# Modeling Framework for the Middle Rio Grande Basin

Nabil Shafike Interstate Stream Commission 10-3-2006



#### Predictive:

Used to predict the consequences of certain actions. Interpretive: Used as a framework for studying system dynamics. Generic: Used to analyze hypothetical system.

#### <u>MRG Models</u>

- 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

# <u>Upper Rio G</u>rande <u>Water Operation</u> <u>Model (URGWOM)</u>



#### URGWOM

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

#### URGWOM models

- Accounting (Reclamation, NMISC)

  - 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



# <u>URGWOM</u>

#### Improvements

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



### URGWOM



### 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, L 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

F	Riparian Model Flow Librar	У
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

Rio Grande at Albuquerque: Measured flow vs. assigned Library flow



# **Riparian ET**





# Riparian Model





# MRG Irrigation Scheduling Model



# MRGCD DSS

#### Demand

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# MRGCD DSS

### Supply



# MRGCD DSS

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