

### To the Nolan Creek Partnership:

Monthly water quality data for September 2016 and July 2017 are provided below. I plotted bacteria data in a variety of formats and in my view, nothing major “pops out.” There is a lot of variability in the data, but the good news is that bacteria concentrations are not showing increasing trends and values at all stations at times are below the criterion of 126 MPN/100 mL for primary contact recreation. Very low flows as in July 2017 and flood conditions in February 2017 are associated with bacteria concentrations above the criterion throughout the watershed. I know this is a lot of information and somewhat convoluted, so if you have questions, please let me know.

A goal of our August 17<sup>th</sup> meeting is to revisit the monitoring plan to see if we want to make changes. As a reminder, the project is funded for 24-months of monitoring at 10 stations each month. We currently have 10 stations identified as primary stations and 6 as alternates should pooled or dry conditions occur at any of the primary stations. The purpose of the monitoring is to aid in assessing sources and temporal trends in bacteria concentrations. This is an opportunity to add (and drop) stations to allow sampling at other locations.

If you cannot make it to the meeting on August 17, please feel free to provide your feedback via email to Leah ([ltaylor@tiaer.tarleton.edu](mailto:ltaylor@tiaer.tarleton.edu)) or me ([mcfarla@tiaer.tarleton.edu](mailto:mcfarla@tiaer.tarleton.edu)).

Some options that have been discussed include:

Priority Ranking (1, high to 6, low)	Monitoring Options	Comments
	No change	
	Adding a station along North Nolan Creek – This would allow an estimate of flow and bacteria concentrations (and suspected dilution) occurring with the merging of North Nolan and South Nolan Creeks as monitored at station 14237 in Yettie Polk Park in Belton.	
	Monitoring at more upstream locations along Little Nolan Creek – This was suggested assuming Little Nolan Creek is considered a “source” of bacteria along the mainstem of South Nolan Creek.	
	Making Hay Branch in Harker Heights a primary station to evaluate it as a source of bacteria between stations 11912 and 11911.	
	Making station 11908 outside of Nolanville at Levi Crossing a primary station.	
	Other – please specify	

**Primary Stations** - If station or stations are added, which primary stations would you prioritize to keep or remove.

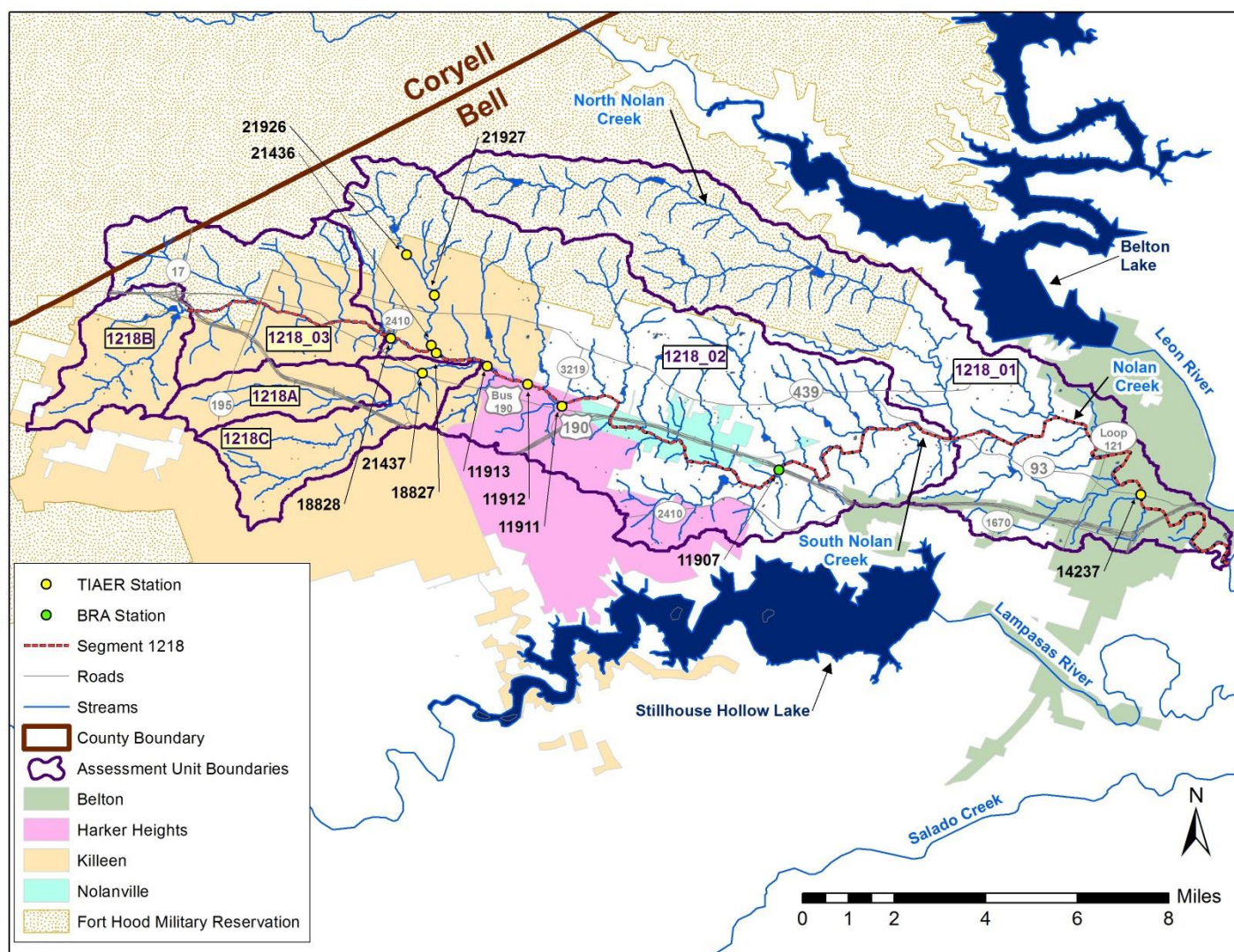
Keep or Remove	Priority for Removal (High, Medium, Low)	TCEQ ID	Site Description	Comments
		18828	South Nolan Creek at 38 <sup>th</sup> St in Killeen	
		21926	Long Branch at Tripp Trail in Killeen	
		21927	Long Branch at Lake Road in Killeen	
		21436	Long Branch just upstream of crossing of South Nolan Creek at Twin Creek Dr in Killeen	
		18827	South Nolan Creek at Twin Creek Dr in Killeen	
		21437	Little Nolan Creek off US 190 in Killeen	
		11913	South Nolan Creek at Roy Reynolds Road in Killeen	
		11912	South Nolan Creek at Amy Lane in Harker Heights	
		11911	South Nolan Creek at FM 3219 in Harker Heights	
		11907	Nolan Creek at US 190 downstream of Nolanville	
		14237	Nolan Creek at SH 93 in Belton (Yettie Polk Park)	

**Alternate Stations** (any suggested changes, please note below)

Keep or Remove	TCEQ ID	Station Description	Currently Priority Ranking <sup>1</sup>	Suggested Changes in Priority Ranking	Comments
	21960	Hay Branch in Harker Heights	1		
	21961	Unnamed Tributary to South Nolan Creek in Harker Heights just west of crossing with FM 3219	2		
	11910	South Nolan Creek at US 190 in Nolanville	3		
	11908	South Nolan Creek at Levi Crossing	4		
	18833	Unnamed Tributary of Little Nolan Creek at US 190	5		
	18834	Little Nolan Creek at US 190	6		

1. Alternate stations are used only when primary stations are pooled or dry. The priority ranking is the order considered with one first and six last. If an alternate station is also dry or pooled, or cannot be accessed for some other reason, then the next station in the priority listing is considered for sampling.

## Monitoring Update – Nolan Creek/South Nolan Creek Watershed



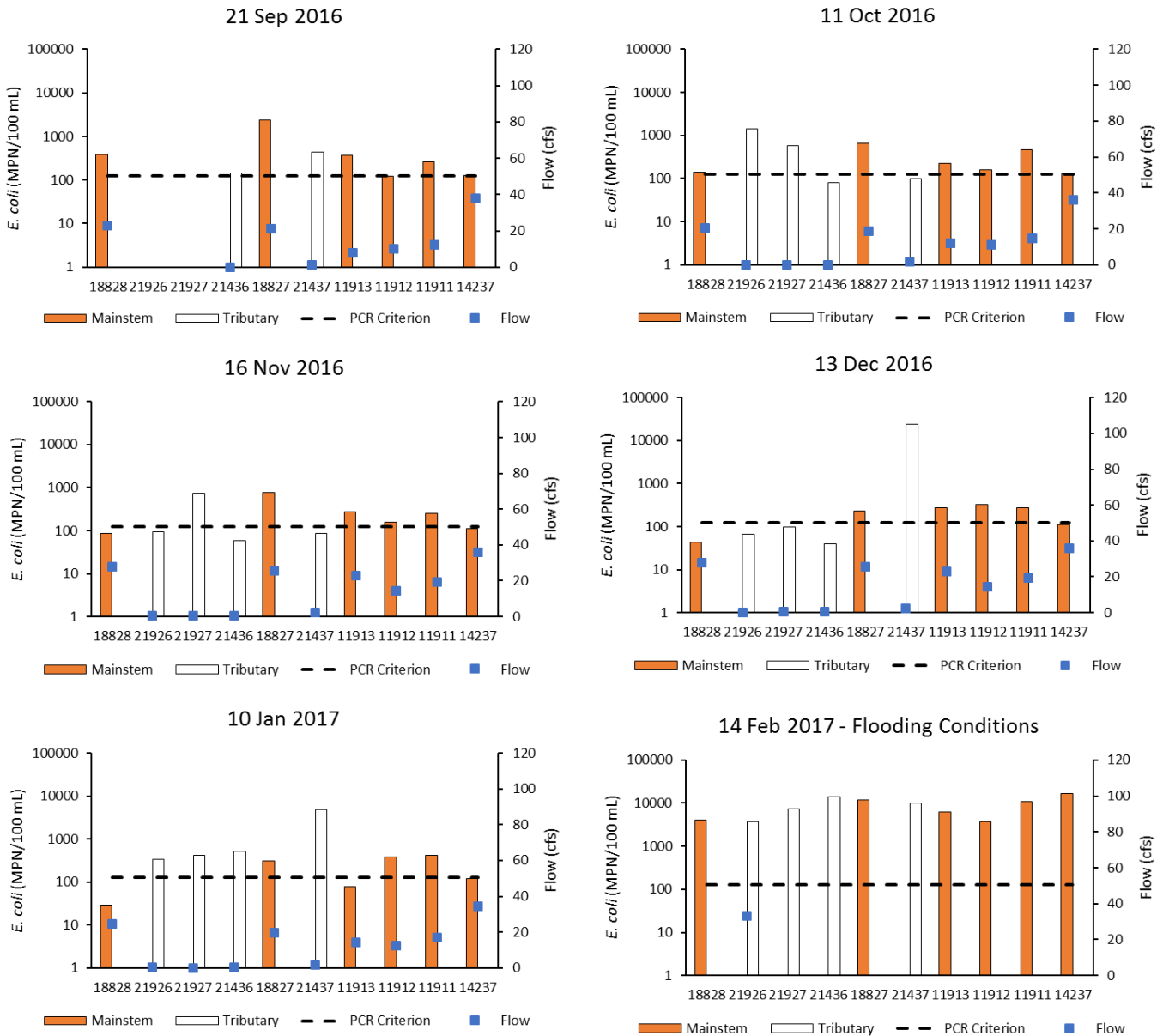
### Nolan Creek/South Nolan Creek Primary Monitoring Stations

TCEQ ID	Site Description	Latitude	Longitude
18828	South Nolan Creek at 38 <sup>th</sup> St in Killeen	31.108091	-97.702156
21926	Long Branch at Tripp Trail in Killeen	31.134587	-97.697216
21927	Long Branch at Lake Road in Killeen	31.121760	-97.688445
21436	Long Branch just upstream of crossing of South Nolan Creek at Twin Creek Dr in Killeen	31.105946	-97.689364
18827	South Nolan Creek at Twin Creek Dr in Killeen	31.103470	-97.687851
21437	Little Nolan Creek off US 190 in Killeen	31.097143	-97.692268
11913	South Nolan Creek at Roy Reynolds Road in Killeen	31.099382	-97.671748
11912	South Nolan Creek at Amy Lane in Harker Heights	31.093611	-97.658890
11911	South Nolan Creek at FM 3219 in Harker Heights	31.086666	-97.648056
11907	Nolan Creek at US 190 downstream of Nolanville	31.066560	-97.579500
14237	Nolan Creek at SH 93 in Belton (Yettie Polk Park)	31.058743	-97.464989

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## Monthly Routine Grab Data – Preliminary Results for Bacteria & Flow September 2016 – February 2017

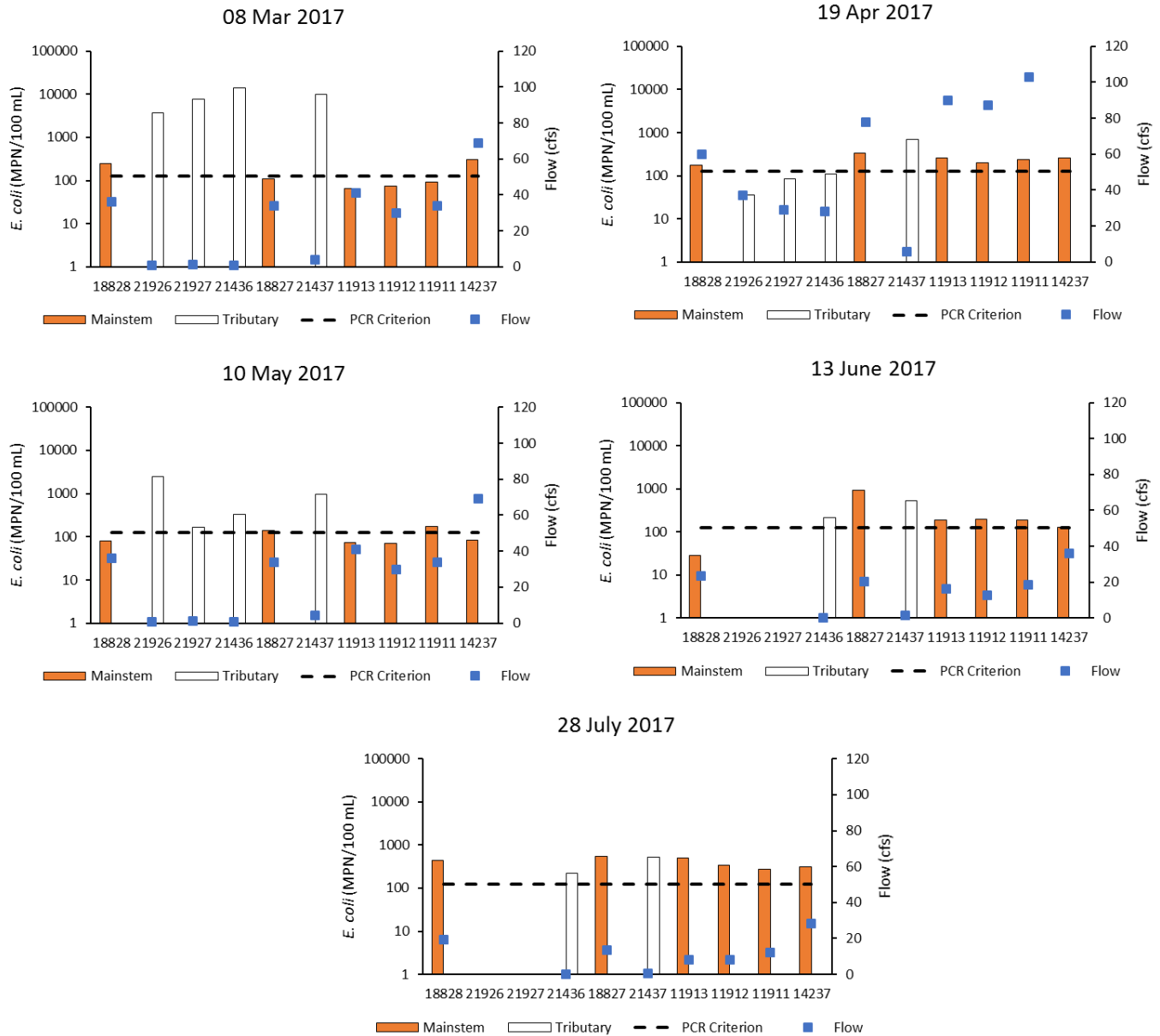
Stations presented in most upstream to downstream order from left to right.



### Notes:

- Sep. 21, 2106 – No flow at stations 21926 or 21927 on Long Branch, so no samples were collected.
- Feb. 14, 2017 – Nolan Creek/South Nolan Creek was in flood conditions, thus, flow could only be safely measured at station 21926, the most upstream site on Long Branch.

## Monthly Routine Grab Data – Preliminary Results for Bacteria & Flow March 2017 – July 2017

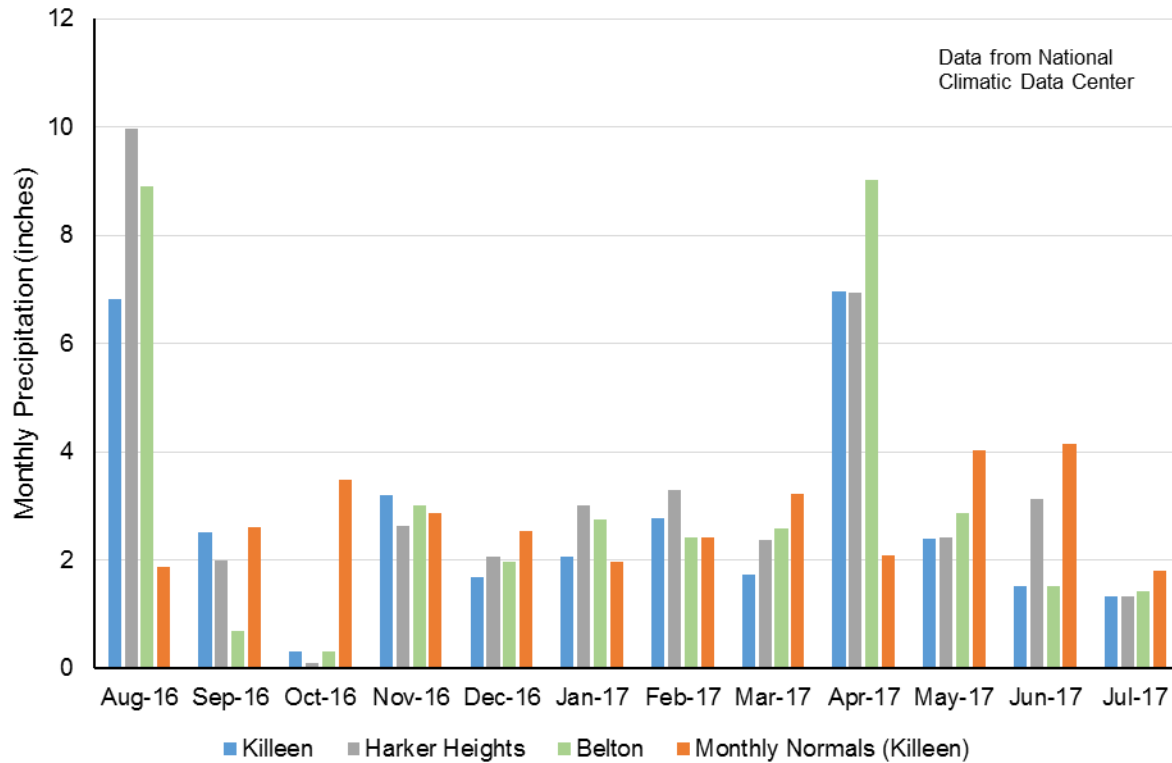


Stations presented in most upstream to downstream order from left to right.

### Notes:

- April 19, 2017 – Deep water levels prevented flow measurements at station 14237.
- June 13 and July 28, 2017 – No flow at stations 21926 or 21927 on Long Branch, so no samples were collected.

## Precipitation Conditions during the Monitoring Period



Total Precipitation Aug2016 through July 2017:

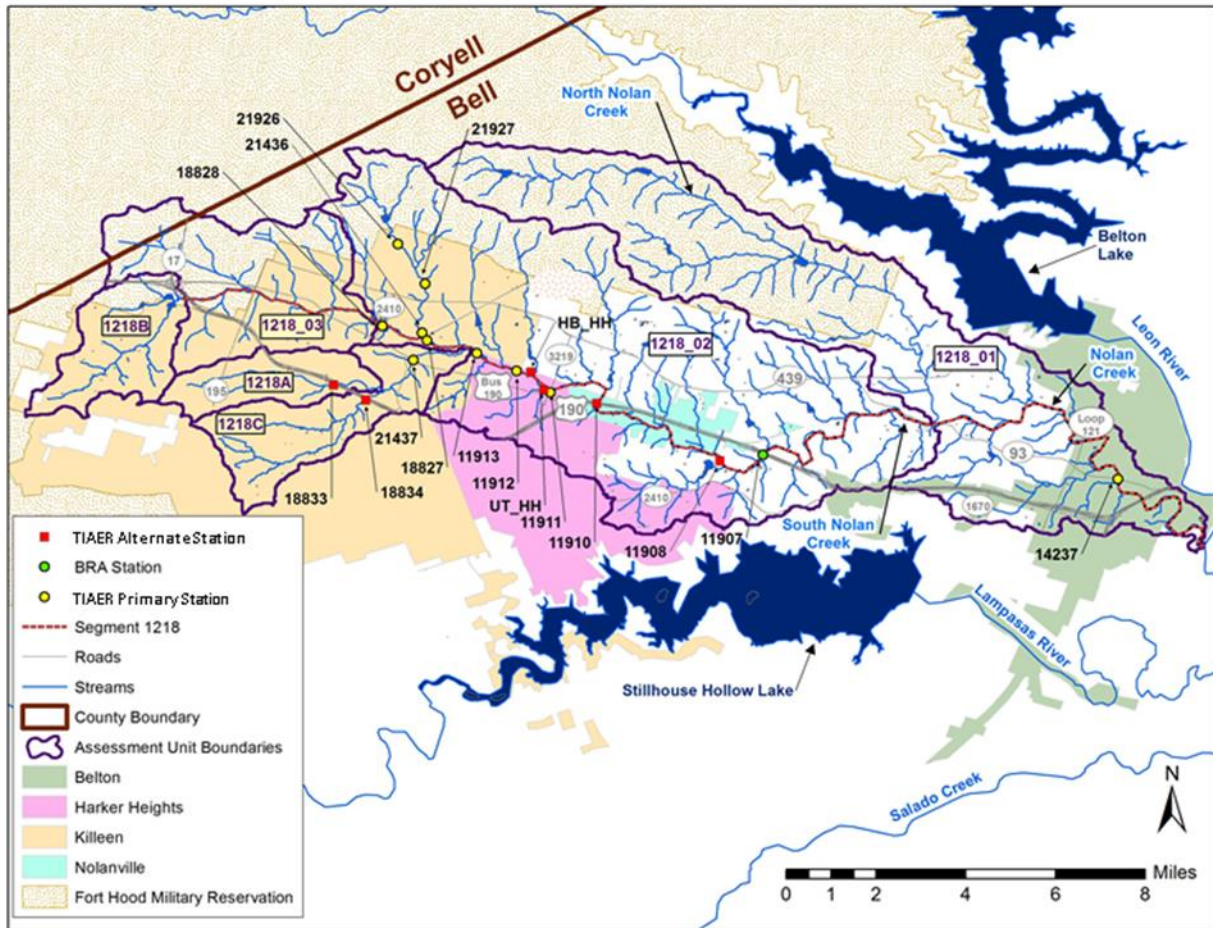
Killeen = 33.4 inches

Harker Heights = 39.2 inches

Belton = 37.5 inches

Normal Annual Precipitation for Killeen = 33.1 inches





In June and July 2017 stations 21926 and 21927 on Long Branch were pooled or dry. Samples were collected at alternative stations 11910, South Nolan Creek at US 190 in Nolanville, and 11908, South Nolan Creek at Levi Crossing. These two alternate stations are shown on the map above with a brief description given in the table below. Alternate stations 21960 on Hay Branch in Harker Heights and 21961 on an unnamed tributary in Harker Heights were also dry in June and July 2017.

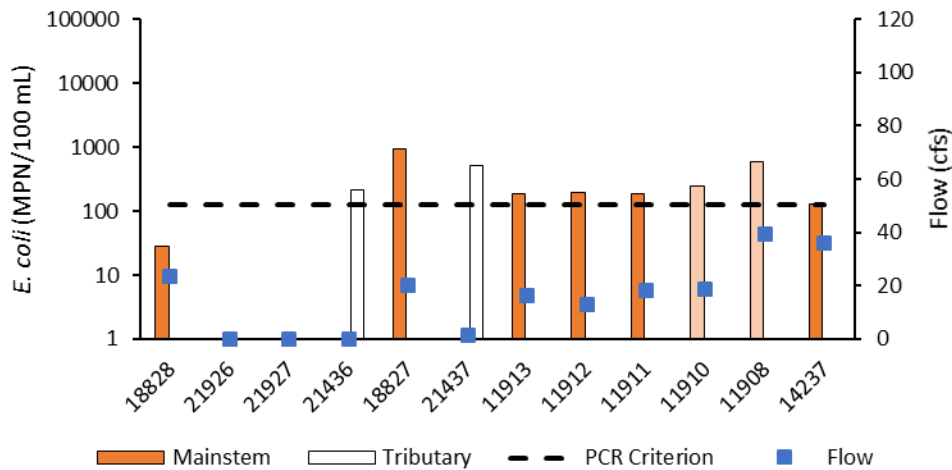
#### Alternate Monitoring Sites for when Primary Stations are Pooled or Dry

Station ID	Station Description	Priority Ranking <sup>1</sup>
21960	Hay Branch in Harker Heights	1
21961	Unnamed Tributary to South Nolan Creek in Harker Heights just west of crossing with FM 3219	2
11910	South Nolan Creek at US 190 in Nolanville	3
11908	South Nolan Creek at Levi Crossing	4
18833	Unnamed Tributary of Little Nolan Creek at US 190	5
18834	Little Nolan Creek at US 190	6

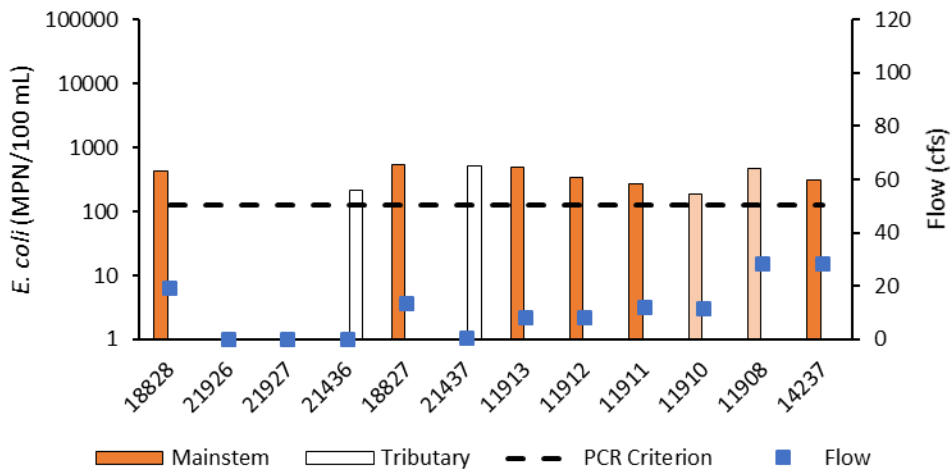
1. Alternate stations are used only when primary stations are pooled or dry. The priority ranking is the order considered with one first and six last. If an alternate station is also dry or pooled, or cannot be accessed for some other reason, then the next station in the priority listing is considered for sampling.



13 June 2017



16 July 2017



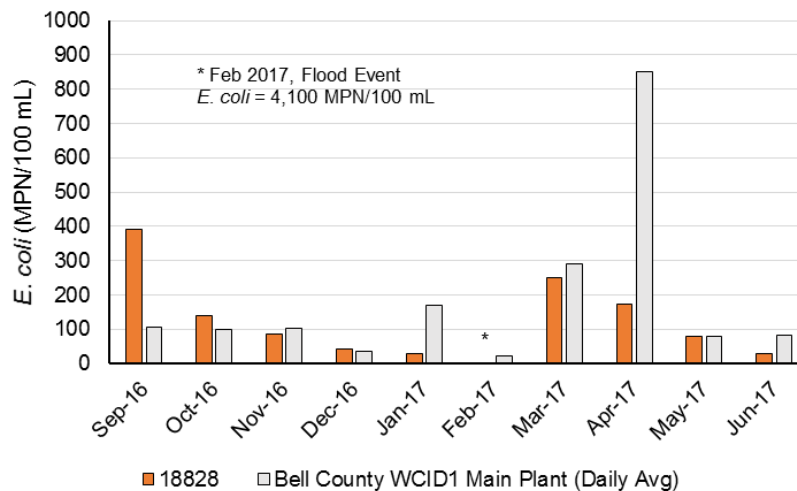
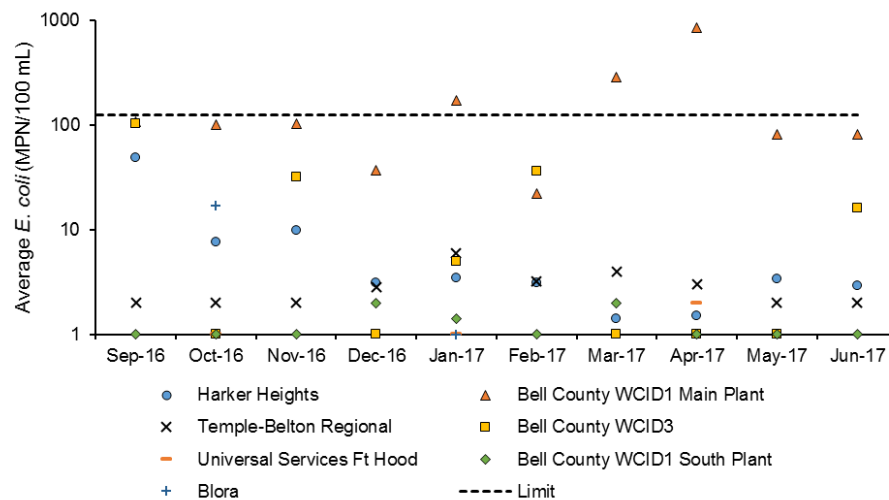
Note: Alternate stations 11910 & 11908 are on the mainstem of South Nolan Creek and are shaded a lighter orange to differentiate them from primary mainstem stations.

Increased flows between stations 11910 and 11908 are largely attributed to discharges from the Bell County WCID 1 South Plant (#3) and the Bell County WCID 3 wastewater treatment facilities.

*Station 11907 shown on the station maps with a green marker is monitored quarterly by the Brazos River Authority as part of TCEQ's Clean Rivers Program. As of August 1, 2107, only data for September 2016 were available from the TCEQ SWQMIS database. An E. coli concentration of 160 MPN/100 mL and a flow severity of 3 for normal were noted for September 16, 2016 at station 11907.*

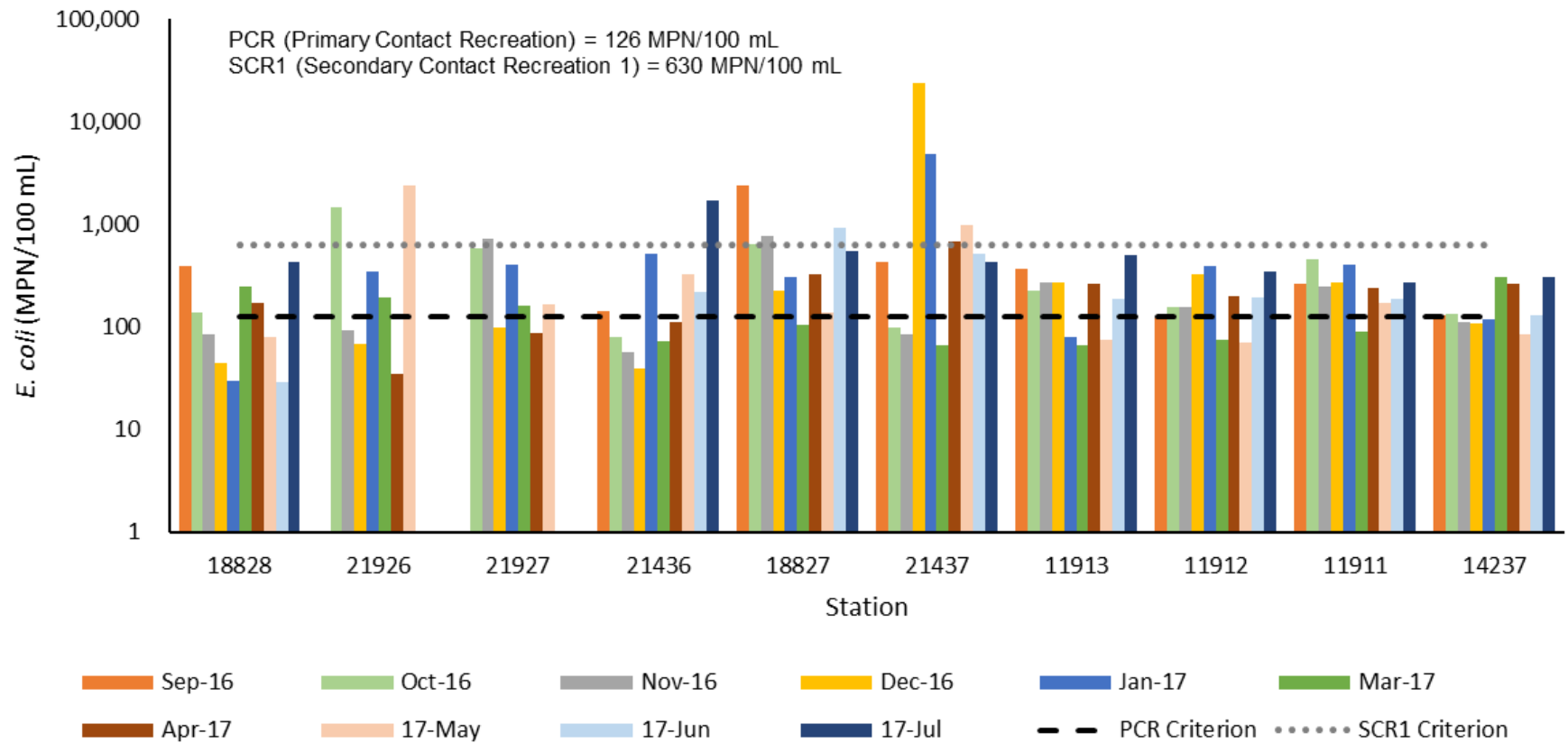
## Wastewater Treatment Facility Discharge and Reported Bacteria Concentrations

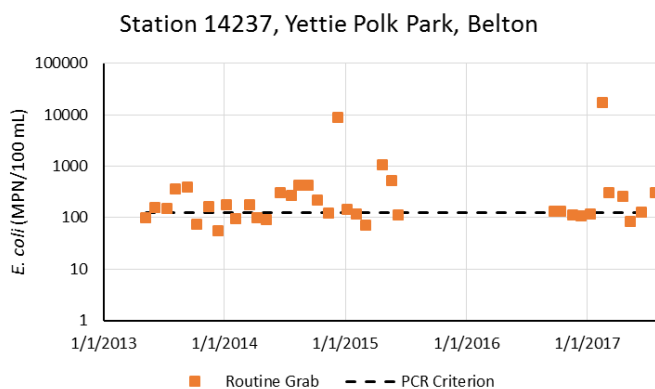
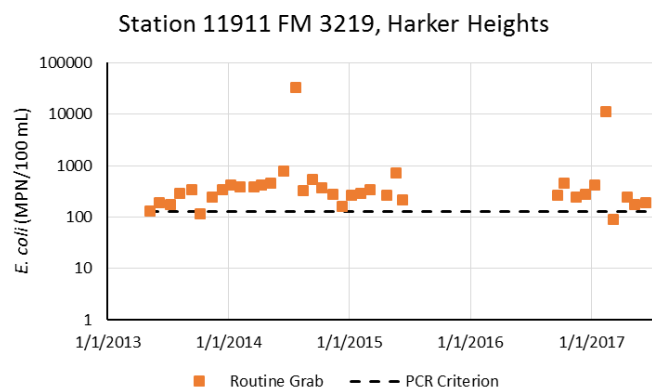
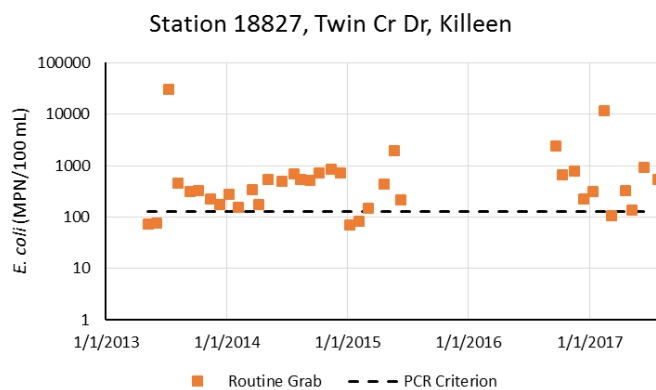
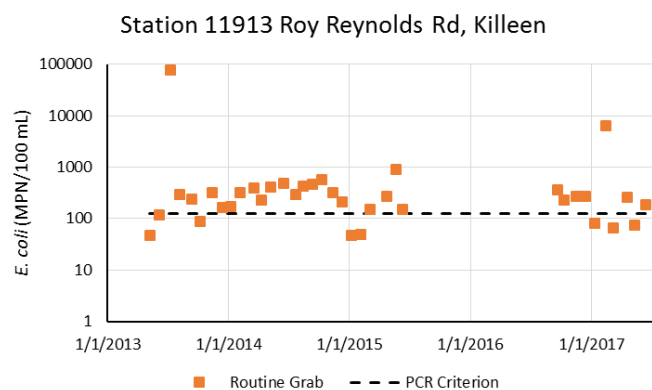
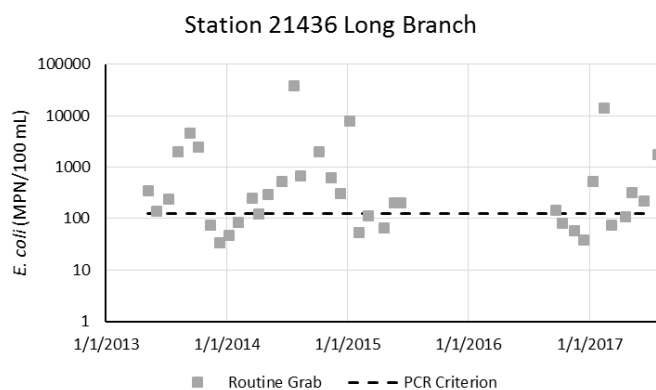
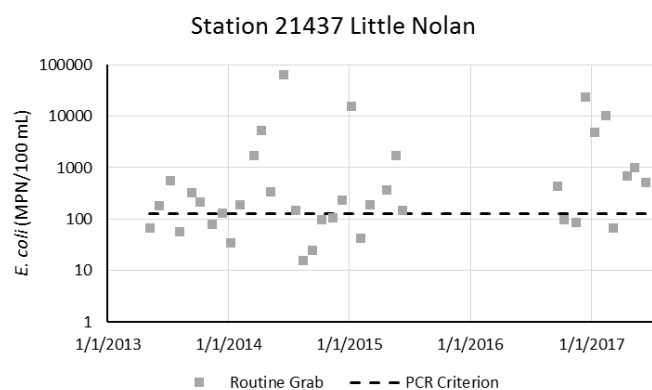
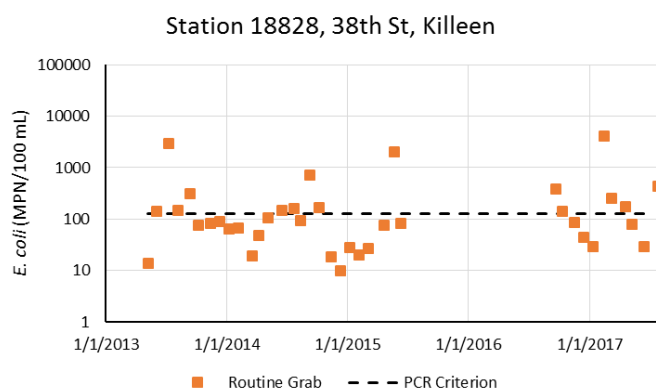
Facility Name	Facility Location	Discharge Location relative to Monitoring Stations	Latitude	Longitude	EPA ID	Permitted Discharge (MGD)	Permitted Discharge (cfs)
Universal Services Ft Hood WWTF	Ft Hood, TX	Headwaters in Segment 1218B	31.11351	-97.786686	TX0101869	0.09	0.14
Bell County WCID No. 1 (Plant 2)	Killeen, TX	Just upstream station 18828	31.10931	-97.703785	TX0102938	6	9.3
Bell County WCID No. 1 WWTF (Main Plant)	Killeen, TX	Just upstream station 18828	31.10828	-97.702507	TX0024597	18	27.9
City of Harker Heights WWTF	Harker Heights, TX	Between stations 11912 & 11911	31.09233	-97.654673	TX0024473	3	4.6
Bell County WCID No. 1 (Plant 3, South Plant)	Killeen, TX	Between alternate stations 11910 & 11908	31.07884	-97.62279	TX0125377	6	9.3
Bell County WCID No. 3 WWTF	Nolanville, TX	Between alternate stations 11910 & 11908	31.06903	-97.605045	TX0069191	0.675	1
Blora WWTF	Ft Hood, TX	North Nolan Creek	31.13052	-97.5523898	TX0132446	0.03	0.05
Temple Belton Regional WWTF	Belton, TX	Below station 14237	31.04329	-97.438697	TX0058378	10	15.5



Note: July 2017 *E. coli* data not available for WWTFs. Station 18828 at 38<sup>th</sup> St in Killeen is located directly below the discharge from the Bell County WCID 1 Main Plant.

**Monthly values September 2016 – July 2017 compared between primary monitoring stations (February 2017 values excluded due to flooding conditions)**





## Comparison of *E. coli* Concentrations over Time





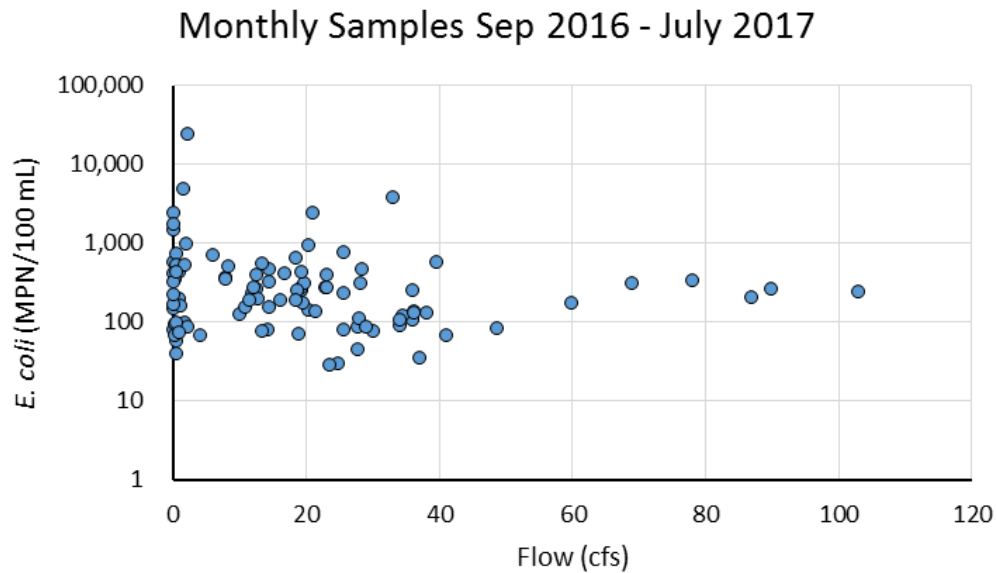
### Preliminary Data – September 2016 – July 2017

\* Geometric means presented for primary stations with and without *E. coli* concentrations from flood flows on February 14, 2017.

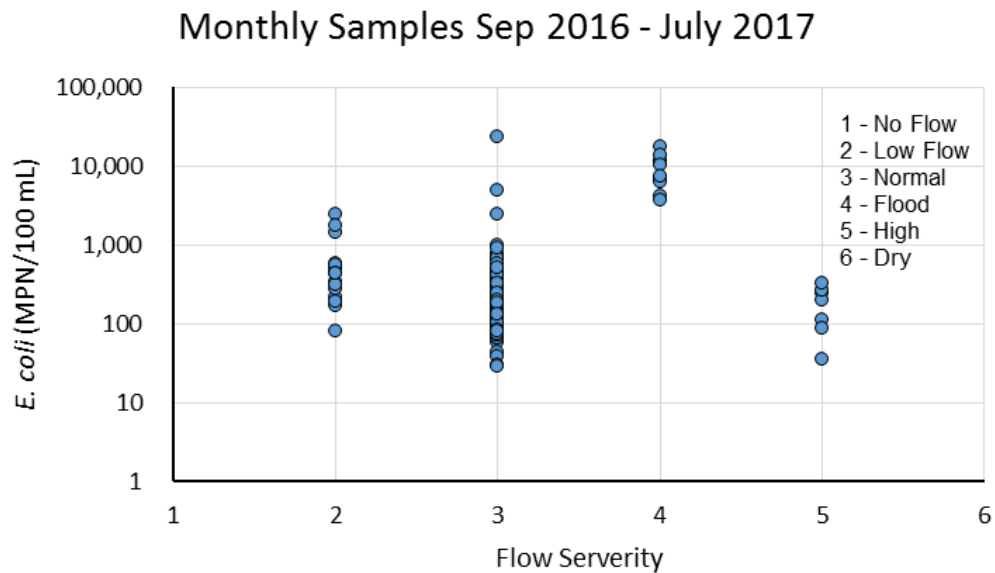
Station	Brief Station Description	Collection Date	Collection Time	Flow (cfs)	Flow Comment	<i>E. coli</i> (MPN/100mL)
18828	38th St Killeen	21-Sep-16	8:46	23		390
18828	38th St Killeen	11-Oct-16	9:19	20		140
18828	38th St Killeen	16-Nov-16	10:08	28		85
18828	38th St Killeen	13-Dec-16	10:53	28		44
18828	38th St Killeen	10-Jan-17	10:31	25		30
18828	38th St Killeen	14-Feb-17	11:17		Flood flows	4,100
18828	38th St Killeen	8-Mar-17	10:49	36		250
18828	38th St Killeen	19-Apr-17	9:31	60		172
18828	38th St Killeen	10-May-17	9:30	26		81
18828	38th St Killeen	13-Jun-17	8:56	24		29
18828	38th St Killeen	26-Jul-17	9:49	19		435
					Geomean	153/110*
21926	Long Branch, Tripp Trail	21-Sep-16	8:32	0	Dry	
21926	Long Branch, Tripp Trail	11-Oct-16	9:03	<0.1		1,500
21926	Long Branch, Tripp Trail	16-Nov-16	9:54	0.26		93
21926	Long Branch, Tripp Trail	13-Dec-16	10:39	0.26		68
21926	Long Branch, Tripp Trail	10-Jan-17	10:17	0.33		340
21926	Long Branch, Tripp Trail	14-Feb-17	11:02	33		3,700
21926	Long Branch, Tripp Trail	8-Mar-17	10:32	0.84		190
21926	Long Branch, Tripp Trail	19-Apr-17	9:18	37		35
21926	Long Branch, Tripp Trail	10-May-17	9:14	<0.1	Very low flow	2420
21926	Long Branch, Tripp Trail	13-Jun-17	NA	0	Pooled, no flow	No sample
21926	Long Branch, Tripp Trail	26-Jul-17	NA	0	Dry	No sample
					Geomean	343/244*
21927	Long Branch, Lake Rd	21-Sep-16	8:30	0	No flow	
21927	Long Branch, Lake Rd	11-Oct-16	8:48	<0.1	Very low flow	580
21927	Long Branch, Lake Rd	16-Nov-16	9:43	0.41		730
21927	Long Branch, Lake Rd	13-Dec-16	10:26	0.41		99
21927	Long Branch, Lake Rd	10-Jan-17	10:06	0.12		410
21927	Long Branch, Lake Rd	14-Feb-17	10:47		Flood flows	7,500
21927	Long Branch, Lake Rd	8-Mar-17	10:20	1.1		160
21927	Long Branch, Lake Rd	19-Apr-17	9:05	29		86
21927	Long Branch, Lake Rd	10-May-17	9:02	<0.1	Very low flow	
21927	Long Branch, Lake Rd	13-Jun-17	NA	0	Pooled, no flow	No sample
21927	Long Branch, Lake Rd	26-Jul-17	NA	0	Pooled, no flow	No sample
					Geomean	405/249*
21436	Long Branch nr Twin Ck Rd	21-Sep-16	8:27	0.10		140
21436	Long Branch nr Twin Ck Rd	11-Oct-16	8:32	0.10		80
21436	Long Branch nr Twin Ck Rd	16-Nov-16	9:30	0.55		57
21436	Long Branch nr Twin Ck Rd	13-Dec-16	10:13	0.55		39
21436	Long Branch nr Twin Ck Rd	10-Jan-17	9:53	0.40		520
21436	Long Branch nr Twin Ck Rd	14-Feb-17	10:31		Flood flows	14,000
21436	Long Branch nr Twin Ck Rd	8-Mar-17	10:05	0.9		73
21436	Long Branch nr Twin Ck Rd	19-Apr-17	8:50	28		110

Station	Brief Station Description	Collection Date	Collection Time	Flow (cfs)	Flow Comment	<i>E. coli</i> (MPN/100mL)
21436	Long Branch nr Twin Ck Rd	10-May-17	8:48	0.08		330
21436	Long Branch nr Twin Ck Rd	13-Jun-17	8:41	<0.1	Very low flow	220
21436	Long Branch nr Twin Ck Rd	26-Jul-17	9:38	<0.1	Very low flow	1700
					Geomean	244/162*
18827	Twin Ck Rd Killeen	21-Sep-16	8:16	21		2,400
18827	Twin Ck Rd Killeen	11-Oct-16	8:19	19		650
18827	Twin Ck Rd Killeen	16-Nov-16	9:23	26		770
18827	Twin Ck Rd Killeen	13-Dec-16	10:04	26		230
18827	Twin Ck Rd Killeen	10-Jan-17	9:43	20		310
18827	Twin Ck Rd Killeen	14-Feb-17	10:15		Flood flows	12,000
18827	Twin Ck Rd Killeen	8-Mar-17	9:49	34		110
18827	Twin Ck Rd Killeen	19-Apr-17	8:38	78		330
18827	Twin Ck Rd Killeen	10-May-17	8:38	21		140
18827	Twin Ck Rd Killeen	13-Jun-17	8:32	20		920
18827	Twin Ck Rd Killeen	26-Jul-17	9:31	13		550
					Geomean	583/431*
21437	Little Nolan US 190 Killeen	21-Sep-16	8:04	1.0		440
21437	Little Nolan US 190 Killeen	11-Oct-16	8:06	1.7		99
21437	Little Nolan US 190 Killeen	16-Nov-16	9:12	2.2		86
21437	Little Nolan US 190 Killeen	13-Dec-16	9:52	2.2		24,000
21437	Little Nolan US 190 Killeen	10-Jan-17	9:32	1.5		4,900
21437	Little Nolan US 190 Killeen	14-Feb-17	10:00		Flood flows	10,000
21437	Little Nolan US 190 Killeen	8-Mar-17	9:38	4.1		66
21437	Little Nolan US 190 Killeen	19-Apr-17	8:27	5.9		690
21437	Little Nolan US 190 Killeen	10-May-17	8:28	1.9		980
21437	Little Nolan US 190 Killeen	13-Jun-17	8:21	1.7		520
21437	Little Nolan US 190 Killeen	26-Jul-17	9:22	0.4		440
					Geomean	754/583*
11913	Roy Reynolds Rd Killeen	21-Sep-16	7:51	7.9		370
11913	Roy Reynolds Rd Killeen	11-Oct-16	7:51	12		230
11913	Roy Reynolds Rd Killeen	16-Nov-16	8:59	23		280
11913	Roy Reynolds Rd Killeen	13-Dec-16	9:40	23		280
11913	Roy Reynolds Rd Killeen	10-Jan-17	9:18	14		79
11913	Roy Reynolds Rd Killeen	14-Feb-17	9:44		Flood flows	6,300
11913	Roy Reynolds Rd Killeen	8-Mar-17	9:26	41		66
11913	Roy Reynolds Rd Killeen	19-Apr-17	8:13	90		260
11913	Roy Reynolds Rd Killeen	10-May-17	8:15	13		75
11913	Roy Reynolds Rd Killeen	13-Jun-17	8:09	16		190
11913	Roy Reynolds Rd Killeen	26-Jul-17	9:12	8.2		500
					Geomean	262/191*
11912	Amy Lane Harker Heights	21-Sep-16	7:36	10		120
11912	Amy Lane Harker Heights	11-Oct-16	7:33	11		160
11912	Amy Lane Harker Heights	16-Nov-16	8:45	15		160
11912	Amy Lane Harker Heights	13-Dec-16	9:09	14		330
11912	Amy Lane Harker Heights	10-Jan-17	9:03	13		390
11912	Amy Lane Harker Heights	14-Feb-17	9:24		Flood flows	6,800
11912	Amy Lane Harker Heights	8-Mar-17	9:13	30		75
11912	Amy Lane Harker Heights	19-Apr-17	7:52	87		200
11912	Amy Lane Harker Heights	10-May-17	8:02	19		71

Station	Brief Station Description	Collection Date	Collection Time	Flow (cfs)	Flow Comment	<i>E. coli</i> (MPN/100mL)
11912	Amy Lane Harker Heights	13-Jun-17	7:54	13		200
11912	Amy Lane Harker Heights	26-Jul-17	9:00	8.0		350
					Geomean	246/177*
11911	FM 3219 Harker Heights	21-Sep-16	7:23	12		260
11911	FM 3219 Harker Heights	11-Oct-16	7:18	15		460
11911	FM 3219 Harker Heights	16-Nov-16	8:32	19		250
11911	FM 3219 Harker Heights	13-Dec-16	8:53	19		280
11911	FM 3219 Harker Heights	10-Jan-17	8:48	17		410
11911	FM 3219 Harker Heights	14-Feb-17	9:04		Flood flows	11,000
11911	FM 3219 Harker Heights	8-Mar-17	9:01	34		91
11911	FM 3219 Harker Heights	19-Apr-17	7:43	103		240
11911	FM 3219 Harker Heights	10-May-17	7:49	19		170
11911	FM 3219 Harker Heights	13-Jun-17	7:41	18		190
11911	FM 3219 Harker Heights	26-Jul-17	8:50	12		270
					Geomean	341/241*
11910	US 190 in Nolanville	13-Jun-17	7:27	19	Alternate site	250
11910	US 190 in Nolanville	26-Jul-17	8:38	12	Alternate site	190
11908	Levi Crossing	13-Jun-17	7:08	40	Alternate site	580
11908	Levi Crossing	26-Jul-17	8:25	28	Alternate site	460
11907	Nolan Creek at US 190	19-Sep-16	12:10		BRA collected	160
14237	Yettie Polk Park, Belton	21-Sep-16	6:56	38		130
14237	Yettie Polk Park, Belton	11-Oct-16	6:48	36		130
14237	Yettie Polk Park, Belton	16-Nov-16	8:04	36		110
14237	Yettie Polk Park, Belton	13-Dec-16	8:26	36		110
14237	Yettie Polk Park, Belton	10-Jan-17	8:22	35		120
14237	Yettie Polk Park, Belton	14-Feb-17	8:35		flood flows	17,000
14237	Yettie Polk Park, Belton	8-Mar-17	8:36	69		310
14237	Yettie Polk Park, Belton	19-Apr-17	7:15		Too Deep to Measure	260
14237	Yettie Polk Park, Belton	10-May-17	7:25	49		84
14237	Yettie Polk Park, Belton	13-Jun-17	6:46	36		130
14237	Yettie Polk Park, Belton	26-Jul-17	8:03	28		310
					Geomean	234/152*



Note: No flow measurements collected during flood flows on February 13, 2017.



Note: Flood (4) represent samples collected February 14, 2017.

High (5) represent samples collected April 19, 2017.

Low Flow (2) represents tributary stations October 11, 2016 and May 10 and June 13, 2017; all stations on July 26, 2017.

All other events classified as with Flow Severity Normal (3).