



Forestry Best Management Practices and Their Effectiveness

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Biologist IV

What are BMPs?

- A practice or combination of practices determined to be an effective and practicable means of preventing or reducing the amount of water pollution generated by nonpoint sources.



Good, sound forestry practices that prevent soil erosion and protect water quality.

Why do we have BMPs?

Federal Legislation

Ø 1972 Clean Water Act

- Focused on *Point Source* water pollution

Ø Reauthorized in 1987

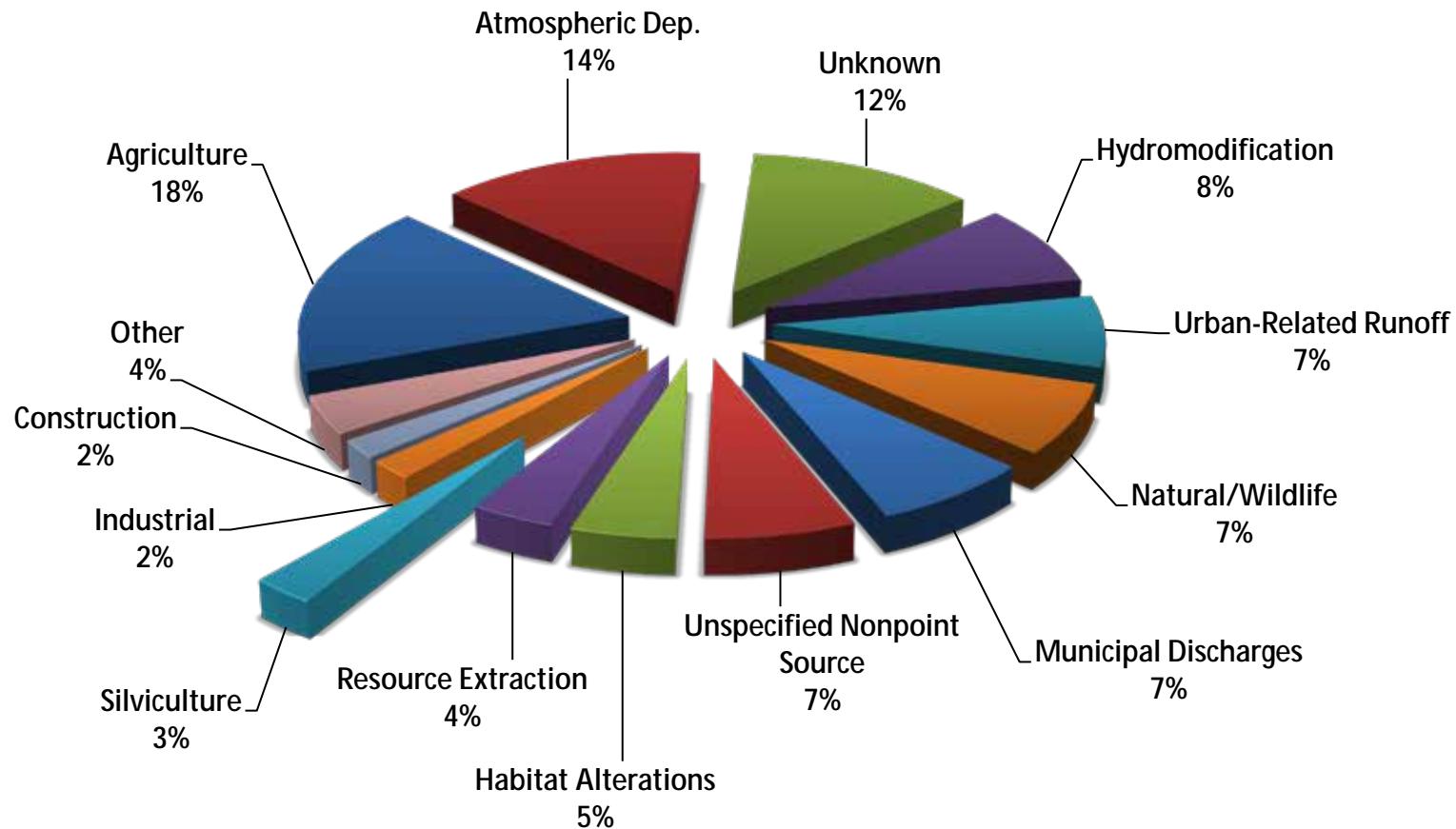
- Shifted focus to *Nonpoint source* (NPS) water pollution

Sources of NPS Pollution

- Urban Landscapes
- Construction Sites
- Mining
- Agriculture
- Silviculture



Breakdown of NPS Sources





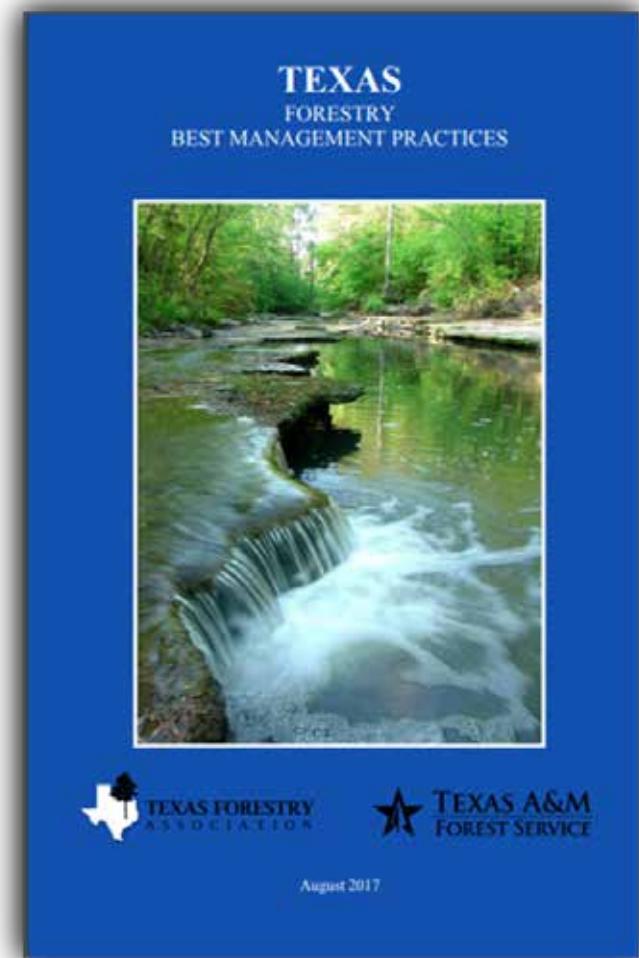
Texas BMP Program

- Ø BMP Development
- Ø BMP Implementation
- Ø BMP Implementation Monitoring
- Ø BMP Effectiveness Monitoring

Texas BMP Program

The Blue Book

- Introduction
- Guidelines
- Recommended Specs
- Glossary
- Wetlands



Texas BMP Program

In Texas -

- Non-Regulatory BMP Program
- Steady growth in compliance rates
- Proven methods



Poll Question 1

What is the regulatory and monitoring agency for surface waters in Texas?

- A. Texas Parks and Wildlife Department
- B. Natural Resources Conservation Service
- C. Soil and Water Conservation Districts
- D. Texas Commission on Environmental Quality
- E. Texas State Soil and Water Conservation Board















Streamside Management Zone (SMZ)

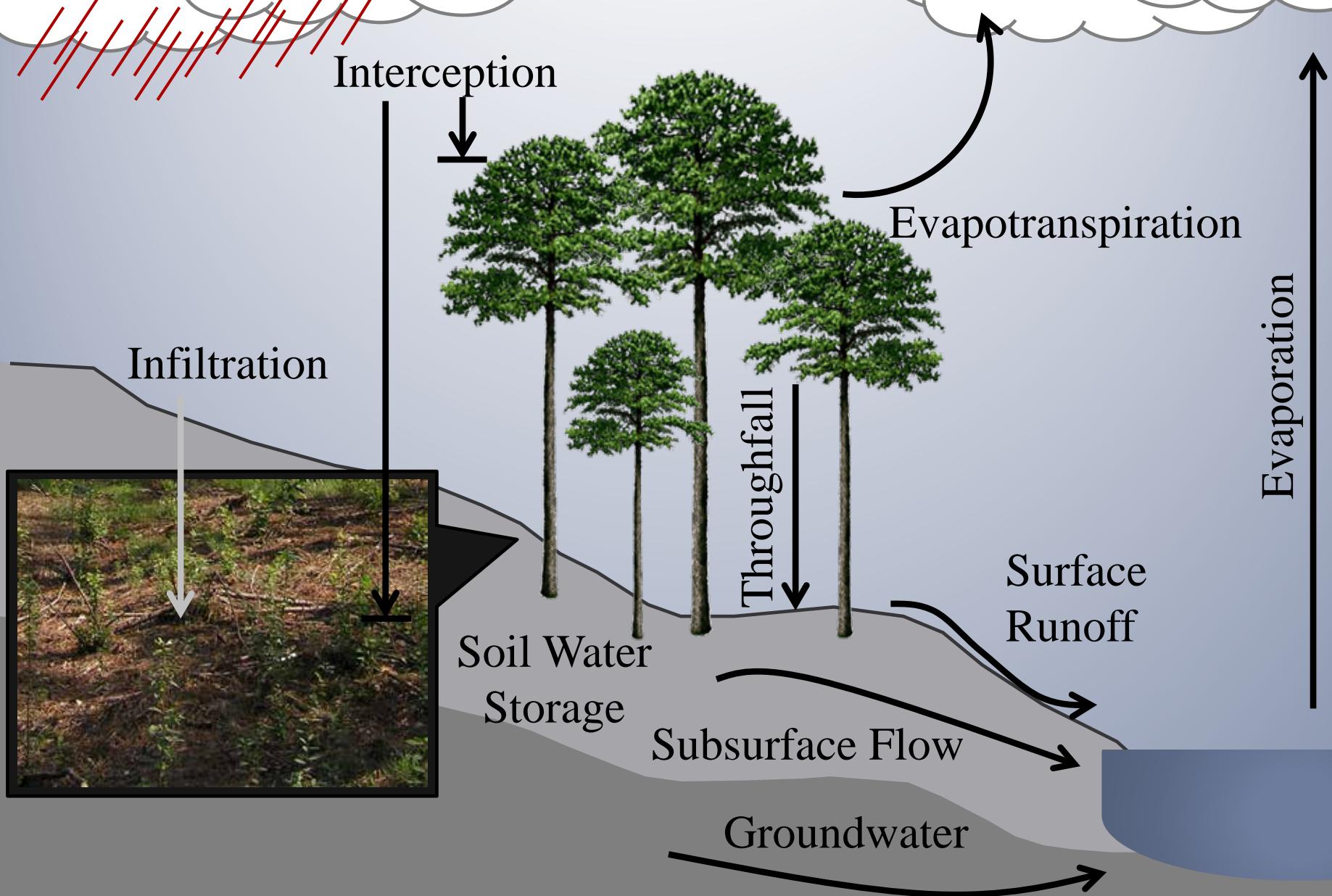


Benefits of SMZs

- Filters sediment from overland flow before it enters the stream
- Stabilizes stream banks
- Provides shade to maintain constant water temperatures
- Provides habitat and travel corridors for wildlife
- Helps to maintain diversity

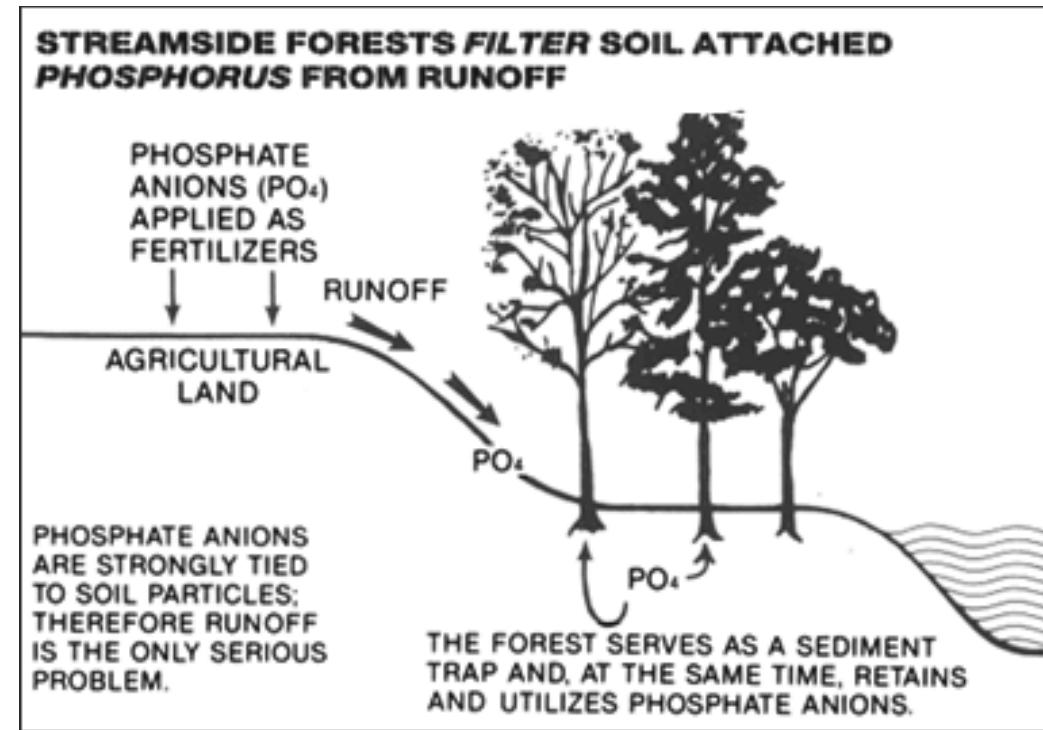


Forests and the Water Cycle:



Forests Act as Pollutant Filters

Riparian vegetation can remove metals, nutrients, and other chemicals from runoff via plant uptake, and by facilitating bacterial transformation.



Reference: Maryland Department of Natural Resources

Studies have shown that buffers along streams can reduce Nitrogen and Phosphorous pollution by 80-90%

















Poll Question 2

What is the #1 water pollutant occurring from forest and other land management activities?

- A. **Herbicides**
- B. **Pesticides**
- C. **Sediment**
- D. **E. coli**
- E. **Nutrients/Fertilizer**

Voluntary Implementation of Forestry Best Management Practices in East Texas



Results from Round 10 of
BMP Implementation Monitoring

TEXAS A&M FOREST SERVICE
A Member of the Texas A&M University System

December 2018

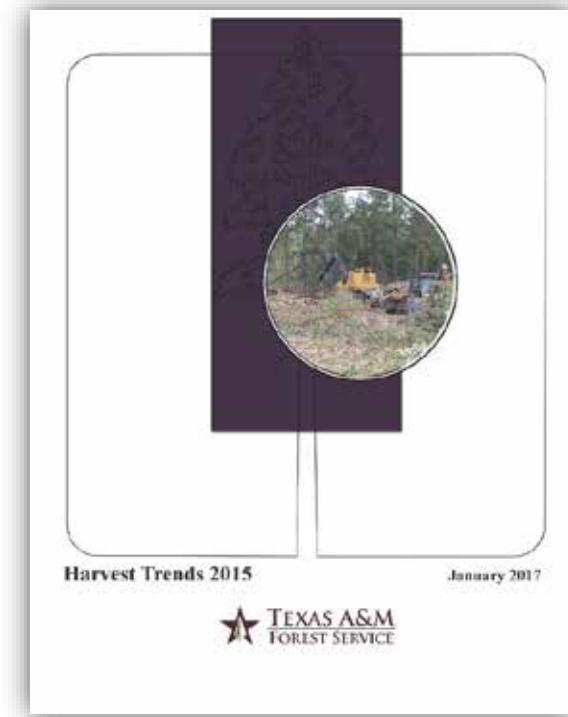
Components of a Voluntary Program

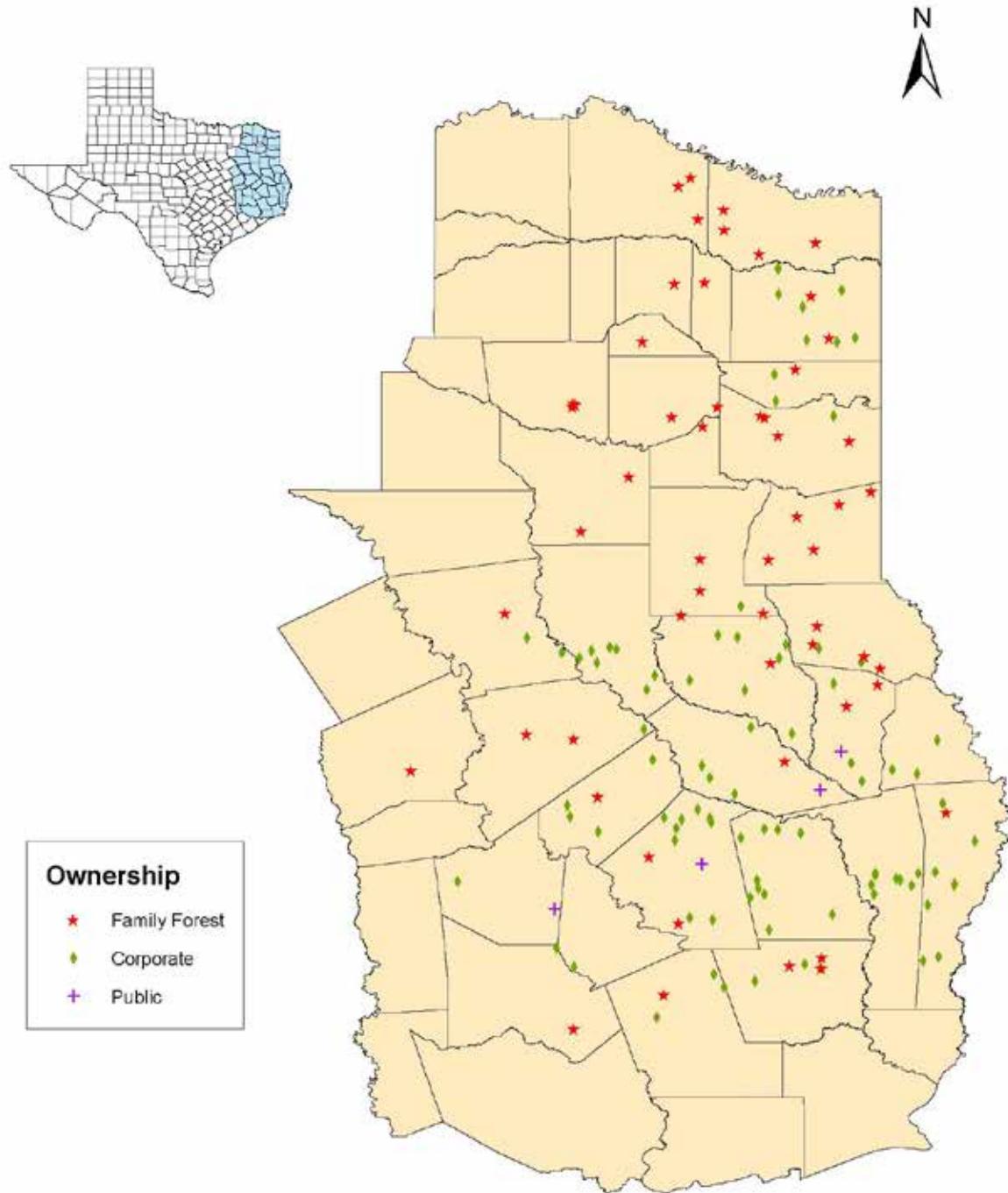
- Education
- Technical Assistance
- Outreach
- Effectiveness Monitoring
- Implementation Monitoring

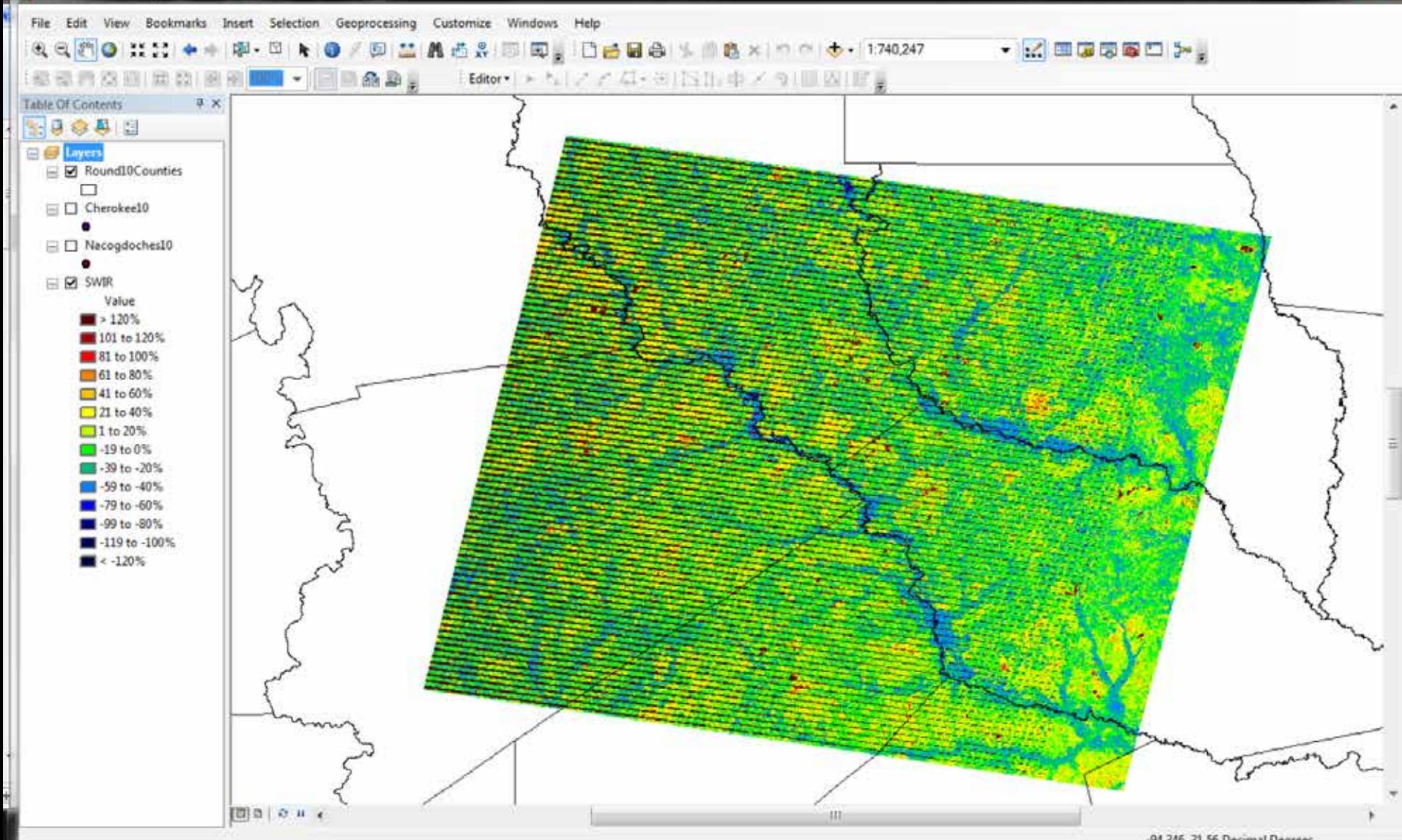


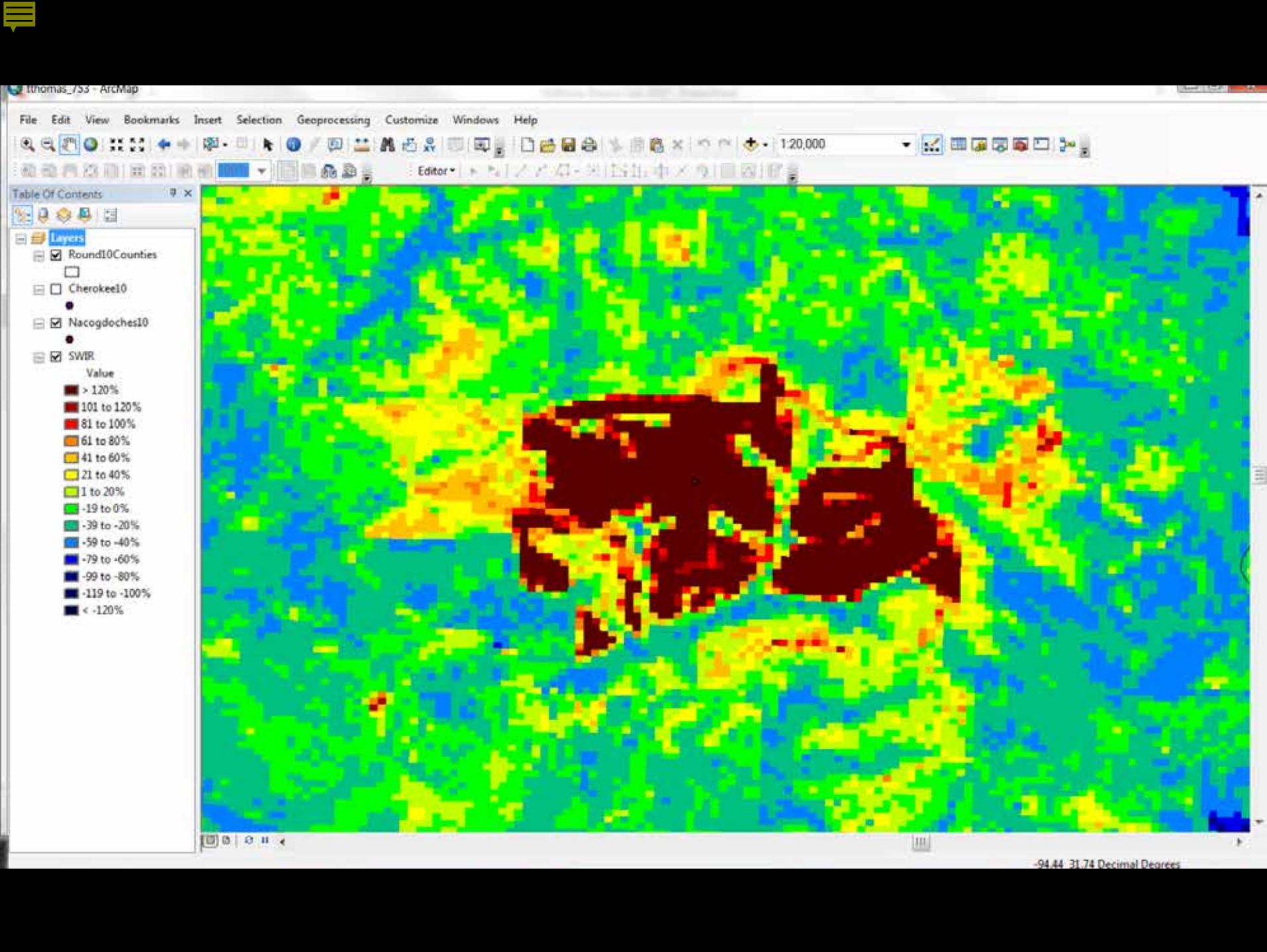
How do we monitor?

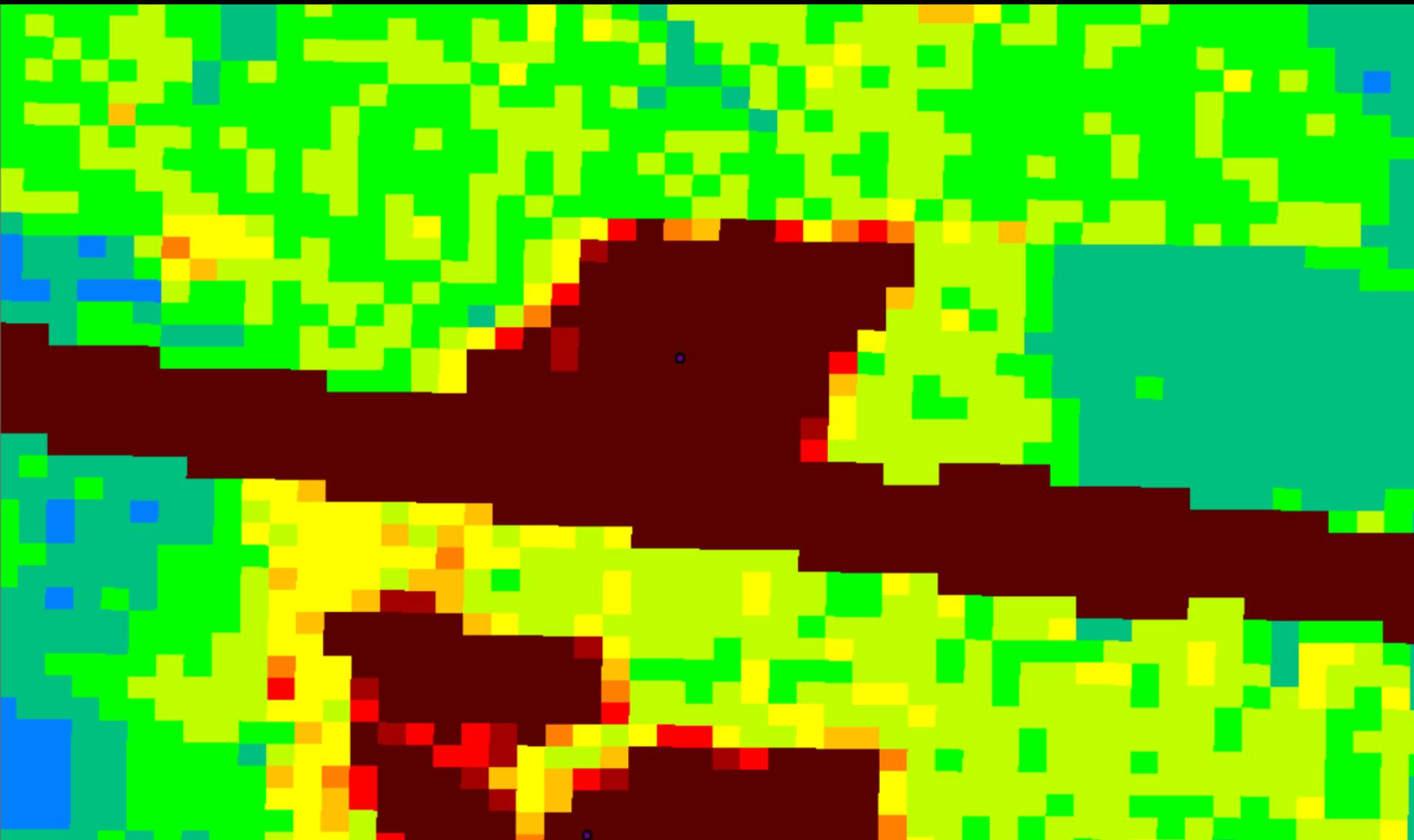
- Harvest Trends
- Site Selection
 - NDVI and SWIR—Landsat 8
 - Google Earth Verification
 - County Appraisal District Data
- 150 Tracts
 - All Silvicultural Operations

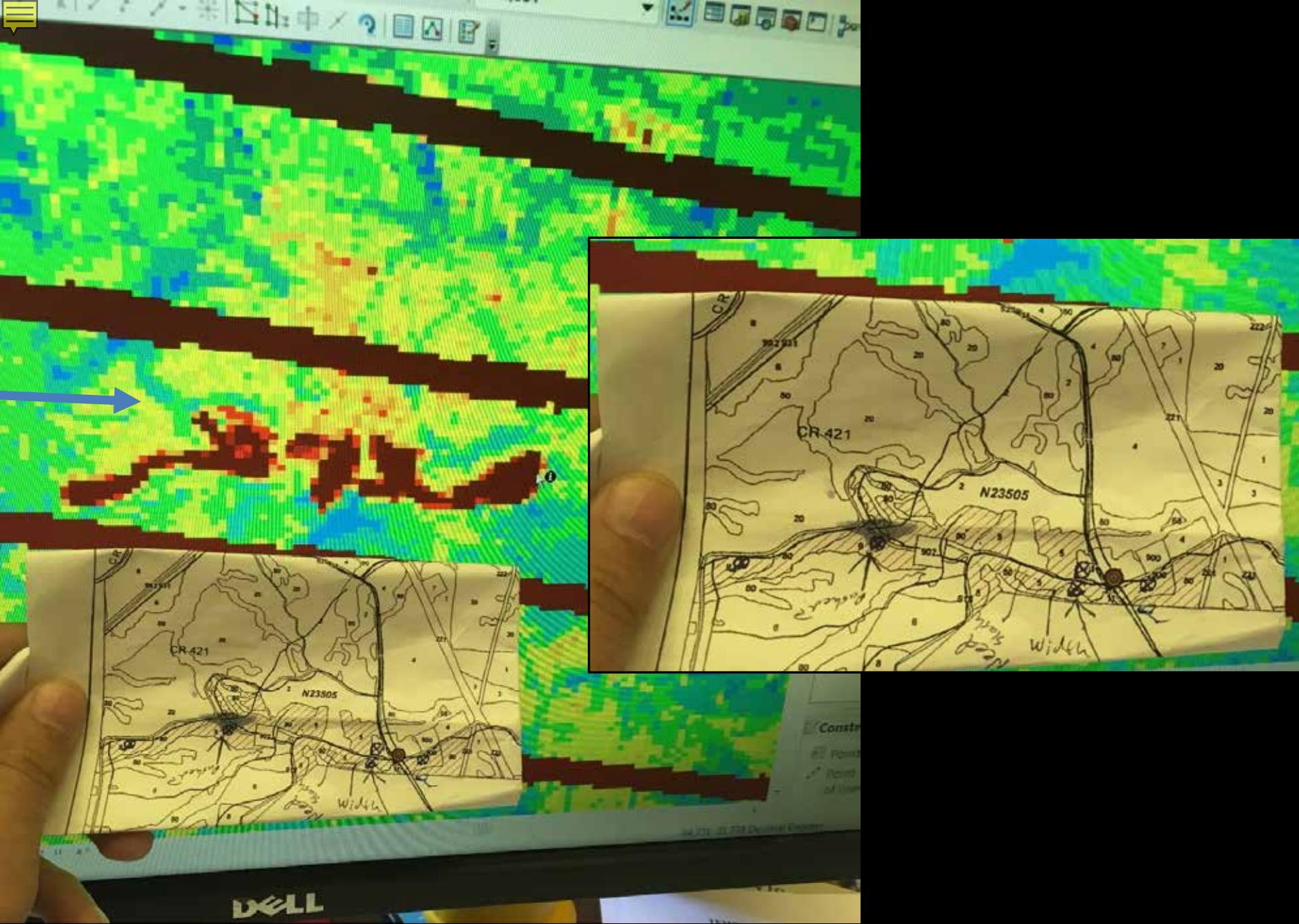












How do we monitor?

Walk out the tract

- *SMZs and Stream Crossings*
- *Roads – Permanent and Temporary*
- *Skid Trails*
- *Sets*
- *Site Prep*
- *Additional Sensitive Areas*

Inspection Form

- 45 Questions
- Yes-No-N/A or N/N
- % Compliance = %Yes
- Significant Risk
- Comment Section



TEXAS BMP
MONITORING
CHECKLIST

Site ID: _____

I. General Landowner and Tract Information

County: _____	Region: _____	Owner Type:
Latitude: _____	Longitude: _____	<input type="checkbox"/> N <input type="checkbox"/> A <input type="checkbox"/> C <input type="checkbox"/> I <input type="checkbox"/> P
Forester Type: _____	Name: _____	Landowner:
Timber Buyer: _____	Contractor: _____	Name: _____
Activity: _____	Acres Affected: _____	Address: _____
Estimated Date of Activity: _____	Date of Inspection: _____	City: _____ State: _____
Inspector: _____	Accompanied by: _____	Zip: _____
Phone: _____		

II. Site Characteristics

River Basin: _____	Distance to nearest permanent water body:
Terrain: <input type="checkbox"/> Flat <input type="checkbox"/> Hilly <input type="checkbox"/> Steep	<input type="checkbox"/> < 300' <input type="checkbox"/> 300 - 800' <input type="checkbox"/> 800 - 1600' <input type="checkbox"/> 1600' +
Erodibility hazard: <input type="checkbox"/> Low <input type="checkbox"/> Medium <input type="checkbox"/> High	Preconcrete soil surface texture:
Type stream present: <input type="checkbox"/> Potential <input type="checkbox"/> Intermittent	<input type="checkbox"/> Clay <input type="checkbox"/> Clay Loam <input type="checkbox"/> Loam <input type="checkbox"/> Sandy Loam <input type="checkbox"/> Sand
Watershed Code: _____	

III. Permanent Roads

1. Respect sensitive areas, such as SMZs, steep slopes, and wet areas.	YES <input type="checkbox"/>	NO <input type="checkbox"/>	N/A/N/N <input type="checkbox"/>	Sig. Risk <input type="checkbox"/>
2. Meet grade specifications by having slopes between two and ten percent.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Routing within allowable specs of less than six inches deep for not more than fifty feet.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Well drained with appropriate structures to minimize soil movement.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Wing ditches, waterbars, and water turnouts do not dump into streams.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Reshaped and/or stabilized to minimize soil movement.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

BMPs present: RD WD WB RE OC
PL RS CU SD BD

Section Total: Percent Implementation:

IV. Temporary Roads / Skid Trails

1. Respect sensitive areas, such as SMZs, steep slopes, and wet areas.	YES <input type="checkbox"/>	NO <input type="checkbox"/>	N/A/N/N <input type="checkbox"/>	Sig. Risk <input type="checkbox"/>
2. Slopes less than 15% and laid out on the contour of the land.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Routing within allowable specs of less than six inches deep for not more than fifty feet.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Well drained with appropriate structures to minimize soil movement.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Stabilized to minimize soil movement.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

BMPs present: RD WD WB RE OC
PL RS CU SD BD

Section Total: Percent Implementation:

Inspection Form

- 45 Questions
- Yes-No-N/A or N/N
- % Compliance = %Yes
- Significant Risk
- Comment Section

V. Stream Crossings			
On Permanent Roads			
1. Crossings avoided or minimized	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Stream crossings correct	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Stream crossing stabilized	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Stream free of sediment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
On Temporary Roads			
5. Crossings avoided or minimized	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Stream crossings correct	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Temporary crossings removed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Stream crossings and approaches stabilized	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Stream free of sediment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
BMPs Present:	<input type="checkbox"/> CU	<input type="checkbox"/> BR	<input type="checkbox"/> LW
Section Total	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Percent Implementation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

VI. Streamside Management Zones			
1. Present on permanent stream	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Present on intermittent stream	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. SMZ adequately wide by leaving fifty feet on both sides of the stream	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Thinning within allowable specs by leaving 50 square feet of BA	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Minimize harvesting bank trees	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. SMZ integrity honored by keeping skidders, roads, landings, and firebreaks out	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Stream clear of debris, such as logs and limbs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Stream free of sediment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Section Total	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Percent Implementation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

VII. Site Preparation			
Site preparation method:	<input type="text"/>		
Regeneration method:	<input type="text"/>		
1. Respect sensitive areas by preventing site prep intrusion	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. No soil movement on site, especially broad scale sheet erosion	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Firebreak erosion controlled to prevent potential erosion	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. SMZ integrity honored by preventing site prep intrusion	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Wedrows on contour / free of soil to minimize soil disturbance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. No chemicals off site or entering water bodies	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Mechanical site prep, machine planting on contour	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Stream free of sediment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Section Total	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Percent Implementation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

VIII. Landings			
1. Locations free of oil / trash and properly disposed of	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Located outside of SMZ to minimize traffic and erosion in the SMZ	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Well drained location to minimize puddling, soil degradation, and soil movement	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Number and size minimized	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Respect sensitive areas, including steep slopes and wet areas	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Restored / stabilized by back filling, spreading bark, or seeding to minimize erosion	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Section Total	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Percent Implementation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Inspection Form

- 45 Questions
 - Yes-No-N/A or N/N
 - % Compliance = %Yes
 - Significant Risk
 - Comment Section

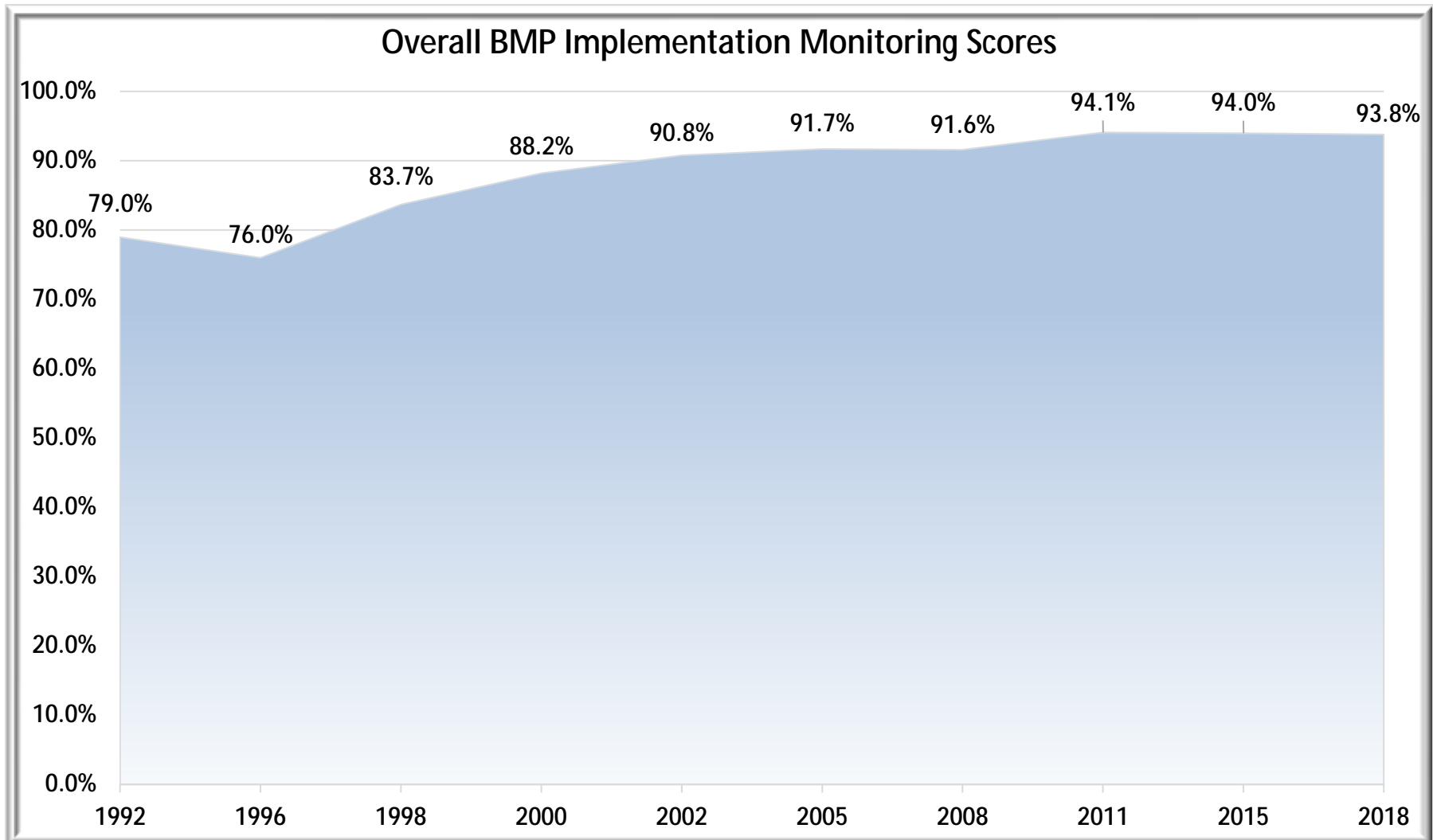
13. Wetlands (may or may not be jurisdictional)	YES	NO	N/A/NR	Sig. Risk
1. Avoid altering hydrology of site by minimizing ruts and soil compaction	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Road drainage structures installed properly to maintain flow of water	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Mandatory road BMPs followed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Section Total <input type="checkbox"/> <input type="checkbox"/>				
Percent Implementation <input type="checkbox"/>				
X. Overall Implementation	YES	NO	N/A/NR	Sig. Risk
III. Permanent Roads	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
IV. Skid Trails/Temporary Roads	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
V. Stream Crossings	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
VI. Streamside Management Zones	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
VII. Site Preparation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
VIII. Landings	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
IX. Wetlands	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Overall Total <input type="checkbox"/> <input type="checkbox"/>				
Total Significant Risk <input type="checkbox"/>				
Percent Implementation <input type="checkbox"/>				
Needs Improvement	Pass			
<input type="checkbox"/> No Effort	<input type="checkbox"/> Poor	<input type="checkbox"/> Fair	<input type="checkbox"/> Good	<input type="checkbox"/> Excellent
Follow Up Questions				
Was activity supervised by landowner or representative?	YES	NO	N/A/NR	
Who? <input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Was landowner familiar with BMPs?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Has logger attended BMP Workshop?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Were BMPs included in the contract?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Is landowner a member of TFA? Landowner Association? Tree Farm? Other? Organization <input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Was timber delivered to STI mill?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Does landowner plan to reforest?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Does landowner have a forest management plan?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Is remediation planned by landowner (if needed)?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Comments (Explain observed actions in the field check. Make recommendations.)				
Date <input type="text"/>				

Quality Control

- Sites Selected at Random
- Limited Personnel
- Methods Approved by
the EPA and TSSWCB

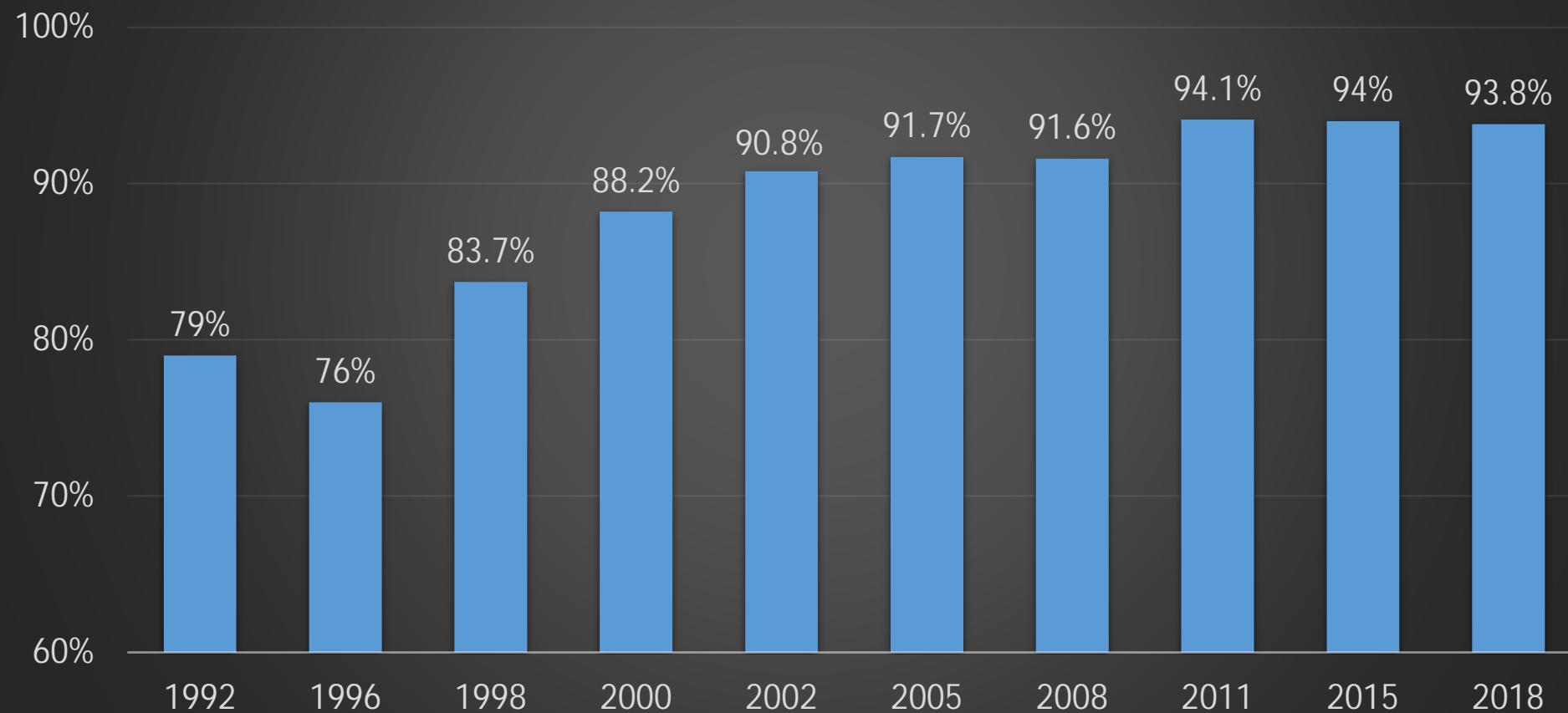


Overall Trends



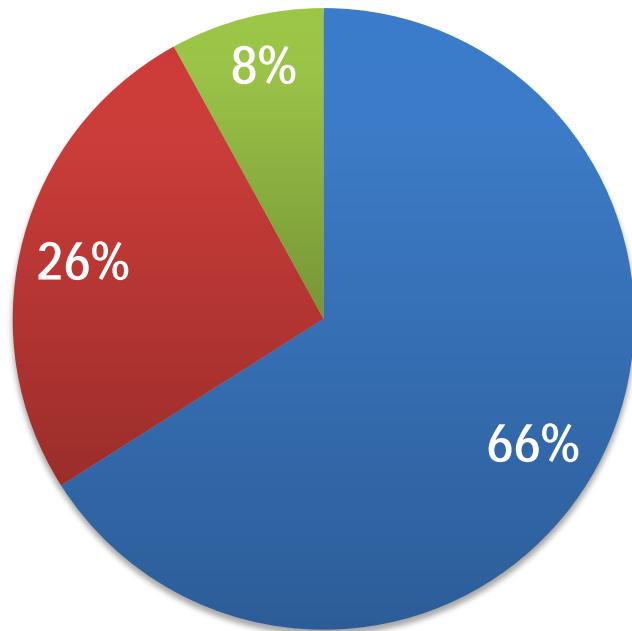
Overall Trends

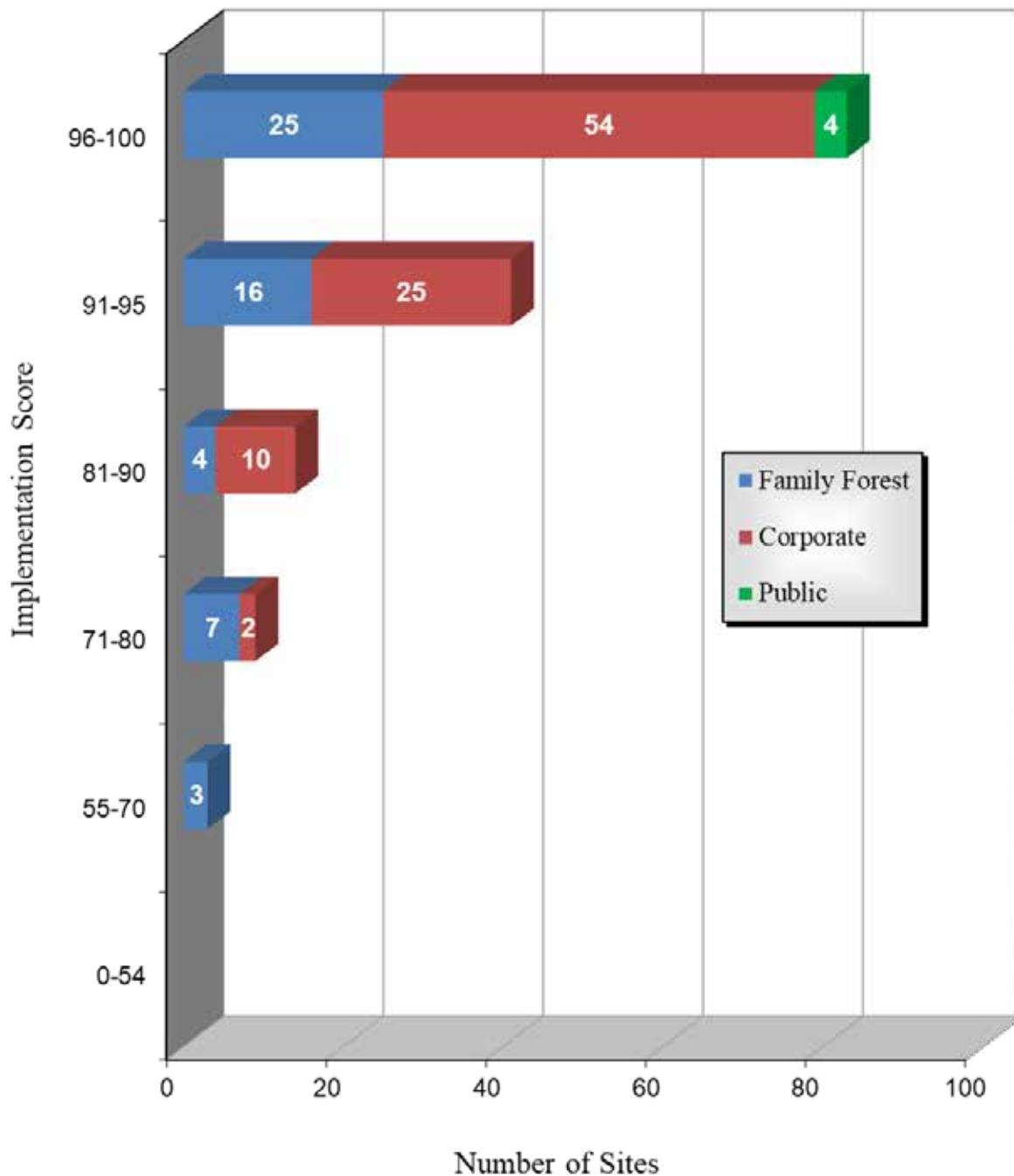
Overall Texas BMP Implementation (1992-2018)



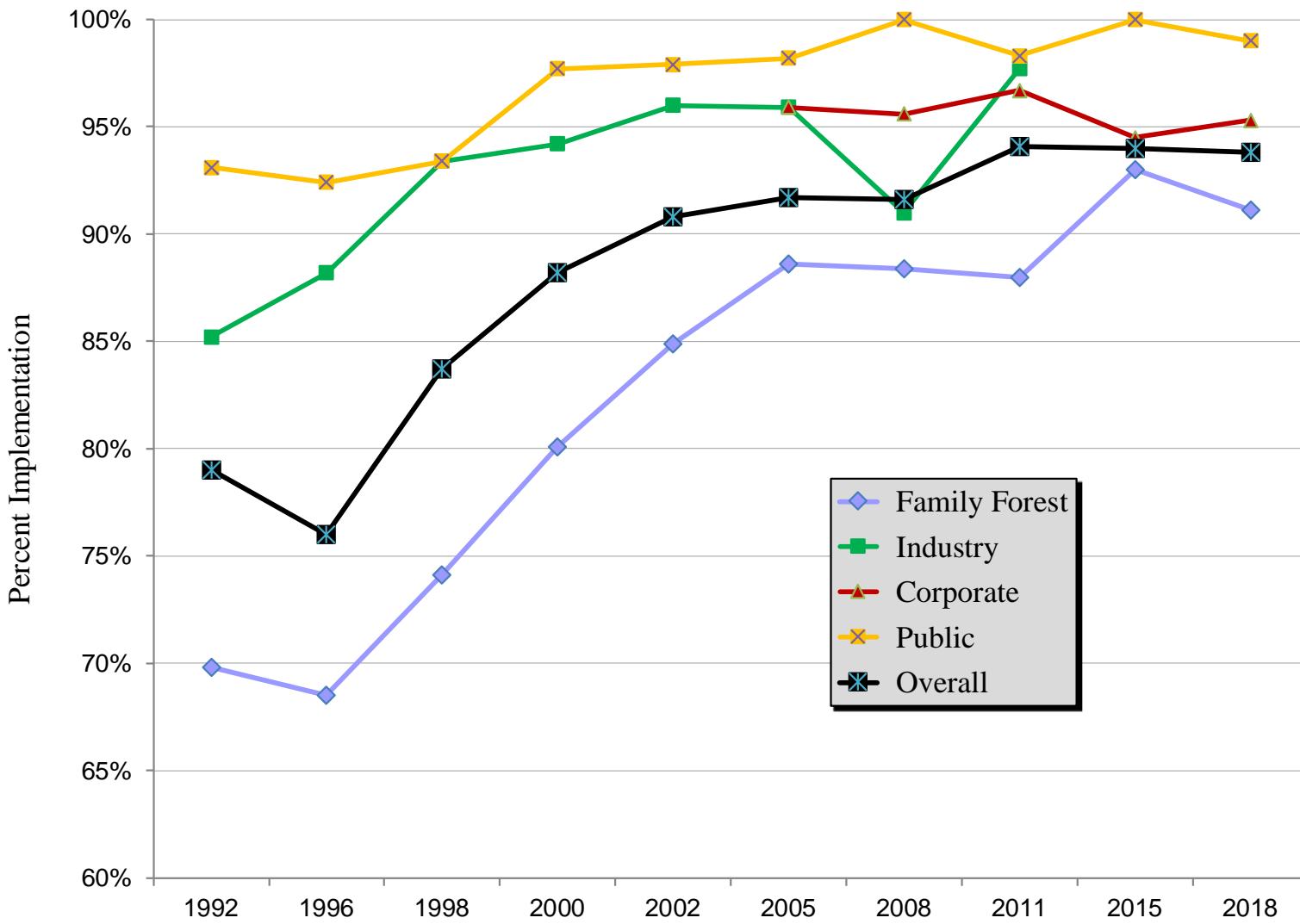
East Texas Land Ownership

■ NIPF ■ Corporate ■ Public





Implementation by Ownership



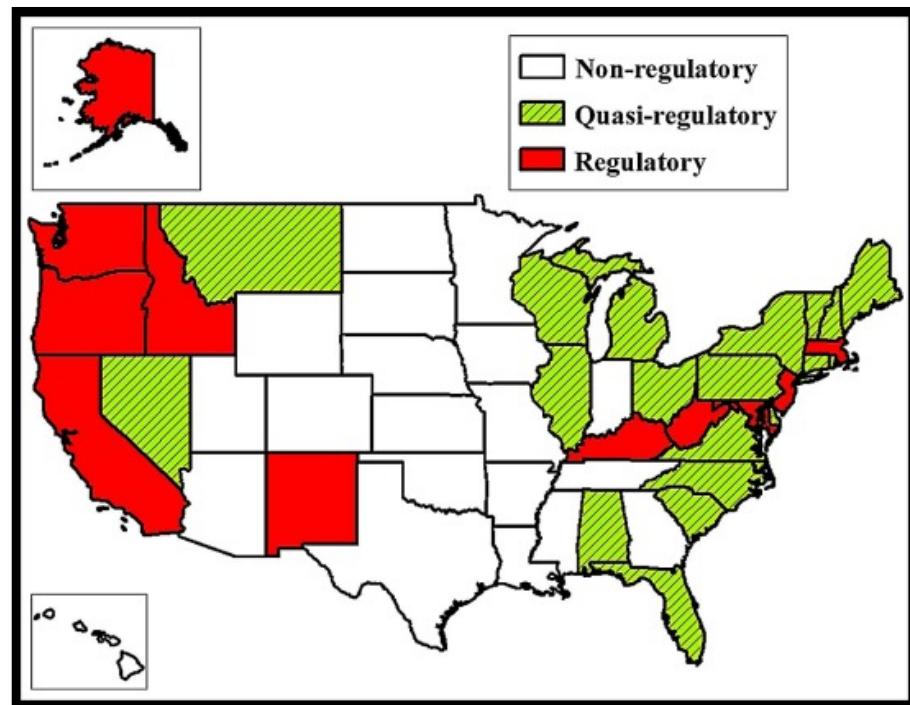
Poll Question 3

What factors do you think are involved in the lower scores of the private landowners in the early years?

- A. Lack of knowledge of BMPs
- B. Some private landowners live away from their forested property
- C. Cost of application of BMPs
- D. All the above
- E. None of the above

BMP Implementation Across U.S.

- Texas is non-regulatory
- Implementation rates across U.S. (2011):
 - Ø Non-regulatory = 90.2%
 - Ø Quasi-regulatory = 90.2%
 - Ø Regulatory = 93.4%



Round 10 Trends

	% Implementation Yes	% Implementation No
Forester Involved	95.4	79.0
Logger Attended BMP Classes	94.9	71.9
Landowner Familiar with BMPs	95.3	77.5
BMPs in Contract	95.2	72.2
SFI® Mill	95.4	78.1
Management Plan	95.2	76.9

Do BMPs Really Work?



BMP Effectiveness Monitoring

- BACI design (before - after / control - impact)
- 4 “worst case scenario” sites near Lufkin, Texas
- 2nd and 3rd order perennial streams
- Sites under operational, intensive forest management
- 100% BMP Implementation on all operations
- Watershed control – no outside influences
- Biological and physiochemical monitoring



EVALUATING THE EFFECTIVENESS OF TEXAS FORESTRY BEST MANAGEMENT PRACTICES

Project Timeline



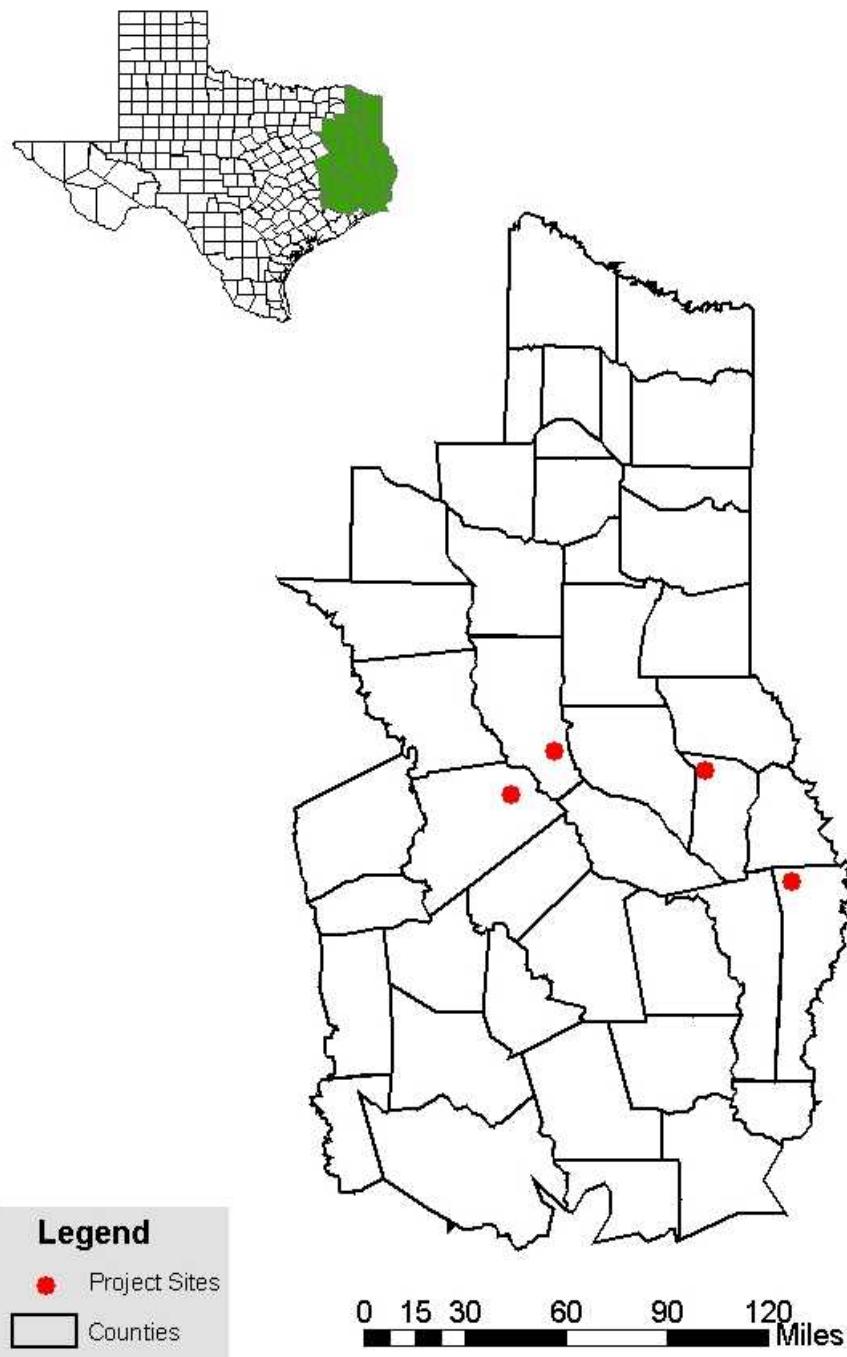
Key Dates

July 2003: Project Begins

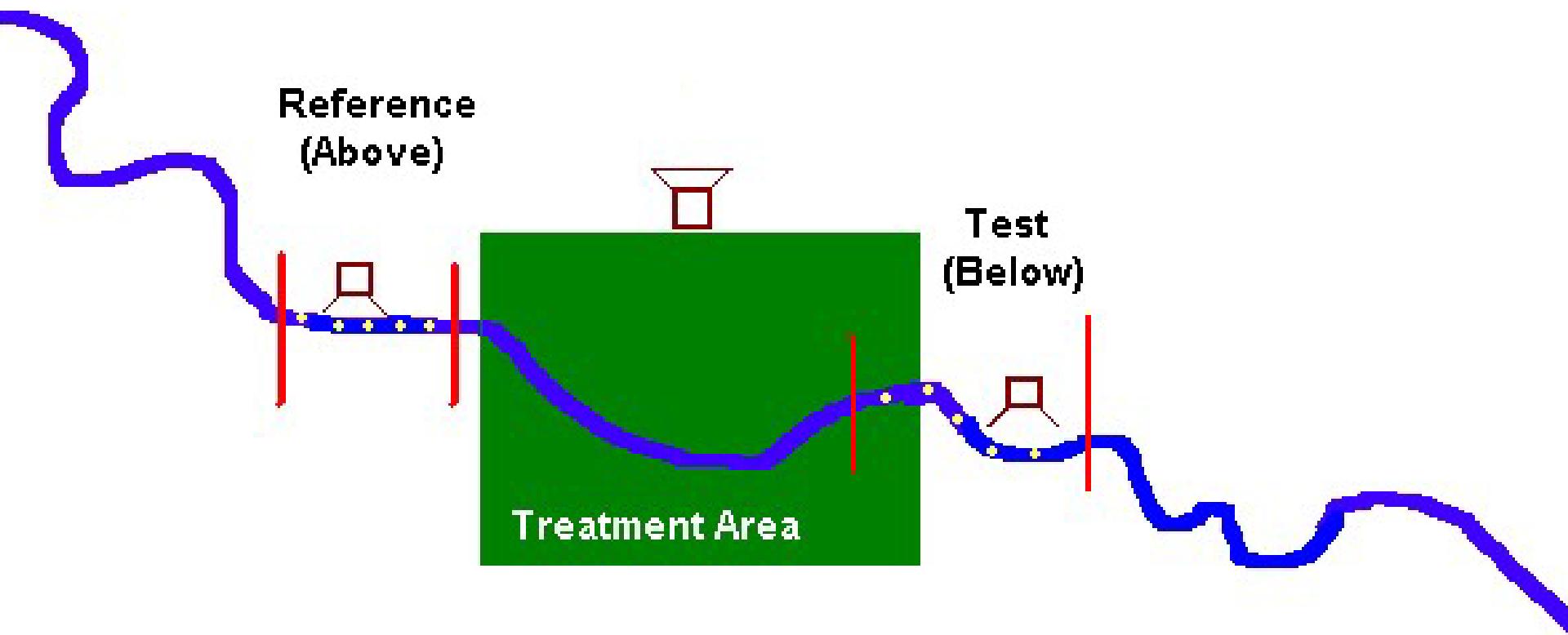
- Monitoring every month
- Conducted 3 pre-treatment biological samplings

November – December 2004:
Treatment - Harvest

September – October 2005:
Treatment - Site Prep



Typical Study Site



Sampling Parameters

Physiochemical

- pH
- Dissolved Oxygen
- Conductivity
- Temperature
- Turbidity
- Total Suspended Solids
- Phosphorous / Nitrogen

Biological

- Habitat assessment
 - Physical Characteristics
- Bioassessment
 - Benthics
 - Fish

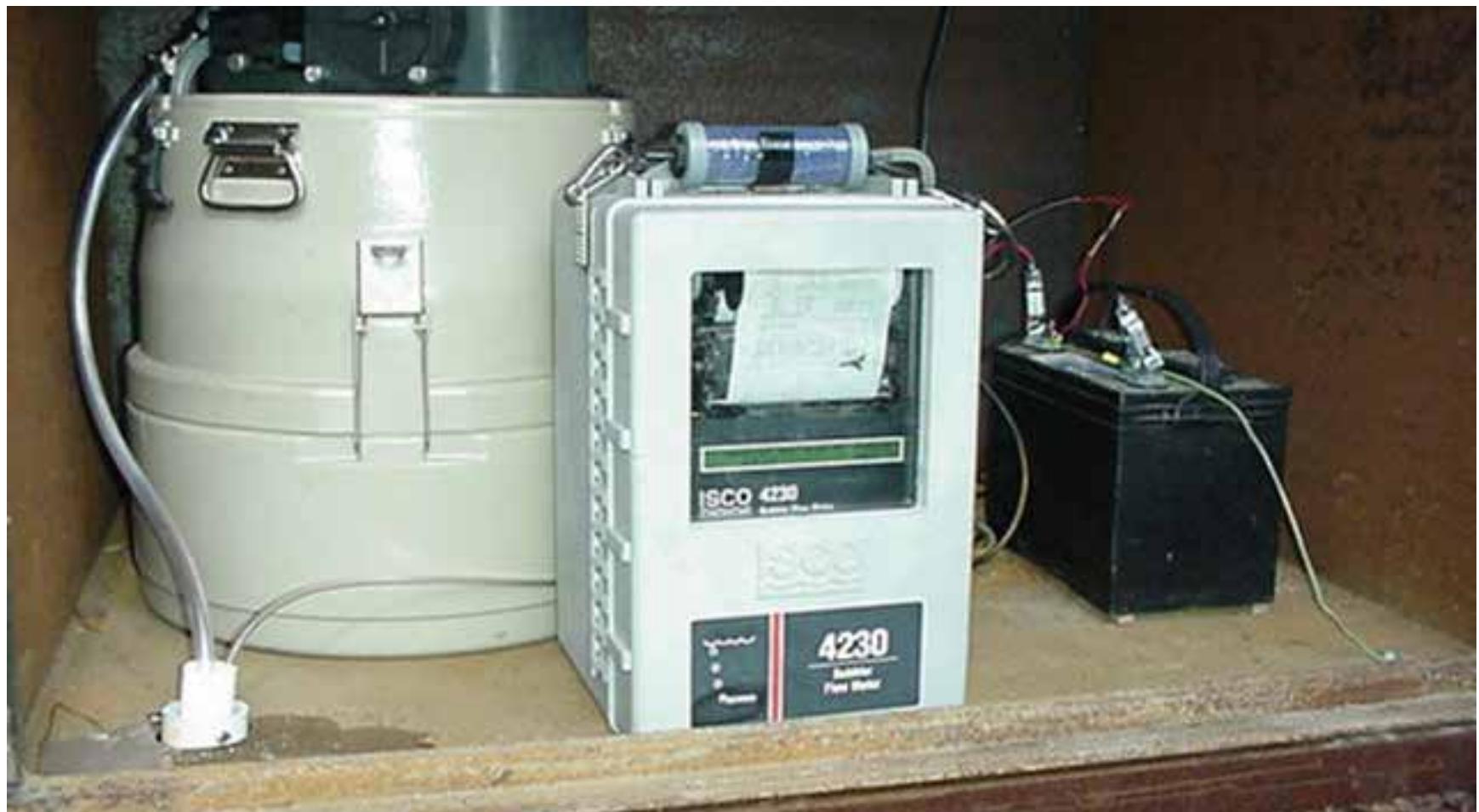
Water Sampling - Grab



Water Sampling – Storm Events



Water Sampling – Storm Events



Water Sampling – Storm Events





Biological Sampling

- Conducted twice a year (spring and fall)
- Consisted of Habitat, Benthics, and Fish
- TCEQ/EPA Sampling Methodology

Benthics

- D-frame kick net
- Picking from debris

Fish

- Electroshocker
- Seine

Habitat Assessment



Habitat Assessment

Available
Instream
Cover

Bank Stability

Bottom
Substrate
Stability

Channel
Sinuosity

Number of
Riffles

Riparian
Buffer
Vegetation

Dimensions of
largest pool

Aesthetics of
Reach

Channel Flow
Status and
Water Depth

Biological Sampling - Benthics





Poll Question 4

When using benthic macroinvertebrates to determine environmental conditions, what 3 key Orders are considered the best indicators of good water quality?

- A. Coleoptera, Decapoda, Odonata
- B. Ephemeroptera, Plecoptera, Trichoptera
- C. Collembola, Diptera, Orthoptera
- D. Hemiptera, Lepidoptera, Siphonaptera

Biological Sampling - Benthics



Dragonfly



Midge



Stonefly



Mayfly



Caddisfly

Biological Sampling - Fish



Biological Sampling - Fish



Biological Sampling - Fish



Biological Sampling - Fish



Spotted Sunfish



Yellow Bullhead



Spotted Bass

Results – Habitat Assessment Scores

Season	Cherokee		Houston		Newton		San Augustine	
	Above	Below	Above	Below	Above	Below	Above	Below
Fall '03	21.50	19.00	20.00	22.00	20.25	20.00	20.00	18.50
Spring '04	21.50	20.50	21.00	24.00	18.00	18.50	21.50	20.50
Fall '04	20.50	20.00	21.50	22.00	21.50	16.50	20.50	19.50
Spring '05	22.00	22.00	21.50	23.50	21.50	20.00	21.50	19.00
Fall '05	18.50	21.00	21.00	22.50	23.00	19.50	21.50	20.50
Spring '06	21.00	22.00	21.50	23.50	23.00	22.50	22.00	20.00
Fall '06	21.50	21.50	21.00	21.50	22.50	22.00	22.00	19.00
Spring '07	19.50	21.00	22.00	23.50	23.50	21.50	23.00	19.50
Fall '07	19.50	20.00	23.00	21.50	22.00	22.00	22.00	18.00

Ratings (per TCEQ):

26 - 31 = Exceptional

20 - 25 = High

14 - 19 = Intermediate

≤ 13 = Limited

Pre-treatment

Post-treatment

Results – Habitat Assessment Scores

Season	Cherokee		Houston		Newton		San Augustine	
	Above	Below	Above	Below	Above	Below	Above	Below
Fall '03	21.50	19.00	20.00	22.00	20.25	20.00	20.00	18.50
Spring '04	21.50	20.50	21.00	24.00	18.00	18.50	21.50	20.50
Fall '04	20.50	20.00	21.50	22.00	21.50	16.50	20.50	19.50
Spring '05	22.00	22.00	21.50	23.50	21.50	20.00	21.50	19.00
Fall '05	18.50	21.00	21.00	22.50	23.00	19.50	21.50	20.50
Spring '06	21.00	22.00	21.50	23.50	23.00	22.50	22.00	20.00
Fall '06	21.50	21.50	21.00	21.50	22.50	22.00	22.00	19.00
Spring '07	19.50	21.00	22.00	23.50	23.50	21.50	23.00	19.50
Fall '07	19.50	20.00	23.00	21.50	22.00	22.00	22.00	18.00

Ratings (per TCEQ):

26 - 31 = Exceptional

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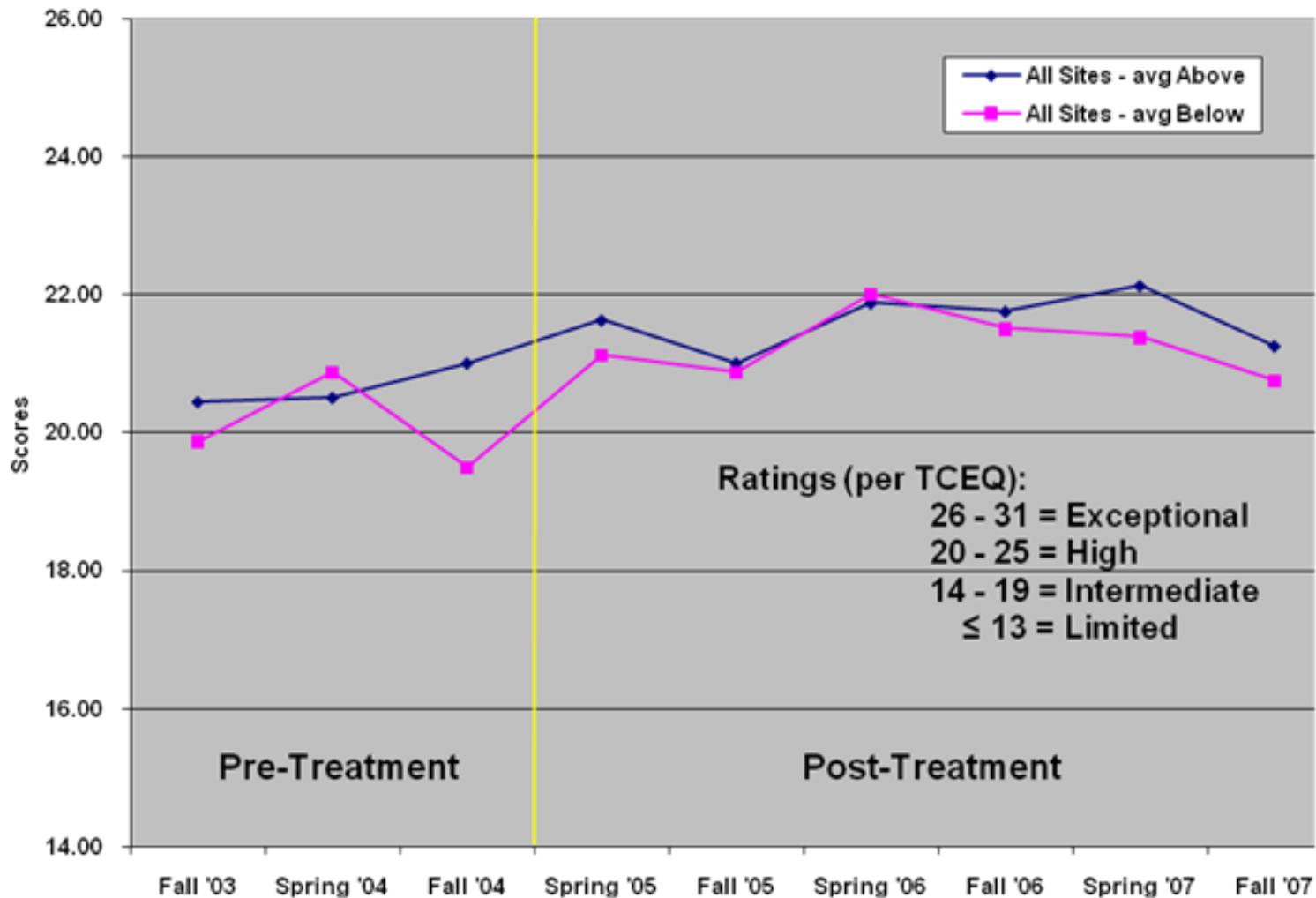
14 - 19 = Intermediate

≤ 13 = Limited

Pre-treatment

Post-treatment

Mean Habitat HQI Scores – All Sites



Results – Benthic Aquatic Life Use Scores

	<i>Above</i>	<i>Below</i>	<i>Above</i>	<i>Below</i>	<i>Above</i>	<i>Below</i>	<i>Above</i>	<i>Below</i>
Fall '03	28	30	30	33	28	27	28	31
Spring '04	36	27	26	31	30	32	26	24
Fall '04	32	31	29	28	31	30	32	32
Spring '05	33	32	27	24	25	32	25	29
Fall '05	35	27	25	29	27	25	29	28
Spring '06	30	23	22	29	28	28	31	27
Fall '06	26	18	23	30	20	24	27	27
Spring '07	31	34	23	28	23	20	33	31
Fall '07	28	25	27	25	25	25	33	24

Ratings (per TCEQ):

> 36 = Exceptional

29 - 36 = High

22 - 28 = Intermediate

< 22 = Limited

Pre-treatment

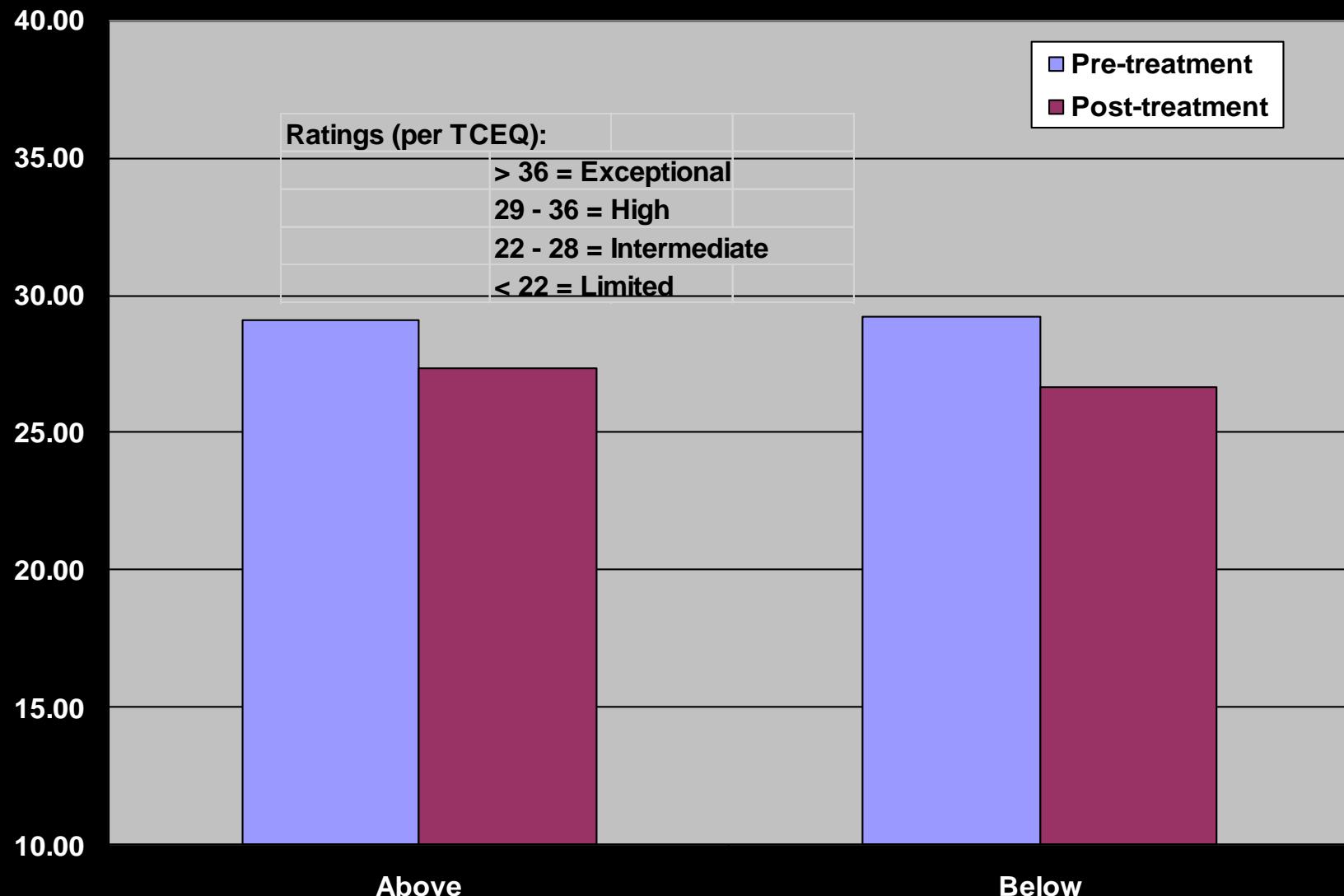
Post-treatment

Benthic Macroinvertebrate Metrics

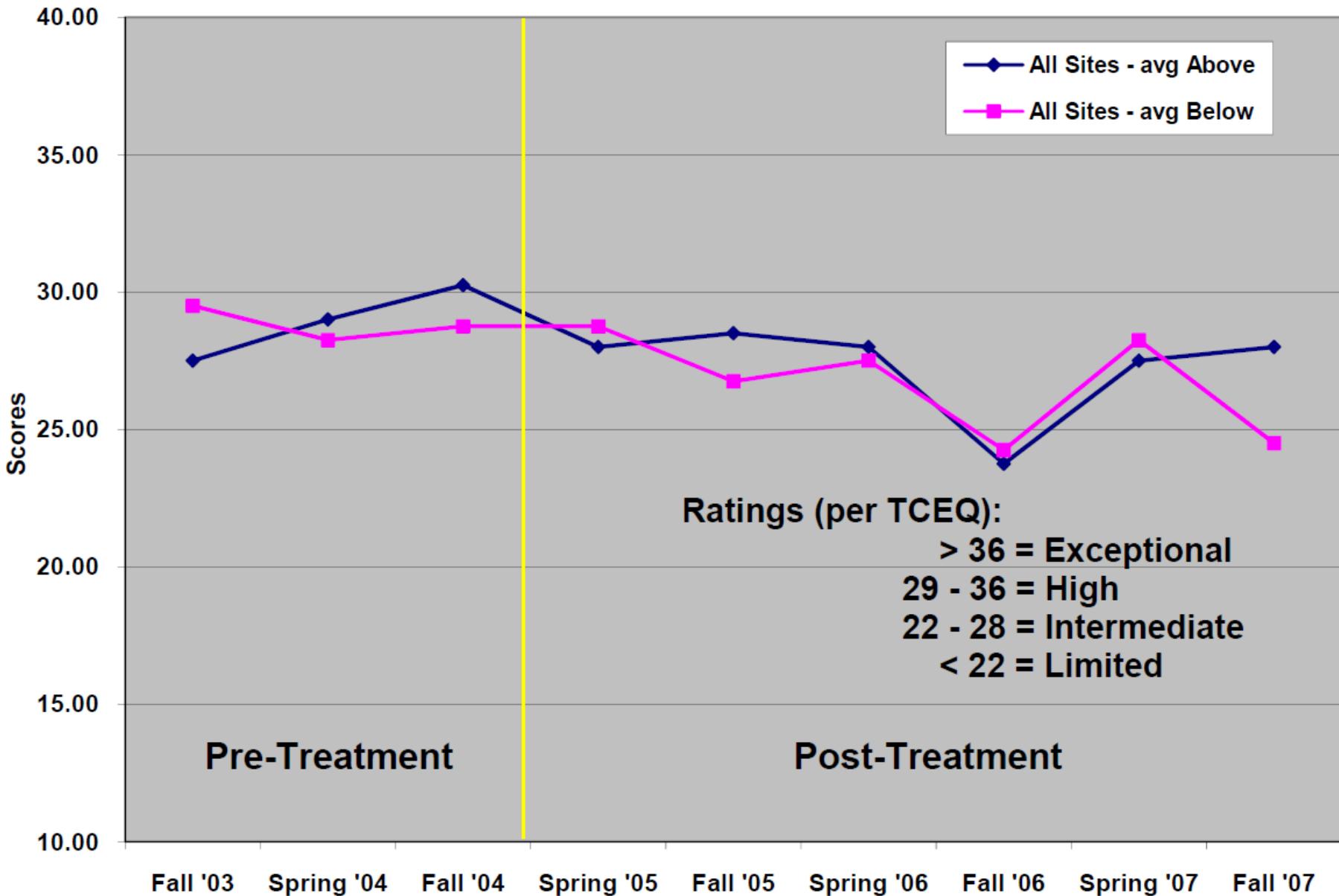
- Taxa Richness
- EPT Taxa Abundance
- Biotic Index (HBI)
- % Chironomidae
- % Dominant Taxon
- % Dominant FFG
- % Predators
- Ratio of Intol/Tol Taxon
- % Total Tricoptera as Hydropsychidae
- # Non-Insect Taxa
- % Collector-Gatherers
- % of Total as Elmidae



Results – Benthic Aquatic Life Use Scores



Mean Benthic ALU Scores – All Sites



Results – Fish Aquatic Life Use Scores

Season	Cherokee		Houston		Newton		San Augustine	
	Above	Below	Above	Below	Above	Below	Above	Below
Fall '03	44	48	44	48	58	55	45	45
Spring '04	45	47	44	39	51	46	46	49
Fall '04	43	51	41	39	58	54	40	45
Spring '05	46	50	39	51	52	53	47	43
Fall '05	47	51	42	42	49	51	42	48
Spring '06	50	51	40	48	51	55	41	45
Fall '06	47	53	44	46	55	55	43	51
Spring '07	49	49	33	43	50	54	42	43
Fall '07	47	49	40	48	54	52	48	48

Ratings (per TCEQ):

> 52 = Exceptional

42 - 51 = High

36 - 41 = Intermediate

< 36 = Limited

Pre-treatment

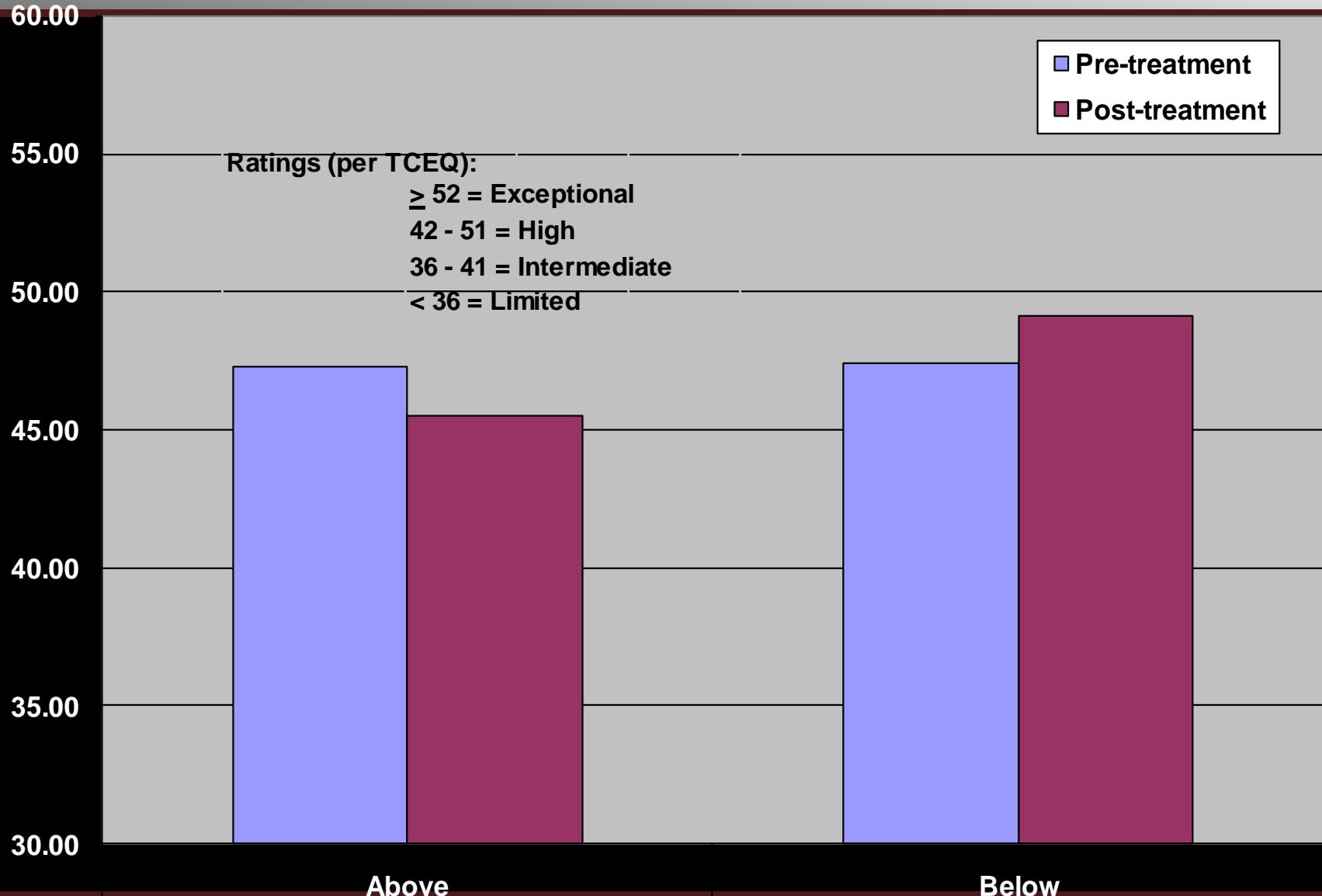
Post-treatment



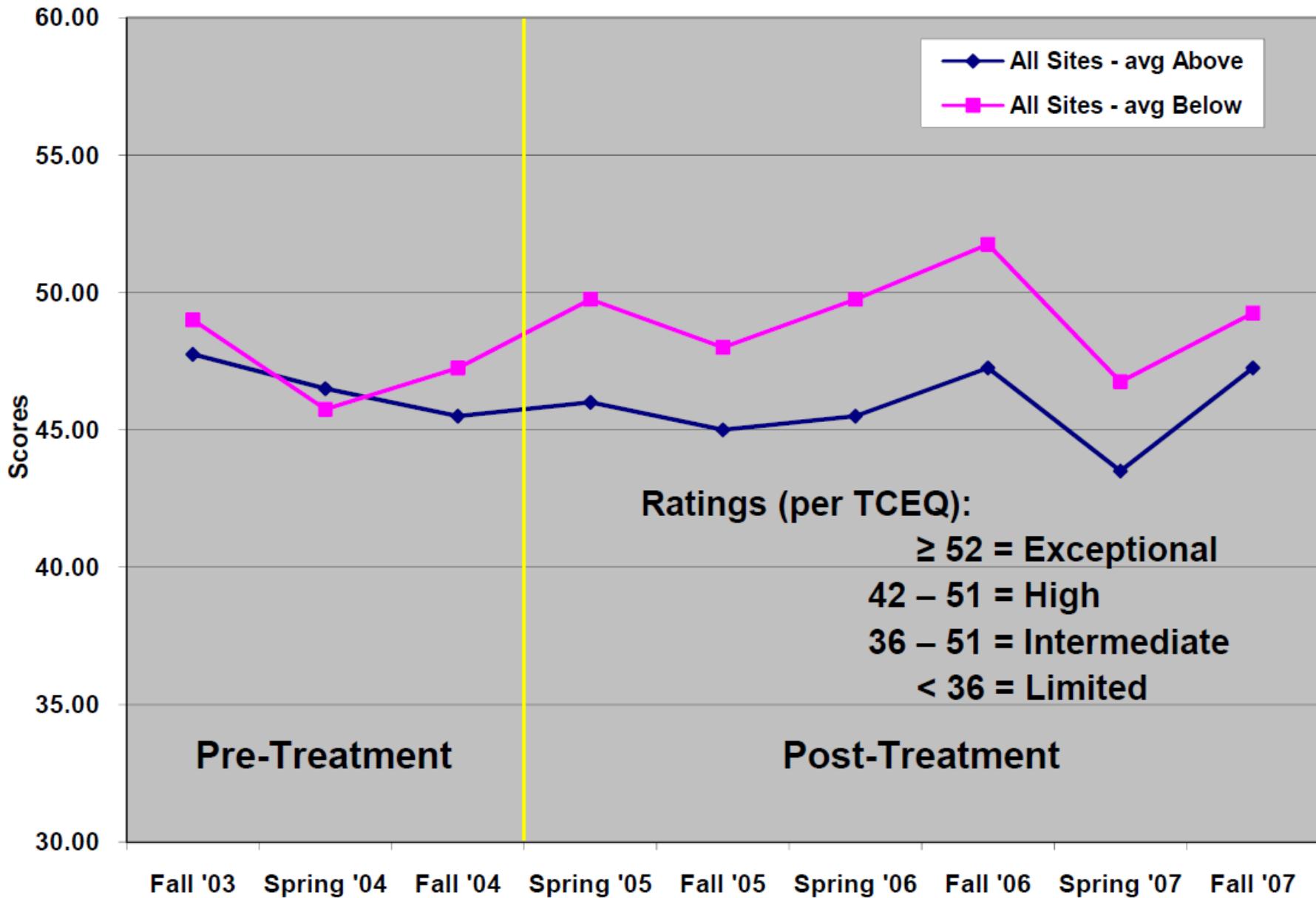
Fish Metrics – Ecoregion 35

- Total # fish species
- # of native cyprinid species
- # benthic invertivore species
- # sunfish species
- # intolerant species
- % individuals as tolerant species
(excl. w. mosquitofish)
- % individuals as omnivores
- % individuals as invertivores
- % individuals as piscivores
- # individuals/seine haul and /min. electrofishing
- % individuals as non-native species
- % individuals with disease or other anomaly

Results – Fish Scores



Mean Fish ALU Scores – All Sites

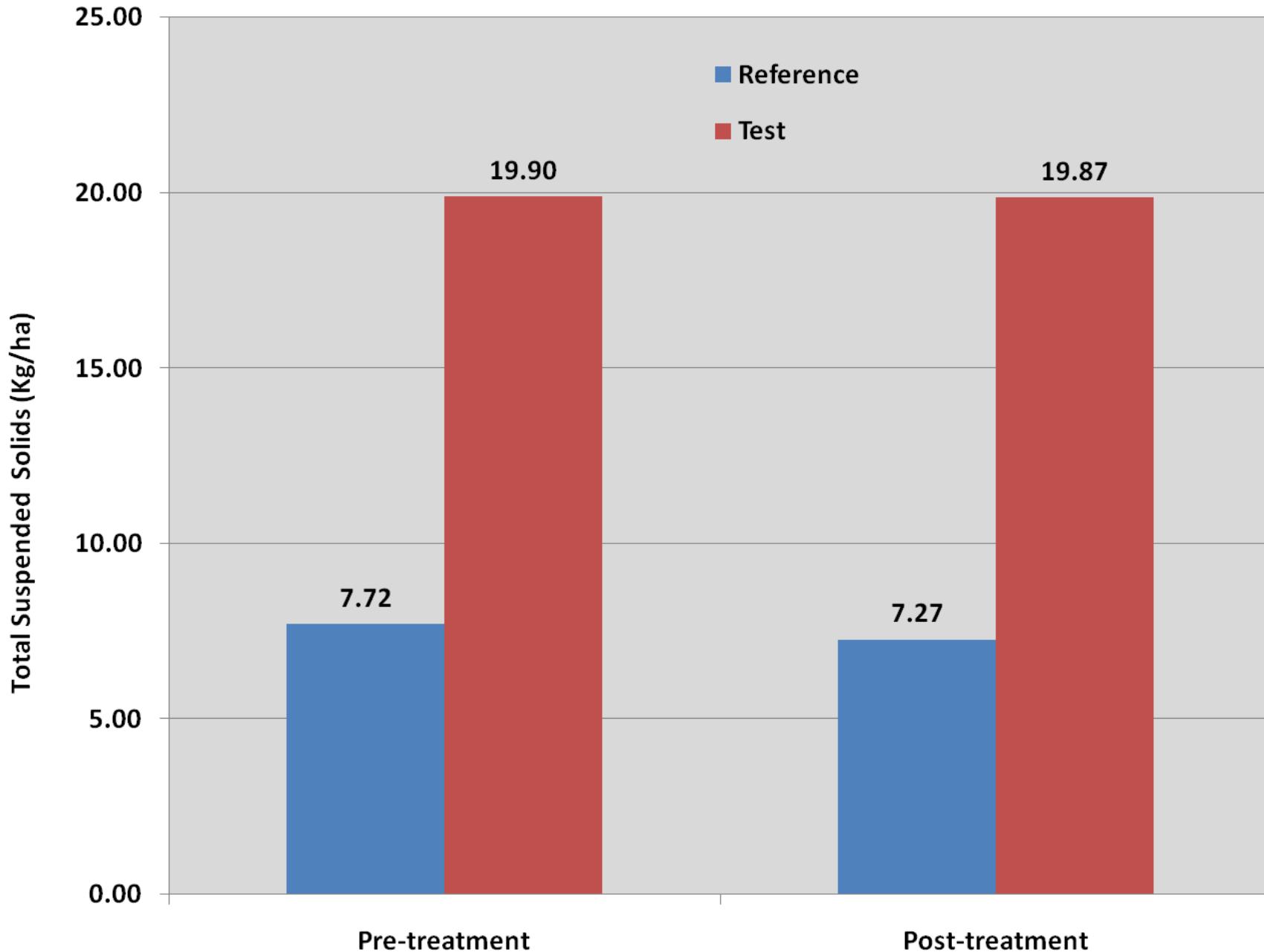


Biological Results Summary

Pre vs. Post Treatment Data

- Slight increase in habitat assessment metrics
(All sites – Reference and Test sections)
- Slight decrease in benthic metrics
(All sites – Reference and Test sections)
- Slight increase in fish metrics
(All sites – primarily Test sections)

Mean Sediment Losses - Pre and Post Treatment



Conclusion



BMPs, when applied properly, are effective in protecting aquatic biological communities and maintaining pre-treatment physiochemical properties; thus, protecting water quality.

Strategies to Protect Water Resources in Developing Areas

- **Watershed Protection Plan**
- **Land Conservation**
 - Acquisition / Easements
 - Restoration
 - Private Land Stewardship
- **NPS Management**
 - BMPs / Low Impact Development
 - Urban Forest Canopy



NPS Management

BMPs / Low Impact Development (LID)

- Landowner
- Developer
- Construction
- Homeowners



We can all make a difference!

- Big and small efforts: All make up a piece of the pie!

Best Management Practices (BMPs)

Conservation practices implemented to protect water quality from nonpoint source (NPS) pollution

- Sediment
- Nutrients
- Pathogens (Bacteria)
- Thermal Changes



Riparian Buffers

- Ø Maintain vegetative buffers along streams
- Ø Minimize disturbance within these zones
- Ø Careful management



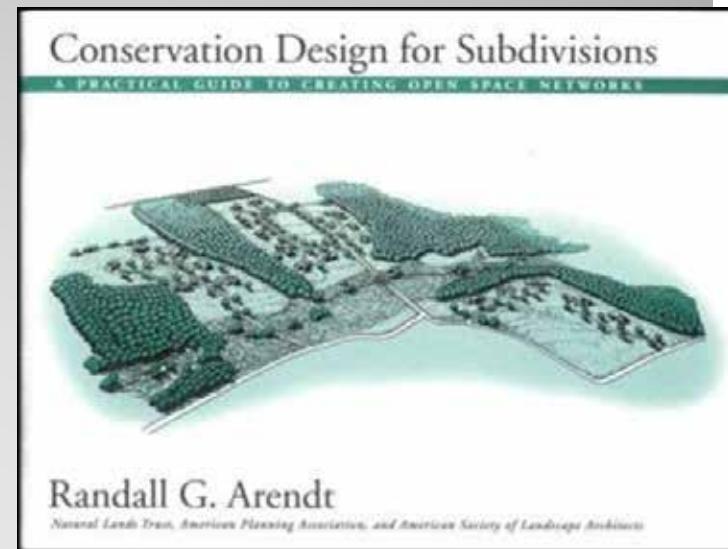
Developer BMPS

LID

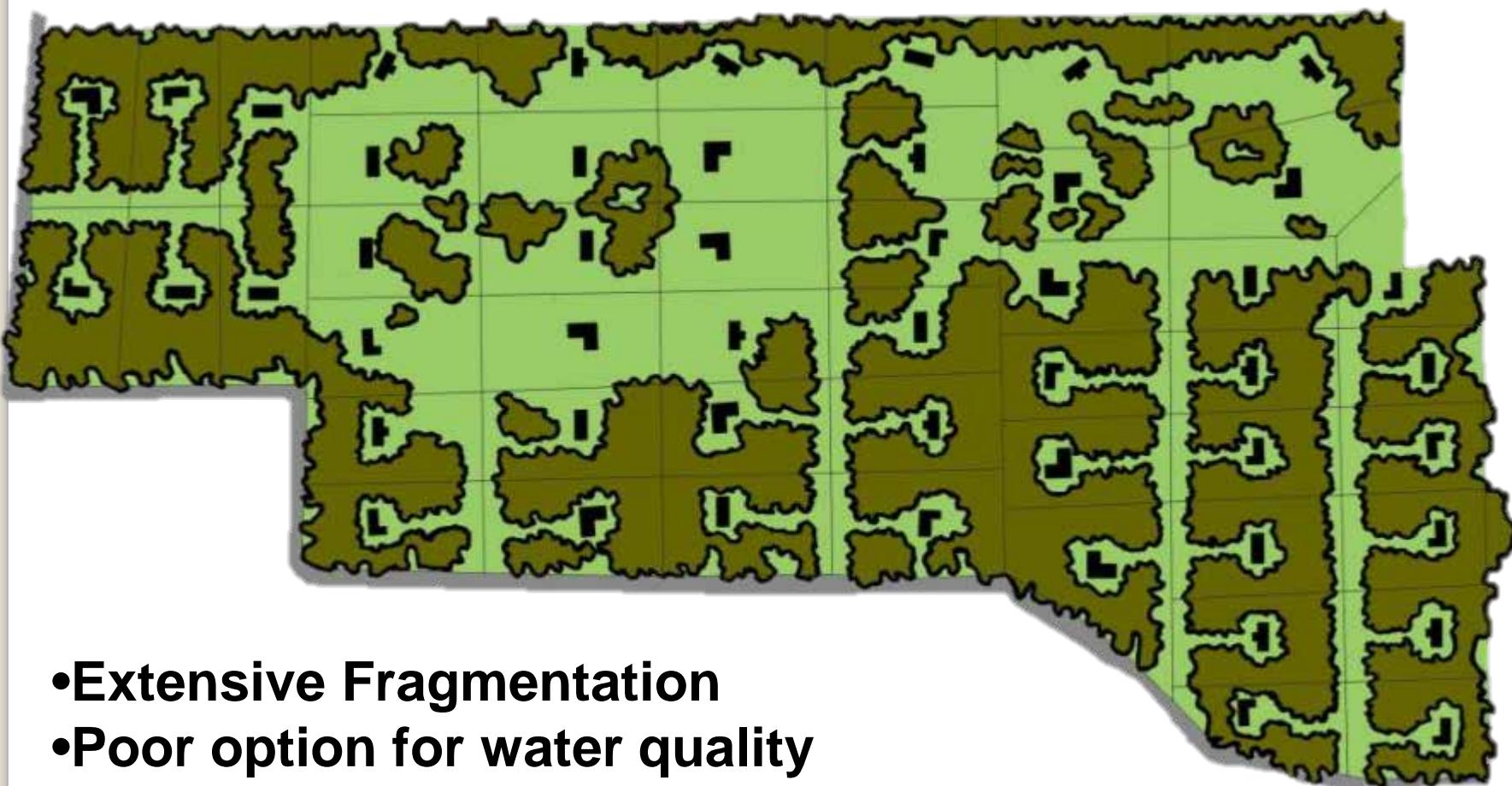
- Treat water where it falls
- Vegetated rooftops

Conservation Design

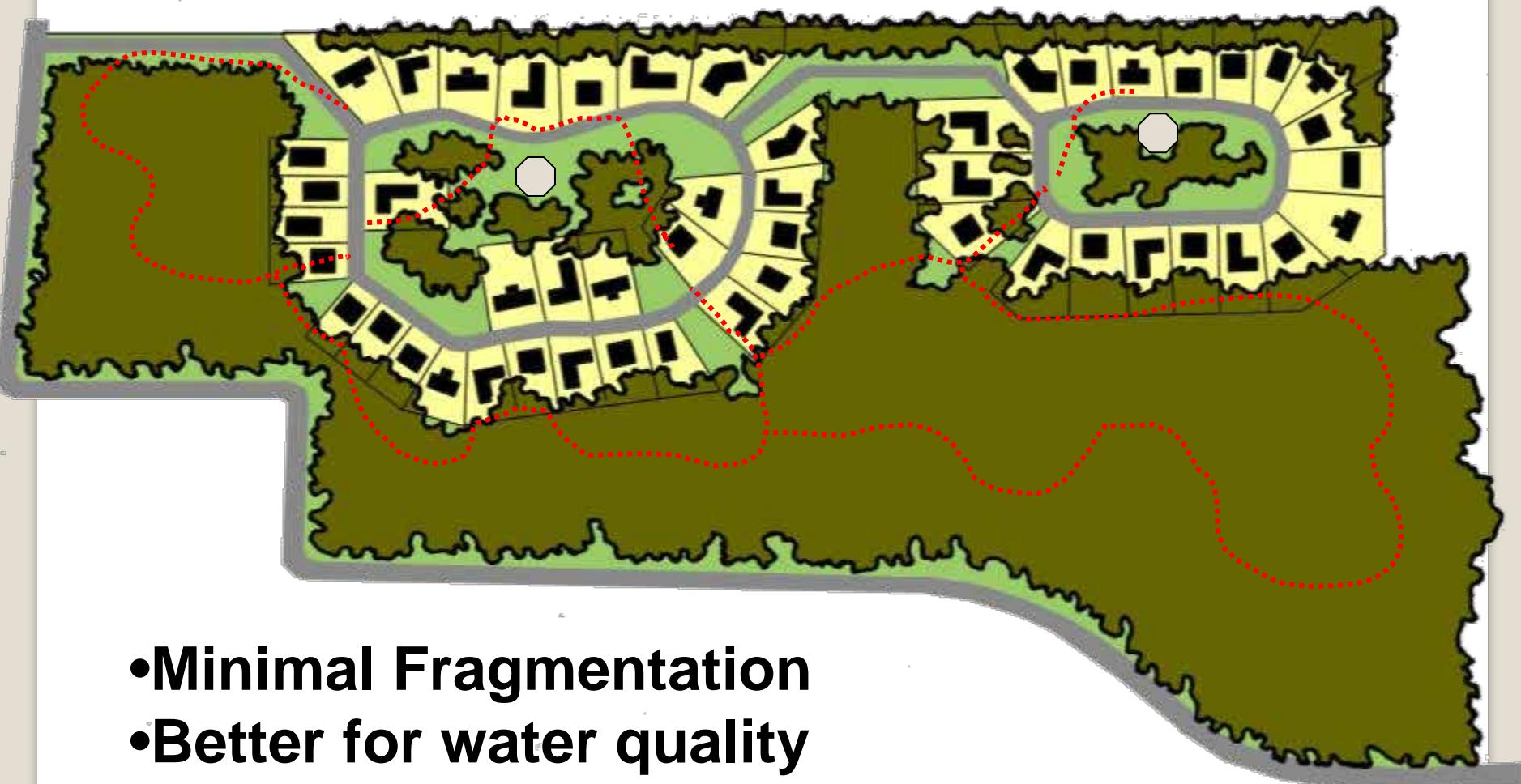
- Incorporate green spaces



2-Acre “Large Lot” Development



1/2 Acre Conservation Development (Still 50 Lots... All with a Premium)



- Minimal Fragmentation
- Better for water quality
- Maintain 1/2 Acre, Access 75.5 Acres

Construction BMPs

Minimize Paved Surfaces

Protect Residual trees

Manage Stormwater



Stormwater BMPs



Vegetated swale



Retention wetlands



Detention pond



Infiltration zones

Stormwater Reduction



**For every 5% increase in canopy,
stormwater drainage is reduced by 2%**

2002 TPL and AWWA Study

27 water suppliers surveyed

- For every 10% \uparrow in forest cover, treatment costs \downarrow 20%
- 50–55% variation in treatment costs explained by % forest cover





URBAN TREE CANOPY

Find Location



Area Report

Download Report



Download Data



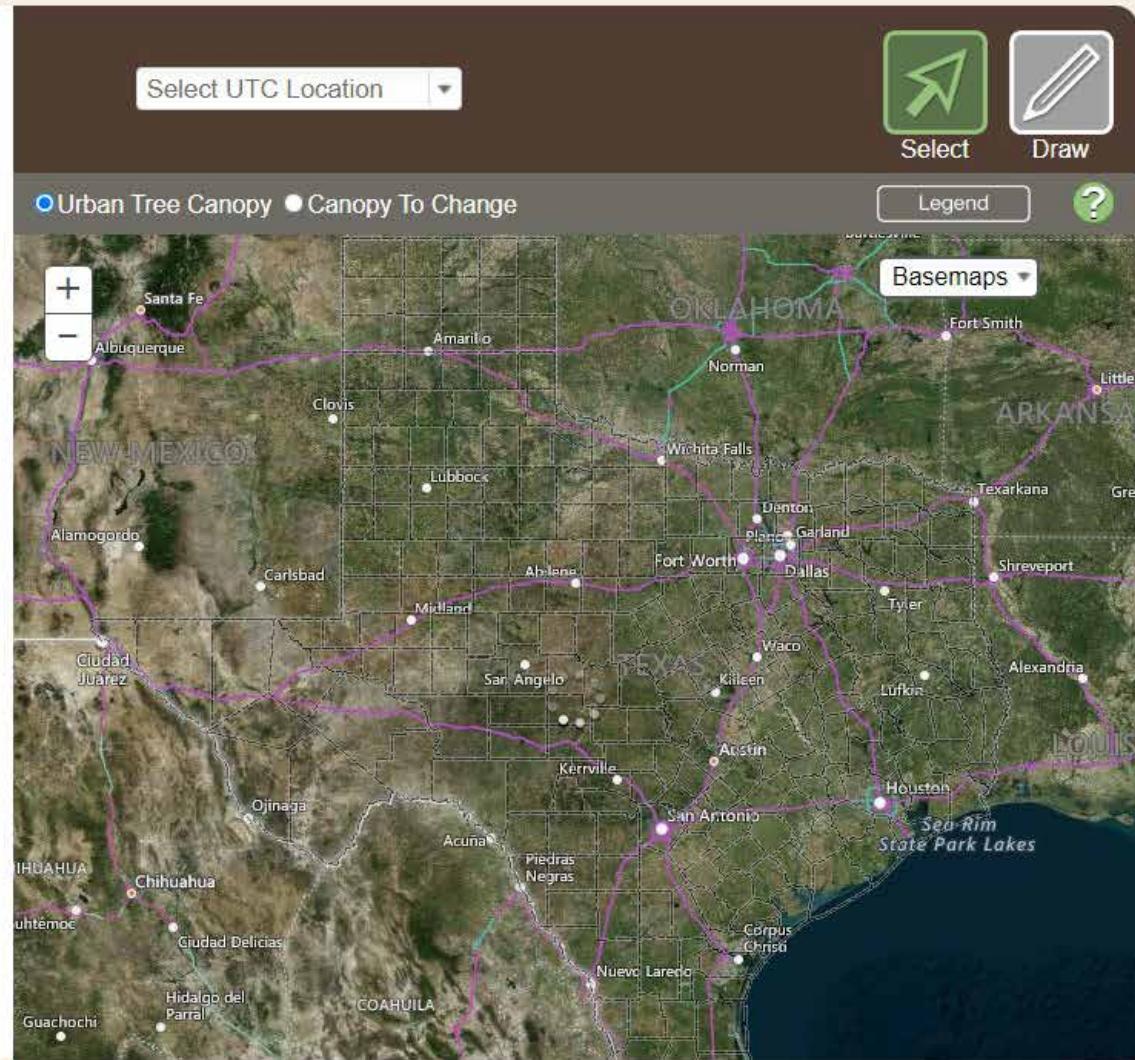
This application displays predicted urban growth areas, UTC for selected communities, and models future UTC based on management policy.

Urban Tree Canopy (UTC)

is the layer of leaves, branches, and stems of trees that cover the ground when viewed from above. Trees provide many economic, environmental, social, and health benefits that form the basis of livability in every community.

Canopy to Change (C2C)

Urbanization can mean a loss of UTC (*canopy-at-risk*), or with proactive ecological planning, it can enhance the community forest resource (*canopy-to-grow*).



Area Report

Download Report 

Download Data 

Urban Tree Canopy

Regional Average:	23%
Regional Target:	30%

Austin Results:

Canopy Cover	36.2%
	70,664 acres
Ecosystem Services Value	\$219 million
Canopy-at-risk	18,310 acres
Canopy-to-grow	26,633 acres

- Target
- Average
- UTC



Future Urban Tree Canopy

Management Approach		
Neglect	Status Quo	Targeted
27%	35%	38%

Austin
UTC layer is from 2010 imagery

Urban Tree Canopy • Canopy To Change

Legend ?

Basemaps

+

-

The map displays a satellite view of the Austin area, including surrounding towns like Georgetown, Leander, Round Rock, and Kyle. Overlaid on the map are several layers: a black outline of the city limits, yellow areas representing 'Urban Tree Canopy', red areas representing 'Canopy To Change To Grow / At Risk', and a purple dashed line representing 'Suggested ETJ'. A legend box on the right side provides a key for these symbols. The map also includes major roads like I-35, 290, and 45, and various neighborhoods and landmarks. A 'bing' logo is visible at the bottom left of the map area.

Georgetown

Leander

Brushy Creek

Round Rock

Hutto

Taylor

Coupland

Jonestown

Cedar Park

Lago Vista

Briarcliff

Hudson Bend

Lakeway

Bee Cave

Barton Creek

Mount Bonnell

Austin

Dripping Springs

Shady Hollow

Manchaca

Buda

Kyle

Wimberley

Legend

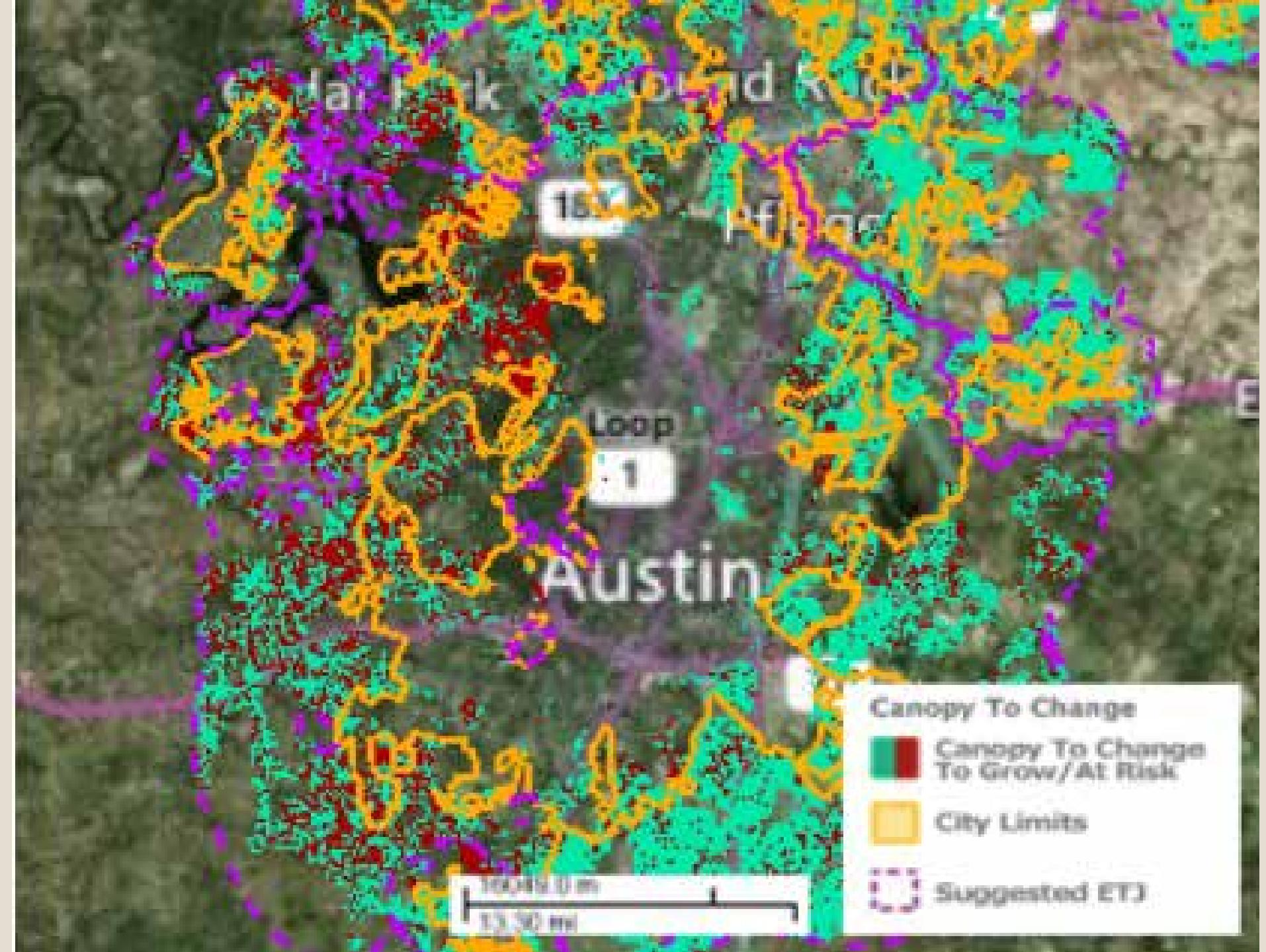
Canopy Layers

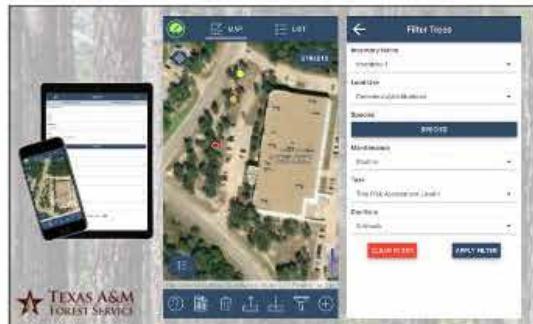
- Urban Tree Canopy
- Canopy To Change To Grow / At Risk

Boundaries

- City Limits
- Suggested ETJ
- Mapping Zones

© 2022 Microsoft Corporation, Earthstar Geographics ...



[Show All](#)
[Forest Management](#)
[Forest Products](#)
[Special Trees and Forests](#)
[Community Forestry](#)
[Landowner Tools](#)
[Featured Apps](#)


Trees Count Mobile App

Trees Count allows users to map trees in communities and characterize them with informative attributes. Inventories can be transferred across devices.

[Forest Management](#), [Community Forestry](#)


Tree Risk Mobile App

The Level 1 Tree Risk Assessment app maps those trees with obvious defects that have a Probable or Imminent likelihood of failure and identifies treatment.

[Community Forestry](#)


Funding Connector

This website serves as a clearinghouse for information about various natural resource programs that offer financial assistance to Texas landowners that implement conservation practices.

[Landowner Tools](#)


Texas Forest Carbon Clock

A widget that displays the real-time tons of carbon captured from the atmosphere and stored in Texas forests.



My Tree ID Mobile App

My Tree ID helps identify tree species based on leaves, flowers, seed, bark or location using a key, descriptions, and full-color images.

[Landowner Tools](#)


TreeMD

This app will help you find the root of your tree's problem. It will help you search by species or symptoms and filter by types of pests, or search pest records, list of symptoms and affected trees.

[Landowner Tools](#)

Increasing Urban Forest Cover



Benefits of Increasing Urban Forest Canopy

Stormwater Reduction



Water Quality
Improvement

Energy Savings

Air Quality

Aesthetics

Property Values



Urban Forest Cover

- Ø Stormwater Reduction
- Ø Water Quality Improvement
- Ø Energy Savings
- Ø Air Quality
- Ø Other co-benefits



i-TreeTM

www.itreetools.org

i-Tree delivers current, peer-reviewed tree benefits estimation science from the USDA Forest Service to all types of users with free tools and support.



The trees around you:
remove hazardous pollutants from
the air you breathe,
absorb carbon dioxide from the air
to store as wood,
and control storm water by
intercepting and absorbing rainfall.

**Trees provide more than
just beauty and shade.**

**They work hard for all of
us, every day!**

[Click here to learn more.](#)

Tools for assessing individual trees



MyTree

Are you new to i-Tree? Start with our EASIEST tool! MyTree helps you quickly assess **individual trees** with a minimum of fuss.
via your web browser or Android / Apple devices



i-Tree Design

A full-featured web tool with expanded building interactions and forecasting for estimating the benefits of **individual trees**.
via your web browser



i-Tree Eco

Eco is our flagship tool that accommodates tree inventory IMPORT or field data evaluation to derive **individual tree** benefit estimates.
requires installation on a Windows PC

Tree canopy area assessment tools



OurTrees

Beta release: Quick **tree canopy** and related information for your community within the continental US!
via your web browser or Android / Apple devices



i-Tree Landscape

US **tree canopy** and Census maps/data at your fingertips! Identify priority planting & protection areas for climate & social issues.
via your web browser



i-Tree Canopy

From your chair, easily estimate land cover and **tree canopy** plus benefits using random point sampling on aerial imagery.
via your web browser

[More tools...](#)

Summary

- Forests provide a number of ecosystem services – including clean water.**
- The more forests and trees in the watershed the better the water quality is likely to be.**
- Best Management Practices / LID / Urban Forest Cover can be used to manage NPS and protect water resources in developing areas.**

Resources

TFS Water Resources Webpage:

Ø <http://tfsweb.tamu.edu/water>

Ø <https://tfsweb.tamu.edu/BMPs>

Ø <https://tfsweb.tamu.edu/BMPMonitoring>

Ø https://tfsweb.tamu.edu/Water_Publications

Texas Forest Info:

Ø <http://texasforestinfo.com>

Questions?



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