BIG ELM CREEK WATERSHED PLANNING

Allen Berthold, Ed Rhodes - Texas Water Resources Institute
February 19, 2019

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Introductions

- Name
- Representation (Agency, Landowner, Etc.)

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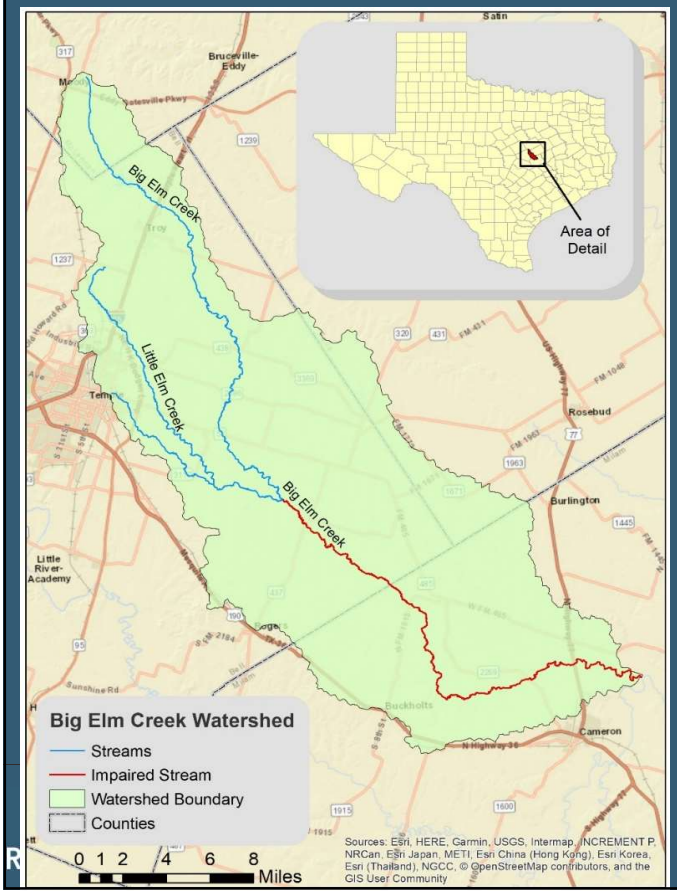
Big Elm Creek Watershed



- Agenda & recap last meeting
  - Background on Water Quality - recap
  - Approaches to Address Water Quality - recap
  - Big Elm Creek Watershed and Water Quality
  - Stakeholder Structure and Decision-Making - recap
  - Example Watershed Protection Plan
  - Next Steps

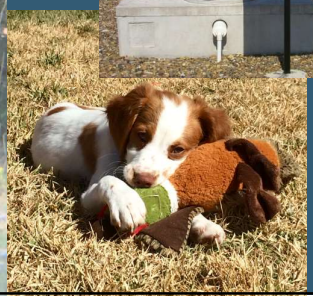
Texas Surface Water Quality Standards Review

Where do they come from?

Some Examples:

Designated Use	Criteria	Parameter
Primary Contact Recreation	**126 MPN/100 mL (FW)** 35 MPN/100 mL (Marine)	***E. coli* Bacteria (FW)** Enterococci (Marine)
Secondary Contact Recreation 1	**630 MPN/100 mL (FW)** 175 MPN/100 mL (Marine)	***E. coli* Bacteria (FW)** Enterococci (Marine)
High Aquatic Life Use	5.0 mg/L Average 3.0 mg/L Minimum	Dissolved Oxygen
General Use	6.5 – 9.0	pH

Sources of *E.coli* Bacteria?



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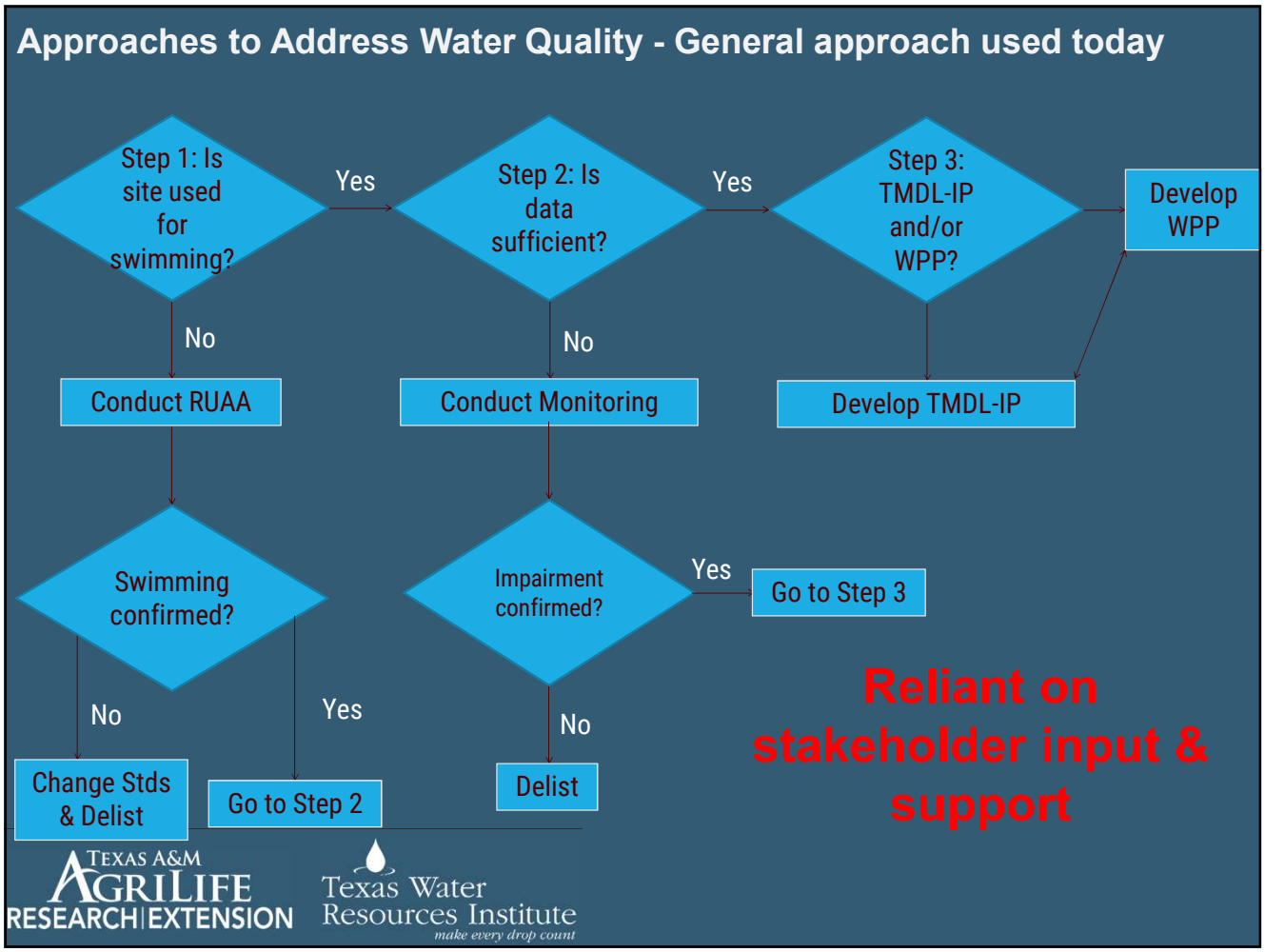
Approaches to Address Water Quality - General approach used today
Step 1: Is site used for swimming?
Yes
Step 2: Is data sufficient?
Yes
Step 3: TMDL-IP and/or WPP?
Develop WPP
No
No
Conduct RUAA
Conduct Monitoring
Develop TMDL-IP
Swimming confirmed?
Impairment confirmed?
Yes
Go to Step 3
No
Yes
No
Change Stds & Delist
Go to Step 2
Delist
Reliant on stakeholder input & support
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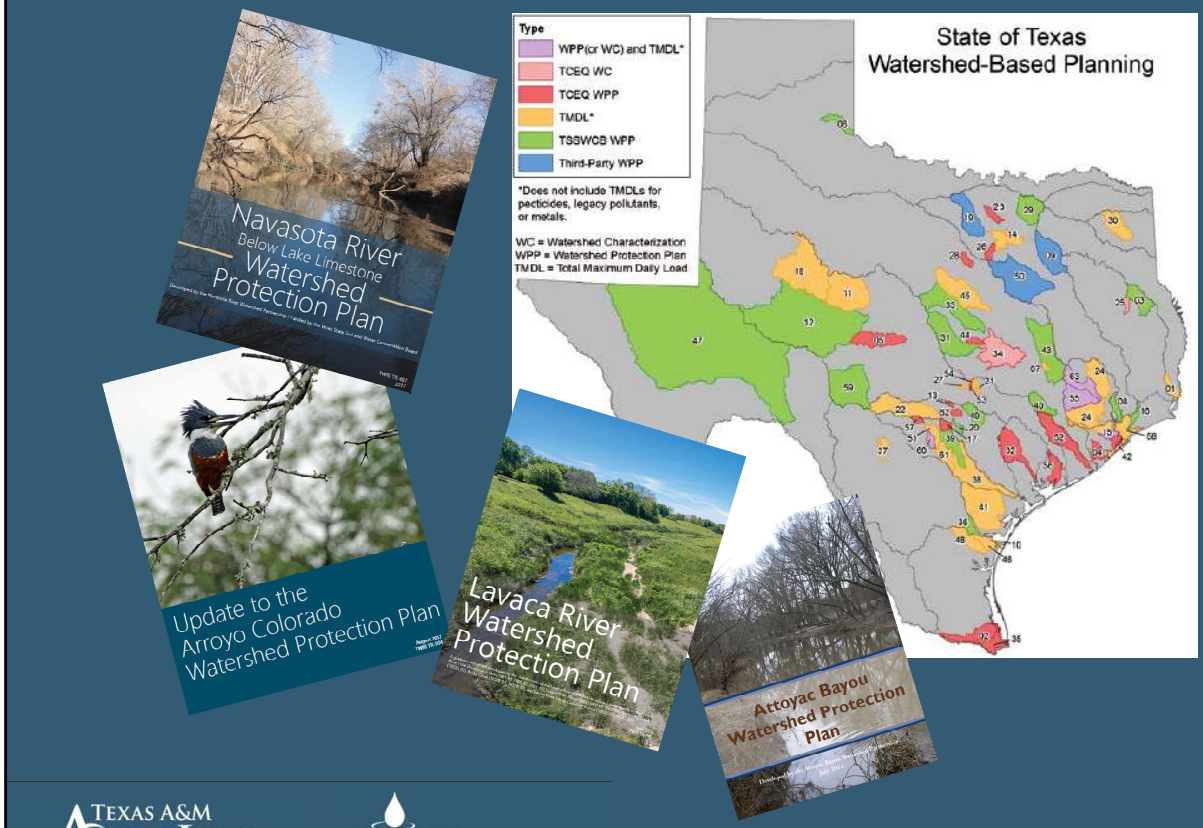
Watershed-Based Plans Across Texas



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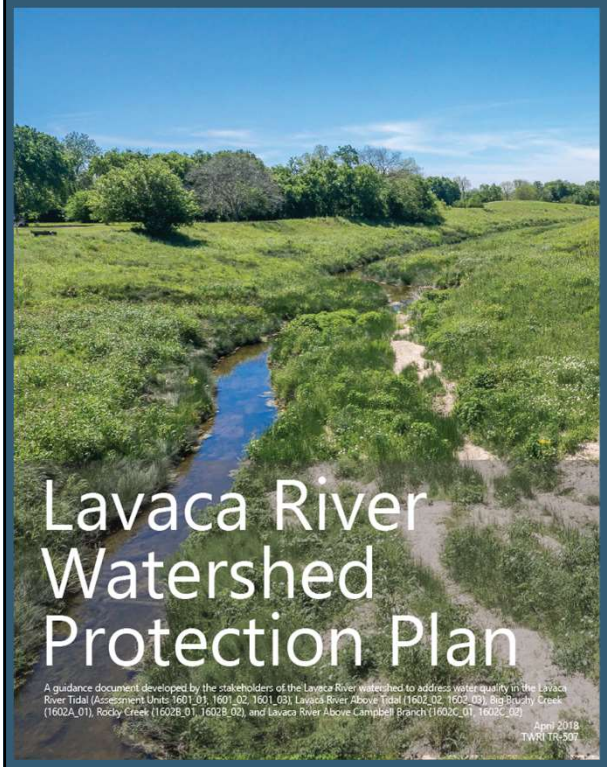
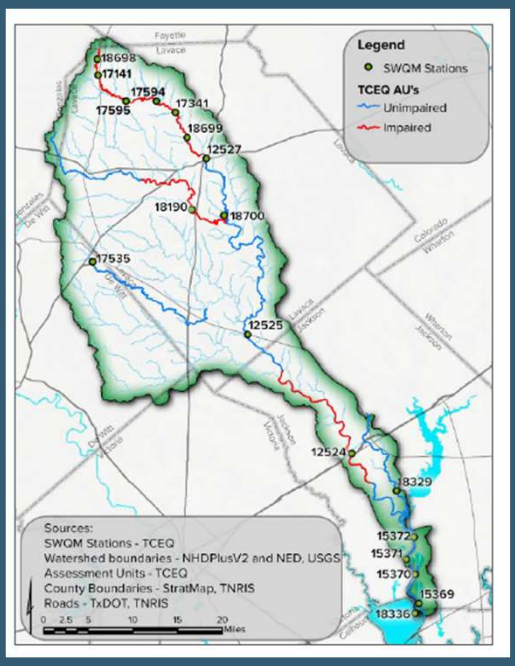


EXAMPLE LOCAL WATERSHED PROTECTION PLANS

Example Watershed Based Plan



- Lavaca River Watershed Protection Plan
  - Problems: Excessive bacteria, low dissolved oxygen

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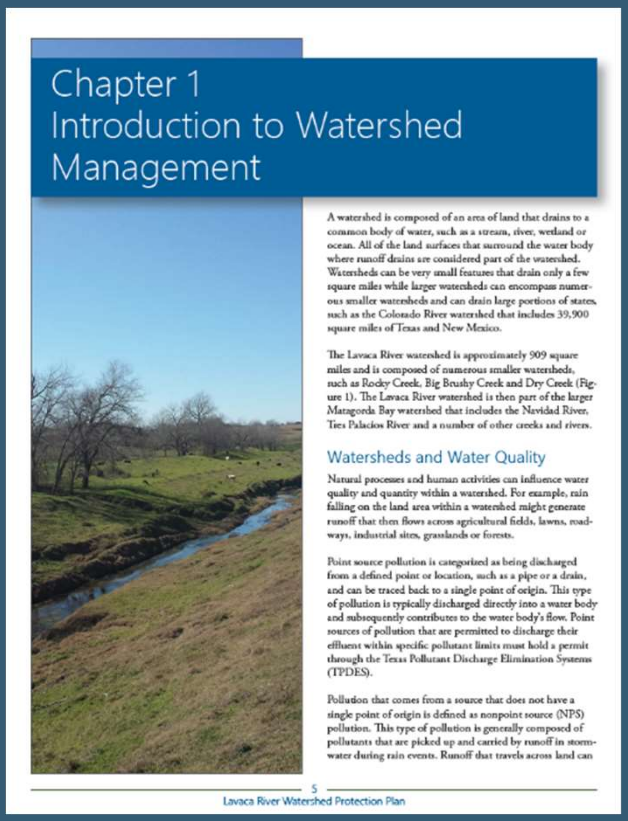
Chapter 1 – Introduction to Watershed Management

- Watersheds and Water Quality
- The Watershed Approach
- Watershed Protection Plan
- Adaptive Management
- Education and Outreach



Chapter 1
Introduction to Watershed Management

A watershed is composed of an area of land that drains to a common body of water, such as a stream, river, wetland or ocean. All of the land surfaces that surround the water body where runoff drains are considered part of the watershed. Watersheds can be very small features that drain only a few square miles while larger watersheds can encompass numerous smaller watersheds and can drain large portions of states, such as the Colorado River watershed that includes 39,900 square miles of Texas and New Mexico.

The Lavaca River watershed is approximately 909 square miles and is composed of numerous smaller watersheds, such as Rocky Creek, Big Brushy Creek and Dry Creek (Figure 1). The Lavaca River watershed is then part of the larger Matagorda Bay watershed that includes the Navidad River, Ties Palacios River and a number of other creeks and rivers.

Watersheds and Water Quality

Natural processes and human activities can influence water quality and quantity within a watershed. For example, rain falling on the land area within a watershed might generate runoff that then flows across agricultural fields, lawns, roadways, industrial sites, grasslands or forests.

Point source pollution is categorized as being discharged from a defined point or location, such as a pipe or a drain, and can be traced back to a single point of origin. This type of pollution is typically discharged directly into a water body and subsequently contributes to the water body's flow. Point sources of pollution that are permitted to discharge their effluent within specific pollutant limits must hold a permit through the Texas Pollutant Discharge Elimination Systems (TPDES).

Pollution that comes from a source that does not have a single point of origin is defined as nonpoint source (NPS) pollution. This type of pollution is generally composed of pollutants that are picked up and carried by runoff in stormwater during rain events. Runoff that travels across land can

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Lavaca River Watershed Protection Plan

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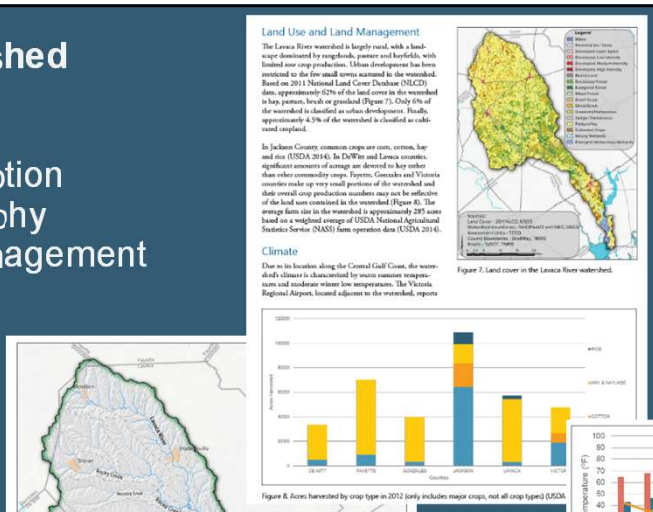
Chapter 2 – Watershed Description

- Watershed Description
- Soils and Topography
- Land Use and Management
- Climate
- Demographics



Land Use and Land Management

The Lavaca River watershed is largely rural, with a landscape dominated by rangelands, pasture and herbfields, with limited row crop production. Urban development has been restricted to the few small towns scattered in the watershed. Based on 2011 National Land Cover Database (NLCD) data, approximately 62% of the land cover in the watershed is hay, pasture, brush or grassland (Figure 7). Only 6% of the watershed is classified as urban development. Finally, approximately 4.5% of the watershed is classified as cultivated cropland.

In Jackson County, common crops are corn, cotton, hay and rice (USDA 2014). In DeWitt and Lavaca counties, significant amounts of acreage are devoted to hay rather than other commodity crops. Fayette, Gonzales and Victoria counties make up very small portions of the watershed and their overall crop production numbers may not be reflective of the land uses contained in the watershed (Figure 8). The average farm size in the watershed is approximately 285 acres based on a weighted average of USDA National Agricultural Statistics Service (NASS) farm operation data (USDA 2014).

Climate

Due to its location along the Central Gulf Coast, the watershed's climate is characterized by warm summer temperatures and moderate winter low temperatures. The Victoria Regional Airport, located adjacent to the watershed, reports

Figure 7. Land cover in the Lavaca River watershed.

Figure 8. Acres harvested by crop type in 2012 (only includes major crops, not all crop types) (USDA

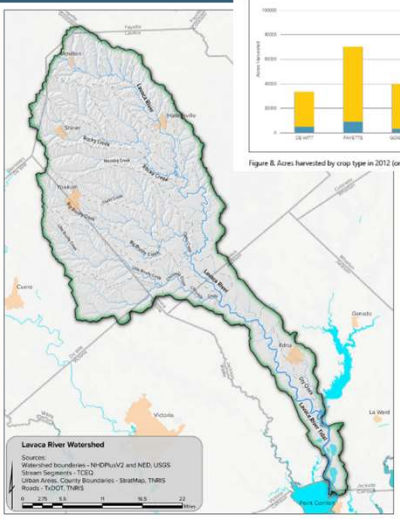


Figure 2. Water bodies of the Lavaca River watershed.

Figure 9. 10-year average watershed temperature and precipitation.

average peak daily highs of 94.5°F occurring in August (Figure 9). Meanwhile, average daily lows reach the lowest temperatures in January at 45°F.

Precipitation peaks in May, with an average of 5.19 inches (in) of rainfall. February sees the lowest average rainfall totals with 2.08 in. Average annual precipitation is around 41 in for the watershed (PRISM 2012). Based on this historic data, steady amounts of precipitation can be expected throughout the year, with slightly drier periods occurring in August and mid-winter.

Demographics

As of 2010, the Lavaca River watershed population was approximately 30,156, with a population density of 33 people/square mile (USCB 2010). Population is most dense within and near the towns of Moulton, Hallettsville, Shiner, Yoakum and Edna (Figure 10). Population projections by the Office of the State Demographer and the Texas Water Development Board (TWDB) for cities in the watershed are provided in Table 1 (TWDB 2016). From 2020 to 2070 the population of Lavaca County is expected to remain stable, Jackson County and DeWitt County are expected to increase by approximately 12% (population increases for Gonzales, Calhoun and Fayette counties are not included due to the very small land area included within the watershed).

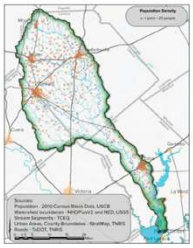


Figure 10. Population density in the Lavaca River watershed (each dot represents 25 people).

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Lavaca River Watershed Protection Plan

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Chapter 3 – Water Quality

- Introduction
- Bacteria
- RUAA
- Dissolved Oxygen
- UAA
- Nutrients
- Flow
- Potential Source of Water Quality Issues
- Water Quality Summary

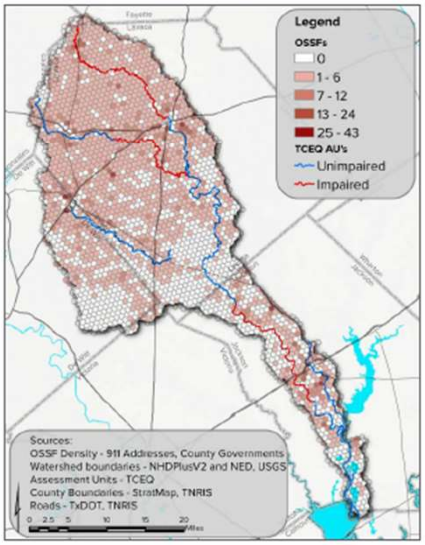

Figure 19. OSSF density.

Table 4. *2014 Texas Integrated Report* Assessment Results for stream segments in the Lavaca River watershed currently monitored for bacteria (TCEQ 2016).

AU	Description	Current Standard	Geomean	Supporting/Not Supporting
1602_02	Lavaca River Above Tidal – From the confluence of Beard Branch upstream to the upper end of segment at the confluence of Campbell Branch in Hallettsville.	126 cfu/100 mL *E. coli*	114.65	Fully Supporting
1602_03	Lavaca River Above Tidal – Lower portion of segment from confluence with NHD RC 12100101002463 south of Edna upstream to confluence with Beard Branch.	126 cfu/100 mL *E. coli*	294.94	Not Supporting
1602B_01	Rocky Creek – From confluence of Lavaca River upstream to confluence of Ponton Creek	126 cfu/100 mL *E. coli*	222.16	Not Supporting

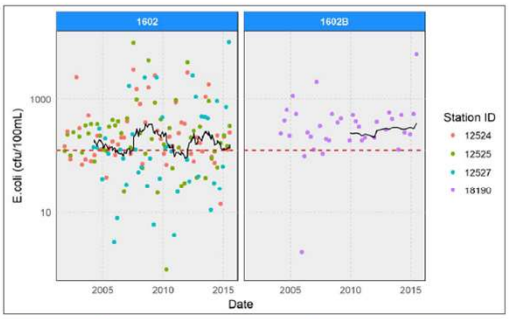

Figure 13. Historical *E. coli* concentrations at monitored segments with bacteria data. Dotted line indicates the 126cfu/100mL criterion and solid black line indicates the mean value of previous 20 measurements.

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Chapter 4 – Pollutant Source Assessment

- Introduction
- Load Duration Curves
- Pollutant Source Load Estimates
- Load Reduction Summary

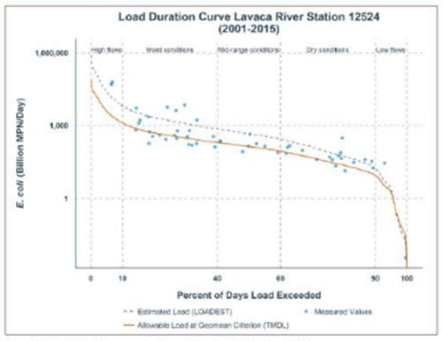

Figure 21. Load duration curve for Lavaca River SWQM Station 12524.

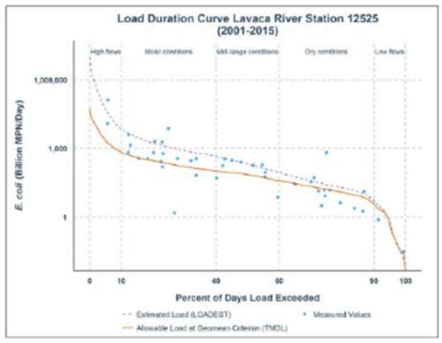

Figure 22. Load duration curve for Lavaca River SWQM Station 12525.

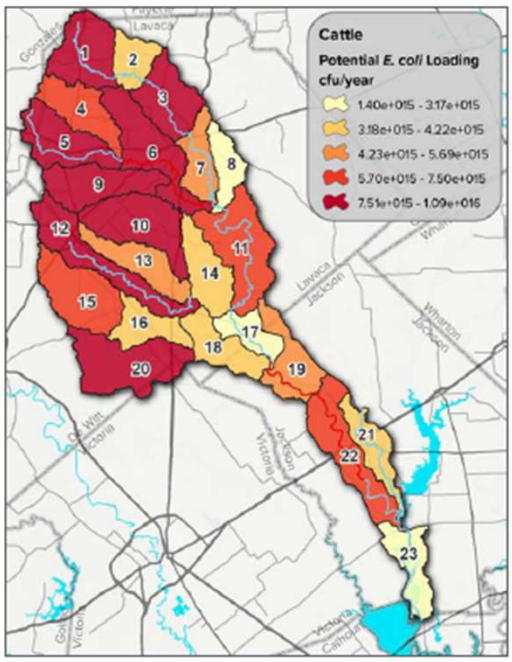

Figure 25. Potential annual bacteria loadings from cattle.

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Table 14. Management measure 1: Promote and implement Water Quality Management Plans or conservation plans.

Source: Cattle and Other Livestock			
Problem: Direct and indirect fecal bacteria loading due to livestock in streams, riparian degradation and overgrazing			
Objectives: • Work with producers to develop conservation plans and WQMPs that improve grazing practices and water quality. • Provide technical and financial support to producers. • Reduce fecal loadings attributed to livestock.			
Critical Areas: All properties with riparian habitat throughout the watershed and all properties in subwatersheds: 1, 3, 5, 6, 9, 10, 12 and 20			
Goal: Develop and implement conservation plans and WQMPs that minimize time spent by livestock in riparian areas and better use available grazing resource across the property.			
Description: Conservation plans and WQMPs will be developed with producers to implement BMPs that reduce water quality impacts from overgrazing, time spent by livestock in and near streams, and runoff from grazed lands. Practices will be identified and developed in consultation with NRCS, TSSWCB and local SWCDs as appropriate. Education programs and workshops will support and promote the adoption of these practices.			
Implementation Strategy			
Participation	**Recommendations**	**Period**	**Capital Costs**
TSSWCB, SWCDs	Develop funding to hire WQMP technician.	2019-2029	Estimated $75,000/yr
Producers, NRCS, TSSWCB, SWCDs	Develop, implement and provide financial assistance for 100 livestock conservation plans and WQMPs (including 30 in Rocky Creek subwatersheds).	2019-2029	$1,500,000 (est. $15,000/plan)
AgriLife Extension, TWRI	Deliver education and outreach programs and workshops (Lone Star Healthy Streams) to landowners.	2019, 2023, 2027	N/A
Estimated Load Reduction			
Prescribed management will reduce loadings associated with livestock by reducing runoff from pastures and rangeland as well as reducing direct deposition by livestock. Implementation of 100 WQMPs and conservation plans is estimated to reduce annual loads from livestock by 1.00×10^{15} cfu *E. coli*/yr in the Lavaca River. Of these 100 plans, at least 30 should be targeted toward the Rocky Creek watershed, which is estimated to reduce loads by 2.25×10^{14} cfu *E. coli*/yr.†			
Effectiveness	High – Decreasing the amount of time livestock spend in riparian areas and reducing runoff from pastures will directly reduce NPS contributions of bacteria in creeks.		
Certainty	Moderate – Landowners acknowledge the importance of good land stewardship practices and management plan objectives; however, financial incentives are often needed to promote the WQMP and conservation plan implementation.		
Commitment	Moderate – Landowners are willing to implement stewardship practices shown to improve productivity; however, because costs are often prohibitive, financial incentives are needed to increase implementation rates.		
Needs	High – Financial costs are a major barrier to implementation, education and outreach are also needed to demonstrate benefits to producers and their operations.		
Potential Funding Sources	Coastal Zone Management Program/Coastal Management Program (CZM program and CMP); EPA CWA §319(h) grant program; NRCS Environmental Quality Incentives Program (EQIP); Conservation Innovation Grants (CIG); Conservation Stewardship Program (CSP); Regional Conservation Partnership Program (RCPP)‡		

†Load reduction calculations described in Appendix B
‡Funding sources described in Section 7.4

Table 13. Available pasture and rangeland practices to improve water quality.

Practice	**NRCS Code**	**Focus Area or Benefit**
Brush management	314	Livestock, water quality, water quantity, wildlife
Fencing	382	Livestock, water quality
Filter strips	393	Livestock, water quality, wildlife
Grade stabilization structures	410	Water quality
Grazing land mechanical treatment	548	Livestock, water quality, wildlife
Heavy use area protection	562	Livestock, water quantity, water quality
Pond	378	Livestock, water quantity, water quality, wildlife
Prescribed burning	338	Livestock, water quality, wildlife
Prescribed grazing	528	Livestock, water quality, wildlife
Range/Pasture planting	550/512	Livestock, water quality, wildlife
Shade structure	N/A	Livestock, water quality, wildlife
Stream crossing	578	Livestock, water quality
Supplemental feed location	N/A	Livestock, water quality
Water well	642	Livestock, water quantity, wildlife
Watering facility	614	Livestock, water quantity

Chapter 5 – Watershed Protection Plan Implementation Strategies

- Introduction
- Management Measures

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Chapter 6 – Education and Outreach

- Watershed Coordinator
- Public Meetings
- Future Stakeholder Engagement
- Education Programs (Extension programs)
- Public Meetings
- Newsletters and News Releases

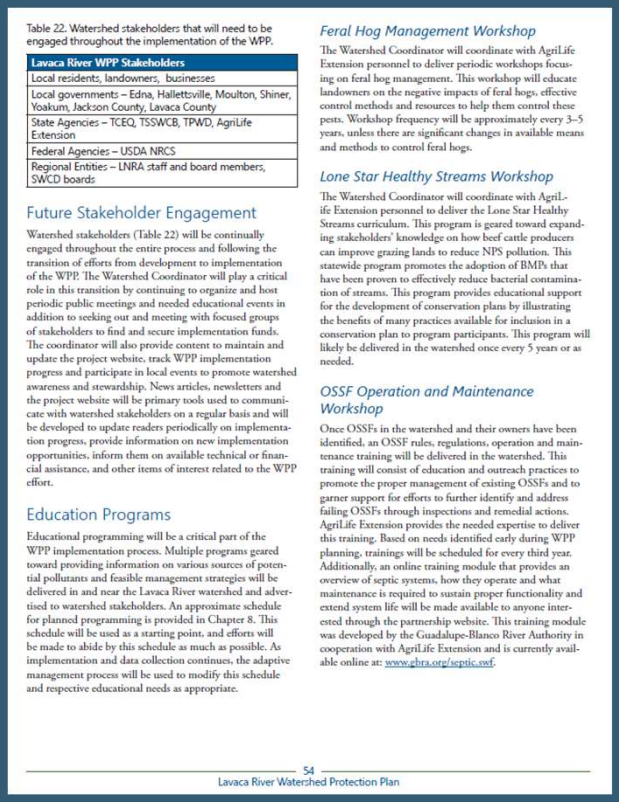

Table 22. Watershed stakeholders that will need to be engaged throughout the implementation of the WPP.

Lavaca River WPP Stakeholders
Local residents, landowners, businesses
Local governments – Edna, Hallettsville, Moulton, Shiner, Yoakum, Jackson County, Lavaca County
State Agencies – TCEQ, TSSWCB, TPWD, AgriLife Extension
Federal Agencies – USDA NRCS
Regional Entities – LNRA staff and board members, SWCD boards

Future Stakeholder Engagement

Watershed stakeholders (Table 22) will be continually engaged throughout the entire process and following the transition of efforts from development to implementation of the WPP. The Watershed Coordinator will play a critical role in this transition by continuing to organize and host periodic public meetings and needed educational events in addition to seeking out and meeting with focused groups of stakeholders to find and secure implementation funds. The coordinator will also provide content to maintain and update the project website, track WPP implementation progress and participate in local events to promote watershed awareness and stewardship. News articles, newsletters and the project website will be primary tools used to communicate with watershed stakeholders on a regular basis and will be developed to update readers periodically on implementation progress, provide information on new implementation opportunities, inform them on available technical or financial assistance, and other items of interest related to the WPP effort.

Education Programs

Educational programming will be a critical part of the WPP implementation process. Multiple programs geared toward providing information on various sources of potential pollutants and feasible management strategies will be delivered in and near the Lavaca River watershed and advertised to watershed stakeholders. An approximate schedule for planned programming is provided in Chapter 8. This schedule will be used as a starting point, and efforts will be made to abide by this schedule as much as possible. As implementation and data collection continues, the adaptive management process will be used to modify this schedule and respective educational needs as appropriate.

Feral Hog Management Workshop

The Watershed Coordinator will coordinate with AgriLife Extension personnel to deliver periodic workshops focusing on feral hog management. This workshop will educate landowners on the negative impacts of feral hogs, effective control methods and resources to help them control these pests. Workshop frequency will be approximately every 3–5 years, unless there are significant changes in available means and methods to control feral hogs.

Lone Star Healthy Streams Workshop

The Watershed Coordinator will coordinate with AgriLife Extension personnel to deliver the Lone Star Healthy Streams curriculum. This program is geared toward expanding stakeholders' knowledge on how beef cattle producers can improve grazing lands to reduce NPS pollution. This statewide program promotes the adoption of BMPs that have been proven to effectively reduce bacterial contamination of streams. This program provides educational support for the development of conservation plans by illustrating the benefits of many practices available for inclusion in a conservation plan to program participants. This program will likely be delivered in the watershed once every 5 years or as needed.

OSSF Operation and Maintenance Workshop

Once OSSFs in the watershed and their owners have been identified, an OSSF rules, regulations, operation and maintenance training will be delivered in the watershed. This training will consist of education and outreach practices to promote the proper management of existing OSSFs and to garner support for efforts to further identify and address failing OSSFs through inspections and remedial actions. AgriLife Extension provides the needed expertise to deliver this training. Based on needs identified early during WPP planning, trainings will be scheduled for every third year. Additionally, an online training module that provides an overview of septic systems, how they operate and what maintenance is required to sustain proper functionality and extend system life will be made available to anyone interested through the partnership website. This training module was developed by the Guadalupe-Blanco River Authority in cooperation with AgriLife Extension and is currently available online at: www.gbra.org/septic.swf.

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Chapter 7 – Resources to Implement the WPP

- Introduction
- Technical Assistance
- Financial Sources

Table 23. Summary of potential sources of technical assistance.

Technical Assistance	
Management Measure	**Potential Sources**
MM1 : Promote and implement WQMPs or conservation plans	TSSWCB; local SWCDs; NRCS; AgriLife Extension
MM2: Promote technical and direct operational assistance to landowners for feral hog control	AgriLife Extension; TPWD; NRCS; TSSWCB
MM3: Identify and repair or replace failing on-site sewage systems	Lavaca County designated representative, Jackson County Office of Permitting; AgriLife Extension
MM4: Increase proper pet waste management	City public works departments; AgriLife Extension
MM5: Implement and expand urban and impervious surface stormwater runoff management	City public works departments; engineering firms; AgriLife Extension
MM6: Address inflow and infiltration	City public works departments; engineering firms, TCEQ
MM7: Reduce illicit dumping	AgriLife Extension; county law enforcement; TPWD game wardens

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Chapter 8 – Measuring Success
- Introduction
- Water Quality Targets
- Additional Data Collection Needs
- Data Review
- Interim Measurable Milestones
- Adaptive Management

Table 25. Lavaca River watershed management measures, responsible party, goals and estimated costs.

Management Measure	Responsible Party	Unit Cost	Implementation Goals (years after implementation begins)† 1	2	3	4	5	6	7	8	9	10	Total Cost
Livestock													
Hire WQMP field technician.	TSSWCB, SWCDs	$75,000/yr	1										
Develop 100 WQMPs/conservations plans.	TSSWCB, SWCDs, NRCS	$15,000	20		40		60		80		100		$1,500,000
Feral Hogs													
Install feral hog enclosures.	Landowners	$200	As many as possible										N/A
Feral hog removal	Landowners	N/A	15% reduction or > 2,439 hogs/yr										N/A
Develop and implement Wildlife Management Plans and Practices.	Landowners, TPWD, TSSWCB, NRCS	N/A	As many as possible										N/A
OSSFs													
Develop OSSF repair/replacement program.	Watershed Coordinator, counties, AgriLife Extension	N/A	1										N/A
Repair/replace faulty OSSFs.	Homeowner	$8,000			10		20		30		40		$320,000
Pet Waste													
Install and maintain pet waste stations.	Cities	$500 for stations plus $100/yr/station			2		3		4		5		$4,400
Develop educational and outreach materials.	Cities, AgriLife Extension, Watershed Coordinator	N/A	Develop and deliver annually										N/A
Urban Stormwater													
Identify and install potential stormwater BMP projects.	Cities	$4,000 to $45,000/acre treated	As many as possible										N/A
SSOs and Unauthorized Discharges													
Develop program to repair private connections contributing to I&I.	Cities, AgriLife Extension, property owners	N/A	1										N/A
Smoke testing and repair of faulty pipes and connections	Cities, contractors	$2,000-$2,500/mile; $3,000-$20,000/repair	As funding allows										N/A
Develop and deliver educational materials.	Cities, AgriLife Extension, TWRI	N/A	Develop and deliver annually										N/A

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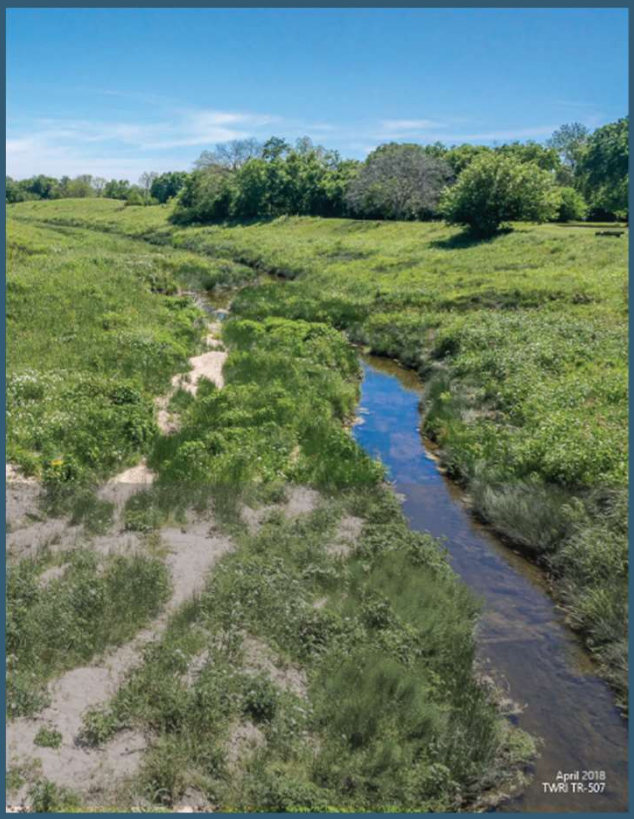
Appendix A – Potential Load Reductions

Appendix B – Load Reduction Calculations

Appendix C – Elements of Successful Watershed Protection Plans (9 elements)



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STAKEHOLDER DRIVEN PROCESS

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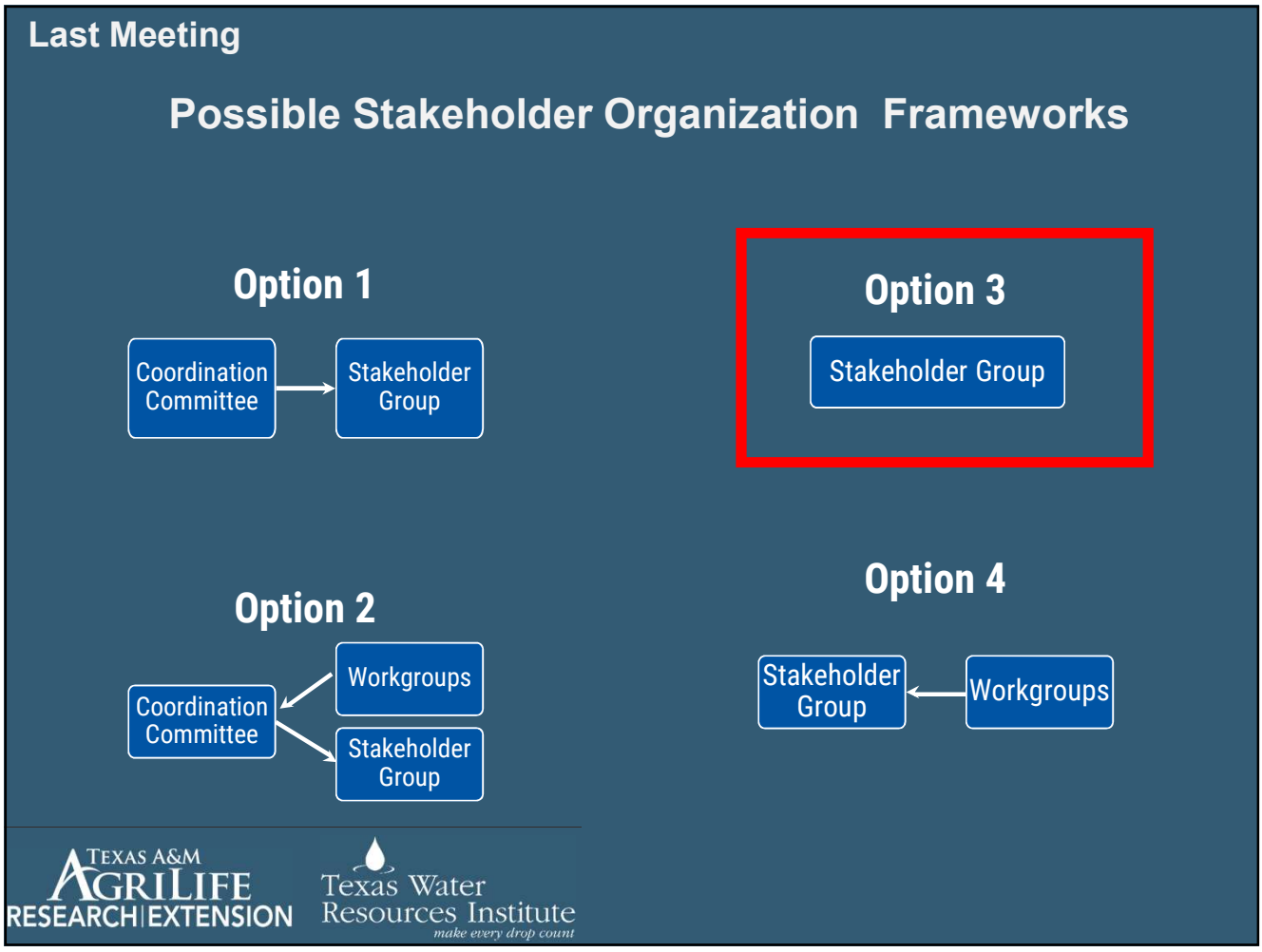
Last Meeting
Possible Stakeholder Organization Frameworks
Option 1
Coordination Committee
Stakeholder Group
Option 3
Stakeholder Group
Option 2
Coordination Committee
Workgroups
Stakeholder Group
Option 4
Stakeholder Group
Workgroups
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Committee Members – If Needed

- Local property owner
- County Extension Agent
- County Health Inspector
- County Judge or Commissioner
- Soil and Water Conservation District Board Member
- Subdivision or Homeowners Association Member
- TPWD
- USDA – NRCS
- Texas Sea Grant
- TSSWCB
- River Authority
- Others?

Possible Work Groups – If Needed

- Work Groups Used in Other Watersheds
  - Agriculture
  - Education & Outreach
  - Habitat
  - Septic Systems
  - Ordinance & Planning
  - Science & Monitoring
  - Urban Stormwater
  - Wastewater Infrastructure
  - Wildlife
- Work Groups to Consider for Big Elm Creek
  - Agriculture
  - Wildlife
  - Septic

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Possible Decision Making Processes – Last Meeting

- Formal –
  - Established bylaws that govern the actions of the committee
  - Adhere to Open Meeting Act Requirements
- Informal –
  - Develop a set of ground rules that will be used to govern the group
  - Committee members approve ground rules and their use
- Consensus Based in Public Meetings

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BIG ELM CREEK WATERSHED AND WATER QUALITY

Allen Berthold, Ed Rhodes - Texas Water Resources Institute
February 19, 2019

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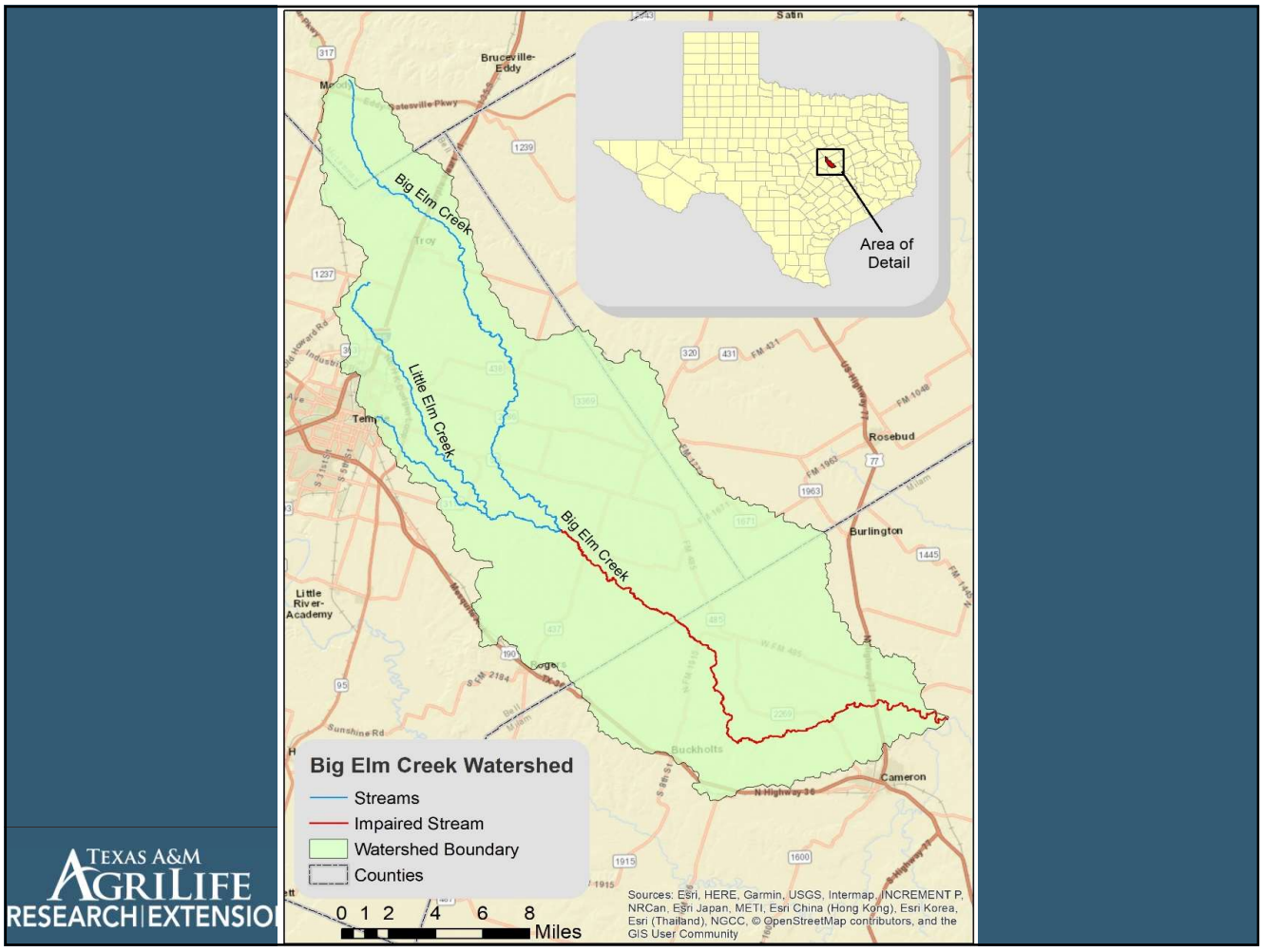
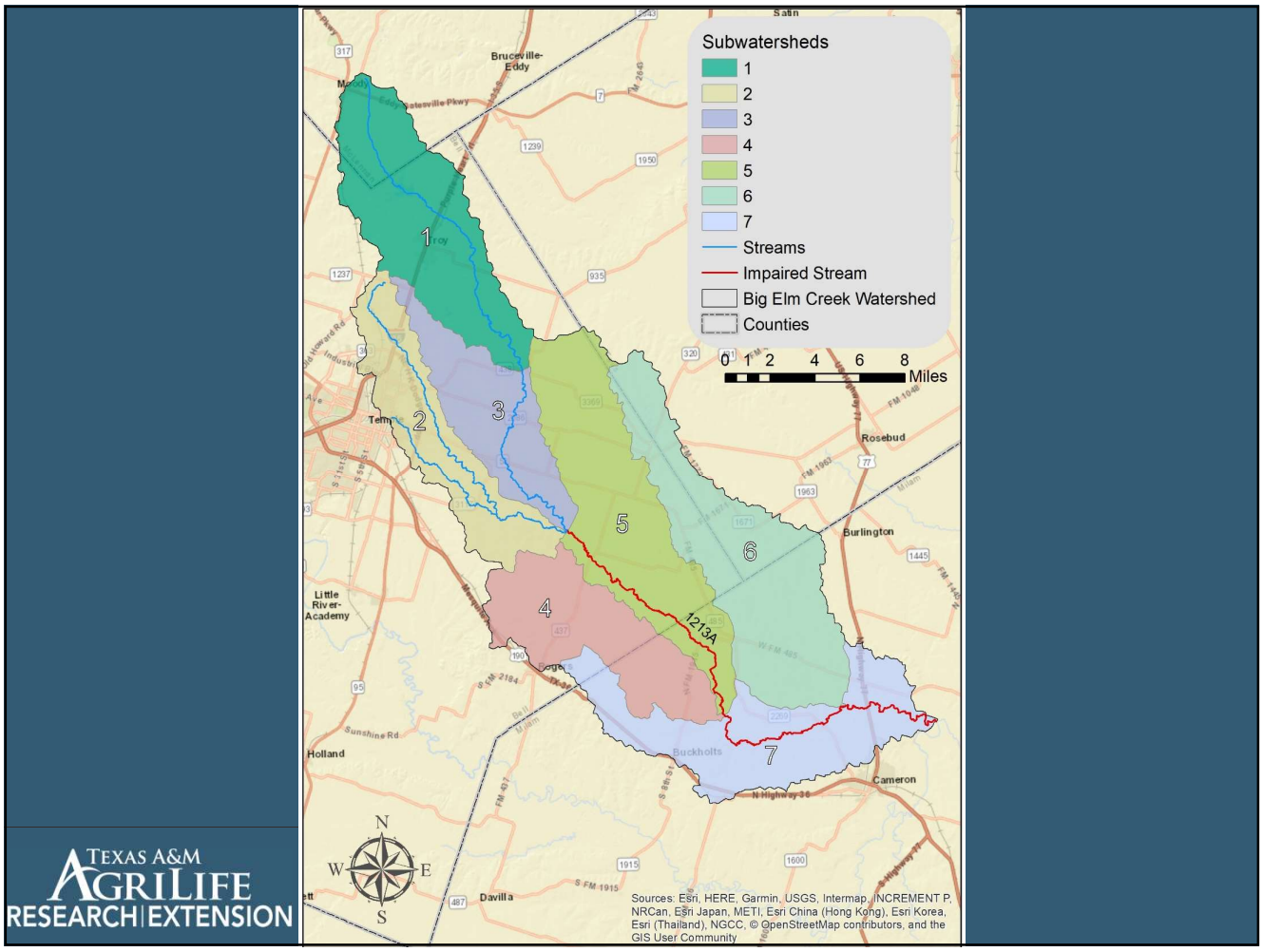
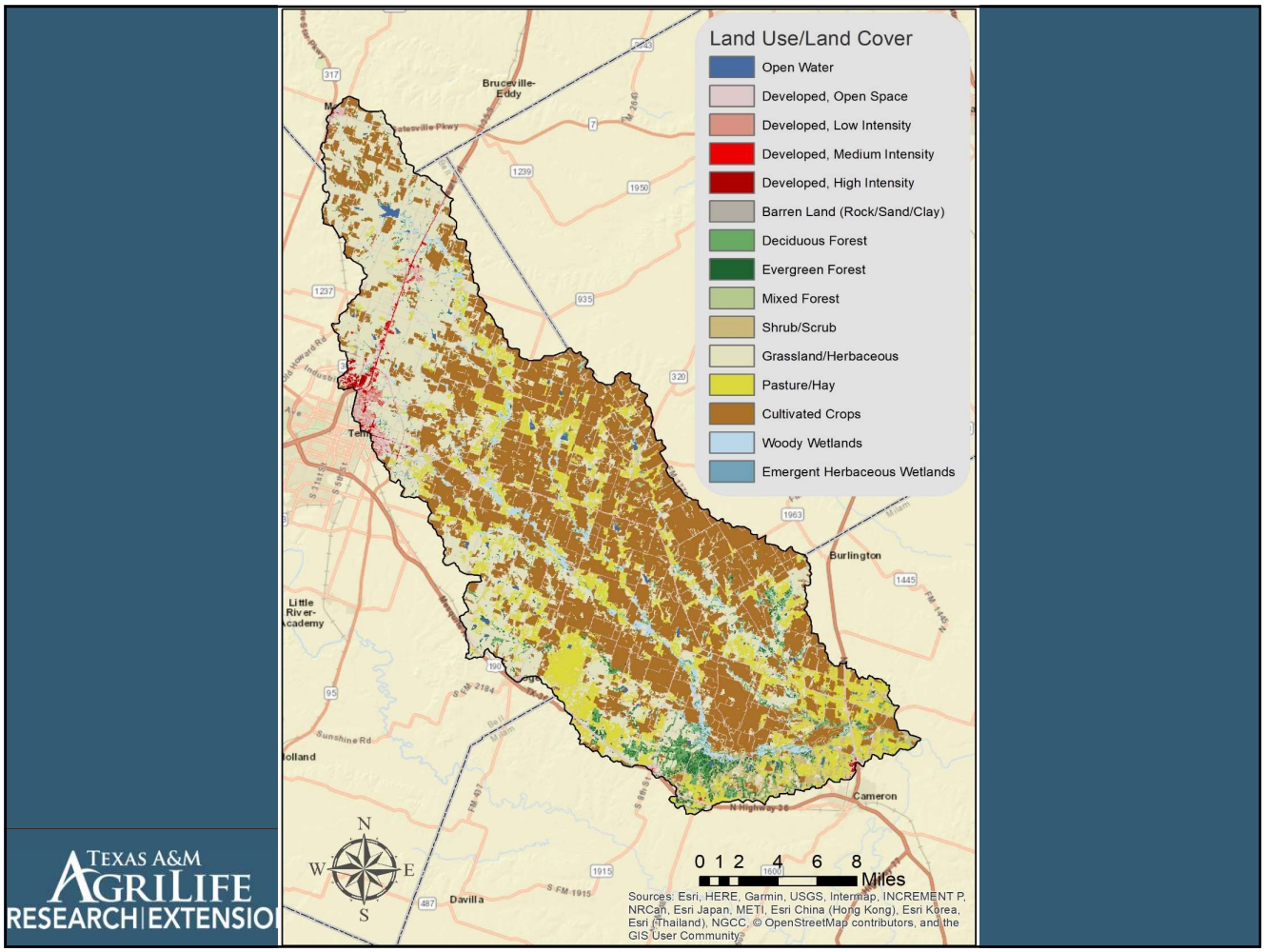
TEXAS A&M AGRILIFE RESEARCH | EXTENSION



TEXAS A&M AGRILIFE RESEARCH | EXTENSION



TEXAS A&M AGRILIFE RESEARCH | EXTENSION


Land Use/Land Cover
Open Water
Developed, Open Space
Developed, Low Intensity
Developed, Medium Intensity
Developed, High Intensity
Barren Land (Rock/Sand/Clay)
Deciduous Forest
Evergreen Forest
Mixed Forest
Shrub/Scrub
Grassland/Herbaceous
Pasture/Hay
Cultivated Crops
Woody Wetlands
Emergent Herbaceous Wetlands
Bruceville-Eddy
Burlington
Cameron
Little River-Academy
Davilla
0 1 2 4 6 8
Miles
N
W
E
S
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, © OpenStreetMap contributors, and the GIS User Community
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Land Use Category	Acres	Percent
Open Water	1,222.49	0.59%
Developed, Open Space	13,217.10	6.38%
Developed, Low Intensity	1,731.81	0.84%
Developed, Medium Intensity	782.22	0.38%
Developed, High Intensity	360.54	0.17%
Barren Land	143.2	0.07%
Deciduous Forest	6,181.56	2.98%
Evergreen Forest	2,284.61	1.10%
Mixed Forest	159.63	0.08%
Shrub/Scrub	4,596.81	2.22%
Grassland/Herbaceous	60,540.21	29.23%
Pasture/Hay	26,838.55	12.96%
Cultivated Crops	82,542.39	39.86%
Woody Wetlands	6,473.11	3.13%
Emergent Herbaceous Wetlands	31.36	0.02%
Total	207,105.59	100.00%

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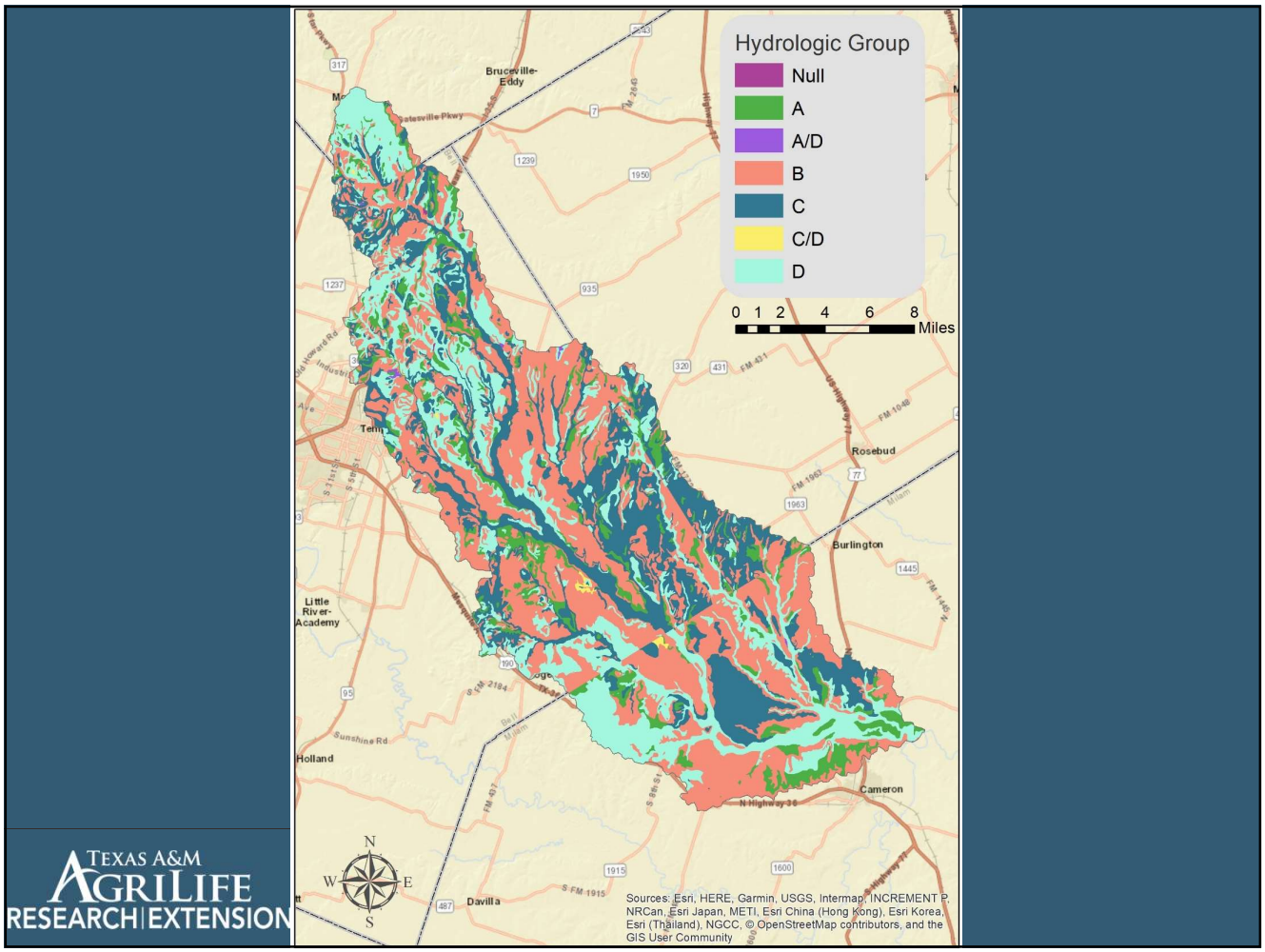

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Hydrologic Soil Group	Acres	Description
Null	42	Not rated (not surveyed or water body)
A	18,952	Soils have a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.
A/D	173	See below[1]
B	82,290	Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.
B/D	0	See below[1]
C	52,000	Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.
C/D	384	See below[1]
D	53,266	Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

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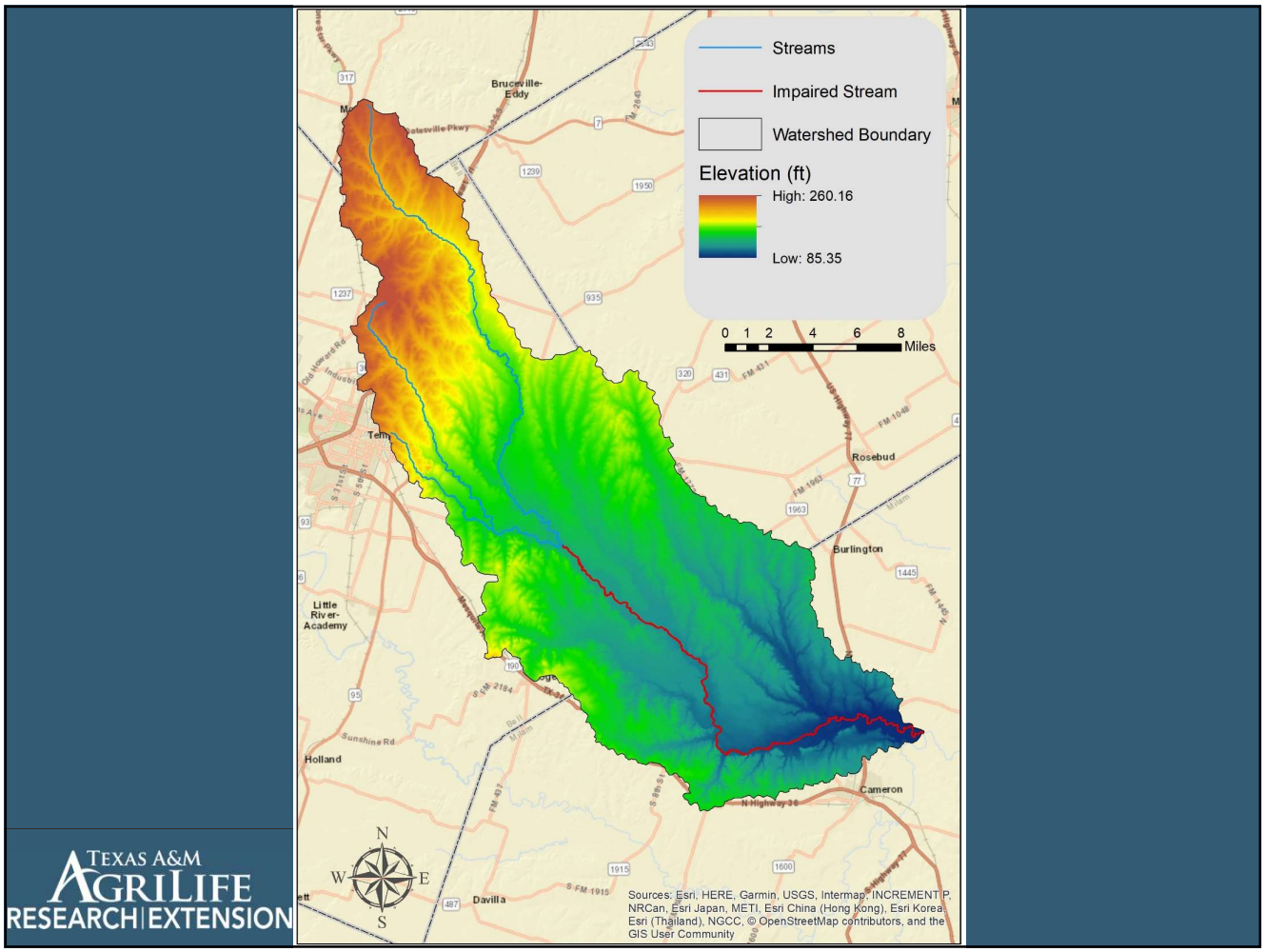

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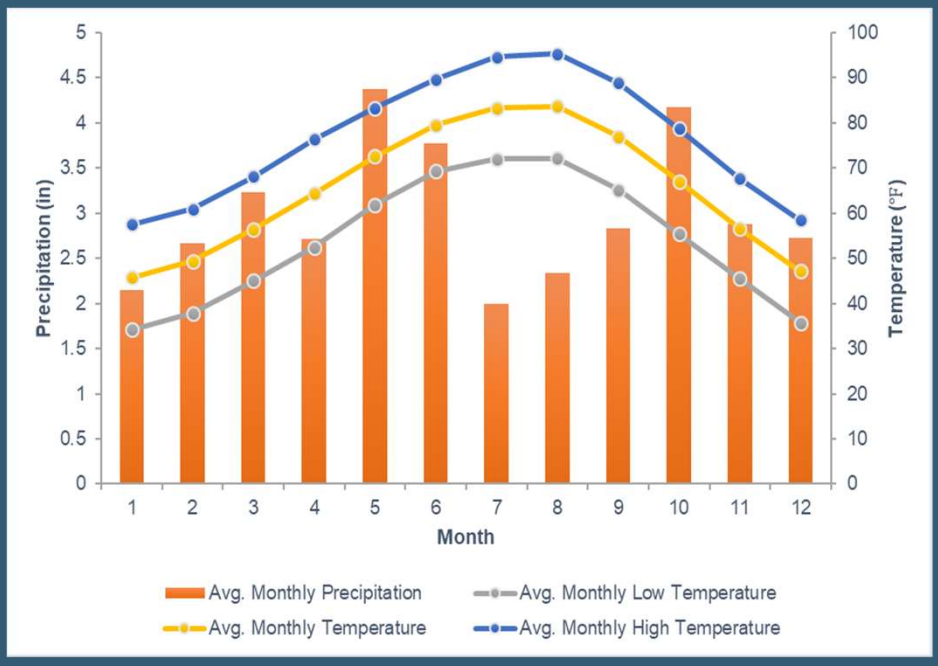

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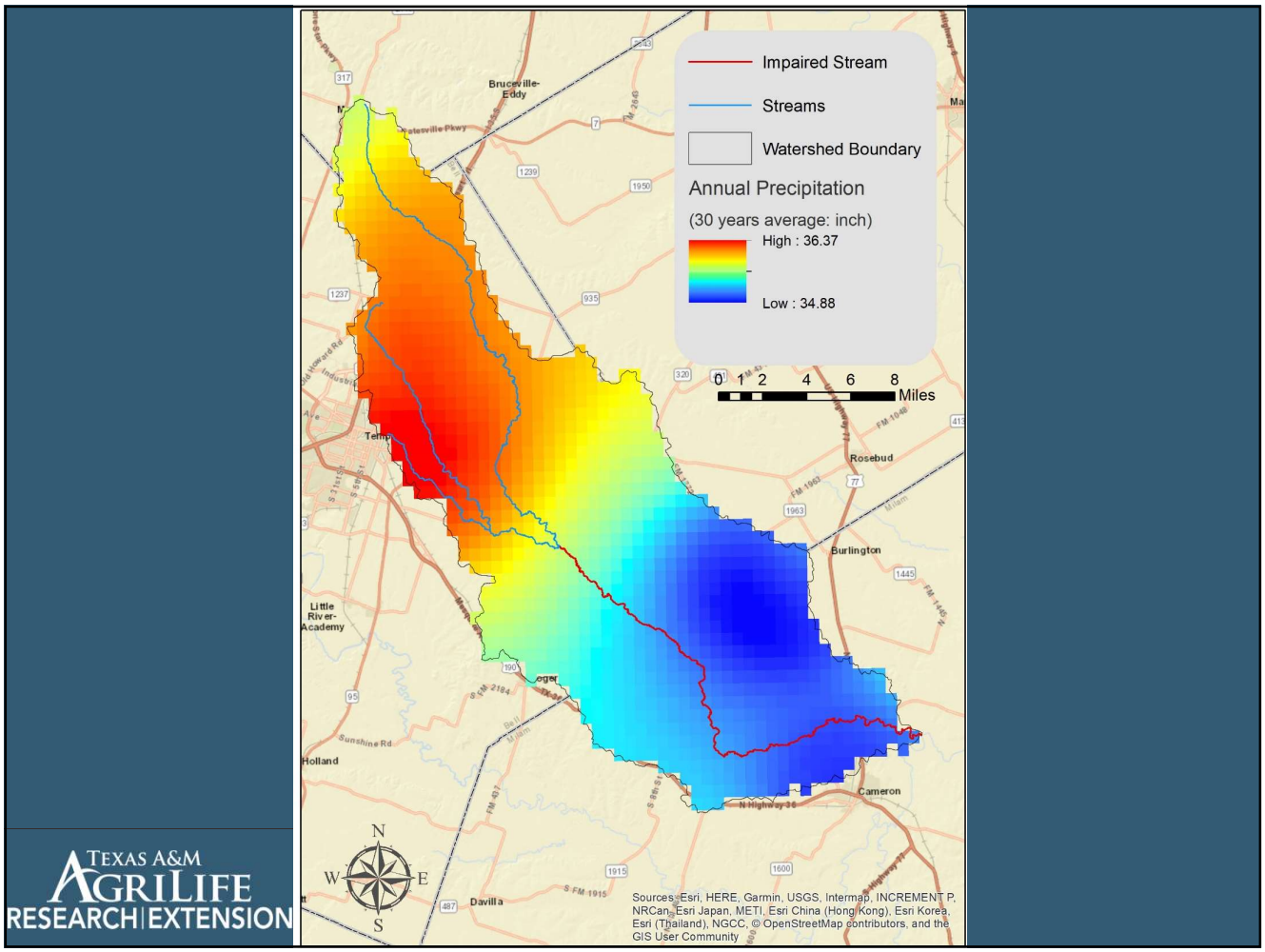

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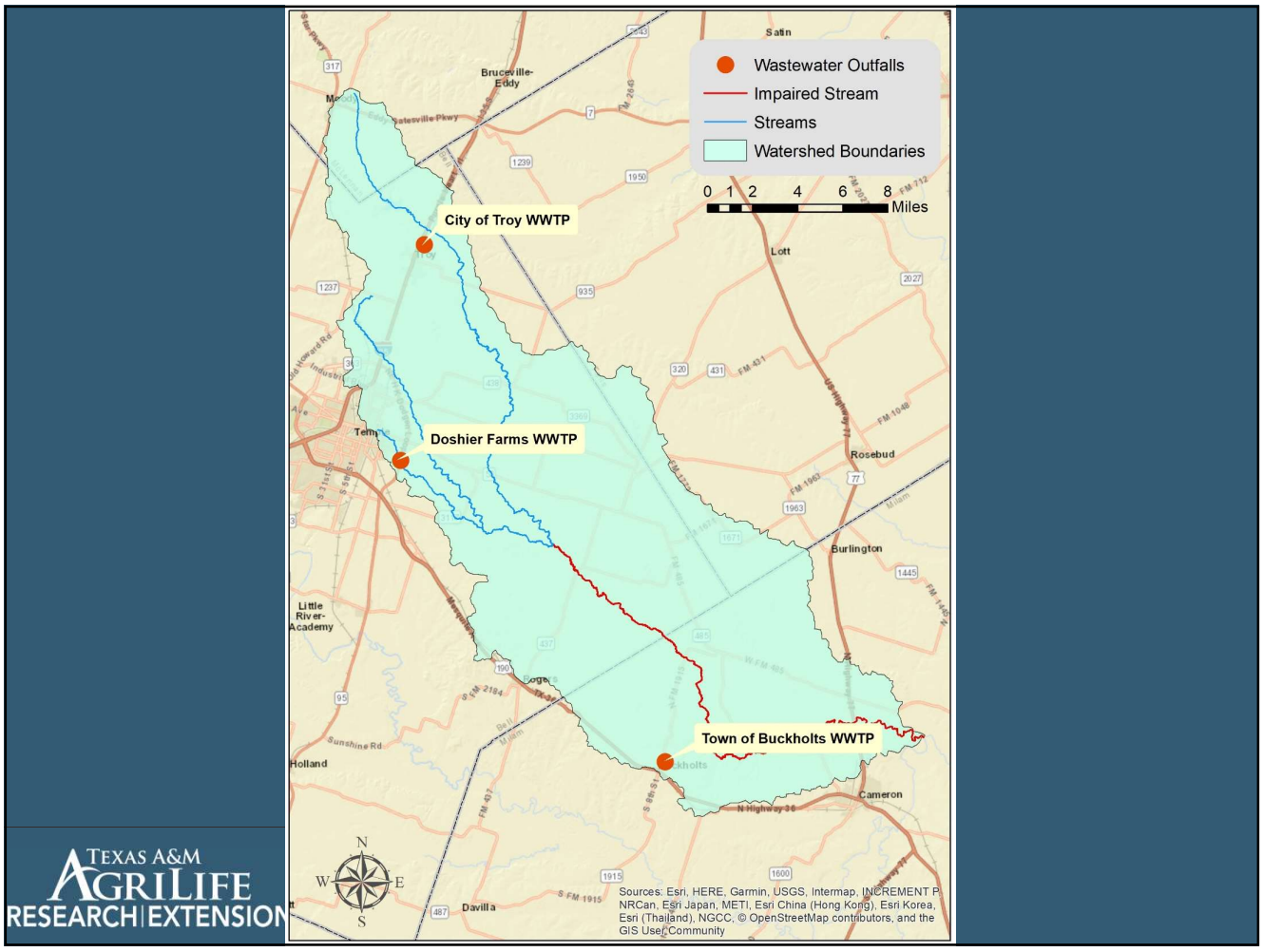

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Facility Name	Receiving Stream	Flow (MGD)		Bacteria (cfu/100 mL)		Number of Quarters in Violation for Exceedance from 04/2015-3/2018
		Permitted	Reported (3-year avg.)	Permitted (Daily Average)	Reported (3-year avg.)	
City of Troy	Kings Branch (1213A_02)	0.3090	0.1317	126	8.84	**0**
Doshier Farm	Unnamed tributary; Little Elm Creek (1213C_01)	7.50	1.69	126	3.01	**0**
Town of Buckholts	Lipan Creek (1213A_01)	0.1000	0.0295	126	1.08	**4** (4 single grab *E. coli*)

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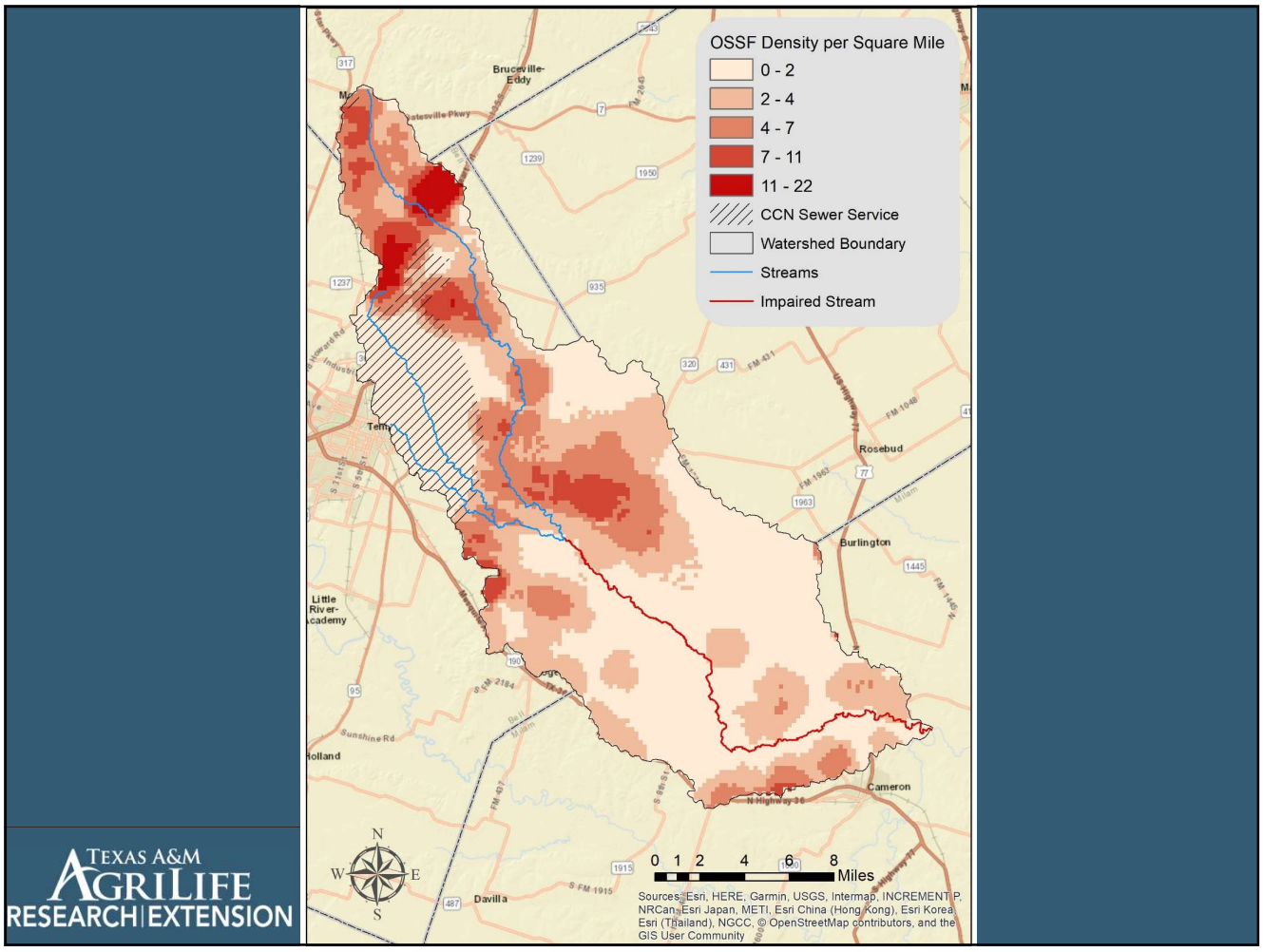

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Water Quality Standards

- **Primary Contact Recreation:**
- 126 MPN/100 mL *E. coli* bacteria
- Equates to an estimated risk of 36 per 1,000 individuals engaged in contact recreation (swimming, diving, and other activities with increased risk of water ingestion) contracting a gastrointestinal illness [1]

[1] EPA Office of Water. 2012. Recreational Water Quality Criteria. URL: https://www.epa.gov/sites/production/files/2015-10/documents/rwqc2012.pdf

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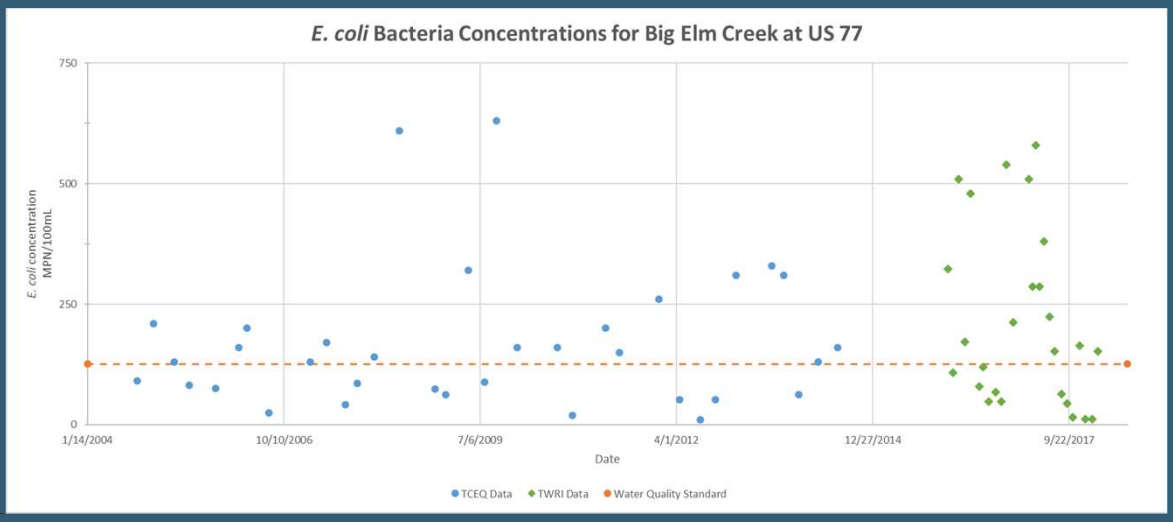
Big Elm Creek

- **Indicator Bacteria**
- **Listed on 303(d) list since 2010**
- **Sept 2004 - Jan 2015 (TCEQ) Data** = 152.05 MPN/100mL
- **Dec 2005 – Nov 2012 Assessment Period** = 135.88 MPN/100mL
- **Dec 2015 – Feb 2018 (TWRI) Data** = 144.09 MPN/100mL



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TCEQ. 2011. 2010 Texas Integrated Report of Surface Water Quality for Clean Water Act Sections 305(b) and 303(d) . URL: https://www.tceq.texas.gov/waterquality/assessment/10twqi

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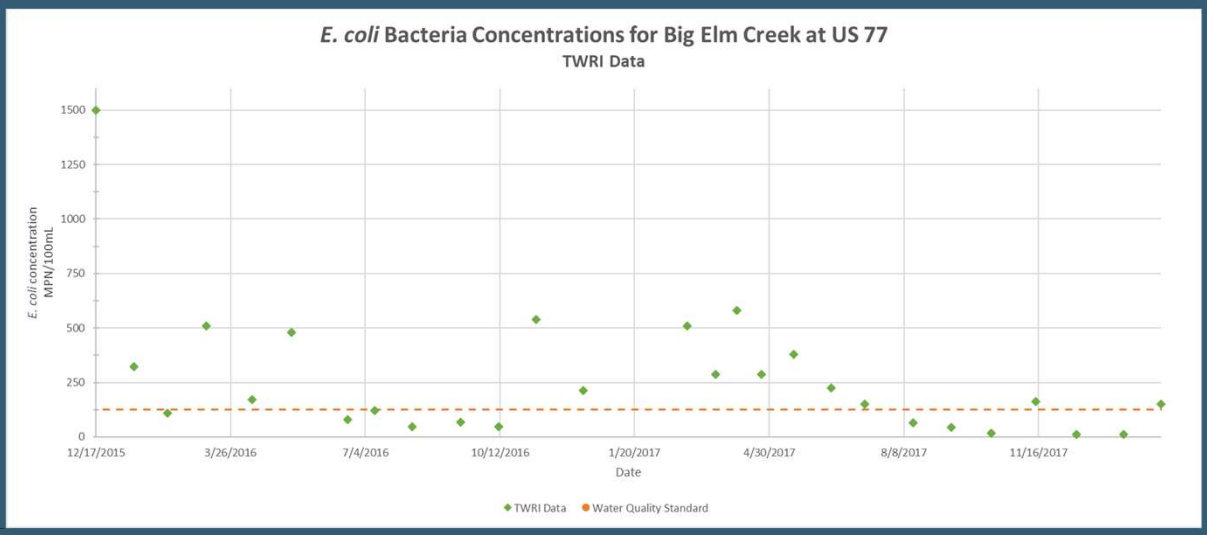

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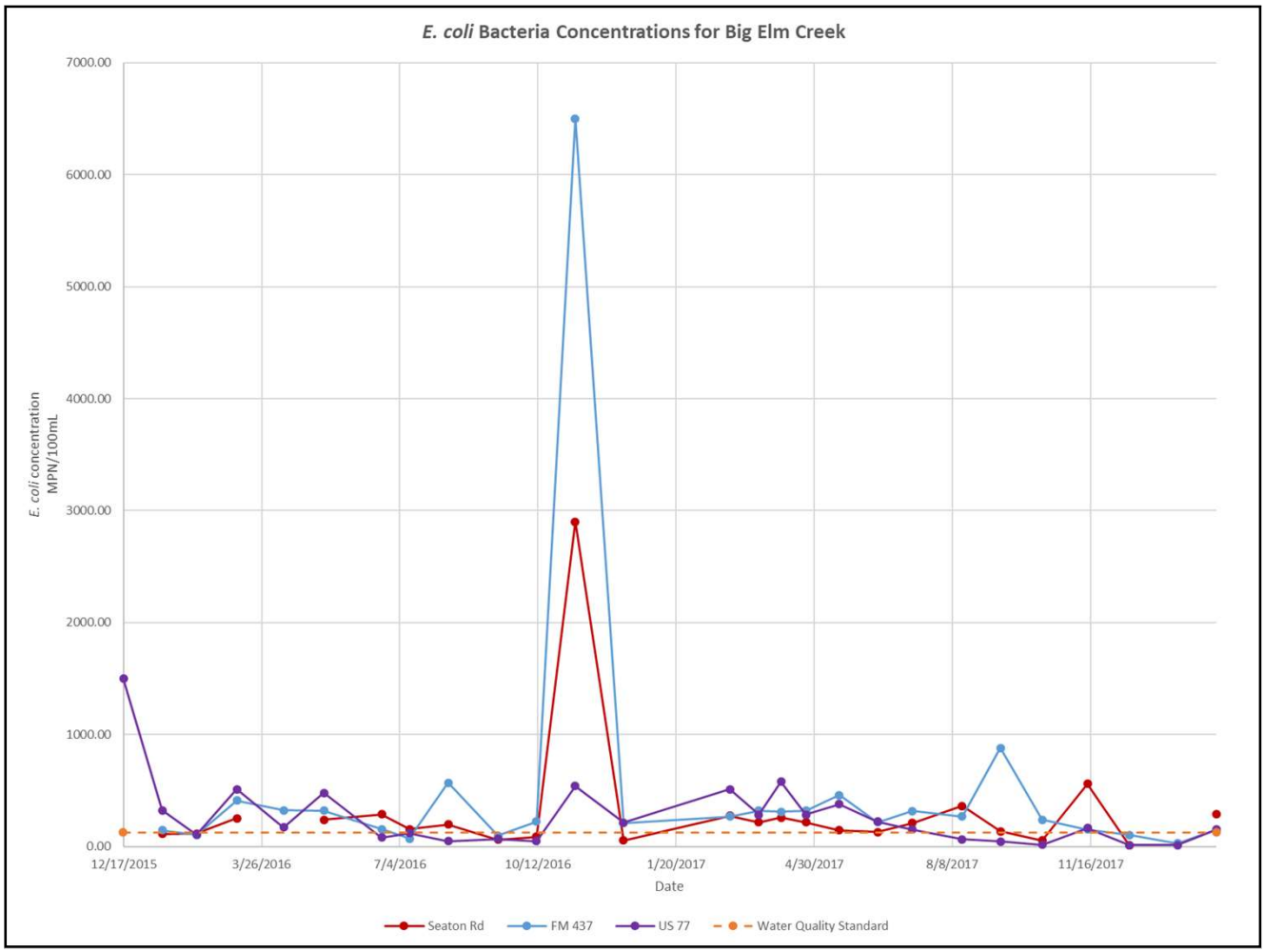
E. coli Bacteria Concentrations for Big Elm Creek
7000.00
6000.00
5000.00
4000.00
3000.00
2000.00
1000.00
0.00
E. coli concentration MPN/100mL
12/17/2015
3/26/2016
7/4/2016
10/12/2016
1/20/2017
4/30/2017
8/8/2017
11/16/2017
Date
Seaton Rd
FM 437
US 77
Water Quality Standard

Recap

- Big Elm Creek is impaired due to elevated indicator bacteria. Recent sampling by TWRI verified likelihood of this impairment.

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