

MEMORANDUM



9900 Northwest Freeway
Houston, TX 77092
713-684-4000

DATE: September 5, 2017
TO: HCFCF Flood Watch/Partners
FROM: Jeff Lindner
Director of Hydrologic Operations/Meteorologist
RE: Immediate Report – #1
Hurricane Harvey - Storm and Flood Information

This is the first report summarizing the catastrophic flooding produce by the landfall and slow movement of Hurricane Harvey.

GENERAL FLOODING STATEMENT

The tropical wave that would eventually develop into Hurricane Harvey moved off the west coast of Africa on August 11th and tracked westward across the tropical Atlantic becoming a tropical storm on August 17th and then moved into the Caribbean Sea where Harvey become disorganized and was downgraded to a tropical wave. The tropical wave entered the Gulf of Mexico on the afternoon of the 22nd and was upgraded again to tropical depression Harvey on the morning of the 23rd. Over the next 48 hours Harvey would undergo a period of rapid intensification from a tropical depression to a category 4 hurricane and make landfall along the Texas coast near Port Aransas around 10:00 p.m. on August 25th. The upper air steering patterns that moved Harvey toward the Texas coast weakened and Harvey's forward motion slowed to near 5mph after landfall and then to a meander just north of Victoria, TX on the 26th. Rain bands on the eastern side of the circulation of Harvey moved into southeast Texas and Harris County on the morning of the 25th and continue through much of the night and into the 26th. A strong rainband developed over Fort Bend and Brazoria Counties during the evening hours of the 26th and spread into Harris County and slowed while training from south to north. Flash flooding developed rapidly between 10:00 p.m. and 1:00 a.m. as tremendous rainfall rates occurred across much of Harris County. Additional rain bands continued to develop into the morning hours of the 27th producing additional excessive rainfall amounts.

As the center of Harvey slowly moved east-southeast and back offshore heavy rainfall continued to spread across Harris County through much of the 29th and the 30th exacerbating the ongoing widespread and devastating flooding. Harvey maintained tropical storm intensity the entire time while inland over the Texas coastal bend and southeast Texas. After moving offshore, Harvey made a third landfall just west of Cameron, Louisiana on the morning of the 30th.

As of August 31st, the Harris County Medical Examiner’s Office has confirmed 18 flooded related deaths.

RAINFALL

Peak total rainfall for the various time periods are listed below for HCFCD gages across Harris County.

Time	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr	2-day	4-day
Peak Rainfall (inches)	6.8	11.9	14.8	18.9	20.9	25.6	34.5	47.4

Duration – Rain began Friday morning, August 26th across the county with the first heavy band entering the county Saturday night, August 27th. Heavy rain bands continued to sweep across the entire county through Monday, August 28th. The majority of the rainfall occurred during a 4 day period and breaks in rainfall between bands were short and infrequent.

Total Amounts – Total rainfall amounts ranged from 25 to 47 inches across the county for the 4 days. The 2 day amount ranged from 20 to 35 inches. The lowest totals occurred over the northwest part of the county with the highest totals focused across the southeast part of the county along I-45 from near the City of South Houston and Pasadena southward to Friendswood and Webster.

A maximum 3 day rainfall total of 34.5 inches was recorded at Clear Creek and I-45 and 34.6 inches at Berry Bayou and Nevada.

A maximum 4 day rainfall total of 47.4 inches was recorded at Clear Creek and I-45

Exceedance Probability – Rainfall was less than a 4% (25-yr) event for the time 15-min to 6-hr time periods for most areas except southeast Harris County and Brays Bayou where 2% (50-yr) to 0.2% (500-yr) and greater rainfall occurred. Rainfall for the 12-hr to 4-day time periods ranged from 2% (50-yr) to 0.2% (500-yr) and greater for all watersheds.

The maximum and weighted ranges shown below are county-wide and recurrence intervals greater than 500-yr are approximate.

Duration	Rainfall Amount	Return Interval – years (exceedance probability)
1-Hour		
Maximum	6.8”	1,500 (0.0667%)
Weighted Range	4-5”	50-500 (2.0% - 0.2%)
24-Hour		
Maximum	28.6”	8,000 (0.0125%)
Weighted Range	16-20”	200-1,000 (0.5%-0.1%)
2-Day		
Maximum	35.2”	9,000 (0.011%)
Weighted Range	27-33”	2,500-6,000 (0.04%-0.0167%)
4-Day		
Maximum	47.4”	40,000 (0.0025%)
Weighted Range	35-43”	500-20,000 (0.2%- 0.005%)

Two other rainfall factors that influence flood levels was the intensity (inches per hour) variation over time and the distribution in the watershed (area distribution). For Hurricane Harvey, the intensity did vary some but was generally of highly intensity. Due to the length of the rainfall event and the numerous bands that developed, the areal distribution in most a watersheds did not vary significantly.

The following table compares the extraordinary rainfall associated with Harvey against Tropical Storm Allison in June 2001 and the Tax Day Flood of April 2016 for various time periods. It is interesting that Tropical Storm Allison exceeds Harvey’s rainfall in the 12 and 24-hr periods. In the 2 day period Harvey dropped 6.0 inches more than Allison and 8.9 inches more over 4 days.

Duration	Max Rainfall (inches)		
	Harvey	Allison June 2001	“Tax Day” 2016
1-hr	6.8	5.7	4.7
2-hr	11.9	9.9	7.3
3-hr	14.8	13.5	8.3
6-hr	18.9	21.2	13.9
12-hr	20.9	28.3	16.7
1 day	25.6	28.4	17.4

2 days	34.5	28.5	17.5
4 days	47.4	38.5	N/A

A total of 1 trillion gallons of water fell across Harris County over the 4 day period which would fill the Houston Astrodome 3200 times and cover Harris County’s 1800 sq miles with an average of 33 inches of water. This volume of water would also run Niagara Falls for 15 days.

CHANNEL FLOODING

Disastrous flooding occurred on nearly every watershed in Harris County with many creeks and bayous rising to record or near record levels. Historical records held by the October 1994 flood and Tropical Storm Allison were exceeded by Harvey at many locations. Field work continues to collect high water marks and document the flooding extents and depth and a more complete picture of the flooding will be available with later releases of this report.

A review of preliminary high water marks and gage data indicate that 54% of the 250 high water marks collected thus far have surpassed the previous record water levels and 57% or 88 of the HCFCD flood warning system gages recorded new record levels. A comprehensive review of all high water marks and gage data is currently underway.

HOUSE FLOODING ESTIMATES

HCFCD estimates that nearly 70% or 1300 sq mi of land over Harris County was covered with up to 1.5 ft of water. A review of peak water surface elevations along creeks and bayous plotted against structural inventory records suggests that 136,000 structures were flooded which is 63,000 more than Tropical Storm Allison (2001). This is nearly 10% of all total structures in the Harris County Appraisal District’s database. HCFCD believes this is a conservative estimate as large areas well away from creeks and bayous flooded from the intense rainfall rates. Damage assessments teams are currently collecting damage estimates in the flooded subdivisions and future updates will provide more accurate numbers or damaged structures.

Harvey flooding was unusually deep in some areas, due in part to the intense short duration rainfall rates and the record flood levels along several creeks and bayous. Water levels reached the second story of some structures near Hobby Airport, lower Hunting and lower Greens Bayous, and along many portions of the San Jacinto River system. This event was one of the only times where HCFCD and emergency management officials urges residents to climb on to their roofs to escape the increasing depths of the flood waters.

ADDICKS AND BARKER RESERVOIRS

Addicks Reservoir peaked at a record elevation of 109.10 ft at 7:00 a.m. on August 30th surpassing the previous record of 102.65 ft last year during the “Tax Day” flood of 2016. At maximum pool the reservoir was impounding 217,726 acre feet of water. The pool elevation exceeded the previous record by 6.45 ft. The pool reached an elevation of 108.0 ft on August 29th at 7:15 a.m. which resulted in uncontrolled flow over the natural ground at the end of the north spillway. The pool elevation fell to 107.99 ft on September 1st at 8:30 p.m. ending the flow around the north end spillway.

A peak maximum inflow of 72,200 cfs was flowing into Addicks Reservoir on the morning of August 28th from Bear, Langham, and South Mayde Creeks. This included a peak flow on Bear Creek of 41,000 cfs. Harvey exceeded the previous maximum inflows recorded during last year’s Tax Day flood by 31,300 cfs. In fact the flow down Bear Creek alone exceeded the entire combined peak inflow of the 2016 Tax Day flood.

Barker Reservoir reached a peak pool elevation of 101.56 ft on August 30th at 6:00 a.m. impounding 171,000 acre feet of water. Barker Reservoir exceeded its previous record pool of 95.22 ft during the 2016 Tax Day flood by 6.34 ft.

Widespread flooding of homes and streets occurred within the pools of both Addicks and Barker Reservoirs. Additionally, house flooding occurred near the northern spillway of Addicks as flow left the reservoir pool and flowed east along Tanner toward Brittmoore Rd.

CYPRESS CREEK OVERFLOW

Initial data collected from the Cypress Creek overflow zone indicates that Harvey exceeded the 2016 Tax Day flood levels by 4-6 inches suggesting that Harvey was a record overflow event across the overflow zone. Structure flooding did occur along the west side of Barker Cypress from the overflow that did not occur with the 2016 Tax Day storm adding additional evidence that this event was a historical record.

HIGH WATER MARKS

HCFCDD is currently in the process of collecting one of the largest high water mark efforts ever attempted in Harris County. A total of 250 marks have been collected on various channels thus far. All watersheds, detention basins, the Cypress Creek overflow zone, and the Addicks Reservoir spillway zone will be marked.

HARRIS COUNTY FLOOD CONTROL DISTRICT ACTIONS

- The HCFCDD Flood Operations and Hurricane Response teams were activated on Wednesday August 23 and remain in full operations at this time
- Clear Creek Second Outlet Gates were opened on the afternoon of August 24 and remain open at this time
- HCFCDD has conducted over 170 media interviews over the last 12 days.
- HCFCDD was able to perform a helicopter survey on Wednesday August 30th and a second survey on the 31st.

- HCFCD will continue to respond to citizen phone calls and collect flood data
- HCFCD will continue to support HCPID, HCOEM, and City of Houston operations

HARRIS COUNTY FLOOD CONTROL DISTRICT FACILITIES

The extended onslaught of excessive rainfall coupled with the extreme record flows and long duration of those flows resulted in damage to HCFCD infrastructure, gage monitoring equipment, and portions of the Inverness Forest Levee.

Back flow of water through the Inverness Forest pump station at the height of water levels along Cypress Creek resulted in erosion of a portion of the base of the levee near the concrete structure housing the pumps. A mandatory evacuation order was issued for that part of the subdivision that would be affected if the levee breached or overtopped on August 27th at 10:10 p.m. and that order was lifted on August 31st at 7:15 p.m. HCFCD contractors completed repairs to the levee in 3 days at a cost of \$ 50,000.

The Harris County Flood Warning System suffered damage to several sites mainly due to the rise of water to heights that flooded the gage structure and the electronics housed. A total of 6 HCFCD gages were completely destroyed with an additional 7 suffering partial damage mainly to the water level measuring devices. 5 additional sites are suspected of have damage. HCFCD crews with the help of out of state contractors will begin repairs to the gage system on September 3.

HCFCD infrastructure crews are actively checking channels for debris and blockages. As of September 2, 1997 cubic yards of debris has been found in HCFCD channels along with 66 significant locations of erosion. HCFCD crews are currently removing debris at several locations across the county and a total amount of 85 cubic yards has been removed.

Rainfall Intensity Report
12AM 8-25-17 thru 10PM 8-29-17

Clear Creek, A100												
Sensor ID	5-min	15-min	30-min	1-hour	2-hour	3-hour	6-hour	12-hour	1-day	2-day	4-day	Site
100	0.6	1.5	2.5	4.0	6.6	9.1	12.8	14.8	18.3	24.8	33.6	A100 Clear Lake 2nd Outlet @ SH 146
110	0.7	2.0	3.2	5.9	10.8	14.6	18.9	20.9	25.6	34.5	47.4	A100 Clear Creek @ I-45
115	0.7	1.6	2.8	4.8	6.4	8.9	10.5	12.5	15.2	25.2	35.4	Cowart Creek @ Baker Road
120	0.6	1.6	3.0	5.7	10.5	13.5	16.2	19.2	22.6	33.5	42.8	A100 Clear Creek @ FM 528
125	0.6	1.6	2.6	4.1	5.6	8.2	9.9	12.4	15.7	25.3	37.2	Chigger Creek @ Windsong Lane
130	0.7	2.0	3.3	6.4	11.9	14.8	17.3	19.4	23.2	33.5	44.0	A100 Clear Creek @ Bay Area Boulevard
140	0.7	1.7	3.2	5.2	9.7	12.2	14.8	17.6	20.5	31.8	40.9	A119 Turkey Creek @ FM 1959
150	0.6	1.6	2.8	5.1	6.5	8.7	10.8	14.2	16.6	28.0	37.0	A100 Clear Creek @ Country Club Drive
160	0.7	1.9	3.6	6.8	9.7	13.2	15.7	18.6	22.2	31.8	39.1	A120 Beamer Ditch @ Hughes Road
170	0.7	1.8	3.0	5.2	8.0	10.4	14.9	16.4	21.5	28.9	36.3	A100 Clear Creek @ Nassau Bay
180	0.6	1.7	2.8	4.2	5.8	6.5	8.4	13.2	15.8	25.5	33.8	A100 Clear Creek @ Mykawa Road
190	0.6	1.5	2.6	3.0	4.3	5.6	6.6	10.6	13.2	23.8	28.9	A100 Clear Creek @ SH 288
200	0.6	1.4	2.4	4.3	6.2	8.1	12.1	14.2	19.1	30.0	39.7	A104 Taylor Lake @ Nasa Road 1

Armand Bayou, B100												
Sensor ID	5-min	15-min	30-min	1-hour	2-hour	3-hour	6-hour	12-hour	1-day	2-day	4-day	Site
210	0.8	1.5	2.9	5.1	7.5	8.9	13.5	15.7	21.2	30.8	40.6	B100 Armand Bayou @ Pasadena Lake (Nasa Road 1)
220	0.8	1.6	2.7	4.9	7.4	9.7	13.3	15.2	21.3	30.8	41.6	B100 Armand Bayou @ Genoa-Red Bluff Road
230	0.7	1.4	2.3	3.4	5.0	5.8	9.2	11.6	18.2	28.0	38.0	B106 Big Island Slough @ Fairmont Parkway
240	0.5	1.4	2.7	4.6	8.4	11.4	14.3	16.7	20.1	31.8	42.6	B100 Armand Bayou @ Beltway 8
250	0.6	1.6	2.9	4.6	8.0	10.8	14.6	16.5	22.5	33.9	44.7	B104 Horsepen Creek @ Bay Area Boulevard
270	0.7	1.8	2.8	5.2	7.4	9.2	12.6	14.6	21.6	32.1	42.9	B112 Willow Spring Bayou @ Fairmont Parkway

Sims Bayou, C100												
Sensor ID	5-min	15-min	30-min	1-hour	2-hour	3-hour	6-hour	12-hour	1-day	2-day	4-day	Site
310	0.6	1.8	3.4	6.0	10.5	14.2	17.0	20.1	23.2	34.6	43.9	C106 Berry Bayou @ Nevada Avenue
320	0.9	2.0	3.6	6.1	9.6	12.8	15.6	19.4	23.0	35.2	44.4	C106 Berry Bayou @ Forest Oaks Boulevard
340	0.7	1.9	3.0	5.1	7.1	9.1	11.3	16.3	19.2	29.4	37.2	C100 Sims Bayou @ Telephone Road
360	0.7	1.8	3.4	4.5	5.1	5.5	6.6	12.3	14.5	24.2	32.6	C100 Sims Bayou @ Martin Luther King Road
370	0.5	1.3	2.2	2.9	4.7	6.3	7.3	11.4	13.8	23.0	30.0	C100 Sims Bayou @ SH 288
380	0.5	1.5	2.6	3.6	4.3	4.9	5.8	10.6	13.4	21.9	29.2	C100 Sims Bayou @ Hiram-Clarke Road

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Brays Bayou, D100												
Sensor ID	5-min	15-min	30-min	1-hour	2-hour	3-hour	6-hour	12-hour	1-day	2-day	4-day	Site
1020	0.6	1.4	2.4	3.2	5.2	6.5	7.8	12.8	15.9	25.0	32.4	NRG Park
400	0.8	1.4	1.9	3.2	5.5	7.3	8.4	12.9	16.0	25.9	33.4	D109 Harris Gully @ South McGregor Way
410	0.7	1.9	2.4	4.0	5.8	7.5	9.5	14.3	17.2	28.8	35.2	D100 Brays Bayou @ Lawndale Street
420	0.4	1.2	1.8	3.2	5.1	6.4	7.4	11.5	14.2	22.8	29.1	D100 Brays Bayou @ South Main Street
430	0.5	1.2	2.0	3.1	4.9	5.7	6.8	11.2	13.8	23.4	30.0	D100 Brays Bayou @ Stella Link Road
435	0.6	1.8	2.9	4.4	4.9	5.4	7.0	13.0	16.6	24.8	32.1	D112 Willow Water Hole @ Willowbend Boulevard
440	0.7	1.8	3.2	4.6	5.2	5.3	7.6	13.6	17.8	27.0	34.1	D100 Brays Bayou @ Rice Avenue
445	0.6	1.7	2.6	3.8	4.4	4.5	7.3	12.4	17.2	25.8	33.5	D112 Willow Water Hole @ Landsdowne Drive
460	0.6	1.4	2.4	3.4	4.5	5.7	10.0	14.0	18.1	27.7	34.9	D100 Brays Bayou @ Gessner Road
465	0.4	1.2	2.0	3.5	4.9	6.0	10.1	14.0	17.6	27.6	34.7	D100 Brays Bayou @ Beltway 8
470	0.6	1.4	2.3	3.1	5.5	6.7	10.2	14.0	17.7	26.6	33.8	D100 Brays Bayou @ Belle Park Drive
475	0.4	1.2	1.9	2.7	4.2	5.3	8.2	11.6	14.9	24.3	30.8	D100 Brays Bayou @ Bellaire Boulevard
480	0.4	1.3	2.3	3.3	6.0	7.3	11.0	14.4	18.1	27.0	35.4	D118 Keegans Bayou @ Roark Road
485	0.6	1.2	1.6	2.4	3.5	4.1	5.8	9.8	16.0	23.3	31.2	D100 Brays Bayou @ SH 6
490	0.6	1.4	2.2	2.8	4.7	5.5	8.6	12.2	15.5	24.7	32.1	D118 Keegans Bayou @ Keegan Road
495	0.4	1.0	1.5	2.2	3.2	3.8	5.0	8.8	14.1	22.2	30.6	D118 Keegans Bayou @ Rocky Valley

White Oak Bayou, E100												
Sensor ID	5-min	15-min	30-min	1-hour	2-hour	3-hour	6-hour	12-hour	1-day	2-day	4-day	Site
510	0.4	1.1	1.9	3.3	5.1	6.0	7.6	12.7	16.8	25.4	31.6	Harris County Flood Control @ Brookhollow
530	0.4	1.1	2.1	3.2	4.8	5.4	6.4	10.2	14.7	23.3	28.8	E100 White Oak Bayou @ Ella Boulevard
535	0.4	1.0	1.9	3.4	5.2	6.0	8.0	12.8	17.7	26.3	32.8	E100 White Oak Bayou @ Pinemont Drive
545	0.3	0.9	1.6	2.4	3.5	3.9	6.1	11.2	16.3	23.8	29.1	E100 White Oak Bayou @ Fairbanks North Houston Road
550	0.3	0.9	1.6	2.6	3.8	4.3	7.0	11.0	16.0	24.0	29.7	E100 White Oak Bayou @ Lakeview Drive
555	0.4	0.9	1.5	2.7	3.8	4.4	6.6	10.0	15.2	21.7	27.4	E100 White Oak Bayou @ Jones Road
560	0.6	1.5	2.5	4.0	4.8	5.2	6.5	12.4	16.8	27.0	33.6	E101 Little White Oak Bayou @ Trimble Street
570	0.6	1.4	2.1	3.6	4.7	6.3	7.6	14.2	18.0	28.5	35.0	E101 Little White Oak Bayou @ Tidwell Road
575	0.5	1.0	2.0	3.6	4.9	5.8	8.0	12.8	18.0	25.7	31.6	E100 White Oak Bayou @ Tidwell Road
580	0.4	1.0	1.8	3.1	4.6	5.4	7.6	11.7	16.6	24.9	30.8	E115 Brickhouse Gully @ Costa Rica Road
585	0.4	1.1	2.0	3.6	4.8	5.5	7.9	12.4	18.4	27.2	34.0	E121 Vogel Creek @ Victory Drive
590	0.4	0.9	1.5	2.5	3.8	4.7	7.1	11.3	16.6	25.6	31.7	E117 Cole Creek @ Deihl Road
595	0.4	1.2	2.0	3.4	4.6	5.5	7.6	12.2	18.2	26.7	33.1	E121 Vogel Creek @ Gulf Bank Road

Little Cedar Bayou, F216												
Sensor ID	5-min	15-min	30-min	1-hour	2-hour	3-hour	6-hour	12-hour	1-day	2-day	4-day	Site
610	0.6	1.3	2.2	3.8	7.0	9.7	13.1	15.0	19.3	29.8	40.6	A104 Taylor's Bayou @ Shoreacres Boulevard
620	0.6	1.4	2.3	4.2	5.8	8.6	12.0	14.3	19.6	30.6	41.4	F216 Little Cedar Bayou @ 8th Street
640	0.5	1.4	2.1	3.5	5.4	7.6	10.6	12.9	19.8	30.9	40.8	F101 Lateral @ Sens Road

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San Jacinto River, G103												
Sensor ID	5-min	15-min	30-min	1-hour	2-hour	3-hour	6-hour	12-hour	1-day	2-day	4-day	Site
720	0.5	1.2	1.9	2.8	4.1	5.0	6.4	10.5	16.8	22.1	31.4	G103 San Jacinto River @ US 90
750	0.4	1.0	1.3	2.1	2.6	3.3	5.8	8.8	14.3	20.4	30.0	G103 Lake Houston Dam Spillway
760	0.4	0.9	1.4	2.4	4.0	4.4	6.0	11.2	17.8	24.3	32.7	G103 San Jacinto River @ US 59
790	0.5	0.8	1.4	1.7	2.2	3.0	5.0	8.0	15.5	20.4	27.2	G103 East Fork San Jacinto @ FM 1485

Hunting Bayou, H100												
Sensor ID	5-min	15-min	30-min	1-hour	2-hour	3-hour	6-hour	12-hour	1-day	2-day	4-day	Site
820	0.7	1.7	3.2	4.3	7.8	9.9	12.1	14.5	19.2	29.8	39.1	H100 Hunting Bayou @ I-10
830	0.6	1.5	2.6	4.4	7.1	9.1	11.8	15.5	19.6	29.2	37.2	H100 Hunting Bayou @ Loop 610 East
840	0.6	1.2	2.0	3.7	5.3	7.2	9.4	14.2	18.8	28.7	36.2	H100 Hunting Bayou @ Lockwood Drive

Vince Bayou, I100												
Sensor ID	5-min	15-min	30-min	1-hour	2-hour	3-hour	6-hour	12-hour	1-day	2-day	4-day	Site
920	0.6	1.7	3.0	4.9	8.8	12.3	15.2	18.0	21.2	32.8	42.0	I100 Vince Bayou @ West Ellaine Down Stream
940	0.6	1.4	2.6	4.2	8.0	11.4	14.1	16.8	20.2	31.6	42.1	I101 Little Vince Bayou @ Jackson Avenue

Spring Creek, J100												
Sensor ID	5-min	15-min	30-min	1-hour	2-hour	3-hour	6-hour	12-hour	1-day	2-day	4-day	Site
1040	0.4	1.0	1.5	2.3	3.4	3.8	6.0	10.7	16.4	22.5	26.8	J100 Spring Creek @ FM 2978
1050	0.4	0.8	1.4	2.6	3.5	4.4	6.4	10.8	17.3	24.3	29.4	J100 Spring Creek @ I-45
1060	0.5	1.2	2.0	3.4	4.0	4.3	5.1	8.5	14.3	22.4	26.9	J100 Spring Creek @ Kuykendahl Road
1070	0.4	0.9	1.5	2.7	3.8	4.5	6.7	10.2	15.6	21.6	25.6	J100 Spring Creek @ SH 249
1074	0.5	1.2	2.1	3.0	3.9	4.8	7.4	12.8	17.0	25.5	28.0	Walnut Creek @ Joseph Road
1076	0.4	1.0	1.8	2.7	3.6	4.8	8.4	13.4	18.4	26.5	28.4	Birch Creek @ Riley Road
1084	0.4	1.0	1.5	2.5	3.9	4.3	6.9	11.5	16.4	24.4	26.6	Threemile Creek @ Joseph Road
1086	0.6	1.2	1.8	2.6	3.4	3.9	6.7	11.1	17.2	26.2	27.8	Threemile Creek @ FM 362
1090	0.4	0.9	1.6	2.9	4.4	4.8	7.6	11.5	16.3	24.9	27.8	J100 Spring Creek @ Hegar Road

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Cypress Creek, K100												
Sensor ID	5-min	15-min	30-min	1-hour	2-hour	3-hour	6-hour	12-hour	1-day	2-day	4-day	Site
1110	0.4	1.2	1.8	2.5	4.1	5.5	7.0	12.2	19.4	28.0	34.9	K100 Cypress Creek @ Cypresswood Drive
1115	0.4	0.8	1.3	2.4	3.4	4.5	6.4	10.6	17.3	24.4	31.1	K600 Cypress Creek @ Inverness Forest
1120	0.4	0.9	1.3	2.3	3.5	4.5	6.4	10.3	17.0	25.0	30.9	K100 Cypress Creek @ I-45
1130	0.5	1.0	1.4	2.2	3.4	4.1	5.6	10.0	16.1	23.8	29.4	K100 Cypress Creek @ Kuykendahl Road
1140	0.3	0.8	1.3	2.0	3.2	3.9	5.9	10.8	16.4	23.9	30.1	K100 Cypress Creek @ Stuebner-Airline Road
1150	0.4	1.0	1.3	2.1	3.2	4.0	6.0	10.1	16.3	23.4	28.9	K100 Cypress Creek @ SH 249
1165	0.4	0.9	1.6	2.9	3.9	4.3	6.2	9.2	13.3	19.3	24.6	K100 Cypress Creek @ Eldridge Parkway N.
1170	0.4	0.9	1.6	2.9	3.9	4.6	7.0	10.4	15.3	22.6	28.6	K100 Cypress Creek @ Huffmeister Road
1180	0.4	1.2	1.8	2.6	3.8	5.1	7.2	10.2	18.2	27.8	31.9	K100 Cypress Creek @ Katy-Hockley Road
1185	0.6	1.6	2.3	2.9	4.2	5.8	8.4	11.3	19.9	28.3	33.0	K100 Cypress creek @ Sharp Road
1186	0.4	1.0	1.6	2.1	3.0	4.4	7.3	10.5	17.0	23.2	26.6	Live Oak Creek @ Penick Road
1190	0.5	1.4	2.6	3.5	4.2	4.5	6.4	9.7	17.1	25.8	29.0	K166 Little Mound Creek @ Mathis Road
1195	0.8	1.7	3.0	4.1	4.8	5.2	6.5	10.8	16.8	23.6	25.8	Mound Creek @ FM 362
1210	0.4	1.0	1.8	3.1	4.0	4.6	6.6	9.8	15.6	22.6	28.6	L100 Little Cypress Creek @ Kluge Road
1220	0.5	1.2	1.9	2.5	3.4	4.4	7.2	11.0	15.8	24.2	29.2	L100 Little Cypress Creek @ Cypress Rosehill Road
1230	0.4	1.0	1.8	3.3	4.9	5.2	8.0	11.7	16.4	26.0	29.8	L100 Little Cypress Creek @ Becker Road

Willow Creek, M100												
Sensor ID	5-min	15-min	30-min	1-hour	2-hour	3-hour	6-hour	12-hour	1-day	2-day	4-day	Site
1320	0.5	1.0	1.4	2.0	2.9	3.6	5.6	8.9	15.3	22.0	27.2	M100 Willow Creek @ Kuykendahl Road
1340	0.4	0.9	1.5	2.6	3.7	4.4	6.6	10.0	15.2	21.6	26.6	M100 Willow Creek @ SH 249

Carpenters Bayou, N100												
Sensor ID	5-min	15-min	30-min	1-hour	2-hour	3-hour	6-hour	12-hour	1-day	2-day	4-day	Site
1420	0.6	1.4	2.5	3.8	4.8	5.8	8.5	10.8	18.4	28.2	38.9	N100 Carpenters Bayou @ I-10
1440	0.5	1.2	2.2	3.6	5.5	6.2	7.5	10.4	18.6	27.4	36.8	N100 Carpenters Bayou @ Wallisville Road
1460	0.5	1.3	2.2	3.9	5.9	6.5	7.9	11.6	18.3	25.5	35.2	N100 Carpenters Bayou @ US 90

Goose Creek, O100												
Sensor ID	5-min	15-min	30-min	1-hour	2-hour	3-hour	6-hour	12-hour	1-day	2-day	4-day	Site
1520	0.6	1.5	2.5	4.1	7.2	9.3	12.6	15.0	20.3	29.6	37.8	O100 Goose Creek @ SH 146
1540	0.6	1.6	2.3	4.1	7.6	10.5	14.2	16.0	24.0	33.0	42.9	O100 Goose Creek @ Baker Road

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Greens Bayou, P100												
Sensor ID	5-min	15-min	30-min	1-hour	2-hour	3-hour	6-hour	12-hour	1-day	2-day	4-day	Site
1600	0.5	1.2	1.6	2.6	3.2	4.5	6.1	8.6	15.2	22.8	31.4	P100 Greens Bayou @ Mount Houston Parkway
1610	0.6	1.2	2.1	3.2	6.3	9.3	11.8	14.8	20.3	30.8	40.6	P100 Greens Bayou @ Normandy Street
1620	0.4	1.0	1.8	2.9	4.9	7.1	10.2	13.8	20.8	29.4	38.3	P100 Greens Bayou @ Ley Road
1630	0.3	0.7	1.3	2.3	4.3	5.0	6.5	9.6	16.4	23.1	32.0	P130 Garners Bayou @ Beltway 8
1640	0.4	1.2	2.0	3.2	4.6	5.9	8.3	13.4	20.0	28.2	37.2	P100 Greens Bayou @ US 59
1645	0.4	1.2	1.7	2.9	4.1	5.4	7.2	11.7	17.7	25.3	34.2	P100 Greens Bayou @ Beltway 8
1650	0.4	1.0	1.4	1.8	3.1	4.6	6.4	10.2	18.0	25.7	35.4	P130 Garners Bayou @ Rankin Road
1660	0.4	0.9	1.4	2.4	3.8	4.7	6.1	10.7	16.5	24.4	31.1	P100 Greens Bayou @ Knobcrest Drive
1665	0.4	1.0	1.3	2.2	3.5	4.2	6.4	10.9	16.5	24.3	30.1	P100 Greens Bayou @ Bammel N Houston Road
1670	0.4	0.9	1.4	2.6	3.4	3.7	6.2	11.0	16.5	23.8	29.6	P100 Greens Bayou @ Cutten Road
1695	0.4	0.9	1.4	2.4	4.0	5.9	7.6	12.6	18.3	26.7	35.2	P138 @ Aldine Westfield Road

Halls Bayou, P118												
Sensor ID	5-min	15-min	30-min	1-hour	2-hour	3-hour	6-hour	12-hour	1-day	2-day	4-day	Site
1675	0.4	1.2	2.3	3.9	6.1	7.9	10.7	14.8	20.6	29.5	38.2	P118 Halls Bayou @ Tidwell Road
1680	0.4	0.9	1.5	2.6	4.1	6.2	8.2	13.0	17.7	26.8	34.4	P118 Halls Bayou @ Jensen Drive
1690	0.3	0.8	1.3	2.5	4.0	5.7	7.3	12.6	17.8	26.8	34.3	P118 Halls Bayou @ Airline Drive

Cedar Bayou, Q100												
Sensor ID	5-min	15-min	30-min	1-hour	2-hour	3-hour	6-hour	12-hour	1-day	2-day	4-day	Site
1720	0.6	1.4	2.3	3.6	5.7	8.0	12.5	14.5	21.8	27.5	35.8	Q100 Cedar Bayou @ SH 146
1725	0.6	1.4	2.8	5.3	8.4	10.0	16.4	18.6	28.6	33.4	41.7	Smith Gully @ SH 146
1740	0.5	1.4	2.5	3.6	5.5	7.2	11.6	14.1	23.2	28.3	37.0	Q100 Cedar Bayou @ US 90

Jackson Bayou, R100												
Sensor ID	5-min	15-min	30-min	1-hour	2-hour	3-hour	6-hour	12-hour	1-day	2-day	4-day	Site
1840	0.5	1.2	2.1	3.5	5.0	6.1	7.6	12.1	21.8	27.5	37.5	R102 Gum Gully @ Diamond Head Boulevard

Luce Bayou, S100												
Sensor ID	5-min	15-min	30-min	1-hour	2-hour	3-hour	6-hour	12-hour	1-day	2-day	4-day	Site
1940	0.4	1.0	1.4	2.1	3.3	4.0	5.5	9.5	17.5	22.9	31.8	S100 Luce Bayou @ FM 2100

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Barker Reservoir, T100												
Sensor ID	5-min	15-min	30-min	1-hour	2-hour	3-hour	6-hour	12-hour	1-day	2-day	4-day	Site
2010	0.4	1.0	1.6	2.4	4.0	4.9	7.3	11.7	18.1	27.7	36.3	Barker Dam
2020	0.6	1.2	1.8	3.1	5.1	6.2	8.0	10.0	16.8	24.6	32.1	T101 Mason Creek @ Prince Creek Drive
2025	0.4	1.0	2.0	3.4	6.0	7.5	9.4	11.0	17.6	24.4	32.4	T100 Buffalo Bayou @ Peek Road
2030	0.4	1.2	2.0	3.4	5.4	6.9	9.3	11.2	18.0	26.6	33.2	T100 Buffalo Bayou @ Greenbusch Road
2040	0.4	1.0	1.8	3.0	4.9	6.5	9.0	11.2	16.8	22.9	29.0	T100 Buffalo Bayou @ US 90
2050	0.5	1.0	1.8	3.1	5.2	6.8	9.8	13.0	20.2	27.0	32.8	Cane Island Branch @ Clay Road
2060												Willow Fork Creek @ Pederson Road
2090	0.4	0.9	1.5	2.0	3.2	4.6	8.4	11.9	16.7	23.0	27.0	Brookshire Katy Drainage District @ Morrison Road

Addicks Reservoir, U100												
Sensor ID	5-min	15-min	30-min	1-hour	2-hour	3-hour	6-hour	12-hour	1-day	2-day	4-day	Site
2110	0.5	1.2	2.0	2.6	5.1	5.8	8.1	11.7	18.2	26.4	33.2	Addicks Dam
2120	0.5	1.0	1.7	2.9	4.1	5.1	7.6	11.2	16.9	25.8	32.3	U100 Langham Creek @ West Little York Road
2130	0.4	1.1	1.9	2.7	4.3	5.2	8.3	11.6	16.0	24.1	29.6	U106 Horsepen @ Trailside Drive
2140	0.5	1.1	1.7	3.0	4.5	5.6	7.0	10.0	17.2	26.4	32.5	U100 Langham Creek @ Longenbaugh Road
2150	0.4	1.2	1.6	2.3	3.6	4.8	6.5	9.4	16.5	24.8	31.8	U101 South Mayde @ Greenhouse Road
2160	0.4	1.1	1.7	2.4	4.0	5.1	6.5	9.4	16.6	25.1	32.3	U102 Bear Creek @ Clay Road
2170	0.6	1.4	2.1	3.0	4.1	5.4	7.7	10.3	17.5	26.7	33.1	U101 South Mayde @ Morton Road
2180	0.6	1.5	2.1	3.0	4.4	5.4	7.7	10.6	17.7	27.0	32.9	U102 Bear Creek @ FM 529
2190	0.6	1.4	2.2	3.0	4.4	5.8	8.1	11.0	18.0	26.7	32.8	U101 South Mayde Creek @ Peek Road

Buffalo Bayou, W100												
Sensor ID	5-min	15-min	30-min	1-hour	2-hour	3-hour	6-hour	12-hour	1-day	2-day	4-day	Site
1000	0.6	1.5	2.3	3.4	4.8	5.9	7.4	13.2	17.5	27.2	34.4	Houston Transtar
2210	0.6	1.2	2.0	3.6	5.8	8.0	10.4	15.0	19.2	28.7	34.4	W100 Buffalo Bayou @ Turning Basin
2240	0.5	1.2	2.2	3.5	5.1	6.6	7.8	13.5	16.5	26.2	32.9	W100 Buffalo Bayou @ Shepherd Drive
2250	0.5	1.1	2.1	2.8	3.6	4.4	7.2	12.3	17.1	25.5	31.4	W140 Spring Branch @ Bingle Road
2255	0.4	1.1	2.0	2.8	3.5	4.1	6.8	11.7	16.5	24.8	30.4	W140-01 Briar Branch @ Campbell Road
2260	0.5	1.2	2.2	3.0	3.6	4.0	7.0	11.6	16.2	24.3	29.7	W100 Buffalo Bayou @ San Felipe Drive
2270	0.5	1.2	2.3	3.9	4.8	5.7	10.4	14.2	18.6	29.4	36.9	W100 Buffalo Bayou @ West Beltway 8
2280	0.4	1.2	2.2	3.5	4.6	5.5	9.6	13.1	17.5	27.2	34.2	W156 Rummel Creek @ Brittmoore Road
2290	0.5	1.3	2.1	3.0	5.1	6.2	9.3	13.1	19.0	27.8	35.4	W100 Buffalo Bayou @ Dairy Ashford Road

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Region 1--Addicks, Barker, Cypress, Spring, and Willow											
Period	5-min	15-min	30-min	1-hour	2-hour	3-hour	6-hour	12-hour	1-day	2-day	4-day
2-year	0.7	1.1	1.4	1.9	2.2	2.5	2.9	3.4	4.1	4.7	5.4
5-year	0.9	1.4	1.8	2.5	3	3.3	4	4.8	5.8	6.6	7.6
10-year	1	1.5	2.1	2.8	3.5	3.9	4.9	5.9	7.1	8.1	9.2
25-year	1.1	1.8	2.4	3.4	4.2	4.8	6.1	7.4	9	10.1	11.3
50-year	1.2	2	2.7	3.8	4.9	5.6	7.2	8.7	10.6	11.8	13.1
100-year	1.3	2.2	3	4.2	5.5	6.5	8.5	10.2	12.4	13.6	14.9
500-year	1.5	2.7	3.9	5.5	7.5	9	12.2	14.7	17.7	18.7	19.8

Region 2--Brays, Buffalo, Greens, Hunting, Luce, West Fork San Jacinto, and White Oak											
Period	5-min	15-min	30-min	1-hour	2-hour	3-hour	6-hour	12-hour	1-day	2-day	4-day
2-year	0.7	1.1	1.5	2.0	2.3	2.6	3.1	3.7	4.4	5.0	5.8
5-year	0.8	1.4	1.8	2.5	3.1	3.5	4.3	5.1	6.2	7.1	8.1
10-year	0.9	1.5	2.1	2.9	3.6	4.1	5.1	6.2	7.6	8.6	9.8
25-year	1.0	1.7	2.4	3.4	4.3	5.0	6.4	7.8	9.6	10.8	12.1
50-year	1.1	1.9	2.7	3.8	5.0	5.8	7.6	9.2	11.3	12.5	14.0
100-year	1.2	2.1	3.0	4.3	5.7	6.7	8.9	10.8	13.2	14.5	15.9
500-year	1.4	2.6	3.8	5.5	7.6	9.2	12.8	15.5	18.9	20.0	21.1

Region 3--Armand, Carpenters, Ceder, Clear, Galveston Bay, Goose, Jackson, Lower San Jacinto River,											
Period	5-min	15-min	30-min	1-hour	2-hour	3-hour	6-hour	12-hour	1-day	2-day	4-day
2-year	0.7	1.1	1.5	2.0	2.4	2.7	3.2	3.8	4.5	5.3	6.2
5-year	0.8	1.4	1.9	2.5	3.1	3.5	4.4	5.3	6.4	7.5	8.7
10-year	0.9	1.5	2.1	2.9	3.7	4.2	5.3	6.4	7.8	9.0	10.5
25-year	1.0	1.7	2.4	3.4	4.4	5.1	6.6	8.0	9.8	11.2	12.9
50-year	1.1	1.9	2.7	3.8	5.0	5.9	7.7	9.5	11.6	13.1	14.8
100-year	1.2	2.1	3.0	4.3	5.7	6.8	9.1	11.1	13.5	15.1	16.9
500-year	1.4	2.5	3.7	5.5	7.7	9.4	13.1	15.9	19.3	20.7	22.3