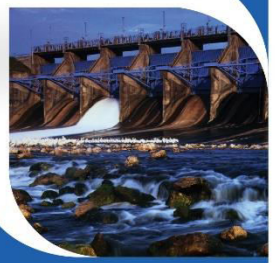
Village Creek-Lake Arlington Watershed Protection

Aaron Hoff
Trinity River Authority
September 28, 2017



Village Creek
Lake Arlington
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Trinity River Authority of Texas
Enriching the Trinity basin as a resource for Texans

Recap from Last Meeting

- Discussed Chapters 1-3 of WPP
  - Drafts approved by Steering Committee in August 2017
- Provided a water quality monitoring update on approved data from November 2016 – February 2017
  - *Angela Kilpatrick, Senior Environmental Scientist - Trinity River Authority*
- Demonstrated WikiWatershed's "Model My Watershed" Tool
- Check the website for last meeting's presentations
  - http://www.trinityra.org/lakearlingtonvillagecreek

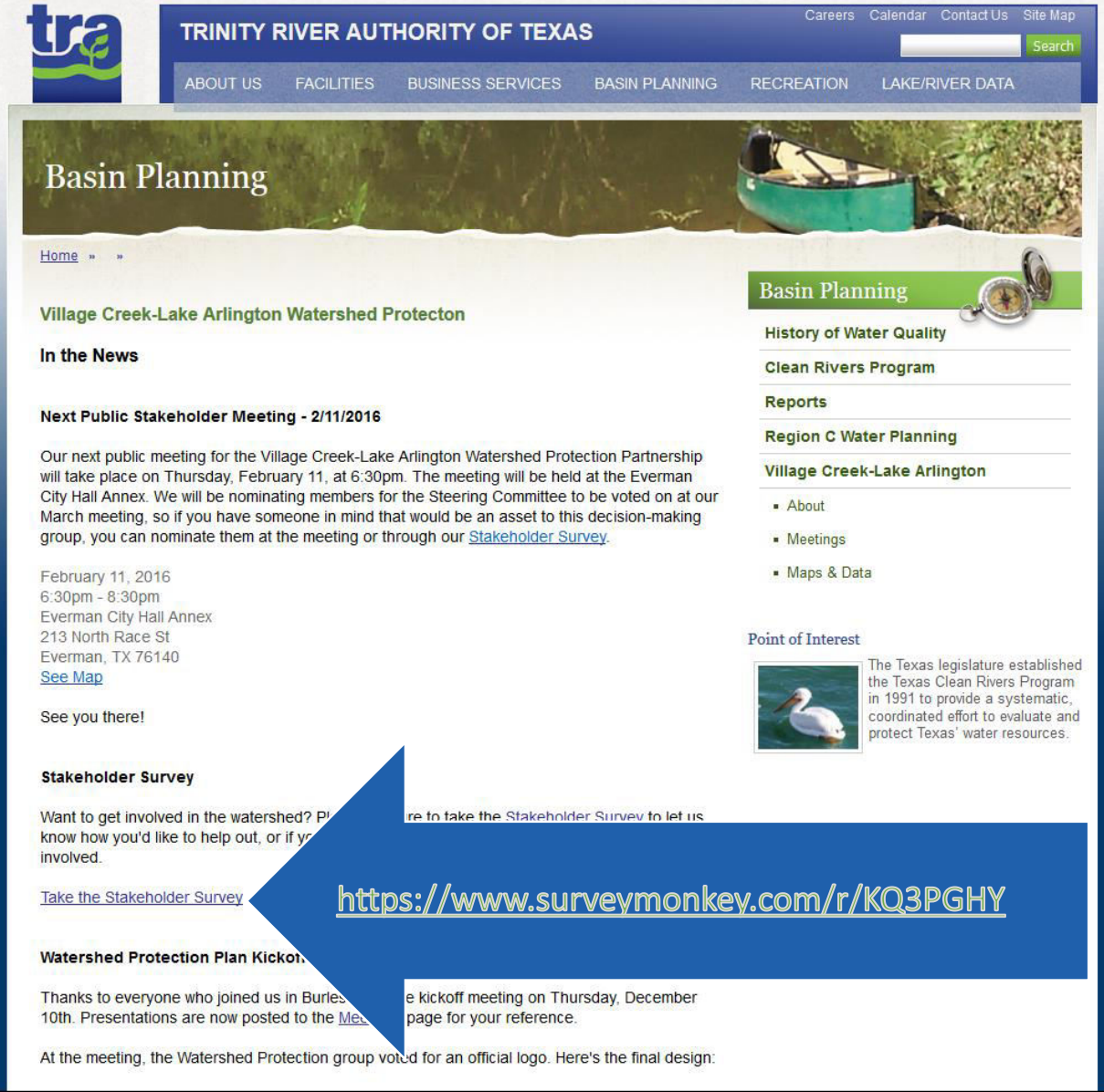
Meeting Overview

- SELECT Inputs Discussion
  - *Open forum w/ all Partnership members*
- Final Water Quality Monitoring Update
  - *Aaron Hoff, Watershed Coordinator - Trinity River Authority*
- Upcoming Events and Meetings
  - *Aaron Hoff, Watershed Coordinator - Trinity River Authority*
- Open Discussion and Closing Comments

Ground Rules for Discussion Periods

- Please save questions until after each presentation has been given (unless speaker says otherwise)
- Any additional questions may be answered during the open discussion period at the end
- Please be respectful of others' time and points of view

http://www.trinityra.org/lakearlingtonvillagecreek



Funding Source

ARLINGTON
THE AMERICAN DREAM CITY

EPA United States Environmental Protection Agency

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Funding provided by the Texas Commission on Environmental Quality through a Clean Water Act Section 319(h) grant from the U.S. Environmental Protection Agency, with match funding from the City of Arlington and in-kind contributions from TRA.

Let’s get started!

http://www.trinityra.org/lakearlingtonvillagecreek

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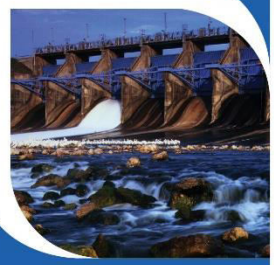

SELECT Inputs and Methods

Aaron Hoff
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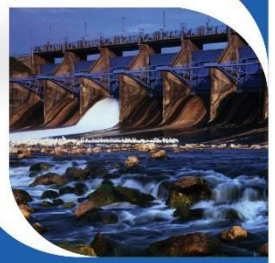

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Game Plan

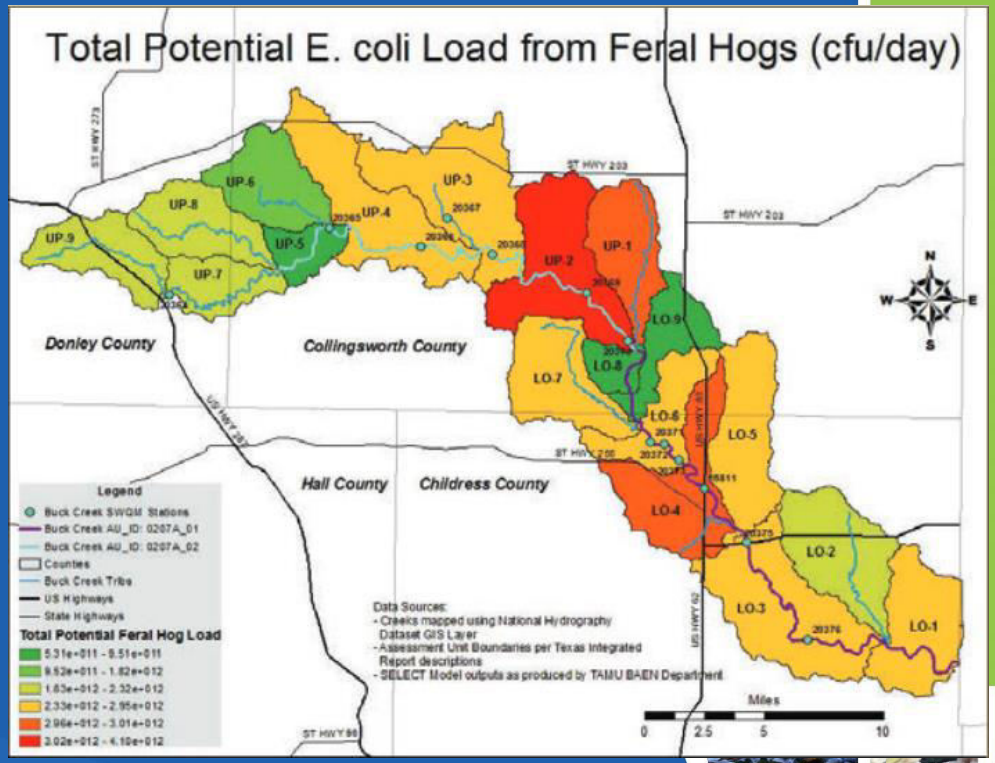
- Data inputs for SELECT modules derived from
  - Industry/agency data
  - TAG recommendations
  - Past WPP reports
- Steering Committee
  - Suggested modifications
  - Approved by consensus
- Committee-approved inputs presented to Partnership for consideration and modification
- Approved inputs used in SELECT to predict *E. coli* loads for selected sources throughout the watershed
- Will present final results to Committee for approval at Nov/Dec meeting

SELECT Refresher

- Spatially Explicit Load Enrichment Calculation Tool (SELECT)
- Analytical approach for determining potential bacterial loads in specific areas of a watershed
- Spatial data inputs
  - Land use data
  - Population data (human and animal)
- Literature values for fecal production rates
- SELECT does *not* account for any natural or anthropogenic mitigation processes
  - Results in an overestimation of potential sources
  - Provides a “worst-case scenario”

Provides visual output

- Evaluates selected pollutant sources separately
- Determines which “catchments” have the greatest contribution to the overall pollutant load
- Targets areas for potential management practices

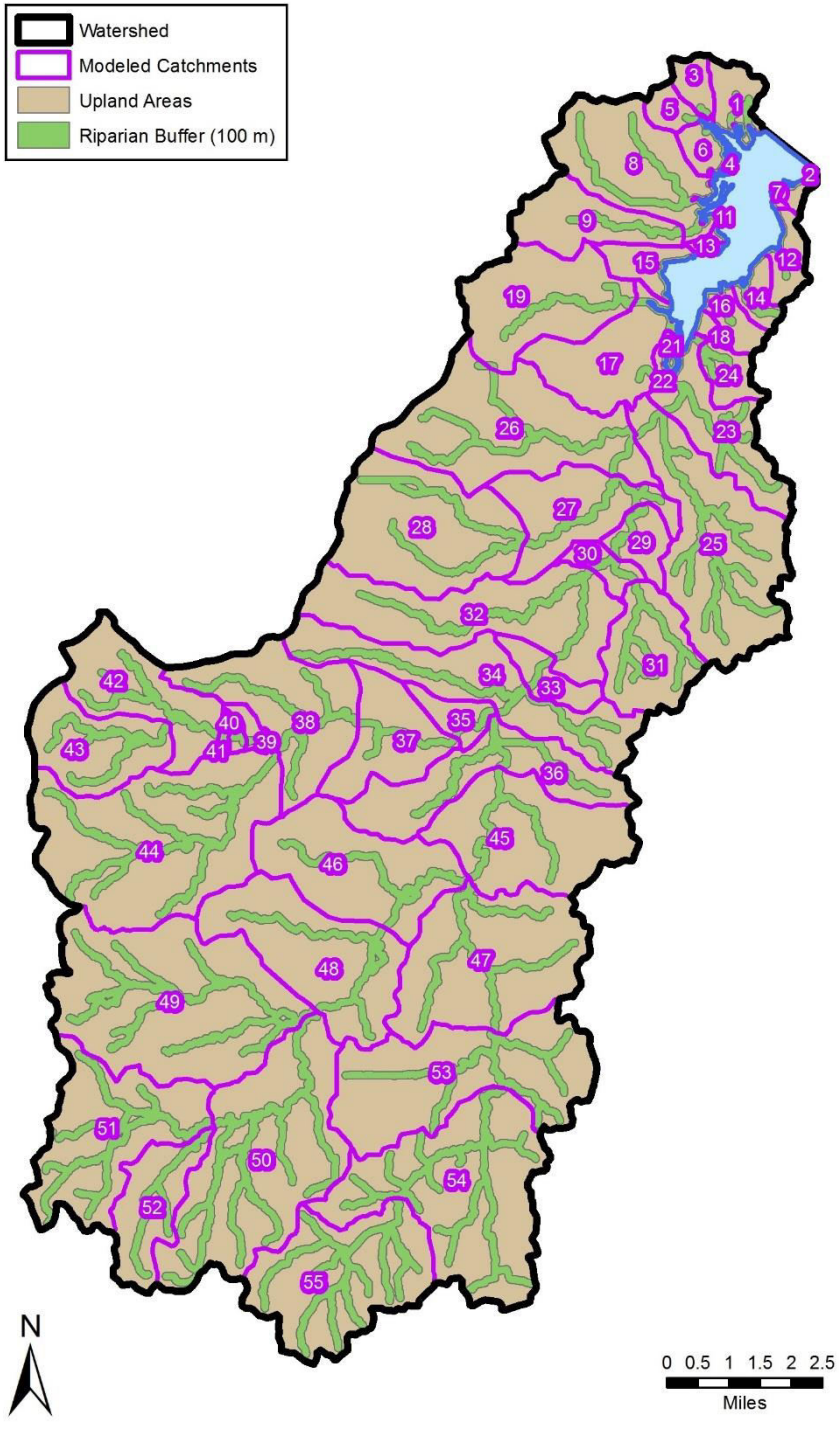


Source: Buck Creek Watershed Protection Plan

“Worst-case scenario” revisited

- Logic follows – sources further from stream will have less influence on load
- Distance from *E. coli* source (the “poop point”) to stream isn’t taken into account automatically
- “Artificially” account for this to a small degree by using a stream buffer
  - Within buffer zone = more influence
  - Outside buffer zone = less influence

- Used catchments developed during the Lake Arlington Master Plan (LAMP) effort
  - 55 catchments
  - used for consistency
- National Hydrography Database (NHD) layer used for streams
- Built a 330-ft (~100-m) buffer around NHD streams
- Inside buffer
  - “riparian band”
  - More *E. coli* reaches stream
- Outside buffer
  - “upland areas”
  - Less *E. coli* reaches stream



Population Density Estimates

- Used to estimate E. coli load contributions
- Animal estimates strongly tied to land use/land cover type
- 1 of 2 main drivers of the SELECT analysis
- Assists with future resource management
- Preliminary estimates calculated for:
  - Cattle
  - Sheep/goats
  - Equine species
  - Deer
  - Feral hogs
  - Domestic dogs
  - Septic Systems (OSSFs)

Where does population data come from?

- Existing datasets
  - U.S. Census Bureau – human population
  - USDA – cattle, sheep/goats, equine species
  - TPWD – deer population density
  - Counties – permitted OSSFs, household address data
  - Texas AgriLife Extension – feral hog population
- Stakeholder input
  - First-hand experience is better than extrapolated national numbers
  - What's your opinion?

Trim Datasets to Watershed

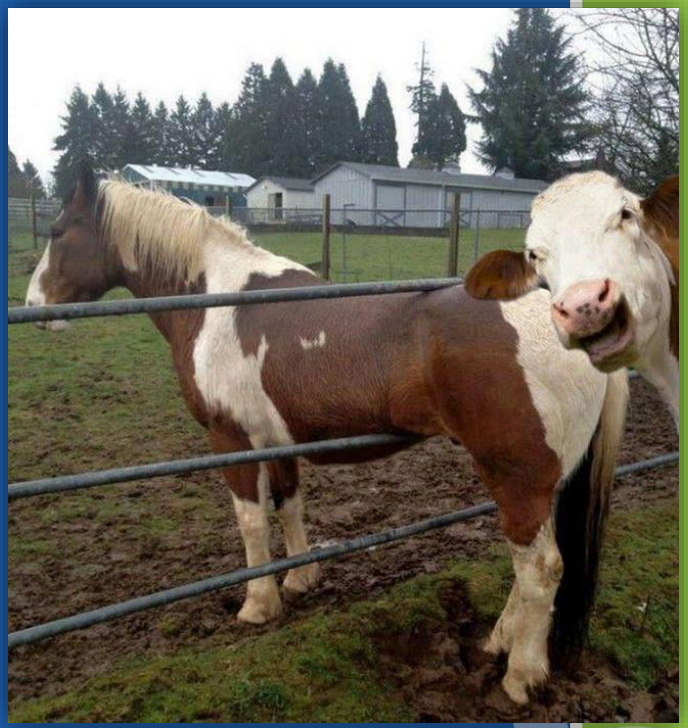
Example: county-level data

- Watershed spans two counties
- Lots of county area outside watershed
- Population approximation by percentage area

County	Total Acres	Acres in Watershed	% of County	% of Watershed
Johnson	469,644.70	35,505.36	7.56%	38.84%
Tarrant	575,125.28	55,897.29	9.72%	61.16%
Total	1,044,769.98	91,402.65		100%

Domestic Animals - NASS

- National Agricultural Statistics Survey
- Conducted by USDA to measure national ag production
  - Unlikely to include “hobby animals” and 4-H projects
- Census of Agriculture
  - Conducted every 5 yrs
  - 2012 is latest full survey published
  - Interim surveys for some species (usually production animals)



Cattle

- NASS Data (2012)
  - 6,488 head in watershed
    - County numbers scaled down to illustrate estimate of cattle only in the watershed
    - limited to grassland and pasture land classes
  - Average watershed density = 34.2 ac per animal
- NRCS Recommendations
  - Animal Unit (AU) = 1,000-lb cow + calf
  - Managed pasture = 3-6 ac/AU
    - 41,753 acres / 6 ac/AU = 6,959 AU
  - Rangeland = 8-15 ac/AU
    - 116,590 acres / 15 ac/AU = 7,773 AU
  - Total AU = 14,732
- Committee recommendation
  - Use NASS Data estimate

Equine Species

- NASS Data (2012)
  - 1,037 head in watershed
    - includes horses, ponies, mules, donkeys, burros
    - County numbers scaled down to illustrate estimate of only in the watershed
    - limited to 100% of grassland and 90% of pasture land classes
  - Average watershed density = 148.9 ac per animal
- Committee recommendation
  - ~2500 head in watershed
  - Attempt to include ‘small acreage’ (non-ag) owners that may not receive NASS
  - Include small 5% of low-density development in estimate?

Sheep & Goats

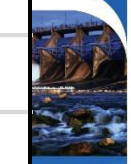
- NASS Data (2012)
  - 839 head in watershed
    - County numbers scaled down to illustrate estimate of only in the watershed
    - limited to 100% of grassland and 90% of pasture land classes
  - Average watershed density = 227.7 ac per animal
- Committee recommendation
  - ~2500 head in watershed
  - Attempt to include ‘small acreage’ (non-ag) owners that may not receive NASS
  - Include small 5% of low-density development in estimate?

Deer - Resource Management Units

- TPWD conducts deer counts annually and quantifies numbers at the RMU level
- RMU is an area that is ecologically similar and supports similar animal populations
  - 33 RMUs across the state
  - Open water and heavy development excluded
- VCLA watershed located wholly within RMU #22
- Committee recommendation
  - Use 53.7 ac/deer
  - Follow habitat application similar to TPWD's

- Densities applied to "acceptable habitat"
  - At 53.7 ac/deer = 1461 deer
  - At 102.4 ac/deer = 766 deer

RMU 22 - 3 yr. average (in acres/deer)	
Density	53.7
Lower 95%	102.4
Upper 95%	28.3



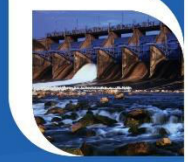
Feral Hogs

- No agency conducts official hog population estimates
- Texas A&M/Institute of Renewable Natural Resources (IRNR) study provides several estimates
- Hogs assumed to utilize riparian zones in all land uses minus open water, heavily developed areas
- Used statewide average and developed high/median/low population density estimates

Feral Hogs

- TAMU/IRNR Densities
  - High: 38.9 ac/hog
  - Med: 50.4 ac/hog
  - Low: 71.5 ac/hog

- VCLA Estimates
  - Riparian buffer only
    - All land uses (excludes lake)
    - High: 474 hogs
    - Med: 366 hogs
    - Low: 258 hogs
  - Committee Recommendation
    - Riparian + forested uplands
    - High: 692 hogs
    - Med: 534 hogs
    - Low: 376 hogs



Permitted Septic Systems (OSSFs)

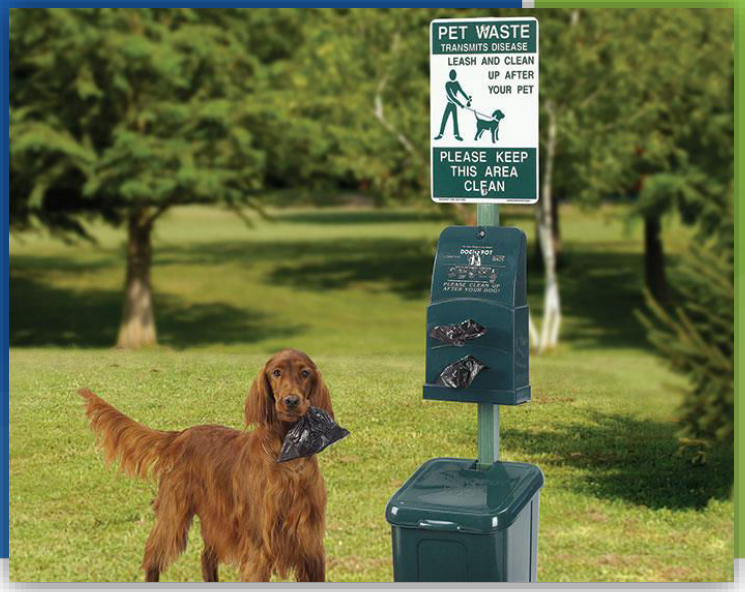
- Tarrant County – GIS layer provided by NCTCOG
- Johnson County – digitized from PDFs provided by County
- Clipped to watershed
- Spot-checked points mapped on road centerlines to verify mis-mapped addresses
  - Common near new road construction areas
  - Used property parcels to correct locations

Unpermitted OSSFs

- Estimate # of buildings in watershed
  - Johnson Co. - 9-1-1 addresses
  - Tarrant Co. - property parcel centroids
- Removed points within Certificates of Convenience & Necessity (CCN) zones
- Removed points potentially serviced by known municipal sewer lines
- Removed other ‘false positives’
  - Vacant lots, right-of-way splits
  - Oilfield pads
  - Ag fields, rangeland
- Remove overlapping points for known permits
- For every known (permitted) OSSF, there are two properties that do not have an associated permit

Dogs and Cats

- Start w/ 9-1-1 address/parcel centroids again (similar to OSSFs)
- American Veterinary Medical Association
  - Estimates 37.2% of households own dogs
  - Average dogs per household is 1.7
- Other WPPs (mostly rural) use 1 dog/household
- Committee Recommendation
  - Use AVMA estimate
  - Also apply to cats
    - Feral, barn, outdoor cats



Other Minor Sources

- Fecal deposition that occurs intermittently and may not be tied to land use
  - Direct human deposition near/under bridges
  - Also deposition from bridge-nesting birds
  - Other sources?
- May not be modeled in SELECT
- Will be addressed in WPP and Final Report
  - Potential impacts
  - Partnership's BMP recommendations

Loading Rates

Table 2. Calculation of potential *E. coli* loads from various sources in the watershed.

Source	Calculation
Cattle	$EC = \#\,\text{cattle} \cdot 2.7 \cdot 10^{9}\ \text{cfu}\ \text{d}^{-1}\ \text{head}^{-1}$
Horses	$EC = \#\,\text{horses} \cdot 2.1 \cdot 10^{8}\ \text{cfu}\ \text{d}^{-1}\ \text{head}^{-1}$
Sheep and goats	$EC = \#\,\text{sheep} \cdot 9 \cdot 10^{9}\ \text{cfu}\ \text{d}^{-1}\ \text{head}^{-1}$
Deer	$EC = \#\,\text{deer} \cdot 1.75 \cdot 10^{8}\ \text{cfu}\ \text{d}^{-1}\ \text{head}^{-1}$
Feral hogs	$EC = \#\,\text{hogs} \cdot 4.45 \cdot 10^{9}\ \text{cfu}\ \text{d}^{-1}\ \text{head}^{-1}$
Dogs	$EC = \#\,\text{households} \cdot \frac{0.8\ \text{dogs}}{\text{household}} \cdot 2.5 \cdot 10^{9}\ \text{cfu}\ \text{d}^{-1}\ \text{head}^{-1}$
Failing septic systems	$EC = \#\,\text{failing systems} \cdot \frac{5 \cdot 10^{5}\ \text{cfu}}{100\ \text{mL}} \cdot \frac{2.65 \cdot 10^{5}\ \text{mL}}{\text{person/day}} \cdot \frac{\text{Avg}\ \#\ \text{persons}}{\text{household}}$
WWTP	$EC = \text{permitted MGD} \cdot \frac{126\ \text{cfu}}{100\ \text{mL}} \cdot \frac{10^{6}\ \text{gal}}{\text{MGD}} \cdot \frac{3758.2\ \text{mL}}{\text{gal}}$

Moving Forward

- Partnership makes additional recommendations
  - Population densities
  - Application areas
- Watershed Coordinator will review recommendations with TAG
- Committee will approve methods and review initial results at Nov/Dec Meeting
- SELECT results presented for consideration at Partnership meeting in January

Questions?

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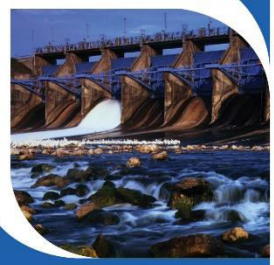

Water Quality Monitoring Results

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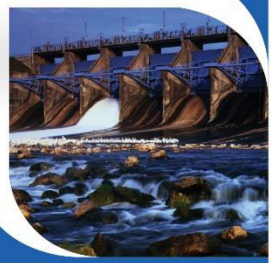

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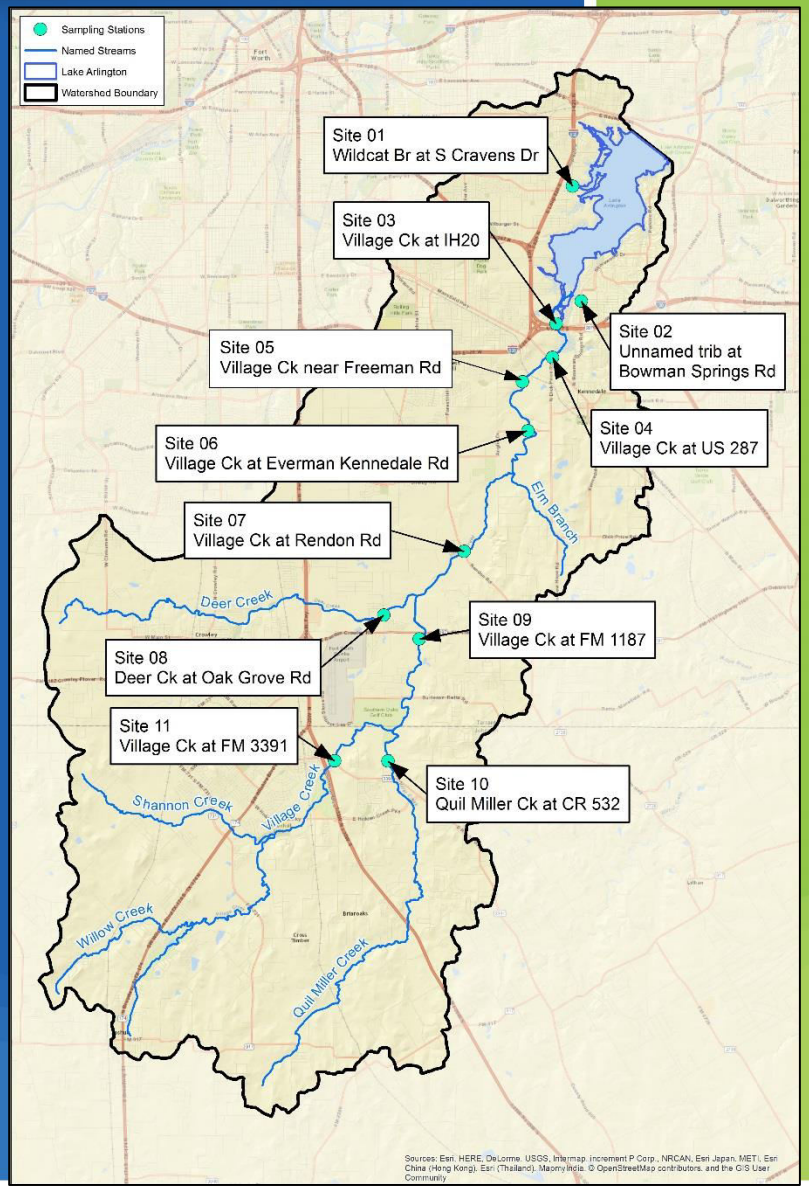
Monitoring Plan and Lab Analysis

- Samples collected by PES staff are dropped off at CRWS lab for analysis of:
  - *E. coli*
  - Nitrate, Nitrite, Total Kjeldahl Nitrogen
  - Total Phosphorus, Orthophosphate
  - Chlorophyll a
  - TDS, TSS, VSS
- QC-approved data



Evaluation Criteria

Analytical results were compared to TCEQ's water quality standards and screening levels to determine if values exceeded criteria

Site-specific Water Quality Criteria for the Village Creek-Lake Arlington Watershed (TCEQ)

Parameter	Segment ID	
	0828	0828A
Cl-1 (mg/L)	100	100
SO4-2 (mg/L)	100	-
TDS (mg/L)	300	300
DO (mg/L) grab minimum	3.0	2.0
DO (mg/L) 24 hour average	5.0	3.0
DO (mg/L) 24 hour minimum	3.0	2.0
pH range	6.5-9.0	6.5-9.0
E. coli #/100ml	126	126
Temperature (°F; °C)	95; 35	95; 35

Texas Nutrient Screening Levels and EPA Nutrient Reference Criteria

Parameter		TCEQ Screening Levels		EPA Reference Criteria				Other Sources
		Lake/Reservoir	Stream	Lake/Reservoir		Stream		
TKN	(mg/L)	-	-	0.38[a]	0.41[b]	0.3[a]	0.4[b]	
NO_2	(mg/L)	-	-	-	-	-	-	0.02[c]
NO_3	(mg/L)	0.37	1.95	-	-	-	-	
NO_2+NO_3	(mg/L)	-	-	0.017[a]	0.01[b]	0.125[a]	0.078[b]	
TP	(mg/L)	0.20	0.69	0.02[a]	0.019[b]	0.037[a]	0.038[b]	
OP	(mg/L)	0.05	0.37	-	-	-	-	
Chl-a[d]	(µg/L)	26.7	14.1	5.18[a]	2.875[b]	0.93[a]	1.238[b]	

[a] Reference conditions for aggregate Ecoregion IX waterbodies, upper 25th percentile of data from all seasons, 1990-1999.

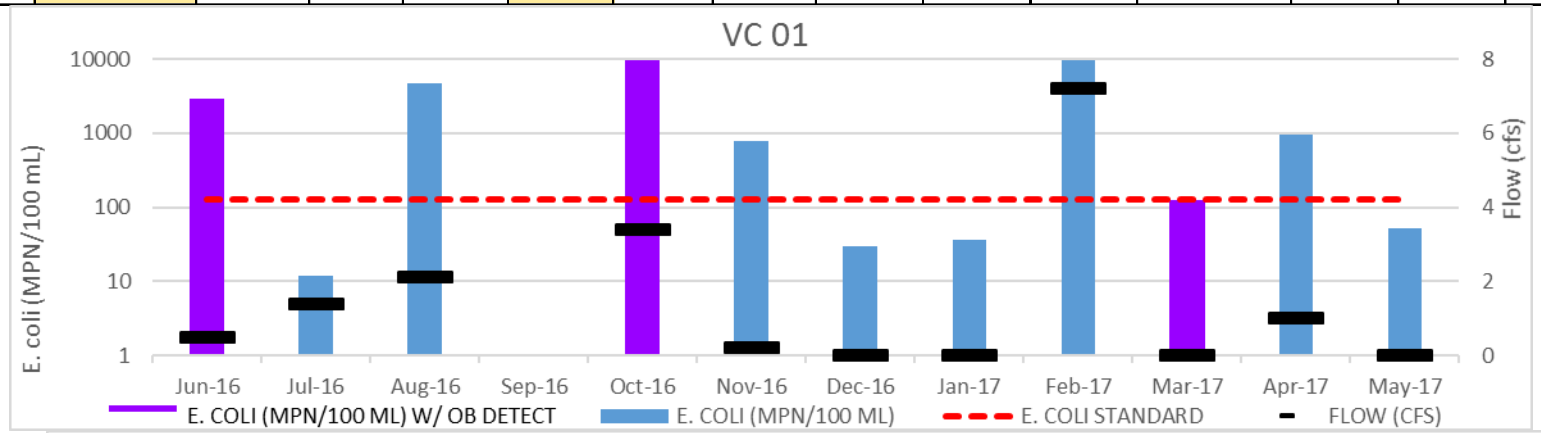
[b] Reference conditions for level III Ecoregion 29 waterbodies, upper 25th percentile of data from all seasons.

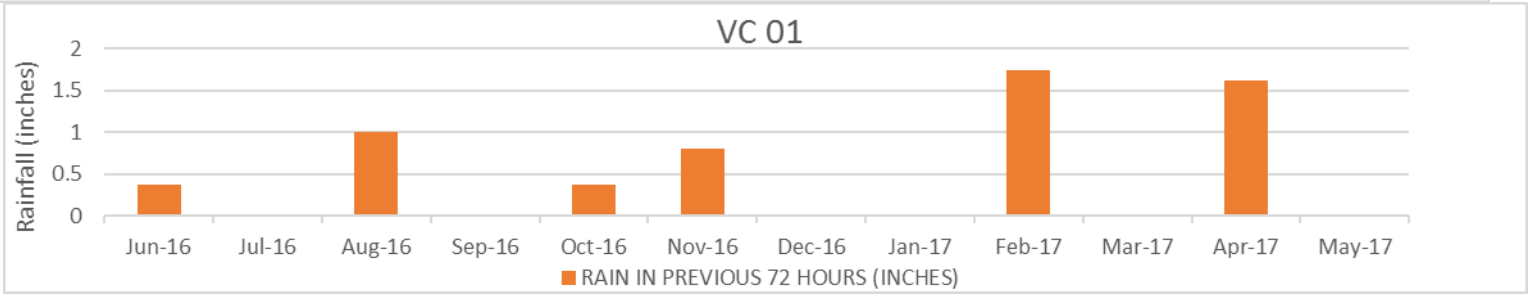
[c] For nitrite, concentrations above 0.02 mg/L (ppm) usually indicate polluted waters (Mesner, N., J. Geiger. 2010. Understanding Your Watershed: Nitrogen. Utah State University, Water Quality Extension.

[d] Chlorophyll a, as measured by Spectrophotometric method with acid correction.

Site 1 – Wildcat Branch at Cravens

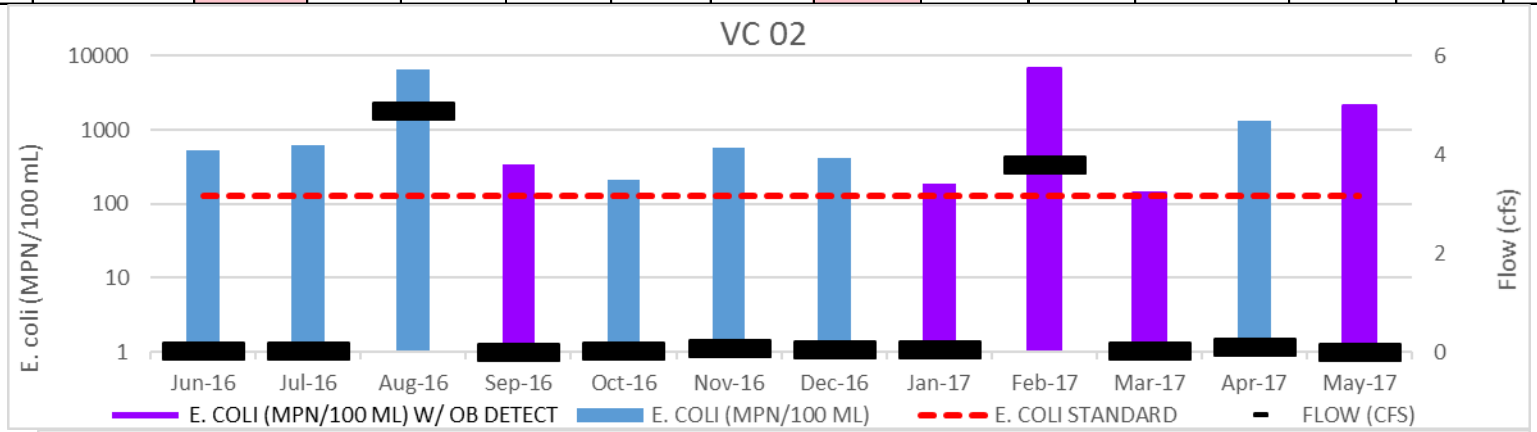
DATE	CHLOROPHYLL-A (UG/L)	E. COLI (MPN/100 ML)	NITRATE (MG/L)	NITRITE (MG/L)	TKN (MG/L)	OP (MG/L)	TP (MG/L)	TDS (MG/L)	TSS (MG/L)	VSS (MG/L)	OBs DETECTED (1=YES, 0=NO)	24 HR RAIN (INCHES)	72 HR RAIN (INCHES)	FLOW (CFS)
6/29/2016	17	2909	0.25	< 0.05	1.08	0.04	0.14	164	10	< 3	1	0.375	0.375	0.5
7/19/2016	17	12	< 0.05	< 0.05	0.65	< 0.02	0.04	244	7	3	0	0	0	1.4
8/15/2016	4	>4800	0.33	< 0.05	0.82	0.03	0.09	187	12	< 8	0	0.63	1	2.1
10/20/2016	<3	>9700	0.41	< 0.05	1.35	0.08	0.22	144	58	10	1	0.375	0.375	3.4
11/9/2016	3	770	0.12	< 0.05	0.55	0.03	0.06	194	3	< 2	0	0.055	0.805	0.2
12/14/2016	< 3	30	< 0.05	< 0.05	0.37	< 0.02	0.05	367	4	< 2	0	0	0	< 0.01
1/10/2017	< 3	37	< 0.05	< 0.05	0.6	0.04	0.09	339	6	< 3	0	0	0	0
2/14/2017	< 3	9700	0.57	< 0.05		0.25	0.34	130	26	< 4	0	1.75	1.75	7.2
3/28/2017	31	120	< 0.05	< 0.05	1.17	< 0.02	0.09	238	8	4	1	0	0	0
4/3/2017	5	9700	0.19	< 0.05	0.8	0.05	0.19	123	38	< 6	0	1.25	1.625	1
5/9/2017	66	52	< 0.05	< 0.05	1.69	< 0.02	0.12	227	20	9	0	0	0	0

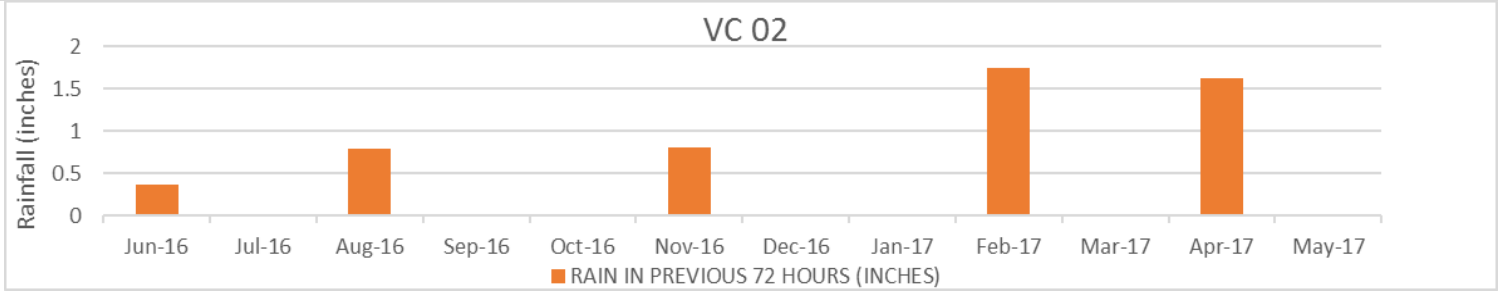




Site 2 – Unnamed trib at Bowman Springs Rd

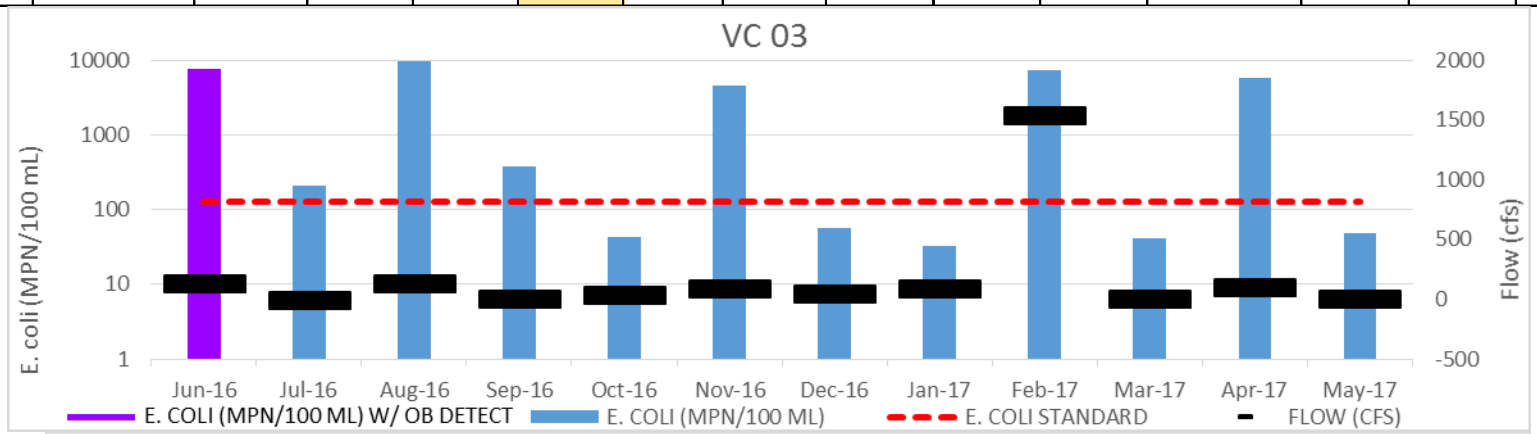
DATE	CHLOROPHYLL-A (UG/L)	E. COLI (MPN/100 ML)	NITRATE (MG/L)	NITRITE (MG/L)	TKN (MG/L)	OP (MG/L)	TP (MG/L)	TDS (MG/L)	TSS (MG/L)	VSS (MG/L)	OBs DETECTED (1=YES, 0=NO)	24 HR RAIN (INCHES)	72 HR RAIN (INCHES)	FLOW (CFS)
6/28/2016	11	530	0.2	< 0.05	0.38	< 0.02	0.02	1304	< 2	< 2	0	0.375	0.375	0.03
7/20/2016	< 3	610	< 0.05	< 0.05	0.36	< 0.02	0.02	1573	4	< 2	0	0	0	0.017
8/17/2016	3	6500	0.4	< 0.05	0.68	< 0.02	0.06	240	19	< 15	0	0	0.8	4.9
9/13/2016	< 3	340	0.06	< 0.05	0.22	< 0.02	0.02	815			1	0	0	0.01
10/11/2016	6	210	< 0.05	< 0.05	0.26	< 0.02	0.03	1093	8	< 2	0	0	0	0.02
11/9/2016	< 3	560	0.18	< 0.05	0.47	< 0.02	0.04	535	3	< 2	0	0.055	0.805	0.07
12/13/2016	< 3	410	0.09	< 0.05	0.47	< 0.02	0.03	1142	< 2	< 2	0	0	0	0.05
1/10/2017	< 3	190	0.1	< 0.05	< 0.2	< 0.02	0.02	1219	3	< 2	1	0	0	0.05
2/14/2017	< 3	6900	0.78	< 0.05		0.27	0.37	207	24	4	1	1.75	1.75	3.8
3/28/2017	12	140	< 0.05	< 0.05	0.81	< 0.02	0.04	1095	5	2	1	0	0	0.03
4/3/2017	7	1300	0.21	< 0.05	0.65	< 0.02	0.08	509	6	< 2	0	1.25	1.625	0.1
5/9/2017	6	2100	0.58	< 0.05	0.31	< 0.02	0.04	1272	5	< 2	1	0	0	0.01

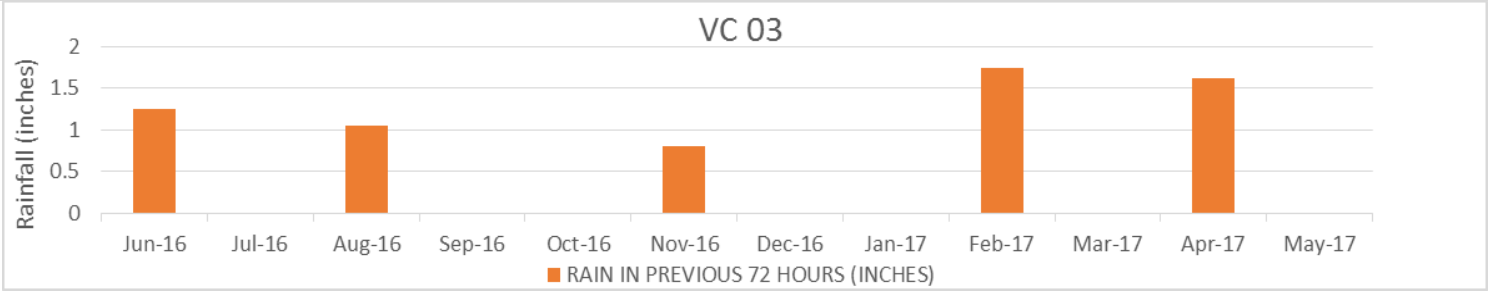




Site 3 – Village Creek at IH-20

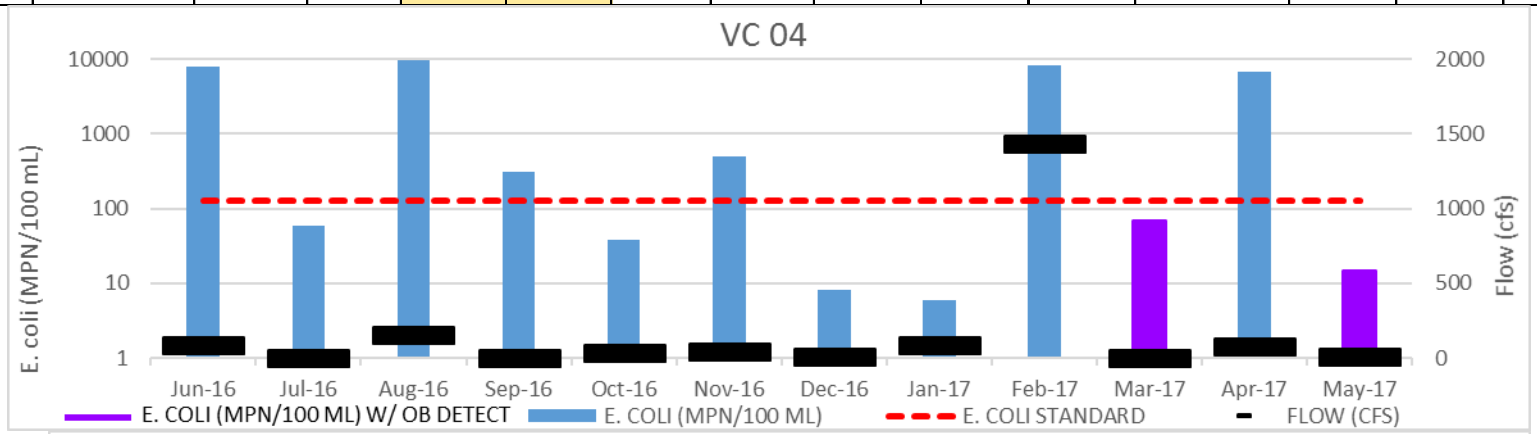
DATE	CHLOROPHYLL-A (UG/L)	E. COLI (MPN/100 ML)	NITRATE (MG/L)	NITRITE (MG/L)	TKN (MG/L)	OP (MG/L)	TP (MG/L)	TDS (MG/L)	TSS (MG/L)	VSS (MG/L)	OBs DETECTED (1=YES, 0=NO)	24 HR RAIN (INCHES)	72 HR RAIN (INCHES)	FLOW (CFS)
6/28/2016	9	7700	0.62	< 0.05	0.96	0.11	0.35	233	116	< 14	1	0.375	1.25	133
7/20/2016	12	210	0.14	< 0.05	0.59	< 0.02	0.05	238	20	3	0	0	0	-2.757
8/17/2016	6	9700	0.23	< 0.05	0.9	0.02	0.28	192	128	12	0	0.88	1.05	132
9/13/2016	8	380	0.63	< 0.05	0.27	0.02	0.06	154			0	0	0	0.4
10/11/2016	5	43	0.71	< 0.05	0.56	0.03	0.06	171	13	2	0	0	0	34
11/9/2016	6	4600	0.25	< 0.05	0.38	0.03	0.08	156	21	< 6	0	0.055	0.805	86
12/13/2016	4	56	0.29	< 0.05	0.46	< 0.02	0.04	164	8	< 2	0	0	0	47
1/10/2017	9	32	0.33	< 0.05	0.22	< 0.02	0.04	173	8	< 2	0	0	0	91
2/14/2017	22	7300	0.71	< 0.05		0.14	0.54	203	426	35	0	1.75	1.75	1545
3/28/2017	18	42	< 0.05	< 0.05	0.69	< 0.02	0.05	335	14	< 3	0	0	0	0
4/3/2017	< 3	5700	0.8	< 0.05	0.92	0.1	0.24	272	68	9	0	1.25	1.625	101
5/9/2017	9	48	0.18	< 0.05	0.58	< 0.02	0.03	263	12	< 2	0	0	0	0

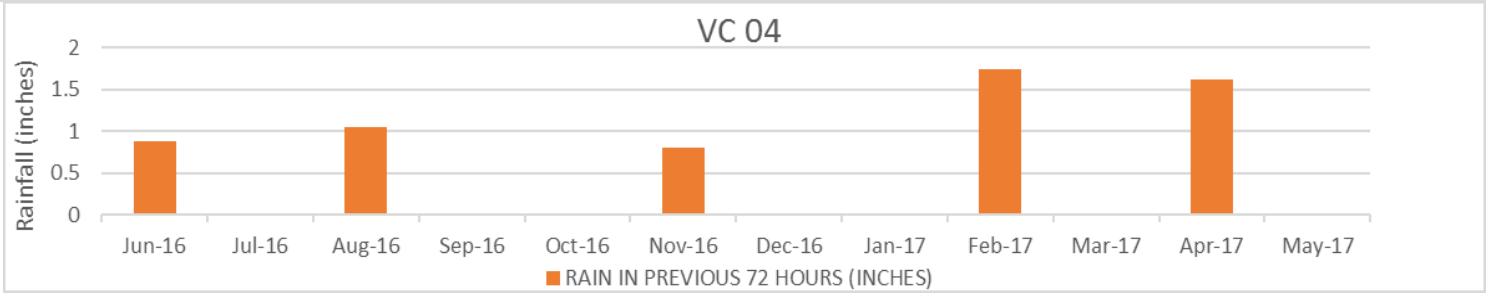




Site 4 – Village Creek at US-287 BUS

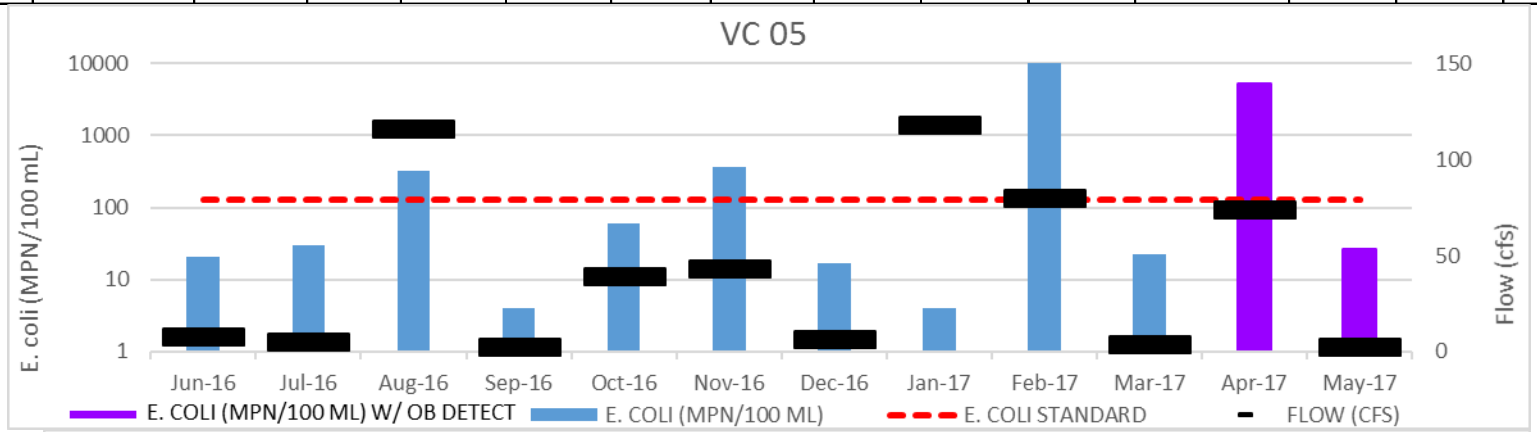
DATE	CHLOROPHYLL-A (UG/L)	E. COLI (MPN/100 ML)	NITRATE (MG/L)	NITRITE (MG/L)	TKN (MG/L)	OP (MG/L)	TP (MG/L)	TDS (MG/L)	TSS (MG/L)	VSS (MG/L)	OBs DETECTED (1=YES, 0=NO)	24 HR RAIN (INCHES)	72 HR RAIN (INCHES)	FLOW (CFS)
6/28/2016	11	7900	0.37	< 0.05	0.61	< 0.02	0.12	304	54	< 6	0	0.875	0.875	83
7/20/2016	5	59	0.2	< 0.05	0.42	< 0.02	0.04	167	9	< 2	0	0	0	3.3
8/15/2016	8	> 9700	0.28	< 0.05	0.88	0.04	0.33	179	152	< 16	0	0.88	1.05	154
9/13/2016	4	310	0.56	< 0.05	0.45	0.03	0.04	157			0	0	0	3.3
10/11/2016	6	38	0.72	< 0.05	0.53	0.03	0.05	161	8	< 2	0	0	0	35
11/9/2016	7	490	0.25	< 0.05	0.45	0.03	0.07	145	12	< 4	0	0.055	0.805	46
12/13/2016	4	8	0.31	< 0.05	0.51	0.02	0.04	151	3	< 2	0	0	0	7.9
1/10/2017	9	6	0.33	< 0.05	< 0.2	< 0.02	0.04	168	8	< 2	0	0	0	87
2/14/2017	14	8200	0.73	< 0.05		0.13	0.65	220	470	40	0	1.75	1.75	1432
3/28/2017	8	70	< 0.05	< 0.05	0.46	< 0.02	0.04	418	15	< 2	1	0	0	0.04
4/3/2017	12	6900	1.06	< 0.05	0.95	0.13	0.26	273	64	< 7	0	1.25	1.625	80
5/9/2017	3	15	0.48	0.09	0.48	< 0.02	0.03	236	9	< 2	1	0	0	9.4

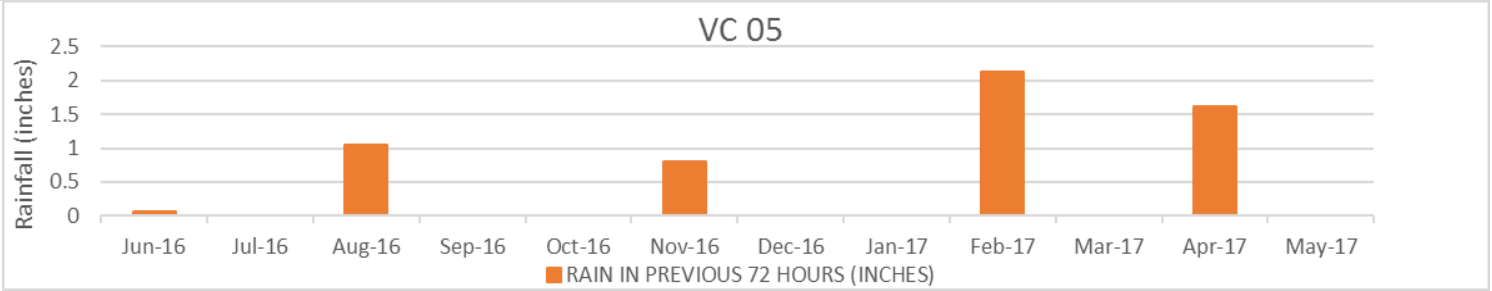




Site 5 – Village Creek near Freeman Dr

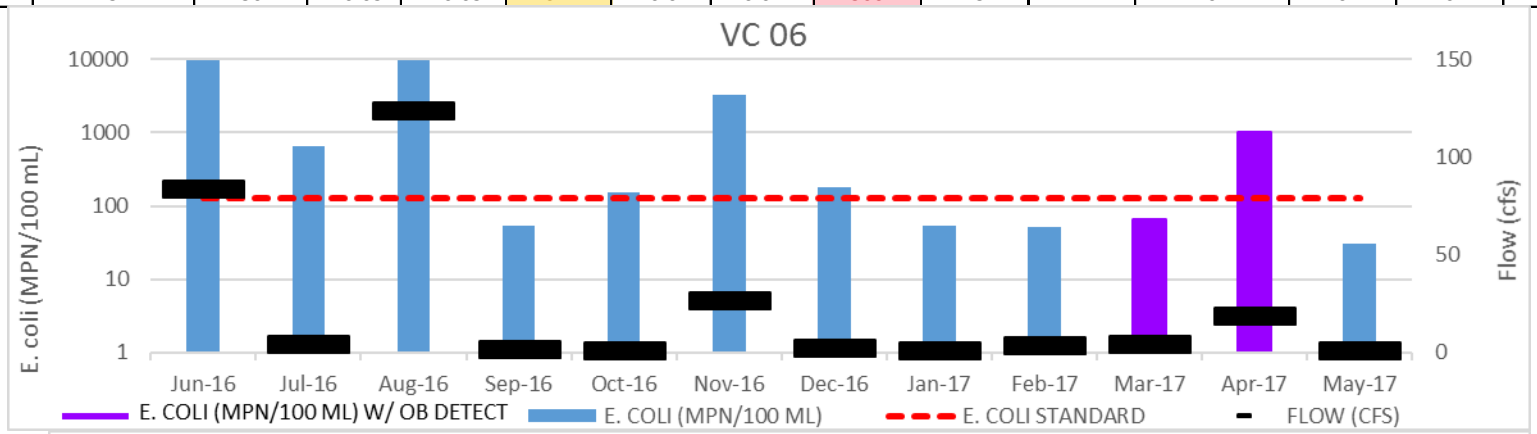
DATE	CHLOROPHYLL-A (UG/L)	E. COLI (MPN/100 ML)	NITRATE (MG/L)	NITRITE (MG/L)	TKN (MG/L)	OP (MG/L)	TP (MG/L)	TDS (MG/L)	TSS (MG/L)	VSS (MG/L)	OBs DETECTED (1=YES, 0=NO)	24 HR RAIN (INCHES)	72 HR RAIN (INCHES)	FLOW (CFS)
7/12/2016	6	21	0.17	< 0.05	0.47	0.02	0.04	152	8	< 2	0	0	0.055	8.2
7/20/2016	< 3	30	0.23	< 0.05	0.42	< 0.02	0.03	191	5	< 2	0	0	0	5
8/17/2016	9	320	0.33	< 0.05	0.45	< 0.02	0.05	146	21	< 9	0	0	1.05	116
9/13/2016	< 3	4	0.67	< 0.05	0.48	0.03	0.04	172			0	0	0	2.6
10/11/2016	8	61	0.74	< 0.05	0.44	0.03	0.06	159	14	3	0	0	0	39
11/9/2016	6	370	0.26	< 0.05	0.51	0.03	0.07	132	15	< 4	0	0.055	0.805	43
12/13/2016	< 3	17	0.32	< 0.05	0.44	0.02	0.04	149	2	< 2	0	0	0	6.5
1/10/2017	11	4	0.35	< 0.05	< 0.2	< 0.02	0.04	162	8	< 2	0	0	0	118
2/15/2017	7	10000	0.93			0.16	0.29	271	59	< 7	0	0.375	2.125	80
3/28/2017	< 3	22	< 0.05	< 0.05	0.44	< 0.02	0.03	408	8	< 2	0	0	0	4.1
4/3/2017	8	5200	0.93	< 0.05	0.77	0.12	0.24	278	72	9	1	1.25	1.625	74
5/9/2017	3	26	< 0.05	< 0.05	0.36	< 0.02	0.02	284	6	< 2	1	0	0	2.4

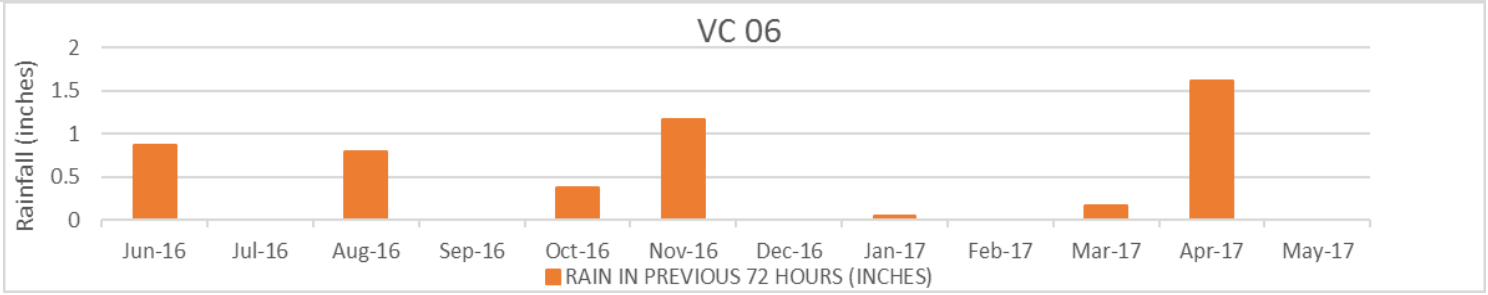




Site 6 – Village Creek at Everman-Kennedale Rd

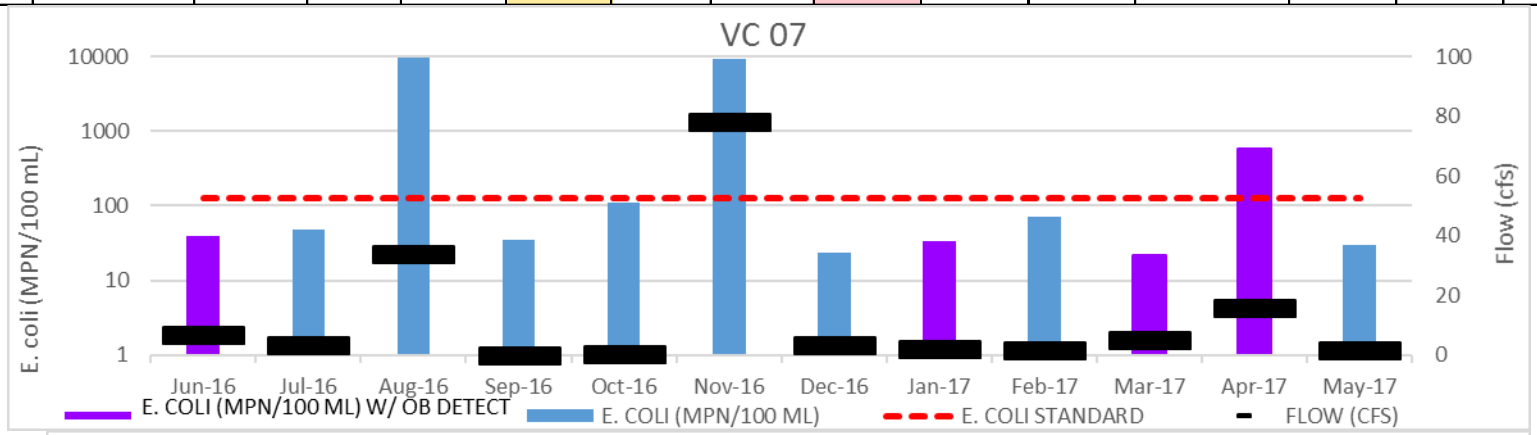
DATE	CHLOROPHYLL-A (UG/L)	E. COLI (MPN/100 ML)	NITRATE (MG/L)	NITRITE (MG/L)	TKN (MG/L)	OP (MG/L)	TP (MG/L)	TDS (MG/L)	TSS (MG/L)	VSS (MG/L)	OBs DETECTED (1=YES, 0=NO)	24 HR RAIN (INCHES)	72 HR RAIN (INCHES)	FLOW (CFS)
6/28/2016	7	> 9700	0.44	< 0.05	0.72	< 0.02	0.17	276	87	< 11	0	0.875	0.875	84
7/20/2016	3	640	< 0.05	< 0.05	0.21	< 0.02	< 0.02	481	5	< 2	0	0	0	4.2
8/15/2016	8	> 9700	0.35	< 0.05	0.88	0.06	0.4	190	196	< 20	0	0.63	0.8	124
9/13/2016	4	53	< 0.05	< 0.05	< 0.2	< 0.02	0.03	355			0	0	0	1.6
10/10/2016	3	150	0.26	< 0.05	0.44	0.04	0.09	216	22	< 4	0	0	0.375	1
11/9/2016	3	3300	0.36	< 0.05	0.53	0.06	0.14	211	42	< 7	0	0.175	1.175	27
12/13/2016	< 3	180	< 0.05	< 0.05	0.32	< 0.02	0.04	312	5	< 2	0	0	0	2.8
1/9/2017	< 3	54	0.84	< 0.05	< 0.2	0.07	0.09	341	6	< 2	0	0	0.055	1
2/13/2017	4	52	0.67	< 0.05	0.48	< 0.02	0.03	416	11	< 2	0	0	0	4.1
3/27/2017	4	65	< 0.05	< 0.05	0.46	< 0.02	0.04	467	15	< 2	1	0	0.175	4.5
4/4/2017	< 3	1000	0.63	< 0.05	0.71	0.07	0.16	285	35	5	1	0	1.625	19
5/8/2017	3	30	< 0.05	< 0.05	0.4	< 0.02	0.04	360	23	< 2	0	0	0	1

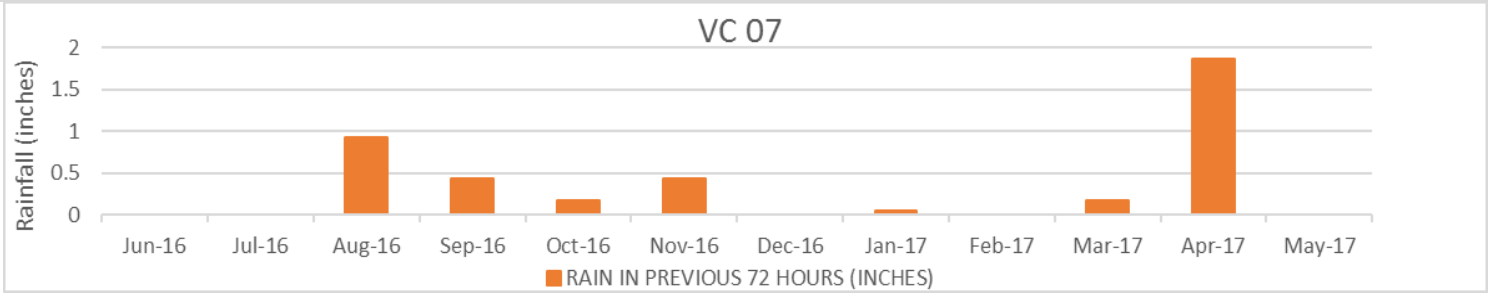




Site 7 – Village Creek at Rendon Rd

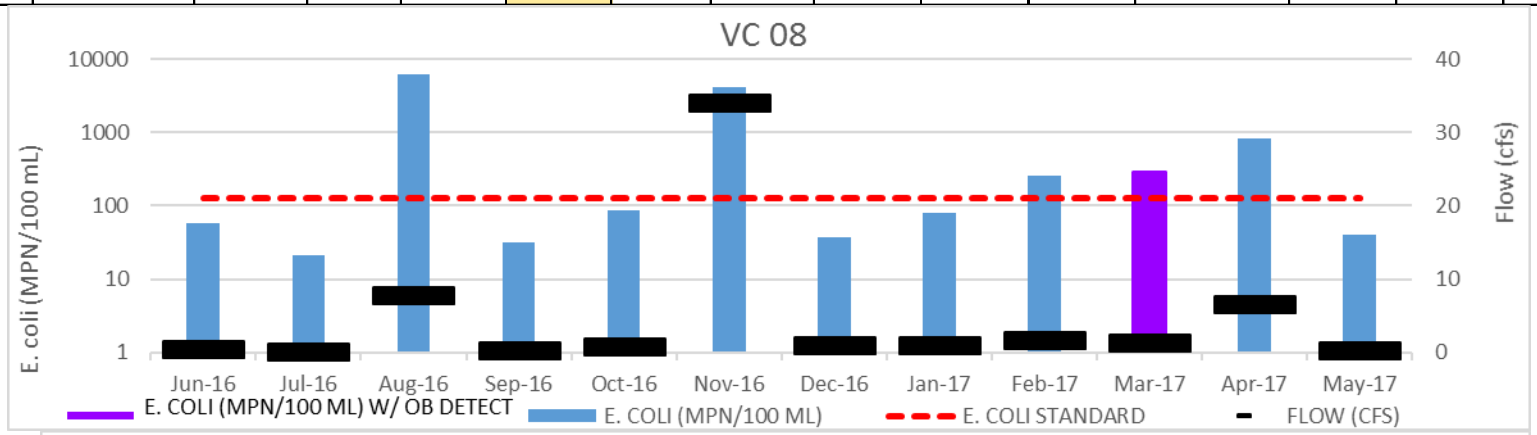
DATE	CHLOROPHYLL-A (UG/L)	E. COLI (MPN/100 ML)	NITRATE (MG/L)	NITRITE (MG/L)	TKN (MG/L)	OP (MG/L)	TP (MG/L)	TDS (MG/L)	TSS (MG/L)	VSS (MG/L)	OBs DETECTED (1=YES, 0=NO)	24 HR RAIN (INCHES)	72 HR RAIN (INCHES)	FLOW (CFS)
6/27/2016	< 3	39	0.14	< 0.05	0.45	< 0.02	0.02	509	5	< 2	1	0	0	7
7/20/2016	4	48	< 0.05	< 0.05	0.37	< 0.02	< 0.02	461	4	< 2	0	0	0	3.2
8/15/2016	4	> 9700	0.33	< 0.05	0.81	0.07	0.25	202	58	< 19	0	0.88	0.93	34
9/12/2016	< 3	35	< 0.05	< 0.05	0.29	< 0.02	0.03	304			0	0	0.43	0.08
10/10/2016	< 3	110	0.08	< 0.05	0.38	0.03	0.05	223	3	< 2	0	0	0.175	0.2
11/8/2016	4	9200	0.42	< 0.05	0.59	0.08	0.16	209	34	< 9	0	0.375	0.43	78
12/12/2016	< 3	24	< 0.05	< 0.05	0.36	< 0.02	0.03	318	2	< 2	0	0	0	3.2
1/9/2017	< 3	34	0.19	< 0.05	< 0.2	0.08	0.11	328	< 2	< 2	1	0	0.055	2.1
2/13/2017	< 3	70	0.78	< 0.05	0.53	< 0.02	0.03	408	< 2	< 2	0	0	0	1.5
3/27/2017	< 3	22	< 0.05	< 0.05	0.43	< 0.02	0.03	430	2	< 2	1	0	0.175	5.3
4/4/2017	< 3	570	0.64	< 0.05	0.62	0.09	0.14	299	12	< 2	1	0	1.875	16
5/8/2017	< 3	30	< 0.05	< 0.05	0.97	< 0.02	0.18	339	140	17	0	0	0	1.7

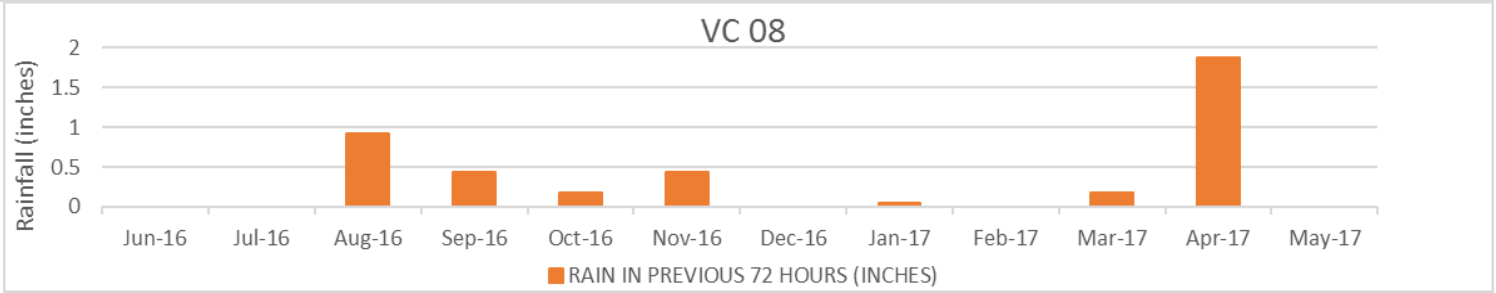




Site 8 – Deer Creek at Oak Grove Rd

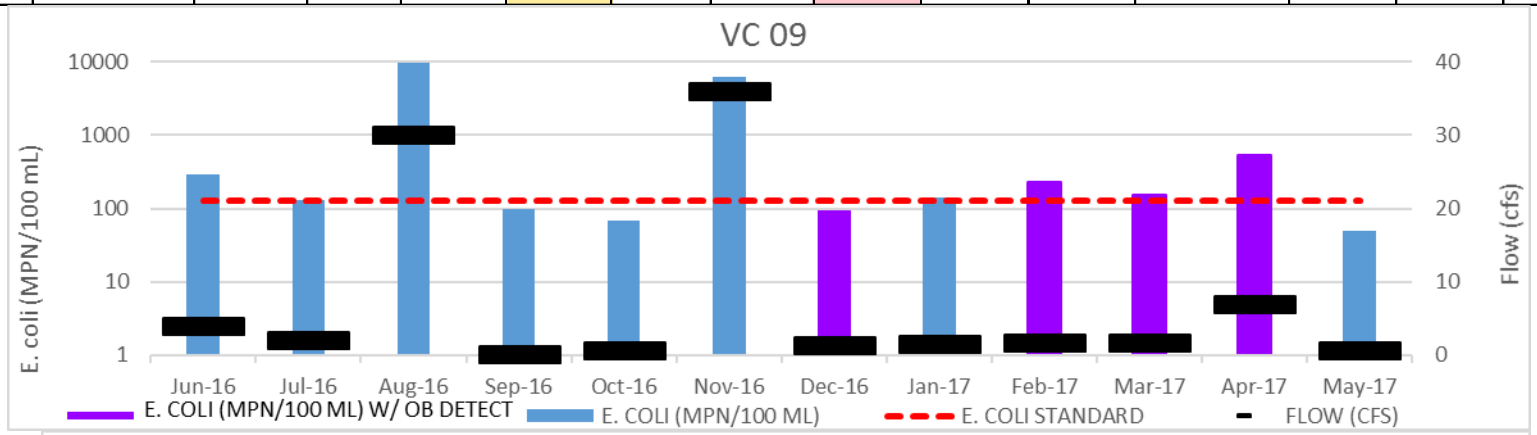
DATE	CHLOROPHYLL-A (UG/L)	E. COLI (MPN/100 ML)	NITRATE (MG/L)	NITRITE (MG/L)	TKN (MG/L)	OP (MG/L)	TP (MG/L)	TDS (MG/L)	TSS (MG/L)	VSS (MG/L)	OBs DETECTED (1=YES, 0=NO)	24 HR RAIN (INCHES)	72 HR RAIN (INCHES)	FLOW (CFS)
6/27/2016	4	58	0.54	< 0.05	0.49	< 0.02	< 0.02	350	4	< 2	0	0	0	0.5
7/19/2016	4	21	0.15	< 0.05	0.45	< 0.02	< 0.02	309	5	< 2	0	0	0	0.2
8/15/2016	8	6200	0.39	< 0.05	0.71	0.04	0.26	212	137	< 14	0	0.88	0.93	7.9
9/12/2016	4	32	< 0.05	< 0.05	0.31	< 0.02	0.03	268			0	0	0.43	0.3
10/10/2016	5	86	0.1	< 0.05	0.42	< 0.02	0.04	253	10	2	0	0	0.175	0.8
11/8/2016	< 3	4100	0.35	< 0.05	0.59	0.03	0.09	216	38	< 8	0	0.375	0.43	34
12/12/2016	< 3	37	0.3	< 0.05	0.24	< 0.02	< 0.02	300	2	< 2	0	0	0	1
1/9/2017	< 3	80	0.25	< 0.05	< 0.2	< 0.02	0.02	286	< 2	< 2	0	0	0.055	1
2/13/2017	< 3	260	0.15	< 0.05	0.49	< 0.02	0.03	324	4	< 2	0	0	0	1.7
3/27/2017	< 3	290	0.08	< 0.05	0.44	< 0.02	0.02	345	5	< 2	1	0	0.175	1.4
4/4/2017	3	820	0.69	< 0.05	0.56	0.03	0.08	297	21	< 2	0	0	1.875	6.7
5/8/2017	< 3	41	0.06	< 0.05	0.48	< 0.02	0.03	284	8	< 2	0	0	0	0.4

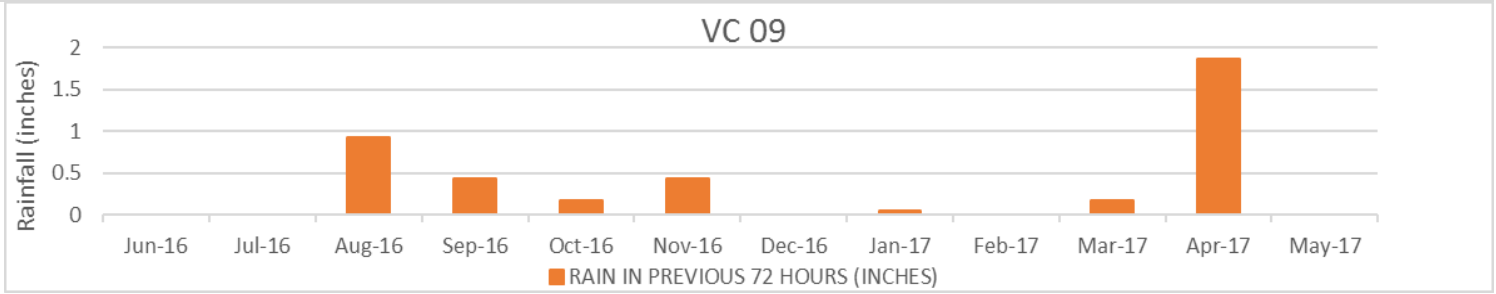




Site 9 – Village Creek at FM 1187

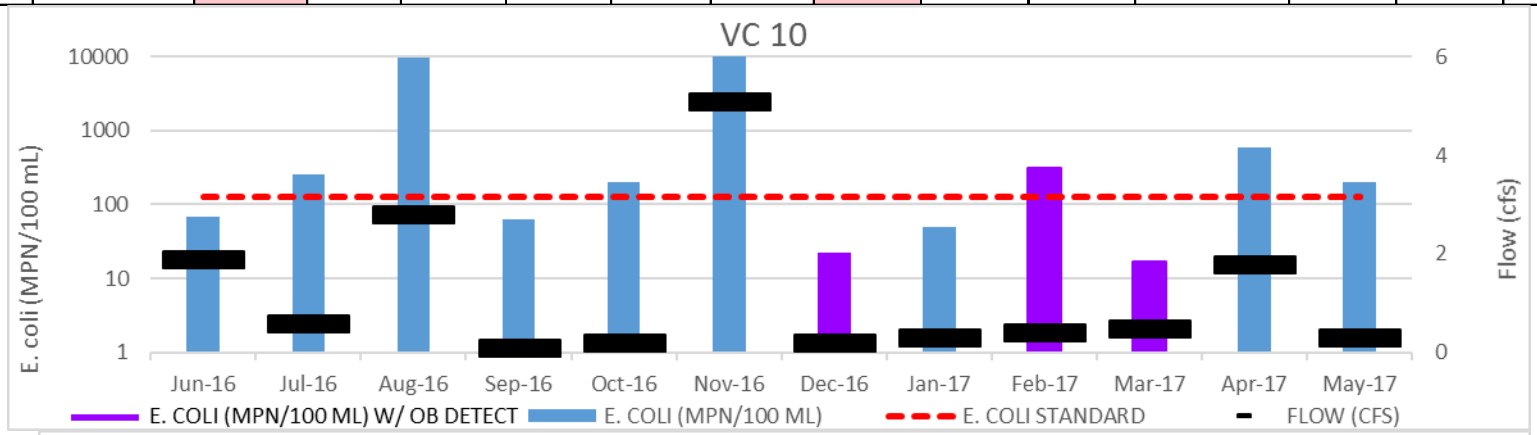
DATE	CHLOROPHYLL-A (UG/L)	E. COLI (MPN/100 ML)	NITRATE (MG/L)	NITRITE (MG/L)	TKN (MG/L)	OP (MG/L)	TP (MG/L)	TDS (MG/L)	TSS (MG/L)	VSS (MG/L)	OBs DETECTED (1=YES, 0=NO)	24 HR RAIN (INCHES)	72 HR RAIN (INCHES)	FLOW (CFS)
6/27/2016	5	290	0.31	< 0.05	0.42	< 0.02	0.03	558	8	< 2	0	0	0	4
7/19/2016	< 3	130	0.4	< 0.05	0.5	< 0.02	0.02	501	4	< 2	0	0	0	2.1
8/15/2016	8	> 9700	0.37	< 0.05	0.83	0.08	0.28	204	54	< 17	0	0.88	0.93	30
9/12/2016	4	100	1.17	< 0.05	0.29	0.03	0.07	402			0	0	0.43	0.2
10/10/2016	< 3	67	0.96	< 0.05	0.36	0.1	0.13	246	2	< 2	0	0	0.175	0.6
11/8/2016	4	6100	0.45	< 0.05	0.54	0.12	0.19	180	24	< 7	0	0.375	0.43	36
12/12/2016	< 3	96	0.41	< 0.05	0.31	0.12	0.15	408	2	< 2	1	0	0	1.4
1/9/2017	< 3	140	0.26	< 0.05	0.24	0.16	0.18	412	< 2	< 2	0	0	0.055	1.5
2/13/2017	11	230	2.02	0.08	0.81	0.04	0.09	514	7	< 2	1	0	0	1.8
3/27/2017	15	150	0.19	< 0.05	0.61	0.07	0.14	535	47	10	1	0	0.175	1.8
4/4/2017	< 3	540	0.78	< 0.05	0.61	0.18	0.25	312	16	< 2	1	0	1.875	7
5/8/2017	3	49	0.16	< 0.05	0.58	0.06	0.1	438	6	< 2	0	0	0	0.6

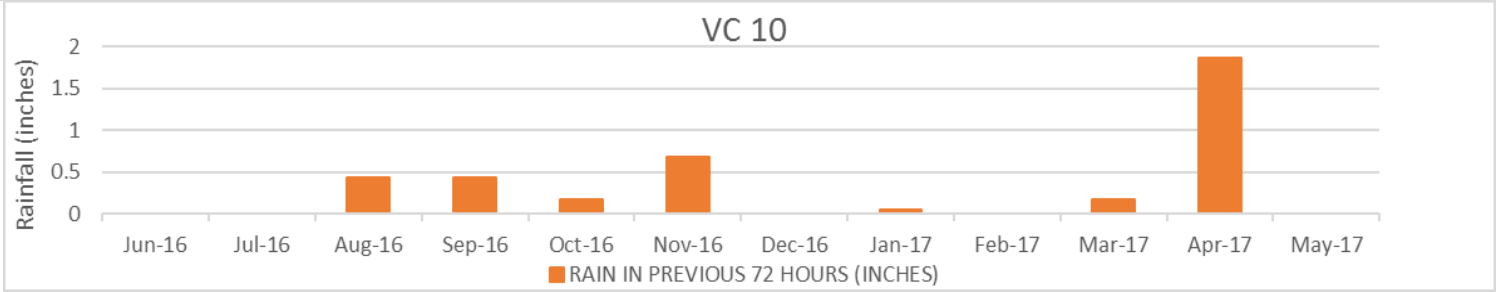




Site 10 – Quil Miller Creek at CR 532

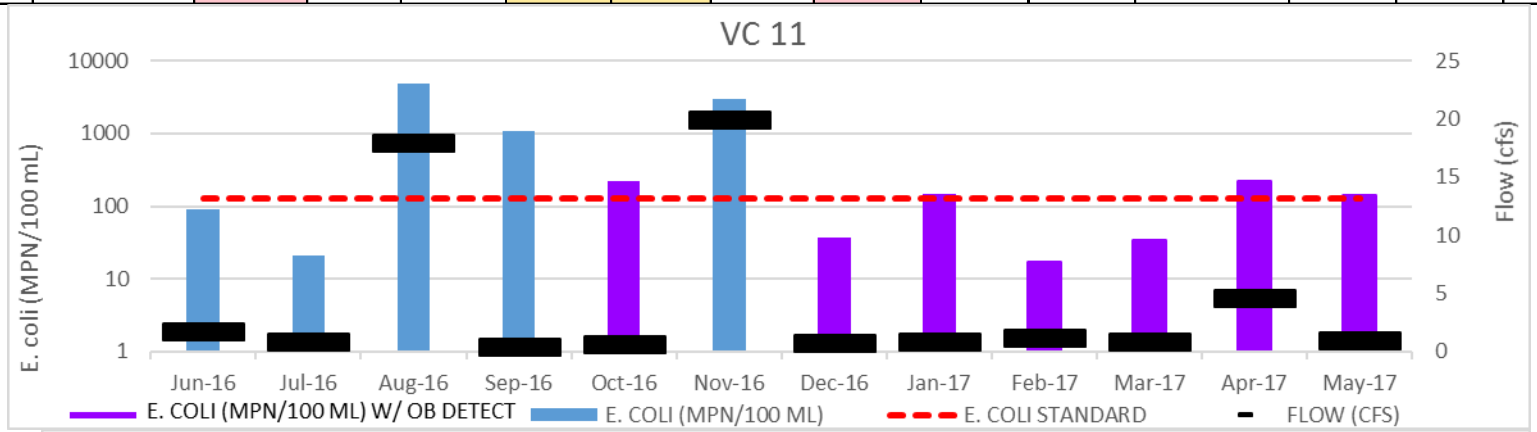
DATE	CHLOROPHYLL-A (UG/L)	E. COLI (MPN/100 ML)	NITRATE (MG/L)	NITRITE (MG/L)	TKN (MG/L)	OP (MG/L)	TP (MG/L)	TDS (MG/L)	TSS (MG/L)	VSS (MG/L)	OBs DETECTED (1=YES, 0=NO)	24 HR RAIN (INCHES)	72 HR RAIN (INCHES)	FLOW (CFS)
6/27/2016	< 3	68	0.29	< 0.05	0.39	0.07	0.05	676	3	< 2	0	0	0	1.9
7/19/2016	< 3	250	0.12	< 0.05	0.26	0.04	0.05	613	4	< 2	0	0	0	0.6
8/15/2016	< 3	> 9700	0.43	< 0.05	0.99	0.17	0.38	234	54	< 14	0	0.38	0.43	2.8
9/12/2016	< 3	64	< 0.05	< 0.05	0.21	0.05	0.06	528			0	0	0.43	0.1
10/10/2016	< 3	200	< 0.05	< 0.05	0.22	0.05	0.06	410	7	< 2	0	0	0.175	0.2
11/8/2016	< 3	10000	0.39	< 0.05	0.79	0.19	0.31	237	35	< 9	0	0.625	0.68	5.1
12/12/2016	< 3	22	< 0.05	< 0.05	< 0.2	0.04	0.06	556	2	< 2	1	0	0	0.2
1/9/2017	< 3	49	< 0.05	< 0.05	< 0.2	0.03	0.04	672	< 2	< 2	0	0	0.055	0.3
2/13/2017	6	310	< 0.05	< 0.05	0.41	0.02	0.04	604	3	< 2	1	0	0	0.4
3/27/2017	< 3	17	< 0.05	< 0.05	0.26	0.02	0.04	662	13	4	1	0	0.175	0.5
4/4/2017	5	600	0.29	< 0.05	0.58	0.1	0.2	384	26	< 3	0	0	1.875	1.8
5/8/2017	4	200	< 0.05	< 0.05	< 0.2	0.03	0.04	585	37	4	0	0	0	0.3

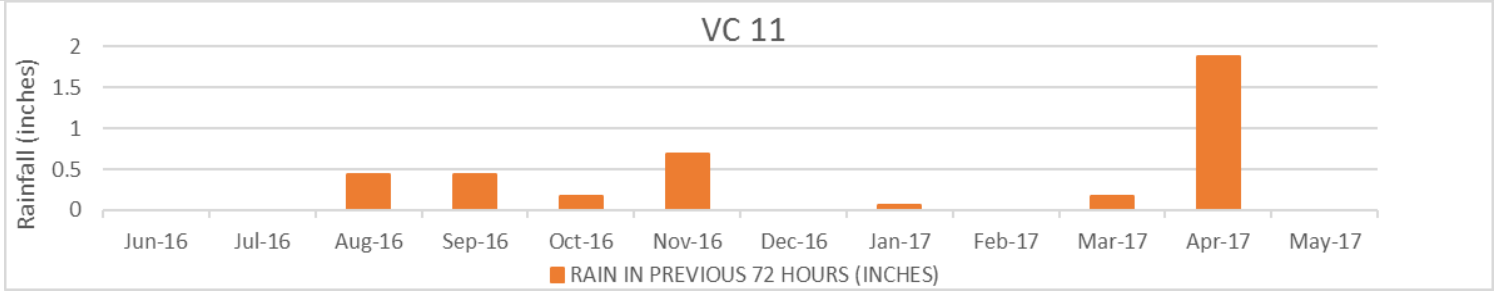




Site 11 – Village Creek at FM 3391

DATE	CHLOROPHYLL-A (UG/L)	E. COLI (MPN/100 ML)	NITRATE (MG/L)	NITRITE (MG/L)	TKN (MG/L)	OP (MG/L)	TP (MG/L)	TDS (MG/L)	TSS (MG/L)	VSS (MG/L)	OBs DETECTED (1=YES, 0=NO)	24 HR RAIN (INCHES)	72 HR RAIN (INCHES)	FLOW (CFS)
6/27/2016	< 3	92	2.45	0.07	0.67	0.1	0.14	553	8	< 2	0	0	0	1.8
7/19/2016	< 3	21	< 0.05	< 0.05	0.41	0.18	0.2	515	8	< 2	0	0	0	0.9
8/15/2016	6	> 4800	0.34	< 0.05	0.72	0.13	0.22	158	40	< 8	0	0.38	0.43	18
9/12/2016	< 3	1100	< 0.05	< 0.05	0.48	0.23	0.25	370			0	0	0.43	0.4
10/10/2016	< 3	220	2.14	0.06	0.58	0.52	0.56	303	8	< 2	1	0	0.175	0.6
11/8/2016	4	3000	1.03	< 0.05	0.63	0.28	0.34	232	28	< 6	0	0.625	0.68	20
12/12/2016	< 3	37	4.65	< 0.05	0.89	1.16	1.24	453	< 2	< 2	1	0	0	0.8
1/9/2017	< 3	150	4.52	< 0.05	0.48	1.75	1.8	455	< 2	< 2	1	0	0.055	0.9
2/13/2017	12	17	4.87	0.16	0.84			527	3	< 2	1	0	0	1.2
3/27/2017	4	34	2.93		0.66	0.88	0.89	529	3	< 2	1	0	0.175	0.9
4/4/2017	6	220	1.2	< 0.05	0.51	0.37	0.38	353	8	< 2	1	0	1.875	4.6
5/8/2017	< 3	140	< 0.05	< 0.05	0.52	0.43	0.48	474	16	2	1	0	0	1



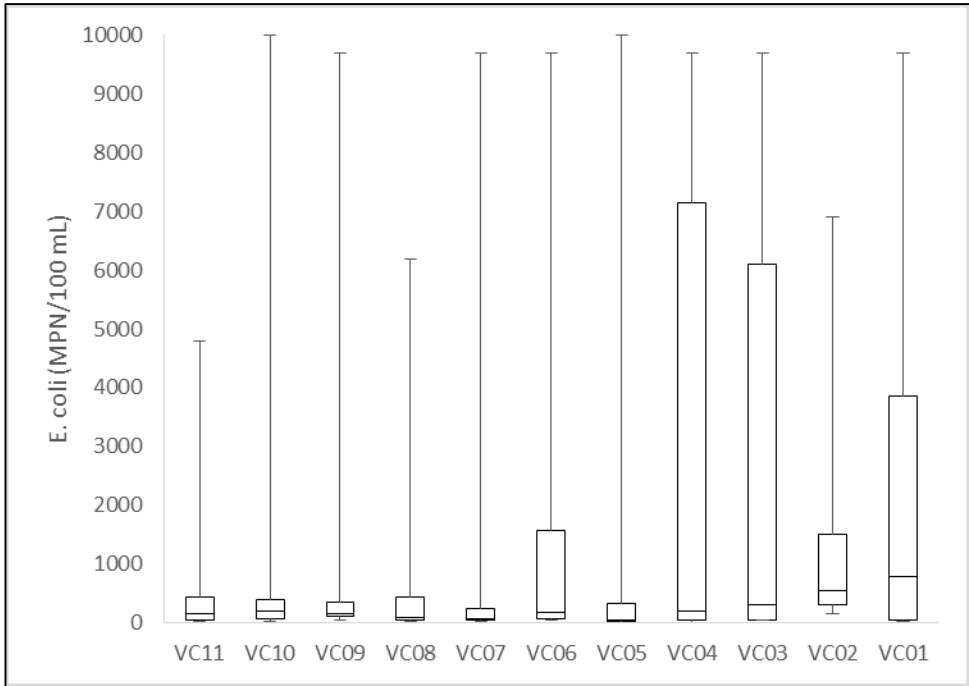


Box-Whisker Plot – *E. coli*

VC11	VC10	VC09	VC08	VC07	VC06	VC05	VC04	VC03	VC02	VC01
21763	**21759**	**10785**	**10805**	**10786**	**13671**	**21762**	**10781**	**10780**	**10798**	**10793**
92	68	290	58	39	9700	21	7900	7700	530	2900
21	250	130	21	48	640	30	59	210	610	12
4800	9700	9700	6200	9700	9700	320	9700	9700	6500	4800
1100	64	100	32	35	53	4	310	380	340	9700
220	200	67	86	110	150	61	38	43	210	770
3000	10000	6100	4100	9200	3300	370	490	4600	560	30
37	22	96	37	24	180	17	8	56	410	37
150	49	140	80	34	54	4	6	32	190	9700
17	310	230	260	70	52	10000	8200	7300	6900	120
34	17	150	290	22	65	22	70	42	140	970
220	600	540	820	570	1000	5200	6900	5700	1300	52
140	200	49	41	30	30	26	15	48	2100	
Site Geomeans										
172	*222*	***275***	*171*	***124***	***328***	***76***	***255***	***487***	*713*	*425*

- Consistently elevated at VC02
- VC05 only site w/ geomean below standard
- Geomean for all sites on VC (in bold) = 210 MPN/100 mL
- Geomean from 2014 TCEQ IR = 302.36 MPN/100 mL

- Median values represented by line in each "box"
- Lower 50% of values are very similar (low variability)
- Significantly increased variability in top 50% of data
  - Greatest variability in top 25% of data upstream of VC04
  - Increased variability in 3rd quartile (Q3 or top box) at sites under lake influence (VC01, VC02, VC03)

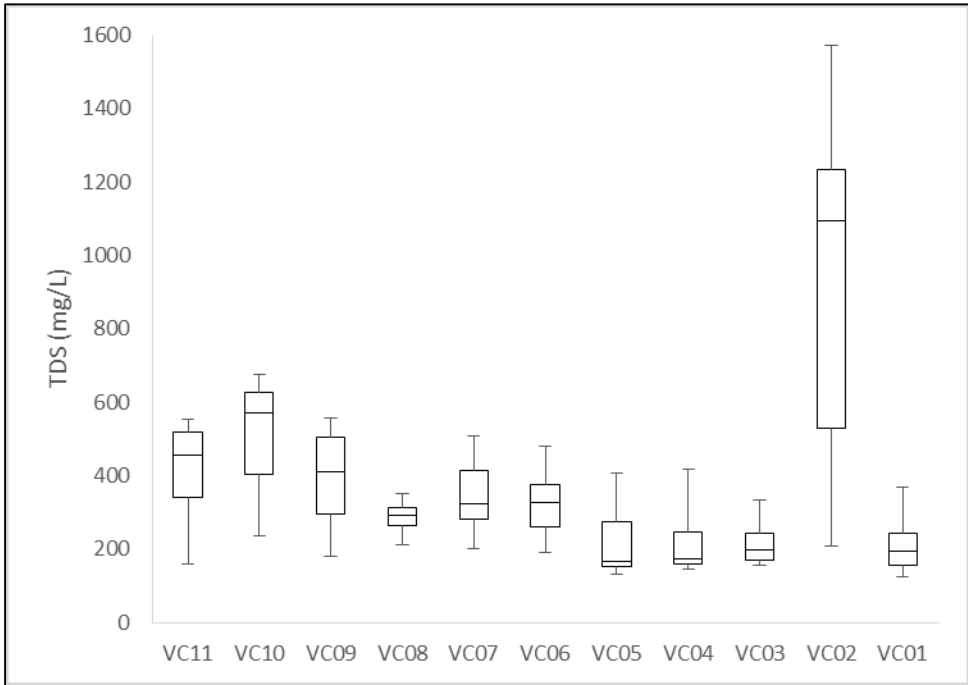


Box-Whisker Plot – TDS

VC11	VC10	VC09	VC08	VC07	VC06	VC05	VC04	VC03	VC02	VC01
21763	**21759**	**10785**	**10805**	**10786**	**13671**	**21762**	**10781**	**10780**	**10798**	**10793**
553	676	558	350	509	276	152	304	233	1304	164
515	613	501	309	461	481	191	167	238	1573	244
158	234	204	212	202	190	146	179	192	240	187
370	528	402	268	304	355	172	157	154	815	144
303	410	246	253	223	216	159	161	171	1093	194
232	237	180	216	209	211	132	145	156	535	367
453	556	408	300	318	312	149	151	164	1142	339
455	672	412	286	328	341	162	168	173	1219	130
527	604	514	324	408	416	271	220	203	207	238
529	662	535	345	430	467	408	418	335	1095	123
353	384	312	297	299	285	278	273	272	509	227
474	585	438	284	339	360	284	236	263	1272	
Site Geomeans										
387	*484*	***369***	*284*	***322***	***312***	***196***	***203***	***207***	*776*	*202*

- Consistently elevated upstream of TRWD outfall
- Also elevated at VC02
- VC05 only site w/ geomean below standard
- Geomean for all sites on VC (in bold) = 210 MPN/100 mL
- Not assessed in 2014 TCEQ IR

- Main channel
  - Similar variance at VC11, 09
  - Again at VC07, 06
  - Significant decrease in median below TRWD outfall, but similar variance, even towards lake influence sites
- Quil Miller (VC10) similar to VC11, 10 but higher median
- Deer Creek (VC08) had lowest variance (smallest box plot)
- Unnamed lake trib (VC02)
  - Highest median (by far)
  - Min higher than all sites below TRWD outfall
  - More variance in Q1 than all Qs of other sites

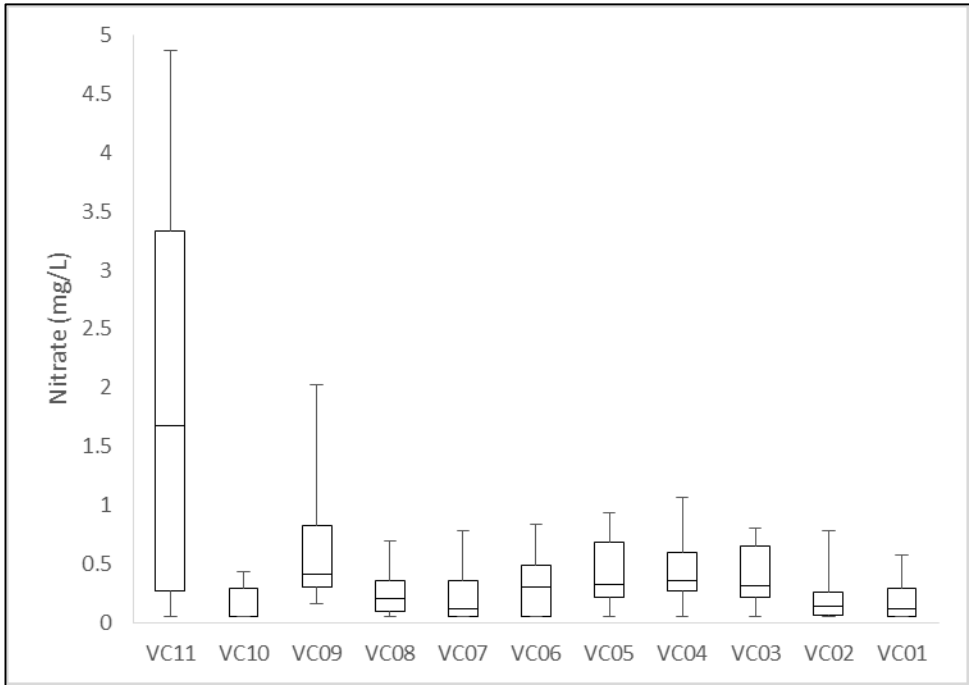


Box-Whisker Plot – Nitrate

VC11	VC10	VC09	VC08	VC07	VC06	VC05	VC04	VC03	VC02	VC01
21763	**21759**	**10785**	**10805**	**10786**	**13671**	**21762**	**10781**	**10780**	**10798**	**10793**
2.45	0.29	0.31	0.54	0.14	0.44	0.17	0.37	0.62	0.2	0.25
0.05	0.12	0.4	0.15	0.05	0.05	0.23	0.2	0.14	0.05	0.05
0.34	0.43	0.37	0.39	0.33	0.35	0.33	0.28	0.23	0.4	0.33
0.05	0.05	1.17	0.05	0.05	0.05	0.67	0.56	0.63	0.06	0.41
2.14	0.05	0.96	0.1	0.08	0.26	0.74	0.72	0.71	0.05	0.12
1.03	0.39	0.45	0.35	0.42	0.36	0.26	0.25	0.25	0.18	0.05
4.65	0.05	0.41	0.3	0.05	0.05	0.32	0.31	0.29	0.09	0.05
4.52	0.05	0.26	0.25	0.19	0.84	0.35	0.33	0.33	0.1	0.57
4.87	0.05	2.02	0.15	0.78	0.67	0.93	0.73	0.71	0.78	0.05
2.93	0.05	0.19	0.08	0.05	0.05	0.05	0.05	0.05	0.05	0.19
1.2	0.29	0.78	0.69	0.64	0.63	0.93	1.06	0.8	0.21	0.05
0.05	0.05	0.16	0.06	0.05	0.05	0.05	0.48	0.18	0.58	
Site Geomeans										
0.81	*0.10*	***0.47***	*0.19*	***0.14***	***0.18***	***0.29***	***0.35***	***0.32***	*0.15*	*0.13*

- Only elevated in upstream reach of main channel
- All site geomeans below TCEQ screening level (1.95 mg/L)
- Screening concerns concentrated in colder months (Dec-March)

- Variance at sites with screening concerns
  - Upstream sites on main channel
- Rapid decrease downstream
  - Dilution from tributaries?
  - Assimilation through biological processes?

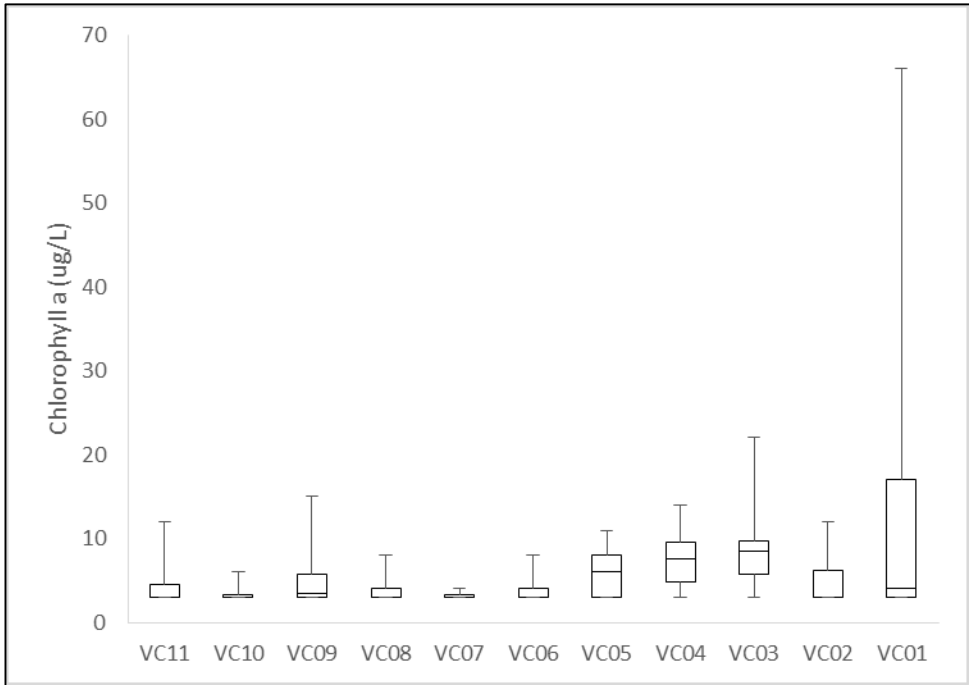


Box-Whisker Plot – Chlorophyll a

VC11	VC10	VC09	VC08	VC07	VC06	VC05	VC04	VC03	VC02	VC01
21763	**21759**	**10785**	**10805**	**10786**	**13671**	**21762**	**10781**	**10780**	**10798**	**10793**
3	3	5	4	3	7	6	11	9	11	17
3	3	3	4	4	3	3	5	12	3	17
6	3	8	8	4	8	9	8	6	3	4
3	3	4	4	3	4	3	4	8	3	3
3	3	3	5	3	3	8	6	5	6	3
4	3	4	3	4	3	6	7	6	3	3
3	3	3	3	3	3	3	4	4	3	3
3	3	3	3	3	3	11	9	9	3	3
12	6	11	3	3	4	7	14	22	3	31
4	3	15	3	3	4	3	8	18	12	5
6	5	3	3	3	3	8	12	3	7	66
3	4	3	3	3	3	3	3	9	6	
Site Geomeans										
3.97	*3.40*	***4.54***	*3.65*	***3.22***	***3.75***	***5.20***	***6.85***	***7.91***	*4.52*	*7.24*

- Almost all hits at lake influence sites (VC01, 03)
- All site geomeans below TCEQ screening level (14.1 µg/L)
- Not correlated to any flow condition

- Lots of "< 3" values converted to 3 for this graph so take with a couple grains of salt
  - Potential skew towards larger values
  - Less variance in lower quartiles
- Medians increase in main channel below TRWD outfall
- Most variance in Wildcat Br (VC01)
  - Two high values in spring/summer



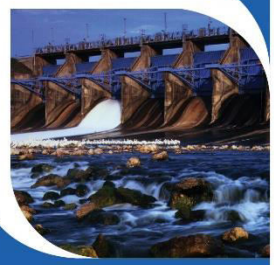
Moving Forward

- All data has been quality assured, approved, and submitted to TCEQ
- TRA will run statistical and load duration curve (LDC) analysis using CRWS data
  - LDCs will be presented at next meeting
  - Full water quality data analysis
- Future monitoring (proposed)
  - 7 sites selected (1 new, above VC11)
  - Monthly until end of contract (Aug ’18)

Questions?

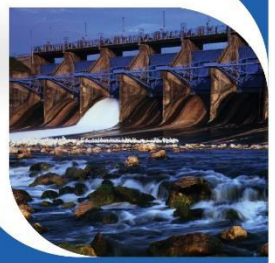
http://www.trinityra.org/lakearlingtonvillagecreek

Aaron Hoff
Trinity River Authority
hoffa@trinityra.org
817.493.5581

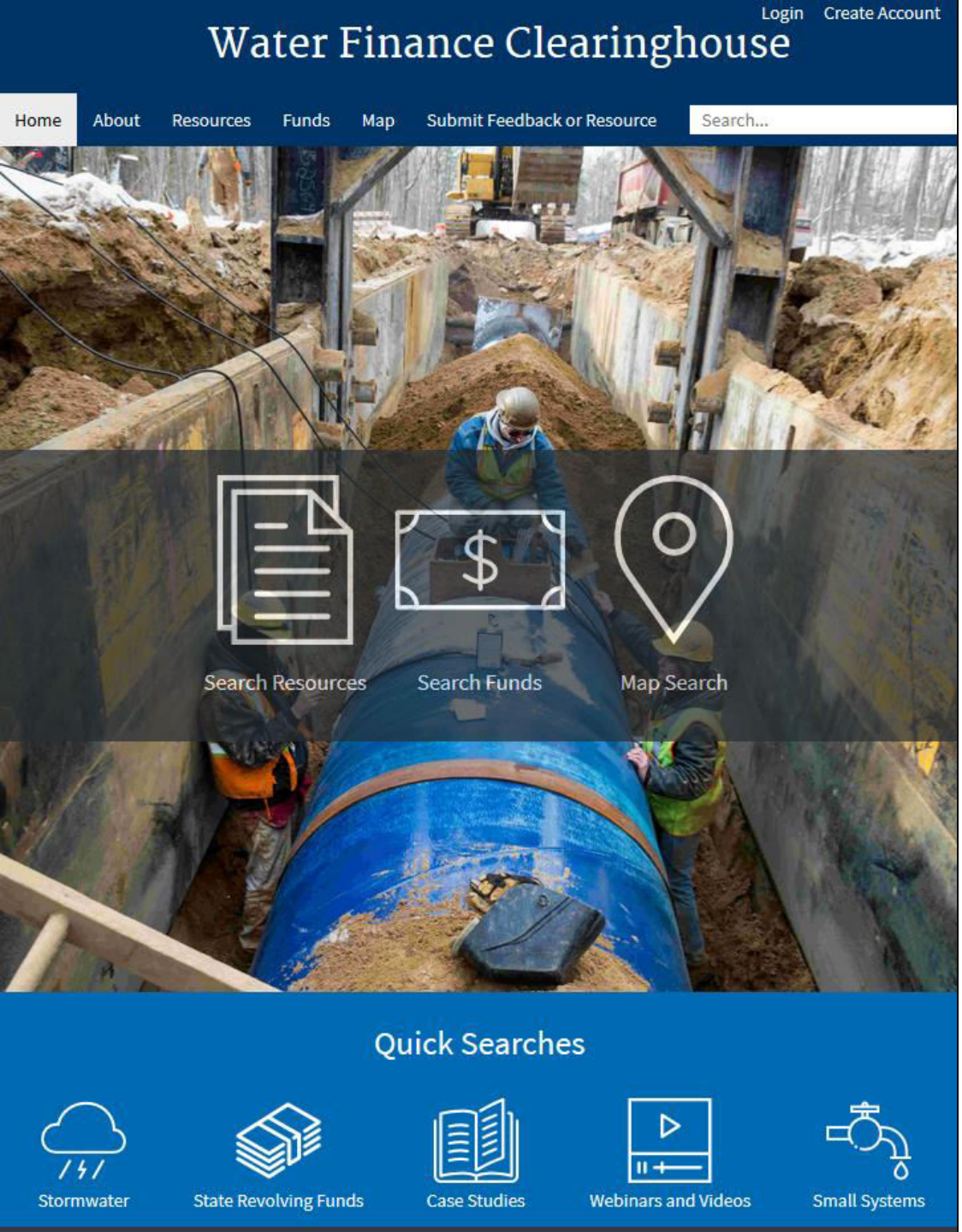


Upcoming Events and Meetings

Aaron Hoff
Trinity River Authority
September 28, 2017



Trinity River Authority of Texas
Enriching the Trinity basin as a resource for Texans



Find out more:

https://www.epa.gov/waterfinancecenter/water-finance-clearinghouse

LANDOWNER WORKSHOP – FORT WORTH

Maren McLaughlin-Klotz

Legal Update and Conservation Strategies for Texas Landowners

Friday, September 29, 2017
Texas A&M University – School of Law
1515 Commerce Street, Fort Worth, TX 76102

Registration at event: $10 per person
Click here to RSVP

Texas families who want to protect their land and their family heritage for generations to come can learn about tools and strategies for all aspects of landownership. This workshop, hosted by the Texas A&M School of Law Program in Natural Resources Systems, will provide useful information for landowners, ranch real estate agents, and for professionals who counsel individuals on land management. Topics include conservation easements and estate tax planning, fencing laws, and strategies for dealing with condemnation.

Workshop Agenda

9:45 – 10:00am **Welcome**
John Tomecek, Extension Wildlife Specialist, Texas A&M AgriLife Extension Service
Mark Steinbach, Executive Director, Texas Land Conservancy

10:00 – 11:00am **Conservation Easements and Estate Tax Benefits: Tools for Voluntary Land Conservation**
Jim Bradbury, Attorney, James D. Bradbury PLLC

11:00 – 12:00pm **Fence Laws in Texas and Landowner Liability**
Kyle Weldon and Jordan S Hayes, Law Students, Texas A&M Law School

12:00 – 1:00pm **Lunch**

1:00 – 1:30pm **Partnering for Conservation: A Landowner Perspective**
Chuck Snakard, Landowner, Chalk Mountain Ranch – Somervell County

1:30 – 2:30pm **Condemnation Strategies and Solutions: How to Protect Your Property**
Luke Ellis, Attorney, Johns Morris Ellis & Hodge

2:30 – 3:15pm **Q&A/Discussion with all presenters**

Find out more:

http://texaslandconservancy.org/landowner-workshop-fort-worth/?utm_content=buffere5418&utm_medium=social&utm_source=twitter.com&utm_campaign=buffer

Future Events and Meetings

- Next Steering Committee Meeting
  - Sometime between Thanksgiving and holiday break
  - Review SELECT module output
  - Discuss load duration curve (LDC) results
- Next Partnership Meeting
  - Tentative for January 11, 2018
    - Alternate dates: 1/18, 1/25
  - Present draft LDC results
  - Present SELECT module output
  - If time permits – begin discussing BMP recommendations

North Texas Feral Hog Forum

- Locations and Dates (tentative)
  - Monday, November 6, 2017 - 8:30am
    - John Bunker Sands Wetland Center
  - Tuesday, November 7, 2017 - 1:00pm
    - Azle Memorial Library
  - Thursday, November 9, 2017 - 1:00pm
    - UTRWD – Lewisville, TX

Open Comment Period

If you have additional concerns or comments, please send them to:

Aaron Hoff
Trinity River Authority
hoffa@trinityra.org
817.493.5581

http://www.trinityra.org/lakearlingtonvillagecreek