

# Developing Base Level Engineering for Texas Watersheds

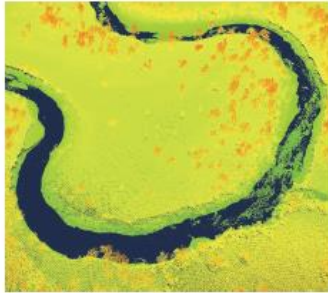
Jacquelyn Campbell, CFM  
Texas Water Development Board\*  
and  
Kelsey Cayeros, PE, CFM  
Half Associates, Inc.

June 8<sup>th</sup>, 2022

\*Unless specifically noted, this presentation does not necessarily reflect official Board positions or decisions.

# What is Base Level Engineering?

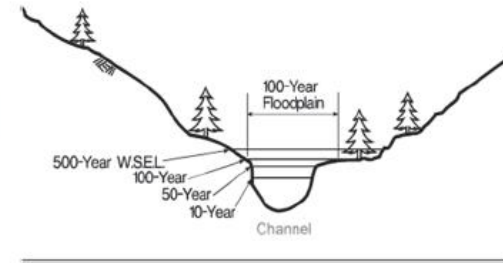
## Base Level Engineering



**Lidar**



**Hydrology**



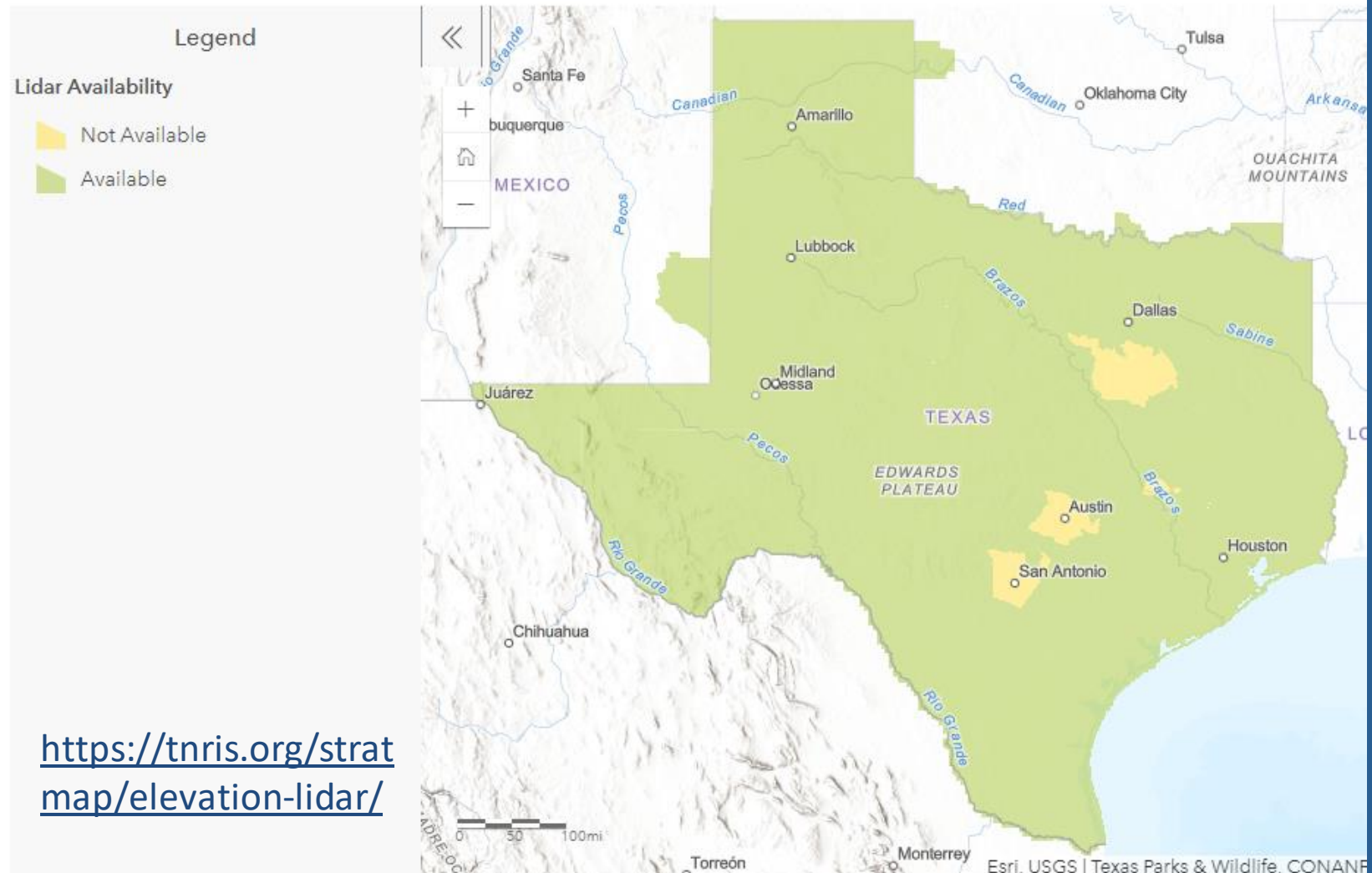
**Hydraulics**



**Base Level Engineering**

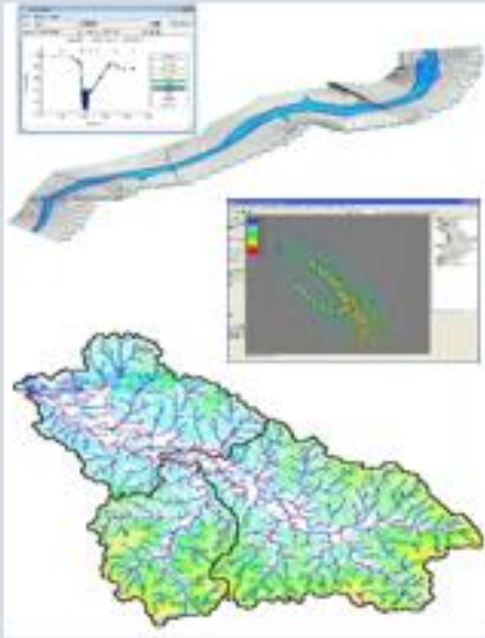
# Texas Lidar Coverage

## TNRIS Lidar Coverage

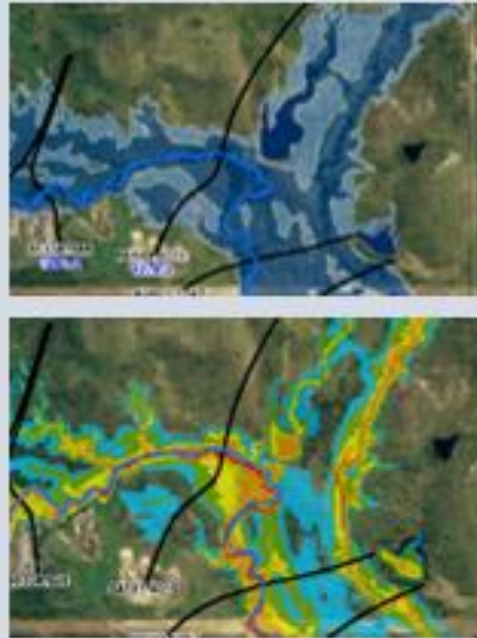


<https://tnris.org/stratmap/elevation-lidar/>

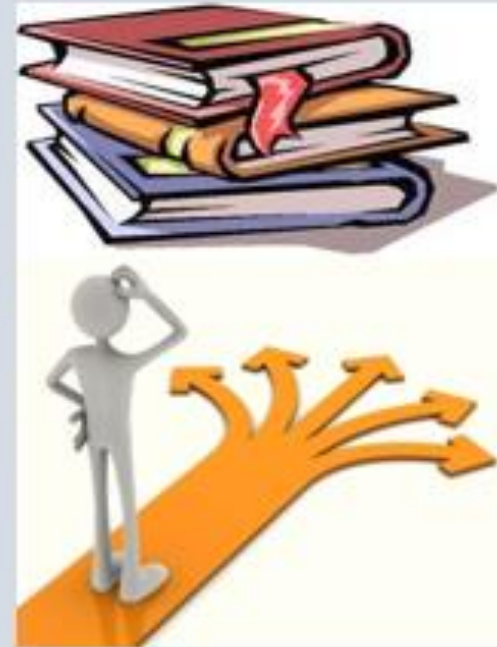
# Base Level Engineering is a programmatic evolutionary step which provides:



Credible engineering analysis and modeling for local communities and developers.



Estimation of flood extents, water surface elevations and flood depths



May be adopted as Best Available Information (BAI) by communities & inform development decisions.

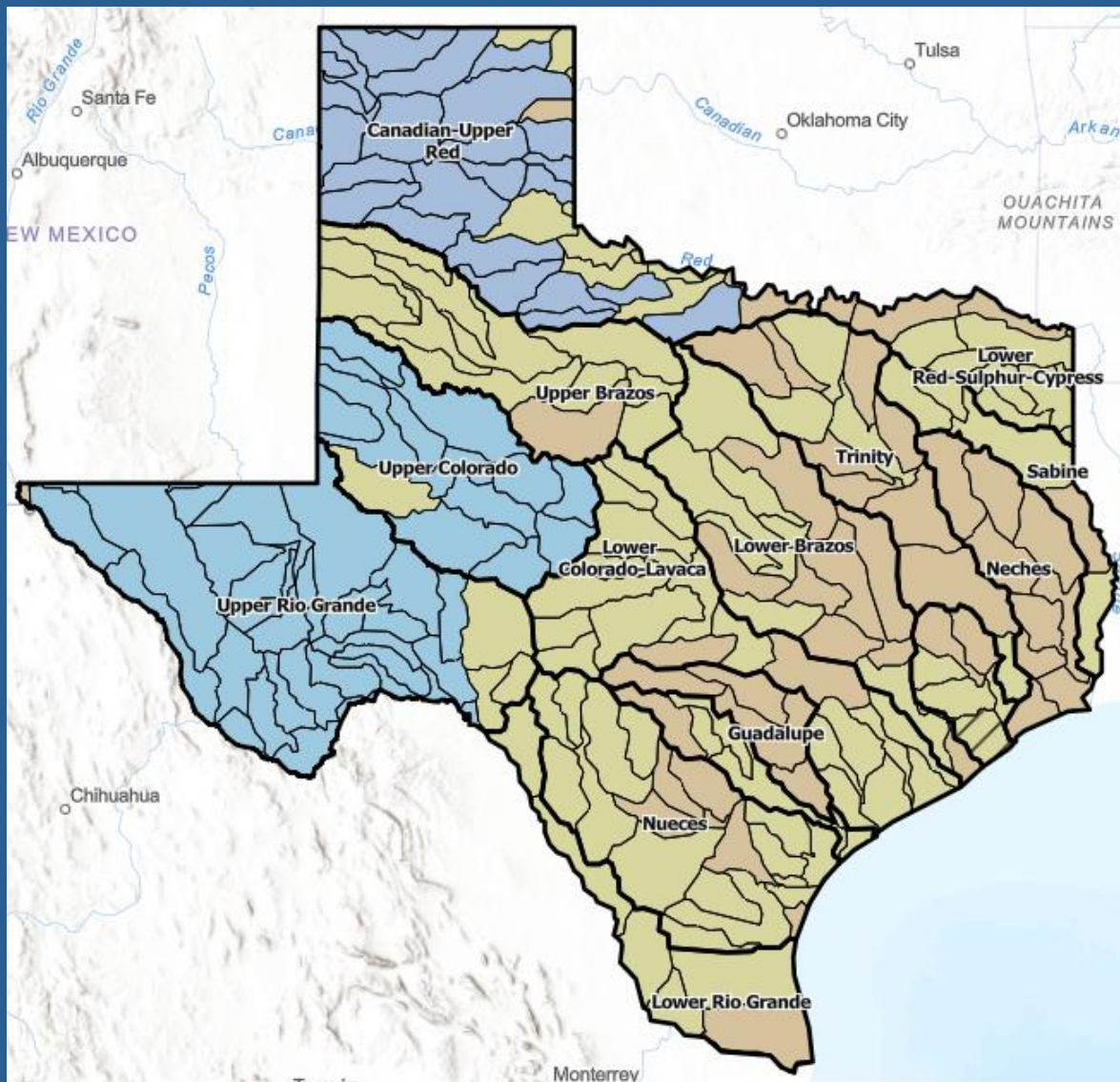
# BLE Benefits

- Comprehensive picture of flood risk for entire watershed (Zone A's)
- Provides modeling to support local flood mitigation strategies, projects, and initiatives
- Information to support local planning and development decisions for multiple community departments.
- Less time intensive than detailed study/FIRM update
- Provided by state and federal partners with no additional cost to communities




# Statewide BLE Coverage

- Our goal is to get updated flood hazard data to Texas communities quickly
  - BLE development ~9-12 months/watershed
- Cost effective
  - Larger scale studies can build on modeling efficiencies
- Support for Regional Flood Planning Groups
  - The TWDB will be administering a new state and regional flood planning process with flood planning regions based on river basins
  - BLE data can inform decision making for the Regional Flood Planning Groups

# Texas BLE Coverage






**BLE Status**

-  Complete
-  In Progress
-  Pending upload to FEMA's EstBFE Viewer


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**Estimated FY Completion**

-  FY2022
-  FY2023
-  FY2024


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**Flood Planning Regions**

- 

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**HUC 8 Watershed Boundaries**

- 

# BLE Status Map

## Base Level Engineering (BLE) Status

The map and tables below show progress and development of new BLE products as of 2/8/2021. This information is subject to change as the projected BLE progress and schedule are contingent on many factors including federal funding availability, partnering agency involvement, and evolving prioritizations. The TWDB will be updating this data quarterly and will include any changes that have developed.



### Status Map

This interactive map application provides the current progress of BLE development throughout the state. For watersheds with status 'complete' (meaning BLE development is complete for that watershed) access and download the BLE modeling files and results by going to FEMA's [Estimated Base Flood Elevation Viewer](#).

### Current BLE Status

	Complete	In Progress	Planned	Total
HUC 8s in Texas	35	66	107	<b>208</b>
State Funded BLE	2	30	98	<b>130</b>
Cooperating Technical Partner (CTP) Funded BLE	2	16	0	<b>18</b>
FEMA Funded HUCs	31	20	9	<b>60</b>
1D BLE	34	16	0	<b>50</b>
2D BLE	1	50	107	<b>158</b>

- HUC stands for Hydrologic Unit Code and is a unit of measurement for watersheds determined by the United States Geological Survey. HUC-8s are very roughly the size of Texas counties.
- 1D and 2D are terms for different flood modeling methods.

What to Do? Before, During, and After a Flood

Flood Infrastructure Fund (FIF)

Flood Planning

Flood Financial Assistance Programs

National Flood Insurance Program (NFIP)

Flood Mapping

- Base Level Engineering (BLE)
- Base Level Engineering (BLE) Status
- Modeling and Mapping Program
- Flood Mapping Resources

Floodplain Management Training

Community Resources

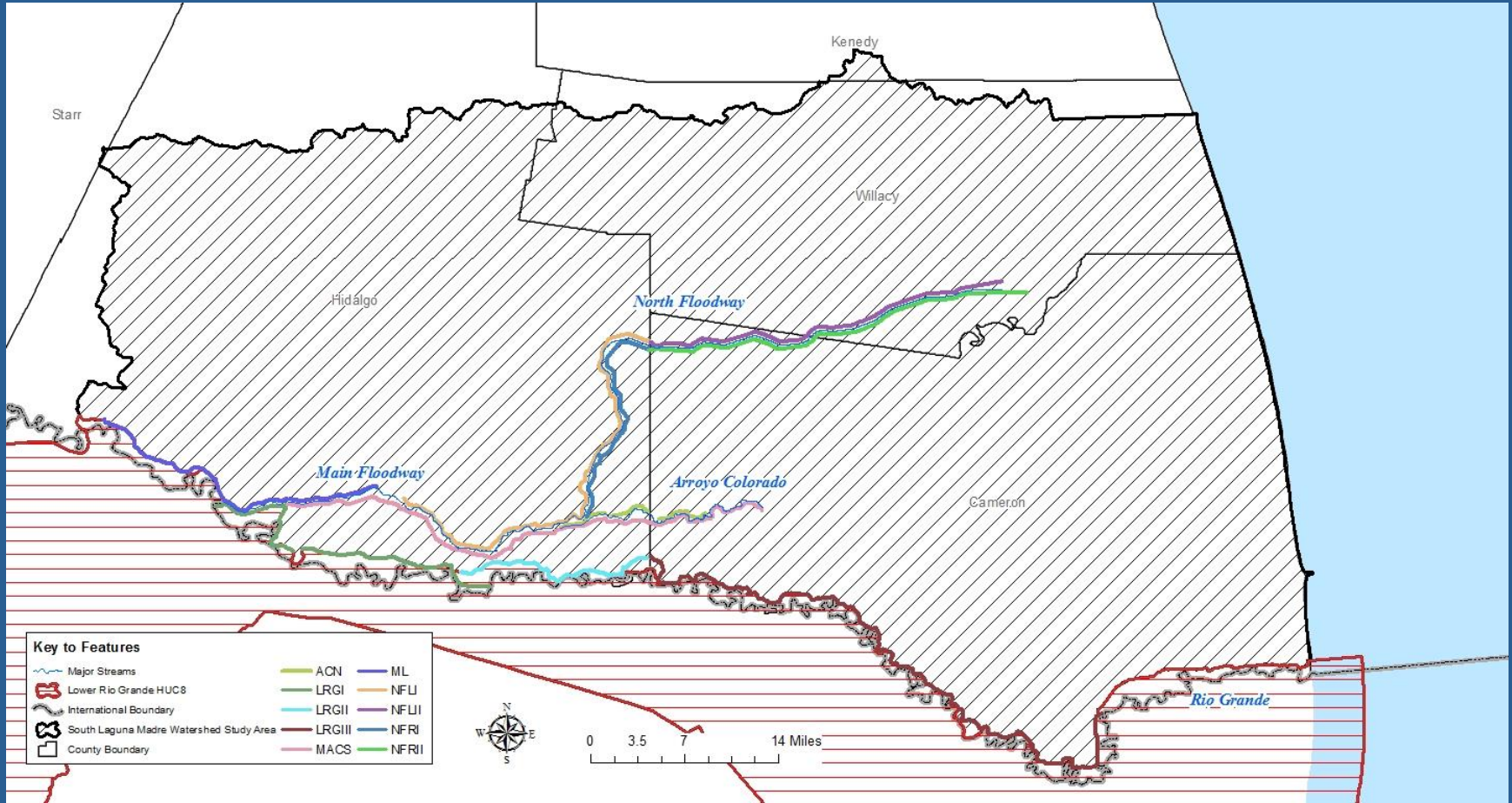
Flood Science and Community Assistance Staff

Flood Planning Staff

TNRIS



# South Laguna Madre BLE & Levee Analysis

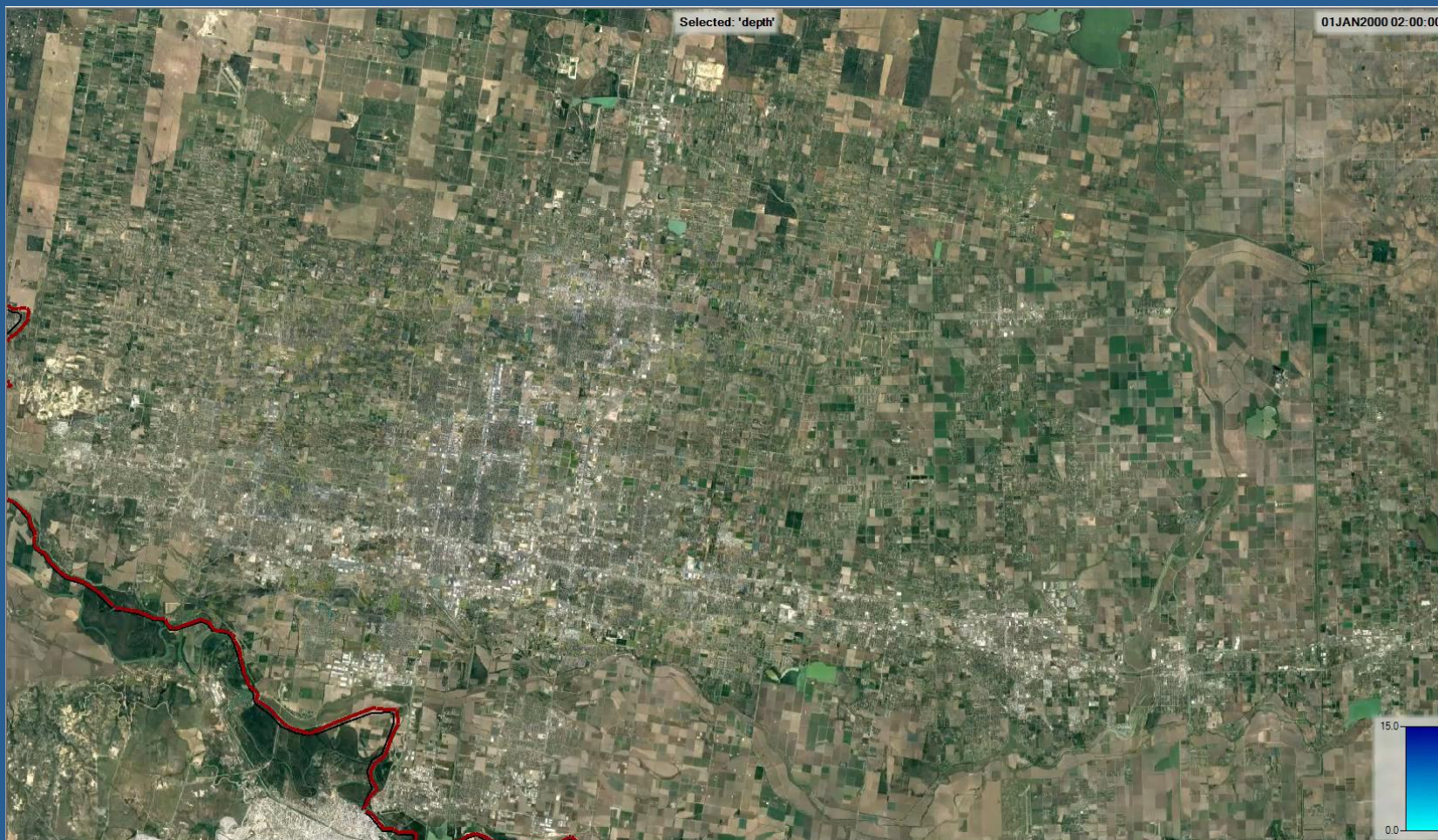


# South Laguna Madre BLE

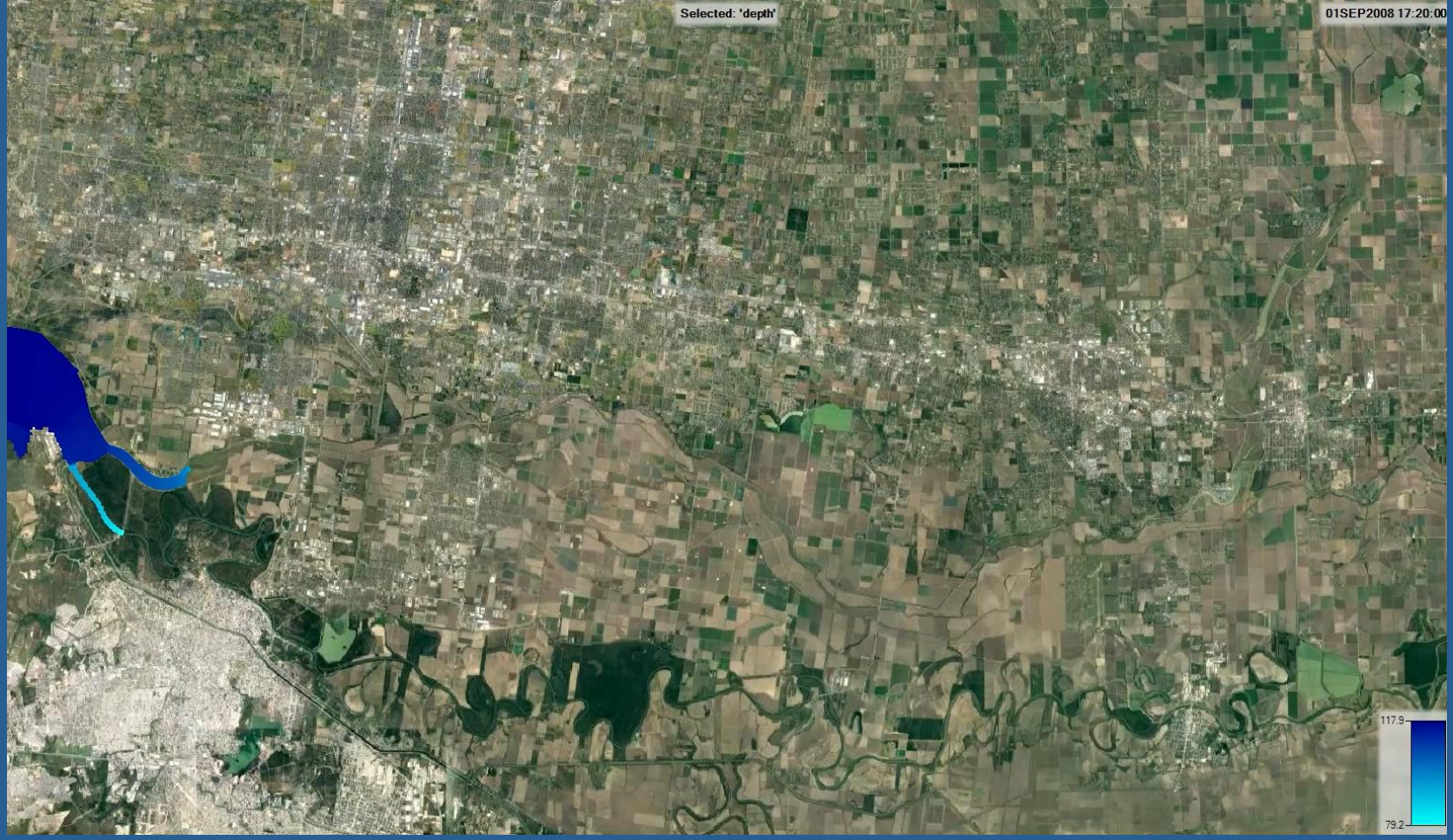
## Incorporated Data:

- 2018 USGS LiDAR
  - 10 ft Cell Size
- Atlas 14 Rainfall Data
  - 10, 4, 2, 1, 1±, 0.2% ACE
- 300 ft Model Cell Size
- Breaklines (Model Refinement)
  - Major Roadways
  - Irrigation Channels
  - Railroads
  - Levee Systems
  - Channels/Ditches/Streams
- USIBWC Data for Rio Grande River Inflow Model

# South Laguna Madre BLE 1% ACE Interior Drainage Model

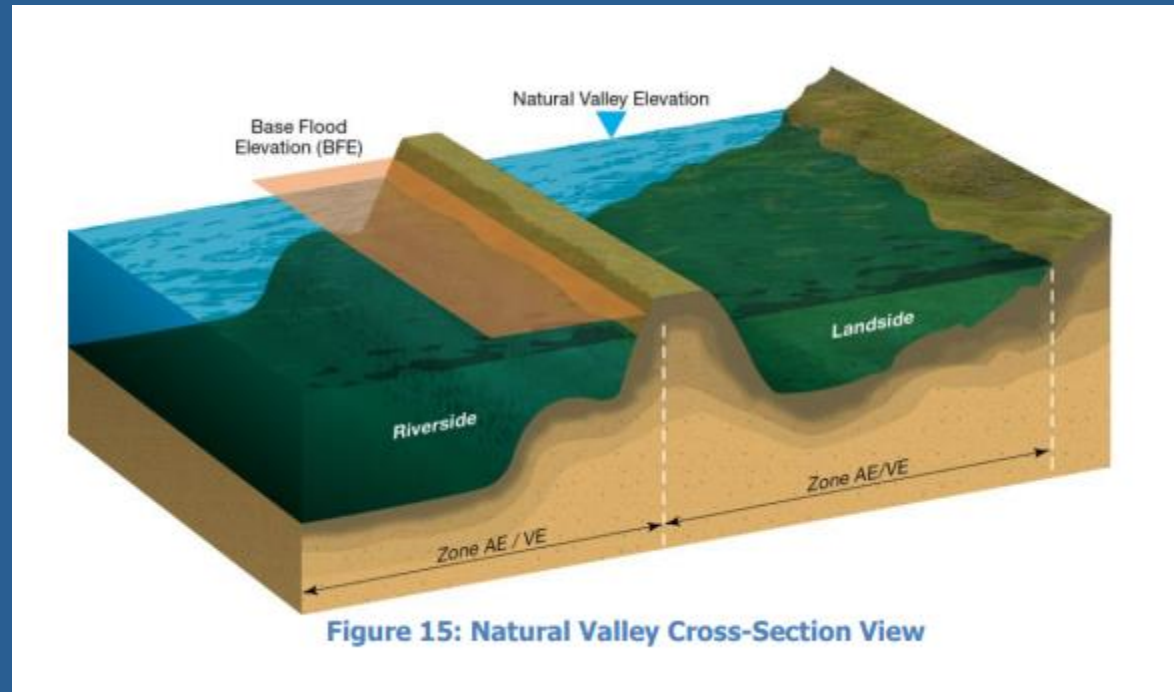


# South Laguna Madre BLE 1% ACE Rio Grande Inflow Model



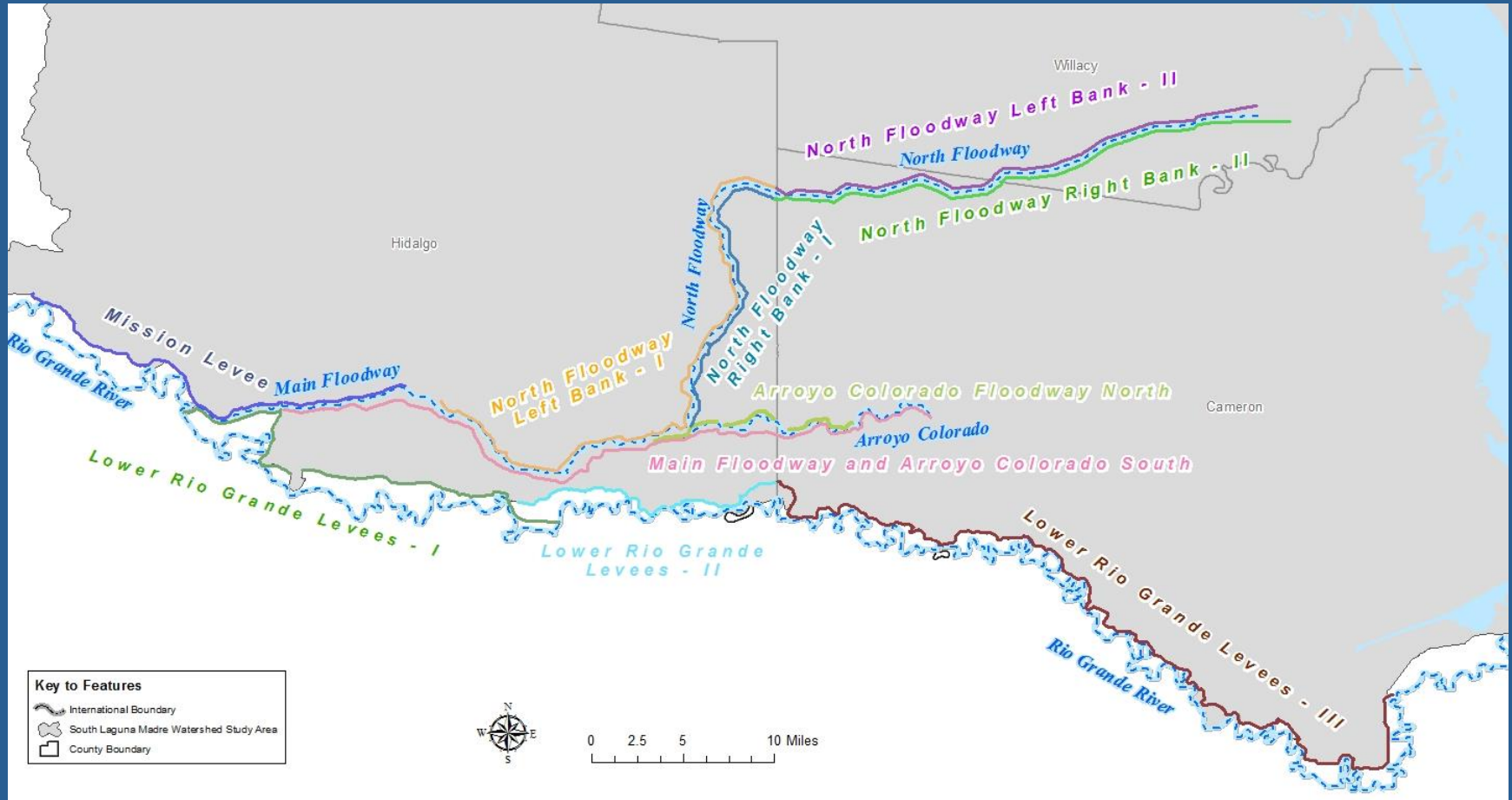
# Natural Valley Procedure

The Natural Valley procedure is used to establish areas that may be flooded if the levee system were to breach, overtop, or fail completely.

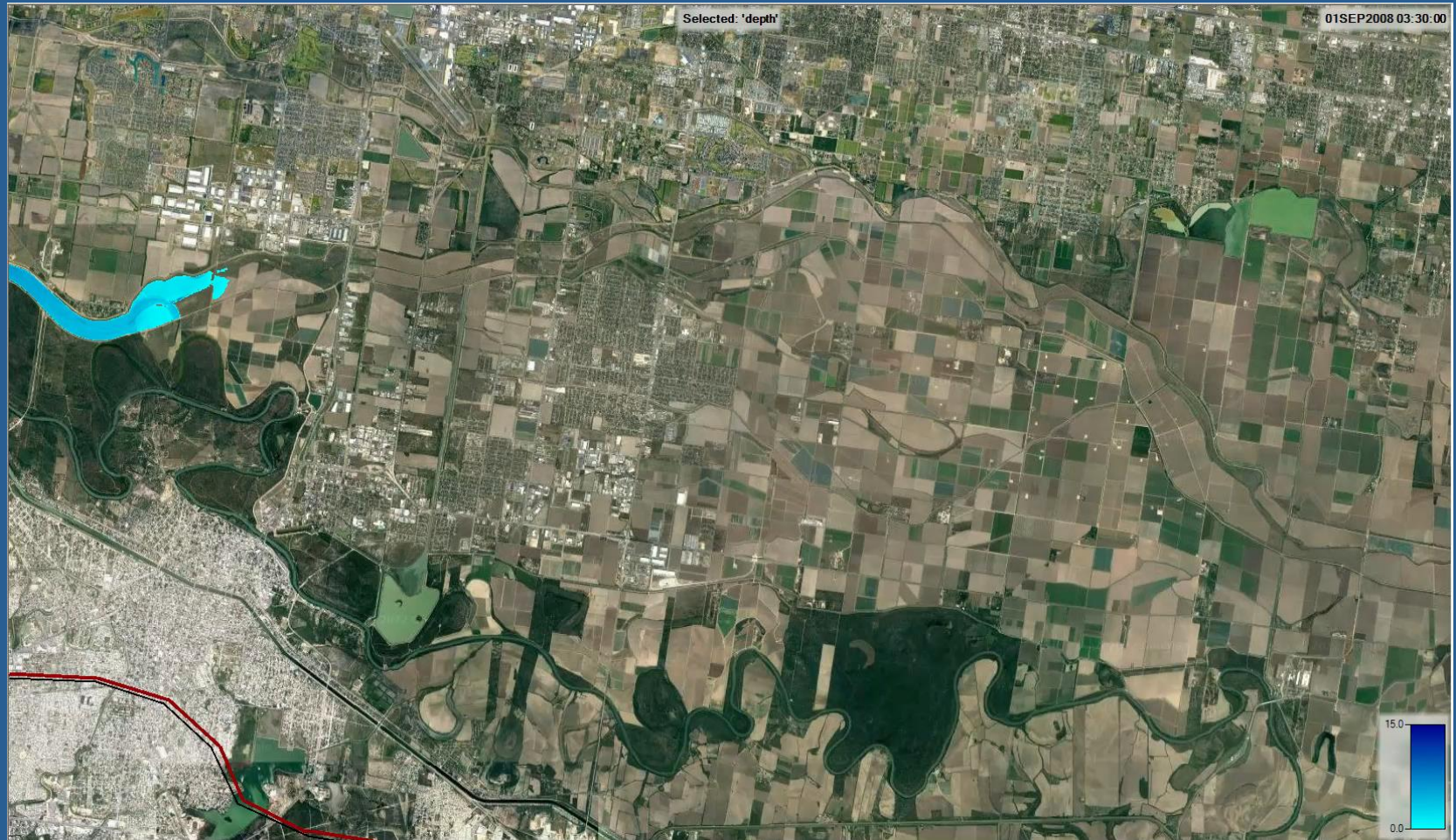


[https://www.fema.gov/sites/default/files/documents/fema\\_levee-guidance.pdf](https://www.fema.gov/sites/default/files/documents/fema_levee-guidance.pdf)

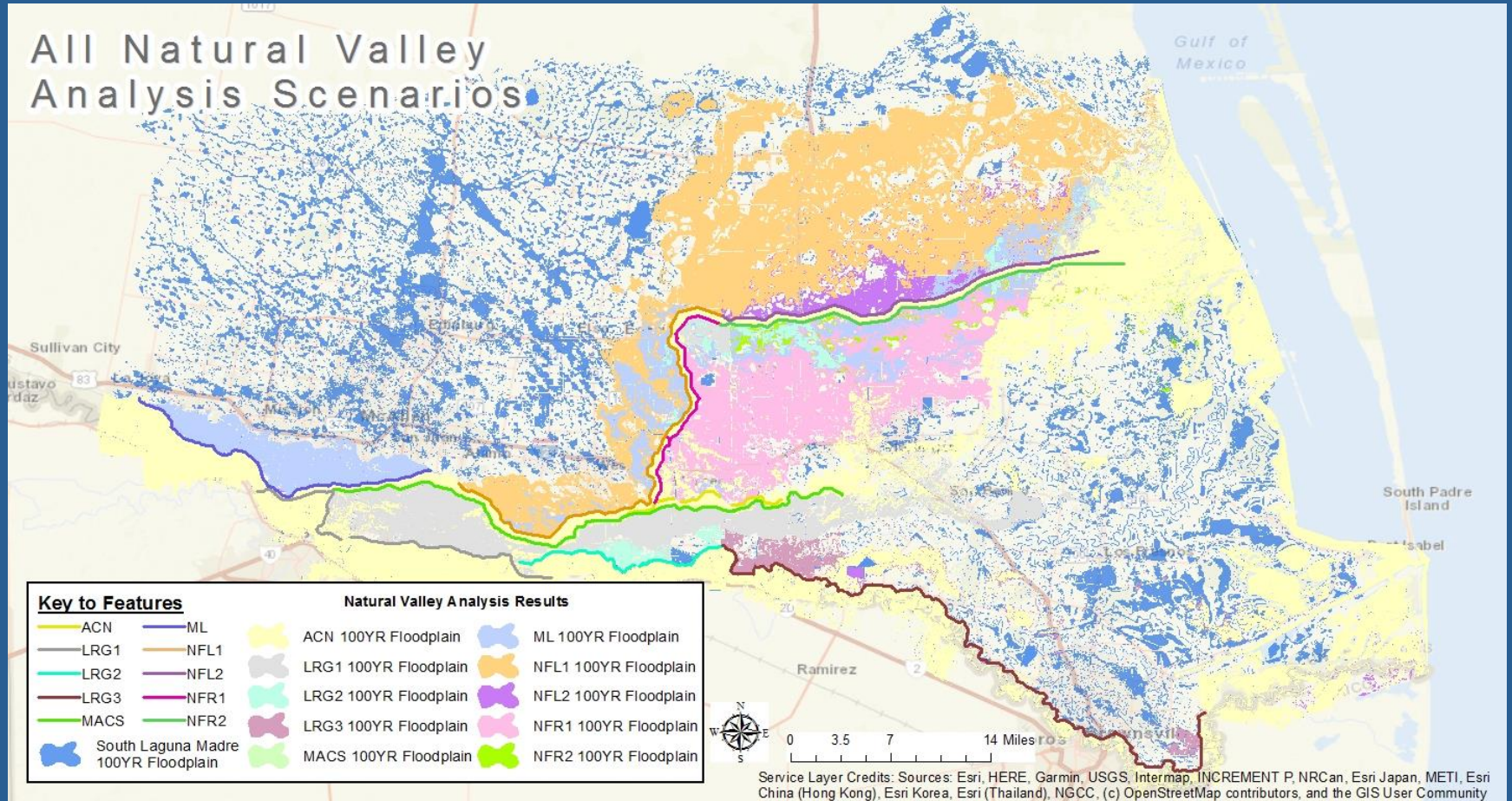
# South Laguna Madre Levee Systems



# Natural Valley Procedure Model Run



# Levee Summary





# BLE & Levee Analysis Summary

- BLE Results
  - Rain on Mesh Interior Drainage Model
  - Rio Grande Inflow Model (With Levees in place)
- Levee Analysis
  - Natural Valley Model
    - Each Levee Reach Modeled Independently
    - Entire Levee System Modeled

# Using the viewer

<https://webapps.usgs.gov/infrm/estBFE/>

### Disclaimer

The Flood Risk Information Report produced by the Estimated Base Flood Elevation (estBFE) Viewer includes estimated Base Flood Elevation (BFE) and approximate flood depths determined from gridded datasets constructed from engineering flood models. These gridded datasets simplify thousands of engineering models and thousands of miles of study into a few datasets, providing users a variety of usable and meaningful information. Reports produced by the estBFE viewer are based on the user's identified location. Please verify the location of interest prior to running a report.

Base Level Engineering watershed assessments use automated modeling and high resolution ground data to produce credible engineering analysis for thousands of miles of stream at a time. This flood data may be used in coordination with regulatory Flood Insurance Rate Maps (FIRMs) as best available flood hazard information. The modeling and mapping available through this site meets FEMA's standards for flood risk studies. Both the spatial and modeling information may be downloaded through the estBFE Viewer.

Users may seek professional review of the results prior to accepting the estimated BFEs and floodplain delineations made available through this site. Additionally, users should always consult the official effective FIRMs and coordinate with local community officials to review the flood risk information available in their area of concern. Users can review effective FIRMs in their vicinity at <http://msc.fema.gov/nfl>.

OK

## Welcome to the

Base Level Engineering assessments are produced using high resolution ground data to create technically credible flood hazard information that may be used to expand and modernize FEMA's current flood hazard inventory.



### View Base Level Engineering Data

Access all available Base Level Engineering data without GIS software.

- Click the **DATA LAYERS** button to add or remove map layers.
- Click the **LEGEND** tab to view an explanation of all data shown.
- Click the **MAP VIEW** button to open or close a second viewing window for side-by-side comparisons.

## Estimated Base Flood Elevation Viewer



### Download Datasets & Models

Download the Base Level Engineering data presented in the viewer.

- Click the **DATA LAYERS** button and add the **DOWNLOADABLE DATA** layer.
- Click shaded areas in the map to open a dialog for choosing datasets to download.



### Property Look Up

Where data is available, produce a property-specific report with estimated base flood information.


- Click the **REPORT** tab to create a flood risk report for a specific location.

Click a topic to get started!

San Antonio

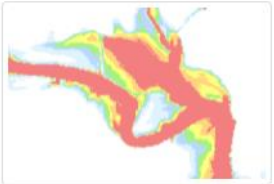
# Estimated Base Flood Elevation Viewer

## Estimated Base Flood Elevation (estBFE) Viewer



Report Legend 2 Data Layers 2 Map View Base Map


Flood Depth (1%) Remove



≤ 1 foot	> 3 to 4 feet
> 1 to 2 feet	> 4 to 5 feet
> 2 to 3 feet	> 5 feet

Comments: Depicts estimated water depths above land surface during a 1% annual chance storm event (a storm that has a 1/100 chance of occurring in any calendar year).

Base Map: Topographic



Quick Start Glossary About

Scale: 1 : 8,782,417

U.S. Department of the Interior | DOI Inspector General | White House | E-Gov | USA.gov | No FEAR Act Data | FOIA

# Run a Site Specific Report

**Estimated Base Flood Elevation (estBFE) Viewer** FEMA

**Create a Flood Risk Report**

More info >

Search for a place

Enter an address or place of interest in the above search box. A popup will appear at the chosen location and you can create a report if BLE data are available there.

OR

**My Location**

Click this button to zoom the map to your actual location. A popup will appear and you can create a report if BLE data are available there.

Tip: Your web browser must support and have geolocation enabled.

OR

**Map Click**

Zoom into your area of interest. Click this button and then the map. A popup will appear and you can create a report if BLE data are available there.

Tip: Click on the center of the roof of your home or the most upstream point of your structure.

Quick Start | Glossary | About

Scale: 1:9,344,043

U.S. Department of the Interior | DOI Inspector General | White House | E.gov | Open Government | No Fear Act | FOIA

Three blue arrows point from the callout boxes to the corresponding buttons on the interface:

- Arrow 1 points to the search box: Enter your address or a City, Stream, Watershed name to zoom in
- Arrow 2 points to the "My Location" button: or CLICK "My Location" to zoom in based on your current location
- Arrow 3 points to the "Map Click" button: Once ZOOMED in, use "Map Click" to place the locator & run report

# Run a Site Specific Report

**Estimated Base Flood Elevation (estBFE) Viewer** FEMA

**Create a Flood Risk Report**

Search for a place

Enter an address or place of interest in the above search box. A popup will appear at the chosen location and you can create a report if BLE data are available there.

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Zoom into your area of interest. Click this button and then the map. A popup will appear and you can create a report if BLE data are available there.

**Tip:** Click on the center of the roof of your home or the most upstream point of your structure.

**Map Click Location**

**High Flood Risk**  
This location is in a 1% (100 year) flood zone.

**Report** **Zoom To** **Close**

Scale: 1 : 2,257 Lat: 30.541 Lon: -97.4425

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# Run a Site Specific Report

https://webapps.usgs.gov/infirm/estBFE/report.htm?lat=29.752455480021392&lng=-97.59292602539062

URL is transferrable, locked to Lat/Long

Print

Tip: The map's zoom level can be adjusted by using the +/- zoom buttons. Users should zoom in and verify the location of the marker prior to printing.

Print Report to PDF or Local Printer

Zoom in or out before printing a report HERE

## Estimated Base Flood Elevation (estBFE)

### Flood Risk Information Report

FEMA is providing a look at flood data availability and relative Base Level Engineering analysis through the Estimated Base Flood Elevation Viewer (Estimated BFE Viewer). Base Level Engineering uses high resolution ground elevation data, flood flow calculations, and fundamental engineering modeling techniques to define flood extents for streams. The viewer is an effective tool for property owners, community officials, and land developers to identify flood risk, estimated flood elevations, and flood depths for watersheds where Base Level Engineering has been prepared.

Caldwell County, Texas Latitude 29.7525 Longitude -97.5929

EXPLANATION

- Stream
- High risk (1% flood zone)

EXPLANATION

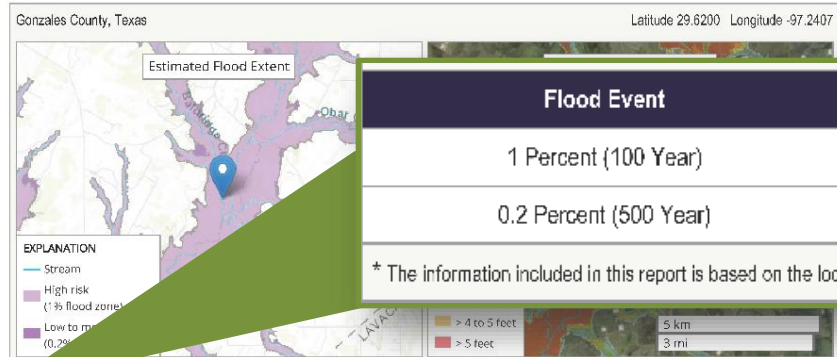
- Stream
- 1% flood depth:
  - ≤ 1 foot
  - > 1 to 2 feet
  - > 2 to 3 feet
  - > 3 to 4 feet
  - > 4 to 5 feet

# Estimated Base Flood Elevation (estBFE)



## Flood Risk Information Report

FEMA is providing a look at flood data availability and relative Base Level Engineering analysis through the Estimated Base Flood Elevation Viewer (Estimated BFE Viewer). Base Level Engineering uses high resolution ground elevation data, flood flow calculations, and fundamental engineering modeling techniques to define flood extents for streams. The viewer is an effective tool for property owners, community officials, and land developers to identify flood risk, estimated flood elevations, and flood depths for watersheds where Base Level Engineering has been prepared.



Flood Event	Estimated Flood Depth*	Estimated Base Flood Elevation*
1 Percent (100 Year)	3.7 feet above land surface	288.9 feet NAVD 1988
0.2 Percent (500 Year)	6.4 feet above land surface	291.6 feet NAVD 1988

\* The information included in this report is based on the location marker shown in the map. Results are not considered an official determination.

Flood Event	Estimated Flood Depth*	Estimated Base Flood Elevation*
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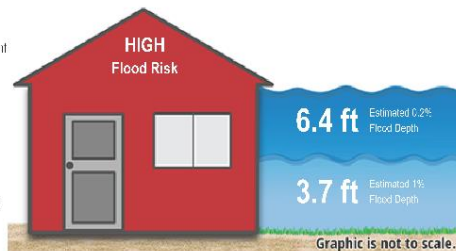
\* The information included in this report is based on the location marker shown in the map. Results are not considered an official determination.

Information made available from the Estimated BFE Viewer needs to be accepted by local community officials to be used for insurance rating purposes.

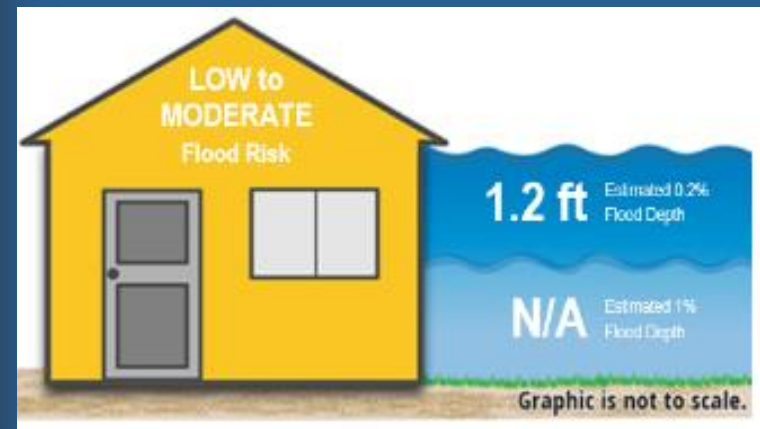
### Knowing Your Risk

Base Level Engineering data availability and analysis information is important because it can be used to:

- Inform floodplain management, decisions and ordinance administration;
- Identify significant floodplain changes;
- Serve as base modeling for map revisions; and
- Support the Zone A BFE information for a Letter of Map Amendment (LOMA) request.



Graphic is not to scale.



Graphic is not to scale.

<https://webapps.usgs.gov/infrm/estBFE/report.html?lat=29.6200272884574&lng=-97.24057687988283>

1/2

# Report Features

# BLE Deliverables

Name of Data Set	File Name	Description
HECRAS models	HUC8#_Models.zip	HEC-RAS hydraulic models for all streams studied in Base Level Engineering assessment. Use <b>HOW2 Find the Right HEC-RAS Model</b> for tips to find the model you need. Detailed models from FIRMs are not included.
1% event depths, raster	HUC8#_Depth01.zip	<b>Flood depth elevations</b> in a gridded format for the <b>1% storm event</b> .
0.2% event depths, raster	HUC8#_Depth002.zip	<b>Flood depth elevations</b> in a gridded format for the <b>0.2% storm event</b> .
1% event elevations, raster	HUC8#_Elev01.zip	<b>Top of water surface elevations</b> in a gridded format for the <b>1% storm event</b> .
0.2% event elevations, raster	HUC8#_Elev002.zip	<b>Top of water surface elevations</b> in a gridded format for the <b>0.2% storm event</b> .
Vector spatial data, file geodatabase	HUC8_VectorData.zip	This database is a <b>collection of spatial data</b> used and created during Base Level Engineering assessment. Use <b>HOW2 Find the Spatial Files</b> for more details.
Reports and Documents	HUC8#_Documents.zip	This download element included the <b>BLE Report</b> to detail terrain, hydrology and other modeling details. This file may also include work maps and/or kmz (Google Earth) files if created.



# Accessing Deliverables

## Welcome to the

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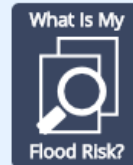
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### Download Datasets & Models

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Click a topic to get started!

# Accessing Deliverables

**Estimated Base Flood Elevation (estBFE) Viewer** 

Report Legend Data Layers Map View Base Map


Downloadable Data (BLE) Remove



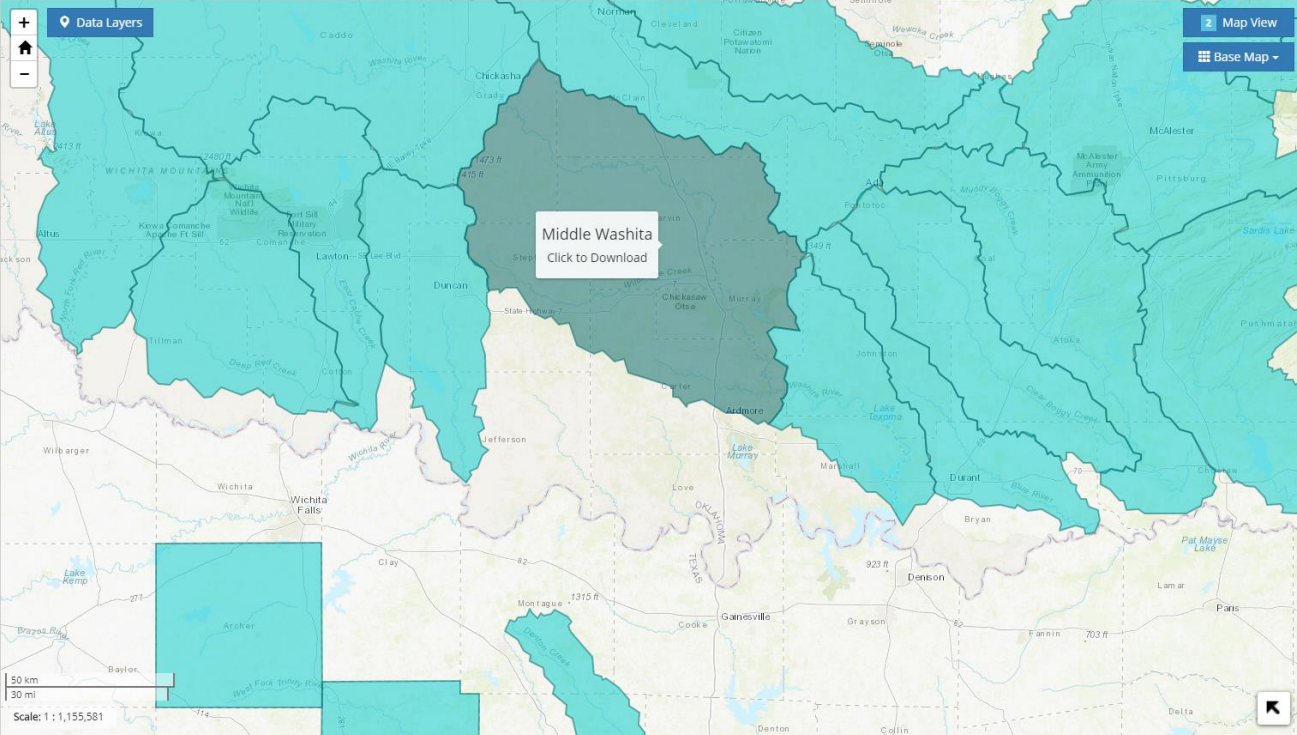
Base Level Engineering (BLE) study area with data available for download

Tip: Click areas to open a download dialog.

Base Map: Topographic



Comments: This base map includes administrative boundaries, cities, water features, physiographic features, parks, landmarks, highways, roads, railways, and airports.  
Data Source: ESRI ArcGIS Online



Scale: 1 : 1,155,581

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# Accessing Deliverables

**Download Data** ✕

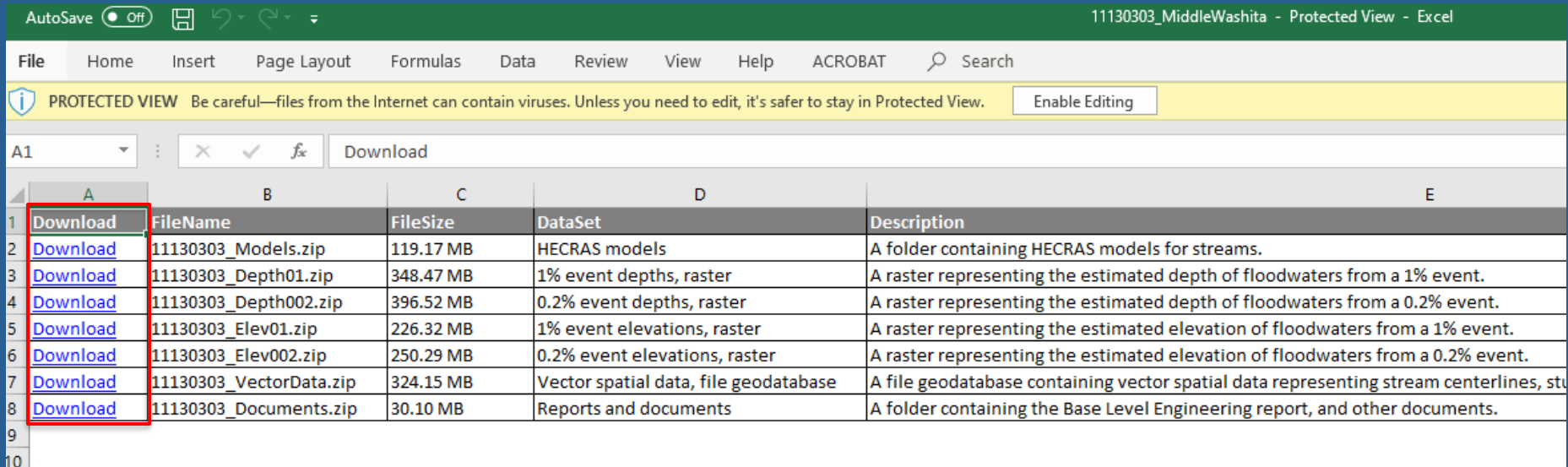
Middle Washita

Data Set	File Name	Size	
HECRAS models	11130303_Models.zip	119.17 MB	<span>ⓘ</span> Description <span>↓</span> Download
1% event depths, raster	11130303_Depth01.zip	348.47 MB	<span>ⓘ</span> Description <span>↓</span> Download
0.2% event depths, raster	11130303_Depth002.zip	396.52 MB	<span>ⓘ</span> Description <span>↓</span> Download
1% event elevations, raster	11130303_Elev01.zip	226.32 MB	<span>ⓘ</span> Description <span>↓</span> Download
0.2% event elevations, raster	11130303_Elev002.zip	250.29 MB	<span>ⓘ</span> Description <span>↓</span> Download
Vector spatial data, file geodatabase	11130303_VectorData.zip	324.15 MB	<span>ⓘ</span> Description <span>↓</span> Download
Reports and documents	11130303_Documents.zip	30.10 MB	<span>ⓘ</span> Description <span>↓</span> Download

ⓘ Description ↓ Download this table

✕ Close

# Accessing Deliverables



The screenshot shows an Excel spreadsheet titled "11130303\_MiddleWashita - Protected View - Excel". The spreadsheet is in Protected View mode. The table below lists various deliverables with their file names, sizes, data sets, and descriptions. The "Download" links in the first column are highlighted with a red border.

	A	B	C	D	E
	Download	FileName	FileSize	DataSet	Description
1	<a href="#">Download</a>	11130303_Models.zip	119.17 MB	HECRAS models	A folder containing HECRAS models for streams.
2	<a href="#">Download</a>	11130303_Depth01.zip	348.47 MB	1% event depths, raster	A raster representing the estimated depth of floodwaters from a 1% event.
3	<a href="#">Download</a>	11130303_Depth002.zip	396.52 MB	0.2% event depths, raster	A raster representing the estimated depth of floodwaters from a 0.2% event.
4	<a href="#">Download</a>	11130303_Elev01.zip	226.32 MB	1% event elevations, raster	A raster representing the estimated elevation of floodwaters from a 1% event.
5	<a href="#">Download</a>	11130303_Elev002.zip	250.29 MB	0.2% event elevations, raster	A raster representing the estimated elevation of floodwaters from a 0.2% event.
6	<a href="#">Download</a>	11130303_VectorData.zip	324.15 MB	Vector spatial data, file geodatabase	A file geodatabase containing vector spatial data representing stream centerlines, st
7	<a href="#">Download</a>	11130303_Documents.zip	30.10 MB	Reports and documents	A folder containing the Base Level Engineering report, and other documents.
8					
9					
10					

Downloads an excel file with hyperlinks for the available datasets for the watershed.

# FEMA BLE Guidance and Resources

- <https://www.fema.gov/media-collection/base-level-engineering-ble-tools-and-resources>
  - BLE Vector Geodatabase Flash Card
  - BLE and Letters of Map Amendment
  - LOMA Documentation and Submittal Process
  - BLE Data Download Reference Flash Card
  - How to Use BLE Data for Local Permitting
  - State Quick Guide
  - Water Surface Elevation Grids
  - Flood Depth Grids
  - BLE, Social Media, and Flood Risk Awareness
  - How to Use the Estimated BFE Viewer
  - How to Find the Right Spatial Data Files
  - Base Level Engineering Overview
  - Using the Estimated BFE Viewer
  - How to Find the Right HEC-RAS Model

# Contact Information

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[kcayeros@halff.com](mailto:kcayeros@halff.com)