Improving Water Quality in Pond Creek :

Using GIS to Identify Non-Point Source Pollution and Develop a Remediation Strategy

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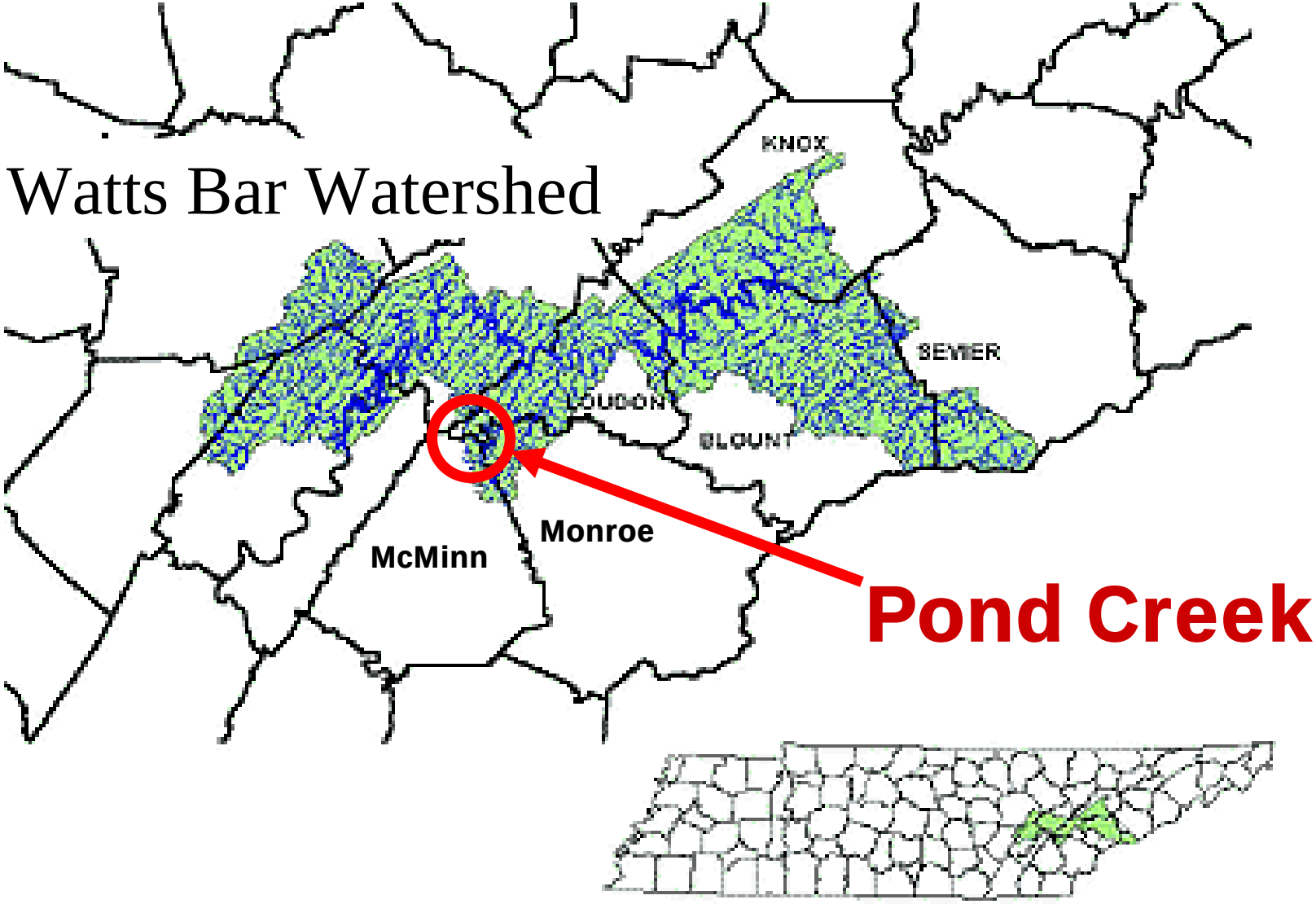
Pond Creek Watershed Project

- Research from 2001
- Extension from 2003
- Objectives
  - Clean-up the water using voluntary approaches
  - Identify and implement BMPs that farmers will implement
  - Develop model approach to Watershed Management in the “ridge and valley”

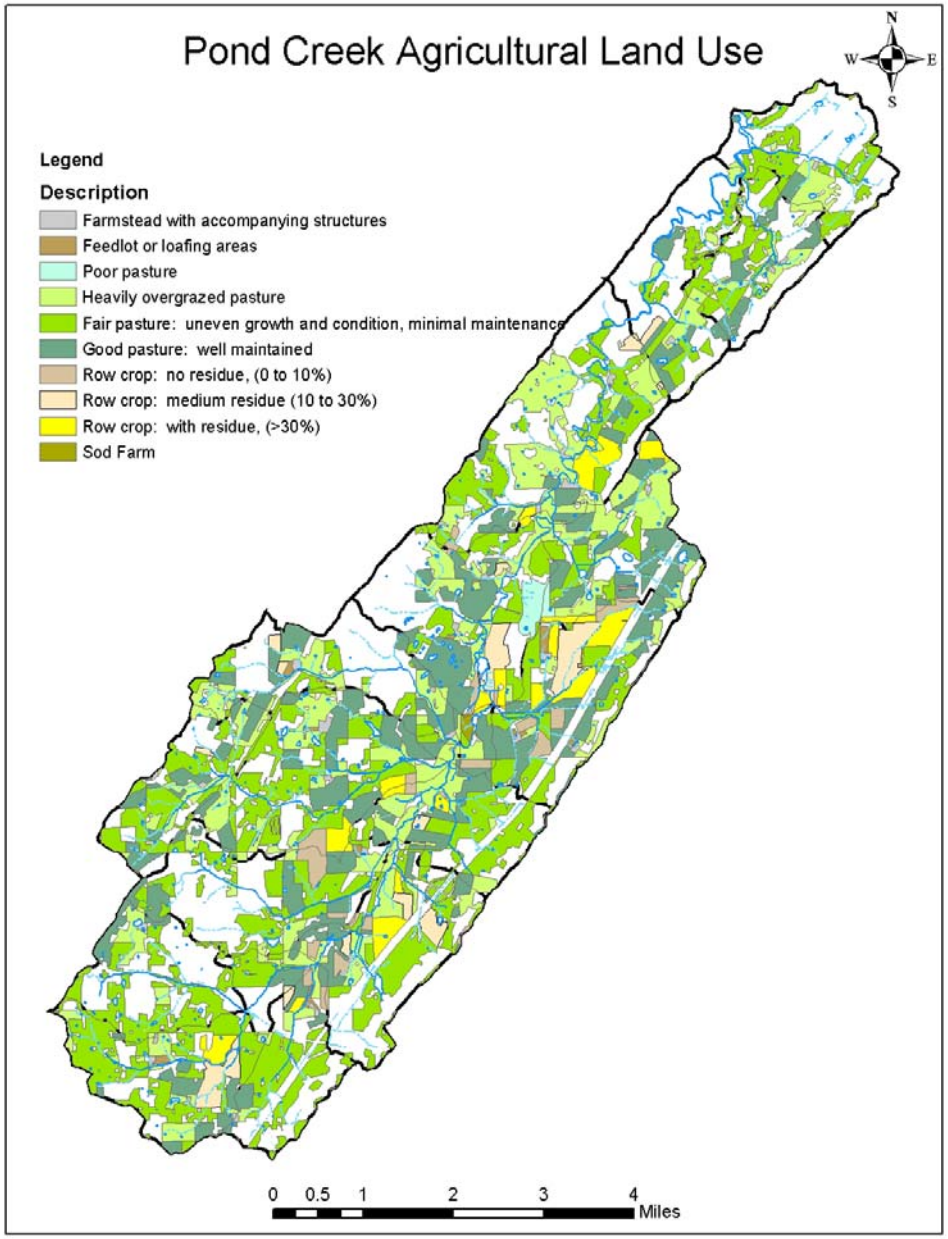
Watts Bar Watershed



www.state.tn.us/environment/wpc/wshed1.htm

Land Use

- Pasture based beef and dairy operations
  - Total 9,432 ha (23,579 acres)
  - Pasture = 55%; 5,152 ha (12,880 acres)
  - Row crops = 7%; 623 ha (1,558 acres)
  - Forest = 26%; 2,454 ha (6,135 acres)



Water Quality in Pond Creek

- June 2001 to June 2002 and August 2003 to present;
  - Monthly grab samples; 8 sites
  - In the field: pH, conductivity, water temperature, and dissolved oxygen
  - In the lab: nutrients, solids and pathogens
  - Compared with Eco-Region reference data
- Phosphorus (nitrogen & pathogens) were HIGH (most places in watershed on most dates)
- Phosphorus (and pathogens) influenced by rainfall: “flushing” effect

Water Quality in Pond Creek

35.6 miles of Mud Creek, Greasy Branch and Pond Creek listed on 2002 303 (d) list as impaired for:

- Pathogens
- Nutrients (P and N)
- Sediments

(E. coli and nitrates in 2004)

Primary cause “Pasture Grazing”

How much is coming from runoff, cattle in streams, bank erosion?

Steps to Improving Water Quality

1. Talk to the farmers!
2. Conduct land use inventory and estimate potential pollution
3. Develop implementation strategy and identify Best Management Practices (BMPs)
4. Monitor water quality improvements

Farmer Comments; 2002

- "Traditional" best management practices
  - Fencing
  - Alternative watering systems
  - Vegetative buffers
- Farmer opinions
  - Seasonal flooding
  - Expense of establishment
  - Expense of maintenance
- Bottom-line = Economics!

Funding the Project

- 2001 to present: 10 grants for $531,649
  - TDA, EPA, TVA, UT
  - Project Co-ordinator: Ms. Lena Beth Carmichael
  - BMP implementation
  - Monitoring
- UT Research Projects:
  - Tiffany Day
  - Melody Sasser
  - Stacy Clark
  - Tyaisha Blount
  - Michael Barrowclough

Land Use Assessment

- **I**ntegrated **P**ollutant **S**ource **I**dentification (IPSI) model; “simple” planning tool developed by Tennessee Valley Authority
  - **Step 1**: Take low altitude, infrared photographs of watershed (March 2002)
  - **Step 2**: Photo Interpretation (June 2003)
    - Assign land-use classes; urban, agriculture, forestland, barren land, disturbed areas and water
    - Agriculture; crop land or pasture
  - Step 3: Estimate loads (September 2003)
    - Run soil loss equation to estimate loads by land-use classes and sub-watershed

Agricultural Land Use

- **Crop Land**: based on residue cover
  - Row crop: no residue, (0 to 10%)
  - Row crop: with residue, (>30%)
  - Row crop: Medium residue (10 to 30%)
- **Pasture**
  - Good pasture: well maintained
  - Fair pasture: uneven growth and condition, minimal maintenance
  - Heavily overgrazed pasture
  - Poor pasture: sparse cover, shallow soils, steep slopes, often gullies

Fair

Good

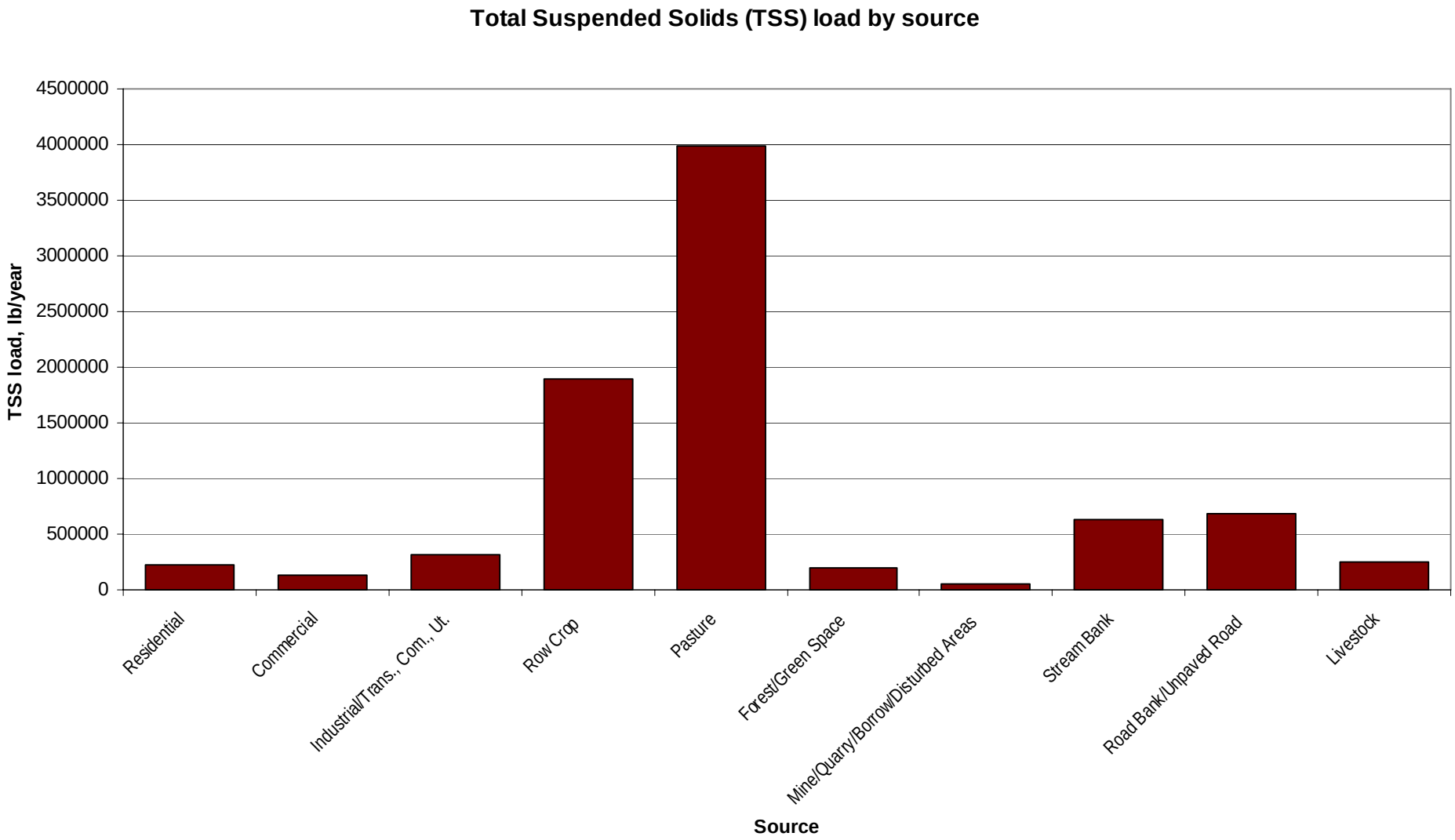
Low-residue

Over-grazed

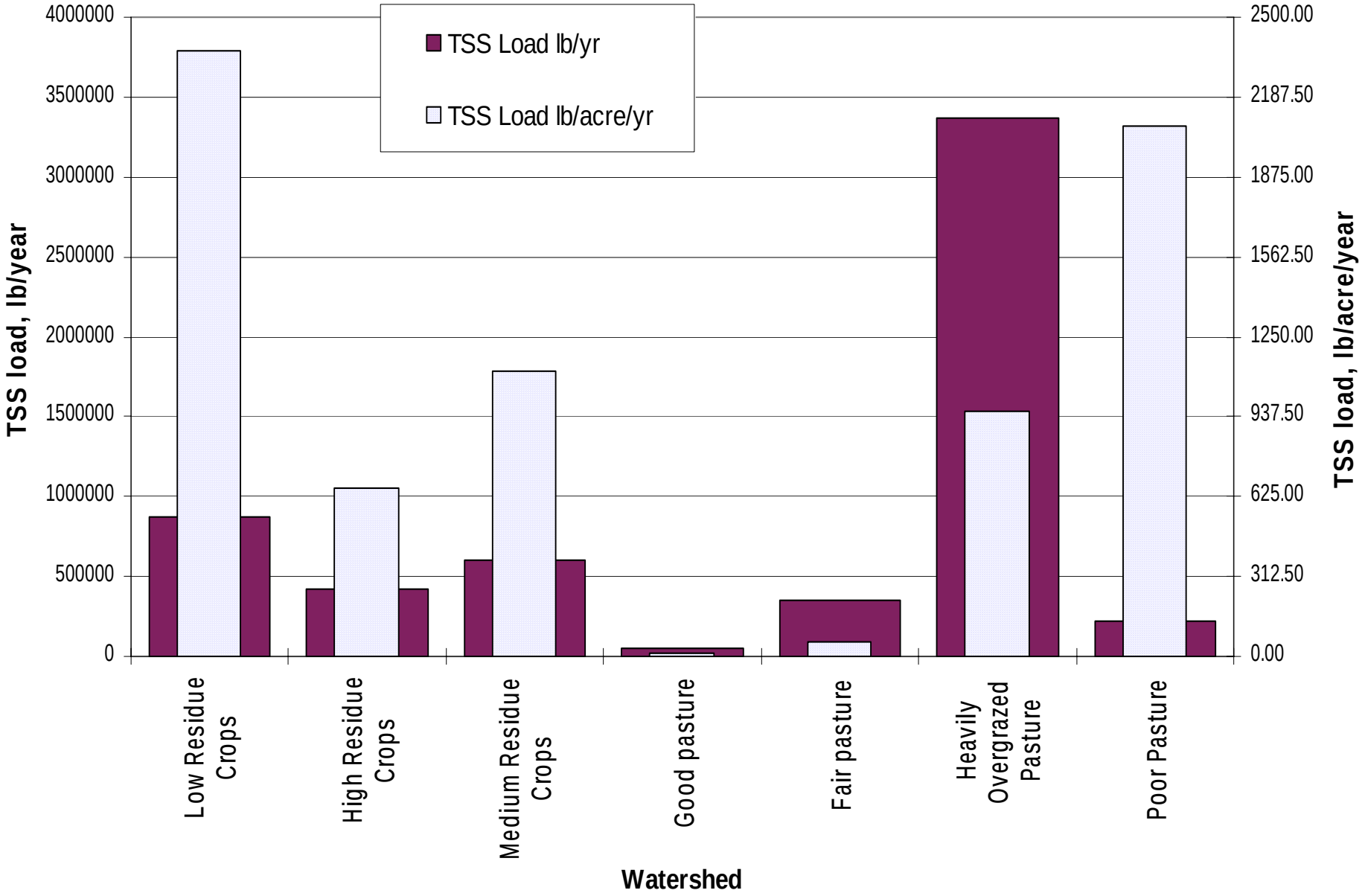
Erosion Estimates

- Use of Universal Soil Loss Equation (soil, climate, topography, land use)
- Soil Loss = A = R K L S C P
  - **R** (rainfall) and **P** (support practices) constant
  - **K** (soil), **L** (length of slope) and **S** (slope) varies by landscape position / elevation
  - **C** = varied land use (residue)
- Identify potential sources of erosion by sub-watershed

Suspended Solids: by source

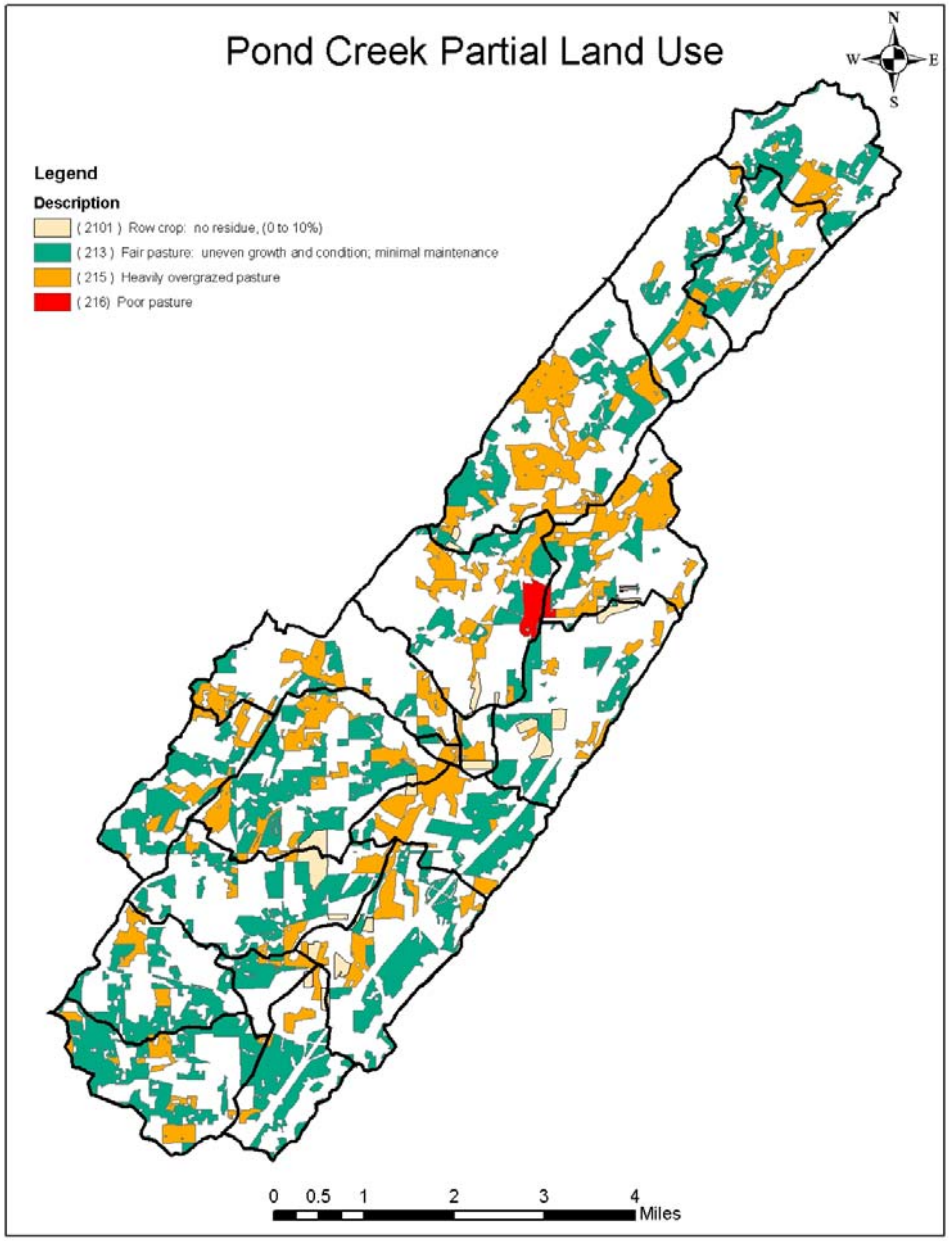


Total Suspended Solids (TSS) loading by Agricultural Classification



Suggested Target Areas

- Fair, poor and over-grazed pasture (40% all land use)
- Low residue row crops (1.6% all land use)



Improved Pastures for Better Water Quality

More Grass = More Beef and Milk
= More $$ (and less EROSION)

OR

- More erosion (P)
- Less nutrient uptake
- Poor physical barrier (pathogens, soil particles)

- Less soil erosion
- More nutrient uptake
- Better physical barrier (“vegetative buffer”)

Pasture Management

- Soil and forage testing
  - How many test their soils?
  - Interpretation of results
- Soil fertility management
  - Lime
  - NPK; not just 19-19-19
  - Manure and biosolids
- Weed control
- Species and variety selection

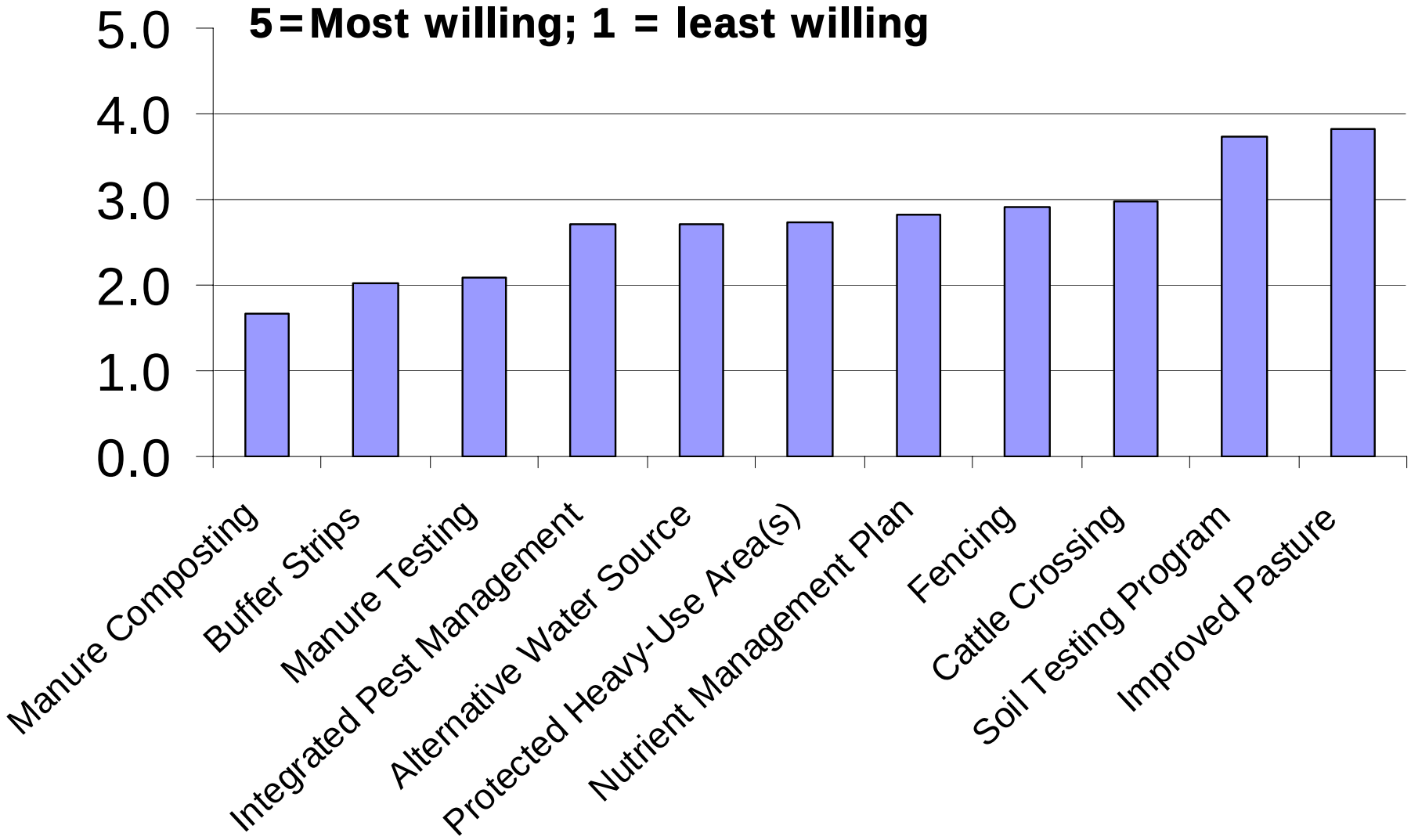
Farmer Survey: Jan / Feb 2004

- 28 producers interviews; average age = 51 years old (range 80 to 20 years)
  - Dairy cattle = 2,800
  - Beef cattle = 1,465
- Recent improvements:
  - Farm Equipment Upgrade/Repair = 29%
  - New Barn = 18%
  - Fencing = 18%
  - Buffer Strips, Improve Pasture = 0%

Farmer Survey

- Condition of pastures
  - Excellent = 4%
  - Good = 50%
  - Fair = 21%
  - Poor = 25%
- Soil sampling (pastures)
  - Every year = 30%
  - Every two years = 21%
  - Every three years = 21%

Willingness to Adopt BMPs to Improve Water Quality



BMP Implementation 2004 / 5

- **Jan. to April**: Soil tests, 42 fields / 4 farms (lower fertilizer / manure rates)
- **March to April**: Weed management: 200+ ha (improved pasture stands)
- **April and September**: Re-seeding of overgrazed pastures (reduce erosion)
- Work with other agencies on “engineered” BMPs (fencing, manure storage, watering systems)

2004

2004

2005

2005

On-Going Activities

- Continue water quality monitoring
- Work with farmers on pasture renovations, nutrient management plans, installation of “engineered” BMPs
- Refine IPSI modeling approach – BMPs, RUSLE, satellite imagery? Use SWAT and/or AgNPS?
- Source tracking: sediment
- Extension demos etc.
- Share results

Acknowledgements

- Tennessee Department of Agriculture
  - Non-point source program
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- Extension, NRCS, Tennessee Co-op