FEMA's CNMS Database – More Than Metrics: Hurricane Harvey Disaster Response

Association of State Floodplain Managers
Annual Conference
Phoenix AZ
June 21, 2018

AECOM

Tammie Tucker
Erik Danielson

Hurricane Harvey

- Intensified rapidly from a tropical storm to a major hurricane in less than 2 days
- Made landfall with winds of 130 mph on the Texas coast on August 25, 2017
- 1st Category 4 hurricane to make landfall along the Texas coast since 1961
- Stalled over the Texas coast for 4 days
- The area that received at least 20” of rain is greater in size than the State of West Virginia. The area that received >40” of rain is larger than the State of Delaware. The top rainfall total occurred in Nederland, TX where over 60” fell.
- Nearly 800,000 Texans evacuated their homes
- Nearly 80,000 homes had at least 1.5’ of floodwater
- 24 hospitals were evacuated
- 68 people died from the direct effects of Harvey

Christian Tycksen - Reuters

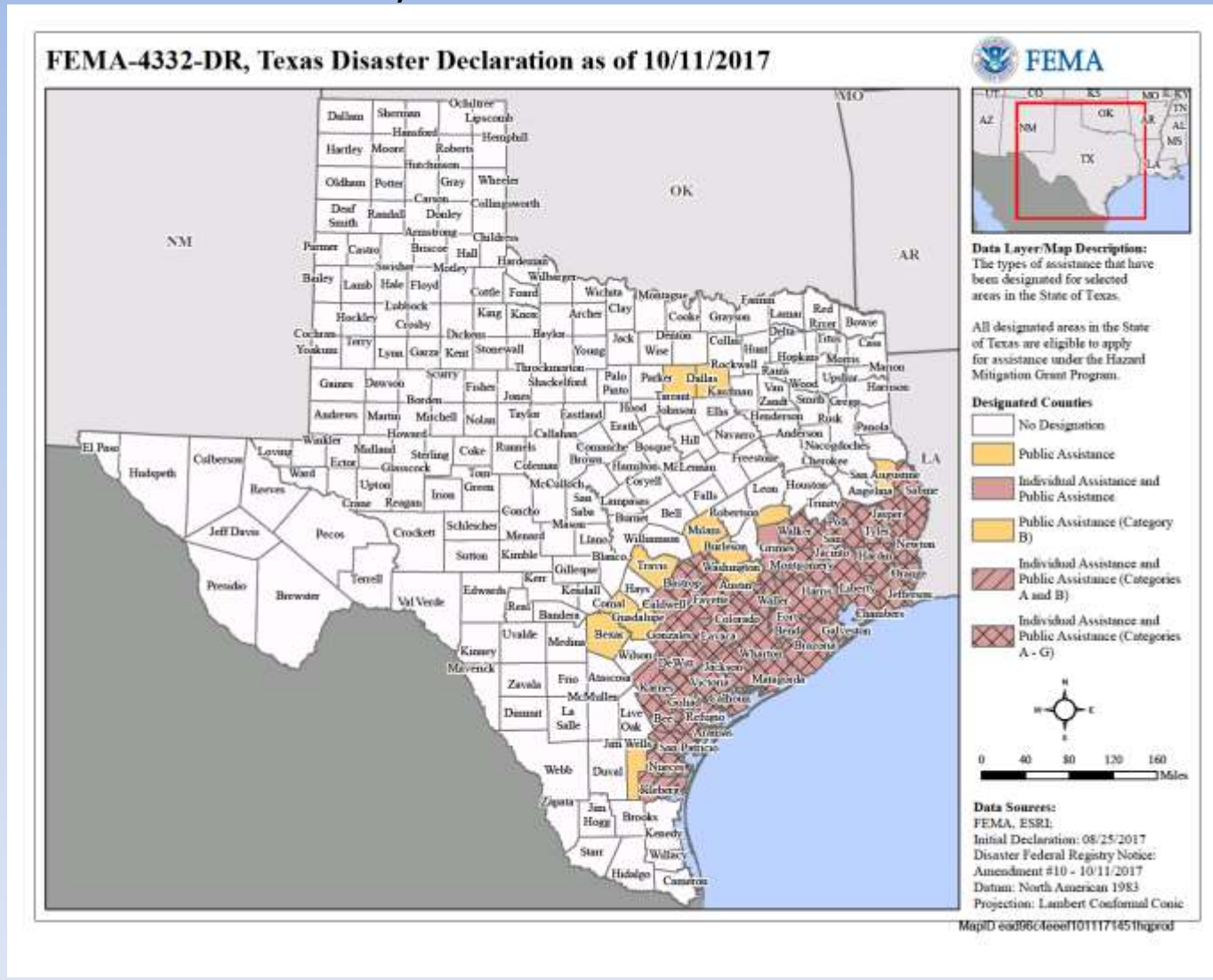
Joe Raedle – Getty Images

John Mone - AP

Marcus Yam – Getty Images

Hurricane Harvey

Presidentially-declared disaster in 41* TX counties



* Caldwell and Grimes Counties received disaster declaration after the start of the project this presentation covers

Texas Floodplain Mapping Studies

Prior to Hurricane Harvey the 39 counties in Texas that received a declaration of disaster as of mid-September:

- 5,242 riverine miles of effective detailed (Zone AE or AO) study (3,447 miles valid)
- 16,692 riverine miles of effective approximate (Zone A) study (2,101 miles valid)
- 6,195 riverine miles of draft/preliminary study (1,194 miles unmapped)

Is an update to FEMA's valid effective studies warranted due to Hurricane Harvey?

Are FEMA's preliminary studies still acceptable to become effective studies post-Harvey?

Coordinated Needs Management Strategy (CNMS)

- Inventory of FEMA's riverine and coastal mapped special flood hazard areas.
- Comprehensive approach to managing mapping needs.
- Used to organize, store and analyze flood hazard mapping needs as well as document study reaches that meet FEMA's validity standards.
- A Geospatial Database that tracks:
  - New, Validated or Updated Engineering (**NVUE**)
  - Unverified study reaches (need of restudy)
  - Flood mapping requests

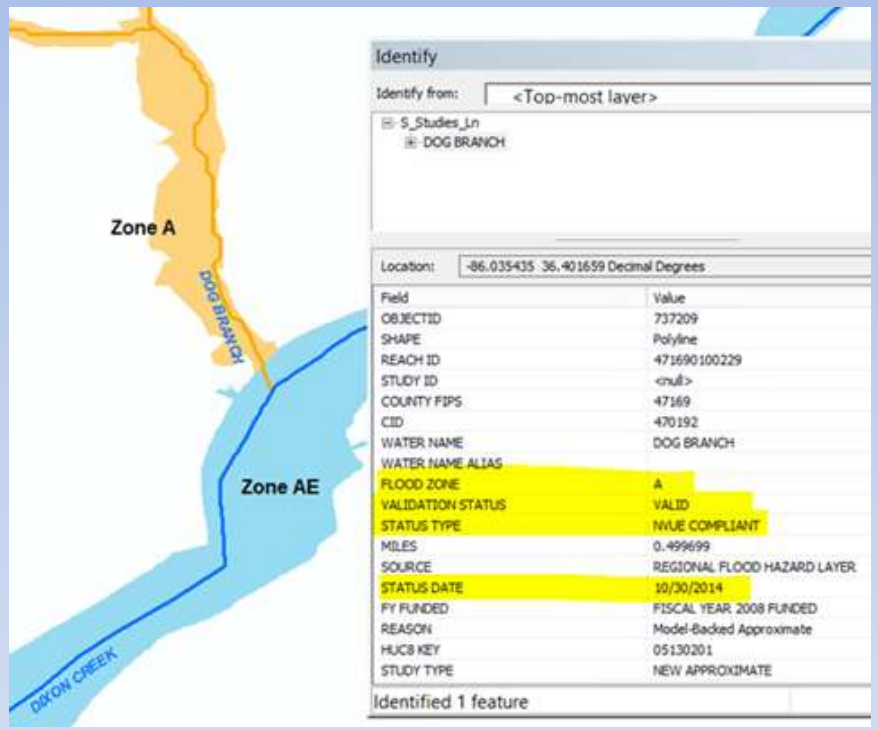
CNMS Components

CNMS Inventory

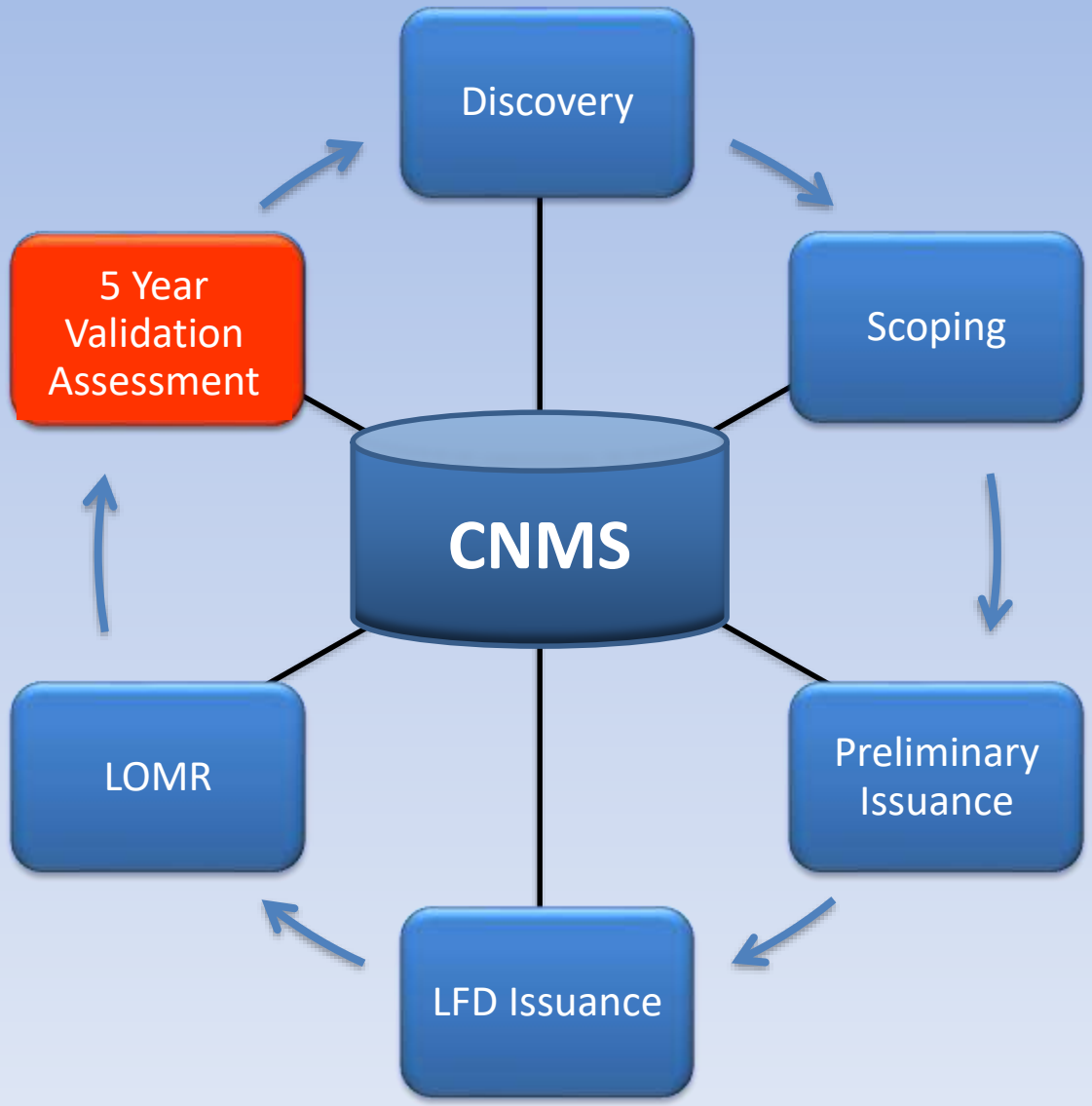
- flooding source centerlines (streamlines) and coast lines that contain FEMA's inventory of flood hazard studies.

CNMS Requests

- polygons or points that identify areas where study or mapping updates are desired.



CNMS Touchpoints



CNMS Validation Assessments

- Engineering studies that adequately identify the level of flood risk identified on a community's flood insurance rate map are classified in CNMS as **"VALID – NVUE COMPLIANT"**
- Studies found to be deficient are classified as **"UNVERIFIED"**
- Valid studies require re-assessment by FEMA every five years
  - Validation assessment procedures for Detailed, Approximate and Coastal Studies
  - Changes in topography, hydrology & land development are evaluated
  - Unverified studies can only become Valid through a restudy

Detailed Study Assessment Checks

CRITICAL ELEMENTS

- C1: Major change in gage record since effective analysis
- C2: Updated and effective peak gage discharges differ significantly based on confidence limits criteria
- C3: Model methodology no longer appropriate
- C4: Additional/removal of a major flood control structure
- C5: Current channel reconfiguration is outside the effective Special Flood Hazard Area (SFHA)
- C6: Five or more new/removed hydraulic structures that impact Base Flood Elevations (BFEs)
- C7: Significant channel fill or scour

The failure of <u>any</u> single critical element will result in a study becoming UNVERIFIED.

Detailed Study Assessment Checks

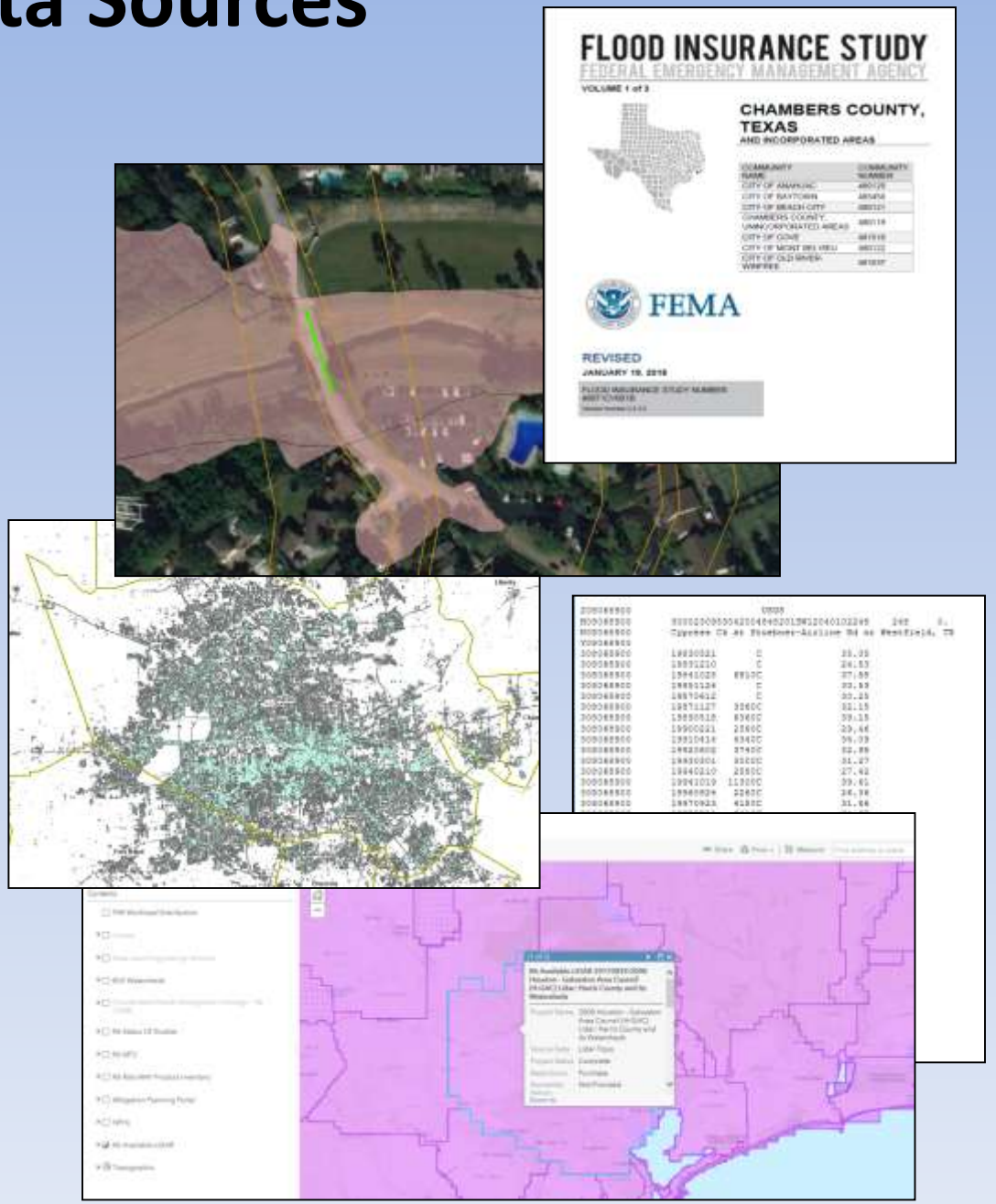
SECONDARY ELEMENTS

- S1: Use of rural regression equations in urbanized areas
- S2: Repetitive property losses outside the effective SFHA
- S3: >50% increase in impervious area in the sub-basin
- S4: 1-4 new/removed hydraulic structures that impact BFEs
- S5: Channel improvements
- S6: Availability of better topography
- S7: Significant changes to vegetation or land use
- S8: Significant storms with High Water Marks (HWMs) since effective analysis
- S9: New regression equations

Failure of at least 4 secondary elements for a study to be flagged UNVERIFIED.

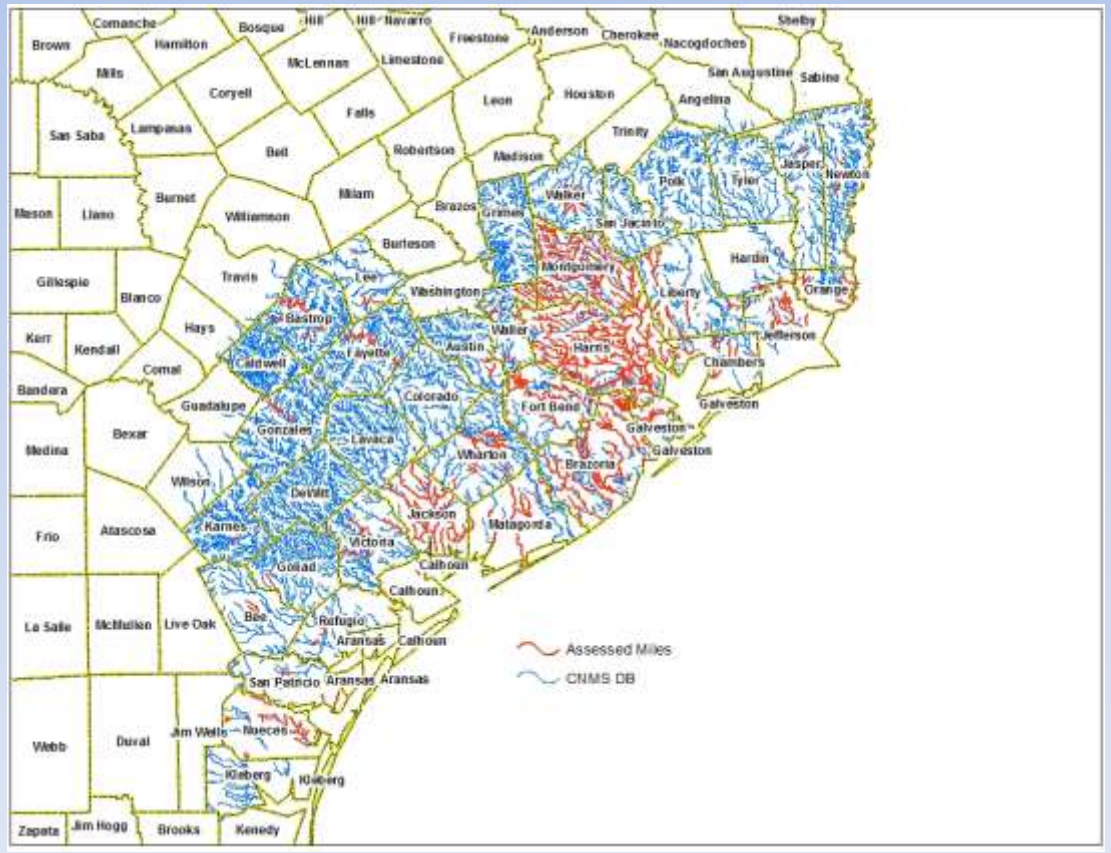
Data Sources

- National Inventory of Dams (NID)
- National Levee Database (NLD)
- National Bridge Inventory (NBI)
- National Land Cover Database (NLCD)
- National Urban Change Indicator (NUCI)
- FEMA Rep Loss Inventory
- Topography Inventory
- Flood Insurance Studies (FIS)
- USGS Gage data
- Letters of Map Change (LOMR)
- Effective DFIRM Database
- Ortho imagery
- High Water Mark (HWM) data



Project Approach

- Assess all VALID detailed riverine miles in the 39 disaster-declared counties
- Assess all BEING STUDIED detailed riverine miles in the 39 counties
  - Assess based on the draft or preliminary data
- **4,661** total detailed miles were assessed



Two-phased approach:

1. Phase I – Assess Critical Elements C1 and C2 using Hurricane Harvey streamflow analyses. This phase gave a very quick snapshot of how significantly Harvey affected gage records and discharges
2. Phase II – Assess the remainder of the critical and all secondary elements using available post-disaster data to classify studies as VALID or UNVERIFIED.

Phase I

C1 and C2 assessments utilized existing USGS gage record data and Hurricane Harvey Precipitation and Streamflow Analysis results.

RMD RISK MANAGEMENT DIRECTORATE

FEMA

Table 7: Stream Gage Analysis Summary

Station ID	Station Name	Drainage Area (mi²)	Peak Discharge (cfs) for selected AEPs								Percent Change from Flood Frequency Analyses updated through 2016 Water Year, for selected Annual Exceedance Probabilities								Hurricane Harvey Peak Event				
			50%	20%	10%	4%	2%	1%	0.5%	0.2%	50%	20%	10%	4%	2%	1%	0.5%	0.2%	Peak Flow	Peak Stage	Peak Date	AEP, % chance	ARI, years
08026000	Sabine River near Burkeville	7,482	35,500	46,700	56,800	100,000	133,000	172,000	221,000	304,000	-2.7%	-3.2%	-3.5%	-3.2%	-3.8%	-2.9%	-2.7%	-2.6%	83,500	46.18	8/31/17	6.0	17
08026500	Sabine River near Bon Weir	8,229	29,900	52,400	71,200	105,000	125,000	154,000	187,000	236,000	-0.7%	-2.1%	-3.1%	-4.5%	-5.6%	-6.5%	-7.5%	-8.9%	153,000	39.97	9/2/17	1.0	99
08030500	Sabine River near Ruliff	9,329	35,400	57,500	75,300	102,000	124,000	149,000	178,000	220,000	-0.6%	-1.9%	-3.2%	-5.1%	-5.6%	-6.7%	-8.4%	-9.5%	161,000	31.60	9/2/17	0.74	135
08031000	Cow Bayou near Mauriceville	83.3	1,430	2,420	3,260	4,570	5,750	7,120	8,720	11,200	-0.7%	-4.1%	-6.1%	-9.2%	-11.3%	-13.3%	-15.5%	-17.8%	8,510	28.62	8/30/17	0.54	184
08040600	Neches River near Town Bluff	7,574	19,600	30,900	40,400	55,300	66,600	84,100	102,000	131,000	-1.5%	-3.2%	-4.2%	-5.6%	-6.6%	-7.6%	-8.2%	-9.9%	67,800	60.51	8/31/17	2.1	48
08041500	Village Creek near Kountze	860	9,440	20,900	32,400	52,700	73,000	98,800	131,000	188,000	-1.4%	-4.8%	-7.4%	-10.2%	-12.6%	-14.7%	-16.8%	-19.5%	119,000	34.70	8/30/17	0.63	158
08041700	Pine Island Bayou near Sour Lake	336	4,220	8,710	13,300	21,500	29,900	40,800	54,800	79,300	-0.7%	-6.5%	-9.0%	-13.0%	-16.1%	-18.9%	-21.7%	-25.2%	70,300	39.42	8/30/17	0.27	371
08041749	Pine Island Bayou above Bl Pump Plant Beaumont	633	7,070	11,800	15,900	22,500	28,500	35,600	44,100	57,700	0.7%	0.0%	-1.3%	-4.0%	-6.0%	-8.1%	-10.4%	-13.5%	28,100	20.97	8/30/17	2.1	48
08041780	Neches River Saltwater Barrier at Beaumont	9,789	32,600	53,800	74,200	109,000	144,000	188,000	244,000	341,000	-0.6%	-3.5%	-6.7%	-10.7%	-13.9%	-17.6%	-20.6%	-24.9%	231,000	21.51	9/1/17	0.58	173
08055800	Bedias Creek near Madisonville	321	8,710	19,300	28,500	42,400	54,200	67,200	81,400	102,000	-3.2%	-4.7%	-5.3%	-5.7%	-6.1%	-6.4%	-6.9%	-7.4%	39,400	25.67	8/29/17	4.7	21
08066250	Trinity River near Goodrich	16,844	47,800	75,000	91,400	110,000	122,000	133,000	144,000	155,000	-1.7%	-2.5%	-3.0%	-3.6%	-4.1%	-3.8%	-4.0%	-5.2%	113,000	48.39	8/29/17	3.3	30
08066300	Menard Creek near Rye	152	2,520	5,660	8,700	13,800	18,700	24,600	31,700	43,000	-3.2%	-6.3%	-6.6%	-8.0%	-8.6%	-9.8%	-10.7%	-11.6%	15,100	36.97	8/29/17	3.3	31
08067000	Trinity River at Liberty	17,468	41,000	65,400	82,400	104,000	121,000	138,000	154,000	176,000	-1.0%	-1.5%	-2.1%	-1.9%	-3.3%	-3.6%	-3.9%	-4.0%	127,000	32.74	8/31/17	1.8	65
08067500	Cedar Bayou near Crosby	84.9	2,440	3,790	4,750	6,040	7,050	8,090	9,180	10,700	-2.0%	-6.0%	-8.7%	-9.1%	-10.8%	-12.2%	-13.7%	-15.7%	8,350	56.98	8/28/17	0.84	119
08068000	W Fork San Jacinto River near Conroe	828	9,040	19,700	31,400	53,800	79,100	111,000	155,000	236,000	-0.9%	-4.1%	-6.7%	-9.9%	-12.3%	-14.6%	-16.9%	-19.7%	115,000	126.97	8/29/17	0.93	108
08068090	W Fork San Jacinto River above Lake Houston near Porter	962	11,600	25,700	39,900	64,800	89,400	120,000	159,000	224,000	-0.9%	-3.6%	-6.3%	-9.3%	-11.4%	-13.3%	-15.7%	-18.8%	130,000	94.83	8/29/17	0.82	122
08068325	Willow Creek near Tomball	41.0	1,600	3,230	4,820	7,590	10,300	13,800	18,100	25,400	-4.4%	-12.4%	-17.2%	-22.8%	-26.4%	-30.3%	-33.7%	-37.4%	15,100	133.70	8/28/17	0.79	126
08068780	Little Cypress Creek near Cypress	41.0	1,520	3,080	4,460	6,780	8,880	11,400	14,300	18,800	-3.9%	-8.1%	-10.5%	-13.4%	-15.4%	-17.5%	-19.0%	-21.3%	8,530	161.10	8/28/17	2.20	45
08069000	Cypress Creek near Westfield	285	5,510	9,460	12,200	15,700	18,200	20,700	23,100	26,300	-0.4%	-3.4%	-5.7%	-8.9%	-10.4%	-12.6%	-14.3%	-16.3%	28,100	97.10	8/29/17	0.2 – 0.1	500 – 1,000
08070000	E Fork San Jacinto River near Cleveland	326	5,400	13,800	22,900	40,200	58,200	82,000	113,000	166,000	-1.3%	-4.3%	-5.7%	-8.7%	-10.5%	-12.3%	-14.4%	-16.3%	95,500	27.17	8/28/17	0.72	139
08070200	E Fork San Jacinto River near New Caney	388	5,050	12,500	21,000	38,000	57,000	83,100	119,000	186,000	0.0%	-4.0%	-6.7%	-11.1%	-14.5%	-17.8%	-21.2%	-25.3%	119,000	60.05	8/29/17	0.50	200
08070500	Caney Creek near Splendora	106	2,820	6,350	10,100	17,100	24,500	34,300	47,200	70,400	-2.5%	-4.4%	-5.7%	-6.4%	-7.3%	-8.2%	-8.9%	-9.7%	20,900	28.59	8/28/17	2.7	37
08071000	Peach Creek at Splendora	117	1,900	5,340	9,300	17,000	26,200	36,100	50,300	75,500	-2.6%	-6.0%	-8.4%	-11.2%	-13.5%	-15.5%	-17.3%	-19.7%	31,300	25.57	8/28/17	1.3	76
08073600	Buffalo Bayou at W Belt Drive Houston	290	3,320	4,870	6,120	7,960	9,540	11,300	13,300	16,400	2.7%	-3.5%	-9.2%	-16.8%	-22.9%	-27.6%	-32.6%	-39.0%	16,900	71.18	8/30/17	0.2 – 0.1	500 – 1,000
08073700	Buffalo Bayou at Piney Point	299	3,590	5,360	6,660	8,560	10,100	11,700	13,500	16,200	1.9%	-3.5%	-8.2%	-14.3%	-19.7%	-22.6%	-26.7%	-32.1%	18,500	63.89	8/27/17	0.2% – 0.1%	500 – 1000
08074000	Buffalo Bayou at Houston	336	5,660	9,020	11,300	14,300	16,500	18,800	21,000	24,000	-0.4%	-2.2%	-5.3%	-8.4%	-10.3%	-12.8%	-14.9%	-17.1%	24,000	38.78	8/28/17	0.20	500
08074500	Whiteoak Bayou at Houston	96.1	7,460	13,300	17,400	22,600	26,600	30,400	34,200	39,200	-1.5%	-2.3%	-2.9%	-2.7%	-3.4%	-3.3%	-3.5%	-4.1%	22,700	40.62	8/27/17	3.9	26
08075000	Brays Bayou at Houston	94.9	11,100	19,900	26,200	34,300	40,400	46,400	52,400	60,100	-1.6%	-2.0%	-2.3%	-2.6%	-2.7%	-2.8%	-3.1%	-3.2%	33,000	45.67	8/27/17	4.6	22
08075500	Sims Bayou at Houston	63.0	6,070	10,400	14,000	18,900	23,900	29,000	34,700	43,300	-0.3%	-3.6%	-7.1%	-10.9%	-14.2%	-16.9%	-19.6%	-22.9%	31,500	28.56	8/27/17	0.73	138

Should a gage be considered?

- There should be a gage on the stream within a distance of the reach being assessed that a statistical analysis would influence. A good approximate rule of thumb is that a gage analysis would affect 0.5 - 1.5 times the drainage area (DA) of the gage.
- There should be a minimum of 10 years of record at the gage to perform statistical analysis. For CNMS assessment purposes, this means there needs to be at least 10 years of record *prior to the effective date of analysis.*
- To assess elements C1 and C2, there must be new gage records since the effective date of analysis.

C1 Assessment

Has a record event or event > the published 1%-annual-chance discharge been recorded at gage since the effective date of analysis?

- Approximately 32% (1,500 mi) of the assessed miles had useful stream gage data available
- Approximately 24% (1,100 mi) of the assessed miles failed this check

- Approximately 22% (1,050 mi) of the assessed miles had Hurricane Harvey gage data available
- Approximately 17% (780 mi) of the assessed miles failed this check.

*** ¾ of the assessed miles that had Harvey gage data available showed the event to be a record event at that gage and/or the Harvey peak discharge to be > the published 1%-annual-chance discharge**

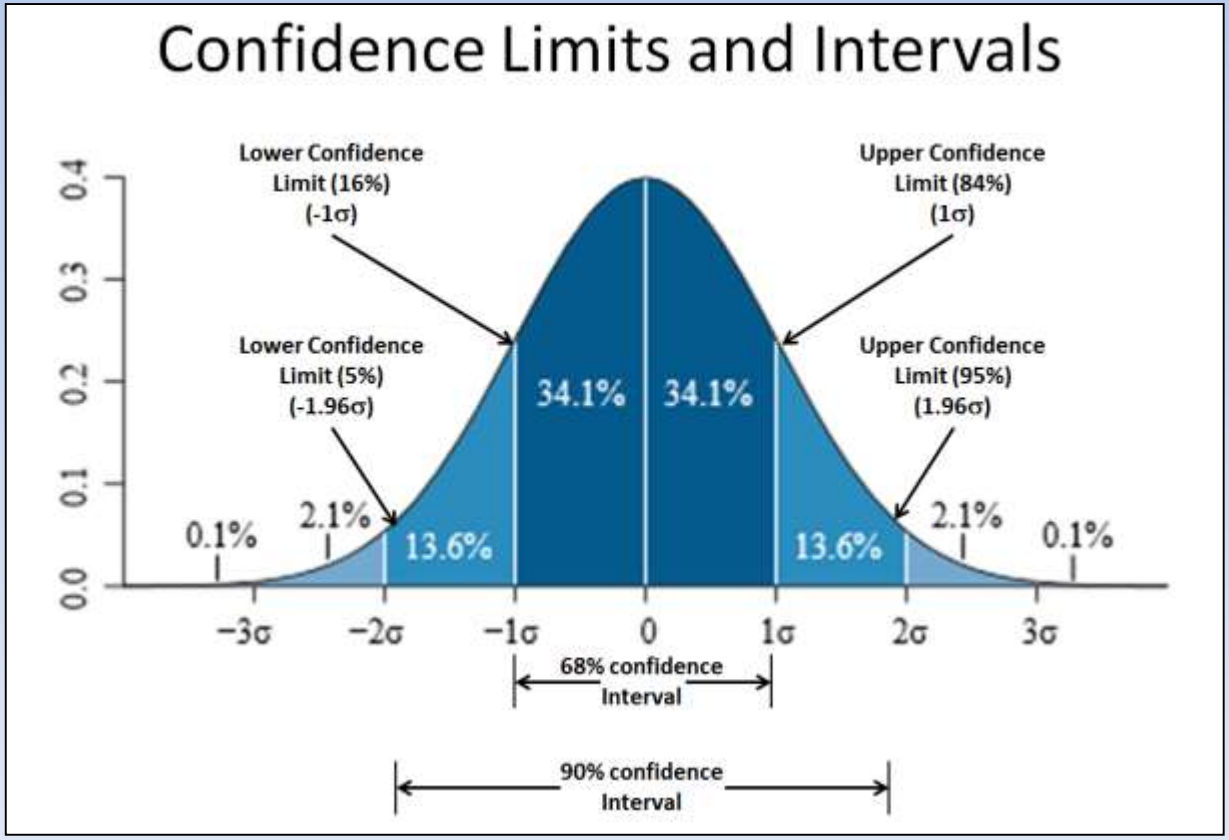
C2 Assessment

Do the effective and current peak gage discharges differ significantly based on confidence limits criteria?

From FEMA CNMS Technical Reference:

- Determine if 100-yr discharge obtained by running PeakFQ at effective date is still within 68% confidence interval of the Bulletin 17B 100-yr estimate using updated gage data and PeakFQ. If not, Critical Element is set to "FAIL".

What does the 68% confidence interval represent?



C2 Assessment

There has been confusion as to what confidence interval or limit to use in the PeakFQ Output Options tab to achieve the desired 68% confidence interval.

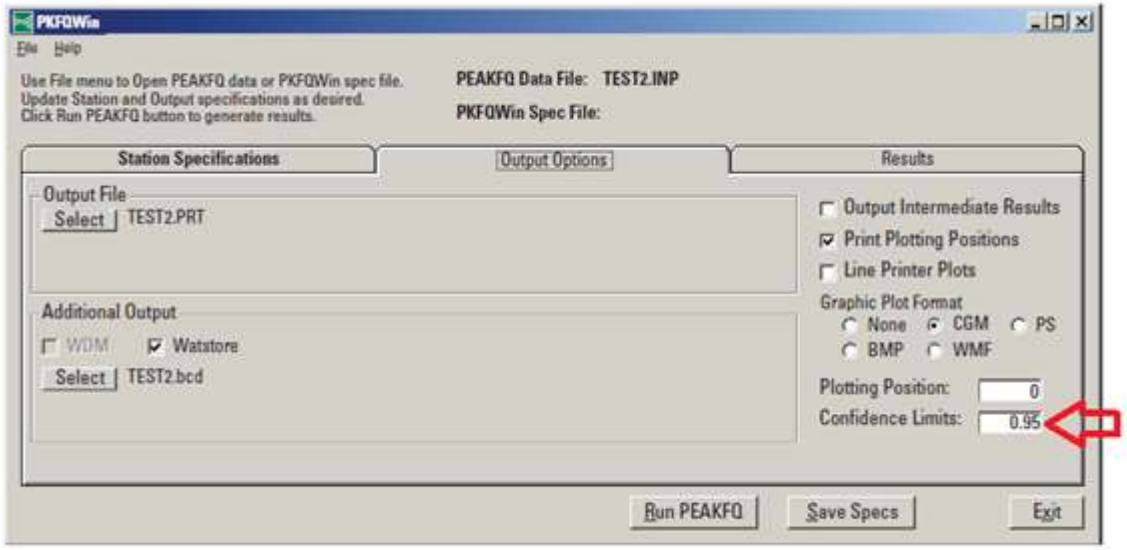
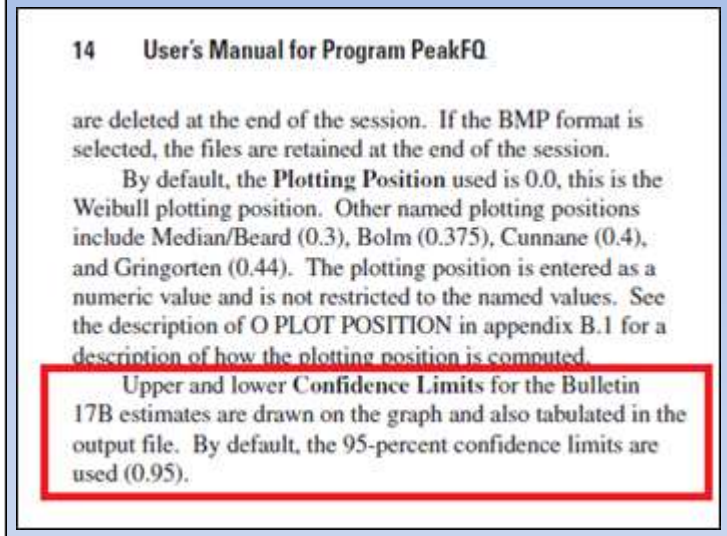


Figure 6. Example of the Output Options tab of program PKFQWin after an input file has been opened.

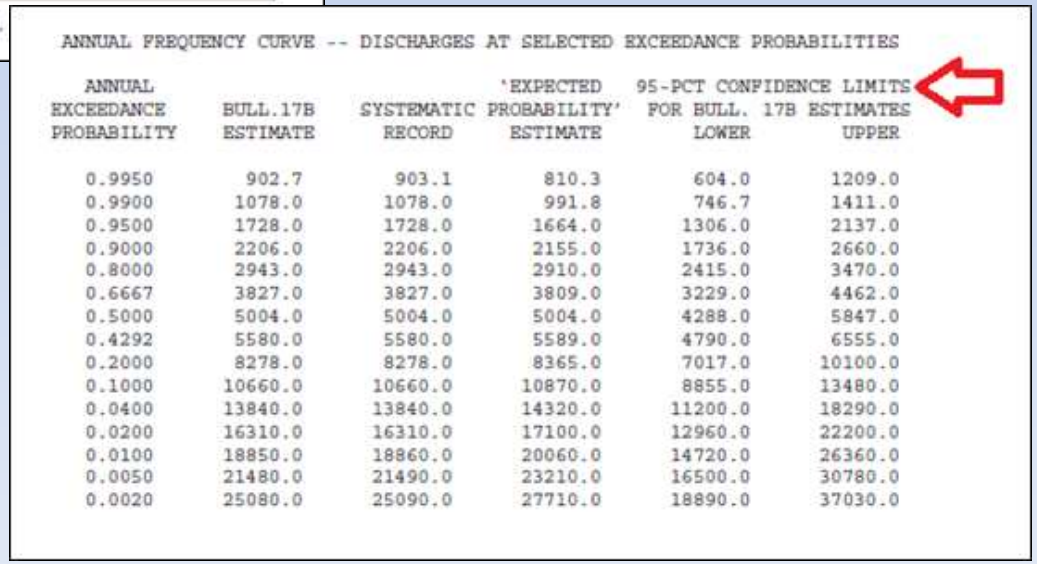


14 User's Manual for Program PeakFQ

are deleted at the end of the session. If the BMP format is selected, the files are retained at the end of the session.

By default, the **Plotting Position** used is 0.0, this is the Weibull plotting position. Other named plotting positions include Median/Beard (0.3), Bolm (0.375), Cunnane (0.4), and Gringorten (0.44). The plotting position is entered as a numeric value and is not restricted to the named values. See the description of O PLOT POSITION in appendix B.1 for a description of how the plotting position is computed.

Upper and lower **Confidence Limits** for the Bulletin 17B estimates are drawn on the graph and also tabulated in the output file. By default, the 95-percent confidence limits are used (0.95).



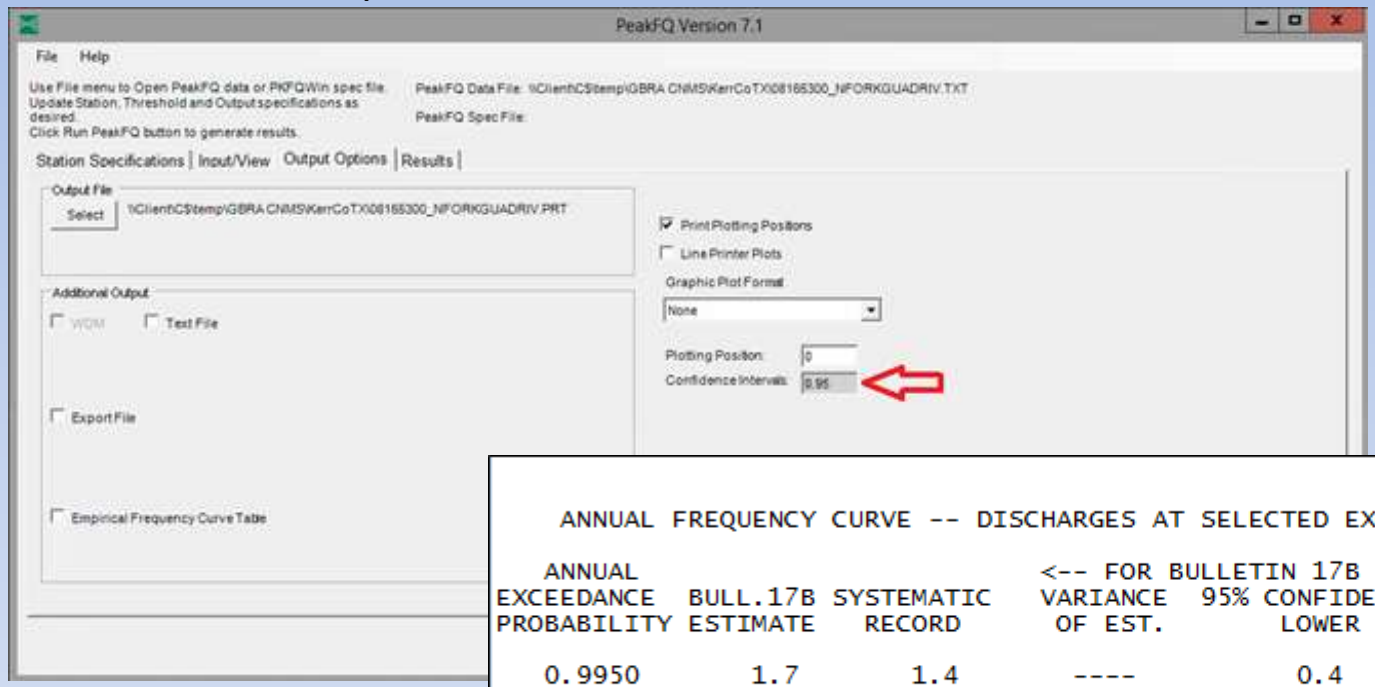
ANNUAL FREQUENCY CURVE -- DISCHARGES AT SELECTED EXCEEDANCE PROBABILITIES

ANNUAL EXCEEDANCE PROBABILITY	BULL.17B ESTIMATE	SYSTEMATIC RECORD	'EXPECTED PROBABILITY' ESTIMATE	95-PCT CONFIDENCE LIMITS FOR BULL. 17B ESTIMATES LOWER	UPPER
0.9950	902.7	903.1	810.3	604.0	1209.0
0.9900	1078.0	1078.0	991.8	746.7	1411.0
0.9500	1728.0	1728.0	1664.0	1306.0	2137.0
0.9000	2206.0	2206.0	2155.0	1736.0	2660.0
0.8000	2943.0	2943.0	2910.0	2415.0	3470.0
0.6667	3827.0	3827.0	3809.0	3229.0	4462.0
0.5000	5004.0	5004.0	5004.0	4288.0	5847.0
0.4292	5580.0	5580.0	5589.0	4790.0	6555.0
0.2000	8278.0	8278.0	8365.0	7017.0	10100.0
0.1000	10660.0	10660.0	10870.0	8855.0	13480.0
0.0400	13840.0	13840.0	14320.0	11200.0	18290.0
0.0200	16310.0	16310.0	17100.0	12960.0	22200.0
0.0100	18850.0	18860.0	20060.0	14720.0	26360.0
0.0050	21480.0	21490.0	23210.0	16500.0	30780.0
0.0020	25080.0	25090.0	27710.0	18890.0	37030.0

All screen shots are from the current PeakFQ User's Manual (https://pubs.usgs.gov/tm/2006/tm4b4/)

C2 Assessment

The Output Options tab of the current version of PeakFQ (V 7.1) looks a little different from the examples in the current User's Manual.



ANNUAL FREQUENCY CURVE -- DISCHARGES AT SELECTED EXCEEDANCE PROBABILITIES

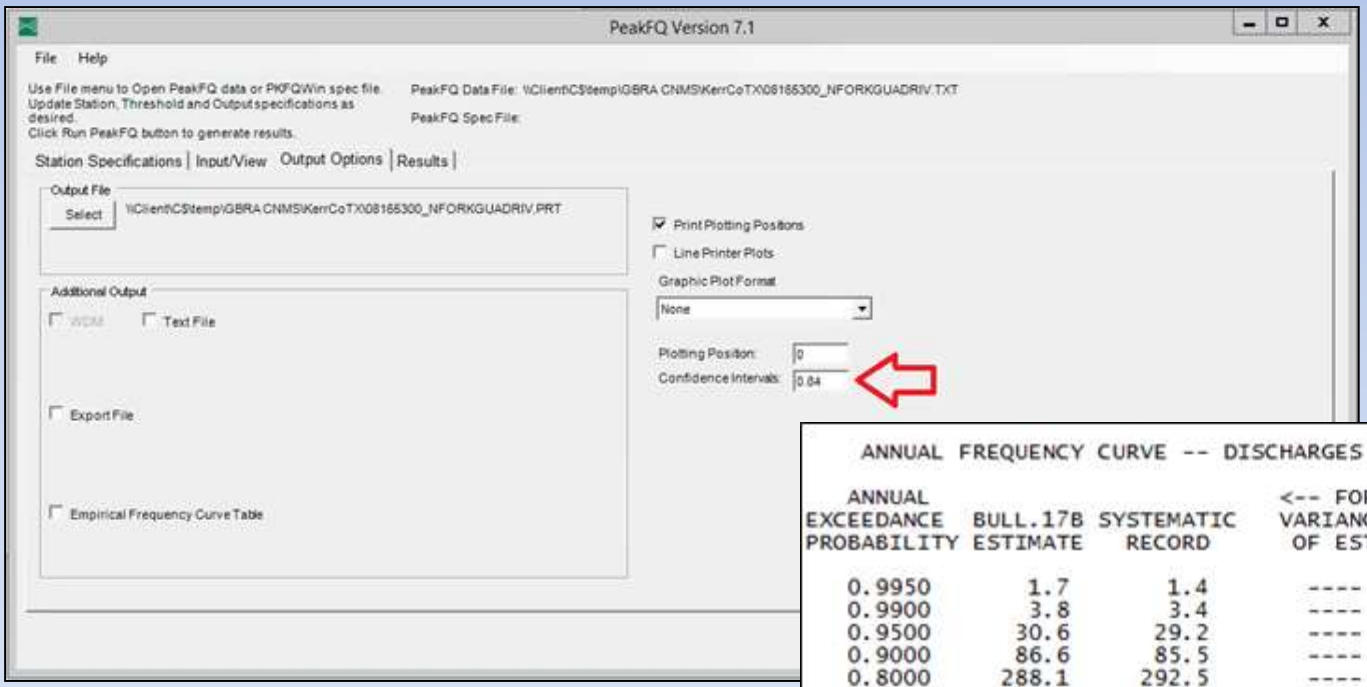
ANNUAL EXCEEDANCE PROBABILITY	BULL.17B ESTIMATE	SYSTEMATIC RECORD	<-- FOR BULLETIN 17B ESTIMATES --> VARIANCE OF EST.	95% CONFIDENCE INTERVALS LOWER	UPPER
0.9950	1.7	1.4	----	0.4	5.4
0.9900	3.8	3.4	----	0.9	10.9
0.9500	30.6	29.2	----	10.7	68.3
0.9000	86.6	85.5	----	35.7	174.6
0.8000	288.1	292.5	----	139.6	530.2
0.6667	835.9	860.4	----	449.3	1476.0
0.5000	2410.	2487.	----	1363.0	4301.0
0.4292	3673.	3781.	----	2086.0	6688.0
0.2000	16130.	16170.	----	8714.0	33630.0
0.1000	39980.	38870.	----	20190.0	94070.0
0.0400	98900.	91960.	----	45830.0	267200.0
0.0200	171700.	154200.	----	75050.0	507700.0
0.0100	275800.	239300.	----	114400.0	884000.0
0.0050	418100.	350500.	----	165200.0	1441000.0
0.0020	677000.	542200.	----	252500.0	2540000.0

1

C2 Assessment

Clarification from USGS:

- The Confidence Intervals/Limits (depending on what version of PeakFQ you are using) entry is meant to represent the ***Upper Limit of the Confidence Interval*** you want to be produced in the output file.
- So, for CNMS assessment purposes, the 68% Confidence Interval has lower and upper limits of 0.16 and 0.84. In PeakFQ, you would enter 0.84 as the Confidence Intervals/Limits. The output file will say 84% Confidence Interval, but it is in fact the 68% Confidence Interval.



The output file says 84% confidence interval, but it is actually the 68% confidence interval

ANNUAL FREQUENCY CURVE -- DISCHARGES AT SELECTED EXCEEDANCE PROBABILITIES

ANNUAL EXCEEDANCE PROBABILITY	BULL.17B ESTIMATE	SYSTEMATIC RECORD	<-- FOR BULLETIN 17B ESTIMATES --> VARIANCE OF EST.	84% CONFIDENCE INTERVALS LOWER	UPPER
0.9950	1.7	1.4	----	0.7	3.6
0.9900	3.8	3.4	----	1.7	7.5
0.9500	30.6	29.2	----	16.8	50.8
0.9000	86.6	85.5	----	52.2	134.4
0.8000	288.1	292.5	----	189.5	420.4
0.6667	835.9	860.4	----	580.0	1182.0
0.5000	2410.	2487.	----	1711.0	3406.0
0.4292	3673.	3781.	----	2607.0	5237.0
0.2000	16130.	16170.	----	11010.0	24660.0
0.1000	39980.	38870.	----	26060.0	65260.0
0.0400	98900.	91960.	----	60900.0	174100.0
0.0200	171700.	154200.	----	101700.0	317600.0
0.0100	275800.	239300.	----	157900.0	533500.0
0.0050	418100.	350500.	----	232000.0	841700.0
0.0020	677000.	542200.	----	361900.0	1429000.0

1

C2 Assessment

In Phase I, only the assessed miles that passed the C1 check then had the C2 check assessed.

- Approximately 400 miles with useable gage data passed the C1 check and then had the C2 check assessed
- Approximately 32% of these miles failed this check

*** In 2-3 weeks time, AECOM was able to complete Phase I assessments and determine that 1,231 of the 4,661 assessed miles would become UNVERIFIED studies due to changes in gage data. The change in validation status of these studies was due in large part to Hurricane Harvey.**

Phase II

Phase II included:

- Back check of Phase I results due to the Hurricane Harvey Streamflow Analysis being finalized simultaneously
- Assessment of element C2 for all applicable studies that failed C1 (since Phase I only assessed it for the applicable reaches that passed C1)
- Assessment of elements C3 – C7 and S1 – S9

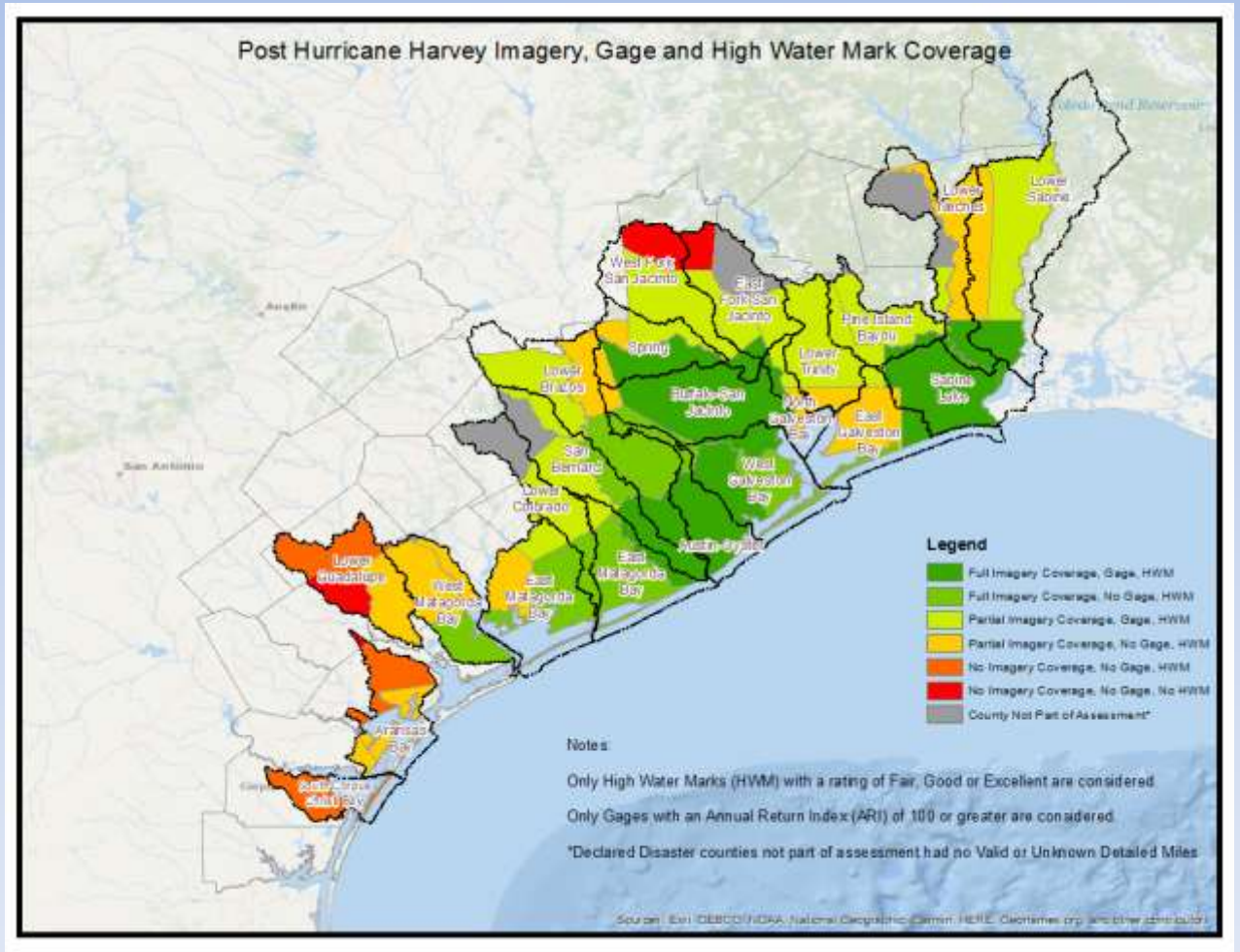
Phase II resulted in the full CNMS Validation Assessment of all detailed study reaches being assessed.

Post-Harvey Data Sources

Even though all elements were assessed, the impacts of Harvey on the studies could only be assessed through certain elements.

Post-Harvey data sources provided for this analysis were:

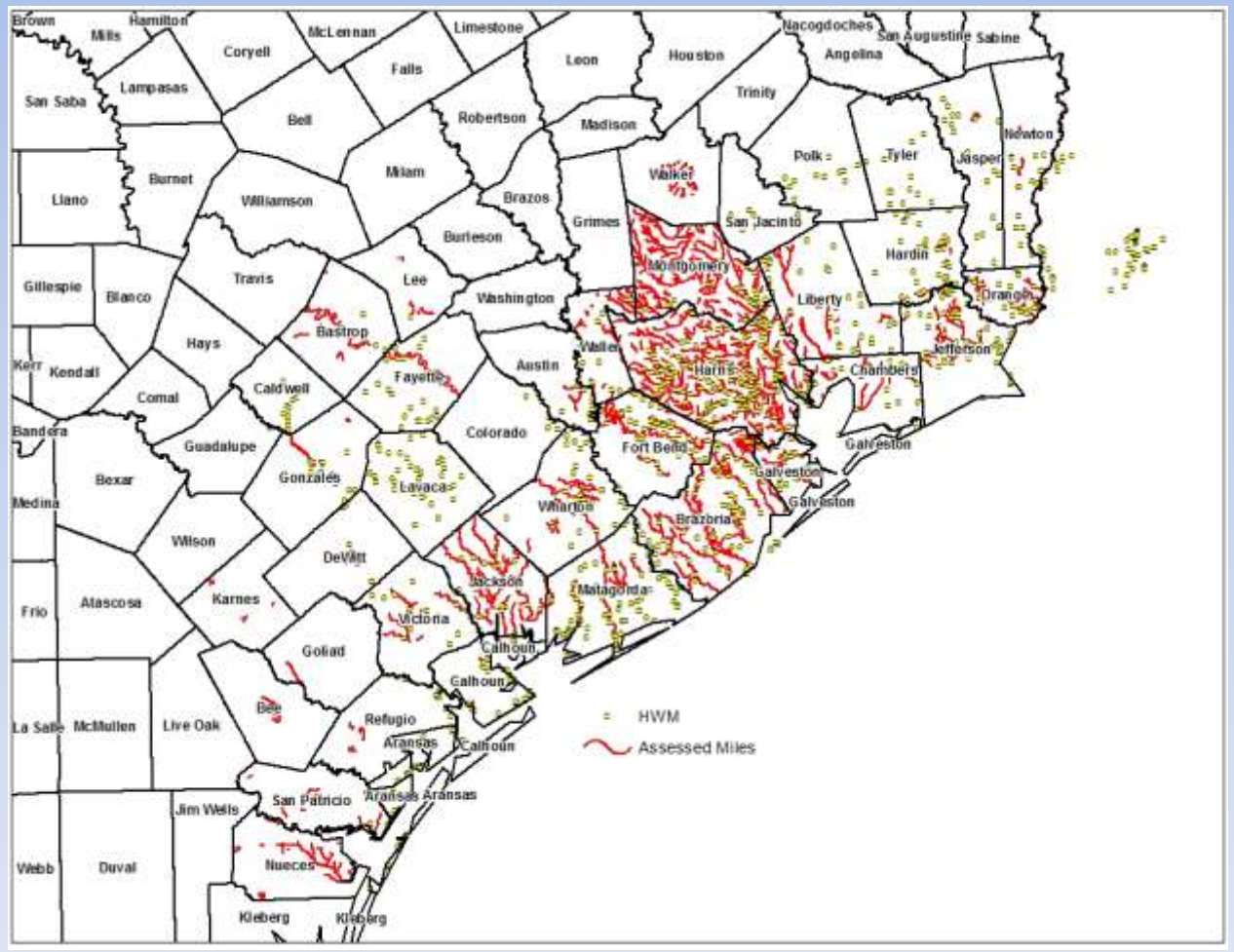
- Harvey Streamflow Analysis (used for C1 & C2)
- HWMs collected for Harvey (used for S8)
- Orthoimagery collected (used for C4 - C7 & S4 – S5)



High Water Mark Data

Over 1,500 quality HWMs were collected between September 2 – October 9, 2017

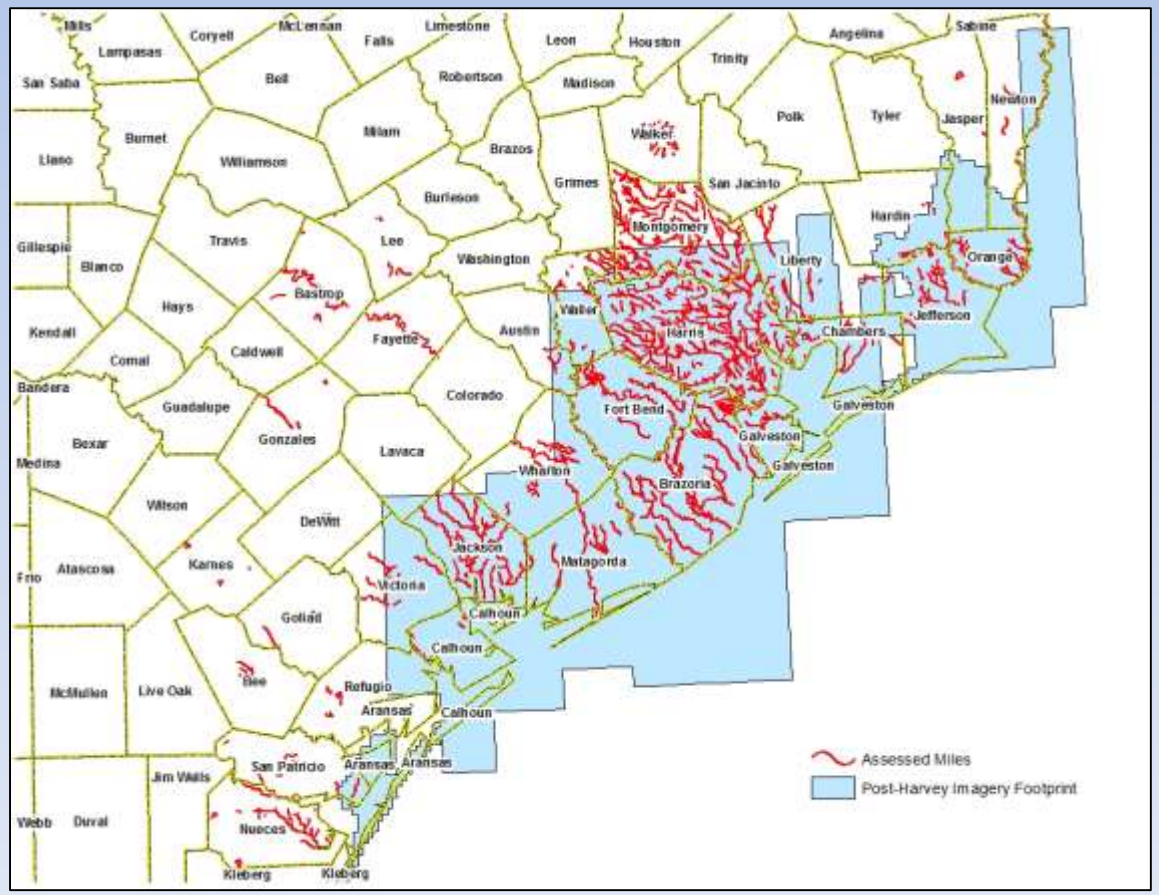
* There were an additional 600 HWMs collected classified as Poor or Very Poor quality that were excluded from this analysis



Orthoimagery

Post-event imagery was collected from various sources:

- National Oceanic and Atmospheric Administration (NOAA) – (Collected August 27 – September 3, 2017)
- Digital Globe (Collected August 29 – September 3, 2017)
- U.S. Army Corp of Engineers (USACE)
- USGS Hazard Data Distribution (HDD)

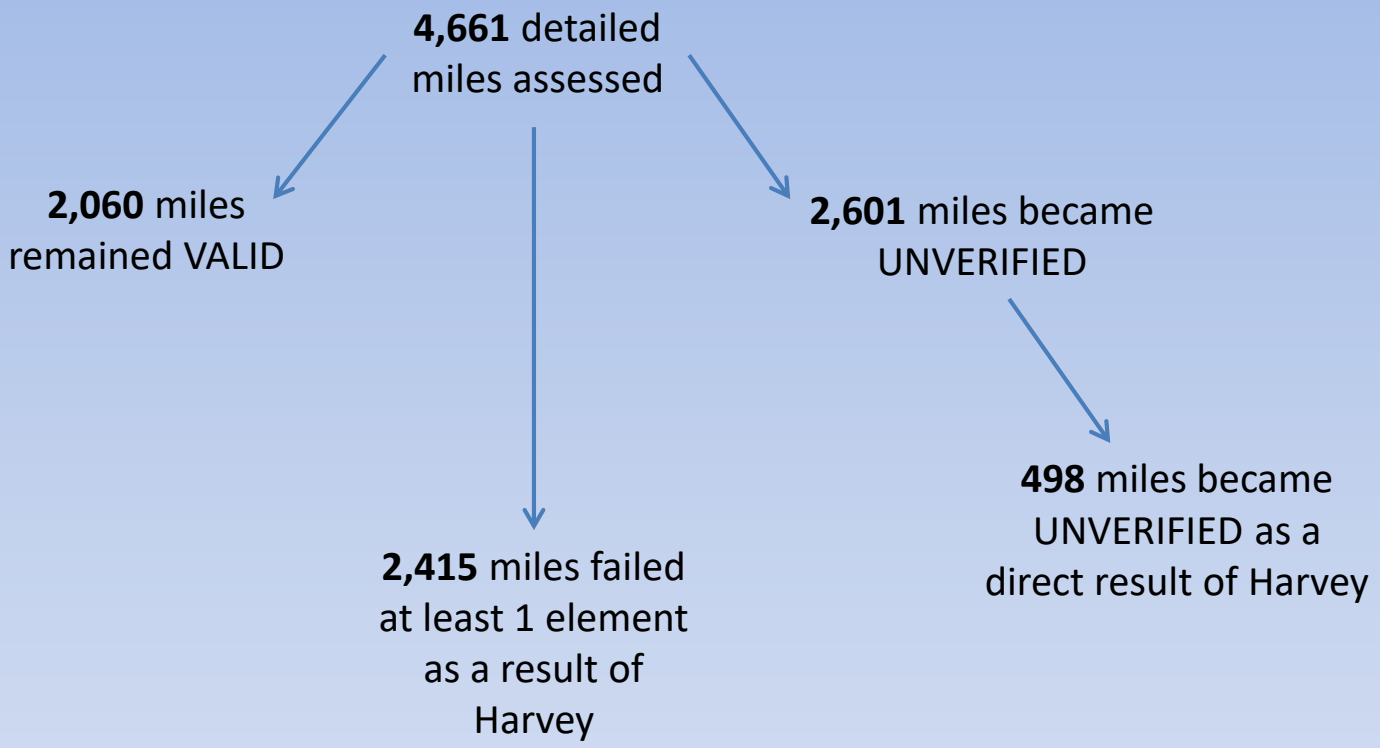


Orthoimagery

Orthoimagery is used to assess current conditions of stream channels and in-stream structures and is a very valuable tool.

Much of the post-event imagery was collected immediately after the event when floodwaters were still high and channels, floodplains, roadways, and structures were still inundated. So, it was often unclear where in-stream structures had been destroyed or damaged.

Results

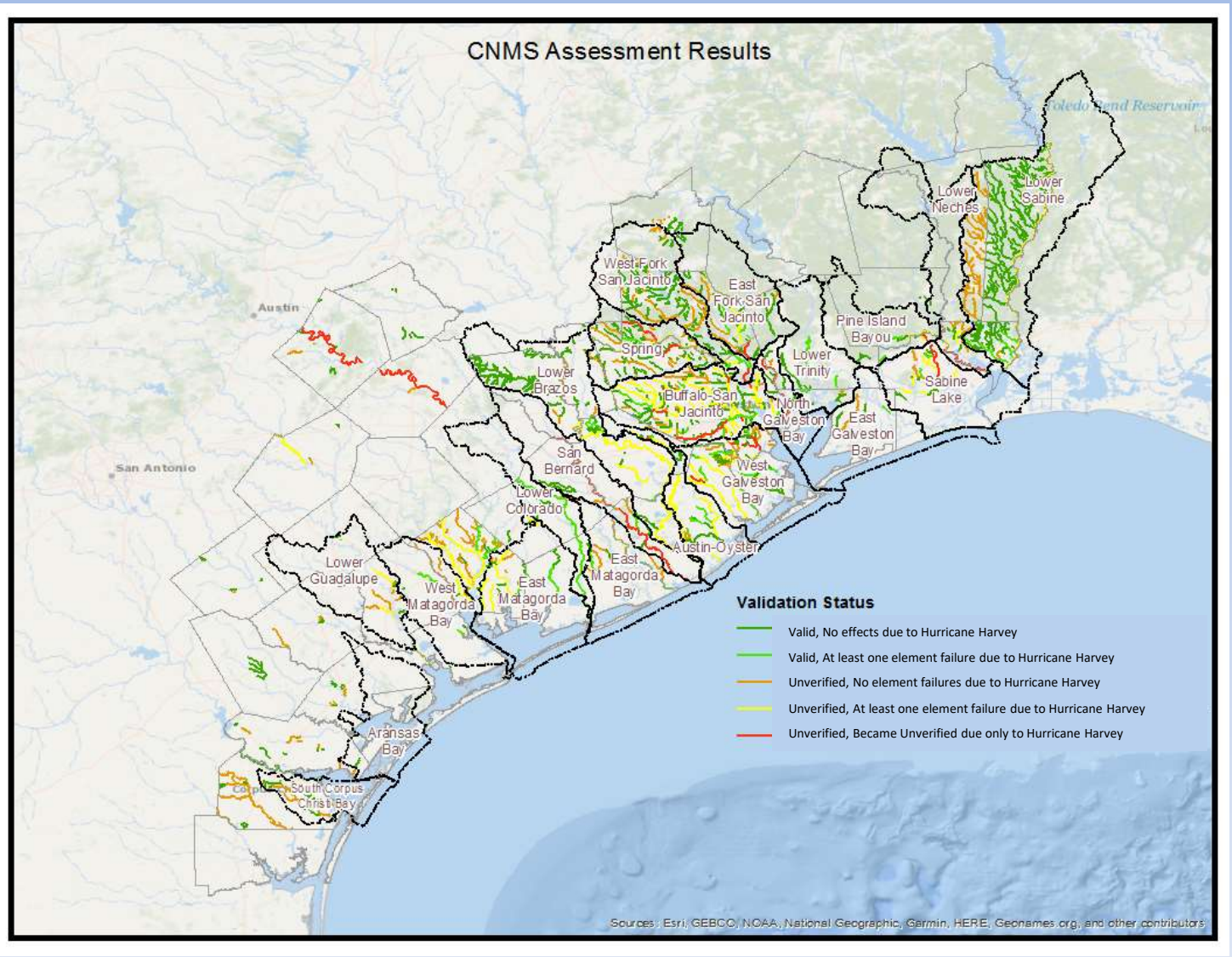


*** 52% of the miles assessed had at least one element affected by Harvey**

*** 56% of the valid miles assessed became UNVERIFIED as a result of this analysis**

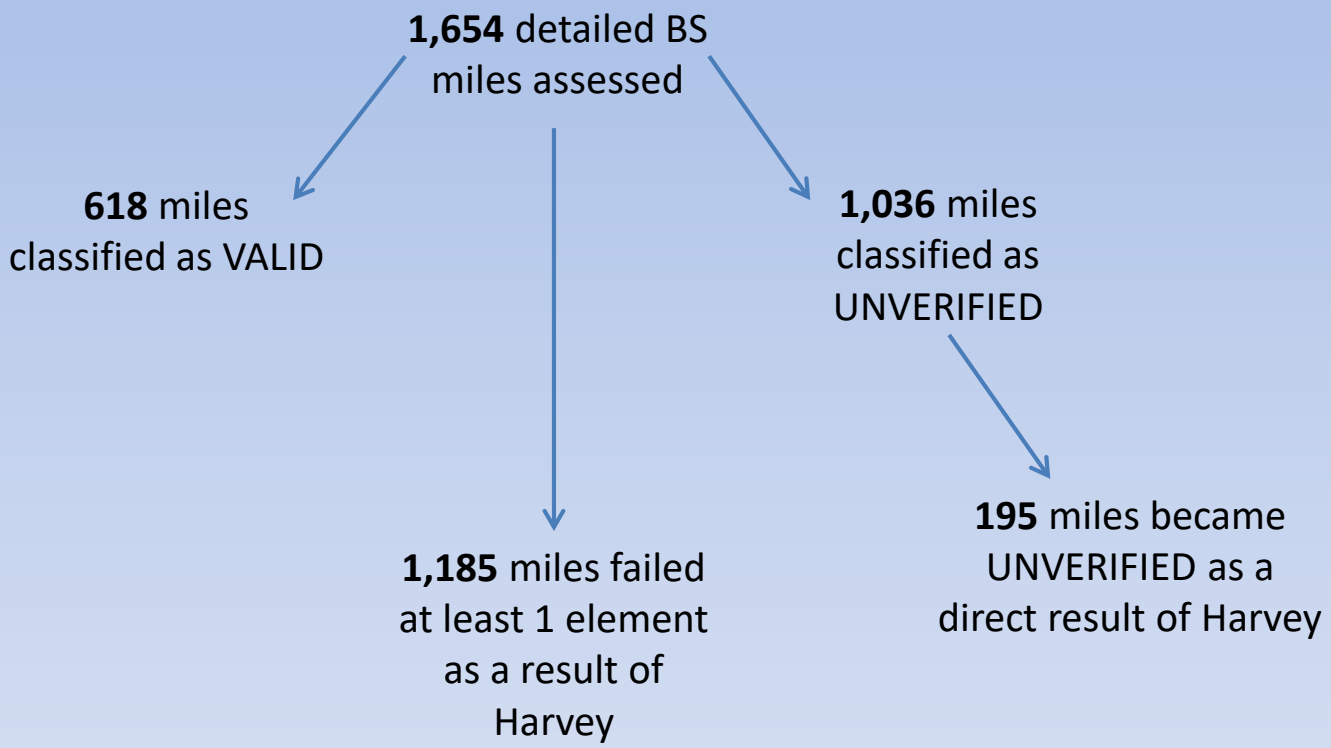
*** 11% of the assessed miles would not have become UNVERIFIED if Harvey had not occurred**

Results


CNMS Assessment Results
Austin
San Antonio
Lower Neches
Lower Sabine
West Fork San Jacinto
East Fork San Jacinto
Pine Island Bayou
Spring
Lower Trinity
Lower Brazos
Buffalo-San Jacinto
Sabine Lake
North Galveston Bay
East Galveston Bay
San Bernard
West Galveston Bay
Lower Colorado
Austin-Oyster
East Matagorda Bay
Lower Guadalupe
West Matagorda Bay
East Matagorda Bay
Aransas Bay
South Corpus Christi Bay
Validation Status
Valid, No effects due to Hurricane Harvey
Valid, At least one element failure due to Hurricane Harvey
Unverified, No element failures due to Hurricane Harvey
Unverified, At least one element failure due to Hurricane Harvey
Unverified, Became Unverified due only to Hurricane Harvey
Sources: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other contributors

Results

35% of the assessed miles were BEING STUDIED miles (not yet effective studies)

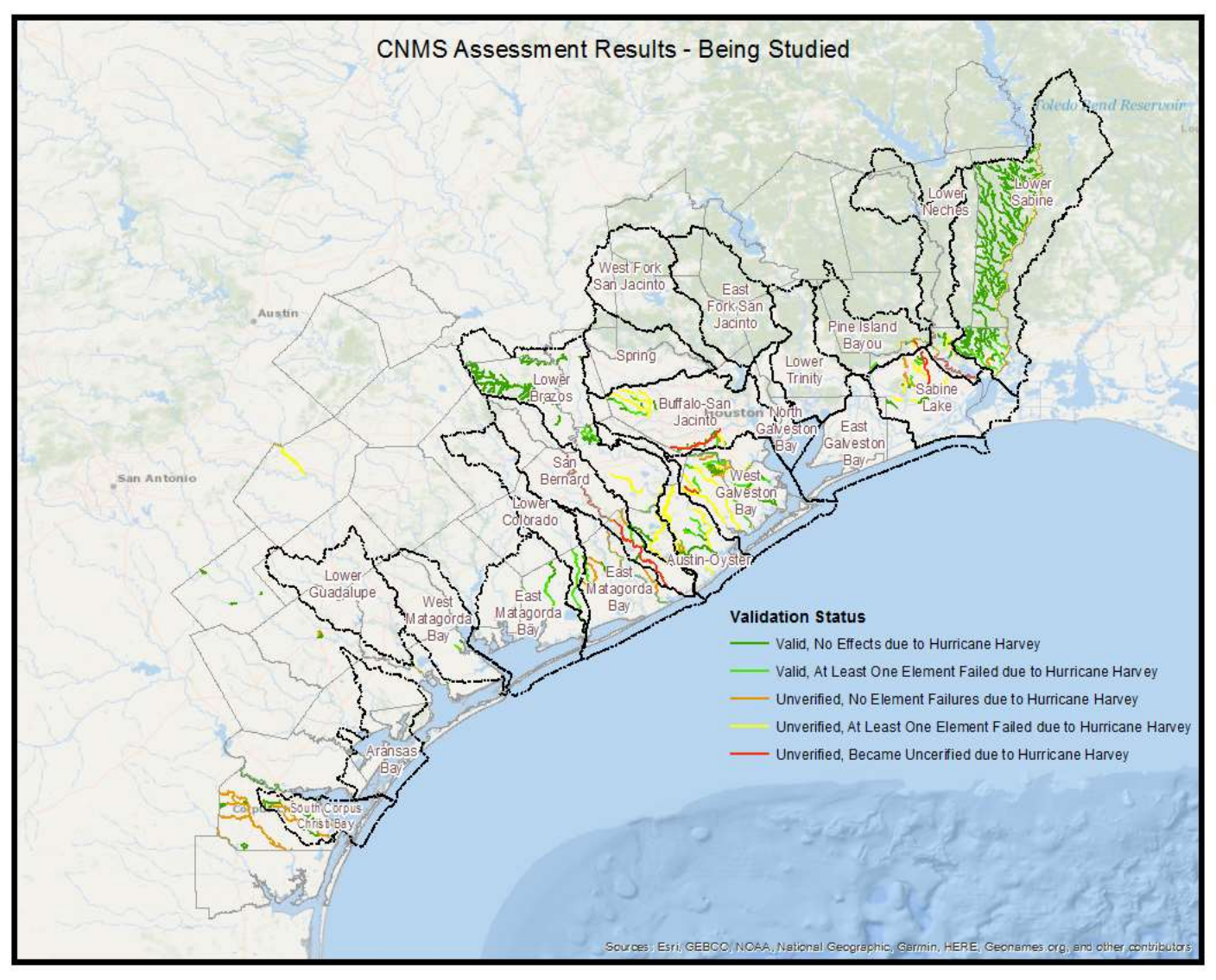


*** 72% of these miles had at least one element affected by Harvey**

*** 63% of these not yet effective study miles became UNVERIFIED as a result of this analysis**

*** 12% of the assessed miles would not have become UNVERIFIED if Harvey had not occurred**

Results


CNMS Assessment Results - Being Studied
Austin
San Antonio
Houston
Lower Sabine
Lower Neches
West Fork San Jacinto
East Fork San Jacinto
Pine Island Bayou
Spring
Lower Trinity
Lower Brazos
Buffalo-San Jacinto
Sabine Lake
North Galveston Bay
East Galveston Bay
San Bernard
West Galveston Bay
Lower Colorado
Austin-Oyster
Lower Guadalupe
West Matagorda Bay
East Matagorda Bay
East Matagorda Bay
Aransas Bay
South Corpus Christi Bay
Validation Status
Valid, No Effects due to Hurricane Harvey
Valid, At Least One Element Failed due to Hurricane Harvey
Unverified, No Element Failures due to Hurricane Harvey
Unverified, At Least One Element Failed due to Hurricane Harvey
Unverified, Became Uncerified due to Hurricane Harvey
Sources: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other contributors

Lessons Learned

Lessons learned to apply to future post-disaster CNMS assessments:

- Post-disaster orthoimagery collected after floodwaters have receded will provide a more complete picture of the effects of a flood event on the channels and in-stream structures (C4 – C7 and S4 – S5).
- Bridge inspection data collected post-disaster would be beneficial in assessing the impacts of the event on bridge scour (C7).
- Local community inventory and input on destroyed and damaged structures would allow for further refinement of elements C6, C7, and S4.
- Updated FEMA Repetitive Claims data that includes claims made as a result of the declared disaster would support refinement of element S2.

Future Considerations

The CNMS DB does not provide insight on the degree to which approximate (Zone A) studies are affected by disasters. The elements assessed for Zone A studies are:

- A1: Availability of better topography
- A2: Availability of newer regression equations
- A3: >50% increase in impervious area in the sub-basin
- A4: Studies are backed by technical data

FEMA Regions do have the option to assess additional elements as they see fit. A suggestion made was to consider this option for future assessments.

A potential added check would be for HWMs collected on Zone A study reaches. While Zone A studies are not typically calibrated, the availability of HWM data could indicate impacts of disasters on these studies. Also, as regulatory-ready Zone A studies are becoming more prevalent it would be useful to assess additional elements for Zone A studies.

References

- FEMA's CNMS Technical Reference

https://www.fema.gov/media-library-data/1521832299221-9e218ec1310c357befe493e534482673/CNMS_Technical_Reference_Feb_2018.pdf

- PeakFQ User's Guide

https://www.fema.gov/media-library-data/1521832299221-9e218ec1310c357befe493e534482673/CNMS_Technical_Reference_Feb_2018.pdf

- Bulletin 17B

https://www.fema.gov/media-library-data/20130726-1553-20490-7937/dl_flow_body.pdf

Questions?

Tammie Tucker
Tammie.tucker@aecom.com

Erik Danielson
Erik.danielson@aecom.com