2012 Update of the Oklahoma Comprehensive Water Plan

Schedule

Priority & Supporting Recommendations

Watershed Planning Region Reports

OWRB Meeting: August 9, 2011

Oklahoma Comprehensive Water Plan
2011 OWRB Schedule

August 9 Board Meeting:

- Finalize Implementation Priorities
- Presentation of Draft Final Executive Report
- Presentation of Regional Reports

August 26:

- Final OCWP Executive Report Public Review Draft posted to OWRB website

September 13 Board Meeting:

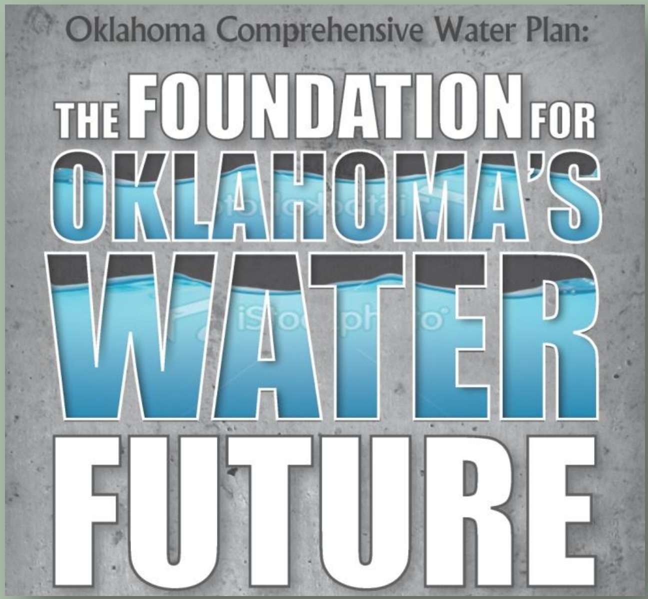
- Final Water Board review and public comment on draft OCWP
- Discussion and Possible Action by Board to Request Any Changes

October 17 Board Meeting:

- Formal Board consideration and adoption of OCWP

October 18-19:

- OCWP unveiled at Governor's Water Conference



Goals of the 2012 OCWP Update

1. Characterize **demands** by water use sector.
2. Identify reliable **supplies** to meet forecasted demands.
3. Perform **technical studies** in support of the evaluation of emerging water management issues.
4. Comprehensive **stakeholder engagement** to make recommendations regarding the management of Oklahoma's water resources.
5. Ensure water resources management programs that **create reliability**.
6. Make **"implementable" recommendations** regarding the future of water management in Oklahoma based upon technical evaluations and stakeholder input.

Oklahoma Comprehensive Water Plan
OCWP

Planning for What, Exactly?

A Plan for Reliability Means Having a Reliable Plan

- Expert Technical Evaluation
- Consistent, Defensible Methodologies
- Robust Public Participation
- Innovative and Forward-thinking
- Integrated and Coordinated
- Consistent with Emerging Federal Priorities and Initiatives

What is this Plan?
"A Foundation"

- An answer to a statutory mandate.
- A driver for economic development.
- Well-vetted and scientifically sound.
- A living document.
- A picture of where we are and what we have:
  - An impressive compendium of water related information on 82 basins and 13 regions across the state.
  - A thorough and frank evaluation of Oklahoma's current and future water policies and programs.
- What the future will look like:
  - Technical information on water supplies, demands, limitations and options to prepare for the future.
  - An evaluation of both emerging issues and future opportunities.
  - A deliberation of public and stakeholder input on innovative technical analyses and diverse policy evaluations.
- A strategy on how to get us there:
  - A tool to inform decision-making and stimulate intensive local planning.
  - Synthesized information resulting in priority water policy recommendations and other initiatives that will ensure a reliable water future for Oklahoma.

What this Plan is Not

- It is not the answer to everything.
- It is not a document that has mandatory provisions, the force and effect of law.
- It is not an inflexible mandate that precludes opportunities for additional stakeholder input.
- It does not call for sweeping, fundamental changes in water management policy and the law.
- It does not prioritize one water source or use over another.
- It does not contain predetermined recommendations that ignore science.
- It does not usurp local decision-making.
- It is not the final resolution of complex issues.

Components of the OCWP Update

I. Executive Report:
   - Synthesis of OCWP Technical Studies and Results
   - Water Policy Recommendations

II. Watershed Planning Region Reports:
   - Presents results of OCWP technical analyses, including options to address identified water shortages

Components of the OCWP Update
Executive Report

1. Introduction
2. Water Resources Planning in Oklahoma:
   - History of Planning
3. Water Management in Oklahoma:
   - Water Law/Agencies
4. Statewide Summary:
   - Surface/Groundwater Resources

Components of the OCWP Update
Executive Report

5. Statewide Water Assessment
   a. Water Demand
   b. Water Availability (Physical, Permit & Water Quality)
   c. Climate Change Projections and Implications
   d. Water Supply Limitations
   e. Results of Excess and Surplus Water Analysis

Components of the OCWP Update Executive Report

6. Regional and Statewide Opportunities and Solutions
   a. Water Supply Limitations, Options & Effectiveness
   b. Advanced Options
   c. Hot Spot Evaluation
   d. Tools
   e. Drinking Water and Wastewater Infrastructure Needs
7. Water Policy Recommendations & Implementation
8. Appendix
   – Workgroup Report/Study Summaries

Agenda 4B-2.

REVIEW AND DISCUSSION OF DRAFT PRIORITY RECOMMENDATIONS

Oklahoma Comprehensive Water Plan
Draft Priority Recommendations for Implementation

Key Questions of Priority Recommendations:

- Justification – What is the urgency?
- What issues identified through OCWP public input and technical study processes (i.e., water shortages, "hot spots," funding gaps, regional planning, etc.) would implementation help resolve?
- What is the estimated timeline and cost of specific programs requiring implementation?

Draft Priority Water Policy Recommendations for Implementation

"The Big 8"

- Water Quality & Quantity Monitoring
- State/Tribal Water Consultation and Resolution
- Instream (Environmental) Flows
- Water Supply Reliability
- Excess & Surplus Water
- Regional Planning Groups
- Water Project & Infrastructure Funding
- Water Efficiency & Reuse

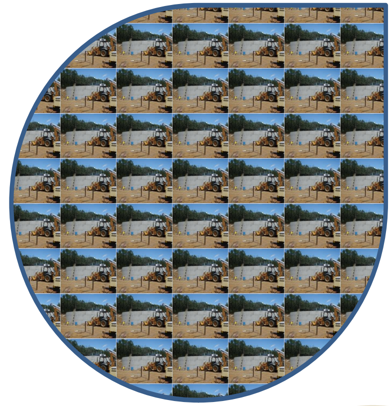
Water Project & Infrastructure Funding

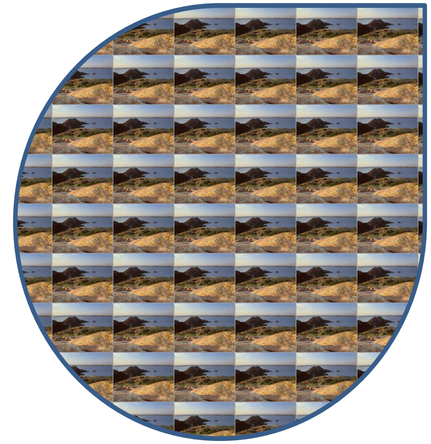
Addressing Oklahoma's $166 Billion Water and Wastewater Project Need

SUGGESTED CONSOLIDATED RECOMMENDATION:

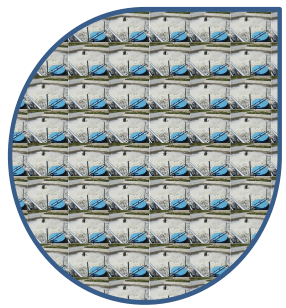
To address Oklahoma's considerable drinking water and wastewater infrastructure need and the inability of current programs to meet that need, a team of financial and water/wastewater infrastructure professionals, led by the OWRB, should investigate development of a more robust state funding program to meet the state's projected $166 billion water and wastewater infrastructure need between now and 2060. Any potential program should include a specific mechanism to address the significant financing requirement of small communities in the state, as well as encourage regionalization of water/wastewater systems, where appropriate.

Financial Assessment of the OCWP

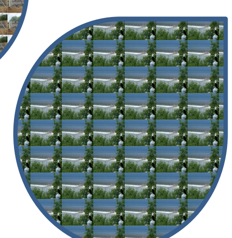




State of Oklahoma
OWRB
WATER RESOURCES BOARD
the water agency



Addressing Oklahoma's $166 Billion Water and Wastewater Project Need



Executive Summary

- FirstSouthwest, utilizing projections provided by CDM, performed the following:
  - Description of OWRB's Existing Programs
  - Review of OCWP
  - Conduct Financial and Programmatic Analysis of Existing Funding Sources
  - Develop Comprehensive Model
  - Prepare Financial Scenarios
  - Quantify the Economic Impact of the Financial Investment in Oklahoma
  - Small Issuer Strategies

Emergency Grants

Income Source: FAP Bond Reserve Interest	
Since 1983 funded 562 Grants for	$33,482,977.17
Funds Available	$599,072.00

Rural Economic Action Plan Grants (REAP)

Income Source: State Appropriations of $51,064,000.00	
Since 1996 funded 563 Grants for	$49,948,322.65
FY 2011 Carryover	$467,425.44
2012 Appropriations	$1,628,065.00
Total Funds Available	$2,095,490.44

State Revenue Bond Issue Loan Program (FAP)

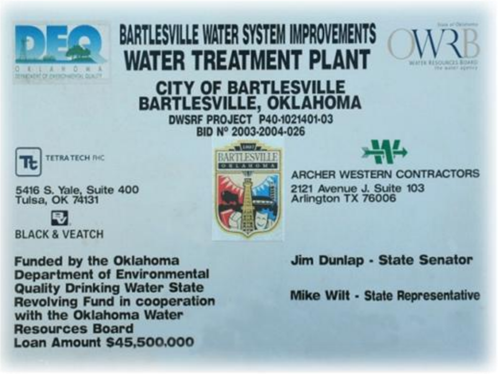
Reserve Funds	
State Funds	$18,115,948.67
Gross Production Tax	$1,845,000.00
AMBAC Surety Policies	$28,500,000.00
TOTAL RESERVES	$48,460,948.67
Since 1985 funded 327 Loans for:	$704,840,000.00
Available Funds	$0.00

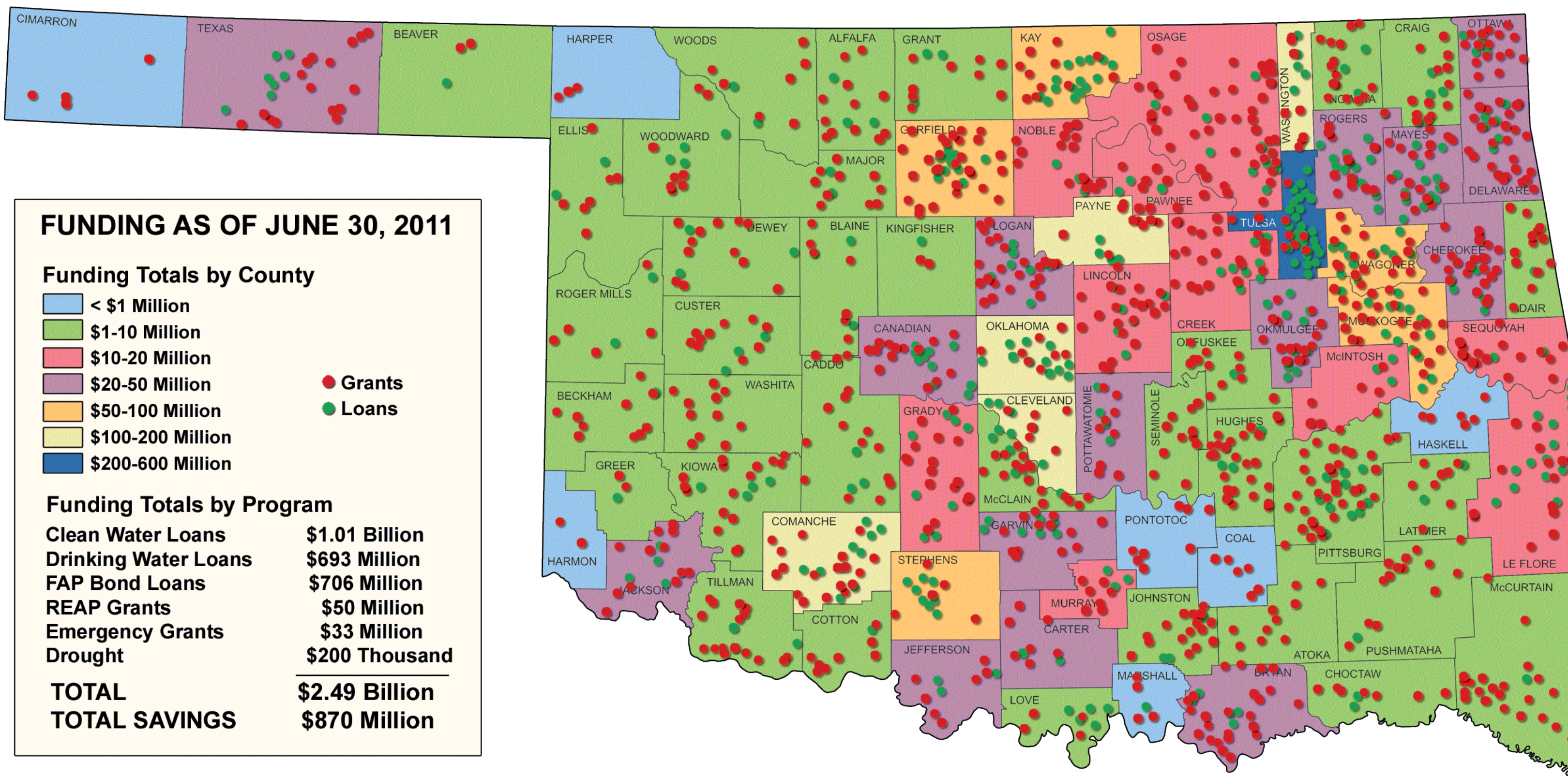
Clean Water State Revolving Fund Loan Program (CWSRF)

State Match Funds	
State Funds	$14,261,359.40
Ute Reservoir Settlement Funds	$200,000.00
Debt Issuance	$33,708,740.60
Total State Match	$48,170,100.00
Since 1990 funded 243 Loans for	$1,006,107,003.59
Available Funds	$141,500,000.00
Fund Commitments	$304,000,000.00
Additional Funds Needed	($162,500,000.00)

Drinking Water State Revolving Fund Loan Program (DWSRF)

State Match Funds	
State Funds	$5,500,000.00
Gross Production Tax	$4,800,320.00
Debt Issuance	$25,903,080.00
Total State Match	$36,203,400.00
Since 1997 funded 131 Loans for	$697,064,642.40
Available Funds	$90,900,000.00
Fund Commitments	$371,550,000.00
Additional Funds Needed	($280,640,000.00)





The DWSRF, CWSRF and the FAP have funded on a combined basis over $2.49 billion in water and wastewater related projects and have saved communities over $870 million in debt service costs

Funding Agency Coordinating Team

- Group of federal and state organizations that offer financing to eligible Oklahoma public entities for water and wastewater projects
- Meet quarterly with the purpose of facilitating infrastructure funding through communication and streamlined application processes

Members	
Oklahoma Water Resources Board	USDA Rural Development
Oklahoma Department of Commerce	Oklahoma Council of Governments
Indian Health Service	Community Resource Group
Oklahoma Department of Environmental Quality	

Working together to find solutions to Oklahoma's most challenging water and wastewater infrastructure needs

Quantifying the Economic Impact

Oklahoma Advantages Assessment and Scoring for Infrastructure Solutions (OASIS) is a web based application which quantifies the social, economic and environmental benefits of infrastructure investments to communities and the state beyond regulatory compliance.

The computer program, which was developed specifically for Oklahoma, will be available on the OWRB website (www.owrb.ok.gov) in October 2011. Communities will be able to enter details regarding their current or pending infrastructure investments. The result will be output statements which allow community leaders to document and/or better articulate the benefits of the investment including but not limited to:

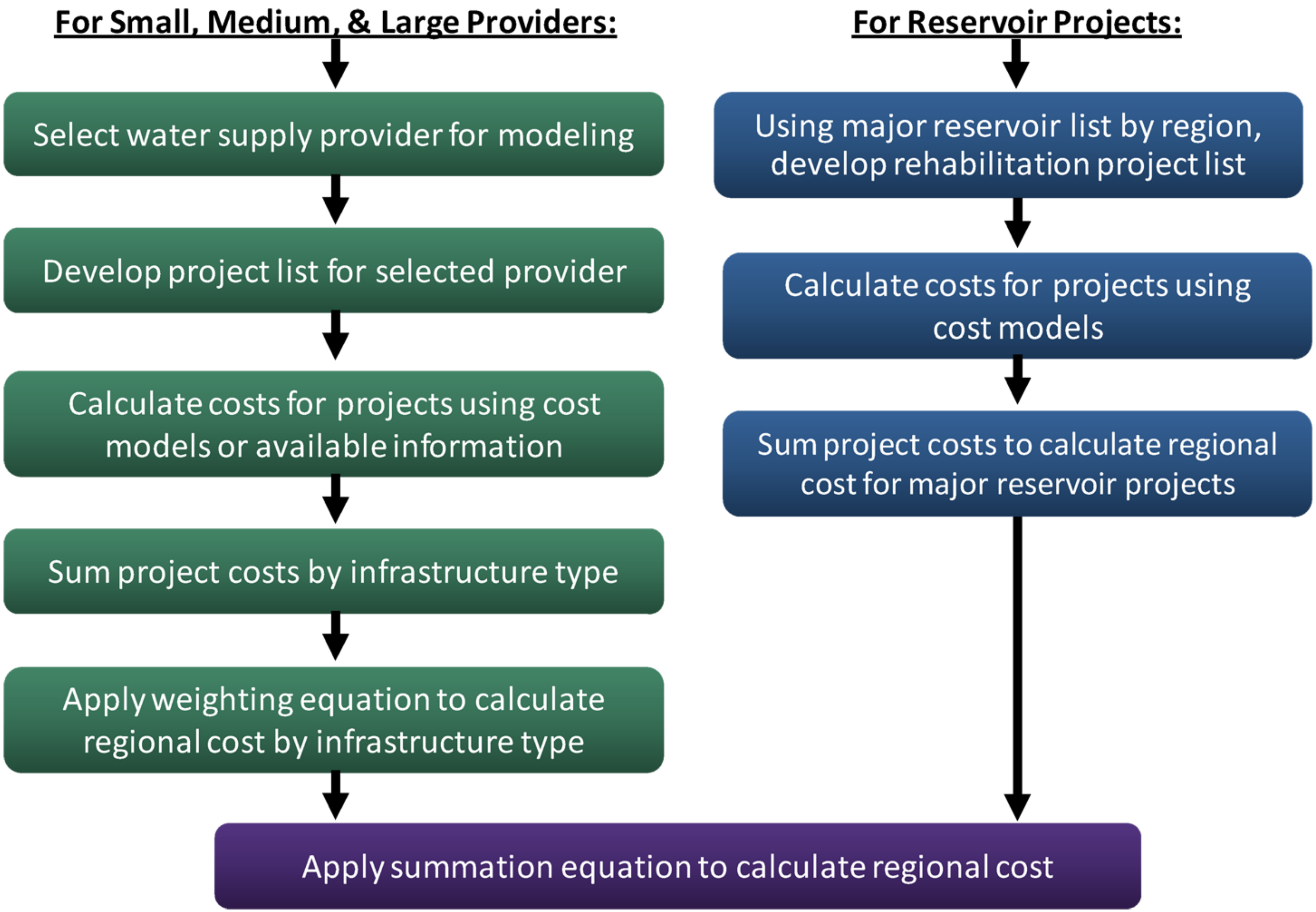
- Impacts on economic growth
- Impacts on quality of life
- System sustainability
- Cost of delaying improvements
- Reduced health risks from waterborne illnesses
- Energy cost savings from efficiency upgrades
- Impacts to property values

What is the Urgency for Infrastructure Funding?

- Address health concerns
  - Cannot ensure potable water unless adequately addressing wastewater
- Aging Infrastructure
- Need clean water for economic development

Review of the Projected Drinking Water Infrastructure Costs

Review of OCWP



Review of OCWP

Category[A]	Potential Funding Source[B]	Present - 2020 Infrastructure Need (millions of 2007 dollars)	2021-2040 Infrastructure Need (millions of 2007 dollars)	2041-2060 Infrastructure Need (millions of 2007 dollars)	Total Period Infrastructure Need (millions of 2007 dollars)	Total Period Infrastructure Need (percent by category)	Total Period Infrastructure Need (percent by population)
Small	DWSRF Eligible	$ 3,395.29	$ 5,059.79	$ 8,766.65	$ 17,221.73		
	Non-DWSRF Eligible	$ 43.97	$ 66.94	$ 66.93	$ 177.84		
Small Subtotal		$ 3,439.26	$ 5,126.72	$ 8,833.59	$ 17,399.57	45%	13%
Medium	DWSRF Eligible	$ 4,323.54	$ 4,054.95	$ 6,122.61	$ 14,501.09		
	Non-DWSRF Eligible	$ 53.42	$ 61.91	$ 61.90	$ 177.23		
Medium Subtotal		$ 4,376.96	$ 4,116.85	$ 6,184.51	$ 14,678.32	39%	51%
Large	DWSRF Eligible	$ 1,720.54	$ 1,173.15	$ 1,689.45	$ 4,583.14		
	Non-DWSRF Eligible	$ 50.48	$ 16.78	$ 16.78	$ 84.04		
Large Subtotal		$ 1,771.02	$ 1,189.93	$ 1,706.23	$ 4,667.18	12%	36%
Reservoir	DWSRF Eligible	$ -	$ -	$ -	$ -		
	Non-DWSRF Eligible	$ 95.27	$ 256.52	$ 806.61	$ 1,158.40		
Reservoir Subtotal		$ 95.27	$ 256.52	$ 806.61	$ 1,158.40	4%	0%
Total		$ 9,682.51	$ 10,690.02	$ 17,530.94	$ 37,903.46		

[A] Large systems are those serving more than 100,000 people, medium systems are those serving between 3,301 and 100,000 people and small systems are those serving 3,300 and fewer people.

[B] The "reservoir" category includes all regional reservoir rehabilitation projects. This study assumes that distributiono projects for new growth and all reservoir projects are non-DWSRF eligible. All other projects were assumed to be DWSRF eligible.

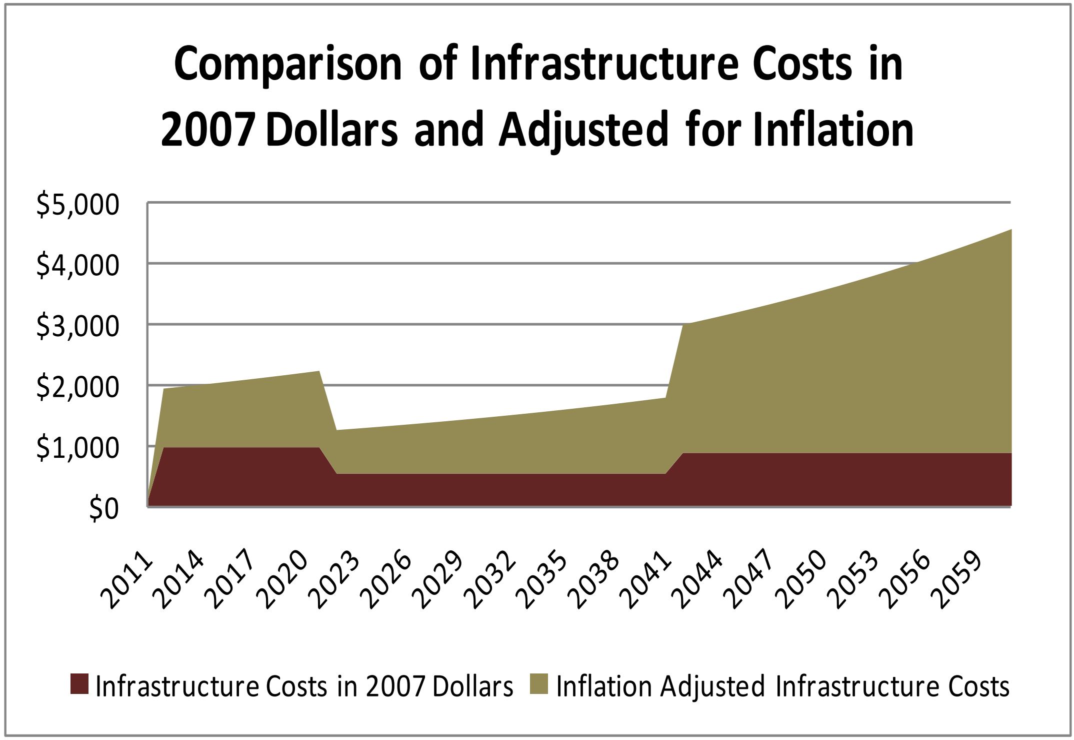
Review of OCWP

DRINKING WATER INFRASTRUCTURE NEED (All shown in Millions of 2007 Dollars)				
	Present - 2020	2021-2040	2041-2060	Total Period
Total Period Costs	$ 9,682.51	$ 10,687.86	$ 17,530.94	$ 37,901.31
Average Cost per Year	$ 968.25	$ 534.39	$ 876.55	$ 758.03
Cost Inflation Adjusted	$ 11,089.69	$ 19,221.18	$ 56,722.09	$ 87,032.96

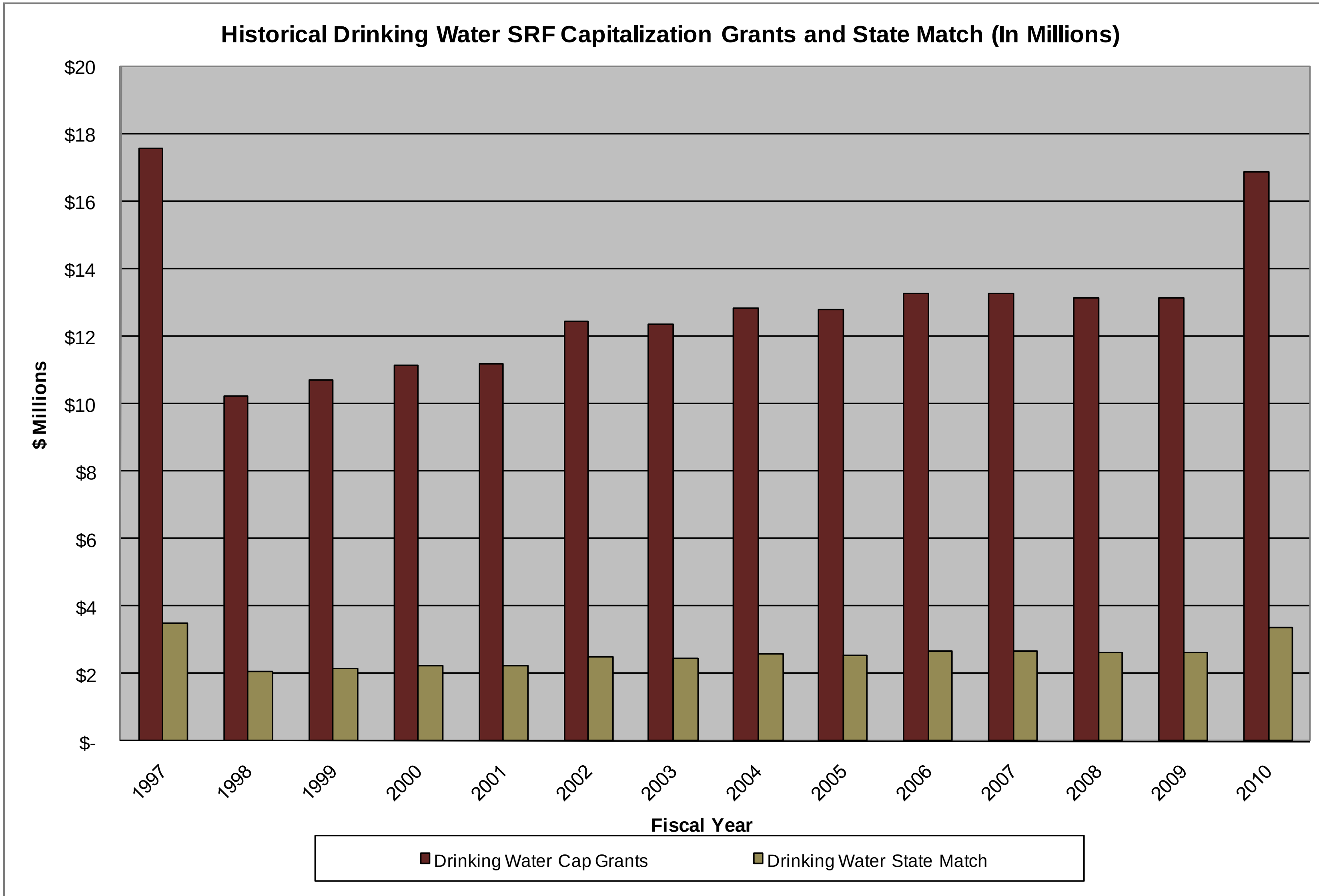
- Infrastructure cost projections from CDM were provided in 2007 dollars
- Figures were adjusted to more accurately calculate infrastructure costs closer to time of construction
- Figures were adjusted at a rate of 2.98%, representing average U.S. CPI over the last 15 years plus 50 basis points

Review of OCWP

- While the actual CPI will be different than the assumption, this analysis provides some quantification of the compounding impact over time
- Debt is often the tool utilized to finance projects that have long useful lives like the proposed infrastructure projects



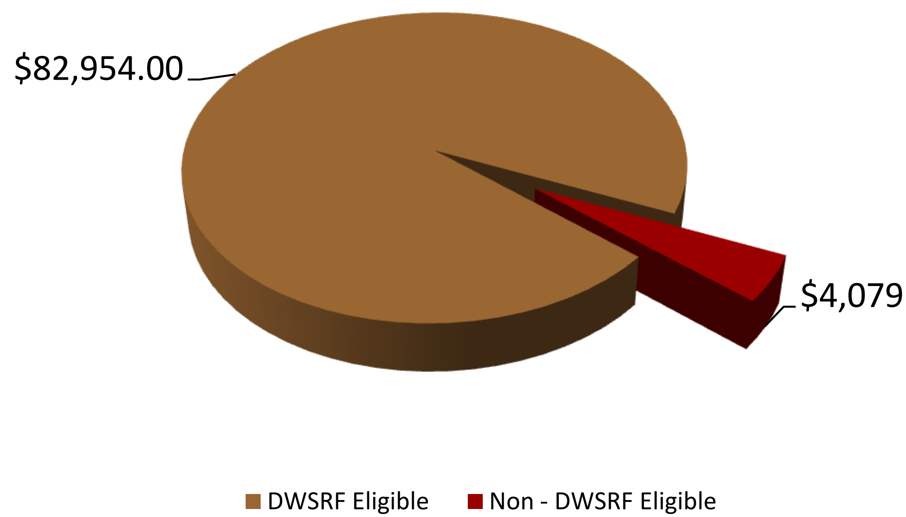
Financial & Programmatic Analysis of Existing Programs



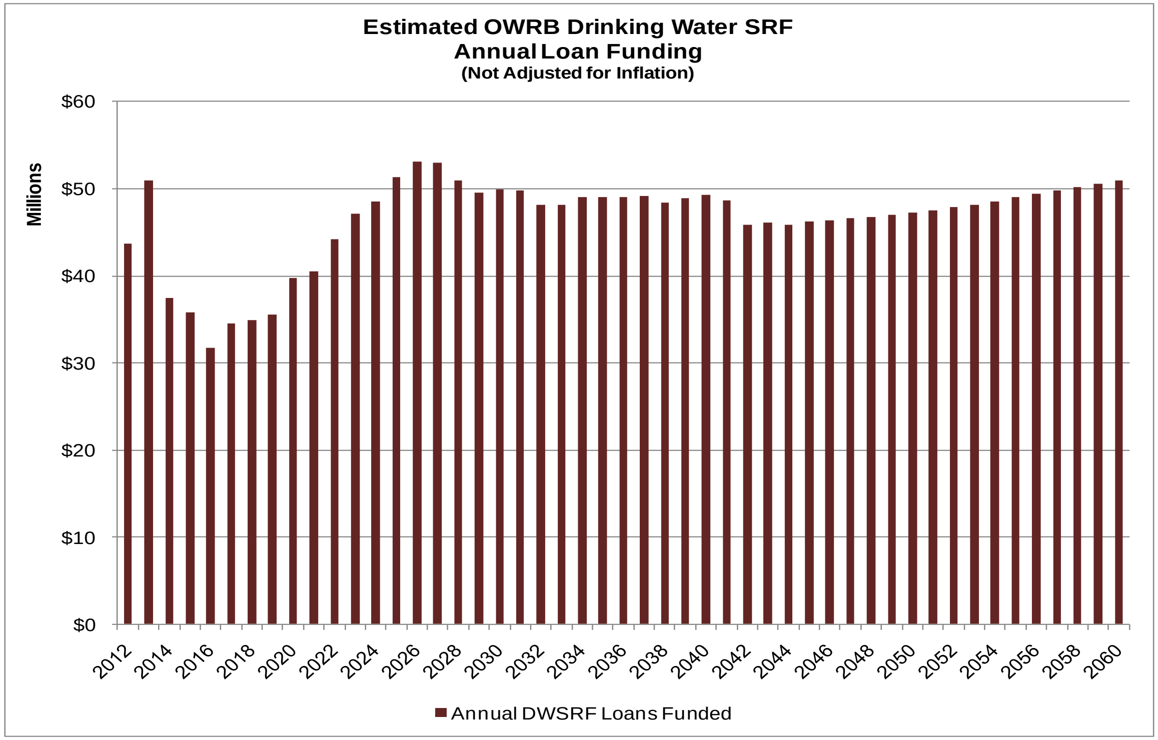
Financial & Programmatic Analysis of Existing Programs

- Most, not all, projects qualify for the DWSRF funding
- The inflation adjusted allocations between DWSRF eligible and Non-DWSRF eligible are shown in the table
- Approximately 96% of the infrastructure projects qualify

DRINKING WATER INFRASTRUCTURE NEED (All Shown in Inflation Adjusted Dollars)				
	Present - 2020	2021-2040	2041-2060	Total Period
DWSRF Eligible	$ 10,811.22	$ 18,501.71	$ 53,641.08	$ 82,954.00
Non - DWSRF Eligible	$ 278.48	$ 719.47	$ 3081.01	$ 4078.96
Total Costs	$ 11,089.69	$ 19,221.18	$ 56,722.09	$ 87,032.96

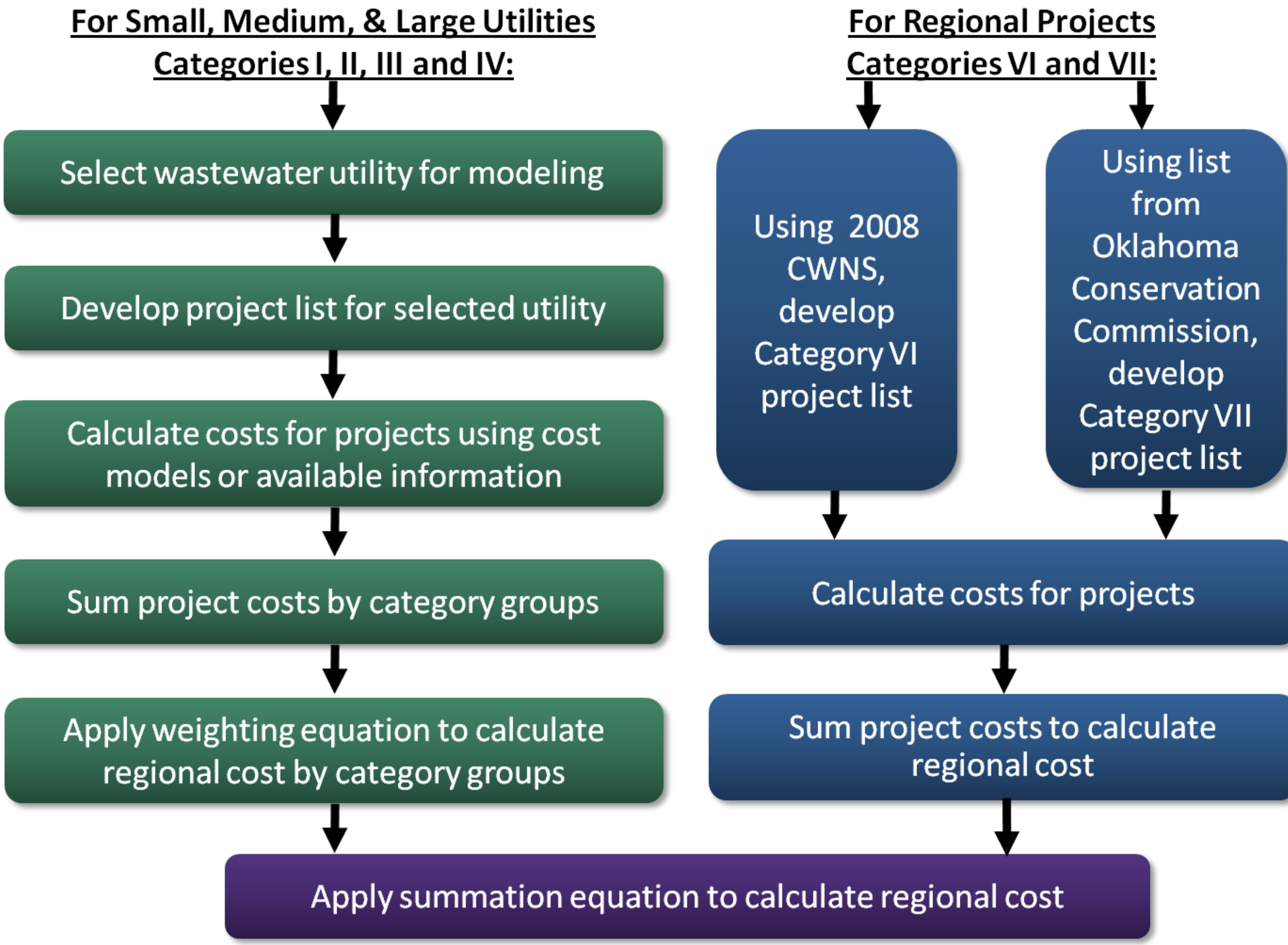


Financial & Programmatic Analysis of Existing Programs



DRINKING WATER INFRASTRUCTURE NEED (All shown in Millions of 2007 Dollars)				
	Present - 2020	2021-2040	2041-2060	Total Period
Average Cost per Year	$ 452.13	$ 977.44	$ 958.93	$ 2,388.50
Total Funding Need	$ 9,439.37	$ 10,287.87	$ 16,578.71	$ 36,305.95

Review of the Projected Wastewater Infrastructure Costs


For Small, Medium, & Large Utilities
Categories I, II, III and IV:
Select wastewater utility for modeling
Develop project list for selected utility
Calculate costs for projects using cost models or available information
Sum project costs by category groups
Apply weighting equation to calculate regional cost by category groups
For Regional Projects
Categories VI and VII:
Using 2008 CWNS, develop Category VI project list
Using list from Oklahoma Conservation Commission, develop Category VII project list
Calculate costs for projects
Sum project costs to calculate regional cost
Apply summation equation to calculate regional cost

Review of OCWP

Category[A]	Official Needs Category Group[B]	Present - 2020 Infrastructure Need (millions of 2010 dollars)	2021 - 2040 Infrastructure Need (millions of 2010 dollars)	2041 - 2060 Infrastructure Need (millions of 2010 dollars)	Total Period Infrastructure Need (millions of 2010 dollars)[C]	Total Period Infrastructure Need (percent by category)	Total Period Infrastructure Need (percent by population)
Small	I and II	$ 170	$ 1,300	$ 530	$ 2,000		
	III and IV	$ 2,200	$ 5,000	$ 1,100	$ 8,300		
Small Subtotal		$ 3,370	$ 6,300	$ 6,630	$ 10,300	24%	13%
Medium	I and II	$ 1,100	$ 4,100	$ 1,170	$ 6,370		
	III and IV	$ 7,600	$ 10,000	$ 4,000	$ 21,600		
Medium Subtotal		$ 8,700	$ 14,100	$ 6,170	$ 27,970	65%	51%
Large	I and II	$ 230	$ 690	$ 620	$ 1,540		
	III and IV	$ 670	$ 1,200	$ 580	$ 2,450		
Large Subtotal		$ 900	$ 1,890	$ 1,200	$ 3,990	9%	36%
Regional	VI	$ 240	$ -	$ -	$ 240		
	VII	$ 170	$ 130	$ 130	$ 430		
Regional Subtotal		$ 410	$ 130	$ 130	$ 640	2%	
Total		$ 12,380	$ 22,420	$ 8,130	$ 42,930		

[A] Large systems are those serving more than 100,000; medium systems are those serving between 3,301 and 100,000 people; and small systems are those serving 3,300 and fewer people.

[B] Official EPA needs categories where Category I includes secondary wastewater treatment, Category II includes advanced wastewater treatment, Category III is for existing collection systems, Category IV includes new collection systems, Category VI includes stormwater management, and Category VII includes nonpoint source pollution control. Costs were not developed for Category V combined sewer overflow correction (Oklahoma does not have combined sewer overflow systems,) Category X recycled water distribution (Oklahoma does not have these systems,) and Category XII decentralized wastewater systems (category not consistent with public utilities included.)

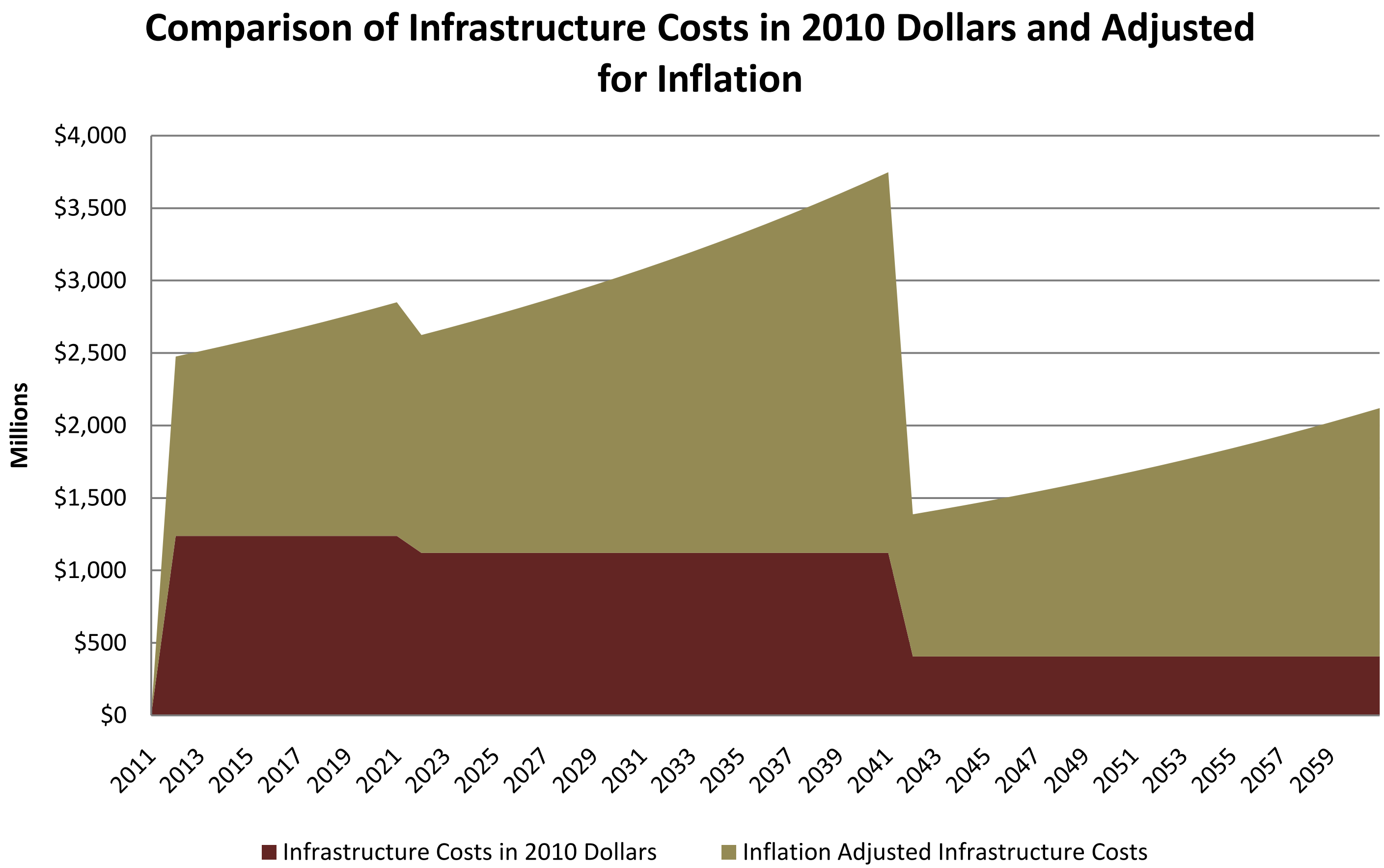
[C] Small differences in values may result from rounding.

Review of OCWP

WASTEWATER INFRASTRUCTURE NEED (All shown in Millions of 2010 Dollars)				
	Present - 2020	2021-2040	2041-2060	Total Period
Total Period Costs	$ 12,380	$ 22,420	$ 8,130	$ 42,930
Average Cost per Year	$ 1,238	$ 1,121	$ 407	$ 859
Cost Inflation Adjusted	$ 14,179	$ 38,817	$ 26,305	$ 79,301

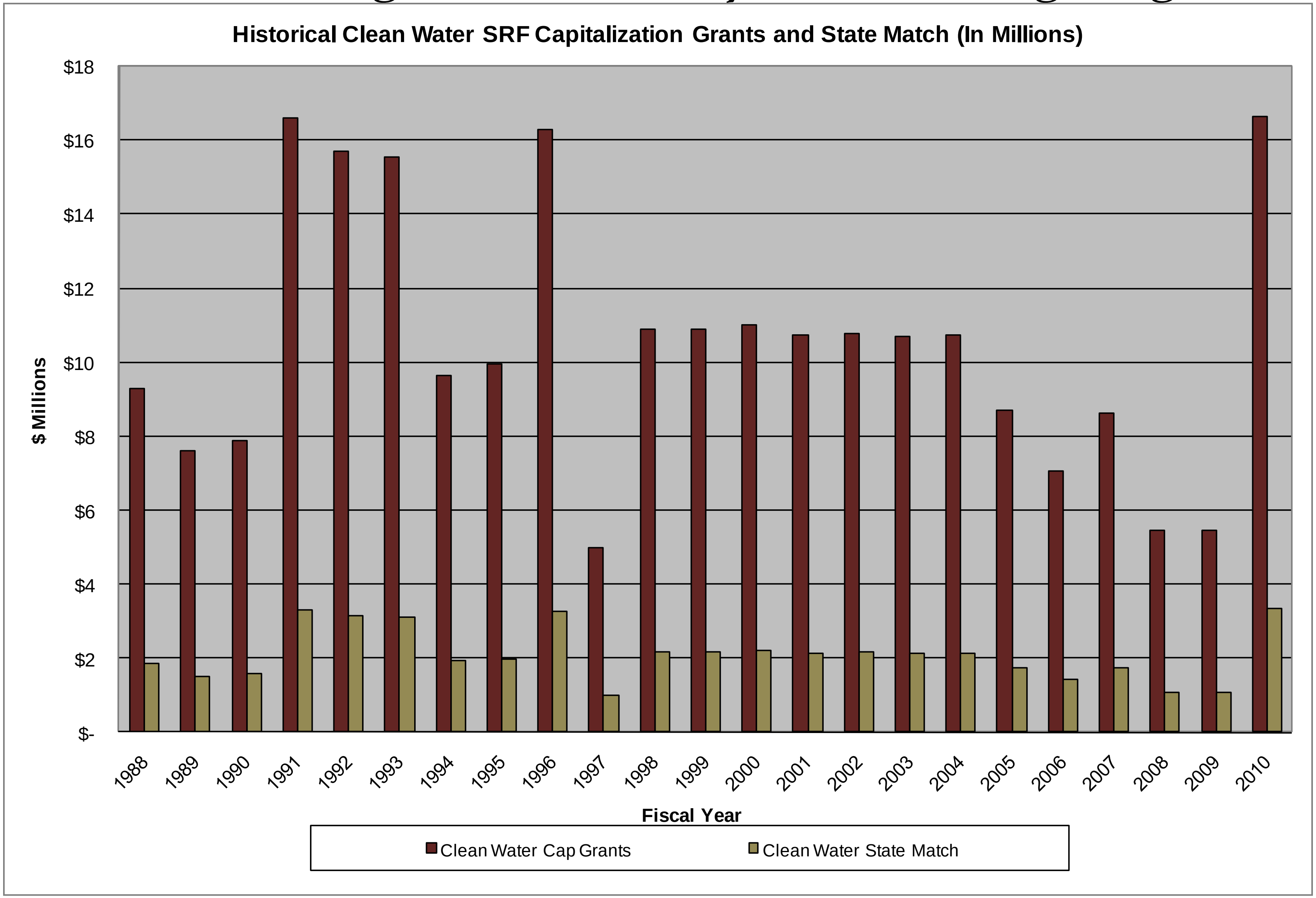
- Infrastructure cost projections from CDM were provided in 2010 dollars
- Figures were adjusted to more accurately calculate infrastructure costs closer to time of construction
- Figures were adjusted at a rate of 2.98%, representing average U.S. CPI over the last 15 years plus 50 basis points

Review of OCWP



- While the actual CPI will be different than the assumption, this analysis provides some quantification of the compounding impact over time
- Debt is often the tool utilized to finance projects that have long useful lives like the proposed infrastructure projects

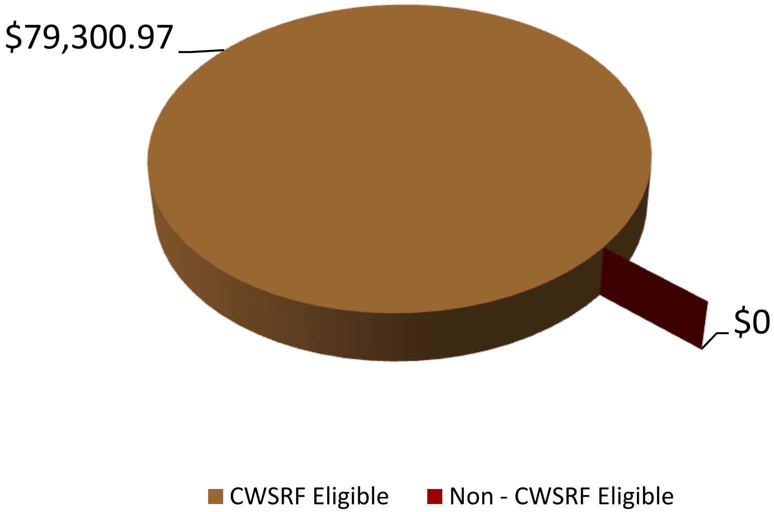
Financial & Programmatic Analysis of Existing Programs



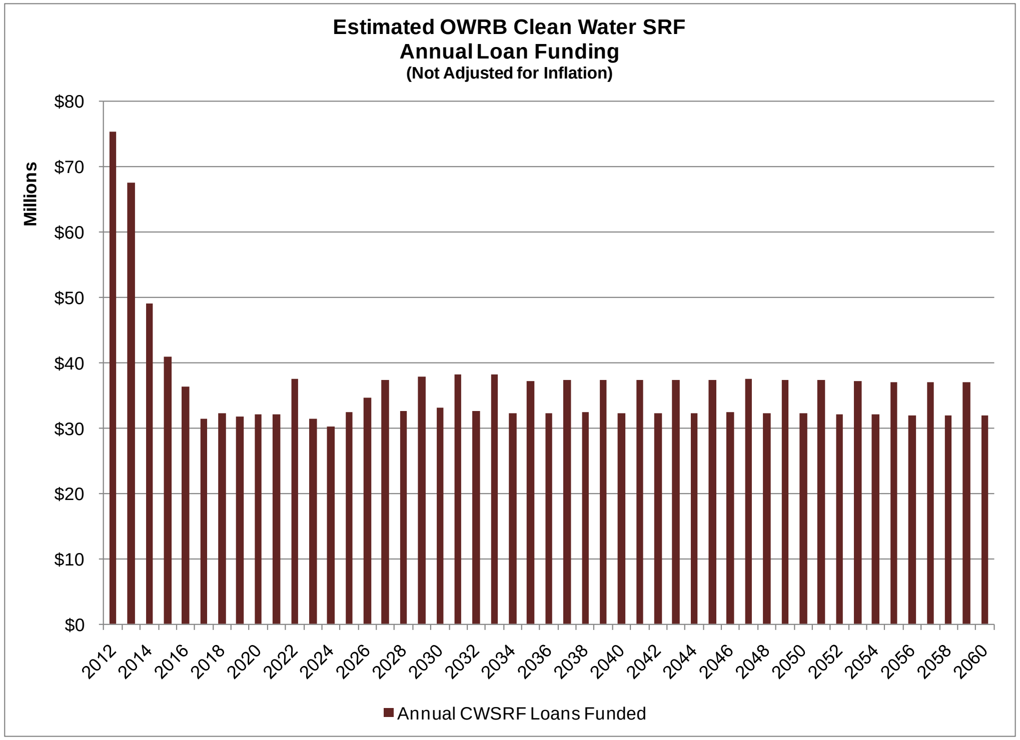
Financial & Programmatic Analysis of Existing Programs

- Most, not all, projects qualify for the CWSRF funding
- The inflation adjusted allocations between CWSRF eligible and Non-CWSRF eligible are shown in the table
- Approximately 100% of the infrastructure projects qualify

WASTEWATER INFRASTRUCTURE NEED (All Shown in Inflation Adjusted Dollars)				
	Present - 2020	2021-2040	2041-2060	Total Period
CWSRF Eligible	$ 14,179	$ 38,817	$ 26,305	$ 79,301
Non - CWSRF Eligible	$ -	$ -	$ -	$ -
Total Costs	$ 14,179	$ 38,817	$ 26,305	$ 79,301



Financial & Programmatic Analysis of Existing Programs



WASTEWATER INFRASTRUCTURE NEED Cumulative Funding Capacity (All shown in Millions of 2010 Dollars)				
	Present - 2020	2021-2040	2041-2060	Total Period
Average Cost per Year	$ 535	$ 690	$ 695	$ 1,921
Total Funding Need	$ 12,380	$ 22,420	$ 8,130	$ 42,930

Financial & Programmatic Analysis of Existing Programs

- The second program to be analyzed has only received capitalization from the State of Oklahoma
- The Financial Assistance Program (FAP) was created in 1985 and has received approximately $20 million in funding
- Like the DWSRF and CWSRF, the FAP has been leveraged and has the highest rating of AAA
- Approximately $705 million has funded 327 projects
- The projected capacity of the FAP is insufficient to fund the projected infrastructure needs

Financial & Programmatic Analysis of Existing Programs

- Given the magnitude of the funding gap, we suggest that a new program be created or the FAP be restructured
- Utilize the same framework and statutory authority that provided for the creation of the FAP
- Will allow the maximum flexibility in creating the program guidelines, legal parameters and bond requirements

Given the AAA ratings on the DWSRF, CWSRF and FAP programs, we recommend that the borrower credit analysis, loan administration and on-going surveillance of those programs be the foundation for any new program

Comprehensive Model

- A 50-year strategic planning model has been developed
- It includes the following variables:
  - Projected Program Demand
  - Underlying Borrower loans
  - Lending Rates
  - Investment of Funds
- The model has been and will continue to be a tool in analyzing various alternatives related to the funding gap
- For purposes of illustration, the analysis is based on funding projects in $1 billion increments
- Reasonable market assumptions have been utilized in the model
- With a project funding horizon of 50 years, the related debt extends 70 years assuming a 20 year amortization

Comprehensive Model

Providing interest rate subsidies can be valuable in the following ways:

- **Incentivize communities financially to move forward with projects**
- **Encourage communities by reducing the cost to the end ratepayer**
- **Influence communities by creating a partnership to share the debt service costs**

Comprehensive Model

There are two types of funding methodologies for consideration:

NON-PERPETUITY

- Contribute only the amount of funding needed to subsidize the debt service
- Once the funding stops, the program ceases
- Lowest cost option

PERPETUITY

- Contribute more capital than is required to subsidize debt service
- After the funding period, the accumulated equity creates a revolving fund program
- More expensive option, but provides a more sustainable funding options

Comprehensive Model

Capitalization impacts with creating a Perpetuity Program

- **More capitalization is required up-front in order to create a 1.40 debt service coverage factor**
- **Over time less Capitalization is required versus a Non-Perpetuity Program**
- **Additional coverage provides additional benefits from a credit perspective**

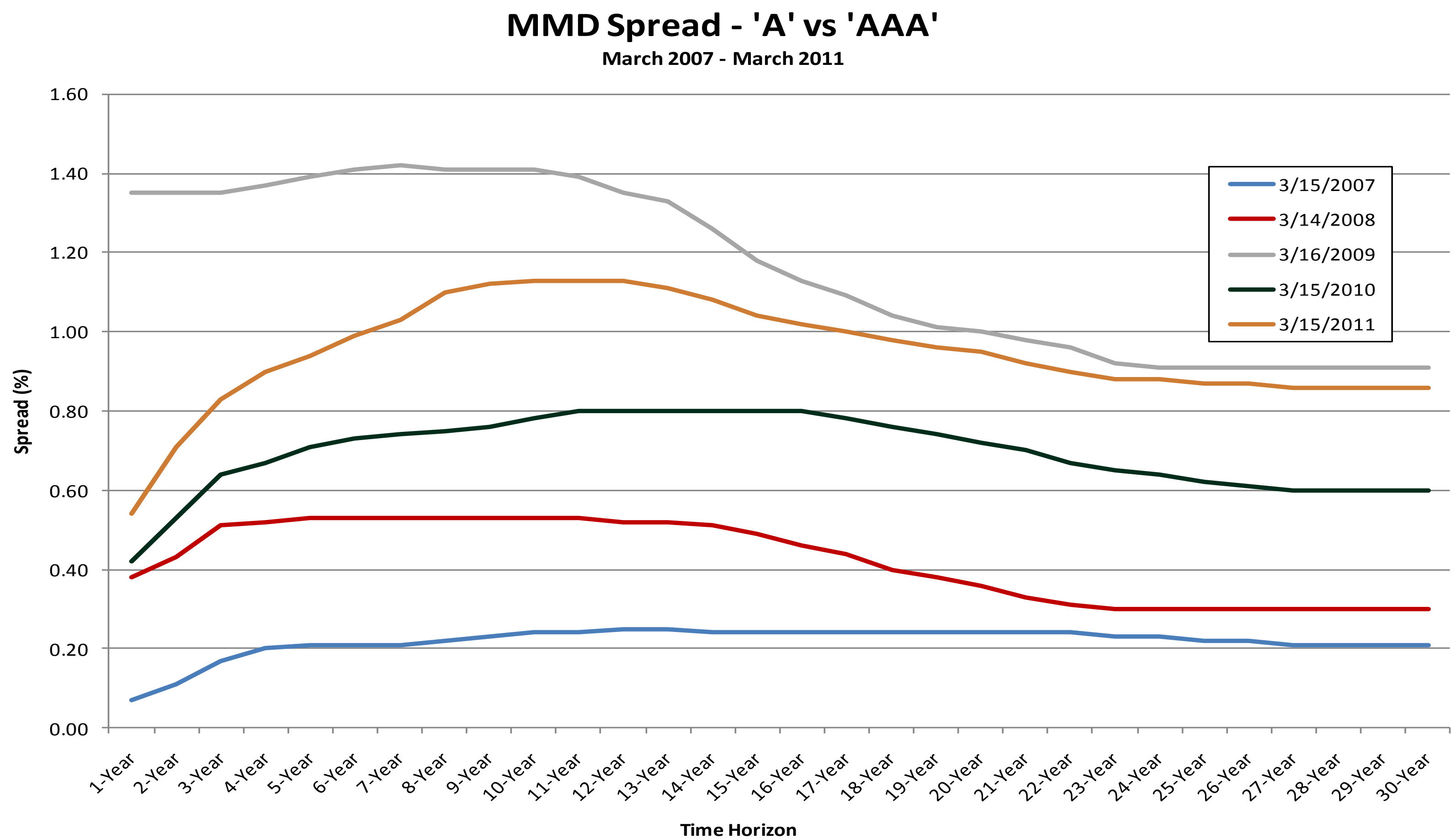
- The first table on the next page shows the total loans projected to be funded over a 50 year period with a factor of 1.40 times applied
- The second table on the next page shows the amount of capitalization required to create the 1.40 times debt service coverage and creates a revolving fund with the annual capacity in the above table

Comprehensive Model

$1+ Billion Construction Funding Over 50 Year Period TOTAL LOANS FUNDED Revolving Program (Provided in $ Millions)	Present to 2020	2021-2040	2041-2060	Total Loans Funded	Annual Capacity
Subsidy 0%	200.00	455.55	484.10	1,139.65	24.20
Subsidy 10%	200.00	438.18	464.28	1,102.46	23.24
Subsidy 20%	200.00	421.51	442.27	1,063.79	22.29
Subsidy 30%	200.00	413.04	427.58	1,040.62	21.43
Subsidy 40%	200.00	400.28	409.18	1,009.46	20.64

$1+ Billion Construction Funding Over 50 Year Period Allocation of Alternative Funding Source for Interest Subsidy by Defined Timeframes Revolving Program (Provided in $ Millions)	Present to 2020	2021-2040	2041-2060	Total Equity
Subsidy 0%	38.13	1.43	0.00	39.56
Subsidy 10%	47.17	4.92	0.00	52.09
Subsidy 20%	56.50	9.62	0.00	66.12
Subsidy 30%	65.74	18.86	0.00	84.60
Subsidy 40%	75.21	26.74	0.47	102.42

Credit and Rating Agency Considerations



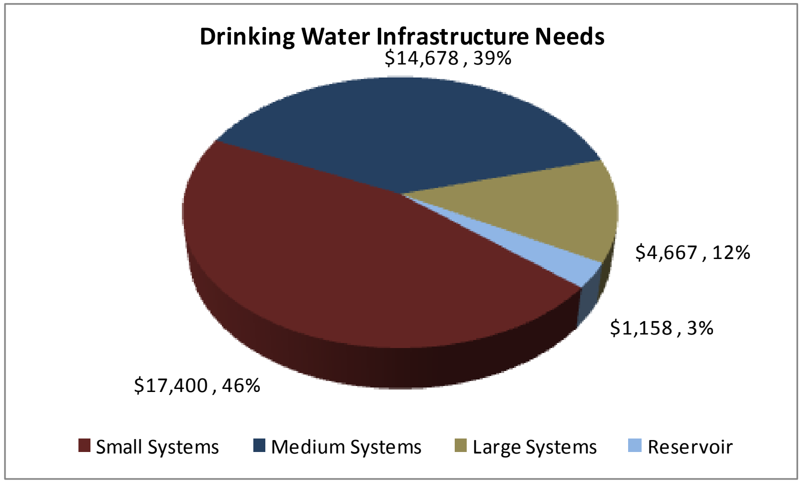
This graph depicts historical interest rates and their respective relationships. Future interest rates are dependent upon many factors such as, but not limited to, interest rate trends, tax rates, supply, changes in laws, rules and regulations, as well as changes in credit quality and rating agency considerations. The effect of such changes in such assumptions may be material and could effect the projected results. These results should be viewed with these potential changes in mind as well as the understanding that there may be interruptions in the short term market or no market may exist at all.

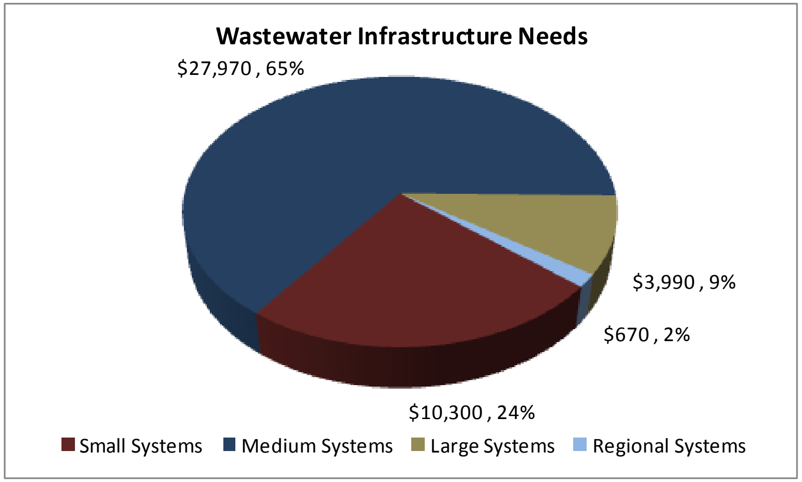
Small Issuer Strategies

- The OCWP identifies small providers have the largest overall drinking water infrastructure cost
- Comprises 46% of the State's drinking water and 24% of the wastewater needs
- A strategy should be formulated related to small providers

Some challenges in funding small systems include:

- Credit and financial implications to the program due to the inclusion of low or non-rated credits;
- Difficulties meeting financial ratios and credit thresholds in the loan evaluation process by the OWRB
- Performance considerations relative to the ongoing surveillance requirements
- Lack of audited financial statements





Small Issuer Strategies

To the extent policy considerations and program goals include funding small systems, there are ways to ensure funding while minimizing the impact of the challenges:

- Define annual funding goal to ensure funding levels
  - Fixed dollar amount
  - Percent of annual funding
- Allows capacity models to integrate information so determine if coverage goals need to be adjusted to achieve targeted Program ratings
- Create a second smaller revolving fund for direct loans to communities with weak credits and financial circumstances
  - This non-leveraged fund would not impact the ratings of the leveraged pool
  - Could also be a source for projects that have private activity components

Summary

- In order to meet 60% of the anticipated $166 billion of need and provide a drinking water infrastructure subsidy of 30% and a wastewater infrastructure subsidy of 40% would require projected capital contributions to create a revolving fund of:

DRINKING WATER INFRASTRUCTURE NEED (All shown in Millions of 2007 Dollars)				
	Present - 2020	2021-2040	2041-2060	Total Period
Total Period Costs	$ 9,683	$ 10,688	$ 17,531	$ 37,901
60% FUNDED	$ 5,810	$ 6,413	$ 10,519	$ 22,741
Equity Needed @ 30% Subsidy	$ 1,834	$ 22	$ 128	$ 1,984

WASTEWATER INFRASTRUCTURE NEED (All shown in Millions of 2010 Dollars)				
	Present - 2020	2021-2040	2041-2060	Total Period
Total Period Costs	$ 12,380	$ 22,420	$ 8,130	$ 42,930
60% FUNDED	$ 7,428	$ 13,452	$ 4,878	$ 25,758
Equity Needed @ 40% Subsidy	$ 2,611	$ 1,041	$ -	$ 3,652

Summary

- Propose creation of new or restructured FAP Loan Program as well as a small issuer loan program:
  - Retain FAP reserve earnings
  - Maintain Gross Production Tax on oil
  - Recommend the redirection of all or a portion of REAP funds
  - Identify other state funding sources
- Explore new alternative funding sources
- Encourage maintaining or increasing federal SRF funding
- Consider necessity of subsidy reduction

Timeline

- Convene and meet with a team of financial and water/wastewater infrastructure professionals by 08/31/11
- Present recommendations to the Legislative committee on 10/19/11

Water Efficiency & Reuse

Innovative Solutions to Forecasted Water Shortages

Suggested Consolidated Recommendation:

To address water shortages forecasted in the 2012 Update of the OCWP, as well as avoid the costly development of new supplies, the OWRB should collaborate with various representatives of the state's water use sectors – with particular emphasis on crop irrigation, municipal/industrial, and thermoelectric power – to incentivize voluntary initiatives that would collectively achieve an aggressive goal of maintaining statewide water use at current levels through 2060. In its associated evaluation of appropriate programs and policies, the OWRB should identify the optimum financial incentives, as well as recognize the potential for lost water provider revenues resulting from improved conservation. In particular, the OWRB should consider the following:

Water Efficiency & Reuse

Innovative Solutions to Forecasted Water Shortages

Suggested Consolidated Recommendation:

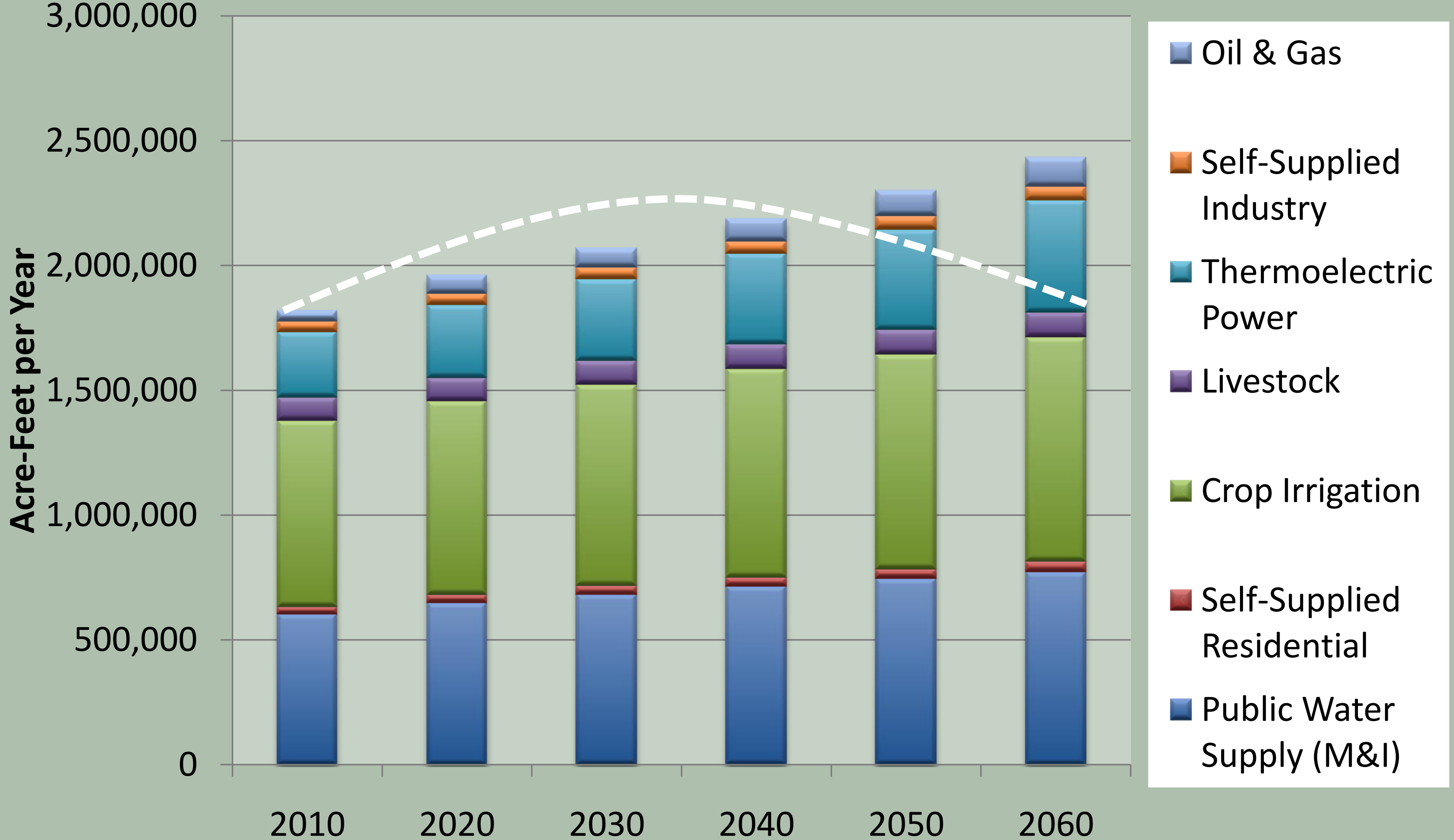
…

- *Implementation of incentives (tax credits, zero-interest loans, cost-share programs, increasing block rate/tiered water pricing mechanisms, etc.) to encourage improved irrigation and farming techniques, efficient (green) infrastructure, retrofitting of water-efficient infrastructure, use of water recycling/reuse systems in new buildings, promotion of "smart" irrigation techniques, control of invasive species, and use of marginal quality waters (including treated gray and waste water).*
- *Establishment of education programs that modify and improve consumer water use habits.*
- *The applicability of existing or new financial assistance programs that encourage Oklahoma water systems to implement leak detection and repair programs that result in reduced loss and waste of water.*

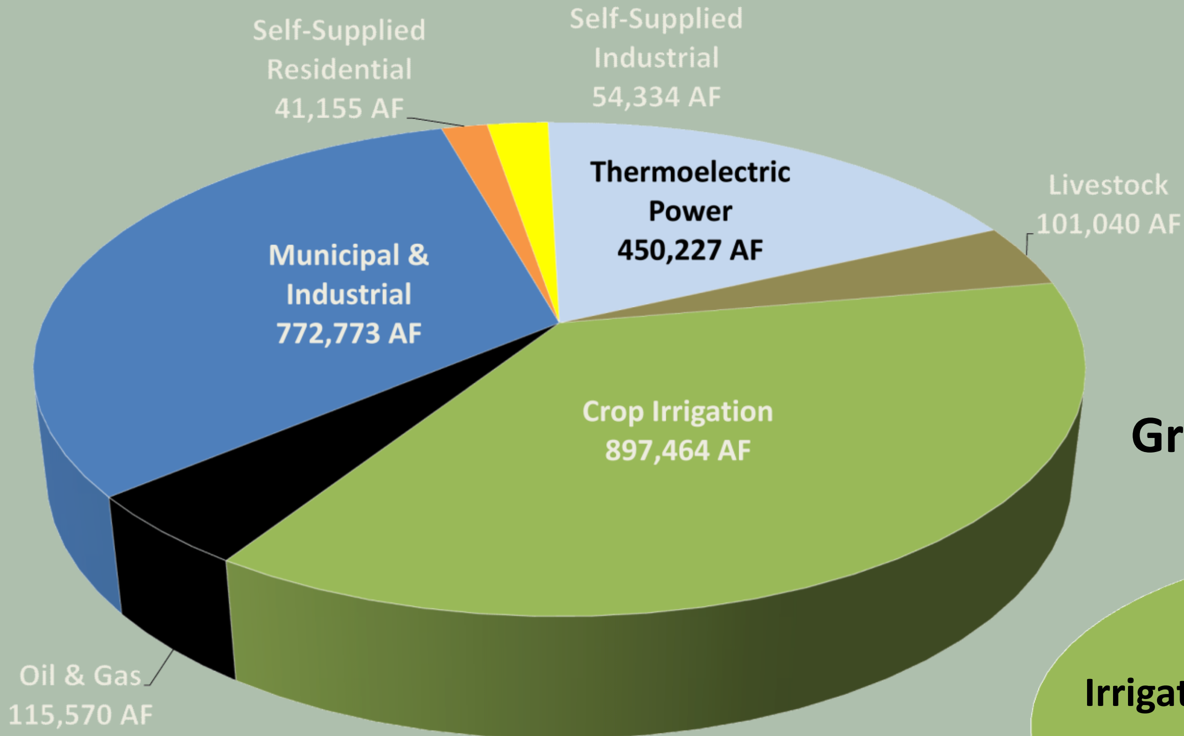
Important Elements of the Recommendation

- Reducing forecasted 2060 demand to current levels:
  - By developing programs and policies that are *voluntary*.
  - By offering financial incentives to encourage the adoption of practices, the development and employment of technologies, and the use of equipment, fixtures and infrastructure that reduce demand and increase supply.
  - By creating education programs that change consumer behavior and instill an ethic of conservation.

Demand Projections Characterize the Need for Water

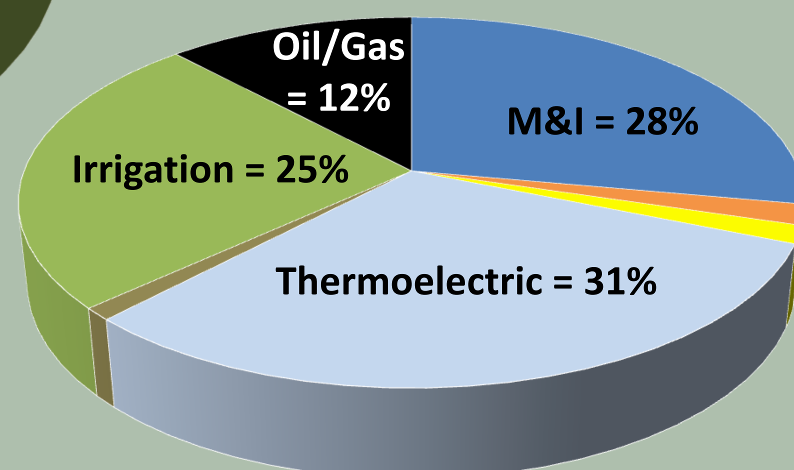


Water Efficiency & Reuse
The Opportunity



2060 Demand

Growth by Water Use Sector (2010-2060)



What Do We Mean?

- "Water use efficiency" refers to conservation through such things as specific consumer decisions and activities, employing more efficient equipment and technology, and the adoption of voluntary programs and policies.
- "Reuse" is the utilization of either untreated (gray) or treated wastewater instead of freshwater or potable water for appropriate purposes.

Effect on Supply and Demand

- Both affect the supply AND the demand side of water use and management.
- When you reduce demand, you increase supply; when you increase available supply you mitigate the impacts of future demands:
  - Water Efficiency/Conservation both reduces demand and increases available supply
  - Water Reuse typically stretches currently available supplies and reduces need for development of new supplies but does not necessarily reduce demand

How Did the OCWP Explore These Issues?

- Conservation:
  - Evaluated various scenarios in the Municipal/Industrial and Irrigation sectors
  - Analysis performed statewide and in all 82 basins
  - Used the information to evaluate effectiveness as an option to reduce shortages
- Reuse (MQW Workgroup):
  - Analyzed potential for reuse across the state and proposed where where most feasible
  - Discussed considerations necessary to determine local applicability: regulatory, treatment, suitability for various applications, etc.

OCWP Municipal/Industrial Conservation Analysis

Scenario I (Moderate Level) Considerations:

- Passive Conservation: water savings that are the direct result of plumbing codes of the federal Energy Policy Act of 1992 requiring water efficient plumbing fixtures
- Metering: installing meters to monitor water loss
- Tiered Rate Structure: increasing tiers of cost with increased water use
- Community Education and Information: changing fundamental habits

OCWP Municipal/Industrial Conservation Analysis

Scenario II (Substantial Level) Considerations:

- More aggressive implementation of various components of Scenario I
- Analyzed the impact of high efficiency indoor water use regulations beyond that of passive conservation

Fixture	Passive Mandates	High Efficiency Examples
Toilet	1.6 gpf	1.0 gpf
Urinal	1.0 gpf	0.5 gpf
Faucet	2.5 gpm	1.0 gpm
Showerhead	2.5 gpm	2.0 gpm

OCWP Irrigation Conservation Analysis

- Scenario I (Moderate Level)
  - Considered trends in the conversion to higher efficiency irrigation methods in the following categories:
    - Sprinkler (low pressure systems)
    - Surface/Flood (improvements in the infrastructure of the conveyance system)
    - Micro (at or near the surface or root zone)
- Scenario II (Substantial Level)
  - Considered the above plus an analysis of the impact of shifting to less water-intensive crops (e.g., grain sorghum instead of corn, forage crops like alfalfa and pasture grass instead of grain, etc.) beginning in 2015.

OCWP Conservation Analysis
Other Savings

- OCWP Analysis Also Considered Other Savings Associated with Conservation
- Energy:
  - Less energy required to produce water (treatment and delivery)
  - Less energy required to convey and treat wastewater (since less water in system)
  - *Therefore, less water requires less energy*
- Cost/Benefit :
  - Monetary savings associated with having to treat and convey less water and wastewater

OCWP Conservation Analysis
Conservation-Associated Cost Savings

- Considered direct operational costs for water (by source) and wastewater treatment and delivery saved due to conservation.
- Took into account electricity, labor, chemical costs, water analysis, regulatory compliance.

	Surface Water	Groundwater	Wastewater	Total
Scenario I	$26,036,731	$2,903,100	$18,510,151	$47,449,981
Scenario II	$38,961,078	$4,344,167	$23,880,443	$67,185,689

Energy/Water Nexus Savings

- It takes water to produce thermoelectric power; energy is used in the distribution and treatment of water and wastewater.
- Therefore, energy savings associated with reduced water production and wastewater treatment are important.

	Energy Saved	Water Saved
	GW hours	Acre-Feet/Year
Scenario I	102	221
Scenario II	146	316

OCWP Conservation Analysis
Total Water Savings

	M&I and Agriculture Statewide Demand Projections & Water Savings for Conservation Scenarios (AFY)						
	2010	2020	2030	2040	2050	2060	2060 with Energy Savings
Baseline	1,377,318	1,455,309	1,523,273	1,587,406	1,642,069	1,711,392	
Scenario I	N/A	1,301,816	1,332,781	1,388,603	1,435,807	1,496,643	1,496,422
Scenario II	N/A	1,155,397	1,170,248	1,209,372	1,244,123	1,295,569	1,295,252

OCWP Conservation Analysis
What is the Impact?

Gaps/Depletions Mitigation Statewide (2060)

Source	Baseline Shortage Amount	Total & Percent Reduction from Baseline Shortage Amount			
		Moderate Conservation		Substantial Conservation	
SW	75,240 AFY	18,810 AFY	25%	23,980 AFY	32%
AGW	38,980 AFY	12,474 AFY	32%	22,554 AFY	59%
BGW	92,710 AFY	13,906 AFY	15%	73,784 AFY	78%

OCWP Conservation Analysis
What is the Impact?

Gaps/Depletions Mitigation for Hot Spots (2060)

Source	Baseline Shortage Amount	Total & Percent Reduction from Baseline Shortage Amount			
		Moderate Level		Substantial Level	
SW	14,590 AFY	7,440 AFY	51%	8676 AFY	60%
AGW	12,070 AFY	6,036 AFY	50%	9036 AFY	75%
BGW	69,000 AFY	24,080 AFY	35%	61,320 AFY	89%

OCWP Conservation Analysis

Improving the Water Future of Basins

	Reduction in the Number of Basins with Gaps and/or Storage Depletions		
	Surface Water	Alluvial Groundwater	Bedrock Groundwater
Baseline	55	63	34
Scenario I	42	51	26
Scenario II	33	41	23

OCWP Conservation Analysis
Further Benefits of Conservation

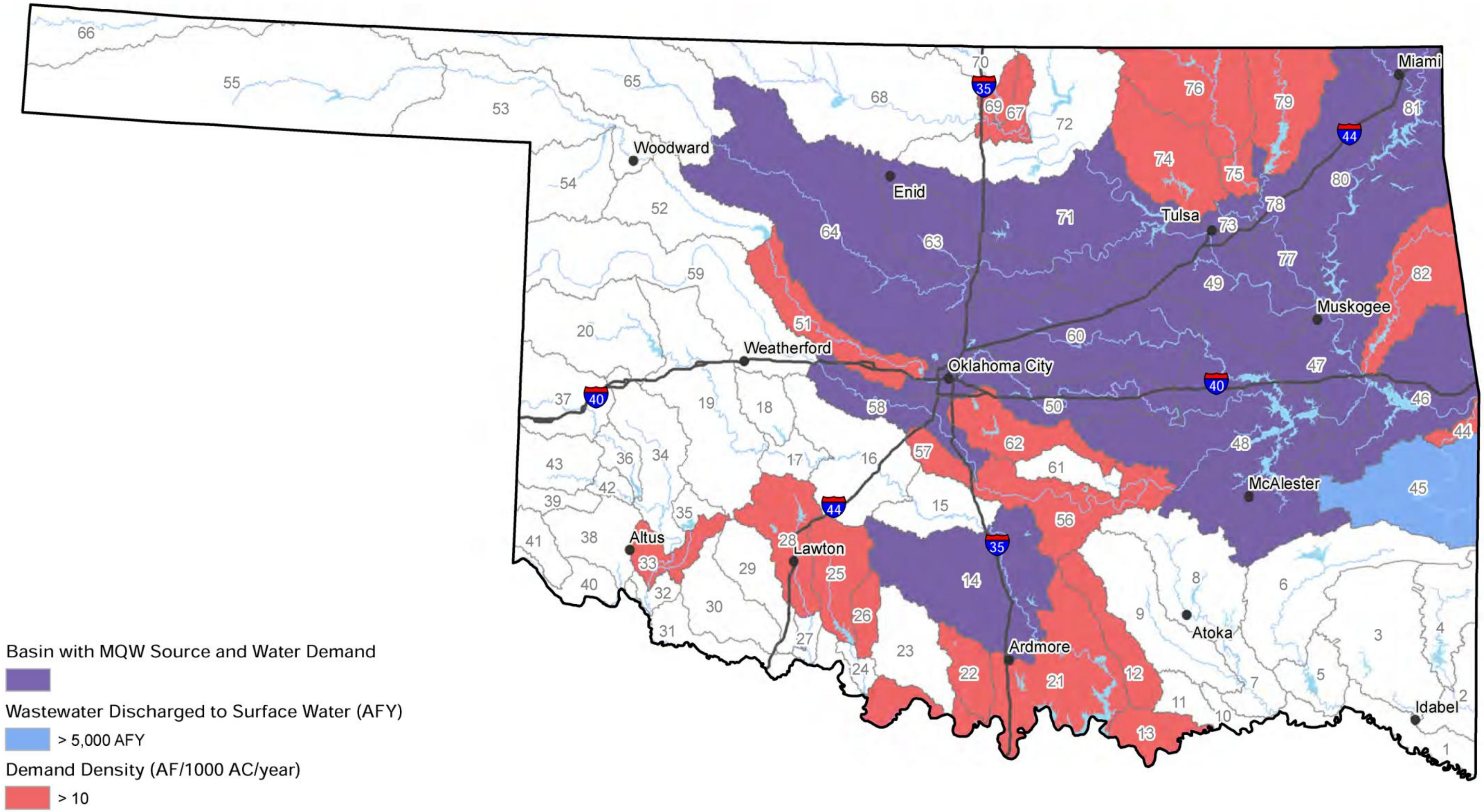
- Reduce Capital Needs for Forecasted Infrastructure Needs:
  - Can stretch supplies and thereby reduce *$166 billion* need
- Drought Mitigation:
  - Reduces demand
  - Stretches supplies
  - Delays or avoids acute drought restrictions
- More Water for Non-consumptive Uses:
  - Protect Oklahoma's 3rd largest industry – tourism & recreation
  - Equally important to fish & wildlife, both sport industry and ecological protections (e.g., endangered species protection)
  - Can reduce impacts of drought on non-consumptive needs

OCWP Conservation Analysis
Reuse of Wastewater

- Includes uses for gray water and treated wastewater.
- Gray water uses include subsurface landscape irrigation of non-edible plants, for example.
- Treated Wastewater uses were analyzed by the OCWP Marginal Quality Water Workgroup:
  - Determined it to be a viable source for non-potable uses
  - Matched greatest supply availability with greatest demand
  - M&I landscape irrigation, crop irrigation, and power and industrial use are most likely the most cost-effective and viable uses
  - May require slightly greater levels of treatment beyond that required for discharges depending upon site-specific conditions

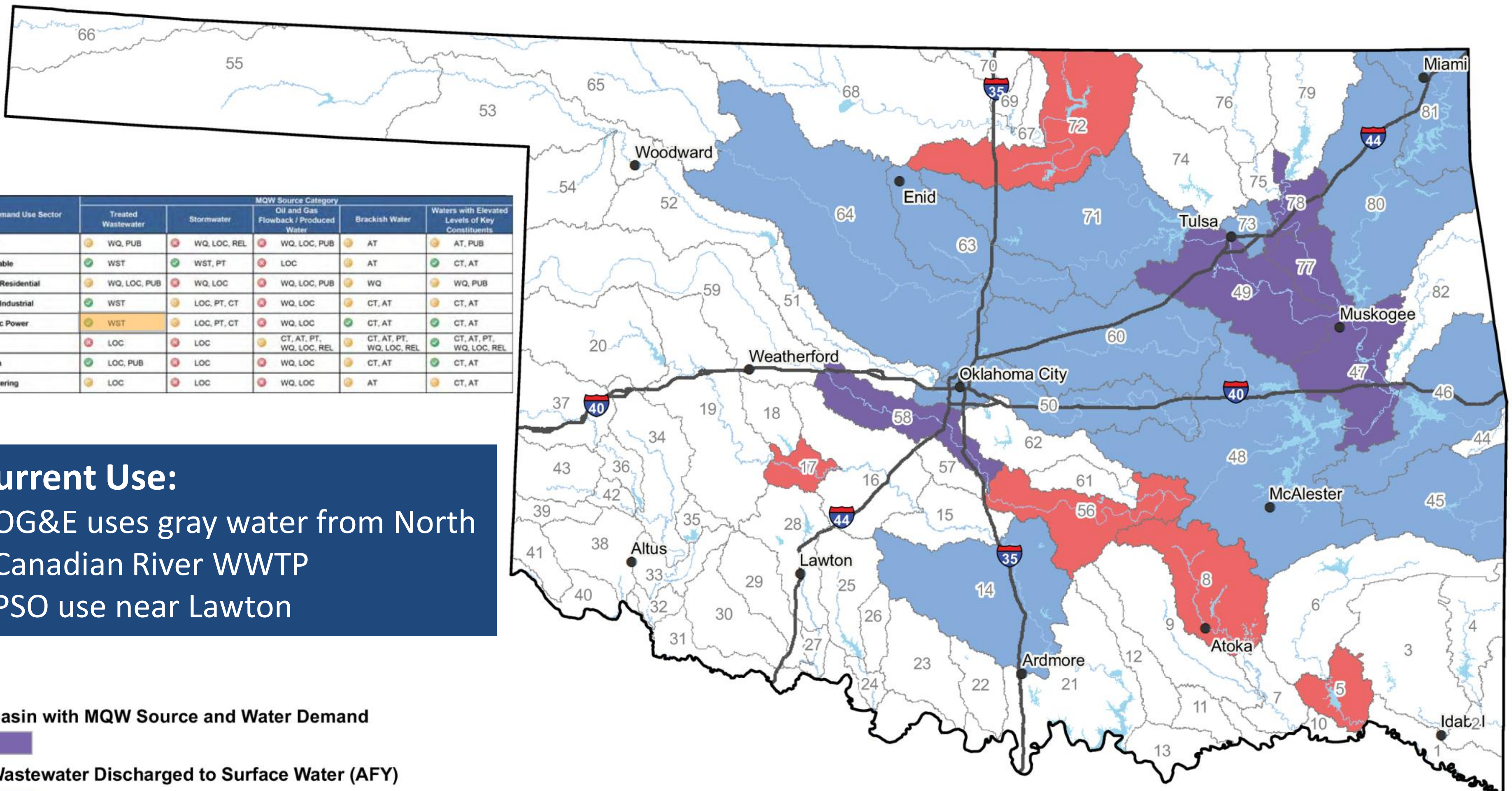
OCWP Conservation Analysis

Treated Wastewater for M&I Use (2060)



OCWP Conservation Analysis

Treated Wastewater for Thermoelectric Power Use (2060)



Water Demand Use Sector	MQW Source Category				
	Treated Wastewater	Stormwater	Oil and Gas Flowback / Produced Water	Brackish Water	Waters with Elevated Levels of Key Constituents
M&I - potable	WQ, PUB	WQ, LOC, REL	WQ, LOC, PUB	AT	AT, PUB
M&I - non-potable	WST	WST, PT	LOC	AT	CT, AT
Self-Supplied Residential	WQ, LOC, PUB	WQ, LOC	WQ, LOC, PUB	WQ	WQ, PUB
Self-Supplied Industrial	WST	LOC, PT, CT	WQ, LOC	CT, AT	CT, AT
Thermoelectric Power	WST	LOC, PT, CT	WQ, LOC	CT, AT	CT, AT
Oil and Gas	LOC	LOC	CT, AT, PT, WQ, LOC, REL	CT, AT, PT, WQ, LOC, REL	CT, AT, PT, WQ, LOC, REL
Crop Irrigation	LOC, PUB	LOC	WQ, LOC	CT, AT	CT, AT
Livestock Watering	LOC	LOC	WQ, LOC	AT	CT, AT

Current Use:

- OG&E uses gray water from North Canadian River WWTP
- PSO use near Lawton

Basin with MQW Source and Water Demand

Wastewater Discharged to Surface Water (AFY)

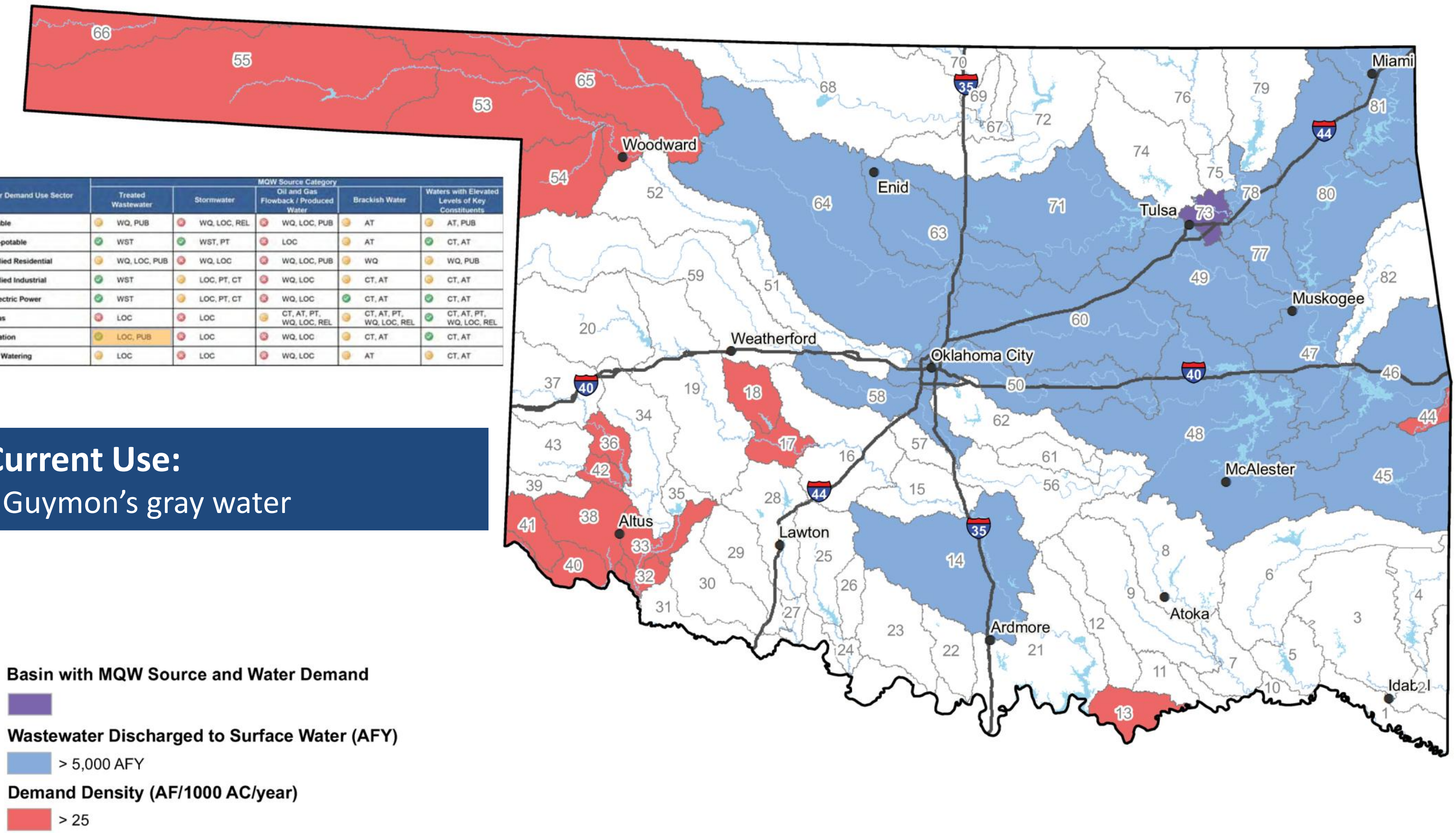
> 5,000 AFY

Demand Density (AF/1000 AC/year)

> 25

OCWP Conservation Analysis

Treated Wastewater for Crop Irrigation Use (2060)



Water Demand Use Sector	MQW Source Category				
	Treated Wastewater	Stormwater	Oil and Gas Flowback / Produced Water	Brackish Water	Waters with Elevated Levels of Key Constituents
M&I - potable	WQ, PUB	WQ, LOC, REL	WQ, LOC, PUB	AT	AT, PUB
M&I - non-potable	WST	WST, PT	LOC	AT	CT, AT
Self-Supplied Residential	WQ, LOC, PUB	WQ, LOC	WQ, LOC, PUB	WQ	WQ, PUB
Self-Supplied Industrial	WST	LOC, PT, CT	WQ, LOC	CT, AT	CT, AT
Thermoelectric Power	WST	LOC, PT, CT	WQ, LOC	CT, AT	CT, AT
Oil and Gas	LOC	LOC	CT, AT, PT, WQ, LOC, REL	CT, AT, PT, WQ, LOC, REL	CT, AT, PT, WQ, LOC, REL
Crop Irrigation	LOC, PUB	LOC	WQ, LOC	CT, AT	CT, AT
Livestock Watering	LOC	LOC	WQ, LOC	AT	CT, AT

Current Use:

- Guymon's gray water

How Do We Get There?

- Work with key sectors and data from OCWP to develop the most viable options for Oklahoma.
- In response, develop programs and policies that encourage voluntary conservation activities.
- Provide financial incentives in the form of tax credits, grants, low/zero interest loans, etc. as a part of programs, where applicable.
- Promote and facilitate research that helps develop technologies to achieve conservation savings, such as “smart” irrigation.

Benefits of
Water Efficiency & Reuse

- Make more supply available for non-consumptive and consumptive uses
- Allowing for greater economic development with reduced impact on water availability and shortages
- Savings in energy, operational and future infrastructure costs for utilities and ratepayers
- Lower operational costs for irrigators and the opportunity for increased acres in crop production with minimal to no net increase in water use
- Business growth opportunities for Oklahoma in the water efficiency technology sector
- Be a national leader in conservation and water efficiency

Water Quality & Quantity Monitoring

Better Data for Improved Decision-Making

SUGGESTED CONSOLIDATED RECOMMENDATION:

The State Legislature should provide a dedicated source of funding to enable the State of Oklahoma to accurately assess the quality and quantity of its water resources, thereby ensuring improved water quality protection, accurate appropriation and allocation, and long-term collection of data to inform water management decisions…

Water Quality & Quantity Monitoring

Better Data for Improved Decision-Making

SUGGESTED CONSOLIDATED RECOMMENDATION:

…Such funding should be directed toward development and maintenance of a permanent statewide water quality and quantity monitoring program(s), specifically allowing for:

- *Integration of all state surface and groundwater quality and quantity monitoring programs into one holistic, coordinated effort.*
- *Stable and dedicated appropriations for the Cooperative Stream Gaging and Beneficial Use Monitoring Programs.*
- *Creation of an ambient groundwater quality monitoring program.*
- *Full implementation of a statewide program for the collection of biological data to provide a better indication of long-term water quality.*

Water Quality & Quantity Monitoring

Better Data for Improved Decision-Making

Justification:

- Reliable water management is predicated on the consistent, long-term collection of "good" data, its availability and interpretation:
  - Water Quality Protection & Pollution Remediation
  - Permitting
  - Public Health
  - Pollution Remediation
  - Flood Forecasting
  - Drought Preparedness
  - Planning
- Does a particular swimming area pose a risk to me or my family?
- Where's the optimum location to drill a water supply well?
- When and where could the next blue-green algae outbreak occur?

Water Quality & Quantity Monitoring

Better Data for Improved Decision-Making

Supported by OCWP Technical Analyses:

- Insufficient streamflow data in some locations reduced confidence in supply/demand assessment.
- Lack of comprehensive data on groundwater quality reduced confidence in water supply assessment.

Water Quality & Quantity Monitoring

Better Data for Improved Decision-Making

Implementation:

		Annual Cost	*Timeline
Surface Water Quality Monitoring:			
– Current Funding	= $	800,000	
– Additional Funds Required	= $	975,000	2012
Surface Water Quantity Monitoring:			
– Current Funding	= $	120,000	
– Additional Funds Required	= $	445,000	2012
Groundwater Quality/Quantity Monitoring:			
– Current Funding	= $	0	
– Additional Funds Required	= $	815,000	2012
Total New Funding Requirement	**= $**	**2,235,000**	

Existing program framework in place.

Water Supply Reliability

Ensuring Water Availability for Future Growth

Suggested Consolidated Recommendation:

To address projected increases in water demands and related decreases in availability, as well as to ensure the fair, reliable, and sustainable allocation of Oklahoma's water supplies, the Oklahoma Water Resources Board should implement the following recommendations:

- *Address the growing backlog of maximum annual yield studies and required 20 year updates on groundwater basins within the state – including characterizations of the valid interactions between surface and groundwater sources – to accurately determine water available for use…*

Water Supply Reliability

Ensuring Water Availability for Future Growth

SUGGESTED CONSOLIDATED RECOMMENDATION:

- *…Develop stream water allocation models on all stream systems within the state to assess water availability at specific locations, manage junior/senior surface water rights under various drought scenarios, anticipate potential interference of use, and evaluate impacts of potential water transfers.*
- *Facilitate a workgroup of stakeholders, researchers and other professionals to investigate:*
  - *transitioning from an average annual to seasonal stream water allocation program; and*
  - *implementation of a conjunctive surface water/groundwater management program.*

Water Supply Reliability
Ensuring Water Availability for Future Growth

Justification:

– Hydrologic studies are **fundamental for determining water available** for allocation.
– **Lack of hydrogeologic study** on water budget, demands, flow delineation, and surface water-groundwater interactions allows for **over-appropriation**; **uncertainty** for economic sustainability and growth, and ongoing **back-end management** of conflicts between water users.
– Scientifically-based hydrologic study and allocation of water rights **explicitly contemplated and set out in Oklahoma Statute.**
– Provides policy-makers a **basis for forecasting** water shortages in **drought** and **high-use conditions** and in **specific location.**
– Local and state **economies depend** upon reliable water supply.

Water Supply Reliability
Ensuring Water Availability for Future Growth

Justification:

- **Limit** potential intrastate and interstate **conflicts** and litigation.
- **Addresses public issues** brought by OCWP process: **fairness** in water rights administration, **priority** on unstudied basins/outdated studies, assessment of **SW/GW interaction**, **interstate water issues**; legislative **funding.**
- Accounting for **seasonal variations** in use and the interrelationship between **surface and groundwaters minimizes over appropriation** and shortage.

Water Supply Reliability
Ensuring Water Availability for Future Growth

Supported by OCWP Technical Analyses:

- Identified "Hot Spot" basins facing significant future water supply challenges.
- Identified basins with forecasted surface water gaps and groundwater storage depletions.

Water Supply Reliability
Ensuring Water Availability for Future Growth

Implementation:

Annual Hydrologic Study Costs (through 2022)

Unstudied and Overdue 20-Year Groundwater Basin Updates	$1,045,200
Stream Water Hydrologic Studies	$ 73,125
Total	**$1,118,325**

Annual Hydrologic Study Costs (2023 through 2060)

20-Year GW Basin Updates	$ 342,134
Stream Water Hydrologic Studies	$ 18,750
Total	**$ 360,884**

Instream/Environmental Flows

Recognizing Nonconsumptive Water Needs and Supporting Recreational & Local Economic Interests

SUGGESTED CONSOLIDATED RECOMMENDATION:

The establishment of an instream flow program should be investigated and evaluated to preserve water quality, protect ecological diversity, and sustain and promote economic development, including benefits associated with tourism, recreation, and fishing. The process developed by the OCWP Instream Flow Workgroup should be implemented and followed to ascertain the suitability of such a program for Oklahoma. The OWRB should seek express authority from the State Legislature prior to promulgating rules to accommodate and protect instream flows.

Instream/Environmental Flows

Recognizing Nonconsumptive Water Needs and Supporting Recreational & Local Economic Interests

Justification:

- Significant interest in value of non-consumptive water uses of water, especially related to recreation & tourism (our 3rd biggest industry).
- Associated factors related to ecological integrity, endangered species, interstate compact compliance, etc.
- Consistent with holistic water planning principles and in calculating excess/surplus water.

Instream/Environmental Flows

Recognizing Nonconsumptive Water Needs and Supporting Recreational & Local Economic Interests

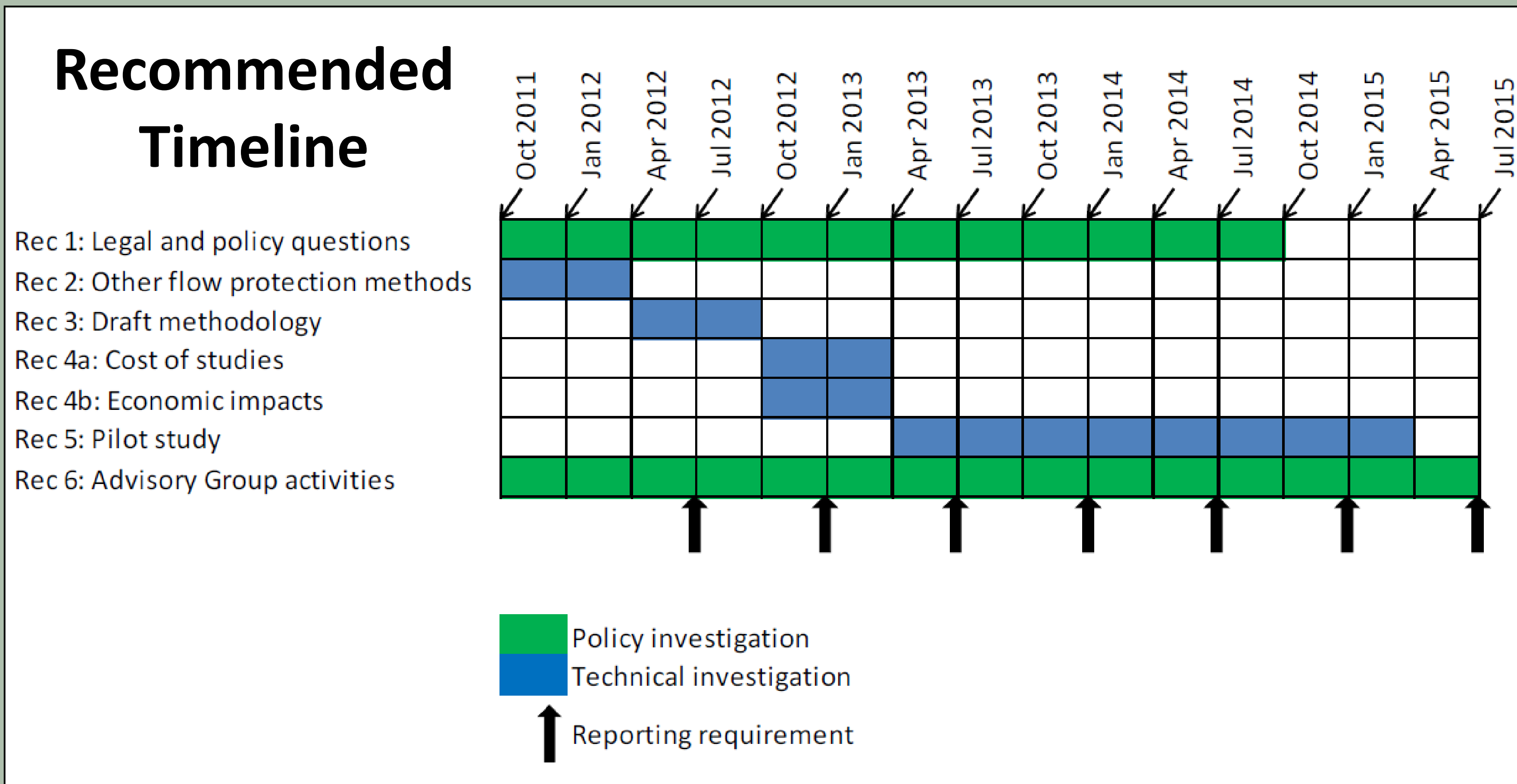
Supported by OCWP Technical Analyses:

- Generally recognized the importance of nonconsumptive water uses (recreation, tourism, etc.) to state and local economies.
- Instream and environmental flows specifically investigated by OCWP workgroup.
- Developed water use models that can be used on the local level to incorporate nonconsumptive demands and adjust management schemes accordingly.

Instream/Environmental Flows

Recognizing Nonconsumptive Water Needs and Supporting Recreational & Local Economic Interests

Implementation Costs = $ 1.5 million over 4 years



State/Tribal Water Consultation & Resolution

Building Cooperation to Avoid Future Conflict & Remove Uncertainties to Water Use

SUGGESTED CONSOLIDATED RECOMMENDATION:

To address uncertainties relating to the possible validity of water rights claims by the Tribal Nations of Oklahoma and to effectively apply the prior appropriation doctrine in the fair apportionment of state waters, the Oklahoma Governor and State Legislature should establish a formal consultation process as outlined in the OCWP Report on Tribal Issues and Concerns.

State/Tribal Water Consultation & Resolution

Building Cooperation to Avoid Future Conflict & Remove Uncertainties to Water Use

Justification:

- Resolve longstanding uncertainty over tribal claims.
- Strengthen state planning efforts.
- Allow effective application of appropriation doctrine
- Facilitate the fair apportionment of water
- Avoid costly, protracted litigation
- Opportunity for amicable resolution and recognition of State and Tribal sovereignty.

State/Tribal Water Consultation & Resolution

Building Cooperation to Avoid Future Conflict & Remove Uncertainties to Water Use

Supported by OCWP Technical Analyses:

- Recognized in Excess/Surplus Water calculation:
  - "...exclude from consideration for any permit for out-of-basin use... the quantity of water adjudicated or agreed by cooperative agreement or compact to be reserved for Federal or Tribal rights"

State/Tribal Water Consultation & Resolution

Building Cooperation to Avoid Future Conflict & Remove Uncertainties to Water Use

Implementation:

- To be established by Oklahoma Governor and State Legislature.

Cost:

- To be determined by Oklahoma Governor and State Legislature.

Excess & Surplus Water

Protecting Local Water Needs While Addressing Statewide Demands

SUGGESTED DEFINITION:

The OWRB adopts the following definition and procedure for determining excess and surplus water for inclusion in the OCWP update:

'Excess and surplus water' means the projected surface water available for new permits in 2060, less an in-basin reserve amount, for each of the 82 basins as set forth in the 2012 OCWP Watershed Planning Region Reports; provided that nothing in this definition is intended to affect ownership rights to groundwater and that groundwater is not considered excess and surplus water.

Excess & Surplus Water

Protecting Local Water Needs While Addressing Statewide Demands

SUGGESTED PROCEDURE:

1) *Each of the 82 OCWP watershed planning basins shall be considered an individual stream system wherein water originates (i.e., area of origin) for purposes of appropriation and permitting.*
2) *The total annual amount of available stream water for new permits in 2060 is equal to the total Surface Water Permit Availability amount as set forth in the OCWP Watershed Planning Region Reports minus the amount of the annual Anticipated Surface Water Permits in 2060 also set forth in those reports. The in-basin reserve amount is equal to 10% of the total Surface Water Permit Availability amount plus 10% of the annual Anticipated Surface Water Permits in 2060…*

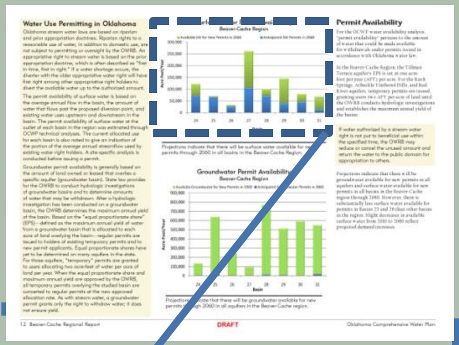
Excess & Surplus Water

Protecting Local Water Needs While Addressing Statewide Demands

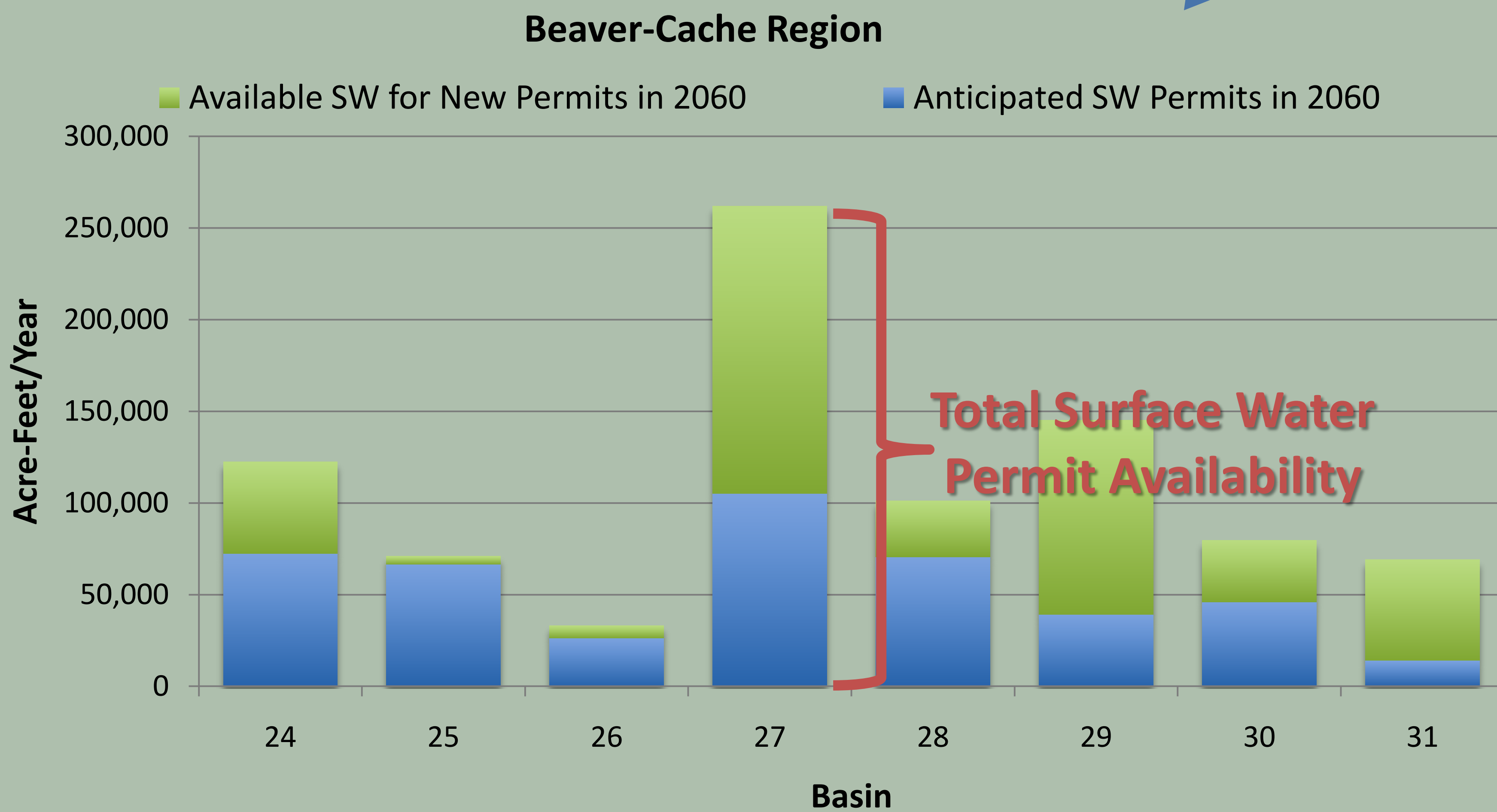
SUGGESTED PROCEDURE:

3) *In considering individual applications for permits to transport and use more than 500 acre-feet of stream water per year outside the stream system wherein the water originates, the Board shall determine whether there is "unappropriated water available in the amount applied for" by considering only the remaining amount of excess and surplus water calculated for the stream system where the point of diversion is proposed, and for stream systems located downstream from this proposed point of diversion.*
4) *The Board will also exclude from consideration for any permit for out-of-basin use:*
   a) *the quantity of water adjudicated or agreed by cooperative agreement or compact to be reserved for Federal or Tribal rights, and*
   b) *the quantity of water reserved for instream or recreational flow needs established pursuant to law.*

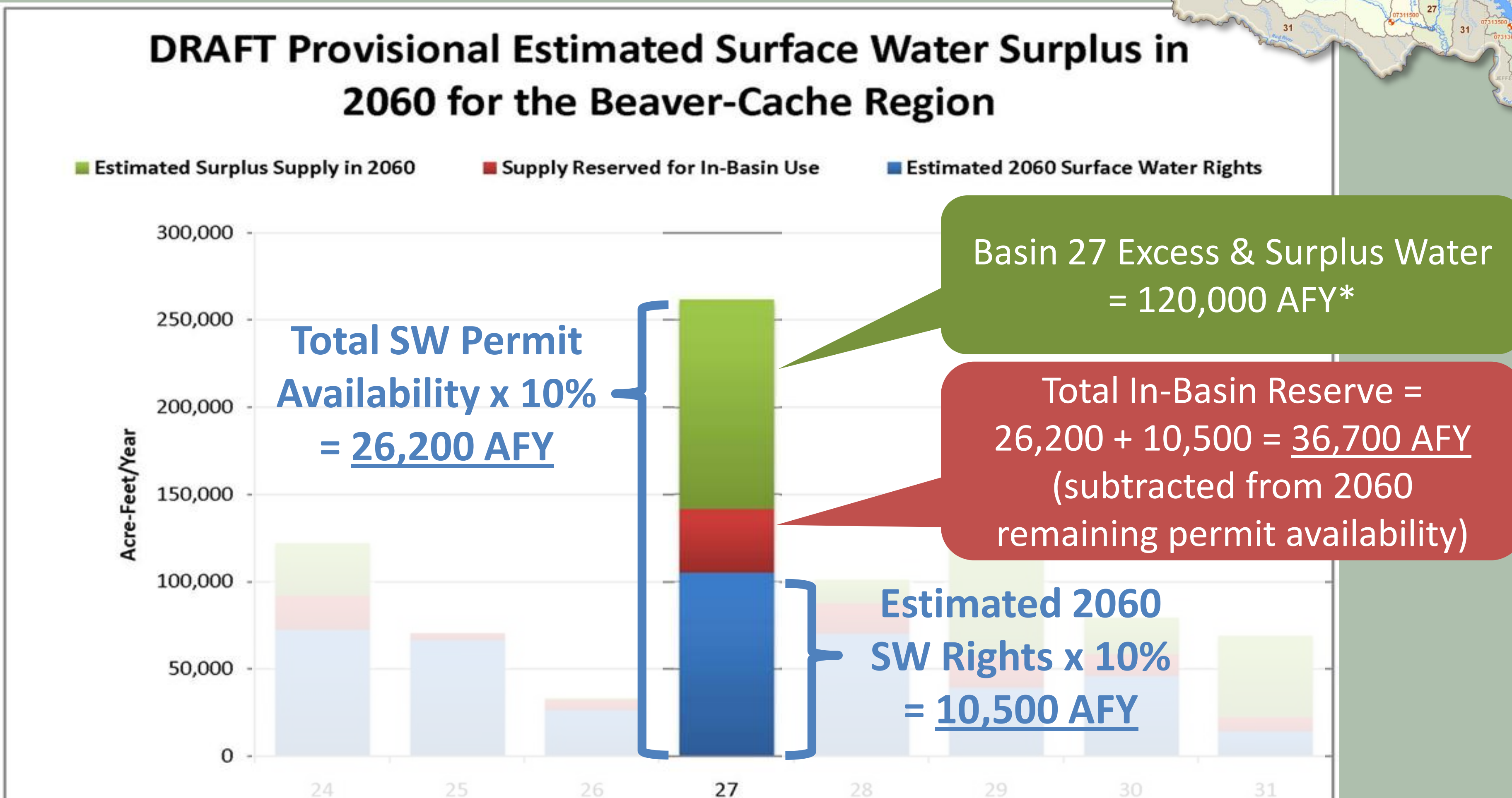
Calculating Surplus Water



Surface Water Permit Availability



Example
Calculating Surplus Water



*does not include potential federal/Tribal rights or instream flow requirements

Excess & Surplus Water
Protecting Local Water Needs While Addressing Statewide Demands

Justification:

- Definition and procedure required by OCWP statute to protect areas-of-origin.

Excess & Surplus Water
Protecting Local Water Needs While Addressing Statewide Demands

Supported by OCWP Technical Analyses:

- OCWP Excess/Surplus Water Assessment applied draft definition and procedure to supply/demand data collected for individual planning basins ("areas-of-origin").

Excess & Surplus Water
Protecting Local Water Needs While Addressing Statewide Demands

Implementation:

- Initial assessment and calculation completed.

Cost:

- Negligible; utilized data collected through OCWP technical analyses.

Regional Planning Groups

Addressing Regional Variability through Direct Local Input

SUGGESTED CONSOLIDATED RECOMMENDATION:

The OWRB should form a workgroup to investigate and make appropriate recommendations to the State Legislature related to the creation of at least 13 Regional Planning Groups to assist in planning and implementing OCWP initiatives at the regional level. These regional groups should consist of local stakeholders, as well as appropriate agency representatives, charged with developing regional water plans in a manner consistent with the OCWP and its implementation priorities. Such plans would include the identification of specific projects, studies, programs, research and other evaluations designed to address the unique needs and issues identified by Regional Planning Group participants. The State Legislature should establish regular appropriations to the OWRB to coordinate the activities of these groups.

Regional Planning Groups
Addressing Regional Variability through Direct Local Input

Justification:

- Included in 9 OCWP Recommendations.
- Facilitate OCWP implementation and establish groundwork for next OCWP update.
- Recognize unique regional characteristics and needs.
- Prioritize regional issues through regional water plans.
- Establish feedback mechanism between OWRB/stakeholders.
- Facilitate local outreach on water issues.

Regional Planning Groups
Addressing Regional Variability through Direct Local Input

Supported by OCWP Technical Analyses:

- Regional/basin delineations formed the basis of OCWP supply/demand studies and other technical analyses.
- Public input recognized the integral importance of regional citizen representation.

Regional Planning Groups
Addressing Regional Variability through Direct Local Input

Implementation:

- Continue momentum and local citizen/stakeholder relationships established through OCWP Update.
- Work with State Legislature/Joint Water Committee to draft legislation next session.
- Contemplates OWRB administration of and coordination with RPGs to "seed" local water planning projects.

***Estimated Cost = $2,000,000/year**

***based on Texas model**

Draft Priority Water Policy Recommendations for Implementation

"The Big 8"

- Water Quality & Quantity Monitoring
- State/Tribal Water Consultation and Resolution
- Instream (Environmental) Flows
- Water Supply Reliability
- Excess & Surplus Water
- Regional Planning Groups
- Water Project & Infrastructure Funding
- Water Efficiency & Reuse

Agenda 4B-3.

REVIEW AND DISCUSSION OF DRAFT SUPPORTING RECOMMENDATIONS

Draft Priority Water Policy Recommendations for Implementation

Supporting Recommendations & Initiatives

Identified by OCWP public input participants as those necessary to the future use, management and protection of Oklahoma's water resources.

- Interstate Water Issues
- Navigation
- Nonpoint Source Pollution
- Regionalization of Water Supply Systems
- Reservoir Maintenance & Development
- Source Water Protection
- Water Emergency & Drought Planning
- Water Supply Augmentation

Draft Priority Water Policy Recommendations for Implementation

Supporting Recommendations & Initiatives

Interstate Water Issues:

- Explore creation of standing planning committees with neighboring states to proactively address interstate conflicts and litigation.

Navigation:

- Continued collaboration between OWRB and ODOT Waterways Advisory Board to advance navigation interests.

Nonpoint Source Pollution:

- Advance voluntary BMPs, incentives and related programs to decrease NPS pollution.

Regionalization of Water Supply Systems:

- Develop a state plan to incentivize interconnections and shared water storage between water systems.

Draft Priority Water Policy Recommendations for Implementation

Supporting Recommendations & Initiatives

Reservoir Maintenance & Development:

- State and federal agencies should collaborate to maximize the benefits of existing reservoir projects and evaluate potential projects.

Source Water Protection:

- The State should provide technical assistance to public water systems for the development of source water and wellhead protection plans.

Water Emergency/Drought Planning:

- Update and expand the Oklahoma Drought Management Plan to improve response to all water-related emergencies.

Water Supply Augmentation:

- Investigate beneficial use of unconventional water sources (marginal quality waters, stormwater runoff, water produced through artificial aquifer recharge, etc.) and evaluate supply augmentation through programs to manage invasive plant species, increase water filtration and reduce runoff.

Draft Priority Water Policy Recommendations for Implementation

Supporting Recommendations & Initiatives Workgroup & Agency Submissions

Submitted by various OCWP workgroups and agencies commissioned to investigate specific water-related issues.

- Agricultural Water Research
- Climate & Weather Impacts on Water Management
- Water Quality Management

Draft Priority Water Policy Recommendations for Implementation

Workgroup & Agency Submissions

Agricultural Water Research:

- Agencies and tribal governments should continue to work collaboratively with the agriculture industry to support research, education and extension activities.

Climate & Weather Impacts on Water Management:

- Agencies and tribal governments should continue to collaborate with the Oklahoma Climatological Survey to advance the understanding of climate impacts on water use.

Water Quality Management:

- Agencies and tribal governments should continue to collaborate on and advance programs to improve water quality.

Draft Priority Water Policy Recommendations for Implementation

Supporting Recommendations & Initiatives

OWRB Recommendations

Submitted by the OWRB by virtue of its unique statutory authority and experience in managing Oklahoma's water resources.

- Water Management & Administration
- Water-Related Research
- Permit Condition Associated with Protecting Reservoir Yield and Defining Interference

Draft Priority Water Policy Recommendations for Implementation
OWRB Recommendations

Water Management & Administration:

- Various suggestions to improve water rights administration, groundwater protection, floodplain protection, and hazard mitigation.

Water-Related Research:

- Advance, coordinate, and prioritize state water research activities.

Permit Condition Associated with Protecting Reservoir Yield and Defining Interference:

- The OWRB should form a workgroup to investigate conditioning junior permits to discontinue water diversions during periods of probable interference.

Draft Priority Water Policy Recommendations for Implementation

Supporting Recommendations & Initiatives

Additional Issues for Consideration

Submitted by various OCWP workgroups and agencies commissioned to investigate specific water-related issues.

- Interstate Water Issues
- Interstate Water Sales
- Interagency Coordination
- General Conditions on Permits
- Riparian Rights to Reasonable Use
- Statewide Water Planning
- Water Dispute Resolution
- Water Emergency & Drought Planning
- Water Sales & Transfers
- Water Use Permitting

Draft Priority Water Policy Recommendations for Implementation

Additional Issues for Consideration

Interstate Water Issues:

- Investigate development of an interstate (Ogallala) groundwater compact.

Interstate Water Sales:

- Allocation of potential interstate water sale proceeds to a specified trust or authority, limiting uses to water infrastructure projects and OCWP water studies.

Interagency Coordination:

- The State should create an interagency water resources committee to improved coordination and communication.

General Conditions on Permits:

- Amend statute to provide express authority to the OWRB in imposing permit conditions and limitations.

Riparian Rights to Reasonable Use:

- Amend Constitution or statutes to resolve uncertainty of future use claims by riparian landowners.

Draft Priority Water Policy Recommendations for Implementation

Additional Issues for Consideration

Statewide Water Planning:

- Provide that each OCWP utilize a Town Hall or similar forum to review, discuss and frame proposed water policy as well as the Governor's Water Conference to exchange OCWP-related information.

Water Dispute Resolution:

- The OWRB and other state agencies should establish a formal alternative dispute resolution program.

Water Emergency/Drought Planning:

- The OCWP should include a transparent process for regional prioritization of water uses during emergencies.

Water Sales & Transfers:

- The OWRB should require recipients of an intra- or interstate water transfer to submit a water conservation plan that protects the basin of origin.

Water Use Permitting:

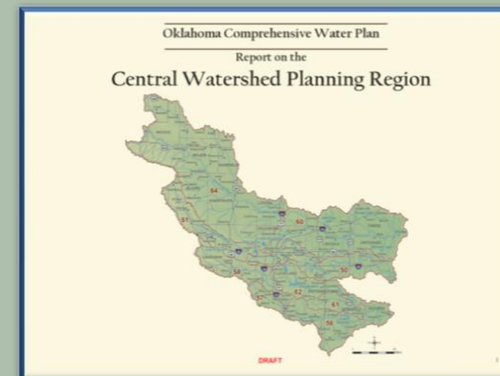
- The use of mining (pit) water should be subject to the OWRB's water rights administration procedures.

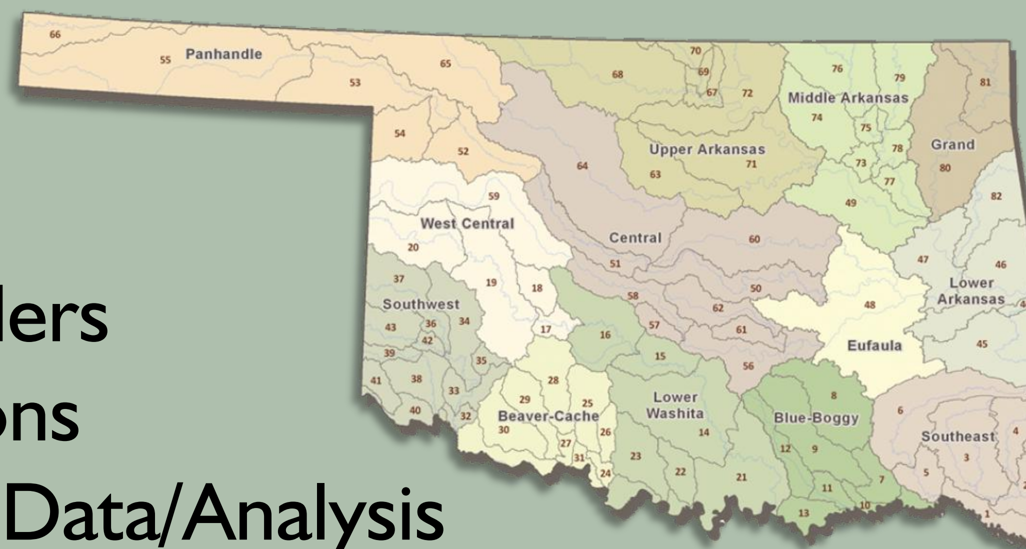
Agenda 4B-4.

PRESENTATION AND DISCUSSION OF 13 DRAFT WATERSHED PLANNING REGION REPORTS

Watershed Planning Region Reports

- Introduction (Regional Overview)
- Regional Summary
- Water Supply:
  - Physical Water Availability
  - Permit Availability
  - Water Quality
- Water Demand
- Public Water Providers
- Water Supply Options
- Basin Summaries & Data/Analysis





Oklahoma Comprehensive Water Plan

Report on the

Central Watershed Planning Region

Introduction

Contents

Introduction

The Oklahoma Comprehensive Water Plan (OCWP) was originally developed in 1980 and last updated in 1995. With the specific objective of establishing a reliable supply of water for state users throughout at least the next 50 years, the current update represents the most ambitious and intensive water planning effort ever undertaken by the state. The 2012 OCWP Update is guided by two ultimate goals:

1. Provide safe and dependable water supply for all Oklahomans while improving the economy and protecting the environment.
2. Provide information so that water providers, policy makers, and water users can make informed decisions concerning the use and management of Oklahoma's water resources.

In accordance with the goals, the 2012 OCWP Update has been developed under an innovative parallel-path approach: inclusive and dynamic public participation to build sound water policy complemented by detailed technical evaluations.

> The primary factors in the determination of reliable future water supplies are physical supplies, water rights, water quality, and infrastructure. Gaps and depletions occur when demand exceeds supply, and can be attributed to physical supply, water rights, infrastructure, or water quality constraints.

Also unique to this update are studies conducted according to specific geographic boundaries (watersheds) rather than political boundaries (counties). This new strategy involved subdividing the state into 82 surface water basins for water supply availability analysis (see the OCWP Physical Water Supply Availability Report). Existing watershed boundaries were revised to include a United States Geological Survey (USGS) stream gage at or near the basin outlet (downstream boundary), where practical. To facilitate consideration of regional supply challenges and potential solutions, basins were aggregated into 13 distinct Watershed Planning Regions.

This Watershed Planning Region Report, one of 13 such documents prepared for the 2012 OCWP Update, presents elements of technical studies pertinent to the Central Region. Each regional report presents information from both a regional and multiple basin perspective, including water supply/demand analysis results, forecasted water supply shortages, potential supply solutions and alternatives, and supporting technical information.

> As a key foundation of OCWP technical work, a computer-based analysis tool, "Oklahoma H2O," was created to compare projected demands with physical supplies for each basin to identify areas of potential water shortages.

Integral to the development of these reports was the Oklahoma H2O model, a sophisticated database and geographic information system (GIS) based analysis tool created to compare projected water demand to physical supplies in each of the 82 OCWP basins statewide. Recognizing that water planning is not a static process but rather a dynamic one, this versatile tool can be updated over time as new supply and demand data become available, and can be used to evaluate a variety of "what-if" scenarios at the basin level, such as a change in supply sources, demand, new reservoirs, and various other policy management scenarios.

Primary inputs to the model include demand projections for each decade through 2060, founded on widely-accepted methods and peer review of inputs and results by state and federal agency staff, industry representatives, and stakeholder groups for each demand sector. Surface water supply data for each of the 82 basins used 58 years of publicly-available daily streamflow gage data collected by the USGS. Groundwater resources were characterized using previously-developed assessments of groundwater aquifer storage and recharge rates.

Additional information gained during the development of the 2012 Update is provided in various OCWP supplemental reports. Assessments of statewide physical water availability and potential shortages are documented in the OCWP Physical Water Supply Availability Report. Statewide water demand projection methods and results are presented in the Water Demand Forecast Report. Permitting availability was evaluated based on the OWRB's administrative protocol and documented in the Water Supply Permit Availability Report. All supporting documentation can be found on the OWRB's website.

Regional Overview

The Central Watershed Planning Region includes nine basins (for reference, numbered 50, 51, 56-58, 60-62, and 64). The region is located in the Central Lowland physiography province, encompassing 10,142 square miles in central Oklahoma, spanning from southern Woods County to Hughes and Pontotoc Counties in the southeastern portion of the region and including all or portions of Alfalfa, Woodward, Garfield, Major, Kingfisher, Logan, Blaine, Dewey, Creek, Lincoln, Okmulgee, Canadian, Oklahoma, Okfuskee, Caddo, Seminole, Pottawatomie, Grady, Cleveland, McClain, and Garvin Counties.

The region displays many of the physical diversities of the state. The extremes range from the metropolitan areas of Oklahoma City in Oklahoma County to the more forested areas of the southeast, the open farmland in the central and western areas, and the sand hills in the western portion of the region.

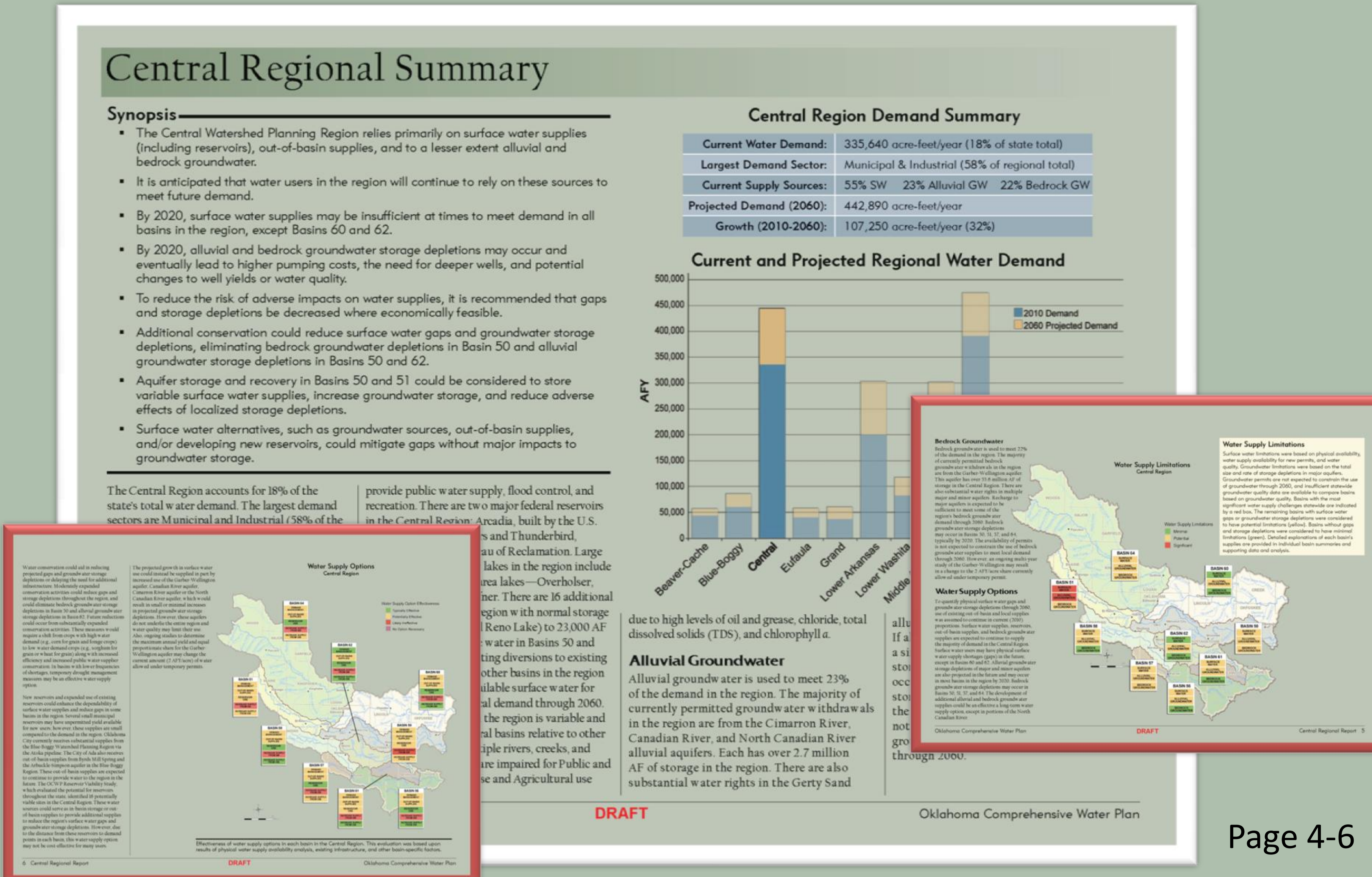
The region's climate is moist and sub-humid with the mean annual temperature ranging from 59°F to 62°F. Annual average precipitation ranges from 26 inches in the northwest to 46 inches in the southeastern corner. Annual lake evaporation ranges from 50 to 62 inches and exceeds precipitation. Frequent droughts cause severe crop damage while severe flooding also occurs as the result of concentrated areas of heavy precipitation. Thunderstorms accompanied by high winds, hail, and heavy rain increase the likelihood of flash flooding, emphasizing the necessity of watershed protection and flood prevention projects.

The largest cities in the region include Oklahoma City (2010 population of 501,450), Norman (109,865), Edmond (79,562), Midwest City (56,886), and Moore (52,621). The greatest demand is from Municipal and Industrial water use.

By 2060, this region is projected to have a total demand of 442,890 acre-feet per year (AFY), an increase of approximately 107,250 AFY (32%) from 2010.

Page 3

Regional Summary



Central Regional Summary

Synopsis

- The Central Watershed Planning Region relies primarily on surface water supplies (including reservoirs), out-of-basin supplies, and to a lesser extent alluvial and bedrock groundwater.
- It is anticipated that water users in the region will continue to rely on these sources to meet future demand.
- By 2020, surface water supplies may be insufficient at times to meet demand in all basins in the region, except Basins 60 and 62.
- By 2020, alluvial and bedrock groundwater storage depletions may occur and eventually lead to higher pumping costs, the need for deeper wells, and potential changes to well yields or water quality.
- To reduce the risk of adverse impacts on water supplies, it is recommended that gaps and storage depletions be decreased where economically feasible.
- Additional conservation could reduce surface water gaps and groundwater storage depletions, eliminating bedrock groundwater depletions in Basin 50 and alluvial groundwater storage depletions in Basins 50 and 62.
- Aquifer storage and recovery in Basins 50 and 51 could be considered to store variable surface water supplies, increase groundwater storage, and reduce adverse effects of localized storage depletions.
- Surface water alternatives, such as groundwater sources, out-of-basin supplies, and/or developing new reservoirs, could mitigate gaps without major impacts to groundwater storage.

Central Region Demand Summary

Current Water Demand:	335,640 acre-feet/year (18% of state total)
Largest Demand Sector:	Municipal & Industrial (58% of regional total)
Current Supply Sources:	55% SW 23% Alluvial GW 22% Bedrock GW
Projected Demand (2060):	442,890 acre-feet/year
Growth (2010-2060):	107,250 acre-feet/year (32%)

Current and Projected Regional Water Demand

The Central Region accounts for 18% of the state's total water demand. The largest demand sectors are Municipal and Industrial (58% of the

provide public water supply, flood control, and recreation. There are two major federal reservoirs in the Central Region: Arcadia, built by the U.S. ...s and Thunderbird, ...au of Reclamation. Large ... lakes in the region include ...rea lakes—Overholser, ...ner. There are 16 additional ...egion with normal storage ...l Reno Lake) to 23,000 AF ... water in Basins 50 and ...ting diversions to existing ... other basins in the region ...ilable surface water for ...al demand through 2060. ... the region is variable and ...al basins relative to other ...iple rivers, creeks, and ...re impaired for Public and ...se and Agricultural use

due to high levels of oil and grease, chloride, total dissolved solids (TDS), and chlorophyll *a*.

Alluvial Groundwater

Alluvial groundwater is used to meet 23% of the demand in the region. The majority of currently permitted groundwater withdrawals in the region are from the Cimarron River, Canadian River, and North Canadian River alluvial aquifers. Each has over 2.7 million AF of storage in the region. There are also substantial water rights in the Gerty Sand

... through 2060.

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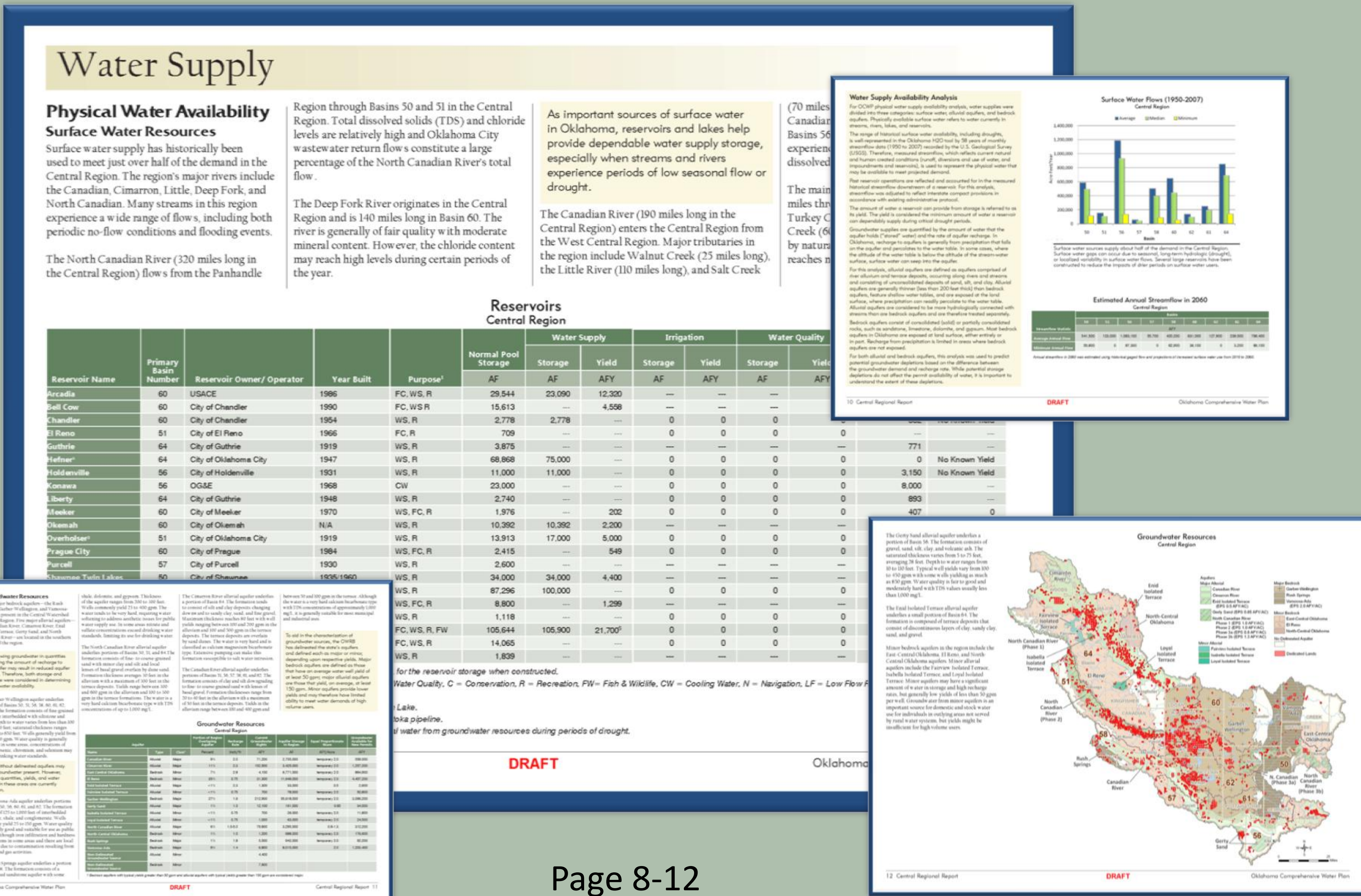
Physical Water Availability



Water Supply

Physical Water Availability

Surface Water Resources

Surface water supply has historically been used to meet just over half of the demand in the Central Region. The region's major rivers include the Canadian, Cimarron, Little, Deep Fork, and North Canadian. Many streams in this region experience a wide range of flows, including both periodic no-flow conditions and flooding events.

The North Canadian River (320 miles long in the Central Region) flows from the Panhandle Region through Basins 50 and 51 in the Central Region. Total dissolved solids (TDS) and chloride levels are relatively high and Oklahoma City wastewater return flows constitute a large percentage of the North Canadian River's total flow.

The Deep Fork River originates in the Central Region and is 140 miles long in Basin 60. The river is generally of fair quality with moderate mineral content. However, the chloride content may reach high levels during certain periods of the year.

As important sources of surface water in Oklahoma, reservoirs and lakes help provide dependable water supply storage, especially when streams and rivers experience periods of low seasonal flow or drought.

The Canadian River (190 miles long in the Central Region) enters the Central Region from the West Central Region. Major tributaries in the region include Walnut Creek (25 miles long), the Little River (110 miles long), and Salt Creek

Reservoirs
Central Region

Reservoir Name	Primary Basin Number	Reservoir Owner/ Operator	Year Built	Purpose[1]	Normal Pool Storage AF	Water Supply Storage AF	Water Supply Yield AFY	Irrigation Storage AF	Irrigation Yield AFY	Water Quality Storage AF	Water Quality Yield AFY		
Arcadia	60	USACE	1986	FC, WS, R	29,544	23,090	12,320	—	—	—			
Bell Cow	60	City of Chandler	1990	FC, WS R	15,613	—	4,558	—	—	—			
Chandler	60	City of Chandler	1954	WS, R	2,778	2,778	—	0	0	0			
El Reno	51	City of El Reno	1966	FC, R	709	—	—	0	0	0	0		
Guthrie	64	City of Guthrie	1919	WS, R	3,875	—	—	—	—	—	—	771	—
Hefner[2]	64	City of Oklahoma City	1947	WS, R	68,868	75,000	—	0	0	0	0	0	No Known Yield
Holdenville	56	City of Holdenville	1931	WS, R	11,000	11,000	—	0	0	0	0	3,150	No Known Yield
Konawa	56	OG&E	1968	CW	23,000	—	—	0	0	0	0	8,000	—
Liberty	64	City of Guthrie	1948	WS, R	2,740	—	—	0	0	0	0	893	—
Meeker	60	City of Meeker	1970	WS, FC, R	1,976	—	202	0	0	0	0	407	0
Okemah	60	City of Okemah	N/A	WS, R	10,392	10,392	2,200	—	—	—	—		
Overholser[2]	51	City of Oklahoma City	1919	WS, R	13,913	17,000	5,000	0	0	0	0		
Prague City	60	City of Prague	1984	WS, FC, R	2,415	—	549	0	0	0	0		
Purcell	57	City of Purcell	1930	WS, R	2,600	—	—	—	—	—	—		
Shawnee Twin Lakes	50	City of Shawnee	1935/1960	WS, R	34,000	34,000	4,400	—	—	—	—		
				WS, R	87,296	100,000	—	0	0	0	0		
				WS, FC, R	8,800	—	1,299	—	—	—	—		
				WS, R	1,118	—	—	0	0	0	0		
				FC, WS, R, FW	105,644	105,900	21,700[5]	0	0	0	0		
				FC, WS, R	14,065	—	—	0	0	0	0		
				WS, R	1,839	—	—	—	—	—	—		

for the reservoir storage when constructed.
Water Quality, C = Conservation, R = Recreation, FW= Fish & Wildlife, CW = Cooling Water, N = Navigation, LF = Low Flow
Lake.
toka pipeline.
l water from groundwater resources during periods of drought.

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Permitting (Legal) Availability

Permit Availability

For the OCWP water availability analysis, "permit availability" pertains to the amount of water that could be made available for withdrawals under permits issued in accordance with Oklahoma water law.

If water authorized by a stream water right is not put to beneficial use within the specified time, the OWRB may reduce or cancel the unused amount and return the water to the public domain for appropriation to others.

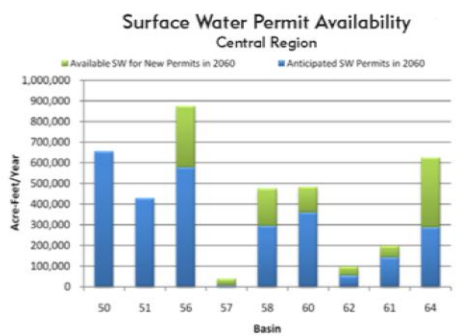
Projections indicate that there will be no surface water available for new permits in Basins 50 and 51, but surface water will be available for new permits through 2060 in all other basins in the Central Region. For groundwater, equal proportionate shares in the Central Region range from 0.5 acre-feet per year (AFY) per acre to 2 AFY per acre.

Water Use Permitting in Oklahoma

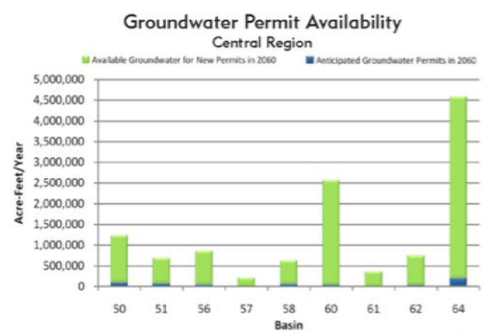
Oklahoma stream water laws are based on riparian and prior appropriation doctrines. Riparian rights to a reasonable use of water, in addition to domestic use, are not subject to permitting or oversight by the OWRB. An appropriative right to stream water is based on the prior appropriation doctrine, which is often described as "first in time, first in right." If a water shortage occurs, the diverter with the older appropriative water right will have first right among other appropriative right holders to divert the available water up to the authorized amount.

The permit availability of surface water is based on the average annual flow in the basin, the amount of water that flows past the proposed diversion point, and existing water uses upstream and downstream in the basin. The permit availability of surface water at the outlet of each basin in the region was estimated through OCWP technical analyses. The current allocated use for each basin is also noted to give an indication of the portion of the average annual streamflow used by existing water right holders. A site-specific analysis is conducted before issuing a permit.

Groundwater permit availability is generally based on the amount of land owned or leased that overlies a specific aquifer (groundwater basin). State law provides for the OWRB to conduct hydrologic investigations of groundwater basins and to determine amounts of water that may be withdrawn. After a hydrologic investigation has been conducted on a groundwater basin, the OWRB determines the maximum annual yield of the basin. Based on the "equal proportionate share"—defined as the maximum annual yield of water from a groundwater basin that is allocated to each acre of land overlying the basin—regular permits are issued to holders of existing temporary permits and to new permit applicants. Equal proportionate shares have yet to be determined on many aquifers in the state. For those aquifers, "temporary" permits are granted to users allocating two acre-feet of water per acre of land per year. When the equal proportionate share and maximum annual yield are approved by the OWRB, all temporary permits overlying the studied basin are converted to regular permits at the new approved allocation rate. As with stream water, a groundwater permit grants only the right to withdraw water; it does not ensure yield.



There is no surface water available for new permits in Basins 50 and 51, but projections indicate that there will be surface water available for new permits through 2060 in all other basins in the Central Region. Water users throughout the region need to consider the rights of existing major reservoirs.



Projections indicate that the use of groundwater to meet in-basin demand is not expected to be limited by the availability of permits through 2060 in the Central Region.

Characterization of Water Quality

Water Quality

Water quality of the Central Watershed Planning Region is defined by numerous minor and major water supply reservoirs and the middle Cimarron and lower Canadian River watersheds. The area is co-dominated by two ecoregions, the Central Great Plains (CGP) to the west and the Cross Timbers (CT) to the east. Several additional ecoregions intersect the periphery of the planning region, but their impact is minimal and they will not be addressed in this discussion.

The western half of the planning region is characterized by the Prairie Tablelands and several other intervening CGP ecoregions, the Pleistocene Sand Dunes/Sandsage Grassland, and Gypsum Hills. The Cimarron and North Canadian Rivers drain the area from northwest to southeast, and the Canadian River intersects the area in the south. The Prairie Tablelands are nearly level, underlain by shale, sandstone, and siltstone. They are dominated by cropland with dense mixed grass prairies. Streams are typically turbid and silt-dominated with some sand, lying in broad, shallow, low gradient channels with highly incised banks. The tributaries of the major rivers best exemplify water quality in the tablelands. These include Buggy Creek along the Canadian, and from west to east on the Cimarron, Eagle Chief, Turkey, Kingfisher, and Cottonwood Creeks. Salinity is high throughout the watersheds. Mean conductivities range from 1,029 µS/cm on Cottonwood Creek to near 2,300 µS/cm on Kingfisher Creek, while Buggy Creek is 1,100 µS/cm. Nutrient concentrations are also high. Mean concentrations of total phosphorus (TP) and total nitrogen (TN) range from 0.18 and 2.05 ppm on Kingfisher Creek to 0.98 and 4.08 ppm on Cottonwood Creek. Buggy Creek is similar with mean TP and TN of 0.38 and 2.0 ppm. Water clarity is poor to very poor, with mean turbidity ranging from 65 NTU on Eagle Chief Creek to 184 NTU on Cottonwood Creek; Buggy Creek is 160 NTU. Ecological diversity is average and highly impacted by siltation/sedimentation, habitat degradation, and channelization.

Lake Trophic Status

A lake's trophic state, essentially a measure of its biological productivity, is a major determinant of water quality.

Oligotrophic: Low primary productivity and/or low nutrient levels.

Mesotrophic: Moderate primary productivity with moderate nutrient levels.

Eutrophic: High primary productivity and nutrient rich.

Hypereutrophic: Excessive primary productivity and excessive nutrients.

Conversely, the Pleistocene Sand Dunes have more permeable sandy soils interlaced with springs and inter-dune wetlands. Streams have incised, highly erodible banks but are typically sandy. The northern and eastern banks of the major river systems are influenced heavily by the features and are typically sandier than many of their tributaries. The Cimarron and North Canadian best exemplify the area, as well as El Reno Lake in the North Canadian watershed. Salinity on the Cimarron is very high and steadily decreases from west to east. Near Waynoka, mean conductivity is nearly 29,000 µS/cm, but at Guthrie, it decreases to 8,730 µS/cm. Salinity on the North Canadian (including El Reno Lake) and Canadian is much lower with mean conductivities of 1,350-1,400 µS/cm. Nutrient concentrations increase steadily along the Cimarron. Near Waynoka, the river is mesotrophic, with low TP and TN mean concentrations of 0.05 and 0.69 ppm. The river gradually becomes eutrophic to hyper-eutrophic; at Guthrie, TP and TN increase to 0.36 and 1.95 ppm. The North Canadian and Canadian are also hyper-eutrophic, with TP ranging from 0.20-0.22 ppm and TN from 0.99-1.24 ppm. El Reno Lake is hyper-eutrophic and nitrogen-limited. Water clarity is excellent to average on the Cimarron with mean turbidity values of 6

The Central Planning Region is a transitional area between the Central Great Plains and Cross Timbers. Water quality is highly influenced by both geology and land use practices, and is generally poor to good depending on drainage and location.

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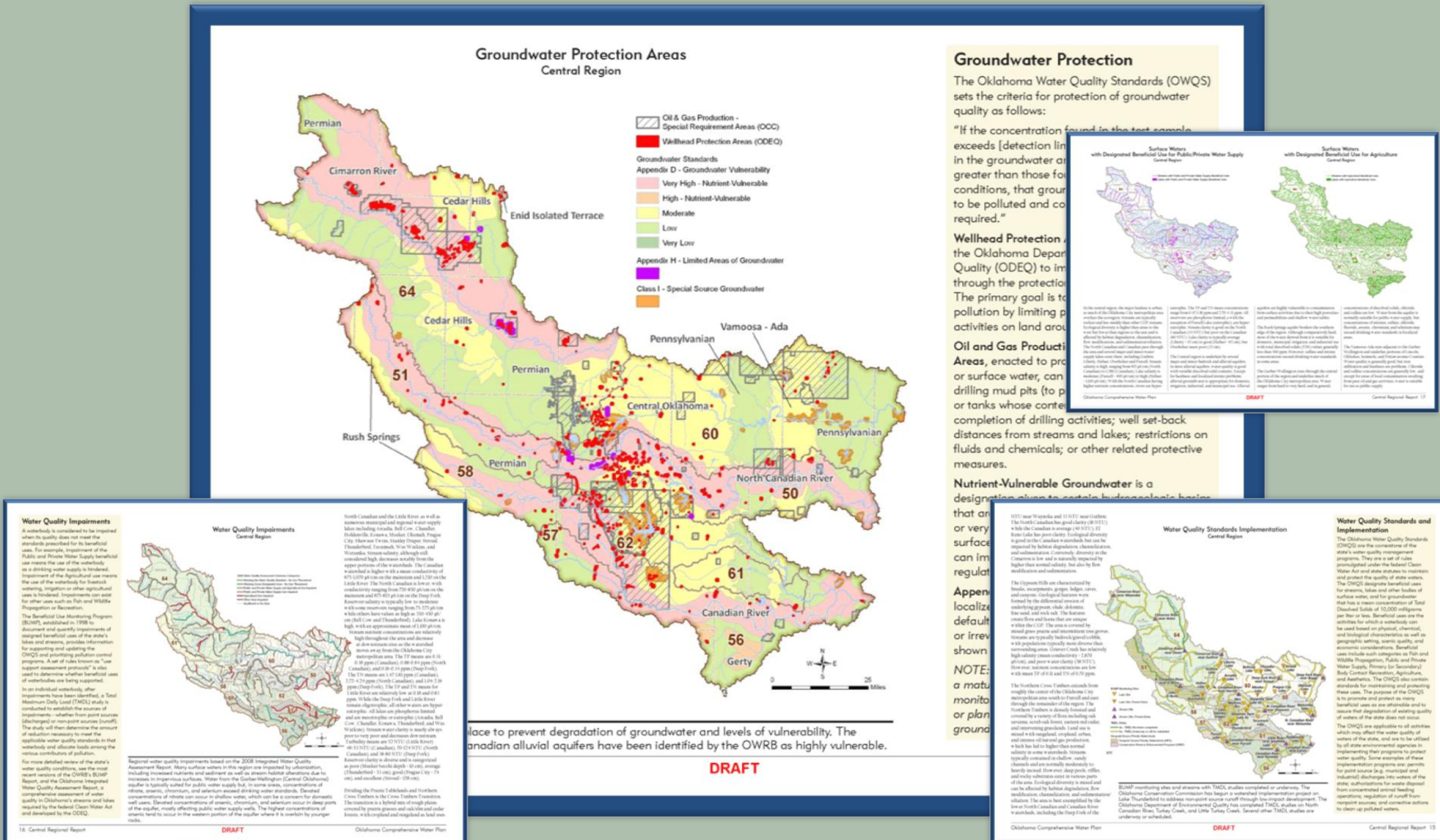
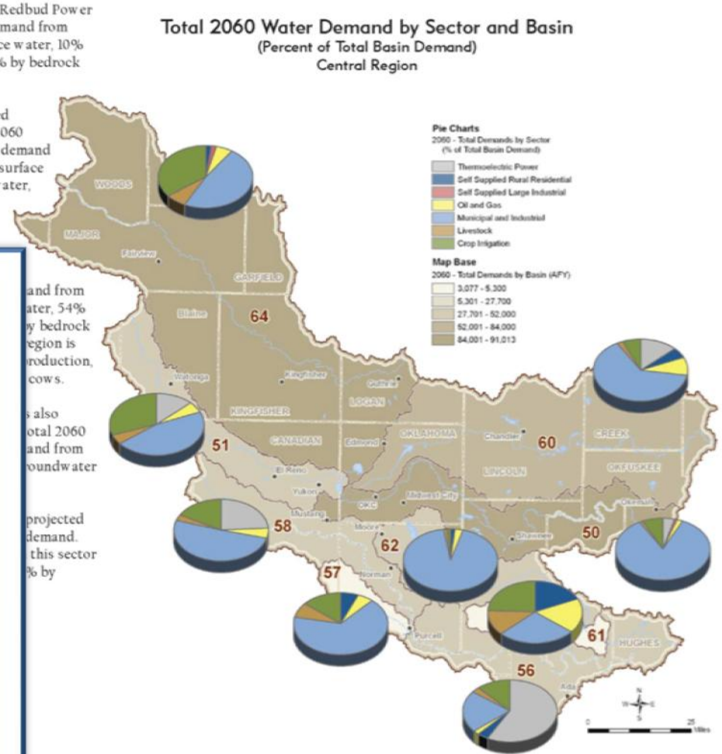
Water Quality Protections-Standards-Trends



Water Demand
Source-Sector thru 2060



Water Demand

The Central Region accounts for about 18% of the total statewide water demand. Regional demand will increase by 32% (107,250 AFY) from 2010 to 2060. Municipal and Industrial use will continue to be the largest demand sector.

By 2060, Municipal and Industrial (M&I) demand is projected to account for approximately 58% of the Central Region's total demand. Currently, 62% of the region's M&I demand is supplied by surface water, 12% by alluvial groundwater, and 26% by bedrock groundwater.

and InterGen North America's Redbud Power Plant. Currently, 89% of the demand from this sector is supplied by surface water, 10% by alluvial groundwater, and 1% by bedrock groundwater.

Oil and Gas demand is projected to account for 5% of the total 2060 demand. Currently, 68% of the demand from this sector is supplied by surface water, 12% by alluvial groundwater, and 20% by bedrock groundwater.

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Projected water demand by sector. Municipal and Industrial is expected to remain the largest demand sector in the region, accounting for 58% of the total regional demand in 2060.

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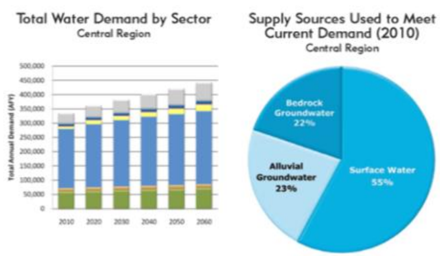

The Central Region's water needs account for about 18% of the total statewide demand. Regional demand will increase by 32% (107,250 AFY) from 2010 to 2060. Municipal and Industrial use will continue to be the largest demand sector.

Total Water Demand by Sector
Central Region

Planning Horizon	Crop Irrigation	Livestock	Municipal & Industrial	Oil & Gas	Self Supplied Industrial	Self Supplied Residential	Thermoelectric Power	Total
	AFY							
2010	58,100	13,850	208,390	7,100	2,420	8,680	37,100	335,640
2020	60,700	14,020	222,260	12,450	2,420	9,370	41,390	362,620
2030	63,290	14,190	233,370	12,900	2,510	9,990	46,180	382,430
2040	65,890	14,360	242,520	14,680	2,690	10,580	51,520	402,240
2050	67,880	14,530	249,970	17,240	2,870	11,140	57,470	421,100
2060	71,080	14,700	257,500	20,700	3,060	11,730	64,120	442,890

Water Demand

Water demand refers to the amount of water required to meet the needs of people, communities, industry, agriculture, and other users. Growth in water demand frequently corresponds to growth in population, agriculture, industry, or related economic activity. Demands have been projected from 2010 to 2060 in ten-year increments for seven distinct consumptive water demand sectors.

Water Demand Sectors

- **Thermoelectric Power:** Thermoelectric power producing plants, using both self-supplied water and municipal-supplied water, are included in the thermoelectric power sector.
- **Self Supplied Residential:** Households on private wells that are not connected to a public water supply system are included in the SSR sector.
- **Self Supplied Industrial:** Demands from large industries that do not directly depend upon a public water supply system. Available water use data and employment counts were included in this sector.
- **Oil and Gas:** Oil and gas drilling and exploration activities, excluding water used at oil and gas refineries (typically categorized as self supplied industrial use), are included in the oil and gas sector.
- **Municipal and Industrial:** These demands represent water that is provided by public water systems to homes, businesses, and industries throughout Oklahoma, excluding water supplied to thermoelectric power plants.
- **Livestock:** Livestock demands were evaluated by livestock group (beef, poultry, etc.) based on the 2007 Agriculture Census.
- **Crop Irrigation:** Water demands for crop irrigation were estimated using the 2007 Agriculture Census data for irrigated acres by crop type and county. Crop irrigation requirements were obtained primarily from the Natural Resource Conservation Service Irrigation Guide Reports.

OCWP demands were not projected for non-consumptive or instream water uses, such as hydroelectric power generation, fish and wildlife, recreation and instream flow maintenance. Projections, which were augmented through user/stakeholder input, are based on standard methods using data specific to each sector and planning basin.

Projections were initially developed for each county in the state, then allocated to each of the 82 basins. To provide regional context, demands were aggregated by Watershed Planning Region. Water shortages were calculated at the basin level to more accurately determine areas where shortages may occur. Therefore, gaps, depletions, and options are presented in detail in the Basin Summaries and subsequent sections. Future demand projections were developed independent of available supply, water quality, or infrastructure considerations. Impacts of climate change, increased efficiency, conservation, and non-consumptive uses, such as hydropower, are presented in supplemental OCWP reports.

Present and future demands were applied to supply source categories to facilitate an evaluation of potential surface water gaps and aquifer storage depletions at the basin level. For this baseline analysis, the proportion of each supply source used to meet future demands for each sector was held constant at the proportion established through current active water use permit allocations. For example, if the crop irrigation sector in a basin currently uses 80% bedrock groundwater, then 80% of that projected future demand is assumed to use bedrock groundwater. Existing out-of-basin supplies are represented as surface water supplies in the receiving basin and as demand on the source basin.

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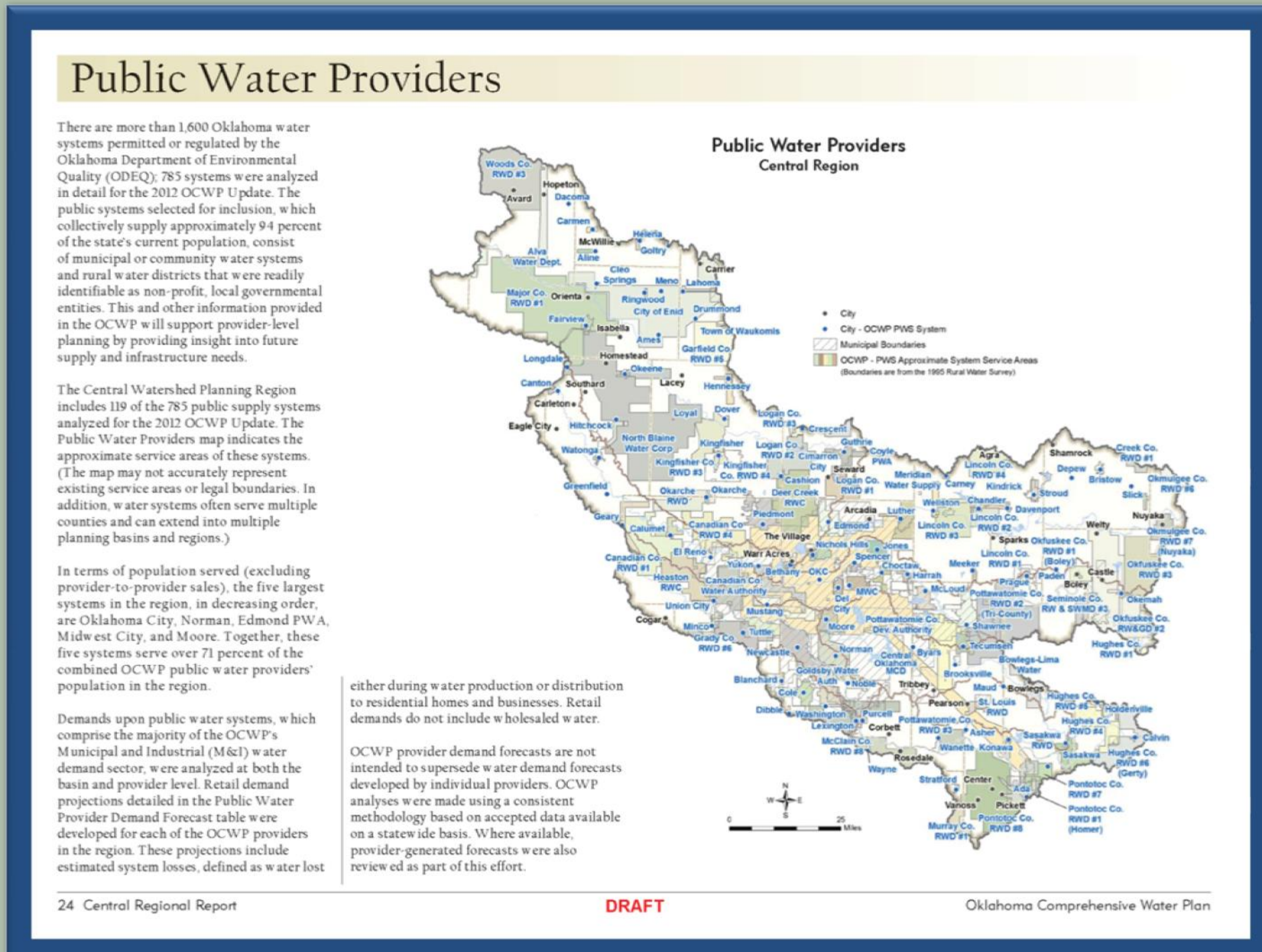
Public Water Providers

Customers-Demand Forecasts-Infrastructure Needs



Public Water Providers

There are more than 1,600 Oklahoma water systems permitted or regulated by the Oklahoma Department of Environmental Quality (ODEQ); 785 systems were analyzed in detail for the 2012 OCWP Update. The public systems selected for inclusion, which collectively supply approximately 94 percent of the state's current population, consist of municipal or community water systems and rural water districts that were readily identifiable as non-profit, local governmental entities. This and other information provided in the OCWP will support provider-level planning by providing insight into future supply and infrastructure needs.

The Central Watershed Planning Region includes 119 of the 785 public supply systems analyzed for the 2012 OCWP Update. The Public Water Providers map indicates the approximate service areas of these systems. (The map may not accurately represent existing service areas or legal boundaries. In addition, water systems often serve multiple counties and can extend into multiple planning basins and regions.)

In terms of population served (excluding provider-to-provider sales), the five largest systems in the region, in decreasing order, are Oklahoma City, Norman, Edmond PWA, Midwest City, and Moore. Together, these five systems serve over 71 percent of the combined OCWP public water providers' population in the region.

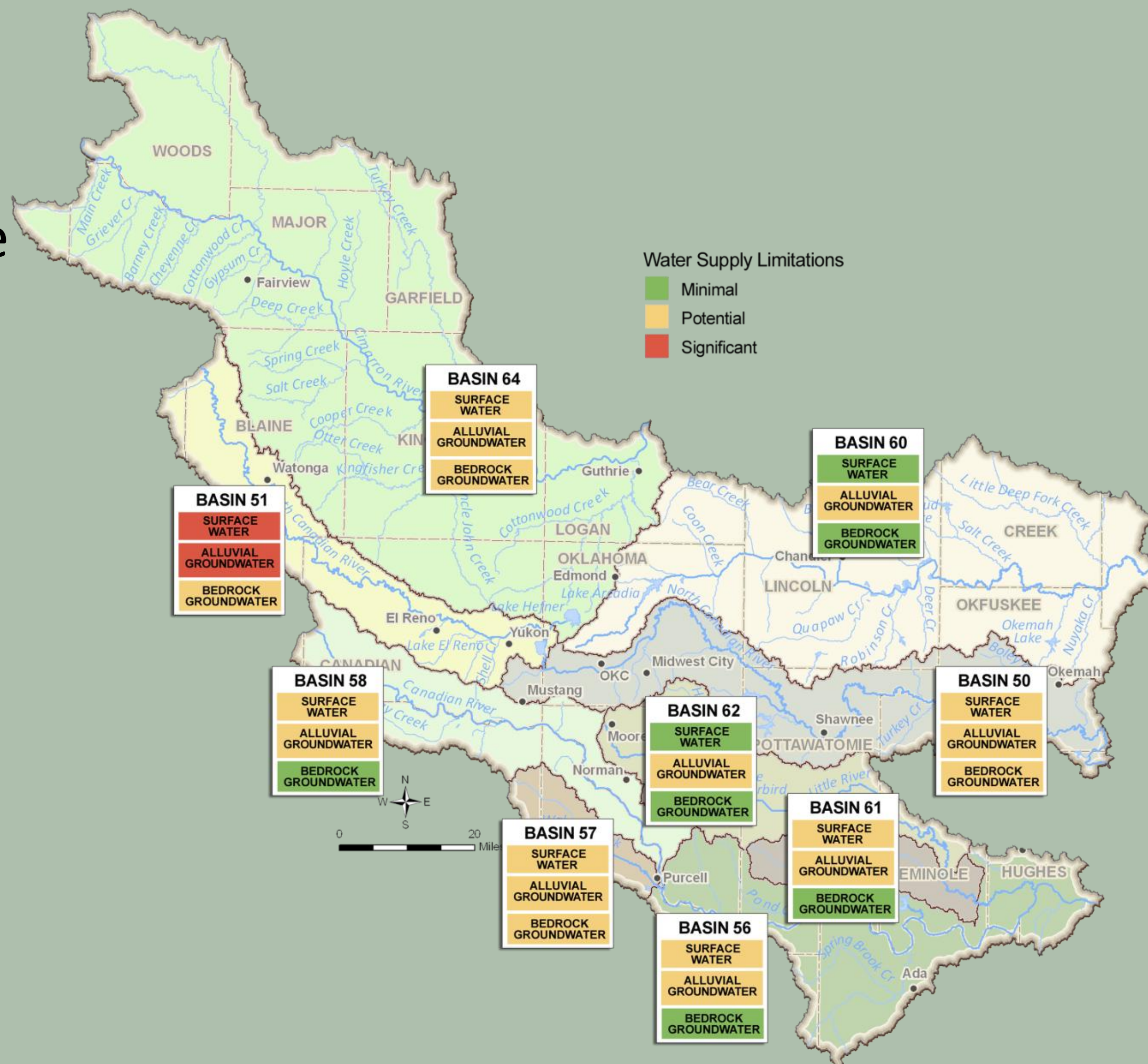
Demands upon public water systems, which comprise the majority of the OCWP's Municipal and Industrial (M&I) water demand sector, were analyzed at both the basin and provider level. Retail demand projections detailed in the Public Water Provider Demand Forecast table were developed for each of the OCWP providers in the region. These projections include estimated system losses, defined as water lost either during water production or distribution to residential homes and businesses. Retail demands do not include wholesaled water.

OCWP provider demand forecasts are not intended to supersede water demand forecasts developed by individual providers. OCWP analyses were made using a consistent methodology based on accepted data available on a statewide basis. Where available, provider-generated forecasts were also reviewed as part of this effort.

Water Supply Limitations & Options

Limitations Analysis:

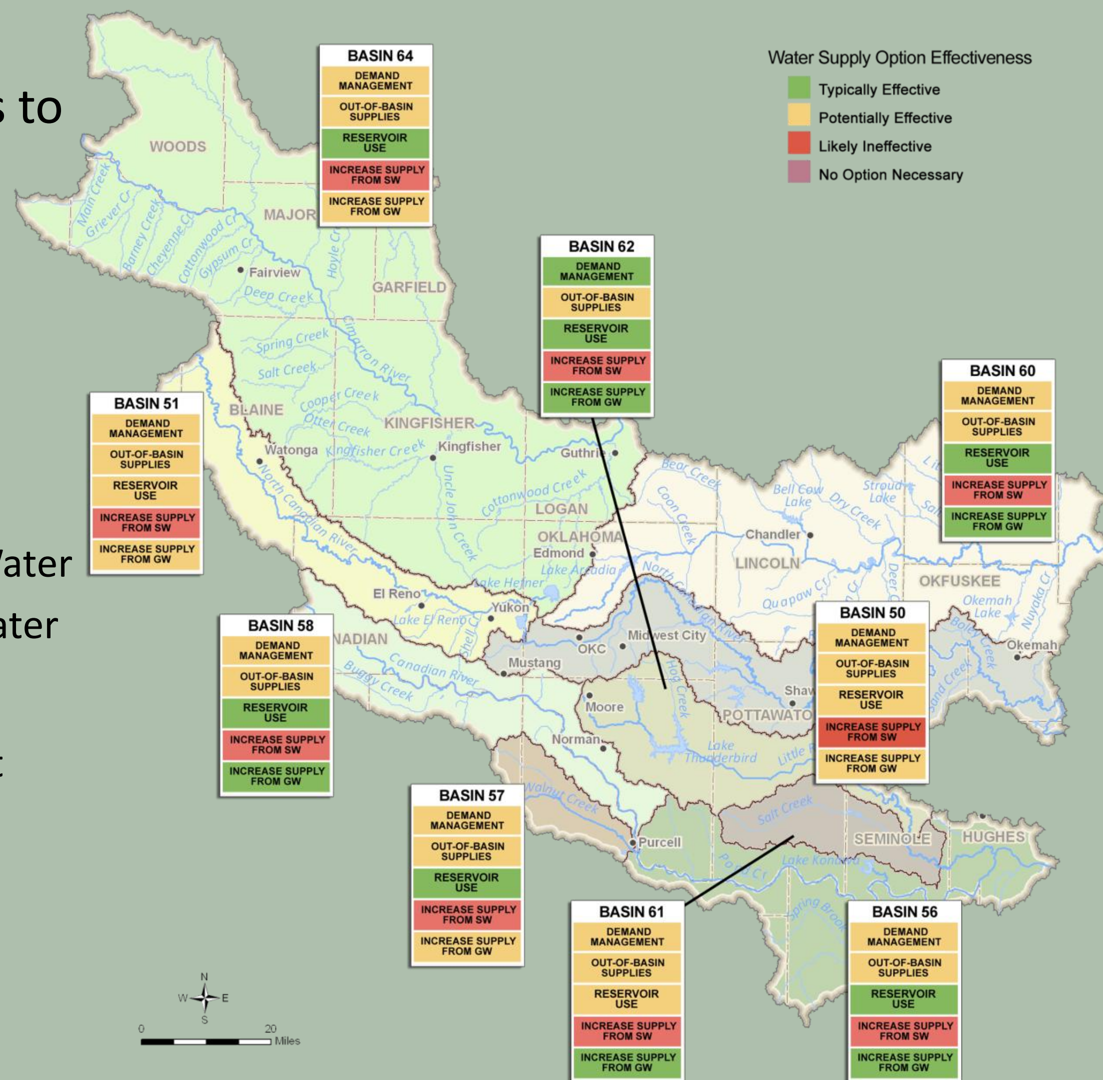
- Assessed factors limiting the use of the three major supply categories:
  - surface water
  - alluvial groundwater
  - bedrock groundwater



Water Supply Limitations & Options

Options Analysis:

- Assessed the ability of options to potentially mitigate identified water supply shortages
- Primary Options:
  - Demand Management
  - Out-of-Basin Supplies
  - Reservoir Use
  - Increasing Reliance on Surface Water
  - Increasing Reliance on Groundwater
- Additional Options:
  - Potential Reservoir Development
  - Water Conveyance System
  - Artificial Groundwater Recharge
  - Marginal Quality Water Sources



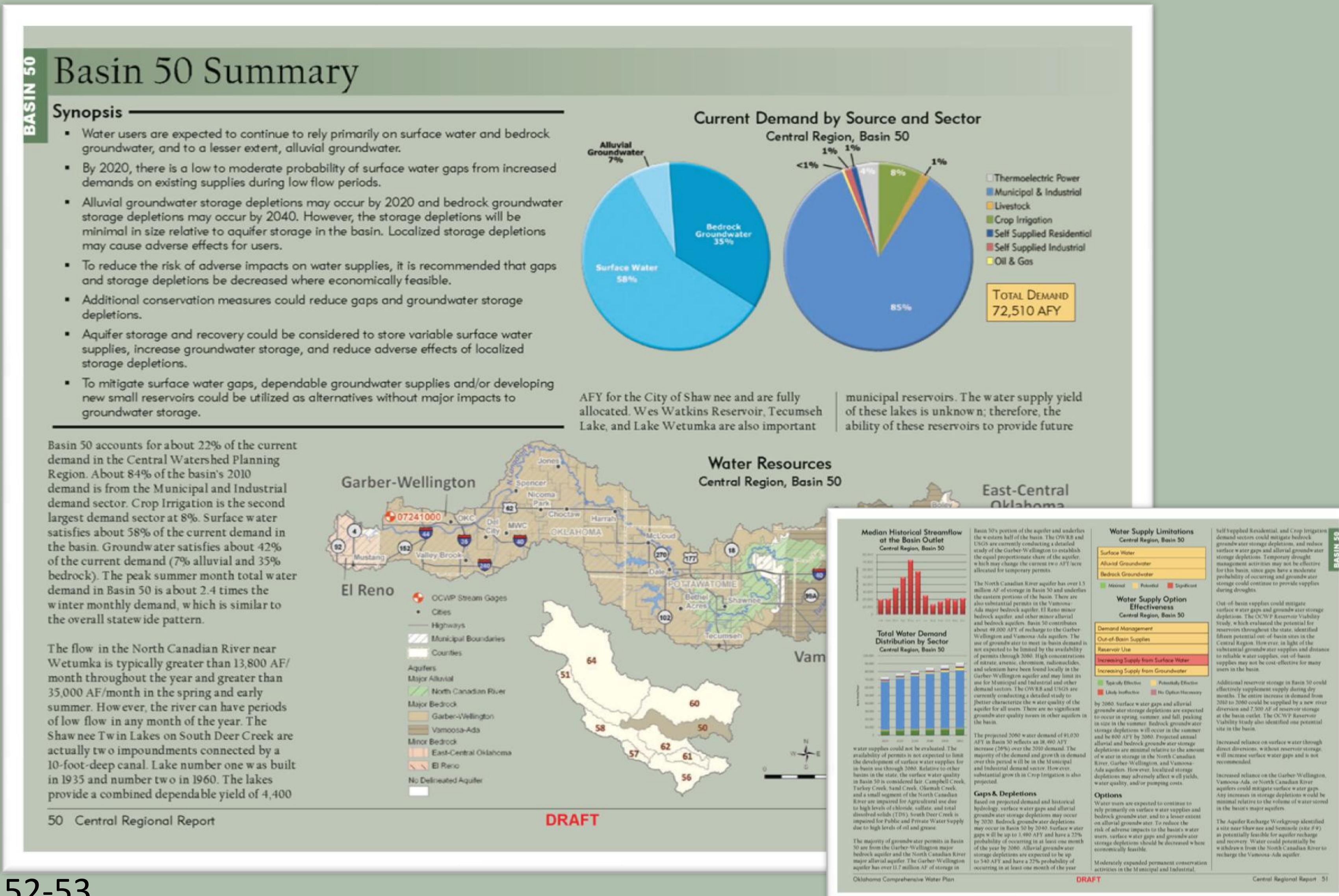
Oklahoma Comprehensive Water Plan

Data & Analysis

Central Watershed Planning Region

Basin 50

Basin Summary



BASIN 50

Basin 50 Summary

Synopsis

- Water users are expected to continue to rely primarily on surface water and bedrock groundwater, and to a lesser extent, alluvial groundwater.
- By 2020, there is a low to moderate probability of surface water gaps from increased demands on existing supplies during low flow periods.
- Alluvial groundwater storage depletions may occur by 2020 and bedrock groundwater storage depletions may occur by 2040. However, the storage depletions will be minimal in size relative to aquifer storage in the basin. Localized storage depletions may cause adverse effects for users.
- To reduce the risk of adverse impacts on water supplies, it is recommended that gaps and storage depletions be decreased where economically feasible.
- Additional conservation measures could reduce gaps and groundwater storage depletions.
- Aquifer storage and recovery could be considered to store variable surface water supplies, increase groundwater storage, and reduce adverse effects of localized storage depletions.
- To mitigate surface water gaps, dependable groundwater supplies and/or developing new small reservoirs could be utilized as alternatives without major impacts to groundwater storage.

Basin 50 accounts for about 22% of the current demand in the Central Watershed Planning Region. About 84% of the basin's 2010 demand is from the Municipal and Industrial demand sector. Crop Irrigation is the second largest demand sector at 8%. Surface water satisfies about 58% of the current demand in the basin. Groundwater satisfies about 42% of the current demand (7% alluvial and 35% bedrock). The peak summer month total water demand in Basin 50 is about 2.4 times the winter monthly demand, which is similar to the overall statewide pattern.

The flow in the North Canadian River near Wetumka is typically greater than 13,800 AF/month throughout the year and greater than 35,000 AF/month in the spring and early summer. However, the river can have periods of low flow in any month of the year. The Shawnee Twin Lakes on South Deer Creek are actually two impoundments connected by a 10-foot-deep canal. Lake number one was built in 1935 and number two in 1960. The lakes provide a combined dependable yield of 4,400 AFY for the City of Shawnee and are fully allocated. Wes Watkins Reservoir, Tecumseh Lake, and Lake Wetumka are also important municipal reservoirs. The water supply yield of these lakes is unknown; therefore, the ability of these reservoirs to provide future

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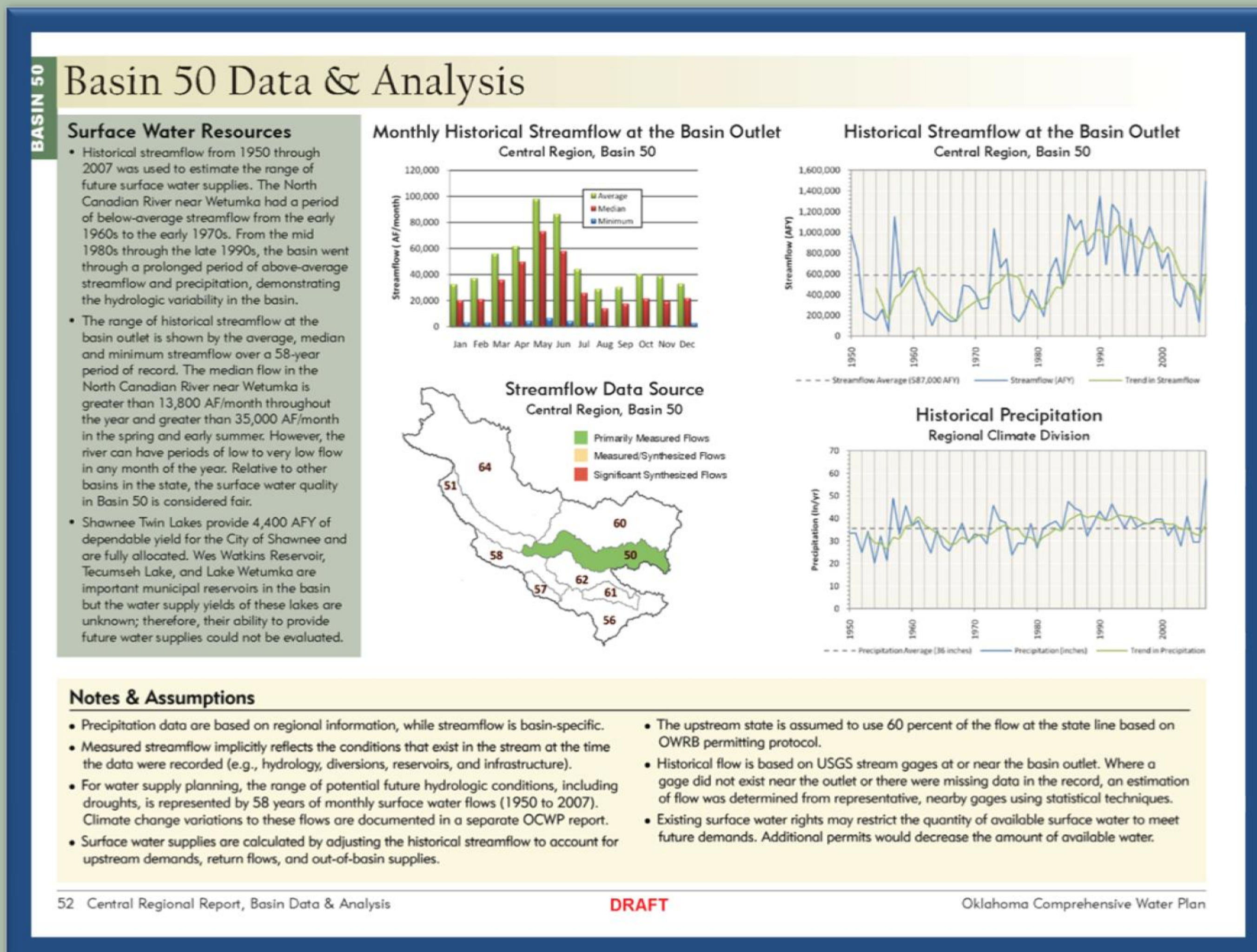
Historical/Monthly Precipitation & Streamflow



BASIN 50

Basin 50 Data & Analysis

Surface Water Resources

- Historical streamflow from 1950 through 2007 was used to estimate the range of future surface water supplies. The North Canadian River near Wetumka had a period of below-average streamflow from the early 1960s to the early 1970s. From the mid 1980s through the late 1990s, the basin went through a prolonged period of above-average streamflow and precipitation, demonstrating the hydrologic variability in the basin.
- The range of historical streamflow at the basin outlet is shown by the average, median and minimum streamflow over a 58-year period of record. The median flow in the North Canadian River near Wetumka is greater than 13,800 AF/month throughout the year and greater than 35,000 AF/month in the spring and early summer. However, the river can have periods of low to very low flow in any month of the year. Relative to other basins in the state, the surface water quality in Basin 50 is considered fair.
- Shawnee Twin Lakes provide 4,400 AFY of dependable yield for the City of Shawnee and are fully allocated. Wes Watkins Reservoir, Tecumseh Lake, and Lake Wetumka are important municipal reservoirs in the basin but the water supply yields of these lakes are unknown; therefore, their ability to provide future water supplies could not be evaluated.

Notes & Assumptions

- Precipitation data are based on regional information, while streamflow is basin-specific.
- Measured streamflow implicitly reflects the conditions that exist in the stream at the time the data were recorded (e.g., hydrology, diversions, reservoirs, and infrastructure).
- For water supply planning, the range of potential future hydrologic conditions, including droughts, is represented by 58 years of monthly surface water flows (1950 to 2007). Climate change variations to these flows are documented in a separate OCWP report.
- Surface water supplies are calculated by adjusting the historical streamflow to account for upstream demands, return flows, and out-of-basin supplies.
- The upstream state is assumed to use 60 percent of the flow at the state line based on OWRB permitting protocol.
- Historical flow is based on USGS stream gages at or near the basin outlet. Where a gage did not exist near the outlet or there were missing data in the record, an estimation of flow was determined from representative, nearby gages using statistical techniques.
- Existing surface water rights may restrict the quantity of available surface water to meet future demands. Additional permits would decrease the amount of available water.

Groundwater Supply Sources

Groundwater Resources - Aquifer Summary 2010

Central Region, Basin 50

Aquifer			Portion of Basin Overlaying Aquifer	Current Groundwater Rights	Aquifer Storage in Basin	Equal Proportionate Share	Groundwater Available for New Permits
Name	Type	Class[1]	Percent	AFY	AF	AFY/Acre	AFY
North Canadian River	Alluvial	Major	17%	17,100	1,541,000	1.0	100,500
East-Central Oklahoma	Bedrock	Minor	18%	300	1,892,000	temporary 2.0	242,700
El Reno	Bedrock	Minor	3%	6,100	100,000	temporary 2.0	36,300
Garber-Wellington	Bedrock	Major	52%	71,400	11,736,000	temporary 2.0	556,600
Vamoosa-Ada	Bedrock	Major	24%	2,600	2,632,000	2.0	313,500
Non-Delineated Groundwater Source	Bedrock	Minor	N/A	400	N/A	temporary 2.0	N/A
Non-Delineated Groundwater Source	Alluvial	Minor	N/A	400	N/A	temporary 2.0	N/A

1 Bedrock aquifers with typical yields greater than 50 gpm and alluvial aquifers with typical yields greater than 150 gpm are considered major.

Groundwater Resources

BASIN 50

- The majority of groundwater permits in Basin 50 are from the Garber-Wellington major bedrock aquifer and the North Canadian River major alluvial aquifer. The Garber-Wellington aquifer has over 11.7 million AF of storage in Basin 50's portion of the aquifer and underlies the western half of the basin. The OWRB and USGS are currently conducting a detailed study of the Garber-Wellington that will establish the equal proportionate share for the aquifer, which may change the amount of the current two AFY/acre allocated for temporary permits. The North Canadian River aquifer has over 1.5 million AF of storage in Basin 50 and underlies the eastern portion of the basin. There are also substantial permits in the Vamoosa-Ada major bedrock aquifer, El Reno minor bedrock aquifer, and other minor alluvial and bedrock aquifers. Basin 50 contributes about 49,000 AFY of recharge to the Garber-Wellington and Vamoosa-Ada aquifers.
- High concentrations of nitrate, arsenic, chromium, radionuclides, and selenium have been found locally in the Garber-Wellington aquifer and may limit its use for Municipal and Industrial and other demand sectors. The OWRB and USGS are currently conducting a detailed study to better characterize the water quality of the aquifer for all users. There are no significant groundwater quality issues in other aquifers in the basin.

Notes & Assumptions

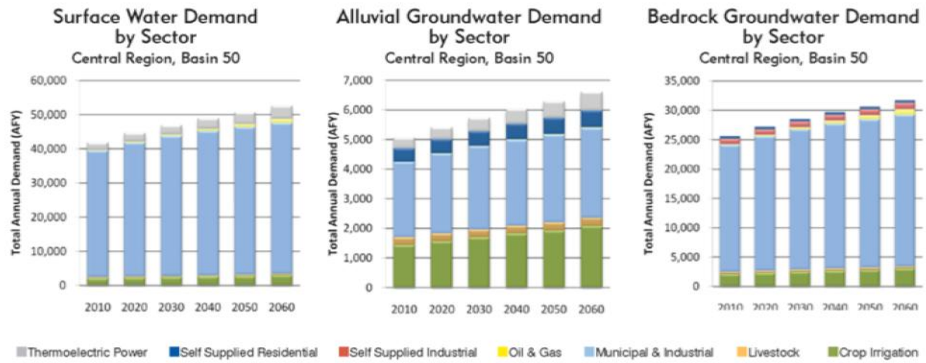
- Alluvial groundwater recharge is not considered separately from streamflow in physical supply availability analyses because any increases or decreases in alluvial groundwater recharge or storage would affect streamflow. Therefore, surface water flows are used to represent available alluvial groundwater recharge.
- Site-specific information on minor aquifers should be considered before large scale use. Suitability for long term supply is typically based on recharge, storage yield, capital and operational costs, and water quality.
- Groundwater permit availability is generally based on the amount of land owned or leased that overlies a specific aquifer.
- Temporary permit amounts are subject to change when the aquifer's equal proportionate share is set by the OWRB.
- Current groundwater rights represent the maximum allowable use. Actual use may be lower than the permitted amount.
- Bedrock groundwater recharge is the long-term annual average recharge to aquifers in the basin. Recharge rates on a county- or aquifer-wide level of detail were established from literature (published reports) of each aquifer. Seasonal or annual variability is not considered; therefore the modeled bedrock groundwater supply is independent of changing hydrologic conditions.

Water Demand thru 2060
Source & Water Use Sector

BASIN 50

Water Demand

- Basin 50's water needs are about 22% of the demand in the Central Watershed Planning Region and will increase by 26% (18,510 AFY) from 2010 to 2060. The majority of the demand and growth in demand over this period will be in the Municipal and Industrial demand sector.
- Surface water is used to meet 58% of total demand in the basin and its use will increase by 26% (10,740 AFY) from 2010 to 2060. The majority of surface water use and growth in surface water use over this period will be in the Municipal and Industrial demand sector. Out-of-basin supplies moved from the Blule-Boggy Region via Oklahoma City's Atoka Pipeline currently helps meet a portion of the surface water demand.
- Alluvial groundwater is used to meet 7% of total demand in the basin and its use will increase by 30% (1,540 AFY) from 2010 to 2060. The majority of alluvial groundwater use and growth in alluvial groundwater use over this period will be in the Crop Irrigation and Municipal and Industrial demand sectors.
- Bedrock groundwater is used to meet 35% of total demand in the basin and its use will increase by 24% (6,210 AFY) from 2010 to 2060. The majority of bedrock groundwater use and growth in bedrock groundwater use over this period will be in the Municipal and Industrial demand sector.



Total Demand by Sector
Central Region, Basin 50

Planning Horizon	Crop Irrigation	Livestock	Municipal & Industrial	Oil & Gas	Self Supplied Industrial	Self Supplied Residential	Thermoelectric Power	Total
	AFY							
2010	5,570	1,050	61,240	310	900	700	2,740	72,510
2020	6,070	1,060	64,910	560	900	740	3,060	77,300
2030	6,560	1,070	67,690	830	910	780	3,410	81,250
2040	7,060	1,080	69,860	1,170	950	810	3,810	84,740
2050	7,440	1,090	71,510	1,580	990	840	4,250	87,700
2060	8,060	1,100	73,170	2,040	1,030	880	4,740	91,020

Notes & Assumptions

- Demand values represent total demand (the amount of water pumped or diverted to meet the needs of the user).
- Values are based on the baseline demand forecast from the March 2011 OCWP Water Demand Forecast Report.
- The effect of climate change, conservation, and non-consumptive uses, such as hydropower, are not represented in this baseline demand analysis but are documented in separate OCWP reports.
- The proportion of each supply source used to meet each water use sector's demand was assumed to be equal to the existing proportion, as represented in water rights.
- The proportions of future demands between water use sectors will vary due to differing growth rates.
- The overall proportion of supplies used to meet demand will change due to differing growth rates among the water use sectors.

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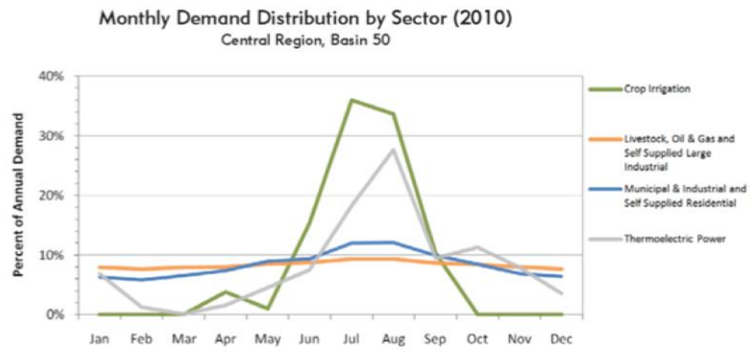
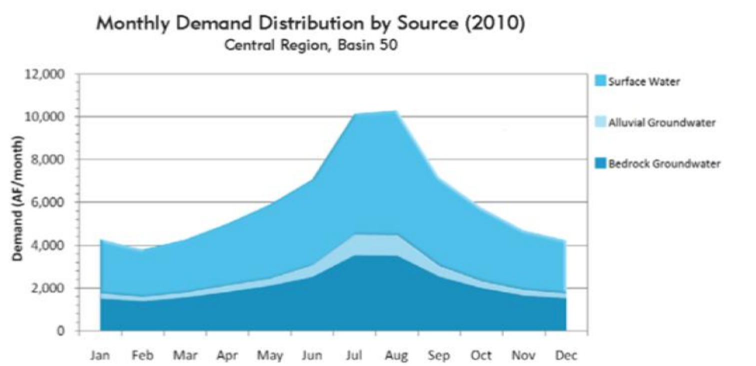
Distribution Among Uses/Sources of Current & Projected Supply





BASIN 50

Current Monthly Demand Distribution by Sector

- The Municipal and Industrial and Self Supplied Residential demand sectors use 81% more water in summer months than in winter months. Crop Irrigation has a high demand in summer months and little or no demand in winter months. Thermoelectric Power demand peaks in August and is lowest in March. Other demand sectors have more consistent demand throughout the year.

Current Monthly Demand Distribution by Source

- The peak summer month total water demand in Basin 50 is nearly 2.4 times the monthly winter demand, which is similar to the overall statewide pattern. Surface water use in the peak summer month is about 2.3 times the monthly winter use. Monthly alluvial groundwater use peaks in the summer at about 4 times the monthly winter use. Monthly bedrock groundwater use peaks in the summer at about 2.3 times the monthly winter use.

Notes & Assumptions

- The proportions of future demands between demand sectors will vary due to differing growth rates between those sectors.
- The overall proportion of supplies used to meet demand will change due to differing growth rates among the demand sectors.

Likelihood & Severity of Shortages

Surface Water Gaps-Groundwater Depletions

BASIN 50

Gaps and Storage Depletions

- Based on projected demand and historical hydrology, surface water gaps and alluvial groundwater storage depletions may occur by 2020. Bedrock groundwater depletions may occur in Basin 50 by 2040.
- Surface water gaps in Basin 50 may occur during the spring, summer, and fall, peaking in size in the summer. Surface water gaps in 2060 will be up to 17% (1,250 AF/month) of the surface water demand in the peak summer month, and as much as 7% (300 AF/month) of the spring monthly surface water demand. There will be a 22% probability of gaps occurring in at least one month of the year by 2060. Surface water gaps are most likely to occur during summer and fall months.
- Alluvial groundwater storage depletions in Basin 50 may occur during the spring, summer, and fall, peaking in size during the summer. Alluvial storage depletions in 2060 will be up to 16% (210 AF/month) of the alluvial groundwater demand in the peak summer month and as much as 8% (30 AF/month) of the spring monthly alluvial groundwater demand. There will be a 22% probability of alluvial storage depletions occurring in at least one month of the year by 2060. Alluvial depletions are most likely to occur during summer and fall months.
- Bedrock groundwater storage depletions in Basin 50 will occur in the summer and in 2060 will be 9% (420 AF/month) of the bedrock groundwater demand in the peak summer month.
- Projected annual groundwater storage depletions are minimal relative to the amount of water in storage in the North Canadian River, Garber-Wellington, and Vamoosa-Ada aquifers. However, localized storage depletions may adversely affect well yields, water quality, and/or pumping costs.

Surface Water Gaps by Season (2060 Demands)

Central Region, Basin 50

Months (Season)	Maximum Gap[1]	Median Gap	Probability
	AF/month	AF/month	Percent
Dec-Feb (Winter)	0	0	0%
Mar-May (Spring)	300	300	5%
Jun-Aug (Summer)	1,250	1,110	16%
Sep-Nov (Fall)	560	470	14%

1 Amount shown represents largest amount for any one month in season indicated.

Alluvial Groundwater Storage Depletions by Season (2060 Demands)

Central Region, Basin 50

Months (Season)	Maximum Storage Depletion[1]	Median Storage Depletion	Probability
	AF/month	AF/month	Percent
Dec-Feb (Winter)	0	0	0%
Mar-May (Spring)	30	30	5%
Jun-Aug (Summer)	210	200	16%
Sep-Nov (Fall)	70	55	14%

1 Amount shown represents largest amount for any one month in season indicated.

Magnitude and Probability of Annual Gaps and Storage Depletions

Central Region, Basin 50

Planning Horizon	Maximum Gaps/Storage Depletions			Probability of Gaps/ Storage Depletions	
	Surface Water	Alluvial GW	Bedrock GW	Surface Water	Alluvial GW
	AFY			Percent	
2020	180	30	0	9%	9%
2030	670	110	0	17%	17%
2040	1,460	240	160	19%	19%
2050	2,270	360	450	21%	21%
2060	3,490	540	800	22%	22%

Bedrock Groundwater Storage Depletions by Season (2060 Demands)

Central Region, Basin 50

Months (Season)	Storage Depletion[1]
	AF/month
Dec-Feb (Winter)	0
Mar-May (Spring)	0
Jun-Aug (Summer)	420
Sep-Nov (Fall)	0

1 Amount shown represents largest amount for any one month in season indicated.

Notes & Assumptions

- Gaps and Storage Depletions reflect deficiencies in physically available water (or "wet water"). Permitting, water quality, infrastructure, and nonconsumptive demand constraints are considered in separate OCWP analyses.
- Local gaps and storage depletions may vary from basin-level values due to local variations in demands and local availability of supply sources.
- For this baseline analysis, each basin's future demand is met by the basin's available supplies.
- For this baseline analysis, the proportion of future demand supplied by surface water and groundwater for each sector is assumed equal to current proportions.
- The available surface water supplies used in the OCWP water supply availability analysis include changes in historical streamflow due to increased upstream demand, return flows, and increases in out-of-basin supplies from existing infrastructure.
- Analysis of bedrock groundwater supplies is based upon recharge from major aquifers.
- Groundwater storage depletions are defined as the amount that future demands exceed available recharge.
- Median gaps and storage depletions are based only on months with gaps or storage depletions.
- Annual probability is based upon the number of years that a gap or depletion occurs in at least one month of that year.

Options & Alternatives to Forecasted Shortages

Reducing Water Needs Through Conservation

Central Region, Basin 50

Conservation Activities[1]	2060 Gap/Storage Depletion			2060 Gap/Storage Depletion Probability	
	Surface Water	Alluvial GW	Bedrock GW	Surface Water	Alluvial GW
	AFY			Percent	
Existing Conditions	3,490	540	800	22%	22%
Moderately Expanded Conservation in Crop Irrigation Water Use	3,190	480	690	22%	22%
Moderately Expanded Conservation in M&I Water Use	530	100	0	10%	10%
Moderately Expanded Conservation in Crop Irrigation and M&I Water Use	390	70	0	10%	10%
Substantially Expanded Conservation in Crop Irrigation and M&I Water Use	0	0	0	0%	0%

1 Conservation Activities are documented in the OCWP Demand Forecast Report.

Reliable Diversions Based on Available Streamflow and New Reservoir Storage

Central Region, Basin 50

Reservoir Storage	Diversion
AF	AFY
100	3,800
500	5,000
1,000	6,200
2,500	9,200
5,000	14,000
Required Storage to Meet Growth in Demand (AF)	7,500
Required Storage to Meet Growth in Surface Water Demand (AF)	3,100

Water Supply Options & Effectiveness

Typically Effective · Potentially Effective · Likely Ineffective · No Option Necessary

BASIN 50

Demand Management

Moderately expanded permanent conservation activities in the Municipal and Industrial, Self Supplied Residential, and Crop Irrigation demand sectors could mitigate bedrock groundwater storage depletions, and reduce surface water gaps and alluvial groundwater storage depletions by 89% and 87%, respectively. Temporary drought management activities may not be effective for this basin, since gaps have a moderate probability of occurring and groundwater storage could continue to provide supplies during droughts.

Out-of-Basin Supplies

Out-of-basin supplies could mitigate groundwater storage depletions and surface water gaps.The OCWP Reservoir Viability Study, which evaluated the potential for reservoirs throughout the state, identified fifteen potential out-of-basin sites in the Central Region: Asher and Scissortail in Basin 56; Dibble and Purcell in Basin 57; Union in Basin 58; Fallis, Nuyaka, Wellston and Welty in Basin 60; Sasakwa in Basin 61; Tate Mountain and West Elm Creek (terminal storage) in Basin 62; and Crescent, Hennessey and Navina in Basin 64. However, in light of the substantial groundwater supplies and distance to reliable water supplies, out-of-basin supplies may not be cost-effective for many users in the basin.

Reservoir Use

Additional reservoir storage in Basin 50 could effectively supplement supply during dry months. The entire increase in demand from 2010 to 2060 could be supplied by a new river diversion and 7,500 AF of reservoir storage at the basin outlet. The use of multiple reservoirs in the basin or reservoirs upstream of the basin's outlet may increase the amount of storage necessary to mitigate future gaps and storage depletions. The OWRB Reservoir Viability Study identified one potential site in Basin 50 (Centerpoint).

Increasing Reliance on Surface Water

Increased reliance on surface water through direct diversions without reservoir storage will increase surface water gaps and is not recommended.

Increasing Reliance on Groundwater

Increased reliance on the Garber-Wellington, Vamoosa-Ada, or North Canadian River aquifers could mitigate surface water gaps. Any increases in storage depletions would be minimal relative to the volume of water stored in the basin's major aquifers. The Aquifer Recharge Workgroup identified a site near Shawnee and Seminole (site # 9) as potentially feasible for aquifer recharge and recovery. Water could potentially be withdrawn from the North Canadian River to recharge the Vamoosa-Ada aquifer.

Notes & Assumptions

- Water quality considerations may limit the use of supply sources, which may require new or additional treatment before use.
- Infrastructure related to the diversion, conveyance, treatment, and distribution of water will affect the cost-effectiveness of using any new source of supply.
- The ability to reduce demands will vary based on local acceptance of additional conservation and temporary drought management activities.
- Gaps and depletions may be mitigated in individual calendar months without reductions in the annual probability (chance of having shortage during another month).
- Yield from new, unused, or additional reservoir storage is based on a hypothetical on-channel reservoir at the basin outlet. Reported yields will vary depending upon the reservoir location; placement at the basin outlet would likely result in a higher yield.
- Surface water diversions may provide substantial annual dependable yield with little or no reservoir storage if surface supplies are frequently equal to or greater than the annual total and monthly pattern of demand.
- Aquifer storage and recovery may provide additional storage or an alternative to surface storage and should be evaluated on a case by case basis.

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