OK Water Planning Water/Energy Nexus

November 16, 2022

Oklahoma Geological Survey
Workshop

Owen Mills, Director of Water Planning,
Oklahoma Water Resources Board

Oklahoma Water / Energy Nexus

2021 Hydrogen Task Force

Oklahoma's Office of Secretary of Energy & Environment

Hydrogen Task Force – OSEE 2021

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Multi-agency effort to bid for 1 of 4 proposed Hydrogen Hubs

Water Plan Informed the H2 Task Force

- Geospatial Water Availability in surface and groundwater
- Geospatial Water Quality in surface and groundwater and marginal / nontraditional water supplies
- 50-year Supply/Demand projections

Oklahoma Water / Energy Nexus Produced Water Working Group

(PWWG)

(~2016-2018)

Water for 2060 Act

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Statewide Goal:

Use no more *fresh water* in 2060 than reported in 2010

WATER FOR 2060
EFFICIENCY · CONSERVATION · RECYCLING · REUSE

ALL WATER USE SECTORS
DEVELOP PUBLIC EDUCATION AND OUTREACH MATERIALS, A STATEWIDE RESOURCES CONSERVATION CAMPAIGN, AND AN OKLAHOMA WATER EFFICIENCY PORTAL.
GOAL Best practices and information sharing
LEGISLATIVE ACTION Support Water for 2060 Coordinator position and provide authority and funding for its activities; provide funding for development and maintenance of the portal.
ESTIMATED COST $300,000-1,000,000 per year depending on extent of outreach

PUBLIC WATER SUPPLY RECOMMENDATION 1
DEVELOP AN OKLAHOMA PUBLIC WATER SUPPLY SYSTEM WATER EFFICIENCY BEST PRACTICES GUIDE.
GOAL Developing strategies and benchmarks for Public Water Supply water efficiency
LEGISLATIVE ACTION Provide funding for development and distribution of the guide.
ESTIMATED COST $200,000 initial cost plus annual updating

PUBLIC WATER SUPPLY RECOMMENDATION 2
DEVELOP A STATE RECOGNITION AND REWARDS PROGRAM FOR HIGHLY EFFICIENT PUBLIC WATER SUPPLY SYSTEMS.
GOAL Recognizing Public Water Supply systems with high levels of efficiency and reuse
LEGISLATIVE ACTION Establish the program, annually recognize efficient communities and systems, and provide funds for administration of the program.
ESTIMATED COST $30,000-50,000 per year (plus implications of lower interest rates and statewide Public Water Supply rating)

PUBLIC WATER SUPPLY RECOMMENDATION 3
DEVELOP AN OKLAHOMA WATER SYSTEM LOSS REDUCTION BEST PRACTICES GUIDE.
GOAL Reducing water loss in transmission/ distribution systems
LEGISLATIVE ACTION Provide funding for development and distribution of the guide.
ESTIMATED COST $200,000

PUBLIC WATER SUPPLY RECOMMENDATION 4
PROVIDE STATE FUNDING AND FINANCING FOR WATER SYSTEM LOSS REDUCTION.
GOAL Reducing water loss in transmission/ distribution systems
LEGISLATIVE ACTION Provide funds for state matching-fund grant program.
ESTIMATED COST $1,000,000

PUBLIC WATER SUPPLY RECOMMENDATION 5
ENCOURAGE REGIONALIZATION AND SUPPLY SHARING.
GOAL Best practices and information sharing
LEGISLATIVE ACTION Continue gross production tax funding for OCWP implementation.
ESTIMATED COST $200,000 plus annual allocations for infrastructure mapping

CROP IRRIGATION RECOMMENDATION 1
APPLY STATE FINANCING PROGRAMS TO WATER-EFFICIENT CROP IRRIGATION EQUIPMENT CONVERSION AND PRACTICES.
GOAL Providing financial incentives and mechanisms for irrigators to implement efficient technologies and practices and increase crop yields
LEGISLATIVE ACTION Allocate annual funding for program costs and authorize expansion of the Oklahoma Agricultural Linked Deposit Program.
ESTIMATED COST Funds for OK EQIP and matching-grant programs; linked deposits from current OWRB Financial Assistance Program funds

CROP IRRIGATION RECOMMENDATION 2
DEVELOP AN OKLAHOMA CROP IRRIGATION BEST PRACTICES GUIDE.
GOAL Best practices and information sharing
LEGISLATIVE ACTION Provide funding for development and distribution of the guide.
ESTIMATED COST $300,000

CROP IRRIGATION RECOMMENDATION 3
ACTIVELY SUPPORT FEDERAL CROP INSURANCE REFORM.
GOAL Reducing or eliminating water waste required to prove out crop insurance claims
LEGISLATIVE ACTION Introduce legislative resolution seeking relief at the federal level.
ESTIMATED COST Negligible

ENERGY AND INDUSTRY RECOMMENDATION 1
FACILITATE INCREASED SHARING OF INFORMATION AND SUPPLIES BETWEEN ENERGY AND INDUSTRY WATER USERS.
GOAL Facilitating the sharing of best practices and more efficient shared use of supplies between Energy and Industry water users
LEGISLATIVE ACTION None required.
ESTIMATED COST $200,000

ENERGY AND INDUSTRY RECOMMENDATION 2
DEVELOP AN ENERGY AND INDUSTRY WATER USE BEST PRACTICES GUIDANCE AND RECOGNITION PROGRAM.
GOAL Increasing awareness and recognition of efficient Energy and Industry water use practices
LEGISLATIVE ACTION Establish the program and annually recognize efficient Energy and Industry water users; provide funds for development of guidance and administration.
ESTIMATED COST $30,000-$50,000 per year

ENERGY AND INDUSTRY RECOMMENDATION 3
PROMOTE INDUSTRIAL USE OF MARGINAL QUALITY WATERS.
GOAL Increasing the use of marginal quality water supplies in industrial applications
LEGISLATIVE ACTION None required.
ESTIMATED COST $100,000 and state agency staff time

Water for 2060 Act

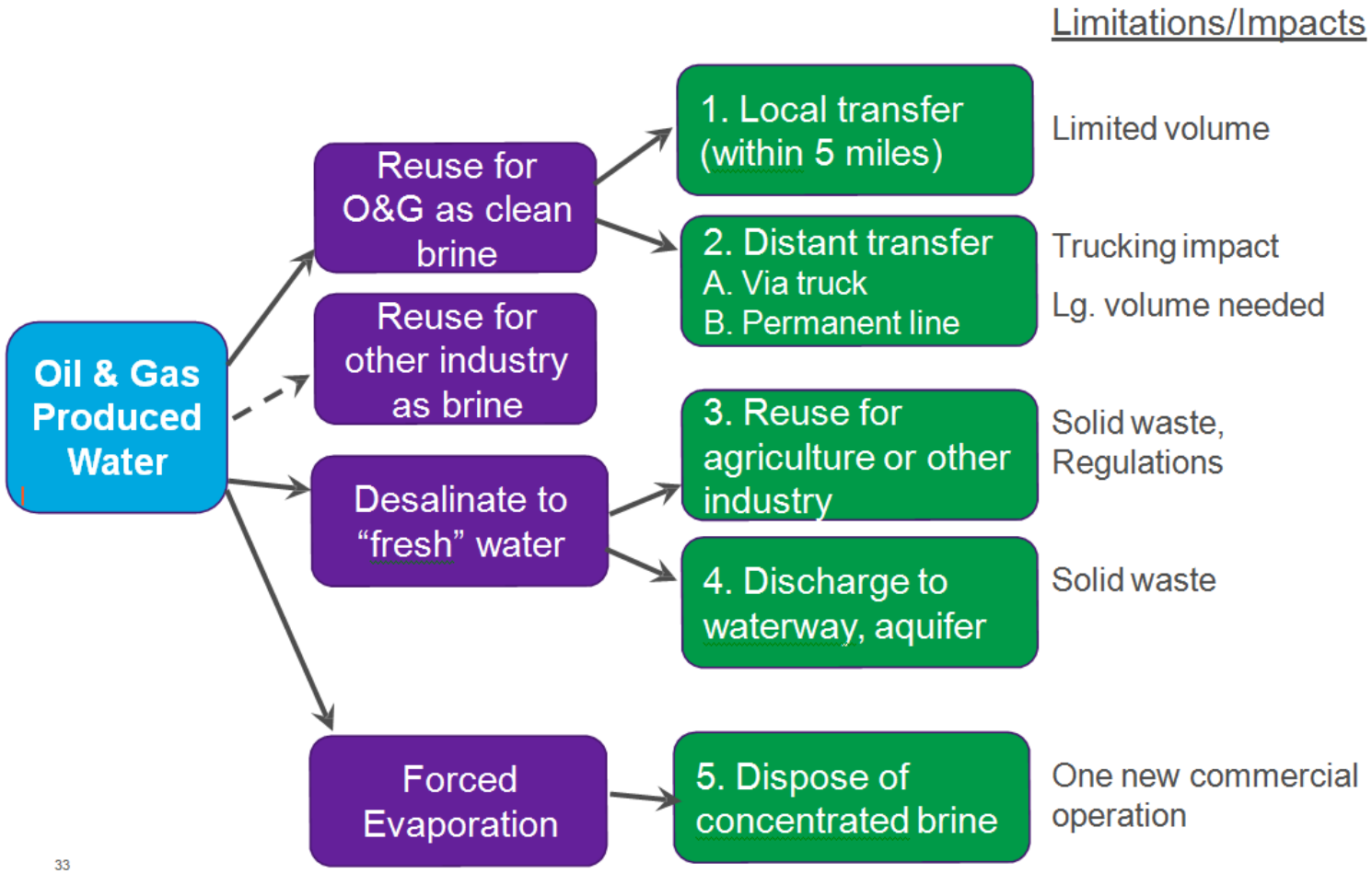
Statewide Water-Use:

50-yr Growth Projected @ 33% or 600,000 AFY

Statewide Water Demand by Sector

Planning Horizon	Crop Irrigation	Livestock	Municipal & Industrial	Oil & Gas	Self-Supplied Industrial	Self-Supplied Residential	Thermoelectric Power	Total
	AFY							
2010	745,210	94,480	601,891	42,107	88,780	30,217	260,539	1,863,244
2020	775,661	95,792	647,038	74,403	87,558	32,610	290,660	2,003,721
2030	806,112	97,104	682,391	78,202	92,313	34,770	324,262	2,115,154
2040	836,562	98,416	713,982	90,080	96,730	36,863	361,750	2,234,382
2050	859,932	99,728	743,158	102,536	101,258	39,978	403,571	2,349,161
2060	897,464	101,040	772,773	115,570	105,683	41,155	450,227	2,483,912

PWWG Study: Preliminary Reuse Options



PW Challenges

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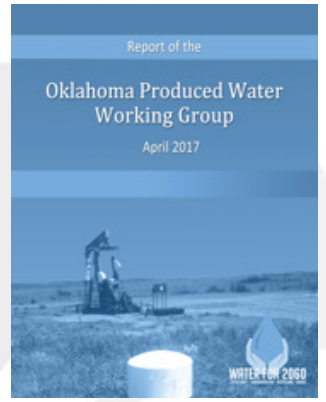
- PW Miss-Lime commonly >150k TDS
- Water to Oil ratio 20:1
- Distances are great
- Sites always moving target



Pilot Study on Reuse

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1. Transportation Costs not included in Cases 1 & 2
2. Re-use Costs less than sourcing and disposing!
3. New transfer lines could make O&G re-use grow.
4. Are there existing lines in certain locations?

New Case	Case Description	Total Capital ($Millions)	Capacity BWPD	County	Assumed Wtr TDS (mg/L)	Normalized $/BW
1	Typical Source and Dispose - STACK & SCOOP	NA	NA	Central OK	NA	1.09
2	**Oil and gas re-use (treatment cost only)**	**NA**	**NA**	**State-wide**	**NA**	**0.57**
3	Clean Brine Transfer & treatment	208	200,000	Alfalfa	213,000	1.03
4	Evaporation - low TDS (SCOOP & STACK)	NA	20,000+	Blaine	17,000	1.66
5	Evaporation - high TDS (Miss. Lime)	NA	20,000+	Alfalfa	213,000	1.79
6	Desalination for Surface Discharge	22	15,000	Beckham	9,000	3.58
7	Desalination for Power Use	88	130,000	Pawnee	125,000	4.37
8	Desalination for Power Use	95	230,000	Seminole	180,000	4.43
9	Desalination for Industrial Use	35	30,000	Grant	227,000	7.41
10	Desalination for Surface Discharge	38	30,000	Grant	227,000	7.49

Re-use Recommendations

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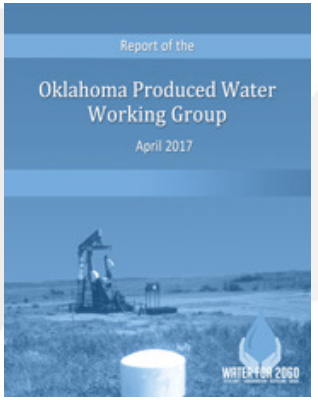
- **Reduce challenges through targeted Legislation**
- **Further investigate best options identified in preliminary study**
- **Identify research needs- water quality, existing distribution lines, etc.**



Industry PW Re-use in Oklahoma

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- Continental Resources: Re-use up to 4.2 MGD in SCOOP & STACK
- Newfield Exploration: Re-use of 100% (1.4 MGD) in STACK play at Barton WRF
- Devon Energy: Network of Re-use pipelines under construction; deal with OKC for treated wastewater substitute for fresh water – (never happened)
- Chesapeake & White Star – began Pipe networks

PWWG Feasibility Study

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Further investigate:

- Water transfer of Miss. Lime to STACK recycling facilities
- Evaporation technologies
- Environmental and Stakeholder impacts
- Incentivize with Legislation

SB 1875- **Oil & Gas Produced Water and Waste Recycling Act –** defines ownership and disposal responsibilities – Incentivizes investment by industry

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Water Treatment & Energy

Saving Water Saves Energy

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Water treatment has enormous energy requirements for processes, lift stations, pumps, etc.

Avg $5,252,656

Fiscal Year	Pumpage	Avg MG	Max MG	COST	
13	28,701	78.56	88.97	$ 8,608,500	
14	26,150	70.42	80.40	$ 7,800,413	
15	19,922	54.04	79.92	$ 5,679,171	
16	6,880	19.58	76.30	$ 2,390,046	offline 8 months
17	21,518	58.67	78.07	$ 5,476,768	
18	11,915	54.78	77.65	$ 5,704,301	
19	16,812	46.70	70.66	$ 4,199,470	
20	20,761	56.05	75.50	$ 5,783,620	
21	24,035	62.60	78.65	$ 5,067,250	
22	17,839	48.60	69.75	$ 5,508,642	$ 5,252,656

In FY 22 The pipeline was down a lot for construction. At least 90 days.

The City of OKLAHOMA CITY

Saving Water Saves Energy

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Leak Detection Program ORWA

- *Funded by DOE thru OK Dept. of Commerce*
- Leak Assessments of Water and Wastewater Treatment Plants
- WTPs commonly leak 20% to 30% of water produced (even 60%!!)

Electricity Generation Cooling stations require entire lakes to maintain *(tho much is returned to the system)*

Saving Energy Saves Water

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Energy Efficiency Programs in Water Treatment

- *Funded by DOE and EPA*
- Grants available for high efficiency pumps, lighting, insulation, etc. through State loan program, ORWA and others

Saving Energy Saves Water

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Lots of Water to produce Energy

- 750,000 bbl of water to frack one well
- Grants available for high efficiency pumps, lighting, insulation, etc.
- 2015 Total Thermoelectric consumptive use ~60,000 AFY (USGS)
  - *Reworking with OG&E how OCWP calculates this*

Environmental Flows of particular interest to Energy Sector (and many others)

Hydroelectric Challenges

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Make Electricity or Sell Water?

- GRDA Assessment
- Lake Powell may quit generating in 2023 (if drops below 3,490')*
- Lake Mead may quit generating in 2025 (if drops below 1,000')*
- Lake Oroville in northern California hydropower shut down*

* I just googled this stuff - Yale E360 online 2021

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State Water Planning??

Authorities/Programs of the Oklahoma Water Resources Board

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Water Rights
Permitting Water-Use
Modeling & Gauging
Basin Yield / Stream Flow
Well Drillers Licensing

Hazard Mitigation
Dam Safety
Floodplain / NFIP
Flood Plan (1st ever OFP)

State Water Plan (OCWP)

Financial Assistance
CWSRF
DWSRF (DEQ)
State SRF Program

Water Quality
Water Quality Monitoring
Water Quality Studies

Oklahoma Water Resources Board Authorities

* Disclaimer… There are exceptions to many of these bullets.
Happy to discuss in more detail
405.530.8904

OWRB Authorities

- Water Rights Permitting – GW *(private)* & SW *(public)*
  - *Develop water availability for permitting – GW & SW*
    - *GW basin studies for Max Annual Yield to 5,000 ppm TDS*
    - *SW gauging / precip by watershed / more…*
  - Water-Use Reporting (unmetered) collaborate w/ USGS
- Quantify/Model & provide data on GW & SW basins
- License and enforce water well drillers (5,000 TDS & BTW)

OWRB Authorities

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- License and enforce dam construction and maintenance
- Negotiate interstate compacts
- 50-yr state-level supply and demand (OCWP)
- Ambient monitoring of SW & GW *Quantity & Quality*
  - 100's of stream locations, biological crews, lake crews
  - 100's of groundwater locations
- *and other authorities…*

OWRB Authorities – Not!

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Authorities OWRB does NOT have:

- Require regional plans
- Fund projects** e.g. build infrastructure, move water
- Meter water use* *(OK Use reporting is honor system, except municipal)*
- Formalized Interference Enforcement* *(no Water-Masters)*
- Consider GW/SW interactions*
- Consider environmental flows in a permit*
- Deny a permit* *(if requirements are met)*

** There are exceptions*

*** OWRB does finance projects (CWSRF/DWSRF/State SRF)*

Groundwater Monitoring & Assessment Program (GMAP)

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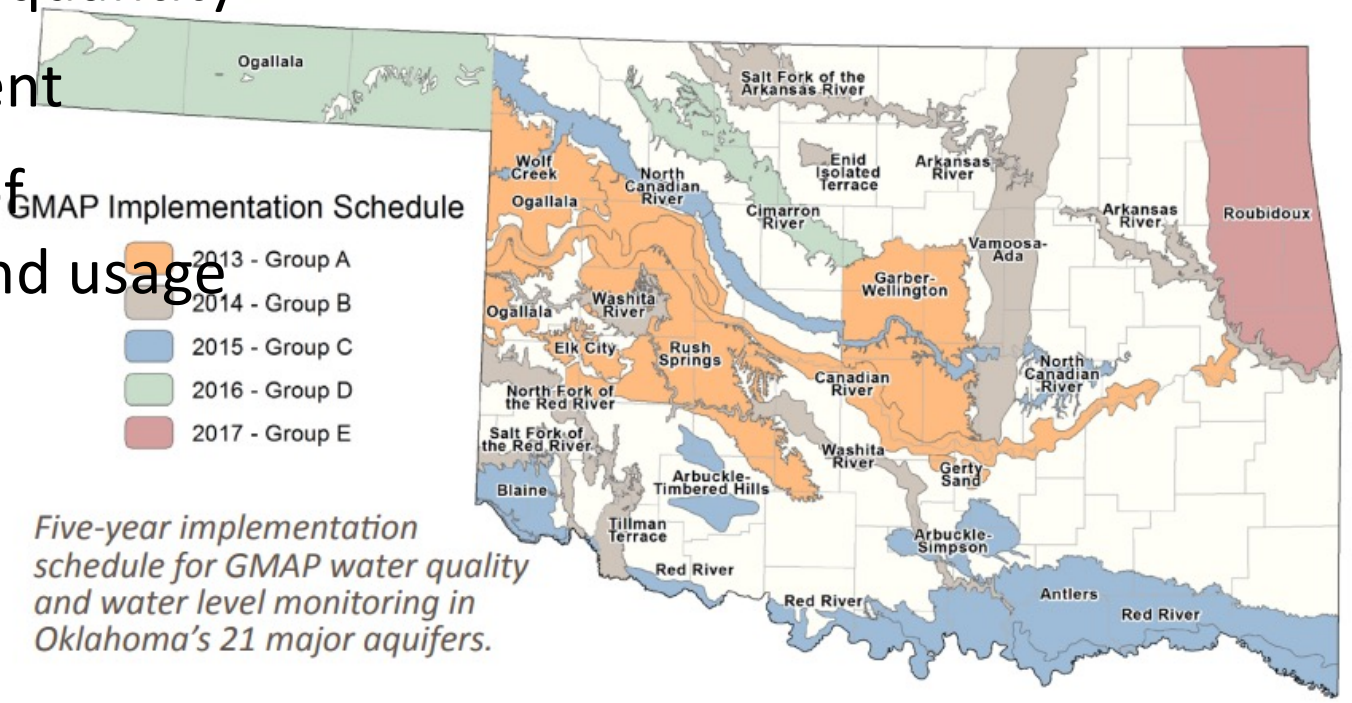
- Ambient quality and quantity
- ID areas of impairment
- Understand effects of seasonal, climatic, and usage patterns
- Trend monitoring



Five-year implementation schedule for GMAP water quality and water level monitoring in Oklahoma's 21 major aquifers.

Authority - Develop Legal Water Availability (permits) - Groundwater

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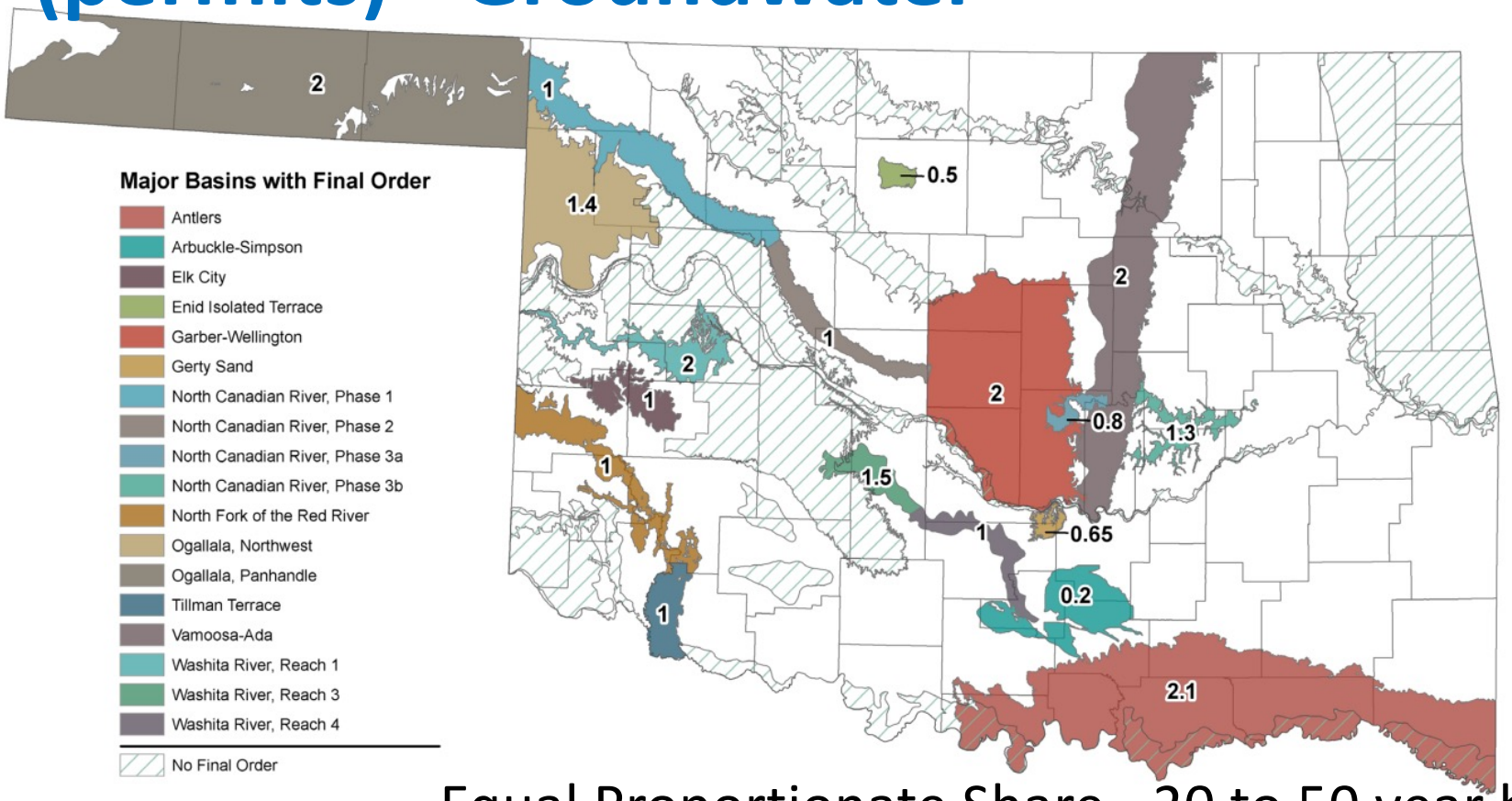
- Maximum Annual Yield (MAY)
  - Amt. of fresh GW that can be withdrawn over 20-50 years
  - Does not consider GW/SW Interactions*
- Hydrologic Investigations
  - Land area, amount in storage, rate of recharge, discharge, and transmissivity

** Except Sensitive Sole-Source Aquifers (Arbuckle-Simpson)*

Develop Legal Water Availability (permits) - Groundwater



Equal Proportionate Share - 20 to 50 year basin life

OKLAHOMA Water Resources Board

the water agency

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- Water Use Permitting
- Financial Assistance
- Well Drilling
- Water Planning
- Water Quality Standards
- Monitoring & Assessment
- Groundwater Studies
- Dam Safety
- Floodplain Management
- Interactive Maps & Data

Sign up for the latest news and updates from the OWRB.

Groundwater Studies

Oklahoma statutes direct the OWRB to conduct hydrologic investigations to determine the amount of fresh groundwater available for appropriation. Staff hydrogeologists, modelers, engineering consultants, and federal agencies assist in characterizing hydrologic properties of aquifers and determine recharge, effects of pumping, and water demand. Investigations include the determination of the upper, lower, and lateral boundaries of the groundwater basin as well as aquifer properties, such as saturated thickness, hydraulic conductivity, transmissivity, specific yield, and storage coefficient to understand the storage and yield capacity of the basin.

Status of investigation for Oklahoma's 22 major aquifers and related scientific reports:

- Ada-Vamoosa
- Antlers
- Arbuckle-Simpson
- Arbuckle-Timbered Hills
- Arkansas River

Resources

- Hydrologic Investigation Reports
- Groundwater Monitoring & Assessment Program
- Maximum Annual Yield Fact Sheet
- Oklahoma Geological Survey
- US Geological Survey

www.owrb.ok.gov

What is State Water Planning in Oklahoma?

Why do a State Plan?

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1. Data: Standardized data across the state dataset & info
   for public, government, academia...
   - 50-yr Supply and Demand projections *(required)*
   - Infrastructure needs estimates
   - 50-yr Permit Availability & Physical Availability
   - Basin data summaries, concerns, and supply options
   - and more…
2. Engage the public – ***Discover new*** or ***validate existing*** priorities
3. **Recommendations - Submit to Legislature & Increase Awareness**

2012 OCWP

What did OK get?

State Planning - Related Legislation
Since 2012

2012:

- **New GW Monitoring Network**
- HB 3055 **Water for 2060 Act**
- SQ 764 – **Water Infrastructure Credit Enhancement Reserve Fund**
- SB 1043 **ODEQ Reuse Framework**

2016:

- SB 1219 – **Aquifer Storage and Recovery framework**

2017:

- HB 1485 **Aquifer Storage and Recovery pilot studies**

State Planning - Related Legislation
Since 2012

OKLAHOMA

2018:

- SB 1294 –Phased GW Use Reduction & updates to well spacing.
- HB 3405 – **Authority in marginal quality basins/marginal water wells**

2019:

- HB 2263 - **GW Irrigation District Act**

2020:

- SB 1875- **Oil & Gas Produced Water and Waste Recycling Act –** defines ownership and disposal responsibilities (Water for 2060)
- SB 1269 - Statewide Flood Resiliency Plan and creates revolving fund

2025 OCWP

What's Next?

Big Picture

OKLAHOMA

Crop Irrigation (groundwater)

- **Local control/governance?**

Small/Rural Infrastructure Needs

- **$17,400,000,000 by 2060** (<3,300 pop.)

- **Determine the need, forecast the scenarios**
- **Offer potential solutions**
- **Build local consensus and support across interest groups**
- **Build local consensus statewide**
- **Develop Recommendations for statute/rule/studies/other?**

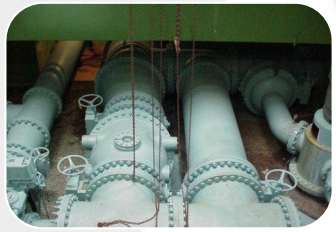
2025 Water Plan: What Now?

- Supply/Demand Vulnerabilities
- ID 50-yr infrastructure needs
- Funding for ??
- Publicly supported Recommendations
- Supplemental reports & studies on current issues
  - OCWP methodology & justification for legislation, funding, & studies
- Water for 2060 Act
- Statewide OK Flood Plan – *Project Prioritization*

We're Listening for Today's Hot Topics

OKLAHOMA

Regional/Tribal planning



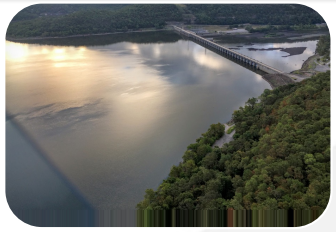
Infrastructure needs

Irrigation Districts

Energy??

Water Reuse Action Plan

Workforce development



Source water protection

State Water Planning in Oklahoma

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