Office of the State Engineer Groundwater Models and Administrative Guidelines

Western States Water Council

Tom Blaine P.E.
State Engineer

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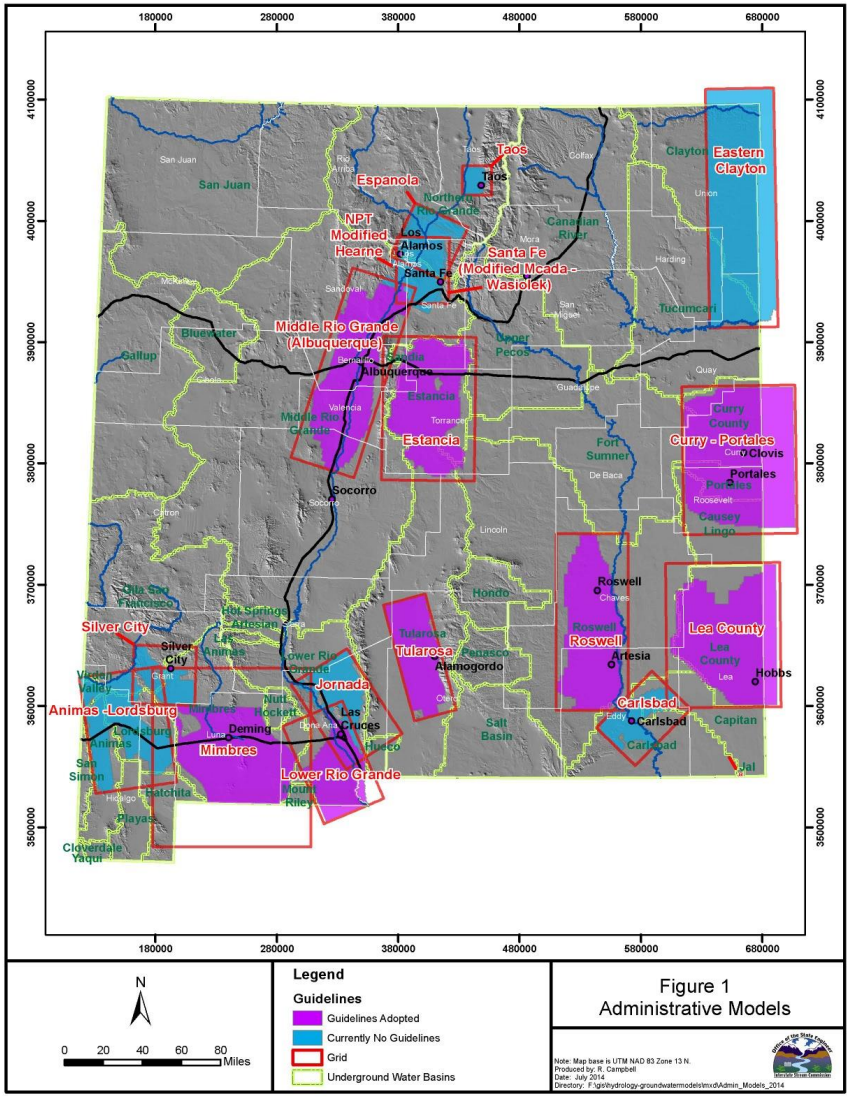
What does OSE use models for?

- Impairment analysis
- Quantification of offsets
- Unappropriated water
- Permit administration
- State / regional water planning
- General water management



Impairment

- Impairment Analysis
  - Statutory requirement before granting a permit
  - Issue in most protested cases
  - May be created by hydrologic effects from applied-for action that adversely impact or prevent exercise of existing water rights

- Hydrologic effects include:
  - Reduction in surface water flows (depletion)
  - Decline in groundwater levels (drawdown)

- Hydrologic effects in and of themselves do not constitute impairment

- New appropriations or point of diversion moves ("transfers") cause greatest effects

- Analysis to estimate the *net hydrologic effect* of water right change:
  - Net Effect = Changed Conditions Due to Application – Baseline Conditions

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Guidance on determination of impairment

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- General Effects
- Area Specific

Guidance on determination of impairment

- General: “Morrison guidelines” (Morrison, 2006 / 2017) for assessment of drawdown effects

  Effects assessed on individual groundwater points of diversion (POD)

Guidance on determination of impairment

- Area-specific: Basin guidelines/Critical Management Areas (CMAs) (areas with less than a 40-year supply)
  - Numerical models form the basis for administrative guidelines (similar to old “block system”, with model grid cells as the blocks)
  - Drawdown projections used to identify CMAs
  - “Regional assessment” = drawdown on blocks/cells (MODFLOW)
  - “Local assessment” = drawdown on nearby wells (Theis and Morrison)

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Modeling

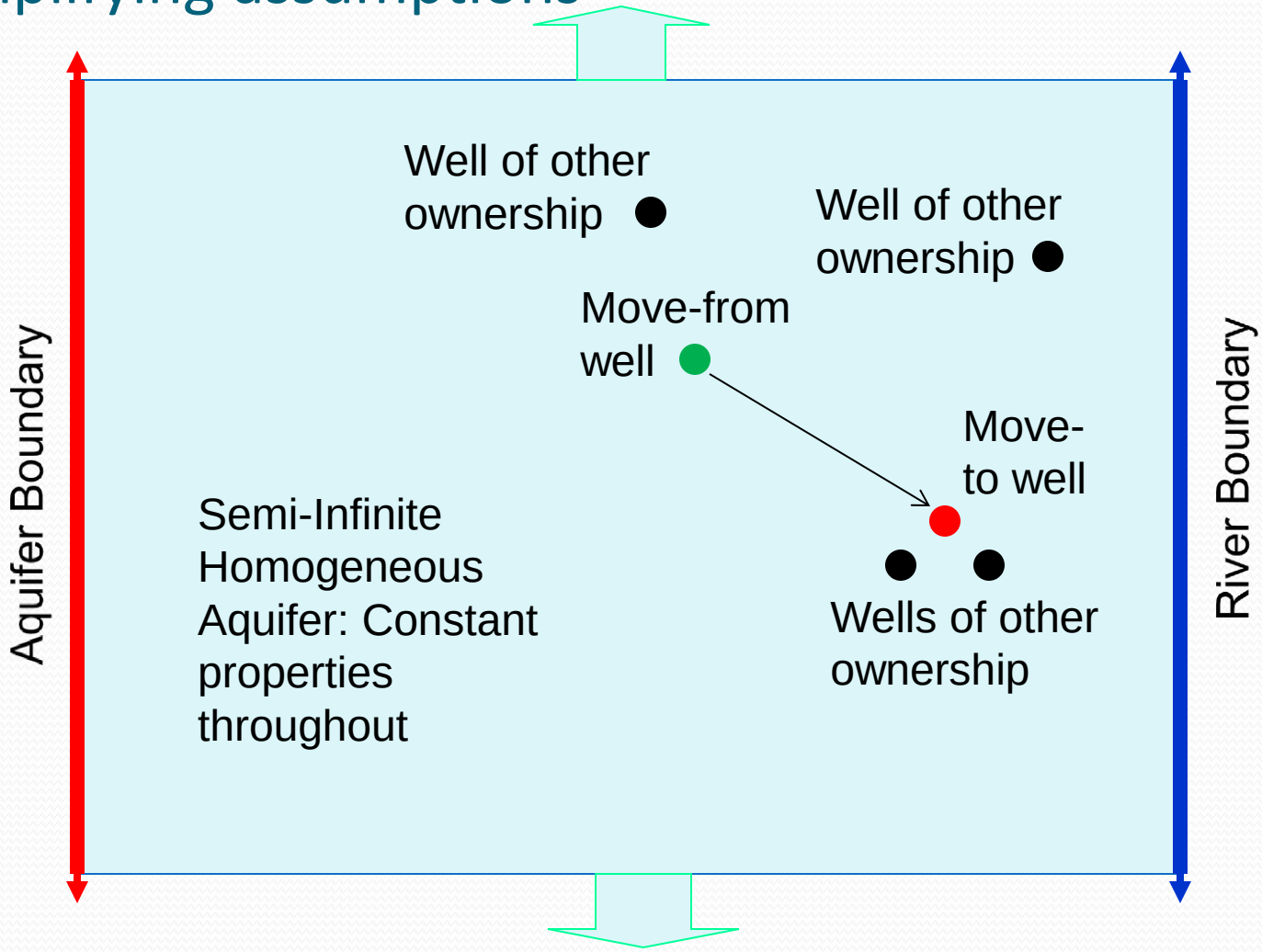
HOW?

- Data/Information → Conceptual Model → Mathematical Model
  - Analytical = Theis (drawdown); Glover-Balmer (depletions)
  - Numerical = groundwater flow model (MODFLOW)
- Start with **calibrated model** (history-matched to measured or estimated heads/flows)
- Use model to predict drawdown due to existing water rights
- May create **superposition version** for ease of administrative use
- Quantify the *net effect* of application (feet of drawdown; acre-feet of depletions)
- Wide variation in degree of uncertainty
- OSE: Reasonable but conservative case-by-case approach

WHO?

- Models usually developed by OSE and/or U.S. Geological Survey, others
- Water Rights Division = evaluations for routine unprotested applications
- Hydrology Bureau:
  - Provides assistance (methods, models, support tools and training) to WRD
  - Evaluates non-routine unprotested and protested applications

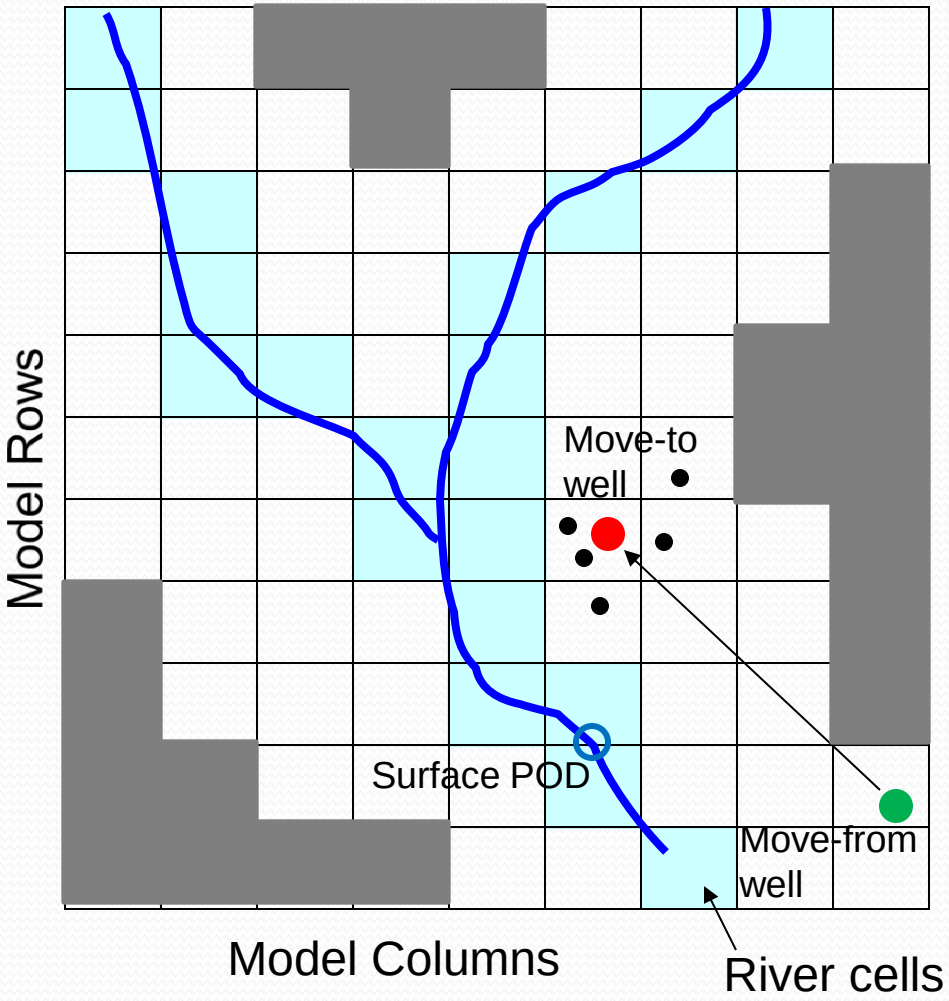
Analytical models (Theis/Glover-Balmer) require simplifying assumptions



Numerical Models (MODFLOW) allow more realistic simulation of complex hydrologic systems

Map view of stream-aquifer system with numerical model grid

Numerical models can also simulate more than one aquifer through vertical layering



Each cell can have different properties and be turned “on” or “off” (boundaries)

Model provides both stream depletions and drawdown for any cell at any point in time

Values calculated at each cell *node* (center), so are averages for cell area

Basin Guidelines and Critical Management Areas

- Allowable drawdown over planning period (usually 40 years) = 70% of average water column from existing PODs
- Model projection run with full exercise of existing rights to determine drawdown over planning period
- Areas that exceed allowable drawdown designated as Critical Management Areas or “CMAs”
- CMAs have less than 40-year supply
- More stringent limits (~1 to 4 ft/40 yrs) on net drawdown effect in CMAs
- No new appropriations within CMAs, transfers within CMAs are allowed, transfers from outside (non-CMA) into a CMA generally denied

Basin Guidelines and Critical Management Areas

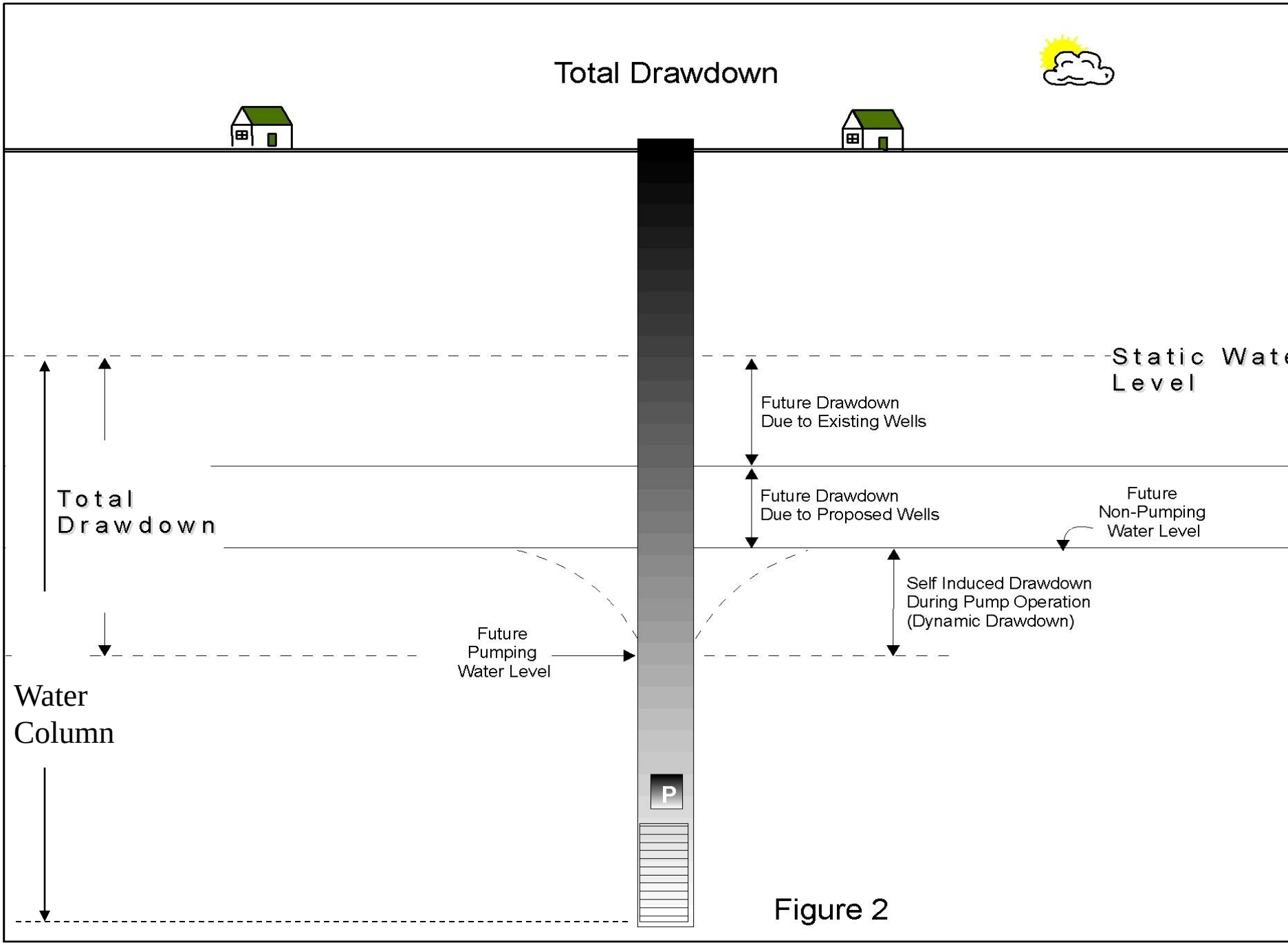

Total Drawdown
Static Wate
Level
Future Drawdown
Due to Existing Wells
Future Drawdown
Due to Proposed Wells
Future
Non-Pumping
Water Level
Total
Drawdown
Self Induced Drawdown
During Pump Operation
(Dynamic Drawdown)
Future
Pumping
Water Level
Water
Column
P

Figure 2

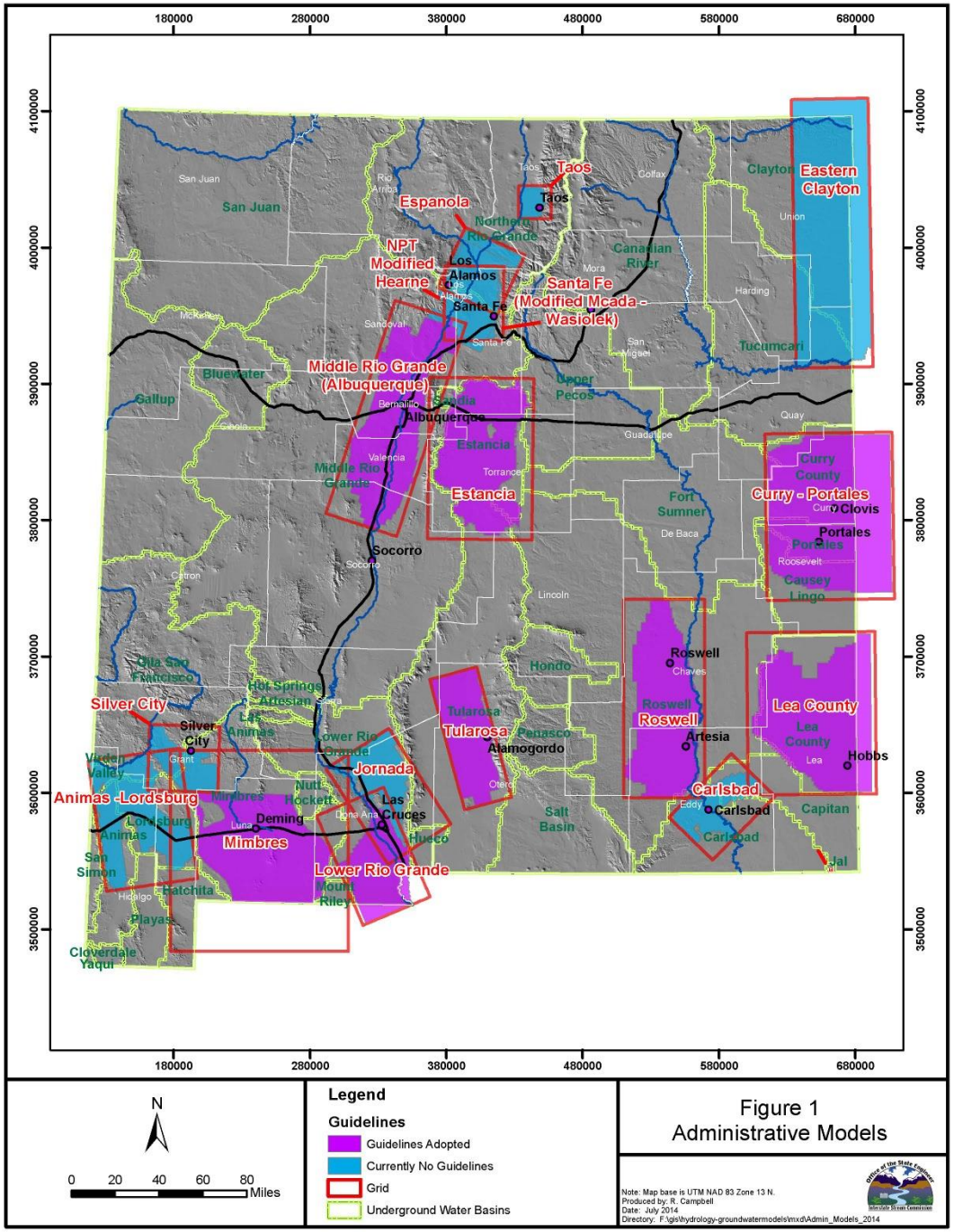
Areas with OSE models used for water rights administration

Basins with adopted guidelines:

Estancia
Middle Rio Grande (Albuquerque area)
Lower Rio Grande (Mesilla Valley area)
Curry County and Portales
Lea County
Roswell
Tularosa (Alamogordo – Tularosa area)
Mimbres (Deming – Columbus area)

Basins with guidelines in progress:

Clayton (Eastern Clayton area)
Rio Grande (Santa Fe area)
Lower Rio Grande (Southern Jornada)
Animas and Lordsburg
Mimbres (Silver City area)



Summary comparison of OSE basin guidelines

UNDERGROUND WATER BASIN (ADMINISTRATIVE AREA)	PLANNING / PROJECTION PERIOD	CMA?	CMA DRAWDOWN LIMIT (feet/year)	CMA DRAWDOWN ALLOWANCE (feet/year)
Estancia	2000 – 2040	Yes	1.50 and saturated thickness of 80 feet or less (for valley-fill aquifer)	0.10
Rio Grande (Middle Rio Grande)	2000 – 2040	Yes	2.50	------
Lower Rio Grande (Mesilla Valley)	None defined	No	------	------
Curry County and Portales (Curry – Portales)	2010 – 2050	No	No CMA per se but CMA-type drawdown allowance applied to entirety of both basins	0.025
Lea County	2005 – 2045	Yes	Saturated thickness of 55 feet or less	0.05
Roswell Artesian	40-year projection to determine shallow aquifer CMA	Yes	1.50	0.05
Tularosa (Alamogordo – Tularosa)	2010 – 2050	Yes	2.00	0.05 – 0.20 Varies with water quality
Mimbres (Deming – Columbus)	2010 – 2050	Yes	2.50	0.10