Metropolitan Groundwater Model for Water-Supply Availability Analysis

Technical Advisory Group Meeting

June 25, 2007

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What we would like to accomplish with this meeting…

- Establish what problems this model is intended to address
- Discuss conceptual hydrogeologic model
- Discuss model particulars (domain, discretization, calibration, etc.)
- Discuss data availability
- Other stuff (schedule, etc.)

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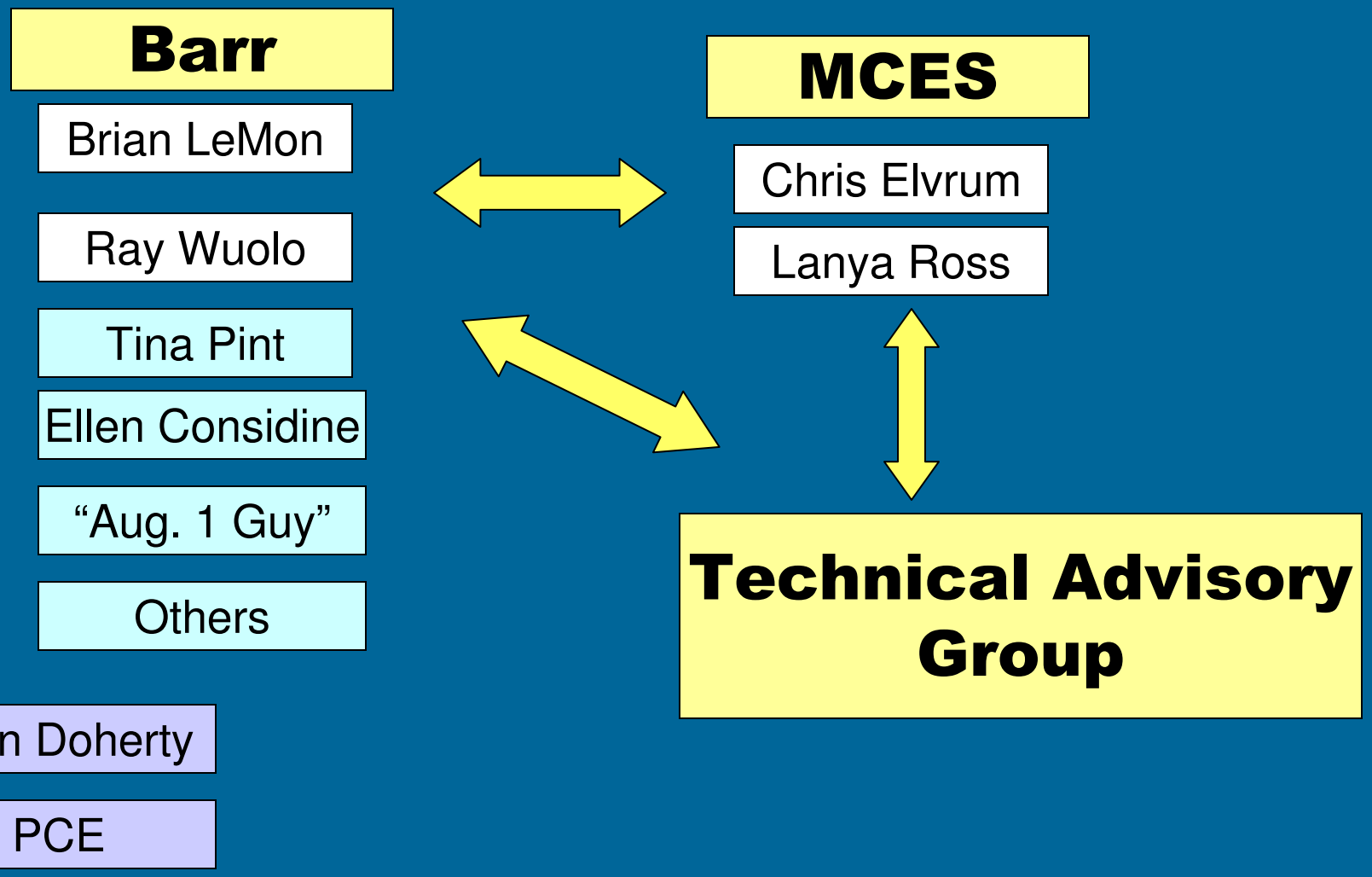
Barr is a contractor to MCES. Barr will be doing the following:

- Develop and calibrate a MODFLOW groundwater model(s) of the 7-County Twin Cities Metro area
- Use this model (and other tools) to identify and evaluate water supply alternatives

Project Team



What problems will be addressed with this model?

- What will groundwater levels likely be in the future, given projected water demand?
- How might future pumping affect flows in streams?
- How might land use and development patterns affect recharge (and groundwater levels)?

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What problems will be addressed with this model? (cont.)

- What is a good estimate for the maximum pumping capacity of a well field or area?
- Given a proposed well and pumping rate, what will the drawdown look like and what existing wells might be affected?
- How might future pumping affect other important ecological resources?

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A guiding principal in developing the model…

- The model must be adaptive for future modification and use

General Layering (Vertical Discetization)

GEOLOGIC UNITS	DESCRIPTION	HYDROSTRATIGRAPHIC UNIT	MODFLOW Model Layer
Glacial Drift/Recent Alluvium	mostly silt, sand, and gravel with till lenses and lake deposits	Aquifer with some local aquitard units	Typically Layers 1 & 2
Decorah Shale	glauconitic shale	Aquitard	Not in model
Platteville Formation and Glenwood Shale	massive to thinly bedded, fractured dolomite & shale	poorly transmissive aquifer to aquitard	Not in model
St. Peter Sandstone	upper 100 feet is uniform fine sandstone; lower 50 feet is shale	Aquifer	Typically Layer 2
		Aquitard	Leakance on Layer 2
Prairie du Chien Group	Shakopee Fm (upper unit) contains zones of highly fractured rock; Oneota Dol. (lower) is massive	Aquifer (Shakopee)	Typically Layer 3
		Aquitard (Oneota)	Typically Layer 4
Jordan Sandstone	medium sandstone with fractures and some cementation	Aquifer	Typically Layer 5
St. Lawrence Formation	dolomitic shale	Aquitard	Typically Layer 6
Franconia Formation	calcareous sandstone to shaley sandstone	Aquifer (upper Franconia)	Typically Layer 7
		Aquitard (lower Franconia)	Leakance on Layer 7
Ironton-Galesville Sandstones	fine to medium sandstone	Aquifer	Layer 8
Eau Claire Formation	dolomitic shale	Aquitard	Leakance on Layer 8
Mt. Simon and Hinckley Sandstones	sandstone	Aquifer	Layer 9
Precambrian Crystaline Rocks	undifferentiated crystalline and volcanic rocks	Aquitard	Not in model

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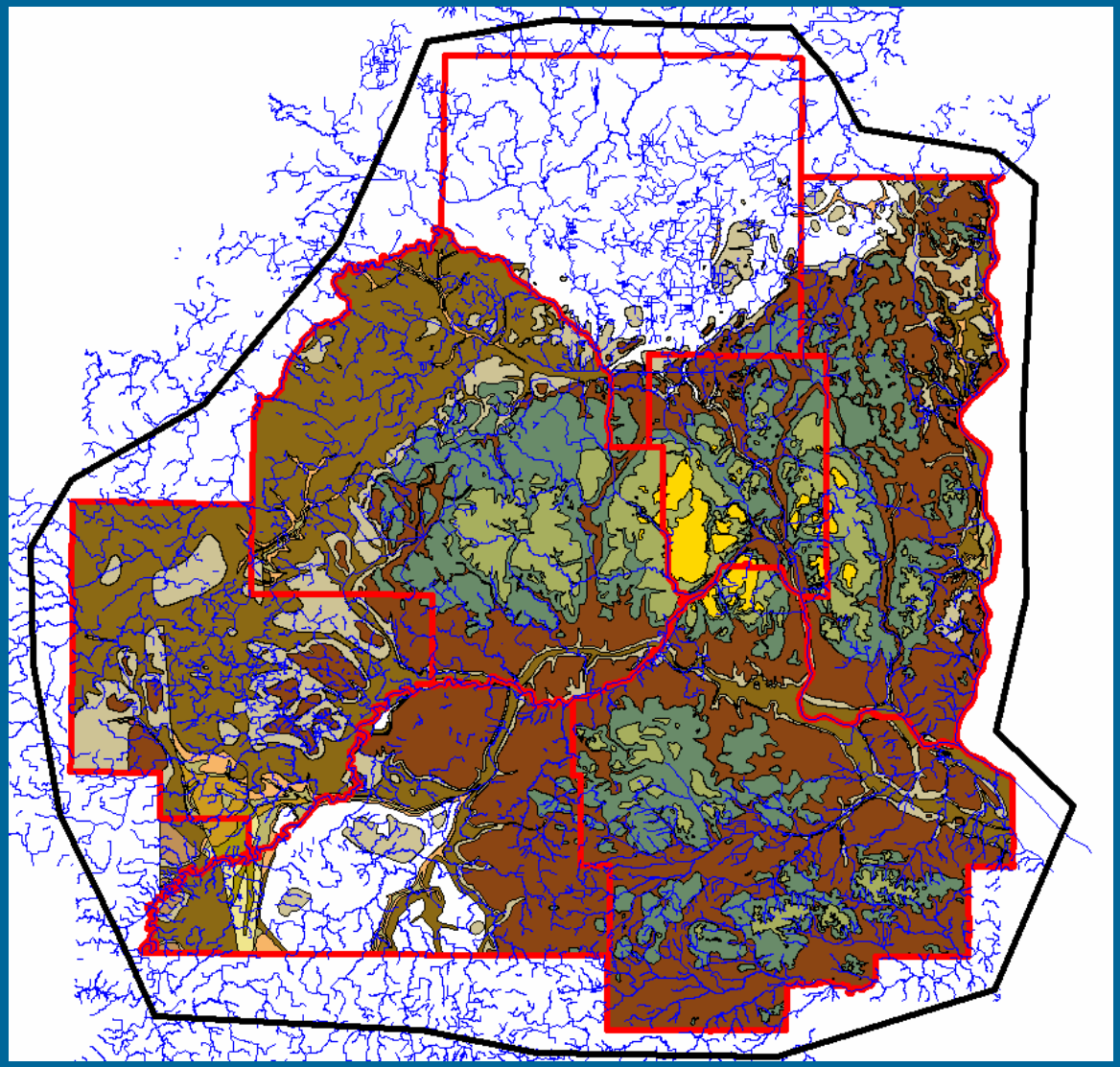
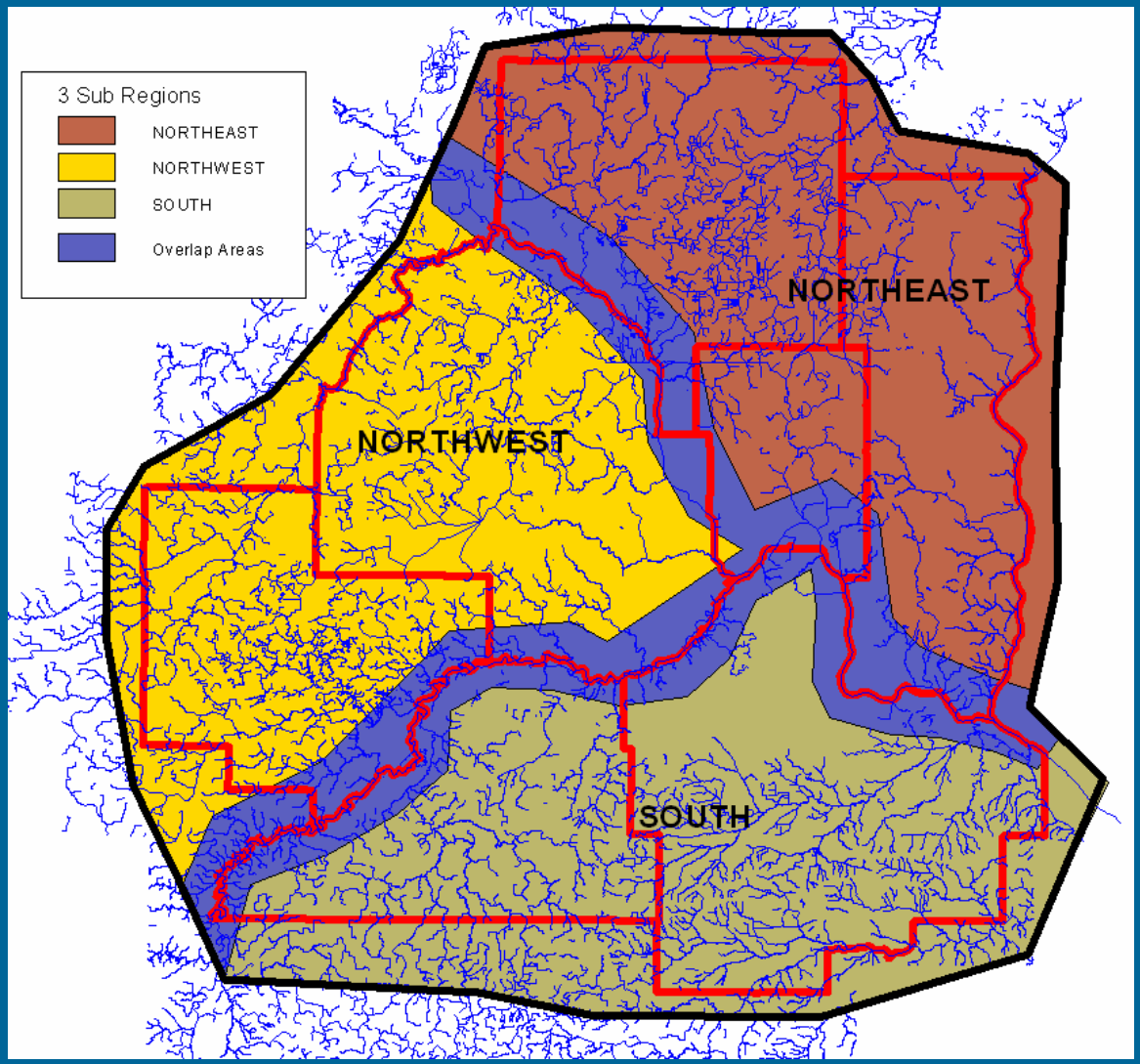
1. Proposed Model Domain



Sub-Regional Models
Option 1: 3 "hydrologic" provinces



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Other thoughts on sub-regions?

- Anoka Sand Plain?
- Carver and northwestern Hennepin?
- Northern Washington?

2. Hydrostratigraphic Layer Geometries

- Layer tops and bottoms will be spatially varying grids – not polygons
- Begin with MGS grids
- Areal extent…
- Deeper Layers?

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Computational Layers vs. Hydrostraigraphic Layers

- Model layers will represent different geologic units in different areas
- Dealing with faults
- Issues with multiple layers representing a single unit

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3. Recharge Estimation

- Propose using SWB (Soil Water Balance) Code (in final beta testing)
- Modified Thornthwaite-Mather soil-moisture balance approach – water balance calculated on a daily basis
- Recharge calculated on a weekly, monthly, or annual basis

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SWB Requires 6 Input Parameters

- Hydrologic Soil group
- Land cover
- Available soil-moisture capacity
- Surface-flow direction (topography)
- Initial soil moisture and snow cover
- Meteorological inputs

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Why SWB?

- Spatial variability of recharge at the grid scale of the model
- Recharge tied to soil and land use
- Fast
- Good results from “uncalibrated” SWB

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4. Calibration Approach

- PEST with SVD-Assist
- Pilot points for Kx and Kz within zones
- Targets:
  - Steady-state heads
  - Base flows
  - Pumping test drawdown and head

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How many parameters?

- Probably thousands
- SVD-A uses "super parameters" to substantially reduce computation time
- John Doherty will be assisting us in implementation

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Future Calibration

- Calibration will be set-up to be repeatable in the future as new data and observations become available

Modeling particulars

- Groundwater Vistas will be the GUI
- Doherty dry-cell correction will be used in calibration (MODFLOW-96)
- Conversion to MODFLOW-2000
  - Shouldn't be a problem but no promises

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Model-Related "Products"

- MODFLOW files and GUI projects
- GIS coverages of all parameters (UTM 83)
- Report

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Schedule

- Model needs to be finished @ January 1, 2008
- Water supply alternative evaluations in Spring 2008

Data Wish List

- Geologic unit grids? Latest? Deeper Units?
- Till coverages?
- Stream base flow estimates?
- Calibration targets for heads?
- Carver County?
- Anoka Sand Plain?
- What else should we know about now?