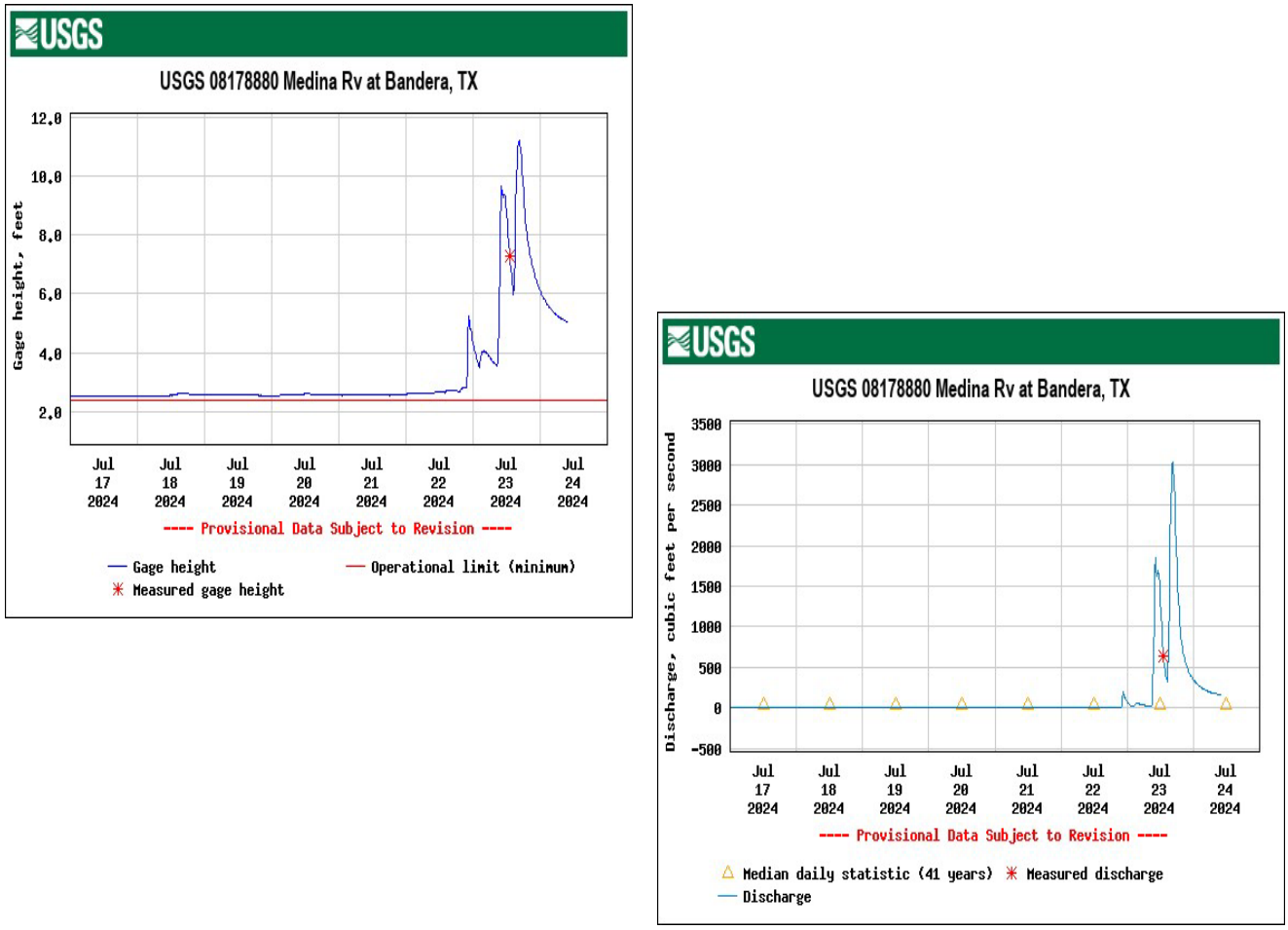


Figure 3 – Initial and Secondary Gage-Height and Discharge Peaks of the Medina River at Hwy-173, Bandera, Tx July 23, 2024

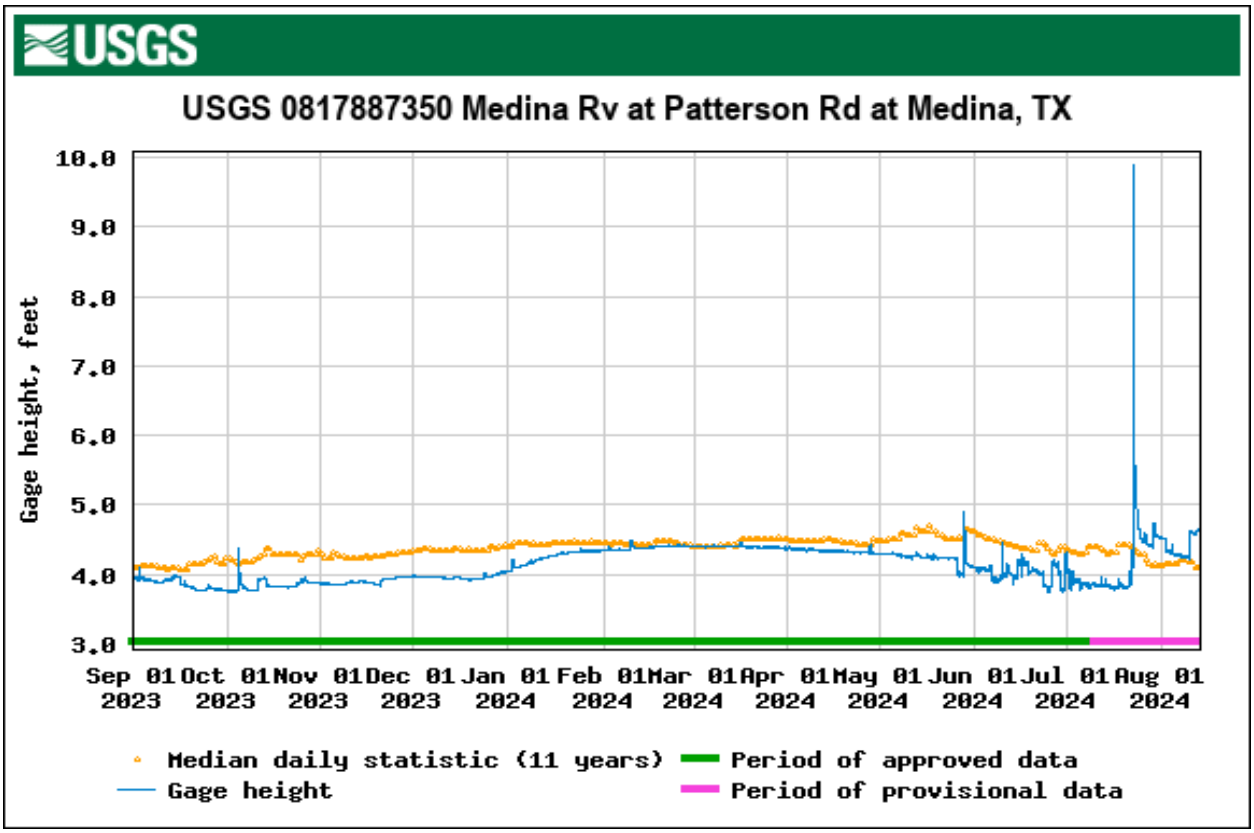


Figure 4 – Medina River at Patterson Road USGS Station Number 0817887350 Gage-Height Hydrograph September 01, 2023, through August 31, 2024

Minimal evacuations occurred along low-lying areas of RV parks in the immediate area of Bandera and several up-stream, highway low-water crossings were temporarily inundated and closed within the FEWS locations. There were no injuries or property damage reported, resulting from this event.

The peak discharge (flow) of 3,040 cfs, **(Figure 5)** occurred at USGS stream gage number 08178880 Medina River at Hwy-173 Bandera, Tx as recorded by USGS with a corresponding water surface stage of 11.20 ft ght on July 23, 2024, **(Figure 6).** A forecast of a ten-foot (10ft) water surface stage / gage-height value of the Medina River at Hwy-173 is determined as the critical first action level for Bandera County Emergency Operations Center to prepare for evacuations of occupied low-lying areas within the city limits of Bandera.

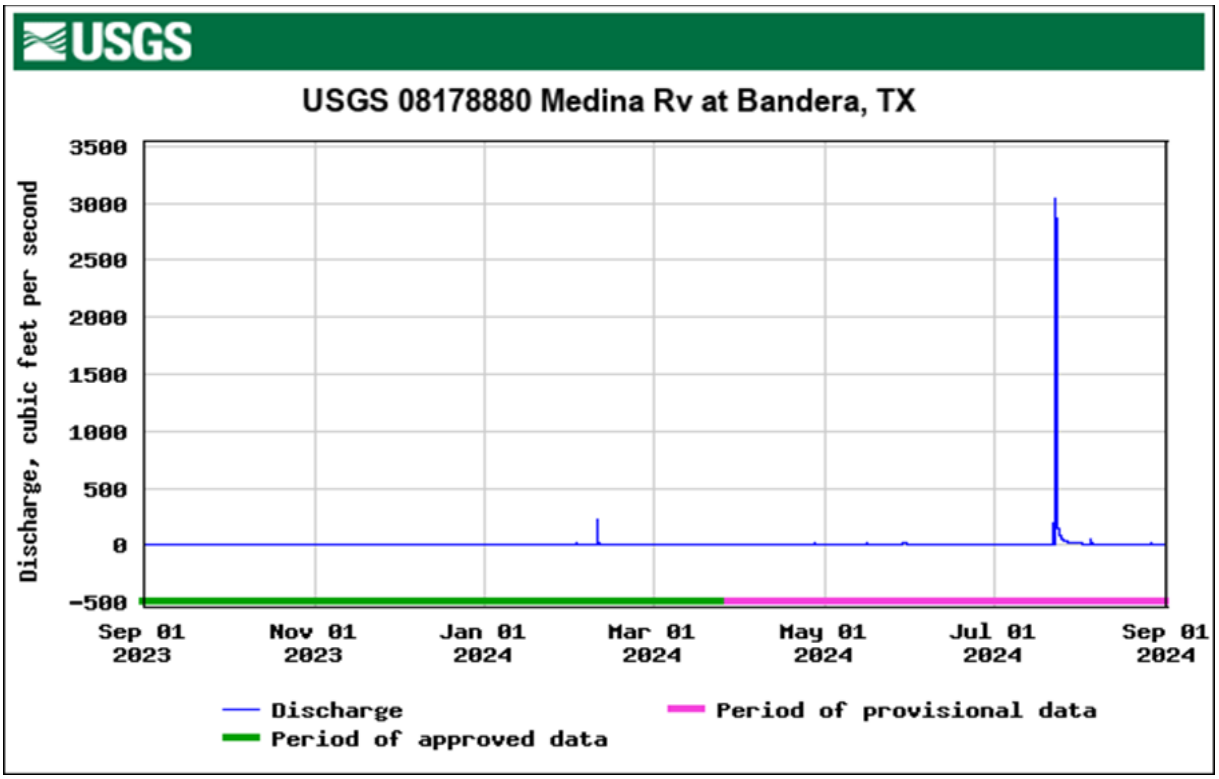


Figure 5 – Medina River at Bandera, Tx. USGS Station Number 08178880 Discharge (flow) Hydrograph September 01, 2023, through August 31, 2023

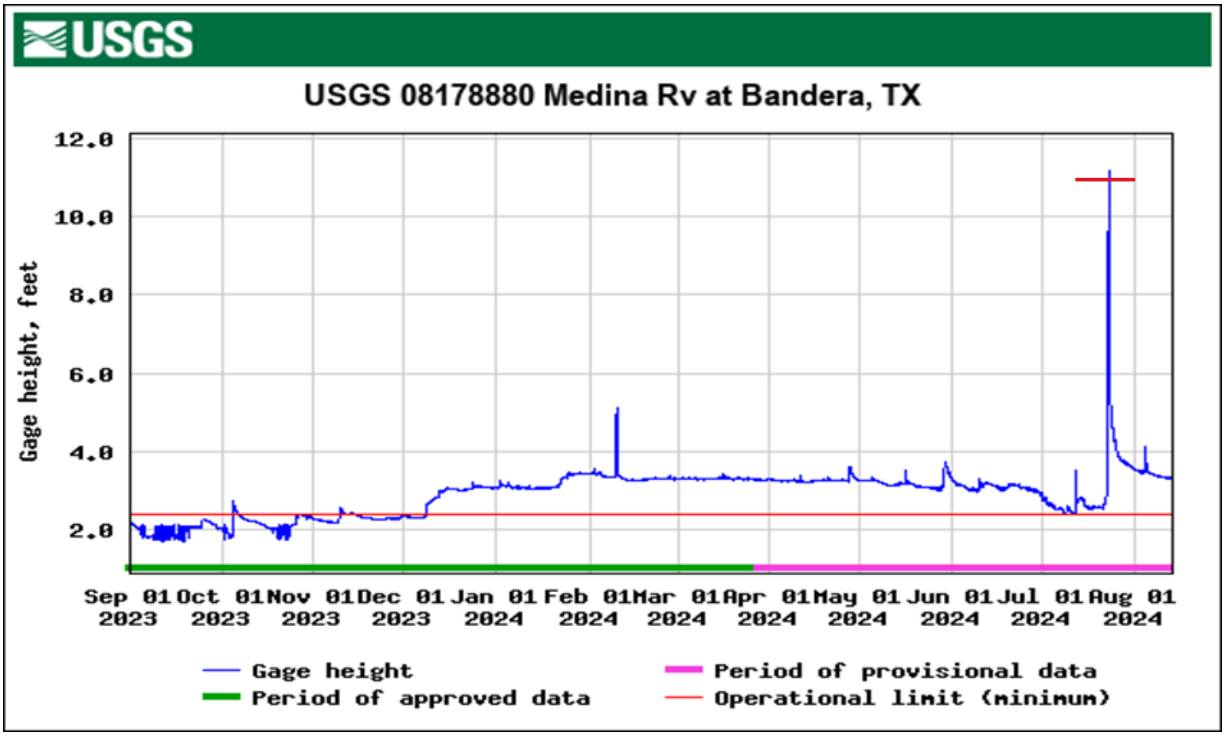


Figure 6 – Medina River at Bandera, Tx. USGS Station Number 08178880 Gage-Height (Stage) Hydrograph September 01, 2023, through August 31, 2023

BCRAGD coordinates with Bandera County Emergency Operations Center (EOC) during storm events which may produce a flood threat providing real-time conditions as related to the Flood Early Warning System (FEWS). During significant and potential flooding events, the BCRAGD, Flood Science Manager (FSM) may temporarily relocate to the EOC support command area to have direct communication with the EOC for verifying and relaying real-time flood conditions which may require immediate response.

Due to the persistent drought and prior to the rain event noted for July 23, 2024, there were several intermittent periods of no-flow conditions (0.0 ft/s) during September 01, 2023, to July 22, 2024, of the Medina River at the USGS stream-gage, number 08178880 located at Highway-173 Bandera, Tx. Many gage-height values were below the stream-gage operational limit. **(**Figure 7**)**

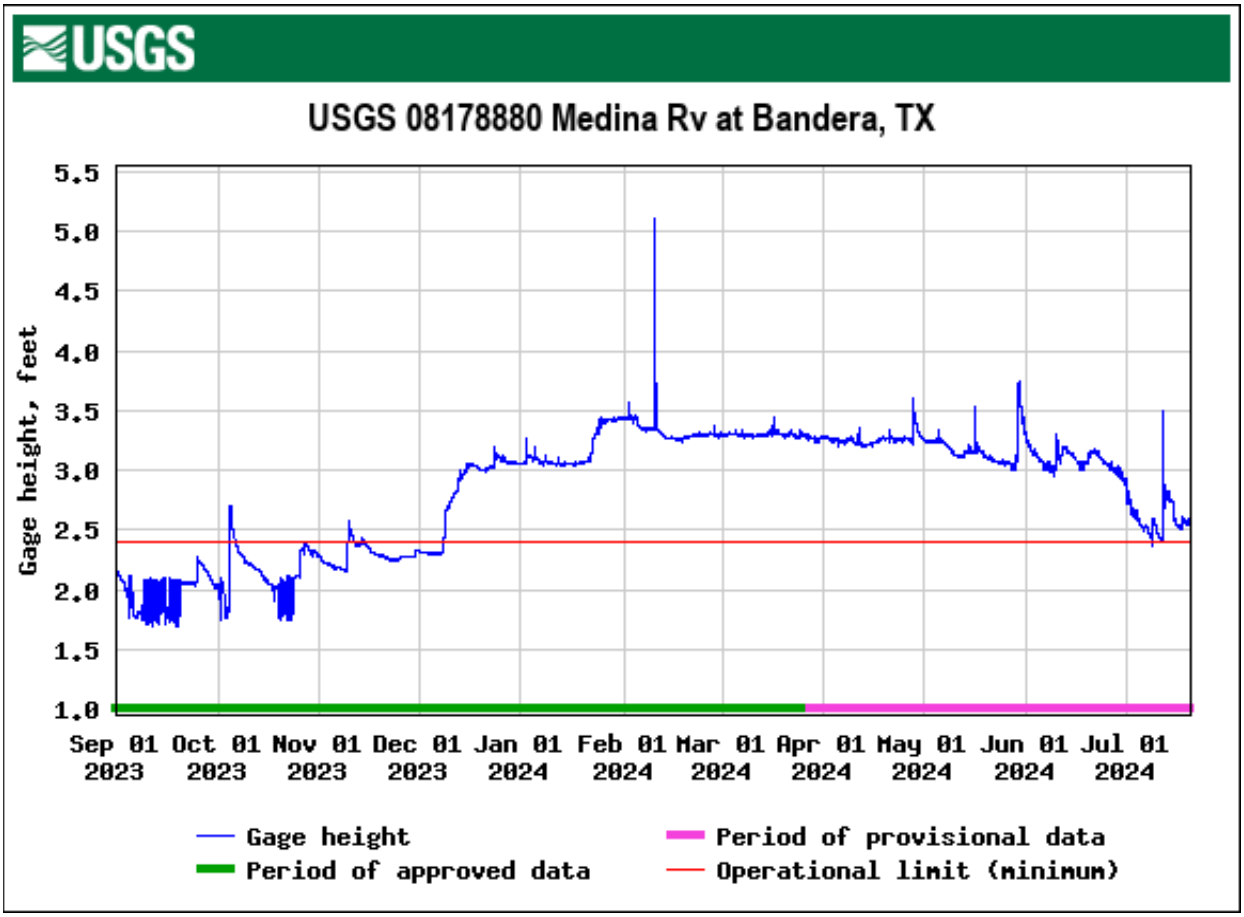


Figure 7 – Medina River at Bandera. USGS Stream-Gage 08178880, Drought Related Gage-Height September 01, 2023, to July 22, 2024

Final Annual Progress Report for Medina River FEWS, No. APR-2024-005, summarizes task completions and accomplishments by the BCRAGD and USGS during the period September 1, 2023, through August 31, 2024.

Flood Early Warning System of the Medina River for Bandera County, Texas

To: Marla Waters | Flood Mitigation Grant Coordinator
Texas Water Development Board
1700 N. Congress Avenue 5th Floor
Austin, TX 78711 | (512) 463-3509
marla.waters@twdb.texas.gov

From: Larry B. Thomas, CFM, NRS
Flood Early Warning System Project Manager
Bandera County River Authority and Groundwater District
440 FM 3240, P.O. Box 177
Bandera, Tx. 78003-0177
lthomas@bcragd.org

Subject: **Annual Progress Report for the Period – September 01, 2023, to August 31, 2024. Texas Water Devolvement Board -- Contract Number: 1600012035**

1. Initial 3-year Project Development Period: August 25, 2016 - May 31, 2019

2. Annual Progress Report Period: September 1, 2023, to August 31, 2024

3. A Five Year BCRAGD commitment to maintain the Medina River Flood Early Warning System (FEWS) operation and maintenance funding to USGS and provide annual progress reports to Texas Water Development Board (TWDB) project manager, no later than 30 days following August 31st each year. Beginning FY-2020 (September 01st, 2019) through FY-24 (August 31st, 2024).

    1. APR #001, 9-1-2019 to 8-31-2020 FY-20 Submitted 09-01-2020.
    2. APR #002, 9-1-2020 to 8-31-2021 FY-21 Submitted 09-10-2021.
    3. APR #003, 9-1-2021 to 8-31-2022 FY-22 Submitted 09-22-2022.
    4. APR #004, 9-1-2022 to 8-31-2023 FY-23 Submitted 08-31-2023.
    5. APR #005, 9-1-2023 to 8-31-2024 FY-24 Submitted 09-10-2024.
    (TWDB recipient email invalid – Revised and submitted 9-24-2024)

USGS - Completed contractual tasks 1 through 4 and percentage of task completions are referenced to the TWDB Final Report dated 8-20-2019 and updated or revised as needed for current annual progress report.

Task 1: Routine data collection and equipment maintenance; (Continual data collection)
Task 1 is 100% complete for the stream-gage installations. The ongoing routine maintenance is continuing, as USGS routinely performs preventative maintenance on a 6 to 8-week interval and is more frequent during storm related events when required.

USGS Medina River FEWS Stations continued Operation and Maintenance (O&M):

- West Prong Medina River at Carpenter Creek Rd nr Medina, TX.
  USGS No. 08178871
- N. Prong. Medina River at Brewington Crossing, FM-2107 nr Medina, TX.
  USGS No. 08178861
- Medina River at Patterson Rd at Medina, TX.
  USGS No. 0817887350

Task 2: Development and calibration of a HEC-RAS model for the study area.
Task 2 is 100% complete.

Task 3: Model scenarios and development of a flood atlas.
Task 3 is 100% complete.
(https://webapps.usgs.gov/infrm/fdst/?region=tx)

Task 4: Reporting and integration with Flood Inundation Mapping Program (FIMP)
Task 4 is 100% complete.
Website. (https://pubs.usgs.gov/sir/2019/5067/sir20195067.pdf)

USGS Tasks Completed: September 01, 2022, through August 31, 2023

Routine on-site inspections and data collection activities by USGS have occurred as scheduled and typically are on a 6-to-8-week interval. Electronic data collections and satellite telemetry data are reviewed daily and processed for continued calibrations of the FIM.

USGS has maintained the operation and maintenance of all FEWS related equipment. All USGS hydrologic monitoring equipment has been fully operational and functioning correctly.

The USGS web site link at https://waterdata.usgs.gov/monitoring-location/08178880 has incorporated a Flood Visualization Control interactive map of the Medina River study area and can be user edited from a gage-height of 10 ft/stage to a maximum of 38 ft/stage for flood inundations.

In addition, a user can view this monitoring location on the USGS Flood Information Inundation Mapper at: https://fim.wim.usgs.gov/fim/?site no=08178880.

- Stream Gage Elevation Levels for water surface stage above the North American Vertical Datum of 1988 (NAVD 88) were completed by USGS at the FEWS stream-gage locations, including culverts, low water crossings and specific locations within the study area during the initial 3-year development period. Lidar elevations were applied to the Flood Inundation Map (FIM) created using the Hydrologic Engineering Center – River Analysis System (HEC-RAS) model by USGS and are on file at the USGS, South Texas Program Oklahoma -Texas Water Science Center, San Antonio, Tx.

Bandera County River Authority and Groundwater District (BCRAGD) Tasks Completed: September 01, 2023, through August 31, 2024

Presentations and status overview provided of the Medina River FEWS

Nueces River Authority (NRA) Region 13 - Regional Flood Planning Group (RFPG) at Tilden Tx. Emergency Response Headquarters June 26th, 2023.

Utopia, Tx. Uvalde County - Community meeting overview of "Drought in Bandera County and Sabinal River Flood Early Warning System | June 2, 2023" and included discussions of the Medina River FEWS. The meeting was held at the Utopia, Tx Civic Center.

June 22, 2023, BCRAGD met with Bandera County Emergency Coordinator 'Judy Lefever' regarding (in-part) coordination of activities and combined efforts of BCRAGD and Bandera EMC during a flood event.

June 26th, Attended Region 12, San Antonio RFPG on-line meeting as part of BCRAGD responsibility representing Flood Districts of the Region 13 Nueces River Basin and liaison between Region 13 and Region 12 (San Antonio).

On August 3, 2023, a KSAT-12 news interview was held at the BCRAGD office describing the Medina River present water quality and drought related conditions, in addition an overview was provided of the Medina and Sabinal FEWS. BCRAGD provided specifics of the flood inundation tool set and included information of the Flood Inundation Mapping System (FIMS). A USGS Scientific Investigations Report (SIR-2019-5067), USGS Fact Sheets, were made available during the scheduled interview.

A BCRAGD internal document titled 'BCRAGD - Flood Plan' for internal use during significant storm events was revised February 22, 2024. (Attachment – 1)

Routine monitoring of USGS satellite telemetry data of the instantaneous river streamflow, reported as cubic feet per second (cfs), water surface stage (gage-height / elevation ft) and rainfall totals (inches), when occurred are reported from the FEWS gages are reviewed daily. Continual review of the river streamflow and water surface elevation responses during rainfall events are compared by hydrographic relationships (drainage basin delineation signatures) of each station within the FEWS for determining river flow trends as well as travel times between upstream / downstream locations, specifically for use during a flooding occurrence. (http://waterdata.usgs.tx.gov)

BCRAGD received and paid as agreed, all outstanding USGS invoices to-date for the beginning FEWS three-year installation and development period which included the TWDB grant contribution, cost shared payments. BCRAGD contractual obligations for fully funding the operation and maintenance of the Medina FEWS with USGS as the third-party Federal contractor for a five-year period, post-2019, have been maintained as agreed. Continued funding of the FEWS is continuing beyond the 5-year conclusion.

The BCRAGD Final report of the initial 3-year data collection period and USGS development of the Flood Inundation map library was approved by TWDB on August 20, 2019. BCRAGD Annual Progress Reports (APR's) FY-20, 21, 22 and 23, have been submitted to TWDB as required. Annual progress report for the period – September 01, 2023, to August 31, 2024 (A.P.R. -2024-005), concludes the five (5) year contractual obligation between TWDB and BCRAGD, Texas Water Devolvement Board -- Contract Number: 1600012035.

End of Medina River Flood Early Warning System, Annual Progress Report 'APR-2024-005, for the period **September 01, 2023, to August 31, 2024,** due to Texas Water Development Board no later than 30 days following 08/31/2024.

Submitted on September 10, 2024 (TWDB recipient address invalid)
Revised, resubmitted September 24, 2024

Attachment 1- Bandera County River Authority and Groundwater District, Flood Plan

Bandera County River Authority and Groundwater District, Flood Plan

May 2017 (revised 2-22-2024)

Photo courtesy of Jerry Sides

Prepared by:
Larry Thomas, CFM, NRS
Flood Science Manager (lthomas@bcragd.org)

CONTENTS

ACRONYMS

(AGM) **Assistant General Manager**

(BCRAGD) **Bandera County River Authority and Groundwater District**

(CFM) **Certified Floodplain Manager**

(EOC) **Emergency Operations Center**

(ERA) **Emergency Response Agency**

(FEWS) **Flood Early Warning Systems**

(FSM) **Flood Science Manager**

(GM) **General Manager**

(MUTCD) **2009 Texas Manual on Uniform Traffic Control Devices**

(NWS) **National Weather Service**

(PFD) **Personal Floatation Device**

(TCD) **Traffic Control Devices**

(TCP) **Traffic Control Plans**

(TWDB) **Texas Water Development Board**

(TxDOT) **Tx Department of Transportation**

(USGS) **U.S. Geological Survey**

PURPOSE

The Bandera County River Authority Groundwater District (BCRAGD) has established a "Flood Plan" for use during significant rainfall runoff events resulting in minor to significant flooding conditions of the Medina River and Sabinal River within Bandera County, TX.

Floods can occur rapidly and with short notice. It is the purpose of this flood plan to outline a plan of operation to effectively coordinate employees and provide reliable information during flooding events to others.
This plan defines lines of communication, personnel assignments, safety, special flood conditions, and post-flood operations.

During various magnitudes of flood events, there may be significant areas of Bandera County affected which require evacuations and pre-planned coordination of activities to prevent loss of life and reduce property damage. The coordinated efforts of this flood plan are combined with BCRAGD employees, Bandera Emergency Response Agencies (ERA), National Weather Service (NWS), Tx Department of Transportation (TxDOT), Local residence, Visitors, and others.

INTRODUCTION

Because of the extreme variability of the occurrence of floods in Bandera County, this plan is designed around BCRAGD office operations and designated employee responsibilities during a flood event.

BCRAGD received a funding grant from the Texas Water Development Board-(TWDB) to establish a Flood Early Warning System (FEWS) for Bandera County. BCRAGD established a cooperative agreement with the U. S. Geological Survey (USGS) for the installation and continuous operation of Streamflow and Rainfall stations within the upper watershed of the Medina and Sabinal River basins. These stations are designed to monitor continuous streamflow, water surface stage (elevations), and rainfall data.

This information is then transmitted hourly and every fifteen minutes during major flood events, via satellite telemetry, which can be found on the USGS web site at 'usgstx.gov' for each station established. Data is also available through several web-based and cell phone communications.

PROJECT ALERT

The office of the BCRAGD may be called upon to furnish information on extreme hydrologic events to other agencies, local cooperators, ERA(s), the public, media, and local governments. The BCRAGD flood response coordinator is the primary Certified Floodplain Manager (CFM). It is the duty of the CFM to alert the BCRAGD General Manager (GM) of an occurrence or possibility of occurrence of such an event, who in turn will notify personnel and subject agencies as may be required.

BCRAGD PERSONNEL / AGENCY CONTACTS

Primary BCRAGD Personnel for flood response are denoted as (#)

BCRAGD Office (830) 796-7260 - www.bcragd.org

BCRAGD President - Don Sloan - sloanmedina@cs.com

(#) General Manager - David Mauk, CFM - dmauk@bcragd.org

(#) Assistant General Manager – Luke Whitmire, Ph.D. - lwhitmire@bcragd.org

(#) Field Operations Manager - Clint Carter - ccarter@bcragd.org

(#) Flood Science Manager – Larry Thomas, CFM, NRS. lthomas@bcragd.org

Education Outreach Manager - Corrina Fox - cfox@bcragd.org

Education and Outreach Coordinator - Charley Curd - ccurd@bcragd.org

Inter-Governmental Affairs Manager - Hayli Hernandez - hhernandez@bcragd.org

Office Manager & Executive Assistant– Diane Irvin - dirvin@bcragd.org

Natural Resource Specialist – Shelby Sckittone – shelbys@bcragd.org

Groundwater Well Inspectors – Clint, Shelby, Larry

Environmental Hazards Compliance & Investigations – Luke, Clint, Larry

COMMUNICATIONS

During an Emergency, Call 911 or phone direct to the following ERA's.

- **NWS Forecast Office, Austin / San Antonio Tx Warning Coordination Meteorologist – (830) 221 - 8595.**
- **Bandera County, Tx. Emergency Management - (830) 460 - 8299**
- **Bandera County, Tx. Sheriff Department - (830) 796 - 3771**
- **Bandera, Tx. Fire Marshal Office - (830) 796 - 3771**
- **Bandera, Tx. Fire Department - (830) 796 - 3777**
- **Bandera County, TxDOT - (830) 796 – 3731**
- **Bandera Emergency Operations Center – (830) 460 - 8299**
- **Medina, Tx. Fire Department - (830) 796 - 3771**
- **Pipe Creek, Tx. Fire Department - (830) 535 – 4511**
- **USGS / San Antonio, TX. Program Office - (210) 691 - 9200, https://tx.usgs.gov**
- **Utopia, Tx. Fire Department - (830) 966 - 3333**
- **Uvalde County Sheriff Department - (830) 278 - 4111**
- **Vanderpool, Tx. Fire Department - (830) 966 - 5500**
- **TX. Dept. Public Safety - Bandera County - (830) 796 - 7274**
- **TX. Dept. Public Safety - Uvalde County - (830) 278 - 5630**

BCRAGD OPERATIONS DURING A FLOOD EVENT

All BCRAGD personnel are subject to being contacted for assistance during a flooding event, regardless of their discipline specialty. Assistance may be required in the Office and in specific field-related assignments.

Key personnel are denoted with (#) on page 4 of this flood plan under the "BCRAGD Personnel / Agency Contacts" listings.

A pending hydrologic event, which may lead to flooding of any condition being of 'minor', 'significant', 'major' or 'catastrophic' occurrence, shall be reviewed prior to such an event as soon as reasonably possible by key personnel.

The projected storm approach and rainfall intensity as predicted by the NWS shall be reviewed and disseminated to all BCRAGD personnel.

The appropriate local ERA for each localized area(s) of predicted impact shall be notified as soon as possible by the BCRAGD GM, and communications maintained throughout the event duration contingent upon the predicted magnitude and intensity of the event.

Communications with BCRAGD personnel and appropriate local ERA(s) shall include specifics of the event data availability as obtained from, but not limited to, U.S. Geological Survey (USGS) Flood Warning stations located within the pending conditions area (as available). This data and information obtained shall be from real-time observations, USGS satellite telemetry, local residence, ERA staff, BCRAGD staff, and the NWS. The data shall be documented and dispersed on the BCRAGD home page web site.

Data may include, but not limited to, the following information:

1. **Present real-time water stage level**
2. **Rate-of-change in stage**
3. **Flow rate measured as cfs/3 (as available)**
4. **Rainfall total amounts and intensity**
5. **Storm cell track and potential future track**
6. **Impacted areas / bridge or road closures**
7. **Other pertinent information**

STREAMFLOW & RAINFALL STATIONS FOR REVIEW DURING FLOOD

Primary Bandera County Flood Warning USGS Streamflow & Rainfall Stations Located within the Medina Rv Basin including the Upper Medina River Basin of the North and West Prongs

- **USGS 08178871, W Prong Medina Rv at Carpenter Ck Rd nr Medina, TX (Stage and Rainfall)**
- **USGS 08178861 N. Prong Medina Rv @ Brewington Crossing nr Medina, Tx (Stage and Rainfall)**
- **USGS 0817887350 Medina Rv at Patterson Rd at Medina,TX (Stage-River flow and Rainfall)**
- **USGS 08178880 Medina Rv at Bandera, TX (Stage and Riverflow)**

Primary Bandera County Flood Warning USGS Streamflow & Rainfall Stations within the Nueces River Basin on the Sabinal River above Utopia, Tx.

- **USGS 08197936 Sabinal Rv bl Mill Ck nr Vanderpool, TX (Stage-River flow and Rainfall**
- **USGS 08197970 Sabinal Rv below West Sabinal Rv at Utopia, TX (Stage-River flow and Rainfall)**
- **USGS 295204099340201, AS-69-12-206 N. W. Bandera County, Edwards GW Well 1 (Groundwater level and Rainfall)**

Additional Monitoring Stations Available for Review During Pending Storm Conditions -

- **Edwards Aquifer Authority - EAA Weather Station at Bandera County River Authority Office 'www.bcragd.org'**
  - **Sensors are - Temperature: °F, Rain: inches, RH:%, Dew Point: °F, Pressure: inHg, Wind Speed: mph, Wind Direction: NSEW, Solar Radiation: KW/m^2**
- **USGS 08179500 Medina Lk nr San Antonio, TX (Lake Stage, Reservoir Capacity and Rainfall)**
- **USGS 08178980 Medina Rv above English Crossing near Pipe Creek, TX (River Stage -River Flow and Rainfall**
- **USGS 08179110 Red Bluff Crk. at FM 1283 near Pipe Crk., TX (Stage and Rainfall)**

USGS Streamflow stations located within the following river basins and others may provide additional information for localized pre-storm planning and should be reviewed contingent upon the present storm track projections and predicted storm severity.

Hydrologic data from various USGS real-time satellite telemetry streamflow and rainfall stations, within the following water sheds and river basins can be found at https://tx.usgs.gov.

- **Upper Medina River Water Shed**
- **Sabinal River Water Shed**
- **Nueces River Basin**
- **San Antonio River Basin**
- **Guadalupe River Basin**

SAFETY

It is the responsibility of every employee to take proper precautions to ensure his or her own safety as well as the safety of the public within the vicinity of assigned duties such as while working from the road surface or bridges.

Safety controls for alerting motorists and the public shall always be utilized while performing assigned field operations, specifically during periods of work requiring activities to be completed from a bridge or roadway.

The following recommendations of the Safety Officer, which have been approved by the BCRAGD GM, must be followed:

(1) BCRAGD vehicles shall not park on a roadway, highway bridge, or otherwise impede normal traffic flow at any time unless approved by BCRAGD General Manager or designee.

(2) Only during absolute essential circumstances shall a vehicle be parked within 7 ft minimum distance of the travel lane for short duration periods to complete assigned duties. At which time the vehicle flashers and recommended 360-degree visibility rotating or strobe warning light shall be used. Short duration is considered less than 30 minutes.

(3) During periods which may require a vehicle to be parked within the 7 ft minimum spacing for longer than 30-minute periods, the operator or person in charge shall follow the 2009 Texas Manual on Uniform Traffic Control Devices (MUTCD), Part VI, revisions 1 and 2 for the specific road design in which work is to be performed at. http:/www .tx dot.gov .txdot library/publications/government/project development/traffic operations.ht.

Modified TCP's and generic templates for use are attached .

1) **The BCRAGD Safety Officer shall have in place specific Traffic Control Plans (TCP) for existing locations normally scheduled to visit by field personnel, in addition to approved generic TCP's to be utilized accordingly during non-routine site visits.**

2) **All BCRAGD vehicles shall be equipped with a minimum of four (4) Traffic Control devices (TCDs), ie: TXDOT approved traffic cones. In addition to TCDs, all BCRAGD vehicles shall have approved First Aid kits, reflective vests, emergency throw ropes, personal floatation devices (PFDs), rain gear, throwable floatation, vehicle equipped with 360-degree visibility blue / yellow strobe lights, and communication capabilities for alerting BCRAGD personnel (and-or) Emergency response personnel if required.**

6) **Additional traffic control devices shall be readily available as needed and maintained in good working conditions. At a minimum the following TxDOT approved items shall be readily available.**

two (2) - Workers Ahead Signs, two (2) - Right, and Left, Lane closed ahead signs, two (2) - Slow/Stop Signs, four (4) - handheld orange flags, ten (10) - traffic control cones, and six (6) portable sign holder stands.

TRAFFIC CONTROL DEVICE RECOMMENDATIONS

General National Traffic Cone Standards:

All traffic device safety cones must be orange, fluorescent red-orange, or fluorescent yellow/orange. Daytime and low-speed area cones on roads at or below 40 miles per hour must be at least 18 inches tall; cones intended for use for locations with above 45 miles per hour - must be at least 28 inches tall. All cones must be stable enough to withstand environmental and traffic conditions, so they can be doubled up or weighted down as needed. Flashing light devices can be attached to cones if the lights increase visibility in bad weather, on curvy roads or in areas with many distractions.

Night-Use Traffic Safety Cones:

Night-use traffic device safety cones must be at least 28 inches tall and have reflectors or lighting devices. Cones measuring 28 to 36 inches must have two white reflector bands that measure six and four inches wide; if the cones are taller than 36 inches, they must have at least two white reflector bands measuring four to six inches creating alternating orange and white stripes with the top stripe being orange. Non-reflective gaps cannot exceed three inches.

POST FLOODING PROCEDURE

Location Reconnaissance Plan & Call in Procedure:

- **Preliminary itinerary of site visits planned by BCRAGD personnel during a storm event, shall include at a minimum, the following information and approved by the GM prior to departure.**

  - **Written site visit (s) planned**
  - **Vehicle description and Texas License Plate ID**
  - **Date and Time of departure and anticipated return date and time**
  - **Personnel and responsible party in charge**
  - **Contact phone number (s)**

- **Post Flood Operations and required actions:**

  - **Post calls in to GM.**
  - **Sign written reconnaissance plan as completed with date and time of returning to BCRAGD office.**
  - **Notify ERAs of actions required if any.**
  - **Document reconnaissance findings and file digital photos of conditions found.**

BCRAGD Vehicle, Boat, and Boat Trailer Safety Inspection - Requirements

- **State required Vehicle Inspections**
- **BCRAGD Annual Inspections / and Available Field use Equipment as needed.**
- **Fire extinguisher inspections**
- **First Aid Kit**
- **Traffic Control devices**
- **Traffic Control; written and description sketch (Tx-MUTCD revision 2 Oct. 2014)**
- **Swift Water rescue throw ropes**
- **Organized - Secured Vehicles – No loose tools or potential projectile objects in cab or open truck bed.**
- **Vehicle overall condition including Tires, Spare Tire and manufactured recommended-Jack – Hoist**
- **Shovel – Tow Strap**
- **Hip-Boots / Chest Waders / PFD when required**
- **Snake Chaps or protective boots**
- **Pre and Post trip schedule**

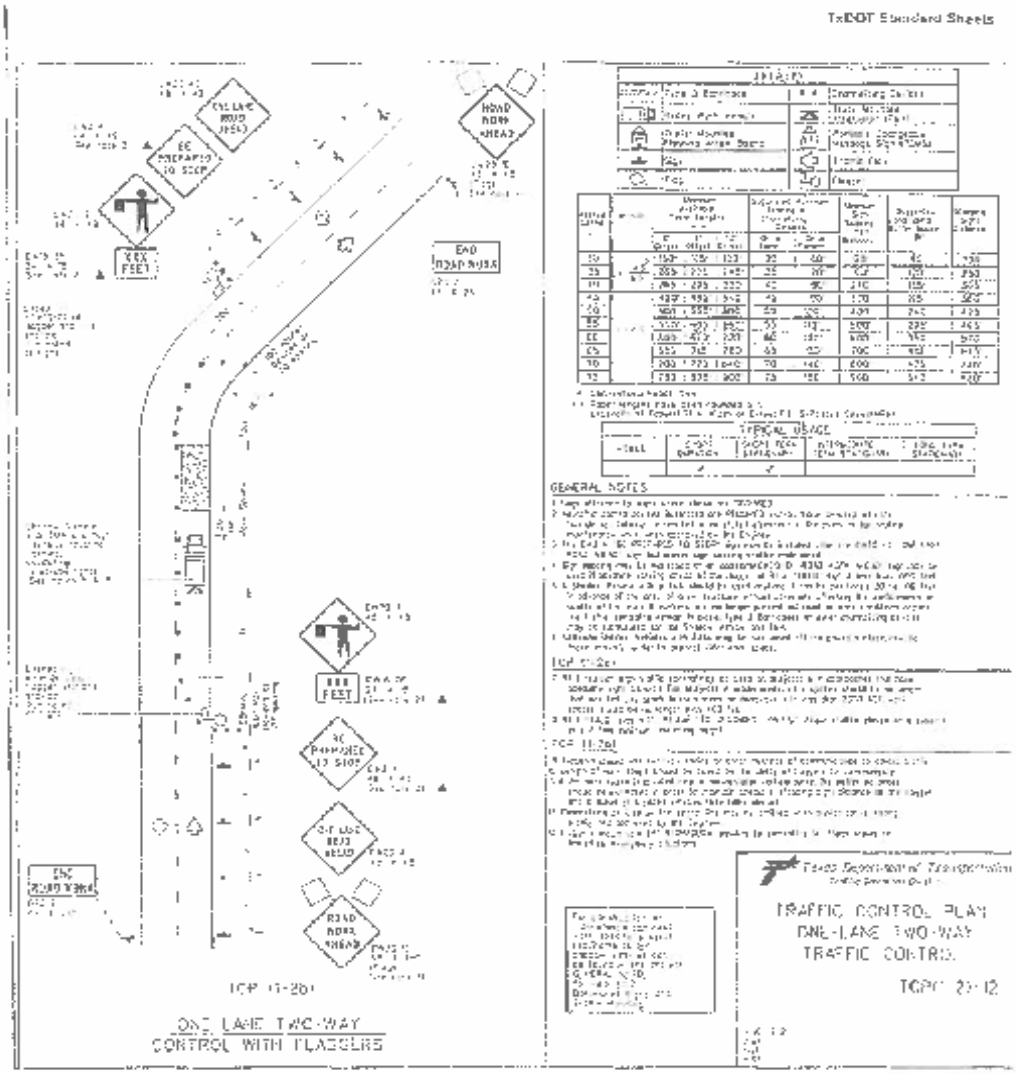
Watercraft and Trailer

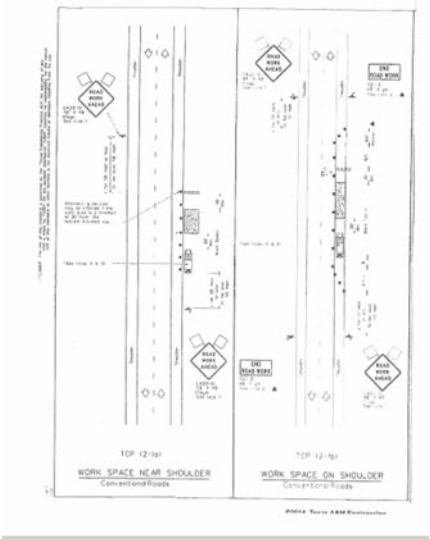
All required U.S. Coast Guard safety items as per impoundments of use and vessel type. Including a Pre -Trip Float Plan

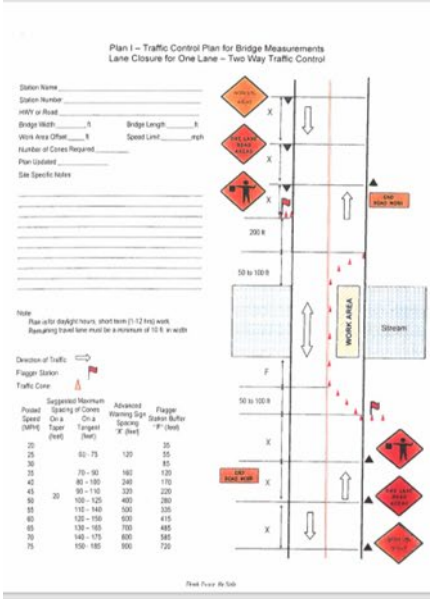
- **Float plan filed at BCRAGD office and physical copy accompanied with boat**
- **Waterproof first aid kit**
- **Approved watercraft fire extinguisher**
- **BCRAGD reflective decal / placard attached on Port and Starboard bow of boat**
- **Operational running lights, anchor light and proper stern light extension**
- **Anchor of correct type for channel bottom and proper length of rope and chain**
- **Whistle and Horn**
- **Navigable chart (electronic or channel map)**
- **Communication device, i.e., cell phone, marine radio**
- **Portable flood light**
- **Paddle and Gaff**
- **Spare boat drain plug**
- **Bilge pump in good working condition and insure a clean unobstructed pump intake**
- **GPS – Navigational Chart – Depth indicator**
- **Waterproof Toolbox with spare spark plugs**
- **Boat battery secured and in good condition. (Consider mounting 20 W solar panel and regulator for charging battery remotely if needed)**
- **Throwable floating ring or cushion**
- **Adequate and in good condition PFD's**
- **Spare prop with retaining key or nut**
- **Engine emergency cutoff lanyard in good condition and working properly.**
- **Battery jumper cables**
- **Reflective BCRAGD -Vi- on Starboard and Port sides near bow**
- **Diver flags and buoy when required**
- **Waterproof writing tablet and markers**
- **Fluorescent orange elastic flagging**
- **Anti-skid adhesive strips -or- anti-skid paint applied on Bow area working surface**
- **Trash Bags**
- **Change of clothing in waterproof bag**

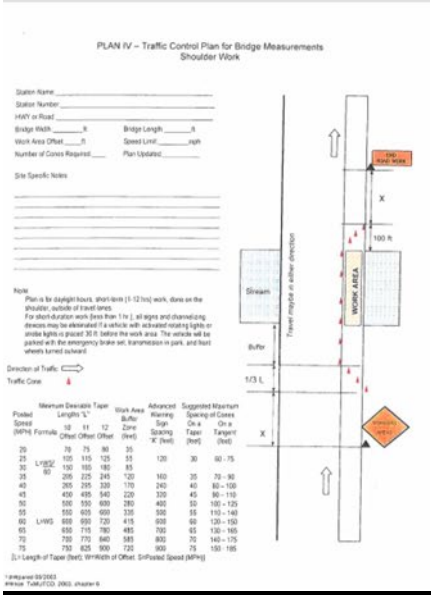
Boat Trailer

- **Good condition tires**
- **Good condition trailer bunks or rollers**
- **Good condition Stern tie down buckles and watercraft mid-ship or Aft strap**
- **Good condition boat hitch safety chain and winch strap**
- **Trailer lights in good working condition**
- **Trailer hitch and safety chains in good condition**
- **Trailer tag with up-to-date registration**




TCP (2-1a)
WORK SPACE NEAR SHOULDER
Conventional Roads
TCP (2-1b)
WORK SPACE ON SHOULDER
Conventional Roads


Plan I – Traffic Control Plan for Bridge Measurements
Lane Closure for One Lane – Two Way Traffic Control
Station Name
Station Number
HWY or Road
Bridge Width: ft
Bridge Length: ft
Work Area Offset: ft
Speed Limit: mph
Number of Cones Required:
Plan Updated:
Site Specific Notes
Note:
Plan is for daylight hours, short term (1-12 hrs) work.
Remaining travel lane must be a minimum of 10 ft. in width
Direction of Traffic
Flagger Station
Traffic Cone
Posted Speed (MPH)
Suggested Maximum Spacing of Cones On a Taper (feet)
Suggested Maximum Spacing of Cones On a Tangent (feet)
Advanced Warning Sign Spacing "A" (feet)
Flagger Station Buffer "F" (feet)
20
25
30
35
40
45
50
55
60
65
70
75
20
60 - 75
70 - 90
80 - 100
90 - 110
100 - 125
110 - 140
120 - 150
130 - 165
140 - 175
150 - 185
120
160
240
320
400
500
600
700
800
900
35
55
85
120
170
220
280
335
415
485
585
720
200 ft
50 to 100 ft
WORK AREA
Stream
F
X


PLAN IV – Traffic Control Plan for Bridge Measurements
Shoulder Work
Station Name:
Station Number:
HWY or Road:
Bridge Width: ft
Bridge Length: ft
Work Area Offset: ft
Speed Limit: mph
Number of Cones Required:
Plan Updated:
Site Specific Notes
Note:
Plan is for daylight hours, short-term (1-12 hrs) work, done on the shoulder, outside of travel lanes.
For short-duration work (less than 1 hr.), all signs and channelizing devices may be eliminated if a vehicle with activated rotating lights or strobe lights is placed 30 ft. before the work area. The vehicle will be parked with the emergency brake set, transmission in park, and front wheels turned outward.
Direction of Traffic
Traffic Cone
Minimum Desirable Taper Lengths "L"
Posted Speed (MPH)
Formula
10 Foot Offset
11 Foot Offset
12 Foot Offset
Work Area Buffer Zone (feet)
Advanced Warning Sign Spacing "A" (feet)
Suggested Maximum Spacing of Cones On a Taper (feet)
Suggested Maximum Spacing of Cones On a Tangent (feet)
20
25
30
35
40
45
50
55
60
65
70
75
L=WS2/60
L=WS
70
105
150
205
265
450
500
550
600
650
700
750
75
115
165
225
295
495
550
605
660
715
770
825
80
125
180
245
320
540
600
660
720
780
840
900
35
55
85
120
170
240
320
400
500
600
680
800
120
160
240
320
400
500
600
700
800
900
30
35
40
45
50
55
60
65
70
75
60 - 75
70 - 90
80 - 100
90 - 110
100 - 125
110 - 140
120 - 150
130 - 165
140 - 175
150 - 185
[L= Length of Taper (feet), W=Width of Offset, S=Posted Speed (MPH)]
Prepared 09/2003
Stream
Travel maybe in either direction
WORK AREA
Buffer
1/3 L
100 ft
X