Lone Star Healthy Streams

AgriLIFE EXTENSION
Texas A&M System
Clean Water Act (1972 & 1977)

- Clean Water Act (CWA) is the foundation for surface water quality protection in U.S.
- Act is to restore and maintain chemical, physical, and biological characteristics of the nation’s waters.
- Requires states to set standards for surface water quality and regulate wastewater discharge.
- EPA has “delegated” responsibility for the CWA to the TSSWCB & TCEQ.
Clean Water Act

The CWA has five main elements:

(1) A system of minimum national effluent standards for each industry;
(2) Water quality standards;
(3) A discharge permit program that translates these standards into enforceable limits;
(4) Provisions for special problems such as toxic chemicals and oil spills; and
(5) A revolving construction loan program (formerly a grant program) for publicly-owned treatment works.
Responsible State Agencies

• Texas State Soil & Water Conservation Board
  – Charged with agricultural *nonpoint source* pollution oversight
  – *Nonpoint source* pollution originates from multiple locations, carried primarily by rainfall runoff.

• Texas Commission on Environmental Quality
  – Charged with *point source* pollution and urban and other *nonpoint source* oversight
  – Pollution from *point sources* can be traced to a specific location and point of discharge.
Impaired Watersheds

An impaired or threatened waterbody is any waterbody that is listed according to section 303(d) of the Clean Water Act. A waterbody is considered impaired if it does not attain water quality standards. Standards may be violated due to an individual pollutant, multiple pollutants, thermal pollution, or an unknown cause of impairment. A waterbody is considered threatened if it currently attains water quality standards but is predicted to violate standards by the time the next 303(d) list is submitted to EPA. The 303(d) list is a comprehensive public accounting of all impaired or threatened waterbodies, regardless of the cause or source of the impairment or threat.
Texas Water Quality Standards

Standards define the goals for a body of water. The uses prescribe the purposes for which the water should be suitable. Five general categories of use are defined under the Texas Surface Water Quality Standards:

- Aquatic life
- Contact recreation
- Public water supply
- Fish consumption
- General uses
303(d) List:
List of Impaired Water Bodies

Once a watershed is on the 303(d) list, states are required to develop management plans establishing Total Maximum Daily Loads (TMDL) for the pollutant impairing the use of the water.
WATER QUALITY IMPAIRMENTS IN TEXAS
Texas Water Bodies on the 303(d) List for 2008

- Number of Bodies of Water: 386
- Stream/River Miles: 7,240
- Reservoir/Lake Acres: 550,792
- Estuary Square Miles: 664
- Ocean Coast Miles: 388
Best Management Practices to Protect Water Quality
Maintain Adequate Ground Cover

Soil and Water Loss
Raindrop falling on bare soil can detach soil particles to be lost in runoff.
Raindrop Impact…

- Releases tremendous energy on bare soil.
- Dislodges soil particles resulting in sediment production.
  - Soil loss and water loss from site.
- Causes sealing of larger pores reducing infiltration rates (crusting).
  - Increases overland water flow.
  - Water loss from site.
Forces of Erosion

Splash

Runoff

Wind

Result

Unprotected

Protected

Sandy, rocky, stony soil

Dead leaves on surface

Good soil management

From Nebel 1981
Water Erosion Occurs As:

- Sheet (interrill) erosion
- Rill erosion
- Gully erosion
- Streambank erosion

Gully erosion is often created by vegetative material.
Wind Erosion

- In certain areas, effects can be worse than water erosion (i.e., US Great Plains).
- Factors affecting wind erosion are similar to those listed for water erosion (+ wind velocity).
- Lack of vegetative cover is the leading cause of soil loss.
Grazing Effects on Soil Erosion

• Indirectly by consumption of plant parts
  – Overstocking reduces vegetative cover.
    • Exposes bare soil
    • Increases runoff quantity and energy
  – Overstocking leads to overgrazing (i.e., change in plant species)
    • Generally increases runoff
    • Reduces carrying capacity

• Directly by hoof action (soil compaction)
From Taylor et al., 1993.
Gully erosion created by a cattle trail.
With changes in management, some eroded areas can heal over time.
Maintain Adequate Ground Cover

Nutrients, Pesticides and Bacteria
Managing Nutrients

• Fertilize based on soil test recommendation.
  – Reduces potential for over-application of nutrients.
• Always follow label directions when using pesticides.
• Using the appropriate stocking rate and grazing system maintains adequate ground cover.
  – Traps nutrients, pesticide, and bacteria in forage.
  – Vigorous forage system reduces need for herbicides.
• Provide grass filter strips along riparian areas.
  – Excess fertilizers and pesticides may prove toxic to aquatic animals and lead to destructive algae blooms.
• Manage cattle so they do not contribute to erosion of stream banks.
Vegetative Filter Strips Along Riparian Areas

- **PURPOSE:** Vegetative filter strips remove sediment and other pollutants from runoff before they are carried into streams.
- Vegetative filter strips also aid with reducing the flow rate of runoff and allow runoff to infiltrate into the soil to recharge the groundwater supply.
- Vegetative filter strips act as a barrier and slows fast-moving water laden with sediment.
- As water runs through the vegetative filter strip, the sediment settles and is trapped in the strip.
- **NOTE:** Well-managed pastures act as large vegetative filter strips.
How a riparian buffer strip functions to protect the stream from contaminants. Illustration Carolyn Brooks.
Note denuded stream banks, sand depositions in creek, and algal bloom.

Note the effectiveness of a vegetative filter strip in trapping sediment that would have wound up in the creek or reservoir. Nutrients, pesticides and bacteria were also trapped.
Filter Strip Specifications

Minimum width for vegetative filter strips.


<table>
<thead>
<tr>
<th>Slope</th>
<th>Minimum width of buffer strip</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-3%</td>
<td>25 ft</td>
</tr>
<tr>
<td>4-7%</td>
<td>35 ft</td>
</tr>
<tr>
<td>8-10%</td>
<td>50 ft</td>
</tr>
</tbody>
</table>
Maintain Adequate Ground Cover

Forage Persistence and Animal Performance
Stocking Rate Fundamentals
Factors Influencing Stocking Rate:

• Forage Species
• Fertility
• Improved Animal Distribution
• Improved Harvest Efficiency
• Complementary Grazing Systems
Dry matter production of selected warm-season perennial grasses at Overton, TX. 1999

Dry Matter (lbs/ac)

Coastal | Tifton 85 | Pensacola | Tifton 9
Factors Influencing Stocking Rate:

- Forage Species
- Fertility
- Improved Animal Distribution
- Improved Harvest Efficiency
- Complementary Grazing Systems
Coastal bermudagrass response to different rates and sources of N

Rouquette and Keisling, 1981
Factors Influencing Stocking Rate:

- Forage Species
- Fertility
- Improved Animal Distribution
- Improved Harvest Efficiency
- Complementary Grazing Systems
Grazing Adjustments Required Due to Distance From Water

0 - 1 mile = 0 adjustment
1 - 2 miles = 50% adjustment
>2 miles = ungrazed
Problem: Poor animal distribution due to distance from water - Solution #1: Water & salt
Problem: Poor animal distribution due to distance from water - Solution #2: Cross-fencing
Problem: Lack of grazeable acres – Adjust stocking rate for only the acres cattle have access to.

Instead of 1000 acres, there may actually only be 350 acres suitable for cattle grazing.
Factors Influencing Stocking Rate:

- Forage Species
- Fertility
- Improved Animal Distribution
- Improved Harvest Efficiency
- Complementary Grazing Systems
Improved Harvest Efficiency = Grazing Management

- Continuous Stocking
  - Not necessarily a sin…
    - Consider variable continuous stocking

- Rotational Stocking
  - Several alternatives
  - Offers more flexibility in management
Factors Influencing Stocking Rate:

- Forage Species
- Fertility
- Improved Animal Distribution
- Improved Harvest Efficiency
- Complementary Grazing Systems
Complementary Grazing Systems

• Use different kinds of animals that have minimal diet overlap. (i.e., grass-roughage eaters + intermediate feeders or concentrate selectors)
  - Example = cattle + goats
  - Example = cattle + white-tailed deer
Long-term annual precipitation at Overton, TX. 1968 - 2001

* Incomplete data
Suggested Management Strategies

• USE THE PROPER STOCKING RATE!
• Use the appropriate grazing system.
• Use perennial forage crops when possible.
• For annual crops, consider conservation tillage.
• Watch cattle trails to prevent erosion.
• Consider using alternative water sources away from riparian zones.
Managing Bacteria

• *Escherichia coli* (*E. coli*) is the leading cause of food borne illness.
• 73,000 cases of infection and 61 deaths occur in the United States each year.
• Because the organism lives in the intestines of healthy cattle, preventive measures on cattle ranches, during meat processing, and during the growth, harvest and processing of produce are being investigated.
CWA Bacteria Concerns:

- **Sources**
  - Urban, livestock, wildlife

- **Prior recommendations for livestock…**
  - Fence out the stream?

- **Lone Star Healthy Streams**
  - Funded by EPA and TSSWCB through 319 funds.
Lone Star Healthy Streams

The goal of Lone Star Health Streams is to reduce the levels of bacterial contamination of Texas watersheds from grazing livestock by:

• Developing an educational curriculum,
• Evaluating and demonstrating the effectiveness of best management practices,
• Testing the functionality of the education program and,
• Promoting statewide adoption of appropriate best management practices.
Understanding Animal Behavior is Key to Developing BMPs

- Where do animals water?
- Why do they water there?
- Where do they loaf?
- Why do they loaf there?
- How can we affect their behavior?
- Can we affect their behavior in an economically viable manner?
Initial Behavioral Aspect

• Livestock watering in the streams…
• Our hypothesis:
  – Alternative livestock watering sources will reduce bacteria levels in the stream.
• How to test whether or not alternative is effective?
Testing the Hypothesis

- Identify watershed
- Identify cooperator
- Begin stream water sampling to obtain benchmark bacteria data
- GPS collars on cattle
- Obtain benchmark data for one year
- Obtain second year data
- Compare the results
Initial Project

• Identify watershed
• Identify cooperator

Results to date

Plum Creek
On 303d list for bacteria
Initial Project

- Identify watershed
- Identify cooperator

Results to date

Bill & Doris Steubing
250 acres on Clear Fork of the Plum
Initial Project

- Identify watershed
- Identify cooperator
- Begin stream water sampling to obtain benchmark bacteria data

1. Turned off water to troughs, forcing cattle to water in the stream.
2. Began obtaining water samples entering and leaving property 1\textsuperscript{st} and 3\textsuperscript{rd} Thursday of each month.
Initial Project

- Identify watershed
- Identify cooperator
- Begin stream water sampling to obtain benchmark bacteria data

1. Randomly place GPS collars on 6-8 cows mid point of each “season”.
2. Leave collars on for three weeks. Data point on location collected every five minutes.
3. Used to document cattle movement patterns.
Initial Project

- Identify watershed
- Identify cooperator
- Begin stream water sampling to obtain benchmark bacteria data
- GPS collars on cattle
- Results to date
Figure 3. *E. coli* levels entering and leaving project grazing management unit.
Percent Time Cattle Spend Within Various Distances from Stream

<table>
<thead>
<tr>
<th>Buffer Width (ft)</th>
<th>July</th>
<th>October</th>
<th>Jan</th>
<th>April</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 feet</td>
<td>2%</td>
<td>4%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>35 feet</td>
<td>6%</td>
<td>8%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50 feet</td>
<td>10%</td>
<td>12%</td>
<td>4%</td>
<td>8%</td>
</tr>
</tbody>
</table>

Buffer Width (ft)
Alternative Water Source

- Encourages livestock to obtain water away from the stream.
- Cost?
- Easy to implement
Additional BMPs

• Portable Shade Structures
  – Behavioral Situation: Cattle spend time loafing in shaded riparian areas. This leads to increased levels of bacteria and sediment in water bodies.
  – Hypothesis: Establishment of portable shade structures will encourage cattle to spend less time in riparian areas, especially when used in conjunction with salt & mineral.
Portable Shade Structures

Side View

8'

12'

Top View

10'

12'
From Drawings to Product!
Portable Shade Structures

- Coupled with salt/mineral locations, may encourage cattle to cool themselves in the shade instead of along riparian areas.
- Moderate cost associated with building and maintaining.
- Easy to implement after construction.
Additional BMPs

• Single-Point Water Locations
  – Behavioral Situation: Cattle water in streams. This leads to increased levels of bacteria and sediment in water bodies.
  – Hypothesis: Establishment of single-point water locations will encourage cattle to spend less time in riparian areas.
Single-Point Water Locations

• Firm footing single-point water locations along streams designed for one animal encourages animals to spend less time in stream while watering.
• Moderate cost associated with building and installation.
• Easy to implement after construction.
Good ideas, but possibly too wide a watering point…

Source: NOBLE Foundation
Additional BMP

- Use of Rip-Rap as Barriers
  - Behavioral Situation: Cattle water in streams. This leads to increased levels of bacteria and sediment in water bodies.
  - Hypothesis: *Use of rip-rap will discourage cattle from using existing travel corridors in riparian areas and may be as effective as exclusionary fencing but at reduced cost.*
Use of Rip-Rap

- Cattle will not travel over large rocks.
- Use of large rocks modify cattle travel patterns.
- Reduced cost compared to fencing?
- Easy to implement after construction.
Exclusionary Fencing

• Current recommendation.
• Eliminates cattle access to streams.
• Permanent fences are expensive to construct & maintain.
• Not feasible to fence-off entire stream in many cases.
• Electric fencing may provide a lower-cost alternative.
Salt/Mineral Locations

- When used in conjunction with alternative water sources or shade encourages cattle to spend time away from streams.
- Inexpensive
- Easy to implement
Where Are We Headed?

• Identify additional “value added” BMPs
• Promote adoption of BMPs.
  – Develop educational materials for state-wide delivery based on BMP evaluations.
  – Be proactive rather than reactive
  – Cost share assistance?
• Reduce potential for regulatory action.
• Be good stewards of Texas water.
  – It’s our state…let’s take care of it!

• NOTE: Educational programs are designed to “inform”, not “alarm”.
Questions?

"A thing is right if it tends to preserve the stability, integrity, and beauty of the biotic community. It is wrong if it tends otherwise."
Aldo Leopold, 1966.