GROUNDWATER MONITORING AND ASSESSMENT PROGRAM

GMAP

State of Oklahoma

OWRB

WATER RESOURCES BOARD

the water agency

PROGRAMATIC INITIATIVE

Lack of a comprehensive groundwater monitoring program in the State of Oklahoma. (Context of monitoring heavily directed toward regulatory monitoring and special purpose studies).

OK Comprehensive Water Plan Update (2010-2060)

- Adopted by OK Legislature May 2012.

- 8 High Priority Recommendations to Legislature to Meet Water Demand/Supply Needs for 2060.

- Resulted in Funding to Enhance Surface Water Monitoring and Initiate a Groundwater Monitoring Program (Total Appropriation 1.5 million/yr.)

Peer Reviewed Monitoring Plan

- Reviewed and Incorporated State and National Strategies in Proposal
- Areas of Review Included:
  - Purpose and Objectives
  - Data Elements
  - Spatial Design
  - Well Selection
  - Measurement Frequency
  - Water Quality Parameters/Field Parameters

Monitoring Objectives

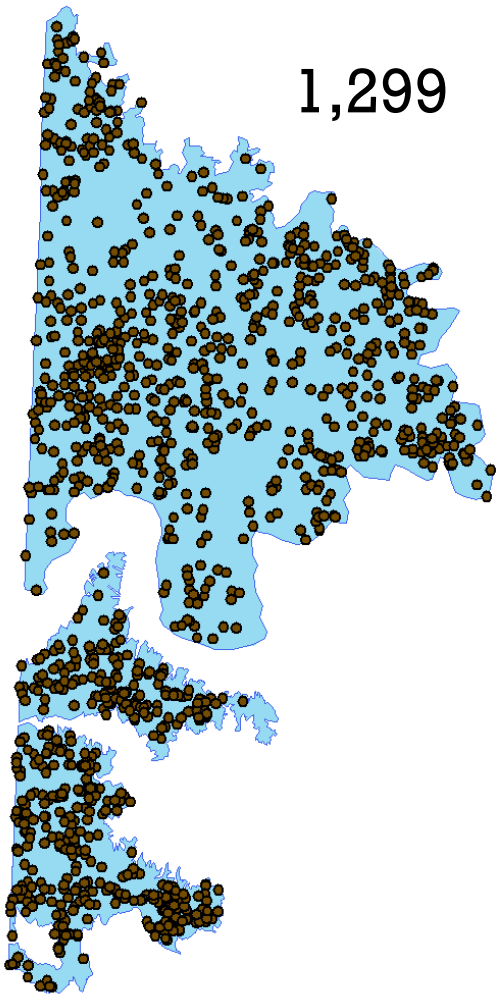
- Obtain data on current conditions of groundwater levels and quality (baseline).
- Describe and compare the spatial distribution, occurrence, and magnitude of groundwater levels and quality.
- Collect long-term data to observe changing conditions over time (trends).
- Identify and report as appropriate unexpected water quality results (hot spots).

Monitoring Targets

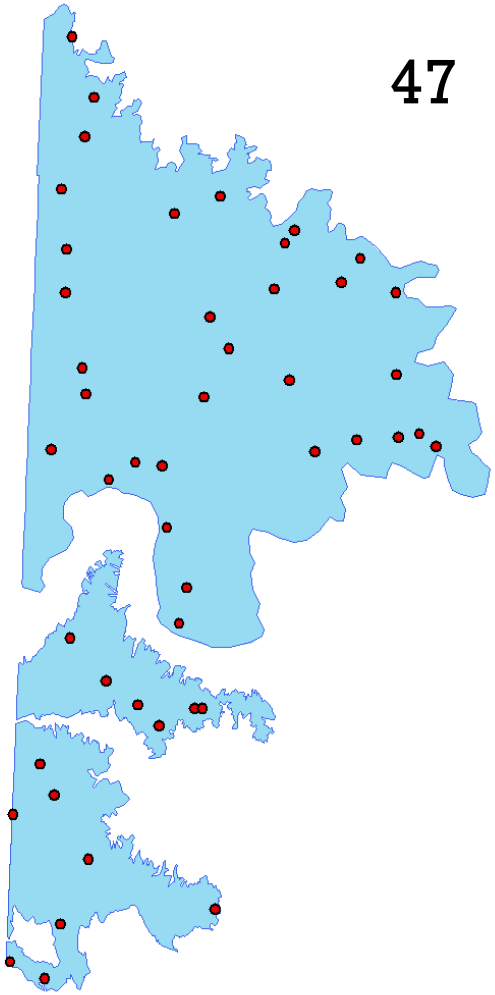
Design Elements for Water Quality Monitoring Sites

- Generalized Random Tessellation Stratified Survey Design
  - Probabilistic, spatially distributed network
  - Population consists of accessible wells
  - Accessible wells further characterized by aquifer type, lithology, depth, thickness, well type (no point source monitoring wells), etc.
  - Construction records are used as an additional screen
  - Site draw completed by Tony Olsen (EPA Corvallis) with a 500% oversample
- Sample size determined by area extent of aquifer
  - Minimum sample size of 30
  - E.g., aquifers > 5,000 km2 are spatially represented by design at ~ 1 well per 150km2.
- Monitoring frequency(s) per annum.
  - (baseline = 1; trend = 2).
- Includes both a water level and water quality network

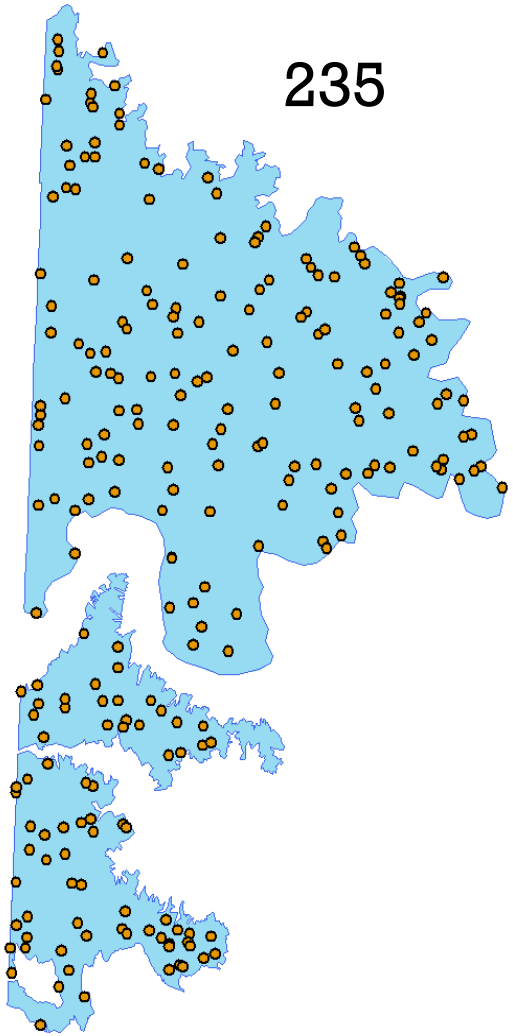
Ogallala Northwest



All eligible wells



Sampling sites



Alternate sites

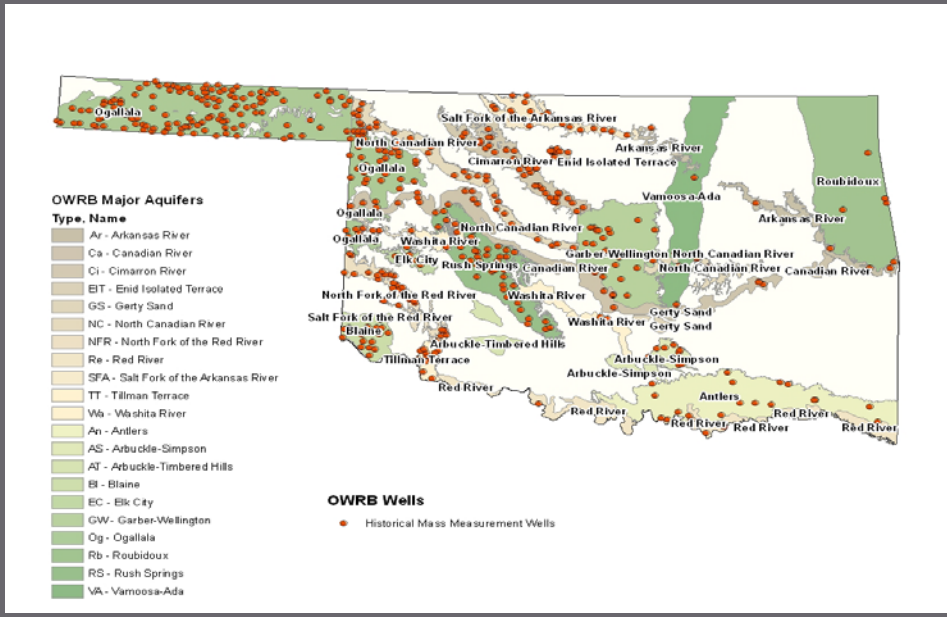
GMAP Laboratory and Field Parameters

Water Quality Groups: 1) nutrients; 2) metals; 3) major ions; 4) general chemistry.

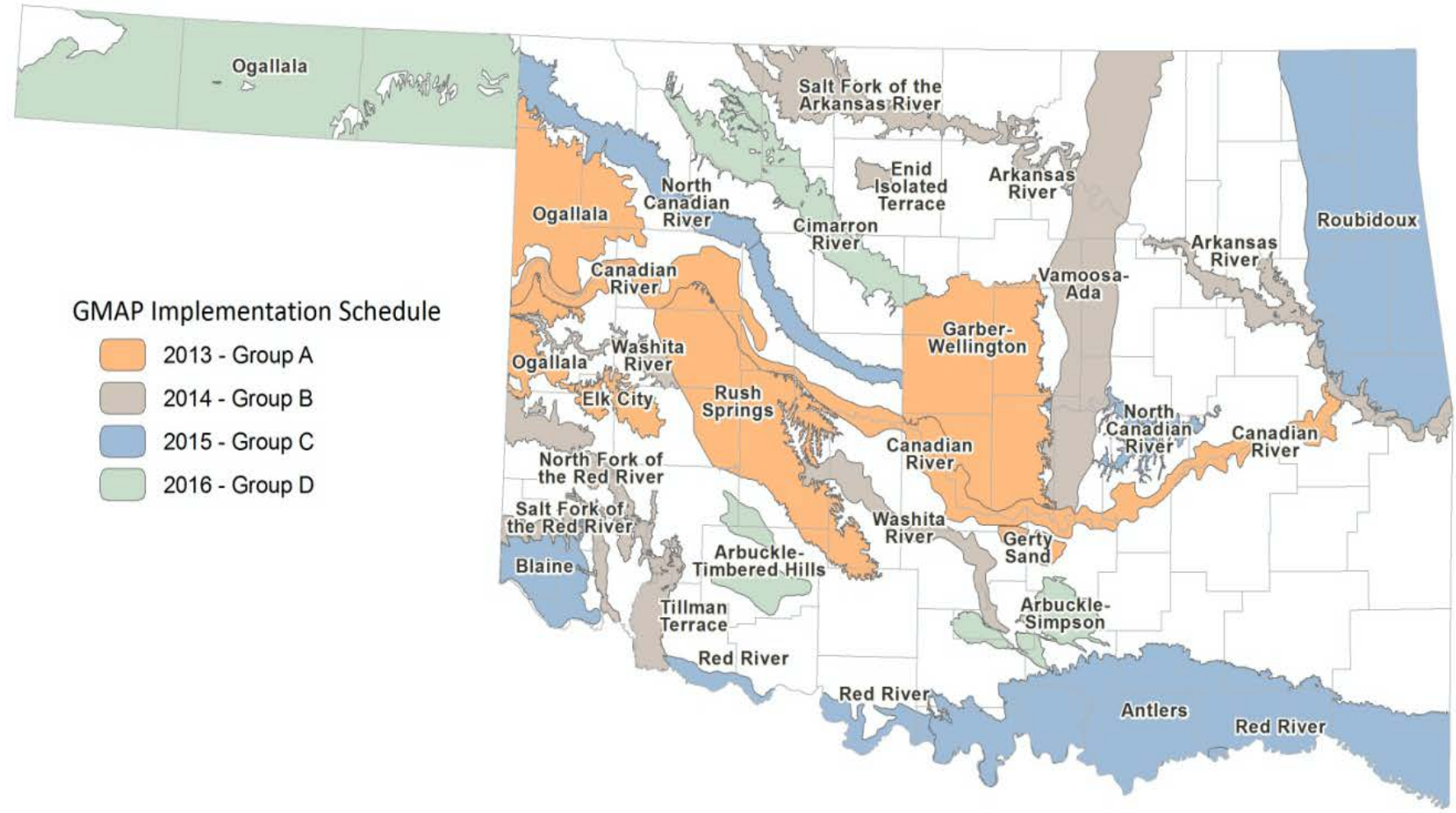
Laboratory Analytical	Laboratory Analytical	Field Data
Nutrients-Filtered mg/L	*Metals-Filtered ug/L*	*Purge Parameters*
Total P	Aluminum	Dissolved Oxygen mg/L
N-Ammonia	Barium	Temperature °C
Nitrate+Nitrite	Beryllium	Specific Conductance uS/cm
Minerals-Filtered mg/L	Cadmium	pH
Chloride	Cobalt	*Field Chemistry mg/L*
Bromide	Chromium	Total Alkalnity, CACO3
Flouroide	Copper	Total Hardness, CACO3
Sodium	Mercuy	*Hydrologic Data*
Sulfate	Molybdenum	Depth to Water (feet)
Silica	Nickel	Flow Rate (gpm)
TDS (Unfiltered)	Lead	*Location Data*
Specific Conductance uS/cm	Thalium	X, Y Coordinates, Dec. Degrees
Hardness	Uranium	Altitude (ft., mean sea level)
Macronutrients-Filtered mg/L	Vanadium	
Calcium	Zinc	
Magnesium	*Metalloids-Filtered ug/L*	
Potassium	Anitmony	
Micronutrients-Filtered mg/L	Arsenic	
Boron	*Non-Metals-Filtered ug/L*	
Iron	Selenium	
Manganese	**Total Analytical Costs = $987.95**	

Design Elements for Water Level Monitoring Sites

- Water level sites are to be a mix of random and preferred private landowner wells.
- Water level network for each aquifer will be ~ 25% larger in number of sites as compared to water quality sites.
- Water level measurement frequencies will range from annual, to tri-annual to continuous.



GMAP Baseline Implementation



GMAP Group A Networks

4 Year Phase In (Aquifer Groups A-D)

- Incorporate 4-6 aquifers per year for four years.
- Prioritization based on schedule to implement technical groundwater allocations studies and relative geographic proximity.

Group A Aquifers 2013	Water Quality and Water Level	Water Level Only
Canadian	37	11
Elk City	16	4
Garber-Wellington	50	25
Gerty	6	2
Ogallala (NW)	47	13
Rush Springs	72	18

Network When Fully Implemented

Long-term monitoring of Oklahoma's Major Aquifers

Water Quality

- 700 wells in the main Baseline Network
- Sub-population of 140 wells in the long-term Water Quality Trend Network

Water Quantity

- 1068 wells in the main Baseline Network
- Sub-population of 530 wells in the long-term Water Quantity Trend Network

Why This Program Now?

- Contact: Mark Belden, OWRB, 405-530-8800
- An increased reliance on the resource.
- Program data necessary to describe and characterize the availability and usability of groundwater resources.
- A stable source of funding.
- Recognition of the importance to monitor GW resources in a similar fashion to SW resources.

Decisions don't *require* data
But *GOOD* decisions do!