Getting More for Less:
the Economics of Watershed Protection and LID
What’s the Game Plan?

- Basic Elements
- Why Watershed Protection?
- What is Watershed Planning?
- Selecting BMPs to Improve Water Quality in a Reservoir
- Selecting BMPS for the Hickory Creek Watershed
- What are the tradeoffs?
What is watershed management?

Land Use Practices

Water Management Practices

Protect and Improve Water and Other Natural Resources
What is watershed management?

Source: maps.lcra.org
Benefits of a watershed approach?

- Identifies and quantifies sources of pollution
- Recognizes importance of both nonpoint source and point source pollutant loads
- Develops integrated strategy for managing water quality among multiple stakeholders
- Provides opportunities for the public to increase awareness of and provide input to watershed activities
Common pollutants resulting in waterbody impairments

- Pathogens
- Nutrients
- Metals
- Sediment
- Temperature
Potential Pollutant Sources

- Point source discharges
- Nonpoint sources
  - Agricultural runoff
  - Urban runoff
Common features of watershed plans

- Iterative and adaptive process

Common features of watershed plans

- Holistic, multi-disciplinary, multi-jurisdictional process
- Study area is geographically defined—typically involves multiple political subdivisions

Common features of watershed plans

Typical Planning Steps

- Identify stakeholders and develop partnerships
- Characterize watershed problems
- Define goals
- **Identify solutions**
- Develop implementation program
- Implement plan
- Measure progress and adjust

Why implement a watershed management plan?

- Water quality targets achieved
- Potential water treatment benefits
  - Improved treatability
  - Fewer taste and odor issues
  - Lower treatment costs
- Potential recreation benefits
  - Improved aesthetic appeal
  - Improved aquatic life/fisheries production
Selecting BMPs to Improve Water Quality in a Reservoir
Reservoir Chlorophyll-a Trend

Chl'a, ug/L

APR = 3.85%

21.5 ug/L

30.0 ug/L
TP Budget by year

WWTPs (point sources) contribute about 7% of the load.
Reservoir Model Applied to Assess Target Load Reduction for Phos.

- Option 1: 15% load reduction
  Result: no measurable decrease in chl-a.
- Option 2: 25% load reduction
  Result: no measurable decrease in chl-a.
- Option 3: 35% load reduction
  Result: measurable decrease in chl-a.

Wastewater TP comprises about 1/3 of the 35% load reduction target.
SWAT Model of Total Phosphorus (TP) load

34,000 acres in the watershed
Point Sources: 9 WWTPs Were Evaluated for Load Reduction

- 2050 flows with 3 sets of discharge limits for nutrients.

Level I: Existing permit conditions
Level II: TP limit of 1 mg/L
Total nitrogen (TN) limit of 10 mg/L
Level III: TP limit of 0.5 mg/L
TN limit of 5 mg/L
### WWTP loads, load reductions, and improvement costs (9-plants)

<table>
<thead>
<tr>
<th></th>
<th>Loads Associated with 2050 Flows (tons/yr)</th>
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<tbody>
<tr>
<td></td>
<td>Level 1</td>
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<tr>
<td>Total <strong>Nitrogen</strong> Load (tons/yr)</td>
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</tr>
<tr>
<td>Load Reduction (tons/yr) Level 1 to Level 2</td>
<td>322</td>
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<tr>
<td>Load Reduction (tons/yr) Level 2 to Level 3</td>
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<tr>
<td>Total <strong>Phosphorus</strong> Load (tons/yr)</td>
<td>60</td>
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<tr>
<td>Load Reduction (tons/yr) Level 1 to Level 2</td>
<td></td>
</tr>
<tr>
<td>Load Reduction (tons/yr) Level 2 to Level 3</td>
<td></td>
</tr>
<tr>
<td><strong>Total Costs</strong></td>
<td><strong>$18.6 MM</strong></td>
</tr>
</tbody>
</table>
Nonpoint Sources: Stakeholder Group Selected BMPs to Consider

- **Agricultural**
  - Cropland to Grass
  - Contour Farming
  - Nutrient Management
  - Filter Strip
  - Grassed Waterways
  - Terraces

- **Urban**
  - Riparian Buffer Strips -- critical areas
  - Riparian Buffer Strips – noncritical areas
  - Constructed Wetland
  - Voluntary Nutrient Mgmt.
  - Required Nutrient Mgmt.
  - 2,000-ft Buffer Strip

- **Point Sources**
  - Level I to II
  - Level I to III
Economic evaluation of 20 BMPs
Results of economic evaluation

- Optimal cost solution included the top 8 BMPs
  1. Filter strips
  2. Grade stabilization structures
  3. Terracing
  4. Contour farming
  5. WWTPs Level I to Level II
  6. Cropland to grass
  7. Prescribed grazing
  8. 2,000 ft. buffer around the reservoir

- Annualized cost projected at $2.23 million/yr or $13 million at year 0.

- Requiring WWTP Level II to Level III improvements increased the annualized cost to $3.05 million/yr.
TP Load with 8 BMPs

Filter Strips
Graded Stabilization Structures
Grassed Waterway
Terrace
WWTP
Conversion to Pasture
Prescribed Grazing
2000 Ft Buffer
Cost-related Observations

- Average cost is $382/acre up front or $66/acre/yr
- Implementing only urban BMPs will more than double the cost.
- Point Sources (WWTPs).
  - Level II requirements are in the baseline solution (1 mg/L TP and 10 mg/L).
  - Increasing requirements to Level III increases overall cost.
- Some BMPs are relatively inefficient in reducing TP load, based on cost.
Selecting BMPS for the Hickory Creek Watershed
Driving Concerns

- Sedimentation in the Hickory Creek arm of Lake Lewisville was a known issue.
- Sedimentation loads generally indicate similar increases in phosphorus (TP) load.
- The watershed contains significant cropland and pasture.
- The watershed is rapidly urbanizing.
- Land use change modifies load scenario and flow impacts.
Initial Modeling
Sources of Load Defined

- Identified 282 parcels of 80-120 acre size
- Best trade-off of fine resolution (BMP scale) and model accuracy
- Determine loads of each sub-watershed using existing model
Close-up View of Some Priority Watersheds
Categorized Controllable Loads Throughout the Watershed
Consideration of Master Planned Communities (MPCs)
Change in Land Use for MPCs

**MPC Existing and Future Land Use**

<table>
<thead>
<tr>
<th>Percent of Total</th>
<th>Existing</th>
<th>Future</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cole Ranch</strong></td>
<td>58%</td>
<td>79%</td>
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<tr>
<td><strong>Inspiration</strong></td>
<td>68%</td>
<td>80%</td>
</tr>
<tr>
<td><strong>Rayzor Ranch</strong></td>
<td>83%</td>
<td>83%</td>
</tr>
</tbody>
</table>

Legend:
- **Urban**
- **Forest**
- **Range**
- **Agriculture**

Change in land use for MPCs is shown with a focus on different land categories for existing and future states of Cole Ranch, Inspiration, and Rayzor Ranch.
Land Use Change in Cole Ranch (about 3300 acres)
BMP Options for Cole Ranch

Results are similar for all MPCs.
Observations from MPC Evaluation

- Opportunities may exist to significantly control post-development loads (e.g., 50%, 30%, 25% for TSS, TP, TN) for an investment of less than $150/ac.
- Sometimes—depending on relationship of pre- vs. post-development land use mix—it may be possible to reduce loads below pre-development levels.
- Some BMP-land use combinations are not cost-effective.
- Looking at the larger watershed — some agricultural areas may need pre-development BMPs.
- Pre-development BMPs may or may not be applicable to a post-development land use.
Additional Thoughts

- There are other tradeoffs with BMP implementation
  - Land costs must be considered, but impacts vary with LID approaches—lot size, street width, porous pavements, green roofs, on-lot catchments.
  - Have you considered the real value of other benefits of BMPs – aesthetics, ecosystem, air quality, stormwater peak flow reduction (reduces detention costs)?
- Which BMPs are of greatest interest to local agencies? Does this increase total BMP cost?
Questions?