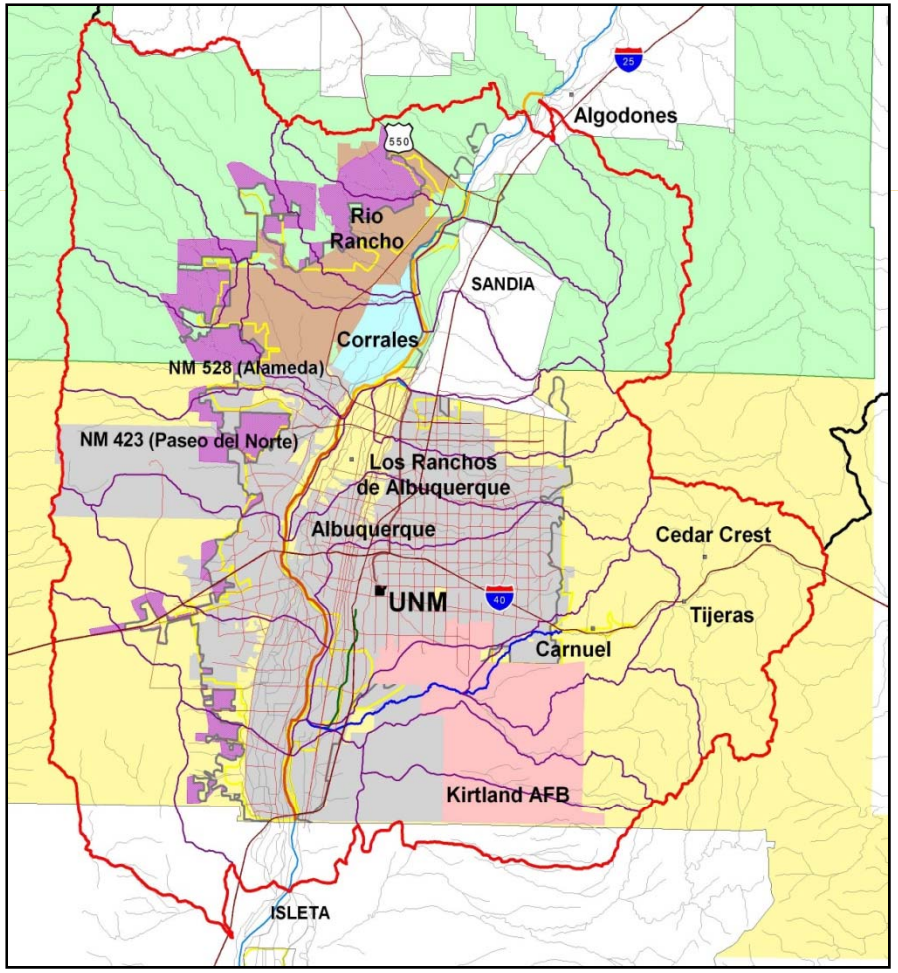
SUSTAIN Model Case Study

Middle Rio Grande



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What is SUSTAIN?

- ***SUSTAIN – S****ystem for* ***U****rban* ***S****tormwater* **T**reatment, and **A**nalysis **IN**tegration
- An ArcGIS-based framework designed to support decision-making
- Developed by Tetra Tech for EPA Office of Research and Development
- Objective: Identify strategies to meet water quality goals at minimum cost

http://www.epa.gov/nrmrl/wswrd/wq/models/sustain/

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SUSTAIN Basic Questions

- How effective are BMPs or green infrastructure (GI) in reducing runoff and pollutant loadings?
- What are the most cost-effective BMP solutions for meeting the water quantity and quality objectives?
  - Where should the BMPs be located?
  - What type of BMPs should be used?
  - How large should the BMPs be?

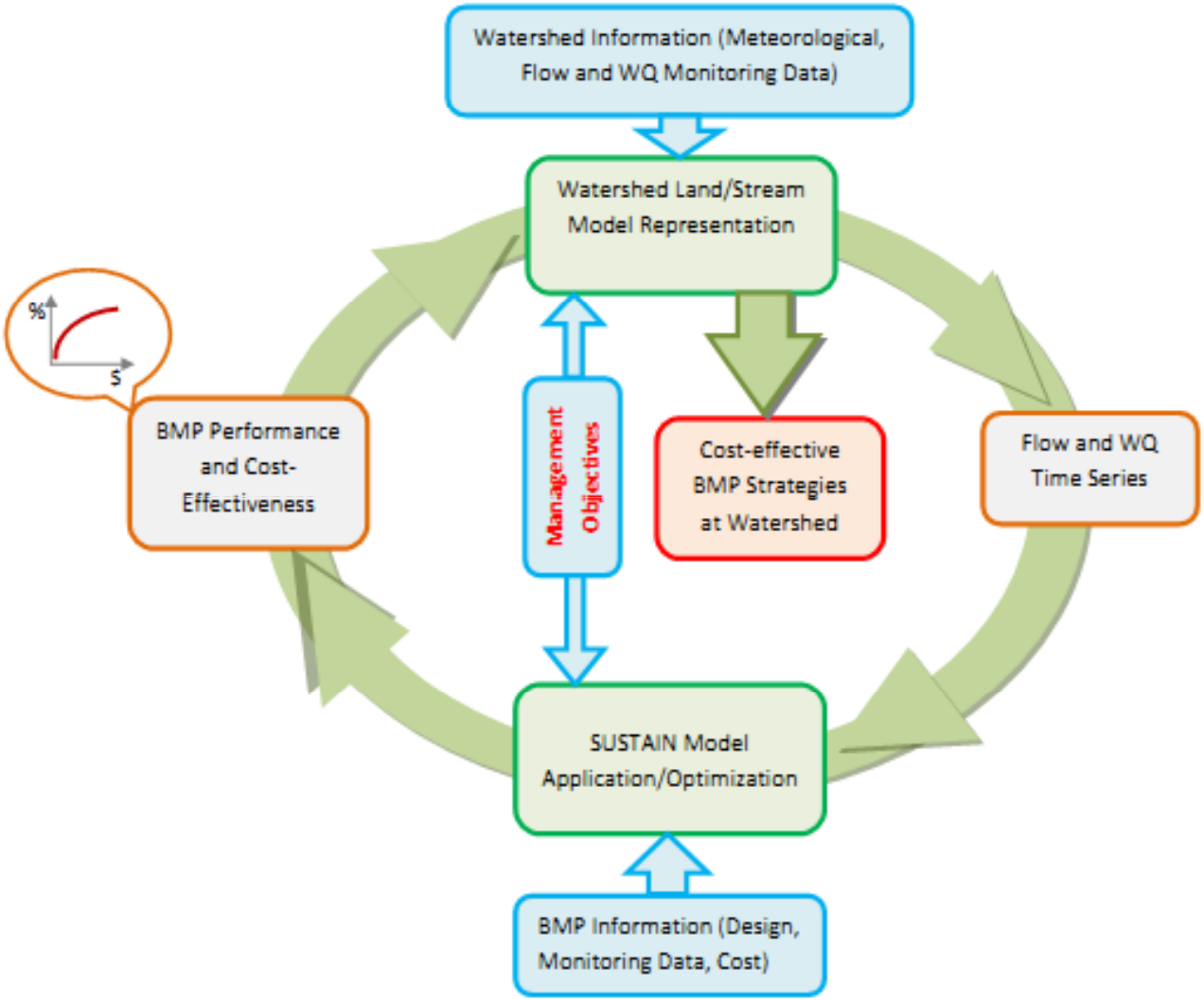
SUSTAIN Capabilities

- Watershed modeling
- BMP process simulation
- BMP cost-benefit optimization
- Green infrastructure placement, performance, and cost for meeting flow and/or water quality targets

SUSTAIN Modules

- **Framework Manager**: Manages the data exchanges (ArcGIS)
  - **BMP Siting Tool**: Supports users in selecting suitable locations for common structural BMPs
  - **Watershed/Land Module**: Computes runoff and pollutant loads from land (SWMM5/HSPF)
  - **BMP Module**: Provides simulation of flow and pollutant transport for structural BMPs
  - **Optimization Module**: Identifies cost-effective BMP placement and selection strategies
  - **Post-Processor**: Centralized location for analyzing and interpreting simulation outputs at multiple locations, and for scenarios and parameters of interest

SUSTAIN Process Diagram



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SUSTAIN Applications

- *TMDL implementation plans*
- *Management practices* to achieve pollutant reductions
- *Optimal green infrastructure strategies* for reducing volume and peak flows
- *Benefits of distributed green infrastructure* on water quantity and quality in urban streams
- *Phased BMP installation plan* using the cost effectiveness curve

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SUSTAIN Case Studies

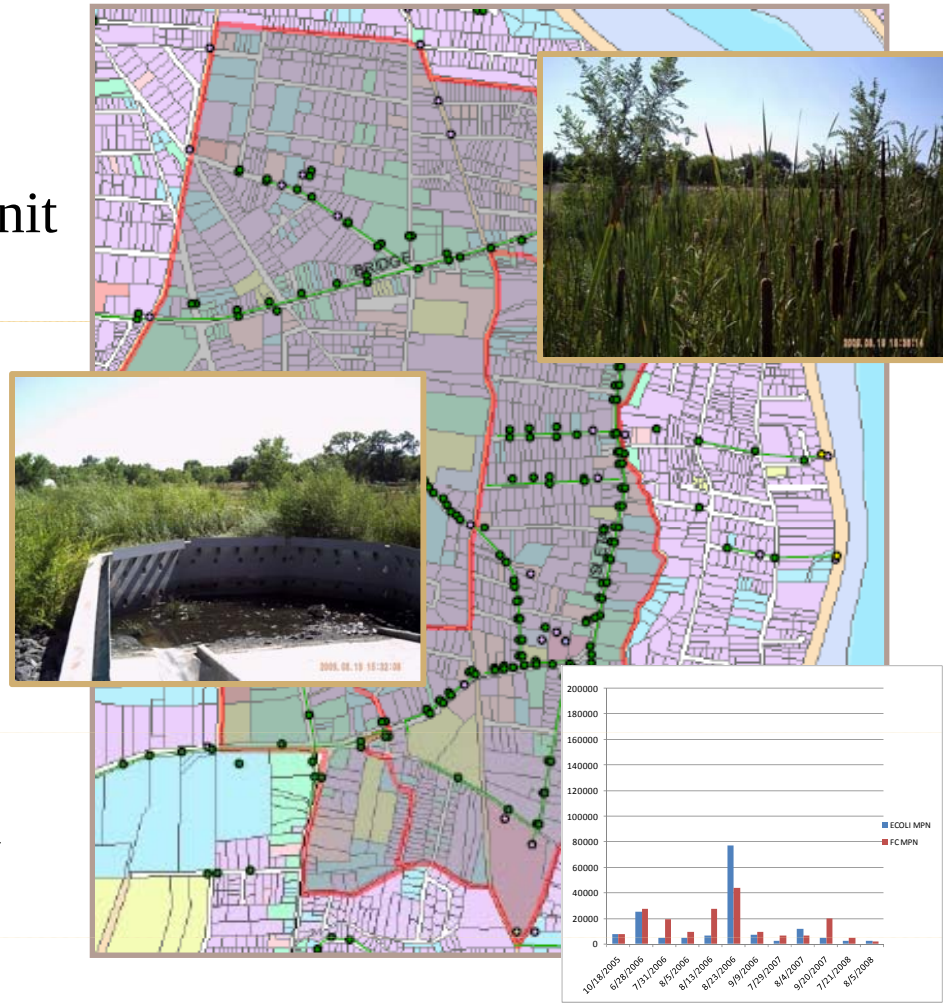
- Kansas City, MO and Louisville, KY
  - Investigated the use of green and/or gray infrastructure practices to mitigate CSOs in temperate climate regions
- Middle Rio Grande
  - Evaluate performance of small-scale structural and non-structural management practices for various storm sizes in an arid region
  - Estimate the regional response of wide-spread adoption of these practices

MRG Case Study Objectives

- Site-scale BMP optimization to derive cost-benefit relationships for a selection of potential BMPs
- Watershed-scale optimization in light of existing TMDL targets
- Integration into a regional watershed modeling framework
  - Inform basin-scale management decisions
  - Provide technical guidance for the pending watershed-based MS4 permit

Site-Scale: Criteria

- <1000 acres
- Representative land use and hydrologic release unit (HRU) distribution
- Pre and post BMP implementation monitoring data
- Available weather data (precipitation, evapotranspiration)
- Available GIS data (land use, soil, pipe network, existing BMPs, etc.)



Bernalillo County Sanchez Farm Facility

Site-Scale: Key Questions

- What are the rainfall-runoff and rainfall-pollutant load responses by HRUs?
- How well will potential GI practices perform for various storm sizes?
- What is the impact of non-structural BMPs (e.g. street sweeping) on structural BMP treatment requirements and performance?
- How would different formulation of TMDL objectives affect the BMP solutions?

Site-Scale: Info Needed

- Pollutant of concern: *E. coli*
  - Death or regrowth rates
- BMP information
  - Suggested local BMP types
  - Local BMP design standards
  - Local BMP cost data
  - Suitable non-structural BMPs and supporting performance metrics
- Representative simulation time period

BMP Performance in Bernalillo County

- Comparison of two sites provides a basis for quantifying the performance of the implemented BMPs
- Must have a similar mix of land uses
  - Sanchez Farms (managed with existing BMPs)
    - Trash removal structures
    - Sedimentation structures
    - Flow-through wetland
  - Adobe Acres (control group without existing BMPs).

Watershed-Scale: Criteria

- Clearly defined management goal
  - TMDL allocation
  - Permit requirements
- Instream monitoring data
- Weather data
- GIS data (land use, digital elevation models, soil, pipe network, stream, existing BMPs, weather stations, etc.)
- Existing flow and water quality models

Watershed-Scale: Key Questions

- What are the downstream regional responses to upstream BMP implementation?
  - Structural and non-structural
  - Based on performance derived from site-scale
- How can SUSTAIN be integrated into a watershed management decision making process?
- What is the cumulative cost-benefit relationship of management at the watershed scale?

Watershed-Scale: Info Needed

- Stormwater management objectives (TMDL target, permit requirement)
  - E.g. Load duration curve analyses for pollutant loading

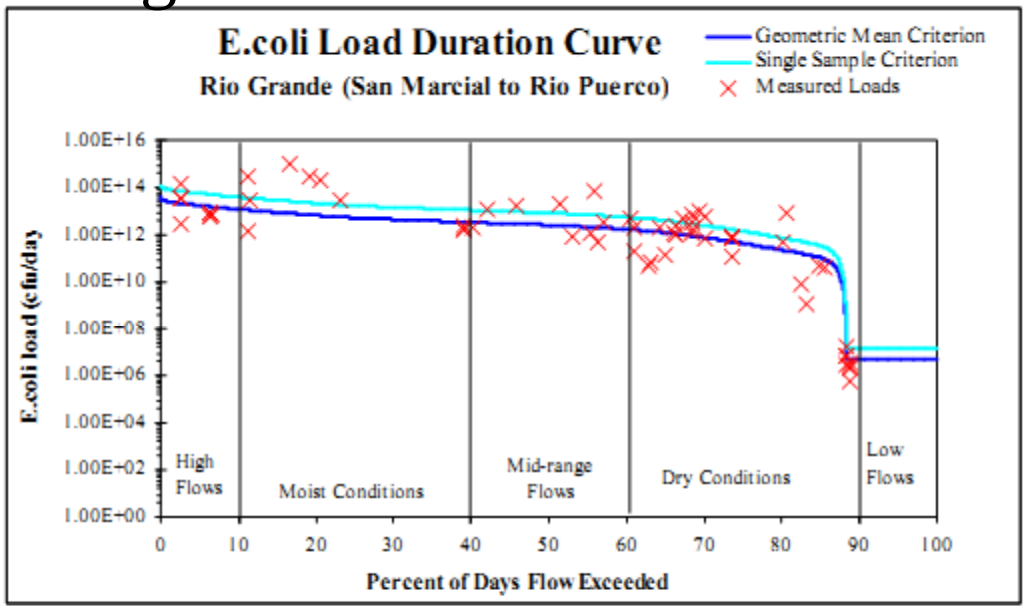


Figure 4.5 ***E. coli*** **Load Duration Curve – Rio Grande (San Marcial to Rio Puerco)**

Practice Identification

Favorable Practice

- Harvesting parking lot runoff
- Extensive use of rain barrels
- Harvesting street runoff
- Detention facilities to capture *first flush flows*
- Increased urban tree cover

Unfavorable Practices

- Swales
- Flow-through structures
- Rain gardens
- Green roofs

LaBadie, K.T. 2010. *Identifying Barriers to LID and GI in the Albuquerque Area.*

BMPs Considered In MRG SUSTAIN Study

- Nonstructural BMPs
  - Street sweeping
  - Pet waste management

- Structural BMPs
  - Rainwater harvesting (harvest runoff from rooftop, parking lot, and street)
  - Xeriscaping or xerogardening
  - Detention basins designed to collect first flush flows

BMP Simulation Parameters

Parameter	Xeriscape	Rainwater collection	Detention basin
Substrate			
Ponding depth (ft)	0.042	--	4
Substrate layer depth (ft)	2	--	1
Substrate layer porosity	0.4	--	0.3
Vegetative parameter, A	1	--	1
Background soil saturated infiltration rate* (in/hr), fc	0.3	--	0.3
ET rate (in/day)	0.104	--	0.104
Water Quality			
TSS 1st order decay rate (1/day), k	0.8	0.8	0.8
Fecal coliform 1st order decay rate (1/day), k	0.5	0.5	0.5

Next Steps

- A comprehensive *SUSTAIN* project is being developed to present all combinations of BMP opportunities in the 100-acre composite study area (Sanchez Farm)
  - Nonstructural BMP scenarios will not be optimized
    - Applied as background conditions for the structural BMP optimization runs
  - Effectiveness of BMPs combinations, including nonstructural and structural, will be evaluated and presented
- BMP performance evaluations are performed using three design storm time series.
  - Methodology to tie the storm-based BMP performance with the ultimate water quality control targets is being developed
  - The overall water quality targets will be used to further configure the optimization

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Questions and Discussion