2017 BASIN HIGHLIGHTS REPORT

Trinity River Authority

Clean Rivers Program

Acknowledgements

PREPARED IN COOPERATION WITH THE TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

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On the cover: Lake Livingston (August 24, 2016)

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Texas Clean Rivers Program

The Texas Clean Rivers Program (CRP) was created in 1991 by Texas Senate Bill 818 and is administered by the Texas Commission on Environmental Quality (TCEQ) which contracts with local planning agencies to conduct the program in each river basin. The program is tasked with protecting and improving the water quality resources of the state. In the Trinity River basin, the Trinity River Authority (TRA) Clean Rivers Program focuses on water quality monitoring, special projects, and public outreach to achieve the goals of the program. Data collected by the TRA CRP and other river authorities are used for regulatory purposes, such as setting water quality standards and modeling for permit limits and for water quality assessments.

Figure 1: Lake Livingston, Pine Island (August 24, 2016)

Annual Reports

Each year, the local planning agencies produce a Basin Highlights Report which summarizes the CRP activities in their basin and may include information on events affecting water quality, a summary of water quality data, an overview of public outreach activities, and updates on special projects. Every fifth year, a greatly expanded Basin Summary Report provides a detailed analysis of water quality data and potential sources of impairments, as well as offering recommendations for future basin activities.

A Basin Summary Report was completed in 2015. In that report, the draft 2014 Texas Integrated Report was discussed and analyzed in detail. The final 2014 Texas Integrated Report was approved in November 2015 and was summarized in the 2016 Basin Highlights Report. In addition, detailed watershed characterization Basin Highlights Reports were completed in 2012, 2013, and 2014. Each of these basin reports are available on TRA's website at http://www.trinityra.org/default.asp?contentID=97. As the 2016 Texas Integrated Report is currently in development, this basin highlights report will provide updates to program activities that have occurred in the previous year.

Trinity River Basin Monitoring

Current TRA CRP FY 2017 monitoring is being conducted by 10 partner agencies and TRA. Samples are being collected at varying frequencies at over 200 stations throughout the basin. These partner agencies have allowed TRA a coverage of the basin that would otherwise be impossible with in-house resources. In addition, the work performed by these agencies provides a four to one return for each dollar spent on monitoring activities. The table below provides a summary of monitoring sites and sampling frequencies. A complete monitoring schedule is available at https://cms.lcra.org/.

Table 1: Monitoring Stations and Frequencies

Entity	# of Sites	Monitoring Frequencies								
		Metals in Water	Organics in Water	Conventionals	E. coli	Flow	Field	24 Hour DO	Organics in Sediment	Biological
TRA CRP (TR)	16						1		1	
	1									2
	9	2		4	4	4	4			
	2			4	4	4	4			
	2				4	4	4			
	2			4	4		4			
	1					5	5	5		
	1			5	5	5	5			
City of Arlington (AR)	4	4		4	12	12	12			
	4	4			12	12	12			
City of Dallas (DA)	30	2					12			
DFW Airport Environmental Affairs Department (DF)	6	4	4	4	4	4	4			
City of Dallas Trinity Watershed Management (DT)	3				4	4	4			
City of Fort Worth (FW)	6				4	12	12			
	1				4		12			
City of Grand Prairie (GP)	4	1		4	12	12	12			
	3	1		4	12		12			
City of Irving (IR)	3	2		6	6	6	6			
	4				6	6	6			
	1				6		6			
	1	2		6	6		6			

Entity	# of Sites	Monitoring Frequencies								
		Metals in Water	Organics in Water	Conventionals	E. coli	Flow	Field	24 Hour DO	Organics in Sediment	Biological
TRA Lake Livingston Project	3							2		
	3	2		2	2	2	2			
	1	2		4	4	4	4			
	4	2		4	4		4			
	1	2		12	12	12	12			
	2	2		12	12		12			
	4			2	2	2	2			
	1			2	2		2			
	1			2		2	2			
	3			2			2			
	1						4			
	1			12		12	12			
North Texas Municipal Water District (NM)	2	12		12	12	12	12			
	14	12		12	12		12			
Tarrant Regional Water District (TD)	7							2		
	3	12		12	12	12	12			
	1	12		12	12		12			
	2	12		12	4		12			
	5	5		5	4		5			
	2	6		6	6	6	12			
	6	6		6	6		12			
	1	4		4	4	4	4			
	1	4		4	4		4			
	1	2		2	2	2	2			
	4			12	12	12	12			
	2			12	12		12			
	2			12		12	12			
	1			12			12			
	2			6	6		12			
	25			5	4		5			
	2				4	4	4			
	8				4		4			

The parameters collected vary by entity; the most commonly collected parameters for each grouping are listed on the following page.

Figure 2: Water quality sampling on Joe Pool Lake, August 2016

Figure 3: Measuring flow on the Elm Fork at Wildwood Drive in Dallas, July 2016

- Metals in Water – total and/or dissolved aluminum, arsenic, barium, cadmium, chromium, copper, iron, lead, magnesium, manganese, nickel, silver, and zinc
- Organics in Water – total petroleum hydrocarbons
- Conventionals – Total alkalinity, biochemical oxygen demand, total and dissolved organic carbon, chlorophyll-a, hardness, nitrogen series, phosphorus series, residues, chloride, and sulfate
- Flow – flow severity, instantaneous flow, and flow measurement method
- Field – Air and water temperature, dissolved oxygen, pH, specific conductance, contact recreation and drought parameters, Secchi depth, and turbidity
- 24 Hour DO – 24-hour deployment summary data for water temperature, dissolved oxygen, pH, and specific conductance
- Organics in Sediment – these parameters will be collected as part of a special project for PCBs, dioxins, and furans
- Biological – Habitat, benthic macroinvertebrate, and nekton data

Aquatic Life (Biological) Monitoring

Aquatic life monitoring includes an assessment of the quality of the habitat in and around the stream. In addition, fish and benthic macroinvertebrates are collected to evaluate population diversity and health. This information is used to provide baseline data for a stream in order to determine if aquatic life uses are being supported.

Aquatic life monitoring protocols require sampling during the critical and index period of a single year. The index period is from March 15 to October 15 which represents the warmer times of the year. The critical period occurs within this index period from July 1 to September 30. This represents the portion of the year when the lowest stream flows, highest temperatures, and lowest dissolved oxygen levels are expected to occur. Occasionally, sampling may occur outside of these date ranges if critical and/or index period conditions are present and stable. Monitoring occurs during these periods because it is assumed that if aquatic life uses are being met under these extreme conditions, then they are also being met during times of the year with higher flows, lower temperatures, and higher dissolved oxygen.

Biological monitoring occurs over a stream reach as opposed to a single discrete location for routine water quality monitoring. The length of the reach is defined by the average stream width up to a maximum of 500 meters for a wadeable stream. Once fish, benthic macroinvertebrate, and habitat data are tabulated, the results are used to calculate a score for each data type.

Figure 4: Picking benthic macroinvertebrates, Village Creek, October 2016

Figure 5: Visual observations for habitat assessment, Village Creek, October 2016

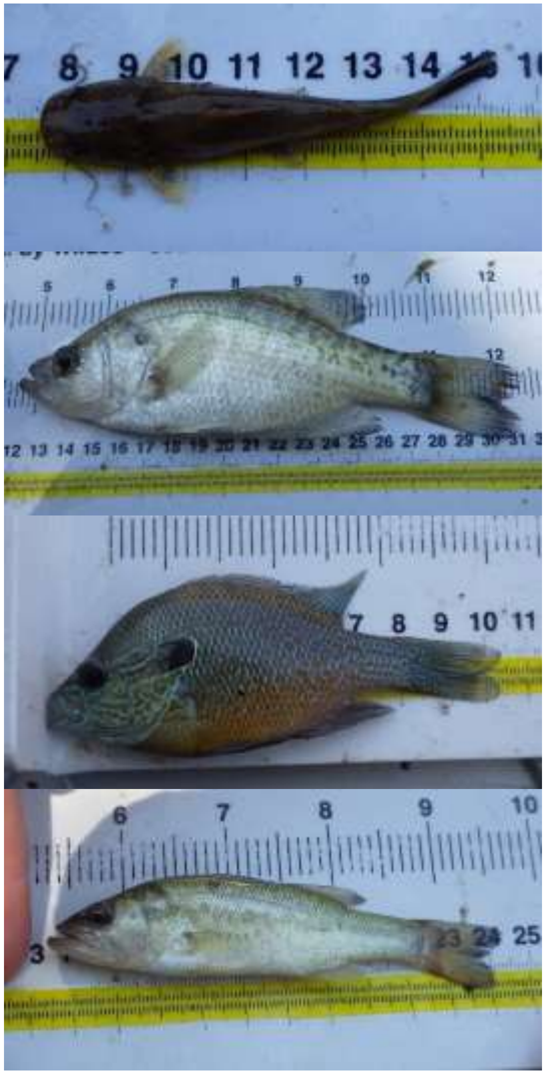

Figure 6: Fish specimens (from top to bottom - flathead catfish, white crappie, longear sunfish, largemouth bass), Village Creek, August 2016

The numeric scores correlate to a spectrum of aquatic life use levels that are described as Exceptional, High, Intermediate, and Limited. Table 2 describes the metrics that define the two ends of this spectrum.

Monitoring was conducted on Village Creek near Everman in August (critical period) and October (index period) of 2016. Historically, this stream is characterized as intermittent with perennial pools sufficient to support significant aquatic life use. Based on this flow status, aquatic life use in this stream is presumed to be limited. The findings of the monitoring in Village Creek indicate that the stream is supporting its aquatic life uses. Fish scores were Exceptional for both the critical and index period events. Benthic macroinvertebrate and habitat scores were Intermediate for the critical period sample and High for the Index period sample. Scores were slightly higher in the Index period due to increased bank stabilizing vegetation and instream cover for the habitat assessment and a shift in the benthic macroinvertebrate populations that were found.

Figure 7: Fish specimens (clockwise from top left - yellow bullhead catfish, blackstripe topminnow, green sunfish, bluntnose darter), Village Creek, October 2016

Table 2: Scoring Metrics for Aquatic Life Monitoring

	Exceptional	Limited
Fish	1. Large number of species relative to basin size 2. Large number of native cyprinid species 3. Larger number of benthic invertivore species 4. Large number of native sunfish species 5. Lower percentage of individuals as tolerant species 6. Lower percentage of individuals as omnivores 7. Higher percentage of individuals as invertivores 8. Higher percentage of individuals as piscivores 9. Higher number of individuals per seine haul 10. Higher number of individuals per minute of electrofishing 11. Lower percentage of individuals as non-native species 12. Lower percentage of individuals with disease or other anomaly	1. Small number of species relative to basin size 2. Few native cyprinid species 3. No benthic invertivore species 4. Few native sunfish species 5. Higher percentage of individuals as tolerant species 6. Higher percentage of individuals as omnivores 7. Lower percentage of individuals as invertivores 8. Lower percentage of individuals as piscivores 9. Lower number of individuals per seine haul 10. Lower number of individuals per minute of electrofishing 11. Higher percentage of individuals as non-native species 12. Higher percentage of individuals with disease or other anomaly
Benthic Macroinvertebrates *EPT-Ephemeroptera, Plecoptera, and Tricoptera	1. Large number of species overall 2. Large number of species within the orders EPT* 3. Lower Hilsenhoff Biotic Integrity score (higher relative abundance of intolerant taxa) 4. Lower percentage of individuals as Chironomidae 5. Lower ratio of individuals in the dominant taxon to the total number of individuals 6. Lower ratio of individuals in the dominant functional feeding group to the total number of individuals 7. Lower ratio of predator individuals to the total number of individuals 8. Higher ratio of individuals in intolerant taxa to those in tolerant taxa 9. Lower percentage of total Tricoptera individuals as Hydropsychidae 10. Higher number of non-insect taxa 11. Lower ratio of collector-gatherer individuals to the total number of individuals 12. Lower ratio of Elmidae individuals to the total number of individuals	1. Small number of species overall 2. Few species within the orders EPT* 3. Higher Hilsenhoff Biotic Integrity score (higher relative abundance of tolerant taxa) 4. Higher percentage (or extremely low percentage) of individuals as Chironomidae 5. Higher ratio of individuals in the dominant taxon to the total number of individuals 6. Higher ratio of individuals in the dominant functional feeding group to the total number of individuals 7. Higher ratio (or extremely low ratio) of predator individuals to the total number of individuals 8. Lower ratio of individuals in intolerant taxa to those in tolerant taxa 9. Higher percentage of total Tricoptera individuals as Hydropsychidae (or no Trichoptera individuals) 10. Lower number of non-insect taxa 11. Higher ratio (or extremely low ratio) of collector-gatherer individuals to the total number of individuals 12. Higher ratio (or extremely low ratio) of Elmidae individuals to the total number of individuals
Habitat	1. Large amount and many types of substrate that provides instream cover or habitat 2. Higher substrate stability (dominant substrate is gravel or larger) 3. Higher number of riffles 4. Higher dimensions for largest pool 5. Higher water level within the channel 6. Highly stable banks 7. Higher channel sinuosity 8. Wide natural riparian buffer strips 9. Undeveloped surrounding area	1. Low amount or very few types of substrate that provides instream cover or habitat 2. Low substrate stability (dominant substrate sand/silt/clay or bedrock) 3. Lower number of riffles 4. Lower dimensions for largest pool 5. Lower water level within the channel 6. Unstable banks 7. Lower channel sinuosity 8. Narrow natural riparian buffer strips 9. Highly developed surrounding area

Climate

2016 was slightly wetter than average with 35.63 inches of rain as measured by the NOAA gage located at DFW International Airport. This followed the record breaking 62.8 inches of rain in 2015. Due to the rainfall of 2015 and subsequent filling of reservoirs above the conservation pool elevations as well as the rainfall of 2016, flows in the river stayed above the median well into the early summer of 2016 (see graph below).

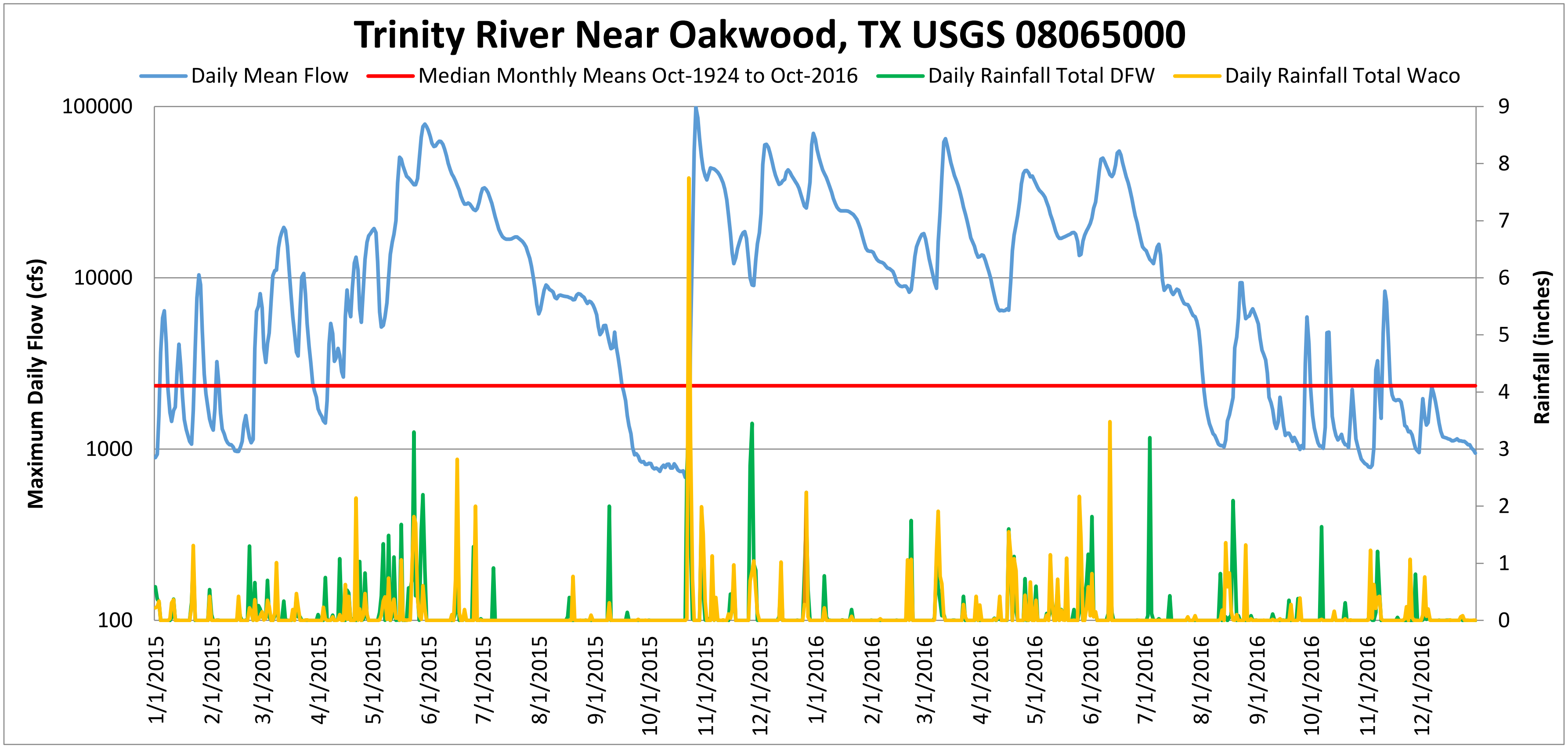

Figure 8: Rainfall and flow in the Trinity River near Oakwood

The graph below illustrates the effects of the El Niño/La Niña cycle on the climate in Texas. The Oceanic Niño Index (ONI) represents the intensity of sea surface temperature changes in the tropical Pacific. When the ONI is greater than 0.5, El Niño conditions exist and the water is warmer than normal. When the water is cooler than normal, values are -0.5 or lower and La Niña conditions exist. The graph below presents the inverse of the ONI values because El Niño generally results in cooler and wetter weather in Texas. Conversely, La Niña results in warmer and drier weather. This can be seen especially well for the period between 2011 and 2015 where more than 70% of the state was in some level of drought (from abnormally dry to exceptional drought) during a fairly prolonged period of La Niña or near La Niña conditions.

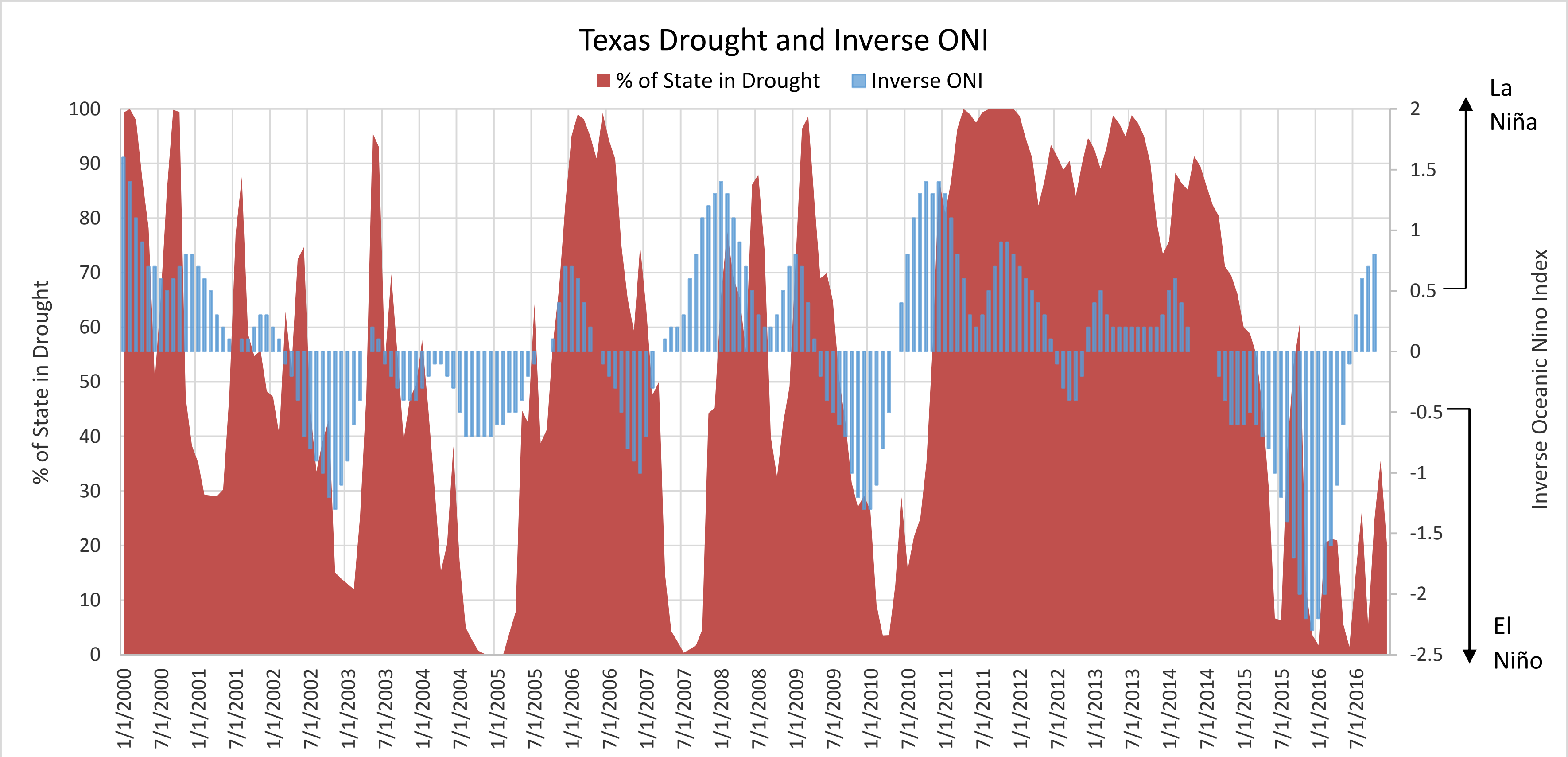

Figure 9: Effects of El Niño/La Niña cycle on Texas climate

Village Creek-Lake Arlington Watershed Protection Plan

Figure 10: Flow measurement, Village Creek at FM 3391, June 2016

A watershed protection plan (WPP) was started in September 2015 for the Village Creek-Lake Arlington watershed. This project is being funded by a Clean Water Act Section 319(h) grant provided by the EPA through the TCEQ, with matching funds from the City of Arlington. The project homepage is located at http://www.trinityra.org/lakearlingtonvillagecreek. This homepage provides information on current project activities and links to project documents as well as information on how to get involved. Over the course of 2016, many project activities have started, such as water quality monitoring and public outreach.

Water quality monitoring began in June of 2016 and will continue through May of 2017. Samples are taken on a routine basis every even numbered month; meaning that these samples are scheduled without regard to weather conditions or stream flows. Flow biased samples are scheduled any time between the routine samples and are targeted to capture specific stream flows. The goal of this alternating scheduling is to collect samples across all conditions from high to low flow.

Optical brightener testing is being conducted during each sampling event as well in order to help identify potential sources of E. coli in the watershed. This sampling consists of soaking unbleached cotton media in the stream for up to 48 hours depending on flow status. Afterwards, the cotton media are dried, then viewed under a UV light and inspected for fluorescence. If any fluorescence is observed, optical brighteners are present in the stream. Ideally, this observation would indicate the presence of human sewage from either failing septic systems or broken pipelines as laundry detergents are a source of optical brighteners. This observation in conjunction with high E. coli levels may provide additional lines of evidence that E. coli sources are anthropogenic rather than from wildlife, pets, or livestock. However, there are many other products that contain optical brighteners such as car wash detergents and antifreeze. Influences from these non-laundry detergent sources can create “false positives” in that they may be correlated to both high and low levels of E. coli. These confounding factors may make it difficult to make definitive conclusions about the sources of E. coli in the stream. Nonetheless, it is a rather inexpensive way to obtain another piece of data that could potentially help identify sources of E. coli in the watershed.

The graph below shows E. coli plotted against flow for all the sites in this project. Data shown were collected between June 2016 and October 2016, the complete dataset available at the time this report was written. E. coli are plotted on a log scale. Oversized symbols indicate that optical brighteners were detected at the time the samples were collected. Higher E. coli levels seen during low flows with optical brightener detections may indicate that there are human sewage sources in the watershed as discussed in the preceding paragraph. Optical brighteners are typically not expected to be observed during high flows due to dilution and the inability to detect fluorescence at highly diluted concentrations. However, there is one sample where fluorescence was observed during a high flow event in conjunction with a high E. coli value (large yellow circle). This could be due to a large sewage spill in the watershed or some other non-sewage source such as a spill from a laundromat, car wash, or antifreeze. Conversely, there is an optical brightener detection for a sample with very low E. coli levels (large green triangle). Again, this could be due to optical brighteners unrelated to sewage. As stated previously, optical brightener testing is not intended to give definitive results; rather it will provide another piece of data to be analyzed and interpreted.

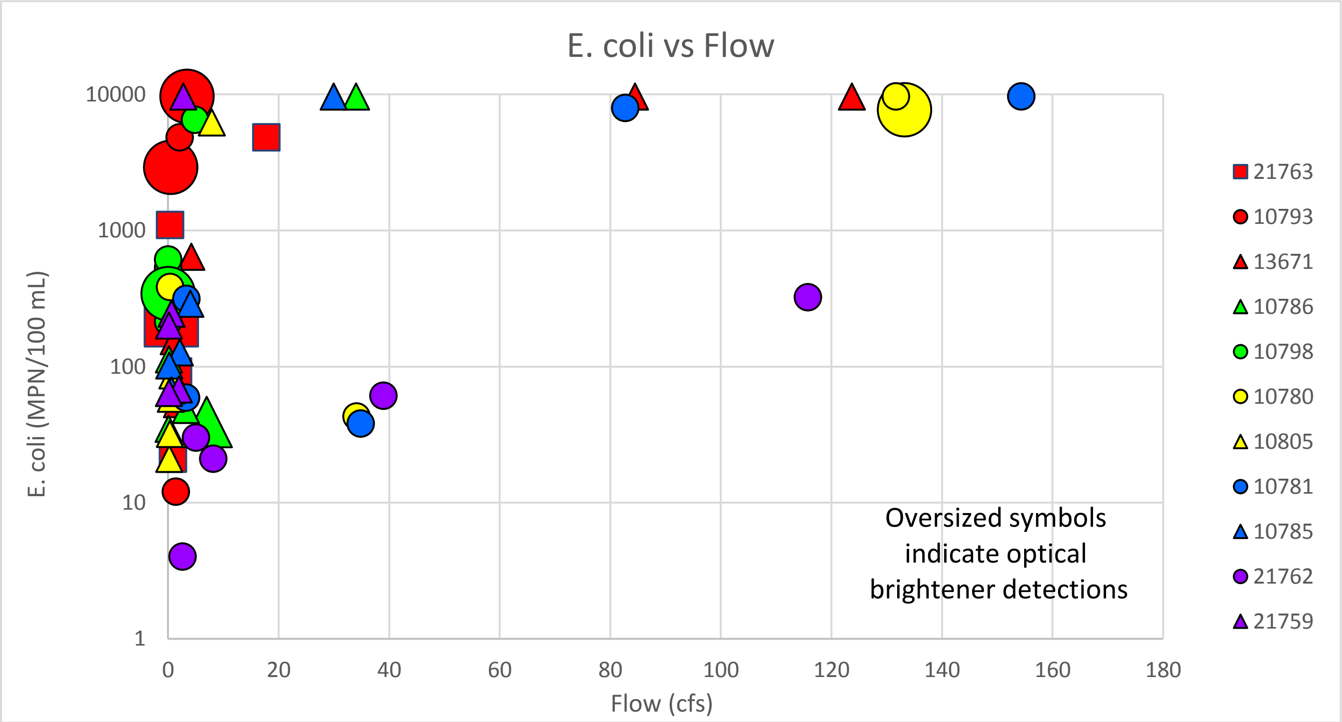

Figure 11: E. coli vs. Flow for the Village Creek watershed

An initial correlation analysis was conducted on the data collected between June and October 2016. An arbitrary cutoff of +/- 0.5 was defined to indicate those correlations that might be significant. The table below is an excerpt of the resultant coefficients. Not shown are some correlations that are obvious such as a strong positive correlation between flow and solids or between flow and recent rainfall totals. Each of the coefficients in the table below has a p-value of 0.000038 or less making the results significant.

Table 3: Correlation coefficients for selected parameters in the Village Creek watershed

Parameter	*Secchi Depth (m)*	*Turbidity (NFU)*	*Flow (cfs)*	*Days Since Precipitation*	*24-hr Rain Total (inches)*	*72-hr Rain Total (inches)*	*TKN (mg/L)*	*TP (mg/L)*	*TSS (mg/L)*	*VSS (mg/L)*
TKN (mg/L)	-0.5409	0.5540		-0.5823	0.6559	0.5750				
TP (mg/L)		0.5410		-0.5253	0.5505	0.5467	0.6413			
TSS (mg/L)					0.7656	0.7207	0.5975	0.6637		
VSS (mg/L)					0.7573	0.7636	0.7692	0.6329		
E. coli (MPN/100 mL)	-0.6942	0.7229	0.5742	-0.6548	0.8965	0.7985	0.7835	0.6484	0.8010	0.8987

Based on this limited dataset, the correlation coefficients above seem to indicate that constituents such as E. coli, nutrients, and solids are being introduced to the watershed primarily through non-point source runoff. Total Suspended Solids (TSS) and Volatile Suspended Solids (VSS) are strongly correlated to recent rainfall events. Likewise, Total Kjeldahl Nitrogen (TKN) and Total Phosphorus (TP) are strongly correlated to TSS, VSS and recent rainfall. The strong correlations between E. coli and recent rainfall, TKN, TP, TSS, and VSS confirm that E. coli is largely a non-point source issue.

Public outreach activities conducted as part of the grant include regular meetings of the overall stakeholder group, where TRA provides watershed monitoring updates, educational materials, and guidance for the stakeholder group as they prepare to write and review the WPP for their watershed. TRA has also provided stakeholders with several opportunities to attend educational workshops on a variety of water quality topics. A brief summary of these programs includes:

Figure 12: Texas Well Owners Network meeting, August 2016

- Texas Well Owners Network – demonstration and importance of private well water testing and maintenance, domestic septic system maintenance and education

As part of the outreach effort, the watershed coordinator for the WPP also regularly assists with watershed-related outreach efforts at external events, staffing booths at events such as environmental fairs and youth education events, as well as promoting general watershed stewardship and the Village Creek-Lake Arlington WPP when invited to meetings of non-profits, non-governmental organizations, and church groups. TRA will continue with its outreach efforts by these means throughout the lifetime of the grant.

- Texas Watershed Stewards - general watershed awareness, potential threats to water quality, and management of negative impacts from human activity
- Texas Riparian & Stream Ecosystems – functions of riparian/stream ecosystems, interactive demonstrations of these functions, and benefits of employing riparian buffers in urban and rural environments

Figure 13: Scout Badge Day at River Legacy Park Living Science Center, December 2016

Fish Tissue Study in Lake Livingston

Figure 14: White Bass and Blue Catfish, Lake Livingston Wolf Creek Park, August 2016

In December of 2015, the Texas Department of State Health Services (TxDSHS) issued a fish consumption advisory (ADV-53) that extended from the downstream border of existing advisories on the Trinity River at US 287 near Corsicana to US 90 near Liberty. This advisory included Lake Livingston and was enacted due to elevated levels of dioxins and PCBs in fish tissue. A full list of current advisories for the state of Texas, associated documentation, and maps can be found at https://www.dshs.texas.gov/seafood/advisories-bans.aspx.

ADV-53 is based on 280 fish collected from July 2012 to May 2013 at 15 sites within the river and reservoir. Fifteen species of fish were represented in this effort and included individual species in the gar, catfish, buffalo, drum, bass, and crappie groups. As discussed in the Climate section of this report and in the 2016 Basin Highlights Report (http://serv.trinityra.org/reports/BasinSummaryReports/2016TRABHR.pdf), 2015 was an abnormally wet year. There was extreme and prolonged flooding throughout the basin until the summer of 2016. It was expected that some fish populations might have been displaced during this flooding.

In August 2016, TRA staff conducted a small pilot study to try to determine if there were any changes in the PCB and dioxin concentrations in the fish within Lake Livingston that might warrant a resample of the reservoir by the TxDSHS. This study focused on blue catfish and white bass collected at one area within Lake Livingston near Wolf Creek Park. Ten samples of each species were caught and the tissue was analyzed by two labs. The results are still being studied but initial data analysis indicates that PCB levels in these two fish species near Wolf Creek Park are moderately lower than previously determined by TxDSHS. Dioxin levels appear to be significantly lower than those seen by TxDSHS. However, dioxin levels in these two species at this particular site were well below the criteria for the TxDSHS data as well.

Related to ADV-53, TRA staff will undertake a sediment sampling study in 2017. PCBs and dioxins are hydrophobic and will bind to sediments. The sediment study will attempt to identify hotspots in the river where these contaminants may be found.