Modeling Framework for the Middle Rio Grande Basin

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Interstate Stream Commission
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Model Types

Predictive:

Used to predict the consequences of certain actions.

Interpretive:

Used as a framework for studying system dynamics.

Generic:

Used to analyze hypothetical system.

MRG Models

- Surface Water Models:
  - *Upper Rio Grande Water Operation Model (URGWOM).*
  - *Flo-2D Model.*
- Groundwater Models:
  - *Albuquerque Basin Model.*
  - *Socorro Basin Model.*
  - *High Resolution GW models (riparian models).*
- Irrigation Management Models:
  - *MRG Decision Support System.*

URGWOM

Upper Rio Grande Water Operation Model (URGWOM)

URGWOM

- Rio Grande modeled in RiverWare™ Software
- Four Daily Time-Step Models: Accounting, Forecasting, Water Operations, & Planning
- Seven USBR & CORPS-operated reservoirs
- Physical modeling, reservoirs, reaches, diversions, etc.
- 16 Accounts of trans-basin “San Juan-Chama” water
- NRCS/NWS “coordinated” spring-runoff forecasts
- Rio Grande Compact “Lite” helps see Article VII status
- Operational “Rules” on how to run reservoirs (releases)

URGWOM models

- Accounting (Reclamation, NMISC)
  - Input ♦ Up-to-current data; contractor and total outflows, storage (elevation), weather data , streamgages, and forecasted (from Forecast model)diversions, wastewater, etc.
  - Output ♦ Contractor losses and storages, total losses and computed inflow, local inflows, and reservoir reports

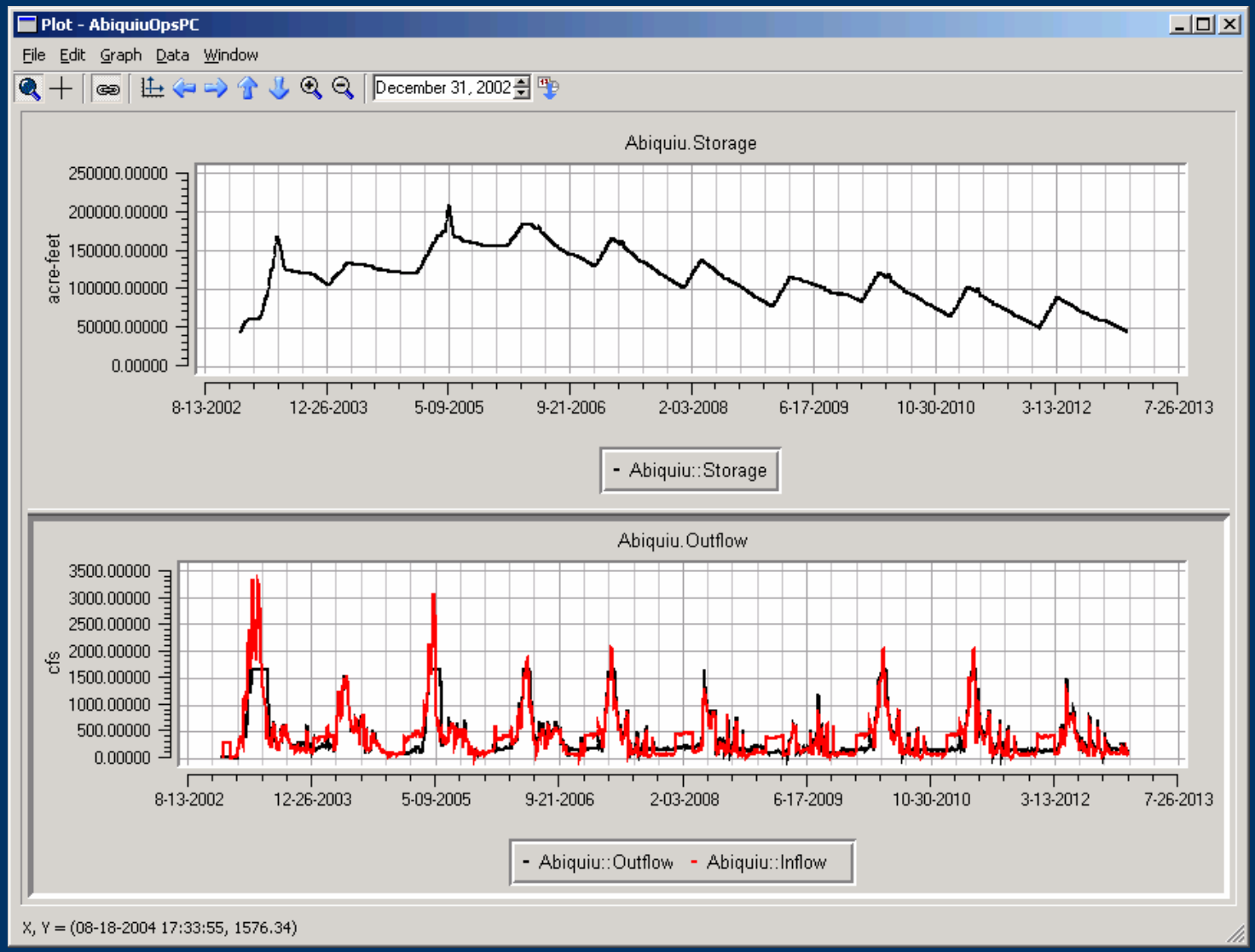
- Forecasting (Corps, Reclamation, NMISC)
  - Input ♦ Up-to-current volumes (from Account model), historic year hydrograph shapes, user-selected # of hydrograph shapes to average, and NRCS March-July (Volume) Forecasts to apply to shapes
  - Output ♦ Daily hydrographs, other parameters

URGWOM models

- Water Operations (Corps, Reclamation, NMISC)
  - Input ♦Past days inflows, initial storages (total and contractor, from Account model) , and forecasted daily inflows, other parameters (from Forecast model)
  - Output ♦Forecasted reservoir outflows and resulting streamflows, total and contractor storages (generally, releases from reservoirs are set by rules which consider all factors)

- Planning (Corps, NMISC, Reclamation)
  - Input ♦Long-term forecasts and up-to-current conditions (total and contractor)
  - Output ♦Long-term daily hydrographs, storages, system conditions (again, releases from reservoirs are set by rules)

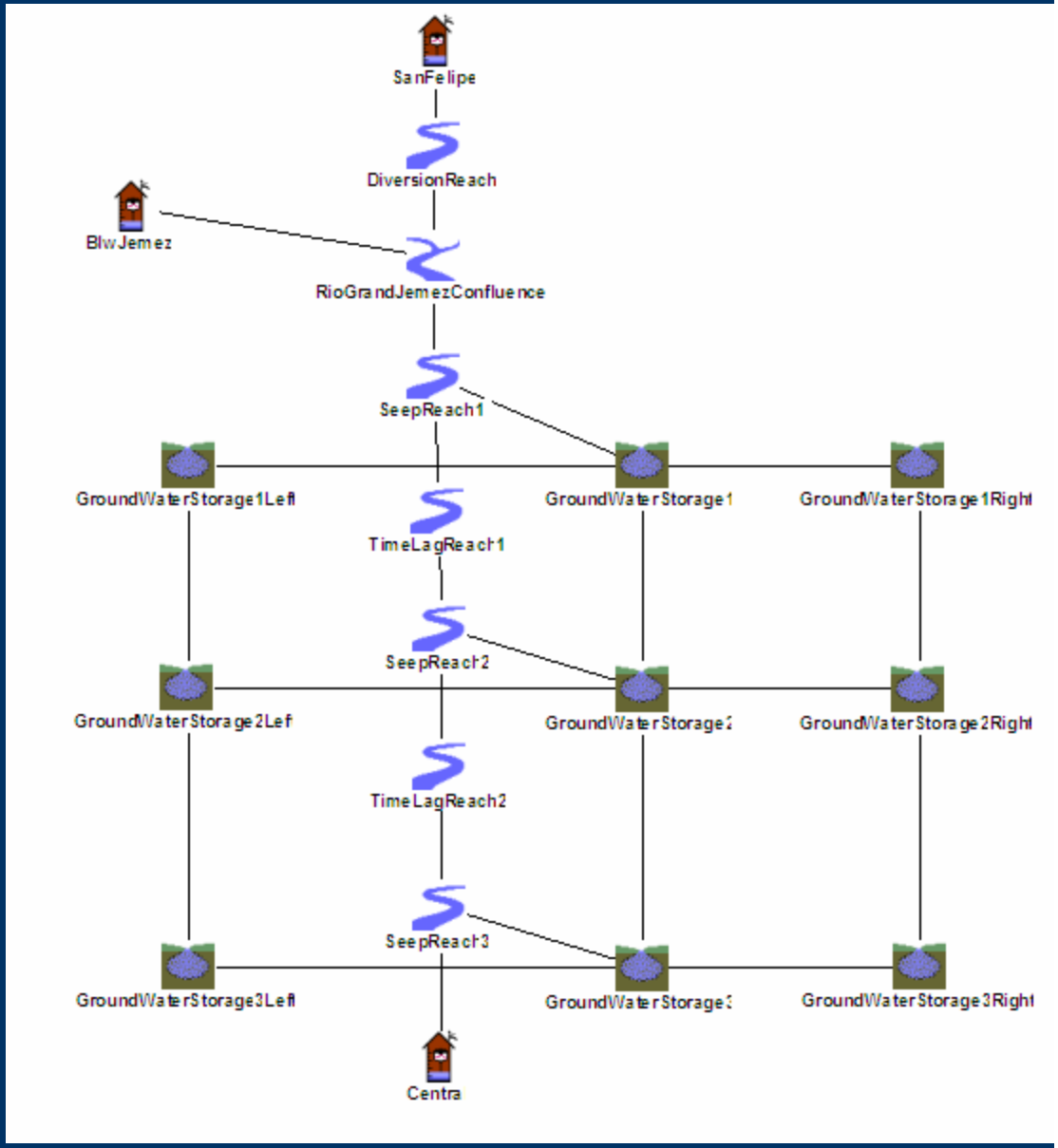
URGWOM


Plot - AbiquiuOpsPC
File Edit Graph Data Window
December 31, 2002
Abiquiu.Storage
acre-feet
250000.00000
200000.00000
150000.00000
100000.00000
50000.00000
0.00000
8-13-2002
12-26-2003
5-09-2005
9-21-2006
2-03-2008
6-17-2009
10-30-2010
3-13-2012
7-26-2013
Abiquiu::Storage
Abiquiu.Outflow
cfs
3500.00000
3000.00000
2500.00000
2000.00000
1500.00000
1000.00000
500.00000
0.00000
8-13-2002
12-26-2003
5-09-2005
9-21-2006
2-03-2008
6-17-2009
10-30-2010
3-13-2012
7-26-2013
Abiquiu::Outflow
Abiquiu::Inflow
X, Y = (08-18-2004 17:33:55, 1576.34)

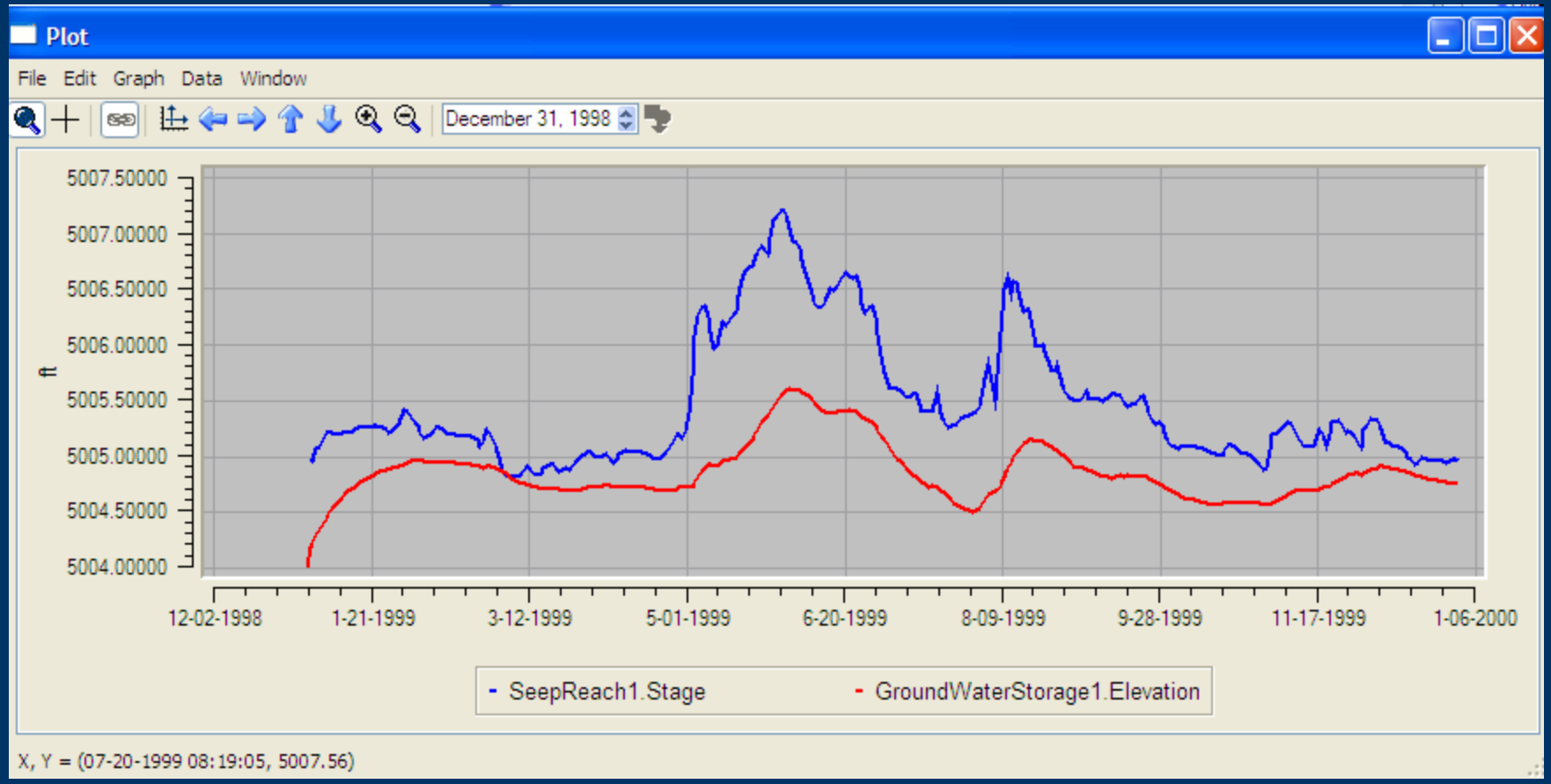
URGWOM

Improvements

1. *New Conceptual Design for the middle valley*
2. *SW/GW interaction*
3. *Monthly model (powersim)*

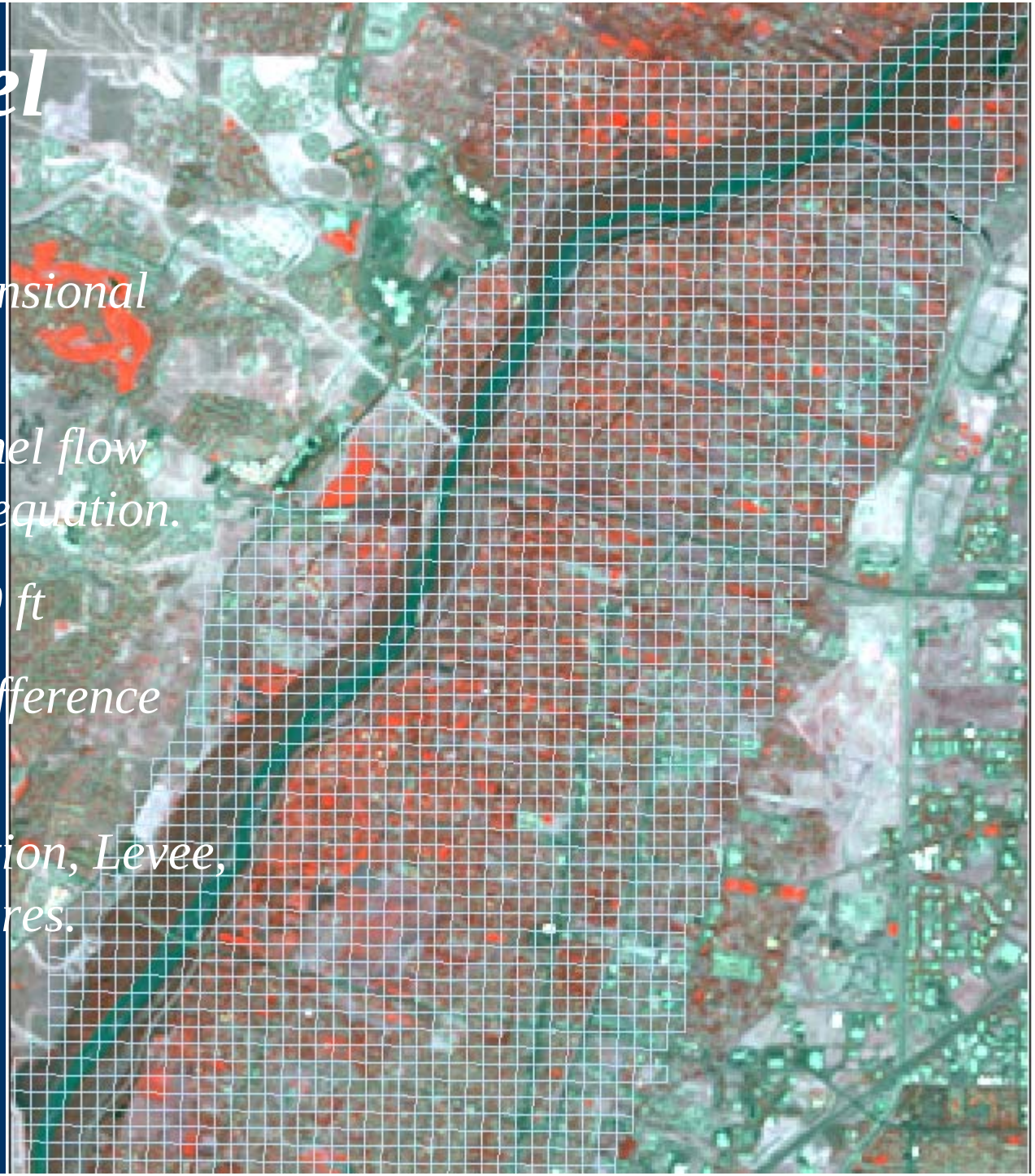


URGWOM


Plot
File Edit Graph Data Window
December 31, 1998
5007.50000
5007.00000
5006.50000
5006.00000
5005.50000
5005.00000
5004.50000
5004.00000
ft
12-02-1998
1-21-1999
3-12-1999
5-01-1999
6-20-1999
8-09-1999
9-28-1999
11-17-1999
1-06-2000
SeepReach1.Stage
GroundWaterStorage1.Elevation
X, Y = (07-20-1999 08:19:05, 5007.56)

Flo-2D Model

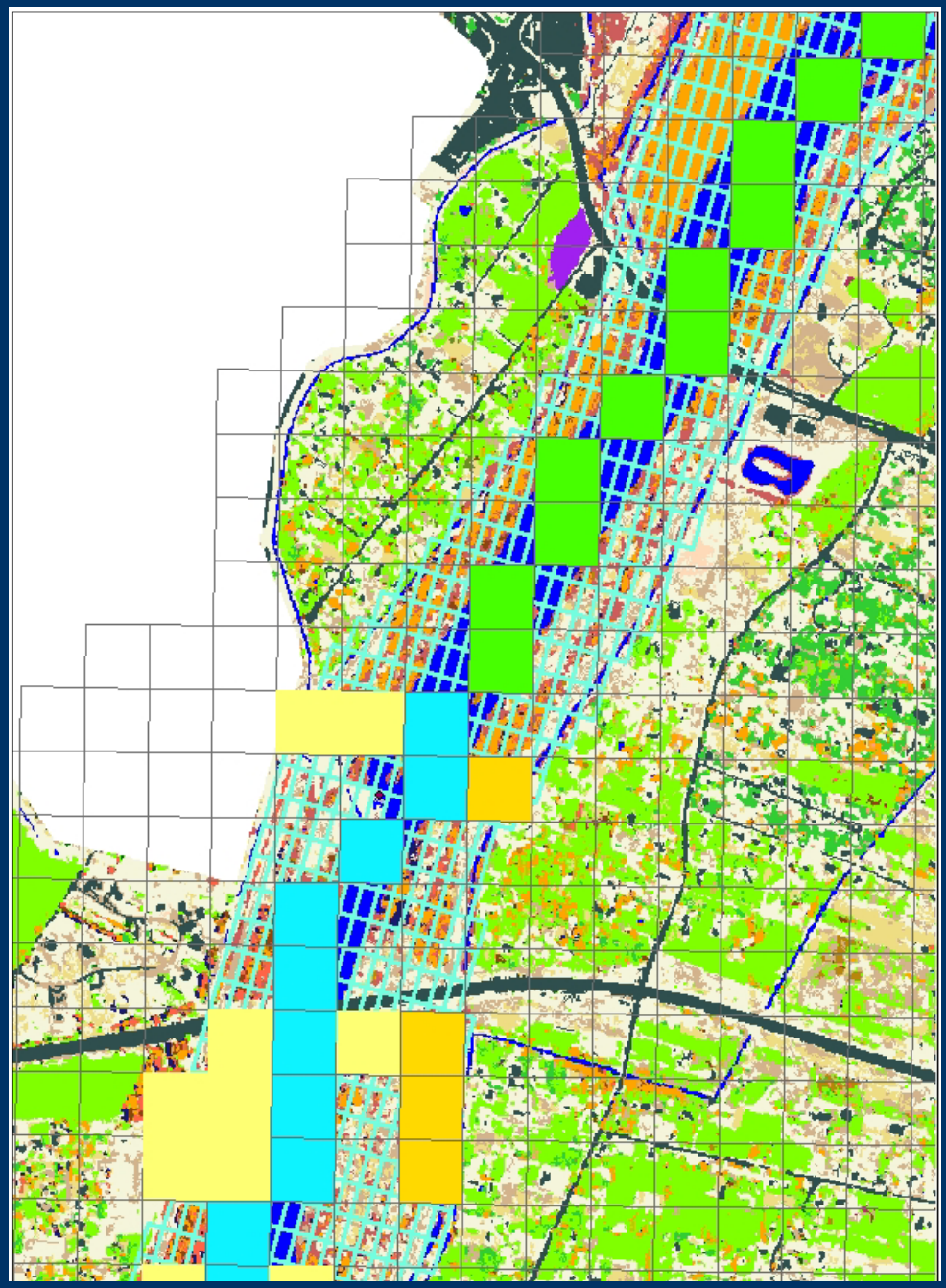
- *Flo-2D is a two dimensional flood routing model.*
- *One dimension channel flow using dynamic wave equation.*
- *Grid size 500 ft x 500 ft*
- *Uses explicit finite difference approach.*
- *Infiltration, Evaporation, Levee, and hydraulic structures.*



Flo-2D Model

Predicts:

- *Downstream Hydrograph*
- *Overland flooding.*

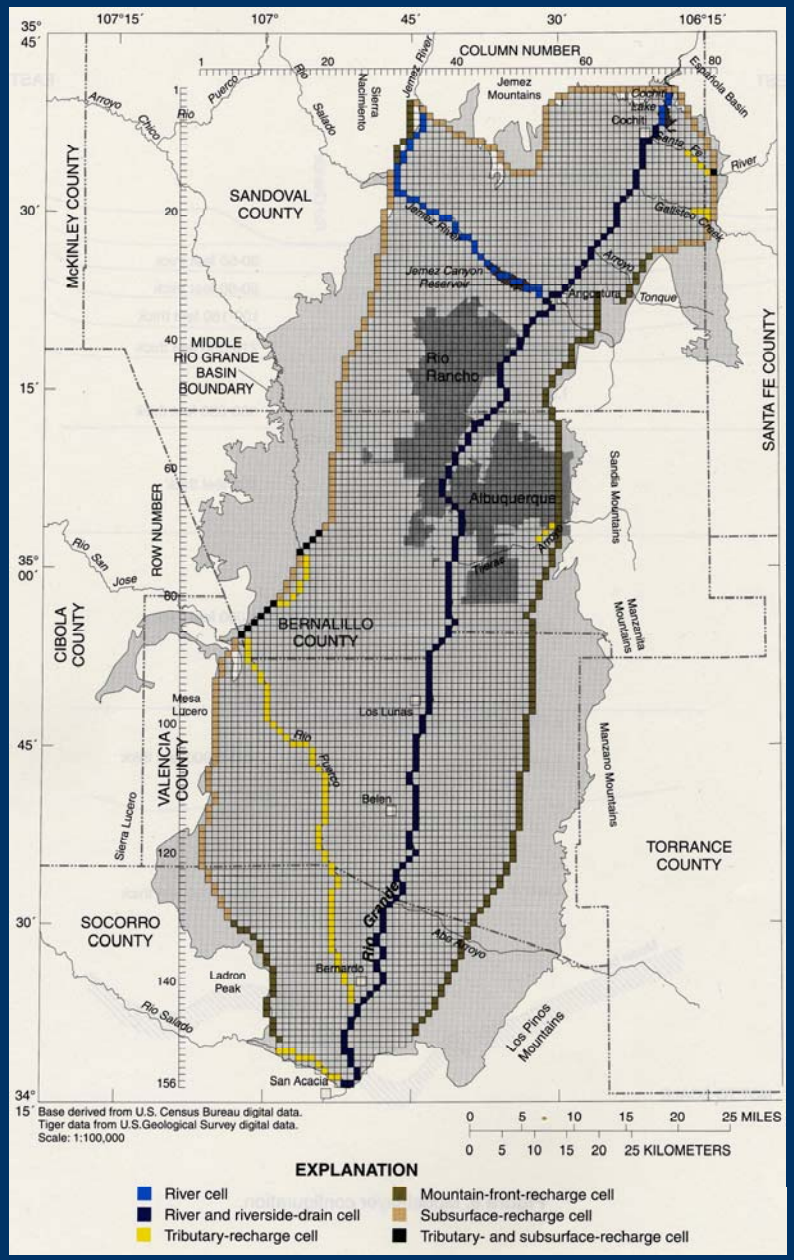


Albuquerque Basin Model

McAda and Barroll 2002 model grid is 1000x1000 meter uniform resolution and 9000 ft deep represented by 9 model layers. Seasonal stress period starts from 1990 to end of simulation.

Represented Physical Process:

- *Specified Flow*
  - *Canal Seepage*
  - *Crop Deep Percolation*
  - *GW withdrawal*
  - *Septic-Field Seepage*
  - *Rio Puerco and Rio Jemez*



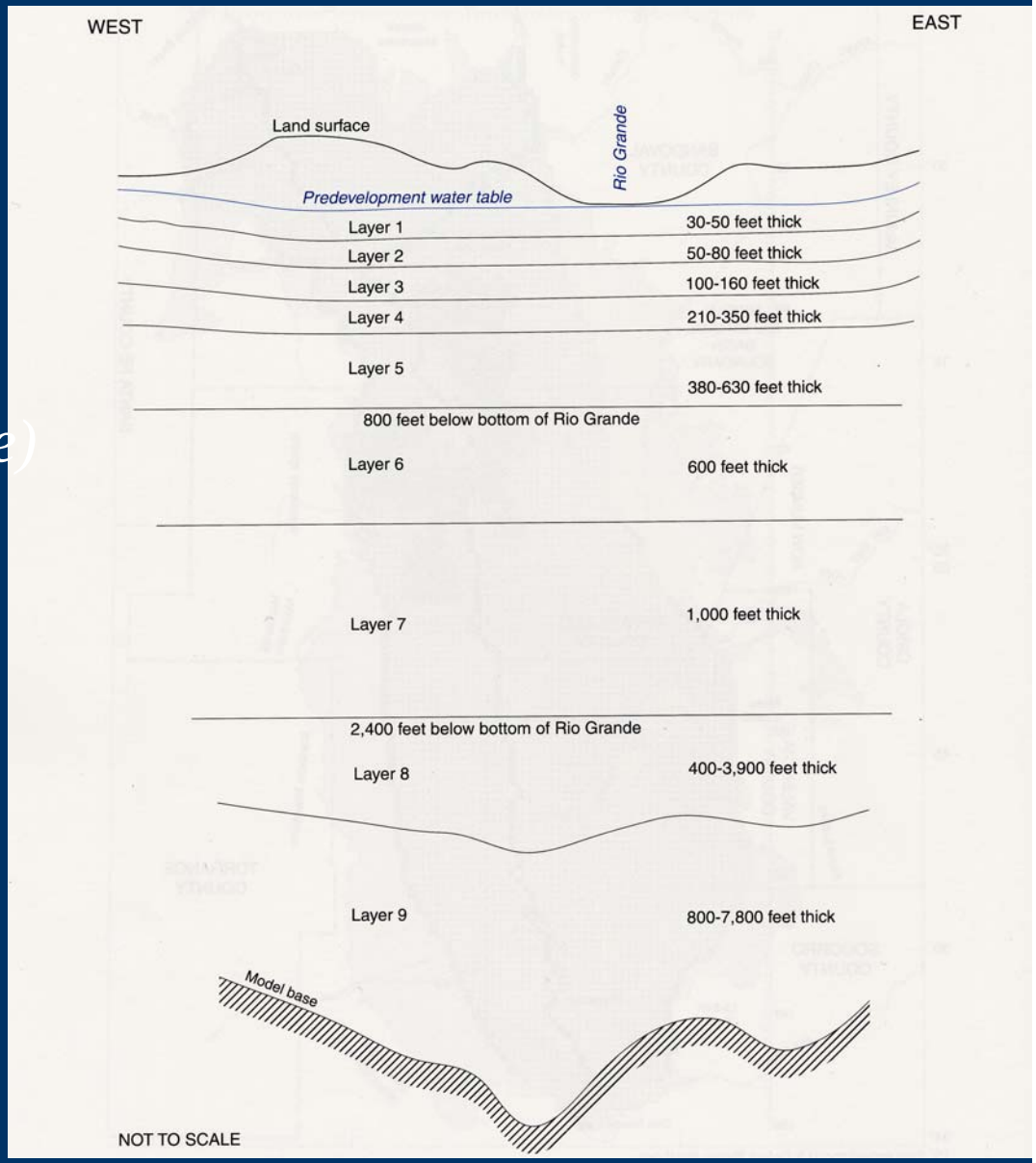
Albuquerque Basin Model

Head Dependent Flow

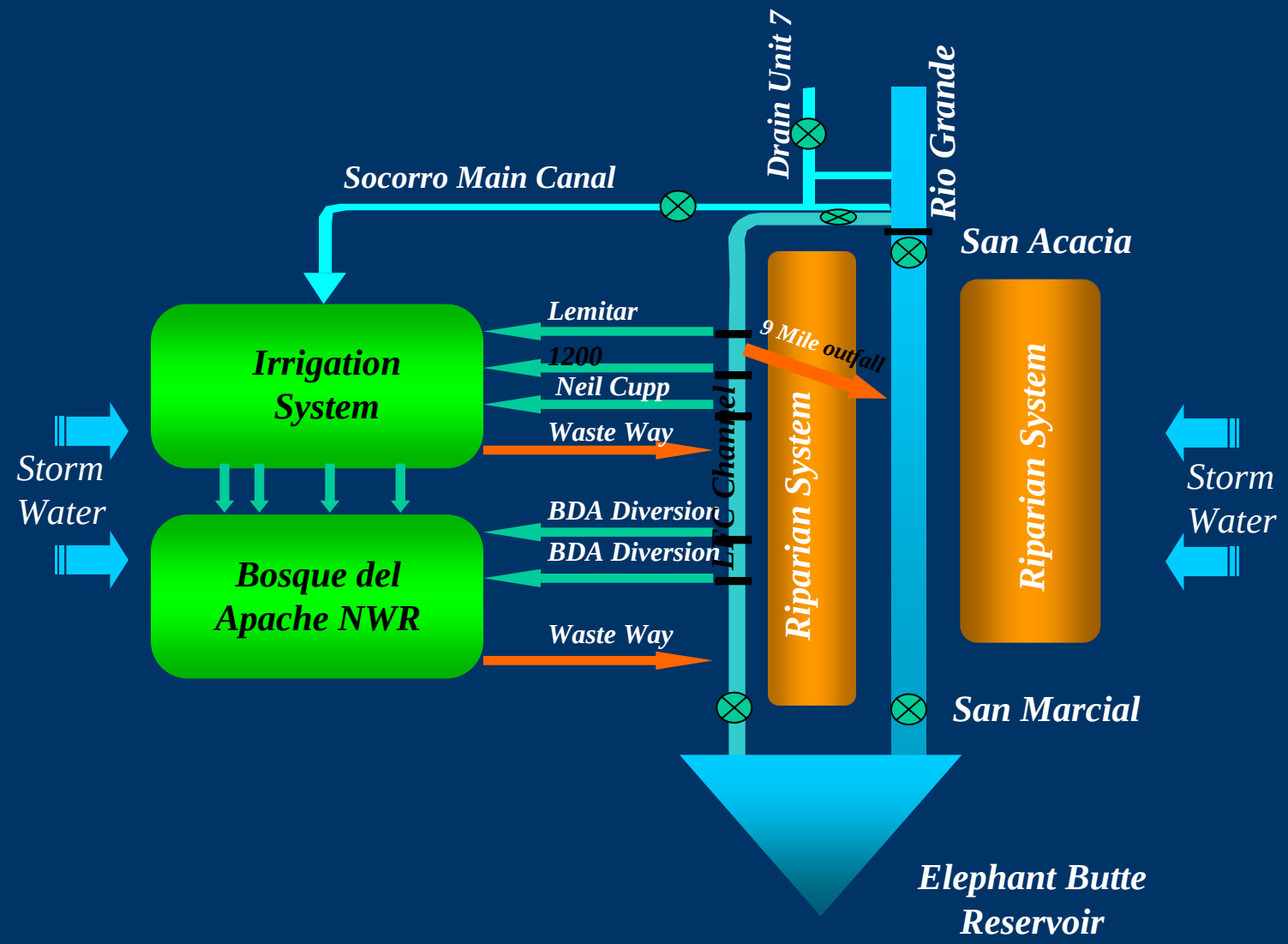
- *Rio Grande (Riv1)*
- *Riverside Drains (Riv1)*
- *Jemez River (Riv1)*
- *Riparian ET (ET-package)*

Predicts:

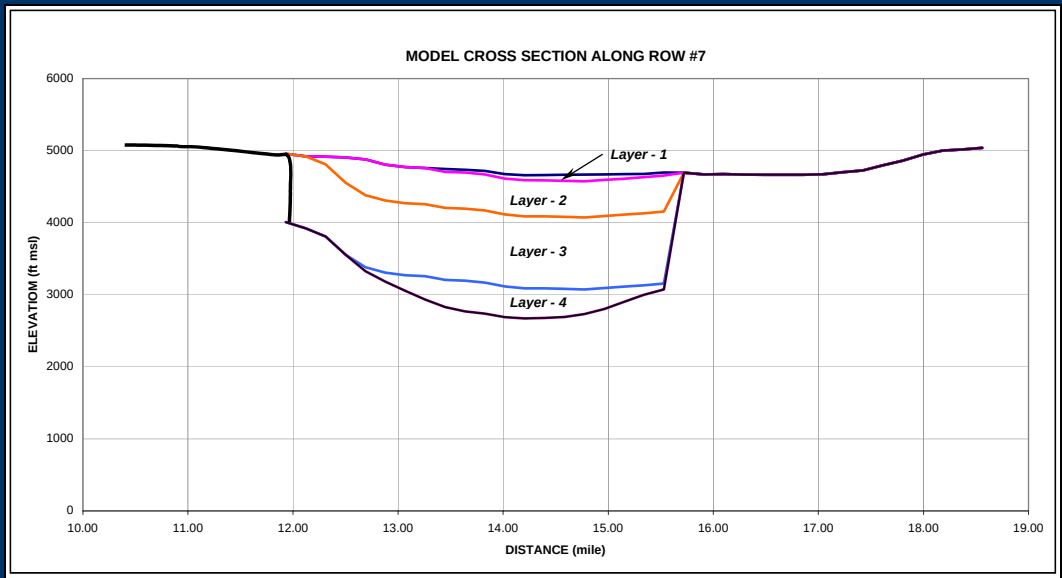
- *SW/GW Interaction.*
- *Aquifer Head and Drawdown.*

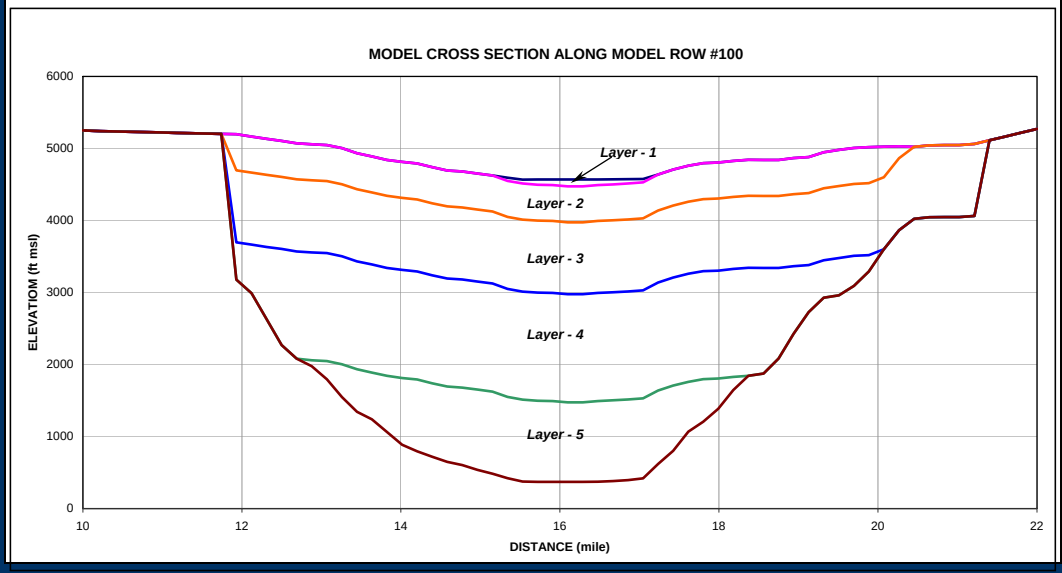


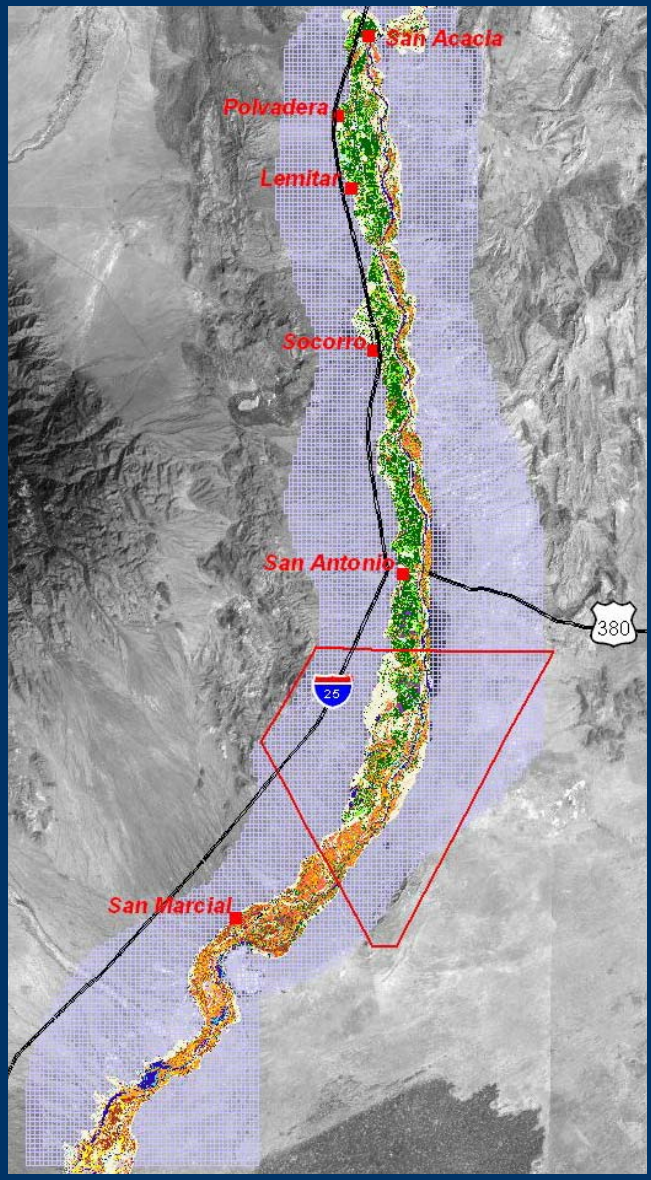
Socorro Basin Model



Socorro Basin Model







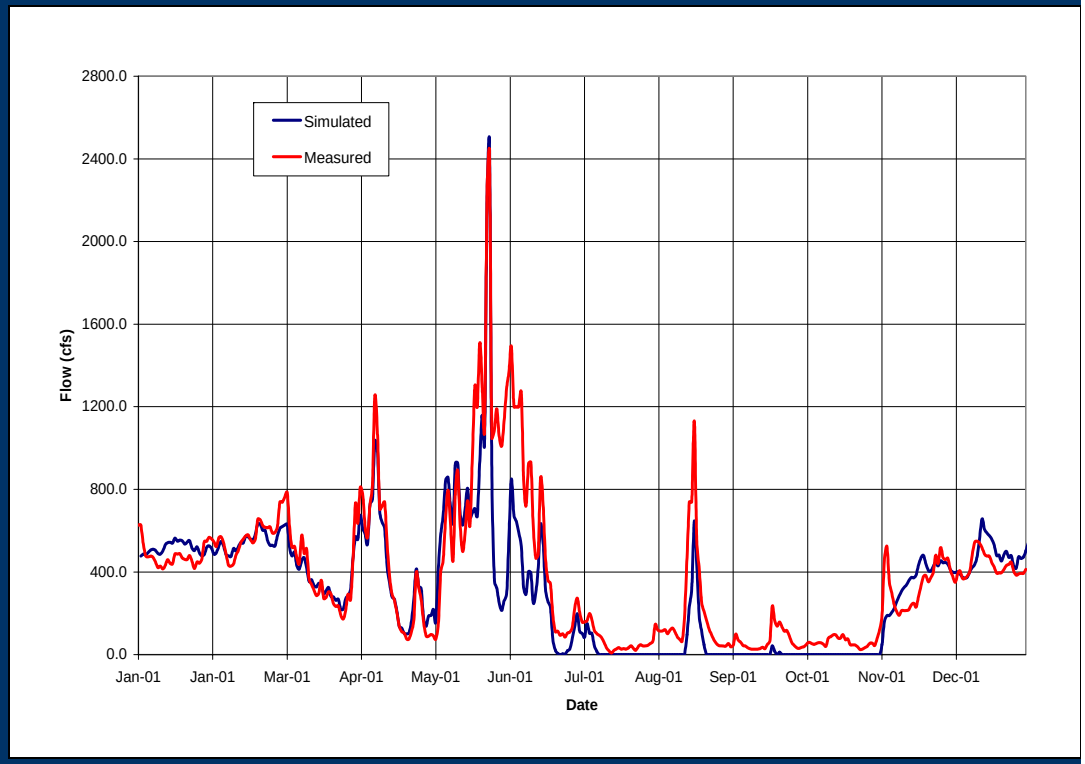
Socorro Basin Model

Represented Physical Process:

- *Rio Grande (Branch & Str.)*
- *LFCC (Branch & Str.)*
- *Crop Deep Percolation (Rch.)*
- *Canal Seepage (Str.)*
- *Drains (str-package)*
- *Riparian ET (ET-pckg)*
- *Mountain Front Recharge*

Predicts:

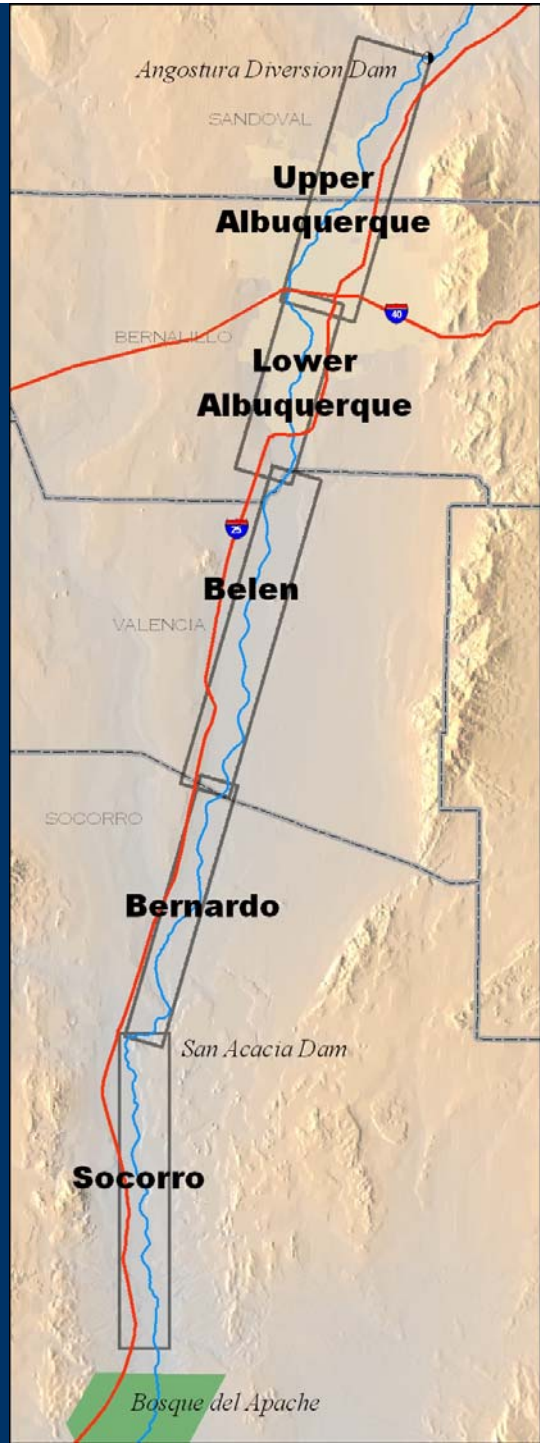
- *SW/GW Interaction*
- *SW downstream flow*
- *Aquifer Head and Drawdown*



Riparian Models

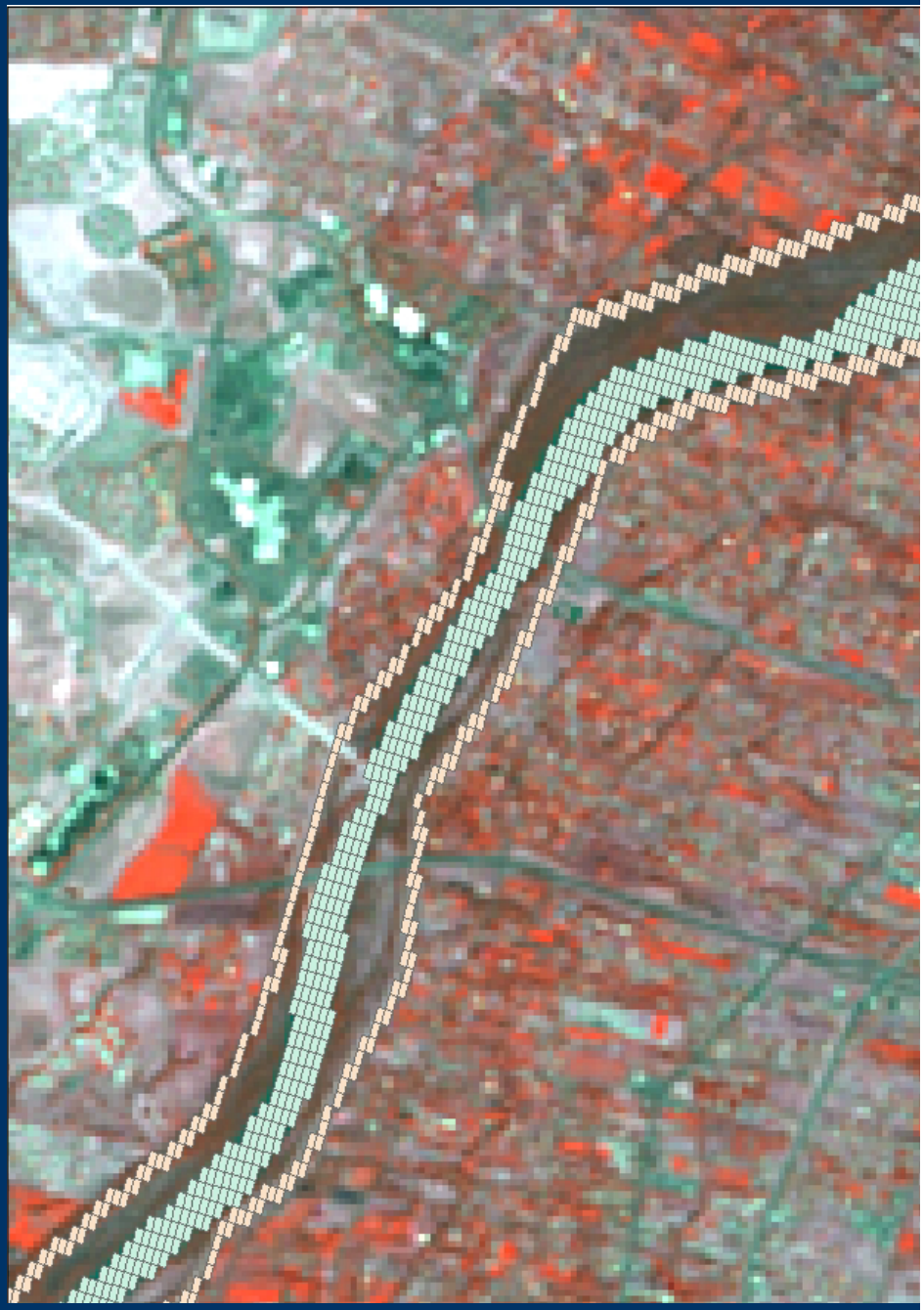
Series of 5 models, covering the Rio Grande from Angostura Diversion Dam to North Boundary of Bosque del Apache:

- ***Upper Albuquerque*** **-** Angostura Diversion Dam to I-40
- ***Lower Albuquerque*** **-** I-40 to Bernalillo-Valencia county line
- ***Belen*** **–** Bernalillo-Valencia county line to Valencia-Socorro county line
- ***Bernardo*** **-** Valencia-Socorro county line to San Acacia Dam
- ***Socorro*** **-** San Acacia Dam to North Boundary of the Bosque del Apache National Wildlife Refuge



Riparian Models

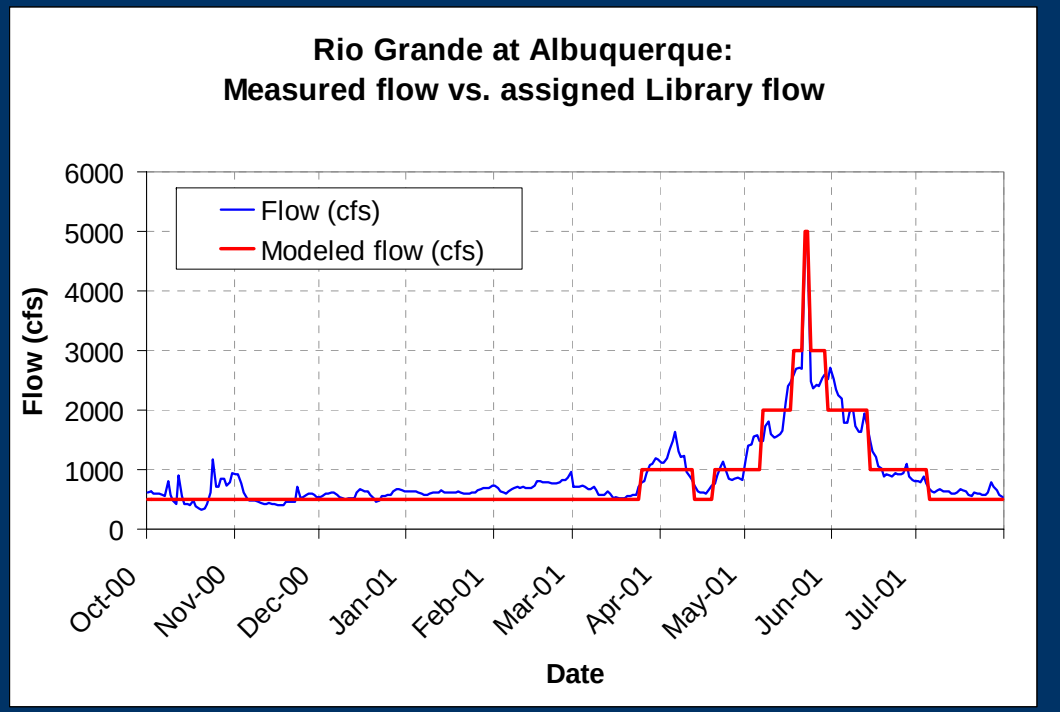
- Constructed in MODFLOW 2000
- Covers area between levees, including river, riverside drains, and riparian corridor contained within the levees
- Cells are 125’ by 250’ feet
- Four model layers:
  - Three layers within the Rio Grande Alluvium: 20’, 30’, 30’ in thickness
  - One layer within the Santa Fe Formation: 100’ in thickness



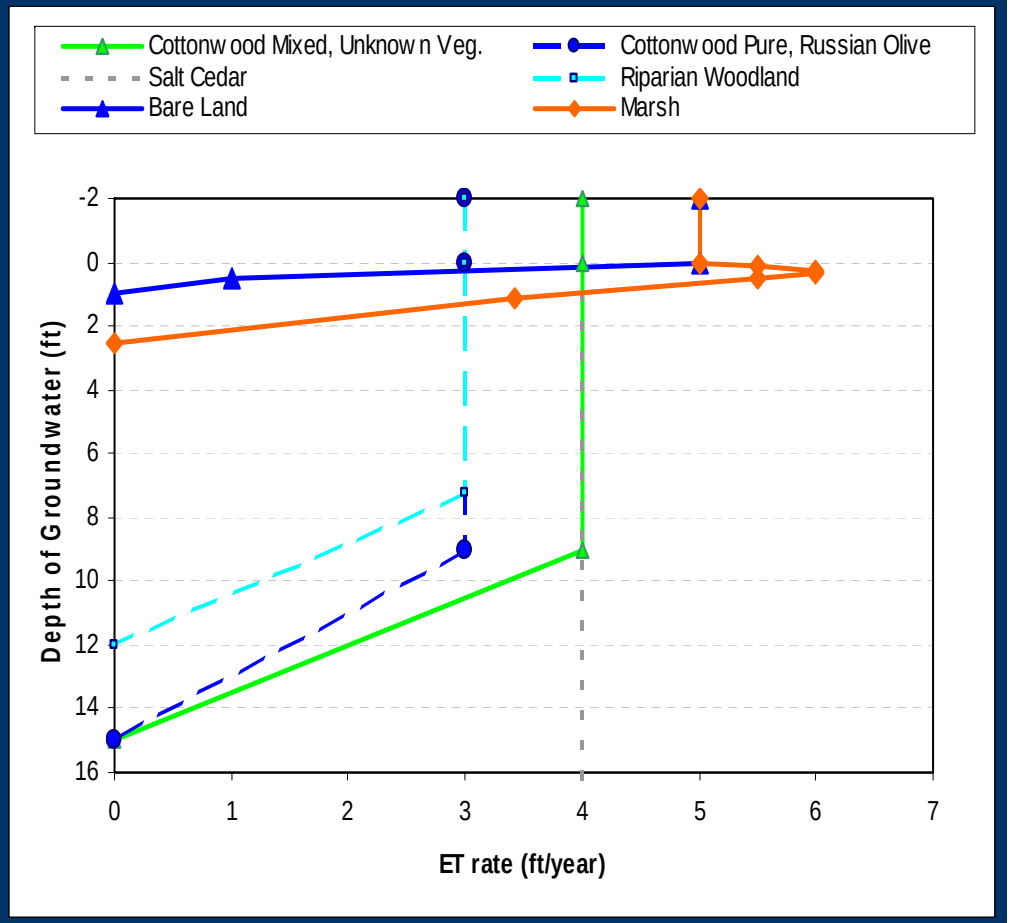
Structure

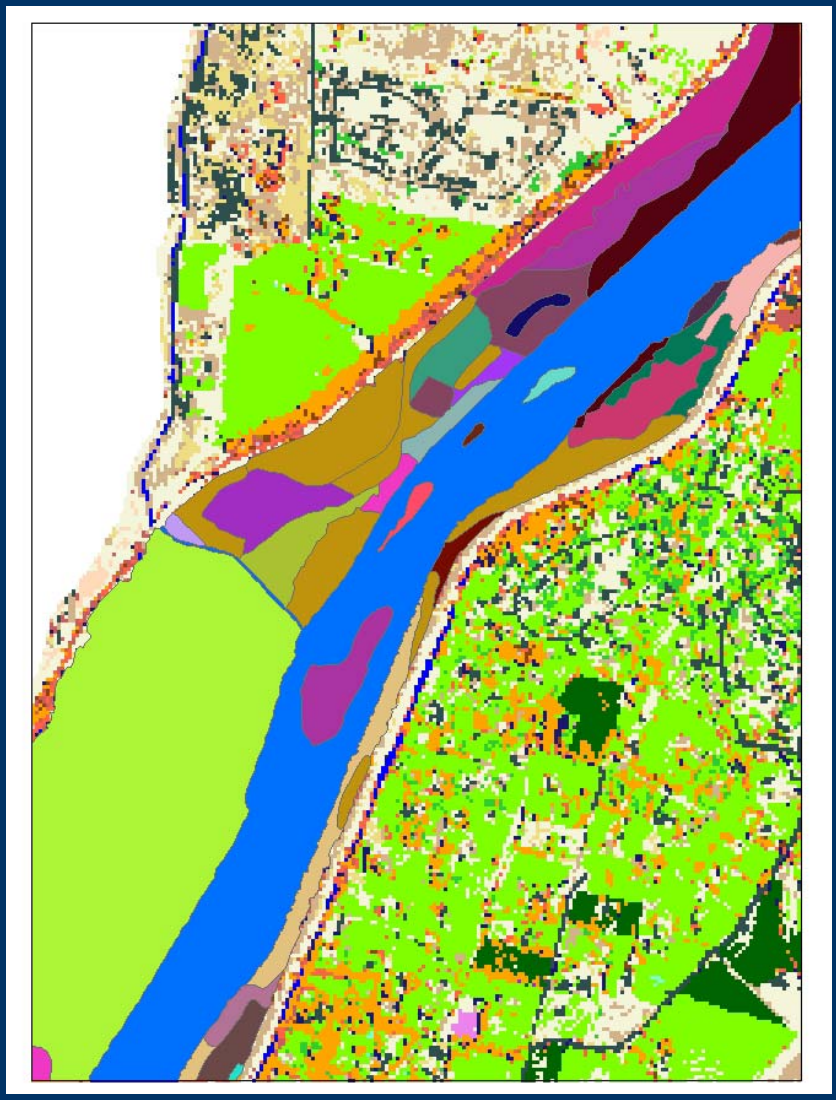
- Lateral boundaries include riverside drains (layer 1) and GHB cells (layers 2, 3, 4)
- Regional boundary conditions for GHB cells were obtained from regional groundwater model
- Variable riparian ET rates, dependent on mapped vegetation classifications.

Riparian Model Flow Library		
Low flow	Moderate Flow	High Flow
100 cfs	1,000 cfs	5,000 cfs
500 cfs	2,000 cfs	7,000 cfs
	3,000 cfs	10,000 cfs

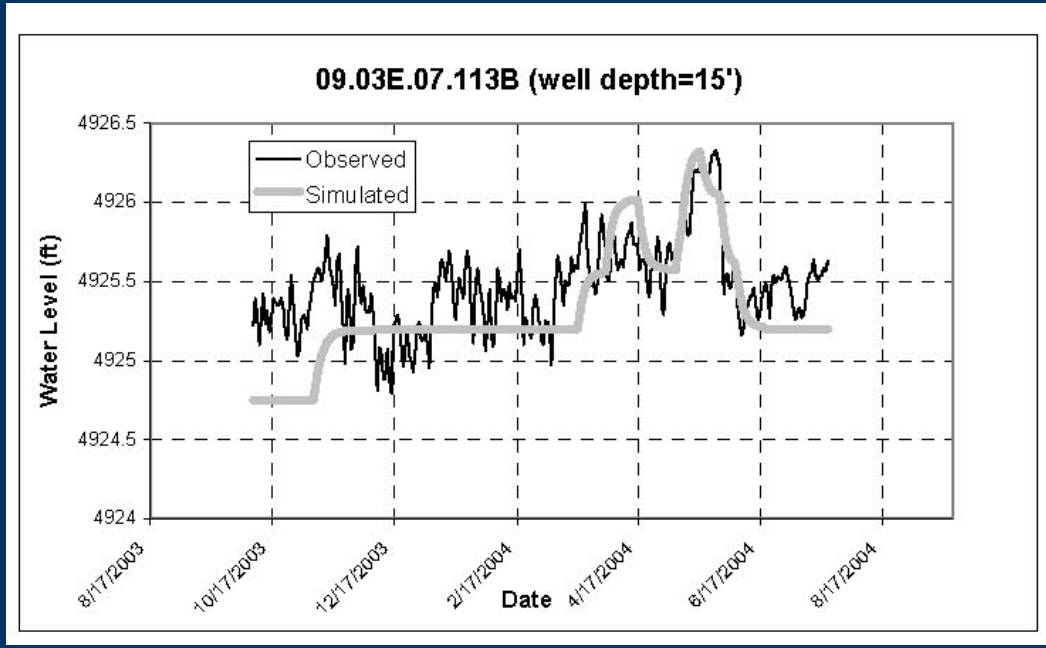


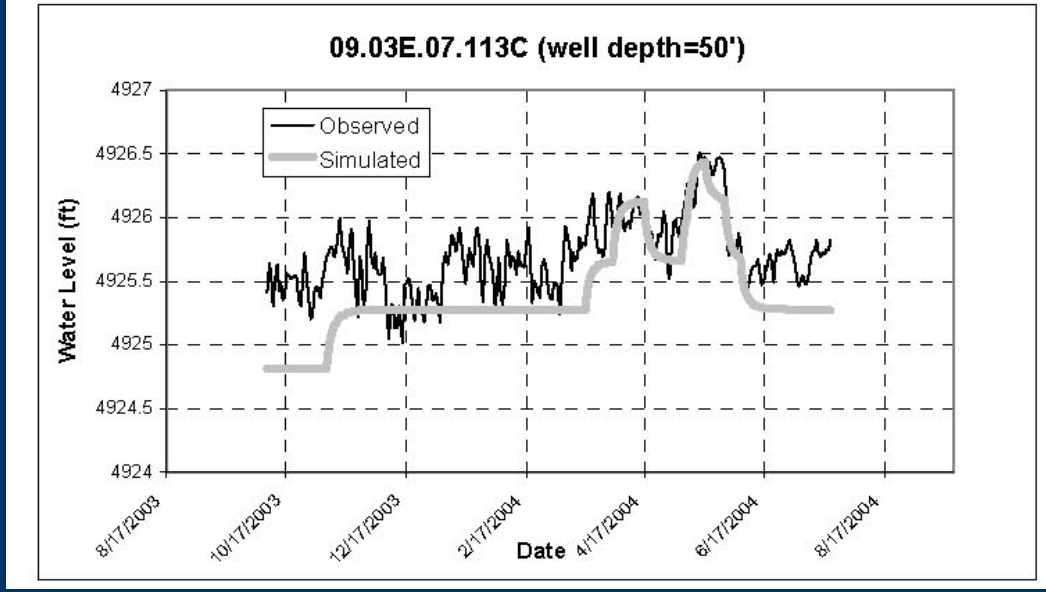
Riparian ET


Cottonwood Mixed, Unknown Veg.
Cottonwood Pure, Russian Olive
Salt Cedar
Riparian Woodland
Bare Land
Marsh
Depth of Groundwater (ft)
-2
0
2
4
6
8
10
12
14
16
0
1
2
3
4
5
6
7
ET rate (ft/year)

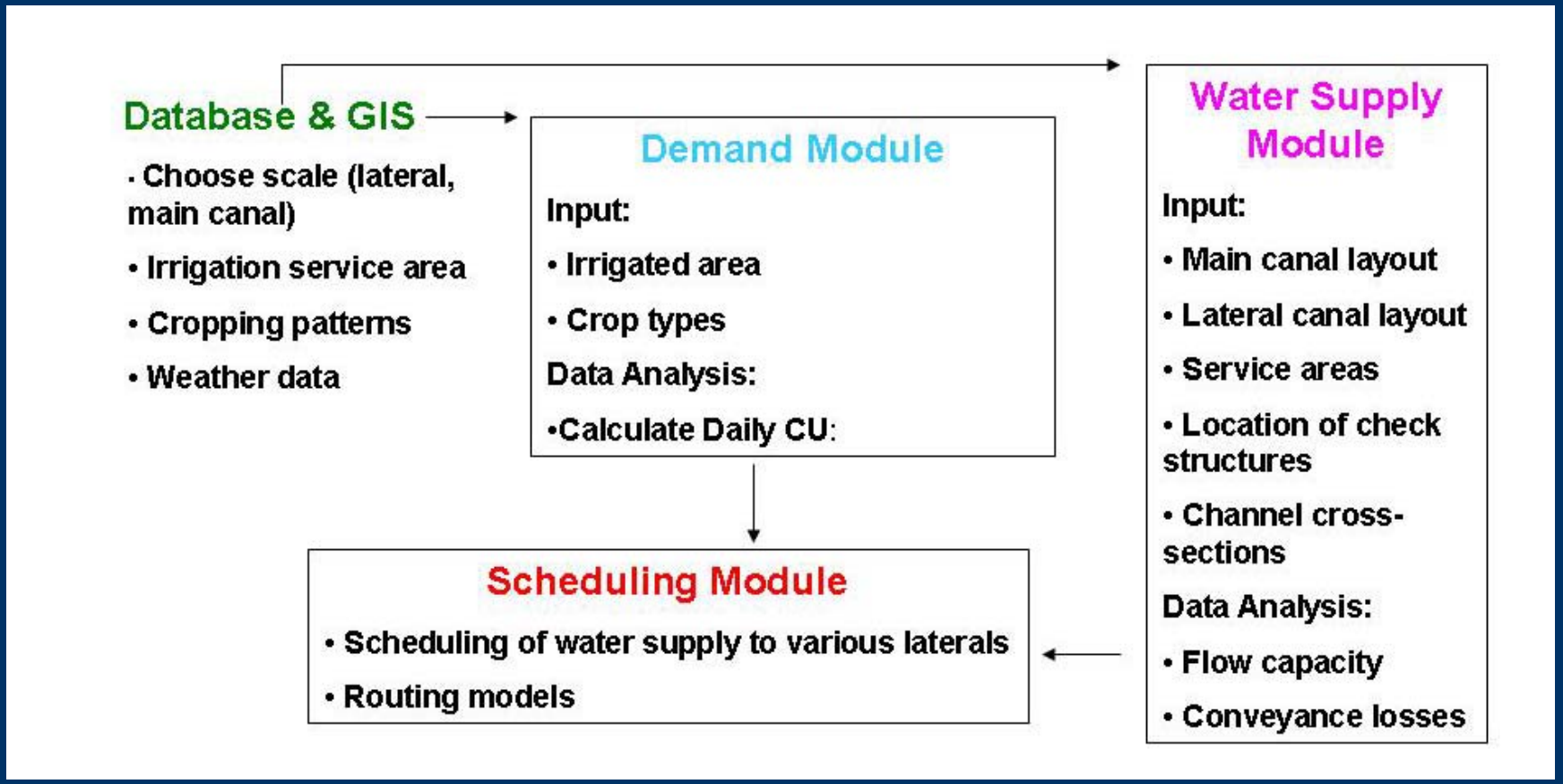


Riparian Model



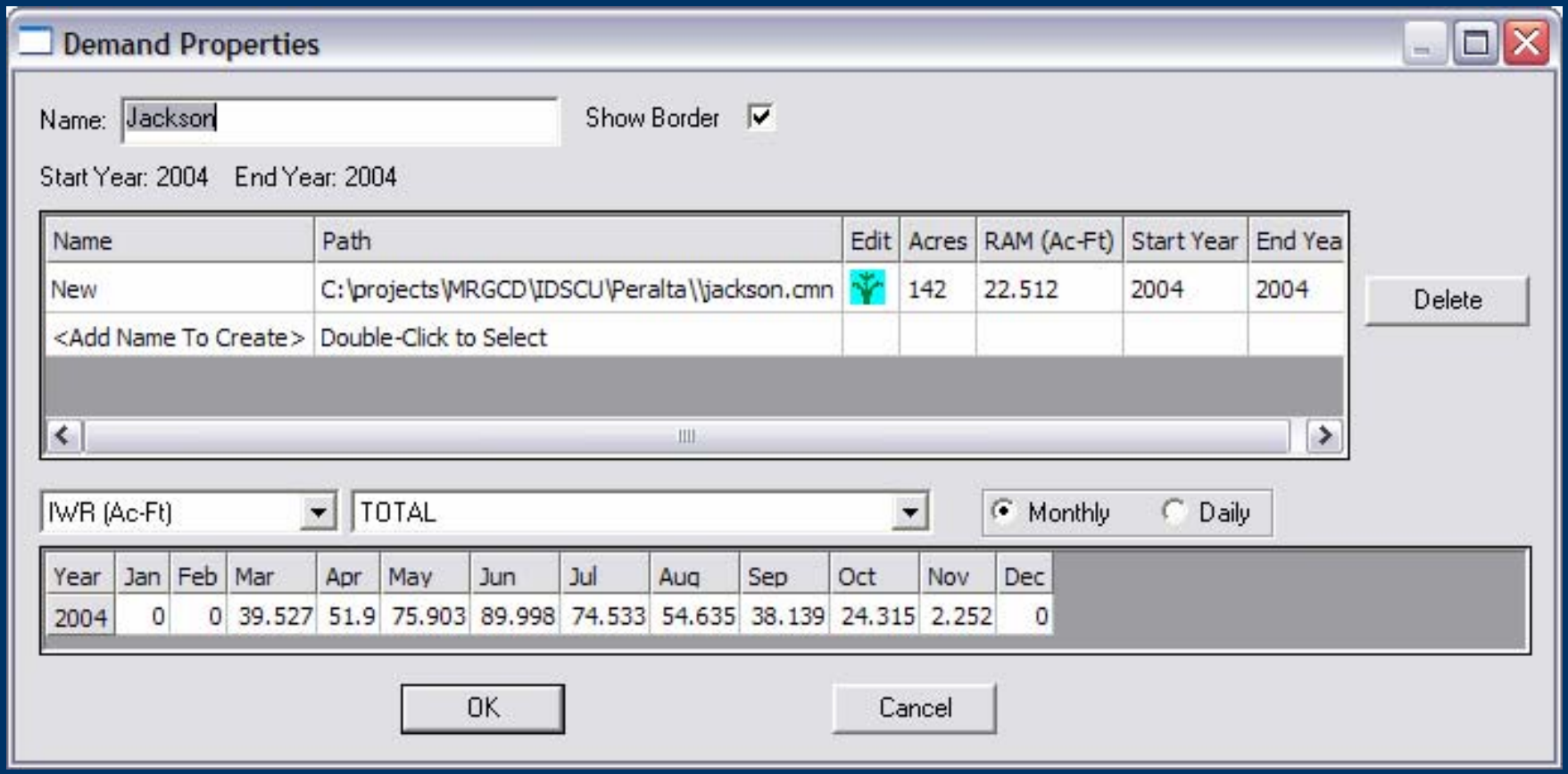


MRG Irrigation Scheduling Model



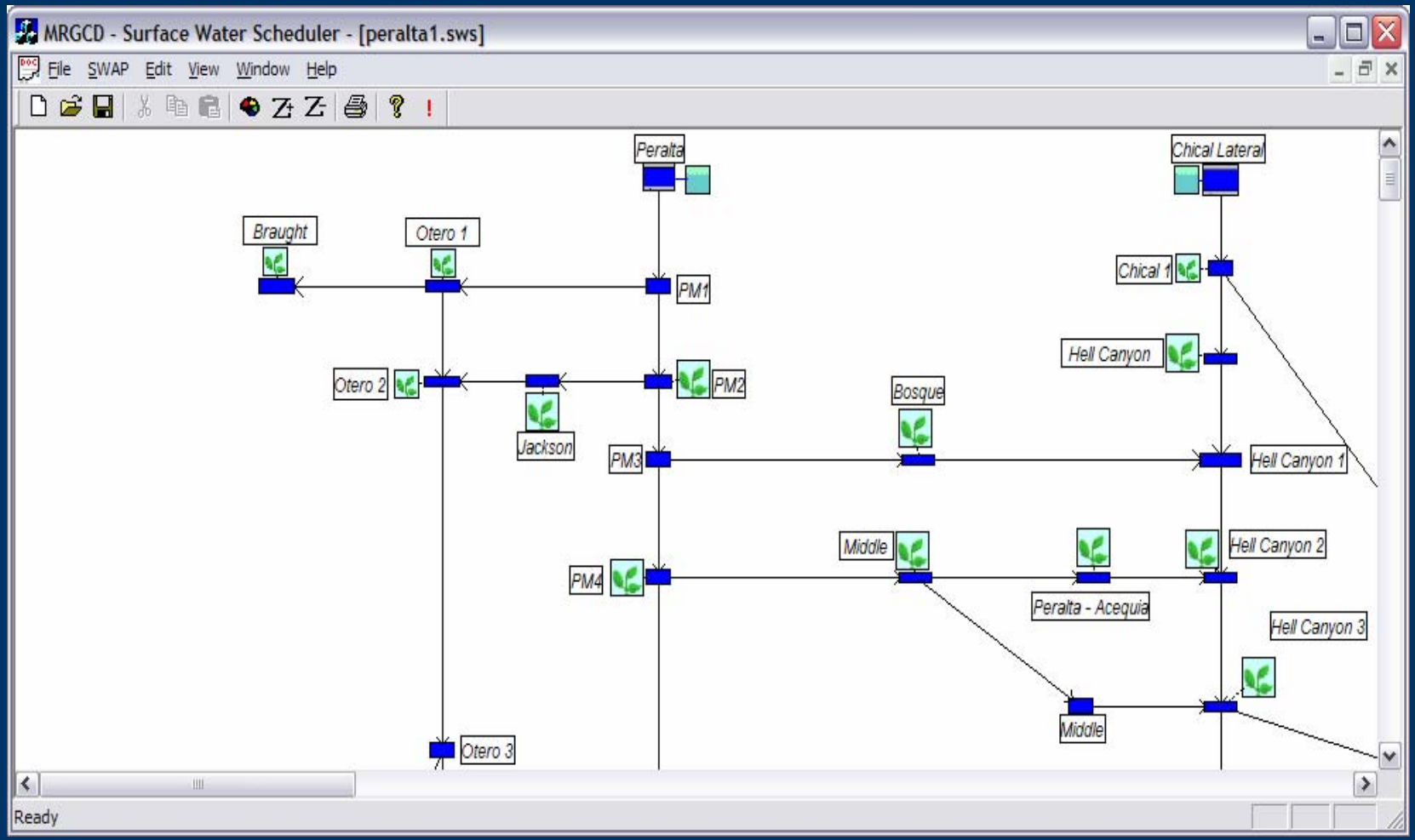
MRGCD DSS

Demand



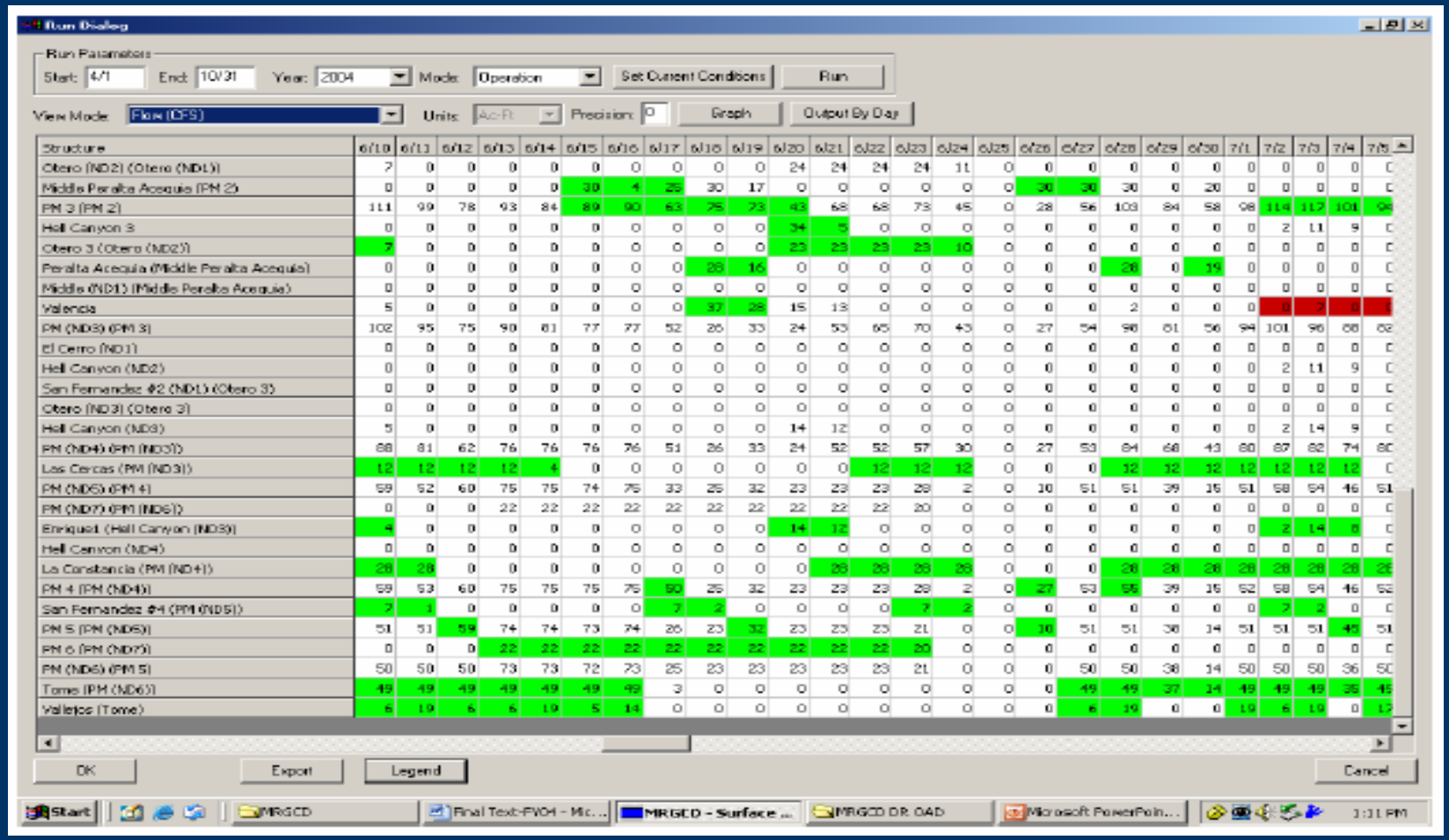
MRGCD DSS

Supply

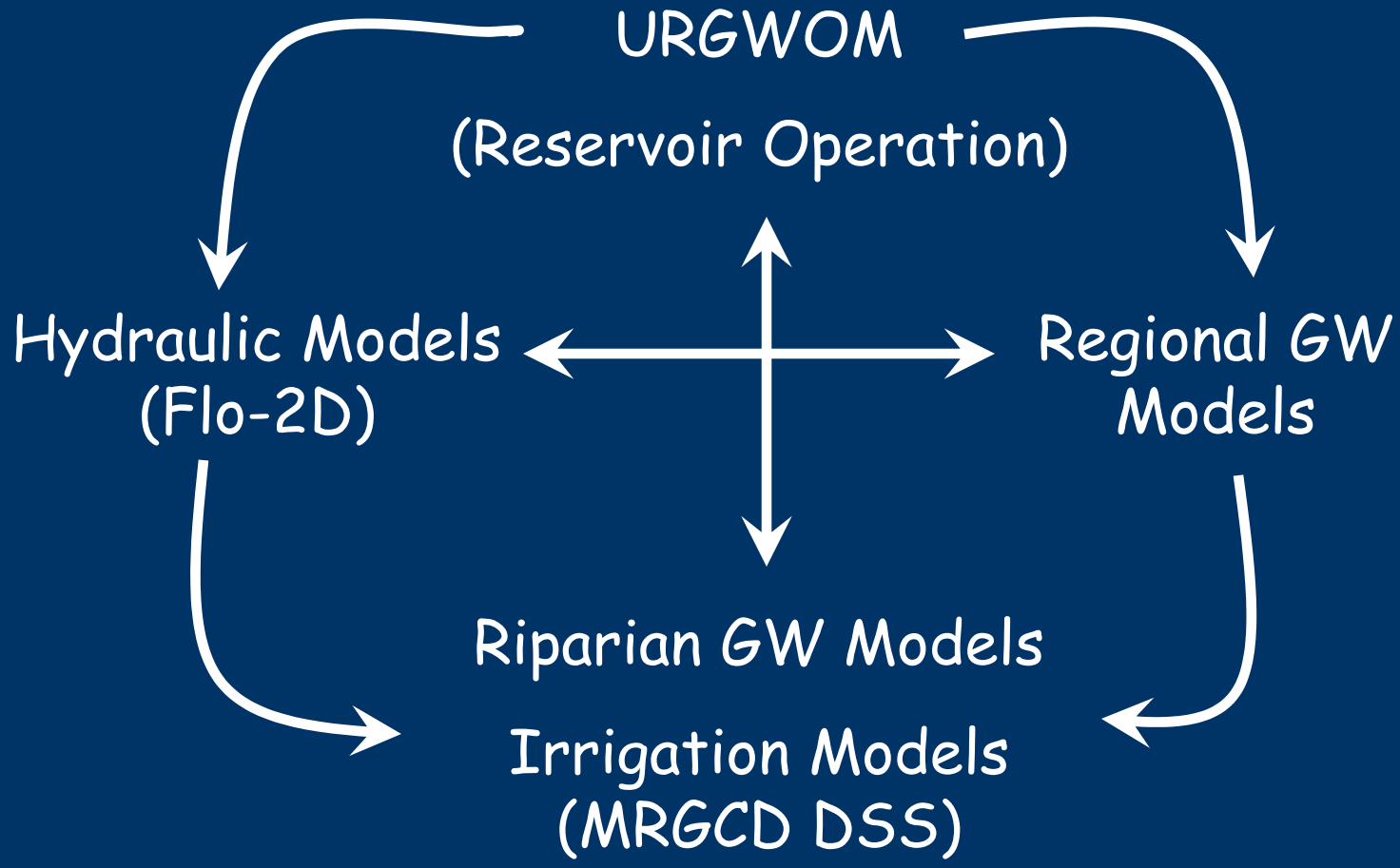


MRGCD DSS

Scheduling



Framework


URGWOM
(Reservoir Operation)
Hydraulic Models
(Flo-2D)
Regional GW
Models
Riparian GW Models
Irrigation Models
(MRGCD DSS)