MERCED AREA
GROUNDWATER POOL INTERESTS

Merced Water Resources Model (MercedWRM)

Application to GSP Development

WOODARD &CURRAN

May 29,2018

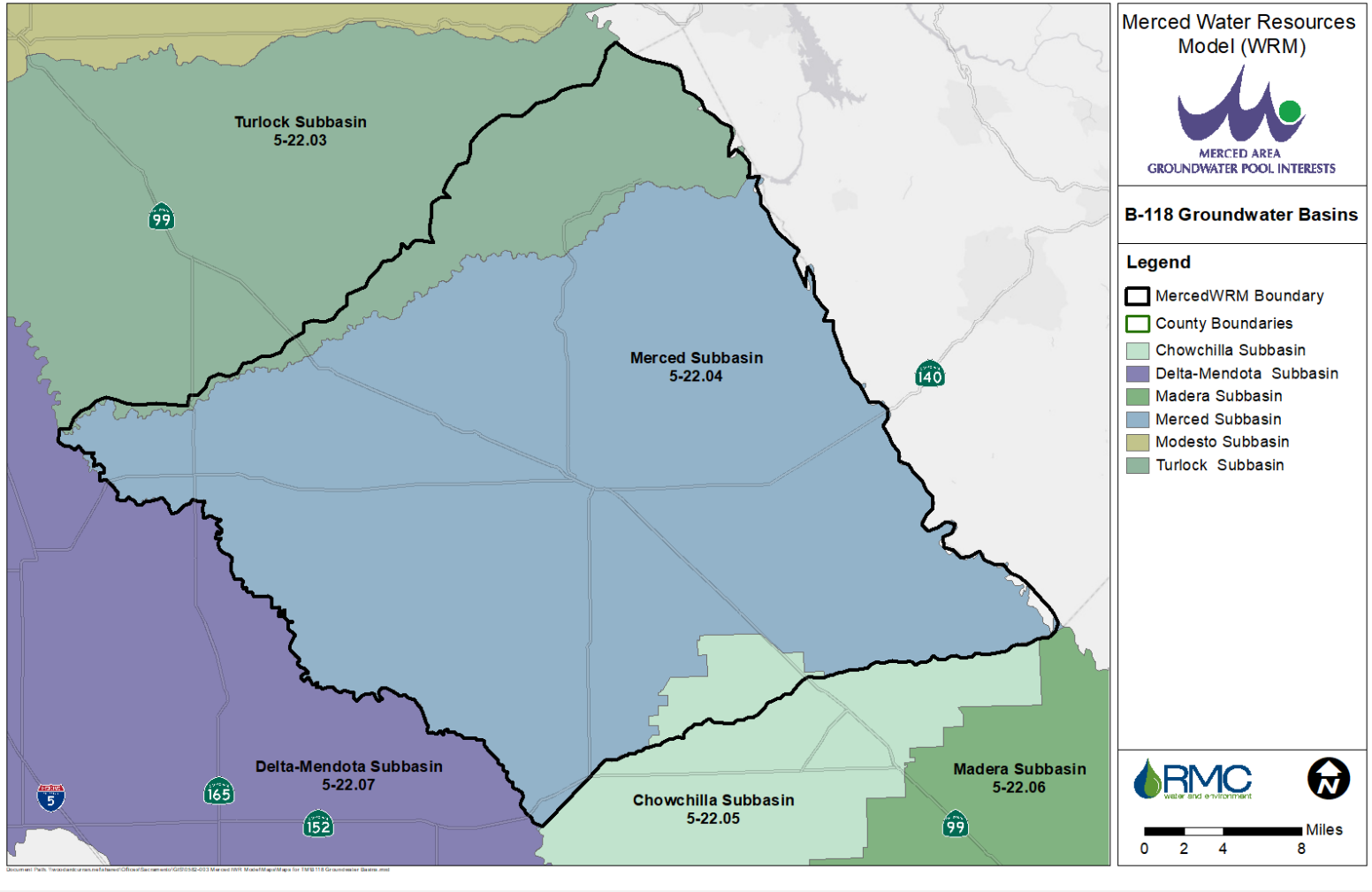
Meeting Agenda

- **Introductions**
- Review of Model Input Data
- Review of Model Calibration
- Review of Model Baseline
- Discussion on Model Applications

Model Area

Intended Uses

- Basin Characteristics
  - Natural Conditions
  - Stream-Aquifer Interaction
  - Land Subsidence
  - Water Quality
- SGMA Support
  - Groundwater Banking
  - Groundwater Sustainability
  - Water Availability
  - Project Beneficiary Assessment



Model Objectives

Basin Characteristics

Historical, Current and Projected Levels of Development

Conjunctive Management

Natural Conditions

Stream-Aquifer Interaction

Reservoir Operations

Land Subsidence

Water Quality

Water-Energy

Model Objectives

Project Evaluations

SGMA, IRWM, GWMP

Storm water and Recycled Water Opportunities

Groundwater Banking

Groundwater Sustainability

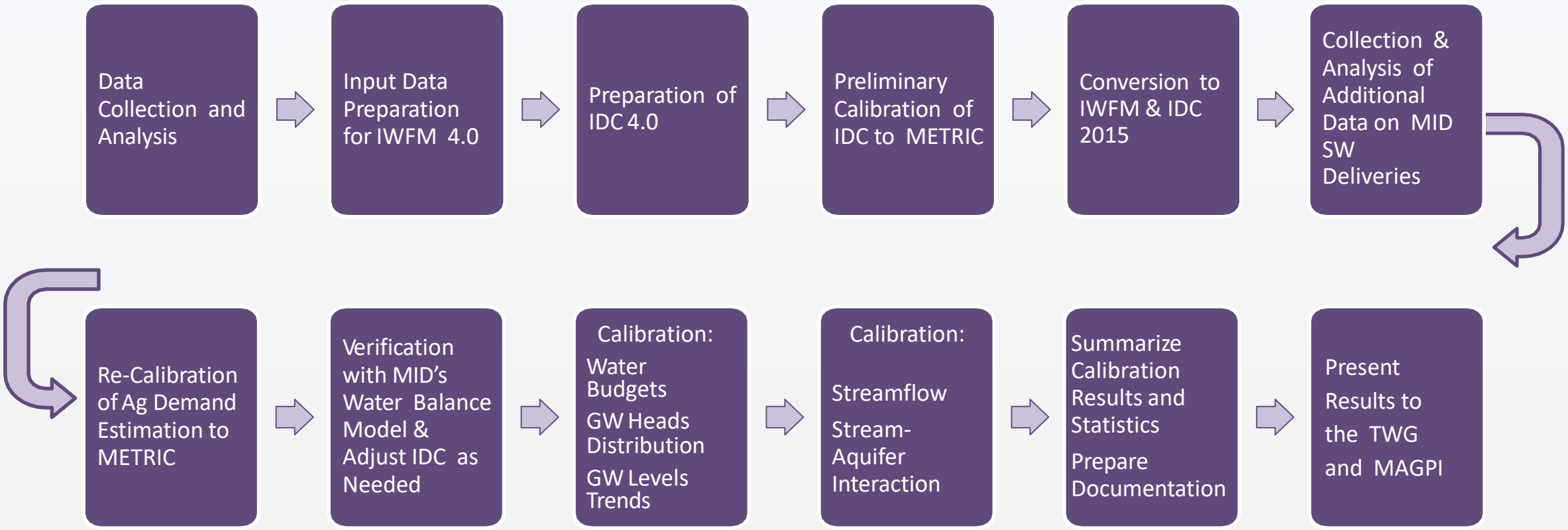
Hydro-Economic Evaluations

Water Availability

Urban Water Supply

Project Beneficiary Assessment

Model Development; A Multi-Year Process

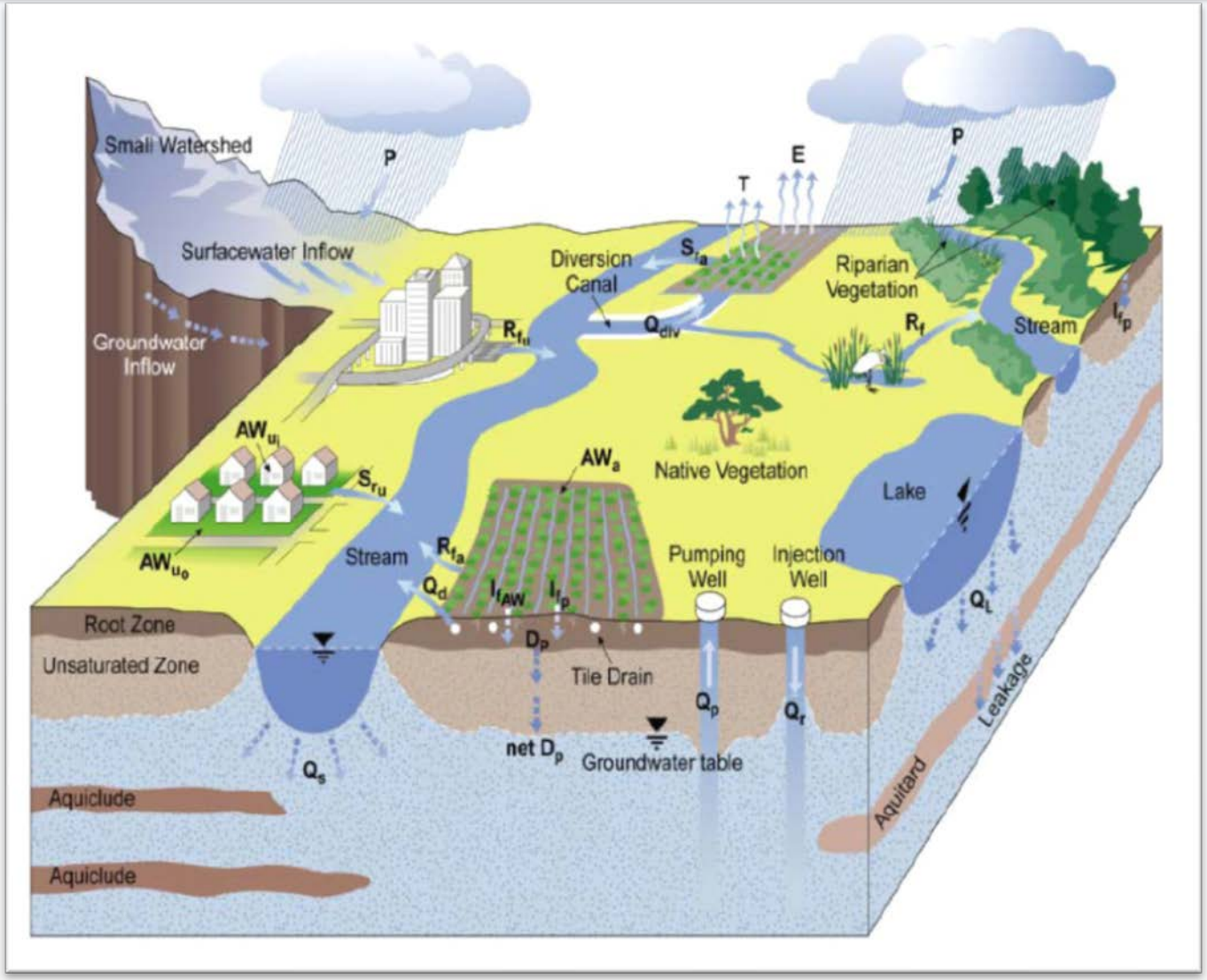


Model Developed in Open and Transparent Environment

- Development period: 2010 to ~2017
- Originally developed within MAGPI framework
- Model development primary partners:
  - Merced Irrigation District
  - City of Merced
  - Merced County
  - Department of Water Resources
- Other Collaborators: MAGPI Members
- Technical Advisory Committee: DWR, USGS, UC Merced

Integrated Hydrologic Processes

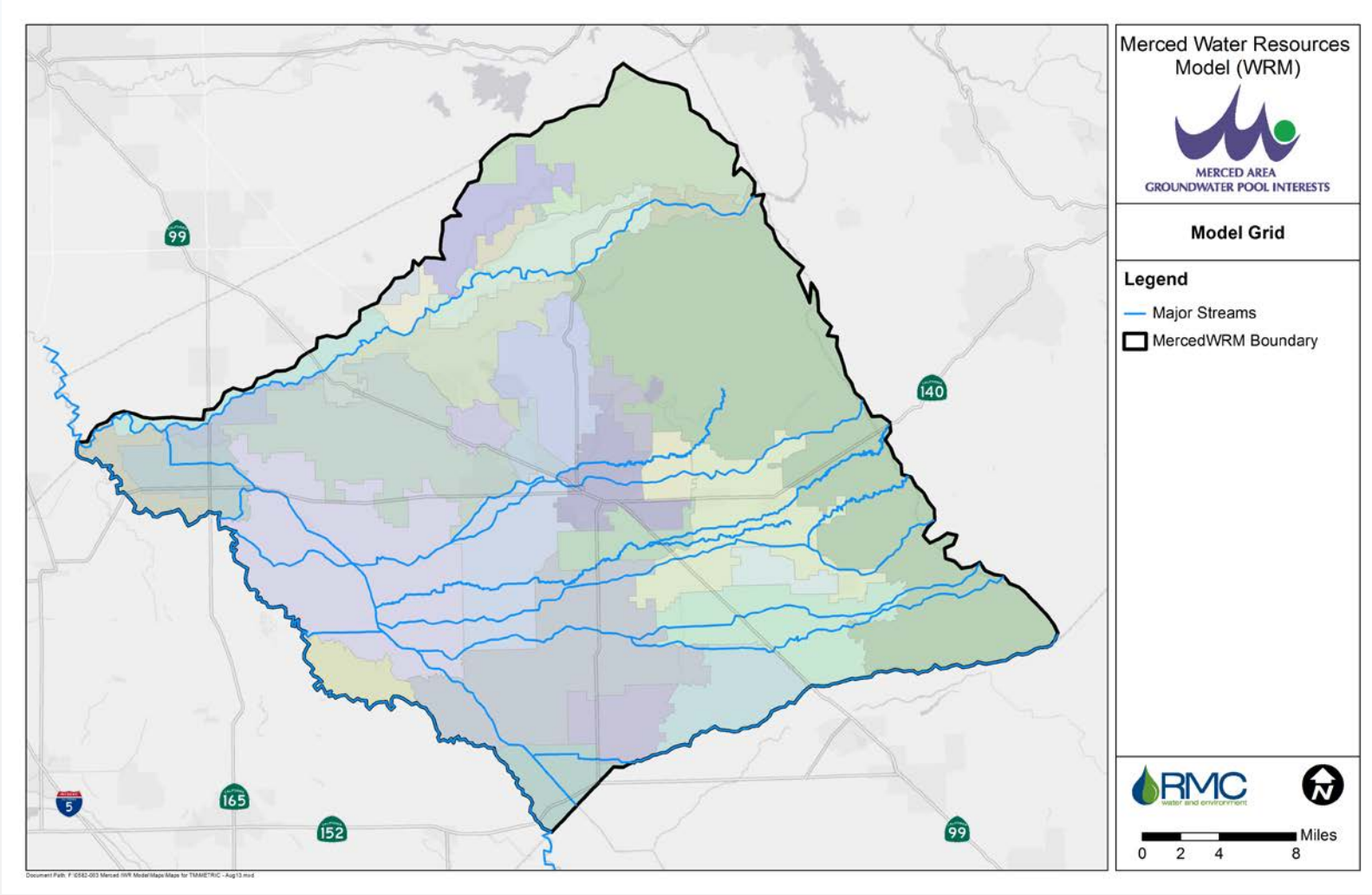
- Land Surface Processes
- Groundwater Flow
- Streamflow
- Physical Systems Integration
- Water Budgets



Model Grid Features

Grid Criteria

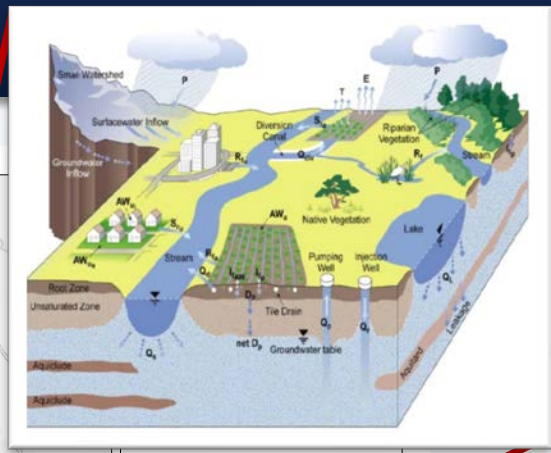
- Bulletin 118 (2003) Groundwater Basin Boundaries
- Agency Boundaries
- Operational Boundaries
- Stream Flow Lines
- Major Conveyance Features
- Unincorporated Land Use
- Topography/Drainage
- 5-Mile Boundary Buffer

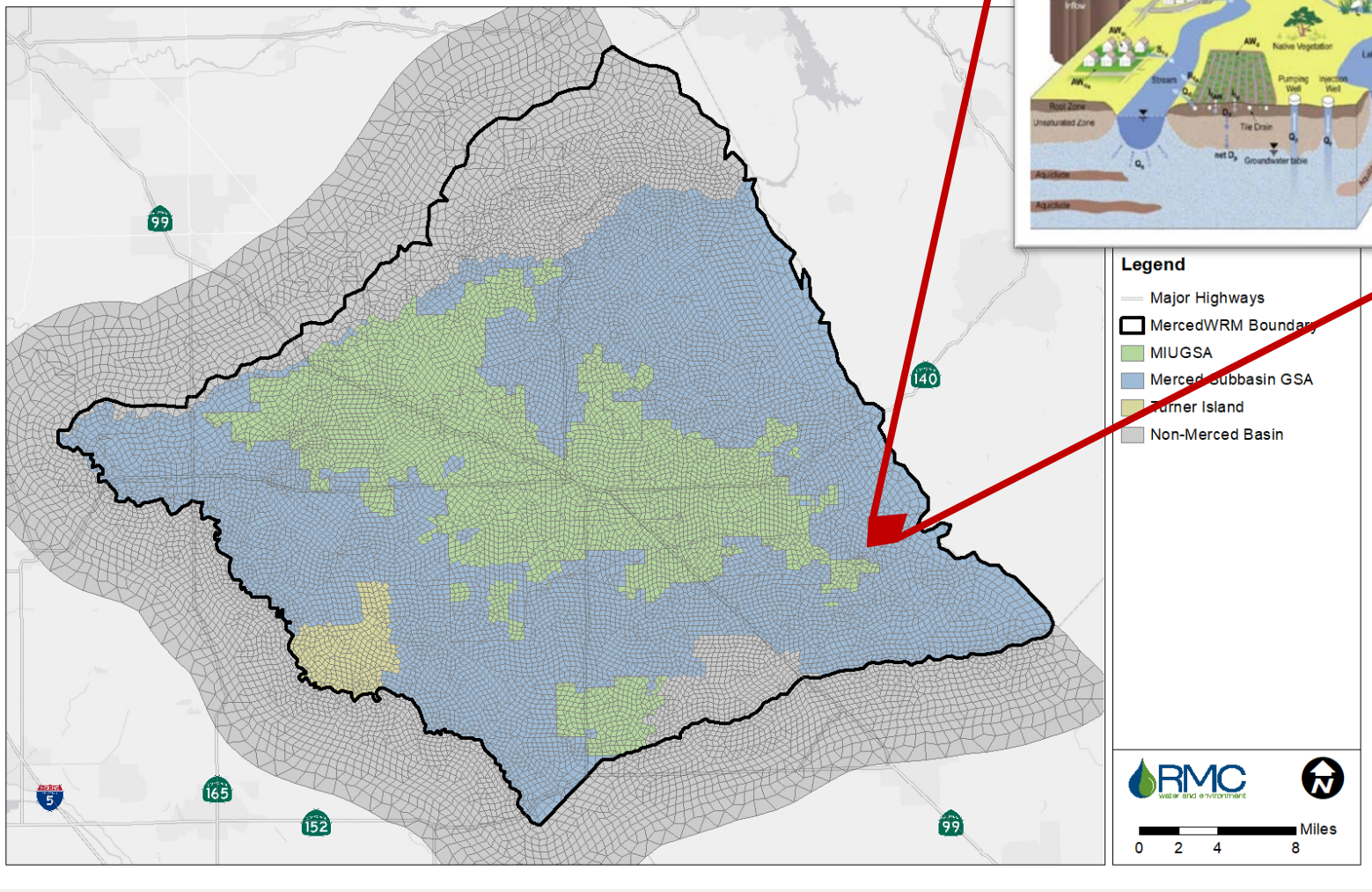


Merced WR Model and GSA Boundaries

Grid Statistics

- 607,000 Total Acres
- 71 Stream Reaches
- 37 Subregions
- 17,696 Nodes
  - Stream Lines
  - Agency Boundaries
  - ¼ Mile Discretization
- 19,563 Elements
  - Average Size = 24 Acres





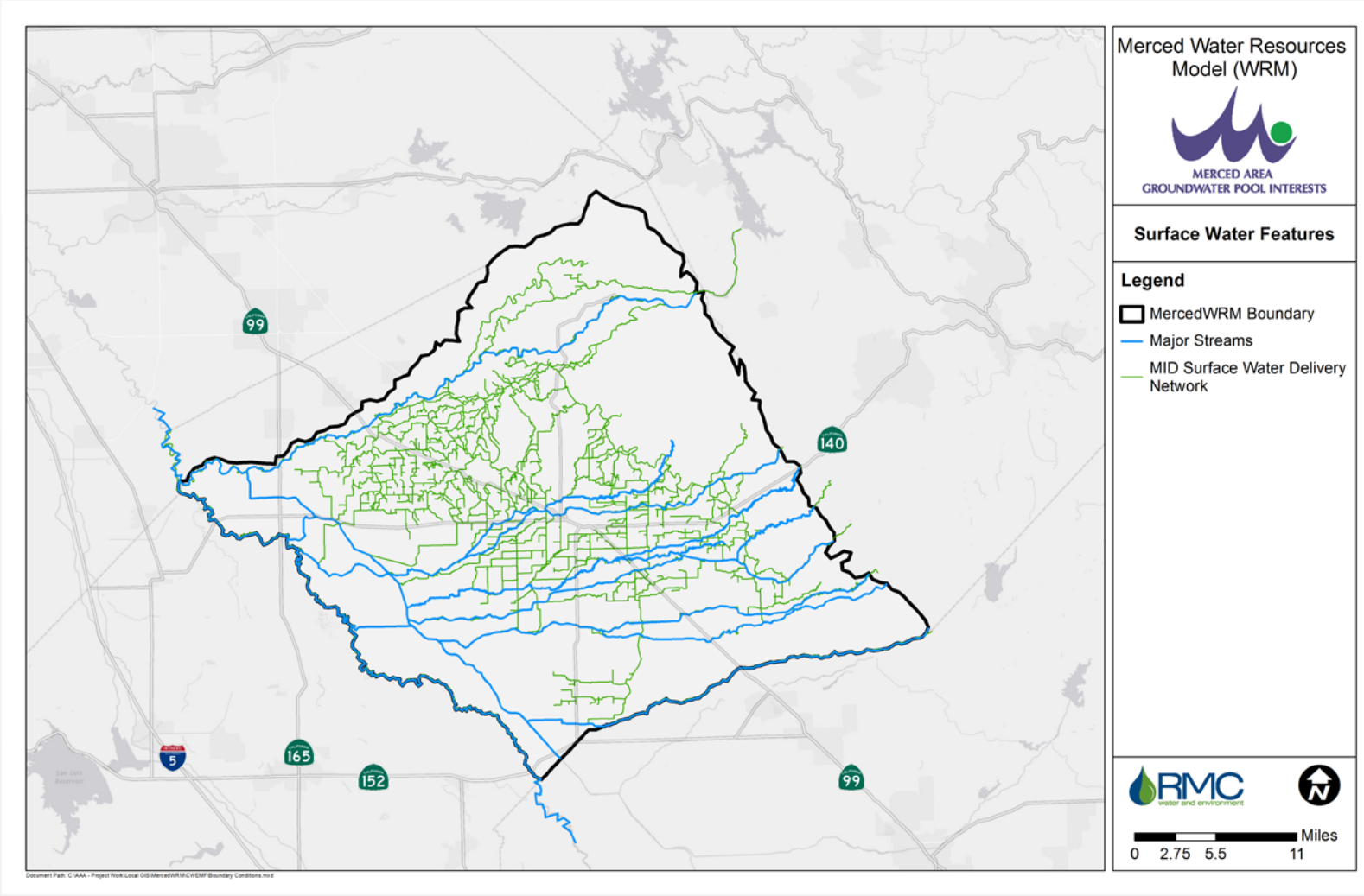
Stream Network

Simulated Streams

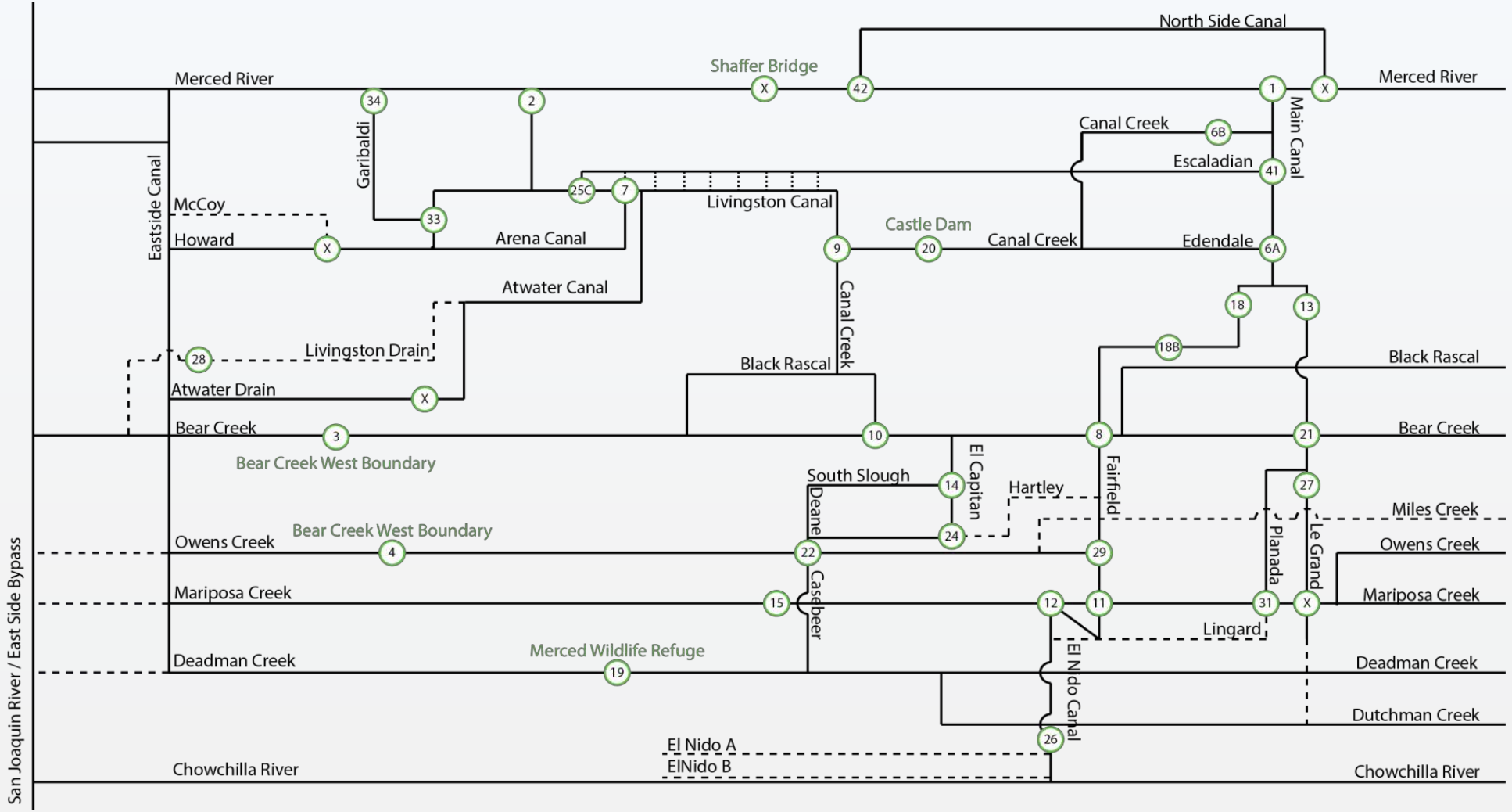
- 71 Stream Reaches
- 1548 Stream Nodes
- Gauged Stream Inflow

MID Canal Network

- Over 200 canals accounted for in grid
- Canal recharge based on canal size and lining



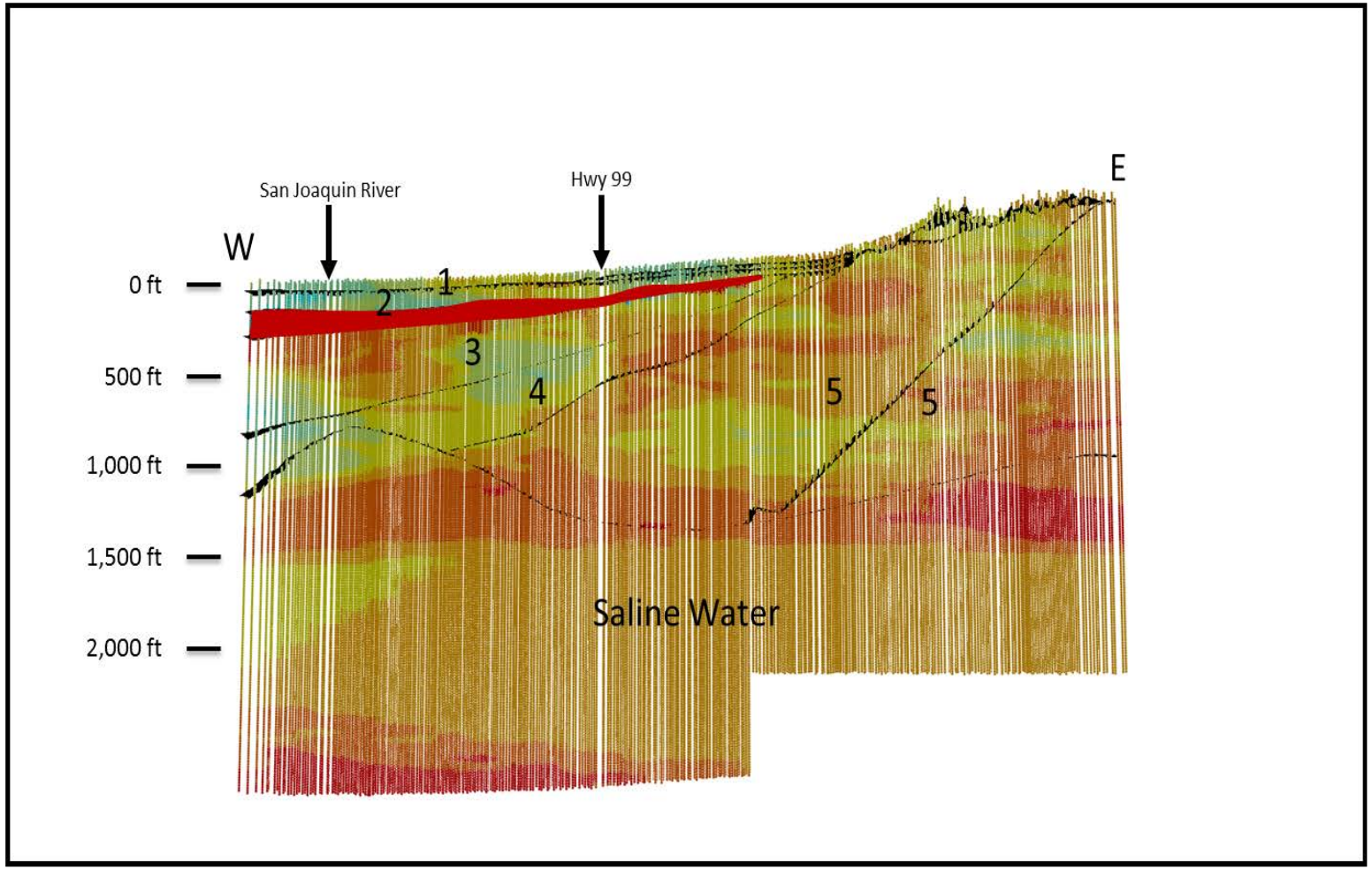
Stream Network



Geology / Hydrogeology

Source Data

- USGS
  - Page & Balding 1973
  - Page 1977
  - Digital Elevation Model
  - Corcoran Clay Depth
  - Corcoran Clay Thickness
  - USGS Texture Model
- C2VSim-2015
  - Base of Fresh Water
  - Continental Deposit



Model Stratigraphic Layering

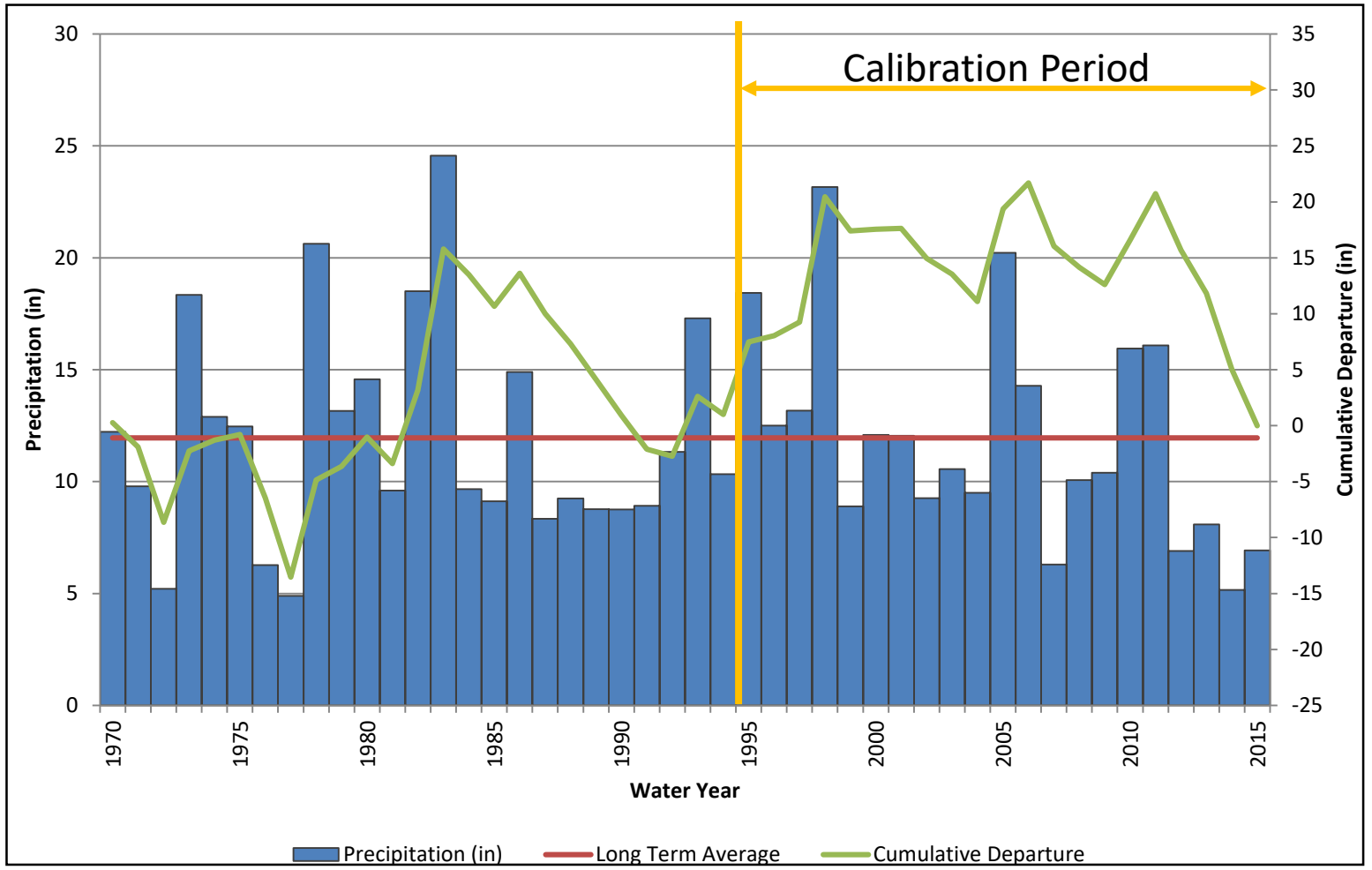
Merced WR Model Hydrology

Rain Gauges

- 3 local rain stations
- Daily data from 1967

PRISM

- 4 kilometer discretization
- 26,318 in California
- 620 in the MercedWRM
- Daily Data from 1921

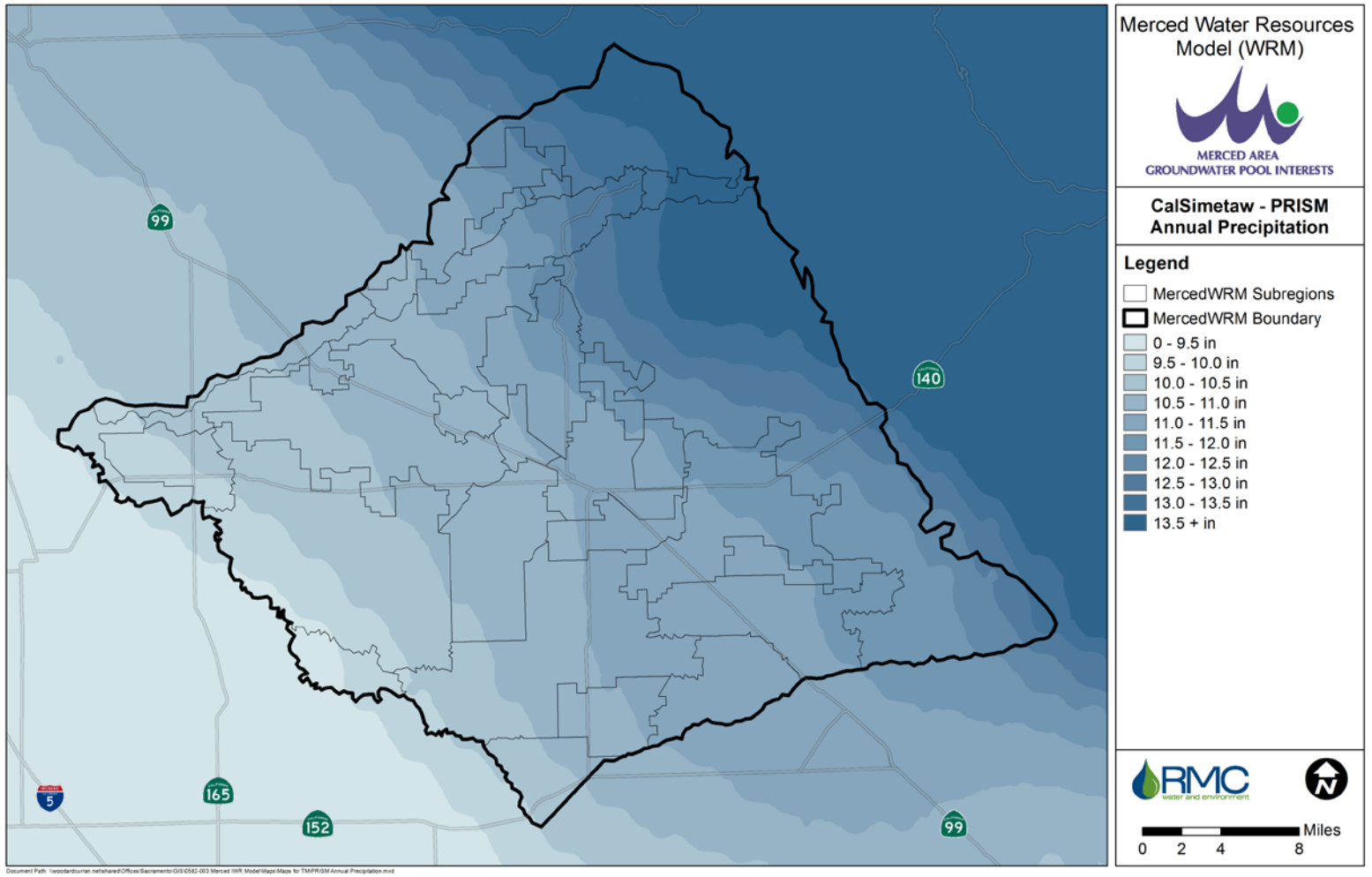


Merced WR Model Hydrology

Rainfall Distribution

Based on PRISM Model

(Oregon State University: **P**arameter-elevation **R**elationships on **I**ndependent **S**lopes **M**odel)



Water Demand Estimation (IDC)

- **Urban Water Demand**
  - **Basis:** Population, Per capita water use, water sales estimates/measurements, indoor/Outdoor ratios
  - **Sources of data:** UWMPs, Census

- **Agricultural Water Demand**
  - **Basis:** Land use, Crop acreage, ET estimates, precipitation
  - **Sources of data:** DWR land use surveys, Ag Commissioner Data, CropScape, ITRC METRIC, MID data, MID-WBM (Water Balance Model)

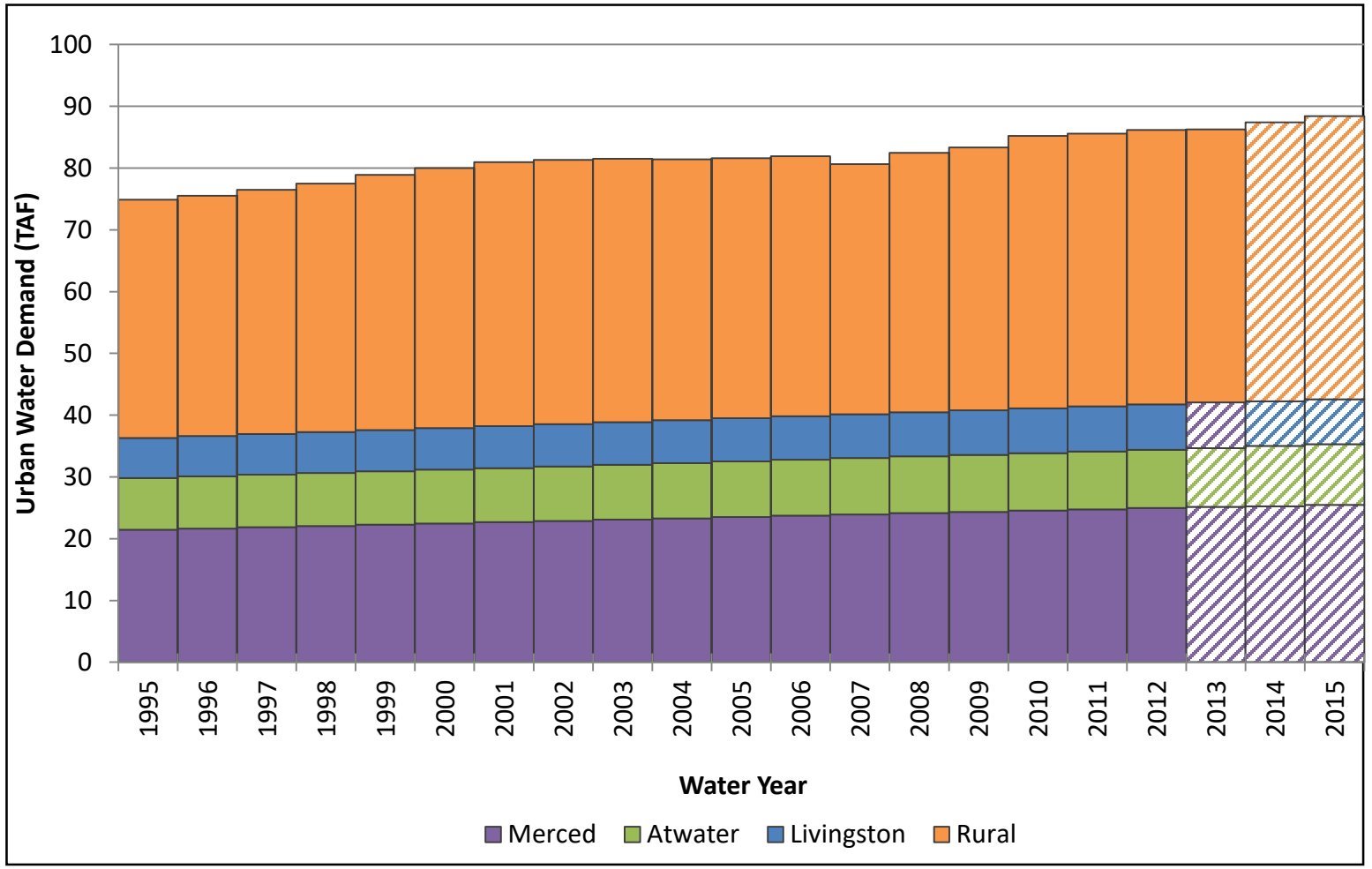
Estimation of Urban Water Demand

Urban Components

- Population
- Per-Capita Water Use

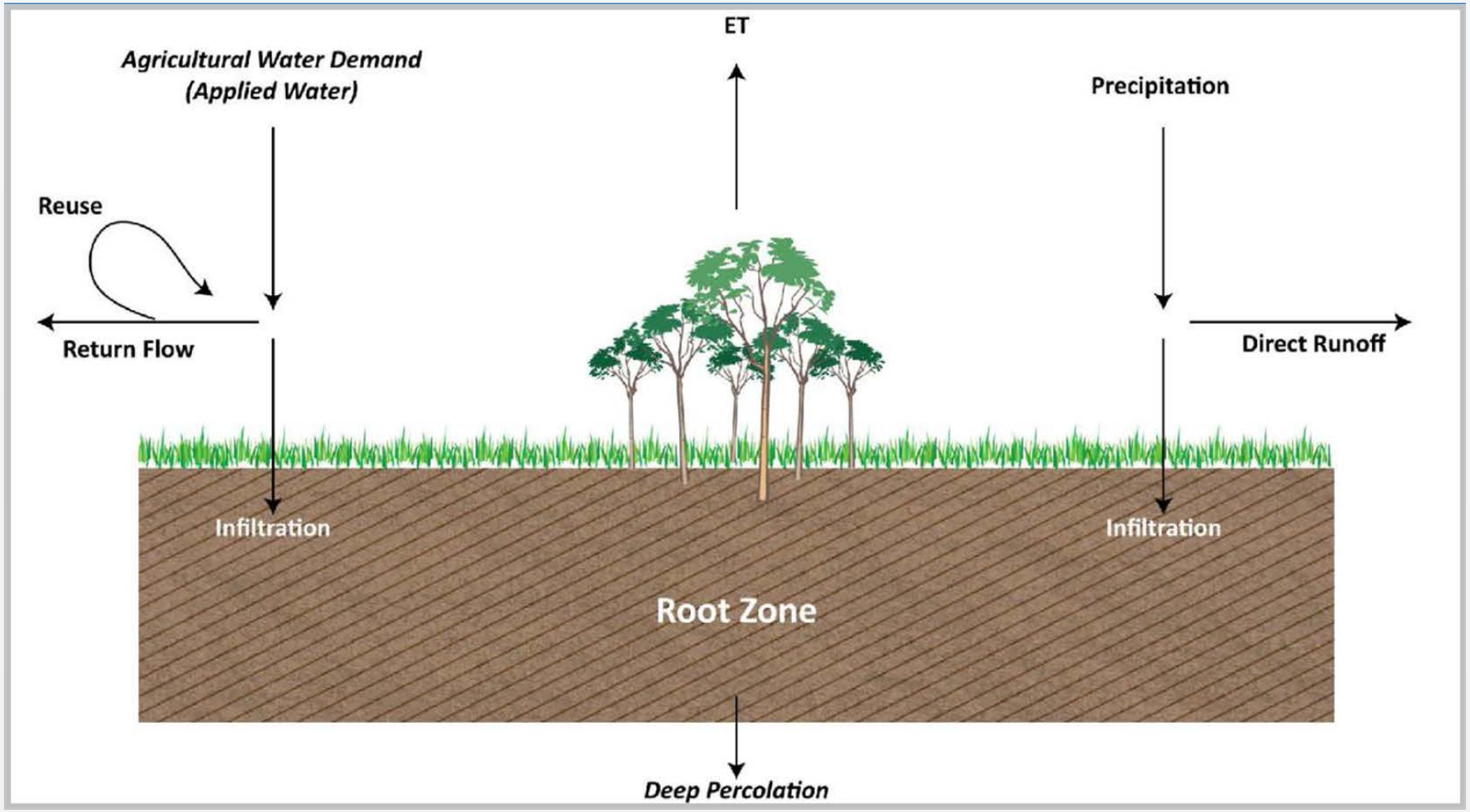
Available Data

- Census Data
- Municipal Groundwater Production Records

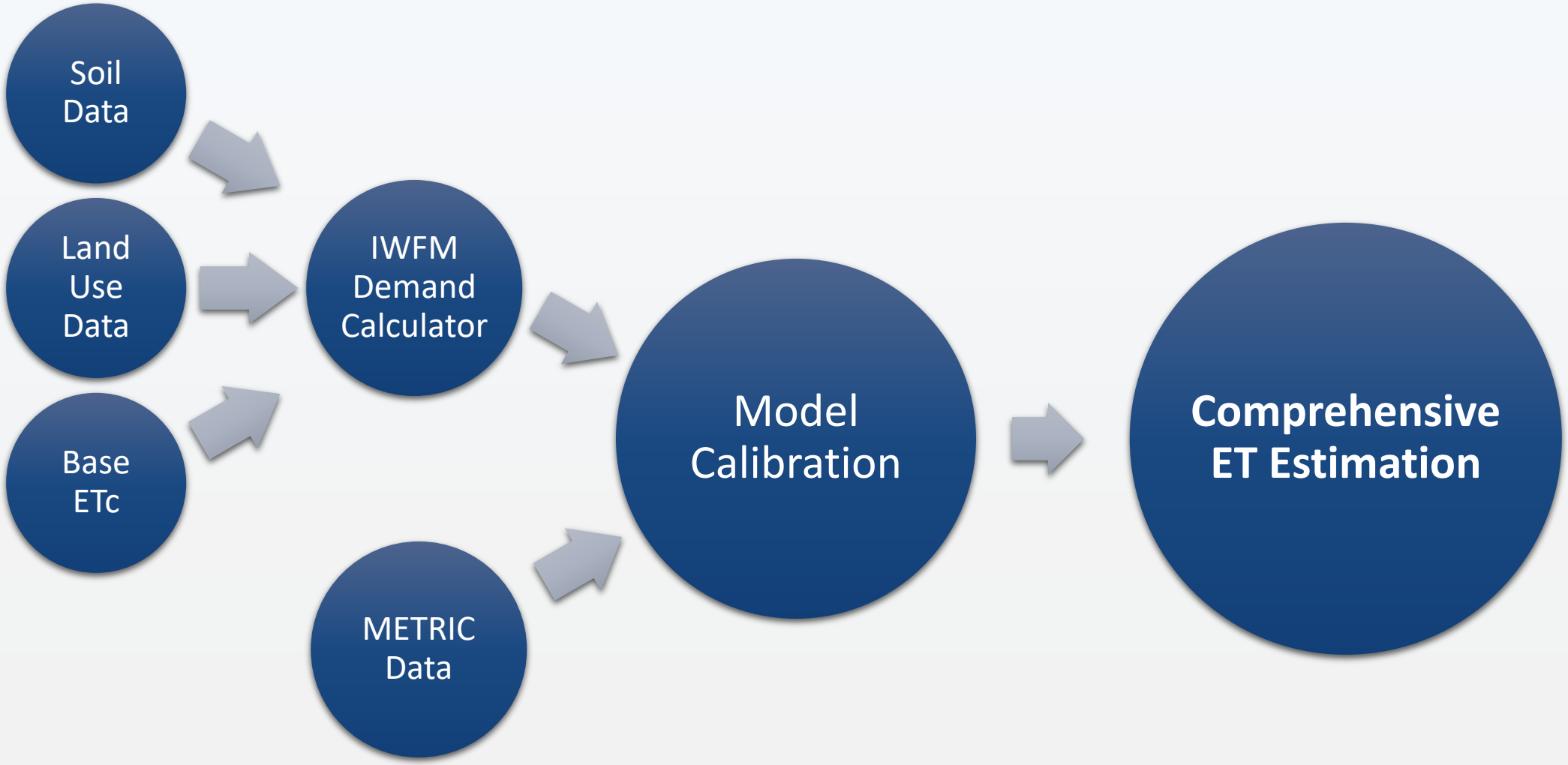


*Hatched fill indicates estimated values

Estimation of Agricultural Water Demand



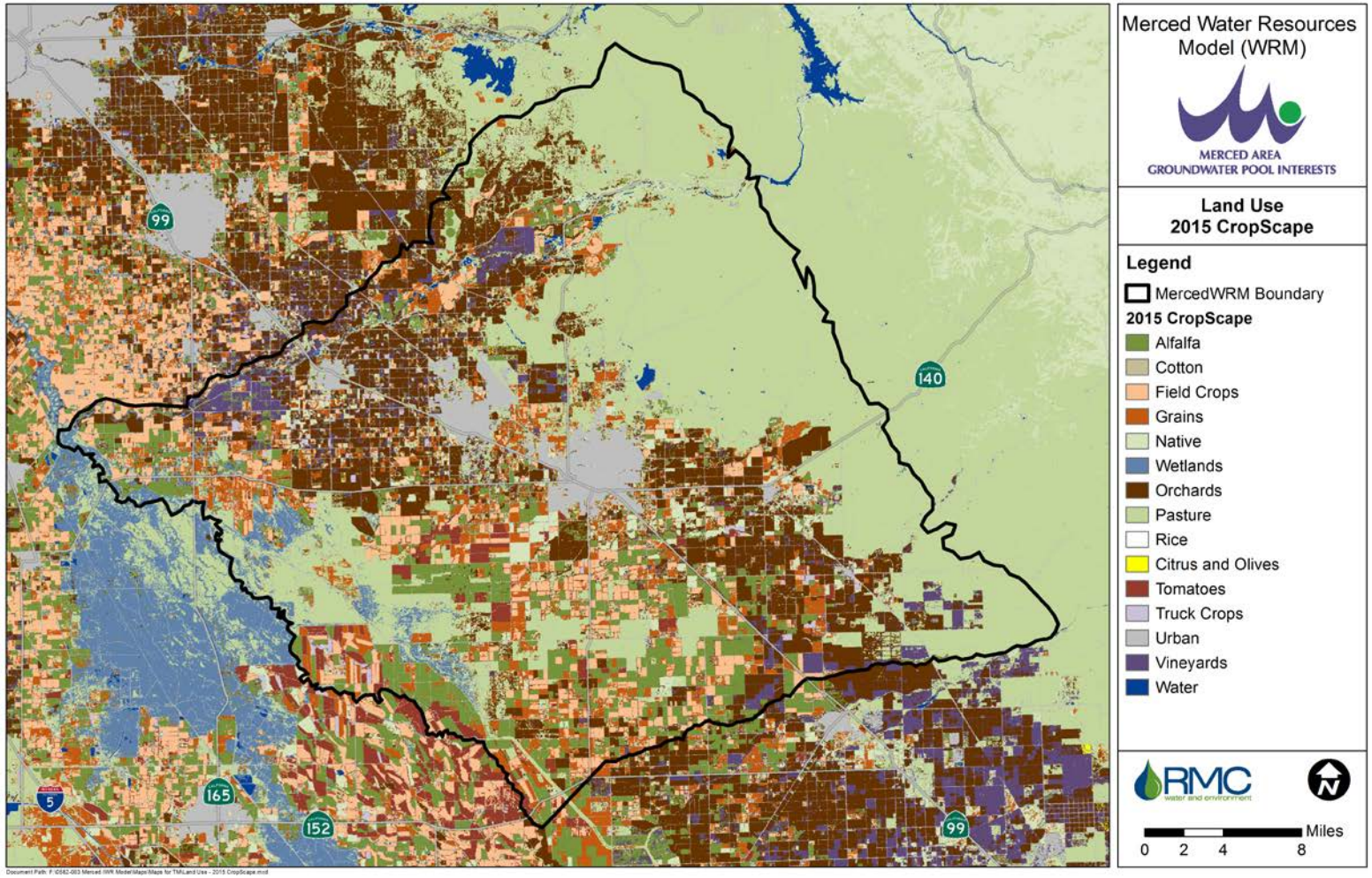
Estimation of Agricultural Water Demand



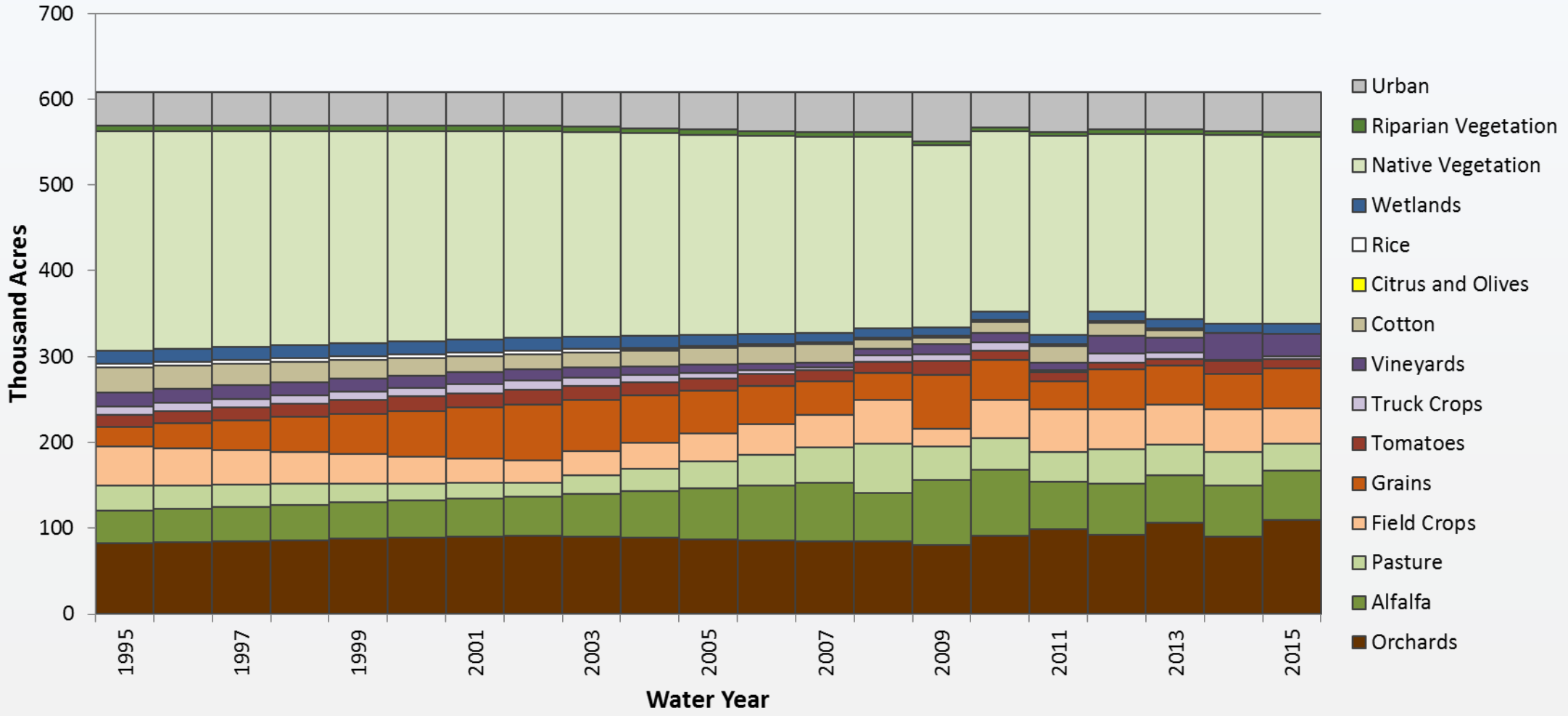
Land Use

Available Data

- DWR Land Use Surveys
  - 1995, 2002, 2012
- USDA NASS CropScape
  - 2007 – 2015
- Other Data Sources
  - MID Annual Reports
  - Merced County Ag Commissioner Reports



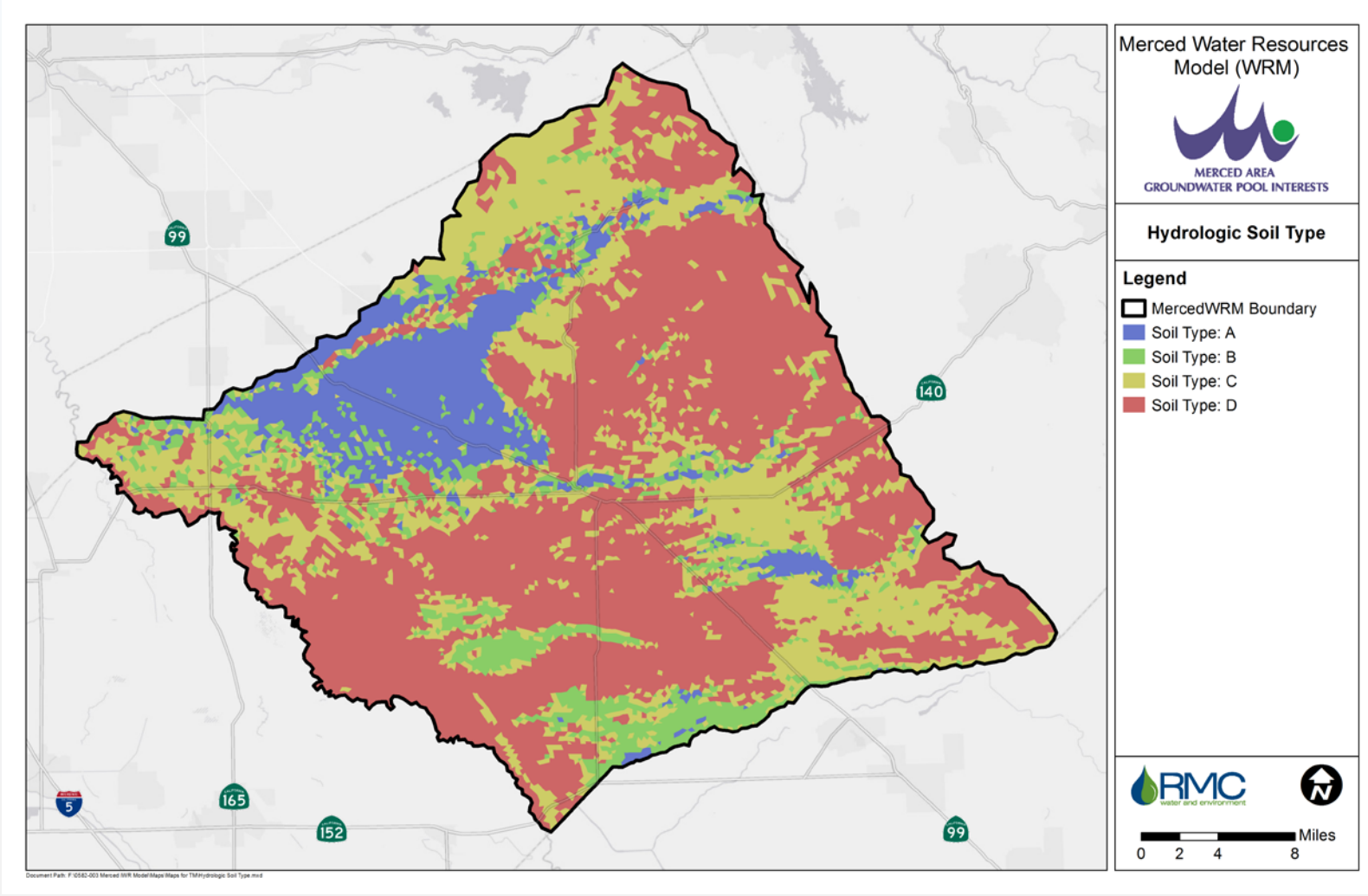
Land Use – MAGPI Area



Soil Parameters

SURGO

- Elemental Discretization
- Soil Hydrologic Group
- Input Parameters
  - Hydraulic Conductivity
  - Pour Size Distribution Index
  - Total Porosity
  - Field Capacity
  - Wilting Point



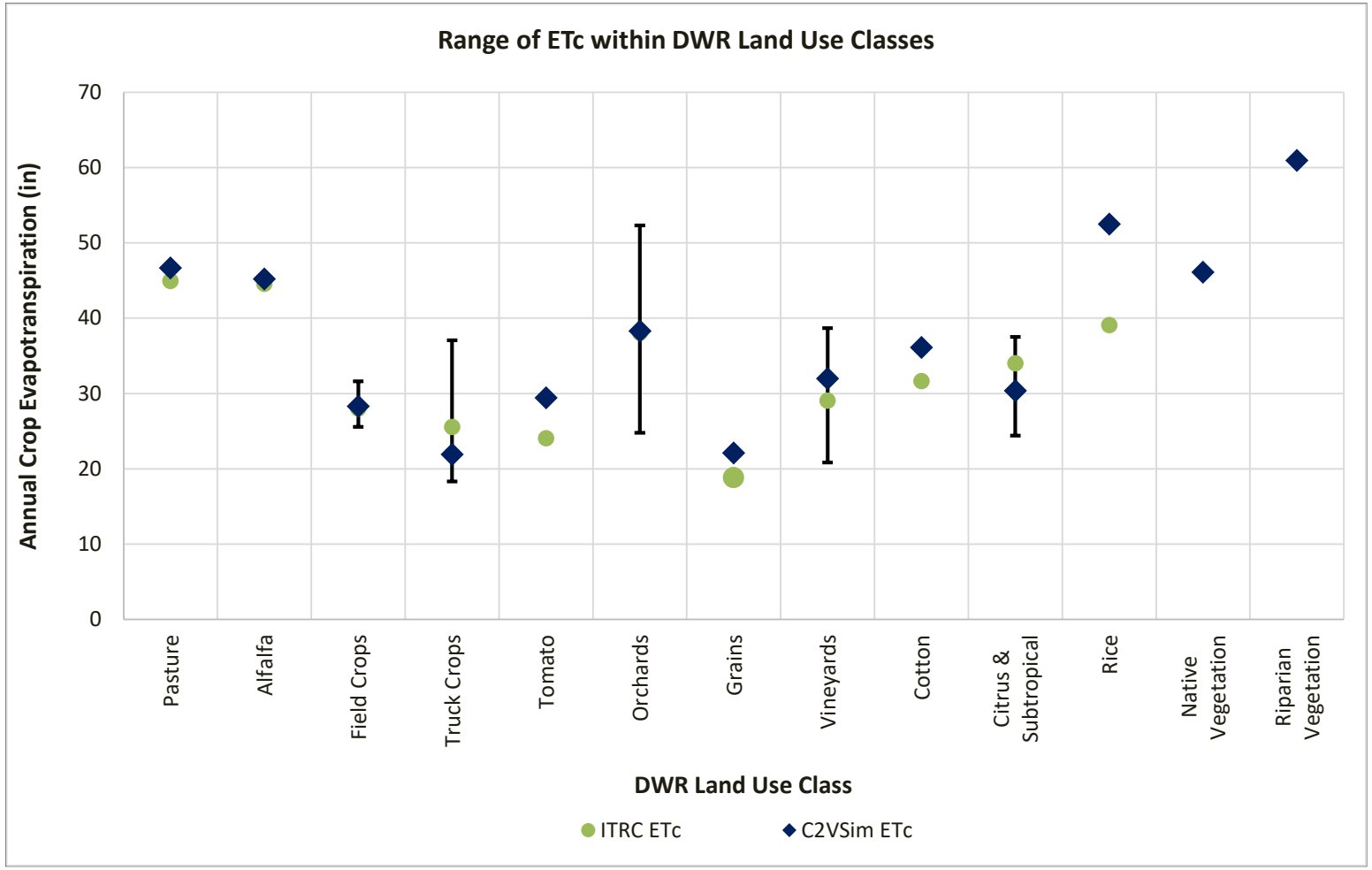
Soil Parameters

Reference Evapotranspiration

- Valiance in data gives offers range for model calibration.

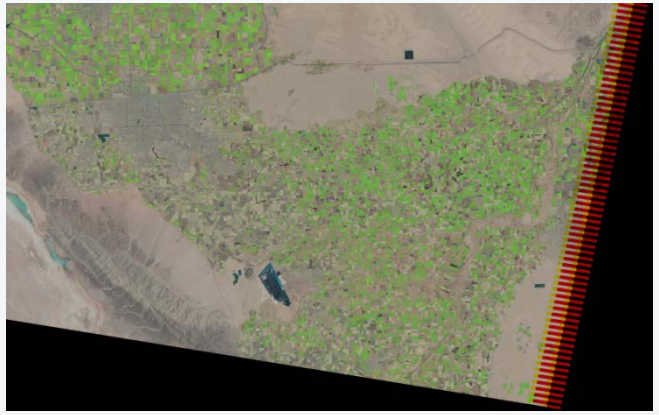
Data Sources

- C2VSimFG
- CIMIS
- ITRC

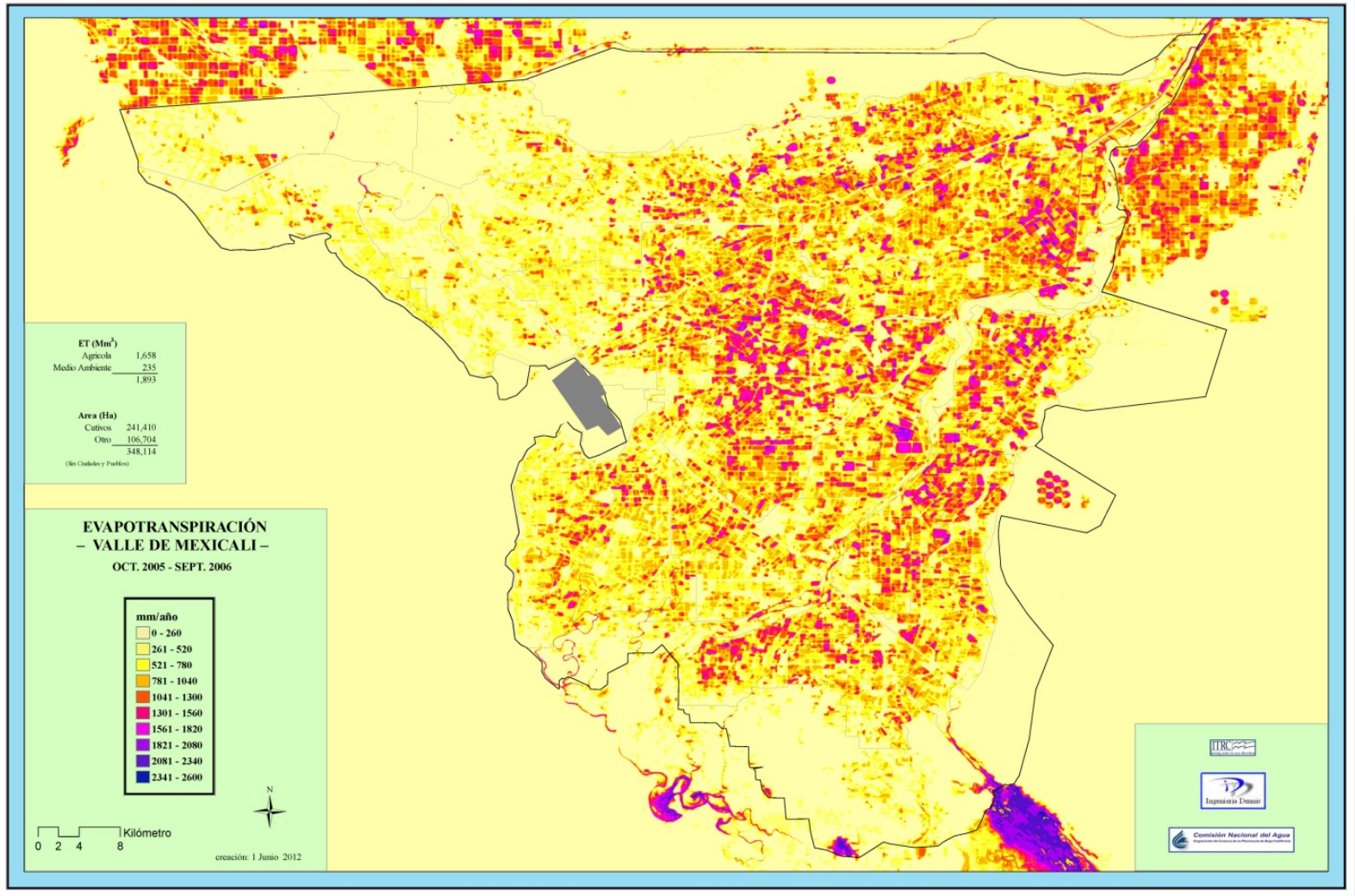


Estimation of Agricultural Water Demand

LandSAT Image



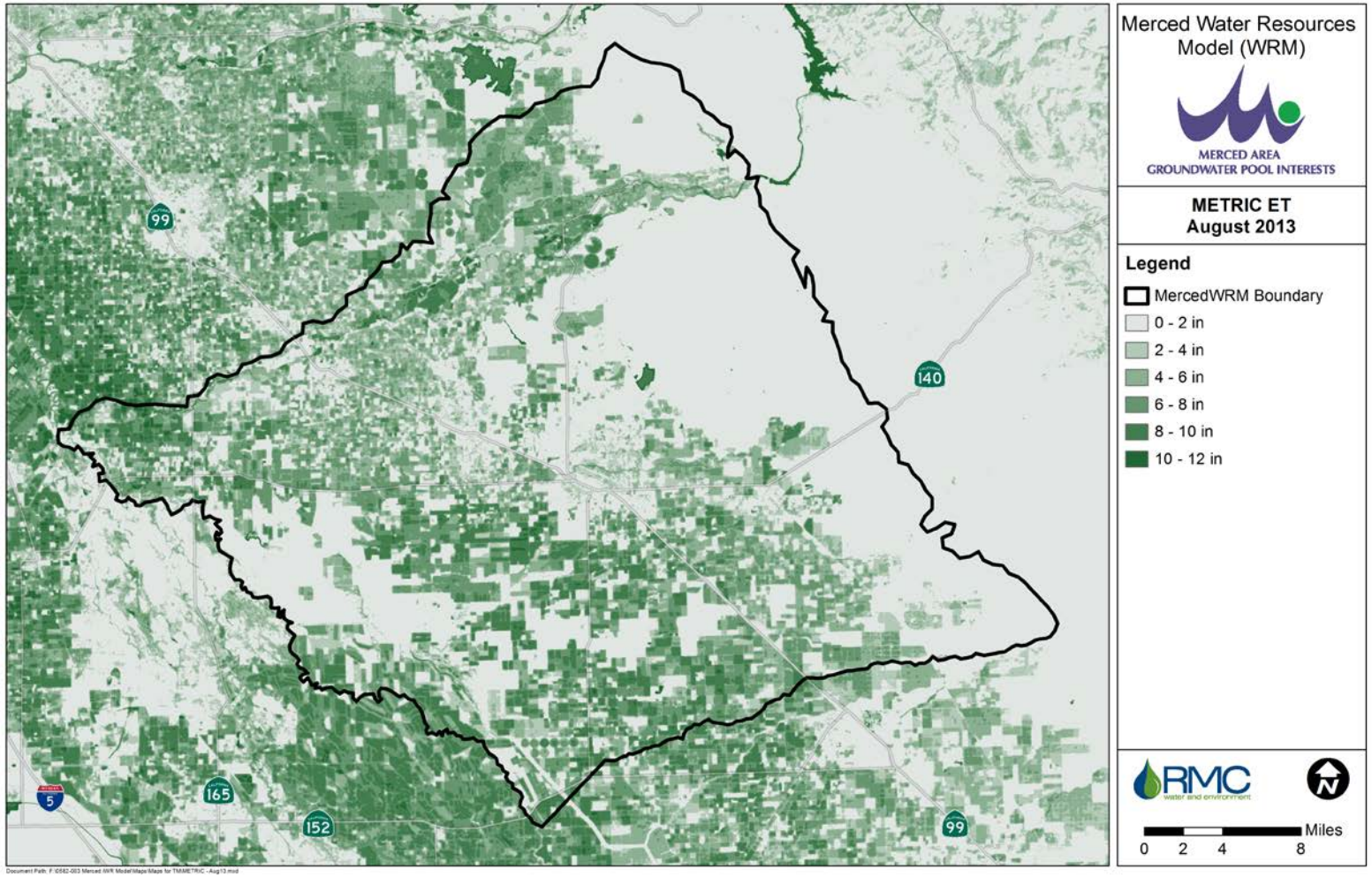
ITRC-METRIC Model Computations



Estimation of Agricultural Water Demand

METRIC Process

- Base Data
  - 30 Meter Grid
  - Available Monthly
- Processed Data
  - Subregional Aggregation
  - Used as calibration tool for IWFM Demand Calculator



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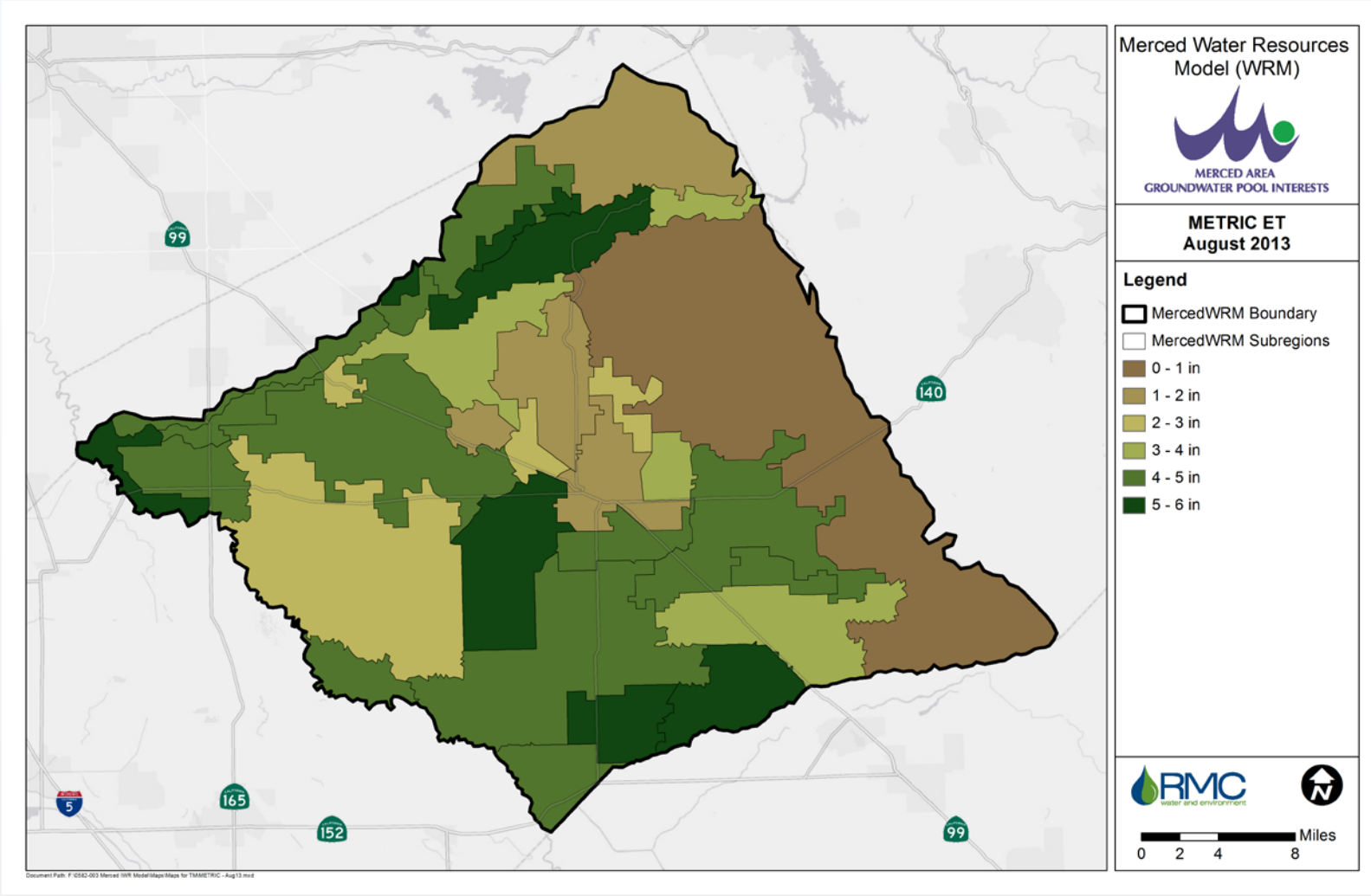
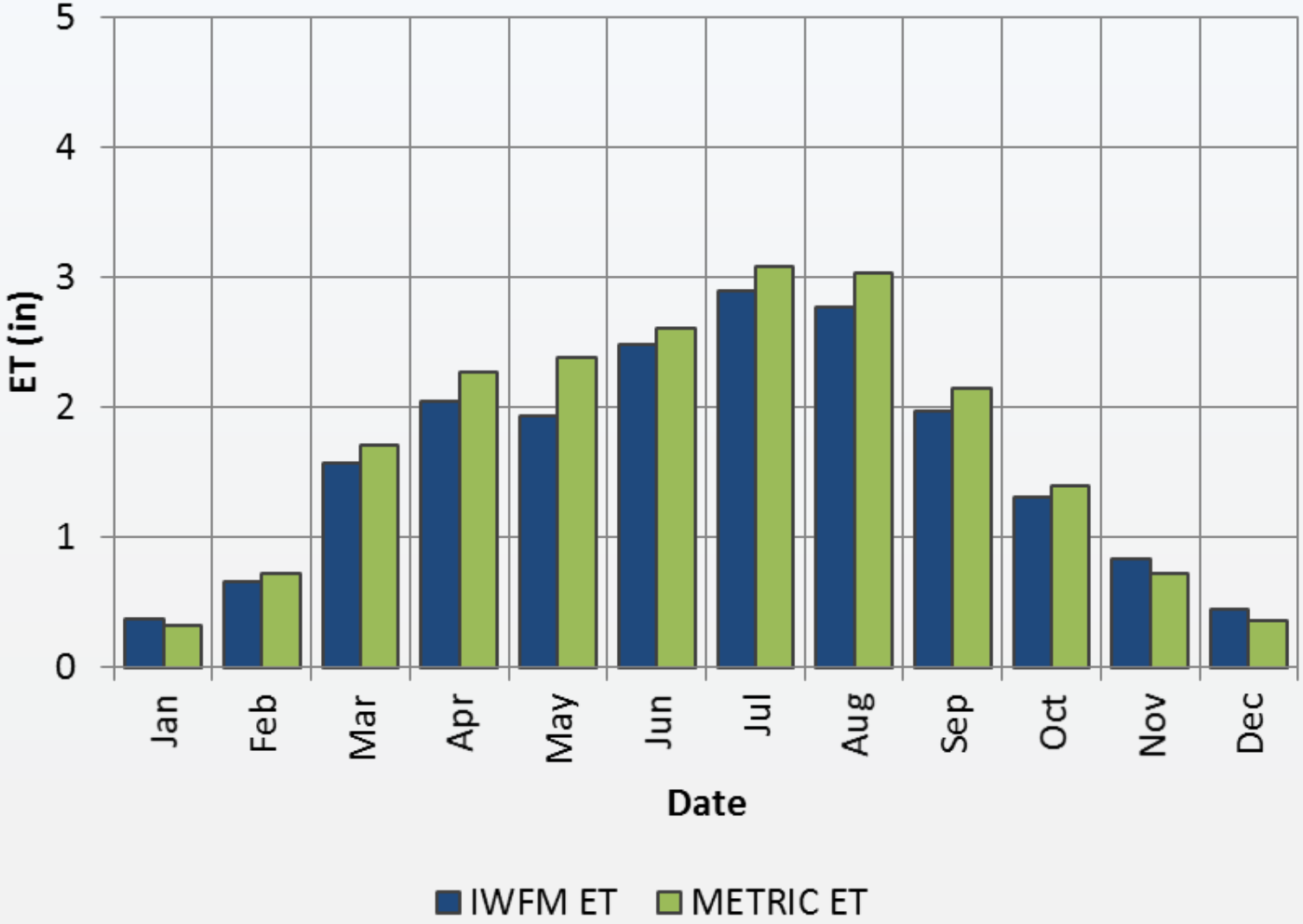
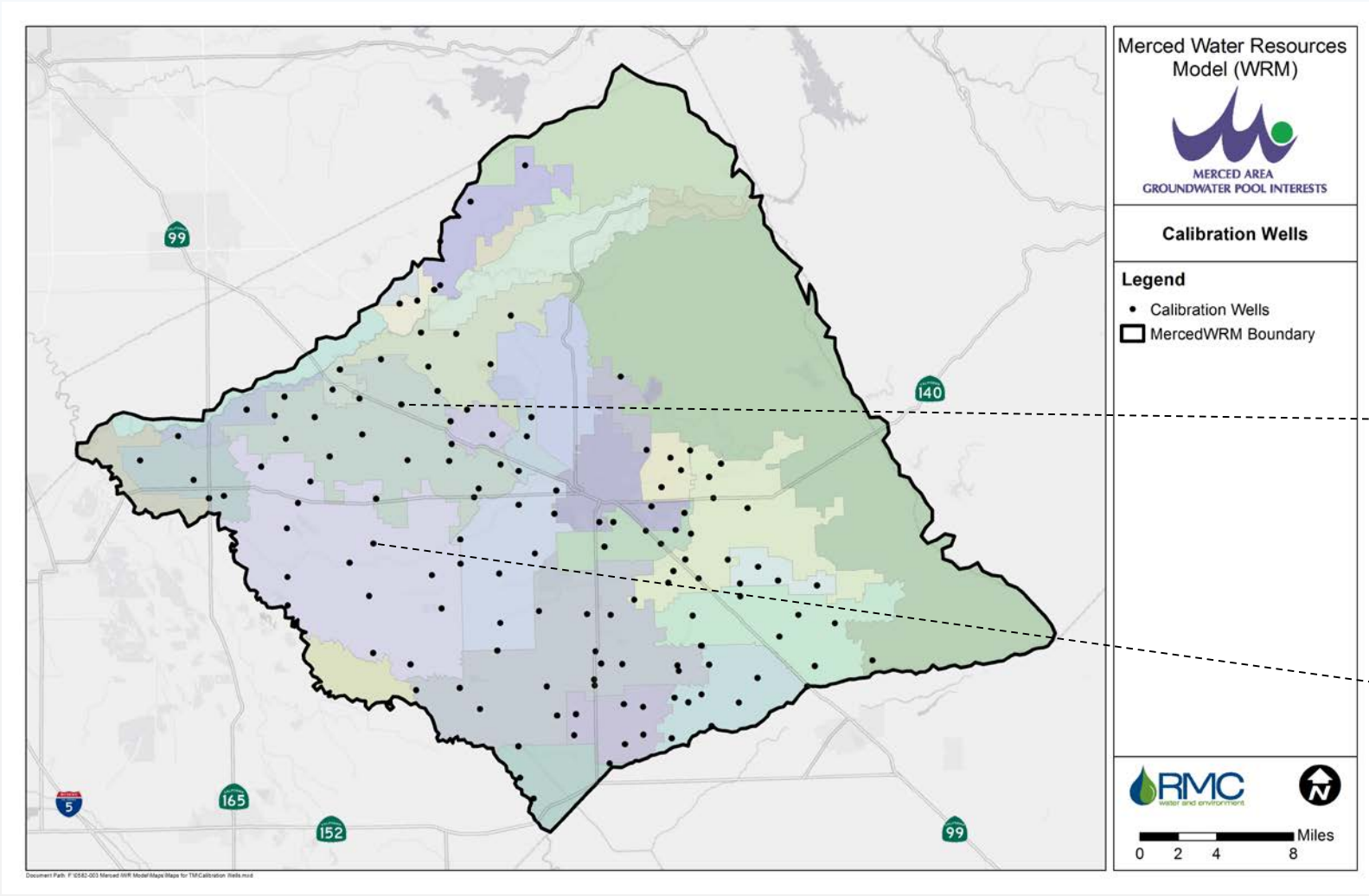
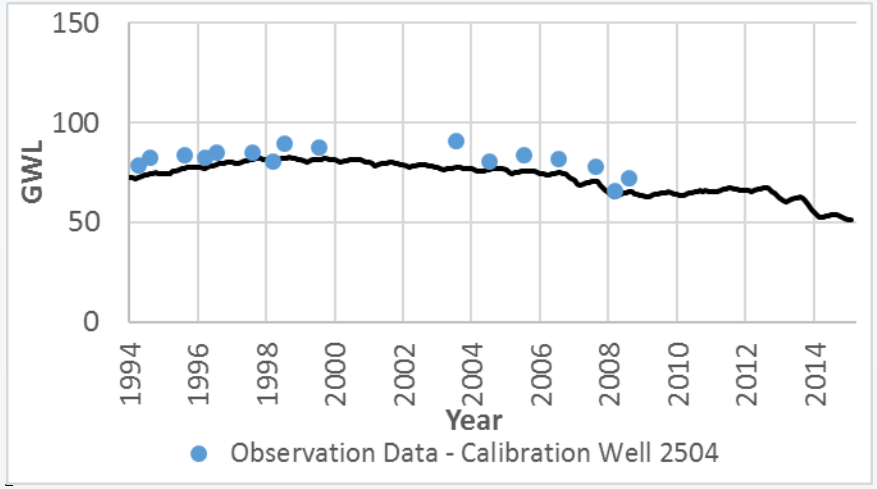


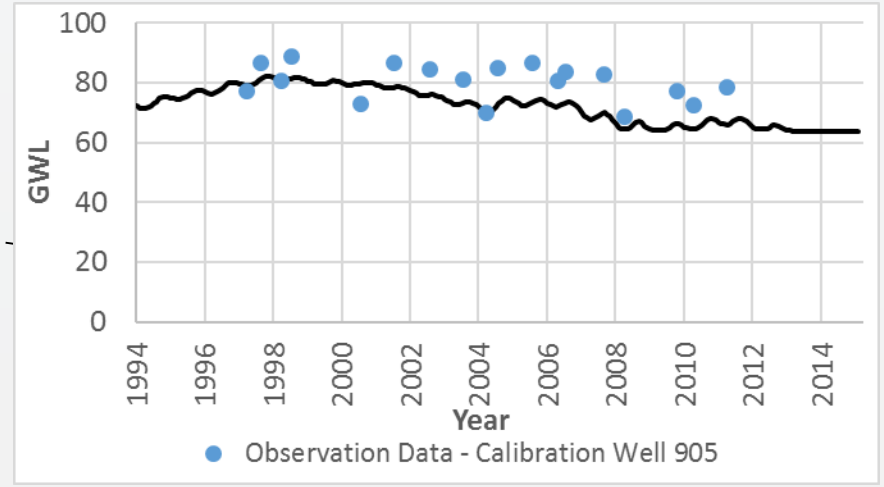
Estimation of Agricultural Water Demand- MAGPI Area



Model Calibration: Groundwater Levels







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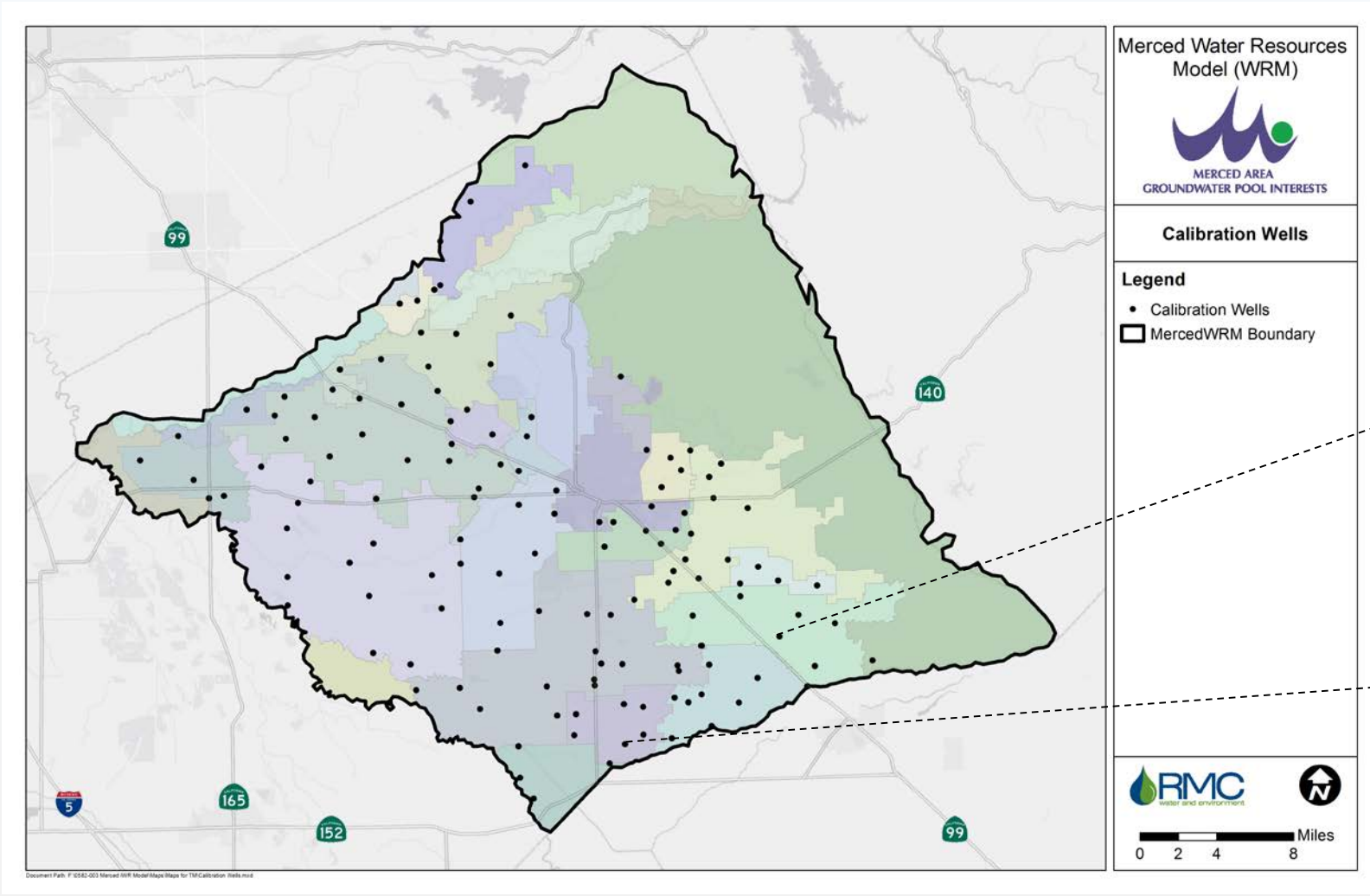
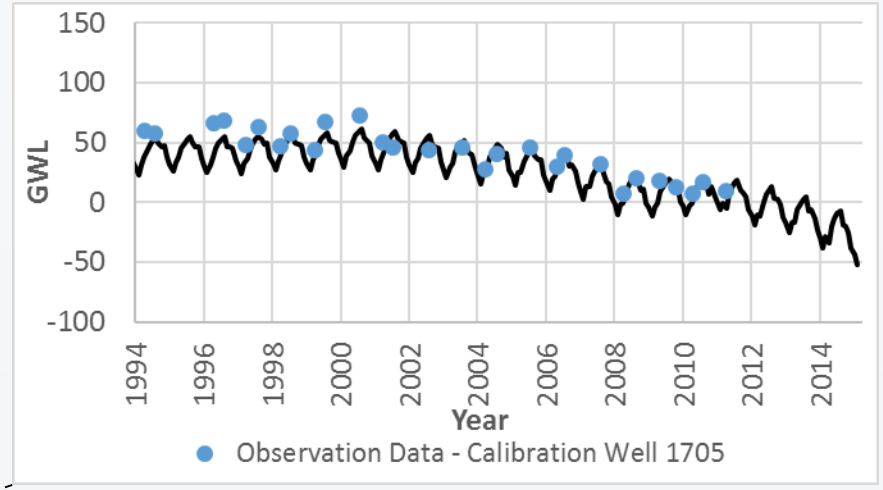
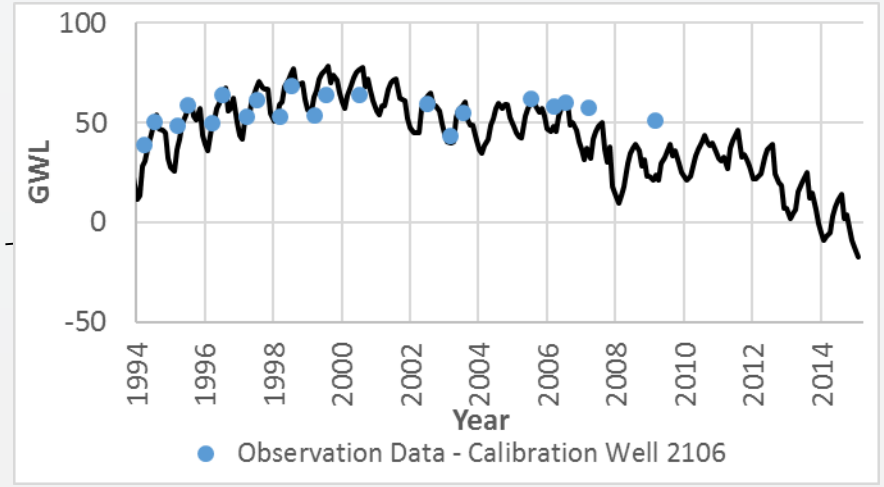
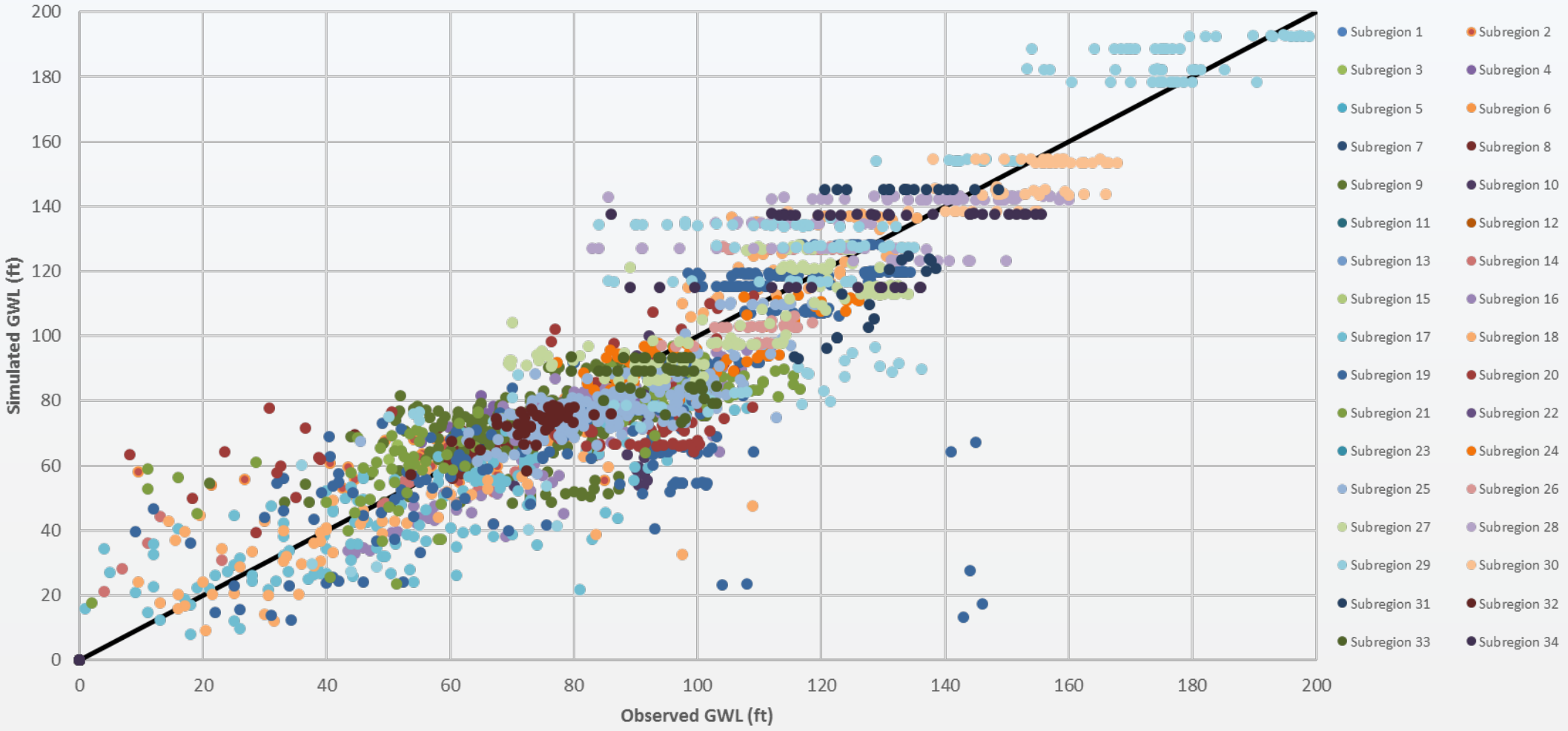


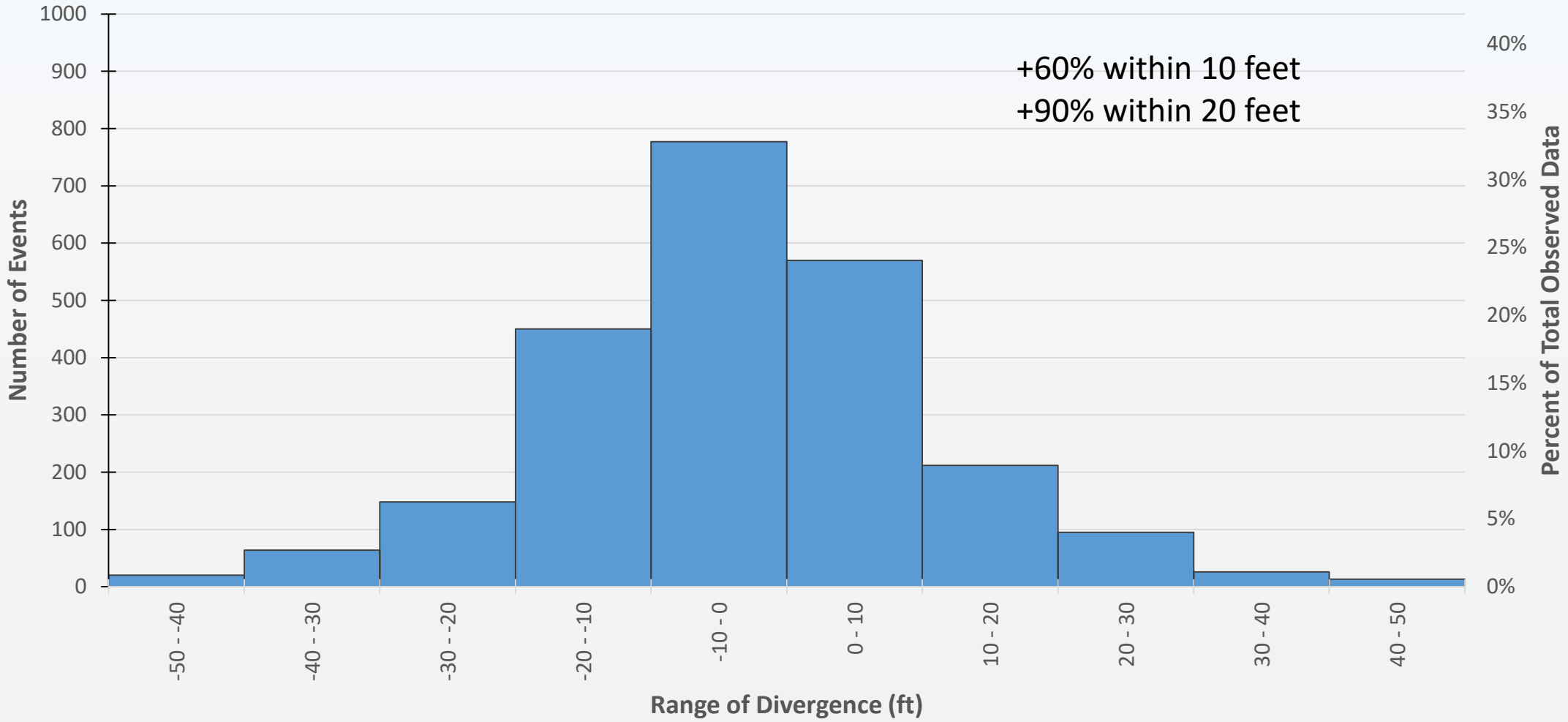




Model Calibration: Statistics



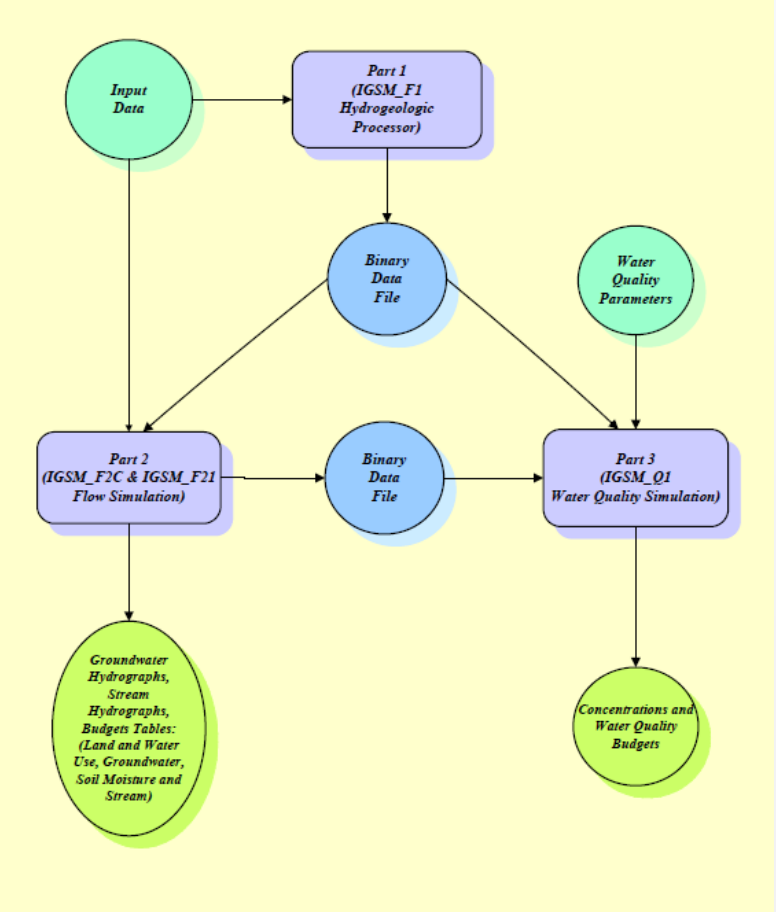
Model Calibration: Statistics



Merced Water Quality Model

Water Quality Framework

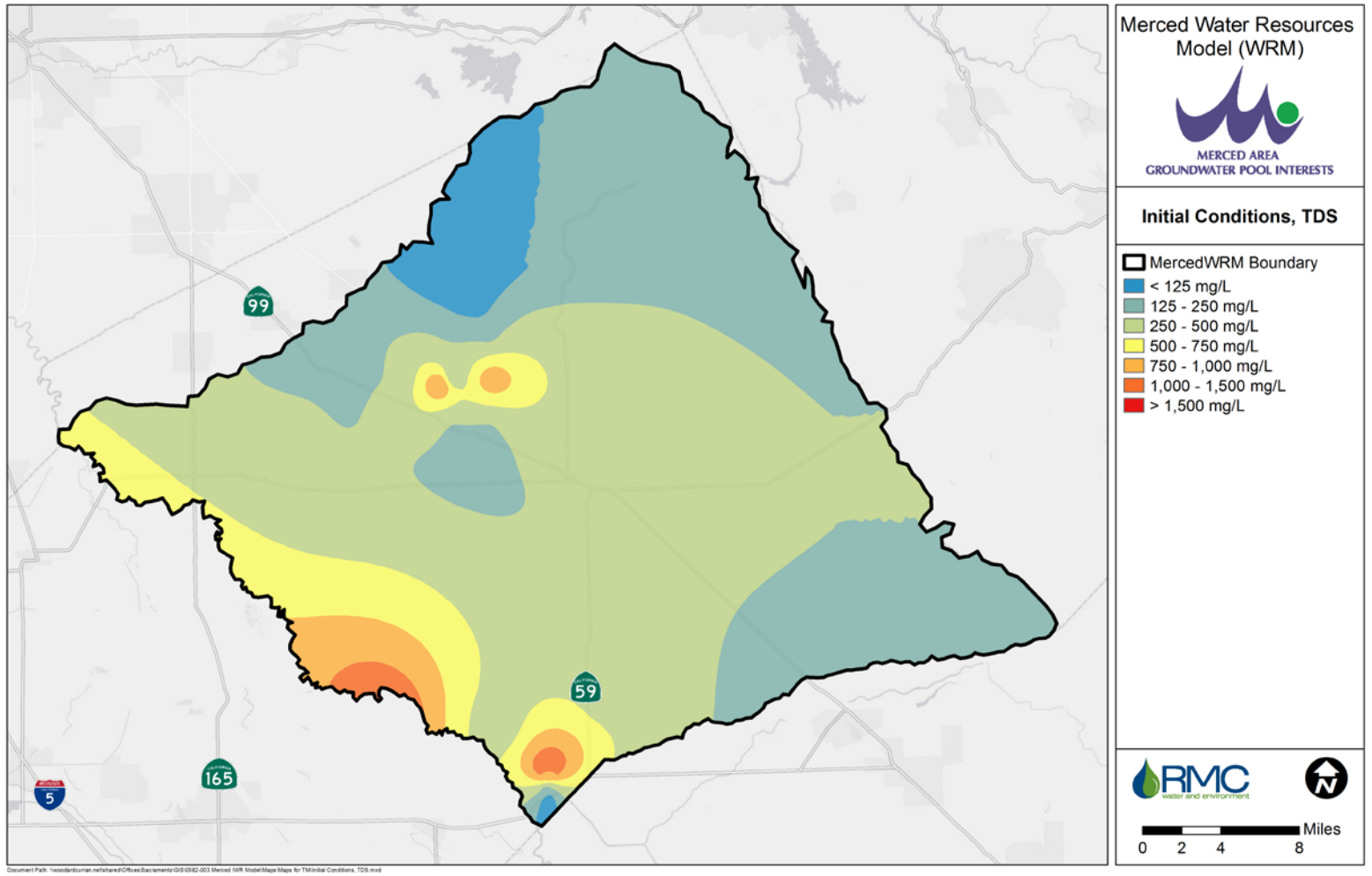
- A quasi 3-D solute transport model that simulates the advective-dispersive movement of conservative substances in the groundwater system



Merced Water Quality Model: TDS

Model Assumptions

- Boundary Conditions
  - North: 196 mg/L
  - West: 1,500 mg/L
  - South: 209 mg/L
- Surface Loading
  - Ag: 1,000 lbs/acre
  - Urban: 500 lbs/acre
- Stream Quality
  - Rivers: 35 mg/L
  - Canals: 50 mg/L



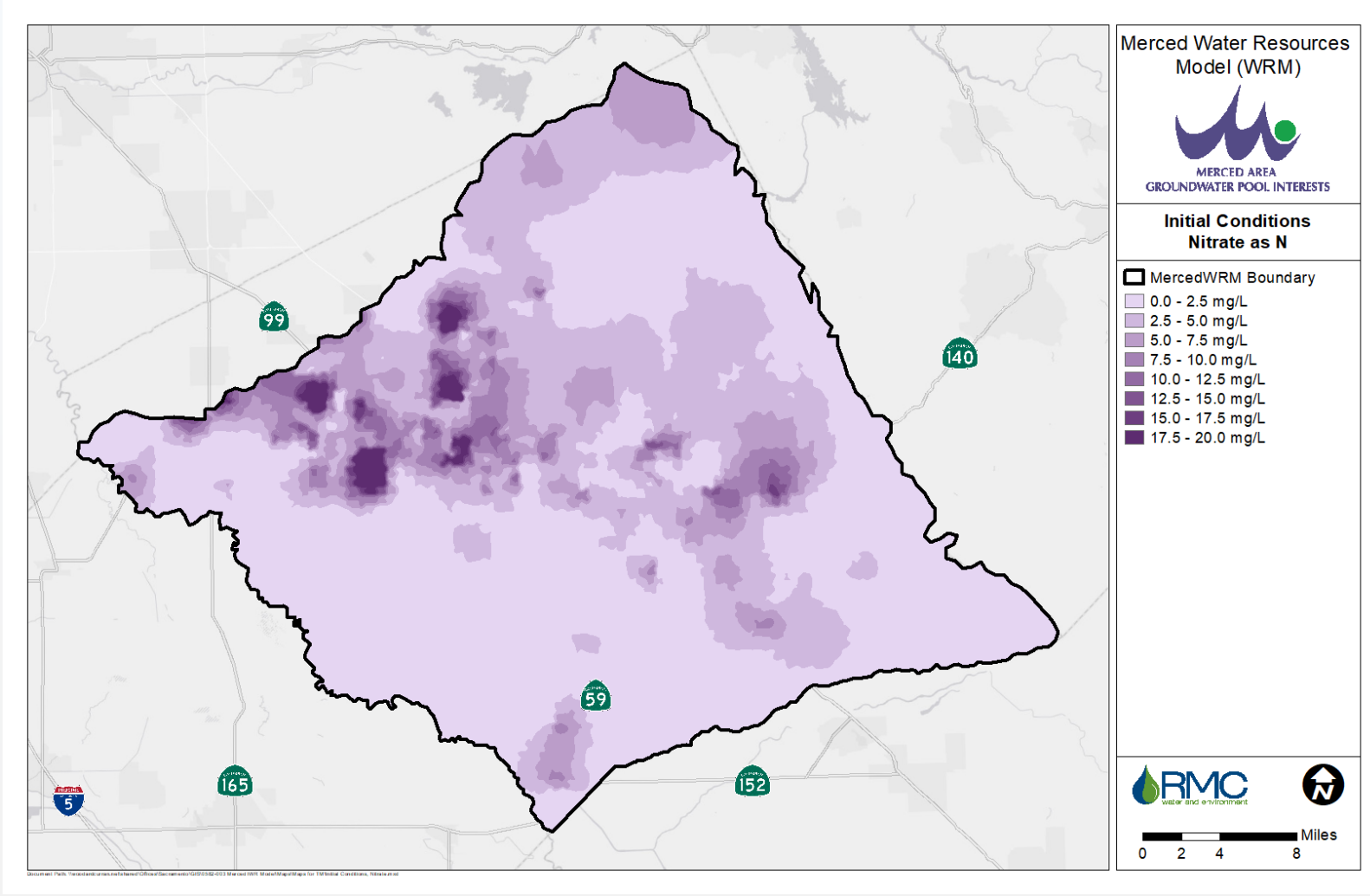
Merced Water Quality Model: Nitrate as N

Model Assumptions

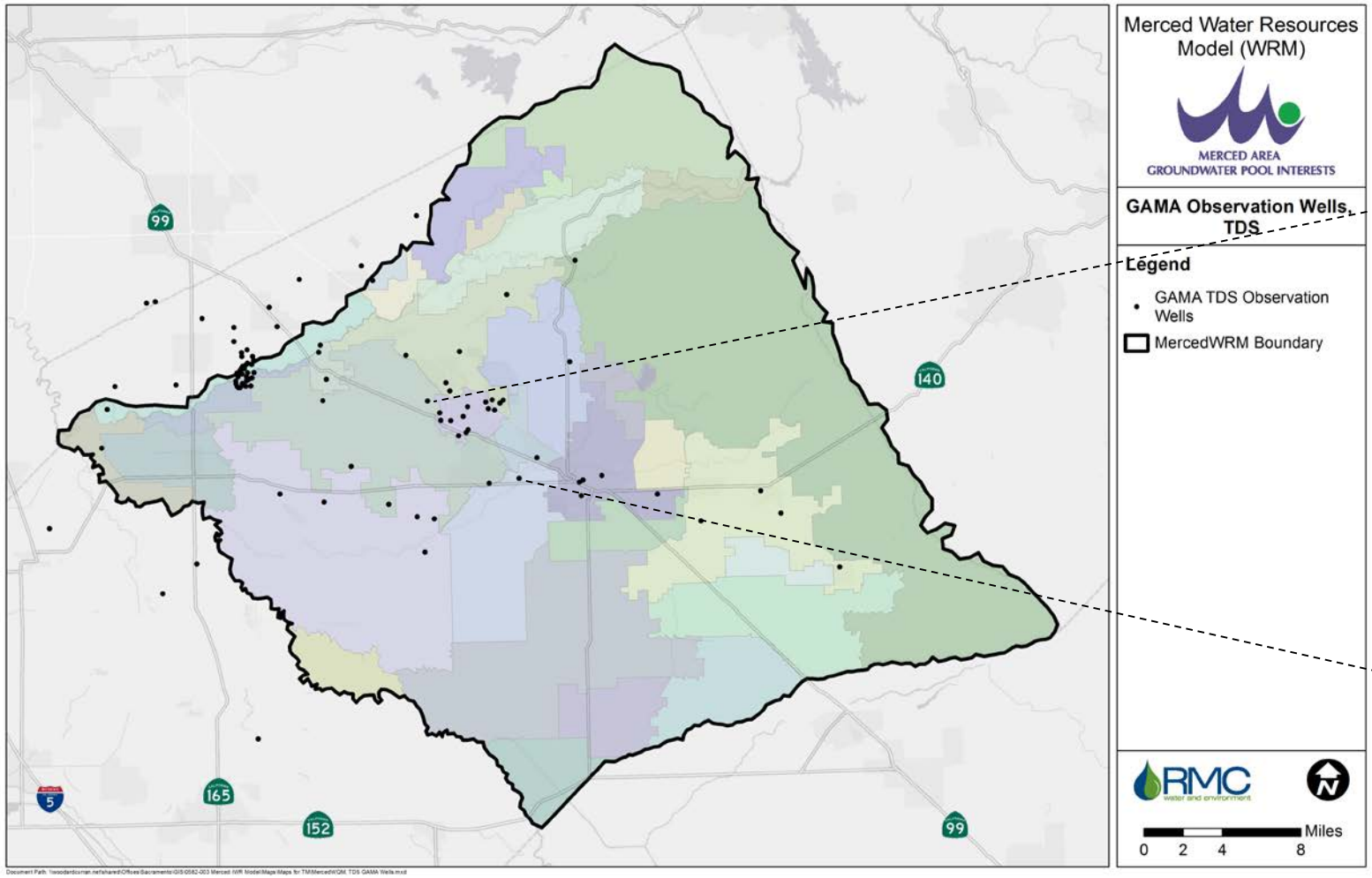
- Boundary Conditions
  - North: 6.84 mg/L
  - West: 1.14 mg/L
  - South: 0.70 mg/L
- Surface Loading
  - Ag: 1,000 lbs/acre
  - Urban: 500 lbs/acre

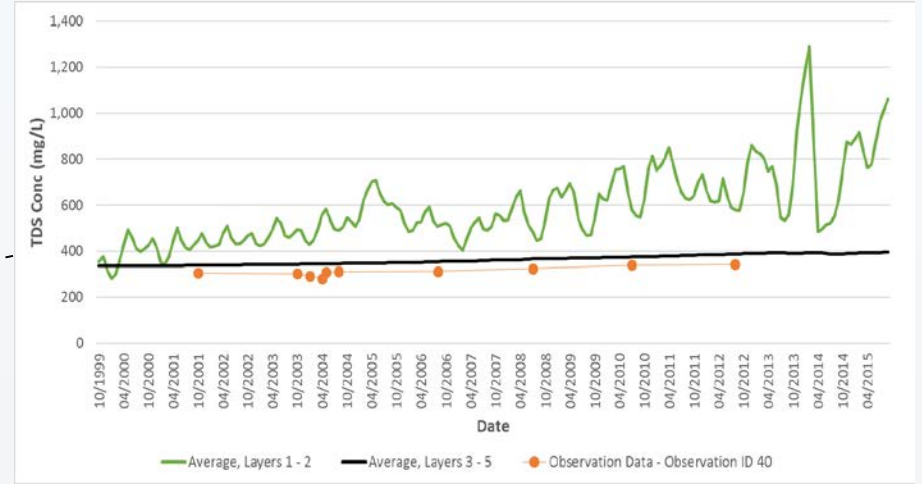
Stream Quality

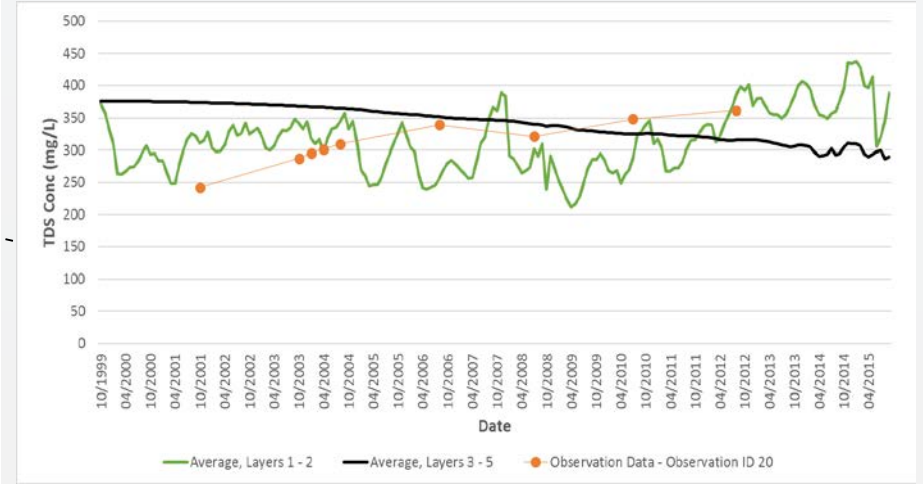
- Rivers: 3.5 mg/L
- Canals: 5.0 mg/L



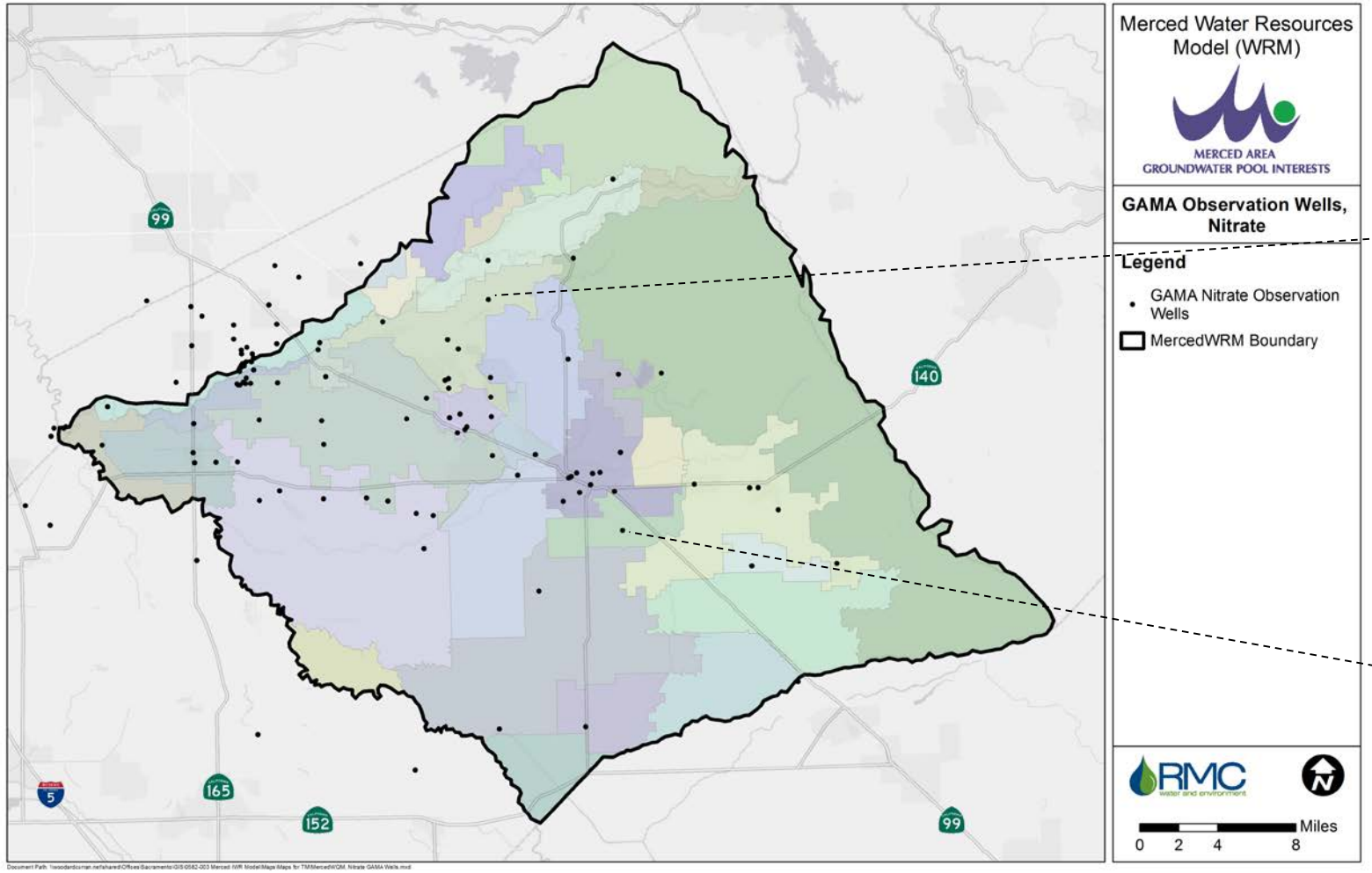
WQ Model: Sample TDS Chemo-graphs







WQ Model: Sample Nitrate Chemo-graphs



Merced Water Resources Model (WRM)

MERCED AREA GROUNDWATER POOL INTERESTS

GAMA Observation Wells, Nitrate

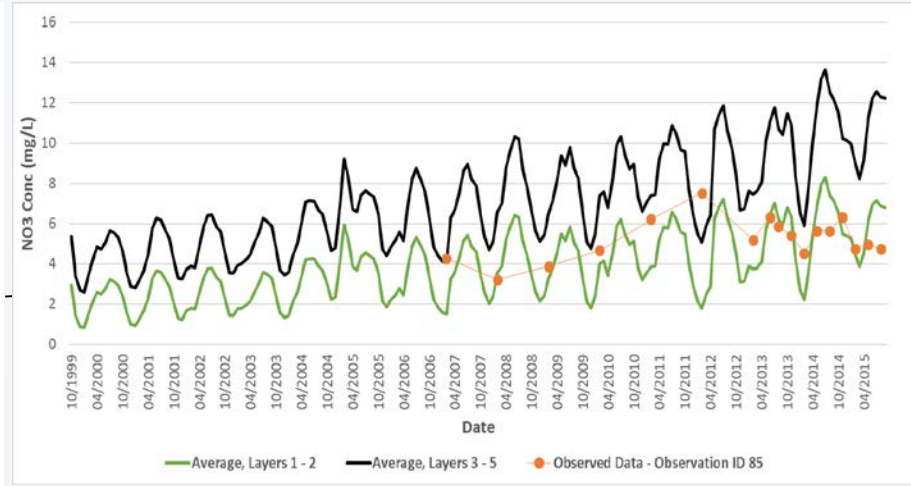
Legend

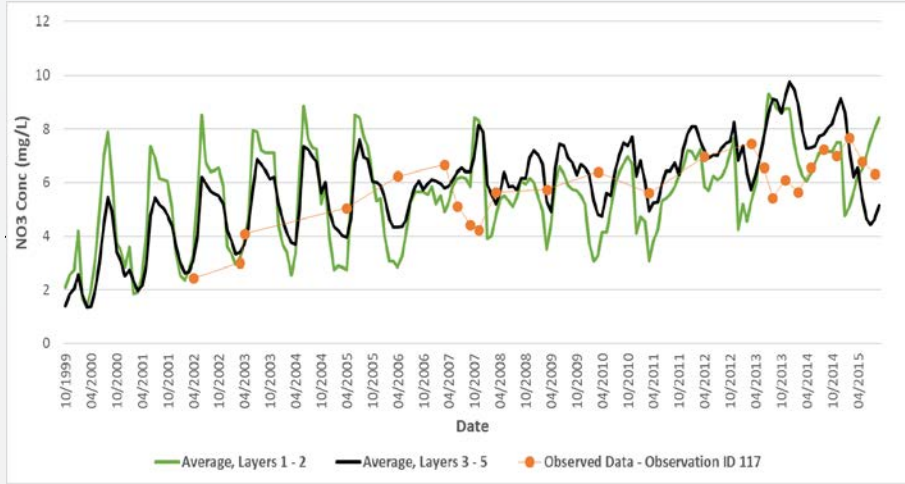
- GAMA Nitrate Observation Wells
- MercedWRM Boundary

RMC water and environment

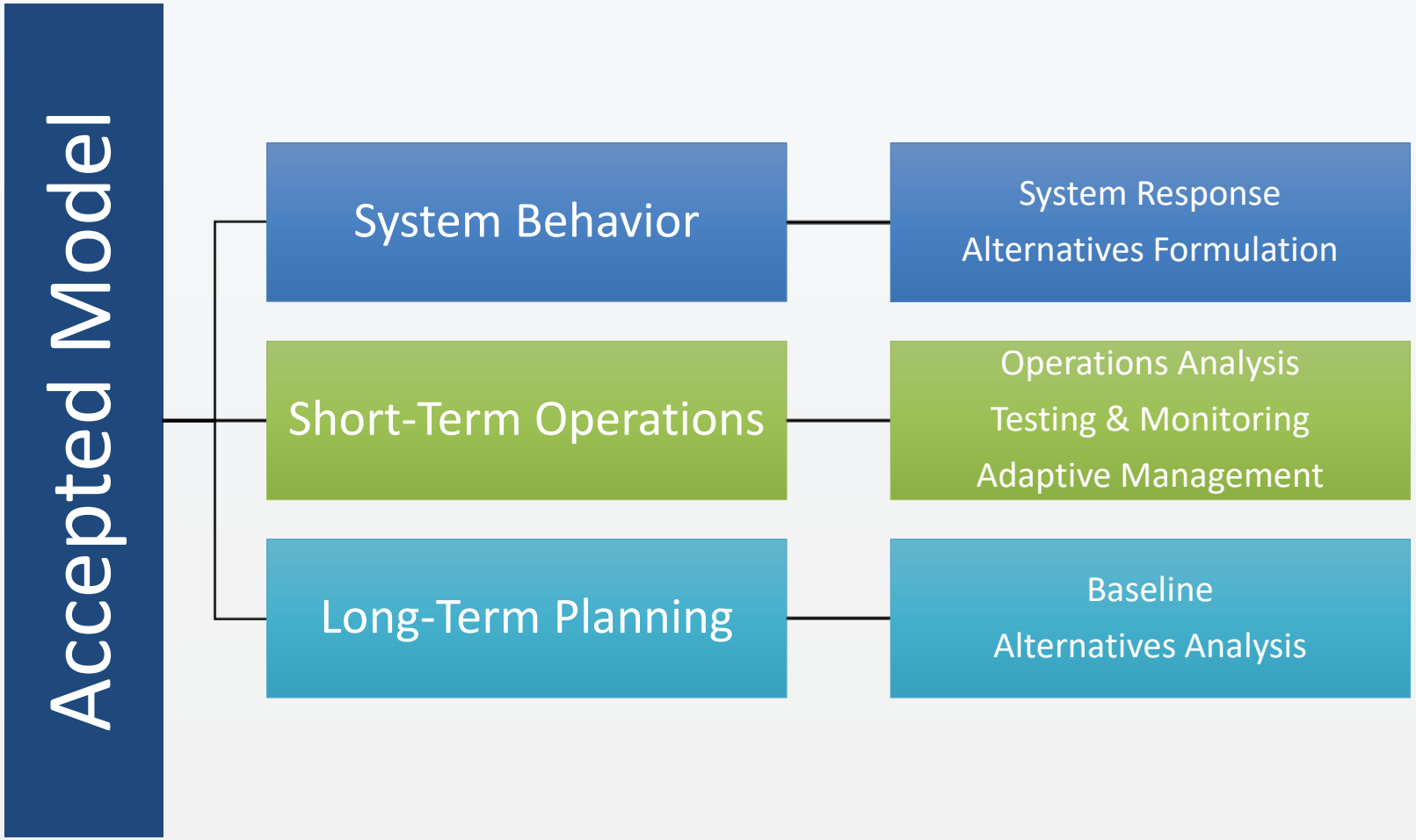
Miles

0 2 4 8





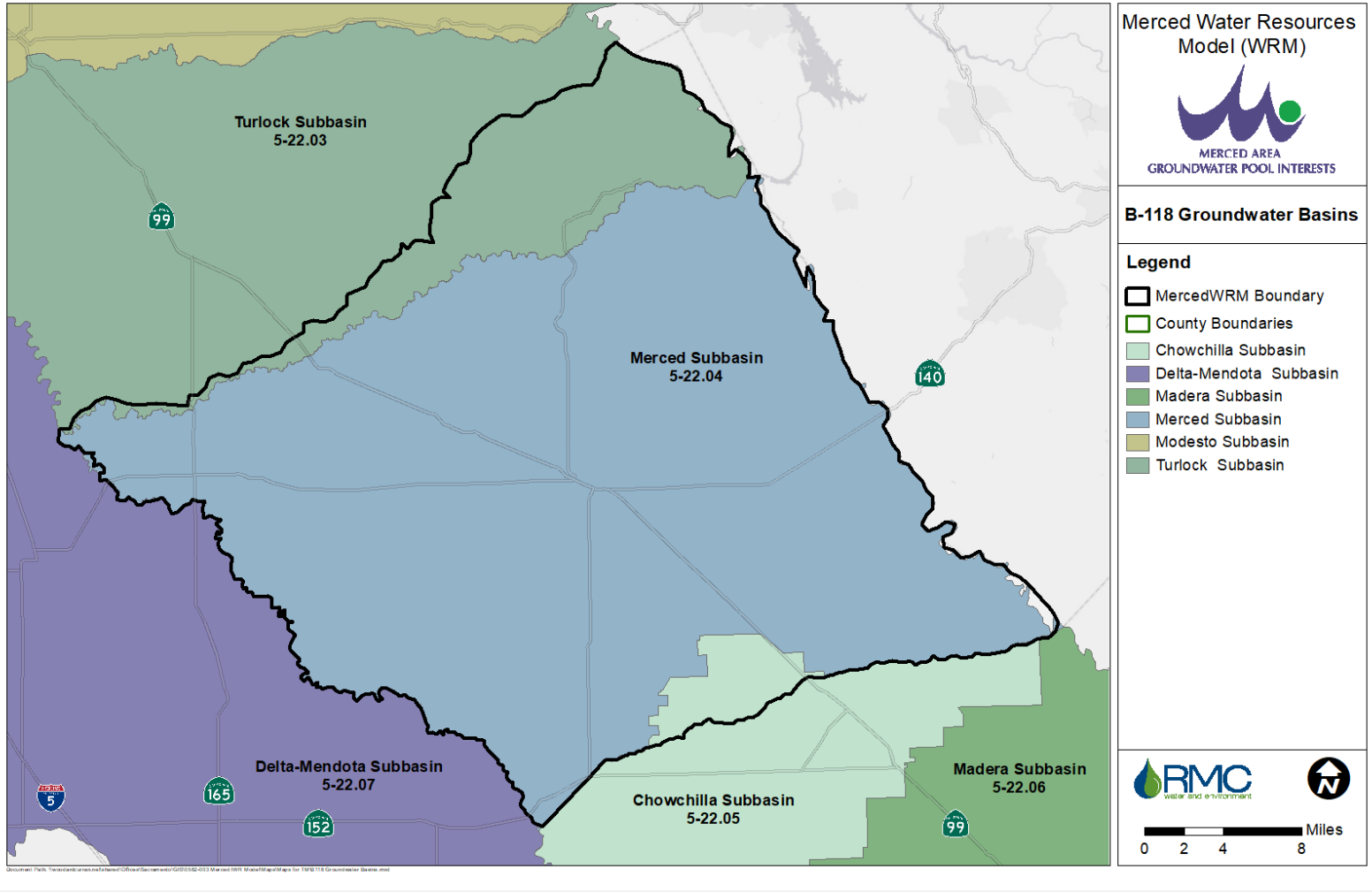
Model Applications



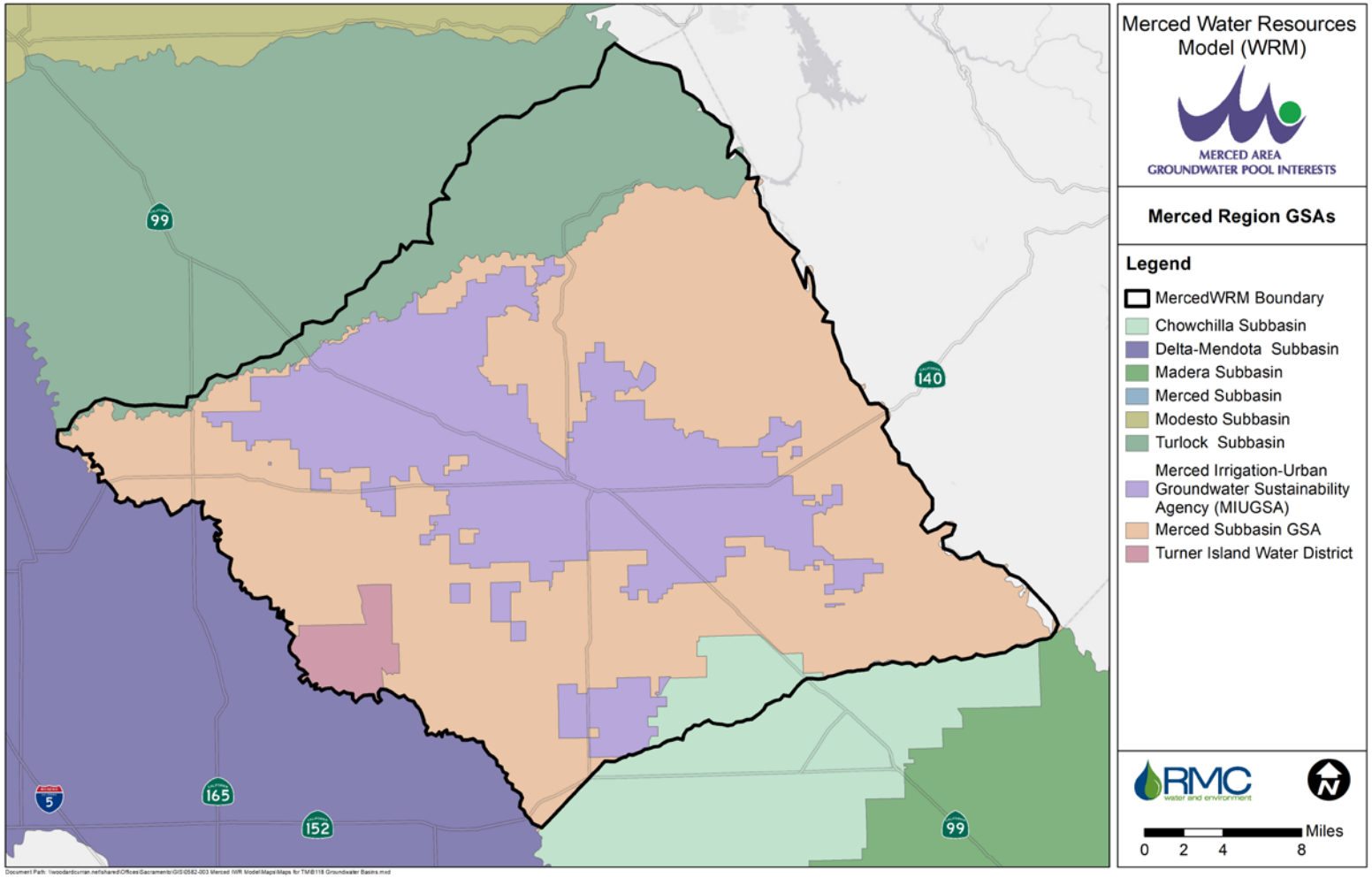
Model Area

Water Budget Areas

- MercedWRM Boundary
- Merced Subbasin
- MIUGSA
- Merced Subbasin GSA
- Turner Island WD GSA-1

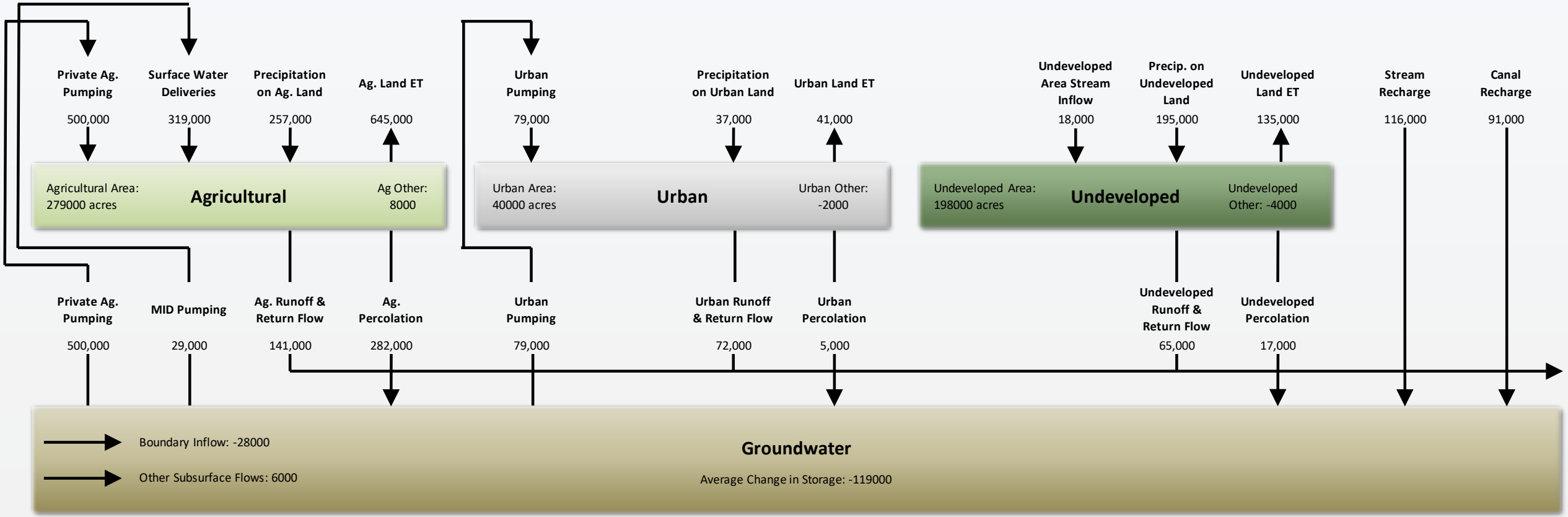


GSA Water Budgets



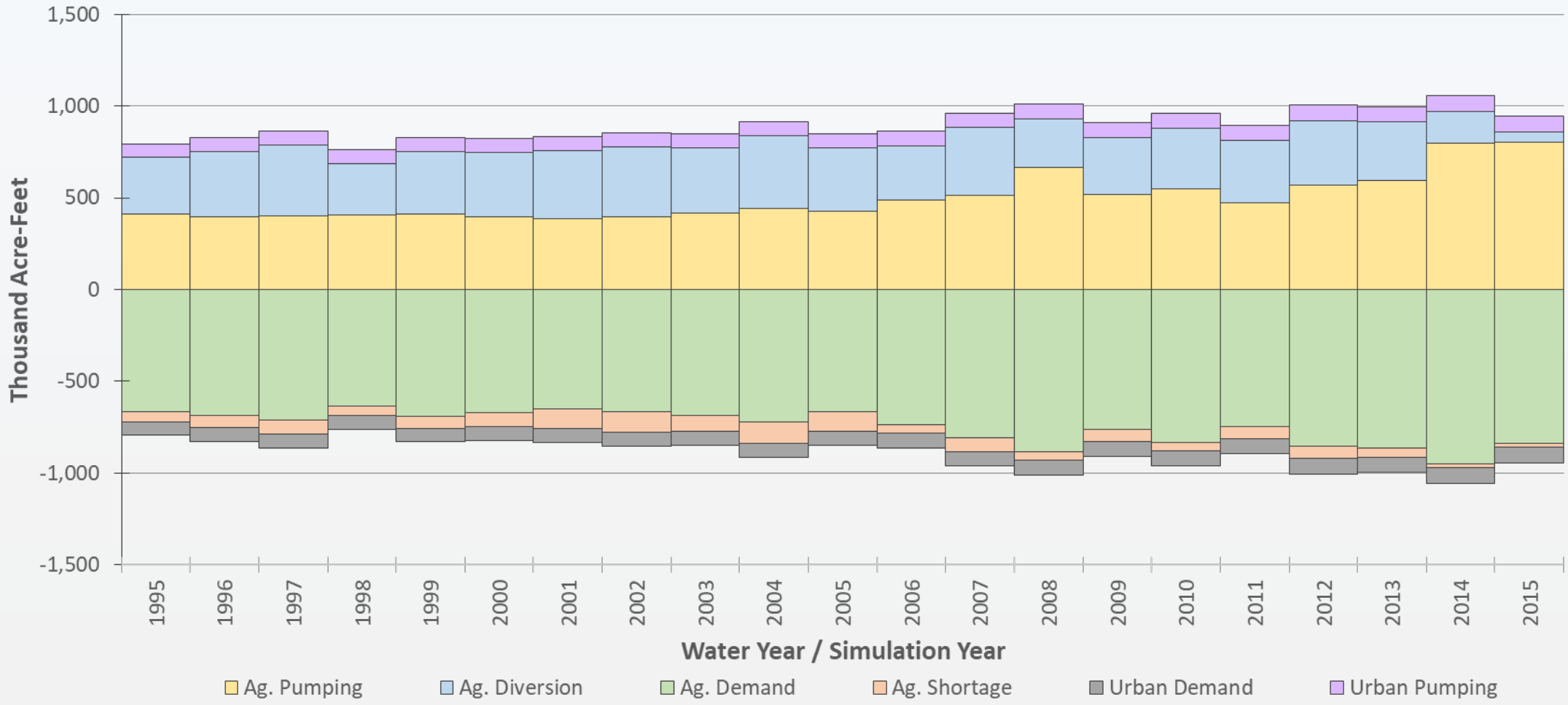
Historical Total Water Budget (WY 1995-2015)

Merced Groundwater Subbasin



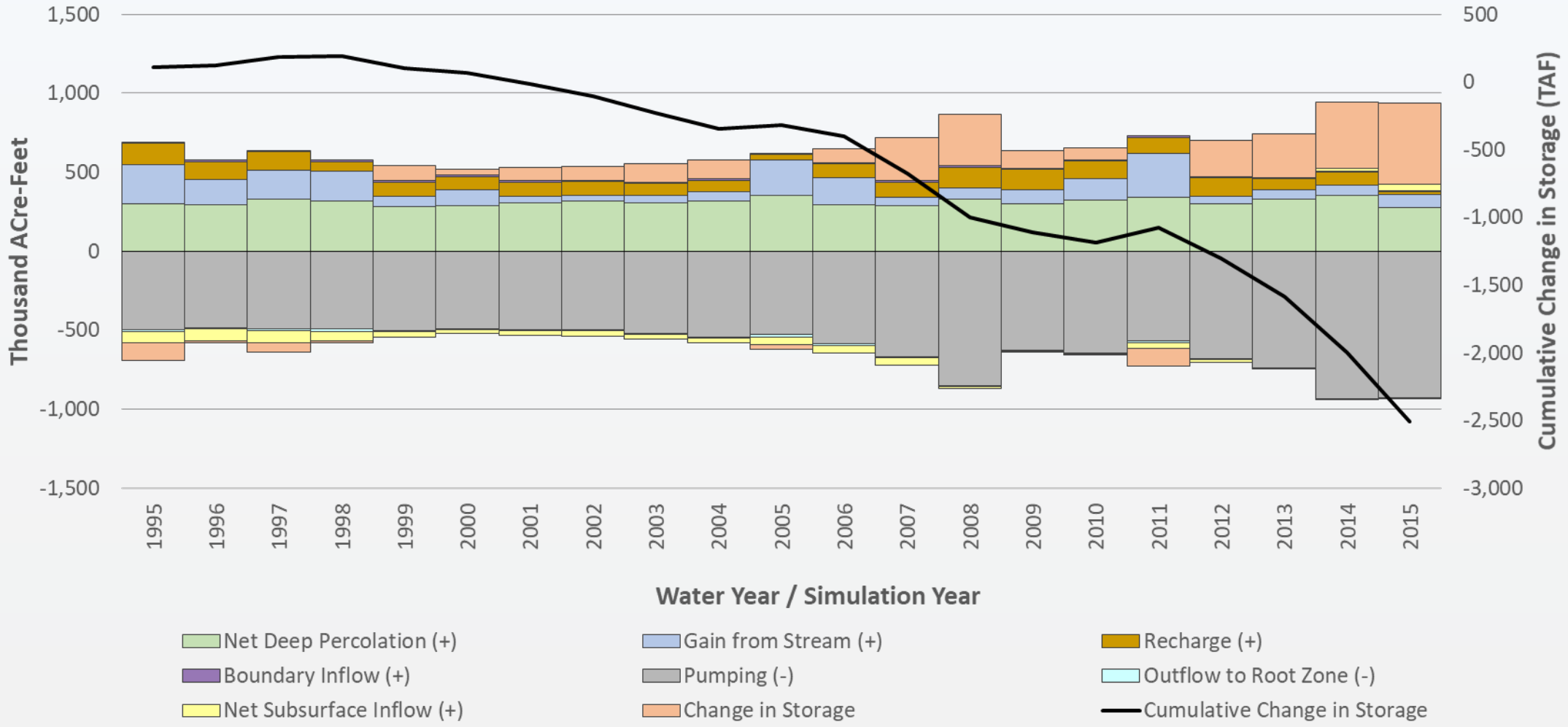
Historical Land & Water Use Budget (WY 1995-2015)

Merced Groundwater Subbasin



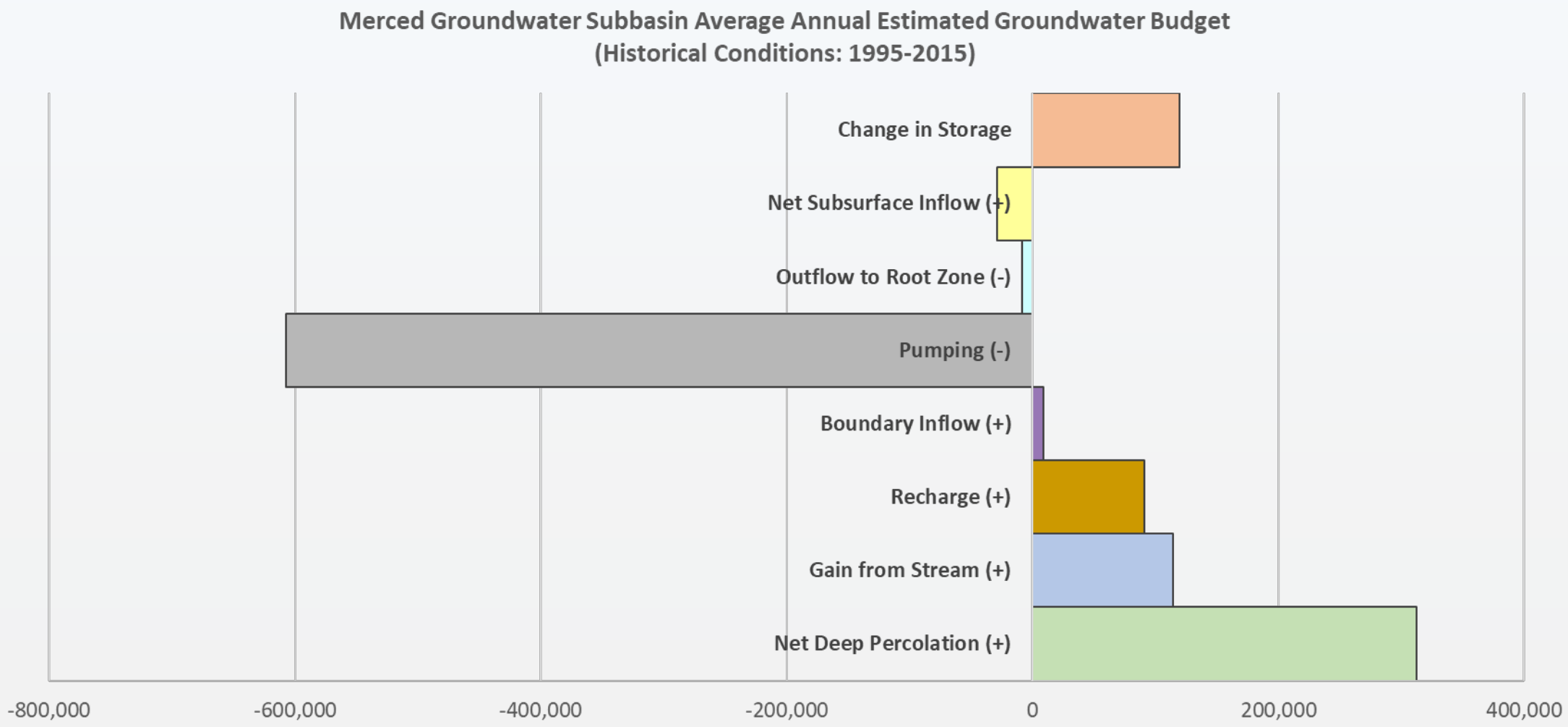
Historical Groundwater Budget (WY 1995-2015)

Merced Groundwater Subbasin



Historical Groundwater Budget (WY 1995-2015)

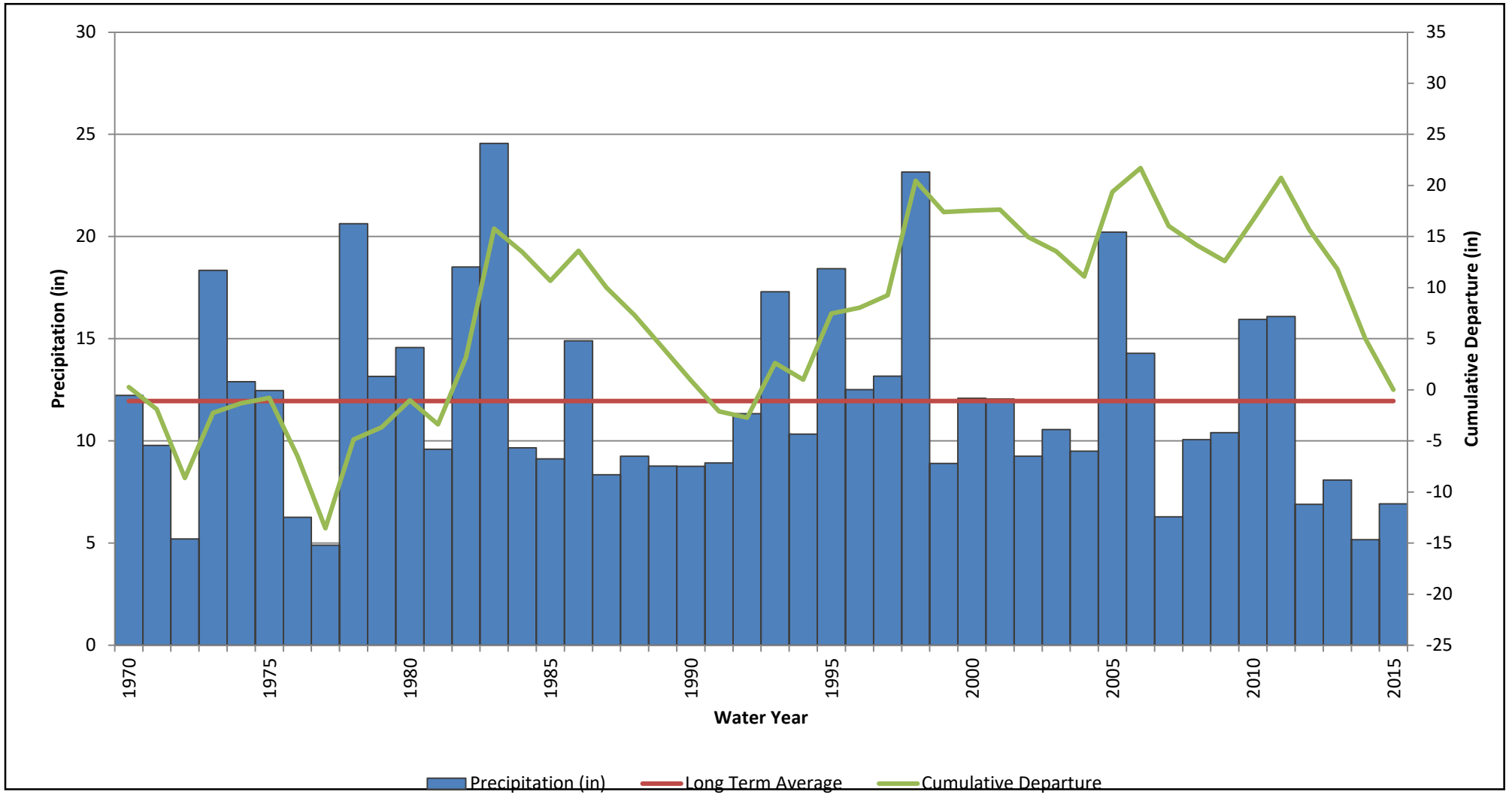
Merced Groundwater Subbasin



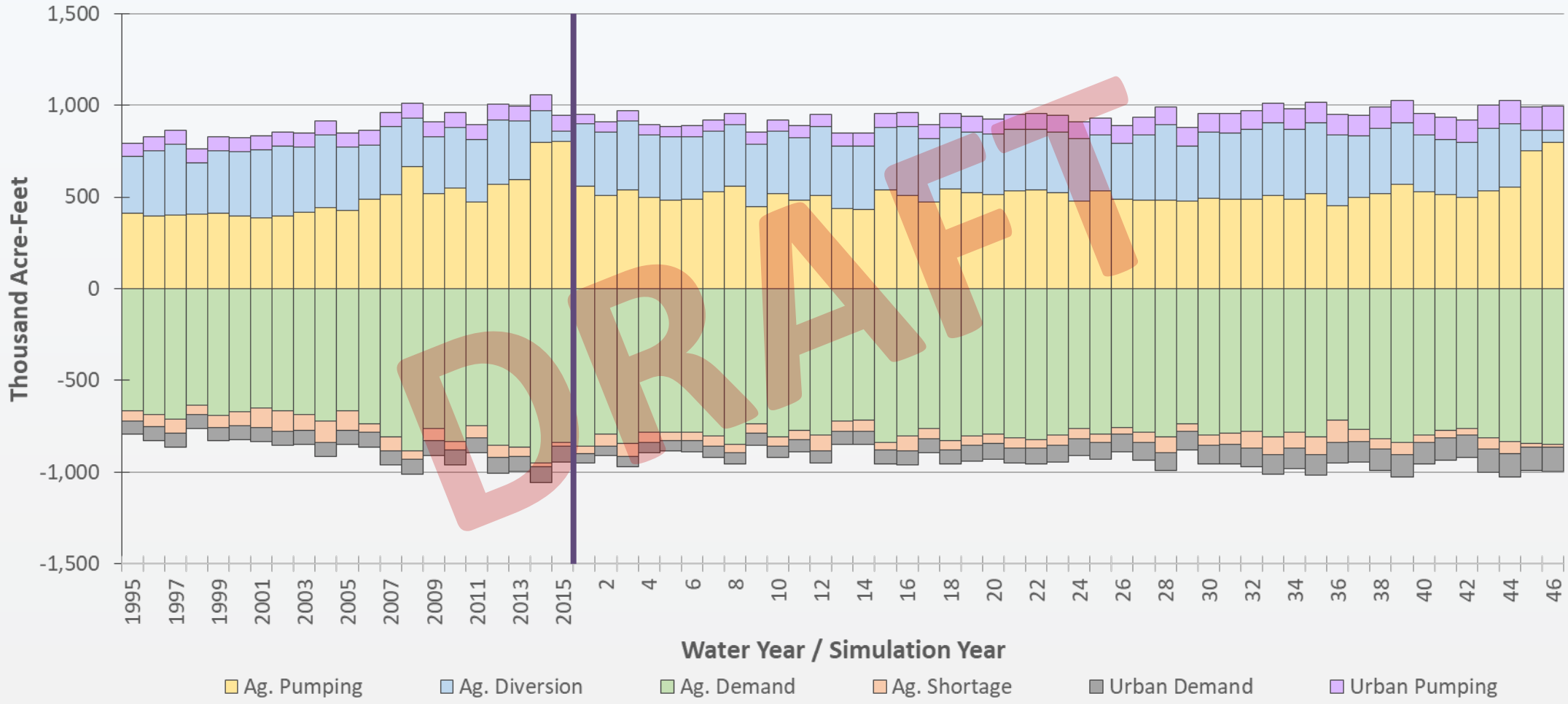
Current Conditions Baseline - Assumptions

- Hydrologic Period: Water Years 1970-2015 (~46 Hydrology)
- Merced River Flow: MercedSIM
- Other Tributaries:
  - Historical record when available
  - Water year index for missing data
- 2013 Land Use and Cropping Patterns
- 2013 Urban Water Use
- Main Canal Diversions: MercedSIM
- MID Deliveries:
  - 1995-2013
    - Historical deliveries adjusted by MercedSIM Main Canal diversions
  - 1970-1994 & 2014-2015
    - Monthly delivery estimated based on WYI for 1995-2013
- Local Water Purveyor Operations: Monthly average by water year index

Merced WR Model Baseline Hydrology

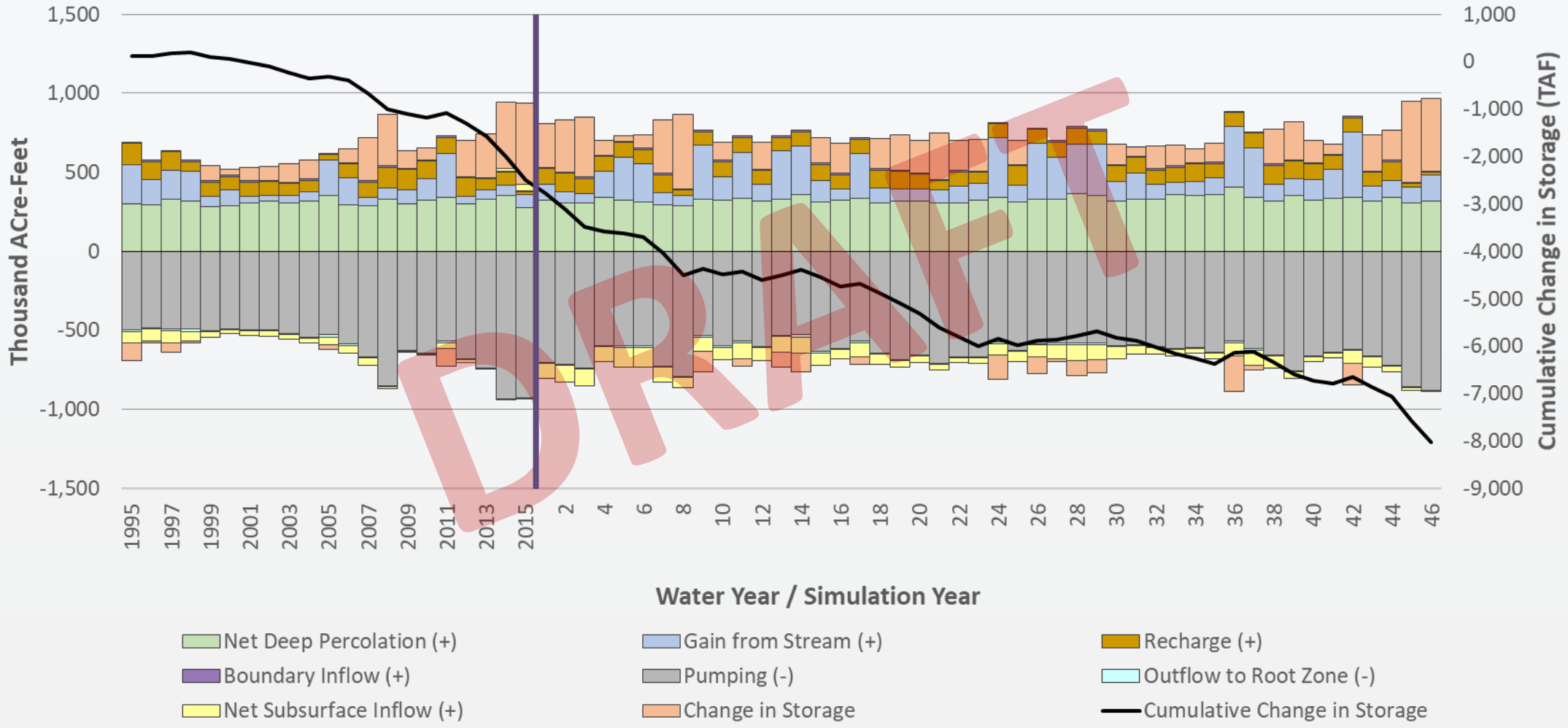


Current Condition Baseline
Land & Water Use Budget
Merced Groundwater Subbasin



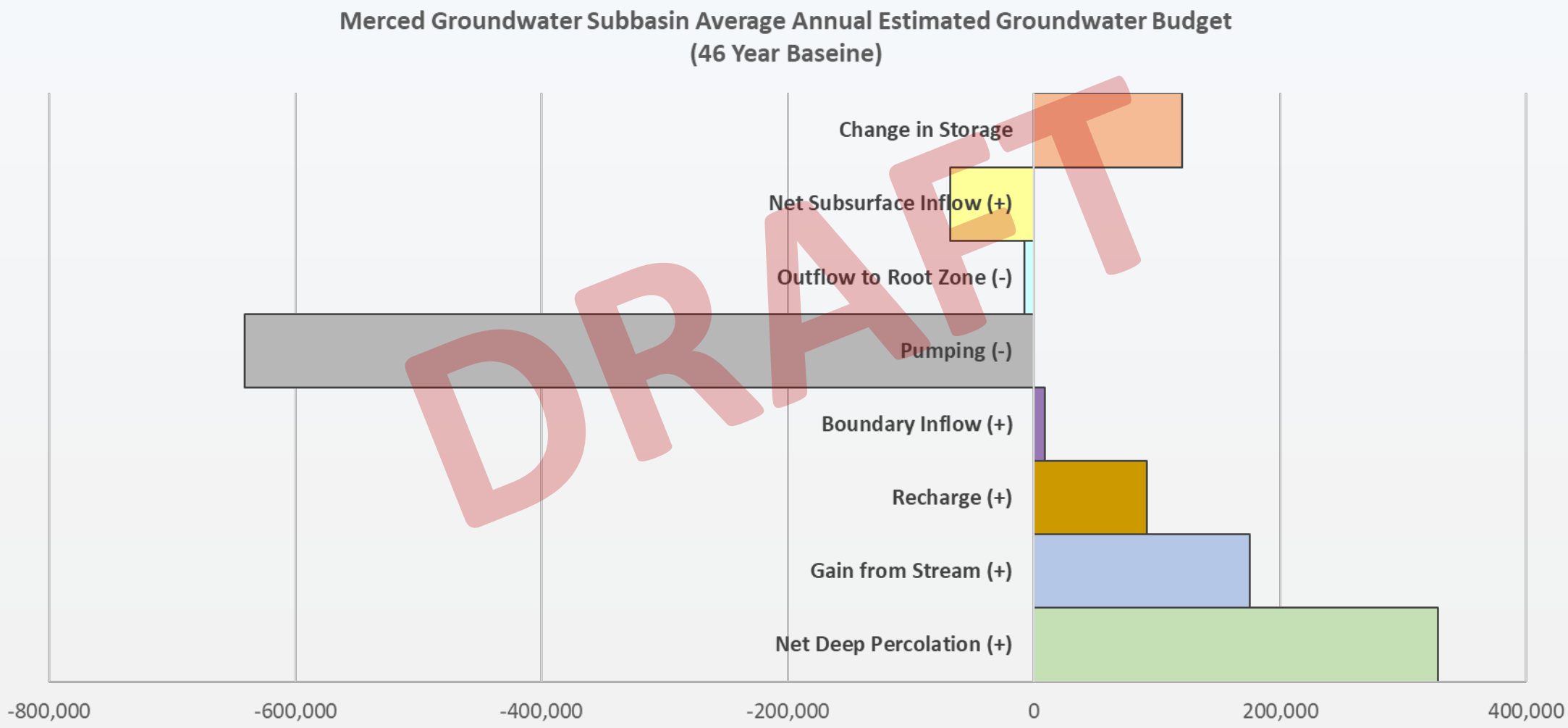
Current Condition Baseline Groundwater Budget

Merced Groundwater Subbasin



Current Condition Baseline Groundwater Budget

Merced Groundwater Subbasin



Future Conditions Baseline

- Hydrologic Period: Water Years 1970-2015 (~46 Hydrology)
- Merced River Flow: MercedSIM
- Other Tributaries:
  - Historical record when available
  - Water year index for missing data
- 2040 Land Use and Cropping Patterns
- Urban Water Use: Buildout Conditions
- Main Canal Diversions: MercedSIM
- MID Deliveries: Projected Conditions based on MercedSIM Estimates

Questions …