The background of the slide is a photograph of a dried plant specimen, likely a branch with leaves, pressed against a light-colored, textured surface. The branch runs vertically on the left side and horizontally across the bottom. The leaves are brownish and appear to be from a woody plant.

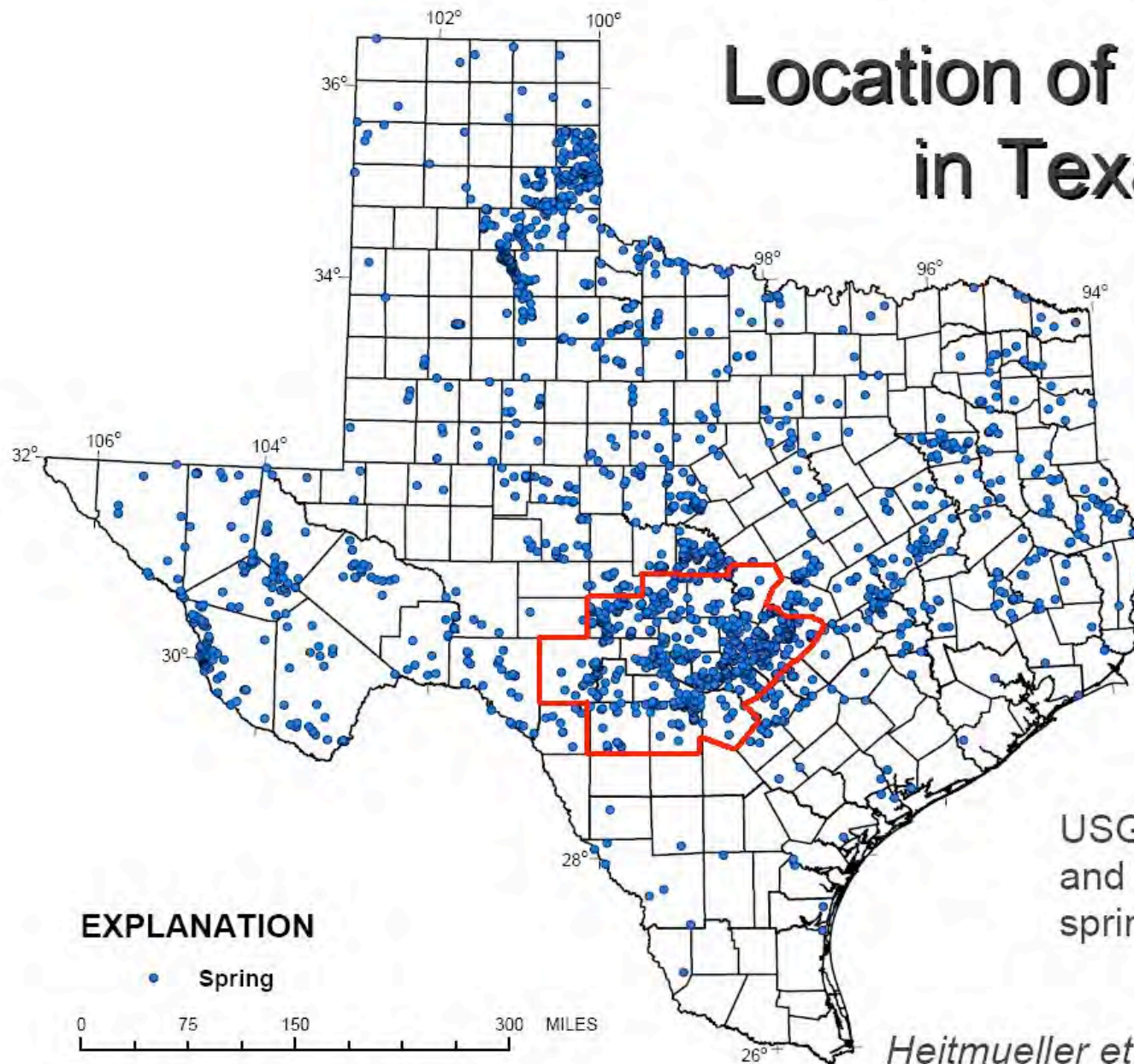
Upper Llano River Watershed Protection Plan & Stewardship

Tom Arsuffi, TTU Llano River Field Station

Emily Seldomridge, TTU Llano River Field Station



Location of Springs in Texas



USGS verified existence
and location of 1,891
springs in Texas

Heitmueller et. al (2003)

Hill Country/Upper Llano Natural Resource Issues

- ☉ Water Management
- ☉ Water Resources
- ☉ Natural Threats
 - ☉ Floods
 - ☉ Droughts
- ☉ Water Resource Impairments due to Development
 - ☉ Groundwater Quantity
 - ☉ Groundwater Quality
 - ☉ Surface Water Quality
- ☉ Invasive Species
- ☉ Wildlife Management
- ☉ Range Management

Our Mission

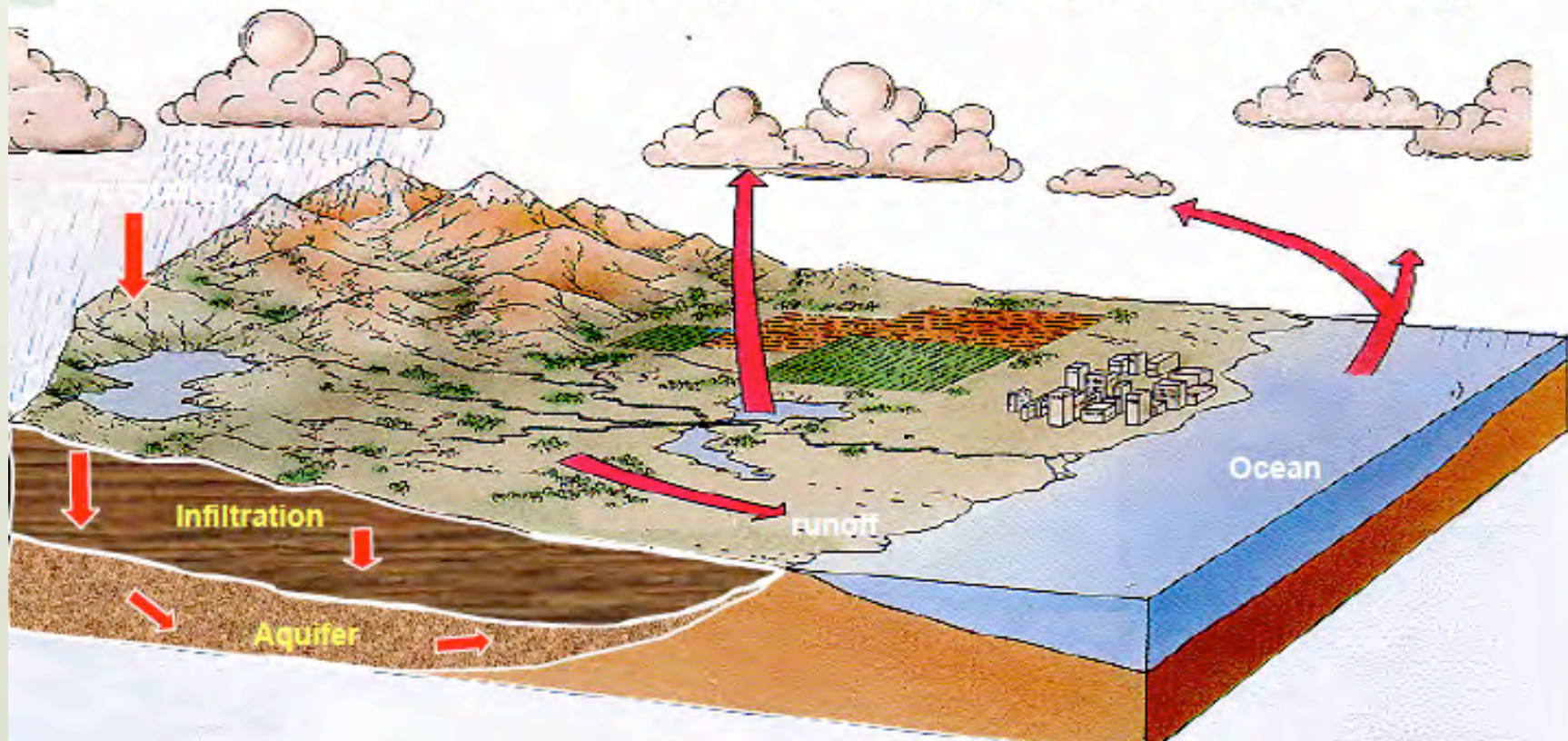
To encourage, educate, engage, conduct and coordinate basic and applied research projects dealing with:

- Water /watersheds
- Exotic species
- Range management
- Natural resources
- Ecological restoration
- Environmental education



Watershed-Based Planning

Watershed is an ideal unit for addressing interlinked concerns on climate change, biodiversity, water, poverty





A Wise Investment for Our Nation's Future

The Healthy Watersheds Initiative encourages states, local governments, watershed organizations and others to take a strategic, systems approach to conserve healthy watersheds with a goal to protect high quality waters and prevent future water quality impairments.

Benefits of Healthy Watersheds

- *Clean, Healthy Water*
- *Fish and Wildlife Habitat*
- *Flood Minimization*
- *Climate Adaptation*
 - *Carbon Sequestration (reduced green house gases)*
 - *Resistant and Resilient Ecosystems (habitat complexity and corridors)*
- *Recreation Opportunities*
- *Drinking Water Protection*
- *Billions in Cost Savings*

EPA's Healthy Watersheds Initiative



Despite billions of dollars spent in the last three decades to address impairments to water resources, aquatic ecosystems are still in decline. A recent EPA survey of the nation's wadeable streams found 42 percent in poor biological condition and 25 percent in fair condition. Nearly 40 percent of North America's freshwater fish, 700 species in total, are imperiled. We face a serious conservation crisis.

The solution demands a more integrated approach that looks broadly to maintain water quality and ecological integrity on a geographic – or watershed basis. Thanks to today's highly advanced assessment, planning and data analysis tools, we now can achieve the vision for holistic water resource management embraced by EPA and others in the early 1990's. Under the new *Healthy Watersheds Initiative*, EPA is proposing:

- ***A Strategic Framework*** that outlines a systems-based approach to integrated watershed assessment, protection and conservation programs.
- ***A New Policy Direction*** that focuses on maintaining healthy waters and meeting Clean Water Act (CWA) goals of fishable and swimmable.
- ***A Collaborative Approach*** that integrates CWA programs and other aquatic resource programs across agencies and the private sector.
- ***Technical Assistance and Funding*** to states and watershed organizations to support healthy watershed assessment and conservation.



Development of a Watershed Protection Plan for the Upper Llano River

- Upper Llano Watershed,
- Impetus for Project
- Project Goals
- Project Tasks
- Getting Involved
- Next Steps

Upper Llano Watershed

- About 250 square miles
- Llano River significant tributary to Colorado River and Highland Lakes
- Drains to Matagorda Bay



Texas State Soil and Water Conservation Board Clean Water Act 7319(h) Nonpoint Source Grant Program

Upper Llano Watershed Planning and Education

- Protect the Upper Llano River watershed and prevent impacts to its aquatic ecosystem (and, thus, water quality impairments) from land use changes and other perturbations (e.g., invasive species) through:
 - Stakeholder Coordination
 - Characterize current water quality & flow conditions
 - Watershed Assessment and Modeling
 - Development of a watershed protection plan that satisfies EPA's nine key elements and EPA's Healthy Watersheds Initiative Framework
 - Public Outreach and Education



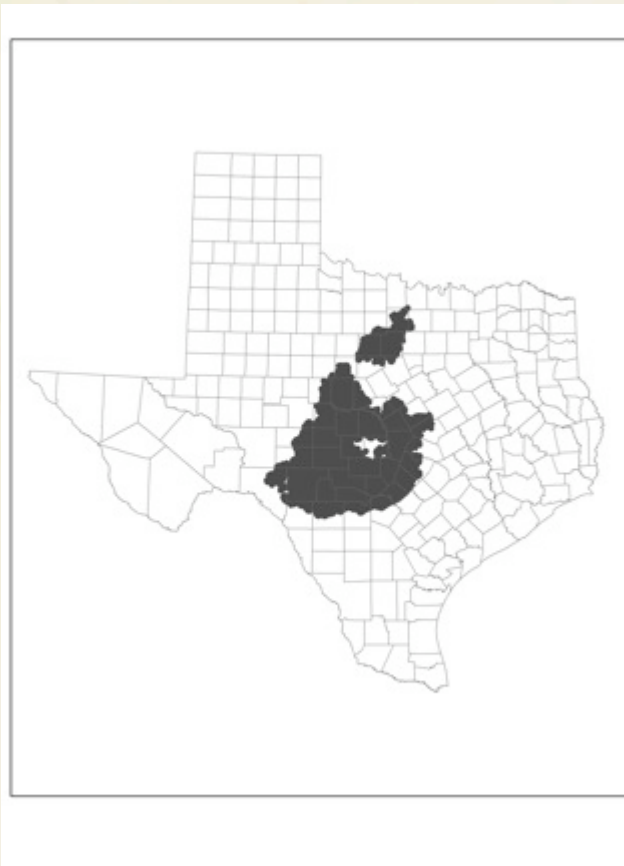
Upper Llano WPP: N&S rivers

- Sites: 14 main stem, 6 spring systems
- Water Quality
Macroinvertebrates
- Fish

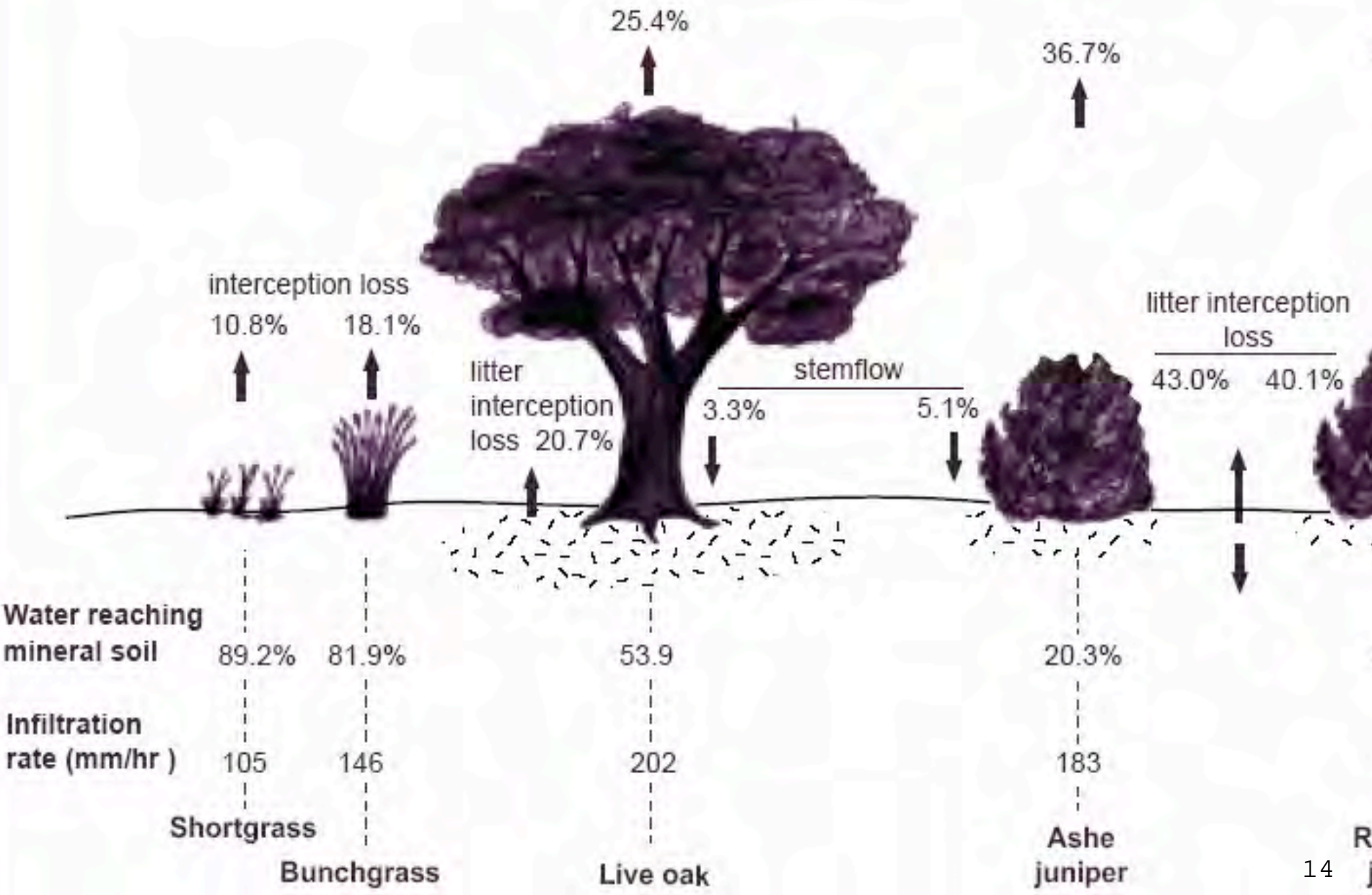
PROBLEM: “Evapotranspiration”

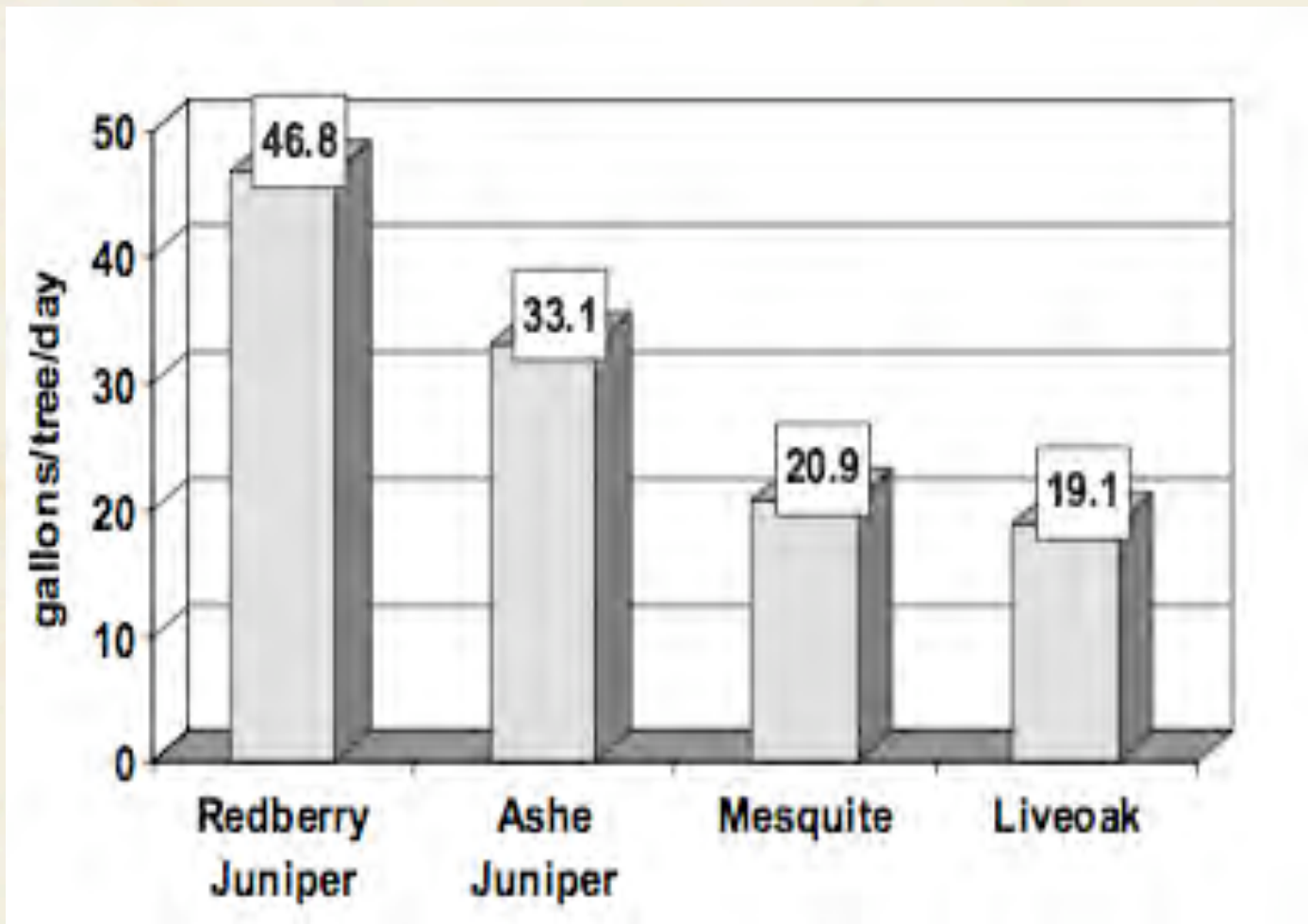


Ashe juniper (*Juniperus ashei*)



canopy interception loss





Models, BMPs & River Flows



USGS
science for a changing world

National Water Information System: Web Interface

USGS Water Resources

[News](#) - updated July 2012

USGS 08149900 S Llano Rv at Flat Rock Ln at Junction, TX
PROVISIONAL DATA SUBJECT TO REVISION

Available data for this site Time-series: Current/Historical Observations **GO**

This station managed by the San Angelo Field Unit.

Available Parameters	Available Period	Output format	Days (2)
<input type="checkbox"/> All 1 Available Parameters for this site		<input checked="" type="radio"/> Graph	
<input checked="" type="checkbox"/> 00065 Gage height	2012-05-16 2012-08-13	<input type="radio"/> Graph w/ stats	-- or --
		<input type="radio"/> Graph w/o stats	Begin date
		<input type="radio"/> Table	2012-05-16
		<input type="radio"/> Tab-separated	End date
			2012-05-18

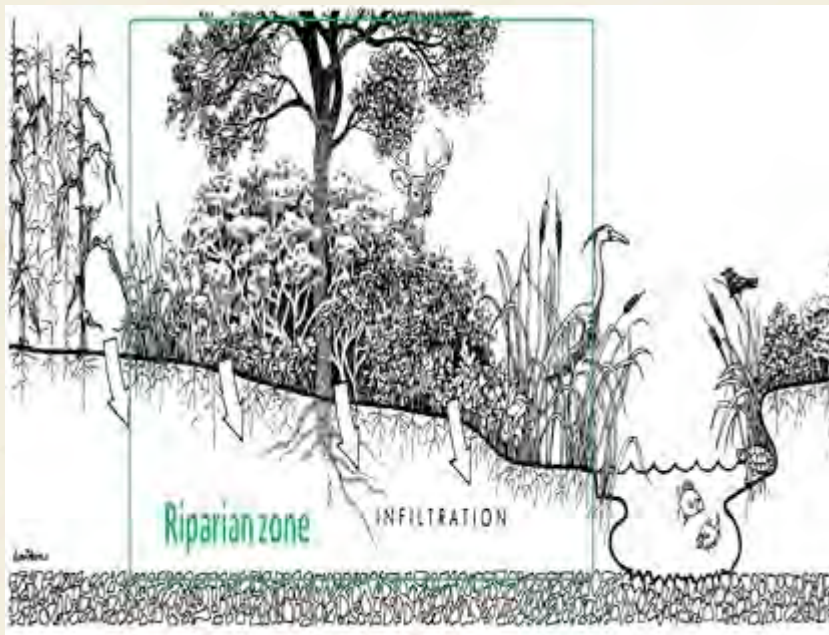
[Summary of all available data for this site](#)
[Instantaneous-data availability statement](#)



Advantages of Watershed Restoration and Brush Control

- Conserves water lost to evapotranspiration
- Recharges and slows groundwater depletion
- Enhances spring and/or stream flows
- Enhances/restores native rangeland with native grasses & other beneficial land cover
- Positive land/water/ecosystem benefits
- Landowner approved brush sculpting improves grazing, wildlife, hunting and recreation income
- Increased land value

Riparian Zone & Ecosystem Services



- sediment pollutant filtering
- bank stabilization
- water storage and release
- aquifer recharge
- habitat: wildlife, waterfowl
- flood control



Project Tasks: Plant Invasives on the Llano River

- Distribution and Map
- Management Plan
- Education & Outreach



Lower Rio Grande Conditions

- **Low flows**
 - recent drought
 - increased agricultural and municipal use
- **Weed infestation**
- **Cessation of flow in summer 2001**



Arundo donax along the Rio Grande

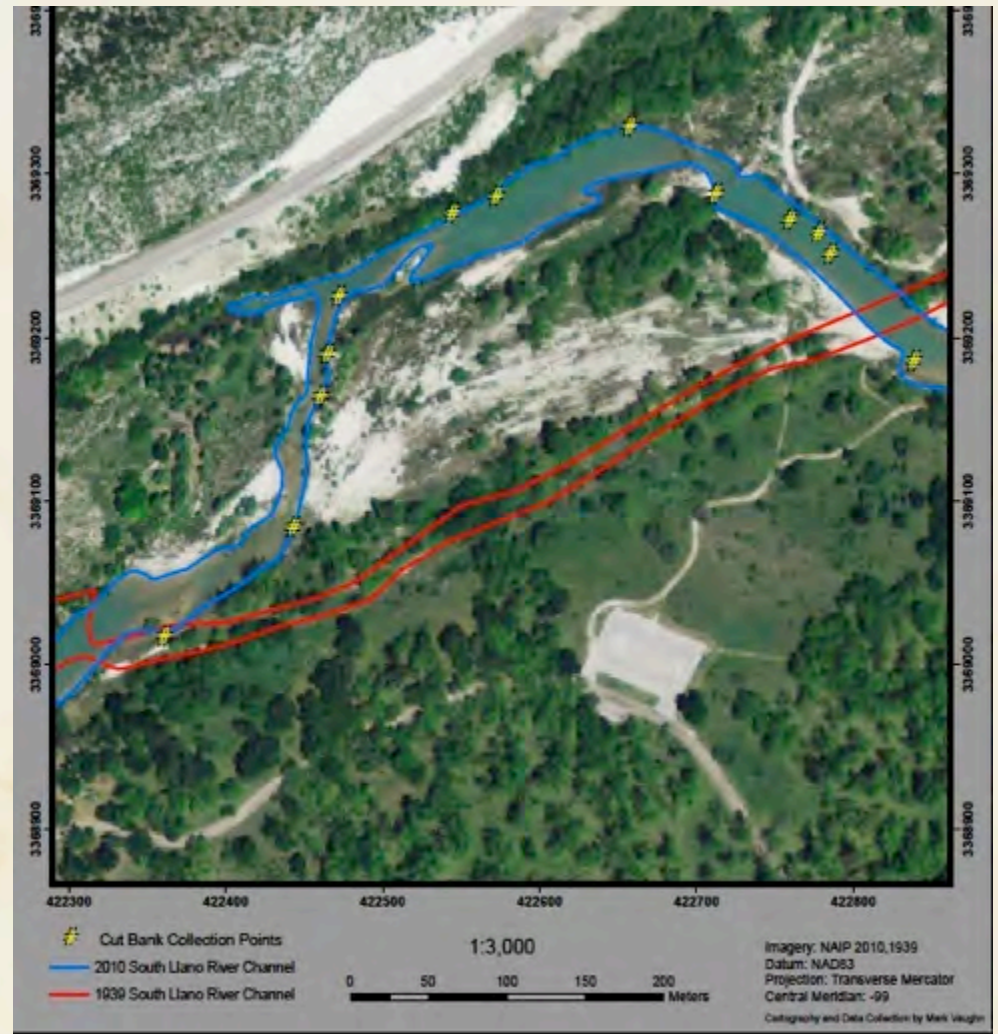


Issues: Cut Banks & Erosion



Project Tasks: Erosion and Cut Banks on the Llano River

- Distribution and Map
- Best Practices Plan
- Education & Outreach





Riparian Management



*Funding (\$20,000): Hal & Charlie Peterson Foundation, Partner's for Fish & Wildlife
Additional Partners: NRCS, Schreiner University Internship Program*



Upper Llano WPP: N&S rivers

- **K-12 TEKS based water and watershed curriculum**
- **TWDB –**
 - Water Cycles
 - Watersheds
 - Water Use
 - Surface Water and Groundwater
 - Water Treatment
 - Water Conservation

LRFS Outdoor School: STEM Learning in Nature



Llano River Field Station

OUTDOOR SCHOOL

- THSP EXEMPLAR 2007-2010
- HB 1700. 1 OS X 130+ TPW X 1000+ ISDs = + STEM Reform
- OBFS HUMAN DIVERSITY AWARD
- International/National Symposia

The screenshot shows the Texas High School Project website. The main header features the logo and a photo of a student. Below the header, there are navigation links and a list of initiatives. The main content area is titled 'Exemplar: Texas Tech University Outdoor School' and includes a 'Mission & Philosophy' section with a photo of students in a field. A 'Demographics' section lists statistics for the program, and a 'Resources' section provides a link to the program website.

OUR INITIATIVES

- Early College
- High School Redesign
- Educational Leadership
- New / Charter Schools
- T-STEM

Home | Initiatives | Grantees | Voices | News | Partners | About Us | THSP Webinar Series

THSP » Initiatives » T-STEM » T-STEM Network » Texas Tech University Outdoor School

Exemplar: Texas Tech University Outdoor School

Mission & Philosophy | **Challenge & History** | **Strategy** | **Outcomes** | **Lessons Learned**

Mission: The mission of the Texas Tech University Outdoor School is to inspire students and teachers to develop passion and a sense of ownership and identity towards nature and the watershed in which they live, while building better classroom environments and generating higher TAKS scores. The Outdoor School program was designed to provide unique opportunities to use the environment as an integrating context for interdisciplinary, collaborative, student-centered, hands-on and engaged learning, with a focus on the sciences and mathematics.

The TTU OS program is consistent with and a component of the goals of the Texas Tech University strategic plan to: provide programs and services that disseminate knowledge and skill and that build strategic partnerships and alliances with external entities; create high-quality field-based science education programs for regional school districts; sustain professional development training for K-12 teachers from the region and increase the enrollment and diversity of students entering college in STEM content areas.

Philosophy on teaching and learning: Several studies indicate that if a child has not had a positive experience in nature and the outdoors by age 8 or 9, they will have little interest in the environment in later life. Early experiences are often through family or school activities. In the case of school activities, field experiences are most meaningful if they are part of, or linked to, a student's science curriculum rather than an isolated "field trip". In this manner the field experience can be integrated with classroom activities. Successful linkage, however, often requires that teachers also have had previous exposure to field experiences, which often is not the case.

Students receive a backpack loaded with testing instruments.

Field experiences can also have a positive influence on heightening students' interest in science and serve as an entry point to considering a career in science. Many researchers in the field biological sciences point to early field exposure as being the life-changing experience, which led to their continued interest in science. The TTU Outdoor School motto is, "Inspiring students to develop passion and a sense of ownership and identity towards nature and the watershed of which they live, while building better classroom environments and generating higher TAKS scores". Very little time is occupied in a lecture mode of instruction. Instead, the program immerses learners in authentic real world, hands-on activities that stimulate imagination, develop a curiosity about life and create an environment to share discoveries.

Demographics:

- Grades Served: K - 12
- Total Students: 6,146 from 2004 to spring 2007
- Caucasian: 51%
- African American: 5%
- Hispanic: 43%
- Other: 1%
- Qualifying for federal free/reduced lunch: 50%

Resources

TTU OS Program Website

- Ecology education and outreach programs at North American Field Stations: Natural resource islands to improve ecological literacy and outdoor learning experiences for a K-Grade urbanized society. Symposium organized by the TTU Llano River Field Station was competitively selected by the Program Committee for inclusion at the international 2008 annual meeting of the Ecological Society of America.
- Environmental Education and Outreach programs at Texas Field Stations, Informal Science Centers, State Agencies and Conservation Organizations: Science Islands to Improve Natural Resource Literacy and Outdoor Learning Experiences for a K-20+ Urbanized Society. Symposium organized by the TTU Llano River Field Station for the 2009 annual meeting of the Texas Academy of Science in Junction.





Challenges for the South Central Region

- Ecosystem restoration
- Fish and wildlife response to climate change
- Invasive species and fires
- Protection of trust species
- Wildlife diseases
- Protection of cultural resources
- Climate impacts on agriculture
- Renewable resources - water

Wildlife, Drought & Flood

Texas drought grinding away at wildlife populations

Mike Leggett, Commentary



Dee Cooney / ILLUSTRATION © RONALD

ENLARGE PHOTO

This fawn was rescued from wildlife conditions in Garzes County recently. Otters are seeing a greater number of deer, especially fawns, suffering from the effects of the state's drought.

MIKE LEGGETT »



► Texas drought grinding away at wildlife populations

Published: 8:43 p.m. Saturday, July 2, 2011

Post a Comment | Email | Print | Share | Larger Type

An epic Texas drought that's leaving ponds dry and cracked and forcing cattle owners to market thousands of animals they can't feed is grinding away at increasingly fragile wildlife populations.

Songbirds, denied the seeds and grains and insects that sustain them, are forced to rely on food provided by people. Rabbits, squirrels and other small mammals can't feed spring young, and that's having an ultimate effect on populations of predators such as foxes, bobcats and coyotes.

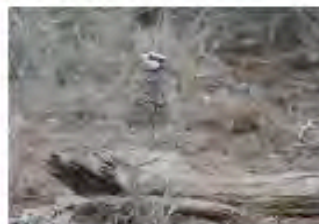
White-tailed deer, Texas' signature animal, are hurting too, just when spring fawns are at their most vulnerable. Does instinctively know that the fawns are a drag on their bodies, and they will abandon their young to keep themselves alive.

"The fawns are not doing real good right now," says Dale Schmidt, a Texas Parks and Wildlife biologist in Laredo. "I'm getting quite a few calls on fawns down, and it's probably not over yet." People are finding fawns either abandoned by their mothers or just struggling to survive on very sparse habitat, and they're calling biologists hoping to get some help.

Tompkins: Drought puts wildlife in precarious position

Lack of rain reduces animals' ground cover, food across state

By SHANNON TOMPKINS
Copyright 2011 Houston Chronicle
May 27, 2011, 3:28PM



Shannon Tompkins / Chronicle
Drought conditions across Texas have meant tough times for cottontail, quail, turkey and other ground-dwelling birds dependent on healthy grasses and other ground cover.

A wobbly-legged white-tail fawn tottered along the edge of a barren field, alone.

The day-old deer was the first of two I spotted while driving Highway 71 between La Grange and Columbus in the middle of an afternoon this past week.

Many people would have been thrilled to spot the delicate, adorable, newly named fawns.

I wasn't. Seeing them was disheartening because of what it said about the challenges Texas wildlife face from the brutal drought that has withered the state over the last eight months or so.

White-tail in most of Texas deliver their fawns in May and June, with those in South Texas dropping their newborns in July.

This year, because of pitiful range conditions in much of the state through late winter and spring, fewer fawns than normal will hit the ground. The worst of these fawns are entering holds much

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The Perch

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Arts/Letters
Audubon News
Background/Reader

How Will the Mississippi River Flooding Affect Birds, Bears, and Other Wildlife?

Categories: Animals, Birds, Nature, Wildlife

By Aileen Opar

05/19/2011



Wildlife, nature tourism, agri-tourism all feeling effects of Texas' worrisome weather

2 years ago | 776 views | 0 | 8 | 0 | 0

COLLEGE STATION – Drought, hurricanes, storms, floods and other weather woes this year have affected much of the state's nature and agriculture-based tourism businesses, according to experts.

"The weather's effect on wildlife and nature sites has led to a reduction in wildlife viewing, hunting and other outdoor recreation and activities in many parts of the state," said Miles Phillips, Texas AgriLife Extension Service nature tourism specialist in College Station.



South Llano Watershed Alliance

[Home](#)[About](#)[Calendar](#)[Get Involved](#)[Issues](#)[Links](#)[News](#)[Resources](#)[About the Watershed](#)

Home

The **South Llano Watershed Alliance** is an organization of landowners and interested stakeholders whose mission is to preserve and enhance the South Llano River *and adjoining watersheds* by encouraging land and water stewardship through collaboration, education, and community participation



Quick Links

- Join the Alliance's [email list](#)

- [Contact us](#)

WEATHER AND CLIMATE

- [Junction Weather forecast](#)

- [LCRA Hydromet: Temperature, Rainfall, Streamflow](#)

- [How Dry is it?...latest drought map](#)

- [Central Texas 180 - Day Rainfall Deficit](#)

- [Long Range Outlook](#)

HYDROLOGICAL INFORMATION

- [Llano River at Junction](#)

- [Llano River at Llano](#)

Drought and Oasis Fire Landowner Workshop

OASIS PIPELINE WILDFIRE RECOVERY & RECLAMATION WORKSHOP



WILDFIRE OVERVIEW



EROSION PROTECTION



Where do we go from here?

REDUCE EROSION
JUMPSTART THE HEALING OF YOUR LAND

NOV. 12, 2011
TTU JUNCTION CAMPUS

Landowners affected by recent wildfires will gain knowledge and resources towards reducing the devastating long-term impacts to their land.



South Llano Watershed Alliance



TEXAS PARKS & WILDLIFE



LLANO RIVER FIELD STATION



Upper Llano Soil & Water Conservation District



NRCS
Natural Resources Conservation Service



NATIVE AMERICAN SEED



Drought and Oasis Fire Demonstration Workshop







They think environmental education is important,

95% of Americans and 96% of parents think environmental education should be taught in schools,



They think they know a lot but they don't...

70% of Americans rate themselves as fairly knowledgeable about environmental issues,

.....

.....but only ~10% receive a passing grade on a multiple choice quiz of basic knowledge.



LANDOWNER WORKSHOPS: Llano River Field Station. TTU-Junction.

- Riparian Essentials in Practice Workshop. March 12 – 14, 2010. Texas Riparian Association. 45 registrants.
- Edwards Plateau Ecoregion Workshop. April 19-20, 2010. Multiagency Stakeholder Meeting to develop Texas Conservation Action Plan. 35 registrants.
- Texas Watershed Steward Workshop. April 29, 2010. 40 registrants.
- Riparian Workshop. May 3, 2010. Sponsored by South Llano Watershed Alliance, Nueces River Authority and Llano River Field Station. 35 registrants.
- Hill Country Land Stewardship Workshop: Plans and Practices for Maximizing the Value and Resources of Your Land. 2009. Organized by WEPTMN, TTU Llano River Field Station, and Texas AgriLife Extension Service. 95 registrants.
- Conservation Across Boundaries Texas Workshop, July 23-31 Teacher Natural Resource Education Workshop. 22 teachers.
- Rainwater Harvesting Workshop, August 16-20 Texas AgriLife Extension Education.

Guadalupe Bass Restoration Initiative: Conserving our State Fish and Its Habitat in Streams of the Edwards Plateau

Tim Birdsong, Chief
Habitat Conservation Branch
TPWD Inland Fisheries Division



Coordinated Watershed Conservation

- Development of a Watershed Conservation Plan for the Upper Llano River
- Expansion of existing landowner cooperative
- Riparian and upland habitat protection and restoration
- Instream habitat restoration





Watershed Management Planning

Keys to Successful Plans

- Involvement of a diversity of interests
- Collaborative decision-making (joint goals and priorities for partnership initiatives)
- Decision-making based on sound science and accurate information
- Strong communication and outreach
- Short-term doable action items and long-term objectives/goals



Major Tasks

- Identify watershed/water resource issues
- Gather data/information & identify gaps
- Set Goals and Objectives
- Identify BMPs that could be implemented to address issues
- Identify Outreach and Education that is needed
- Develop an Implementation Plan & Schedule



Roles of Stakeholder Group and Work Groups

- Responsible for coming up with recommended implementation strategies to include in the Watershed Protection Plan
- Stakeholder Group/Steering Committee – Focus on developing management measures for entire Plan
- Work Groups – focus on work group specific issues
 - Ex. Natural Resources group focuses on solutions to agriculture, habitat, and wildlife related *E. coli* loading
- Work with LRFS, TWRI to draft ideas into Plan

IDENTIFIED RESOURCE ISSUES IN NORTH AND SOUTH LLANO WATERSHEDS

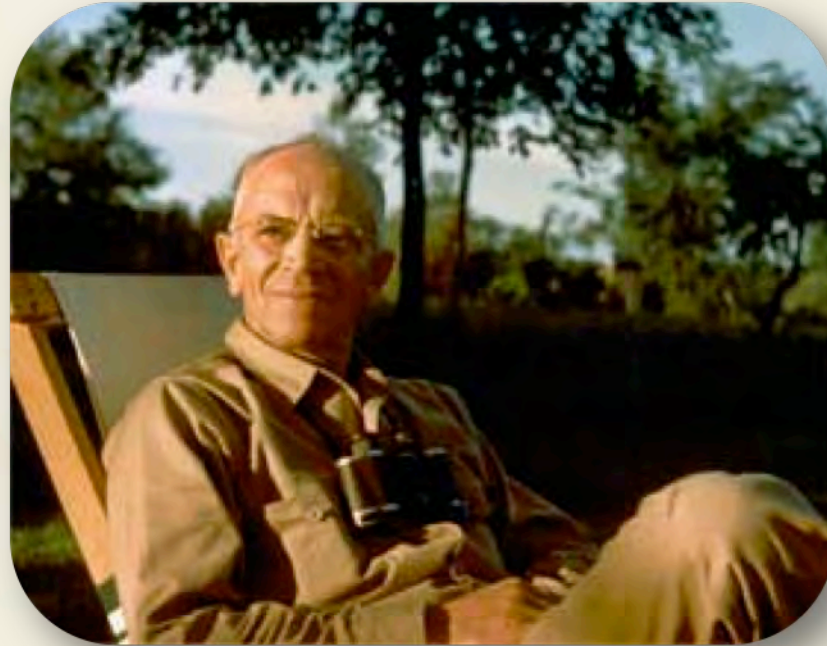
**South Llano Watershed Alliance
North and South Llano River
Watershed Conservation Plan
July 19, 2012**



- WATER RESOURCES
 - *Determining Water Availability: Ground water/Surface*
 - *Water Quality*
- LAND RESOURCES
 - *Riparian Habitat*
 - *Fragmentation*
 - *Land Stewardship*
 - *Wildfire and Drought*

Land Ethic: Aldo Leopold

- 1887-1948
- Ecologist,
Forester, Writer
- A Sand County
Almanac*



“That land is a community is the basic concept of ecology, but that land is to be loved and respected is an extension of ethics.”

“We can be ethical only in relation to something we can see, feel, understand, love, or otherwise have faith in.”



This is YOUR Plan!!!

**This is YOUR
Plan!!!**

We're Here to Help

