SWAT modeling of Arroyo Colorado watershed

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Need for the project

Arroyo Colorado failed to meet Texas water quality standards

- Low dissolved oxygen and high levels of bacteria-Fish kills

  - nutrient loading from agricultural fields
  - wastewater and storm water from urban areas
  - failing septic systems, untreated/poorly treated wastewater

Goal: Identify BMPs control poor water quality

Previous modeling effort :

Modeling of Arroyo Colorado watershed using HSPF model

Modeling period: 1988-1999

Recommendations: 90 % reduction in Sediment, nitrogen and phosphorus reducing substances for 90 % of times between March and October

TCEQ recommendations (2003) : Reassessment of watershed using more data, recent data, sophisticate analysis

Soil and Water Assessment Tool (SWAT)

- developed by Dr. Jeff Arnold, Research Leader-USDA-ARS at Temple, TX

Model details

Physically based, Continuous simulation, Daily time step

Watershed and very large scale assessments, presently used in > 90 countries

Components

Flow, soil erosion, transport of sediment, nutrients, pesticides and bacteria

Processes

Crop growth, Evaporation, infiltration, runoff, soil water routing

Management operations

Crop rotation, Tillage, application of fertilizer, pesticides, irrigation water

Some unique features : auto-fertilizer application, auto-irrigation, auto-calibration

User Interfaces: AVSWAT, ArcSWAT (GIS interface) Windows

Data Sources

Elevation : United States Geological Survey (USGS) 30 m DEM

Soil map : USDA-NRCS

Land use : Spatial Sciences Lab, Texas A&M, College Station

Weather data : State Climatologist Office, Texas A&M

Flow : International Boundary and Water commission (IBWC)

Point Sources / Outfall : Texas Commission on Environmental Quality (TCEQ)

Water Quality data : TCEQ

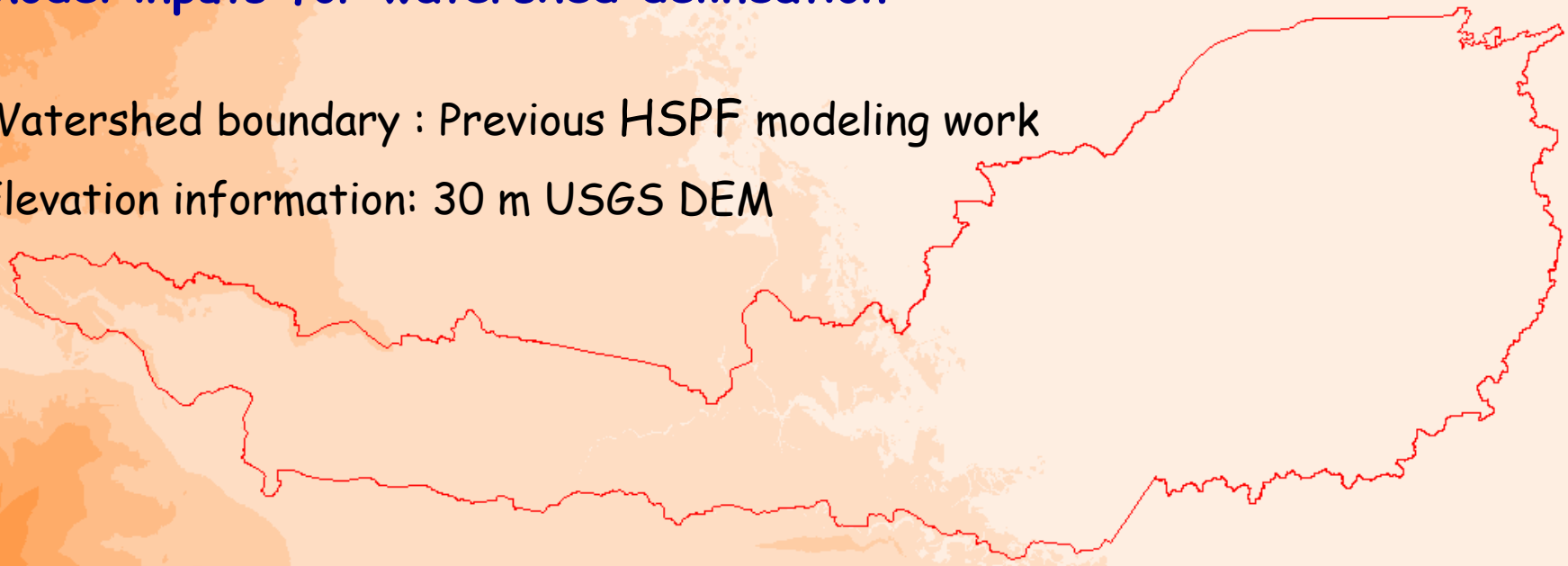
Other data sources:

- Local offices in the valley
- Information from previous HSPF modeling effort

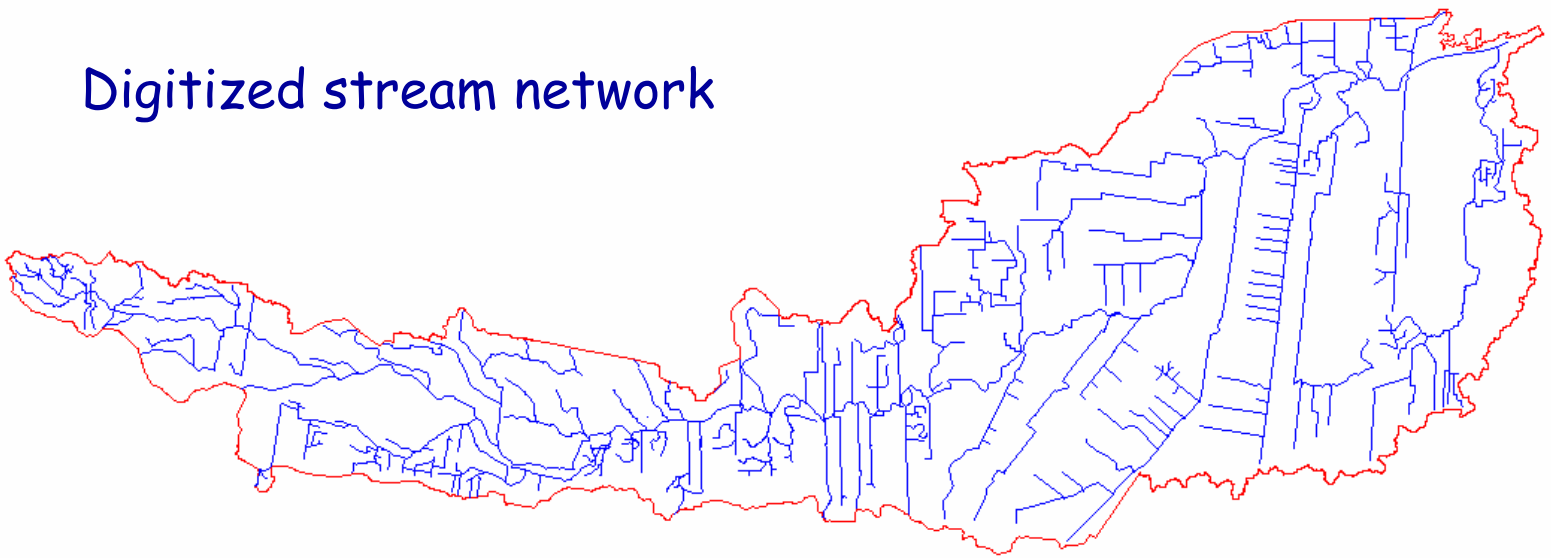
Model inputs for watershed delineation

Watershed boundary : Previous HSPF modeling work

Elevation information: 30 m USGS DEM



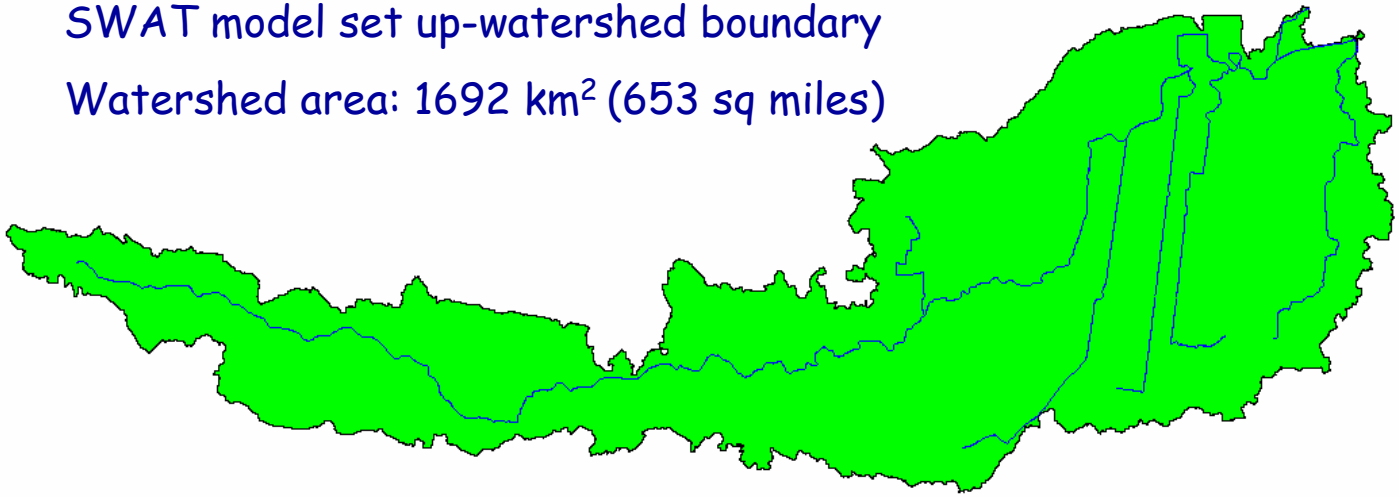
Digitized stream network



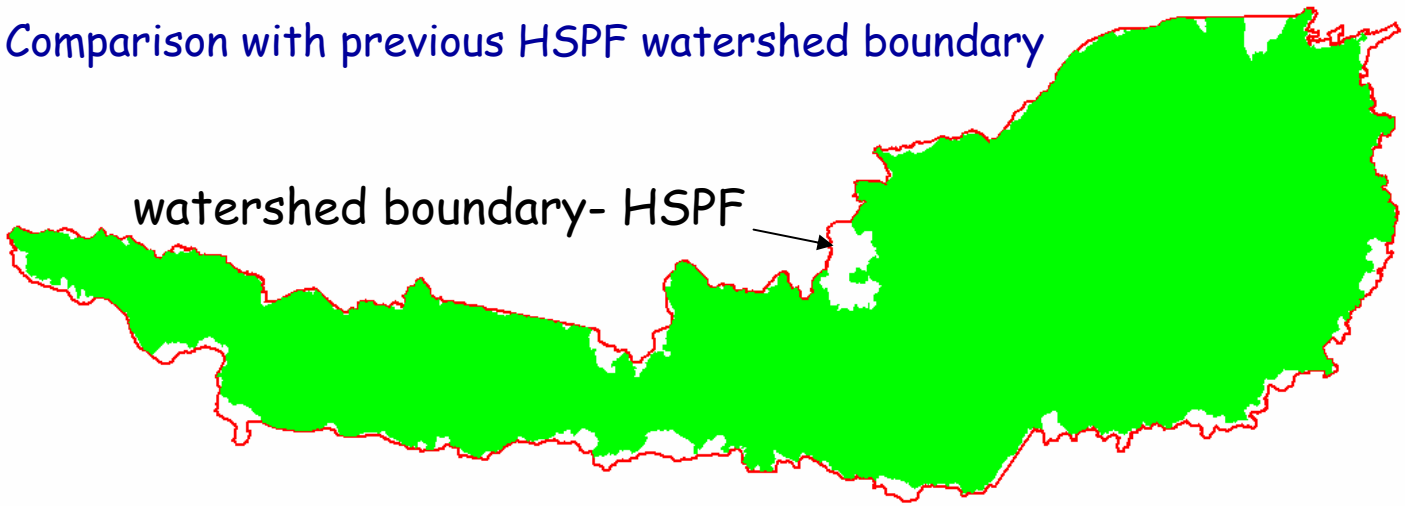
Watershed boundary and stream network

SWAT model set up-watershed boundary

Watershed area: 1692 km^2 (653 sq miles)

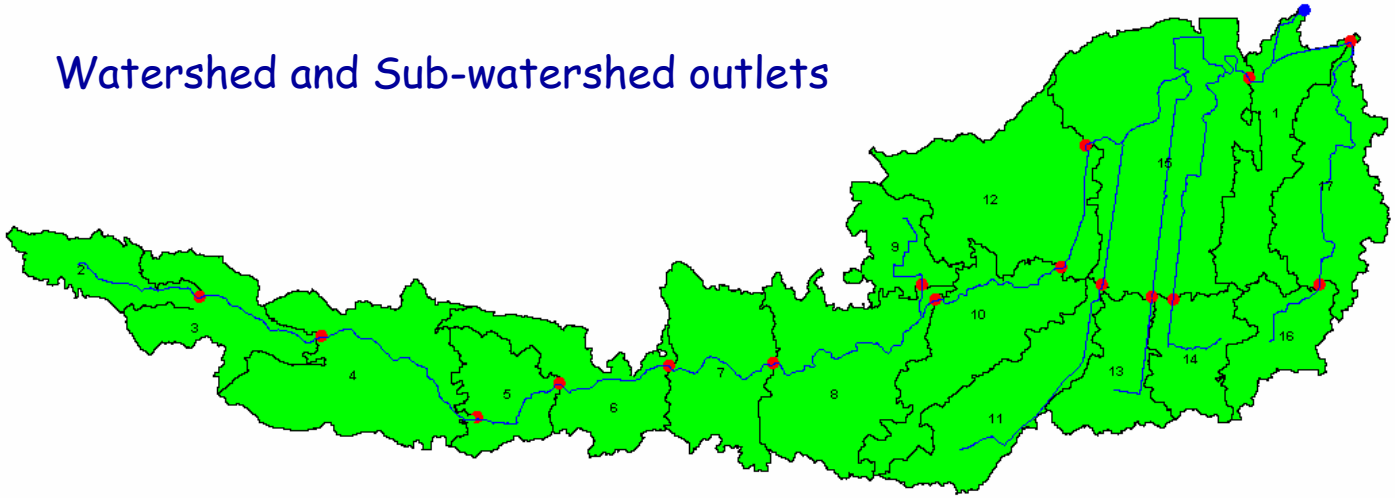


Comparison with previous HSPF watershed boundary

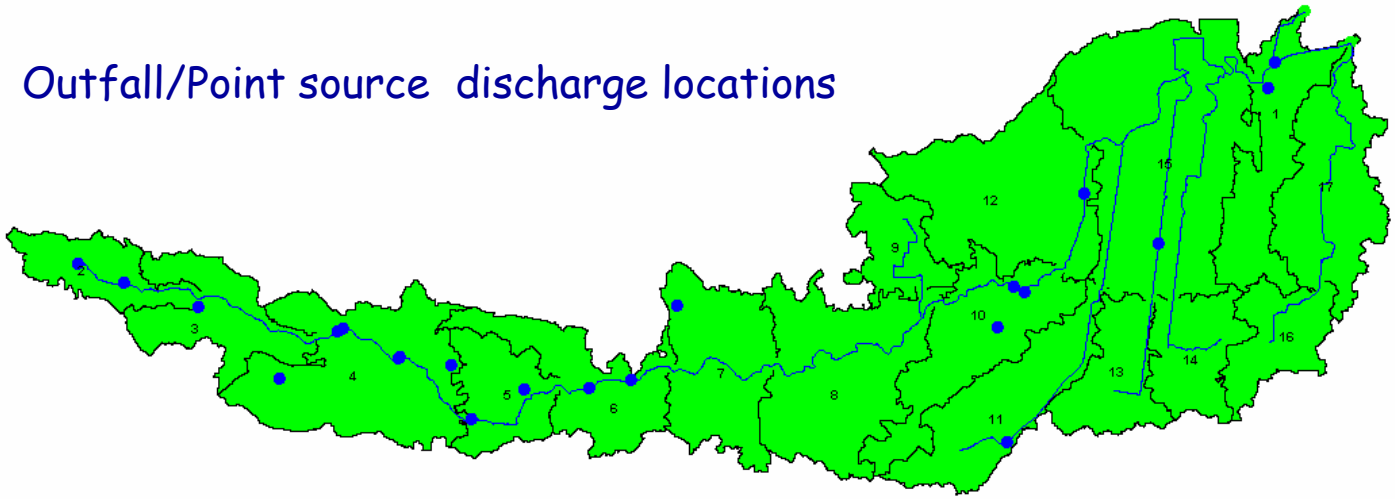


Outlets and Inlets

Watershed and Sub-watershed outlets



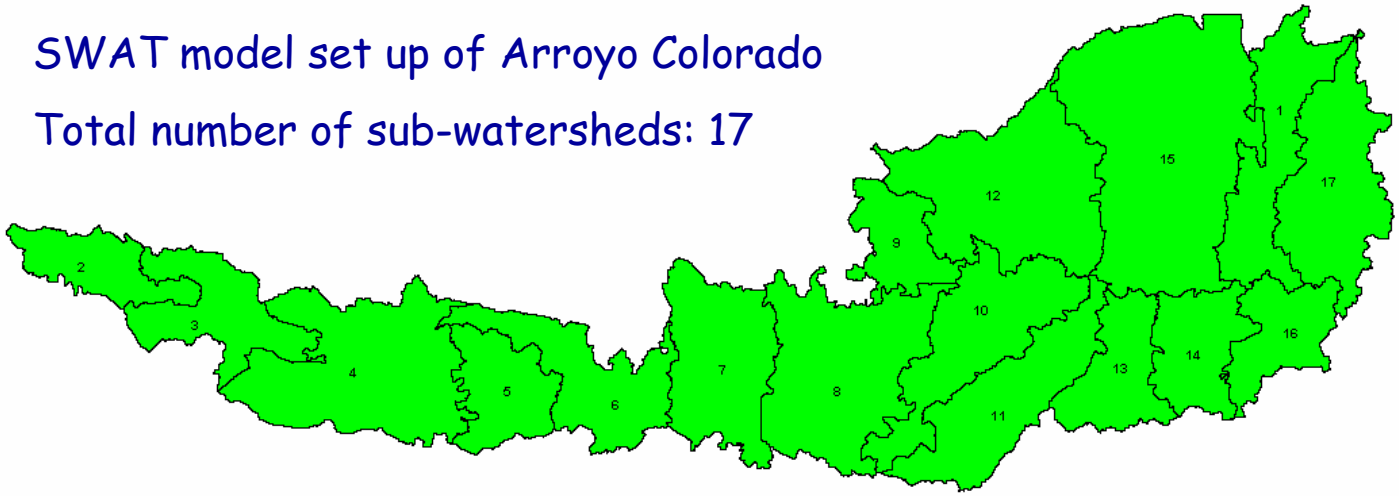
Outfall/Point source discharge locations



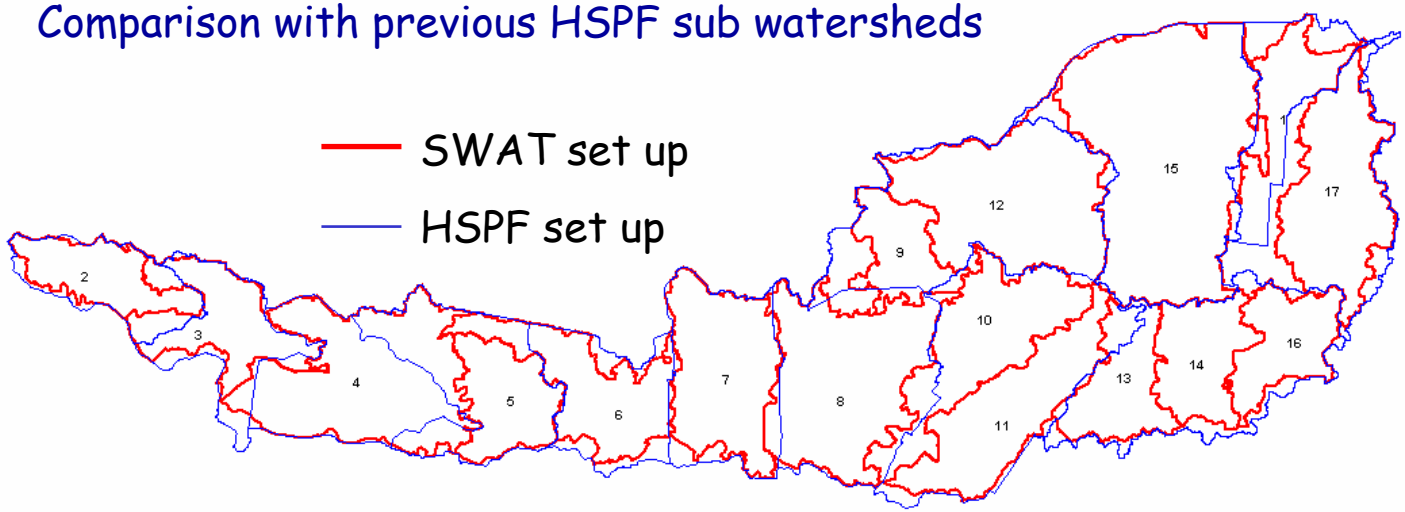
Sub-watersheds

SWAT model set up of Arroyo Colorado

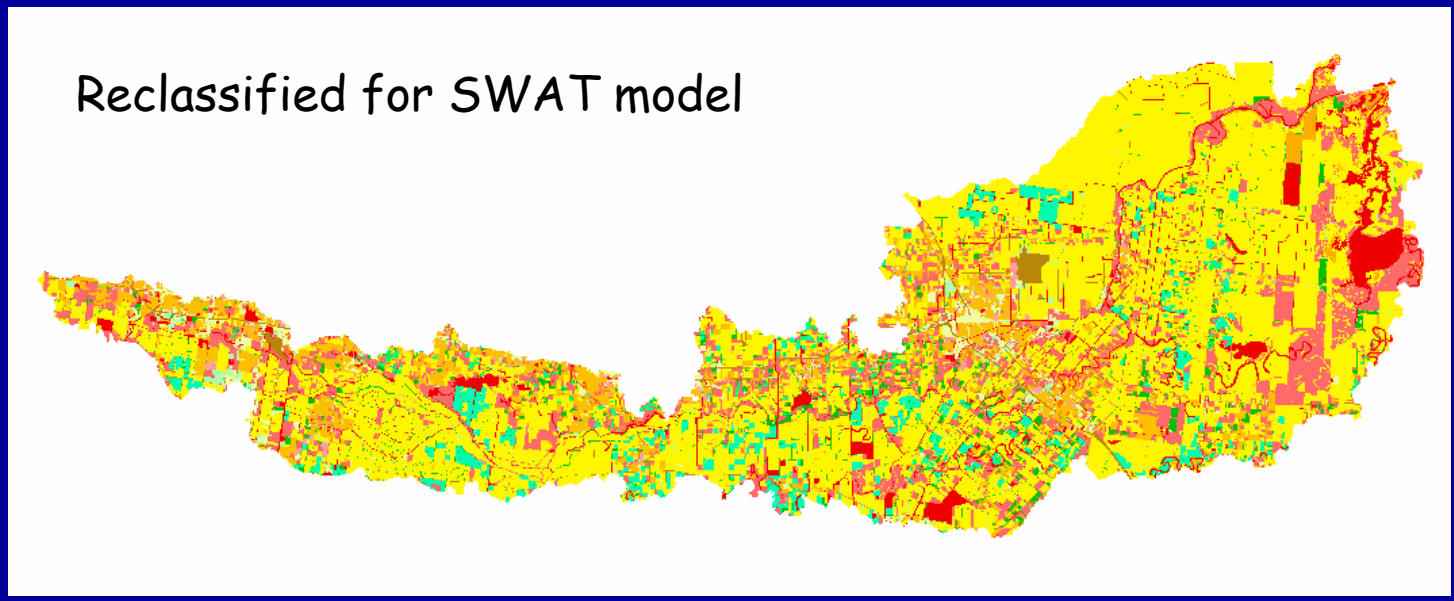
Total number of sub-watersheds: 17

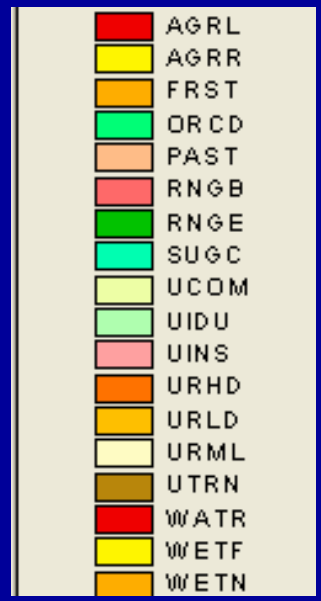


Comparison with previous HSPF sub watersheds



Land use map





AGRL and AGRR : Agricultural land
FRST : Trees/Forest
WATR: Water body
ORCD: Orchard/Citrus
RNGE, RNGB : Range grasses and brush
SUGC : Sugarcane
UCOM, UIDU, UINS, URHD, URLD, URML, UTRN : Urban
WETF, WETN : Wetland

crop rotation for 2004-2007 (Farm Service Agency-USDA)
- Dates of planting
- Irrigation
- field/farm basis

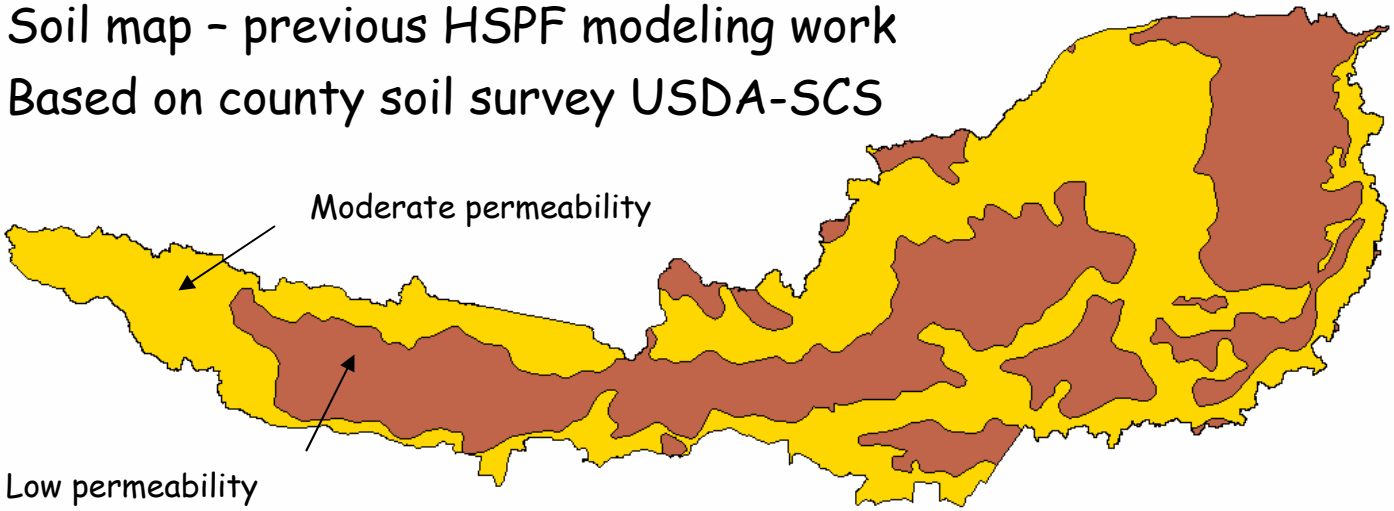
Dominant land use classes

Cultivated land 54 %
Brush-Range grasses 18.5 %
Urban 12.5 %
Water bodies 6 %
Sugarcane 4 %

Soil map

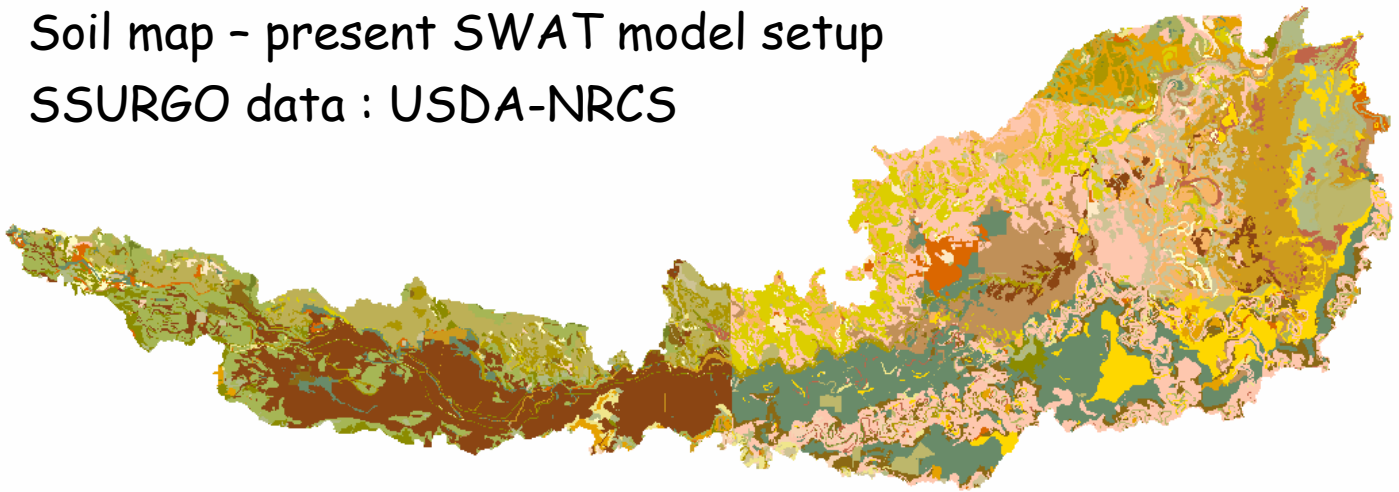
Soil map – previous HSPF modeling work

Based on county soil survey USDA-SCS

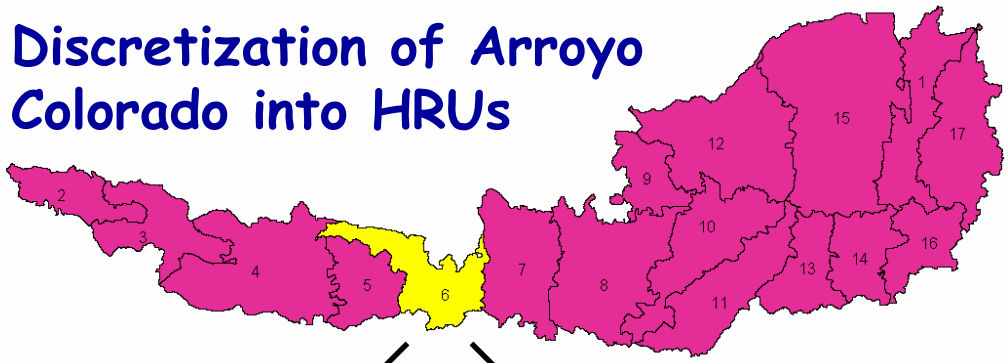


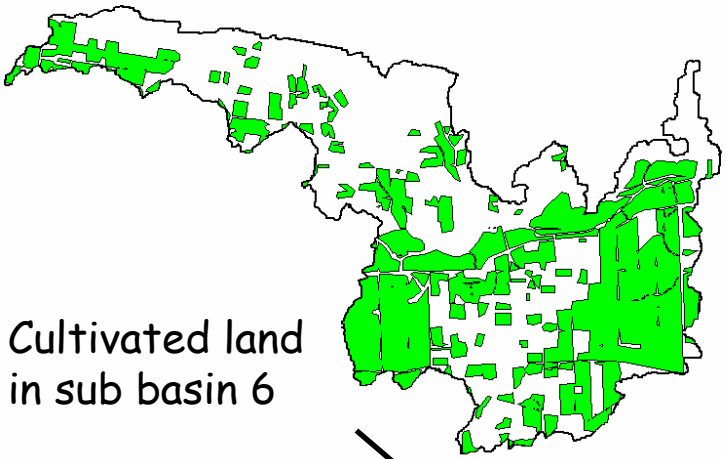
Soil map – present SWAT model setup

SSURGO data : USDA-NRCS

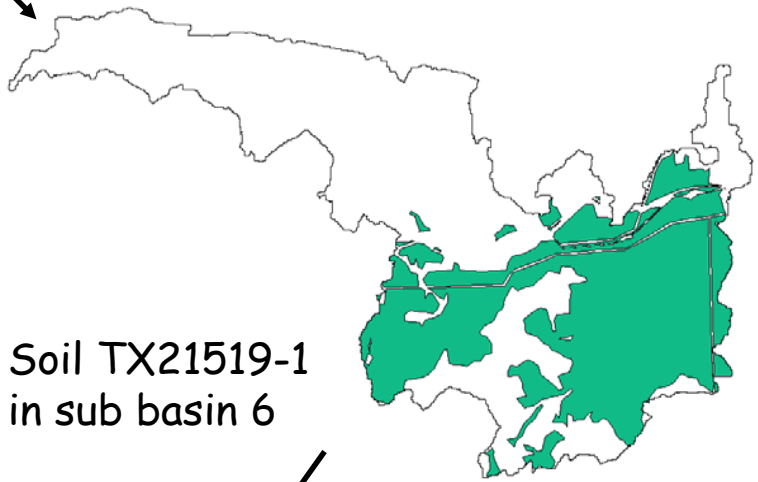


Discretization of Arroyo Colorado into HRUs

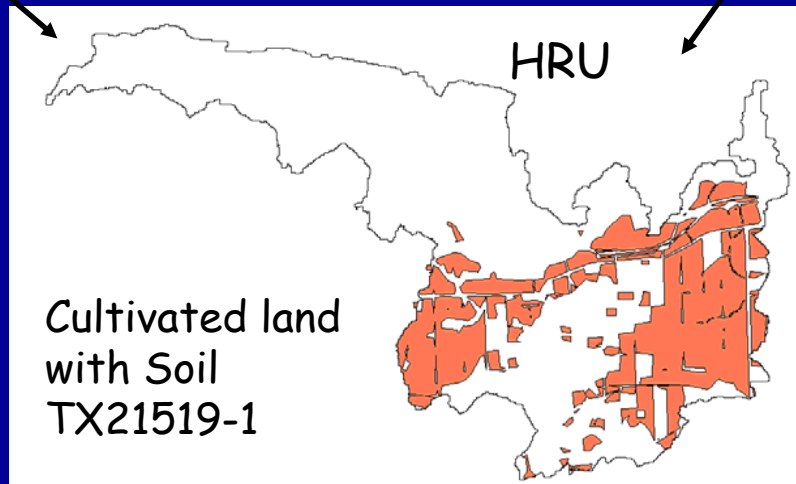




Cultivated land in sub basin 6



Soil TX21519-1 in sub basin 6



Cultivated land with Soil TX21519-1

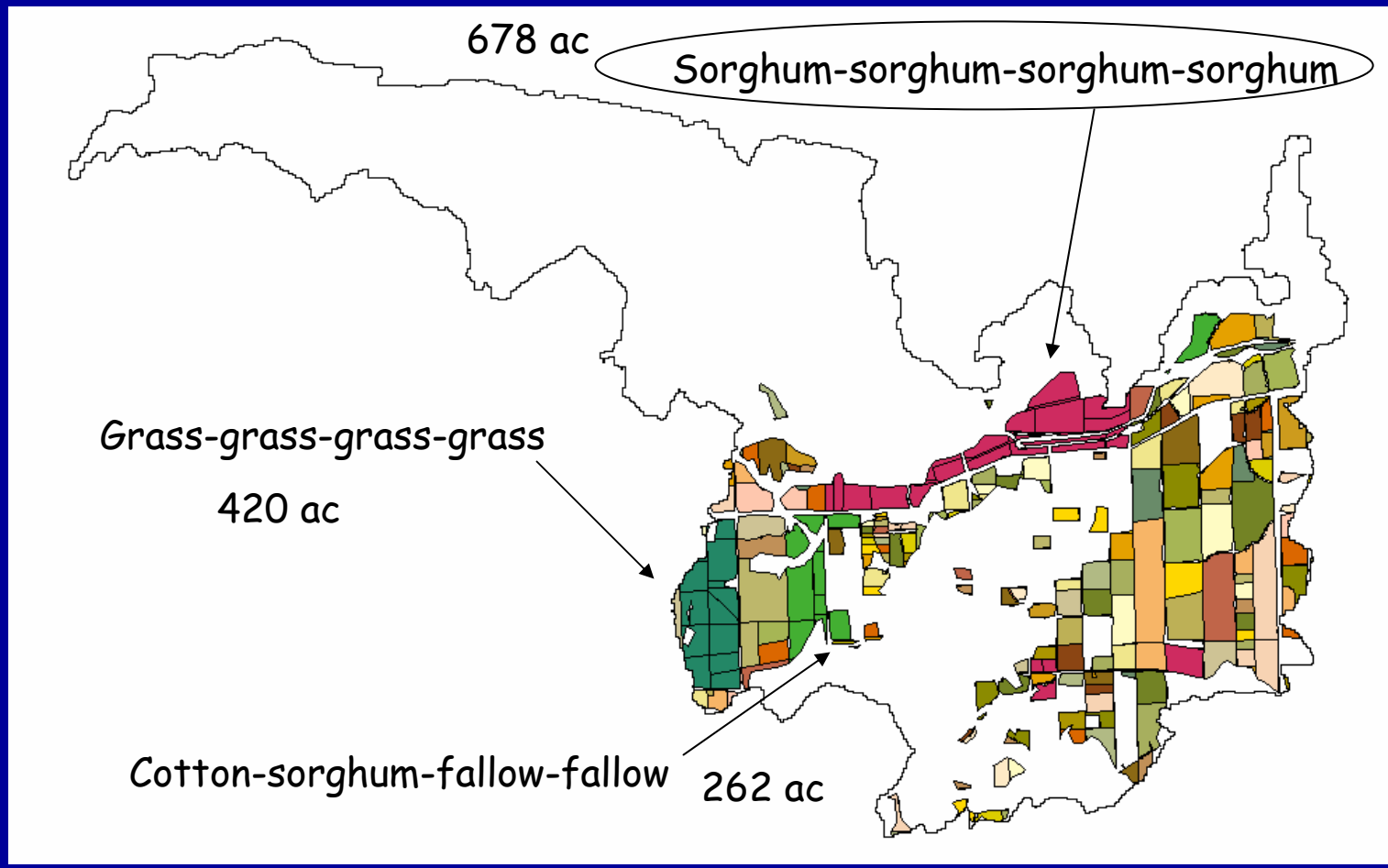
HRU – Hydrologic Response Unit

Unique combination of land use and soil type

475 HRUs in SWAT model set up

Average: 28 HRUs per sub basin

Crop rotation information



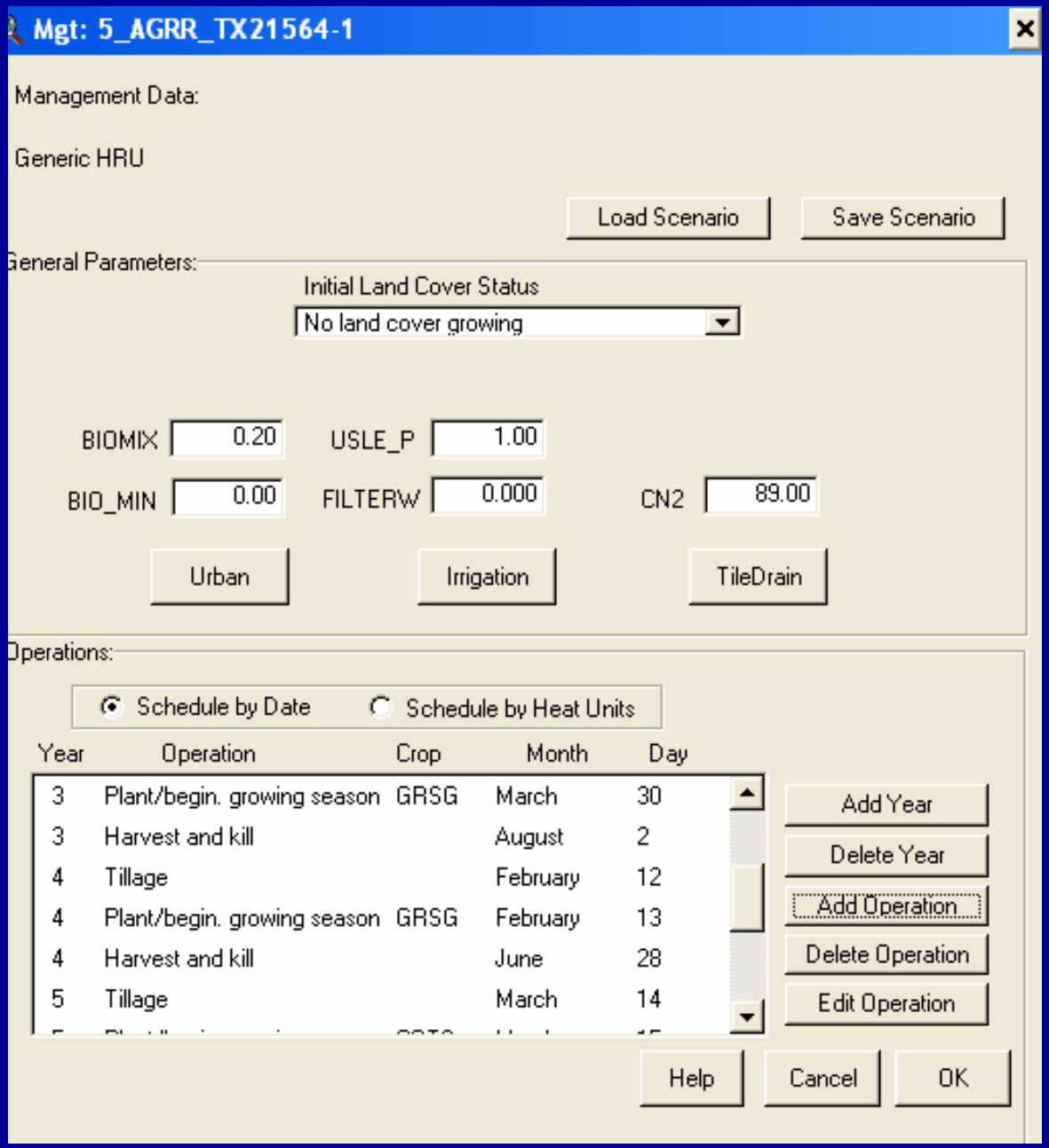
Model simulates crop growth

Tillage: mainly cultivator, deep chiseling after sugarcane harvest

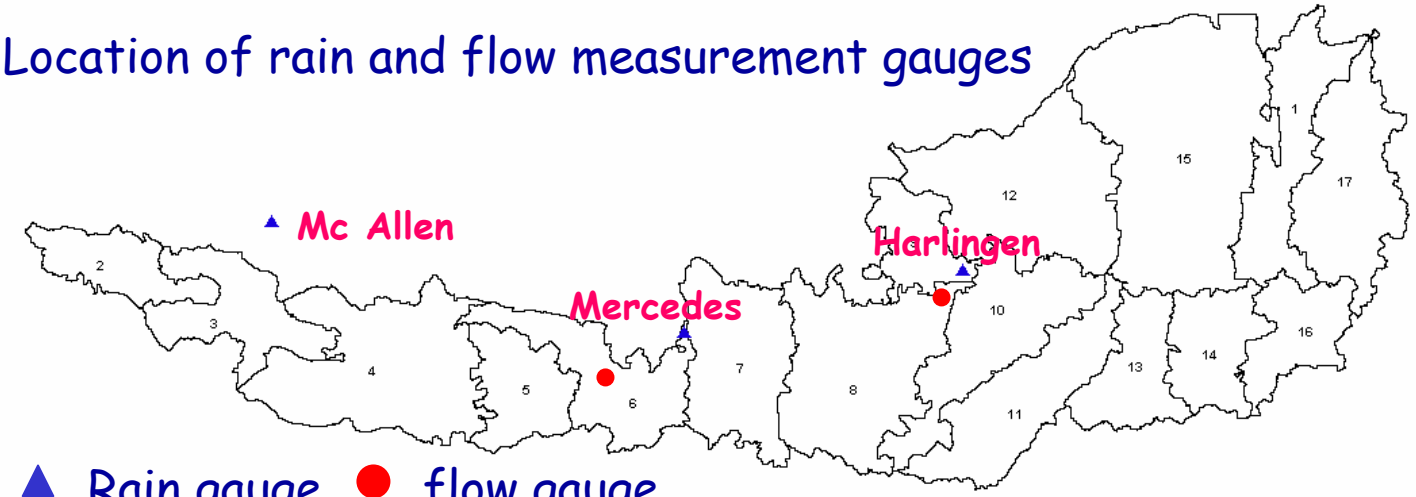
Fertilizer application : auto-fertilizer application option used

Irrigation : auto-irrigation application used

List of management operations

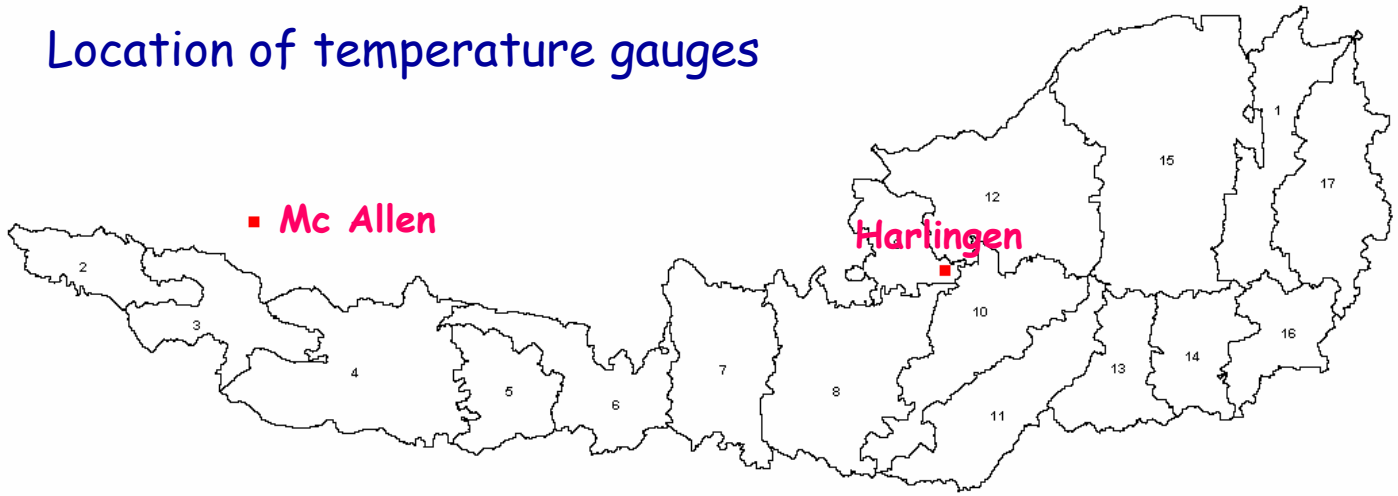


Location of rain and flow measurement gauges



▲ Rain gauge ● flow gauge

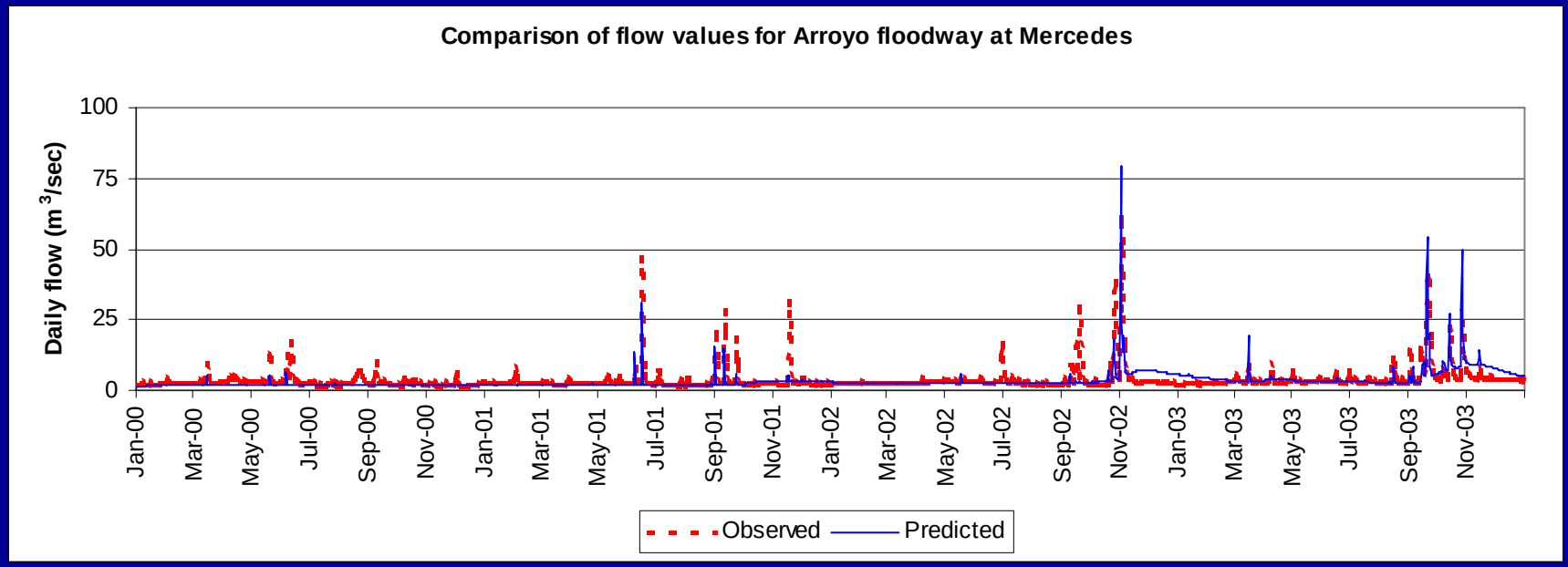
Location of temperature gauges

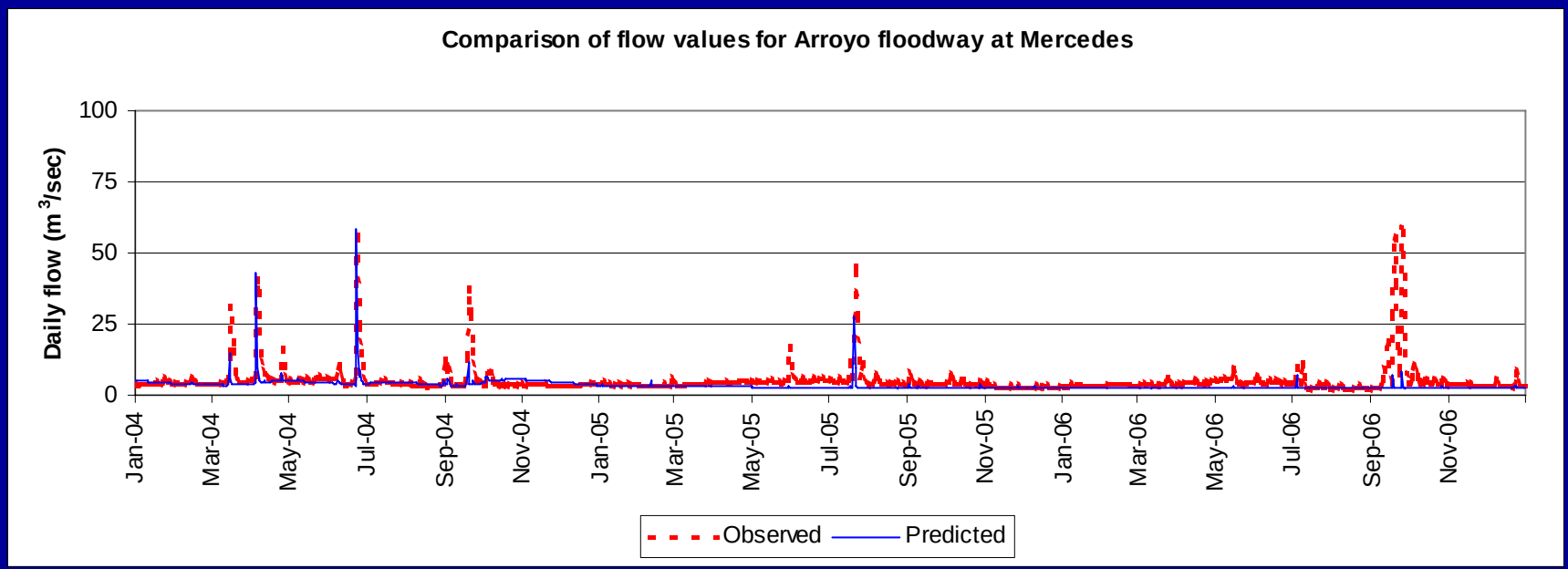


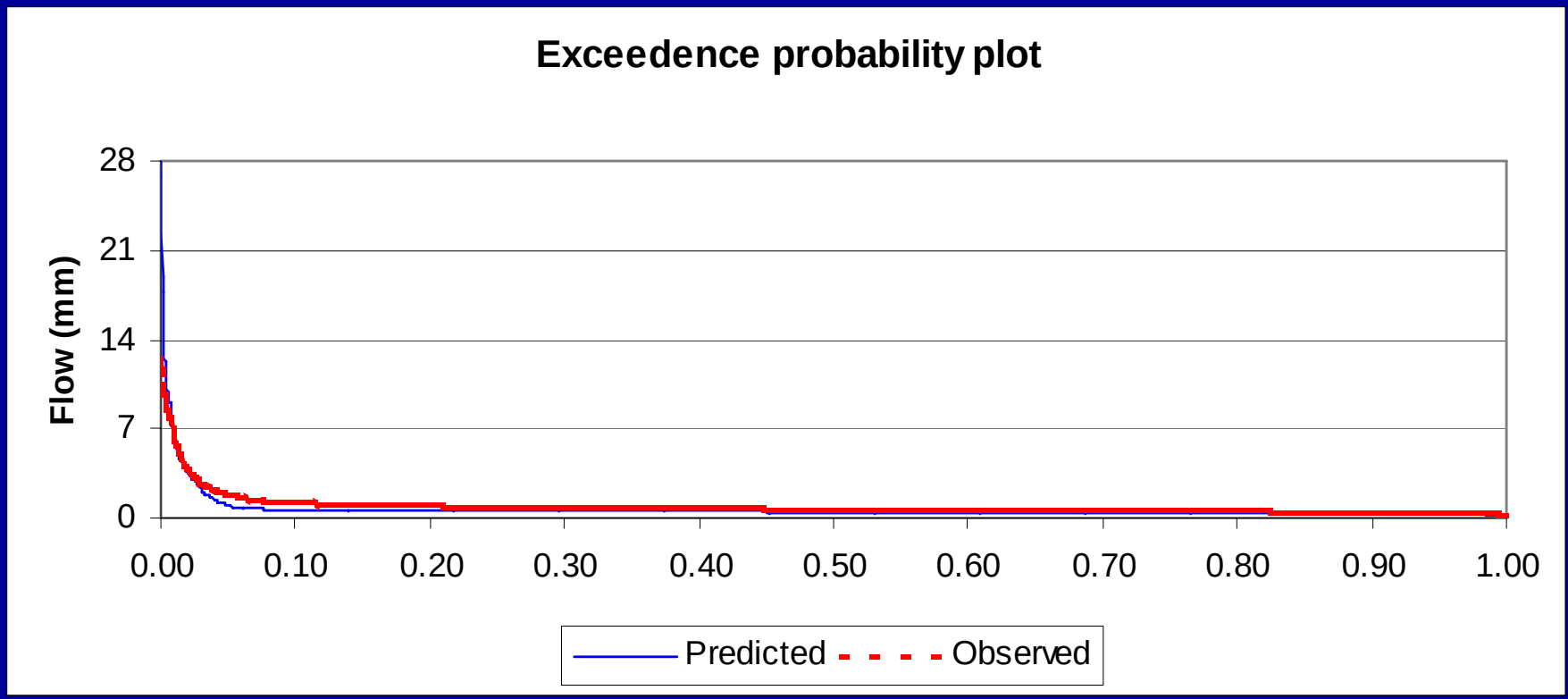
Modeling period: 2000-2006

Brownsville

Preliminary results for flow at Mercedes







Future tasks:

- Flow calibration
- Calibration for sediment, nutrients, water temperature, and dissolved oxygen
- Scenario trials to control water quality impairment

Data requirements

- Fertilizer application
  - rates and tentative dates for different crops

- Irrigation
  - timing, number of irrigations, water applied

For more details contact

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