Managing Water Use to Protect Aquatic Habitats

– Development of a Ground Water/Stream Flow Model for the Upper Monocacy River Basin

Cherie Schultz, Ph.D.
James Palmer
Interstate Commission on the Potomac River Basin

Adams County Agricultural and Natural Resources Center
April 18, 2008

Managing Water Use to Protect Aquatic Habitats

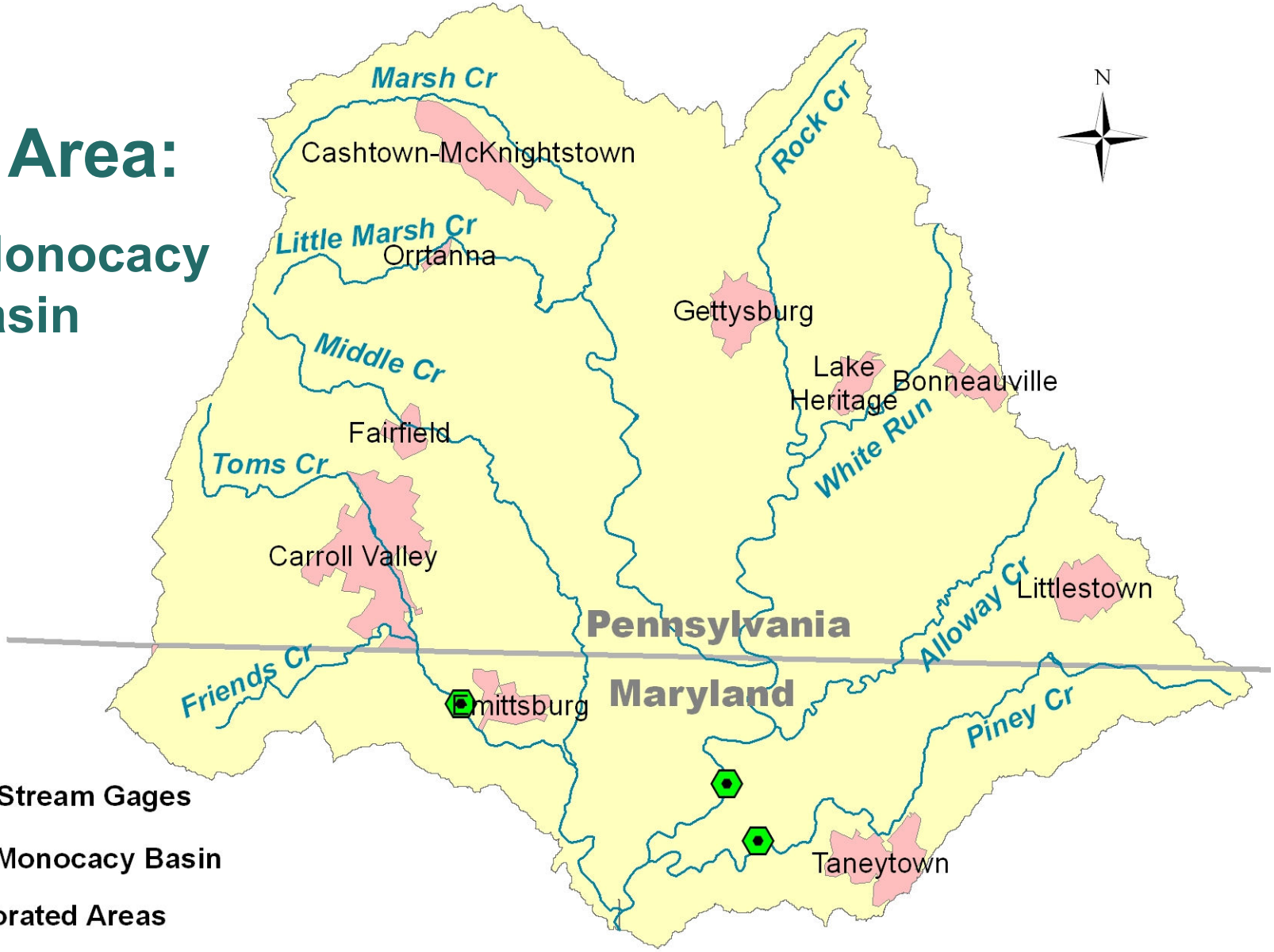
- Objective: Begin development of a water resources planning tool
- Partners:
  - ICPRB
  - USGS
  - WAAC
  - Strawberry Hill Nature Preserve
- Funding: NFWF grant + ICPRB funding
- Project period: July 2007 thru Sept 2008

Project Goals

- Collect new flow data for Rock and Marsh Creeks
- Construct preliminary ground water/stream flow model of upper Monocacy River basin
  - “steady-state” model of summertime conditions
- Provide information for planners and stakeholders on potential uses of this type of model
- Produce set of maps showing changes in conditions under various water use scenarios

Study Area:

Upper Monocacy River Basin



USGS Stream Gages

Upper Monocacy Basin

Incorporated Areas

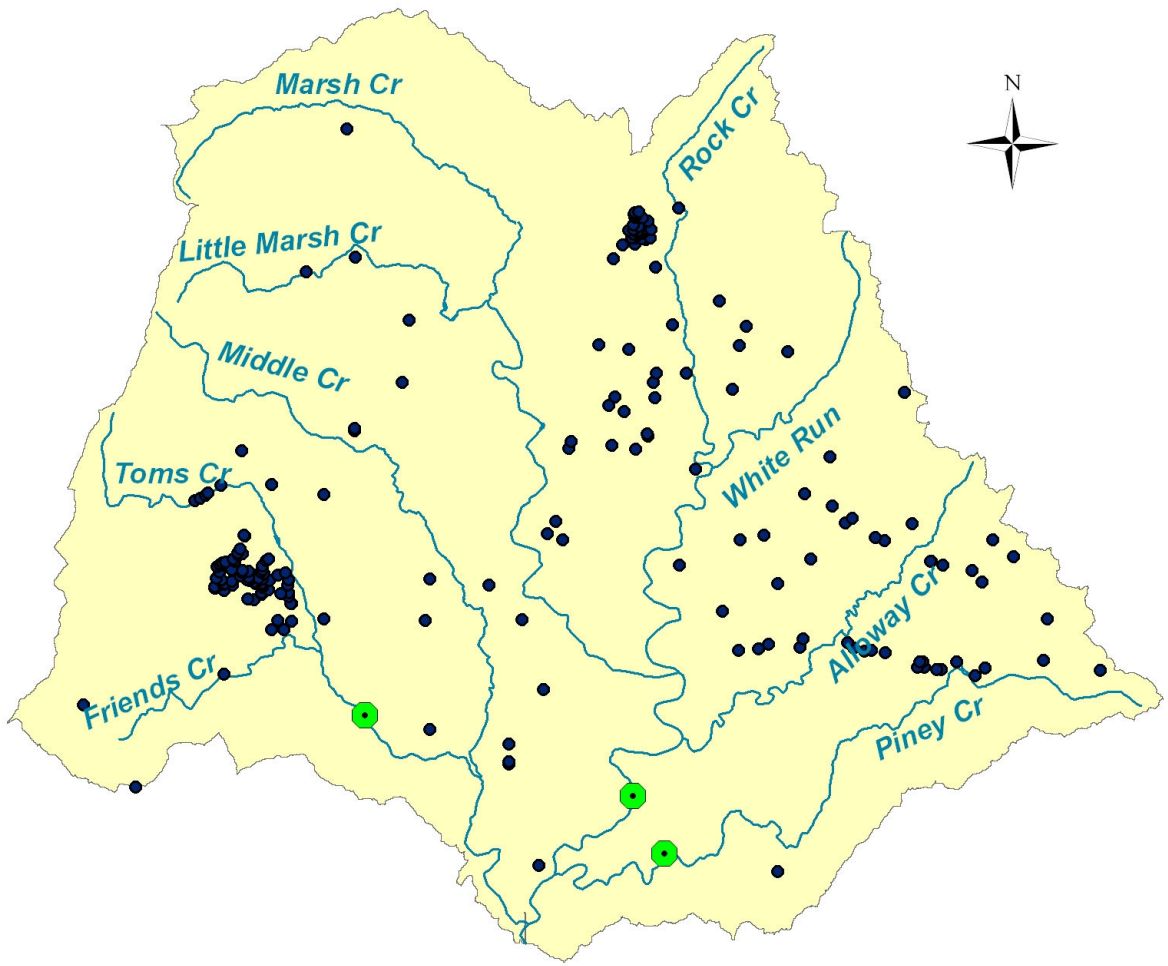
Main Streams

Data Availability

872 wells in NWIS database

362 wells have data in study period (1960 – 2002)

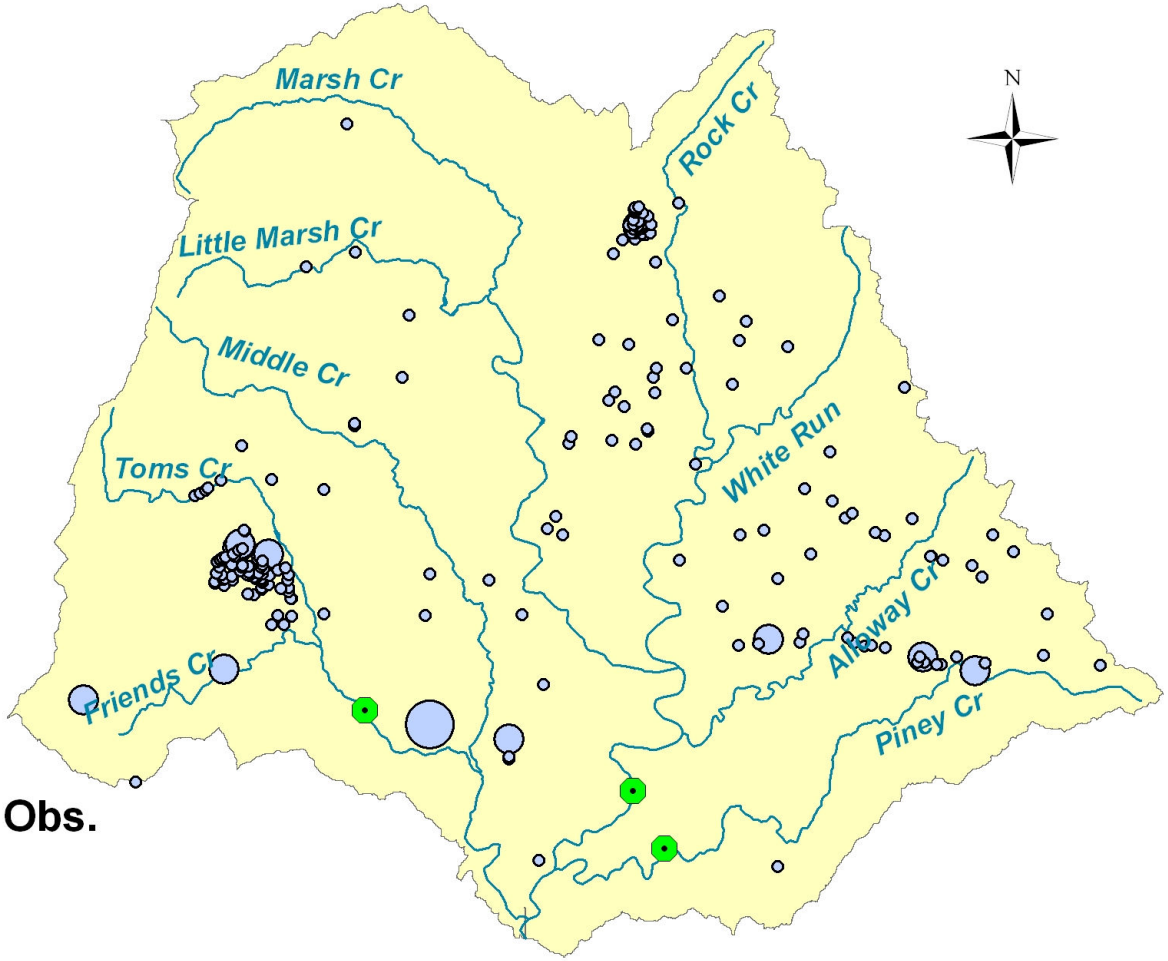
207 wells have summertime data in study period



Data Availability

Number of water levels observations is generally small:

- 1 obs. at 195 wells
- 2 – 5 obs. at 11 wells
- 63 obs. at 1 well



No. Summertime Obs.

- 1
- 2 - 5
- 63

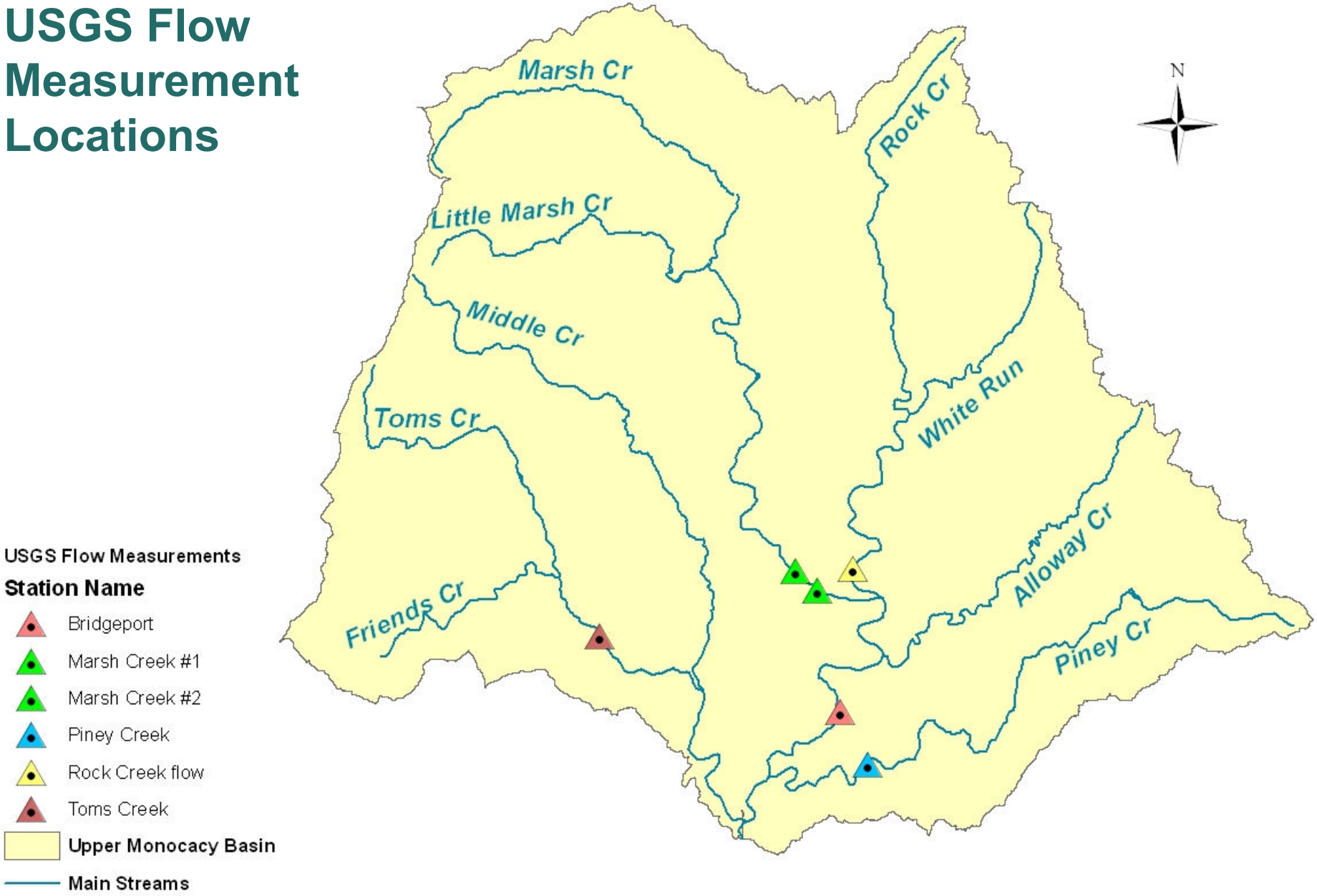
Modeling Approach (tentative)

- Use study period: 1960 - 2002
- Use precipitation data to define 5 summertime conditions:
  - Dry: 1962, 63, 64, 65, 80, 88, 91, 97, 2001, 2002
  - Average/dry: 1966, 69, 77, 78, 81, 82, 85, 86,
  - Average: 1961, 74, 76, 87, 90, 94, 95, 98
  - Average/wet: 1960, 67, 68, 71, 83, 92, 99, 2000
  - Wet: 1970, 72, 73, 75, 79, 84, 89, 93, 96
- Use mean summer baseflow to estimate recharge for each condition
- Simulate average “summertime” (July, August, September) aquifer levels for each condition
- Simulate water levels only at wells uninfluenced by pumping

New Flow Measurements

- Marsh Creek at Mason Dixon Rd.
  - 9 measurements, 03/07 – 03/08
  - Flows from 0.33 cfs to 130 cfs
  - Approximately 50% of flow at Bridgeport
- Rock Creek at Mason Dixon Rd.
  - 6 measurements, 08/07 – 03/08
  - Flows from 0.71 cfs to 43 cfs
  - Approximately 41% of flow at Bridgeport

USGS Flow Measurement Locations



Model Design

- MODFLOW-2000 finite difference groundwater flow model code
- Rectangular grid of 71 rows and 84 columns with 2 layers, horizontal grid spacing of 500 m
- Grid rotated N22°E to align flow directions with regional structure of Mesozoic basin
- Top of Layer 1 is land surface elevation

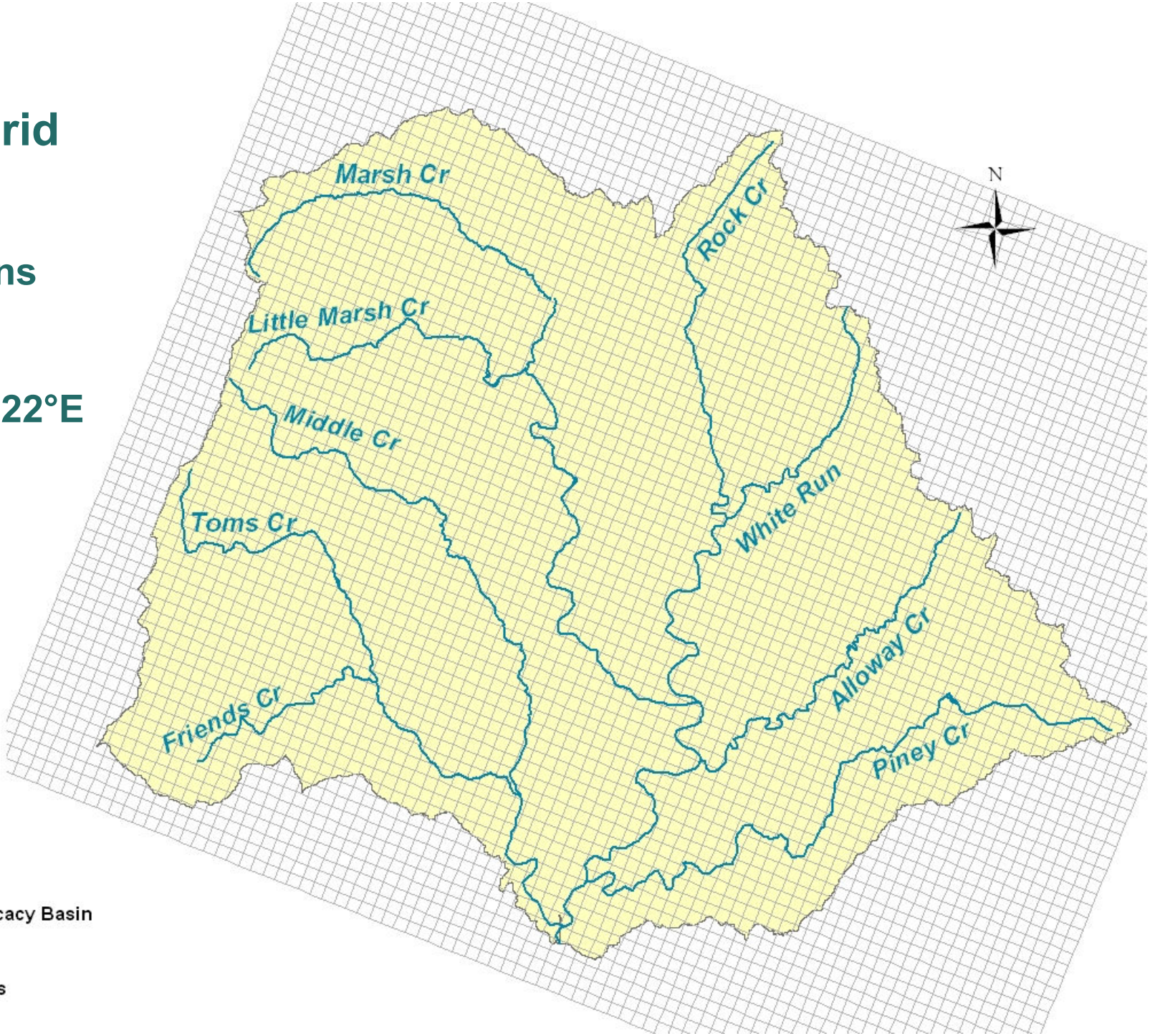
Model Grid

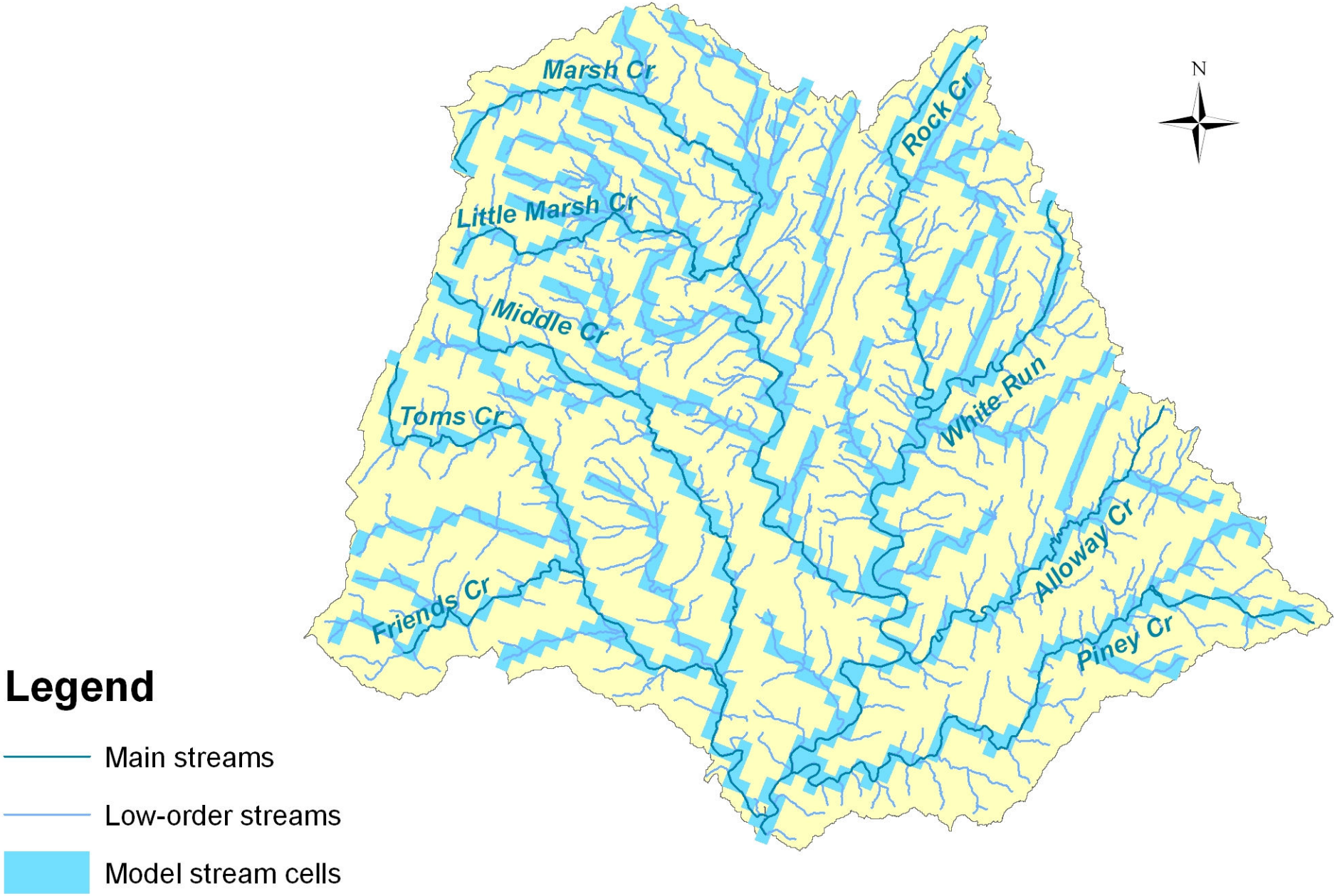
71 Rows

84 Columns

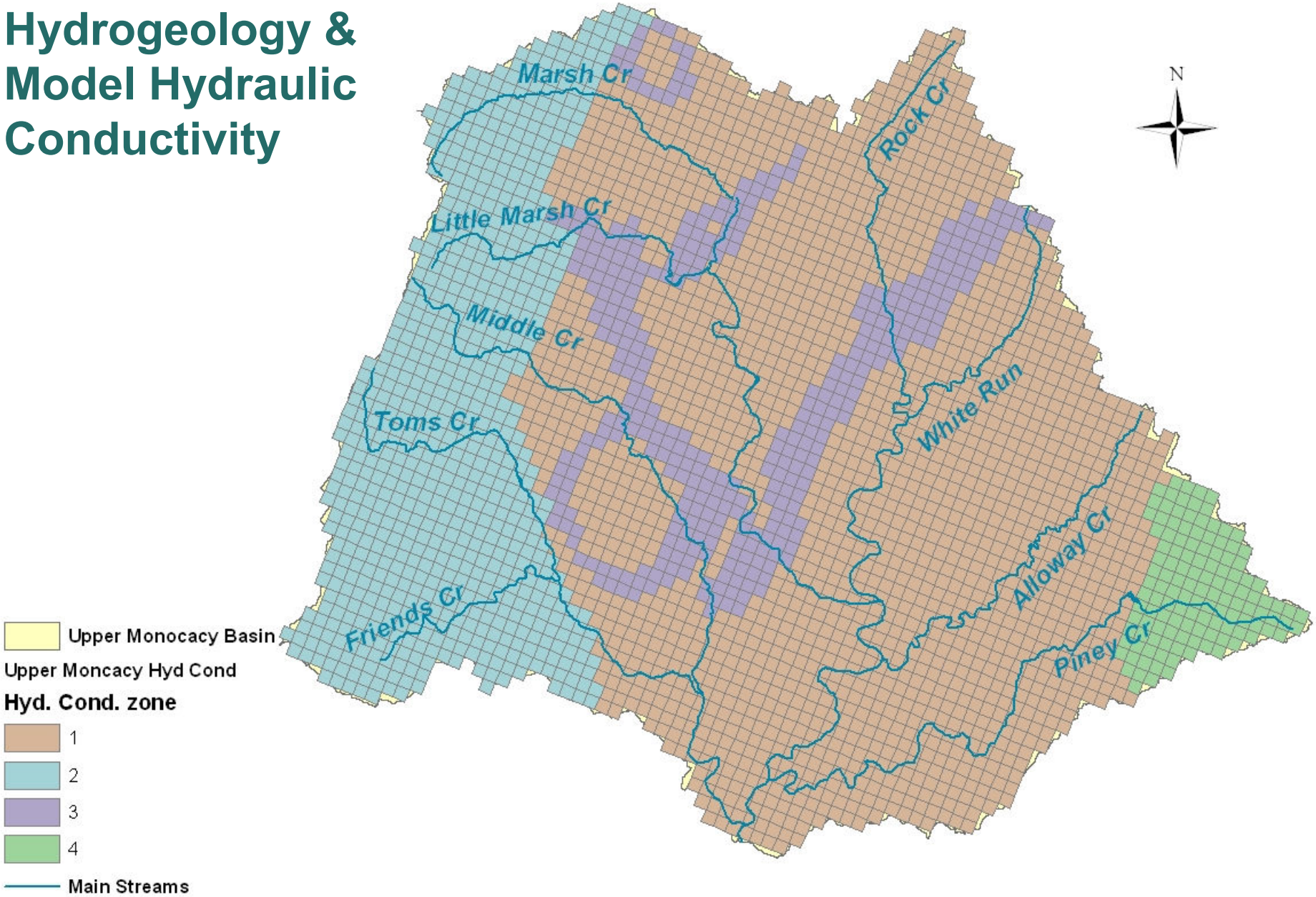
2 Layers

Rotated N22°E

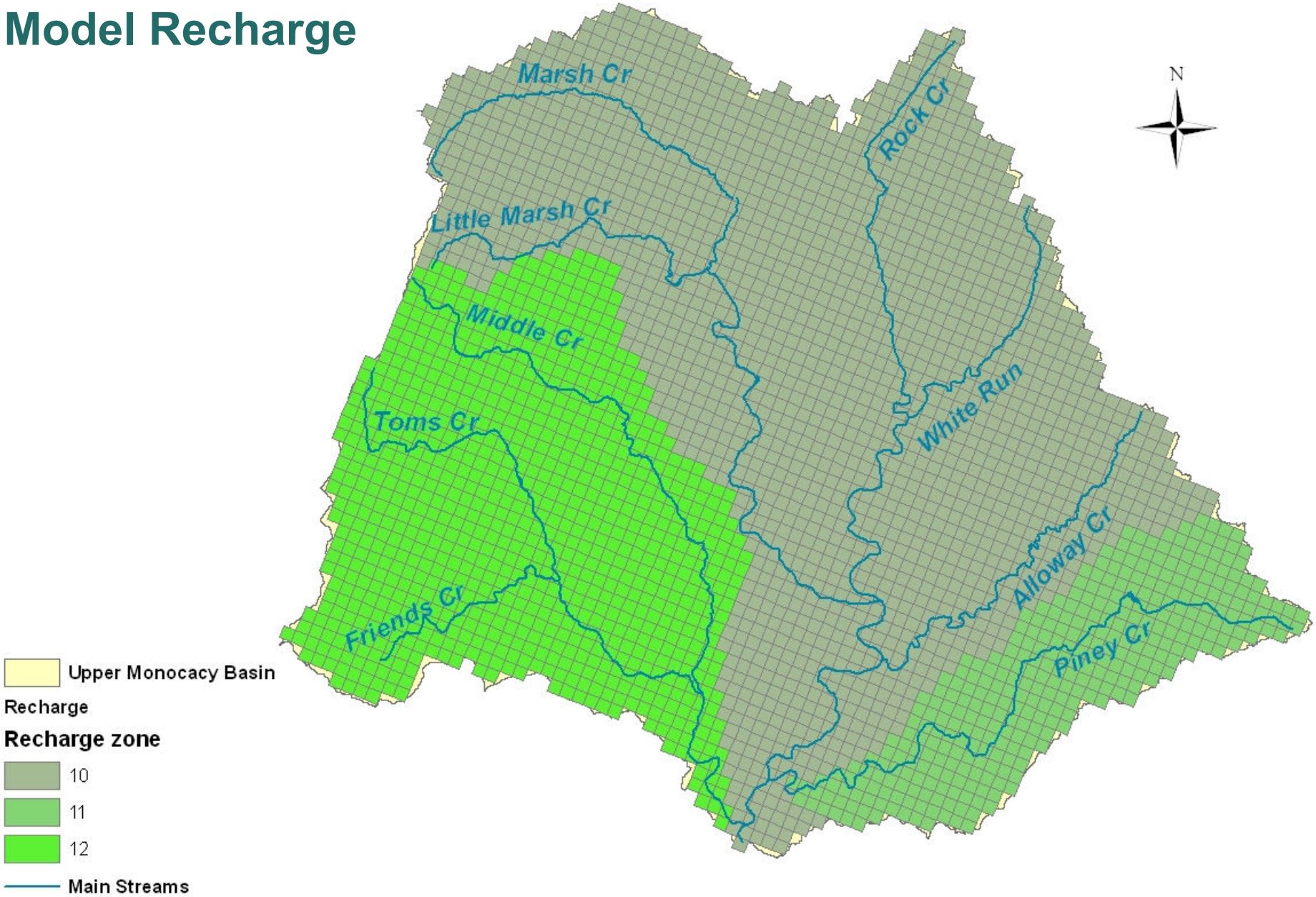



Marsh Cr
Little Marsh Cr
Middle Cr
Toms Cr
Friends Cr
Rock Cr
White Run
Alloway Cr
Piney Cr
N
Legend
Main streams
Low-order streams
Model stream cells

Hydrogeology & Model Hydraulic Conductivity



Model Recharge



Model Limitations

- Won’t simulate seasonal changes in aquifer storage (– would need time-varying seasonal model)
- Won’t simulate localized influences of pumping wells
- Won’t simulate conditions in first order streams
- May not simulate deep flow paths

Need Help From Our Partners

- Water level observation data uninfluenced by pumping wells (1960 – 2002)?
- Info on summertime conditions in headwater streams – in what locations are they sometimes dry?
- Input on potential water use scenarios?

Future Directions

- Data collection effort to support time-varying model?
- Coupled ground water/watershed model (USGS's new GSFlow model)?