State of Oklahoma
OWRB
WATER RESOURCES BOARD
the water agency

Oklahoma Comprehensive Water Plan
Physical Water Supply Availability Report

Final Report

November 2011

This study was funded through an agreement with the Oklahoma Water Resources Board under its authority to update the Oklahoma Comprehensive Water Plan, the state's long-range water planning strategy, due for submittal to the State Legislature in 2012. Results from this and other studies have been incorporated where appropriate in the OCWP's technical and policy considerations.

Oklahoma Comprehensive Water Plan
OCWP

The general goal of the OCWP is to ensure reliable water supplies for all Oklahomans through integrated and coordinated water resources planning and to 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.

Prepared by CDM under a cooperative agreement between the United States Army Corps of Engineers and the Oklahoma Water Resources Board

Contents

Figures

Tables

Acronyms

AF	acre-feet
AFY	acre-feet per year
AGW	alluvial groundwater
BGW	bedrock groundwater
CDM	Camp Dresser & McKee Inc.
CMIP3	Phase 3 Coupled Model Intercomparison Project
GIS	geographical information system
gpcd	gallons per capita per day
gpm	gallons per minute
GRDA	Grand River Dam Authority
GW	groundwater
HUC	Hydrologic Unit Code
ID	identification
M&I	Municipal and Industrial
MCD	Master Conservation District
NASS	National Agricultural Statistics Service
NED	National Elevation Database
NRCS	Natural Resource Conservation Service
NRW	non-revenue water
O&G	Oil and Gas
OCS	Oklahoma Climatological Survey
OCWP	Oklahoma Comprehensive Water Plan
ODC	Oklahoma Department of Commerce
ODEQ	Oklahoma Department of Environmental Quality
OTC	Oklahoma Tax Commission
OWRB	Oklahoma Water Resources Board
OWRRI	Oklahoma Water Resources Research Institute
PSNR	public-supplied non-residential
PSR	public-supplied residential
PWP	Programmatic Work Plan
RWS	rural water system
SIC	Standard Industrial Classification
SSI	Self Supplied Industrial
SSR	Self Supplied Residential
SW	surface water
USACE	United States Army Corps of Engineers
USBR	U.S. Bureau of Reclamation
USDA	United States Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USGCRP	U.S. Global Climate Research Program
USGS	United States Geological Survey
VIC	Variable Infiltration Capacity
WCRP	World Climate Research Programme

Section 1
Introduction and Background

The Oklahoma Water Resources Board (OWRB) is developing a major update of the Oklahoma Comprehensive Water Plan (OCWP), focusing on establishing a reliable supply of water for Oklahoma citizens throughout the next 50 years and beyond. The OCWP is being developed through a unique partnership between the OWRB, the United States Army Corps of Engineers (USACE), the Oklahoma Water Resources Research Institute (OWRRI), and several other state and federal agencies.

The primary goals of the OCWP are to:

- Provide a safe and dependable water supply for all Oklahomans, while improving the economy and protecting the environment
- 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

To help accomplish these goals, the OWRB is pursuing an innovative two-pronged approach—inclusive and robust participation to build sound water policy, complemented by detailed technical evaluations. The final OCWP will result in focused implementation of technically and politically sound water planning initiatives.

This Physical Water Supply Availability Report provides a summary of key findings from the OCWP technical studies conducted to date. This report summarizes the methodology and results of the technical aspects of the physical water supply availability analysis.

The Technical Studies are guided by the OCWP Technical Studies Programmatic Work Plan (PWP). Updated in February 2009, the PWP is available on OWRB's website, www.owrb.ok.gov. Depending on funding availability and other factors, some elements described in the PWP will be developed prior to completion of the OCWP update in 2011, whereas others will follow as part of ongoing planning and/or future implementation activities.

The foundational elements of statewide water planning, as outlined in the PWP, include the following:

- Projection of water demand
- Analysis of available water supplies
- Projection of potential future water shortages (i.e., the physical water supply needed to meet future demand, based on a comparison of future demand and historic supplies)

OCWP technical studies have focused on these foundational elements, providing a view into Oklahoma's future water needs and challenges. This report provides reference information on these elements as follows:

- Section 2: Oklahoma H_2O Tool and Water Supply Availability Methodology
- Section 3: Water Demand Projections
- Section 4: Oklahoma's Water Resources
- Section 5: Physical Water Supply Availability Results
- Section 6: Effects of Water Conservation and Climate Change
- Section 7: Ongoing and Upcoming Technical Studies

The water availability analyses described in this report is based on the demand projections presented in the "Water Demand Forecast Report" (Camp Dresser & McKee Inc. [CDM] 2011).

Subsequent OCWP activities, facilitated through the policy development process, will focus on alternative methods to address projected water needs and challenges on a watershed and community level, and form the basis for a plan that will anticipate and meet those needs.

The remainder of this report focuses on demand, supply, and physical supply availability analyses. The OCWP physical water supply availability analysis characterizes statewide water supplies, compares these supplies with demand projections through the 2060 planning horizon in 10-year increments, and quantifies potential shortages or "gaps" in water supply in those same 10-year increments.

Water supply gaps are defined as the difference between projected supplies and demand when demand exceeds supplies. The current water supply availability analysis described in this report focuses on characterizing physical water availability (wet water). Water planning considerations relating to infrastructure constraints, legal availability and permitting, and water quality issues are being assessed separately as part of related OCWP technical studies. Those studies are documented separately and are not described in detail in this report.

The physical supply availability analysis described in this report focuses on defining the anticipated needs for future water supply, but does not provide solutions to meet those needs. Regional Reports and Detailed Analyses will document potential water supply options to address the shortages presented in this report.

Throughout this report, water supplies and demand are primarily expressed in units of acre-feet (AF) and acre-feet per year (AFY). One AF equals about 325,850 gallons, or approximately the amount of water needed to cover a football field one foot deep. In some instances, water is measured in unit terms such as gallons per capita per day (gpcd) or AFY per 1,000 acres. The use of unit demand such as these allows a more direct comparison of the level of demand from one area in the state to another. Demand and supplies are described in both absolute (e.g., AF) and unit (e.g., AFY/1,000 acres) terms in various sections of this report.

1.1 Categories of Water Supply and Demand

In the OCWP, physical water supply availability is evaluated based on specific water supply sources and major categories of water use. Oklahoma water supply sources include:

- Surface water (SW)
- Bedrock groundwater (BGW)
- Alluvial groundwater (AGW)

Surface water includes water that flows in streams, rivers, or lakes, and is referred to as stream water in Oklahoma water law. Groundwater (GW) is water that exists below the ground surface and is commonly found in aquifers, which are defined as voids or fractures in underlying soils or rock. Alluvial aquifers are made up of sediment deposited by rivers, and are generally filled by infiltration of surface water or precipitation. Bedrock aquifers are generally not associated with rivers and are generally filled with water that percolates into the aquifer from the surface or other overlying aquifers.

Examples of typical water uses include domestic drinking water (tap water), commercial uses, agricultural irrigation and livestock use, and industrial applications. For the OCWP, the major types of water use have been grouped into demand sectors to differentiate between different user groups and rates of use. For instance, the Municipal and Industrial (M&I) demand sector represents the water demand supplied to customers by municipal and rural water districts via public water supply systems. The M&I sector includes all demand served by a public water supply, including residential, commercial, and industrial uses that are connected to the municipal or rural water distribution system. In contrast, the water used by industrial facilities that are not served by a public water supply system is referred to as Self-Supplied Industrial (SSI) demand. The seven OCWP demand sectors are listed below:

- M&I (public water supply)
- Self-Supplied Residential (SSR)
- SSI
- Thermoelectric Power
- Crop Irrigation
- Livestock
- Oil and gas (O&G)

Each of these demand sectors is explained in more detail in the "Water Demand Forecast Report" (CDM 2011). Non-consumptive uses such as recreation, hydropower, and ecosystem needs were not considered in this initial analysis of physical supply availability because they do not reduce the physical availability of streamflow. Section 7 describes how these types of uses are evaluated in the OCWP.

Demand for each sector has been developed on a county, watershed, and statewide level for existing conditions (2010, using recent available historical data) and multiple future planning horizons (10-year increments from 2020 through 2060).

1.2 OCWP Planning and Analysis Basins

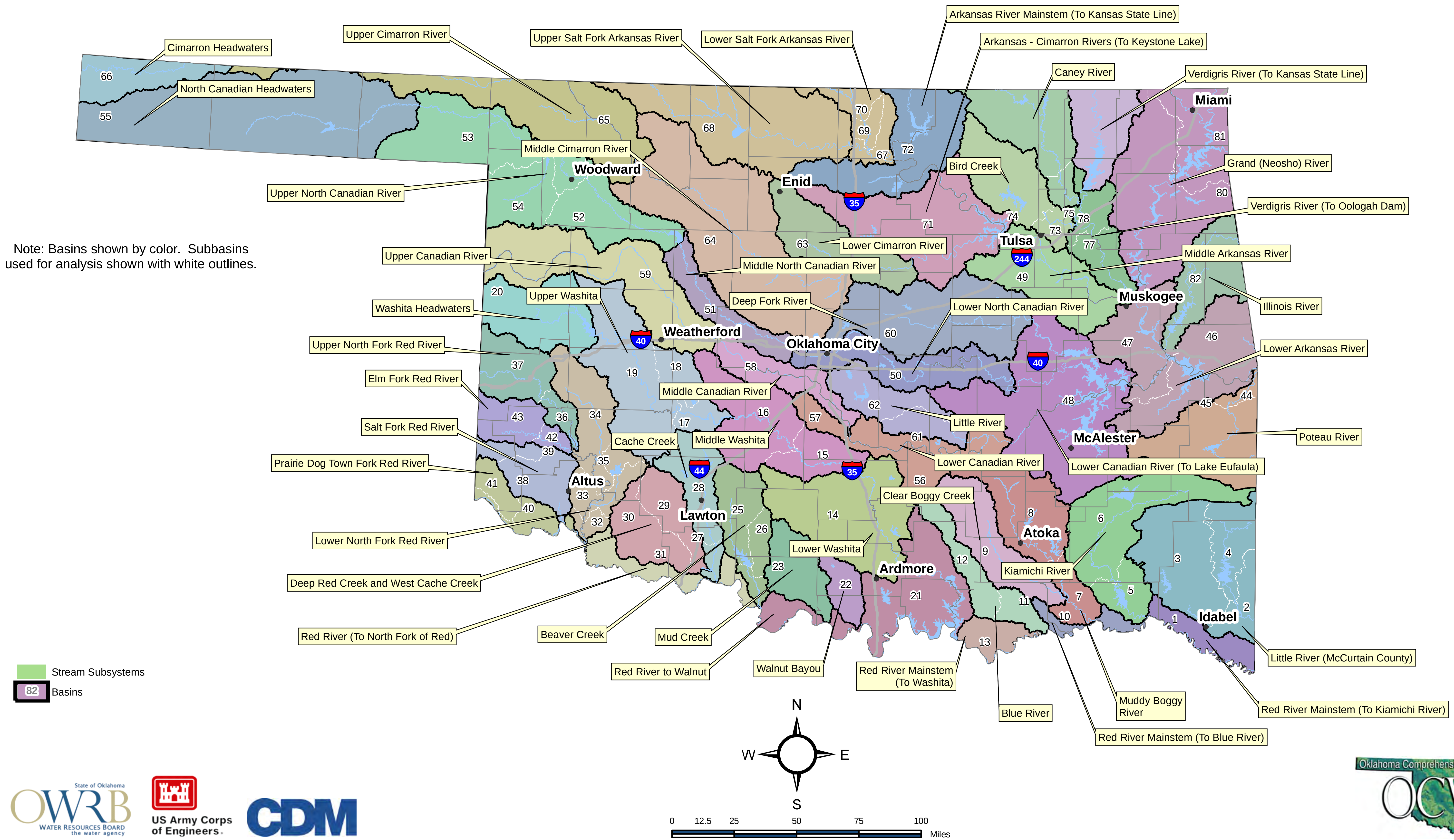
Water demand and supplies can be evaluated using a variety of boundaries and geographic extents. For example, the sum total of all demand and supplies could be analyzed for the entire state, without further subdivision. That level of analysis would not allow local analysis of supply and demand issues. At the other extreme, the analyses could be performed at such a micro-level (e.g., a single residence) that practical results would not be developed. Thus, balancing the spatial extent, or resolution, of the analyses was considered in developing the approach for the OCWP technical analyses.

For the OCWP, most demand projections were initially developed at the county level, because many of the basic forecasting data were available at that scale. Supply analyses were developed on a sub-watershed or "basin" basis using United States Geologic Survey (USGS) stream gage data. The historic supply and future demand comparison was conducted on a basin basis, requiring the projected water demand to be allocated to the sub-watershed or basin scale.

The statewide water supply availability analysis was performed on a hydrologic basis by subdividing the state into 82 surface water basins using USGS 12-digit Hydrologic Unit Code (HUC) boundaries. The basins used for this analysis were adapted from existing OWRB stream system boundaries. Where practical, OWRB stream system boundaries were revised to include a USGS stream gage with a long-term, continuous, streamflow record at or near the basin outlet (downstream end). Each of the 82 basins has been assigned a name, a unique five-digit basin identification (basin ID), and a unique numeric identification for graphical representation (basin number). Figure 1-1 shows the basins used in the supply availability analysis, including basin names and numbers. The basin number, five-digit basin ID, basin name, and basin area (square miles) are tabulated for each basin in Table 1-1.

Cross-reference tables and a figure were prepared to help locate basins contained in a specific community or vice versa, as presented in Table 1-2 (alphabetical listing of communities), Table 1-3 (basin numbers in numerical order), and Figure 1-2 (county seats). When a community or rural water district spans more than one basin, the entity's name is associated with more than one basin number and basin ID in the tables.

Figure 1-1 - Oklahoma Comprehensive Water Plan Basins



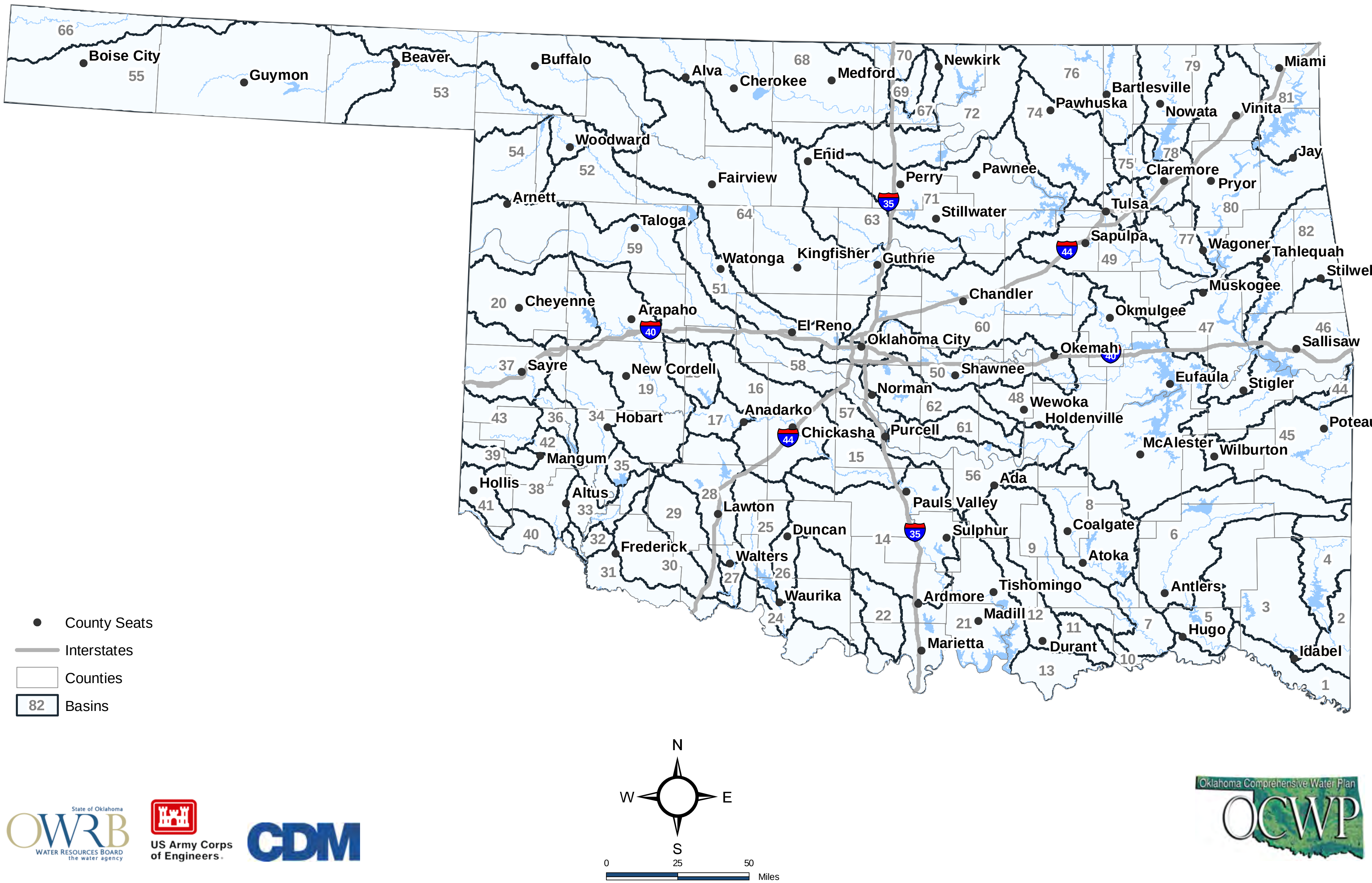
State of Oklahoma OWRB Water Resources Board the water agency

US Army Corps of Engineers

CDM

Oklahoma Comprehensive Water Plan OCWP

Figure 1-2 - Oklahoma County Seats and Comprehensive Water Plan Basins



State of Oklahoma OWRB WATER RESOURCES BOARD the water agency

US Army Corps of Engineers

CDM

Oklahoma Comprehensive Water Plan OCWP

Table 1-1 Basins

Basin Number	Basin ID	Basin Name	Area (Square Miles)
1	10100	Red River Mainstem (To Kiamichi River)	410
2	10201	Little River (McCurtain County) - 1	350
3	10202	Little River (McCurtain County) - 2	1290
4	10203	Little River (McCurtain County) - 3	550
5	10301	Kiamichi River - 1	380
6	10302	Kiamichi River - 2	1440
7	10411	Muddy Boggy River - 1	350
8	10412	Muddy Boggy River - 2	1090
9	10420	Clear Boggy Creek	1000
10	10500	Red River Mainstem (To Blue River)	220
11	10601	Blue River - 1	220
12	10602	Blue River - 2	470
13	10700	Red River Mainstem (To Washita)	330
14	10810	Lower Washita	1870
15	10821	Middle Washita - 1	520
16	10822	Middle Washita - 2	1130
17	10831	Upper Washita - 1	230
18	10832	Upper Washita - 2	310
19	10833	Upper Washita - 3	1590
20	10840	Washita Headwaters	1080
21	10900	Red River Mainstem (To Walnut Bayou)	1690
22	11000	Walnut Bayou	330
23	11100	Mud Creek	650
24	11201	Beaver Creek - 1	110
25	11202	Beaver Creek - 2	560
26	11203	Beaver Creek - 3	190
27	11311	Cache Creek - 1	110
28	11312	Cache Creek - 2	690
29	11321	Deep Red Creek And West Cache Creek - 1	500
30	11322	Deep Red Creek And West Cache Creek - 2	600
31	11400	Red River Mainstem (To North Fork of Red)	520
32	11511	Lower North Fork Red River - 1	120
33	11512	Lower North Fork Red River - 2	340
34	11513	Lower North Fork Red River - 3	800
35	11514	Lower North Fork Red River - 4	130
36	11521	Upper North Fork Red River - 1	190
37	11522	Upper North Fork Red River - 2	670
38	11601	Salt Fork Red River - 1	530
39	11602	Salt Fork Red River - 2	170
40	11701	Prairie Dog Town Fork Red River - 1	280
41	11702	Prairie Dog Town Fork Red River - 2	240
42	11801	Elm Fork Red River - 1	110
43	11802	Elm Fork Red River - 2	450

Table 1-1 Basins

Basin Number	Basin ID	Basin Name	Area (Square Miles)
44	20101	Poteau River - 1	100
45	20102	Poteau River - 2	1250
46	20201	Lower Arkansas River - 1	1430
47	20202	Lower Arkansas River - 2	980
48	20300	Canadian River (To North Canadian River)	3220
49	20400	Middle Arkansas River	1320
50	20510	Lower North Canadian River	1060
51	20520	Middle North Canadian River	720
52	20531	Upper North Canadian River - 1	900
53	20532	Upper North Canadian River - 2	1530
54	20533	Upper North Canadian River - 3	650
55	20540	North Canadian Headwaters	3630
56	20611	Lower Canadian River - 1	940
57	20612	Lower Canadian River - 2	200
58	20620	Middle Canadian River	680
59	20630	Upper Canadian River	2060
60	20700	Deep Fork River	2010
61	20801	Little River - 1	290
62	20802	Little River - 2	600
63	20910	Lower Cimarron River	1090
64	20920	Middle Cimarron River	3640
65	20930	Upper Cimarron River	2020
66	20940	Cimarron Headwaters	700
67	21011	Lower Salt Fork Arkansas River - 1	230
69	21012	Lower Salt Fork Arkansas River - 2	150
70	21013	Lower Salt Fork Arkansas River - 3	220
68	21020	Upper Salt Fork Arkansas River	2240
71	21100	Arkansas River - Cimarron Rivers to Keystone Lake	2030
72	21200	Arkansas River Mainstem (To Kansas State Line)	1490
73	21301	Bird Creek - 1	180
74	21302	Bird Creek - 2	960
75	21401	Caney River - 1	160
76	21402	Caney River - 2	1020
77	21511	Verdigris River (To Oologah Dam) - 1	390
78	21512	Verdigris River (To Oologah Dam) - 2	320
79	21520	Verdigris River (To Kansas State Line)	820
80	21601	Grand (Neosho) River - 1	2060
81	21602	Grand (Neosho) River - 2	900
82	21700	Illinois River	900

Table 1-2 - Cross Reference Table of OCWP Basins in Oklahoma Communities

A

Community	Basin
Achille	13
Ada	8
Ada	12
Ada	9
Ada	56
Adair	80
Addington	26
Afton	81
Agra	71
Agra	60
Albion	6
Alderson	48
Alex	16
Alex	15
Aline	64
Allen	56
Allen	8
Altus	38
Altus	33
Alva	64
Alva	68
Amber	16
Ames	64
Amorita	68
Anadarko	17
Anadarko	16
Antlers	6
Apache	28
Arapaho	19
Arcadia	60
Ardmore	21
Ardmore	14
Arkoma	44
Armstrong	12
Arnett	59
Asher	56
Ashland	8
Atoka	9
Atoka	8
Atwood	56
Avant	74
Avard	64

B

Community	Basin
Barnsdall	74
Bartlesville	76
Bearden	50
Beaver	55
Beaver	53
Beggs	49
Beggs	60
Beggs	48
Bennington	11
Bennington	10
Bernice	81
Bessie	19
Bethany	50
Bethany	64
Bethany	51
Bethel Acres	62
Bethel Acres	50
Big Cabin	80
Billings	72
Binger	16
Bixby	49
Blackburn	71
Blackwell	69
Blackwell	70
Blair	38
Blanchard	57
Blanchard	58
Blanchard	16
Bluejacket	80
Boise City	55
Bokchito	11
Bokoshe	45
Boley	50
Boswell	9
Boswell	7
Bowlegs	48
Bowlegs	62
Boynton	49
Bradley	15
Braggs	47
Braman	70
Bray	14
Breckenridge	71
Breckenridge	72
Breckenridge	63
Bridgecreek	58
Bridgecreek	16

Bridgecreek	57
Bridgeport	59
Bristow	60
Broken Arrow	49
Broken Arrow	78
Broken Arrow	73
Broken Arrow	77
Broken Bow	3
Broken Bow	2
Bromide	9
Brooksville	62
Buffalo	65
Burbank	72
Burlington	68
Burns Flat	19
Burns Flat	34
Butler	19
Byars	14
Byars	56
Byng	56
Byron	68

C

Community	*Basin*
Cache	29
Caddo	9
Caddo	11
Calera	13
Calumet	51
Calvin	56
Camargo	59
Cameron	45
Canadian	48
Caney	9
Canton	51
Canute	20
Canute	19
Capron	68
Cardin	81
Carmen	64
Carnegie	19
Carnegie	17
Carney	60
Carney	63
Carrier	68
Carrier	64
Carter	37
Carter	36
Cashion	64
Castle	60
Castle	50
Catoosa	73
Catoosa	78
Cedar Valley	64
Cement	16
Centrahoma	9
Central High	25
Chandler	60
Chattanooga	29
Chattanooga	30
Checotah	47
Chelsea	80
Cherokee	68
Cheyenne	20
Chickasha	16
Choctaw	50
Chouteau	80
Cimarron City	64
Claremore	80
Claremore	75
Claremore	78
Clayton	6
Clearview	48
Cleo Springs	64
Cleveland	71
Clinton	19
Coalgate	8
Colbert	13
Colcord	82
Colcord	80
Cole	57
Collinsville	74
Collinsville	75
Colony	18
Comanche	25
Comanche	23
Comanche	26
Commerce	81
Cooperton	35
Cooperton	19
Copan	76
Cordell	19
Corn	19
Cornish	23
Council Hill	48
Covington	63
Coweta	49
Coweta	77
Cowlington	46
Coyle	63
Crescent	64
Crescent	63
Cromwell	50

Cromwell	48
Crowder	48
Cushing	71
Custer City	59
Custer City	19
Cyril	16

D

Community	Basin
Dacoma	64
Davenport	60
Davidson	31
Davis	14
Deer Creek	68
Del City	50
Delaware	79
Depew	60
Devol	31
Dewar	48
Dewey	76
Dibble	57
Dibble	15
Dickson	14
Dickson	21
Dill City	34
Disney	81
Disney	80
Dougherty	14
Douglas	63
Dover	64
Drummond	64
Drumright	71
Duncan	23
Duncan	25
Duncan	26
Duncan	14
Durant	21
Durant	13
Durant	12
Dustin	48

E

Community	Basin
Eakly	18
Earlsboro	50
Earlsboro	48
Earlsboro	62
East Duke	38
Edmond	60
Edmond	64
El Reno	58
El Reno	51
El Reno	64
Eldorado	40
Elgin	25
Elgin	28
Elk City	37
Elk City	34
Elmer	40
Elmer	38
Elmore City	14
Empire City	25
Empire City	26
Enid	63
Enid	68
Enid	71
Enid	64
Enid	72
Erick	37
Erin Springs	15
Etowah	62
Eufaula	48

F

Community	Basin
Fair Oaks	77
Fair Oaks	78
Fairfax	72
Fairland	81
Fairmont	71
Fairmont	63
Fairview	64
Fallis	60
Fanshawe	45
Fargo	54
Faxon	29
Fitzhugh	12
Fitzhugh	9
Fitzhugh	56
Fletcher	28
Fletcher	25
Foraker	72
Forest Park	50
Forest Park	60
Forgan	65
Forgan	53
Fort Cobb	17
Fort Coffee	46
Fort Gibson	80
Fort Gibson	47
Fort Supply	53
Fort Towson	5
Foss	19
Foyil	78
Francis	56

Frederick	30
Frederick	31
Freedom	65

G

Community	Basin
Gage	54
Gans	46
Garber	71
Garber	72
Garvin	3
Garvin	1
Gate	65
Geary	59
Geary	51
Geary	58
Gene Autry	14
Geronimo	28
Gerty	8
Glencoe	71
Glenpool	49
Goldsby	58
Goldsby	57
Goltry	64
Goltry	68
Goodwell	55
Gore	82
Gore	47
Gotebo	19
Gould	38
Gould	41
Gracemont	16
Grainola	72
Grand Lake Town	81
Grandfield	30
Grandfield	31
Granite	42
Granite	36
Grayson	48
Greenfield	51
Grove	81
Guthrie	64
Guymon	55

H

Community	Basin
Haileyville	48
Hallett	71
Hammon	20
Hanna	48
Hardesty	55
Harrah	50
Harrah	60
Hartshorne	48
Haskell	49
Hastings	24
Haworth	1
Headrick	34
Headrick	33
Healdton	22
Healdton	23
Heavener	45
Helena	64
Hendrix	13
Hennessey	64
Henryetta	48
Hickory	12
Hickory	21
Hillsdale	68
Hinton	59
Hinton	16
Hitchcock	64
Hitchita	48
Hobart	19
Hobart	34
Hoffman	48
Holdenville	48
Holdenville	56
Hollis	41
Hollister	30
Hominy	74
Hooker	55
Hoot Owl	80
Horntown	48
Howe	45
Hugo	5
Hugo	10
Hulbert	80
Hunter	72
Hydro	59

I

Community	Basin
Idabel	1
Idabel	2
Idabel	3
Indiahoma	29
Indianola	48
Inola	77

J

Community	Basin
Jamestown	79
Jay	80
Jay	81

Jefferson	68
Jenks	49
Jennings	71
Jet	68
Johnson	50
Jones	50
Jones	60

K

Community	Basin
Kansas	80
Kansas	82
Kaw City	72
Kellyville	49
Kemp	13
Kendrick	60
Kenefic	12
Keota	46
Ketchum	80
Ketchum	81
Keyes	55
Kiefer	49
Kildare	67
Kildare	72
Kingfisher	64
Kingston	21
Kinta	46
Kiowa	8
Kiowa	48
Knowles	53
Knowles	65
Konawa	56
Krebs	48
Kremlin	68

L

Community	Basin
Lahoma	64
Lake Aluma	60
Lamar	48
Lambert	68
Lamont	68
Langley	81
Langley	80
Langston	63
Laverne	53
Lawrence Creek	71
Lawton	29
Lawton	28
Le Flore	45
Leedey	19
Leedey	20
Lehigh	8
Lenapah	79
Leon	21
Lexington	58
Lexington	56
Liberty	49
Lima	48
Lindsay	15
Loco	23
Locust Grove	80
Lone Chimney	71
Lone Grove	14
Lone Grove	21
Lone Grove	22
Lone Wolf	34
Longdale	51
Lookeba	16
Loveland	30
Loyal	64
Luther	60

M

Community	Basin
Macomb	62
Madill	21
Manchester	68
Mangum	38
Mangum	39
Mangum	42
Manitou	30
Mannford	71
Mannford	49
Mannsville	21
Maramec	71
Marble City	46
Marietta	21
Marland	72
Marland	67
Marlow	25
Marlow	14
Marshall	63
Martha	38
Maud	62
Maud	61
May	53
Maysville	15
McAlester	48
McCurtain	45
McCurtain	46
McLoud	50
Mead	21
Medford	68

Medicine Park	28
Meeker	50
Meeker	60
Meno	64
Meridian	60
Miami	81
Midwest City	62
Midwest City	50
Milburn	12
Mill Creek	21
Millerton	3
Millerton	1
Minco	58
Moffett	46
Moore	62
Moore	50
Moore	58
Mooreland	52
Morris	48
Morrison	71
Mounds	49
Mountain Park	33
Mountain View	19
Muldrow	46
Mule Barn	71
Mulhall	63
Muskogee	47
Muskogee	80
Muskogee	77
Muskogee	49
Mustang	50
Mustang	58
Mutual	52

N

Community	*Basin*
Nash	68
New Alluwe	79
Newcastle	58
Newcastle	57
Newkirk	67
Newkirk	72
Nichols Hills	60
Nichols Hills	64
Nicoma Park	50
Ninnekah	16
Noble	62
Noble	58
Norge	16
Norman	62
Norman	58
North Enid	63
North Miami	81
Nowata	79

O

Community	*Basin*
Oak Grove	71
Oakland	21
Oaks	80
Oakwood	59
Ochelata	76
Oilton	71
Okarche	64
Okay	77
Okeene	64
Okemah	50
Okemah	60
Oklahoma City	50
Oklahoma City	62
Oklahoma City	64
Oklahoma City	58
Oklahoma City	60
Oklahoma City	51
Okmulgee	48
Oktaha	47
Olustee	38
Oologah	78
Optima	55
Orlando	63
Osage	71
Owasso	74
Owasso	75
Owasso	78
Owasso	73

P

Community	*Basin*
Paden	50
Paden	60
Panama	44
Paoli	15
Paradise Hill	82
Pauls Valley	14
Pawhuska	74
Pawnee	71
Peggs	80
Pensacola	80
Peoria	81
Perkins	63
Perry	71
Phillips	8
Picher	81

Piedmont	64
Pink	62
Pink	50
Pittsburg	48
Pocasset	16
Pocola	45
Pocola	44
Ponca City	72
Ponca City	67
Pond Creek	68
Porter	77
Porter	49
Porum	47
Poteau	45
Poteau	44
Prague	60
Prague	50
Prue	71
Pryor	80
Purcell	58
Purcell	15
Purcell	57
Purcell	56
Putnam	59

Q

Community	Basin
Quapaw	81
Quay	71
Quinton	46

R

Community	Basin
Ralston	71
Ramona	76
Randlett	30
Randlett	31
Ratliff City	14
Rattan	5
Ravia	21
Red Oak	45
Red Rock	72
Redbird	49
Redbird	77
Renfrow	68
Rentiesville	47
Reydon	20
Ringling	23
Ringwood	64
Ripley	63
Ripley	71
Rock Island	45
Rock Island	44
Rocky	34
Roff	12
Roland	46
Roosevelt	35
Rosedale	56
Rosston	53
Rush Springs	14
Ryan	21
Ryan	24

S

Community	Basin
Salina	80
Sallisaw	46
Sand Springs	71
Sand Springs	74
Sand Springs	49
Sapulpa	49
Sasakwa	61
Savanna	48
Sawyer	5
Sayre	37
Schulter	48
Seiling	52
Seminole	48
Seminole	50
Sentinel	34
Shady Grove	71
Shady Point	45
Shamrock	60
Sharon	52
Shattuck	54
Shawnee	60
Shawnee	50
Shawnee	62
Shidler	72
Silo	12
Silo	21
Skedee	71
Skiatook	71
Skiatook	75
Skiatook	74
Slaughterville	62
Slaughterville	58
Slaughterville	56
Slick	60
Smith Village	50
Smithville	4
Snyder	33
Soper	7
South Coffeyville	79

Sparks	60
Spaulding	56
Spavinaw	80
Spencer	50
Sperry	73
Sperry	74
Spiro	46
Spiro	44
Sportsmen Acres	80
Springer	14
St. Louis	61
Sterling	25
Stidham	48
Stigler	47
Stillwater	71
Stilwell	82
Stilwell	46
Stonewall	9
Strang	80
Stratford	56
Stringtown	8
Strong City	20
Stroud	60
Stuart	48
Sugden	24
Sulphur	14
Summit	47

T

Community	Basin
Taft	49
Tahlequah	80
Tahlequah	82
Talala	78
Talihina	6
Taloga	59
Tamaha	47
Tamaha	46
Tatums	14
Tecumseh	50
Tecumseh	62
Temple	31
Temple	27
Terlton	71
Terral	21
Texhoma	55
Texola	37
Texola	43
Thackerville	21
The Village	64
Thomas	59
Tipton	32
Tishomingo	21
Tonkawa	69
Tonkawa	68
Tonkawa	67
Tribbey	61
Tribbey	56
Tribbey	62
Tryon	60
Tryon	63
Tullahassee	77
Tullahassee	49
Tulsa	78
Tulsa	73
Tulsa	77
Tulsa	49
Tulsa	74
Tulsa	75
Tupelo	9
Tushka	9
Tuttle	58
Tyrone	55

U

Community	Basin
Union City	51
Union City	58

V

Community	Basin
Valley Brook	50
Valley Park	78
Valliant	1
Valliant	3
Velma	14
Vera	75
Verden	16
Verdigris	78
Vian	46
Vici	52
Vici	59
Vinita	80

W

Community	Basin
Wagoner	80
Wagoner	77
Wainwright	47
Wakita	68
Walters	29
Walters	28
Walters	27
Wanette	56
Wann	76

Wapanucka	9
Warner	47
Warr Acres	51
Warr Acres	60
Warr Acres	50
Warr Acres	64
Warwick	60
Washington	57
Watonga	64
Watonga	51
Watts	82
Waukomis	63
Waukomis	64
Waurika	26
Waurika	24
Wayne	15
Wayne	56
Waynoka	64
Waynoka	65
Weatherford	59
Webb City	72
Webbers Falls	47
Welch	80
Weleetka	48
Wellston	60
West Siloam Spri	82
Westport	71
Westville	82
Wetumka	50
Wetumka	48
Wewoka	48
Whitefield	47
Wilburton	45
Willow	36
Wilson	22
Winchester	49
Winchester	48
Wister	45
Woodlawn Park	51
Woodville	21
Woodward	53
Wright City	3
Wyandotte	81
Wynnewood	14
Wynona	74

Y

Community	***Basin***
Yale	71
Yeager	48
Yukon	50
Yukon	51

Table 1-3 - Cross Reference Table of Oklahoma Communities in OCWP Basins

Basin - 1
Valliant
Idabel
Garvin
Haworth
Millerton

Basin - 2
Idabel
Broken Bow

Basin - 3
Valliant
Garvin
Broken Bow
Idabel
Wright City
Millerton

Basin - 4
Smithville

Basin - 5
Fort Towson
Hugo
Sawyer
Rattan

Basin - 6
Clayton
Talihina
Antlers
Albion

Basin - 7
Soper
Boswell

Basin - 8
Atoka
Gerty
Ada
Stringtown
Allen
Lehigh
Ashland
Kiowa
Coalgate
Phillips

Basin - 9
Caney
Bromide
Tupelo
Tushka
Caddo
Fitzhugh
Stonewall
Wapanucka
Atoka
Boswell
Centrahoma
Ada

Basin - 10
Hugo
Bennington

Basin - 11
Bennington
Bokchito
Caddo

Basin - 12
Durant
Ada
Silo
Armstrong
Hickory
Fitzhugh
Kenefic
Milburn
Roff

Basin - 13
Calera
Colbert
Kemp
Durant
Achille
Hendrix

Basin - 14
Duncan
Dougherty
Elmore City

Springer
Byars
Lone Grove
Gene Autry
Rush Springs
Marlow
Dickson
Ratliff City
Tatums
Ardmore
Velma
Wynnewood
Pauls Valley
Bray
Sulphur
Davis

Basin - 15

Erin Springs
Lindsay
Paoli
Maysville
Alex
Dibble
Purcell
Wayne
Bradley

Basin - 16

Lookeba
Ninnekah
Blanchard
Anadarko
Cyril
Pocasset
Chickasha
Binger
Cement
Bridgecreek
Gracemont
Norge
Amber
Verden
Alex
Hinton

Basin - 17

Anadarko
Carnegie
Fort Cobb

Basin - 18

Eakly
Colony

Basin - 19

Canute
Burns Flat
Leedey
Gotebo
Custer City
Cordell
Corn
Hobart
Carnegie
Foss
Bessie
Cooperton
Clinton
Mountain View
Butler
Arapaho

Basin - 20

Canute
Hammon
Leedey
Cheyenne
Strong City
Reydon

Basin - 21

Mead
Dickson
Lone Grove
Durant
Hickory
Mill Creek
Terral
Ryan
Oakland
Marietta
Ravia
Silo
Ardmore
Leon
Mannsville
Madill
Woodville
Thackerville
Kingston
Tishomingo

Basin - 22

Healdton

Lone Grove

Wilson

Basin - 23

Duncan

Healdton

Loco

Ringling

Comanche

Cornish

Basin - 24

Waurika

Sugden

Hastings

Ryan

Basin - 25

Central High

Elgin

Empire City

Marlow

Comanche

Duncan

Sterling

Fletcher

Basin - 26

Duncan

Comanche

Empire City

Waurika

Addington

Basin - 27

Temple

Walters

Basin - 28

Lawton

Fletcher

Apache

Walters

Elgin

Medicine Park

Geronimo

Basin - 29

Faxon

Chattanooga

Cache

Lawton

Walters

Indiahoma

Basin - 30

Chattanooga

Loveland

Randlett

Frederick

Hollister

Grandfield

Manitou

Basin - 31

Frederick

Temple

Randlett

Devol

Davidson

Grandfield

Basin - 32

Tipton

Basin - 33

Altus

Headrick

Mountain Park

Snyder

Basin - 34

Rocky

Sentinel

Headrick

Lone Wolf

Hobart

Burns Flat

Elk City

Dill City

Basin - 35

Cooperton

Roosevelt

Basin - 36

Granite

Willow

Carter

Basin - 37

Elk City

Carter

Erick

Texola

Sayre

Basin - 38

Martha
Altus
East Duke
Olustee
Elmer
Blair
Mangum
Gould

Basin - 39

Mangum

Basin - 40

Elmer
Eldorado

Basin - 41

Hollis
Gould

Basin - 42

Mangum
Granite

Basin - 43

Texola

Basin - 44

Arkoma
Poteau
Panama
Rock Island
Spiro
Pocola

Basin - 45

Heavener
Le Flore
Shady Point
Cameron
Rock Island
Fanshawe
Wister
Pocola
Poteau
Red Oak
Bokoshe
McCurtain
Wilburton
Howe

Basin - 46

Keota
Roland
Moffett
Vian
Marble City
Spiro
Muldrow
Tamaha
Fort Coffee
Quinton
Stilwell
Gans
Cowlington
Sallisaw
Kinta
McCurtain

Basin - 47

Muskogee
Fort Gibson
Summit
Checotah
Braggs
Warner
Rentiesville
Wainwright
Porum
Webbers Falls
Whitefield
Oktaha
Gore
Tamaha
Stigler

Basin - 48

Schulter
Weleetka
Henryetta
Hartshorne
Savanna
Cromwell
Stuart
Earlsboro
Lima
Kiowa
Okmulgee
Holdenville
Lamar
Hoffman
Clearview
Beggs

Dewar
Seminole
Eufaula
Dustin
Crowder
Horntown
Hanna
Wetumka
Stidham
Yeager
Indianola
Canadian
Winchester
McAlester
Krebs
Morris
Wewoka
Alderson
Council Hill
Grayson
Pittsburg
Bowlegs
Hitchita
Haileyville

Basin - 49

Tullahassee
Winchester
Jenks
Porter
Coweta
Beggs
Taft
Boynton
Redbird
Mounds
Kellyville
Bixby
Liberty
Sapulpa
Kiefer
Tulsa
Haskell
Broken Arrow
Sand Springs
Mannford
Muskogee
Glenpool

Basin - 50

Bethany
Okemah
Valley Brook
Spencer
Boley
Earlsboro
Warr Acres
Smith Village
Paden
Forest Park
Jones
Cromwell
Seminole
McLoud
Bearden
Del City
Wetumka
Choctaw
Castle
Shawnee
Bethel Acres
Tecumseh
Nicoma Park
Harrah
Johnson
Meeker
Pink
Midwest City
Prague
Oklahoma City
Moore
Mustang
Yukon

Basin - 51

Union City
Greenfield
Bethany
Longdale
Woodlawn Park
Canton
Watonga
Yukon
Oklahoma City
Warr Acres
Geary
El Reno
Calumet

Basin - 52

Seiling
Mutual
Sharon

Vici
Mooreland

Basin - 53

May
Rosston
Fort Supply
Forgan
Knowles
Woodward
Beaver
Laverne

Basin - 54

Fargo
Shattuck
Gage

Basin - 55

Beaver
Hooker
Goodwell
Tyrone
Hardesty
Optima
Boise City
Guymon
Texhoma
Keyes

Basin - 56

Spaulding
Byars
Stratford
Atwood
Ada
Lexington
Allen
Tribbey
Wayne
Purcell
Rosedale
Asher
Calvin
Wanette
Byng
Konawa
Francis
Fitzhugh
Holdenville
Slaughterville

Basin - 57

Purcell
Goldsby
Dibble
Bridgecreek
Blanchard
Newcastle
Cole
Washington

Basin - 58

Bridgecreek
Newcastle
Minco
Purcell
Norman
Geary
Tuttle
Union City
Lexington
Noble
Oklahoma City
Mustang
Goldsby
Slaughterville
Moore
El Reno
Blanchard

Basin - 59

Thomas
Oakwood
Geary
Weatherford
Vici
Taloga
Hinton
Arnett
Camargo
Putnam
Bridgeport
Hydro
Custer City

Basin - 60

Stroud
Lake Aluma
Castle
Slick
Paden
Davenport
Nichols Hills
Carney

Arcadia
Edmond
Luther
Warwick
Warr Acres
Fallis
Beggs
Bristow
Wellston
Chandler
Sparks
Prague
Jones
Oklahoma City
Shamrock
Tryon
Kendrick
Forest Park
Depew
Okemah
Harrah
Agra
Shawnee
Meridian
Meeker

Basin - 61

Sasakwa
Maud
Tribbey
St. Louis

Basin - 62

Earlsboro
Slaughterville
Oklahoma City
Tribbey
Tecumseh
Bethel Acres
Noble
Brooksville
Midwest City
Bowlegs
Moore
Shawnee
Macomb
Pink
Maud
Norman
Etowah

Basin - 63

Covington
Enid
Tryon
North Enid
Douglas
Breckenridge
Marshall
Ripley
Carney
Orlando
Coyle
Crescent
Mulhall
Perkins
Fairmont
Waukomis
Langston

Basin - 64

Helena
Avard
Aline
Goltry
Carmen
Dacoma
Waukomis
Hitchcock
Lahoma
Kingfisher
Loyal
Nichols Hills
Warr Acres
Piedmont
Edmond
Okarche
The Village
Waynoka
Ringwood
Oklahoma City
Fairview
Okeene
Alva
Cedar Valley
Cleo Springs
Cashion
Hennessey
Meno
Dover
Bethany
Cimarron City
Crescent

Watonga
El Reno
Enid
Drummond
Ames
Carrier
Guthrie

Basin - 65

Freedom
Gate
Buffalo
Forgan
Waynoka
Knowles

Basin - 67

Tonkawa
Kildare
Ponca City
Newkirk
Marland

Basin - 68

Alva
Enid
Jefferson
Cherokee
Capron
Deer Creek
Jet
Wakita
Burlington
Byron
Hillsdale

Renfrow
Manchester
Lambert
Pond Creek
Lamont
Nash
Amorita
Goltry
Tonkawa
Carrier
Kremlin
Medford

Basin - 69

Tonkawa
Blackwell

Basin - 70

Blackwell
Braman

Basin - 71

Drumright
Skedee
Blackburn
Osage
Fairmont
Breckenridge
Glencoe
Ralston
Lone Chimney
Mannford
Garber
Stillwater
Skiatook

Agra
Sand Springs
Pawnee
Hallett
Enid
Yale
Westport
Cleveland
Oak Grove
Shady Grove
Terlton
Oilton
Lawrence Creek
Cushing
Ripley
Mule Barn
Quay
Morrison
Maramec
Prue
Perry
Jennings

Basin - 72

Red Rock
Kildare
Marland
Foraker
Burbank
Kaw City
Enid
Newkirk
Shidler
Grainola

Fairfax
Breckenridge
Billings
Ponca City
Garber
Webb City
Hunter

Basin - 73

Sperry
Tulsa
Catoosa
Broken Arrow
Owasso

Basin - 74

Hominy
Wynona
Barnsdall
Skiatook
Sand Springs
Tulsa
Collinsville
Owasso
Sperry
Pawhuska
Avant

Basin - 75

Collinsville
Tulsa
Claremore
Skiatook
Owasso
Vera

Basin - 76

Dewey
Ochelata
Bartlesville
Ramona
Copan
Wann

Basin - 77

Okay
Muskogee
Porter
Broken Arrow
Inola
Fair Oaks
Wagoner
Redbird
Tullahassee
Tulsa
Coweta

Basin - 78

Valley Park
Verdigris
Catoosa
Talala
Claremore
Owasso
Fair Oaks
Foyil
Oologah
Broken Arrow
Tulsa

Basin - 79

Delaware
New Alluwe
Lenapah
Jamestown
Nowata
South Coffeyville

Basin - 80

Hulbert
Fort Gibson
Jay
Spavinaw
Kansas
Chouteau
Ketchum
Colcord
Pryor
Adair
Pensacola
Disney
Hoot Owl
Langley
Bluejacket
Muskogee
Salina
Welch
Vinita
Wagoner
Tahlequah
Strang
Oaks
Big Cabin
Claremore

Chelsea
Peggs
Sportsmen Acres
Locust Grove

Basin - 81

Picher
Quapaw
Peoria
Jay
Disney
Miami
Grove
Fairland
Afton
Cardin
Ketchum
Bernice
Commerce
Grand Lake Tow
Wyandotte
Langley
North Miami

Basin - 82

Watts
Gore
West Siloam Spri
Kansas
Tahlequah
Westville
Colcord
Stilwell
Paradise Hill

Section 2
Oklahoma H_2O Tool and Water Supply Availability Methodology

As a key foundation of the OCWP technical work, a Microsoft *Access* and geographical information system (GIS) based analysis tool was created to compare projected demand with physical supplies for each of the 82 OCWP basins. Named the "Oklahoma H_2O Tool," this tool is used in the planning process to identify areas of potential wet water shortages (physical supply availability constraints), to more closely examine demand and supplies, and to evaluate potential water supply solutions. The supply availability tool was developed to allow flexibility to perform a variety of "what-if" scenarios, and it allows for informed decisionmaking based on a variety of factors. The analysis incorporates data on supply and demand to determine the available wet water (surface water and groundwater) in each OCWP basin. Images of the user interface are presented in Figure 2-1 and Figure 2-2.

An incremental methodology was developed to assess potential surface water supply gaps and groundwater storage depletions. The tool compares physically available supplies, from both SW and GW sources, to future changes in demand. A key component of this analysis is the assumption that current demand, current diversions, current return flows, and current AGW/SW interactions are physically manifested in the historical streamflow record (1949 to 2007). The analysis then compares remaining streamflow to future additional SW and AGW demand. Future upstream increases in SW and AGW demand (increase in demand from 2010 to the future planning year) are subtracted from the available SW and AGW to account for the decrease in available SW and AGW supply based on increasing future demand. Incremental bedrock aquifer recharge rates are also compared to future increase in demand. Incremental bedrock aquifer recharge rates are defined as estimated bedrock aquifer recharge rates, minus existing (2010) BGW demand and withdrawals from BGW for out-of-basin transfers. The year 2010 was used as the "current" condition throughout this report.

Recognizing that both demand and supplies can vary dramatically from one part of the year to another, this analysis was conducted on a monthly time step. The analysis utilizes historical hydrology from water year 1950 through water year 2007, and applies future changes in demand for planning horizons between 2010 and 2060. As opposed to a "calendar year," a "water year" begins in October and ends in September. For example, water year 2006 began October 1, 2005 and ended September 30, 2006.

The water supply availability analysis described in this report represents a statewide screening-level analysis. By its nature, such a statewide analysis requires simplifying assumptions. Examples of some of the primary assumptions in this analysis include the following:

- Water rights or permit obligations are not explicitly considered in the physical supply availability assessment described in this report.

- Water quality, habitat, navigation, and other in-stream issues are not considered in the physical supply availability assessment, but are being evaluated via other elements of the OCWP.

- Changes in GW aquifer volumes and water levels are not explicitly tracked (in other words, the analysis does not predict the water level of an aquifer at any future date).

Each of these major assumptions is either being evaluated in parallel with the physical supply availability analyses, or will subsequently be evaluated. Information on related technical analyses is provided in Section 7. In particular, water supply options to meet future shortages will be documented in the Regional Reports.

Figure 2-1 – Screenshot of the Oklahoma H_2O Main Switchboard

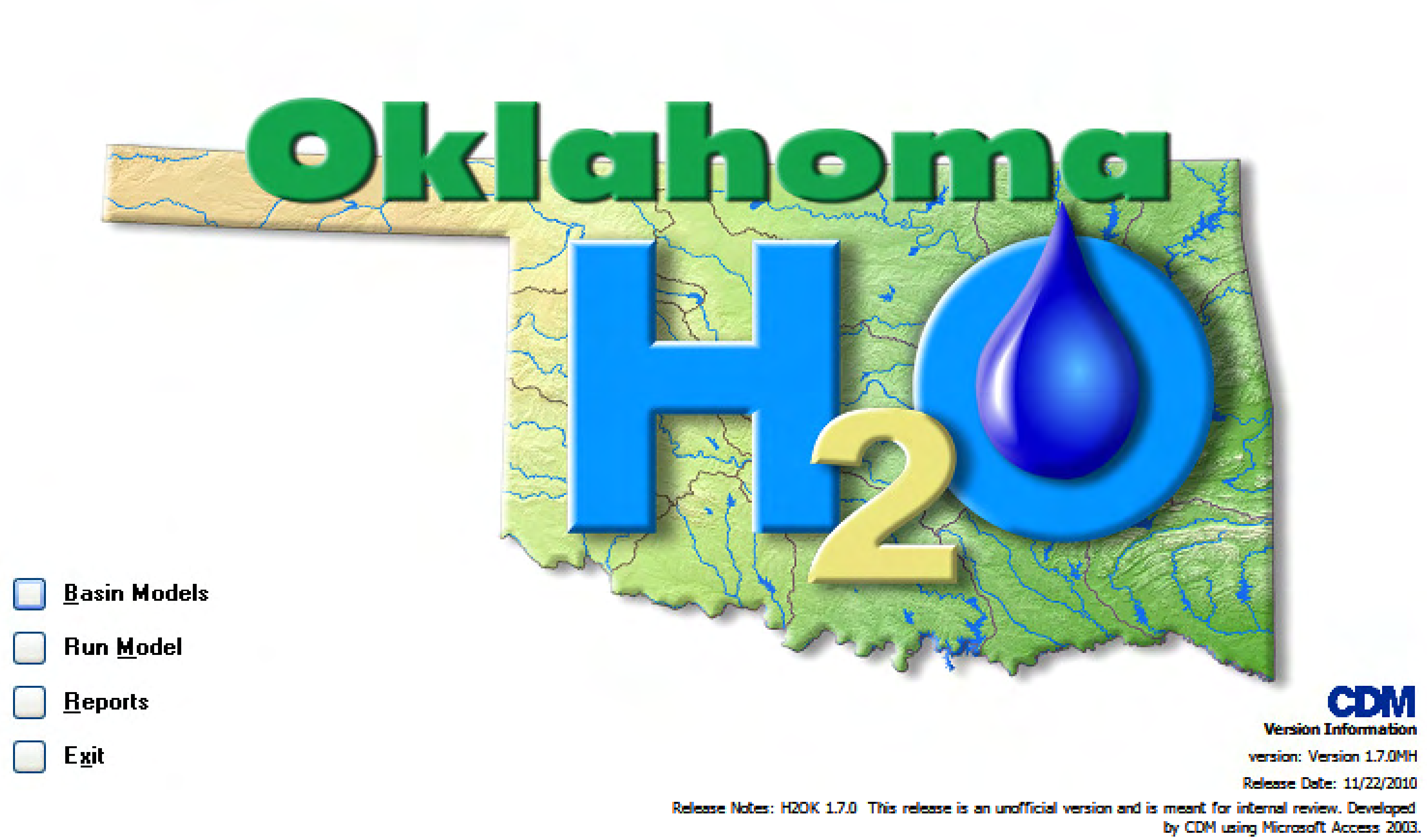
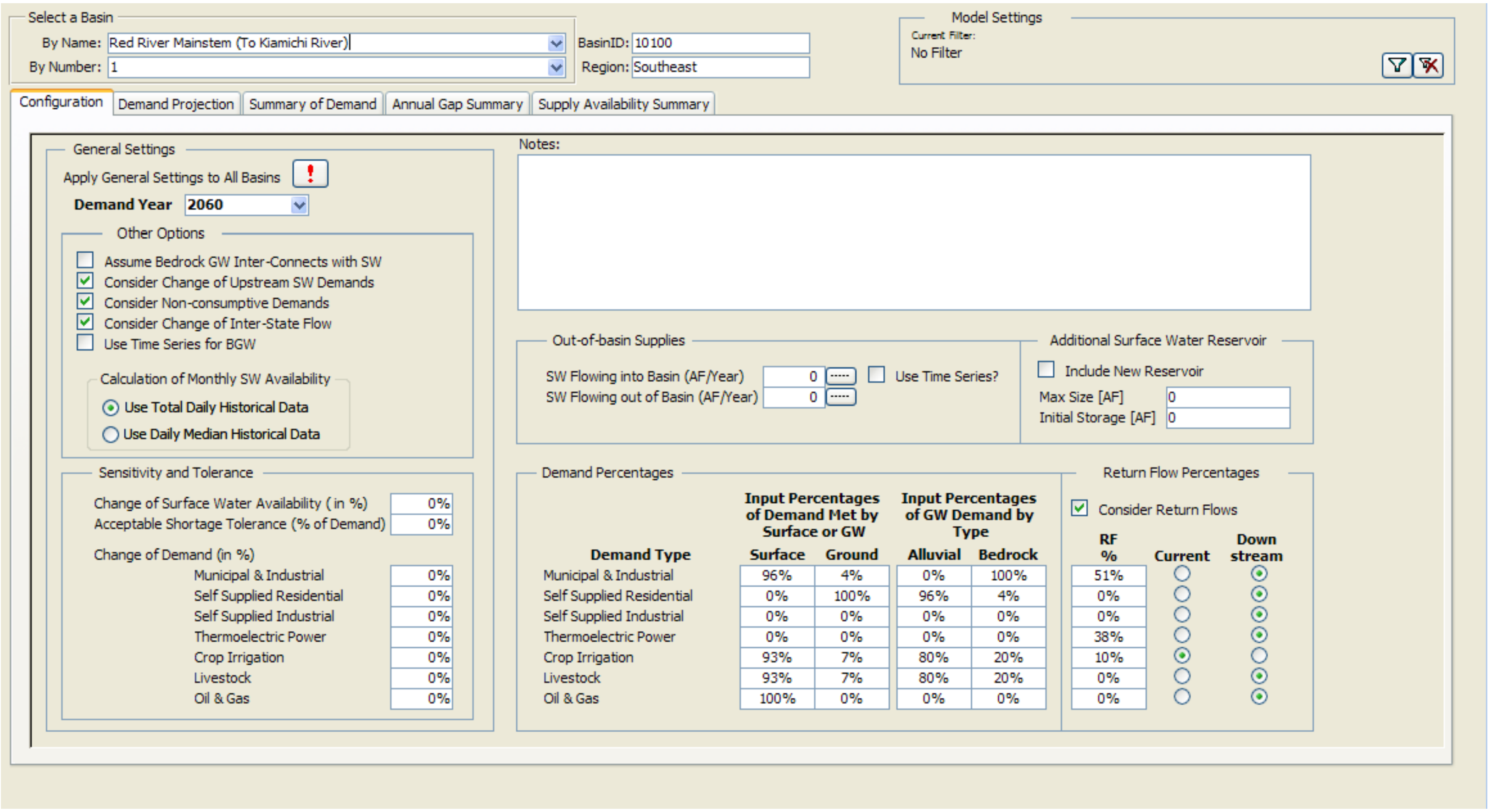


Figure 2-2 – Screenshot of the Oklahoma H_2O Main User Interface



Section 3
Water Demand Projections

This section summarizes the water demand forecasts prepared for the seven OCWP water use sectors and describes the methods and results of allocating the demand to the 82 OCWP planning and analysis basins. The demand sectors are M&I, SSR, SSI, Thermoelectric Power, Crop Irrigation, Livestock, and O&G. A detailed explanation of the methodology and data sources used to estimate the demand is provided in the "Water Demand Forecast Report" (CDM 2011a).

County level demand projections were developed as total water needs or water withdrawals (consumptive plus nonconsumptive demand). Total water demand projections for all major water users throughout the state were developed by county for the base year, or starting point of the forecast (generally 2007), and then at 10-year intervals from 2010 to 2060. The demand projections described in this section are baseline demand. Future climate conditions for this baseline set of demand projections were assumed to be similar to conditions that impact current rates of water use for all demand sectors. In other words, the impacts of climate change were not included in the baseline demand projections. The potential impact of climate change on demand was analyzed separately and is summarized in Section 6.

County-level demand projections were spatially distributed to the OCWP basins and allocated to supply sources (i.e., percent of demand met by SW, percent of demand met by AGW, and percent of demand met by BGW) based on existing source of supply proportions. If, for example, 50 percent of a given basin's M&I demand is currently met by SW and 50 percent is currently met by AGW, the initial assumption for supply availability analyses is that 50 percent of future M&I demand will be met by SW, and 50 percent of future M&I demand will be met by AGW for that basin. Annual demand was converted into monthly demand based on seasonal demand patterns. The demand patterns vary by county and by demand sector, but do not vary due to hydrologic conditions. The specific methodology used to allocate the county-level demand and patterns to basins are presented in Section 3.1.2.

The rates of use for each sector do not account for potential future improvements in water use efficiency (reducing waste) or additional conservation measures (reducing use) beyond current levels. Measures to increase the efficiency of water use or increase implementation of conservation measures (e.g., retrofitting of agricultural irrigation equipment from spray to drip irrigation, or installation of low-flow fixtures, respectively) are one of many options for addressing future water needs. The potential impact of conservation on demand was analyzed separately and is summarized in Section 6.

3.1 Municipal and Industrial

M&I demand represents water that is provided by public water systems to homes, businesses, and industries throughout Oklahoma, excluding water supplied to thermoelectric power plants, agricultural, and SSR water users. Water uses include water for bathing, flushing, cleaning, drinking, working, landscape irrigation, car washing, recreation, domestic animal care, etc. The M&I demand includes an estimate of the quantity of water associated with system losses (e.g., distribution system leakage) and unmetered connections. Monthly demand patterns were developed from historical monthly billing data collected from water providers located throughout the state.

3.1.1 County Demand Forecast

Figure 3-1 shows the annual average residential per-capita water use for public water (CDM 2011a). Approximately two-thirds of the 785 largest municipal and rural water district water suppliers responded to the survey. However, with incomplete participation and self-reporting of historical water use data, the data appeared to contain anomalies. Apparent outliers in the survey response database were investigated, and where appropriate, discarded for purposes of the demand projections. Figure 3-1 also depicts annual average precipitation throughout the state. This figure shows a general trend of lower per-capita consumption in areas of higher precipitation, which is likely attributable to lower outdoor irrigation in those areas. Other characteristics of a public water supplier's service area, such as the level and type of commercial and industrial activity, tourism, or water conservation measures, can influence the per-capita demand values substantially.

The county-level M&I demand estimates are presented in Table 3-1 for 2010 and in 10-year increments from 2010 through 2060. This demand is shown graphically for 2010 and 2060 in Figure 3-2 and Figure 3-3, respectively.

3.1.2 Basin Demand Allocation

3.1.2.1 Basin Demand Allocation Methodology

The county level M&I demand was allocated to the OCWP basins based on the distribution of population within municipal and unincorporated areas. Oklahoma Department of Commerce (ODC) publishes population growth estimates within municipalities and unincorporated areas; these data were used to spatially distribute M&I demand to OCWP basins.

Municipal boundaries were estimated using information available in the Oklahoma Tax Commission (OTC) municipal boundaries GIS shapefile (OTC 2008); a shapefile is a spatial data set. Unincorporated areas, which may be served by a rural water system (RWS) or by self supplied wells (SSR demand sector), were assumed to be areas outside the OTC municipal boundary areas. Public water service is provided by municipalities and RWS providers, and therefore includes municipal and unincorporated areas. Rural service area boundaries were approximated using a RWS report boundary shapefile provided by OWRB (OWRB 2005). The service area for many of the state's public water providers are reflected within these two boundary shapefiles.

The likely M&I service areas were approximated by combining the municipal boundary and RWS boundary shapefiles, as shown in Figure 3-4. This boundary data represent the best available information; however, the data does not include all public water providers.

The basin boundaries and the county boundaries were intersected in GIS to allocate demand from counties to basins. For example, Adair County is contained in two basins: Basin 46 (Basin ID 20201) and 82 (Basin ID 21700). The area of each of the unique county-basin combinations was calculated and used to determine the percent of the county demand that falls within a given basin. For example Basin 46 (Basin ID 20201) accounts for 30 percent (177.5 square miles) of the area in Adair County and Basin 82 (Basin ID 21700) accounts for 70 percent (398 square miles) of the area.

In addition to the basin-county intersections, the area of each municipal and the likely M&I service area were intersected with the county-basins. The percentage of the population in each county living in a municipality or unincorporated area was also calculated using the ODC growth estimates (ODC 2009). Basin demand associated with municipal areas were calculated by multiplying the county M&I demand by the percentage of the county's population living in municipal areas and the percentage of the county's municipalities in a specific basin. Basin demand associated with likely M&I areas were calculated using the same general methodology. The total basin M&I demand was calculated as the sum of the municipal and likely M&I area demand.

3.1.2.2 Basin Demand Results

The resulting M&I demand densities in units of AF per 1,000 acres per year are presented graphically by basin for 2010 and 2060 in Figure 3-5 and Figure 3-6. As expected, the most intensive M&I demand is located near the major metropolitan areas, such as Tulsa. The demand by basin are presented in tabular form in Table 3-2. The baseline demand projections for several basins show a decrease in demand from 2010 to 2050. However, a conservative assumption of no demand growth was modeled.

3.1.3 Monthly Demand Pattern

Monthly demand patterns were determined during the formulation of M&I demand for each county. The county-level monthly patterns were allocated to the M&I areas in each basin following the same methodology used to allocate the annual M&I demand—see Section 3.1.2.1. A demand-weighted M&I pattern was developed for each basin by multiplying the county-basin M&I demand by the county M&I demand pattern, and summing these values in a specific basin, then dividing the sum by the total basin M&I demand. This effectively partitions the monthly demand pattern from counties to basins. This process of demand-weighting the monthly demand pattern was used for the majority of the demand sectors. The monthly demand patterns by basin are presented in Table 3-3.

3.2 Self Supplied Residential

The SSR sector includes demand for households on private wells that are not connected to a public water supply system. It is assumed that these households are located primarily in rural areas of the state. While some SSR homes use well water for livestock care, the SSR sector demand represents only indoor water use and non-agricultural outdoor water use.

3.2.1 County Demand Forecast

Total SSR demand was calculated for each county based on USGS estimates of population on private wells. Monthly demand patterns for the SSR demand sector were assumed to be equal to the M&I demand patterns for each county. The ratio of population using private wells versus population served by public water systems is assumed to remain constant into the future, because no reliable forecasts of potential changes are known to exist.

The county-level demand for the SSR demand sector for 2010 and in 10-year increments through 2060, are presented in Table 3-4. This demand is shown graphically for 2010 and 2060 in Figure 3-7 and Figure 3-8, respectively.

3.2.2 Basin Allocation

County level SSR demand was allocated to the area in each county outside the likely M&I service areas, as described in Section 3.1 and shown in Figure 3-4. Within each county, the SSR demand was distributed uniformly across these self supplied areas. County demand was then allocated to basins based on the percentage of the self supplied areas within a county that intersect a given basin. Total SSR basin demand was calculated by summing the fraction of the county-level SSR demand that fall within a given basin (as described in Section 3.1.2).

The resulting SSR demand is presented graphically by basin for 2010 and 2060 in Figure 3-9 and Figure 3-10. SSR demand is more uniformly distributed throughout the state than M&I demand; however, the greatest densities are generally located at the edges of major metropolitan areas. The SSR demand by basin is presented in tabular form in Table 3-5. The baseline demand projections for several basins show a decrease in demand from 2010 to 2050. However, a conservative assumption of no demand growth was modeled.

3.2.3 Monthly Demand Pattern

SSR monthly demand patterns were assumed to be equal to the M&I demand patterns for each county. The county-level monthly patterns were allocated to the SSR areas in each basin following the same methodology used to allocate the annual SSR demand. A demand-weighted SSR pattern was developed for each basin by multiplying the county-basin SSR demand by the county M&I demand pattern, and summing these values in a specific basin, then dividing the sum by the total basin SSR demand. The monthly SSR demand patterns by basin are presented in Table 3-6.

3.3 Self Supplied Industrial

SSI demand consists of demand associated with large industries identified as self supplied users with available water use data and employment counts. These industries include, but are not limited to, sand companies, gypsum production plants, quarry mines, concrete plants, petroleum refineries, paper mills, sawmills, bottling and distribution plants, chemical plants, tire manufacturing plants, lime production, natural gas plants, and meat packing plants.

3.3.1 County Demand Forecast

The county-level SSI demand is presented in Table 3-7 for 2010 and in 10-year increments from 2010 through 2060. This demand is shown graphically for 2010 and 2060 in Figure 3-11 and Figure 3-12, respectively.

3.3.2 Basin Allocation

The SSI demand sector consists of 27 large industries with the necessary water use data and employment counts. All other industries were included in the M&I demand sector. The location of each of the 27 large industries was determined from northing and easting coordinates provided to the OWRB in the annual surface and groundwater reports. The demand was allocated to the basin where the facility resides. The resulting demand densities, by basin for 2010 and 2060 are presented graphically in Figure 3-13 and Figure 3-14. The demand by basin is presented in tabular form in Table 3-8. The baseline demand projections for multiple basins show a decrease in demand from 2010 to 2050. However, a conservative assumption of no demand growth was modeled.

3.3.3 Monthly Demand Pattern

The monthly demand pattern for each industry, developed as part of the demand development, was allocated to the basin where the facility resides. If more than one industry was located in a basin, a weighted monthly pattern was determined based on each industry's monthly demand. The monthly demand patterns by basin are presented in Table 3-9.

3.4 Thermoelectric Power

3.4.1 County Demand Forecast

Self supplied and municipal-supplied Thermoelectric Power producing plants are included in this demand sector, and are shown in Figure 3-15. County-level demand for the Thermoelectric Power demand sector is presented in Table 3-10 for 2007 and in 10-year increments through 2060. This demand is shown graphically for 2010 and 2060 in Figure 3-16 and Figure 3-17, respectively.

3.4.2 Basin Allocation

Thermoelectric Power demand was allocated to basins similar to SSI demand, based on the location of the specific facility. There were two notable differences, however, for thermoelectric power permit holders. Three of the 48 permit holders were either pending or retired, and one of the permit holders had coordinates that placed it just outside of the state boundaries. All of these four locations had a demand of 0 AFY and therefore did not affect the calculations. The resulting demand densities by basin for 2010 and 2060 demand scenarios are presented graphically in Figure 3-18 and Figure 3-19. The demand by basin is presented in tabular form in Table 3-11.

3.4.3 Monthly Demand Pattern

The monthly demand pattern of each thermoelectric facility was allocated to the basin where the facility was located. If more than one facility was located in a basin, a weighted monthly pattern was determined based on each facility's monthly demand. The monthly demand patterns by basin are presented in Table 3-12.

3.5 Agriculture

Agriculture demand is estimated by two sub-sectors: livestock and crop irrigation. United States Department of Agriculture (USDA) Census of Agriculture data were utilized for both sub-sectors.

3.5.1 Livestock

3.5.1.1 County Demand Forecast

The county-level demand for the livestock demand sector is presented in Table 3 13 for 2007, and in 10-year increments through 2060. This demand is shown graphically for 2010 and 2060 in Figure 3-20 and Figure 3-21, respectively.

3.5.1.2 Basin Allocation

Livestock water demand was assumed to be distributed uniformly across each county. The county demand was allocated to basins based on the fraction of the county within each basin. The resulting demand densities by basin for 2010 and 2060 are presented graphically in Figure 3-22 and Figure 3-23. The demand by basin is presented in tabular form in Table 3-14.

3.5.1.3 Monthly Demand Pattern

Annual demand was assumed to be distributed uniformly over each month; no seasonal variation was assumed for livestock demand.

3.5.2 Crop Irrigation

3.5.2.1 County Demand Forecast

The county-level demand for the crop irrigation demand sector is presented in Table 3-15 for 2007 and in 10-year increments through 2060. This demand is shown graphically for 2010 and 2060 in Figure 3-24 and Figure 3-25, respectively.

3.5.2.2 Basin Allocation

County crop irrigation demand was allocated to basins based on the irrigated lands in each county. Irrigated lands were determined from the OWRB water rights database

(OWRB 2008b). The areas of use and dedicated lands associated with active permits for agricultural land uses, based on the Standard Industrial Classification (SIC) code, were combined to form an irrigated lands shapefile as shown in Figure 3-26. The geographic extent of the areas of use, or dedicated lands, was identified by a legal description by OWRB using the "Spatial Calculator." The Spatial Calculator was developed by Geo Information Systems at the University of Oklahoma and uses latitude/longitude converted from the legal descriptions (quarters and halves down to a 2.5-acre tract of land points) to define the area. Dedicated lands represent the area used to extract GW, not necessarily the area to which the GW is applied; however, common practices statewide indicate that agricultural GW withdrawals are used at or very near the point of extraction.

Demand was evenly distributed across all irrigated lands in each county by area and allocated to basins based on the fraction of total irrigated area in the county that falls within a particular basin. Basin demand was calculated by summing the fraction of the county demand within each basin. The resulting demand densities are presented graphically by basin in Figure 3-27 and Figure 3-28 for 2010 and 2060. The demand by basin is presented in tabular form in Table 3-16.

3.5.2.3 Monthly Demand Pattern

Monthly demand patterns were developed by county in conjunction with the county demand based on the crop mix detailed in the USDA's National Agricultural Statistics Service (NASS). These monthly demand patterns were allocated to basins using a method similar to that used for allocating annual demand. Monthly demand was calculated for each county and evenly distributed across all irrigated lands in each county. Monthly demand was allocated to basins based on the portion of total irrigated area in the county that is located in a particular basin. The monthly basin demand was then calculated by summing the county demand within a given basin. A monthly demand pattern was calculated for each basin based on the sum of the monthly crop irrigation demand in that basin divided by the total crop irrigation demand in that basin. The monthly demand patterns by basin are presented in Table 3-17.

3.6 Oil and Gas

This demand sector represents water used in O&G drilling and exploration activities, but does not include water used at O&G refineries. Drilling and exploration activities use water for supplemental fluid in enhanced recovery operations, during well drilling and completion, during workover of an oil or gas well, as rig wash water, as coolant for equipment, and for sanitary purposes. Water use from both conventional and unconventional drilling techniques was considered.

3.6.1 County Demand Forecast

The county-level demand for the O&G demand sector is presented in Table 3 18 for 2007, and in 10-year increments through 2060. This demand is shown graphically for 2010 and 2060 in Figure 3-29 and Figure 3-30, respectively.

3.6.2 Basin Allocation

The permitted quantity of water issued from 2000 to 2008 was used to allocate county-level O&G demand to basins (OWRB 2008a). The 90-Day permits for this period are shown in Figure 3-31. County demand was assigned to each basin using the percentage of the county withdrawals that occurred in each basin based on the 90-day permits. The resulting demand densities are presented graphically in Figure 3-32 and Figure 3-33 by basin for 2010 and 2060. The demand by basin is presented in tabular form in Table 3-19.

3.6.3 Monthly Demand Pattern

O&G mining operations were assumed to occur evenly throughout the year; therefore 1/12 of the demand was assigned to each month.

3.7 Supply Source Allocation

Demand was allocated to specific supply sources (i.e., SW, AGW, and BGW) using the water rights database, permits, and out-of-basin supply information. The mix of SW/GW and AGW/BGW sourced used to meet existing demand was estimated for each sector in each basin. Active SW diversion and GW well permits were queried from the OWRB Water Rights database (OWRB 2008b). The GW source, either alluvial or bedrock aquifers, was also determined based on the GW source for each permit in the OWRB Water Rights database. If a well permit associated included both alluvial and bedrock aquifers as the source, then the withdrawal was assigned to AGW. For future planning horizons, the proportion of supply sources to meet demand was assumed to be equal to the existing sources. For example, if the existing demand for a specific demand sector within a given basin is currently being met by 50 percent SW, 25 percent AGW, and 25 percent BGW, then in the future 50 percent of the demand will continue to be met by SW, 25 percent of the demand will continue to be met by AGW, and 25 percent of the demand will continue to be met by BGW.

3.7.1 M&I Demand

Methodology for allocating M&I demand to supply sources was developed to account for permitted withdrawals and diversions and existing out-of-basin sources. SW diversion and GW well permits were assigned to M&I demand based on the land use associated with the water rights permit. These permits include both individual water users (i.e., light industry, commercial buildings, car washes, rest stops, etc.) and public water providers. As mentioned previously, future demand was allocated to supply categories based on the current distribution of supply sources in the basin.

For many larger users, such as public water providers, a portion of the demand was met by out-of-basin supplies, which are those supplies that do not originate in the basin of use. Out-of-basin supplies may represent treated water distributed to customers by a public water provider that serves multiple basins. Out-of-basin supplies may also represent raw water inter-basin transfers, such as Oklahoma City's Lake Atoka pipeline, or treated water transfers, such as deliveries from a Master Conservation District (MCD) to a provider. Additional calculations were required for these out-of-basin supplies.

Permits associated with the out-of-basin supplies were excluded from the source basin when determining the SW/AGW/BGW mix. The excluded permitted amount was then added into the basins where the water was used to determine that basin's supply mix. The water was distributed to basins assuming the provider's demand is uniformly distributed across their service area. For example, if a provider serves 20 square miles equally divided in two basins (10 square miles each), then each basin would be assigned 50 percent of the provider's permits corresponding to 50 percent of the provider's area in each basin. The out-of-basin supplies are allocated as SW sources for the physical supply availability analysis. This method reflects the influence of existing out-of-basin supplies on the basin of use through the supply source proportions, while maintaining existing use of permitted in-basin water. The effects of existing diversions or AGW withdrawals on the source stream are represented in the streamflow record. Any increases in existing out-of-basin supplies are represented as a supply source, as discussed in Section 4.4. The effects of existing BGW pumping for out-of-basin supplies are not represented in the recharge dataset; therefore, the demand from the out-of-basin supplies not accounted for in the SW/GW supply allocation are accounted for separately as described in Section 3.8.

3.7.2 Self Supplied Residential Demand

SSR demand was assumed to be fully satisfied with groundwater (AGW or BGW), based on common practices in rural Oklahoma. Source of supply allocations were based on the M&I demand sector allocation for each basin; however, any SW allocation was assumed to be taken from AGW rather than SW.

3.7.3 Self Supplied Industry and Thermoelectric Power Demand

The SW/GW proportion for each basin was determined from the existing permitted GW withdrawals and SW diversions. Permits associated with the specific large industries and thermoelectric power facilities were excluded from the overall analysis and used directly in determining the supply source allocation for these demand sectors. If more than one permit was located in a basin, a demand-weighted supply allocation was calculated.

3.7.4 Crop Irrigation and Livestock Demand

SW diversion and GW well permits were assigned to crop irrigation land uses based on the land use associated with the water rights permit. The crop irrigation supply source allocation was calculated based on the permitted quantity of withdrawals or diversions in each basin. The percentage allocated to each supply source was calculated using a ratio of the supply source's permitted quantity to the total permitted quantity in the basin. The supply allocation for the livestock sector was assigned the same allocation as crop irrigation.

3.7.5 Oil and Gas Demand

The supply allocation for the O&G sector was based on the percent of SW or GW documented in the 90-day provisional permits data. The GW source (AGW or BGW) is not specified in the O&G permit applications. AGW was assumed in all cases for this analysis in lieu of detailed source information, because AGW wells are typically shallower and less expensive to construct and operate than BGW wells.

3.7.6 Summary

The fraction of each basin's demand met by the three source types (SW, AGW, and BGW) is depicted graphically in Figure 3-34 and tabulated in each sector's demand by basin (Tables 3-2, 3-5, 3-8, 3-11, 3-14, 3-16, and 3-19). In Figure 3-34, a pie chart over each OCWP basin depicts the relative contributions of SW, AGW, and BGW (as a weighted average for all demand sectors) in supplying the basin's needs. The background of the figure shows the total demand density for all sectors combined (AF/1,000 acres/year) for each basin.

3.8 Accounting for Bedrock Groundwater Withdrawals for Out-of-Basin Supplies

The effects of existing BGW pumping for out-of-basin supplies are not represented in the recharge dataset; therefore, the demand from the out-of-basin supplies that were not accounted for in the SW/GW supply allocation are accounted for separately in the Oklahoma H_2O Tool. The amount of existing pumping was estimated by multiplying the permit holder's existing demand by the fraction of the total permits represented by the BGW out-of-basin supplies. For example, if a public water provider withdraws out-of-basin supplies from a BGW well permitted for 500 AFY and has 1,000 AFY of total permits, then 50 percent of the provider's demand would be considered BGW withdrawals. Individual permit holder's existing withdrawals were summed by basin and presented in Table 3-20. Incremental BGW recharge was estimated for each surface water basin by subtracting the existing withdrawals from the average annual BGW recharge.

3.9 Summary of Demand Projections

Demand projections for all water use sectors were summarized to show the overall need for water throughout Oklahoma from the present time through 2060. The following figures and tables provide demand summary information:

- Table 3-21: Demand by sector for Oklahoma, 2007 through 2060
- Table 3-22: Total demand by county, 2007 through 2060
- Table 3-23: Total demand by OCWP basin, 2007 through 2060
- Figure 3-35: Total demand by county in 2010
- Figure 3-36: Total demand by county in 2060
- Figure 3-37: Total demand density by OCWP basin in 2010

- **Figure 3-38**: Total demand density by OCWP basin in 2060
- **Figure 3-39**: 2060 total demand density and percentage of total demand growth by sector

To help illustrate future water supply needs, Figure 3-39 shows the relative growth contributions of each demand sector and the total demand density for each basin. For example, the increase in demand in the Oklahoma Panhandle are largely attributable to agricultural irrigation demand, whereas many other basins' increases in demand are driven predominantly by M&I or thermoelectric power uses.

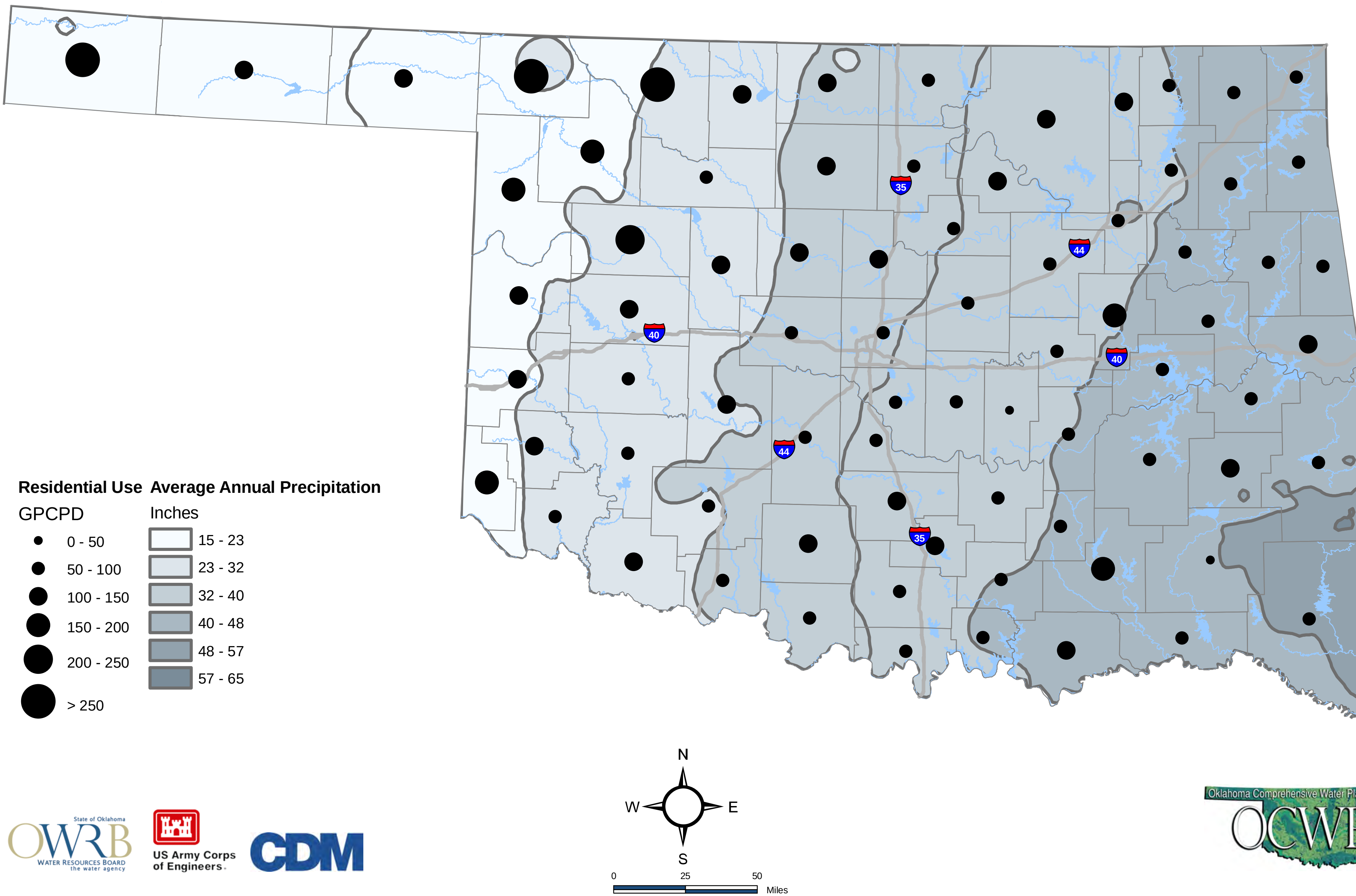
Water demand by sector for each planning horizon is presented in Table 3-21. Crop irrigation is currently the largest water use sector and is projected to be the largest water use sector in 2060 (approximately 42 percent of the total demand in 2007 and 36 percent of the total demand in 2060). M&I is the second largest demand equal to approximately 33 percent of the total demand in 2007 and 32 percent of the total demand in 2060. Although O&G demand is less than 5 percent of the total statewide demand, this sector is projected to experience the greatest growth rate over the next 50 years.

3.10 Uncertainties and Limitations of Demand Projections

Uncertainties associated with the future demand projections derive from the following factors:

- Potential variation in current M&I per-capita water use estimates between actual usage and usage reported in the Fall 2008 water provider survey, and between current and future rates of use.
- Deviation from projected population growth trends.
- Variability in the number of agricultural irrigated acres depends on economic factors, technology advances, and/or water supply availability.
- Potential for future changes in water use efficiencies and conservation that are not reflected in these projections.
- Variability in economic conditions, with the potential to affect nearly all water use sectors.
- Deviation from assumed future locations and water use for thermoelectric power facilities and other SSI water users.

Figure 3-1 - Oklahoma Annual Precipitation and Per Capita Residential Water Use



State of Oklahoma OWRB WATER RESOURCES BOARD the water agency

US Army Corps of Engineers

CDM

Oklahoma Comprehensive Water Plan OCWP

Figure 3-2 - 2010 Municipal and Industrial County Demand

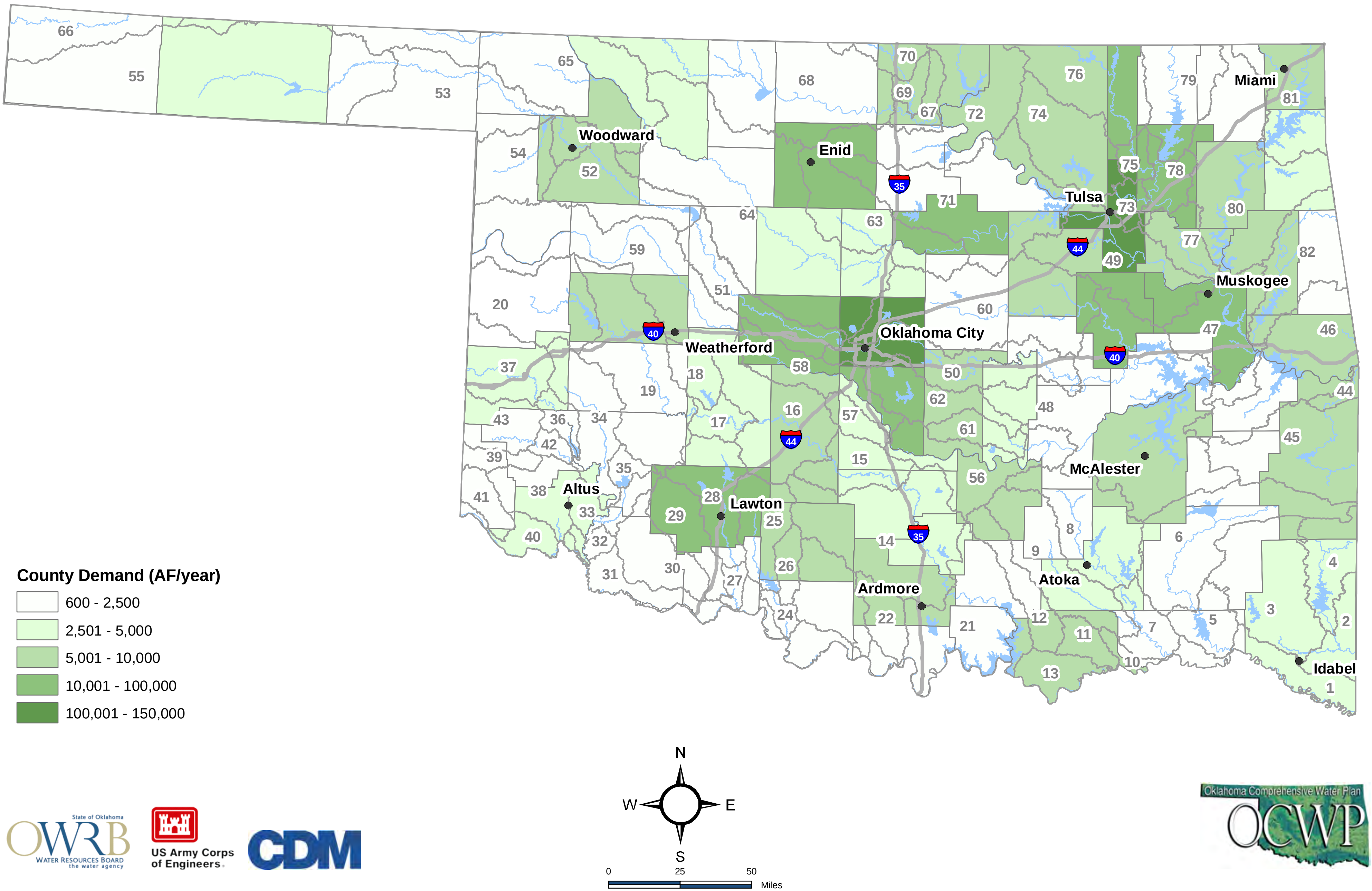
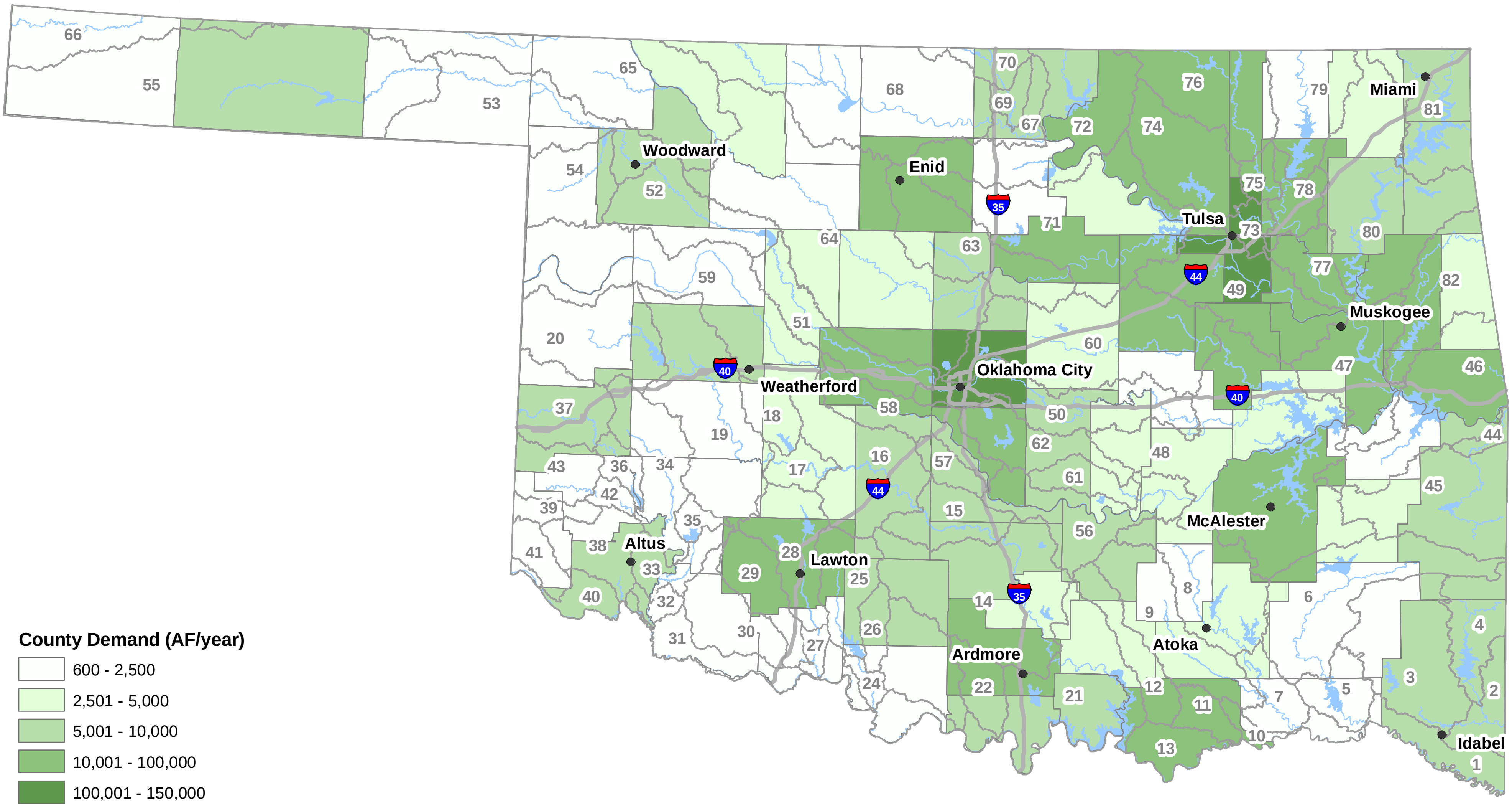


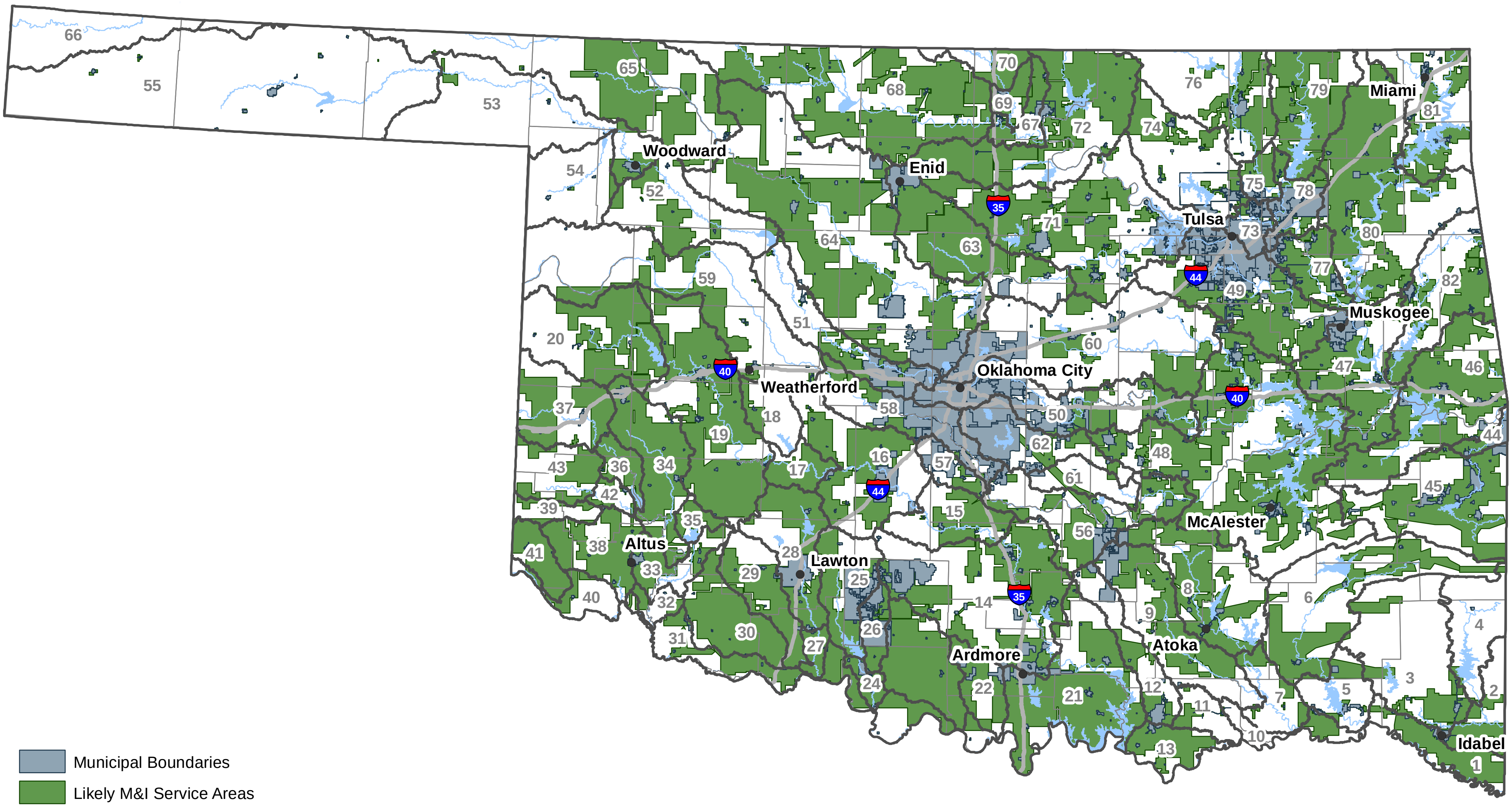
Figure 3-3 - 2060 Municipal and Industrial County Demand



N
W E
S
0 25 50
Miles

OWRB State of Oklahoma Water Resources Board the water agency
US Army Corps of Engineers
CDM
Oklahoma Comprehensive Water Plan OCWP

Figure 3-4 - Municipal Areas and Likely M & I Service Areas

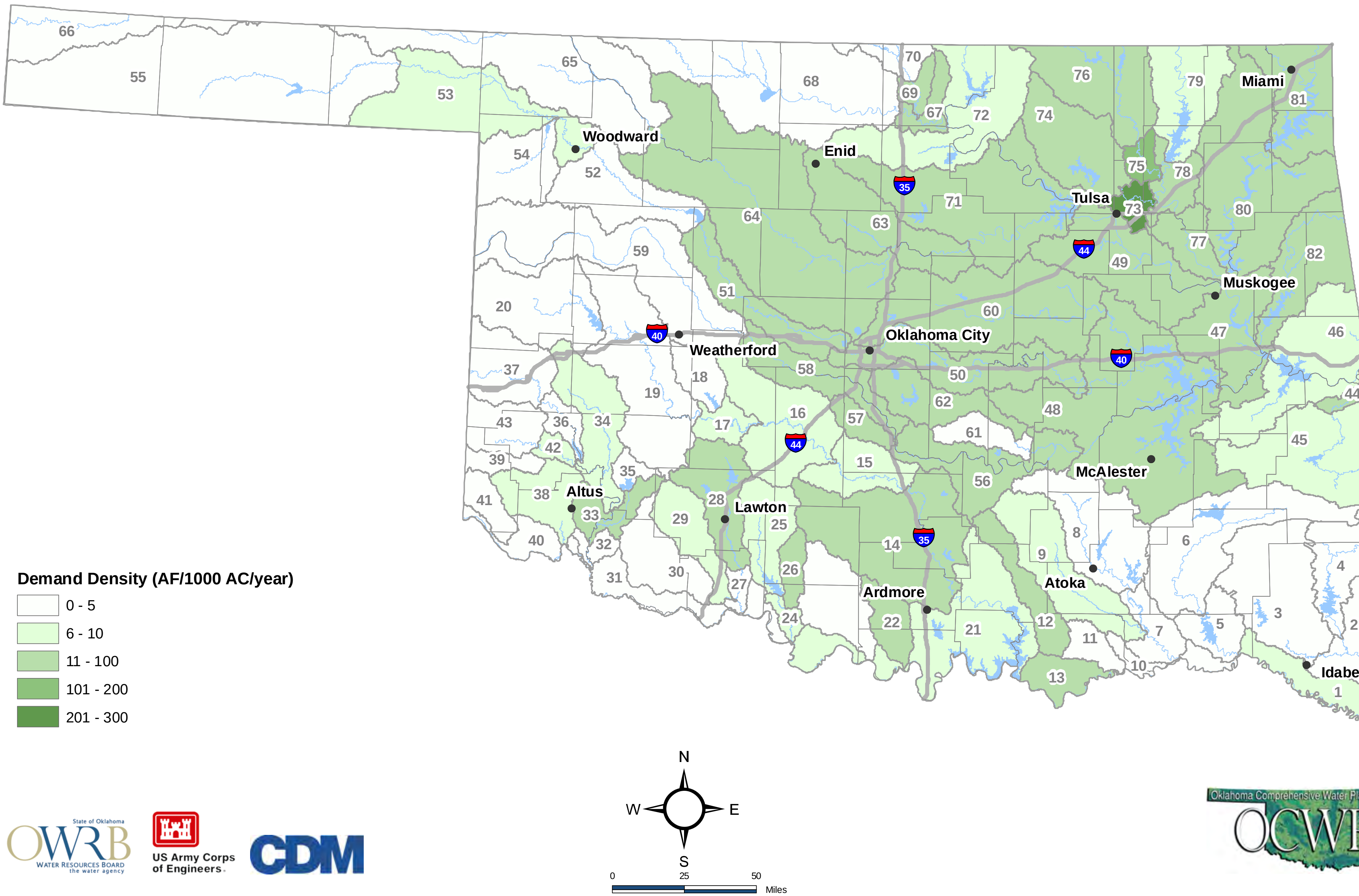


N
W
E
S
0
25
50
Miles

US Army Corps of Engineers

Oklahoma Comprehensive Water Plan

Figure 3-5 - 2010 Municipal and Industrial Demand Density



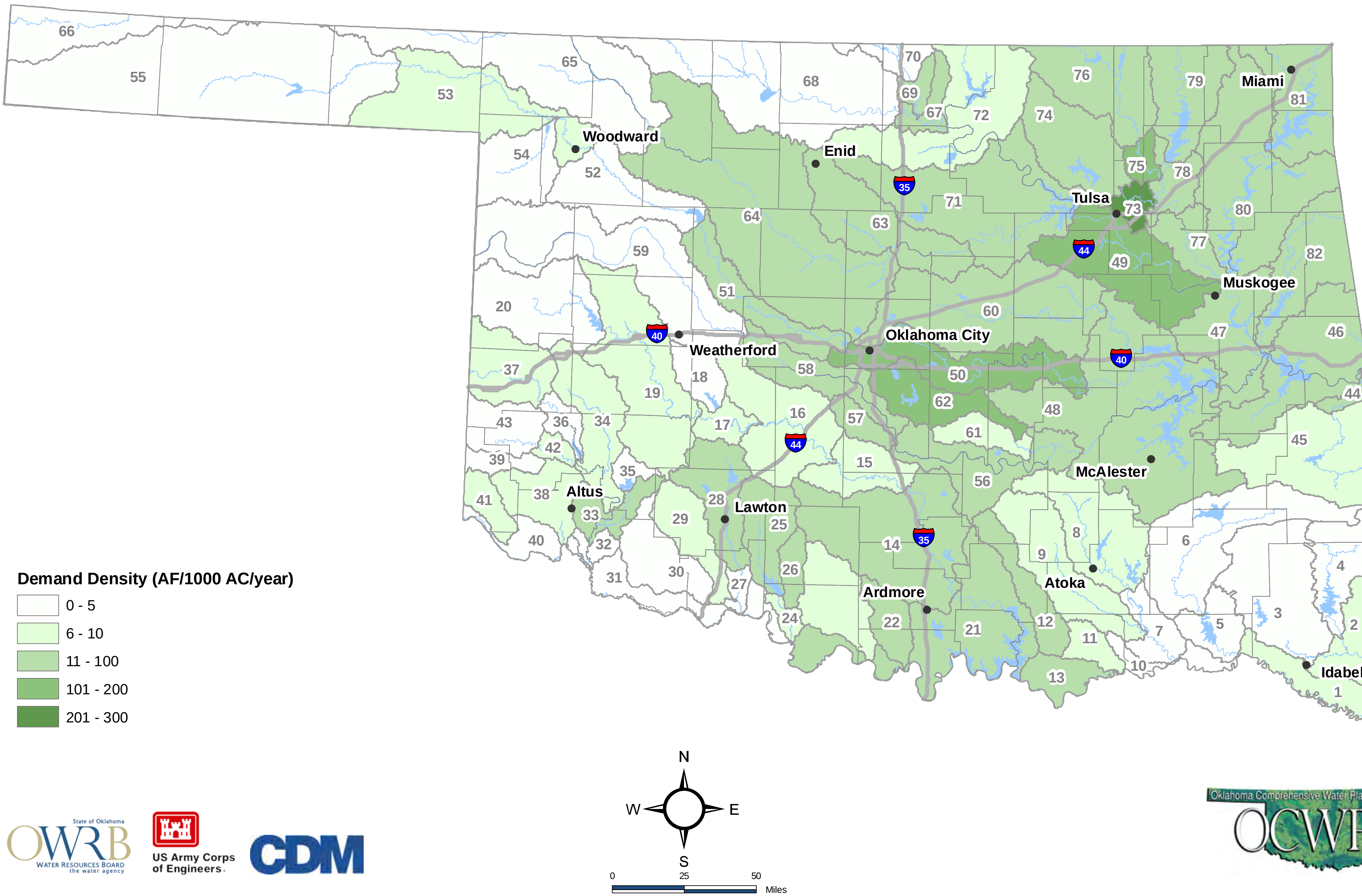
State of Oklahoma OWRB Water Resources Board the water agency

US Army Corps of Engineers

CDM

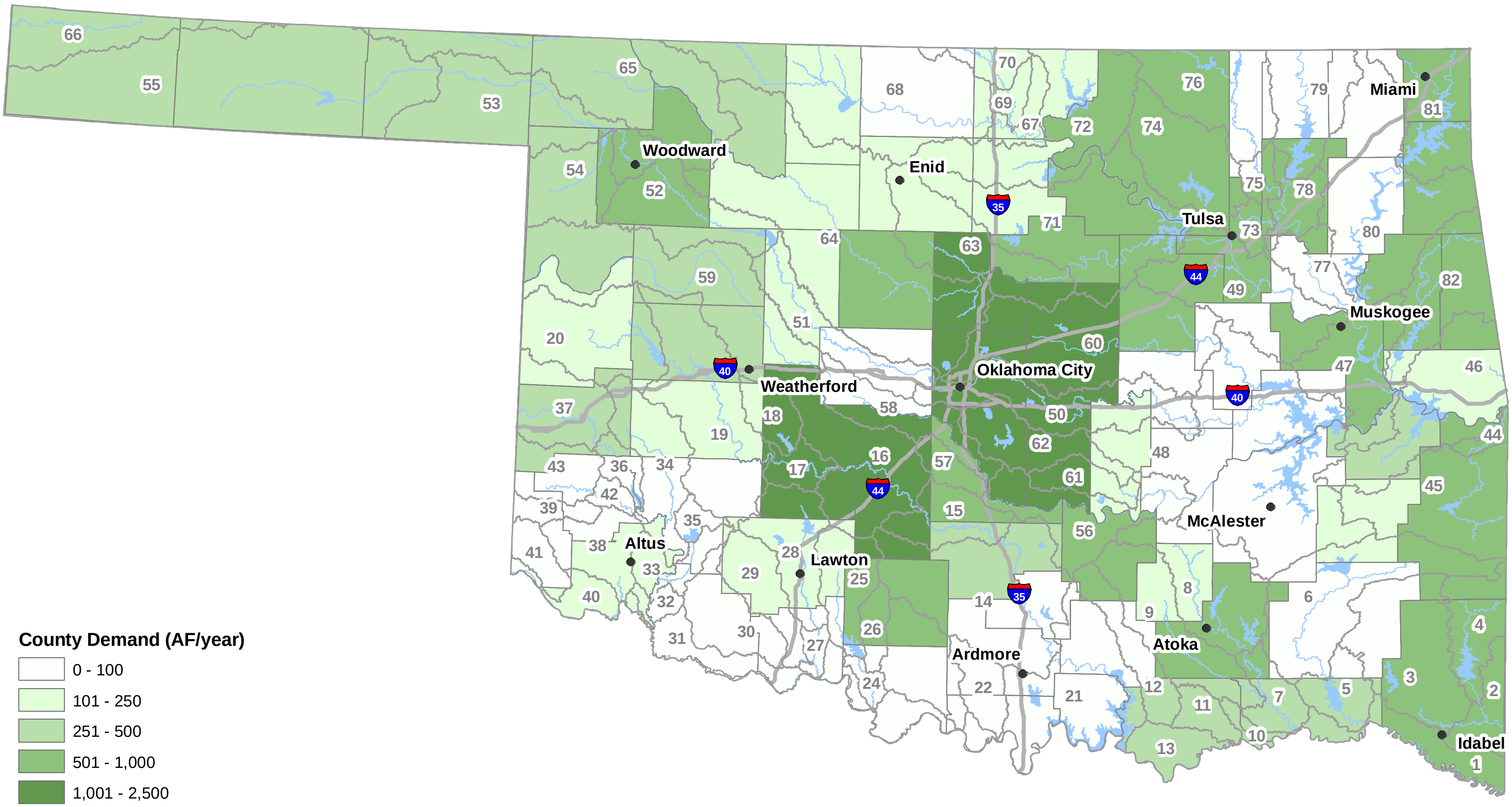
Oklahoma Comprehensive Water Plan OCWP

Figure 3-6 - 2060 Municipal and Industrial Demand Density



State of Oklahoma
OWRB
WATER RESOURCES BOARD
the water agency
US Army Corps of Engineers
CDM
Oklahoma Comprehensive Water Plan
OCWP

Figure 3-7 - 2010 Self Supplied Residential County Demand



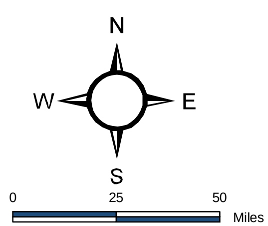
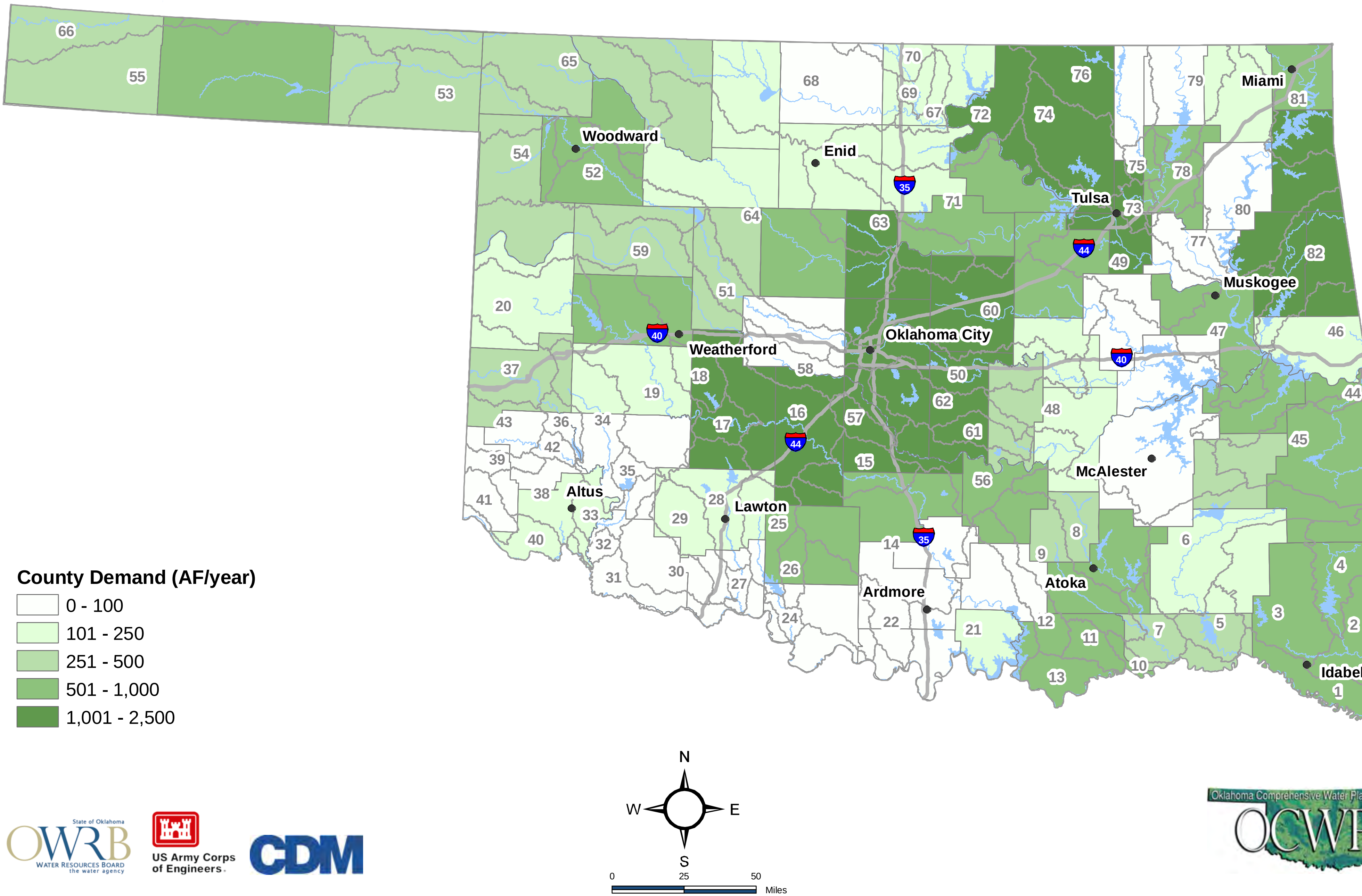


Figure 3-8 - 2060 Self Supplied Residential County Demand



OWRB State of Oklahoma Water Resources Board the water agency

US Army Corps of Engineers

CDM

Oklahoma Comprehensive Water Plan OCWP

Figure 3-9 - 2010 Self Supplied Residential Demand Density

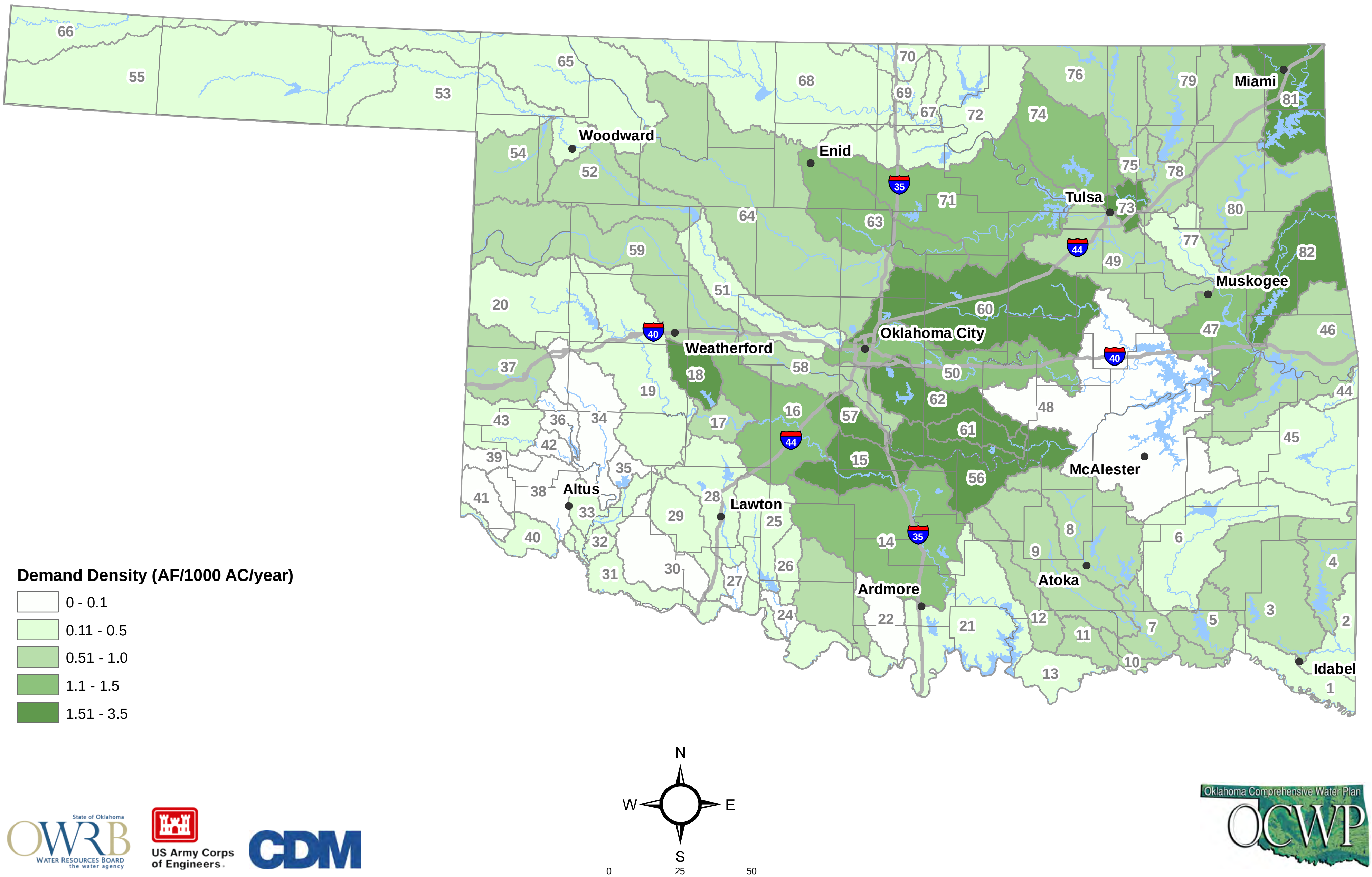
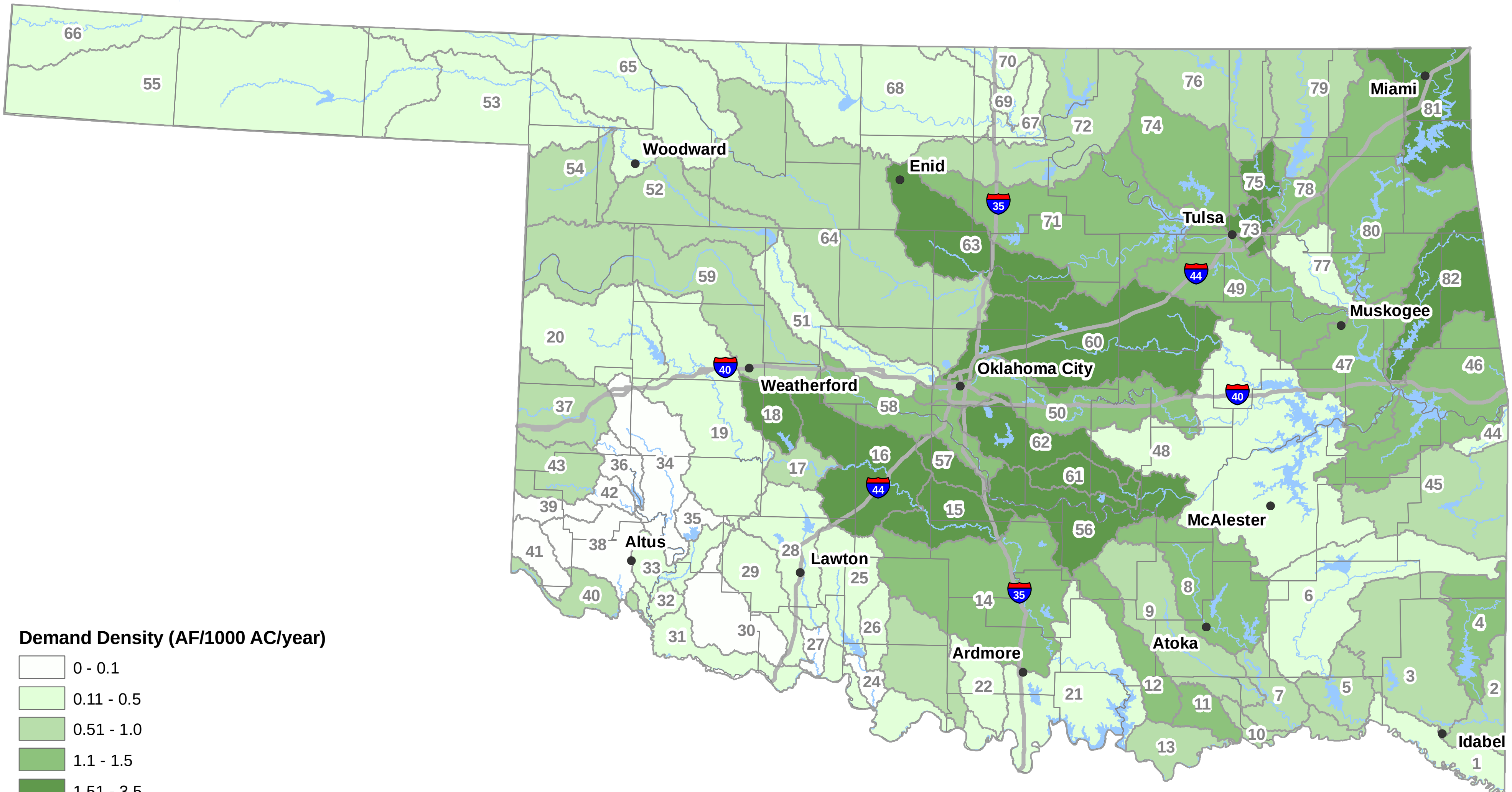


Figure 3-10 - 2060 Self Supplied Residential Demand Density



Demand Density (AF/1000 AC/year)

- 0 - 0.1
- 0.11 - 0.5
- 0.51 - 1.0
- 1.1 - 1.5
- 1.51 - 3.5

State of Oklahoma OWRB WATER RESOURCES BOARD the water agency

US Army Corps of Engineers

CDM

Oklahoma Comprehensive Water Plan OCWP

Figure 3-11 - 2010 Self Supplied Industrial County Demand

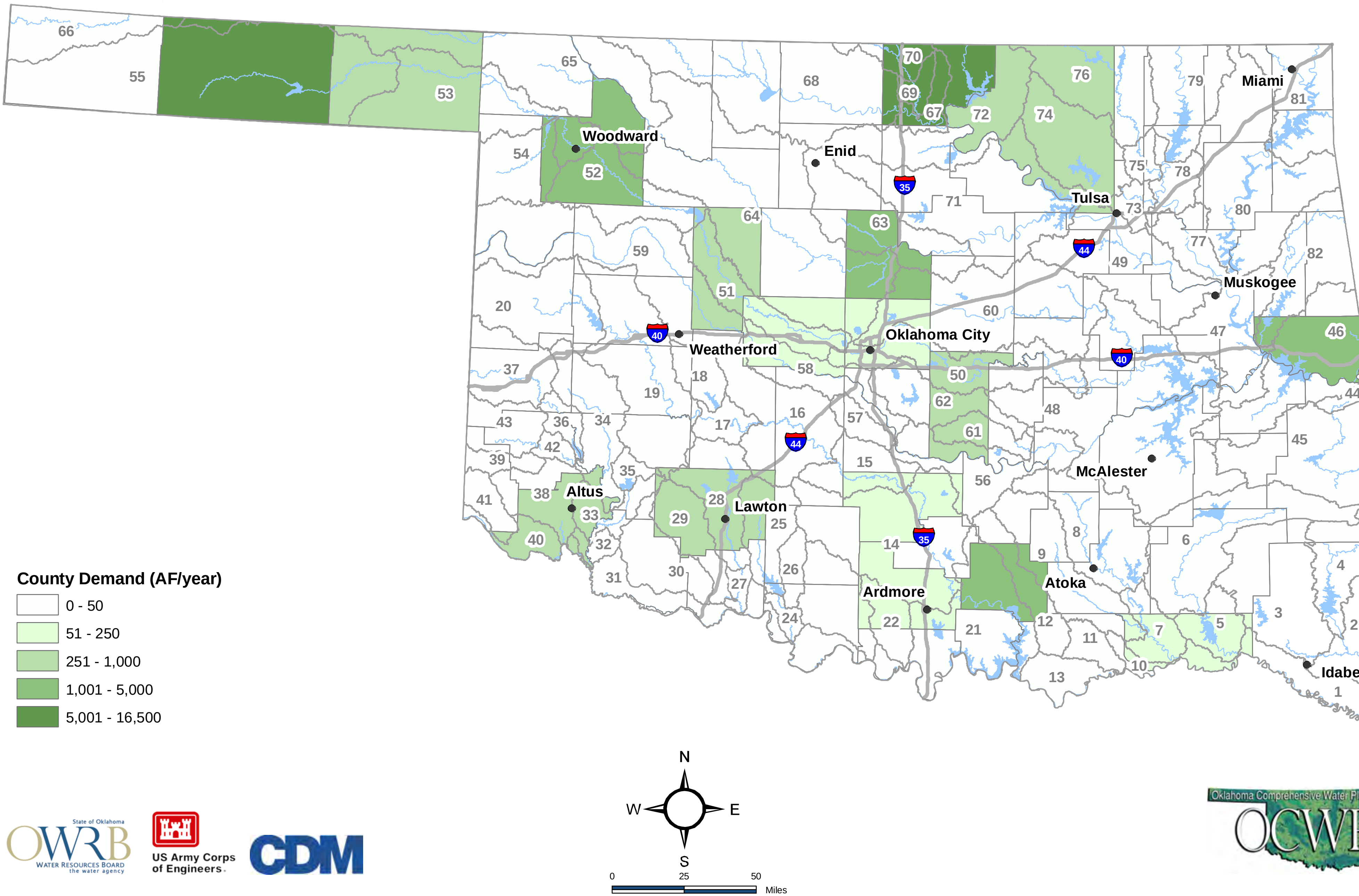
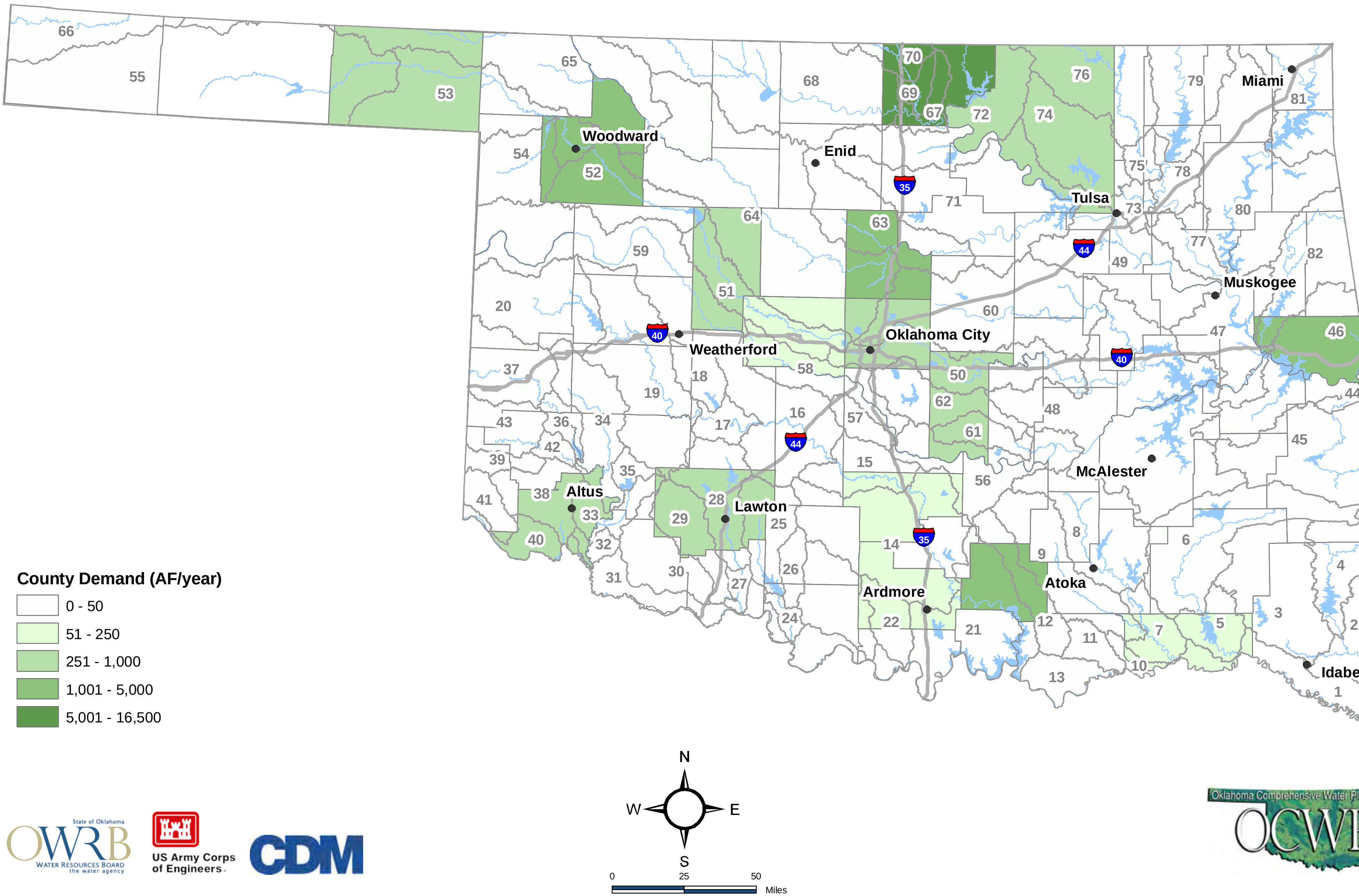


Figure 3-12 - 2060 Self Supplied Industrial County Demand



State of Oklahoma OWRB WATER RESOURCES BOARD the water agency

US Army Corps of Engineers

CDM

Oklahoma Comprehensive Water Plan OCWP

Figure 3-13 - 2010 Self Supplied Industrial Demand Density

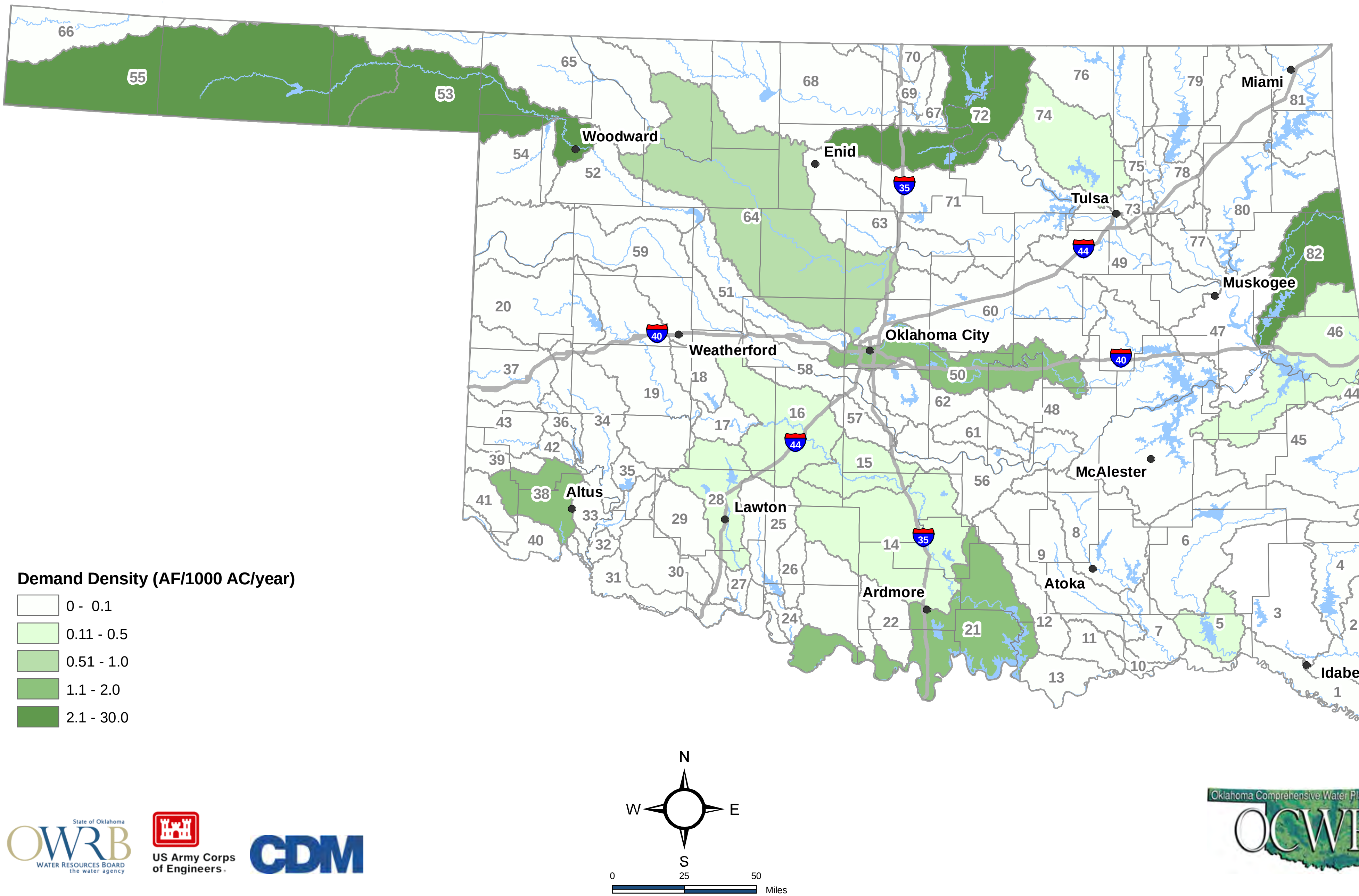
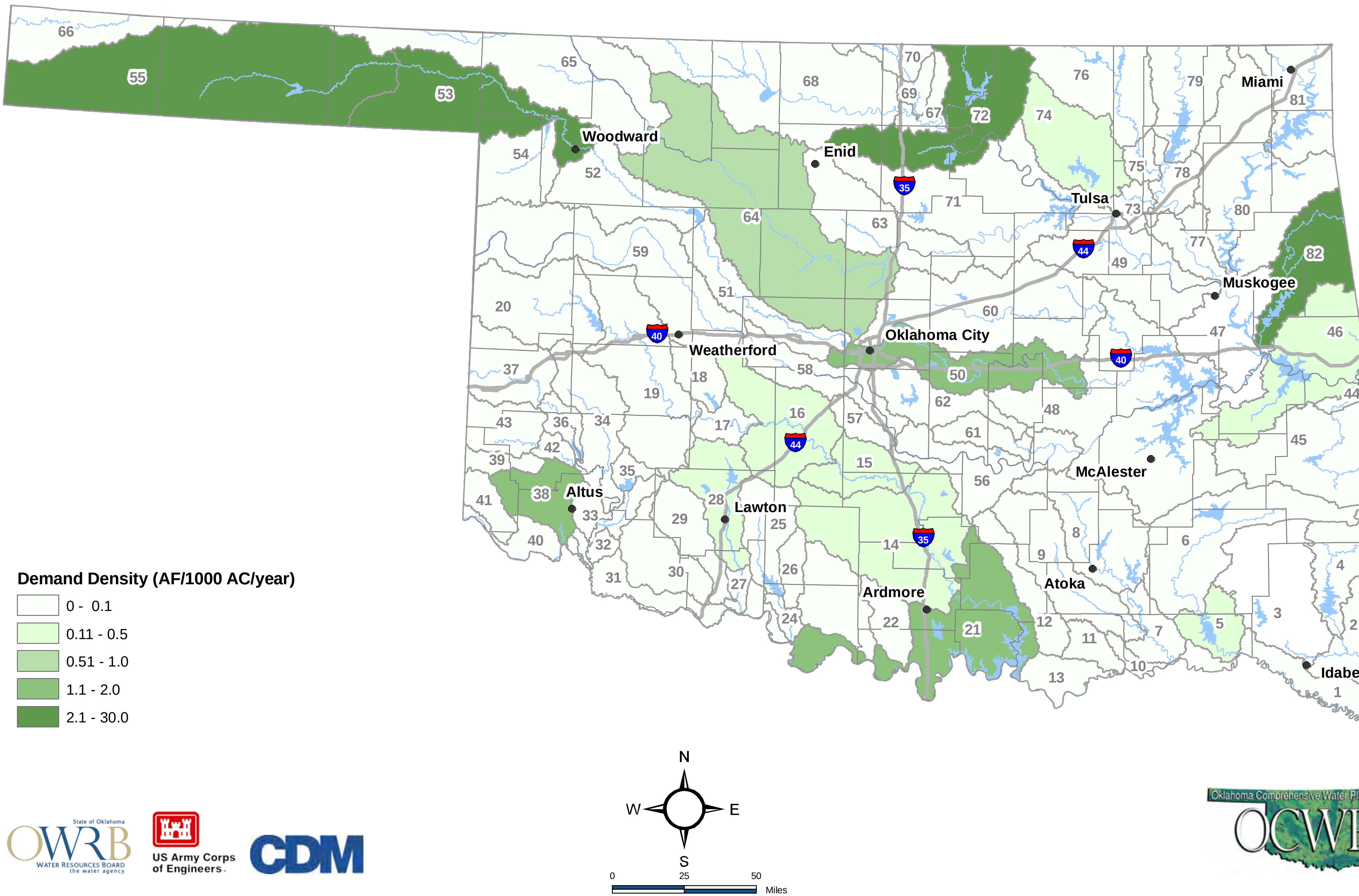


Figure 3-14 - 2060 Self Supplied Industrial Demand Density



State of Oklahoma
OWRB
WATER RESOURCES BOARD
the water agency

US Army Corps of Engineers

CDM

Oklahoma Comprehensive Water Plan
OCWP

Figure 3-15 - Locations and Names of Oklahoma Thermoelectric Power Plants

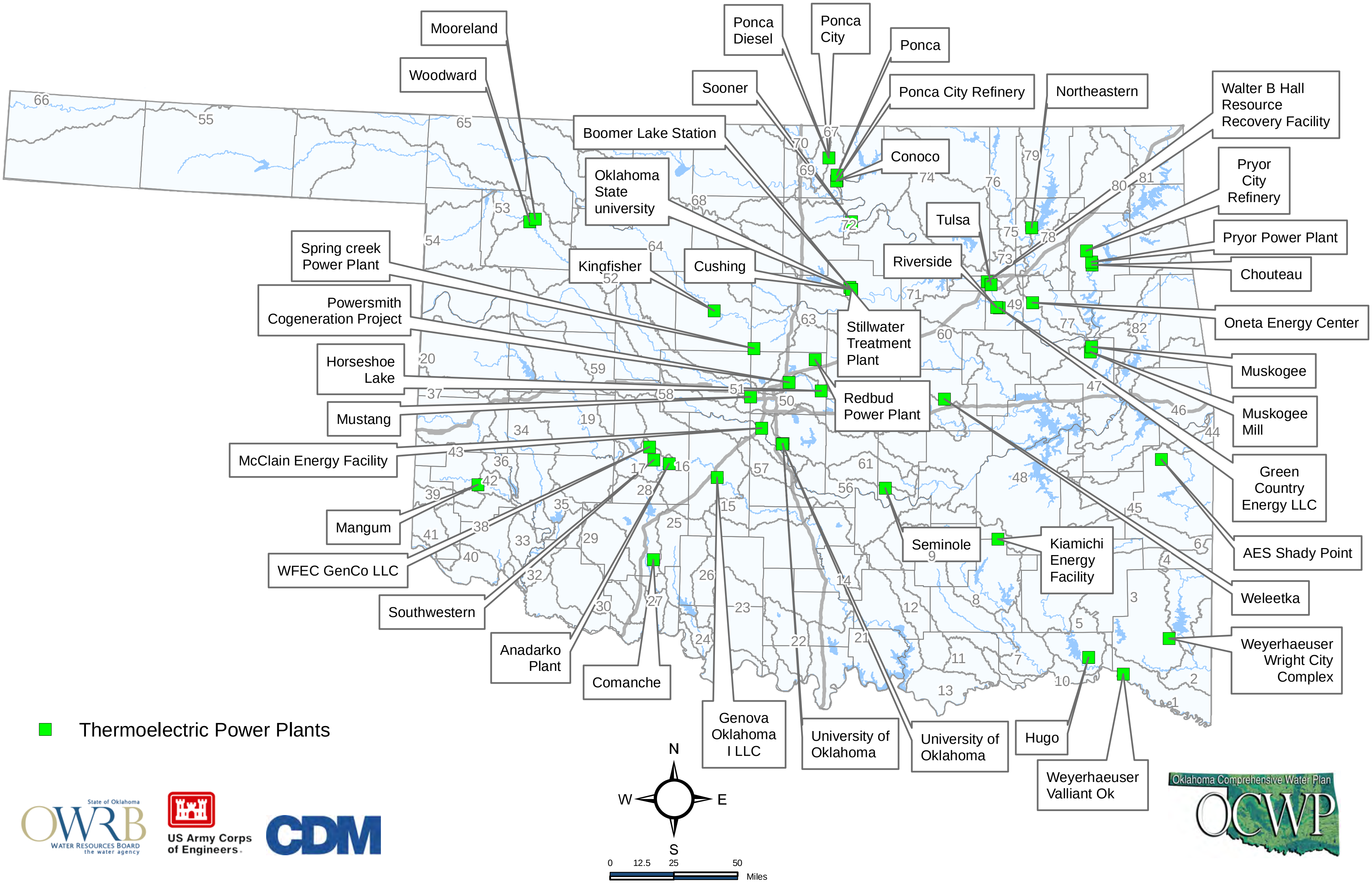


Figure 3-16 - 2010 Thermoelectric Power County Demand

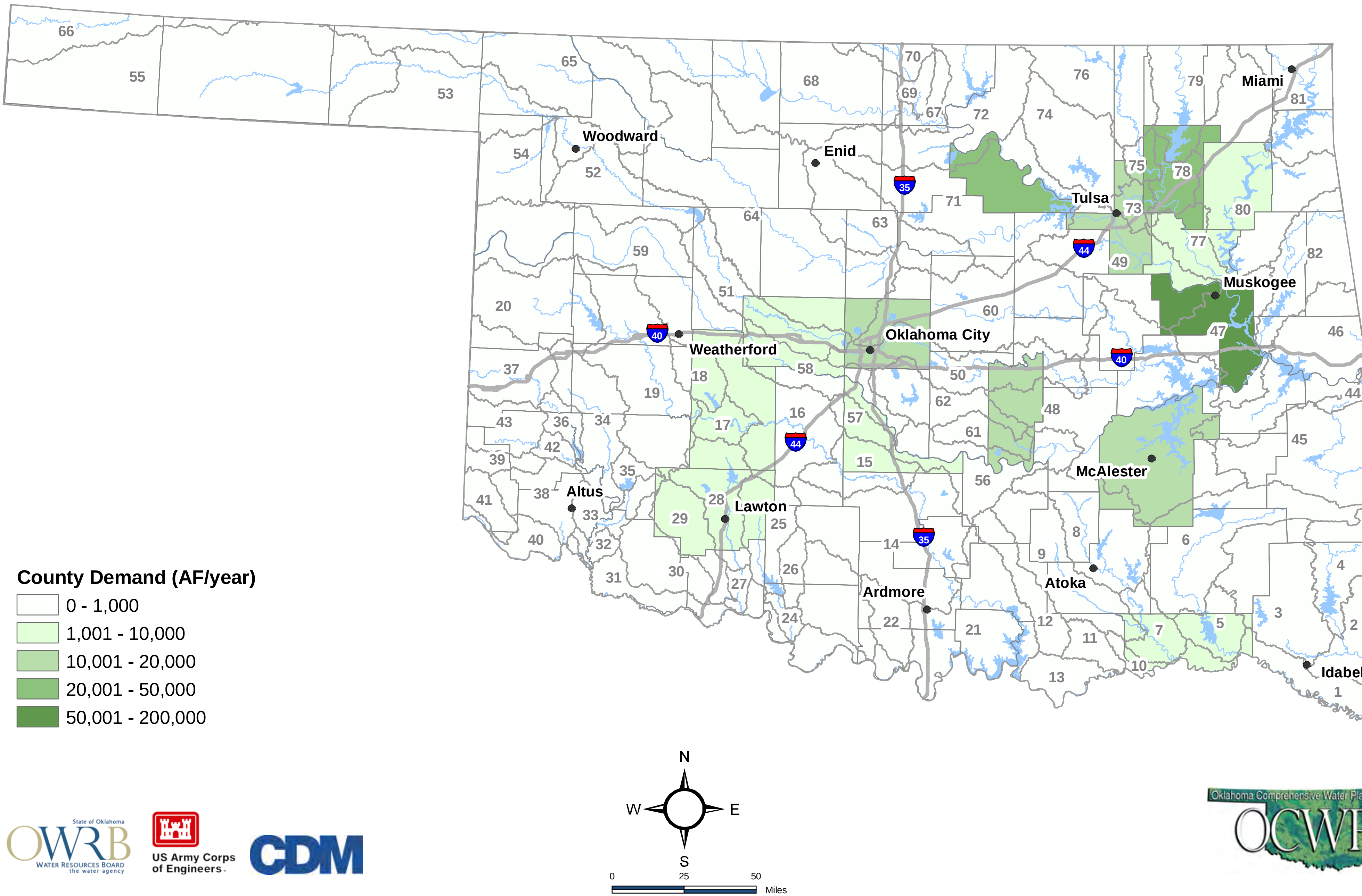


Figure 3-17 - 2060 Thermoelectric Power County Demand

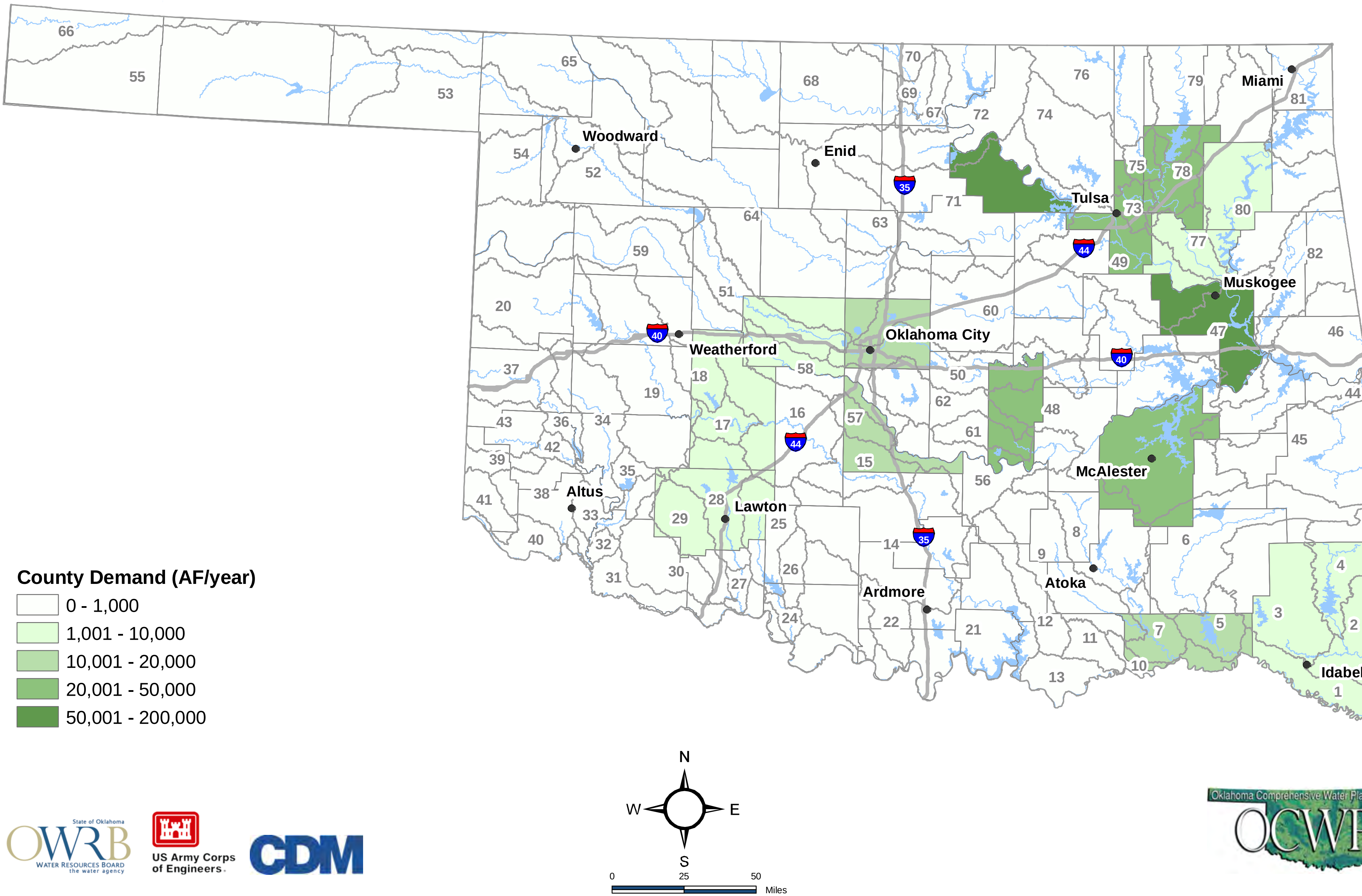
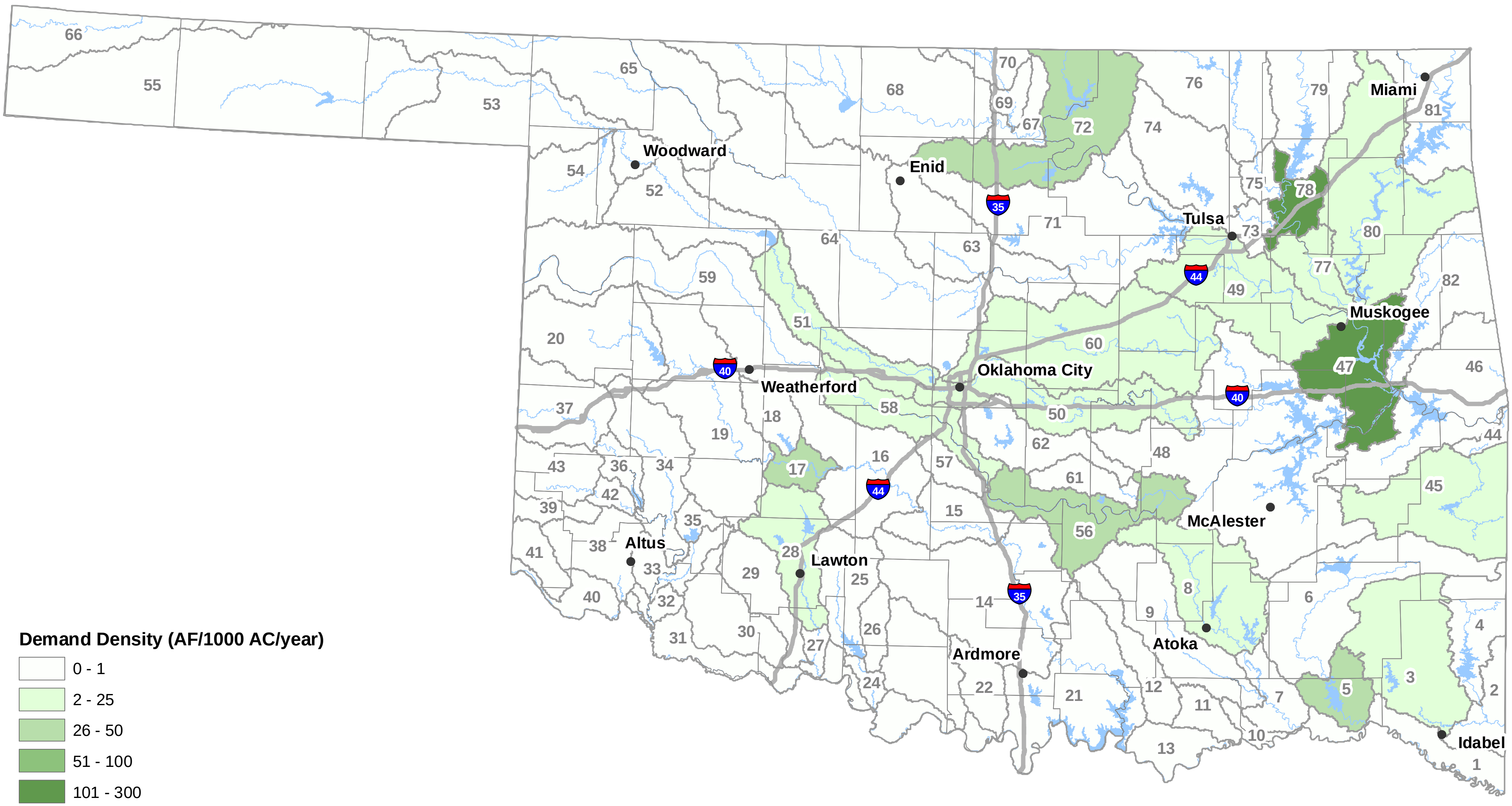


Figure 3-18 - 2010 Thermoelectric Power Demand Density



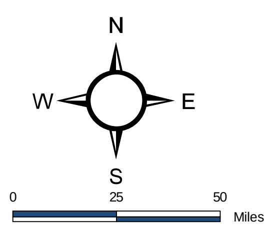
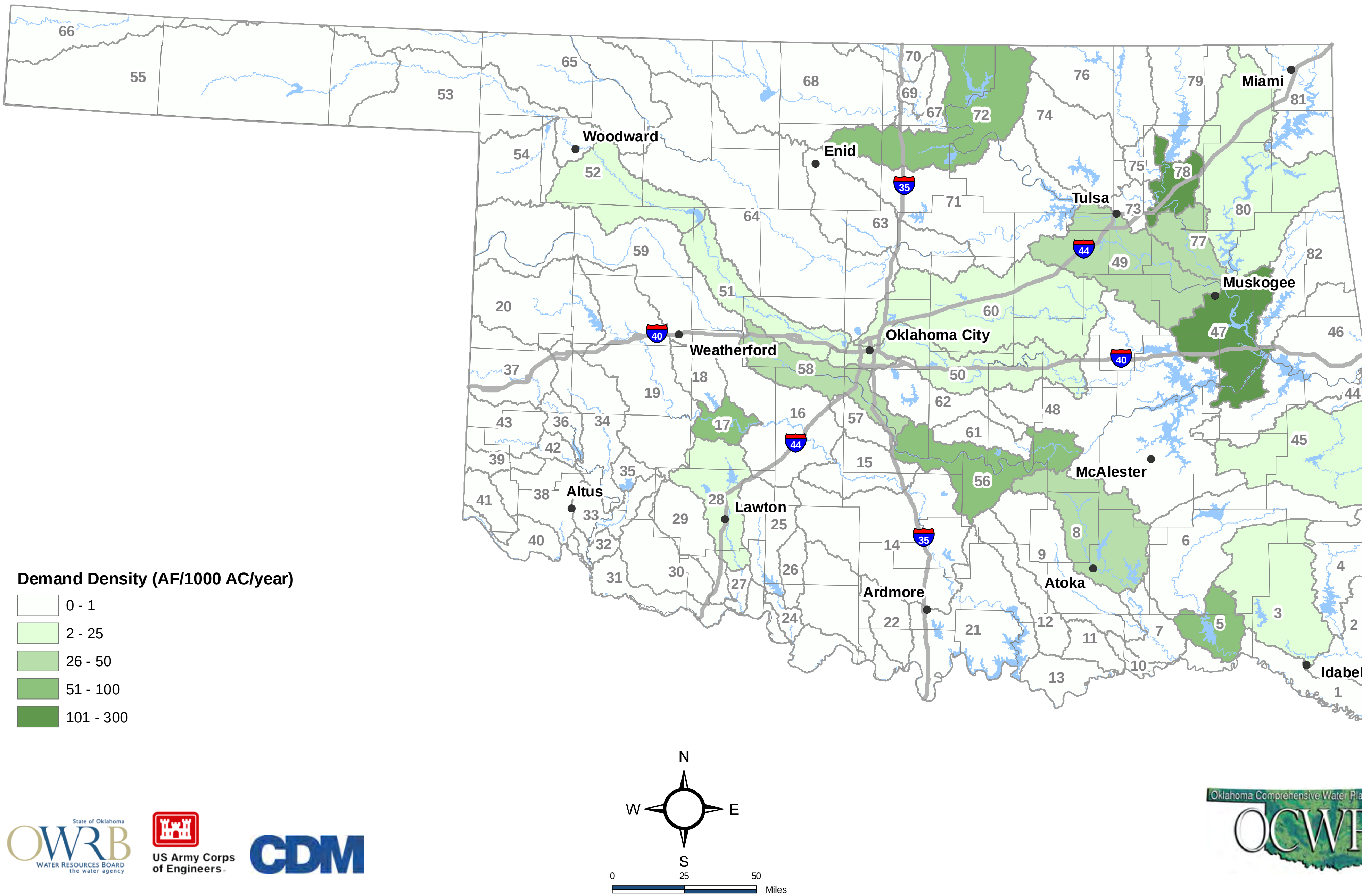


Figure 3-19 - 2060 Thermoelectric Power Demand Density



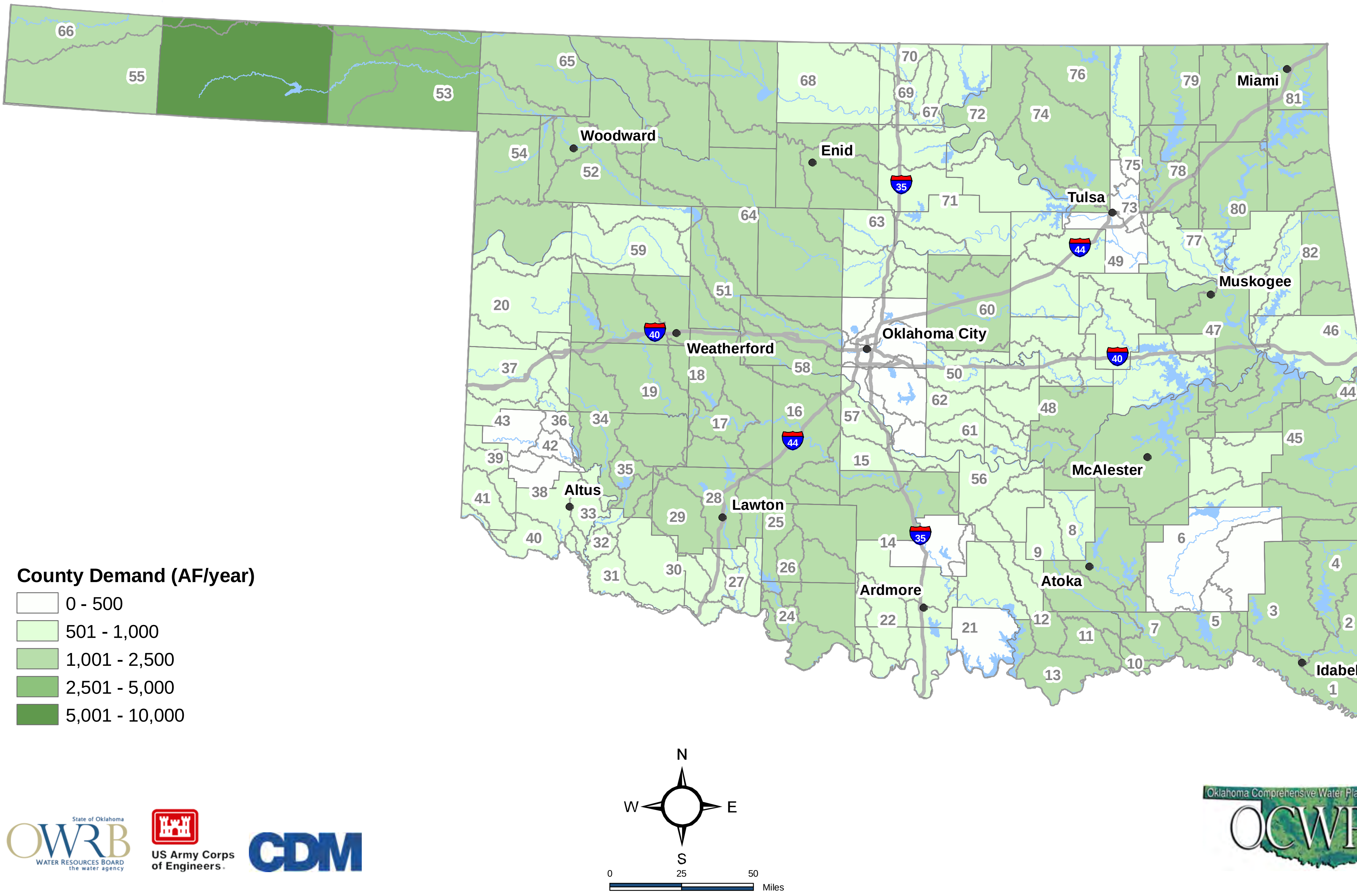
US Army Corps of Engineers

OWRB Water Resources Board

CDM

Oklahoma Comprehensive Water Plan OCWP

Figure 3-20 - 2010 Livestock County Demand



State of Oklahoma OWRB WATER RESOURCES BOARD the water agency

US Army Corps of Engineers

CDM

Oklahoma Comprehensive Water Plan OCWP

Figure 3-21 - 2060 Livestock County Demand

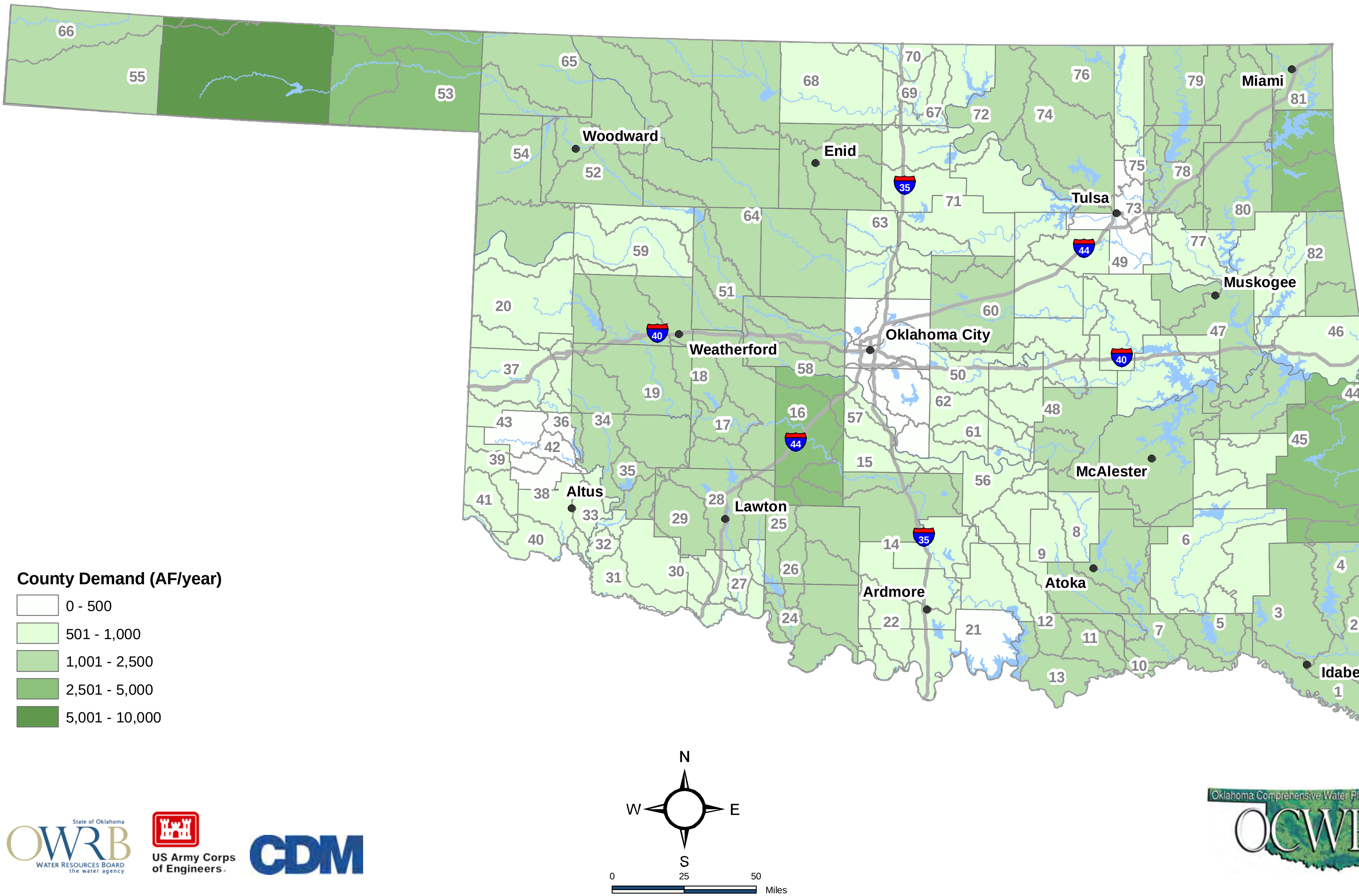
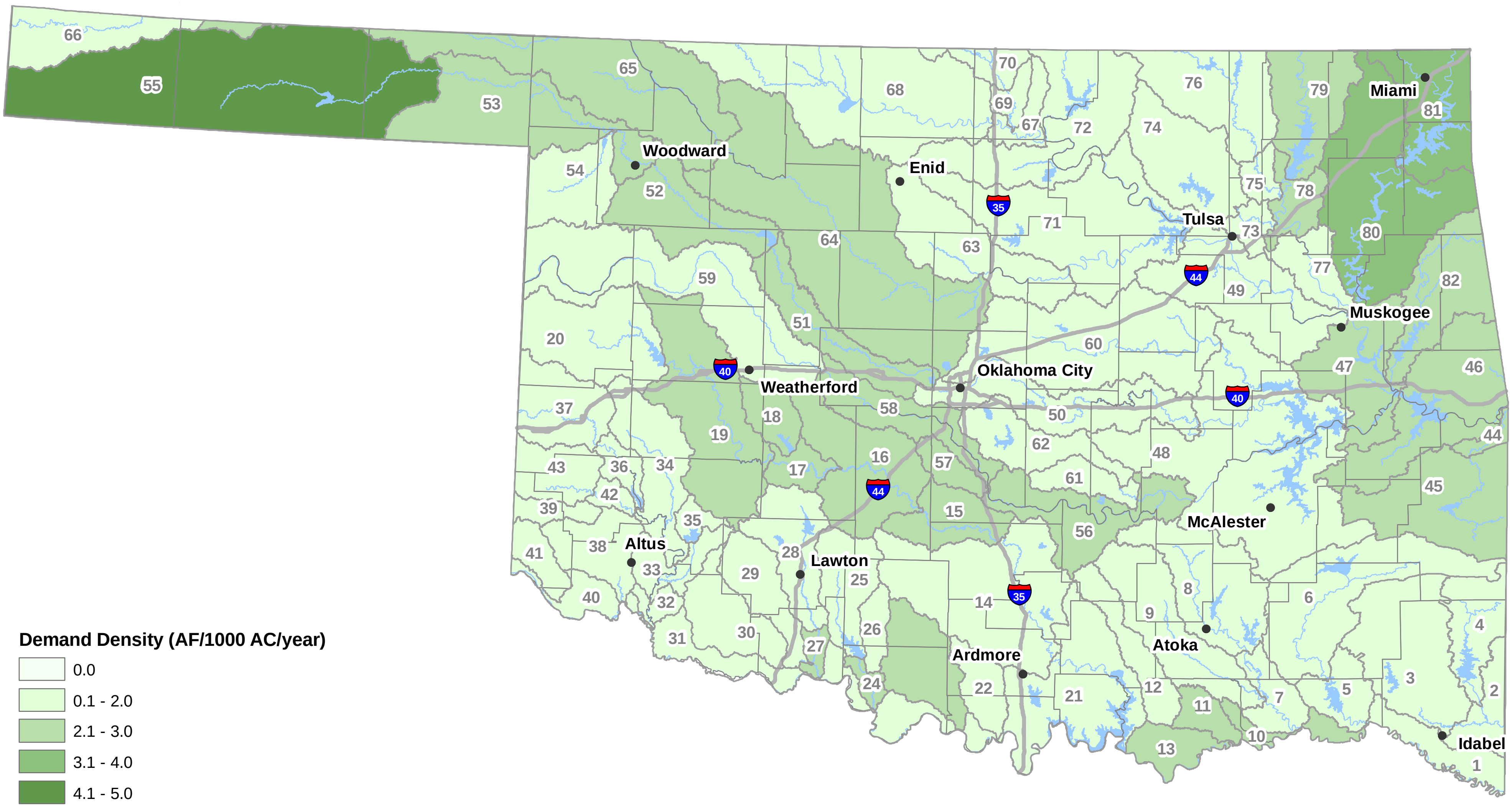
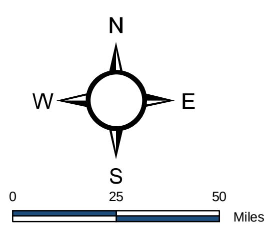


Figure 3-22 - 2010 Livestock Demand Density



Demand Density (AF/1000 AC/year)

- 0.0
- 0.1 - 2.0
- 2.1 - 3.0
- 3.1 - 4.0
- 4.1 - 5.0



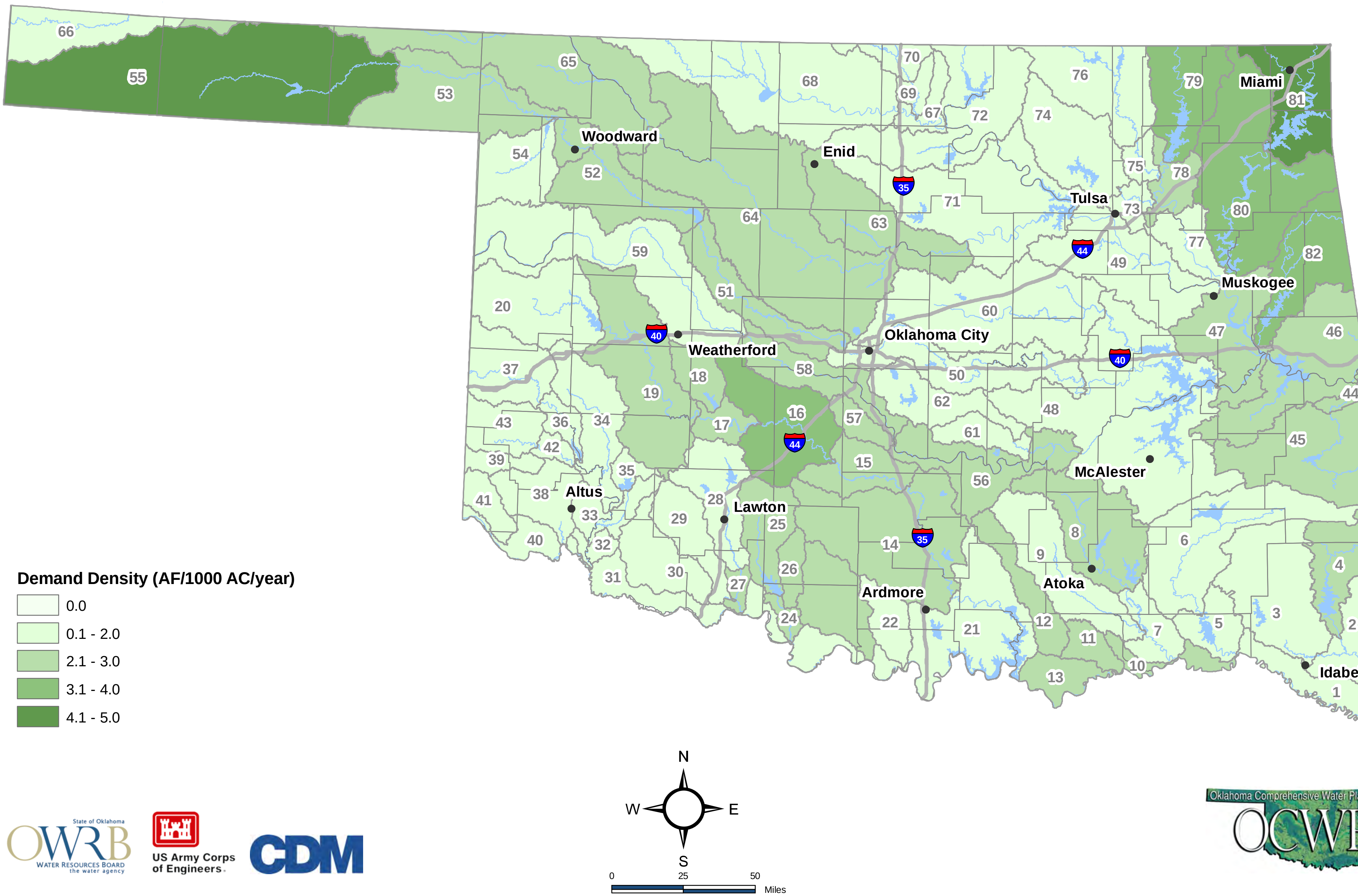
State of Oklahoma OWRB WATER RESOURCES BOARD the water agency

US Army Corps of Engineers

CDM

Oklahoma Comprehensive Water Plan OCWP

Figure 3-23 - 2060 Livestock Demand Density



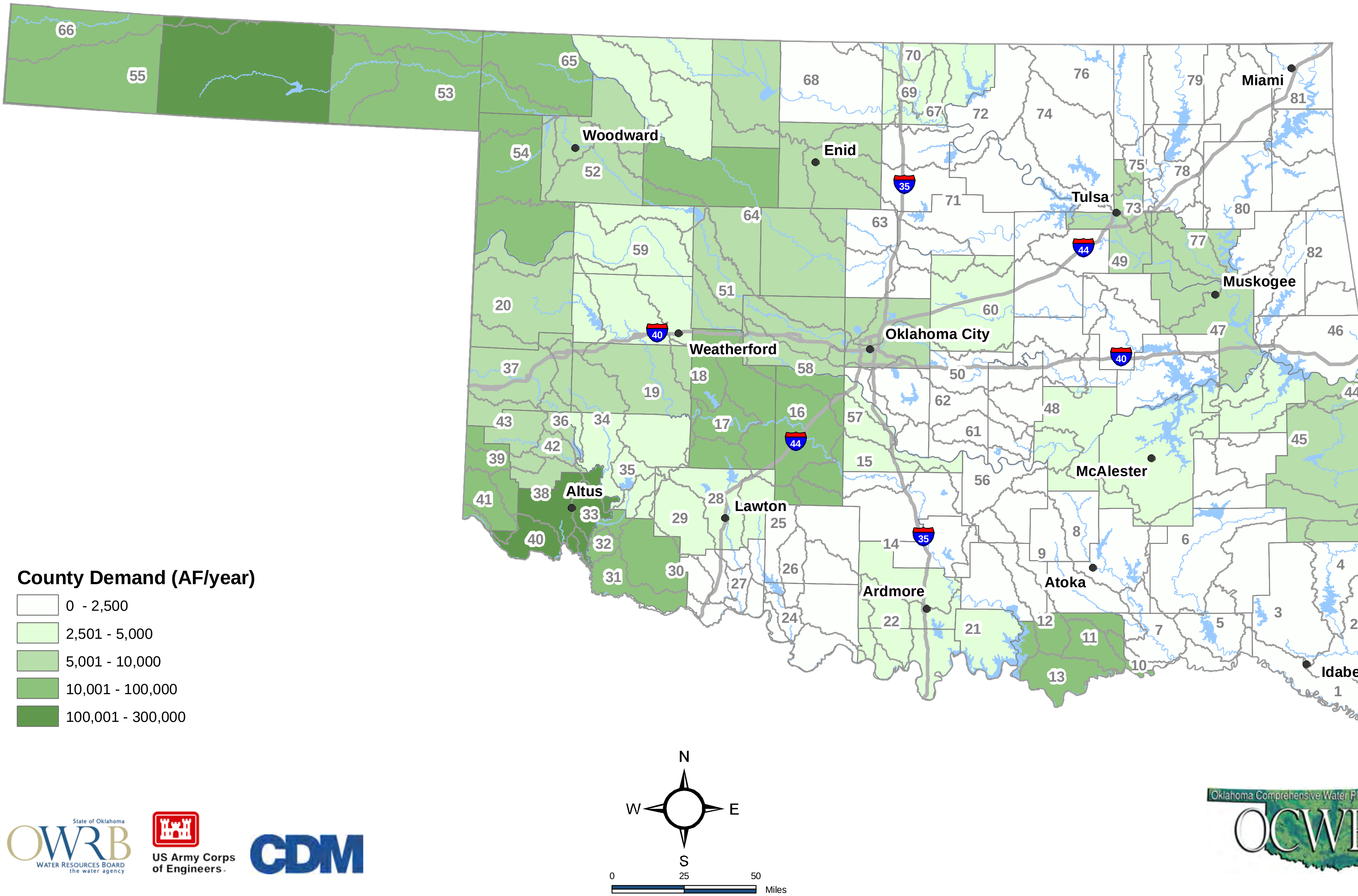
State of Oklahoma OWRB Water Resources Board the water agency

US Army Corps of Engineers

CDM

Oklahoma Comprehensive Water Plan OCWP

Figure 3-24 - 2010 Crop Irrigation County Demand



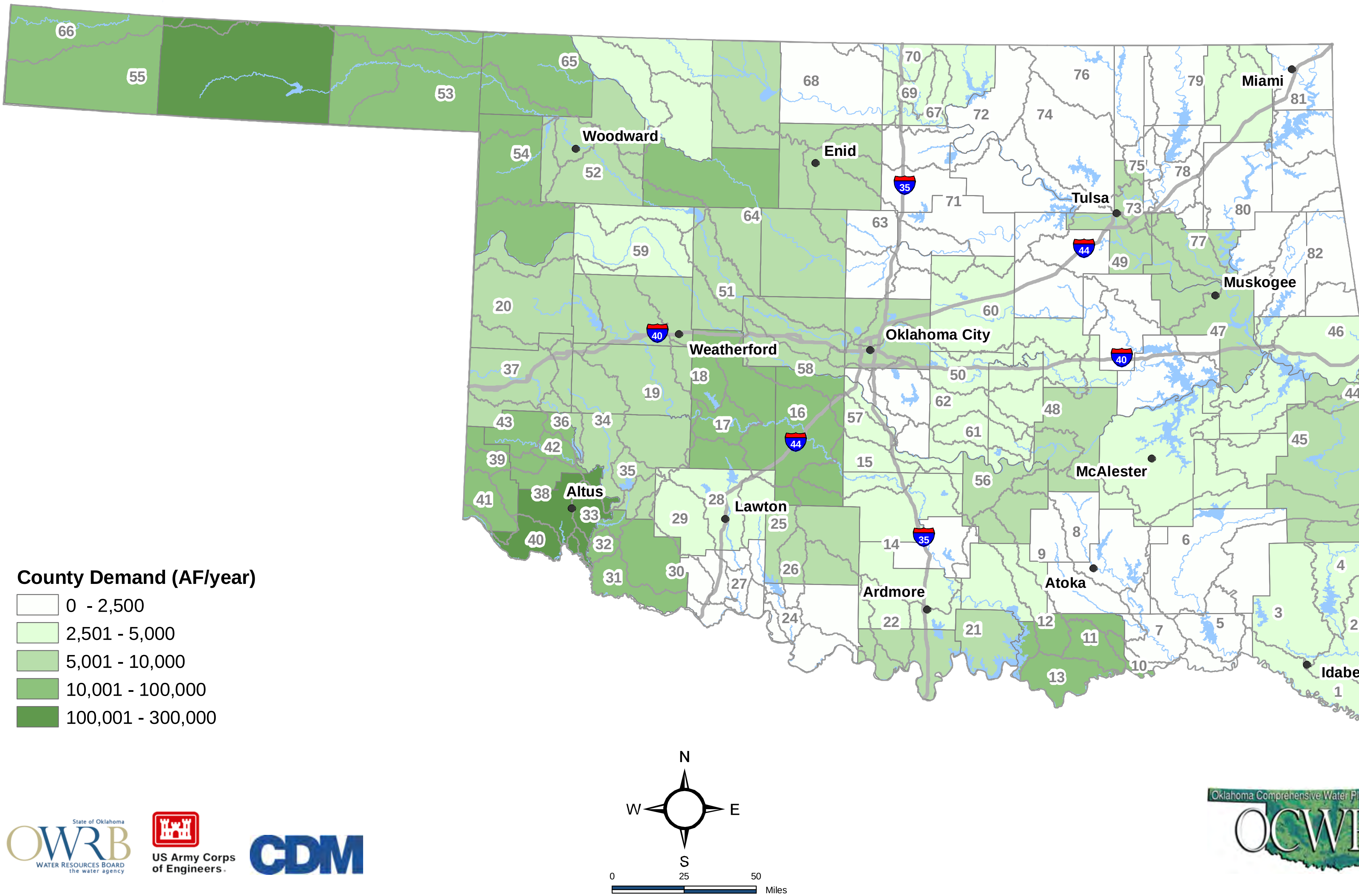
State of Oklahoma
OWRB
WATER RESOURCES BOARD
the water agency

US Army Corps of Engineers

CDM

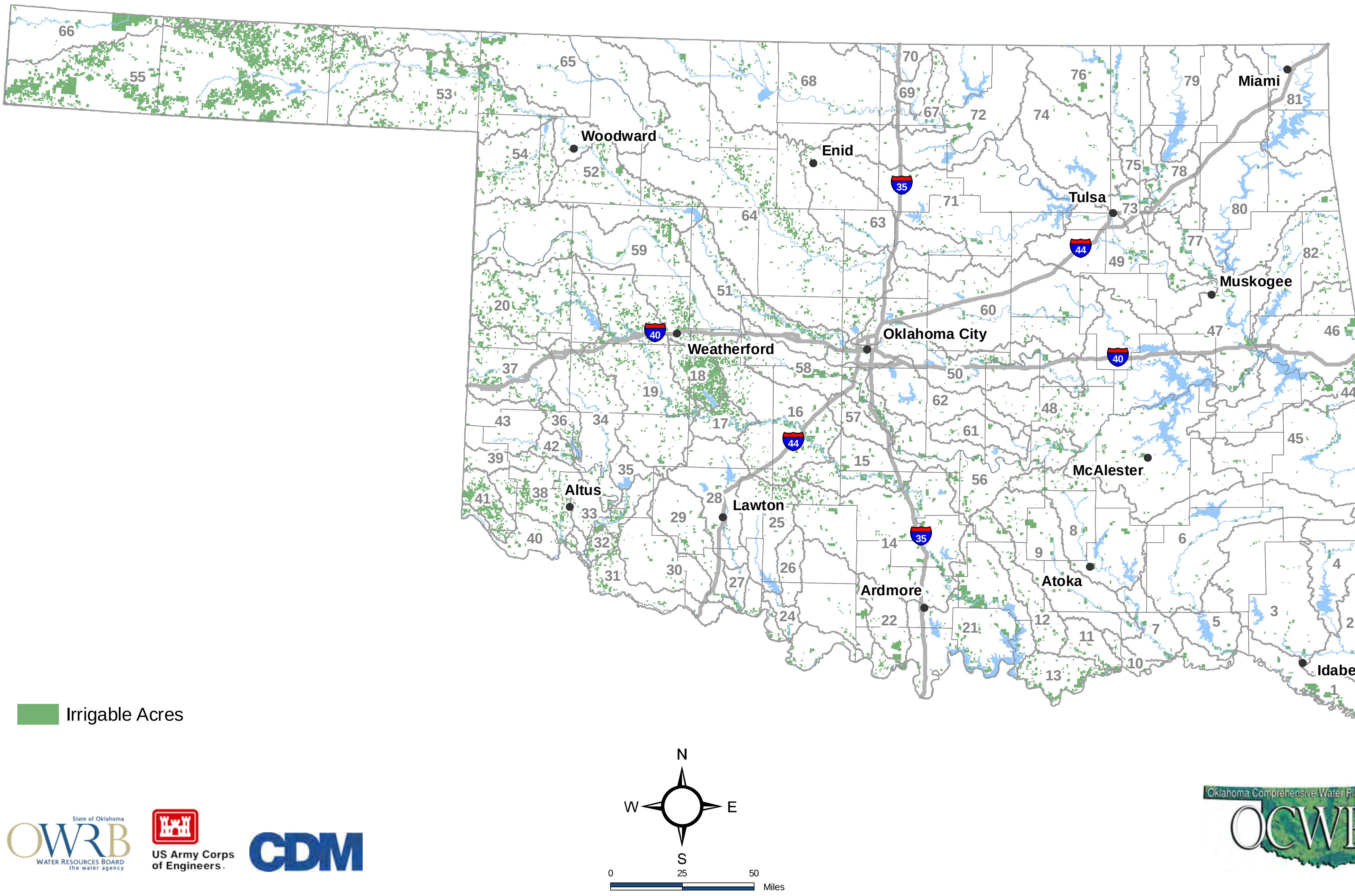
Oklahoma Comprehensive Water Plan
OCWP

Figure 3-25 - 2060 Crop Irrigation County Demand



US Army Corps of Engineers

Figure 3-26 - Irrigated Lands based on the Oklahoma Water Rights Database



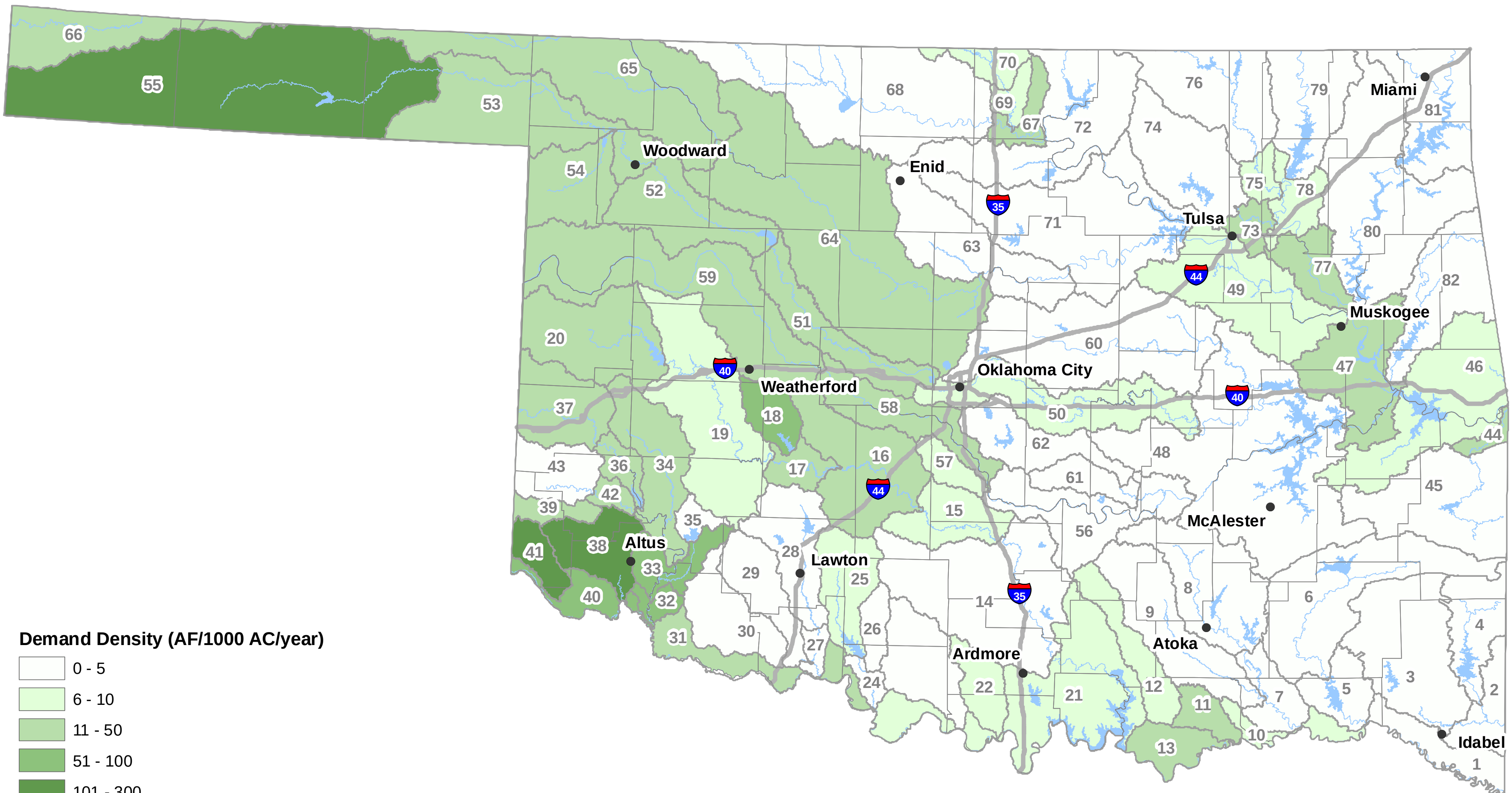
OWRB State of Oklahoma Water Resources Board the water agency

US Army Corps of Engineers

CDM

Oklahoma Comprehensive Water Plan OCWP

Figure 3-27 - 2010 Crop Irrigation Demand Density



Demand Density (AF/1000 AC/year)

- 0 - 5
- 6 - 10
- 11 - 50
- 51 - 100
- 101 - 300

N W E S

0 25 50 Miles

State of Oklahoma OWRB WATER RESOURCES BOARD the water agency

US Army Corps of Engineers

CDM

Oklahoma Comprehensive Water Plan OCWP

Figure 3-28 - 2060 Crop Irrigation Demand Density

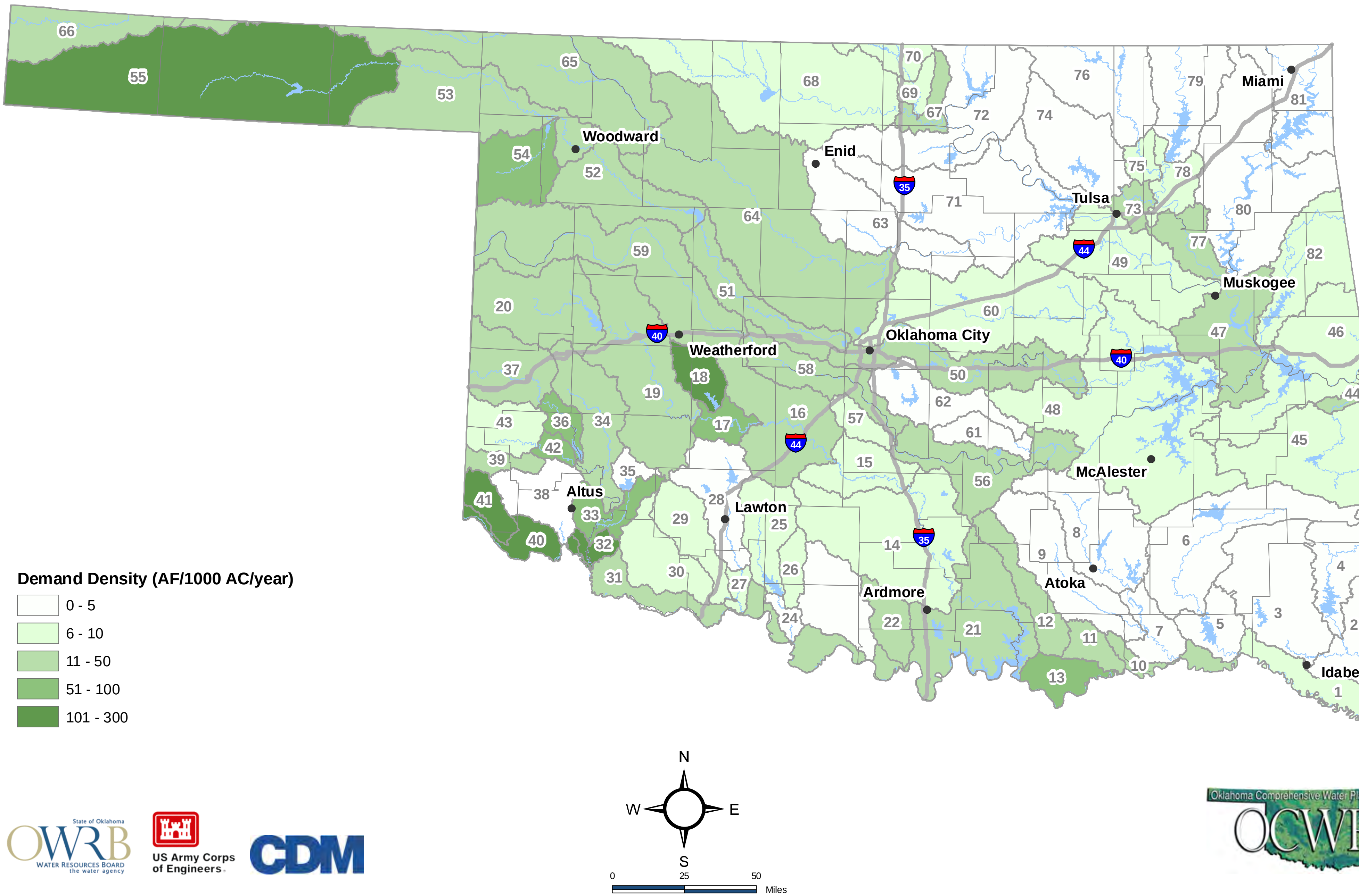


Figure 3-29 - 2010 Oil and Gas County Demand

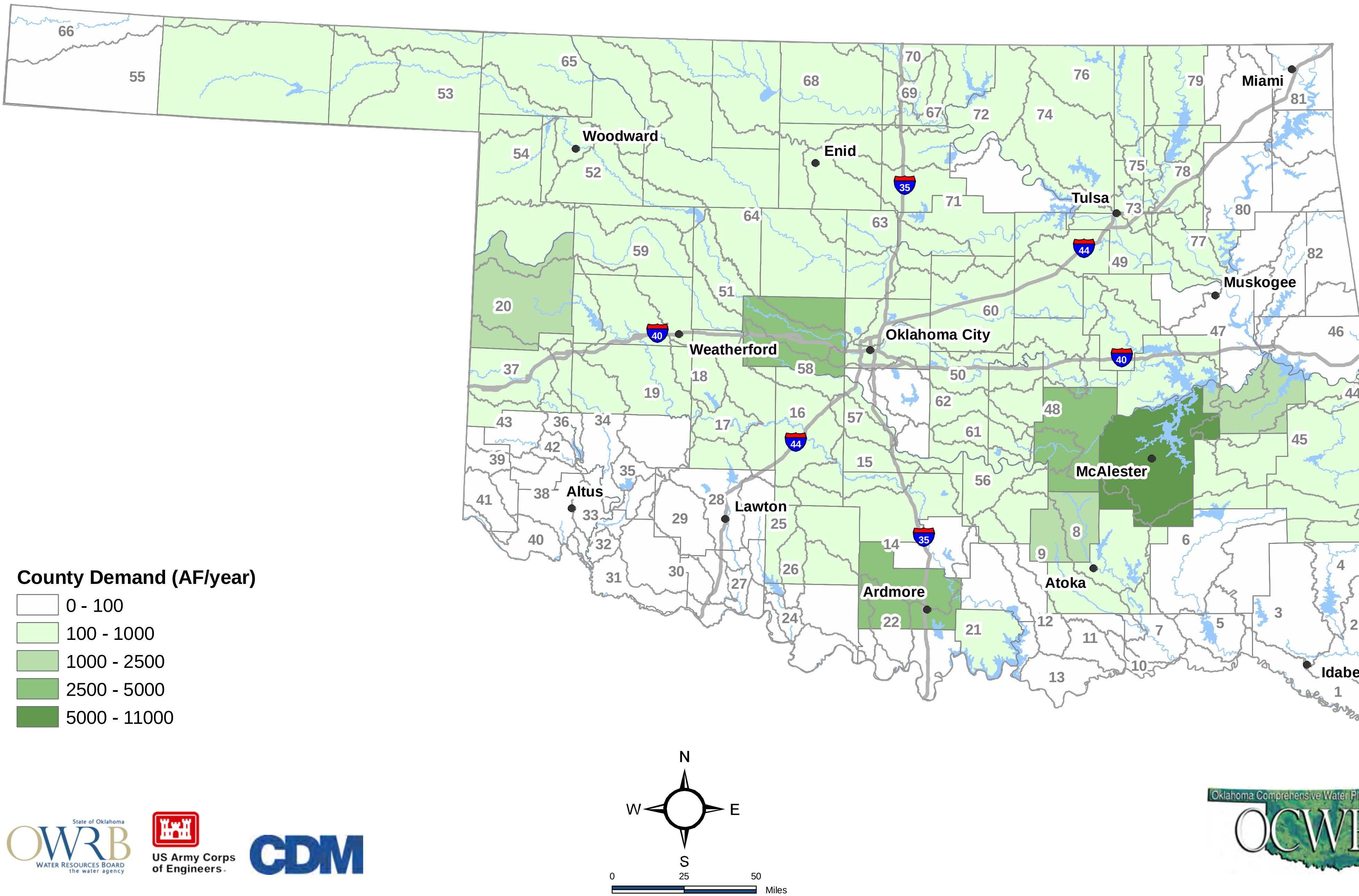
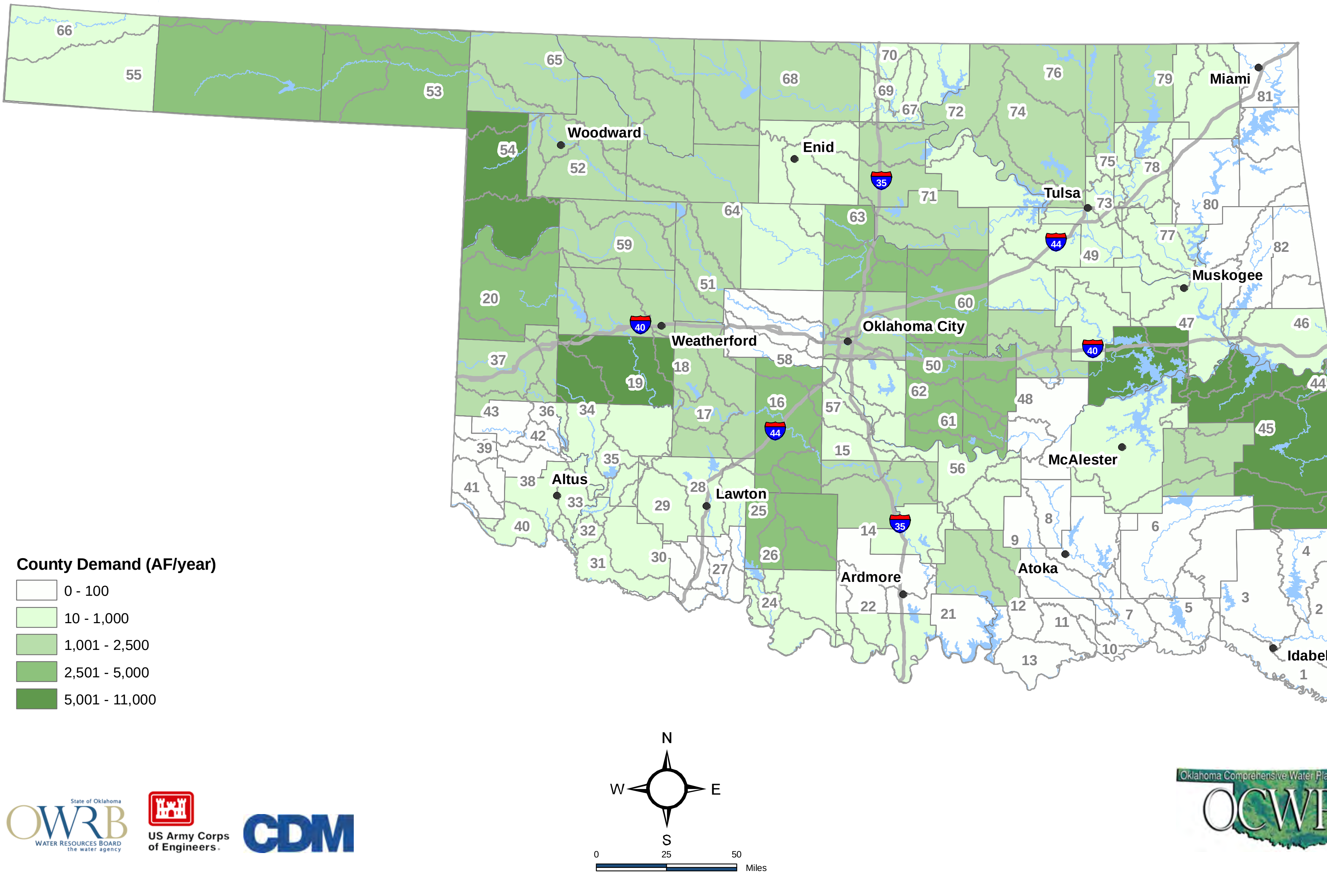


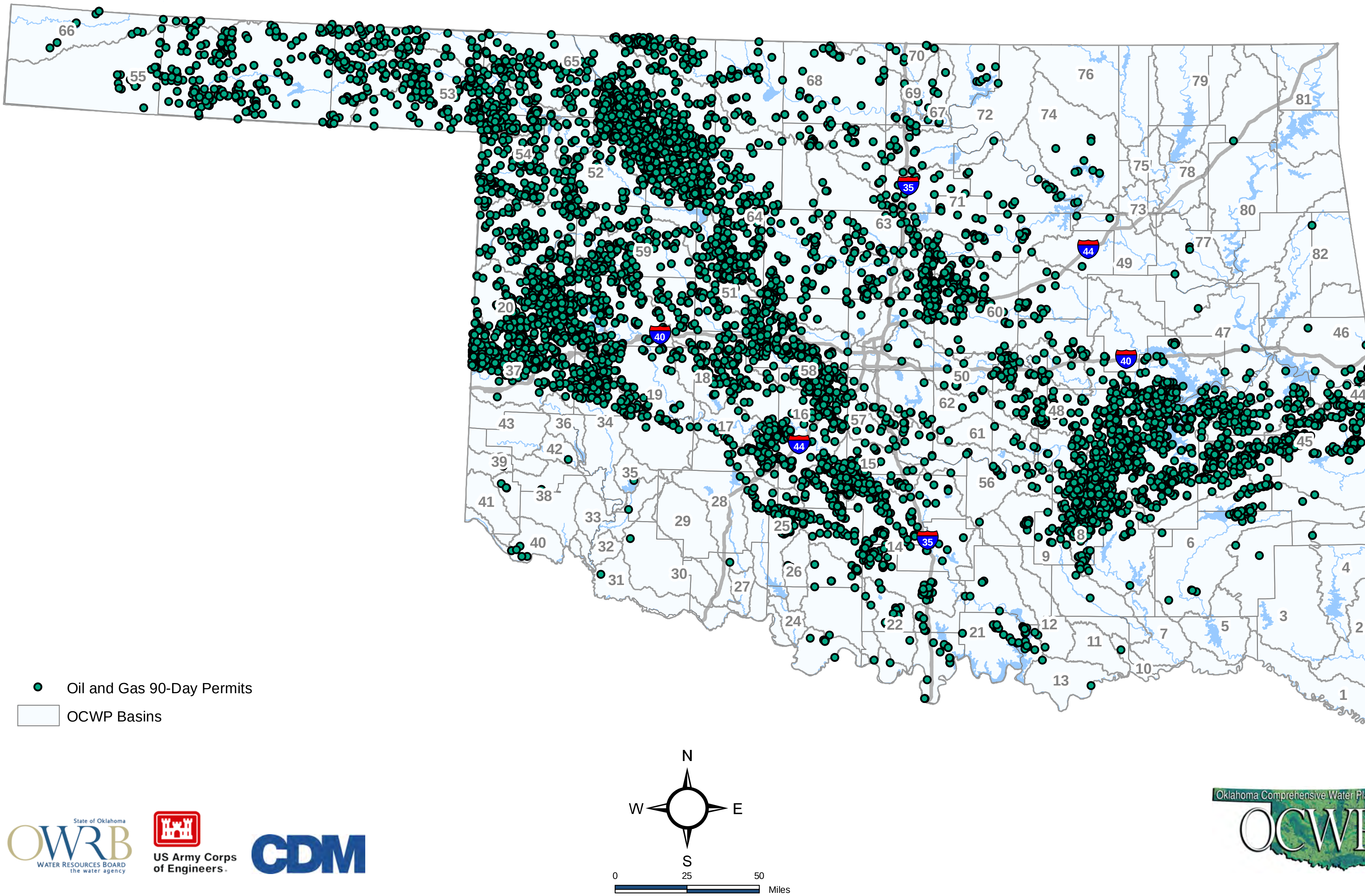
Figure 3-30 - 2060 Oil and Gas County Demand



US Army Corps of Engineers

Oklahoma Comprehensive Water Plan

Figure 3-31 - Oil & Gas 90-Day Permits from 2000 - 2008



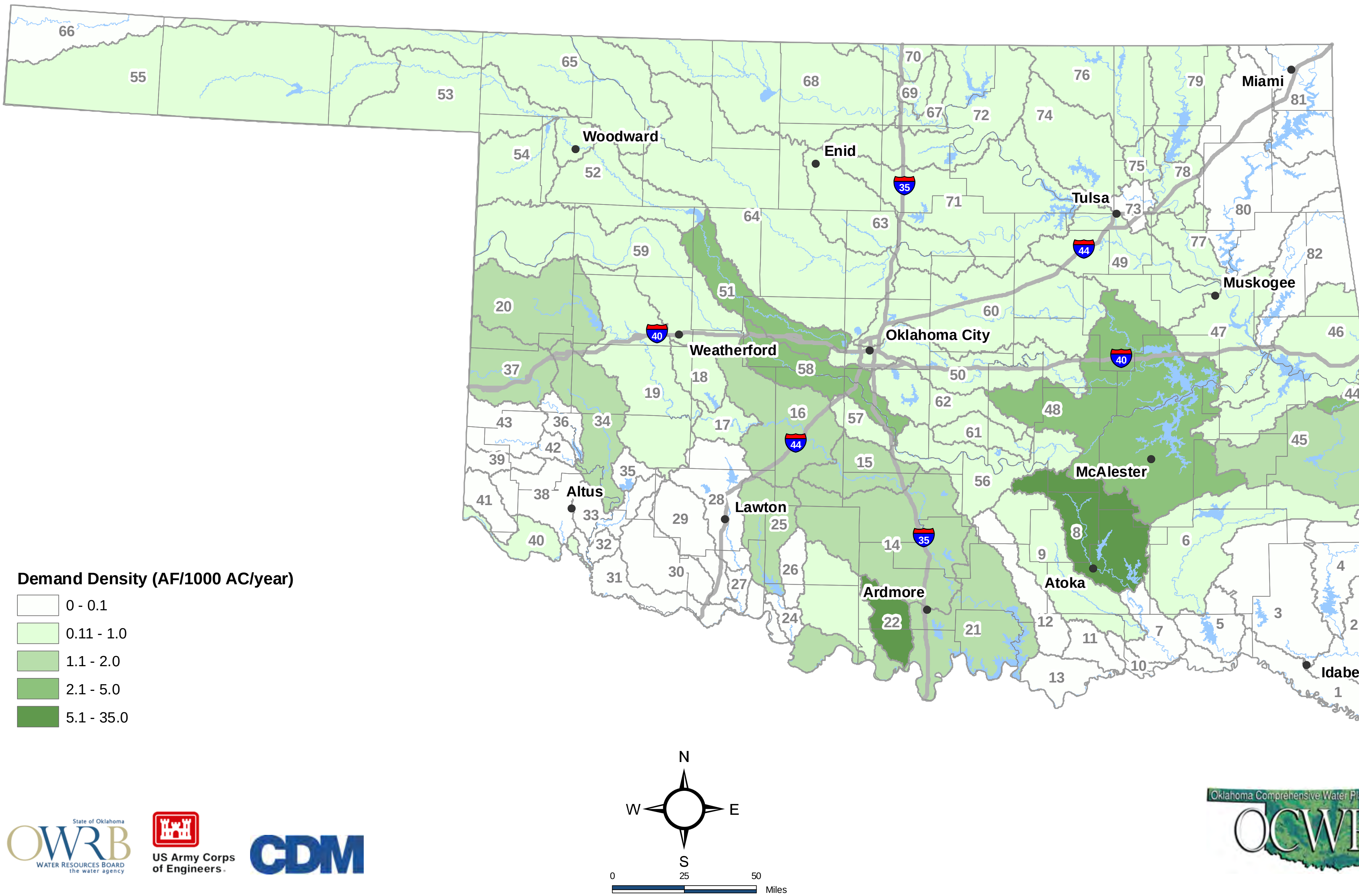
State of Oklahoma OWRB WATER RESOURCES BOARD the water agency

US Army Corps of Engineers

CDM

Oklahoma Comprehensive Water Plan OCWP

Figure 3-32 - 2010 Oil and Gas Demand Density



Demand Density (AF/1000 AC/year)

	0 - 0.1
	0.11 - 1.0
	1.1 - 2.0
	2.1 - 5.0
	5.1 - 35.0

OWRB State of Oklahoma WATER RESOURCES BOARD the water agency

US Army Corps of Engineers

CDM

Oklahoma Comprehensive Water Plan OCWP

Figure 3-33 - 2060 Oil and Gas Demand Density

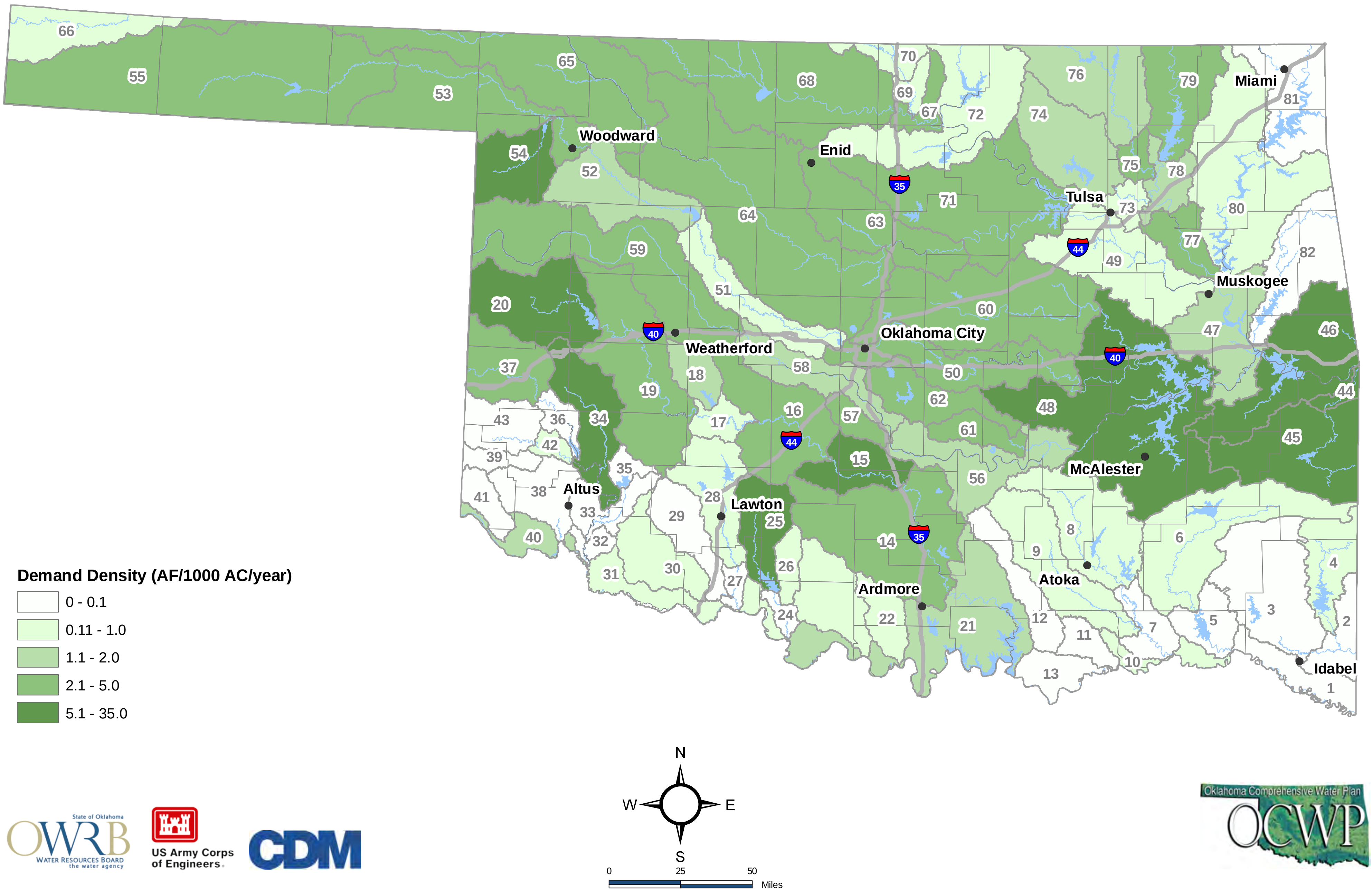
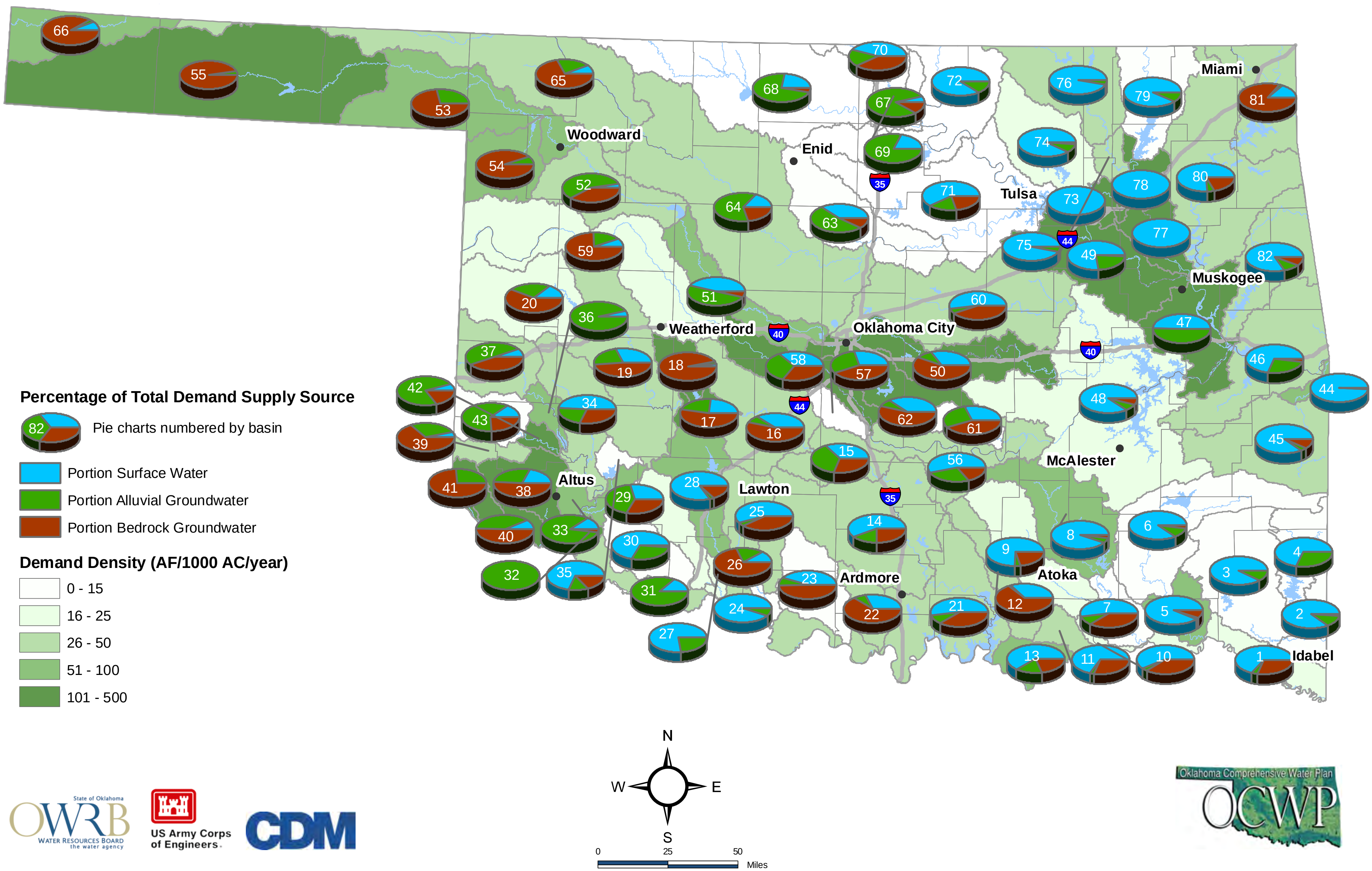


Figure 3-34 - 2060 Total Demand Density and Percentage of Demand Supplied by Source



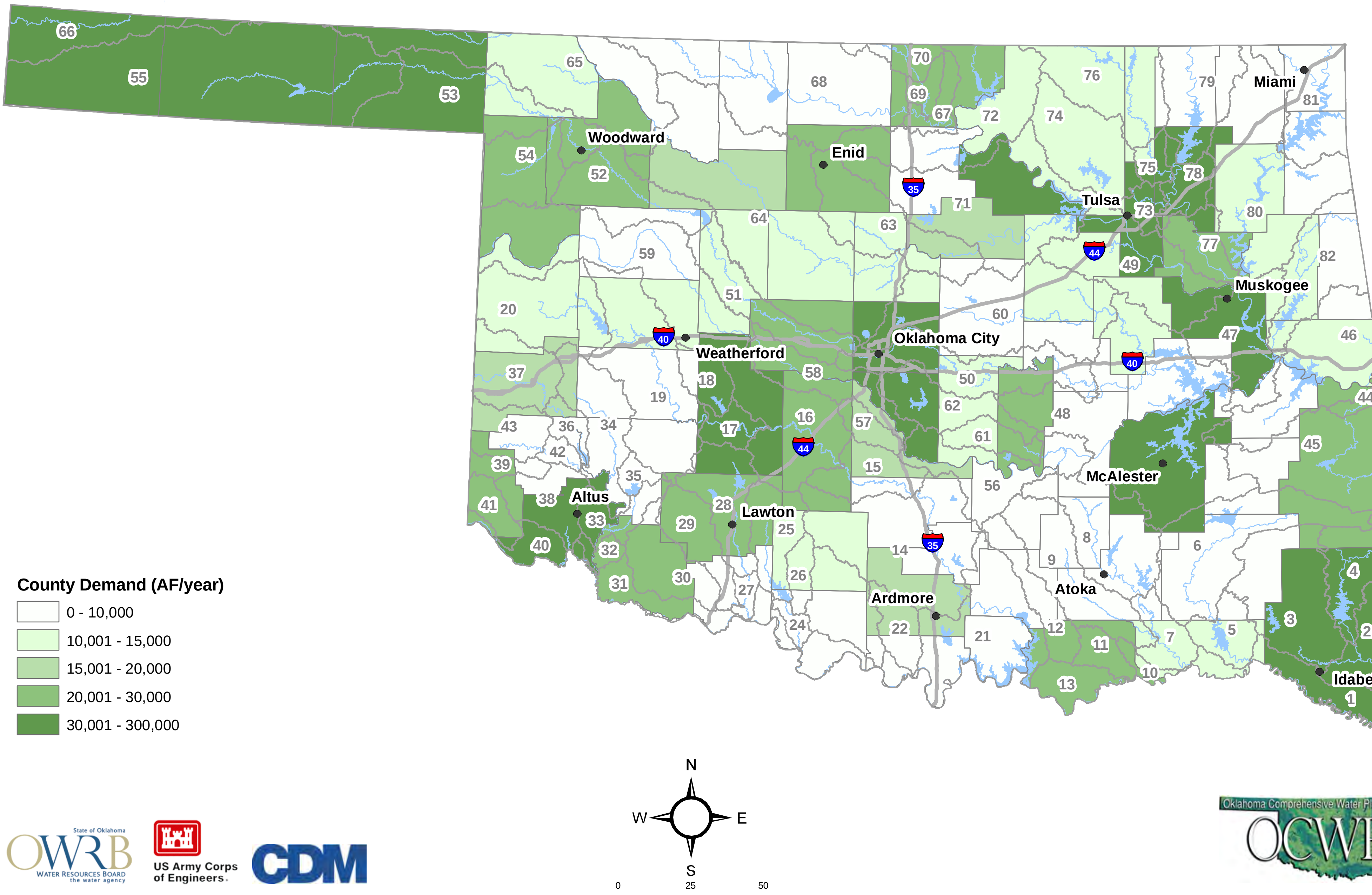
State of Oklahoma OWRB WATER RESOURCES BOARD the water agency

US Army Corps of Engineers

CDM

Oklahoma Comprehensive Water Plan OCWP

Figure 3-35 - 2010 Total County Demand



State of Oklahoma WATER RESOURCES BOARD the water agency

US Army Corps of Engineers

CDM

Oklahoma Comprehensive Water Plan OCWP

Figure 3-36 - 2060 Total County Demand

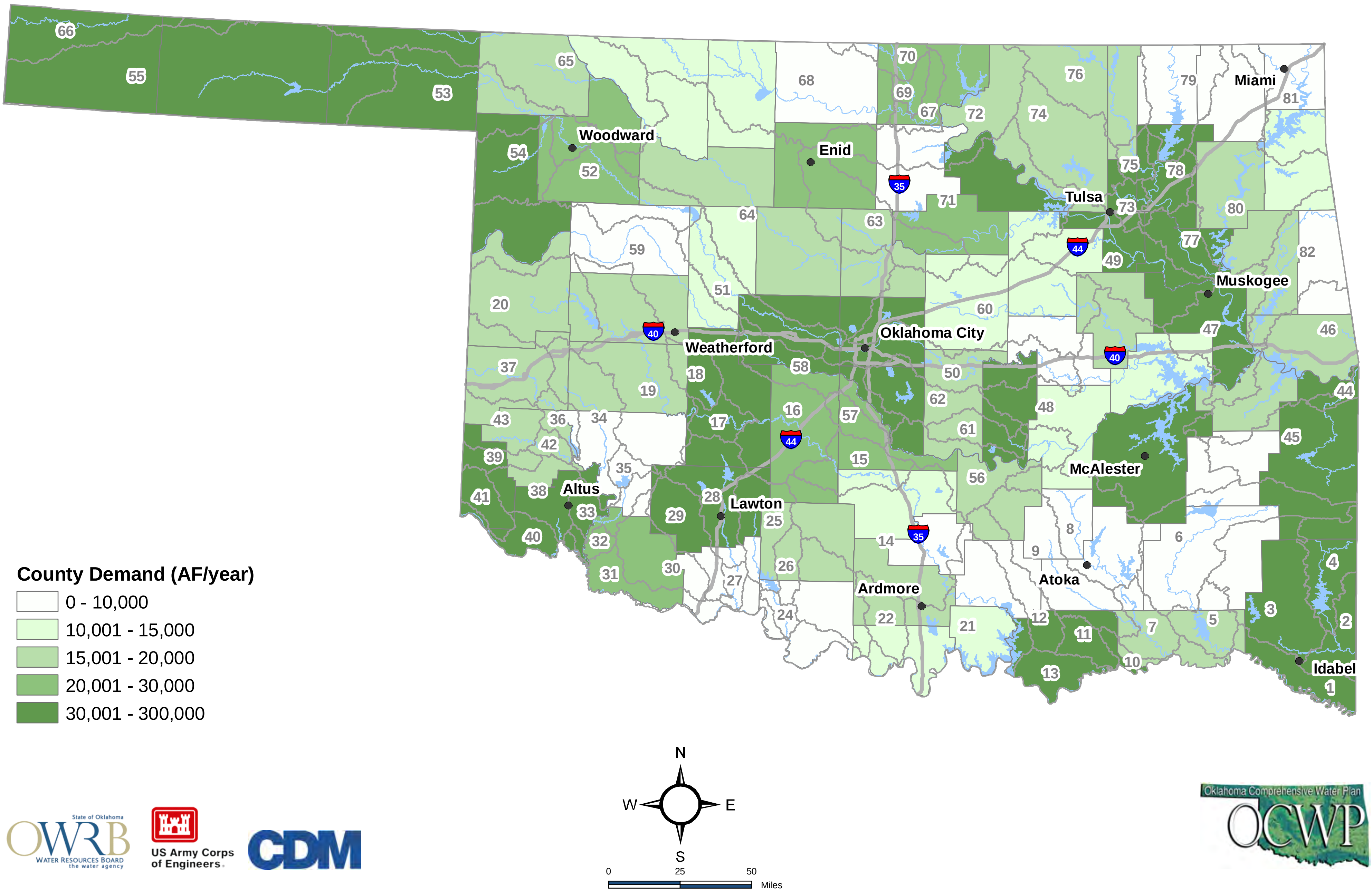
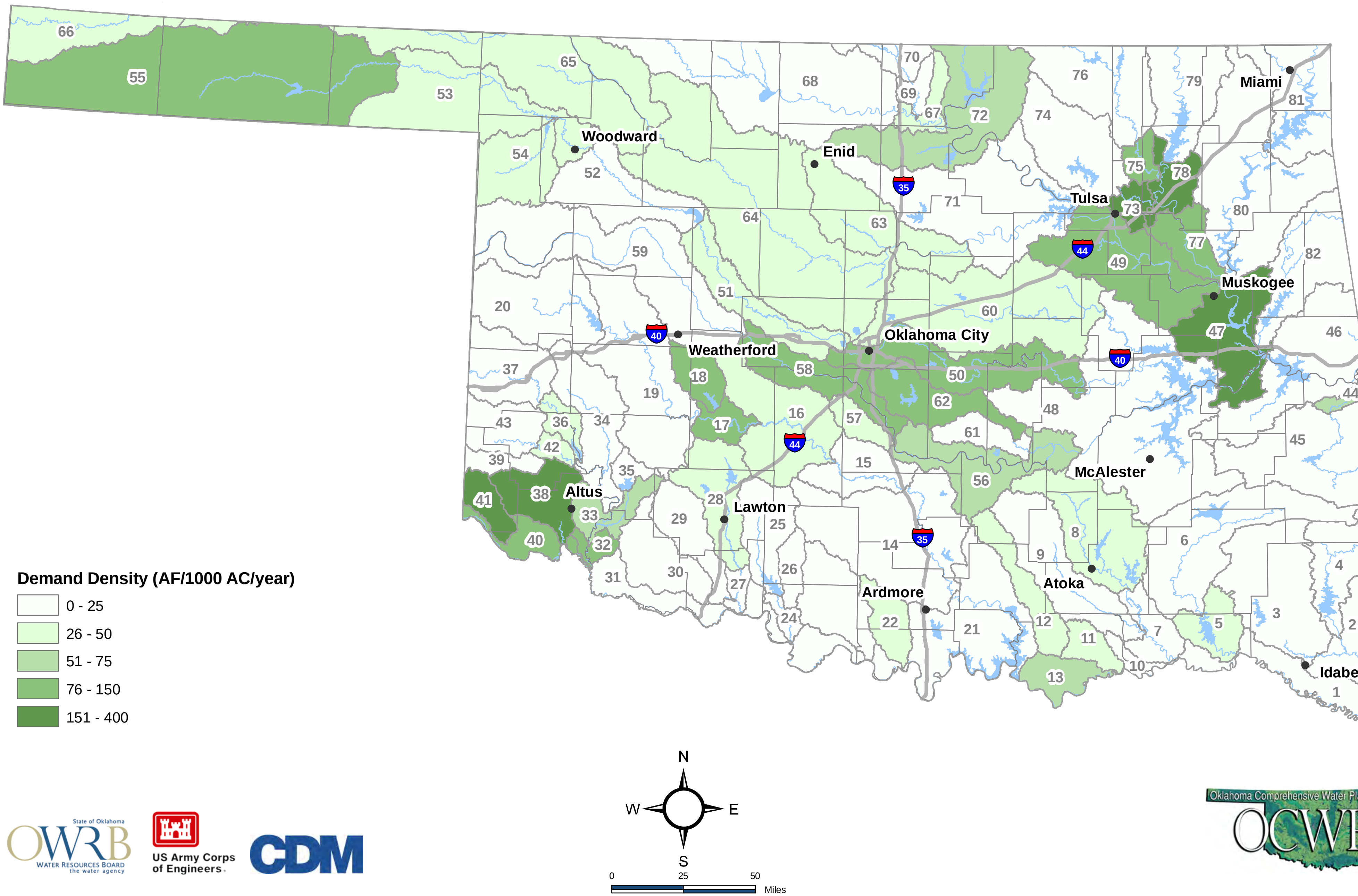


Figure 3-37 - 2010 Total Demand Density



US Army Corps of Engineers

CDM

Oklahoma Comprehensive Water Plan

OCWP

Figure 3-38 - 2060 Total Demand Density

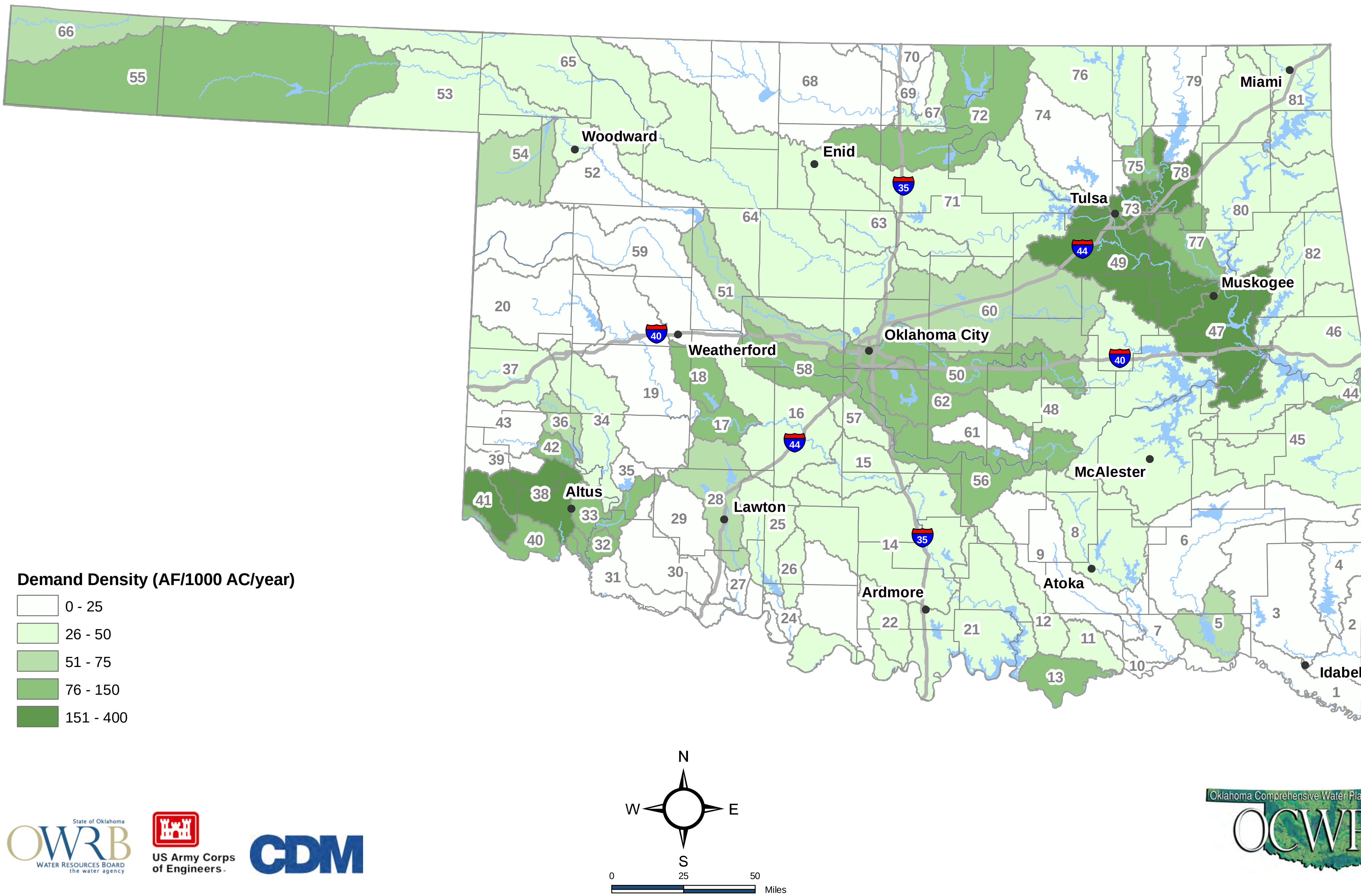
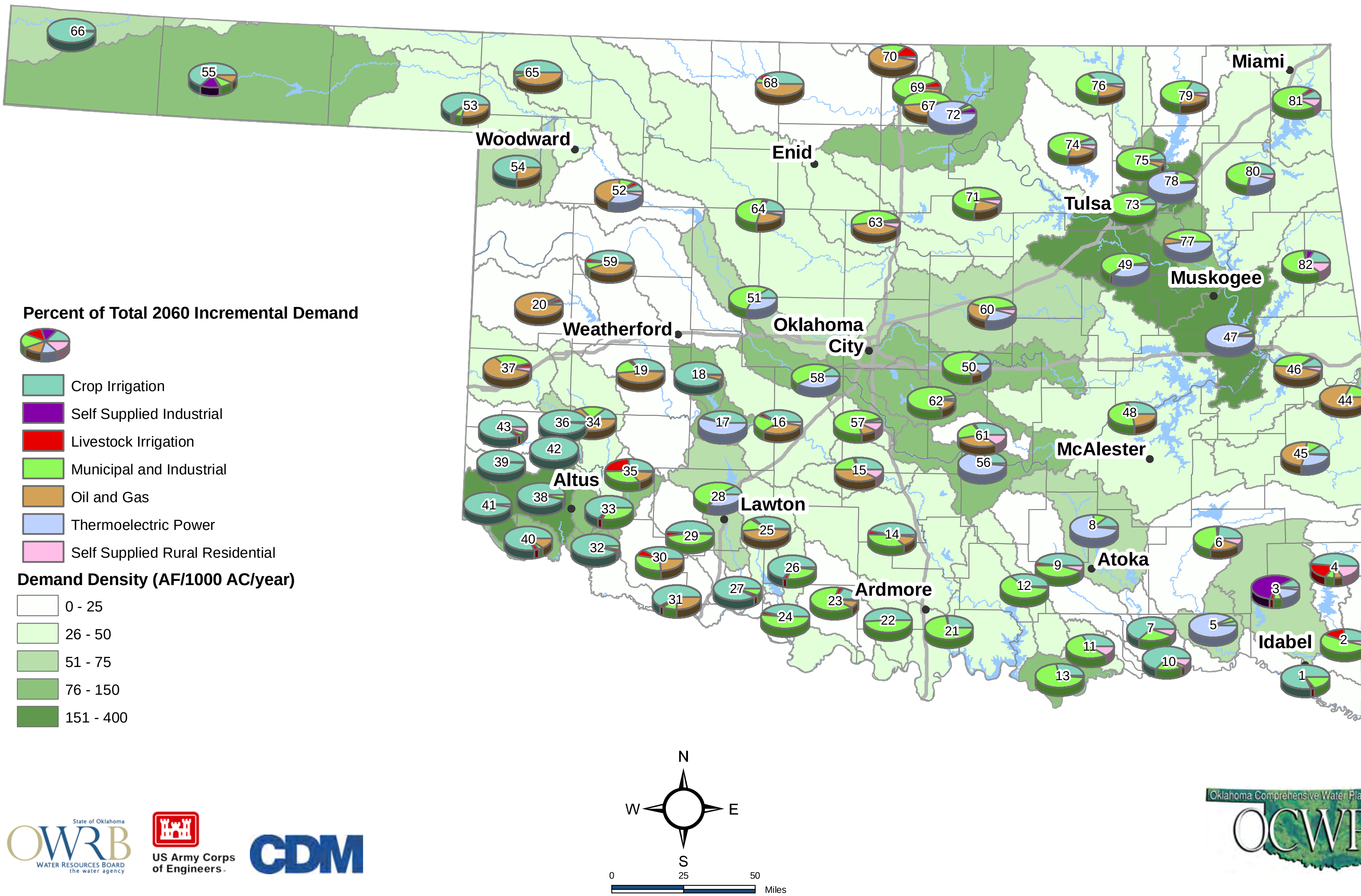


Figure 3-39 - 2060 Total Demand Density and Percentage of Total Demand Growth by Sector



State of Oklahoma OWRB WATER RESOURCES BOARD the water agency

US Army Corps of Engineers

CDM

Oklahoma Comprehensive Water Plan OCWP

Table 3-1 Municipal and Industrial County Demands for 2010 through 2060

County	Annual Water Demands from Municipal and Industrial (AFY)					
	2010	2020	2030	2040	2050	2060
Adair	1,994	2,237	2,555	2,874	3,200	3,526
Alfalfa	873	882	882	882	897	912
Atoka	3,024	3,366	3,733	4,101	4,507	4,913
Beaver	714	740	752	765	777	789
Beckham	4,739	5,120	5,562	6,003	6,444	6,930
Blaine	2,474	2,683	2,918	3,153	3,388	3,642
Bryan	8,145	8,942	9,799	10,655	11,511	12,388
Caddo	3,305	3,470	3,578	3,686	3,794	3,892
Canadian	15,448	16,833	18,000	19,008	19,938	20,884
Carter	9,008	9,535	10,048	10,541	11,073	11,643
Cherokee	6,884	7,767	8,760	9,766	10,745	11,751
Choctaw	1,560	1,637	1,667	1,708	1,749	1,790
Cimarron	645	685	705	705	726	746
Cleveland	37,683	40,538	42,804	44,614	45,886	47,126
Coal	626	711	805	908	1,020	1,132
Comanche	16,682	17,839	18,717	19,400	19,937	20,376
Cotton	783	809	821	833	857	869
Craig	2,294	2,507	2,739	3,000	3,260	3,534
Creek	8,399	8,939	9,391	9,821	10,250	10,715
Custer	5,339	5,619	5,852	6,084	6,259	6,414
Delaware	4,223	4,781	5,384	6,007	6,678	7,377
Dewey	1,154	1,146	1,146	1,146	1,171	1,197
Ellis	736	730	730	711	711	730
Garfield	12,248	12,736	13,049	13,341	13,571	13,842
Garvin	4,760	4,926	5,014	5,101	5,206	5,311
Grady	5,188	5,531	5,848	6,133	6,419	6,715
Grant	716	737	752	752	780	794
Greer	1,037	1,049	1,049	1,067	1,085	1,103
Harmon	789	797	821	845	870	894
Harper	961	973	973	973	1,001	1,001
Haskell	1,324	1,466	1,648	1,840	2,032	2,243
Hughes	1,786	1,975	2,178	2,392	2,629	2,866
Jackson	4,619	4,899	5,129	5,314	5,467	5,590
Jefferson	776	795	807	819	843	866
Johnston	1,787	1,969	2,196	2,423	2,666	2,923
Kay	7,711	8,066	8,272	8,463	8,654	8,860
Kingfisher	2,928	3,193	3,529	3,865	4,202	4,575
Kiowa	1,247	1,274	1,287	1,300	1,326	1,351
Latimer	2,260	2,382	2,506	2,651	2,796	2,961
Le Flore	6,586	7,043	7,499	7,956	8,413	8,895
Lincoln	2,376	2,568	2,745	2,928	3,119	3,322
Logan	4,797	5,354	5,883	6,412	6,929	7,483
Love	1,524	5,138	5,455	5,790	6,144	6,498

Table 3-1 Municipal and Industrial County Demands for 2010 through 2060

	Annual Water Demands from Municipal and Industrial (AFY)					
County	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Major	984	1,013	1,013	1,027	1,040	1,054
Marshall	2,257	3,634	4,333	5,049	5,800	6,586
Mayes	5,534	6,007	6,526	7,071	7,629	8,200
McClain	4,190	4,792	5,428	6,065	6,726	7,400
McCurtain	4,312	4,527	4,685	4,819	4,965	5,099
McIntosh	2,485	2,760	3,066	3,407	3,793	4,202
Murray	2,712	2,941	3,216	3,471	3,765	4,059
Muskogee	10,130	10,580	10,898	11,172	11,446	11,720
Noble	1,662	1,759	1,815	1,871	1,913	1,955
Nowata	1,118	1,256	1,412	1,568	1,733	1,907
Okfuskee	1,408	1,461	1,497	1,533	1,569	1,616
Oklahoma	123,931	131,224	136,613	140,682	143,644	146,570
Okmulgee	10,930	11,716	12,415	13,141	13,893	14,645
Osage	7,895	8,460	8,876	9,258	9,640	10,073
Ottawa	5,179	5,575	5,918	6,292	6,681	7,069
Pawnee	2,350	2,588	2,818	3,062	3,318	3,574
Payne	12,688	13,656	14,671	15,670	16,374	17,045
Pittsburg	8,445	8,815	9,150	9,541	9,987	10,471
Pontotoc	6,074	6,376	6,596	6,816	7,019	7,222
Pottawatomie	6,060	6,460	6,848	7,220	7,583	7,963
Pushmataha	1,114	1,237	1,371	1,514	1,674	1,834
Roger Mills	618	626	626	626	626	626
Rogers	13,376	14,813	16,213	17,513	18,846	20,212
Seminole	2,801	2,923	3,002	3,081	3,171	3,261
Sequoyah	7,380	8,143	8,886	9,612	10,356	11,099
Stephens	8,570	8,785	8,866	8,967	9,109	9,291
Texas	3,819	4,599	5,513	6,427	7,342	8,242
Tillman	1,345	1,388	1,418	1,447	1,477	1,521
Tulsa	110,045	116,516	121,517	125,042	127,717	130,319
Wagoner	8,402	9,329	10,137	10,881	11,613	12,383
Washington	11,940	12,364	12,486	12,656	12,827	13,021
Washita	1,103	1,151	1,179	1,197	1,225	1,244
Woods	3,161	3,189	3,224	3,259	3,293	3,363
Woodward	5,718	5,989	6,169	6,288	6,438	6,558
Total	**601,891**	**647,038**	**682,391**	**713,982**	**743,158**	**772,773**

Table 3-2 Municipal and Industrial Sector Demand by OCWP Basin

			Demand (AFY)						Supply Source (Percent of Demand)			
Basin Number	Basin ID	Basin Name	2010	2020	2030	2040	2050	2060	Surface Water	Ground-water	Alluvial Ground-water	Bedrock Ground-water
1	10100	Red River Mainstem (To Kiamichi River)	1,752	1,839	1,903	1,957	2,016	2,070	96%	4%	0%	100%
2	10201	Little River (McCurtain County) - 1	1,000	1,049	1,086	1,117	1,151	1,182	98%	2%	0%	100%
3	10202	Little River (McCurtain County) - 2	1,561	1,646	1,713	1,773	1,838	1,900	99%	1%	74%	26%
4	10203	Little River (McCurtain County) - 3	176	186	193	199	206	212	100%	0%	0%	100%
5	10301	Kiamichi River - 1	949	1,011	1,054	1,103	1,156	1,209	86%	14%	0%	100%
6	10302	Kiamichi River - 2	1,620	1,761	1,909	2,066	2,235	2,409	100%	0%	0%	100%
7	10411	Muddy Boggy River - 1	507	545	575	608	643	678	61%	39%	0%	100%
8	10412	Muddy Boggy River - 2	3,245	3,552	3,869	4,196	4,552	4,909	95%	5%	26%	74%
9	10420	Clear Boggy Creek	3,811	4,106	4,389	4,675	4,974	5,274	63%	37%	0%	100%
10	10500	Red River Mainstem (To Blue River)	483	508	519	532	546	560	90%	10%	2%	98%
11	10601	Blue River - 1	651	715	783	852	920	990	25%	75%	0%	100%
12	10602	Blue River - 2	4,593	5,010	5,452	5,894	6,336	6,790	37%	63%	0%	100%
13	10700	Red River Mainstem (To Washita)	3,048	3,346	3,666	3,987	4,307	4,635	45%	55%	26%	74%
14	10810	Lower Washita	12,634	13,271	13,842	14,394	15,024	15,683	69%	31%	47%	53%
15	10821	Middle Washita - 1	1,834	1,980	2,114	2,249	2,391	2,536	45%	55%	64%	36%
16	10822	Middle Washita - 2	4,785	5,078	5,330	5,562	5,793	6,025	75%	25%	13%	87%
17	10831	Upper Washita - 1	757	795	819	844	869	891	83%	17%	0%	100%
18	10832	Upper Washita - 2	158	165	169	173	177	180	13%	87%	0%	100%
19	10833	Upper Washita - 3	4,533	4,745	4,910	5,068	5,205	5,324	83%	17%	8%	92%
20	10840	Washita Headwaters	1,001	1,028	1,046	1,065	1,084	1,101	26%	74%	24%	76%
21	10900	Red River Mainstem (To Walnut Bayou)	8,402	12,964	14,326	15,712	17,175	18,697	52%	48%	4%	96%
22	11000	Walnut Bayou	2,443	3,034	3,202	3,368	3,546	3,734	63%	37%	0%	100%
23	11100	Mud Creek	1,673	2,066	2,124	2,185	2,257	2,335	35%	65%	0%	100%
24	11201	Beaver Creek - 1	432	443	450	456	469	483	55%	45%	100%	0%
25	11202	Beaver Creek - 2	3,563	3,688	3,757	3,822	3,894	3,974	84%	16%	0%	100%
26	11203	Beaver Creek - 3	2,116	2,169	2,190	2,215	2,252	2,298	90%	10%	19%	81%
27	11311	Cache Creek - 1	161	167	169	172	177	179	100%	0%	0%	0%
28	11312	Cache Creek - 2	14,554	15,544	16,291	16,877	17,346	17,729	95%	5%	8%	92%
29	11321	Deep Red Creek And West Cache Creek - 1	2,246	2,394	2,505	2,592	2,664	2,721	74%	26%	21%	79%
30	11322	Deep Red Creek And West Cache Creek - 2	772	799	817	834	852	876	98%	2%	100%	0%
31	11400	Red River Mainstem (To North Fork of Red)	752	777	792	807	825	848	45%	55%	94%	6%
32	11511	Lower North Fork Red River - 1	133	138	142	145	148	153	60%	40%	100%	0%
33	11512	Lower North Fork Red River - 2	2,872	3,037	3,171	3,279	3,371	3,446	94%	6%	90%	10%
34	11513	Lower North Fork Red River - 3	3,644	3,898	4,177	4,453	4,735	5,042	87%	13%	6%	94%
35	11514	Lower North Fork Red River - 4	91	93	95	96	97	99	80%	20%	100%	0%
36	11521	Upper North Fork Red River - 1	217	226	234	245	255	266	1%	99%	100%	0%
37	11522	Upper North Fork Red River - 2	1,710	1,846	2,002	2,158	2,315	2,486	2%	98%	50%	50%
38	11601	Salt Fork Red River - 1	1,925	2,024	2,103	2,173	2,232	2,280	95%	5%	100%	0%
39	11602	Salt Fork Red River - 2	104	105	106	108	110	112	100%	0%	0%	0%
40	11701	Prairie Dog Town Fork Red River - 1	322	341	357	370	381	389	12%	88%	0%	100%
41	11702	Prairie Dog Town Fork Red River - 2	705	713	735	757	779	800	100%	0%	0%	0%
42	11801	Elm Fork Red River - 1	448	453	453	461	469	476	92%	8%	0%	100%

Table 3-2 Municipal and Industrial Sector Demand by OCWP Basin

Basin Number	Basin ID	Basin Name	Demand (AFY) 2010	2020	2030	2040	2050	2060	Supply Source (Percent of Demand) Surface Water	Ground-water	Alluvial Ground-water	Bedrock Ground-water
43	11802	Elm Fork Red River - 2	175	182	189	197	206	215	90%	10%	100%	0%
44	20101	Poteau River - 1	1,275	1,364	1,452	1,541	1,629	1,723	100%	0%	0%	100%
45	20102	Poteau River - 2	5,885	6,269	6,656	7,057	7,458	7,891	97%	3%	0%	100%
46	20201	Lower Arkansas River - 1	8,502	9,358	10,242	11,120	12,015	12,927	100%	0%	94%	6%
47	20202	Lower Arkansas River - 2	9,031	9,594	10,104	10,602	11,114	11,643	97%	3%	91%	9%
48	20300	Canadian River (To North Canadian River)	20,673	21,969	23,169	24,470	25,890	27,365	92%	8%	27%	73%
49	20400	Middle Arkansas River	77,584	82,298	86,001	88,819	91,157	93,495	99%	1%	95%	5%
50	20510	Lower North Canadian River	61,244	64,913	67,690	69,856	71,513	73,173	61%	39%	11%	89%
51	20520	Middle North Canadian River	9,631	10,434	11,125	11,726	12,277	12,843	59%	41%	99%	1%
52	20531	Upper North Canadian River - 1	1,337	1,383	1,416	1,438	1,473	1,503	7%	93%	61%	39%
53	20532	Upper North Canadian River - 2	4,923	5,137	5,272	5,366	5,492	5,585	2%	98%	29%	71%
54	20533	Upper North Canadian River - 3	489	489	491	482	484	496	0%	100%	16%	84%
55	20540	North Canadian Headwaters	4,582	5,406	6,343	7,259	8,195	9,118	1%	99%	1%	99%
56	20611	Lower Canadian River - 1	7,301	7,803	8,223	8,608	8,954	9,300	44%	56%	43%	57%
57	20612	Lower Canadian River - 2	1,998	2,261	2,536	2,809	3,092	3,381	45%	55%	12%	88%
58	20620	Middle Canadian River	18,144	19,631	20,890	21,965	22,871	23,779	72%	28%	45%	55%
59	20630	Upper Canadian River	3,353	3,474	3,580	3,677	3,776	3,876	15%	85%	7%	93%
60	20700	Deep Fork River	44,022	46,659	48,645	50,200	51,396	52,598	69%	31%	5%	95%
61	20801	Little River - 1	730	776	820	862	903	946	3%	97%	12%	88%
62	20802	Little River - 2	31,153	33,386	35,159	36,583	37,622	38,645	76%	24%	10%	90%
63	20910	Lower Cimarron River	11,512	12,244	12,871	13,484	14,021	14,603	68%	32%	81%	19%
64	20920	Middle Cimarron River	34,169	36,402	38,279	39,914	41,340	42,841	43%	57%	69%	31%
65	20930	Upper Cimarron River	2,712	2,765	2,802	2,832	2,883	2,928	25%	75%	19%	81%
66	20940	Cimarron Headwaters	0	0	0	0	0	0	0%	0%	0%	0%
67	21011	Lower Salt Fork Arkansas River - 1	2,878	3,011	3,088	3,160	3,231	3,308	57%	43%	100%	0%
69	21012	Lower Salt Fork Arkansas River - 2	1,082	1,132	1,161	1,187	1,214	1,243	81%	19%	100%	0%
70	21013	Lower Salt Fork Arkansas River - 3	296	310	318	325	332	340	81%	19%	0%	100%
68	21020	Upper Salt Fork Arkansas River	2,909	2,970	3,011	3,036	3,098	3,159	5%	95%	100%	0%
71	21100	Arkansas River - Cimarron Rivers to Keystone Lake	21,124	22,671	24,143	25,571	26,718	27,851	83%	17%	40%	60%
72	21200	Arkansas River Mainstem (To Kansas State Line)	7,466	7,862	8,120	8,359	8,587	8,841	60%	40%	74%	26%
73	21301	Bird Creek - 1	27,833	29,505	30,811	31,749	32,482	33,201	100%	0%	0%	0%
74	21302	Bird Creek - 2	8,980	9,546	9,974	10,312	10,604	10,913	98%	2%	28%	72%
75	21401	Caney River - 1	10,901	11,592	12,147	12,569	12,923	13,274	100%	0%	0%	0%
76	21402	Caney River - 2	12,088	12,544	12,701	12,903	13,105	13,334	100%	0%	0%	100%
77	21511	Verdigris River (To Oologah Dam) - 1	7,686	8,467	9,158	9,785	10,399	11,039	100%	0%	0%	0%
78	21512	Verdigris River (To Oologah Dam) - 2	8,423	9,241	10,011	10,707	11,404	12,117	100%	0%	100%	0%
79	21520	Verdigris River (To Kansas State Line)	3,586	3,986	4,396	4,793	5,203	5,629	100%	0%	0%	0%
80	21601	Grand (Neosho) River - 1	13,742	15,148	16,658	18,209	19,777	21,395	81%	19%	0%	100%
81	21602	Grand (Neosho) River - 2	8,319	9,118	9,900	10,726	11,600	12,495	0%	100%	0%	100%
82	21700	Illinois River	5,769	6,480	7,298	8,122	8,944	9,779	96%	4%	8%	92%
		Total	**601,891**	**647,038**	**682,391**	**713,982**	**743,158**	**772,773**				

Table 3-3 Municipal and Industrial Sector Monthly Demand Pattern by OCWP Basin

Basin Number	Basin ID	Basin Name	Monthly Demand Pattern (Percent of Annual Demand)											
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	10100	Red River Mainstem (To Kiamichi River)	7%	6%	7%	7%	8%	9%	11%	12%	9%	8%	7%	7%
2	10201	Little River (McCurtain County) - 1	7%	6%	7%	7%	8%	9%	11%	12%	9%	8%	7%	7%
3	10202	Little River (McCurtain County) - 2	7%	6%	7%	7%	8%	9%	11%	12%	9%	8%	7%	7%
4	10203	Little River (McCurtain County) - 3	7%	6%	7%	7%	8%	9%	11%	12%	9%	8%	7%	7%
5	10301	Kiamichi River - 1	7%	6%	7%	7%	8%	9%	11%	12%	9%	8%	7%	7%
6	10302	Kiamichi River - 2	7%	6%	7%	7%	8%	9%	11%	12%	9%	8%	7%	7%
7	10411	Muddy Boggy River - 1	7%	6%	7%	7%	8%	9%	11%	12%	9%	8%	7%	7%
8	10412	Muddy Boggy River - 2	7%	6%	7%	7%	8%	9%	11%	12%	9%	8%	7%	7%
9	10420	Clear Boggy Creek	7%	6%	7%	7%	9%	9%	12%	12%	9%	8%	7%	7%
10	10500	Red River Mainstem (To Blue River)	7%	6%	7%	7%	8%	9%	11%	12%	9%	8%	7%	7%
11	10601	Blue River - 1	7%	6%	7%	7%	8%	9%	11%	12%	9%	8%	7%	7%
12	10602	Blue River - 2	7%	6%	7%	7%	8%	9%	11%	12%	9%	8%	7%	7%
13	10700	Red River Mainstem (To Washita)	7%	6%	7%	7%	8%	9%	11%	12%	9%	8%	7%	7%
14	10810	Lower Washita	6%	6%	7%	7%	9%	9%	12%	12%	10%	8%	7%	7%
15	10821	Middle Washita - 1	7%	6%	7%	7%	9%	10%	12%	12%	10%	8%	7%	7%
16	10822	Middle Washita - 2	7%	6%	7%	7%	9%	9%	12%	12%	10%	8%	7%	7%
17	10831	Upper Washita - 1	7%	7%	7%	8%	9%	9%	11%	11%	9%	8%	7%	7%
18	10832	Upper Washita - 2	7%	7%	7%	8%	9%	9%	11%	11%	9%	8%	7%	7%
19	10833	Upper Washita - 3	7%	7%	7%	8%	9%	9%	11%	11%	9%	8%	7%	7%
20	10840	Washita Headwaters	7%	7%	7%	8%	9%	9%	11%	11%	9%	8%	7%	7%
21	10900	Red River Mainstem (To Walnut Bayou)	7%	6%	7%	7%	9%	9%	12%	12%	9%	8%	7%	7%
22	11000	Walnut Bayou	7%	6%	7%	7%	9%	10%	12%	12%	10%	8%	7%	7%
23	11100	Mud Creek	6%	6%	7%	7%	9%	9%	12%	12%	10%	8%	7%	6%
24	11201	Beaver Creek - 1	6%	6%	7%	7%	9%	9%	12%	12%	10%	8%	7%	6%
25	11202	Beaver Creek - 2	6%	6%	7%	7%	9%	9%	12%	12%	10%	8%	7%	6%
26	11203	Beaver Creek - 3	6%	6%	7%	7%	9%	9%	12%	12%	10%	8%	7%	6%
27	11311	Cache Creek - 1	7%	7%	7%	8%	9%	9%	11%	11%	9%	8%	7%	7%
28	11312	Cache Creek - 2	7%	7%	7%	8%	9%	9%	11%	11%	9%	8%	7%	7%
29	11321	Deep Red Creek And West Cache Creek - 1	7%	7%	7%	8%	9%	9%	11%	11%	9%	8%	7%	7%
30	11322	Deep Red Creek And West Cache Creek - 2	7%	7%	7%	8%	9%	9%	11%	11%	9%	8%	7%	7%
31	11400	Red River Mainstem (To North Fork of Red)	7%	7%	7%	8%	9%	9%	11%	11%	9%	8%	7%	7%
32	11511	Lower North Fork Red River - 1	7%	7%	7%	8%	9%	9%	11%	11%	9%	8%	7%	7%
33	11512	Lower North Fork Red River - 2	7%	7%	7%	8%	9%	9%	11%	11%	9%	8%	7%	7%
34	11513	Lower North Fork Red River - 3	7%	7%	7%	8%	9%	9%	11%	11%	9%	8%	7%	7%
35	11514	Lower North Fork Red River - 4	7%	7%	7%	8%	9%	9%	11%	11%	9%	8%	7%	7%
36	11521	Upper North Fork Red River - 1	7%	7%	7%	8%	9%	9%	11%	11%	9%	8%	7%	7%

Table 3-3 Municipal and Industrial Sector Monthly Demand Pattern by OCWP Basin

Basin Number	Basin ID	Basin Name	Monthly Demand Pattern (Percent of Annual Demand)											
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
37	11522	Upper North Fork Red River - 2	7%	7%	7%	8%	9%	9%	11%	11%	9%	8%	7%	7%
38	11601	Salt Fork Red River - 1	7%	7%	7%	8%	9%	9%	11%	11%	9%	8%	7%	7%
39	11602	Salt Fork Red River - 2	7%	7%	7%	8%	9%	9%	11%	11%	9%	8%	7%	7%
40	11701	Prairie Dog Town Fork Red River - 1	7%	7%	7%	8%	9%	9%	11%	11%	9%	8%	7%	7%
41	11702	Prairie Dog Town Fork Red River - 2	7%	7%	7%	8%	9%	9%	11%	11%	9%	8%	7%	7%
42	11801	Elm Fork Red River - 1	7%	7%	7%	8%	9%	9%	11%	11%	9%	8%	7%	7%
43	11802	Elm Fork Red River - 2	7%	7%	7%	8%	9%	9%	11%	11%	9%	8%	7%	7%
44	20101	Poteau River - 1	7%	6%	7%	7%	8%	9%	11%	12%	9%	8%	7%	7%
45	20102	Poteau River - 2	7%	6%	7%	7%	8%	9%	11%	12%	9%	8%	7%	7%
46	20201	Lower Arkansas River - 1	7%	6%	7%	7%	8%	9%	11%	12%	9%	8%	7%	7%
47	20202	Lower Arkansas River - 2	7%	7%	7%	8%	9%	10%	12%	10%	9%	7%	7%	7%
48	20300	Canadian River (To North Canadian River)	7%	7%	7%	8%	9%	10%	11%	11%	9%	8%	7%	7%
49	20400	Middle Arkansas River	7%	7%	7%	8%	9%	11%	12%	10%	9%	7%	7%	6%
50	20510	Lower North Canadian River	6%	6%	7%	7%	9%	9%	12%	12%	10%	8%	7%	6%
51	20520	Middle North Canadian River	6%	6%	7%	7%	9%	9%	12%	12%	10%	8%	7%	6%
52	20531	Upper North Canadian River - 1	7%	7%	7%	8%	9%	9%	11%	11%	9%	8%	7%	7%
53	20532	Upper North Canadian River - 2	7%	7%	7%	8%	9%	9%	11%	11%	9%	8%	7%	7%
54	20533	Upper North Canadian River - 3	7%	7%	7%	8%	9%	9%	11%	11%	9%	8%	7%	7%
55	20540	North Canadian Headwaters	7%	7%	7%	8%	9%	9%	11%	11%	9%	8%	7%	7%
56	20611	Lower Canadian River - 1	7%	6%	7%	7%	9%	9%	12%	12%	10%	8%	7%	7%
57	20612	Lower Canadian River - 2	6%	6%	7%	7%	9%	10%	12%	12%	10%	8%	7%	7%
58	20620	Middle Canadian River	6%	6%	7%	7%	9%	9%	12%	12%	10%	8%	7%	7%
59	20630	Upper Canadian River	7%	7%	7%	8%	9%	9%	11%	11%	9%	8%	7%	7%
60	20700	Deep Fork River	6%	6%	7%	7%	9%	9%	12%	12%	10%	8%	7%	6%
61	20801	Little River - 1	7%	6%	7%	7%	9%	10%	12%	12%	10%	8%	7%	7%
62	20802	Little River - 2	6%	6%	7%	7%	9%	9%	12%	12%	10%	8%	7%	7%
63	20910	Lower Cimarron River	6%	6%	7%	7%	9%	9%	12%	12%	10%	8%	7%	6%
64	20920	Middle Cimarron River	6%	6%	7%	7%	9%	9%	12%	12%	10%	8%	7%	6%
65	20930	Upper Cimarron River	7%	7%	7%	8%	9%	9%	11%	11%	9%	8%	7%	7%
66	20940	Cimarron Headwaters	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
67	21011	Lower Salt Fork Arkansas River - 1	6%	6%	7%	7%	9%	9%	12%	12%	10%	8%	7%	6%
69	21012	Lower Salt Fork Arkansas River - 2	6%	6%	7%	7%	9%	9%	12%	12%	10%	8%	7%	6%
70	21013	Lower Salt Fork Arkansas River - 3	6%	6%	7%	7%	9%	9%	12%	12%	10%	8%	7%	6%
68	21020	Upper Salt Fork Arkansas River	7%	6%	7%	7%	9%	9%	11%	11%	9%	8%	7%	7%
71	21100	Arkansas River - Cimarron Rivers to Keystone	7%	6%	7%	8%	9%	10%	12%	11%	9%	8%	7%	7%
72	21200	Arkansas River Mainstem (To Kansas State	7%	6%	7%	8%	9%	10%	12%	11%	10%	8%	7%	6%

Table 3-3 Municipal and Industrial Sector Monthly Demand Pattern by OCWP Basin

Basin Number	Basin ID	Basin Name	Monthly Demand Pattern (Percent of Annual Demand)											
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
73	21301	Bird Creek - 1	7%	7%	7%	8%	9%	11%	12%	10%	9%	7%	7%	6%
74	21302	Bird Creek - 2	7%	7%	7%	8%	9%	11%	12%	10%	9%	7%	7%	6%
75	21401	Caney River - 1	7%	7%	7%	8%	9%	11%	12%	10%	9%	7%	7%	6%
76	21402	Caney River - 2	7%	7%	7%	8%	9%	11%	12%	10%	9%	7%	7%	6%
77	21511	Verdigris River (To Oologah Dam) - 1	7%	7%	7%	8%	9%	11%	12%	10%	9%	7%	7%	6%
78	21512	Verdigris River (To Oologah Dam) - 2	7%	7%	7%	8%	9%	11%	12%	10%	9%	7%	7%	6%
79	21520	Verdigris River (To Kansas State Line)	7%	7%	7%	8%	9%	11%	12%	10%	9%	7%	7%	6%
80	21601	Grand (Neosho) River - 1	7%	7%	7%	8%	9%	11%	12%	10%	9%	7%	7%	6%
81	21602	Grand (Neosho) River - 2	7%	7%	7%	8%	9%	11%	12%	10%	9%	7%	7%	6%
82	21700	Illinois River	7%	7%	7%	8%	9%	10%	12%	10%	9%	7%	7%	7%

Table 3-4 Self Supplied Residential County Demands for 2010 through 2060

County	Annual Water Demands from Self Supplied Residential (AFY)					
	2010	2020	2030	2040	2050	2060
Adair	736	858	980	1,102	1,227	1,353
Alfalfa	115	115	115	115	117	119
Atoka	563	632	702	771	847	923
Beaver	350	355	361	367	373	379
Beckham	321	349	380	410	440	473
Blaine	189	206	224	242	260	280
Bryan	369	407	446	485	524	564
Caddo	1,436	1,496	1,543	1,589	1,636	1,678
Canadian	0	0	0	0	0	0
Carter	22	24	25	26	28	29
Cherokee	793	911	1,028	1,146	1,260	1,378
Choctaw	326	335	341	349	358	366
Cimarron	337	358	369	369	379	390
Cleveland	1,329	1,428	1,508	1,571	1,616	1,660
Coal	153	176	199	224	252	280
Comanche	193	207	217	225	231	236
Cotton	0	0	0	0	0	0
Craig	70	77	84	92	100	109
Creek	544	581	611	639	667	697
Custer	447	468	488	507	522	535
Delaware	998	1,147	1,292	1,441	1,602	1,770
Dewey	263	257	257	257	263	269
Ellis	268	261	261	254	254	261
Garfield	188	193	198	202	206	210
Garvin	469	481	490	498	508	519
Grady	1,202	1,288	1,362	1,429	1,495	1,564
Grant	78	80	81	81	84	86
Greer	0	0	0	0	0	0
Harmon	0	0	0	0	0	0
Harper	267	267	267	267	275	275
Haskell	465	528	593	662	731	807
Hughes	86	96	106	116	128	139
Jackson	112	119	124	129	133	135
Jefferson	12	12	12	12	13	13
Johnston	12	13	15	16	18	20
Kay	186	192	197	202	206	211
Kingfisher	553	618	683	748	813	885
Kiowa	0	0	0	0	0	0
Latimer	192	201	212	224	236	250
Le Flore	553	596	635	673	712	753
Lincoln	1,393	1,518	1,622	1,731	1,843	1,964
Logan	1,442	1,621	1,781	1,941	2,097	2,265
Love	28	75	79	84	89	94

Table 3-4 Self Supplied Residential County Demands for 2010 through 2060

	Annual Water Demands from Self Supplied Residential (AFY)					
County	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Major	206	209	209	212	215	217
Marshall	61	75	89	104	119	136
Mayes	0	0	0	0	0	0
McClain	794	927	1,050	1,173	1,301	1,432
McCurtain	703	734	760	782	805	827
McIntosh	0	0	0	0	0	0
Murray	0	0	0	0	0	0
Muskogee	663	686	706	724	742	759
Noble	128	134	138	143	146	149
Nowata	51	58	65	72	80	88
Okfuskee	95	98	100	102	105	108
Oklahoma	1,098	1,151	1,198	1,234	1,260	1,286
Okmulgee	0	0	0	0	0	0
Osage	998	1,069	1,122	1,170	1,218	1,273
Ottawa	698	746	792	842	895	947
Pawnee	609	676	736	800	867	934
Payne	671	722	775	828	865	901
Pittsburg	0	0	0	0	0	0
Pontotoc	572	594	615	635	654	673
Pottawatomie	1,279	1,366	1,449	1,527	1,604	1,684
Pushmataha	89	101	112	123	136	149
Roger Mills	104	104	104	104	104	104
Rogers	601	675	739	798	859	922
Seminole	225	232	238	244	251	258
Sequoyah	104	115	126	136	146	157
Stephens	833	843	851	860	874	892
Texas	365	454	545	635	725	814
Tillman	80	81	83	85	87	89
Tulsa	919	969	1,010	1,040	1,062	1,084
Wagoner	0	0	0	0	0	0
Washington	0	0	0	0	0	0
Washita	144	148	152	154	158	161
Woods	355	355	358	362	366	374
Woodward	732	763	786	801	820	835
Total	**30,236**	**32,633**	**34,795**	**36,890**	**39,009**	**41,189**

Table 3-5 Self Supplied Residential Sector Demand by OCWP Basin

			Demand (AFY)						Supply Source (Percent of Demand)			
Basin Number	Basin ID	Basin Name	2010	2020	2030	2040	2050	2060	Surface Water	Ground-water	Alluvial Ground-water	Bedrock Ground-water
1	10100	Red River Mainstem (To Kiamichi River)	61	63	65	67	69	71	0%	100%	96%	4%
2	10201	Little River (McCurtain County) - 1	104	108	112	115	119	122	0%	100%	98%	2%
3	10202	Little River (McCurtain County) - 2	425	449	469	487	508	527	0%	100%	100%	0%
4	10203	Little River (McCurtain County) - 3	323	341	357	371	385	400	0%	100%	100%	0%
5	10301	Kiamichi River - 1	132	136	139	143	147	150	0%	100%	86%	14%
6	10302	Kiamichi River - 2	260	284	307	331	356	383	0%	100%	100%	0%
7	10411	Muddy Boggy River - 1	147	155	162	170	179	188	0%	100%	61%	39%
8	10412	Muddy Boggy River - 2	455	511	566	622	684	746	0%	100%	96%	4%
9	10420	Clear Boggy Creek	389	425	461	498	537	576	0%	100%	63%	37%
10	10500	Red River Mainstem (To Blue River)	89	95	100	106	112	118	0%	100%	90%	10%
11	10601	Blue River - 1	122	135	148	161	174	187	0%	100%	25%	75%
12	10602	Blue River - 2	252	266	280	294	308	322	0%	100%	37%	63%
13	10700	Red River Mainstem (To Washita)	70	77	84	92	99	106	0%	100%	59%	41%
14	10810	Lower Washita	1,254	1,294	1,327	1,360	1,398	1,439	0%	100%	84%	16%
15	10821	Middle Washita - 1	671	746	812	877	944	1,013	0%	100%	80%	20%
16	10822	Middle Washita - 2	1,000	1,056	1,102	1,145	1,188	1,230	0%	100%	78%	22%
17	10831	Upper Washita - 1	86	89	92	95	98	100	0%	100%	83%	17%
18	10832	Upper Washita - 2	481	501	516	532	547	561	0%	100%	13%	87%
19	10833	Upper Washita - 3	311	324	335	346	355	362	0%	100%	84%	16%
20	10840	Washita Headwaters	97	99	100	101	102	103	0%	100%	43%	57%
21	10900	Red River Mainstem (To Walnut Bayou)	126	174	195	217	239	263	0%	100%	54%	46%
22	11000	Walnut Bayou	13	29	30	32	34	36	0%	100%	63%	37%
23	11100	Mud Creek	210	212	214	217	220	225	0%	100%	35%	65%
24	11201	Beaver Creek - 1	0	0	0	0	0	0	0%	100%	100%	0%
25	11202	Beaver Creek - 2	128	137	144	151	157	163	0%	100%	84%	16%
26	11203	Beaver Creek - 3	20	20	20	20	21	21	0%	100%	92%	8%
27	11311	Cache Creek - 1	0	0	0	0	0	0	0%	100%	100%	0%
28	11312	Cache Creek - 2	118	125	130	135	139	142	0%	100%	95%	5%
29	11321	Deep Red Creek And West Cache Creek - 1	58	62	65	68	70	71	0%	100%	79%	21%
30	11322	Deep Red Creek And West Cache Creek - 2	15	15	16	16	16	17	0%	100%	100%	0%
31	11400	Red River Mainstem (To North Fork of Red)	36	37	37	38	39	40	0%	100%	97%	3%
32	11511	Lower North Fork Red River - 1	20	20	21	22	22	23	0%	100%	100%	0%
33	11512	Lower North Fork Red River - 2	24	24	25	26	26	27	0%	100%	99%	1%
34	11513	Lower North Fork Red River - 3	26	27	28	28	29	30	0%	100%	87%	13%
35	11514	Lower North Fork Red River - 4	1	1	1	1	1	1	0%	100%	100%	0%
36	11521	Upper North Fork Red River - 1	0	0	0	0	0	0	0%	100%	100%	0%
37	11522	Upper North Fork Red River - 2	220	239	258	277	296	318	0%	100%	51%	49%
38	11601	Salt Fork Red River - 1	21	22	23	24	25	25	0%	100%	100%	0%
39	11602	Salt Fork Red River - 2	0	0	0	0	0	0	0%	100%	100%	0%
40	11701	Prairie Dog Town Fork Red River - 1	77	82	85	88	91	93	0%	100%	12%	88%
41	11702	Prairie Dog Town Fork Red River - 2	0	0	0	0	0	0	0%	100%	100%	0%
42	11801	Elm Fork Red River - 1	0	0	0	0	0	0	0%	100%	92%	8%
43	11802	Elm Fork Red River - 2	115	126	136	147	158	170	0%	100%	100%	0%

Table 3-5 Self Supplied Residential Sector Demand by OCWP Basin

Basin Number	Basin ID	Basin Name	Demand (AFY)						Supply Source (Percent of Demand)			
			2010	2020	2030	2040	2050	2060	Surface Water	Ground-water	Alluvial Ground-water	Bedrock Ground-water
44	20101	Poteau River - 1	7	7	8	8	8	9	0%	100%	100%	0%
45	20102	Poteau River - 2	391	423	454	487	519	554	0%	100%	97%	3%
46	20201	Lower Arkansas River - 1	706	801	898	997	1,097	1,202	0%	100%	100%	0%
47	20202	Lower Arkansas River - 2	679	720	760	798	836	875	0%	100%	100%	0%
48	20300	Canadian River (To North Canadian River)	204	218	232	248	264	282	0%	100%	94%	6%
49	20400	Middle Arkansas River	759	799	832	858	880	901	0%	100%	100%	0%
50	20510	Lower North Canadian River	700	741	778	812	843	877	0%	100%	65%	35%
51	20520	Middle North Canadian River	104	111	120	128	137	147	0%	100%	100%	0%
52	20531	Upper North Canadian River - 1	440	453	464	472	483	492	0%	100%	64%	36%
53	20532	Upper North Canadian River - 2	413	419	425	429	438	443	0%	100%	30%	70%
54	20533	Upper North Canadian River - 3	213	214	217	216	218	223	0%	100%	17%	83%
55	20540	North Canadian Headwaters	660	760	855	943	1,037	1,130	0%	100%	2%	98%
56	20611	Lower Canadian River - 1	1,570	1,694	1,802	1,900	1,986	2,073	0%	100%	68%	32%
57	20612	Lower Canadian River - 2	243	279	312	345	379	414	0%	100%	51%	49%
58	20620	Middle Canadian River	343	370	394	415	435	455	0%	100%	85%	15%
59	20630	Upper Canadian River	843	862	885	905	930	957	0%	100%	22%	78%
60	20700	Deep Fork River	2,998	3,240	3,449	3,652	3,848	4,058	0%	100%	70%	30%
61	20801	Little River - 1	465	495	522	549	575	602	0%	100%	15%	85%
62	20802	Little River - 2	672	719	760	795	824	853	0%	100%	78%	22%
63	20910	Lower Cimarron River	719	792	859	927	990	1,057	0%	100%	94%	6%
64	20920	Middle Cimarron River	1,586	1,724	1,853	1,984	2,114	2,256	0%	100%	83%	17%
65	20930	Upper Cimarron River	530	542	553	562	576	587	0%	100%	39%	61%
66	20940	Cimarron Headwaters	129	137	142	143	148	153	0%	100%	100%	0%
67	21011	Lower Salt Fork Arkansas River - 1	62	65	66	68	69	71	0%	100%	100%	0%
69	21012	Lower Salt Fork Arkansas River - 2	28	29	30	30	31	32	0%	100%	100%	0%
70	21013	Lower Salt Fork Arkansas River - 3	49	51	52	53	54	56	0%	100%	81%	19%
68	21020	Upper Salt Fork Arkansas River	276	278	281	283	289	295	0%	100%	100%	0%
71	21100	Arkansas River - Cimarron Rivers to Keystone Lake	1,318	1,429	1,531	1,634	1,727	1,821	0%	100%	90%	10%
72	21200	Arkansas River Mainstem (To Kansas State Line)	434	468	496	525	554	584	0%	100%	89%	11%
73	21301	Bird Creek - 1	215	228	239	248	255	261	0%	100%	100%	0%
74	21302	Bird Creek - 2	613	654	684	710	735	762	0%	100%	98%	2%
75	21401	Caney River - 1	103	116	127	137	147	158	0%	100%	100%	0%
76	21402	Caney River - 2	355	383	404	424	443	465	0%	100%	100%	0%
77	21511	Verdigris River (To Oologah Dam) - 1	33	37	40	44	47	50	0%	100%	100%	0%
78	21512	Verdigris River (To Oologah Dam) - 2	174	196	214	231	249	267	0%	100%	100%	0%
79	21520	Verdigris River (To Kansas State Line)	271	305	335	364	393	424	0%	100%	100%	0%
80	21601	Grand (Neosho) River - 1	938	1,073	1,205	1,339	1,480	1,625	0%	100%	81%	19%
81	21602	Grand (Neosho) River - 2	980	1,072	1,160	1,254	1,354	1,455	0%	100%	0%	100%
82	21700	Illinois River	1,057	1,224	1,389	1,555	1,723	1,894	0%	100%	96%	4%
		Total	**30,236**	**32,633**	**34,795**	**36,890**	**39,009**	**41,189**				

Table 3-6 Self Supplied Residential Sector Monthly Demand Pattern by OCWP Basin

Basin Number	Basin ID	Basin Name	Monthly Demand Pattern (Percent of Annual Demand)											
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	10100	Red River Mainstem (To Kiamichi River)	7%	6%	7%	7%	8%	9%	11%	12%	9%	8%	7%	7%
2	10201	Little River (McCurtain County) - 1	7%	6%	7%	7%	8%	9%	11%	12%	9%	8%	7%	7%
3	10202	Little River (McCurtain County) - 2	7%	6%	7%	7%	8%	9%	11%	12%	9%	8%	7%	7%
4	10203	Little River (McCurtain County) - 3	7%	6%	7%	7%	8%	9%	11%	12%	9%	8%	7%	7%
5	10301	Kiamichi River - 1	7%	6%	7%	7%	8%	9%	11%	12%	9%	8%	7%	7%
6	10302	Kiamichi River - 2	7%	6%	7%	7%	8%	9%	11%	12%	9%	8%	7%	7%
7	10411	Muddy Boggy River - 1	7%	6%	7%	7%	8%	9%	11%	12%	9%	8%	7%	7%
8	10412	Muddy Boggy River - 2	7%	6%	7%	7%	8%	9%	11%	12%	9%	8%	7%	7%
9	10420	Clear Boggy Creek	7%	6%	7%	7%	8%	9%	12%	12%	9%	8%	7%	7%
10	10500	Red River Mainstem (To Blue River)	7%	6%	7%	7%	8%	9%	11%	12%	9%	8%	7%	7%
11	10601	Blue River - 1	7%	6%	7%	7%	8%	9%	11%	12%	9%	8%	7%	7%
12	10602	Blue River - 2	7%	6%	7%	7%	9%	9%	12%	12%	9%	8%	7%	7%
13	10700	Red River Mainstem (To Washita)	7%	6%	7%	7%	8%	9%	11%	12%	9%	8%	7%	7%
14	10810	Lower Washita	6%	6%	7%	7%	9%	9%	12%	12%	10%	8%	7%	6%
15	10821	Middle Washita - 1	6%	6%	7%	7%	9%	9%	12%	12%	10%	8%	7%	6%
16	10822	Middle Washita - 2	7%	6%	7%	7%	9%	9%	11%	11%	9%	8%	7%	7%
17	10831	Upper Washita - 1	7%	7%	7%	8%	9%	9%	11%	11%	9%	8%	7%	7%
18	10832	Upper Washita - 2	7%	7%	7%	8%	9%	9%	11%	11%	9%	8%	7%	7%
19	10833	Upper Washita - 3	7%	7%	7%	8%	9%	9%	11%	11%	9%	8%	7%	7%
20	10840	Washita Headwaters	7%	7%	7%	8%	9%	9%	11%	11%	9%	8%	7%	7%
21	10900	Red River Mainstem (To Walnut Bayou)	7%	6%	7%	7%	8%	9%	11%	12%	9%	8%	7%	7%
22	11000	Walnut Bayou	7%	7%	7%	7%	9%	10%	12%	12%	10%	8%	7%	7%
23	11100	Mud Creek	6%	6%	7%	7%	9%	9%	12%	12%	10%	8%	7%	6%
24	11201	Beaver Creek - 1	6%	6%	7%	7%	9%	9%	12%	12%	10%	8%	7%	6%
25	11202	Beaver Creek - 2	7%	6%	7%	7%	9%	9%	12%	12%	10%	8%	7%	7%
26	11203	Beaver Creek - 3	6%	6%	7%	7%	9%	9%	12%	12%	10%	8%	7%	6%
27	11311	Cache Creek - 1	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
28	11312	Cache Creek - 2	7%	7%	7%	8%	9%	9%	11%	11%	9%	8%	7%	7%
29	11321	Deep Red Creek And West Cache Creek - 1	7%	7%	7%	8%	9%	9%	11%	11%	9%	8%	7%	7%
30	11322	Deep Red Creek And West Cache Creek - 2	7%	7%	7%	8%	9%	9%	11%	11%	9%	8%	7%	7%
31	11400	Red River Mainstem (To North Fork of Red)	7%	7%	7%	8%	9%	9%	11%	11%	9%	8%	7%	7%
32	11511	Lower North Fork Red River - 1	7%	7%	7%	8%	9%	9%	11%	11%	9%	8%	7%	7%
33	11512	Lower North Fork Red River - 2	7%	7%	7%	8%	9%	9%	11%	11%	9%	8%	7%	7%
34	11513	Lower North Fork Red River - 3	7%	7%	7%	8%	9%	9%	11%	11%	9%	8%	7%	7%
35	11514	Lower North Fork Red River - 4	7%	7%	7%	8%	9%	9%	11%	11%	9%	8%	7%	7%
36	11521	Upper North Fork Red River - 1	7%	7%	7%	8%	9%	9%	11%	11%	9%	8%	7%	7%

Table 3-6 Self Supplied Residential Sector Monthly Demand Pattern by OCWP Basin

Basin Number	Basin ID	Basin Name	Monthly Demand Pattern (Percent of Annual Demand)											
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
37	11522	Upper North Fork Red River - 2	7%	7%	7%	8%	9%	9%	11%	11%	9%	8%	7%	7%
38	11601	Salt Fork Red River - 1	7%	7%	7%	8%	9%	9%	11%	11%	9%	8%	7%	7%
39	11602	Salt Fork Red River - 2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
40	11701	Prairie Dog Town Fork Red River - 1	7%	7%	7%	8%	9%	9%	11%	11%	9%	8%	7%	7%
41	11702	Prairie Dog Town Fork Red River - 2	7%	7%	7%	8%	9%	9%	11%	11%	9%	8%	7%	7%
42	11801	Elm Fork Red River - 1	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
43	11802	Elm Fork Red River - 2	7%	7%	7%	8%	9%	9%	11%	11%	9%	8%	7%	7%
44	20101	Poteau River - 1	7%	6%	7%	7%	8%	9%	11%	12%	9%	8%	7%	7%
45	20102	Poteau River - 2	7%	6%	7%	7%	8%	9%	11%	12%	9%	8%	7%	7%
46	20201	Lower Arkansas River - 1	7%	7%	7%	7%	8%	9%	11%	12%	9%	8%	7%	7%
47	20202	Lower Arkansas River - 2	7%	7%	7%	7%	8%	9%	10%	11%	10%	8%	7%	7%
48	20300	Canadian River (To North Canadian River)	7%	6%	7%	7%	8%	9%	11%	12%	9%	8%	7%	7%
49	20400	Middle Arkansas River	7%	7%	7%	7%	8%	9%	10%	11%	10%	8%	7%	7%
50	20510	Lower North Canadian River	6%	6%	7%	7%	9%	9%	12%	12%	10%	8%	7%	7%
51	20520	Middle North Canadian River	7%	7%	7%	8%	9%	9%	11%	11%	9%	8%	7%	7%
52	20531	Upper North Canadian River - 1	7%	7%	7%	8%	9%	9%	11%	11%	9%	8%	7%	7%
53	20532	Upper North Canadian River - 2	7%	7%	7%	8%	9%	9%	11%	11%	9%	8%	7%	7%
54	20533	Upper North Canadian River - 3	7%	7%	7%	8%	9%	9%	11%	11%	9%	8%	7%	7%
55	20540	North Canadian Headwaters	7%	7%	7%	8%	9%	9%	11%	11%	9%	8%	7%	7%
56	20611	Lower Canadian River - 1	7%	7%	7%	7%	9%	10%	12%	12%	10%	8%	7%	7%
57	20612	Lower Canadian River - 2	6%	6%	7%	7%	9%	9%	12%	12%	10%	8%	7%	7%
58	20620	Middle Canadian River	7%	6%	7%	7%	9%	9%	12%	12%	9%	8%	7%	7%
59	20630	Upper Canadian River	7%	7%	7%	8%	9%	9%	11%	11%	9%	8%	7%	7%
60	20700	Deep Fork River	7%	6%	7%	7%	9%	9%	12%	12%	10%	8%	7%	7%
61	20801	Little River - 1	7%	7%	7%	7%	9%	10%	12%	12%	10%	8%	7%	7%
62	20802	Little River - 2	7%	7%	7%	7%	9%	10%	12%	12%	10%	8%	7%	7%
63	20910	Lower Cimarron River	6%	6%	7%	7%	9%	9%	12%	12%	10%	8%	7%	6%
64	20920	Middle Cimarron River	7%	6%	7%	7%	9%	9%	12%	12%	10%	8%	7%	7%
65	20930	Upper Cimarron River	7%	7%	7%	8%	9%	9%	11%	11%	9%	8%	7%	7%
66	20940	Cimarron Headwaters	7%	7%	7%	8%	9%	9%	11%	11%	9%	8%	7%	7%
67	21011	Lower Salt Fork Arkansas River - 1	6%	6%	7%	7%	9%	9%	12%	12%	10%	8%	7%	6%
69	21012	Lower Salt Fork Arkansas River - 2	6%	6%	7%	7%	9%	9%	12%	12%	10%	8%	7%	6%
70	21013	Lower Salt Fork Arkansas River - 3	6%	6%	7%	7%	9%	9%	12%	12%	10%	8%	7%	6%
68	21020	Upper Salt Fork Arkansas River	7%	6%	7%	8%	9%	9%	11%	11%	9%	8%	7%	7%
71	21100	Arkansas River - Cimarron Rivers to Keystone	7%	7%	7%	7%	8%	9%	11%	12%	10%	8%	7%	7%
72	21200	Arkansas River Mainstem (To Kansas State	7%	7%	7%	7%	8%	9%	11%	12%	10%	8%	7%	7%

Table 3-6 Self Supplied Residential Sector Monthly Demand Pattern by OCWP Basin

Basin Number	Basin ID	Basin Name	Monthly Demand Pattern (Percent of Annual Demand)											
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
73	21301	Bird Creek - 1	7%	7%	7%	7%	8%	9%	10%	11%	10%	8%	7%	7%
74	21302	Bird Creek - 2	7%	7%	7%	7%	8%	9%	10%	11%	10%	8%	7%	7%
75	21401	Caney River - 1	7%	7%	7%	7%	8%	9%	10%	11%	10%	8%	7%	7%
76	21402	Caney River - 2	7%	7%	7%	7%	8%	9%	10%	11%	10%	8%	7%	7%
77	21511	Verdigris River (To Oologah Dam) - 1	7%	7%	7%	7%	8%	9%	10%	11%	10%	8%	7%	7%
78	21512	Verdigris River (To Oologah Dam) - 2	7%	7%	7%	7%	8%	9%	10%	11%	10%	8%	7%	7%
79	21520	Verdigris River (To Kansas State Line)	7%	7%	7%	7%	8%	9%	10%	11%	10%	8%	7%	7%
80	21601	Grand (Neosho) River - 1	7%	7%	7%	7%	8%	9%	10%	11%	10%	8%	7%	7%
81	21602	Grand (Neosho) River - 2	7%	7%	7%	7%	8%	9%	10%	11%	10%	8%	7%	7%
82	21700	Illinois River	7%	7%	7%	7%	8%	9%	10%	11%	10%	8%	7%	7%

Table 3-7 Self Supplied Industrial County Demands for 2010 through 2060

County	Annual Water Demands from Self Supplied Industrial (AFY)					
	2010	2020	2030	2040	2050	2060
Adair	0	0	0	0	0	0
Alfalfa	0	0	0	0	0	0
Atoka	0	0	0	0	0	0
Beaver	375	393	400	406	413	419
Beckham	0	0	0	0	0	0
Blaine	311	304	330	357	383	412
Bryan	0	0	0	0	0	0
Caddo	0	0	0	0	0	0
Canadian	115	113	121	127	134	140
Carter	63	66	70	73	77	81
Cherokee	0	0	0	0	0	0
Choctaw	95	99	101	104	101	99
Cimarron	0	0	0	0	0	0
Cleveland	0	0	0	0	0	0
Coal	0	0	0	0	0	0
Comanche	355	346	363	377	387	396
Cotton	0	0	0	0	0	0
Craig	0	0	0	0	0	0
Creek	0	0	0	0	0	0
Custer	23	23	23	24	25	26
Delaware	0	0	0	0	0	0
Dewey	0	0	0	0	0	0
Ellis	0	0	0	0	0	0
Garfield	0	0	0	0	0	0
Garvin	225	219	223	227	232	236
Grady	0	0	0	0	0	0
Grant	0	0	0	0	0	0
Greer	0	0	0	0	0	0
Harmon	0	0	0	0	0	0
Harper	0	0	0	0	0	0
Haskell	0	0	0	0	0	0
Hughes	0	0	0	0	0	0
Jackson	601	586	614	636	654	669
Jefferson	0	0	0	0	0	0
Johnston	1,397	1,359	1,380	1,400	1,440	1,481
Kay	11,340	11,880	12,184	12,465	12,746	13,050
Kingfisher	0	0	0	0	0	0
Kiowa	0	0	0	0	0	0
Latimer	0	0	0	0	0	0
Le Flore	0	0	0	0	0	0
Lincoln	0	0	0	0	0	0
Logan	1,176	1,154	1,268	1,382	1,493	1,612
Love	0	0	0	0	0	0

Table 3-7 Self Supplied Industrial County Demands for 2010 through 2060

	Annual Water Demands from Self Supplied Industrial (AFY)					
County	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Major	0	0	0	0	0	0
Marshall	0	0	0	0	0	0
Mayes	0	0	0	0	0	0
McClain	0	0	0	0	0	0
McCurtain	34,058	33,179	34,339	35,320	36,390	37,371
McIntosh	0	0	0	0	0	0
Murray	0	0	0	0	0	0
Muskogee	21,658	21,112	21,746	22,293	22,841	23,388
Noble	0	0	0	0	0	0
Nowata	0	0	0	0	0	0
Okfuskee	0	0	0	0	0	0
Oklahoma	244	238	247	255	260	265
Okmulgee	0	0	0	0	0	0
Osage	576	562	590	615	640	669
Ottawa	0	0	0	0	0	0
Pawnee	0	0	0	0	0	0
Payne	0	0	0	0	0	0
Pittsburg	0	0	0	0	0	0
Pontotoc	0	0	0	0	0	0
Pottawatomie	639	623	661	697	732	768
Pushmataha	0	0	0	0	0	0
Roger Mills	0	0	0	0	0	0
Rogers	0	0	0	0	0	0
Seminole	0	0	0	0	0	0
Sequoyah	1,708	1,672	1,825	1,974	2,127	2,280
Stephens	0	0	0	0	0	0
Texas	10,724	10,612	12,722	14,831	16,941	19,018
Tillman	0	0	0	0	0	0
Tulsa	0	0	0	0	0	0
Wagoner	0	0	0	0	0	0
Washington	0	0	0	0	0	0
Washita	0	0	0	0	0	0
Woods	0	0	0	0	0	0
Woodward	3,097	3,016	3,106	3,167	3,242	3,303
Total	**88,780**	**87,558**	**92,313**	**96,730**	**101,258**	**105,683**

Table 3-8 Self Supplied Industrial Sector Demand by OCWP Basin

Basin Number	Basin ID	Basin Name	Demand (AFY)						Supply Source (Percent of Demand)			
			2010	2020	2030	2040	2050	2060	Surface Water	Ground-water	Alluvial Ground-water	Bedrock Ground-water
1	10100	Red River Mainstem (To Kiamichi River)	0	0	0	0	0	0	0%	0%	0%	0%
2	10201	Little River (McCurtain County) - 1	0	0	0	0	0	0	0%	0%	0%	0%
3	10202	Little River (McCurtain County) - 2	34,058	33,179	34,339	35,320	36,390	37,371	100%	0%	0%	0%
4	10203	Little River (McCurtain County) - 3	0	0	0	0	0	0	0%	0%	0%	0%
5	10301	Kiamichi River - 1	95	99	101	104	101	99	100%	0%	0%	0%
6	10302	Kiamichi River - 2	0	0	0	0	0	0	0%	0%	0%	0%
7	10411	Muddy Boggy River - 1	0	0	0	0	0	0	0%	0%	0%	0%
8	10412	Muddy Boggy River - 2	0	0	0	0	0	0	0%	0%	0%	0%
9	10420	Clear Boggy Creek	0	0	0	0	0	0	0%	0%	0%	0%
10	10500	Red River Mainstem (To Blue River)	0	0	0	0	0	0	0%	0%	0%	0%
11	10601	Blue River - 1	0	0	0	0	0	0	0%	0%	0%	0%
12	10602	Blue River - 2	0	0	0	0	0	0	0%	0%	0%	0%
13	10700	Red River Mainstem (To Washita)	0	0	0	0	0	0	0%	0%	0%	0%
14	10810	Lower Washita	225	219	223	227	232	236	0%	100%	16%	84%
15	10821	Middle Washita - 1	115	113	121	127	134	140	100%	0%	0%	0%
16	10822	Middle Washita - 2	160	156	164	170	174	178	0%	100%	0%	100%
17	10831	Upper Washita - 1	0	0	0	0	0	0	0%	0%	0%	0%
18	10832	Upper Washita - 2	0	0	0	0	0	0	0%	0%	0%	0%
19	10833	Upper Washita - 3	0	0	0	0	0	0	0%	0%	0%	0%
20	10840	Washita Headwaters	0	0	0	0	0	0	0%	0%	0%	0%
21	10900	Red River Mainstem (To Walnut Bayou)	1,460	1,425	1,449	1,473	1,517	1,562	100%	0%	0%	0%
22	11000	Walnut Bayou	0	0	0	0	0	0	0%	0%	0%	0%
23	11100	Mud Creek	0	0	0	0	0	0	0%	0%	0%	0%
24	11201	Beaver Creek - 1	0	0	0	0	0	0	0%	0%	0%	0%
25	11202	Beaver Creek - 2	0	0	0	0	0	0	0%	0%	0%	0%
26	11203	Beaver Creek - 3	0	0	0	0	0	0	0%	0%	0%	0%
27	11311	Cache Creek - 1	0	0	0	0	0	0	0%	0%	0%	0%
28	11312	Cache Creek - 2	195	190	200	207	213	217	100%	0%	0%	0%
29	11321	Deep Red Creek And West Cache Creek - 1	0	0	0	0	0	0	0%	0%	0%	0%
30	11322	Deep Red Creek And West Cache Creek - 2	0	0	0	0	0	0	0%	0%	0%	0%

Table 3-8 Self Supplied Industrial Sector Demand by OCWP Basin

Basin Number	Basin ID	Basin Name	Demand (AFY) 2010	2020	2030	2040	2050	2060	Supply Source (Percent of Demand) Surface Water	Ground-water	Alluvial Ground-water	Bedrock Ground-water
31	11400	Red River Mainstem (To North Fork of Red)	0	0	0	0	0	0	0%	0%	0%	0%
32	11511	Lower North Fork Red River - 1	0	0	0	0	0	0	0%	0%	0%	0%
33	11512	Lower North Fork Red River - 2	0	0	0	0	0	0	0%	0%	0%	0%
34	11513	Lower North Fork Red River - 3	0	0	0	0	0	0	0%	0%	0%	0%
35	11514	Lower North Fork Red River - 4	0	0	0	0	0	0	0%	0%	0%	0%
36	11521	Upper North Fork Red River - 1	0	0	0	0	0	0	0%	0%	0%	0%
37	11522	Upper North Fork Red River - 2	0	0	0	0	0	0	0%	0%	0%	0%
38	11601	Salt Fork Red River - 1	601	586	614	636	654	669	0%	100%	5%	95%
39	11602	Salt Fork Red River - 2	0	0	0	0	0	0	0%	0%	0%	0%
40	11701	Prairie Dog Town Fork Red River - 1	0	0	0	0	0	0	0%	0%	0%	0%
41	11702	Prairie Dog Town Fork Red River - 2	0	0	0	0	0	0	0%	0%	0%	0%
42	11801	Elm Fork Red River - 1	0	0	0	0	0	0	0%	0%	0%	0%
43	11802	Elm Fork Red River - 2	0	0	0	0	0	0	0%	0%	0%	0%
44	20101	Poteau River - 1	0	0	0	0	0	0	0%	0%	0%	0%
45	20102	Poteau River - 2	0	0	0	0	0	0	0%	0%	0%	0%
46	20201	Lower Arkansas River - 1	205	200	219	237	255	273	100%	0%	0%	0%
47	20202	Lower Arkansas River - 2	21,658	21,112	21,746	22,293	22,841	23,388	97%	3%	100%	0%
48	20300	Canadian River (To North Canadian River)	0	0	0	0	0	0	0%	0%	0%	0%
49	20400	Middle Arkansas River	0	0	0	0	0	0	0%	0%	0%	0%
50	20510	Lower North Canadian River	882	861	908	951	992	1,034	0%	100%	0%	100%
51	20520	Middle North Canadian River	0	0	0	0	0	0	0%	0%	0%	0%
52	20531	Upper North Canadian River - 1	0	0	0	0	0	0	0%	0%	0%	0%
53	20532	Upper North Canadian River - 2	3,097	3,016	3,106	3,167	3,242	3,303	0%	100%	43%	57%
54	20533	Upper North Canadian River - 3	0	0	0	0	0	0	0%	0%	0%	0%
55	20540	North Canadian Headwaters	11,100	11,006	13,122	15,238	17,354	19,437	0%	100%	0%	100%
56	20611	Lower Canadian River - 1	0	0	0	0	0	0	0%	0%	0%	0%
57	20612	Lower Canadian River - 2	0	0	0	0	0	0	0%	0%	0%	0%
58	20620	Middle Canadian River	0	0	0	0	0	0	0%	0%	0%	0%
59	20630	Upper Canadian River	23	23	23	24	25	26	0%	100%	0%	100%
60	20700	Deep Fork River	0	0	0	0	0	0	0%	0%	0%	0%
61	20801	Little River - 1	0	0	0	0	0	0	0%	0%	0%	0%
62	20802	Little River - 2	0	0	0	0	0	0	0%	0%	0%	0%
63	20910	Lower Cimarron River	0	0	0	0	0	0	0%	0%	0%	0%

Table 3-8 Self Supplied Industrial Sector Demand by OCWP Basin

Basin Number	Basin ID	Basin Name	Demand (AFY) 2010	2020	2030	2040	2050	2060	Supply Source (Percent of Demand) Surface Water	Ground-water	Alluvial Ground-water	Bedrock Ground-water
64	20920	Middle Cimarron River	1,487	1,457	1,598	1,738	1,876	2,025	100%	0%	0%	0%
65	20930	Upper Cimarron River	0	0	0	0	0	0	0%	0%	0%	0%
66	20940	Cimarron Headwaters	0	0	0	0	0	0	0%	0%	0%	0%
67	21011	Lower Salt Fork Arkansas River - 1	0	0	0	0	0	0	0%	0%	0%	0%
69	21012	Lower Salt Fork Arkansas River - 2	0	0	0	0	0	0	0%	0%	0%	0%
70	21013	Lower Salt Fork Arkansas River - 3	0	0	0	0	0	0	0%	0%	0%	0%
68	21020	Upper Salt Fork Arkansas River	0	0	0	0	0	0	0%	0%	0%	0%
71	21100	Arkansas River - Cimarron Rivers to Keystone Lake	0	0	0	0	0	0	0%	0%	0%	0%
72	21200	Arkansas River Mainstem (To Kansas State Line)	11,808	12,337	12,664	12,965	13,266	13,594	82%	18%	89%	11%
73	21301	Bird Creek - 1	0	0	0	0	0	0	0%	0%	0%	0%
74	21302	Bird Creek - 2	107	105	110	115	119	125	100%	0%	0%	0%
75	21401	Caney River - 1	0	0	0	0	0	0	0%	0%	0%	0%
76	21402	Caney River - 2	0	0	0	0	0	0	0%	0%	0%	0%
77	21511	Verdigris River (To Oologah Dam) - 1	0	0	0	0	0	0	0%	0%	0%	0%
78	21512	Verdigris River (To Oologah Dam) - 2	0	0	0	0	0	0	0%	0%	0%	0%
79	21520	Verdigris River (To Kansas State Line)	0	0	0	0	0	0	0%	0%	0%	0%
80	21601	Grand (Neosho) River - 1	0	0	0	0	0	0	0%	0%	0%	0%
81	21602	Grand (Neosho) River - 2	0	0	0	0	0	0	0%	0%	0%	0%
82	21700	Illinois River	1,503	1,472	1,606	1,738	1,872	2,007	100%	0%	0%	0%
		Total	**88,780**	**87,558**	**92,313**	**96,730**	**101,258**	**105,683**				

Table 3-9 Self Supplied Industrial Sector Monthly Demand Pattern by OCWP Basin

Basin Number	Basin ID	Basin Name	Monthly Demand Pattern (Percent of Annual Demand)											
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	10100	Red River Mainstem (To Kiamichi River)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2	10201	Little River (McCurtain County) - 1	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
3	10202	Little River (McCurtain County) - 2	9%	8%	8%	8%	9%	8%	9%	9%	8%	9%	8%	8%
4	10203	Little River (McCurtain County) - 3	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
5	10301	Kiamichi River - 1	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%
6	10302	Kiamichi River - 2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
7	10411	Muddy Boggy River - 1	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
8	10412	Muddy Boggy River - 2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
9	10420	Clear Boggy Creek	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
10	10500	Red River Mainstem (To Blue River)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
11	10601	Blue River - 1	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
12	10602	Blue River - 2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
13	10700	Red River Mainstem (To Washita)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
14	10810	Lower Washita	6%	7%	8%	8%	7%	10%	11%	11%	10%	8%	8%	6%
15	10821	Middle Washita - 1	6%	7%	8%	8%	7%	10%	11%	11%	10%	8%	8%	6%
16	10822	Middle Washita - 2	8%	8%	9%	9%	9%	9%	9%	8%	8%	8%	8%	7%
17	10831	Upper Washita - 1	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
18	10832	Upper Washita - 2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
19	10833	Upper Washita - 3	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
20	10840	Washita Headwaters	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
21	10900	Red River Mainstem (To Walnut Bayou)	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%
22	11000	Walnut Bayou	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
23	11100	Mud Creek	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
24	11201	Beaver Creek - 1	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
25	11202	Beaver Creek - 2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
26	11203	Beaver Creek - 3	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
27	11311	Cache Creek - 1	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
28	11312	Cache Creek - 2	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%
29	11321	Deep Red Creek And West Cache Creek - 1	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
30	11322	Deep Red Creek And West Cache Creek - 2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
31	11400	Red River Mainstem (To North Fork of Red)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
32	11511	Lower North Fork Red River - 1	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
33	11512	Lower North Fork Red River - 2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
34	11513	Lower North Fork Red River - 3	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
35	11514	Lower North Fork Red River - 4	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
36	11521	Upper North Fork Red River - 1	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Table 3-9 Self Supplied Industrial Sector Monthly Demand Pattern by OCWP Basin

Basin Number	Basin ID	Basin Name	Monthly Demand Pattern (Percent of Annual Demand)											
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
37	11522	Upper North Fork Red River - 2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
38	11601	Salt Fork Red River - 1	8%	8%	9%	9%	9%	9%	9%	8%	8%	8%	8%	7%
39	11602	Salt Fork Red River - 2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
40	11701	Prairie Dog Town Fork Red River - 1	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
41	11702	Prairie Dog Town Fork Red River - 2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
42	11801	Elm Fork Red River - 1	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
43	11802	Elm Fork Red River - 2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
44	20101	Poteau River - 1	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
45	20102	Poteau River - 2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
46	20201	Lower Arkansas River - 1	7%	7%	7%	8%	8%	6%	9%	8%	10%	9%	9%	12%
47	20202	Lower Arkansas River - 2	9%	8%	8%	8%	9%	8%	9%	9%	8%	9%	8%	8%
48	20300	Canadian River (To North Canadian River)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
49	20400	Middle Arkansas River	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
50	20510	Lower North Canadian River	7%	7%	7%	7%	9%	9%	11%	11%	9%	9%	8%	7%
51	20520	Middle North Canadian River	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
52	20531	Upper North Canadian River - 1	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
53	20532	Upper North Canadian River - 2	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%
54	20533	Upper North Canadian River - 3	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
55	20540	North Canadian Headwaters	7%	6%	7%	8%	9%	10%	11%	10%	9%	8%	7%	7%
56	20611	Lower Canadian River - 1	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
57	20612	Lower Canadian River - 2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
58	20620	Middle Canadian River	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
59	20630	Upper Canadian River	6%	7%	8%	8%	7%	10%	11%	11%	10%	8%	8%	6%
60	20700	Deep Fork River	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
61	20801	Little River - 1	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
62	20802	Little River - 2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
63	20910	Lower Cimarron River	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
64	20920	Middle Cimarron River	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%
65	20930	Upper Cimarron River	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
66	20940	Cimarron Headwaters	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
67	21011	Lower Salt Fork Arkansas River - 1	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
69	21012	Lower Salt Fork Arkansas River - 2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
70	21013	Lower Salt Fork Arkansas River - 3	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
68	21020	Upper Salt Fork Arkansas River	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
71	21100	Arkansas River - Cimarron Rivers to Keystone	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
72	21200	Arkansas River Mainstem (To Kansas State	6%	7%	8%	8%	7%	10%	11%	11%	10%	8%	8%	7%

Table 3-9 Self Supplied Industrial Sector Monthly Demand Pattern by OCWP Basin

Basin Number	Basin ID	Basin Name	Monthly Demand Pattern (Percent of Annual Demand)											
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
73	21301	Bird Creek - 1	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
74	21302	Bird Creek - 2	7%	7%	7%	8%	9%	9%	11%	10%	9%	9%	7%	7%
75	21401	Caney River - 1	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
76	21402	Caney River - 2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
77	21511	Verdigris River (To Oologah Dam) - 1	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
78	21512	Verdigris River (To Oologah Dam) - 2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
79	21520	Verdigris River (To Kansas State Line)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
80	21601	Grand (Neosho) River - 1	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
81	21602	Grand (Neosho) River - 2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
82	21700	Illinois River	8%	8%	8%	9%	9%	8%	8%	8%	7%	8%	9%	8%

Table 3-10 - Thermoelectric Power County Demands for 2010 through 2060

	Annual Water Demands from Thermoelectric Power (AFY)					
County	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Adair	0	0	0	0	0	0
Alfalfa	0	0	0	0	0	0
Atoka	0	0	0	0	0	0
Beaver	0	0	0	0	0	0
Beckham	0	0	0	0	0	0
Blaine	0	0	0	0	0	0
Bryan	0	0	0	0	0	0
Caddo	5,178	5,776	6,444	7,189	8,020	8,947
Canadian	2,364	2,637	2,942	3,282	3,662	4,085
Carter	0	0	0	0	0	0
Cherokee	0	0	0	0	0	0
Choctaw	7,304	8,149	9,091	10,142	11,314	12,623
Cimarron	0	0	0	0	0	0
Cleveland	0	0	0	0	0	0
Coal	0	0	0	0	0	0
Comanche	2,566	2,863	3,194	3,563	3,975	4,435
Cotton	0	0	0	0	0	0
Craig	0	0	0	0	0	0
Creek	0	0	0	0	0	0
Custer	0	0	0	0	0	0
Delaware	0	0	0	0	0	0
Dewey	0	0	0	0	0	0
Ellis	0	0	0	0	0	0
Garfield	0	0	0	0	0	0
Garvin	0	0	0	0	0	0
Grady	0	0	0	0	0	0
Grant	0	0	0	0	0	0
Greer	0	0	0	0	0	0
Harmon	0	0	0	0	0	0
Harper	0	0	0	0	0	0
Haskell	0	0	0	0	0	0
Hughes	0	0	0	0	0	0
Jackson	0	0	0	0	0	0
Jefferson	0	0	0	0	0	0
Johnston	0	0	0	0	0	0
Kay	0	0	0	0	0	0
Kingfisher	0	0	0	0	0	0
Kiowa	0	0	0	0	0	0
Latimer	0	0	0	0	0	0
Le Flore	0	0	0	0	0	0
Lincoln	0	0	0	0	0	0
Logan	250	279	312	348	388	433
Love	0	0	0	0	0	0

Table 3-10 - Thermoelectric Power County Demands for 2010 through 2060

County	Annual Water Demands from Thermoelectric Power (AFY)					
	2010	2020	2030	2040	2050	2060
Major	0	0	0	0	0	0
Marshall	0	0	0	0	0	0
Mayes	4,491	5,010	5,589	6,236	6,956	7,761
McClain	6,540	7,296	8,139	9,080	10,130	11,301
McCurtain	988	1,103	1,230	1,372	1,531	1,708
McIntosh	0	0	0	0	0	0
Murray	0	0	0	0	0	0
Muskogee	103,395	115,348	128,683	143,560	160,157	178,672
Noble	0	0	0	0	0	0
Nowata	0	0	0	0	0	0
Okfuskee	0	0	0	0	0	0
Oklahoma	10,051	11,213	12,510	13,956	15,569	17,369
Okmulgee	0	0	0	0	0	0
Osage	0	0	0	0	0	0
Ottawa	0	0	0	0	0	0
Pawnee	37,872	42,251	47,135	52,584	58,663	65,445
Payne	0	0	0	0	0	0
Pittsburg	13,316	14,855	16,572	18,488	20,626	23,010
Pontotoc	0	0	0	0	0	0
Pottawatomie	0	0	0	0	0	0
Pushmataha	0	0	0	0	0	0
Roger Mills	0	0	0	0	0	0
Rogers	23,669	26,405	29,458	32,863	36,662	40,901
Seminole	17,898	19,967	22,275	24,851	27,723	30,929
Sequoyah	0	0	0	0	0	0
Stephens	0	0	0	0	0	0
Texas	0	0	0	0	0	0
Tillman	0	0	0	0	0	0
Tulsa	13,507	15,069	16,811	18,754	20,922	23,341
Wagoner	4,733	5,280	5,891	6,572	7,332	8,179
Washington	0	0	0	0	0	0
Washita	0	0	0	0	0	0
Woods	0	0	0	0	0	0
Woodward	0	0	0	0	0	0
Total	**254,123**	**283,502**	**316,277**	**352,841**	**393,632**	**439,139**

Table 3-11 Thermoelectric Power Sector Demand by OCWP Basin

Basin Number	Basin ID	Basin Name	Demand (AFY) 2010	2020	2030	2040	2050	2060	Supply Source (Percent of Demand) Surface Water	Ground-water	Alluvial Ground-water	Bedrock Ground-water
1	10100	Red River Mainstem (To Kiamichi River)	0	0	0	0	0	0	0%	0%	0%	0%
2	10201	Little River (McCurtain County) - 1	0	0	0	0	0	0	0%	0%	0%	0%
3	10202	Little River (McCurtain County) - 2	988	1,103	1,230	1,372	1,531	1,708	100%	0%	0%	0%
4	10203	Little River (McCurtain County) - 3	0	0	0	0	0	0	0%	0%	0%	0%
5	10301	Kiamichi River - 1	7,304	8,149	9,091	10,142	11,314	12,623	93%	7%	0%	100%
6	10302	Kiamichi River - 2	0	0	0	0	0	0	0%	0%	0%	0%
7	10411	Muddy Boggy River - 1	0	0	0	0	0	0	0%	0%	0%	0%
8	10412	Muddy Boggy River - 2	13,316	14,855	16,572	18,488	20,626	23,010	100%	0%	0%	0%
9	10420	Clear Boggy Creek	0	0	0	0	0	0	0%	0%	0%	0%
10	10500	Red River Mainstem (To Blue River)	0	0	0	0	0	0	0%	0%	0%	0%
11	10601	Blue River - 1	0	0	0	0	0	0	0%	0%	0%	0%
12	10602	Blue River - 2	0	0	0	0	0	0	0%	0%	0%	0%
13	10700	Red River Mainstem (To Washita)	0	0	0	0	0	0	0%	0%	0%	0%
14	10810	Lower Washita	0	0	0	0	0	0	0%	0%	0%	0%
15	10821	Middle Washita - 1	0	0	0	0	0	0	0%	0%	0%	0%
16	10822	Middle Washita - 2	0	0	0	0	0	0	0%	0%	0%	0%
17	10831	Upper Washita - 1	5,178	5,776	6,444	7,189	8,020	8,947	61%	39%	94%	6%
18	10832	Upper Washita - 2	0	0	0	0	0	0	0%	0%	0%	0%
19	10833	Upper Washita - 3	0	0	0	0	0	0	0%	0%	0%	0%
20	10840	Washita Headwaters	0	0	0	0	0	0	0%	0%	0%	0%
21	10900	Red River Mainstem (To Walnut Bayou)	0	0	0	0	0	0	0%	0%	0%	0%
22	11000	Walnut Bayou	0	0	0	0	0	0	0%	0%	0%	0%
23	11100	Mud Creek	0	0	0	0	0	0	0%	0%	0%	0%
24	11201	Beaver Creek - 1	0	0	0	0	0	0	0%	0%	0%	0%
25	11202	Beaver Creek - 2	0	0	0	0	0	0	0%	0%	0%	0%
26	11203	Beaver Creek - 3	0	0	0	0	0	0	0%	0%	0%	0%
27	11311	Cache Creek - 1	0	0	0	0	0	0	0%	0%	0%	0%
28	11312	Cache Creek - 2	2,566	2,863	3,194	3,563	3,975	4,435	100%	0%	0%	0%
29	11321	Deep Red Creek And West Cache Creek - 1	0	0	0	0	0	0	0%	0%	0%	0%
30	11322	Deep Red Creek And West Cache Creek - 2	0	0	0	0	0	0	0%	0%	0%	0%
31	11400	Red River Mainstem (To North Fork of Red)	0	0	0	0	0	0	0%	0%	0%	0%
32	11511	Lower North Fork Red River - 1	0	0	0	0	0	0	0%	0%	0%	0%
33	11512	Lower North Fork Red River - 2	0	0	0	0	0	0	0%	0%	0%	0%
34	11513	Lower North Fork Red River - 3	0	0	0	0	0	0	0%	0%	0%	0%
35	11514	Lower North Fork Red River - 4	0	0	0	0	0	0	0%	0%	0%	0%
36	11521	Upper North Fork Red River - 1	0	0	0	0	0	0	0%	0%	0%	0%
37	11522	Upper North Fork Red River - 2	0	0	0	0	0	0	0%	0%	0%	0%
38	11601	Salt Fork Red River - 1	0	0	0	0	0	0	0%	0%	0%	0%
39	11602	Salt Fork Red River - 2	0	0	0	0	0	0	0%	0%	0%	0%
40	11701	Prairie Dog Town Fork Red River - 1	0	0	0	0	0	0	0%	0%	0%	0%
41	11702	Prairie Dog Town Fork Red River - 2	0	0	0	0	0	0	0%	0%	0%	0%
42	11801	Elm Fork Red River - 1	0	0	0	0	0	0	0%	0%	0%	0%
43	11802	Elm Fork Red River - 2	0	0	0	0	0	0	0%	0%	0%	0%
44	20101	Poteau River - 1	0	0	0	0	0	0	0%	0%	0%	0%
45	20102	Poteau River - 2	5,885	6,565	7,324	8,171	9,116	10,170	100%	0%	0%	0%
46	20201	Lower Arkansas River - 1	0	0	0	0	0	0	0%	0%	0%	0%
47	20202	Lower Arkansas River - 2	103,395	115,348	128,683	143,560	160,157	178,672	99%	1%	100%	0%
48	20300	Canadian River (To North Canadian River)	0	0	0	0	0	0	0%	0%	0%	0%
49	20400	Middle Arkansas River	13,507	15,069	16,811	18,754	20,922	23,341	98%	2%	100%	0%
50	20510	Lower North Canadian River	2,741	3,058	3,412	3,806	4,246	4,737	83%	17%	78%	22%

Table 3-11 Thermoelectric Power Sector Demand by OCWP Basin

Basin Number	Basin ID	Basin Name	Demand (AFY)						Supply Source (Percent of Demand)			
			2010	2020	2030	2040	2050	2060	Surface Water	Ground-water	Alluvial Ground-water	Bedrock Ground-water
51	20520	Middle North Canadian River	2,364	2,637	2,942	3,282	3,662	4,085	0%	100%	100%	0%
52	20531	Upper North Canadian River - 1	531	593	661	738	823	918	0%	100%	100%	0%
53	20532	Upper North Canadian River - 2	0	0	0	0	0	0	0%	0%	0%	0%
54	20533	Upper North Canadian River - 3	0	0	0	0	0	0	0%	0%	0%	0%
55	20540	North Canadian Headwaters	0	0	0	0	0	0	0%	0%	0%	0%
56	20611	Lower Canadian River - 1	17,898	19,967	22,275	24,851	27,723	30,929	92%	8%	86%	14%
57	20612	Lower Canadian River - 2	0	0	0	0	0	0	0%	0%	0%	0%
58	20620	Middle Canadian River	6,573	7,333	8,181	9,126	10,181	11,359	100%	0%	0%	0%
59	20630	Upper Canadian River	0	0	0	0	0	0	0%	0%	0%	0%
60	20700	Deep Fork River	7,277	8,118	9,057	10,104	11,272	12,575	100%	0%	0%	0%
61	20801	Little River - 1	0	0	0	0	0	0	0%	0%	0%	0%
62	20802	Little River - 2	0	0	0	0	0	0	0%	0%	0%	0%
63	20910	Lower Cimarron River	0	0	0	0	0	0	0%	0%	0%	0%
64	20920	Middle Cimarron River	250	279	312	348	388	433	100%	0%	0%	0%
65	20930	Upper Cimarron River	0	0	0	0	0	0	0%	0%	0%	0%
66	20940	Cimarron Headwaters	0	0	0	0	0	0	0%	0%	0%	0%
67	21011	Lower Salt Fork Arkansas River - 1	0	0	0	0	0	0	0%	0%	0%	0%
69	21012	Lower Salt Fork Arkansas River - 2	0	0	0	0	0	0	0%	0%	0%	0%
70	21013	Lower Salt Fork Arkansas River - 3	0	0	0	0	0	0	0%	0%	0%	0%
68	21020	Upper Salt Fork Arkansas River	0	0	0	0	0	0	0%	0%	0%	0%
71	21100	Arkansas River - Cimarron Rivers to Keystone Lake	0	0	0	0	0	0	0%	0%	0%	0%
72	21200	Arkansas River Mainstem (To Kansas State Line)	37,872	42,251	47,135	52,584	58,663	65,445	100%	0%	0%	0%
73	21301	Bird Creek - 1	0	0	0	0	0	0	0%	0%	0%	0%
74	21302	Bird Creek - 2	0	0	0	0	0	0	0%	0%	0%	0%
75	21401	Caney River - 1	0	0	0	0	0	0	0%	0%	0%	0%
76	21402	Caney River - 2	0	0	0	0	0	0	0%	0%	0%	0%
77	21511	Verdigris River (To Oologah Dam) - 1	4,733	5,280	5,891	6,572	7,332	8,179	100%	0%	0%	0%
78	21512	Verdigris River (To Oologah Dam) - 2	23,669	26,405	29,458	32,863	36,662	40,901	100%	0%	0%	0%
79	21520	Verdigris River (To Kansas State Line)	0	0	0	0	0	0	0%	0%	0%	0%
80	21601	Grand (Neosho) River - 1	4,491	5,010	5,589	6,236	6,956	7,761	100%	0%	0%	0%
81	21602	Grand (Neosho) River - 2	0	0	0	0	0	0	0%	0%	0%	0%
82	21700	Illinois River	0	0	0	0	0	0	0%	0%	0%	0%
		Total	**260,539**	**290,660**	**324,262**	**361,750**	**403,571**	**450,227**				

Table 3-12 - Thermoelectric Power Sector Monthly Demand Pattern by OCWP Basin

Basin Number	Basin ID	Basin Name	Monthly Demand Pattern (Percent of Annual Demand)											
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	10100	Red River Mainstem (To Kiamichi River)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2	10201	Little River (McCurtain County) - 1	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
3	10202	Little River (McCurtain County) - 2	8%	7%	5%	6%	6%	8%	11%	17%	9%	9%	6%	7%
4	10203	Little River (McCurtain County) - 3	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
5	10301	Kiamichi River - 1	10%	9%	1%	1%	9%	10%	10%	11%	10%	10%	10%	10%
6	10302	Kiamichi River - 2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
7	10411	Muddy Boggy River - 1	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
8	10412	Muddy Boggy River - 2	11%	9%	3%	9%	8%	10%	11%	13%	8%	9%	1%	7%
9	10420	Clear Boggy Creek	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
10	10500	Red River Mainstem (To Blue River)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
11	10601	Blue River - 1	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
12	10602	Blue River - 2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
13	10700	Red River Mainstem (To Washita)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
14	10810	Lower Washita	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
15	10821	Middle Washita - 1	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
16	10822	Middle Washita - 2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
17	10831	Upper Washita - 1	8%	7%	7%	9%	7%	8%	10%	12%	7%	7%	9%	9%
18	10832	Upper Washita - 2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
19	10833	Upper Washita - 3	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
20	10840	Washita Headwaters	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
21	10900	Red River Mainstem (To Walnut Bayou)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
22	11000	Walnut Bayou	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
23	11100	Mud Creek	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
24	11201	Beaver Creek - 1	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
25	11202	Beaver Creek - 2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
26	11203	Beaver Creek - 3	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
27	11311	Cache Creek - 1	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
28	11312	Cache Creek - 2	6%	5%	11%	12%	12%	11%	12%	13%	11%	7%	0%	1%
29	11321	Deep Red Creek And West Cache Creek - 1	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
30	11322	Deep Red Creek And West Cache Creek - 2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
31	11400	Red River Mainstem (To North Fork of Red)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
32	11511	Lower North Fork Red River - 1	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
33	11512	Lower North Fork Red River - 2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
34	11513	Lower North Fork Red River - 3	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
35	11514	Lower North Fork Red River - 4	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
36	11521	Upper North Fork Red River - 1	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
37	11522	Upper North Fork Red River - 2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Table 3-12 - Thermoelectric Power Sector Monthly Demand Pattern by OCWP Basin

Basin Number	Basin ID	Basin Name	Monthly Demand Pattern (Percent of Annual Demand)											
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
38	11601	Salt Fork Red River - 1	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
39	11602	Salt Fork Red River - 2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
40	11701	Prairie Dog Town Fork Red River - 1	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
41	11702	Prairie Dog Town Fork Red River - 2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
42	11801	Elm Fork Red River - 1	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
43	11802	Elm Fork Red River - 2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
44	20101	Poteau River - 1	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
45	20102	Poteau River - 2	9%	8%	3%	5%	9%	9%	9%	9%	9%	10%	9%	9%
46	20201	Lower Arkansas River - 1	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
47	20202	Lower Arkansas River - 2	9%	10%	9%	7%	8%	10%	10%	9%	8%	5%	6%	8%
48	20300	Canadian River (To North Canadian River)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
49	20400	Middle Arkansas River	6%	8%	7%	8%	7%	9%	11%	13%	10%	8%	7%	6%
50	20510	Lower North Canadian River	7%	1%	0%	2%	5%	8%	18%	28%	9%	11%	8%	4%
51	20520	Middle North Canadian River	4%	0%	0%	6%	5%	9%	11%	16%	11%	14%	12%	13%
52	20531	Upper North Canadian River - 1	5%	4%	3%	7%	3%	8%	10%	28%	10%	8%	0%	14%
53	20532	Upper North Canadian River - 2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
54	20533	Upper North Canadian River - 3	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
55	20540	North Canadian Headwaters	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
56	20611	Lower Canadian River - 1	7%	7%	8%	9%	6%	6%	8%	13%	10%	9%	6%	10%
57	20612	Lower Canadian River - 2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
58	20620	Middle Canadian River	9%	7%	6%	8%	9%	8%	9%	9%	8%	9%	10%	9%
59	20630	Upper Canadian River	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
60	20700	Deep Fork River	3%	3%	9%	10%	8%	9%	12%	15%	10%	10%	3%	5%
61	20801	Little River - 1	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
62	20802	Little River - 2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
63	20910	Lower Cimarron River	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
64	20920	Middle Cimarron River	0%	0%	0%	0%	0%	1%	19%	74%	6%	0%	0%	0%
65	20930	Upper Cimarron River	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
66	20940	Cimarron Headwaters	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
67	21011	Lower Salt Fork Arkansas River - 1	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
69	21012	Lower Salt Fork Arkansas River - 2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
70	21013	Lower Salt Fork Arkansas River - 3	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
68	21020	Upper Salt Fork Arkansas River	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
71	21100	Arkansas River - Cimarron Rivers to Keystone Lake	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
72	21200	Arkansas River Mainstem (To Kansas State Line)	11%	10%	11%	10%	10%	8%	6%	8%	8%	8%	3%	7%
73	21301	Bird Creek - 1	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
74	21302	Bird Creek - 2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Table 3-12 - Thermoelectric Power Sector Monthly Demand Pattern by OCWP Basin

Basin Number	Basin ID	Basin Name	Monthly Demand Pattern (Percent of Annual Demand)											
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
75	21401	Caney River - 1	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
76	21402	Caney River - 2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
77	21511	Verdigris River (To Oologah Dam) - 1	2%	3%	5%	2%	11%	15%	17%	25%	13%	6%	1%	1%
78	21512	Verdigris River (To Oologah Dam) - 2	10%	7%	8%	6%	7%	7%	9%	11%	9%	8%	9%	10%
79	21520	Verdigris River (To Kansas State Line)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
80	21601	Grand (Neosho) River - 1	7%	10%	3%	9%	8%	7%	9%	12%	9%	12%	5%	8%
81	21602	Grand (Neosho) River - 2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
82	21700	Illinois River	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Table 3-13 Livestock County Demands for 2010 through 2060

County	Annual Water Demands from Livestock (AFY)					
	2010	2020	2030	2040	2050	2060
Adair	1,441	1,476	1,511	1,546	1,581	1,616
Alfalfa	1,287	1,325	1,363	1,402	1,440	1,478
Atoka	1,116	1,117	1,117	1,117	1,118	1,118
Beaver	3,067	3,120	3,172	3,224	3,276	3,328
Beckham	770	795	820	846	871	897
Blaine	1,565	1,564	1,562	1,560	1,558	1,557
Bryan	1,564	1,567	1,571	1,575	1,579	1,582
Caddo	2,281	2,281	2,281	2,281	2,281	2,282
Canadian	1,510	1,525	1,541	1,556	1,571	1,586
Carter	779	797	814	832	849	867
Cherokee	829	830	830	831	832	833
Choctaw	1,010	1,012	1,013	1,015	1,016	1,018
Cimarron	1,907	1,940	1,974	2,008	2,041	2,075
Cleveland	421	433	444	456	467	479
Coal	596	619	642	665	688	711
Comanche	1,008	1,029	1,049	1,070	1,090	1,111
Cotton	942	950	957	965	972	979
Craig	1,684	1,689	1,694	1,699	1,703	1,708
Creek	654	668	683	697	712	726
Custer	1,254	1,294	1,335	1,375	1,415	1,455
Delaware	2,310	2,368	2,425	2,483	2,540	2,598
Dewey	713	742	771	800	828	857
Ellis	1,381	1,393	1,405	1,417	1,429	1,441
Garfield	1,361	1,368	1,375	1,383	1,390	1,397
Garvin	1,197	1,203	1,209	1,216	1,222	1,228
Grady	2,181	2,259	2,336	2,413	2,491	2,568
Grant	689	720	751	782	813	843
Greer	442	442	443	443	444	444
Harmon	565	577	589	602	614	626
Harper	1,441	1,448	1,456	1,463	1,470	1,478
Haskell	1,167	1,179	1,191	1,203	1,215	1,227
Hughes	1,654	1,673	1,691	1,709	1,727	1,745
Jackson	592	646	701	755	809	864
Jefferson	1,297	1,301	1,305	1,310	1,314	1,318
Johnston	622	631	640	649	658	667
Kay	618	635	652	670	687	705
Kingfisher	2,198	2,215	2,231	2,248	2,265	2,282
Kiowa	1,082	1,092	1,101	1,110	1,119	1,129
Latimer	571	576	580	584	588	593
Le Flore	2,499	2,517	2,535	2,553	2,571	2,588
Lincoln	1,118	1,119	1,121	1,122	1,124	1,125
Logan	742	789	837	884	931	978
Love	655	655	655	655	655	655
Major	1,972	1,998	2,024	2,051	2,077	2,104

Table 3-13 Livestock County Demands for 2010 through 2060

County	Annual Water Demands from Livestock (AFY)					
	2010	2020	2030	2040	2050	2060
Marshall	318	332	347	362	377	392
Mayes	1,322	1,327	1,332	1,337	1,342	1,347
McClain	884	888	892	895	899	903
McCurtain	2,050	2,118	2,187	2,256	2,325	2,394
McIntosh	844	868	892	916	939	963
Murray	401	431	461	491	521	552
Muskogee	1,139	1,146	1,152	1,159	1,166	1,172
Noble	874	876	879	881	883	885
Nowata	1,109	1,108	1,107	1,106	1,105	1,104
Okfuskee	728	736	744	752	760	768
Oklahoma	371	374	377	380	383	386
Okmulgee	744	747	750	753	756	759
Osage	2,323	2,343	2,363	2,384	2,404	2,424
Ottawa	1,055	1,071	1,086	1,102	1,118	1,133
Pawnee	616	617	618	620	621	622
Payne	831	839	848	856	865	874
Pittsburg	1,181	1,194	1,208	1,221	1,235	1,248
Pontotoc	853	870	886	903	919	936
Pottawatomie	947	950	954	957	960	964
Pushmataha	495	502	510	518	525	533
Roger Mills	871	896	921	946	971	996
Rogers	1,119	1,127	1,134	1,142	1,150	1,158
Seminole	627	642	656	671	686	700
Sequoyah	730	758	787	816	845	873
Stephens	1,019	1,044	1,068	1,093	1,117	1,142
Texas	9,161	9,254	9,347	9,440	9,533	9,626
Tillman	889	895	900	905	911	916
Tulsa	338	341	345	349	352	356
Wagoner	640	642	645	647	649	652
Washington	536	539	541	544	547	550
Washita	1,511	1,510	1,510	1,510	1,509	1,509
Woods	1,347	1,374	1,401	1,428	1,455	1,482
Woodward	1,856	1,856	1,857	1,857	1,858	1,858
Total	**94,480**	**95,792**	**97,104**	**98,416**	**99,728**	**101,040**

Table 3-14 Livestock Sector Demand by OCWP Basin

Basin Number	Basin ID	Basin Name	Demand (AFY) 2010	2020	2030	2040	2050	2060	Supply Source (Percent of Demand) Surface Water	Ground-water	Alluvial Ground-water	Bedrock Ground-water
1	10100	Red River Mainstem (To Kiamichi River)	449	463	477	490	504	518	93%	7%	80%	20%
2	10201	Little River (McCurtain County) - 1	372	385	397	410	422	435	100%	0%	0%	0%
3	10202	Little River (McCurtain County) - 2	1,109	1,140	1,172	1,203	1,234	1,265	99%	1%	0%	100%
4	10203	Little River (McCurtain County) - 3	669	685	702	718	734	751	100%	0%	0%	0%
5	10301	Kiamichi River - 1	394	395	396	398	399	400	78%	22%	0%	100%
6	10302	Kiamichi River - 2	986	996	1,005	1,014	1,024	1,033	91%	9%	28%	72%
7	10411	Muddy Boggy River - 1	414	415	415	416	417	417	49%	51%	2%	98%
8	10412	Muddy Boggy River - 2	1,314	1,333	1,351	1,370	1,389	1,407	67%	33%	39%	61%
9	10420	Clear Boggy Creek	1,185	1,202	1,218	1,235	1,251	1,267	83%	17%	0%	100%
10	10500	Red River Mainstem (To Blue River)	297	298	298	299	299	300	89%	11%	0%	100%
11	10601	Blue River - 1	362	363	364	365	366	366	97%	3%	0%	100%
12	10602	Blue River - 2	574	580	586	592	598	604	33%	67%	0%	100%
13	10700	Red River Mainstem (To Washita)	535	536	538	539	540	541	66%	34%	55%	45%
14	10810	Lower Washita	2,284	2,341	2,398	2,454	2,511	2,567	40%	60%	29%	71%
15	10821	Middle Washita - 1	860	873	887	900	913	927	46%	54%	36%	64%
16	10822	Middle Washita - 2	2,096	2,139	2,182	2,225	2,267	2,310	34%	66%	4%	96%
17	10831	Upper Washita - 1	407	407	407	407	407	407	17%	83%	3%	97%
18	10832	Upper Washita - 2	518	519	519	519	520	520	1%	99%	0%	100%
19	10833	Upper Washita - 3	2,041	2,066	2,090	2,115	2,140	2,164	12%	88%	27%	73%
20	10840	Washita Headwaters	937	965	992	1,019	1,047	1,074	3%	97%	32%	68%
21	10900	Red River Mainstem (To Walnut Bayou)	1,815	1,844	1,874	1,903	1,932	1,961	44%	56%	28%	72%
22	11000	Walnut Bayou	350	354	358	363	367	372	0%	100%	14%	86%
23	11100	Mud Creek	918	926	935	943	952	960	10%	90%	1%	99%
24	11201	Beaver Creek - 1	178	179	179	180	180	181	100%	0%	0%	0%
25	11202	Beaver Creek - 2	681	695	709	723	737	751	17%	83%	0%	100%
26	11203	Beaver Creek - 3	248	252	256	260	265	269	28%	72%	11%	89%
27	11311	Cache Creek - 1	156	157	158	160	161	162	78%	22%	100%	0%
28	11312	Cache Creek - 2	840	849	858	867	876	885	35%	65%	3%	97%
29	11321	Deep Red Creek And West Cache Creek - 1	531	540	548	556	565	573	25%	75%	60%	40%
30	11322	Deep Red Creek And West Cache Creek - 2	663	668	673	677	682	687	58%	42%	94%	6%
31	11400	Red River Mainstem (To North Fork of Red)	609	613	617	620	624	628	9%	91%	100%	0%
32	11511	Lower North Fork Red River - 1	111	114	117	120	123	126	9%	91%	100%	0%
33	11512	Lower North Fork Red River - 2	302	314	327	339	351	363	65%	35%	99%	1%
34	11513	Lower North Fork Red River - 3	916	926	937	947	958	968	30%	70%	41%	59%
35	11514	Lower North Fork Red River - 4	133	134	135	136	138	139	0%	100%	0%	100%
36	11521	Upper North Fork Red River - 1	162	164	166	168	171	173	1%	99%	100%	0%
37	11522	Upper North Fork Red River - 2	559	577	595	613	631	649	3%	97%	43%	57%
38	11601	Salt Fork Red River - 1	416	438	460	482	504	526	62%	38%	35%	65%
39	11602	Salt Fork Red River - 2	159	162	165	167	170	172	0%	100%	31%	69%
40	11701	Prairie Dog Town Fork Red River - 1	215	232	249	266	283	300	7%	93%	45%	55%
41	11702	Prairie Dog Town Fork Red River - 2	249	255	262	268	274	281	0%	100%	25%	75%
42	11801	Elm Fork Red River - 1	76	76	76	76	76	76	5%	95%	89%	11%
43	11802	Elm Fork Red River - 2	361	367	373	379	385	391	0%	100%	68%	32%
44	20101	Poteau River - 1	152	153	154	155	157	158	99%	1%	0%	100%
45	20102	Poteau River - 2	1,722	1,735	1,747	1,760	1,772	1,785	67%	33%	1%	99%
46	20201	Lower Arkansas River - 1	2,110	2,156	2,201	2,247	2,292	2,338	37%	63%	89%	11%
47	20202	Lower Arkansas River - 2	1,333	1,345	1,358	1,370	1,382	1,395	72%	28%	96%	4%
48	20300	Canadian River (To North Canadian River)	3,723	3,775	3,828	3,880	3,932	3,984	83%	17%	67%	33%
49	20400	Middle Arkansas River	1,182	1,193	1,204	1,215	1,225	1,236	14%	86%	96%	4%
50	20510	Lower North Canadian River	1,045	1,055	1,066	1,076	1,086	1,097	37%	63%	41%	59%

Table 3-14 Livestock Sector Demand by OCWP Basin

Basin Number	Basin ID	Basin Name	Demand (AFY) 2010	2020	2030	2040	2050	2060	Supply Source (Percent of Demand) Surface Water	Ground-water	Alluvial Ground-water	Bedrock Ground-water
51	20520	Middle North Canadian River	1,159	1,165	1,171	1,177	1,183	1,190	8%	92%	84%	16%
52	20531	Upper North Canadian River - 1	1,223	1,233	1,243	1,252	1,262	1,272	2%	98%	69%	31%
53	20532	Upper North Canadian River - 2	2,380	2,410	2,440	2,470	2,500	2,530	1%	99%	23%	77%
54	20533	Upper North Canadian River - 3	774	779	784	789	795	800	0%	100%	4%	96%
55	20540	North Canadian Headwaters	10,816	10,941	11,066	11,190	11,315	11,440	0%	100%	1%	99%
56	20611	Lower Canadian River - 1	1,251	1,268	1,285	1,302	1,319	1,336	28%	72%	76%	24%
57	20612	Lower Canadian River - 2	328	332	336	339	343	347	70%	30%	89%	11%
58	20620	Middle Canadian River	1,059	1,077	1,095	1,114	1,132	1,151	44%	56%	81%	19%
59	20630	Upper Canadian River	2,188	2,229	2,270	2,311	2,352	2,393	2%	98%	18%	82%
60	20700	Deep Fork River	1,915	1,936	1,957	1,979	2,000	2,021	72%	28%	1%	99%
61	20801	Little River - 1	318	321	325	328	332	335	33%	67%	75%	25%
62	20802	Little River - 2	552	561	569	578	587	596	18%	82%	6%	94%
63	20910	Lower Cimarron River	1,385	1,413	1,441	1,469	1,497	1,525	37%	63%	85%	15%
64	20920	Middle Cimarron River	6,225	6,304	6,384	6,464	6,544	6,623	9%	91%	86%	14%
65	20930	Upper Cimarron River	3,019	3,048	3,077	3,106	3,135	3,164	8%	92%	18%	82%
66	20940	Cimarron Headwaters	796	809	823	836	850	863	8%	92%	0%	100%
67	21011	Lower Salt Fork Arkansas River - 1	171	175	178	182	186	190	14%	86%	38%	62%
69	21012	Lower Salt Fork Arkansas River - 2	97	100	103	106	108	111	100%	0%	0%	100%
70	21013	Lower Salt Fork Arkansas River - 3	148	153	158	163	167	172	37%	63%	27%	73%
68	21020	Upper Salt Fork Arkansas River	2,277	2,346	2,415	2,484	2,553	2,622	17%	83%	93%	7%
71	21100	Arkansas River - Cimarron Rivers to Keystone Lake	2,192	2,207	2,221	2,236	2,250	2,265	24%	76%	42%	58%
72	21200	Arkansas River Mainstem (To Kansas State Line)	1,496	1,509	1,523	1,536	1,550	1,563	5%	95%	95%	5%
73	21301	Bird Creek - 1	141	143	144	145	147	148	100%	0%	0%	0%
74	21302	Bird Creek - 2	947	955	963	971	980	988	100%	0%	0%	0%
75	21401	Caney River - 1	198	199	200	202	203	205	99%	1%	0%	100%
76	21402	Caney River - 2	1,192	1,200	1,207	1,214	1,222	1,229	100%	0%	0%	0%
77	21511	Verdigris River (To Oologah Dam) - 1	462	464	466	468	470	472	100%	0%	0%	0%
78	21512	Verdigris River (To Oologah Dam) - 2	492	495	498	502	505	509	100%	0%	0%	0%
79	21520	Verdigris River (To Kansas State Line)	1,573	1,575	1,577	1,579	1,581	1,583	100%	0%	0%	0%
80	21601	Grand (Neosho) River - 1	4,102	4,139	4,176	4,213	4,249	4,286	0%	100%	0%	100%
81	21602	Grand (Neosho) River - 2	2,221	2,262	2,303	2,344	2,385	2,426	12%	88%	0%	100%
82	21700	Illinois River	1,664	1,697	1,730	1,763	1,796	1,829	82%	18%	0%	100%
		Total	**94,480**	**95,792**	**97,104**	**98,416**	**99,728**	**101,040**				

Table 3-15 Crop Irrigation County Demands for 2010 through 2060

County	Annual Water Demands from Crop Irrigation (AFY)					
	2010	2020	2030	2040	2050	2060
Adair	1,062	1,290	1,518	1,746	1,922	2,203
Alfalfa	5,043	5,492	5,940	6,389	6,733	7,285
Atoka	1,217	1,441	1,666	1,890	2,063	2,339
Beaver	32,642	33,590	34,538	35,486	36,214	37,383
Beckham	8,718	8,718	8,718	8,718	8,718	8,718
Blaine	6,517	6,517	6,517	6,517	6,517	6,517
Bryan	17,108	17,322	17,536	17,750	17,915	18,178
Caddo	31,644	34,361	37,078	39,794	41,879	45,228
Canadian	6,376	6,597	6,818	7,040	7,210	7,482
Carter	2,742	2,777	2,812	2,847	2,874	2,918
Cherokee	1,501	1,573	1,644	1,716	1,770	1,859
Choctaw	859	1,007	1,154	1,302	1,415	1,597
Cimarron	62,125	67,821	73,517	79,214	83,585	90,606
Cleveland	1,166	1,369	1,571	1,773	1,929	2,178
Coal	637	640	643	645	647	650
Comanche	2,690	2,890	3,089	3,289	3,442	3,688
Cotton	581	687	793	898	980	1,110
Craig	147	638	1,128	1,618	1,995	2,599
Creek	349	391	433	475	508	560
Custer	4,774	4,865	4,957	5,048	5,119	5,232
Delaware	949	949	949	949	949	949
Dewey	4,752	4,752	4,752	4,752	4,752	4,752
Ellis	22,940	25,405	27,870	30,334	32,225	35,263
Garfield	6,029	6,029	6,029	6,029	6,029	6,029
Garvin	1,340	1,819	2,298	2,777	3,144	3,734
Grady	11,291	11,291	11,291	11,291	11,291	11,291
Grant	1,801	1,801	1,801	1,801	1,801	1,801
Greer	6,064	8,255	10,445	12,636	14,317	17,016
Harmon	26,455	27,191	27,927	28,664	29,229	30,137
Harper	10,391	11,075	11,759	12,444	12,969	13,813
Haskell	2,589	2,798	3,006	3,215	3,375	3,633
Hughes	3,285	4,323	5,360	6,398	7,195	8,474
Jackson	101,716	103,765	105,813	107,862	109,434	111,960
Jefferson	363	395	427	459	484	523
Johnston	1,464	1,904	2,344	2,783	3,121	3,662
Kay	4,690	4,690	4,690	4,690	4,690	4,690
Kingfisher	7,926	8,321	8,716	9,111	9,415	9,902
Kiowa	4,563	4,688	4,813	4,939	5,035	5,190
Latimer	848	1,347	1,846	2,346	2,729	3,344
Le Flore	9,985	9,985	9,985	9,985	9,985	9,985
Lincoln	3,575	3,575	3,575	3,575	3,575	3,575
Logan	1,991	1,991	1,991	1,991	1,991	1,991

Table 3-15 Crop Irrigation County Demands for 2010 through 2060

County	Annual Water Demands from Crop Irrigation (AFY)					
	2010	2020	2030	2040	2050	2060
Love	2,737	3,216	3,695	4,174	4,542	5,133
Major	13,033	13,078	13,122	13,166	13,200	13,254
Marshall	4,655	4,804	4,952	5,100	5,214	5,397
Mayes	1,196	1,303	1,411	1,519	1,602	1,735
McClain	2,868	2,918	2,969	3,019	3,058	3,120
McCurtain	856	1,306	1,756	2,205	2,550	3,105
McIntosh	682	684	685	687	688	690
Murray	43	188	332	476	587	765
Muskogee	8,882	8,882	8,882	8,882	8,882	8,882
Noble	1,223	1,223	1,223	1,223	1,223	1,223
Nowata	261	438	616	793	929	1,148
Okfuskee	1,887	2,077	2,267	2,457	2,602	2,836
Oklahoma	5,537	5,537	5,537	5,537	5,537	5,537
Okmulgee	1,250	1,250	1,250	1,250	1,250	1,250
Osage	538	691	843	996	1,113	1,302
Ottawa	467	533	598	664	714	795
Pawnee	87	133	179	225	260	317
Payne	1,333	1,339	1,344	1,349	1,353	1,360
Pittsburg	2,859	3,079	3,299	3,519	3,687	3,958
Pontotoc	1,702	2,493	3,284	4,075	4,682	5,657
Pottawatomie	1,980	2,309	2,639	2,969	3,222	3,628
Pushmataha	816	820	824	828	831	836
Roger Mills	9,266	9,281	9,296	9,312	9,323	9,342
Rogers	1,509	1,639	1,769	1,900	1,999	2,160
Seminole	1,328	1,587	1,847	2,106	2,305	2,624
Sequoyah	2,221	2,343	2,465	2,587	2,681	2,832
Stephens	2,231	2,898	3,564	4,231	4,742	5,564
Texas	199,713	201,049	202,385	203,721	204,747	206,393
Tillman	18,163	18,412	18,661	18,910	19,101	19,408
Tulsa	7,503	7,757	8,012	8,266	8,461	8,775
Wagoner	8,392	8,392	8,392	8,392	8,392	8,392
Washington	574	721	867	1,014	1,126	1,306
Washita	5,130	5,350	5,571	5,792	5,962	6,234
Woods	3,353	3,570	3,787	4,005	4,171	4,439
Woodward	8,026	8,026	8,026	8,026	8,026	8,026
Total	**745,210**	**775,661**	**806,112**	**836,562**	**859,932**	**897,464**

Table 3-16 Crop Irrigation Sector Demand by OCWP Basin

Basin Number	Basin ID	Basin Name	Demand (AFY) 2010	2020	2030	2040	2050	2060	Supply Source (Percent of Demand) Surface Water	Ground-water	Alluvial Ground-water	Bedrock Ground-water
1	10100	Red River Mainstem (To Kiamichi River)	600	910	1,220	1,530	1,767	2,149	93%	7%	80%	20%
2	10201	Little River (McCurtain County) - 1	35	53	72	90	104	127	100%	0%	0%	0%
3	10202	Little River (McCurtain County) - 2	240	321	402	484	546	647	99%	1%	0%	100%
4	10203	Little River (McCurtain County) - 3	82	125	168	211	244	297	100%	0%	0%	0%
5	10301	Kiamichi River - 1	288	337	385	434	471	531	78%	22%	0%	100%
6	10302	Kiamichi River - 2	1,284	1,374	1,465	1,556	1,625	1,737	91%	9%	28%	72%
7	10411	Muddy Boggy River - 1	431	507	582	658	716	809	49%	51%	2%	98%
8	10412	Muddy Boggy River - 2	1,486	1,844	2,202	2,560	2,835	3,277	67%	33%	39%	61%
9	10420	Clear Boggy Creek	1,460	1,773	2,085	2,398	2,637	3,023	83%	17%	0%	100%
10	10500	Red River Mainstem (To Blue River)	1,321	1,365	1,409	1,452	1,486	1,540	89%	11%	0%	100%
11	10601	Blue River - 1	3,065	3,103	3,141	3,180	3,209	3,257	97%	3%	0%	100%
12	10602	Blue River - 2	2,088	2,360	2,631	2,903	3,111	3,446	33%	67%	0%	100%
13	10700	Red River Mainstem (To Washita)	10,290	10,419	10,548	10,677	10,776	10,934	66%	34%	55%	45%
14	10810	Lower Washita	4,605	5,395	6,184	6,974	7,579	8,552	40%	60%	29%	71%
15	10821	Middle Washita - 1	2,218	2,421	2,624	2,826	2,981	3,231	46%	54%	36%	64%
16	10822	Middle Washita - 2	10,861	11,392	11,923	12,453	12,861	13,515	34%	66%	4%	96%
17	10831	Upper Washita - 1	6,869	7,459	8,049	8,639	9,091	9,818	17%	83%	3%	97%
18	10832	Upper Washita - 2	15,519	16,808	18,097	19,386	20,375	21,964	1%	99%	0%	100%
19	10833	Upper Washita - 3	8,756	9,082	9,408	9,734	9,984	10,386	12%	88%	27%	73%
20	10840	Washita Headwaters	7,942	7,969	7,997	8,024	8,045	8,078	3%	97%	32%	68%
21	10900	Red River Mainstem (To Walnut Bayou)	8,797	9,553	10,309	11,065	11,645	12,577	44%	56%	28%	72%
22	11000	Walnut Bayou	1,949	2,217	2,485	2,753	2,958	3,288	0%	100%	14%	86%
23	11100	Mud Creek	667	698	730	762	787	826	10%	90%	1%	99%
24	11201	Beaver Creek - 1	101	110	119	128	135	145	100%	0%	0%	0%
25	11202	Beaver Creek - 2	2,344	2,568	2,792	3,016	3,188	3,464	17%	83%	0%	100%
26	11203	Beaver Creek - 3	293	380	466	553	619	726	28%	72%	11%	89%
27	11311	Cache Creek - 1	243	287	331	376	409	464	78%	22%	100%	0%
28	11312	Cache Creek - 2	1,329	1,437	1,544	1,652	1,735	1,868	35%	65%	3%	97%
29	11321	Deep Red Creek And West Cache Creek - 1	1,144	1,246	1,347	1,448	1,525	1,650	25%	75%	60%	40%
30	11322	Deep Red Creek And West Cache Creek - 2	1,916	1,944	1,972	2,000	2,022	2,056	58%	42%	94%	6%
31	11400	Red River Mainstem (To North Fork of Red)	5,022	5,116	5,210	5,304	5,376	5,491	9%	91%	100%	0%
32	11511	Lower North Fork Red River - 1	7,659	7,771	7,884	7,997	8,083	8,222	9%	91%	100%	0%
33	11512	Lower North Fork Red River - 2	13,055	13,292	13,528	13,765	13,946	14,238	65%	35%	99%	1%
34	11513	Lower North Fork Red River - 3	7,494	7,661	7,828	7,996	8,124	8,330	30%	70%	41%	59%
35	11514	Lower North Fork Red River - 4	44	46	47	48	49	51	0%	100%	0%	100%
36	11521	Upper North Fork Red River - 1	3,392	3,946	4,500	5,054	5,479	6,161	1%	99%	100%	0%
37	11522	Upper North Fork Red River - 2	7,605	7,606	7,608	7,609	7,610	7,612	3%	97%	43%	57%
38	11601	Salt Fork Red River - 1	70,670	72,545	74,420	76,296	77,735	80,046	62%	38%	35%	65%
39	11602	Salt Fork Red River - 2	1,112	1,310	1,507	1,705	1,856	2,100	0%	100%	31%	69%
40	11701	Prairie Dog Town Fork Red River - 1	16,421	16,761	17,102	17,443	17,704	18,124	7%	93%	45%	55%
41	11702	Prairie Dog Town Fork Red River - 2	28,274	29,016	29,758	30,499	31,069	31,983	0%	100%	25%	75%
42	11801	Elm Fork Red River - 1	2,316	3,153	3,989	4,826	5,468	6,499	5%	95%	89%	11%
43	11802	Elm Fork Red River - 2	716	896	1,076	1,256	1,395	1,617	0%	100%	68%	32%
44	20101	Poteau River - 1	2,144	2,146	2,147	2,148	2,149	2,150	99%	1%	0%	100%
45	20102	Poteau River - 2	3,743	4,071	4,400	4,728	4,979	5,384	67%	33%	1%	99%
46	20201	Lower Arkansas River - 1	7,724	7,983	8,242	8,501	8,700	9,020	37%	63%	89%	11%
47	20202	Lower Arkansas River - 2	9,941	10,065	10,190	10,314	10,409	10,562	72%	28%	96%	4%
48	20300	Canadian River (To North Canadian River)	6,035	6,907	7,780	8,653	9,323	10,398	83%	17%	67%	33%
49	20400	Middle Arkansas River	7,472	7,618	7,765	7,911	8,024	8,204	14%	86%	96%	4%
50	20510	Lower North Canadian River	5,570	6,067	6,564	7,061	7,443	8,055	37%	63%	41%	59%
51	20520	Middle North Canadian River	7,471	7,596	7,721	7,846	7,942	8,096	8%	92%	84%	16%

Table 3-16 Crop Irrigation Sector Demand by OCWP Basin

Basin Number	Basin ID	Basin Name	Demand (AFY) 2010	2020	2030	2040	2050	2060	Supply Source (Percent of Demand) Surface Water	Ground-water	Alluvial Ground-water	Bedrock Ground-water
52	20531	Upper North Canadian River - 1	9,310	9,329	9,348	9,368	9,383	9,406	2%	98%	69%	31%
53	20532	Upper North Canadian River - 2	26,854	28,075	29,297	30,519	31,456	32,962	1%	99%	23%	77%
54	20533	Upper North Canadian River - 3	17,150	18,841	20,533	22,225	23,523	25,609	0%	100%	4%	96%
55	20540	North Canadian Headwaters	236,750	242,806	248,861	254,917	259,564	267,028	0%	100%	1%	99%
56	20611	Lower Canadian River - 1	2,893	3,740	4,588	5,435	6,086	7,130	28%	72%	76%	24%
57	20612	Lower Canadian River - 2	776	788	800	812	821	836	70%	30%	89%	11%
58	20620	Middle Canadian River	7,541	7,781	8,021	8,261	8,445	8,741	44%	56%	81%	19%
59	20630	Upper Canadian River	15,070	15,760	16,450	17,140	17,670	18,520	2%	98%	18%	82%
60	20700	Deep Fork River	6,083	6,187	6,292	6,397	6,477	6,606	72%	28%	1%	99%
61	20801	Little River - 1	392	464	535	607	662	750	33%	67%	75%	25%
62	20802	Little River - 2	368	433	497	562	611	691	18%	82%	6%	94%
63	20910	Lower Cimarron River	3,382	3,400	3,418	3,436	3,450	3,472	37%	63%	85%	15%
64	20920	Middle Cimarron River	27,010	27,643	28,276	28,910	29,395	30,176	9%	91%	86%	14%
65	20930	Upper Cimarron River	31,067	31,744	32,421	33,098	33,618	34,452	8%	92%	18%	82%
66	20940	Cimarron Headwaters	15,758	16,886	18,014	19,142	20,008	21,399	8%	92%	0%	100%
67	21011	Lower Salt Fork Arkansas River - 1	2,280	2,280	2,280	2,280	2,280	2,280	14%	86%	38%	62%
69	21012	Lower Salt Fork Arkansas River - 2	592	592	592	592	592	592	100%	0%	0%	100%
70	21013	Lower Salt Fork Arkansas River - 3	1,162	1,162	1,162	1,162	1,162	1,162	37%	63%	27%	73%
68	21020	Upper Salt Fork Arkansas River	6,888	7,258	7,628	7,999	8,283	8,739	17%	83%	93%	7%
71	21100	Arkansas River - Cimarron Rivers to Keystone Lake	2,217	2,264	2,311	2,357	2,394	2,451	24%	76%	42%	58%
72	21200	Arkansas River Mainstem (To Kansas State Line)	2,278	2,334	2,391	2,448	2,491	2,561	5%	95%	95%	5%
73	21301	Bird Creek - 1	2,629	2,729	2,828	2,927	3,003	3,126	100%	0%	0%	0%
74	21302	Bird Creek - 2	683	722	760	799	828	876	100%	0%	0%	0%
75	21401	Caney River - 1	518	564	611	657	693	750	99%	1%	0%	100%
76	21402	Caney River - 2	843	1,089	1,335	1,581	1,770	2,074	100%	0%	0%	0%
77	21511	Verdigris River (To Oologah Dam) - 1	6,101	6,105	6,109	6,113	6,116	6,121	100%	0%	0%	0%
78	21512	Verdigris River (To Oologah Dam) - 2	1,049	1,139	1,230	1,320	1,389	1,501	100%	0%	0%	0%
79	21520	Verdigris River (To Kansas State Line)	207	348	489	630	738	912	100%	0%	0%	0%
80	21601	Grand (Neosho) River - 1	1,771	2,351	2,931	3,510	3,955	4,670	0%	100%	0%	100%
81	21602	Grand (Neosho) River - 2	661	758	854	951	1,025	1,143	12%	88%	0%	100%
82	21700	Illinois River	2,821	3,057	3,294	3,531	3,712	4,004	82%	18%	0%	100%
		Total	**745,210**	**775,661**	**806,112**	**836,562**	**859,932**	**897,464**				

Table 3-17 Crop Irrigation Sector Monthly Demand Pattern by OCWP Basin

Basin Number	Basin ID	Basin Name	Monthly Demand Pattern (Percent of Annual Demand)											
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	10100	Red River Mainstem (To Kiamichi River)	0%	0%	0%	0%	0%	25%	33%	29%	13%	0%	0%	0%
2	10201	Little River (McCurtain County) - 1	0%	0%	0%	0%	0%	25%	33%	29%	13%	0%	0%	0%
3	10202	Little River (McCurtain County) - 2	0%	0%	0%	0%	0%	25%	33%	29%	13%	0%	0%	0%
4	10203	Little River (McCurtain County) - 3	0%	0%	0%	0%	0%	25%	33%	29%	13%	0%	0%	0%
5	10301	Kiamichi River - 1	0%	0%	3%	6%	0%	23%	30%	27%	11%	0%	0%	0%
6	10302	Kiamichi River - 2	0%	0%	1%	2%	0%	23%	33%	30%	11%	0%	0%	0%
7	10411	Muddy Boggy River - 1	0%	0%	3%	6%	0%	22%	31%	27%	11%	0%	0%	0%
8	10412	Muddy Boggy River - 2	0%	0%	1%	2%	0%	17%	33%	33%	14%	0%	0%	0%
9	10420	Clear Boggy Creek	0%	0%	1%	2%	0%	21%	32%	30%	15%	0%	0%	0%
10	10500	Red River Mainstem (To Blue River)	0%	0%	0%	1%	0%	18%	39%	35%	7%	0%	0%	0%
11	10601	Blue River - 1	0%	0%	0%	0%	0%	17%	40%	36%	6%	0%	0%	0%
12	10602	Blue River - 2	0%	0%	0%	0%	0%	18%	38%	35%	9%	0%	0%	0%
13	10700	Red River Mainstem (To Washita)	0%	0%	0%	0%	0%	17%	40%	36%	6%	0%	0%	0%
14	10810	Lower Washita	0%	0%	0%	0%	0%	15%	35%	38%	11%	0%	0%	0%
15	10821	Middle Washita - 1	0%	0%	0%	0%	0%	16%	36%	36%	12%	0%	0%	0%
16	10822	Middle Washita - 2	0%	0%	0%	3%	0%	13%	35%	37%	11%	0%	0%	0%
17	10831	Upper Washita - 1	0%	0%	0%	4%	0%	9%	33%	42%	11%	0%	0%	0%
18	10832	Upper Washita - 2	0%	0%	0%	5%	0%	9%	33%	42%	11%	0%	0%	0%
19	10833	Upper Washita - 3	0%	0%	0%	6%	1%	10%	31%	38%	12%	0%	0%	0%
20	10840	Washita Headwaters	0%	0%	0%	3%	9%	16%	30%	30%	12%	0%	0%	0%
21	10900	Red River Mainstem (To Walnut Bayou)	0%	0%	0%	0%	0%	10%	35%	46%	9%	0%	0%	0%
22	11000	Walnut Bayou	0%	0%	0%	0%	0%	15%	33%	40%	13%	0%	0%	0%
23	11100	Mud Creek	0%	0%	0%	0%	0%	17%	31%	36%	16%	0%	0%	0%
24	11201	Beaver Creek - 1	0%	0%	0%	0%	0%	13%	28%	40%	19%	0%	0%	0%
25	11202	Beaver Creek - 2	0%	0%	0%	0%	1%	15%	37%	37%	10%	0%	0%	0%
26	11203	Beaver Creek - 3	0%	0%	0%	0%	1%	9%	37%	47%	6%	0%	0%	0%
27	11311	Cache Creek - 1	0%	0%	0%	0%	0%	21%	36%	30%	13%	0%	0%	0%
28	11312	Cache Creek - 2	0%	0%	0%	1%	1%	13%	36%	41%	9%	0%	0%	0%
29	11321	Deep Red Creek And West Cache Creek - 1	0%	0%	0%	0%	1%	15%	36%	39%	9%	0%	0%	0%
30	11322	Deep Red Creek And West Cache Creek - 2	0%	0%	1%	1%	4%	14%	36%	32%	13%	0%	0%	0%
31	11400	Red River Mainstem (To North Fork of Red)	0%	0%	1%	1%	4%	14%	36%	32%	13%	0%	0%	0%
32	11511	Lower North Fork Red River - 1	0%	0%	1%	1%	3%	12%	35%	34%	14%	0%	0%	0%
33	11512	Lower North Fork Red River - 2	0%	0%	1%	1%	2%	6%	33%	40%	17%	0%	0%	0%
34	11513	Lower North Fork Red River - 3	0%	0%	1%	2%	1%	4%	32%	44%	17%	0%	0%	0%
35	11514	Lower North Fork Red River - 4	0%	0%	1%	3%	2%	11%	41%	34%	7%	0%	0%	0%
36	11521	Upper North Fork Red River - 1	0%	0%	1%	2%	2%	9%	37%	40%	10%	0%	0%	0%
37	11522	Upper North Fork Red River - 2	0%	0%	0%	2%	2%	8%	34%	46%	9%	0%	0%	0%

Table 3-17 Crop Irrigation Sector Monthly Demand Pattern by OCWP Basin

Basin Number	Basin ID	Basin Name	Monthly Demand Pattern (Percent of Annual Demand)											
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
38	11601	Salt Fork Red River - 1	0%	0%	0%	1%	0%	1%	30%	46%	21%	0%	0%	0%
39	11602	Salt Fork Red River - 2	0%	0%	1%	1%	2%	8%	34%	39%	16%	0%	0%	0%
40	11701	Prairie Dog Town Fork Red River - 1	0%	0%	0%	1%	0%	1%	30%	46%	21%	0%	0%	0%
41	11702	Prairie Dog Town Fork Red River - 2	0%	0%	1%	1%	1%	4%	31%	43%	18%	0%	0%	0%
42	11801	Elm Fork Red River - 1	0%	0%	1%	2%	3%	11%	36%	36%	13%	0%	0%	0%
43	11802	Elm Fork Red River - 2	0%	0%	1%	2%	2%	9%	35%	40%	12%	0%	0%	0%
44	20101	Poteau River - 1	0%	0%	4%	9%	0%	20%	31%	29%	7%	0%	0%	0%
45	20102	Poteau River - 2	0%	0%	3%	8%	0%	21%	31%	29%	7%	0%	0%	0%
46	20201	Lower Arkansas River - 1	0%	0%	2%	5%	0%	17%	32%	34%	9%	0%	0%	0%
47	20202	Lower Arkansas River - 2	0%	0%	0%	0%	0%	19%	37%	35%	9%	0%	0%	0%
48	20300	Canadian River (To North Canadian River)	0%	0%	0%	0%	0%	12%	35%	43%	10%	0%	0%	0%
49	20400	Middle Arkansas River	0%	0%	0%	0%	0%	10%	25%	49%	16%	0%	0%	0%
50	20510	Lower North Canadian River	0%	0%	0%	4%	1%	15%	36%	34%	10%	0%	0%	0%
51	20520	Middle North Canadian River	0%	0%	0%	2%	0%	12%	35%	39%	12%	0%	0%	0%
52	20531	Upper North Canadian River - 1	0%	0%	0%	6%	7%	17%	31%	27%	11%	0%	0%	0%
53	20532	Upper North Canadian River - 2	0%	0%	0%	5%	8%	13%	34%	30%	11%	0%	0%	0%
54	20533	Upper North Canadian River - 3	0%	0%	0%	2%	9%	16%	31%	29%	12%	0%	0%	0%
55	20540	North Canadian Headwaters	0%	0%	0%	5%	6%	14%	30%	30%	12%	0%	3%	0%
56	20611	Lower Canadian River - 1	0%	0%	0%	1%	0%	15%	33%	37%	14%	0%	0%	0%
57	20612	Lower Canadian River - 2	0%	0%	0%	0%	0%	14%	32%	38%	15%	0%	0%	0%
58	20620	Middle Canadian River	0%	0%	0%	1%	0%	16%	35%	34%	14%	0%	0%	0%
59	20630	Upper Canadian River	0%	0%	0%	4%	4%	14%	32%	34%	12%	0%	0%	0%
60	20700	Deep Fork River	0%	0%	0%	1%	1%	19%	36%	32%	11%	0%	0%	0%
61	20801	Little River - 1	0%	0%	0%	3%	1%	14%	33%	38%	11%	0%	0%	0%
62	20802	Little River - 2	0%	0%	0%	2%	0%	15%	32%	36%	15%	0%	0%	0%
63	20910	Lower Cimarron River	0%	0%	0%	1%	3%	22%	34%	32%	8%	0%	0%	0%
64	20920	Middle Cimarron River	0%	0%	0%	4%	2%	19%	36%	30%	10%	0%	0%	0%
65	20930	Upper Cimarron River	0%	0%	0%	5%	7%	14%	31%	30%	12%	0%	2%	0%
66	20940	Cimarron Headwaters	0%	0%	0%	5%	6%	15%	30%	30%	11%	0%	3%	0%
67	21011	Lower Salt Fork Arkansas River - 1	0%	0%	0%	0%	2%	9%	32%	44%	13%	0%	0%	0%
69	21012	Lower Salt Fork Arkansas River - 2	0%	0%	0%	0%	2%	9%	32%	44%	13%	0%	0%	0%
70	21013	Lower Salt Fork Arkansas River - 3	0%	0%	0%	0%	2%	9%	33%	44%	12%	0%	0%	0%
68	21020	Upper Salt Fork Arkansas River	0%	0%	0%	2%	2%	14%	34%	36%	12%	0%	0%	0%
71	21100	Arkansas River - Cimarron Rivers to Keystone	0%	0%	0%	1%	4%	19%	33%	34%	9%	0%	0%	0%
72	21200	Arkansas River Mainstem (To Kansas State	0%	0%	0%	0%	5%	19%	33%	35%	9%	0%	0%	0%
73	21301	Bird Creek - 1	0%	0%	0%	0%	1%	5%	17%	56%	21%	0%	0%	0%
74	21302	Bird Creek - 2	0%	0%	0%	0%	0%	5%	18%	56%	20%	0%	0%	0%

Table 3-17 Crop Irrigation Sector Monthly Demand Pattern by OCWP Basin

Basin Number	Basin ID	Basin Name	Monthly Demand Pattern (Percent of Annual Demand)											
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
75	21401	Caney River - 1	0%	0%	0%	1%	1%	11%	26%	46%	14%	0%	0%	0%
76	21402	Caney River - 2	0%	0%	0%	5%	1%	13%	36%	39%	6%	0%	0%	0%
77	21511	Verdigris River (To Oologah Dam) - 1	0%	0%	0%	0%	0%	20%	37%	34%	9%	0%	0%	0%
78	21512	Verdigris River (To Oologah Dam) - 2	0%	0%	0%	0%	3%	22%	37%	31%	7%	0%	0%	0%
79	21520	Verdigris River (To Kansas State Line)	0%	0%	0%	0%	3%	22%	36%	31%	7%	0%	0%	0%
80	21601	Grand (Neosho) River - 1	0%	0%	0%	0%	0%	17%	35%	34%	13%	0%	0%	0%
81	21602	Grand (Neosho) River - 2	0%	0%	0%	0%	0%	18%	36%	34%	11%	0%	0%	0%
82	21700	Illinois River	0%	0%	0%	0%	0%	18%	36%	35%	11%	0%	0%	0%

Table 3-18 - Oil and Gas County Demands for 2010 through 2060

	Annual Water Demands from Oil and Gas (AFY)					
County	2010	2020	2030	2040	2050	2060
Adair	0	0	0	0	0	0
Alfalfa	218	378	583	833	1,128	1,468
Atoka	610	1,177	836	636	361	12
Beaver	698	975	1,300	1,674	2,096	2,566
Beckham	497	702	945	1,226	1,544	1,900
Blaine	296	405	531	674	834	1,011
Bryan	24	33	43	54	67	82
Caddo	556	783	1,051	1,360	1,711	2,102
Canadian	3,581	6,905	4,908	3,733	2,120	70
Carter	3,291	6,344	4,509	3,430	1,948	64
Cherokee	1	1	1	2	2	3
Choctaw	0	0	0	0	0	0
Cimarron	65	90	117	149	185	224
Cleveland	75	122	182	255	340	437
Coal	1,750	3,375	2,399	1,825	1,036	34
Comanche	53	73	95	121	150	181
Cotton	10	14	18	23	28	34
Craig	30	41	54	68	84	102
Creek	216	295	387	492	608	737
Custer	519	755	1,039	1,371	1,751	2,179
Delaware	0	0	0	0	0	0
Dewey	290	427	593	787	1,011	1,263
Ellis	774	1,511	2,478	3,675	5,103	6,760
Garfield	192	283	393	522	671	838
Garvin	504	710	953	1,233	1,550	1,904
Grady	828	1,178	1,594	2,076	2,623	3,237
Grant	211	338	498	690	915	1,172
Greer	6	8	10	13	16	19
Harmon	3	4	5	6	8	9
Harper	356	547	783	1,064	1,389	1,760
Haskell	1,080	2,223	3,735	5,615	7,864	10,481
Hughes	3,185	6,141	4,365	3,320	1,886	62
Jackson	29	60	100	151	211	280
Jefferson	36	50	65	83	103	125
Johnston	96	220	387	596	846	1,140
Kay	161	220	289	366	453	550
Kingfisher	217	316	436	577	739	921
Kiowa	55	75	99	125	155	188
Latimer	521	770	1,072	1,427	1,836	2,297
Le Flore	969	2,009	3,386	5,100	7,151	9,538
Lincoln	491	904	1,442	2,103	2,888	3,797
Logan	396	694	1,078	1,548	2,103	2,744
Love	43	58	77	97	120	146
Major	635	889	1,187	1,531	1,918	2,351

Table 3-18 - Oil and Gas County Demands for 2010 through 2060

County	Annual Water Demands from Oil and Gas (AFY)					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Marshall	434	836	594	452	257	8
Mayes	25	34	45	57	71	86
McClain	183	270	376	501	644	806
McCurtain	0	1	1	1	1	1
McIntosh	609	1,242	2,079	3,120	4,363	5,810
Murray	36	49	65	82	102	123
Muskogee	82	151	242	354	487	640
Noble	384	551	752	986	1,252	1,552
Nowata	397	543	712	904	1,118	1,356
Okfuskee	252	411	612	854	1,138	1,464
Oklahoma	280	430	615	834	1,089	1,379
Okmulgee	194	285	395	525	674	843
Osage	517	708	928	1,178	1,458	1,767
Ottawa	0	0	0	0	0	0
Pawnee	70	116	174	244	326	420
Payne	238	380	557	770	1,019	1,304
Pittsburg	8,477	16,343	11,617	8,836	5,019	165
Pontotoc	186	275	382	509	654	818
Pottawatomie	320	613	997	1,470	2,034	2,689
Pushmataha	14	19	25	32	39	48
Roger Mills	1,040	1,513	2,081	2,747	3,508	4,366
Rogers	158	262	395	555	744	961
Seminole	437	757	1,167	1,667	2,257	2,938
Sequoyah	57	78	102	129	160	194
Stephens	707	1,017	1,388	1,820	2,313	2,866
Texas	870	1,346	1,935	2,639	3,456	4,387
Tillman	41	75	121	177	243	319
Tulsa	128	211	316	443	592	763
Wagoner	118	201	307	436	588	763
Washington	339	464	609	773	957	1,160
Washita	830	1,569	2,535	3,726	5,143	6,786
Woods	509	717	962	1,244	1,563	1,921
Woodward	609	834	1,093	1,388	1,717	2,081
Total	**42,107**	**74,403**	**78,202**	**90,080**	**102,536**	**115,570**

Table 3-19 Oil and Gas Sector Demand by OCWP Basin

Basin Number	Basin ID	Basin Name	Demand (AFY) 2010	2020	2030	2040	2050	2060	Supply Source (Percent of Demand) Surface Water	Ground-water	Alluvial Ground-water	Bedrock Ground-water
1	10100	Red River Mainstem (To Kiamichi River)	0	0	0	0	0	0	100%	0%	0%	0%
2	10201	Little River (McCurtain County) - 1	0	0	0	0	0	0	100%	0%	0%	0%
3	10202	Little River (McCurtain County) - 2	0	0	0	1	1	1	100%	0%	0%	0%
4	10203	Little River (McCurtain County) - 3	4	9	14	22	30	40	100%	0%	0%	0%
5	10301	Kiamichi River - 1	0	0	0	0	0	0	100%	0%	0%	0%
6	10302	Kiamichi River - 2	94	162	237	330	440	565	100%	0%	0%	0%
7	10411	Muddy Boggy River - 1	0	0	0	0	0	0	100%	0%	0%	0%
8	10412	Muddy Boggy River - 2	4,941	9,524	6,775	5,159	4,941	4,941	48%	52%	0%	100%
9	10420	Clear Boggy Creek	439	810	656	592	492	439	100%	0%	0%	0%
10	10500	Red River Mainstem (To Blue River)	4	6	8	10	13	15	100%	0%	0%	0%
11	10601	Blue River - 1	0	0	0	0	0	0	100%	0%	0%	0%
12	10602	Blue River - 2	2	3	4	5	7	8	44%	56%	0%	100%
13	10700	Red River Mainstem (To Washita)	4	6	7	9	11	14	100%	0%	0%	0%
14	10810	Lower Washita	1,894	3,274	3,006	3,059	3,032	2,922	81%	19%	47%	53%
15	10821	Middle Washita - 1	477	683	928	1,213	1,537	1,901	93%	7%	32%	68%
16	10822	Middle Washita - 2	813	1,150	1,549	2,010	2,533	3,118	82%	18%	16%	84%
17	10831	Upper Washita - 1	15	21	29	37	46	57	45%	55%	0%	100%
18	10832	Upper Washita - 2	70	109	158	216	284	361	17%	83%	0%	100%
19	10833	Upper Washita - 3	429	722	1,096	1,550	2,085	2,699	78%	22%	5%	95%
20	10840	Washita Headwaters	1,313	1,916	2,642	3,492	4,466	5,564	66%	34%	32%	68%
21	10900	Red River Mainstem (To Walnut Bayou)	1,421	2,732	2,235	2,072	1,803	1,428	89%	11%	0%	100%
22	11000	Walnut Bayou	1,317	2,534	1,808	1,383	1,317	1,317	80%	20%	0%	100%
23	11100	Mud Creek	51	82	88	100	113	126	100%	0%	0%	0%
24	11201	Beaver Creek - 1	0	0	0	0	0	0	100%	0%	0%	0%
25	11202	Beaver Creek - 2	480	686	932	1,217	1,542	1,907	83%	17%	0%	100%
26	11203	Beaver Creek - 3	4	6	9	11	14	18	100%	0%	0%	0%
27	11311	Cache Creek - 1	0	0	0	0	0	0	100%	0%	0%	0%
28	11312	Cache Creek - 2	29	40	54	69	86	105	53%	47%	0%	100%
29	11321	Deep Red Creek And West Cache Creek - 1	0	0	0	0	0	0	100%	0%	0%	0%
30	11322	Deep Red Creek And West Cache Creek - 2	12	22	36	52	72	94	100%	0%	0%	0%
31	11400	Red River Mainstem (To North Fork of Red)	29	53	85	124	171	225	0%	100%	100%	0%
32	11511	Lower North Fork Red River - 1	0	0	0	0	0	0	100%	0%	0%	0%
33	11512	Lower North Fork Red River - 2	2	3	4	5	6	7	100%	0%	0%	0%
34	11513	Lower North Fork Red River - 3	588	1,094	1,752	2,564	3,528	4,644	75%	25%	0%	100%
35	11514	Lower North Fork Red River - 4	1	2	3	3	4	5	100%	0%	0%	0%
36	11521	Upper North Fork Red River - 1	0	0	0	0	0	0	100%	0%	0%	0%
37	11522	Upper North Fork Red River - 2	478	681	922	1,202	1,520	1,877	39%	61%	31%	69%
38	11601	Salt Fork Red River - 1	5	7	9	11	14	17	14%	86%	0%	100%
39	11602	Salt Fork Red River - 2	0	0	0	1	1	1	100%	0%	0%	0%
40	11701	Prairie Dog Town Fork Red River - 1	29	60	100	151	211	280	85%	15%	0%	100%
41	11702	Prairie Dog Town Fork Red River - 2	0	0	0	0	0	0	100%	0%	0%	0%
42	11801	Elm Fork Red River - 1	3	4	5	7	8	10	100%	0%	0%	0%
43	11802	Elm Fork Red River - 2	0	0	0	0	0	0	100%	0%	0%	0%
44	20101	Poteau River - 1	220	457	770	1,159	1,625	2,167	96%	4%	0%	100%
45	20102	Poteau River - 2	1,023	1,937	3,130	4,603	6,355	8,386	99%	1%	0%	100%
46	20201	Lower Arkansas River - 1	782	1,561	2,465	3,611	4,977	6,560	98%	2%	0%	100%
47	20202	Lower Arkansas River - 2	106	205	334	494	685	906	100%	0%	0%	0%
48	20300	Canadian River (To North Canadian River)	10,212	19,569	16,732	16,289	15,248	13,608	87%	13%	2%	98%
49	20400	Middle Arkansas River	107	181	276	390	525	680	100%	0%	0%	0%
50	20510	Lower North Canadian River	314	556	830	1,172	1,576	2,041	54%	46%	2%	98%

Table 3-19 Oil and Gas Sector Demand by OCWP Basin

			Demand (AFY)						Supply Source (Percent of Demand)			
Basin Number	Basin ID	Basin Name	2010	2020	2030	2040	2050	2060	Surface Water	Ground-water	Alluvial Ground-water	Bedrock Ground-water
51	20520	Middle North Canadian River	1,379	2,616	1,923	1,534	1,379	1,379	52%	48%	6%	94%
52	20531	Upper North Canadian River - 1	169	244	334	440	560	695	31%	69%	49%	51%
53	20532	Upper North Canadian River - 2	691	1,075	1,551	2,119	2,780	3,534	15%	85%	11%	89%
54	20533	Upper North Canadian River - 3	379	734	1,200	1,777	2,464	3,262	10%	90%	1%	99%
55	20540	North Canadian Headwaters	994	1,512	2,149	2,905	3,781	4,776	5%	95%	0%	100%
56	20611	Lower Canadian River - 1	317	546	606	722	849	987	99%	1%	100%	0%
57	20612	Lower Canadian River - 2	77	111	150	197	249	308	67%	33%	40%	60%
58	20620	Middle Canadian River	1,944	3,672	2,766	2,283	1,944	1,944	71%	29%	57%	43%
59	20630	Upper Canadian River	780	1,292	1,763	2,366	3,065	3,860	40%	60%	38%	62%
60	20700	Deep Fork River	1,012	1,679	2,525	3,549	4,753	6,136	82%	18%	0%	100%
61	20801	Little River - 1	60	109	171	248	339	444	100%	0%	0%	0%
62	20802	Little River - 2	179	338	545	801	1,106	1,458	45%	55%	0%	100%
63	20910	Lower Cimarron River	548	903	1,353	1,896	2,534	3,267	93%	7%	16%	84%
64	20920	Middle Cimarron River	1,812	2,823	3,388	4,174	5,046	6,003	65%	35%	76%	24%
65	20930	Upper Cimarron River	1,099	1,558	2,103	2,733	3,448	4,249	76%	24%	37%	63%
66	20940	Cimarron Headwaters	19	26	35	45	56	68	0%	100%	0%	100%
67	21011	Lower Salt Fork Arkansas River - 1	148	210	282	365	460	566	99%	1%	0%	100%
69	21012	Lower Salt Fork Arkansas River - 2	18	24	32	40	50	60	70%	30%	0%	100%
70	21013	Lower Salt Fork Arkansas River - 3	35	50	68	89	113	141	95%	5%	0%	100%
68	21020	Upper Salt Fork Arkansas River	590	933	1,361	1,875	2,474	3,158	86%	14%	64%	36%
71	21100	Arkansas River - Cimarron Rivers to Keystone Lake	631	935	1,303	1,736	2,235	2,798	100%	0%	0%	100%
72	21200	Arkansas River Mainstem (To Kansas State Line)	196	279	379	494	625	773	98%	2%	0%	100%
73	21301	Bird Creek - 1	7	12	18	26	35	45	100%	0%	0%	0%
74	21302	Bird Creek - 2	307	421	552	701	867	1,051	100%	0%	0%	0%
75	21401	Caney River - 1	50	74	102	136	174	217	100%	0%	0%	0%
76	21402	Caney River - 2	345	473	621	789	977	1,185	100%	0%	0%	0%
77	21511	Verdigris River (To Oologah Dam) - 1	88	149	227	321	433	561	100%	0%	0%	0%
78	21512	Verdigris River (To Oologah Dam) - 2	67	112	168	237	317	409	100%	0%	0%	0%
79	21520	Verdigris River (To Kansas State Line)	376	524	697	897	1,121	1,371	100%	0%	0%	0%
80	21601	Grand (Neosho) River - 1	72	104	142	186	237	294	0%	100%	0%	100%
81	21602	Grand (Neosho) River - 2	0	0	0	1	1	1	100%	0%	0%	0%
82	21700	Illinois River	0	0	1	1	1	1	100%	0%	0%	0%
		Total	**42,107**	**74,403**	**78,202**	**90,080**	**105,791**	**124,060**				

Table 3-20 Out-of-Basin Demands on Bedrock Groundwater

Basin Number	Basin ID	Basin Name	Demands on BGW (AFY)
1	10100	Red River Mainstem (To Kiamichi River)	0
2	10201	Little River (McCurtain County) - 1	0
3	10202	Little River (McCurtain County) - 2	6
4	10203	Little River (McCurtain County) - 3	0
5	10301	Kiamichi River - 1	0
6	10302	Kiamichi River - 2	0
7	10411	Muddy Boggy River - 1	14
8	10412	Muddy Boggy River - 2	5
9	10420	Clear Boggy Creek	5
10	10500	Red River Mainstem (To Blue River)	7
11	10601	Blue River - 1	9
12	10602	Blue River - 2	36
13	10700	Red River Mainstem (To Washita)	0
14	10810	Lower Washita	72
15	10821	Middle Washita - 1	6
16	10822	Middle Washita - 2	15
17	10831	Upper Washita - 1	19
18	10832	Upper Washita - 2	6
19	10833	Upper Washita - 3	43
20	10840	Washita Headwaters	5
21	10900	Red River Mainstem (To Walnut Bayou)	87
22	11000	Walnut Bayou	8
23	11100	Mud Creek	0
24	11201	Beaver Creek - 1	0
25	11202	Beaver Creek - 2	93
26	11203	Beaver Creek - 3	0
27	11311	Cache Creek - 1	0
28	11312	Cache Creek - 2	11
29	11321	Deep Red Creek And West Cache Creek - 1	14
30	11322	Deep Red Creek And West Cache Creek - 2	0
31	11400	Red River Mainstem (To North Fork of Red)	0
32	11511	Lower North Fork Red River - 1	0
33	11512	Lower North Fork Red River - 2	0
34	11513	Lower North Fork Red River - 3	0
35	11514	Lower North Fork Red River - 4	0
36	11521	Upper North Fork Red River - 1	0
37	11522	Upper North Fork Red River - 2	19
38	11601	Salt Fork Red River - 1	0
39	11602	Salt Fork Red River - 2	0
40	11701	Prairie Dog Town Fork Red River - 1	0
41	11702	Prairie Dog Town Fork Red River - 2	0

42	11801	Elm Fork Red River - 1	0
43	11802	Elm Fork Red River - 2	0
44	20101	Poteau River - 1	0
45	20102	Poteau River - 2	0
46	20201	Lower Arkansas River - 1	0
47	20202	Lower Arkansas River - 2	0
48	20300	Canadian River (To North Canadian River)	50
49	20400	Middle Arkansas River	0
50	20510	Lower North Canadian River	52
51	20520	Middle North Canadian River	0
52	20531	Upper North Canadian River - 1	25
53	20532	Upper North Canadian River - 2	4
54	20533	Upper North Canadian River - 3	0
55	20540	North Canadian Headwaters	27
56	20611	Lower Canadian River - 1	134
57	20612	Lower Canadian River - 2	0
58	20620	Middle Canadian River	344
59	20630	Upper Canadian River	16
60	20700	Deep Fork River	328
61	20801	Little River - 1	9
62	20802	Little River - 2	375
63	20910	Lower Cimarron River	20
64	20920	Middle Cimarron River	313
65	20930	Upper Cimarron River	4
66	20940	Cimarron Headwaters	0
67	21011	Lower Salt Fork Arkansas River - 1	0
69	21012	Lower Salt Fork Arkansas River - 2	0
70	21013	Lower Salt Fork Arkansas River - 3	0
68	21020	Upper Salt Fork Arkansas River	0
71	21100	Arkansas River - Cimarron Rivers to Keystone Lake	18
72	21200	Arkansas River Mainstem (To Kansas State Line)	0
73	21301	Bird Creek - 1	0
74	21302	Bird Creek - 2	0
75	21401	Caney River - 1	0
76	21402	Caney River - 2	0
77	21511	Verdigris River (To Oologah Dam) - 1	0
78	21512	Verdigris River (To Oologah Dam) - 2	0
79	21520	Verdigris River (To Kansas State Line)	0
80	21601	Grand (Neosho) River - 1	24
81	21602	Grand (Neosho) River - 2	0
82	21700	Illinois River	4

Table 3-21 Demand by Sector for Oklahoma, 2010 through 2060

Sector	2010	2020	2030	2040	2050	2060
Municipal & Industrial	601,891	647,038	682,391	713,982	743,158	772,773
Self Supplied Residential	30,236	32,633	34,795	36,890	39,009	41,189
Oil & Gas	42,107	74,403	78,202	90,080	102,536	115,570
Self Supplied Industrial	88,780	87,558	92,313	96,730	101,258	105,683
Thermoelectric Power	260,539	290,660	324,262	361,750	403,571	450,227
Livestock	94,480	95,792	97,104	98,416	99,728	101,040
Crop Irrigation	745,210	775,661	806,112	836,562	859,932	897,464
Total	**1,863,243**	**2,003,743**	**2,115,179**	**2,234,410**	**2,349,192**	**2,483,946**

Table 3-22 Total County Demands for 2010 through 2060

County	Annual Water Total Demands (AFY)					
	2010	2020	2030	2040	2050	2060
Adair	5,233	5,861	6,565	7,268	7,930	8,697
Alfalfa	7,536	8,192	8,884	9,620	10,314	11,262
Atoka	6,531	7,733	8,054	8,515	8,896	9,306
Beaver	37,846	39,173	40,524	41,923	43,149	44,865
Beckham	15,044	15,685	16,425	17,202	18,018	18,918
Blaine	11,352	11,677	12,081	12,502	12,940	13,418
Bryan	27,209	28,271	29,395	30,519	31,596	32,794
Caddo	44,399	48,167	51,975	55,901	59,322	64,128
Canadian	29,394	34,610	34,329	34,746	34,634	34,247
Carter	15,905	19,542	18,278	17,750	16,850	15,602
Cherokee	10,007	11,081	12,263	13,460	14,610	15,823
Choctaw	11,155	12,238	13,368	14,620	15,954	17,493
Cimarron	65,080	70,895	76,683	82,445	86,916	94,040
Cleveland	40,675	43,889	46,510	48,670	50,238	51,879
Coal	3,763	5,521	4,687	4,267	3,644	2,808
Comanche	23,548	25,246	26,726	28,045	29,213	30,424
Cotton	2,316	2,459	2,589	2,719	2,837	2,993
Craig	4,225	4,951	5,699	6,477	7,142	8,052
Creek	10,161	10,875	11,506	12,124	12,745	13,435
Custer	12,357	13,025	13,693	14,410	15,090	15,840
Delaware	8,481	9,245	10,051	10,881	11,770	12,694
Dewey	7,172	7,324	7,518	7,741	8,025	8,337
Ellis	26,099	29,300	32,744	36,391	39,721	44,456
Garfield	20,018	20,610	21,045	21,478	21,867	22,317
Garvin	8,496	9,358	10,186	11,051	11,862	12,932
Grady	20,691	21,547	22,432	23,343	24,320	25,375
Grant	3,496	3,676	3,883	4,106	4,392	4,696
Greer	7,548	9,754	11,947	14,159	15,861	18,582
Harmon	27,812	28,569	29,343	30,117	30,720	31,665
Harper	13,416	14,311	15,238	16,210	17,105	18,326
Haskell	6,625	8,193	10,174	12,535	15,217	18,391
Hughes	9,997	14,207	13,700	13,935	13,564	13,286
Jackson	107,669	110,075	112,482	114,846	116,708	119,498
Jefferson	2,484	2,553	2,617	2,683	2,756	2,845
Johnston	5,378	6,097	6,961	7,867	8,749	9,893
Kay	24,705	25,684	26,285	26,856	27,436	28,065
Kingfisher	13,821	14,663	15,597	16,550	17,433	18,564
Kiowa	6,946	7,129	7,300	7,474	7,635	7,857
Latimer	4,393	5,276	6,216	7,232	8,185	9,445
Le Flore	26,477	28,716	31,365	34,439	37,947	41,929
Lincoln	8,953	9,685	10,505	11,459	12,549	13,783
Logan	10,794	11,882	13,149	14,505	15,932	17,506
Love	4,987	9,142	9,961	10,801	11,551	12,526
Major	16,830	17,187	17,556	17,986	18,450	18,980

Table 3-22 Total County Demands for 2010 through 2060

County	Annual Water Total Demands (AFY)					
	2010	2020	2030	2040	2050	2060
Marshall	7,725	9,681	10,315	11,067	11,767	12,519
Mayes	12,567	13,682	14,903	16,220	17,600	19,128
McClain	15,459	17,091	18,854	20,734	22,758	24,962
McCurtain	42,967	42,968	44,957	46,755	48,568	50,505
McIntosh	4,620	5,553	6,722	8,129	9,784	11,666
Murray	3,192	3,609	4,074	4,521	4,975	5,499
Muskogee	145,950	157,906	172,310	188,144	205,719	225,234
Noble	4,270	4,544	4,807	5,102	5,416	5,763
Nowata	2,935	3,403	3,912	4,443	4,966	5,603
Okfuskee	4,370	4,782	5,219	5,698	6,174	6,792
Oklahoma	141,512	150,167	157,097	162,877	167,742	172,792
Okmulgee	13,118	13,998	14,811	15,670	16,573	17,496
Osage	12,846	13,833	14,722	15,601	16,474	17,507
Ottawa	7,400	7,925	8,396	8,900	9,407	9,944
Pawnee	41,604	46,380	51,661	57,534	64,055	71,313
Payne	15,761	16,935	18,195	19,474	20,477	21,484
Pittsburg	34,277	44,287	41,846	41,605	40,553	38,853
Pontotoc	9,388	10,608	11,763	12,937	13,928	15,305
Pottawatomie	11,225	12,322	13,547	14,839	16,134	17,695
Pushmataha	2,527	2,679	2,842	3,015	3,206	3,400
Roger Mills	11,899	12,419	13,028	13,734	14,532	15,433
Rogers	40,432	44,922	49,708	54,771	60,261	66,312
Seminole	23,316	26,108	29,185	32,619	36,393	40,710
Sequoyah	12,198	13,109	14,191	15,255	16,315	17,434
Stephens	13,360	14,586	15,737	16,971	18,155	19,755
Texas	224,653	227,314	232,447	237,694	242,743	248,480
Tillman	20,518	20,852	21,183	21,524	21,818	22,254
Tulsa	132,440	140,864	148,011	153,893	159,107	164,638
Wagoner	22,285	23,844	25,371	26,928	28,574	30,369
Washington	13,389	14,088	14,503	14,987	15,456	16,037
Washita	8,717	9,729	10,947	12,380	13,998	15,934
Woods	8,726	9,205	9,733	10,297	10,849	11,577
Woodward	20,568	21,076	21,697	22,264	22,923	23,579
Total	**1,863,243**	**2,003,743**	**2,115,179**	**2,234,410**	**2,349,192**	**2,483,946**

Table 3-23 Total Demands by Basin for 2010 through 2060

Basin Number	Basin ID	Basin Name	Total 2010 Demand (AFY)	Total 2020 Demand (AFY)	Total 2030 Demand (AFY)	Total 2040 Demand (AFY)	Total 2050 Demand (AFY)	Total 2060 Demand (AFY)
1	10100	Red River Mainstem (To Kiamichi River)	2,862	3,275	3,664	4,044	4,356	4,808
2	10201	Little River (McCurtain County) - 1	1,510	1,596	1,667	1,732	1,796	1,866
3	10202	Little River (McCurtain County) - 2	38,381	37,838	39,325	40,640	42,048	43,419
4	10203	Little River (McCurtain County) - 3	1,255	1,346	1,433	1,520	1,600	1,700
5	10301	Kiamichi River - 1	9,163	10,127	11,167	12,323	13,588	15,012
6	10302	Kiamichi River - 2	4,245	4,577	4,923	5,297	5,680	6,127
7	10411	Muddy Boggy River - 1	1,499	1,621	1,735	1,852	1,954	2,092
8	10412	Muddy Boggy River - 2	24,757	31,619	31,336	32,396	35,027	38,291
9	10420	Clear Boggy Creek	7,285	8,316	8,809	9,397	9,892	10,579
10	10500	Red River Mainstem (To Blue River)	2,195	2,271	2,333	2,399	2,456	2,532
11	10601	Blue River - 1	4,200	4,316	4,437	4,557	4,669	4,800
12	10602	Blue River - 2	7,509	8,219	8,953	9,688	10,360	11,170
13	10700	Red River Mainstem (To Washita)	13,947	14,384	14,843	15,303	15,733	16,231
14	10810	Lower Washita	22,897	25,794	26,980	28,469	29,776	31,400
15	10821	Middle Washita - 1	6,177	6,816	7,486	8,192	8,901	9,748
16	10822	Middle Washita - 2	19,716	20,972	22,250	23,564	24,816	26,376
17	10831	Upper Washita - 1	13,311	14,547	15,840	17,210	18,531	20,221
18	10832	Upper Washita - 2	16,746	18,102	19,460	20,826	21,903	23,586
19	10833	Upper Washita - 3	16,070	16,939	17,839	18,813	19,768	20,936
20	10840	Washita Headwaters	11,291	11,976	12,777	13,702	14,743	15,921
21	10900	Red River Mainstem (To Walnut Bayou)	22,021	28,693	30,388	32,442	34,311	36,487
22	11000	Walnut Bayou	6,071	8,168	7,884	7,899	8,223	8,746
23	11100	Mud Creek	3,518	3,985	4,090	4,207	4,329	4,472
24	11201	Beaver Creek - 1	711	732	748	764	784	809
25	11202	Beaver Creek - 2	7,196	7,774	8,334	8,930	9,519	10,260
26	11203	Beaver Creek - 3	2,681	2,827	2,941	3,060	3,170	3,331
27	11311	Cache Creek - 1	560	611	659	707	747	805
28	11312	Cache Creek - 2	19,631	21,049	22,272	23,371	24,369	25,380
29	11321	Deep Red Creek And West Cache Creek - 1	3,979	4,242	4,465	4,664	4,824	5,015
30	11322	Deep Red Creek And West Cache Creek - 2	3,378	3,448	3,513	3,580	3,644	3,731
31	11400	Red River Mainstem (To North Fork of Red)	6,448	6,595	6,741	6,894	7,035	7,232
32	11511	Lower North Fork Red River - 1	7,922	8,044	8,164	8,284	8,377	8,524
33	11512	Lower North Fork Red River - 2	16,255	16,671	17,055	17,413	17,701	18,081
34	11513	Lower North Fork Red River - 3	12,667	13,606	14,722	15,987	17,374	19,014
35	11514	Lower North Fork Red River - 4	271	276	281	285	290	295
36	11521	Upper North Fork Red River - 1	3,771	4,336	4,900	5,467	5,904	6,600
37	11522	Upper North Fork Red River - 2	10,572	10,948	11,385	11,860	12,372	12,942
38	11601	Salt Fork Red River - 1	73,638	75,622	77,630	79,622	81,163	83,563
39	11602	Salt Fork Red River - 2	1,376	1,577	1,778	1,980	2,137	2,385
40	11701	Prairie Dog Town Fork Red River - 1	17,064	17,476	17,894	18,317	18,669	19,186

Table 3-23 Total Demands by Basin for 2010 through 2060

Basin Number	Basin ID	Basin Name	Total 2010 Demand (AFY)	Total 2020 Demand (AFY)	Total 2030 Demand (AFY)	Total 2040 Demand (AFY)	Total 2050 Demand (AFY)	Total 2060 Demand (AFY)
41	11702	Prairie Dog Town Fork Red River - 2	29,228	29,984	30,754	31,524	32,122	33,064
42	11801	Elm Fork Red River - 1	2,843	3,686	4,524	5,370	6,021	7,062
43	11802	Elm Fork Red River - 2	1,367	1,570	1,774	1,980	2,144	2,393
44	20101	Poteau River - 1	3,799	4,126	4,530	5,011	5,568	6,207
45	20102	Poteau River - 2	18,650	21,001	23,712	26,805	30,200	34,169
46	20201	Lower Arkansas River - 1	20,030	22,060	24,267	26,713	29,336	32,320
47	20202	Lower Arkansas River - 2	146,143	158,390	173,175	189,431	207,423	227,441
48	20300	Canadian River (To North Canadian River)	40,847	52,439	51,742	53,540	54,656	55,637
49	20400	Middle Arkansas River	100,612	107,159	112,888	117,947	122,733	127,857
50	20510	Lower North Canadian River	72,497	77,251	81,248	84,734	87,700	91,013
51	20520	Middle North Canadian River	22,107	24,560	25,002	25,695	26,581	27,740
52	20531	Upper North Canadian River - 1	13,010	13,235	13,466	13,707	13,983	14,287
53	20532	Upper North Canadian River - 2	38,358	40,132	42,091	44,069	45,908	48,356
54	20533	Upper North Canadian River - 3	19,004	21,058	23,226	25,489	27,485	30,391
55	20540	North Canadian Headwaters	264,903	272,431	282,395	292,452	301,246	312,929
56	20611	Lower Canadian River - 1	31,229	35,018	38,778	42,818	46,918	51,754
57	20612	Lower Canadian River - 2	3,422	3,770	4,134	4,502	4,885	5,286
58	20620	Middle Canadian River	35,603	39,864	41,346	43,165	45,009	47,428
59	20630	Upper Canadian River	22,257	23,639	24,972	26,424	27,818	29,632
60	20700	Deep Fork River	63,305	67,820	71,925	75,880	79,747	83,993
61	20801	Little River - 1	1,965	2,164	2,373	2,593	2,810	3,077
62	20802	Little River - 2	32,924	35,436	37,531	39,319	40,750	42,243
63	20910	Lower Cimarron River	17,546	18,753	19,942	21,212	22,492	23,923
64	20920	Middle Cimarron River	72,539	76,633	80,090	83,533	86,704	90,357
65	20930	Upper Cimarron River	38,427	39,657	40,955	42,331	43,660	45,380
66	20940	Cimarron Headwaters	16,701	17,859	19,014	20,166	21,062	22,483
67	21011	Lower Salt Fork Arkansas River - 1	5,540	5,740	5,895	6,055	6,226	6,415
69	21012	Lower Salt Fork Arkansas River - 2	1,817	1,877	1,917	1,956	1,996	2,039
70	21013	Lower Salt Fork Arkansas River - 3	1,690	1,726	1,758	1,792	1,830	1,871
68	21020	Upper Salt Fork Arkansas River	12,940	13,785	14,697	15,677	16,697	17,973
71	21100	Arkansas River - Cimarron Rivers to Keystone Lake	27,482	29,505	31,509	33,535	35,324	37,186
72	21200	Arkansas River Mainstem (To Kansas State Line)	61,549	67,041	72,707	78,911	85,737	93,360
73	21301	Bird Creek - 1	30,826	32,617	34,040	35,095	35,921	36,780
74	21302	Bird Creek - 2	11,639	12,403	13,044	13,608	14,134	14,714
75	21401	Caney River - 1	11,770	12,546	13,187	13,701	14,140	14,604
76	21402	Caney River - 2	14,823	15,689	16,268	16,911	17,517	18,287
77	21511	Verdigris River (To Oologah Dam) - 1	19,102	20,502	21,891	23,303	24,796	26,423
78	21512	Verdigris River (To Oologah Dam) - 2	33,873	37,588	41,579	45,860	50,527	55,704
79	21520	Verdigris River (To Kansas State Line)	6,013	6,737	7,495	8,262	9,036	9,919
80	21601	Grand (Neosho) River - 1	25,116	27,826	30,700	33,693	36,655	40,031
81	21602	Grand (Neosho) River - 2	12,181	13,210	14,217	15,275	16,364	17,520
82	21700	Illinois River	12,815	13,930	15,318	16,709	18,048	19,513
		Total	1,863,243	2,003,743	2,115,179	2,234,410	2,352,447	2,492,436

Section 4
Oklahoma's Water Resources

This section summarizes Oklahoma's currently available water resources based on available data for both SW and GW supplies. In addition to SW and GW supplies, return flows and out-of-basin supplies were also accounted for in the OCWP technical analyses, as each affects the supply availability in basins throughout Oklahoma. Each of these water supply sources is discussed below.

4.1 Surface Water Supply

The SW supply includes physically available streamflow to meet demand. The Oklahoma H_2O water supply availability tool compares physically available streamflow to future increases in demand. The physically available streamflow is based on recorded USGS streamgage data. The measured streamflow implicitly reflects the operating conditions that impact the stream at the time the data are recorded (e.g., hydrology, permitted use, infrastructure, or water quality constraints). Historic reservoir operations are also reflected in the streamgage record downstream of a reservoir.

As discussed in more detail in Section 4.2.2, streamflow is directly influenced by alluvial aquifer recharge and discharge, and the resulting changes in flow are assumed to be reflected in the streamgage record. Some streams may also be hydraulically connected to BGW aquifers, and BGW pumping may reduce baseflow. However, because there is less direct connection between BGW and SW than between AGW and SW, BGW and SW were assumed to be disconnected for this analysis. Because the USGS streamgage records include flows attributable to recharge or discharge from alluvial aquifers and reservoir releases, reservoir operations and alluvial groundwater supplies were included implicitly in the SW supply analysis.

4.1.1 Surface Water Supply Considerations

The measured streamflow is used to analyze the physical ("wet water") availability that may be available to meet projected future demand based on historical hydrologic conditions. The water supply availability tool calculates wet water availability based on the change in demand from the present condition. The measured streamflow is assumed to represent the effects of the existing demand and operations. It is likely that the available water is over-predicted in the earlier decades of the historical streamflow dataset for basins that have undergone substantial growth. These uncertainties may be addressed by using recent streamflow data; however, recent streamflow data may not represent historic droughts of record. The supply availability analysis was a long historical streamflow record (1950-2007) which reflects three previous hydrologic droughts: 1952-56, 1961-72, and 1976-81. This period of record was used to determine both the size and probability of gaps and storage depletions.

All of Oklahoma's major river systems receive flow from out-of-state tributary areas. The amount of flow available from out-of-state is regulated based on legal compacts between Oklahoma and surrounding states. A review of compact obligations was performed in the permit availability assessment, which is documented in a separate report. To account for potential compact obligations, the amount of out-of-state water physically coming into Oklahoma was assumed to be reduced by 60 percent (Oklahoma receives 40 percent). This methodology is consistent with the method that OWRB uses to determine the amount of streamflow available for permitting.

4.1.2 USGS Streamflow Gage Selection

USGS streamflow gages were used to determine the monthly streamflow from October 1949 to September 2007 (water years 1950 through 2007). This period of record provides streamflow data for the three previous major hydrologic droughts (1952-56, 1961-72, and 1976-81), as well as the intense 2006 drought. The locations and periods of record for USGS streamflow gages in Oklahoma and in surrounding states were downloaded from the USGS streamflow website, water.usgs.gov, and are presented in Figure 4-1 and Table 4-1. USGS gages with a long period of record, preferably with flow data in the 1950s (light blue ring with a white center in Figure 4-1), were used to determine the surface water supply for each basin where available. Gages that are at or near a basin outlet, gages that isolate a reservoir, gages that isolate an area of intense demand, or gages that divide large tributary areas were also preferentially selected to determine the surface water supply for each basin when available. The selected gages are shown in Figure 4-2. Information on each selected gage, including periods of missing data, is provided in Table 4-2.

4.1.3 Filling Streamflow Records with the MOVE.2 Technique

Periods of missing data were filled based on the hydrologic patterns in nearby gaged streams using the Maintenance of Variance Extension (MOVE.2) statistical technique (Hirsch 1982). MOVE.2 is a statistical flow record extension technique that fills missing data in a streamflow record (y) based on the flow in a nearby reference stream gage (x). The technique shown in the equation below uses the mean (m) and standard deviation (s) of the flow in each of the two streams. The MOVE.2 technique was applied to monthly flow data. An example of a time series that has been filled using the MOVE.2 technique is shown in Figure 4-3.

$$y_i = m_y + \frac{s_y}{s_x} \cdot (x_i - m_x)$$

The selection of an appropriate reference gage is an important aspect of applying the MOVE.2 technique. Due to Oklahoma's pronounced east-west precipitation gradient, it was preferred that only nearby reference gages were selected. Additionally, streamflow records that are measured with and without a reservoir can substantially affect the streamflow estimation; therefore, reference basins with major reservoirs were avoided where possible. The reference gages used to fill the high-quality gages are shown in Figure 4-4.

To better account for hydrologic variations in periods of missing data the mean and standard deviation of the measured period were calibrated using the reference data of the missing period. The calibration essentially emphasized or deemphasized the measured period of the gage being transformed based on the entire period of record of the reference gage, which resulted in greater accuracy in high flow periods. To check the validity of the Move.2 method, the technique was used to synthesize streamflow for USGS streamgage number 7155590 during periods with measured data. The Move.2 flows were compared to the measured streamflow and were found to be similar. As reported in the literature and consistent with other statistical flow estimation methods, the Move.2 technique was more accurate at synthesizing high flows than low flows.

4.1.4 Allocating Streamflow to Basins

Monthly average and median SW supply was determined using the gage data at the outlet of each basin. Since high-quality gages are not located exactly at the outlet of each basin, adjustments were made to the measured flow to synthetically produce a gage at the outlet. The location of the gages relative to the basin outlet is shown in Figure 4-2. Three typical scenarios were identified for the location of preferred gages within a basin as follows:

- A gage was located at or near the basin outlet.
- A gage was located on the basin's major stream, but was located upstream or downstream of the basin outlet.
- A gage could not be used to directly measure the surface water supply in the basin.

Where there was no gage located at or near the basin outlet, a synthetic flow was generated based on measured flow data at a reference gage. The synthetic flow was generated by multiplying the monthly unit flow (AF/square mile/month) of the reference gage by the tributary area of the synthetic gage. Thirty-three of the 82 OCWP basins required the generation of synthetic flows, and 17 of the 33 synthetic flow basins use a gage located away from the basin outlet on the same stream or river.

4.1.4.1 Determination of Gage Watershed

The tributary area of each gage, referred to as the gage watershed, was used to aid in determining surface water supply at each basin outlet. The watershed of each gage was established based on the OWRB basins, USGS 12-digit HUCs, the USGS 1:250,000 scale HUCs, and the topography from the National Elevation Database (NED). Using the OWRB basins as a base, the USGS 12-digit HUCs were used to subdivide an existing OWRB basin at or near the gage. If the gage was not located along a HUC boundary, then the watershed was delineated using topography from the NED. The watershed delineation was created by dividing an existing 12-digit HUC and did not involve re-delineating existing HUCs. All existing OWRB basin boundaries were maintained, but many of the OWRB basins were subdivided.

The USGS 1:250,000 HUCs were also used to determine the tributary watershed area outside of Oklahoma; however, because of the large watershed area for the Canadian and Arkansas Rivers, the 1:250,000 HUCs were not used directly. The watershed area for the gages along these rivers was determined using the reported USGS gage watershed area at the closest gage to the Oklahoma border. The streamflow in the mainstem of the Red River was not considered a SW supply because of its known water quality constraints; therefore, no out-of-state watershed area was determined for the Red River.

The watershed boundaries for each preferred gage are shown in Figure 4-5. A comparison of the generated watershed areas and the USGS reported watershed areas were in agreement.

4.1.4.2 Methodology for Gages at or Near the Basin Outlet

For basins where high-quality gages were at or near the basin outlet, the measured daily data were used directly to determine the monthly average and median flow. A gage was considered at or near the basin outlet if the area of the gage watershed between the basin boundary and the gage (upstream or downstream of the gage) was less than 5 percent of the total basin area. In these cases, the small area was effectively ignored; basins with gage data in this category are shown as green polygons in Figure 4-6.

4.1.4.3 Methodology for Gages Located Away from the Basin Outlet

Where a gage was not located near the basin outlet (more than 5 percent tributary area between the gage and the basin boundary), flow for a synthetic gage was generated to account for the differences between the watershed area at the basin outlet and the watershed area tributary to the gage. The monthly unit flow (AF/square mile/month) for the period of record was calculated from the measured gage data. This unit flow was applied to the synthetic gage watershed area, which may be different from the basin area, to determine the SW supply at the basin outlet. In this scenario, the watershed of the measured data was effectively extended or contracted. For example, if a gage with tributary area of 100 square miles and a unit flow equal to 10 AF/square mile/month (measured flow of 1,000 AF/month) was applied to a synthetic gage at the basin outlet with a 150-square-mile watershed, the synthetic basin SW volume would be estimated as 1,500 AF/month. If the confluence with an upstream basin was downstream of the gage being extended, the upstream basin's flow was added to determine the total basin flow. This method was applied to the basins shaded in light tan in Figure 4-6.

4.1.4.4 Methodology for Basins without Usable Gages

When a high-quality gage could not be used directly within a basin, a reference gage was chosen to estimate flow in the ungaged basin. This is different than the MOVE.2 method, because the ungaged basins using this methodology did not have any gage within the basin, as opposed to the MOVE.2 basins where the data for the basin was not full for the entire period of record. Reference gages were chosen based on the following considerations:

- Nearby location (hydrologically similar)
- Similar demand
- Similar land use, soils, and slope

- Presence or absence of reservoir(s)

The monthly unit flow from the reference gage was applied to the basin area to estimate the SW supply at the basin outlet. The flow from any upstream basins was added to the ungaged basin to determine the total basin flow.

$$Q\_2 = Q\_1/A\_1 \cdot A\_2 + Q\_3$$

Where basin 1 is the reference basin, basin 2 is the basin or partial basin with absent high-quality gage data, and basin 3 is the upstream basin.

This method was used on portions of basins and it was also used on entire basins if no preferred gage data were available. This method was also used extensively on the tributaries to the Red River. The basins utilizing this method for estimating streamflow are shown with dark tan shading in Figure 4-6.

4.1.4.5 Methodology for Special Case Basins

There were several basins that were considered special cases. Boundary conditions for the Canadian River (Basin 59) and Arkansas River (Basin 72) were set at the USGS Gage 7228000 (Canadian River) and USGS Gage 7146500 (Arkansas River). To determine out-of-state flow where the Upper Cimarron River re-enters Oklahoma at multiple locations, the flow leaving the state at Basin 66 was subtracted from the flow entering the state at Basin 65.

4.1.5 Summary of Surface Water Supply by Basins

The average annual and median annual flows for each basin are presented in Table 4-3. The average flows (after existing diversions are taken out of the stream, including out-of-basin supplies) are shown graphically in Figure 4-7 for each basin. The SW supplies follow the strong east-west precipitation gradient in the state and reflect the large quantity of water in the Arkansas River basins. As stated previously, the SW supplies in basins along the Red River do not include the flow in the Red River due to water quality challenges.

4.1.6 Reservoirs

Reservoirs are an important source of water for Oklahoma, providing for water supply, flood protection, hydroelectric power, recreation, and other beneficial uses. Many reservoirs in Oklahoma serve multiple purposes, such as water supply and recreation. Water supply reservoirs capture water when it is available, and store it until needed, traditionally in the late summer and early fall. The Lakes of Oklahoma (OWRB 2010) provides detailed information on each of the major lakes in the state.

4.1.6.1 Historical Reservoir Operation

Historic reservoir operations are implicitly accounted for in the streamflow record in the supply availability analysis. Therefore, reservoir storage and operations are not separate inputs of the analysis. For example, Oklahoma City currently pumps raw water from Lake

Atoka and McGee Creek Reservoir to Stanley Draper Lake. Lake Atoka and McGee Creek Reservoir are in the Muddy Boggy River basin (basin number 8). The flows recorded in the USGS gage downstream of the Muddy Boggy River basin account for the yields taken from these two reservoirs, because the water was transferred out of the basin upstream of the gage. That is, the historic reservoir yields for Lake Atoka and McGee Creek Reservoir do not have to be subtracted from the SW supply for basin 8, because the gage record accounts for the historic withdrawals. When looking at physically available flows to meet future demand, reservoir yields and their role in meeting basin-level needs will be analyzed in more detail in later phases of OCWP technical studies, as described in Section 7 of this report.

4.1.6.2 Unused Reservoir Storage

Oklahoma has over 1.8 million AFY of dependable water supply yield from over 110 major reservoirs. Not all of the storage and subsequent dependable yield in the state is currently being used. Many major reservoirs have yield that is permitted with a schedule of use. In this case, the permit holder has reserved the yield and set a schedule increased the use of the yield in the future, but is not currently using the entire permitted yield. Some major reservoirs, particularly in the North Central or Southeastern portion of the state, have unpermitted yield that could be used by a new water user. The yield of many smaller or municipally owned reservoirs are currently fully permitted or the yield is unknown. Reservoirs with a known yield and unused storage, either due to a schedule of use or having unpermitted yield, are presented in Table 4-4.

The unused reservoir yield from major reservoirs was included in the Oklahoma H_2O tool to account for the substantial water supplies available from these reservoirs. The available yield was used to mitigate SW gaps in the basin where the reservoir is located. However, any future use of these reservoirs would need to take into consideration existing water rights.

4.1.7 Surface Water Supply Confidence

The confidence in the SW supply data or how well the data represent what is actually occurring in the stream for a given location and time, was determined qualitatively. Confidence was assessed based on the source of streamflow data and the calculation method used to apply streamflow data to basins. Confidence intervals were reported as high, medium, or low. Low confidence SW supply data should be used with caution. The confidence in SW supply data can be potentially improved with additional analyses or watershed modeling.

The source of streamflow data was considered to be either gaged or synthesized using the MOVE.2 technique. The accuracy and precision of the data generated by the MOVE.2 technique is largely dependent on the similarities of the reference gage to the gage being filled. Similarities between the gages were determined directly by the correlation of measured data between the fill gage and reference gage. A coefficient of determination (R^2) value greater than or equal to 0.8 was considered to be an acceptable correlation. There was high confidence in surface water supply datasets with less than 10 years of filled data and a R^2 greater than or equal to 0.8. There was medium confidence in datasets with less than 38 years of filled data (20 years of measured data) and a R^2 greater than or equal to 0.5. There was low confidence in all other datasets.

The confidence in the SW supply datasets were also influenced by the method used to apply streamflow to basins. There was high confidence in basins with a gage near the outlet. There was medium confidence in basins that had a gage away from the outlet. Additionally, there was medium confidence in basins without a usable gage, but the basin was within the reference gage's tributary area or vice versa. There was low confidence in all other basins without a usable gage.

The lowest of the two confidence levels (e.g., synthetic data and calculation method) was used to assign the overall confidence in each basin's SW supplies. The confidence level in each basin is presented in Table 4-5. The confidence in the SW supply from out-of-state tributaries is presented in Table 4-6.

4.2 Groundwater Supply

For both AGW and BGW supplies, the water availability analyses were used to predict the rate of GW usage or depletion based on the difference between the GW demand and GW recharge rate. Between the 1995 OCWP Update (OWRB 1995) and the current update, OWRB developed interim draft estimates of water supply and demand. GW availability was quantified based on estimates of current recoverable yields and recharge rates for the major aquifers in the state. Estimates of GW storage and recharge were made for the current analysis using previous studies, analyses of well permit records, and professional judgment.

4.2.1 Major and Minor Aquifers

Major bedrock aquifers are defined as those that yield an average of 50 gallons per minute (gpm) or more per well, and major alluvium and terrace aquifers (also referred to as alluvial aquifers in this report) are those that yield, on average, at least 150 gpm based on analyses by OWRB. OWRB has identified 10 major bedrock aquifers and 11 major alluvial aquifers. Minor GW aquifers—those yielding less than the major aquifers—are an important local source of water for domestic, stock, and other uses. Some of the more prolific minor aquifers include the El Reno, Woodbine, and Boone aquifers. However, not all minor aquifers have been delineated (i.e., their extent and volume have not been assessed). In the OCWP, these aquifers are referred to as non-delineated minor aquifers.

Oklahoma's major and minor aquifers are presented in Figure 4-9 (alluvial aquifers) and Figure 4-10 (bedrock aquifers). The 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.

4.2.2 Alluvial and Terrace Aquifers in the OCWP

Alluvial and terrace aquifers in the OCWP are assumed to be directly connected to SW. A surplus of AGW would be displayed as increased baseflow in the adjacent SW. Conversely, a deficiency of AGW would be displayed as a decrease in baseflow of adjacent SW. AGW recharge is not considered separately in this analysis since any increases or decreases in AGW storage from recharge or depletion would be exhibited in the SW increases and decreases. Due to the complexity of the AGW-SW connection, all AGW demand is attributed to SW for this analysis.

4.2.3 Aquifer Data Evaluation

4.2.3.1 Data Confidence Evaluation

The aquifer analyses undertaken for the current OCWP update identifies the recharge rate and recoverable volumetric storage of selected major alluvial and bedrock aquifers. Minor aquifers, which are typically less studied, were included as sources of supply but not further evaluated in the water supply availability analysis. The aquifers selected for analysis were based on the data confidence provided in existing data and reports, and on discussions with OWRB staff.

Data confidence levels were determined using three criteria: confidence in aquifer configuration; confidence in aquifer storage; and confidence in aquifer recharge. Aquifer configuration is the extent and depth of the saturated portion of the aquifer. Aquifer storage is the specific yield for unconfined aquifers and the porosity for confined aquifers. Recharge is the rate at which an aquifer is replenished, usually by infiltration of precipitation. As shown in Table 4-7, each of these three criteria was assigned a low, medium, or high confidence level. Aquifers with a low confidence level assigned to any of the three evaluation criteria were reviewed in detail. Aquifers for which a low confidence existed for the aquifer configuration or aquifer storage criteria underwent additional analyses that resulted in either medium or high confidence for the new estimates. This included the Roubidoux bedrock aquifer and the Canadian River, North Fork of the Red River, Red River, Salt Fork of the Arkansas River, Arkansas River, and Gerty Sand alluvial aquifers.

4.2.3.2 Aquifer Recharge

The water availability analyses undertaken for the current OCWP update predict if GW storage depletions exist based on the net of the GW demand and GW recharge. All of the alluvial aquifers are known to be physically hydraulically connected with the overlying stream system. For the purposes of this analysis it is assumed that GW recharge to SW from alluvial aquifers is reflected in the SW gage data. It is also assumed that the long-term effects of pumping from these aquifers are reflected in the gage record as a reduction in the streamflow. Therefore, AGW supplies do not specifically include alluvial aquifer recharge rates, and AGW demand in a given basin are assumed to be met by the SW supply, defined as the streamflow at the downstream end of the basin.

In contrast, for bedrock aquifers that are not hydraulically connected with overlying streams, termed BGW, recharge was explicitly included for each aquifer. The range of recharge estimates determined from available literature and the selected average recharge rate are provided for minor aquifers in Table 4-8. County specific recharge rates were used, when available, to distribute aquifer based rates to OCWP basins, which are provided in Table 4-9. Recharge rates are assumed to be distributed evenly across the aquifer or county. Minor aquifer recharge rates, which were only available on an aquifer basis, were taken directly from OWRB's records.

4.2.3.3 Updates to Aquifer Storage Volume

The aquifer storage volume was used to determine the rate of storage depletion of each aquifer. The methodology for determining the storage volume was based on the confidence levels shown in Table 4-4. The storage volume for aquifers with medium and high confidence levels were taken from previous OWRB estimates and not recalculated. The storage volume for aquifers with a low confidence level assigned to the Aquifer Configuration data were recalculated using available OWRB well log information. This included the Roubidoux bedrock aquifer and the Canadian River, North Fork of the Red River, Red River, Salt Fork of the Arkansas River, Arkansas River, and Gerty Sand alluvial aquifers.

The volume of each aquifer was recalculated using the saturated thickness for each well and the spatial extent of the aquifer. Aquifer boundaries were identified from the Oklahoma aquifers shapefile received from the OWRB or the Hydrologic Atlas series (scale 1:250,000). Values for saturated thickness were used as a basis to map the aquifer. These were obtained from literature, when available, and were otherwise estimated from information provided on well drillers' logs on file at the OWRB.

There were areas in each aquifer where there were few to no wells. To undertake further analysis of the data, it was necessary to insert control points in these areas of data scarcity. The saturated thickness values assigned to control points were dependent on the saturated thickness values given in previous OWRB estimates, and on the saturated thickness of nearby wells using engineering judgment. Control points were also inserted along the outer boundaries of the aquifers and given a value of 0 to define the aquifers for the later interpolation.

Once the well data and control point saturated thicknesses were established, ArcGIS was used to convert point data into a continuous 3-D (raster) dataset using an inverse distance squared interpolation method. Saturated thickness volumes were computed using the ArcGIS Surface Analysis Cut/Fill tool on a 100-foot grid basis for each aquifer that was re-evaluated. For the purposes of the OCWP update, aquifer volumetric storage values were calculated for each county by first intersecting and subdividing the saturated thickness volumes with the county boundaries, and then multiplying the resulting county-scale storage volumes by the specific yield estimated for that aquifer on a county by county basis. It is recognized that not all of the water in an aquifer can be recovered; however, the amount of non-recoverable water varies within an aquifer and between aquifers.

Therefore, the amount of recoverable water was not estimated. Table 4-10 presents the recoverable volumes and recharge rates for the major alluvial and bedrock aquifers.

4.2.3.4 Data Limitations

The aquifer storage values were estimated based on regional averages and best available information. The confidence level of storage values varies by aquifer. For example, the Ogallala aquifer has a high density of wells and hydrogeologic information, and has had a number of hydrologic studies conducted on it. The confidence level of the Ogallala storage is much higher than that of the storage in, for example, the Arbuckle-Timbered Hills aquifer, which has very little well control and hydrogeologic information. Because the areal extent, saturated thickness, and porosity of the aquifers with low confidence are poorly understood, the estimated storage could be off by more than an order of magnitude. Additional field investigations and analysis would be needed to increase the confidence of the storage estimates in these aquifers.

4.2.4 Groundwater Supply Results

Aquifer-based data was distributed to the SW basins for the calculation of available water supplies. As stated previously, the recharge rate and recoverable storage volume were needed to determine the storage depletion rate of the aquifer. The recharge value of bedrock aquifers was estimated from available literature. Recharge rates by county were available from previous studies for Antlers, Arbuckle Timbered Hills, Garber Wellington, Ogallala, and Vamoosa-Ada bedrock aquifers. These recharge rates were assumed to be distributed evenly across the aquifer on an aerial basis if no county-scale estimates were available and were applied at a constant monthly rate throughout the year. The county or aquifer recharge rates were distributed to SW basins based on the fraction of the aquifer in each basin. The recharge to major bedrock aquifers was used to represent the bedrock GW supply in the physical availability analyses. As previous discussed, alluvial aquifer recharge was based on the available streamflow. The GW supplies are summarized in Table 4-11.

4.3 Return Flows

A substantial portion of water withdrawals are not consumed and are ultimately returned to a stream, referred to here as return flow. The Oklahoma H_2O Tool allows return flows to occur for SW and GW from each demand sector. The quantity of return flow is based on an assumed percentage of the demand in each sector. For this analysis return flows were considered for the M&I, Thermoelectric Power, and Crop Irrigation demand sectors. In the Oklahoma H_2O tool, the return flow percentage is applied to the minimum monthly M&I demand (indoor use only) of a given basin and the return flows are based on the full demand for all other sectors. Return flows may be used in-basin or they may be applied to the next downstream basin. For this analysis, M&I and Thermoelectric Power return flows were applied to downstream basins and Crop Irrigation return flows were applied to the basin of origin.

If return flows are first used in-basin, then the return flows effectively reduces the demand on the SW supplies. The return flow for the basin is calculated based on demand weighting for each return flow use location (in-basin or downstream basin). For example, a basin with a demand of 100 AF and 10 percent weighted return flow would be met by approximately 91 AF of SW supplies and 9 AF of return flows (return flow generated by the 91 AF of demand). Based on the return flow of the in-basin return flows, 1 AF (9AFx10%return flow) of return flow would be available for downstream use. Return flows first used in the downstream basin (i.e., M&I and Thermoelectric Power return flow in this analysis) are based on the return flow generated from the original demand. For the above example, 100 AF of surface water supplies would generate 10 AF of return flows for the downstream basin.

The return flow percentages for M&I demand were estimated based on the discharge method used by the wastewater facilities prevalent in each basin (e.g., SW discharge, lagoon, land application, or septic system). It was assumed that evaporation facilities generated no return flows; land application facilities generated return flows equal to 50 percent of the lowest month demand; and SW discharge facilities generated return flows equal to 95 percent of the lowest month's demand. Return flows from basins with multiple treatment facilities were determined based on the number of facilities for each discharge type, since information on the size of the facilities was not directly available. The resulting return flow percentage is used in Oklahoma H_2O to calculate M&I return flow volumes by basin. M&I return flows were applied to the basin directly downstream of the basin. The basin M&I return flow percentages are presented in Table 4-12, along with the corresponding estimates of annual M&I return flows for 2007 through 2060.

Return flows from the Thermoelectric Power demand sector were equal to the difference between the total and consumptive demand divided by the total demand, typically 40 percent. Thermoelectric Power return flows were applied to the basin directly downstream of the basin the demand is generated within.

Based on a review of available literature, crop irrigation return flows were estimated for state-wide analyses at 10 percent of the total demand. The return flow represents the portion of the demand that is not evaporated, transpired, or lost to deep GW. Crop irrigation return flows were used to meet demand in the basin they were generated within.

4.4 Future Out-of-Basin Supplies

Future out-of-basin supplies (water withdrawn in one basin and used in another basin) were accounted for as a supply to the receiving basin and as a demand on the basin of origin. Existing out-of-basin supplies are implicitly represented in the streamflow record; therefore, only the incremental increase in out-of-basin supplies was used in Oklahoma H_2O. Incremental future out-of-basin supplies transfers were determined from available OWRB permitting and GIS information for M&I providers. Incremental out-of-basin supplies were estimated by subtracting the future demand from the 2007 demand. In parallel to the water supply availability analysis, provisional provider-specific demand has been calculated using demand and population information from a survey of public providers and other sources. The transfer quantities in this analysis were limited to existing permitted amounts or the provider's demand. Only providers with more than 500 AFY of out-of-basin supplies were considered in this analysis. The demand for specific Thermoelectric Power facilities was assigned to the basin where the facility resides. Where the permitted source was outside of the facilities' basins, transfers were also defined as out-of-basin supplies. The size of out-of-basin supplies was based on the increase in demand from 2010 to the maximum of the existing permitted source or the projected demand. The out-of-basin supplies in 10-year increments from 2010 to 2060 are summarized in Table 4-13.

Sufficient information is not available to accurately predict increases or decreases in specific provider-to-provider transfers in the future; therefore, these transfers were excluded as sources of supply in the water supply availability analysis.

Figure 4-1 - USGS Streamflow Gages Period of Record

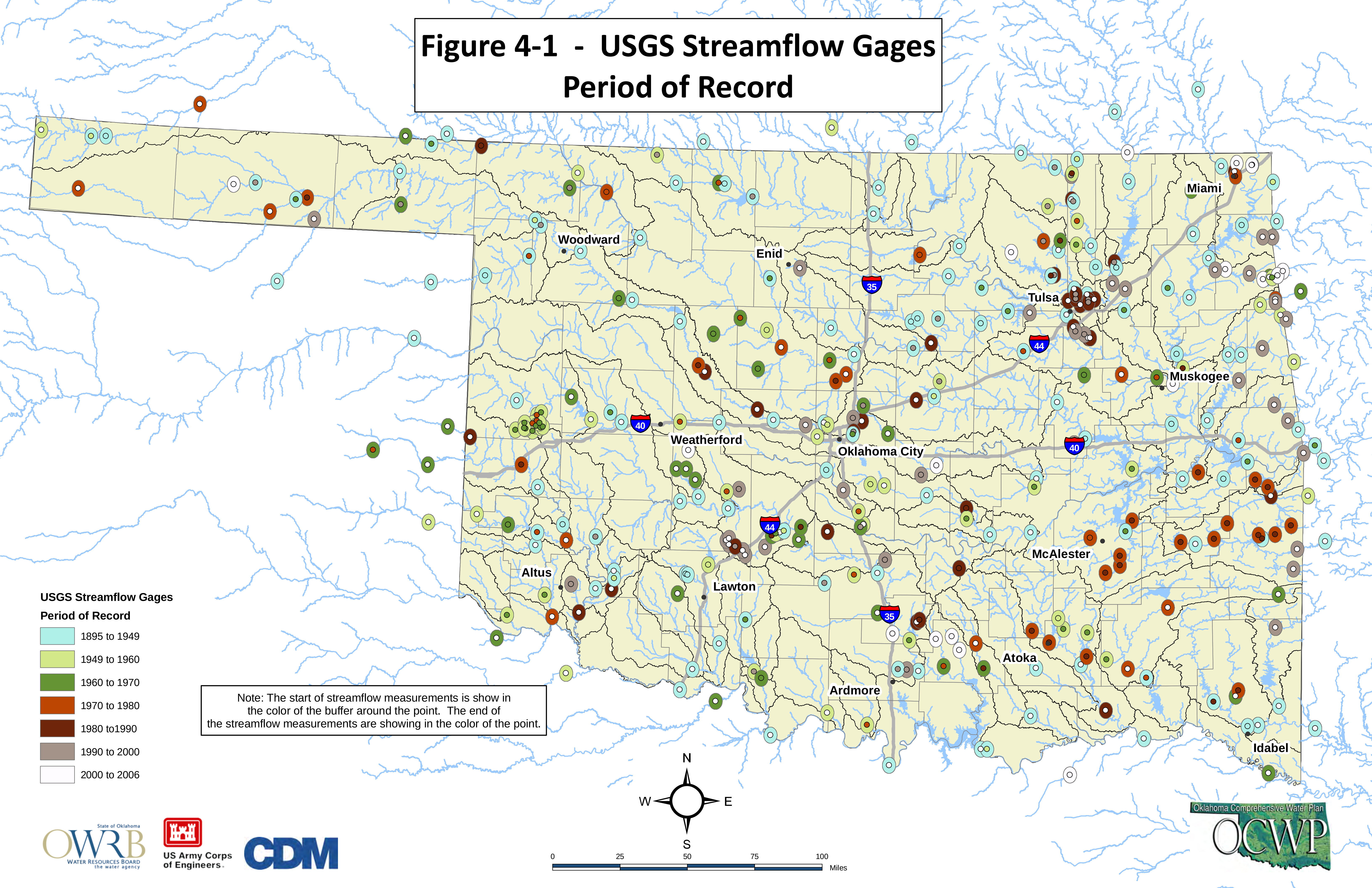
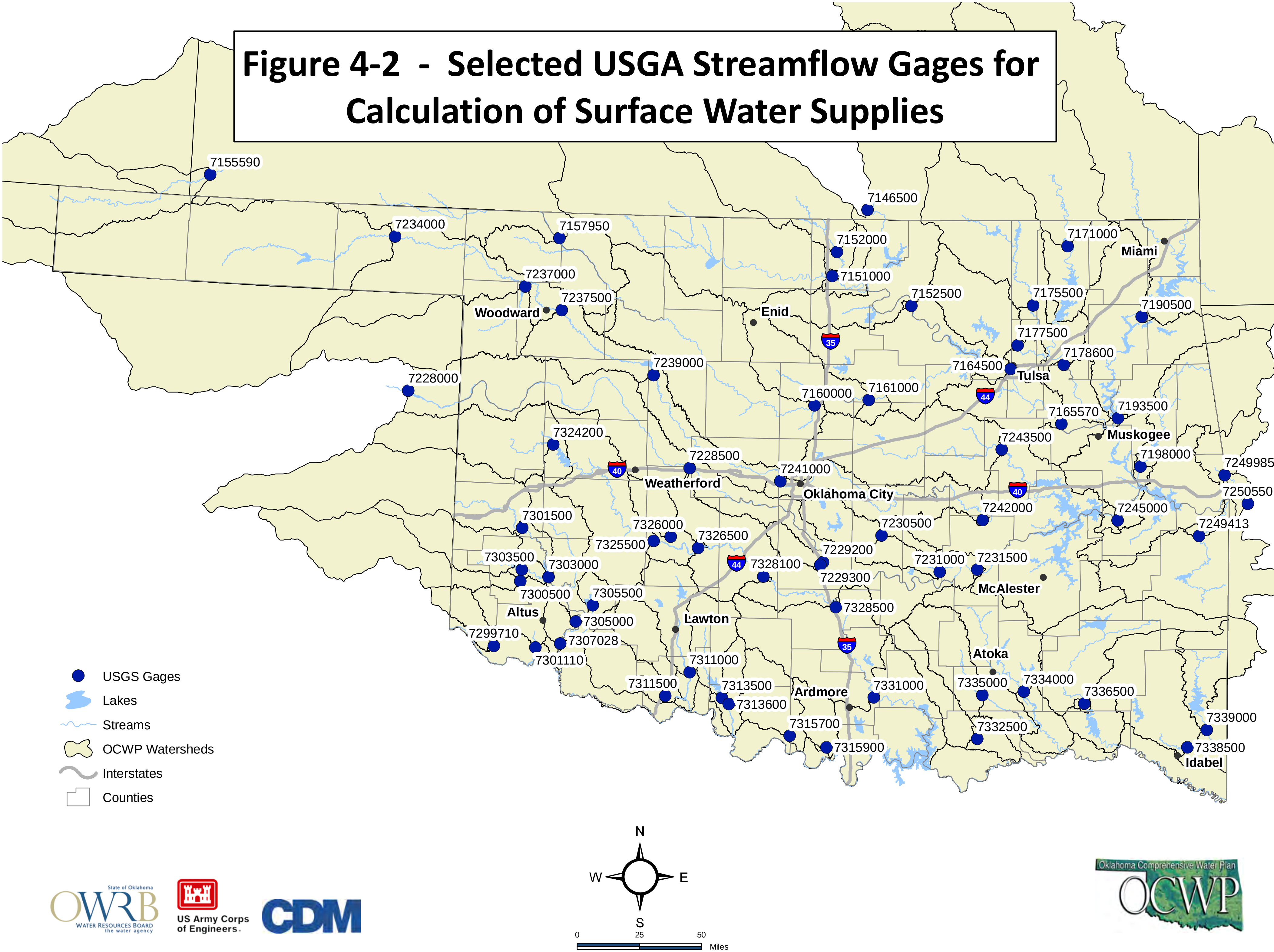


Figure 4-2 - Selected USGA Streamflow Gages for Calculation of Surface Water Supplies



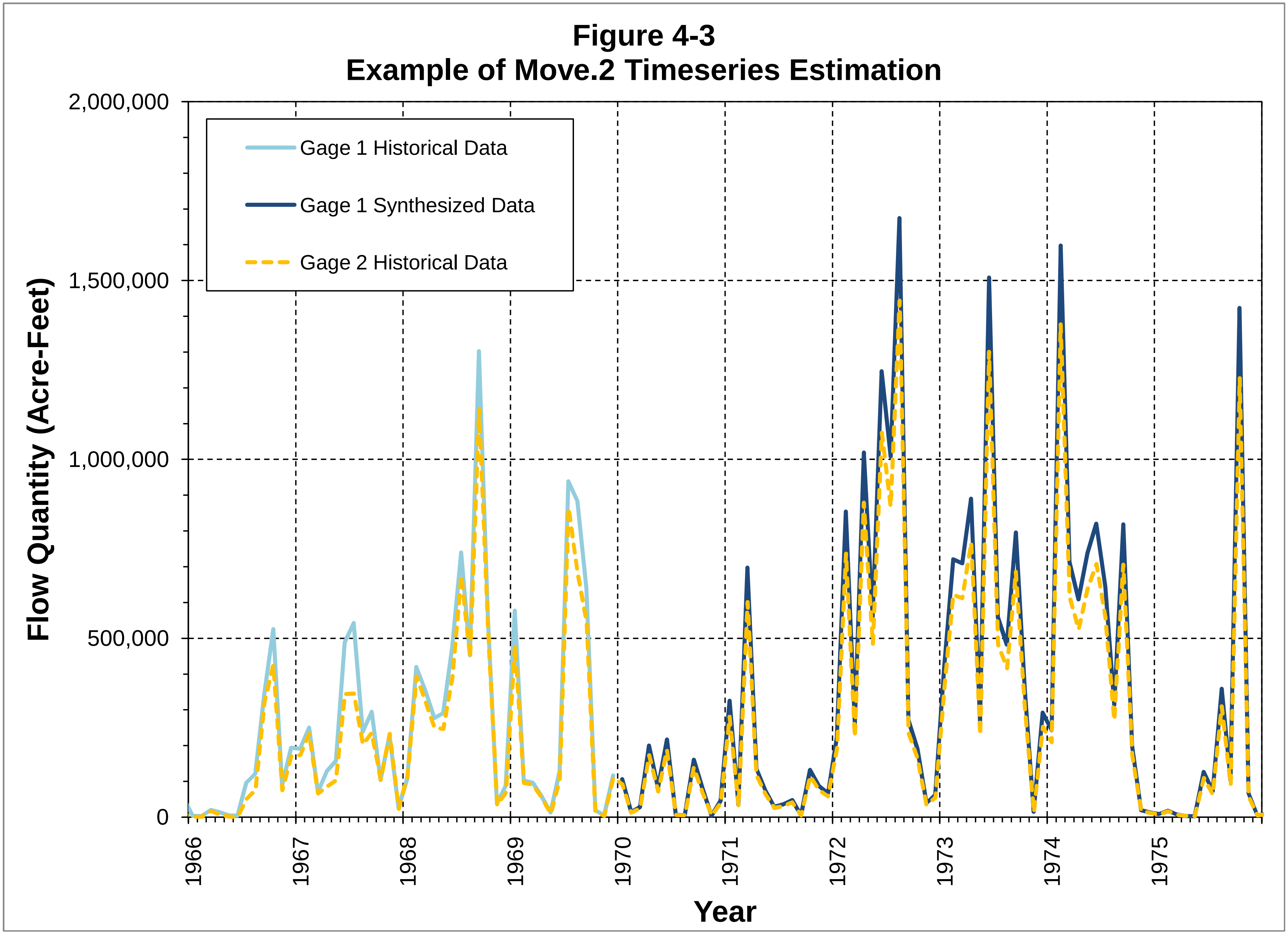
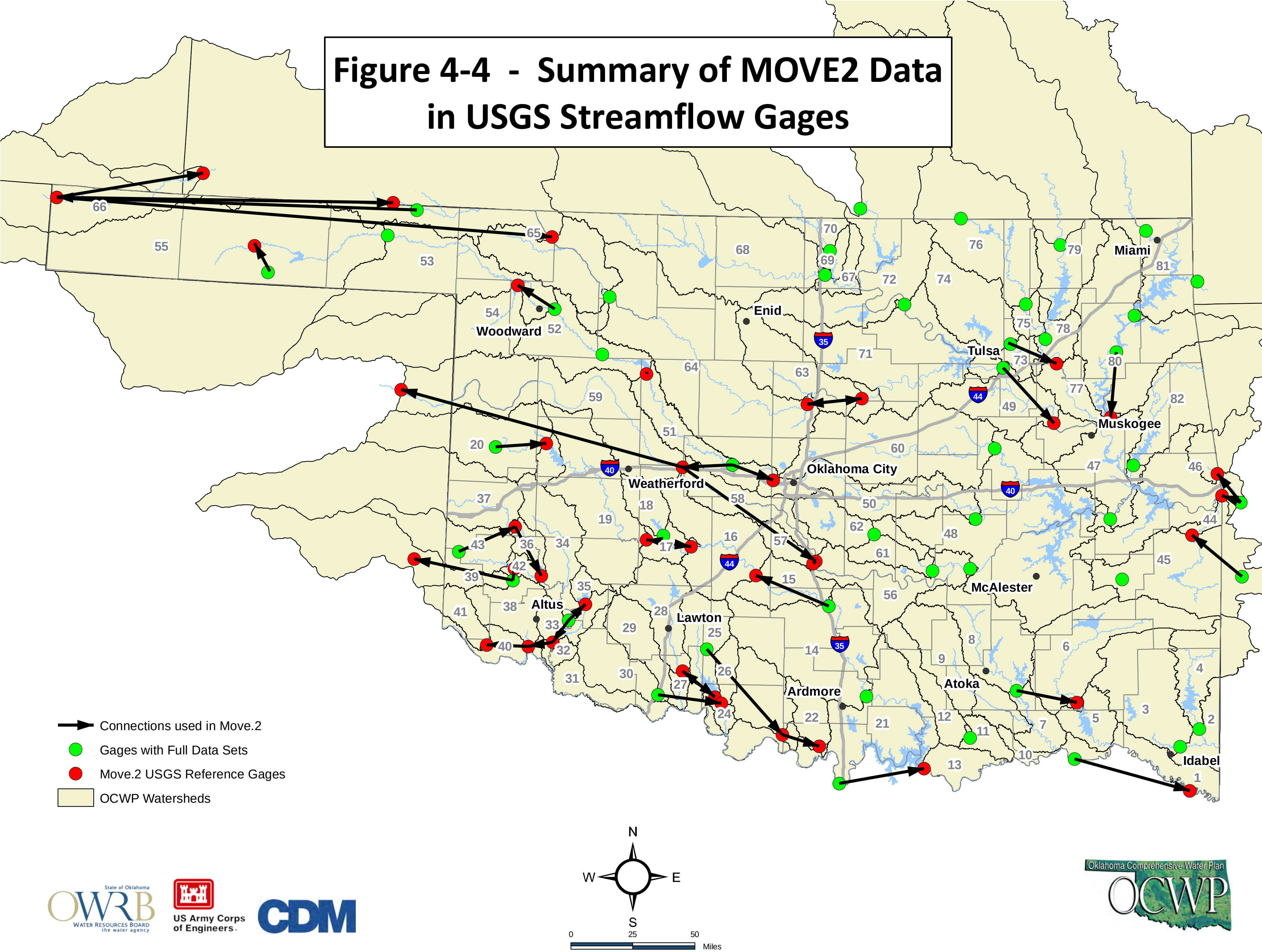


Figure 4-3
Example of Move.2 Timeseries Estimation
Gage 1 Historical Data
Gage 1 Synthesized Data
Gage 2 Historical Data
2,000,000
1,500,000
1,000,000
500,000
0
Flow Quantity (Acre-Feet)
1966
1967
1968
1969
1970
1971
1972
1973
1974
1975
Year

Figure 4-4 - Summary of MOVE2 Data in USGS Streamflow Gages



State of Oklahoma OWRB WATER RESOURCES BOARD the water agency

US Army Corps of Engineers

CDM

Oklahoma Comprehensive Water Plan OCWP

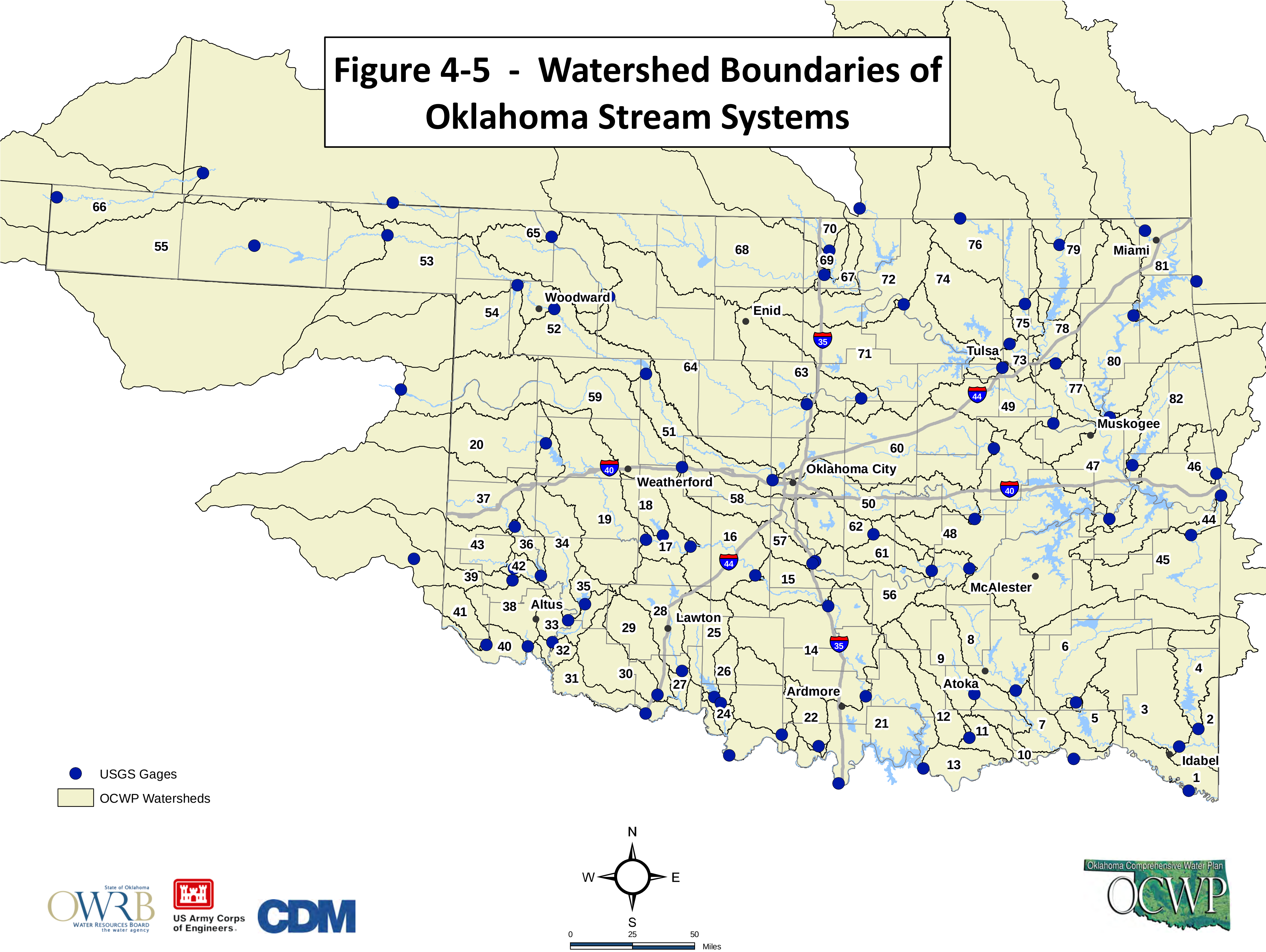
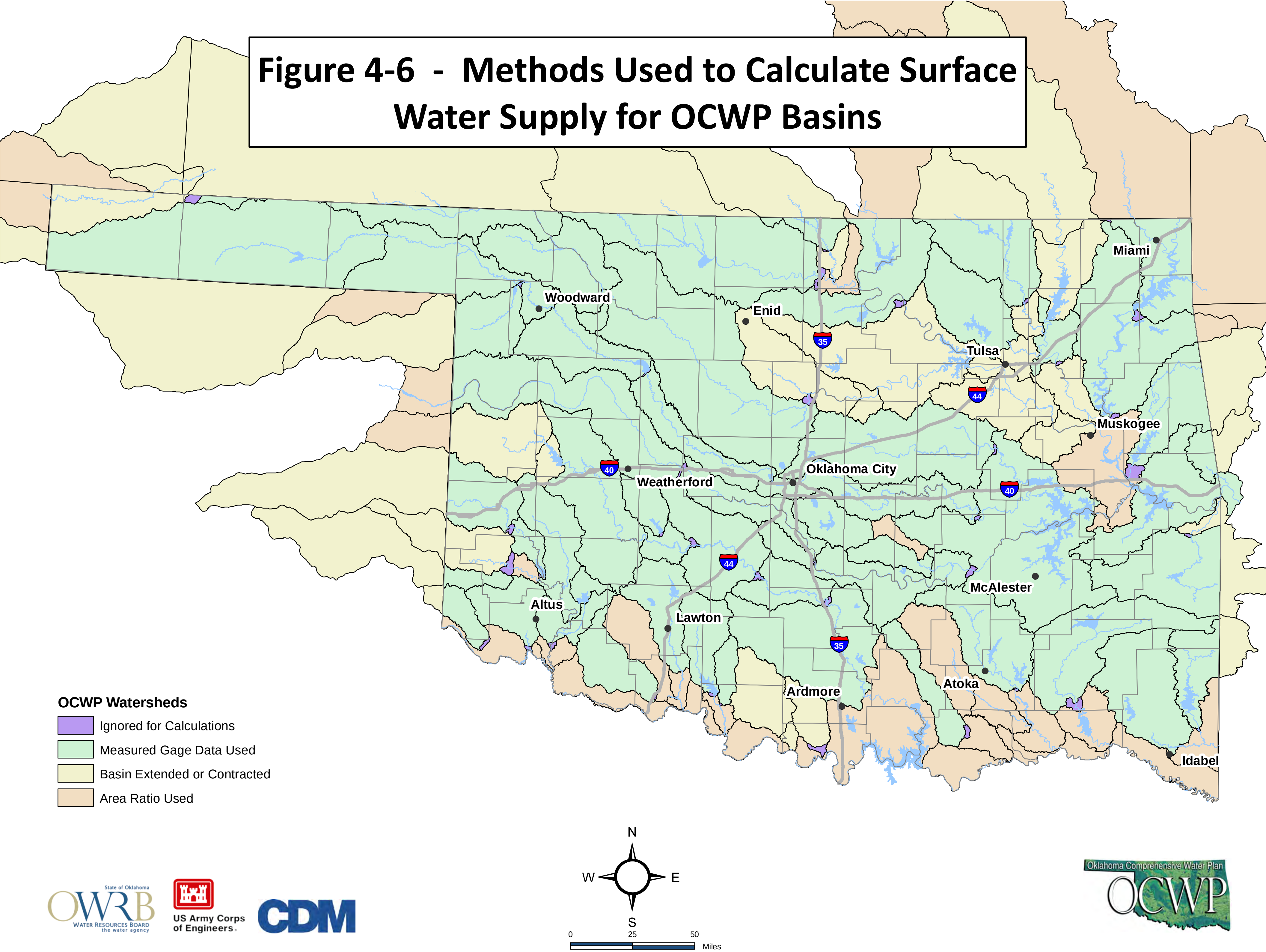


Figure 4-5 - Watershed Boundaries of Oklahoma Stream Systems

Figure 4-6 - Methods Used to Calculate Surface Water Supply for OCWP Basins



OCWP Watersheds

- Ignored for Calculations
- Measured Gage Data Used
- Basin Extended or Contracted
- Area Ratio Used

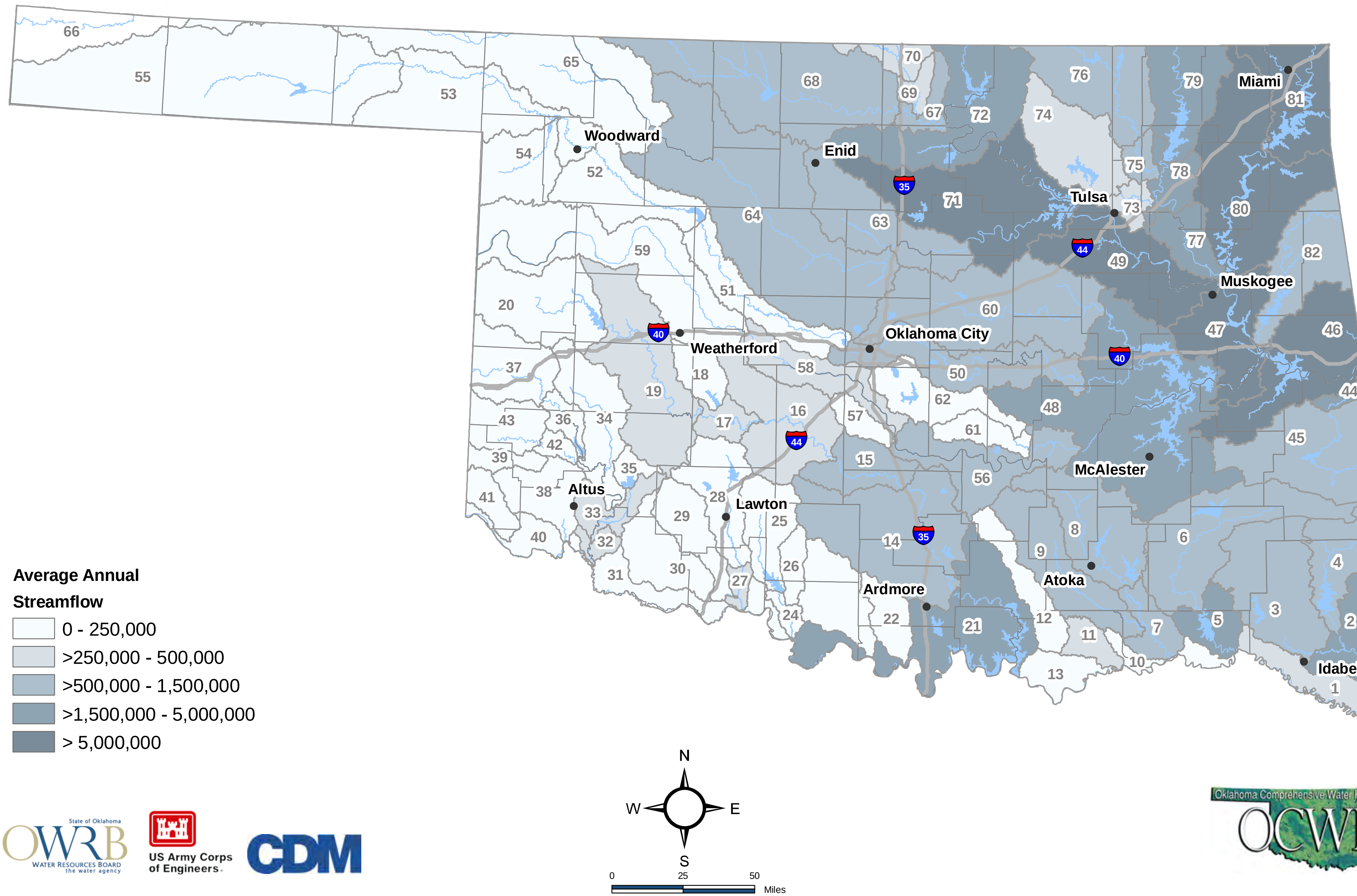
State of Oklahoma OWRB WATER RESOURCES BOARD the water agency

US Army Corps of Engineers

CDM

Oklahoma Comprehensive Water Plan OCWP

Figure 4-7 - Average Streamflow for 1950 through 2007



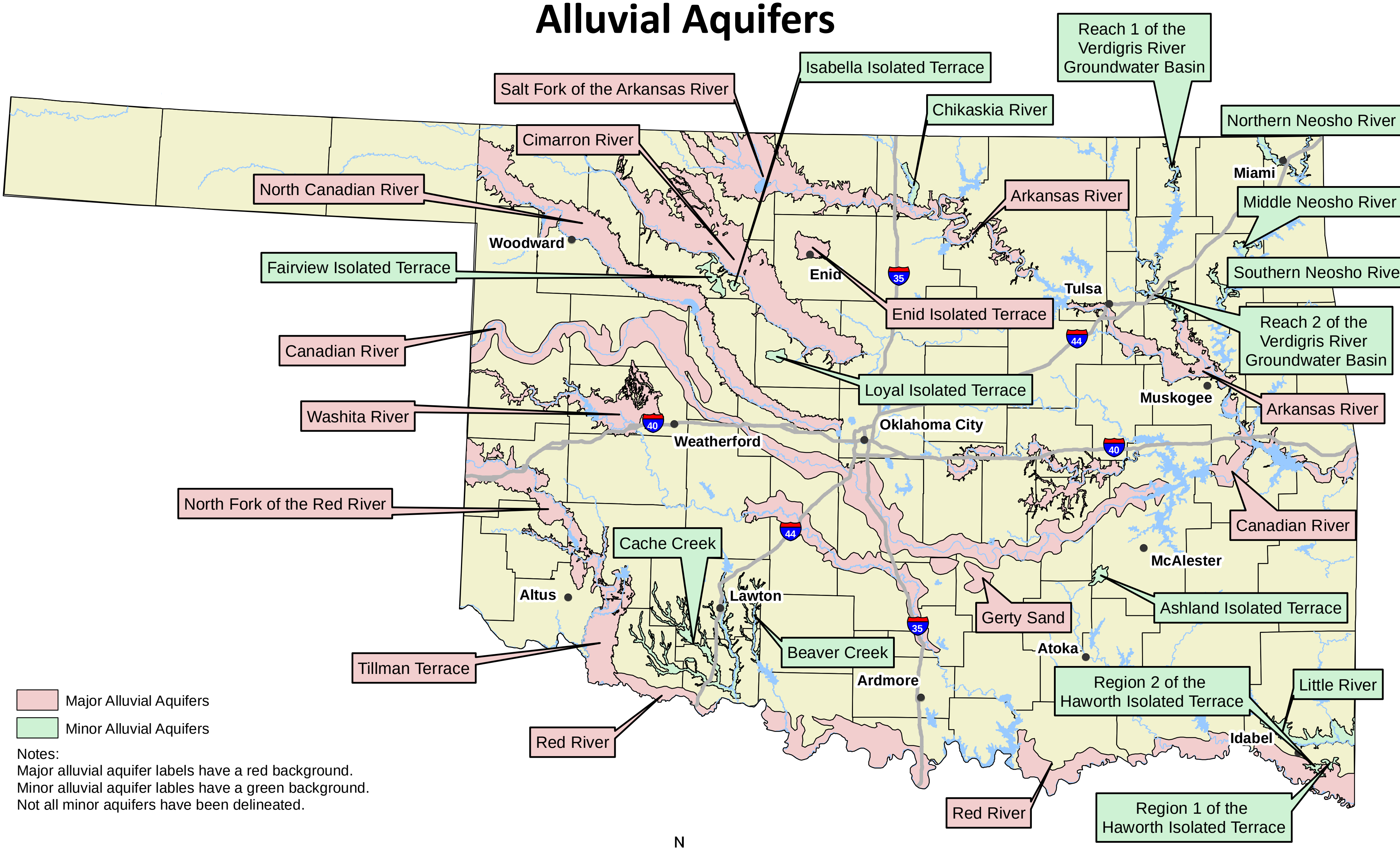
OWRB State of Oklahoma WATER RESOURCES BOARD the water agency

US Army Corps of Engineers

CDM

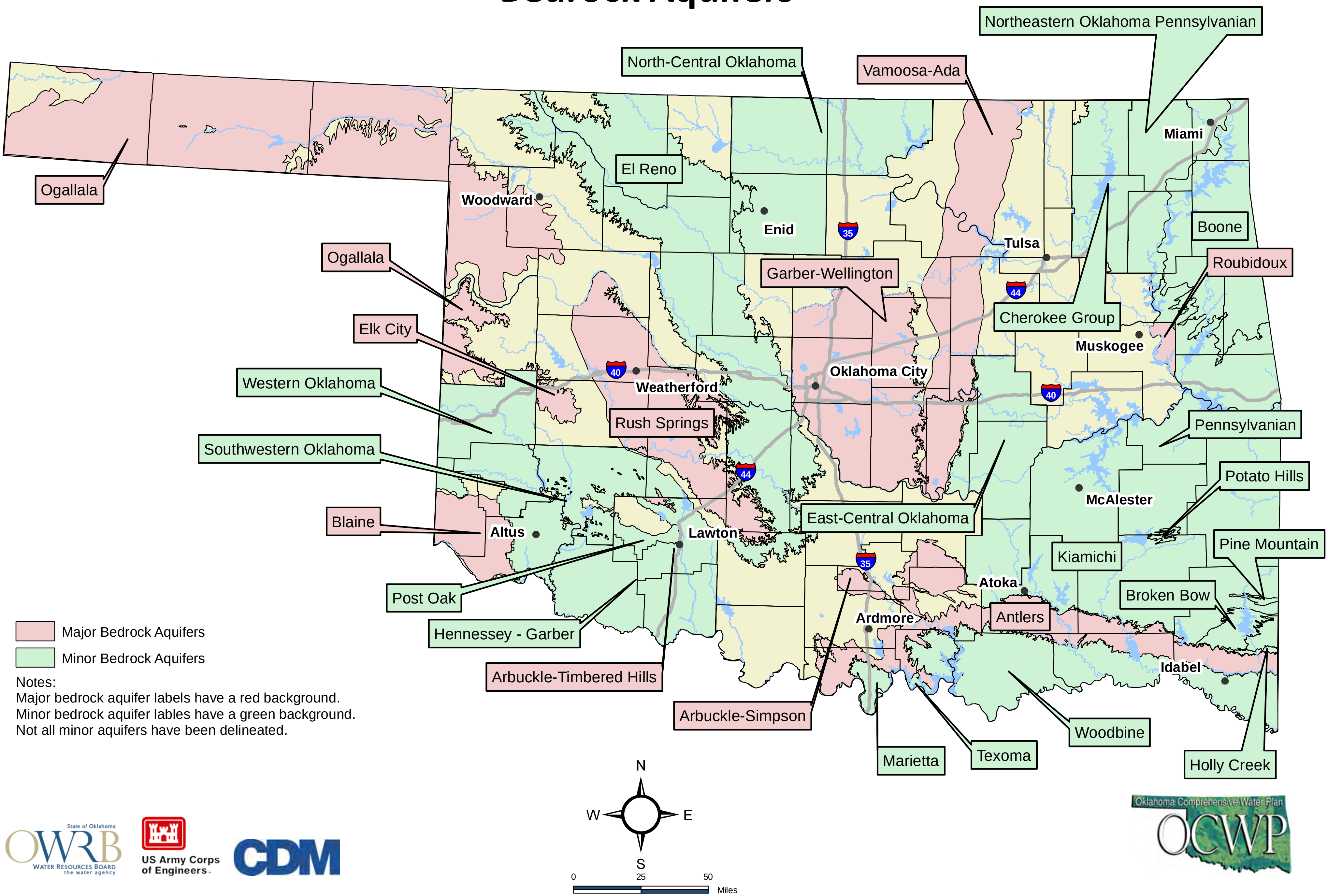
Oklahoma Comprehensive Water Plan OCWP

Figure 4-8 - Major and Minor Alluvial Aquifers



Notes:
Major alluvial aquifer labels have a red background.
Minor alluvial aquifer lables have a green background.
Not all minor aquifers have been delineated.

Figure 4-9 - Major and Minor Bedrock Aquifers



Notes:
Major bedrock aquifer labels have a red background.
Minor bedrock aquifer lables have a green background.
Not all minor aquifers have been delineated.

Table 4-1 USGS Gages Analyzed for Applicability in the Determination of Surface Water Supplies for the Oklahoma Comprehensive Water Plan

Site Number	Station Name	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)	USGS Hydrologic Unit	Reported Drainage Area (Square Miles)	Start of Flow Data (Date)	End of Flow Data (Date)
7148350	Salt Fork Arkansas River nr Winchester, OK	36.9617	-98.782312	11060002	856	10/1/1959	9/30/1993
7148400	Salt Fork Arkansas River nr Alva, OK	36.81503	-98.64814	11060002	1,009	4/1/1938	5/31/2008
7148450	Salt Fork Arkansas River nr Ingersoll, OK	36.8217	-98.360073	11060002	1,140	9/1/1961	9/30/1979
7149000	MEDICINE LODGE R NR KIOWA, KS	37.03892	-98.470909	11060003	903	2/11/1938	5/31/2008
7149500	Salt Fork Arkansas River nr Cherokee, OK	36.81836	-98.319239	11060004	2,439	10/1/1940	9/30/1950
7150500	Salt Fork Arkansas River nr Jet, OK	36.75253	-98.128955	11060004	3,202	10/1/1937	9/30/1993
7151000	Salt Fork Arkansas River at Tonkawa, OK	36.67198	-97.309489	11060004	4,528	10/1/1935	5/31/2008
7151500	CHIKASKIA R NR CORBIN, KS	37.12891	-97.601995	11060005	794	9/1/1950	5/31/2008
7152000	Chikaskia River near Blackwell, OK	36.81142	-97.277265	11060005	1,859	4/1/1936	5/31/2008
7152290	Greasy Creek near Watchorn, OK	36.45616	-96.994205	11060006		8/1/1974	6/30/1976
7152500	Arkansas River at Ralston, OK	36.50422	-96.728367	11060006	54,465	10/1/1925	5/31/2008
7153000	Black Bear Creek at Pawnee, OK	36.34367	-96.799479	11060006	576	10/1/1944	5/31/2008
7153100	Ranch Creek at Clev Dam nr Cleveland, OK	36.2834	-96.576693	11060006	22	12/1/1944	9/30/1963
7154500	Cimarron River near Kenton, OK	36.92669	-102.9591	11040001	1,106	10/1/1950	5/31/2008
7155000	Cimarron River ab Ute Creek nr Boise City, OK	36.9128	-102.61936	11040002	1,955	10/1/1905	9/30/1954
7155500	Cimarron River near Boise City, OK	36.91891	-102.51963	11040002	2,214	10/1/1938	9/30/1942
7155590	CIMARRON R NR ELKHART, KS	37.12197	-101.89795	11040002	2,899	4/1/1971	5/31/2008
7156900	Cimarron River near Forgan, OK	37.01114	-100.49182	11040006	8,536	10/1/1965	5/31/2008
7157000	Cimarron River near Mocane, OK	36.97586	-100.31431	11040006	8,670	10/1/1942	9/30/1965
7157500	CROOKED C NR ENGLEWOOD, KS	37.03253	-100.21125	11040007	1,157	10/1/1942	5/31/2008
7157580	Cimarron River near Englewood, KS	36.97725	-99.975968	11040008	10,096	4/1/1982	9/30/1987
7157950	Cimarron River near Buffalo, OK	36.85197	-99.315387	11050001	12,004	5/1/1960	5/31/2008
7157960	Buffalo Creek near Lovedale, OK	36.77059	-99.367054	11050001	408	8/1/1966	9/30/1993
7157980	Cimarron River at Freedom, OK	36.75503	-99.11649	11050001	12,706	10/1/1973	9/30/1980
7158000	Cimarron River near Waynoka, OK	36.51726	-98.879537	11050001	13,334	10/1/1937	5/31/2008
7158150	Salt Creek near Hitchcock, OK	36.01559	-98.370352	11050002	44	8/1/1968	9/30/1970
7158400	Salt Creek near OKeene, OK	36.10309	-98.193678	11050002	196	7/1/1961	9/30/1979
7158500	Preacher Creek near Dover, OK 18N-08W-13 BBB	36.04171	-98.01367	11050002	15	10/1/1951	4/30/1957
7159000	Turkey Creek near Drummond, OK	36.31809	-98.001172	11050002	248	10/1/1947	9/30/1970
7159100	Cimarron River near Dover, OK	35.95171	-97.914499	11050002	15,713	10/1/1973	5/31/2008
7159200	Kingfisher Creek near Kingfisher, OK	35.83421	-98.066169	11050002	157	10/1/1966	9/30/1970
7159400	Cimarron River near Crescent, OK	35.88671	-97.58949	11050002	16,453	10/1/1970	9/30/1972
7159500	Bluff Creek ab Lake Hefner nr Oklahoma City, OK	35.54256	-97.59643	11050002	2	3/1/1950	9/30/1958
7159720	Cottonwood Creek near Navina, OK	35.77672	-97.546154	11050002	247	10/1/1977	9/30/1989
7159750	Cottonwood Creek near Seward, OK	35.81366	-97.478097	11050002	320	3/1/1973	6/30/2002
7160000	Cimarron River near Guthrie, OK	35.9206	-97.425875	11050002	16,892	10/1/1937	5/31/2008
7160350	Skeleton Creek at Enid, OK	36.37614	-97.800333	11050002	70	3/1/1996	5/31/2008
7160500	Skeleton Creek near Lovell, OK	36.06004	-97.585047	11050002	410	10/1/1949	5/31/2008
7161000	Cimarron River at Perkins, OK	35.95756	-97.031975	11050003	17,852	10/1/1939	9/30/1991
7161450	Cimarron River near Ripley, OK	35.98589	-96.91225	11050003	17,979	10/1/1987	5/31/2008
7162000	Stillwater Creek at Stillwater, OK	36.09811	-97.046978	11050003	168	10/1/1934	9/30/1937
7162500	West Fork Brush Creek near Stillwater, OK	36.11672	-97.005311	11050003	13	10/1/1934	9/30/1937
7163000	Council Creek near Stillwater, OK	36.11617	-96.867809	11050003	31	4/1/1934	9/30/1993
7163500	Cimarron River at Oilton, OK	36.09396	-96.58141	11050003	18,669	10/1/1934	9/30/1945
7164000	Cimarron River at Mannford, OK	36.15896	-96.398627	11050003	18,849	10/1/1938	6/30/1963
7164200	Keystone Lake near Sand Springs, OK	36.15064	-96.252509	11060006	74,506	10/1/1999	9/30/2001
7164500	Arkansas River at Tulsa, OK	36.14065	-96.006387	11110101	74,615	10/1/1925	5/31/2008
7164600	Joe Creek at 61st St at Tulsa, OK	36.07565	-95.96055	11110101	12	4/1/1988	6/1/2008
7164650	Fred Creek at Evanston Avenue, at Tulsa, OK	36.05232	-95.946938	11110101	2	11/1/1991	9/30/1992
7165500	Polecat Creek blw Heyburn Res near Heyburn, OK	35.94508	-96.29445	11110101	123	10/1/1943	9/30/1979
7165550	Snake Creek near Bixby, OK	35.81899	-95.888601	11110101	50	7/1/1961	9/30/1970
7165562	Haikey Creek at 101st St South at Tulsa, OK	36.01704	-95.848878	11110101	18	2/1/1988	5/31/2008
7165564	Little Haikey Tributary at S. Memorial, Tulsa, OK	36.03621	-95.886102	11110101	1	4/1/1991	9/30/1992
7165565	Little Haikey Creek at 101st St South at Tulsa, OK	36.0176	-95.860823	11110101	5	10/1/1987	5/31/2008
7165570	Arkansas River near Haskell, OK	35.82093	-95.63887	11110101	75,473	6/1/1972	5/31/2008
7165600	Arkansas River near Tullahassee, OK	35.80427	-95.403026	11110101	75,815	10/1/1969	5/31/1972
7170500	VERDIGRIS R AT INDEPENDENCE, KS	37.22368	-95.677757	11070103	2,892	8/1/1895	5/31/2008
7171000	Verdigris River near Lenapah, OK	36.8512	-95.586088	11070103	3,639	10/1/1938	5/31/2008
7171400	Verdigris River near Oologah, OK	36.42065	-95.684426	11070105	4,339	5/1/1988	4/17/1995
7171500	Verdigris River near Sageeyah, OK	36.39176	-95.671092	11070105	4,402	1/1/1939	9/30/1945
7173000	Caney River near Hulah, OK	36.92701	-96.085264	11070106	733	10/1/1937	9/30/1993
7174000	Little Caney River near Copan, OK	36.97091	-95.934981	11070106	424	10/1/1943	9/30/1958
7174200	Little Caney River blw Cotton Cr, nr Copan, OK	36.89508	-95.969427	11070106	502	10/1/1958	2/10/1981
7174310	Little Caney River below Copan Lake nr Copan, OK	36.8848	-95.974705	11070106		5/1/1991	5/30/1991
7174400	Caney River above Coon Creek at Bartlesville, OK	36.75564	-95.972206	11070106	1,392	10/1/1985	6/1/2008
7174500	Caney River at Bartlesville, OK	36.74509	-95.960262	11070106	1,465	10/1/1949	10/6/1993
7174600	Sand Creek at Okesa, OK	36.71952	-96.132494	11070106	139	10/1/1959	7/25/1994
7174700	Caney River near Ochelata, OK	36.64065	-95.934153	11070106	1,753	4/1/1956	9/30/1976
7175000	Double Creek Sws 5 near Ramona, OK	36.51398	-95.940545	11070106	2	12/1/1954	9/30/1969
7175500	Caney River near Ramona, OK	36.50898	-95.841931	11070106	1,955	10/1/1945	5/31/2008
7175550	Caney River near Collinsville, OK	36.39509	-95.810264	11070106	2,046	10/1/1935	9/30/1938

Table 4-1 USGS Gages Analyzed for Applicability in the Determination of Surface Water Supplies for the Oklahoma Comprehensive Water Plan

Site Number	Station Name	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)	USGS Hydrologic Unit	Reported Drainage Area (Square Miles)	Start of Flow Data (Date)	End of Flow Data (Date)
7176000	Verdigris River near Claremore, OK	36.30732	-95.698037	11070105	6,534	4/1/1997	5/31/2008
7176465	Birch Creek blw Birch Lake nr Barnsdall, OK	36.53341	-96.162224	11070107	66	3/1/1977	11/30/1992
7176500	Bird Creek at Avant, OK	36.48509	-96.060274	11070107	364	10/1/1945	5/31/2008
7176800	Candy Creek near Wolco, OK	36.53509	-96.048605	11070107	31	10/1/1969	5/18/1981
7176950	Hominy Creek near Hominy, OK	36.47368	-96.378906	11070107		10/1/2003	9/30/2007
7177000	Hominy Creek near Skiatook, OK	36.3487	-96.110002	11070107	340	4/1/1944	9/30/1981
7177410	Hominy Creek below Skiatook Lake nr Skiatook, OK	36.35259	-96.088612	11070107	354	10/1/1984	9/30/1993
7177500	Bird Creek near Sperry, OK	36.27843	-95.954162	11070107	905	10/1/1938	5/31/2008
7177600	Bird Creek at 66th Street near Tulsa, OK	36.24926	-95.943329	11070107	967	7/1/1987	6/30/1991
7177650	Flat Rock Creek at Cincinnati Ave at Tulsa, OK	36.21537	-95.995276	11070107	8	12/1/1987	5/31/2008
7177700	Flat Rock Creek at Us Hwy 75 at Tulsa, OK	36.22565	-95.944718	11070107	23	5/1/1987	6/30/1991
7177800	Coal Creek at Tulsa, OK	36.19454	-95.91416	11070107	8	2/1/1988	5/31/2008
7178000	Bird Creek near Owasso, OK	36.24871	-95.868602	11070107	1,022	10/1/1935	5/31/2008
7178035	Mingo Creek at 36th Street North at Tulsa, OK	36.20621	-95.859157	11070107	56	10/1/1987	6/2/1991
7178040	Mingo Creek at 46th Street North at Tulsa, OK	36.22065	-95.858601	11070107	60	5/1/1987	6/30/1998
7178200	Bird Ck at State Highway 266 near Catoosa, OK	36.22315	-95.819432	11070107	1,103	8/1/1988	5/31/2008
7178520	Dog Creek South of Claremore, OK	36.27871	-95.611368	11070105	75	9/1/1997	9/30/2004
7178600	Verdigris River near Inola, OK	36.16427	-95.619979	11070105	7,911	10/1/1944	9/30/1970
7183500	NEOSHO R NR PARSONS, KS	37.34006	-95.109969	11070205	4,905	10/1/1921	5/31/2008
7185000	Neosho River near Commerce, OK	36.92868	-94.957457	11070206	5,876	10/1/1939	5/31/2008
7185090	Tar Creek near Commerce, OK	36.94368	-94.853286	11070206		8/1/2004	9/30/2007
7185095	Tar Creek at 22nd Street Bridge at Miami, OK	36.90007	-94.868288	11070206	45	2/1/1984	5/31/2008
7185100	Tar Creek at Miami, OK	36.87479	-94.862455	11070206	52	9/1/1980	1/10/1984
7188000	Spring River near Quapaw, OK	36.93451	-94.747171	11070207	2,510	10/1/1939	5/31/2008
7188007	Beaver Creek abv Spring River near Quapaw, Ok	36.9325	-94.750556	11070206		8/1/2004	1/29/2007
7188500	Lost Creek at Seneca, MO	36.84118	-94.608557	11070206	42	10/1/1948	9/30/1959
7189000	Elk River near Tiff City, Mo	36.63146	-94.586889	11070208	872	10/1/1939	5/31/2008
7189500	Neosho River near Grove, OK	36.61258	-94.823843	11070206	9,969	10/1/1924	9/30/1939
7189540	Cave Springs Branch near South West City, MO	36.5473	-94.618	11070206	8	10/1/1997	5/31/2008
7189542	Honey Creek near South West City, MO	36.54889	-94.683611	11070206		10/1/1997	5/31/2008
7190500	Neosho River near Langley, OK	36.43897	-95.048573	11070209	10,335	10/1/1939	5/31/2008
7190600	Big Cabin Creek near Pyramid Corners, OK	36.80174	-95.163578	11070209	71	10/1/1963	9/30/1972
7191000	Big Cabin Creek near Big Cabin, OK	36.56842	-95.152189	11070209	450	10/1/1947	5/31/2008
7191160	Spavinaw Creek near Maysville, AR	36.36452	-94.55133	11070209	88	10/1/2001	5/31/2008
7191179	Spavinaw Creek near Cherokee, AR	36.34202	-94.58772	11070209	104	10/1/2001	5/31/2008
7191200	Spavinaw Creek near Row, OK	36.33064	-94.624388	11070209	128	3/1/1959	9/30/1962
7191220	Spavinaw Creek near Sycamore, OK	36.33472	-94.641389	11070209	133	10/1/1961	5/31/2008
7191222	Beaty Creek near Jay, OK	36.35536	-94.776339	11070209	59	8/1/1998	5/31/2008
7191288	Spavinaw Creek near Eucha, OK	36.37925	-94.936901	11070209	358	10/1/2001	5/31/2008
7191297	Black Hollow near Spavinaw,Ok	36.37647	-95.006071	11070209	6	8/1/1998	9/30/2001
7191500	Neosho River near Chouteau, OK	36.22954	-95.182741	11070209	11,534	10/1/1937	5/31/2008
7192000	Pryor Creek near Pryor, OK	36.28121	-95.325802	11070209	229	10/1/1947	9/30/1963
7192500	Neosho River near Wagoner, OK	35.92899	-95.269128	11070209	12,307	4/1/1924	9/30/1949
7193500	Neosho River blw Ft Gibson Lake nr Ft Gibson, OK	35.85288	-95.229128	11070209	12,495	10/1/1950	9/30/1989
7194500	Arkansas River near Muskogee, OK	35.76954	-95.297187	11110102	96,674	8/1/2003	5/31/2008
7195430	Illinois River South of Siloam Springs, AR	36.10861	-94.533333	11110103	575	8/1/1995	5/31/2008
7195500	Illinois River near Watts, OK	36.13008	-94.572165	11110103	635	10/1/1955	5/31/2008
7195800	Flint Creek at Springtown, AR	36.25597	-94.433556	11110103	14	7/1/1961	5/31/2008
7195855	Flint Creek near West Siloam Springs, OK	36.21619	-94.604387	11110103	60	10/1/1979	5/31/2008
7195865	Sager Creek near West Siloam Springs, OK	36.20175	-94.605221	11110103	19	10/1/1996	5/31/2008
7196000	Flint Creek near Kansas, OK	36.18647	-94.706891	11110103	110	10/1/1955	5/31/2008
7196500	Illinois River near Tahlequah, OK	35.92287	-94.923566	11110103	959	10/1/1935	5/31/2008
7196900	Baron Fork at Dutch Mills, AR	35.88008	-94.486606	11110103	41	4/1/1958	5/31/2008
7196973	Peacheater Creek at Christie, OK	35.95481	-94.696337	11110103	25	9/1/1992	9/16/2004
7197000	Baron Fork at Eldon, OK	35.9212	-94.838563	11110103	307	10/1/1948	5/31/2008
7197360	Caney Creek near Barber, OK	35.78481	-94.856062	11110103	90	10/1/1997	5/31/2008
7198000	Illinois River near Gore, OK	35.57315	-95.068846	11110103	1,626	4/1/1924	5/31/2008
7198500	Dirty Creek near Warner, OK	35.5551	-95.308023	11110102	227	10/1/1939	9/30/1946
7228000	Canadian Rv nr Canadian, TX	35.93504	-100.37069	11090106	22,866	4/1/1938	5/31/2008
7228400	Deer Creek at Hydro, OK	35.54116	-98.578126	11090201	274	10/1/1960	9/30/1980
7228500	Canadian River at Bridgeport, OK	35.54366	-98.317839	11090202	25,276	10/1/1944	5/31/2008
7229000	Canadian River near Newcastle, OK	35.3009	-97.59865	11090202	25,763	10/1/1938	9/30/1945
7229050	Canadian River at Norman, OK	35.19451	-97.485034	11090202		2/1/1996	5/31/2008
7229100	Canadian River near Noble, OK	35.08201	-97.381419	11090202	25,911	10/1/1959	9/30/1975
7229200	Canadian River at Purcell, OK	35.01396	-97.347528	11090202	25,939	10/1/1959	5/31/2008
7229300	Walnut Creek at Purcell, OK	34.99896	-97.366973	11090202	202	10/1/1965	9/30/1993
7229427	Canadian Sandy Creek near Ada, OK	34.78453	-96.713902	11090202		10/1/1986	9/30/1988
7229500	Little River near Norman, OK	35.22785	-97.305863	11090203	120	10/1/1951	9/30/1955
7230000	Little River blw Lk Thunderbird nr Norman, OK	35.22174	-97.213917	11090203	257	10/1/1952	5/31/2008
7230500	Little River near Tecumseh, OK	35.17257	-96.931966	11090203	456	10/1/1943	5/31/2008
7230597	Little River near Bowlegs, OK	35.10536	-96.668628	11090203		2/1/1983	9/30/1988

Table 4-1 USGS Gages Analyzed for Applicability in the Determination of Surface Water Supplies for the Oklahoma Comprehensive Water Plan

Site Number	Station Name	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)	USGS Hydrologic Unit	Reported Drainage Area (Square Miles)	Start of Flow Data (Date)	End of Flow Data (Date)
7230800	Salt Creek near Dewright, OK	35.05008	-96.666961	11090203	210	10/1/1959	9/30/1967
7231000	Little River near Sasakwa, OK	34.96536	-96.512511	11090203	884	10/1/1942	5/31/2008
7231500	Canadian River at Calvin, OK	34.97787	-96.243617	11090202	27,952	7/1/1905	5/31/2008
7231965	Ti Creek near Blanco, OK	34.7626	-95.749987	11090204	5	7/1/1980	9/30/1981
7231975	Brushy Creek near Haileyville, OK	34.80149	-95.654707	11090204	139	7/1/1978	1/6/1983
7231990	Peaceable Creek near Haileyville, OK	34.85204	-95.654429	11090204	134	7/1/1978	1/6/1983
7232000	Gaines Creek near Krebs, OK	34.98343	-95.61693	11090204	588	10/1/1942	9/30/1963
7232010	Blue Creek near Blocker, OK	35.04065	-95.572762	11090204	12	2/1/1976	1/6/1983
7232024	Deer Creek near McAlester, OK	34.94954	-95.850272	11090204	38	10/1/1978	7/31/1980
7232250	Beaver River near Felt, OK	36.62975	-102.68158	11100101	879	10/1/1980	6/30/2002
7232470	Beaver River near Goodwell, OK	36.70586	-101.63683	11100101	2,043	10/1/2001	5/31/2008
7232500	Beaver River near Guymon, OK	36.72141	-101.4896	11100101	2,139	10/1/1937	9/30/1993
7232900	Coldwater Creek near Guymon, OK	36.57197	-101.38155	11100103	1,903	10/1/1980	5/31/2008
7233000	Coldwater Creek near Hardesty, OK	36.64392	-101.21099	11100103	1,967	10/1/1939	9/30/1964
7233210	Beaver River near Hardesty, OK	36.65642	-101.13544	11100102	5,029	10/1/1977	9/30/1986
7233650	Palo Duro Creek at Range, OK	36.54392	-101.08099	11100104	1,513	10/1/1991	5/31/2008
7234000	Beaver River at Beaver, OK	36.82225	-100.51932	11100102	7,955	10/1/1937	5/31/2008
7234100	Clear Creek near Elmwood, OK	36.64503	-100.50237	11100201	170	10/1/1965	9/30/1993
7234500	Beaver River near Fort Supply, OK	36.5917	-99.59206	11100201	9,615	10/1/1937	4/30/1951
7235000	Wolf Ck at Lipscomb, TX	36.23865	-100.27569	11100202	697	10/1/1940	5/31/2008
7235500	Wolf Creek near Shattuck, OK	36.28615	-99.9129	11100203	1,183	10/1/1937	9/30/1946
7236000	Wolf Creek near Fargo, OK	36.3992	-99.623171	11100203	1,624	10/1/1942	9/30/1976
7237000	Wolf Creek near Fort Supply, OK	36.5667	-99.551781	11100203	1,739	10/1/1937	10/3/1993
7237500	North Canadian River at Woodward, OK	36.4367	-99.278438	11100301	11,589	1/1/1905	5/31/2008
7237800	Bent Creek near Seiling, OK	36.1906	-99.010375	11100301	139	10/1/1966	9/30/1970
7238000	North Canadian River near Seiling, OK	36.18337	-98.921206	11100301	12,261	10/1/1946	5/31/2008
7239000	North Canadian River at Canton, OK	36.07698	-98.59675	11100301	12,484	10/1/1937	5/31/2008
7239200	North Canadian River near Watonga, OK	35.84504	-98.465352	11100301	12,692	10/1/1979	9/30/1983
7239300	North Canadian River blw Weavers Ck nr Watonga, OK	35.81199	-98.420905	11100301	12,736	10/1/1983	5/31/2008
7239450	North Canadian River near Calumet, OK	35.61699	-98.065332	11100301	12,962	10/1/1988	5/31/2008
7239500	North Canadian River near El Reno, OK	35.56311	-97.95755	11100301	13,042	10/1/1902	5/31/2008
7239700	North Canadian River near Yukon, OK	35.5395	-97.742544	11100301	13,183	10/1/1999	5/31/2008
7240000	Lake Hefner Canal near Oklahoma City, OK	35.55311	-97.620042	11050002		4/1/1944	5/31/2008
7241000	North Canadian River blw Lk Overholser nr OKC, OK	35.47867	-97.663375	11100301	13,222	10/1/1952	5/31/2008
7241500	North Canadian River near Oklahoma City, OK	35.49451	-97.428092	11100302	13,354	11/1/1938	6/30/1961
7241503	North Canadian River at NE 36th St at OKC, OK	35.50784	-97.42337	11100301	13,356	10/1/1989	6/30/1991
7241520	North Canadian River at Britton Rd at OKC, OK	35.56561	-97.367258	11100302	13,413	10/1/1988	5/27/2008
7241550	North Canadian River near Harrah, OK	35.50034	-97.193919	11100302	13,501	10/1/1968	5/31/2008
7241750	Tecumseh Creek at Tecumseh, OK	35.28146	-96.970856	11100302	2	8/1/1991	9/30/1992
7241800	North Canadian River at Shawnee, OK	35.33313	-96.869466	11100302	13,730	3/1/2001	5/31/2008
7242000	North Canadian River near Wetumka, OK	35.26565	-96.206117	11100302	14,290	10/1/1937	5/31/2008
7242100	Wewoka Creek near Wetumka, OK	35.22092	-96.219728	11100302	396	10/1/1959	9/30/1967
7242247	Deep Fork at Hefner Rd at Oklahoma City, Ok	35.58006	-97.42726	11100303		10/1/1995	6/30/1998
7242350	Deep Fork near Arcadia, OK	35.64728	-97.360037	11100303	105	10/1/1969	5/31/1998
7242380	Deep Fork at Warwick, OK	35.6809	-97.008362	11100303	532	10/1/1983	5/31/2008
7242500	Bellcow Creek at Chandler, OK	35.70229	-96.889192	11100303	46	10/1/1948	9/30/1955
7243000	Dry Creek near Kendrick, OK	35.78201	-96.854192	11100303	69	10/1/1955	9/30/1994
7243500	Deep Fork near Beggs, OK	35.67399	-96.068608	11100303	2,018	10/1/1938	5/31/2008
7244000	Deep Fork near Dewar, OK	35.47872	-95.882773	11100303	2,307	10/1/1937	9/30/1950
7244100	Coal Creek near Henryetta, OK	35.45288	-95.955831	11100303		4/1/1996	9/30/2004
7244500	North Canadian River near Eufaula, OK	35.31677	-95.572484	11100302	17,657	8/1/1960	9/30/1962
7245000	Canadian River near Whitefield, OK	35.26232	-95.237189	11090204	47,576	10/1/1938	5/31/2008
7245030	Taloka Creek near Stigler, OK	35.29621	-95.132462	11090204	20	10/1/1978	9/30/1981
7245500	Sallisaw Creek near Sallisaw, OK	35.46454	-94.862171	11110104	182	10/1/1942	9/30/1976
7246000	Sans Bois Creek near Keota, OK	35.26037	-94.965788	11110104	346	10/1/1938	9/30/1942
7246500	Arkansas River near Sallisaw, OK	35.34954	-94.80467	11110104	147,757	10/1/1947	9/30/1970
7246615	Coal Creek near Spiro, OK	35.25315	-94.755225	11110104	15	10/1/1978	9/30/1982
7247000	Poteau River at Cauthron, AR	34.91899	-94.299658	11110105	203	3/1/1939	5/31/2008
7247015	Poteau River at Loving, OK	34.87982	-94.484111	11110105	269	4/1/1992	5/31/2008
7247250	Black Fork below Big Creek nr Page, OK	34.77371	-94.512169	11110105	74	3/1/1992	5/31/2008
7247450	Fourche Maline near Wilburton, OK	34.92371	-95.253025	11110105	56	7/1/1978	9/30/1981
7247500	Fourche Maline near Red Oak, OK	34.9126	-95.155799	11110105	122	10/1/1938	5/31/2008
7247550	Red Oak Creek near Red Oak, OK	34.93982	-95.033016	11110105	13	7/1/1978	9/30/1982
7248500	Poteau River near Wister, OK	34.9376	-94.715228	11110105	993	4/1/1938	9/30/1986
7248600	Caston Creek at Wister, OK	34.9576	-94.738562	11110105	73	10/1/1978	9/30/1982
7248620	Morris Creek at Howe, OK	34.95954	-94.629392	11110105	19	10/1/1978	9/30/1981
7248700	Sugarloaf Creek near Monroe, OK	35.00565	-94.522723	11110105	54	10/1/1978	9/30/1981
7249080	Brazil Creek near Walls, OK	35.0226	-94.944401	11110105	69	10/1/1978	9/30/1985
7249100	Owl Creek near McCurtain, OK	34.12788	-94.884389	11110105	28	7/1/1978	9/30/1981
7249413	Poteau River near Panama, OK	35.16565	-94.653002	11110105	1,767	10/1/1989	5/31/2008
7249422	Holi-tuska Creek near Panama, OK	35.21287	-94.672724	11110105	4	7/1/1978	9/30/1981

Table 4-1 USGS Gages Analyzed for Applicability in the Determination of Surface Water Supplies for the Oklahoma Comprehensive Water Plan

Site Number	Station Name	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)	USGS Hydrologic Unit	Reported Drainage Area (Square Miles)	Start of Flow Data (Date)	End of Flow Data (Date)
7249455	Arkansas River at Ft. Smith, Ar.	35.39176	-94.432437	11110104	149,977	5/1/1997	9/30/2007
7249800	Lee Creek at Short, OK	35.56592	-94.53244	11110104	236	10/1/1999	5/31/2008
7249870	Little Lee Creek near Greasy, OK	35.65203	-94.622443	11110104	51	10/1/2000	9/30/2005
7249985	Lee Creek near Short, OK	35.51731	-94.464382	11110104	420	10/1/1930	5/31/2008
7250500	AR River at Van Buren, AR	35.43085	-94.356514	11110104	150,482	10/1/1927	9/30/1970
7250550	AR River at James W. Trimble L&D nr Van Buren, AR	35.34898	-94.298545	11110104	150,547	10/1/1927	10/3/2007
7299710	Sandy Creek near Eldorado, OK	34.47924	-99.678704	11130101	280	6/1/1960	12/31/1963
7300000	Salt Fk Red Rv nr Wellington, TX	34.95755	-100.22095	11120202	1,222	7/1/1952	5/31/2008
7300500	Salt Fork Red River at Mangum, OK	34.85839	-99.508701	11120202	1,566	10/1/1937	5/31/2008
7301100	Turkey Creek at Olustee, OK	34.59424	-99.436756	11120202	317	7/1/1960	9/30/1963
7301110	Salt Fork Red River near Elmer, OK	34.47896	-99.38231	11120202	1,878	10/1/1979	5/31/2008
7301200	McClellan Ck nr McLean, TX	35.32922	-100.6093	11120301	759	10/1/1967	9/30/1980
7301300	N Fk Red Rv nr Shamrock, TX	35.26422	-100.24179	11120302	1,082	3/1/1964	5/31/2008
7301410	Sweetwater Ck nr Kelton, TX	35.4731	-100.12095	11120302	287	12/1/1961	5/31/2008
7301420	Sweetwater Creek near Sweetwater, OK	35.42227	-99.969277	11120302	424	5/1/1986	5/28/2008
7301481	North Fork Red River near Sayre, OK	35.28477	-99.622041	11120302	2,159	5/1/1978	9/30/1984
7301500	North Fork Red River near Carter, OK	35.16811	-99.507313	11120302	2,337	10/1/1944	5/31/2008
7302000	North Fork Red River near Granite, OK	34.97339	-99.333694	11120302	2,494	10/1/1903	9/30/1944
7303000	North Fork Red River blw Altus Dam nr Lugert, OK	34.8895	-99.307028	11120303	2,515	10/1/1977	5/31/2008
7303400	Elm Fork of North Fork Red River nr Carl, OK	35.01172	-99.903714	11120304	416	10/1/1959	5/31/2008
7303420	Elm Fork of North Fork Red River nr Reed, OK	34.96117	-99.694818	11120304	579	5/1/1965	9/30/1967
7303500	Elm Fork of North Fork Red River nr Mangum, OK	34.92672	-99.500367	11120304	838	5/1/1905	9/30/1976
7304500	Elk Creek near Hobart, OK	34.91423	-99.113967	11120303	549	10/1/1904	9/30/1993
7305000	North Fork Red River near Headrick, OK	34.63813	-99.103691	11120303	4,244	4/1/1905	5/31/2008
7305500	West Otter Creek at Snyder Lk nr Mt Park, OK	34.73396	-98.986466	11120303	132	4/1/1903	6/30/2003
7306500	Otter Creek at Mountain Park, OK	34.69507	-98.984243	11120303	164	4/1/1946	9/30/1951
7307010	Otter Creek near Snyder, OK	34.63785	-98.998688	11120303	217	10/1/1984	5/31/2008
7307026	Ozark Canal at Altus, OK, Altus AFB IRP Ch005	34.65701	-99.265085	11120303		5/1/1991	9/30/1991
7307028	North Fork Red River near Tipton, OK	34.50702	-99.208139	11120303	4,691	7/1/1983	5/31/2008
7309000	East Cache Creek near Elgin, OK	34.78201	-98.366998	11130202	248	10/1/1955	9/30/1958
7310000	Little Medicine Bluff Creek nr Lawton, OK	34.72924	-98.514225	11130202	7	10/1/1912	9/30/1919
7310500	Medicine Bluff Creek near Lawton, OK	34.72507	-98.500336	11130202	101	10/1/1912	9/30/1919
7311000	East Cache Creek near Walters, OK	34.36231	-98.282547	11130202	675	4/1/1938	5/31/2008
7311200	Blue Beaver Creek near Cache, OK	34.62341	-98.563671	11130203	25	7/1/1964	9/30/2003
7311500	Deep Red Creek near Randlett, OK	34.22092	-98.45311	11130203	617	10/1/1949	5/31/2008
7313000	Little Beaver Creek near Duncan, OK	34.49314	-98.114207	11130208	158	10/1/1948	12/31/1963
7313500	Beaver Creek near Waurika, OK	34.21676	-98.049482	11130208	563	10/1/1953	9/30/1993
7313600	Cow Creek at Waurika, OK	34.18204	-98.001703	11130208	193	3/1/1966	9/30/1970
7315500	Red Rv nr Terral, OK	33.87871	-97.93448	11130201	28,723	4/1/1938	5/31/2008
7315700	Mud Creek near Courtney, OK	34.00427	-97.566968	11130201	572	10/1/1960	5/31/2008
7315900	Walnut Bayou near Burneyville, OK	33.94177	-97.30585	11130201	314	10/1/1960	9/30/1971
7316000	Red River near Gainesville, TX	33.72788	-97.160013	11130201	30,782	10/1/1936	5/31/2008
7316500	Washita River near Cheyenne, OK	35.62644	-99.668439	11130301	794	10/1/1937	5/31/2008
7317500	Sandstone Creek SWS 16A nr Cheyenne, OK	35.46949	-99.669824	11130301	9	1/1/1952	9/30/1970
7318000	Sandstone Creek SWS 16 nr Cheyenne, OK	35.4806	-99.611489	11130301	20	10/1/1952	9/30/1969
7318500	Sandstone Creek SWS 14 nr Cheyenne, OK	35.47783	-99.603156	11130301	1	10/1/1952	9/30/1970
7319000	Sandstone Creek SWS 17 nr Cheyenne, OK	35.50838	-99.61149	11130301	10	10/1/1952	9/30/1970
7319500	Sandstone Creek near Berlin, OK	35.50727	-99.557877	11130301	45	10/1/1952	9/30/1972
7320000	Sandstone Creek SWS 10A nr Elk City, OK	35.46672	-99.555932	11130301	3	10/1/1951	9/30/1970
7320500	Sandstone Creek SWS 6 near Elk City, OK	35.48616	-99.503153	11130301	6	10/1/1952	9/30/1970
7321000	Sandstone Creek SWS 5 near Elk City, OK	35.49172	-99.489264	11130301	4	10/1/1952	9/30/1970
7321500	Sandstone Creek SWS 3 near Elk City, OK	35.51116	-99.511487	11130301	1	10/1/1952	9/30/1970
7322000	Sandstone Creek SWS 9 near Elk City, OK	35.49449	-99.53371	11130301	4	10/1/1951	9/30/1970
7322500	East Branch Sandstone Creek nr Elk City, OK	35.52227	-99.530377	11130301	23	4/1/1951	9/30/1972
7323000	Sandstone Creek near Cheyenne, OK	35.55283	-99.530933	11130301	87	10/1/1951	6/30/1974
7324000	Sandstone Creek SWS 1 near Cheyenne, OK	35.56672	-99.503155	11130301	5	10/1/1951	9/30/1970
7324200	Washita River near Hammon, OK	35.65644	-99.306209	11130301	1,387	10/1/1969	5/31/2008
7324400	Washita River near Foss, OK	35.53894	-99.169813	11130302	1,551	3/1/1956	5/31/2008
7324500	Barnitz Creek near Arapaho, OK	35.5806	-99.043422	11130302	243	10/1/1945	12/31/1963
7325000	Washita River near Clinton, OK	35.53088	-98.96703	11130302	1,977	10/1/1935	5/31/2008
7325500	Washita River at Carnegie, OK	35.11728	-98.56395	11130302	3,129	10/1/1937	9/30/2006
7325800	Cobb Creek near Eakly, OK	35.29061	-98.594231	11130302	132	10/1/1968	5/31/2008
7325840	Lake Creek near Sickles, OK	35.39172	-98.517842	11130302	19	10/1/2005	5/31/2008
7325850	Lake Creek near Eakly, OK	35.29089	-98.529229	11130302	60	10/1/1969	5/31/2008
7325860	Willow Creek near Albert, OK	35.23339	-98.46617	11130302	29	10/1/1970	5/31/2008
7326000	Cobb Creek near Fort Cobb, OK	35.14367	-98.442836	11130302	307	10/1/1939	5/31/2008
7326500	Washita River at Anadarko, OK	35.08423	-98.243385	11130302	3,656	1/1/1903	5/31/2008
7327000	Sugar Creek near Gracemont, OK	35.17506	-98.255886	11130302	208	10/1/1955	9/30/1974
7327050	Spring Creek near Gracemont, OK	35.18923	-98.17644	11130302	34	7/1/1991	9/30/1994
7327442	Little Washita River near Cyril, OK	34.89257	-98.233105	11130302	12	10/1/1992	5/31/2008
7327445	Chetonia Creek Tributary blw Cyril, OK	34.88312	-98.192271	11130302	3	10/1/1989	7/31/1991

Table 4-1 USGS Gages Analyzed for Applicability in the Determination of Surface Water Supplies for the Oklahoma Comprehensive Water Plan

Site Number	Station Name	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)	USGS Hydrologic Unit	Reported Drainage Area (Square Miles)	Start of Flow Data (Date)	End of Flow Data (Date)
7327447	Little Washita River near Cement, OK	34.83785	-98.12449	11130302	62	2/1/1992	5/31/2008
7327483	Boggy Creek near Ninnekah, OK	34.88396	-97.99532	11130302		4/1/1996	9/30/2004
7327490	Little Washita River near Ninnekah, OK	34.94479	-97.952543	11130302	208	10/1/1963	12/31/1985
7327500	Little Washita River at Ninnekah, OK	34.95673	-97.926431	11130302	227	10/1/1951	9/30/1963
7327550	Little Washita River East of Ninnekah, OK	34.9634	-97.899486	11130302	236	2/1/1992	5/31/2008
7328000	Washita River near Tabler, OK	34.97173	-97.872819	11130302	4,706	10/1/1939	9/30/1952
7328070	Winter Creek near Alex, OK	34.99312	-97.761428	11130303	33	10/1/1964	5/14/1987
7328100	Washita River at Alex, OK	34.9259	-97.773927	11130303	4,787	10/1/1964	5/31/2008
7328180	North Criner Creek near Criner, OK	34.97146	-97.584756	11130303	7	10/1/1989	5/31/2008
7328500	Washita River near Pauls Valley, OK	34.7548	-97.251412	11130303	5,330	10/1/1937	5/31/2008
7328550	Washington Creek near Pauls Valley, OK	34.82591	-97.202246	11130303	8	7/1/1991	3/31/1994
7329000	Rush Creek at Purdy, OK	34.69619	-97.598919	11130303	145	10/1/1939	9/30/1994
7329500	Rush Creek near Maysville, OK	34.74341	-97.405304	11130303	206	10/1/1954	9/30/1976
7329700	Wildhorse Creek near Hoover, OK	34.54147	-97.247244	11130303	604	10/1/1969	5/31/2008
7329780	Honey Creek below Turner Falls near Davis, OK	34.43176	-97.147241	11130303	16	10/1/2004	5/31/2008
7329851	Outflow From Vendome Well at Sulphur, OK	34.50592	-96.972239	11130303		12/1/1985	9/30/1989
7329852	Rock Creek at Sulphur, OK	34.49537	-96.988628	11130303	44	10/1/1989	5/31/2008
7329900	Rock Creek at Dougherty, OK	34.39731	-97.036405	11130303	138	10/1/1956	6/30/1967
7330500	Caddo Creek near Ardmore, OK	34.24259	-97.10807	11130303	298	10/1/1936	12/31/1997
7330700	Caddo Creek Site 7cmp near Gene Autry, OK	34.24037	-97.05168	11130303	326	4/1/1996	9/30/1998
7331000	Washita River near Dickson, OK	34.23343	-96.975845	11130303	7,202	10/1/1928	5/31/2008
7331200	Mill Creek near Mill Creek, OK	34.40509	-96.863344	11130304	46	10/1/2006	5/31/2008
7331250	Mill Creek near Ravia, OK	34.25982	-96.810562	11130304	89	10/1/1968	9/30/1971
7331295	Pennington Creek East of Mill Creek, OK	34.42037	-96.758896	11130304		10/1/2006	5/31/2008
7331300	Pennington Creek near Reagan, OK	34.34759	-96.70806	11130304	66	10/1/2003	5/31/2008
7331600	Red River at Denison Dam nr Denison, TX	33.81899	-96.563326	11140101	39,720	1/1/1924	5/31/2008
7332000	Red River near Colbert, OK	33.81844	-96.523325	11140101	39,777	10/1/1923	9/30/1959
7332390	Blue River near Connerville, OK	34.38343	-96.600558	11140102	162	10/1/1976	5/31/2008
7332400	Blue River at Milburn, OK	34.25065	-96.548888	11140102	203	10/1/1965	6/30/1987
7332500	Blue River near Blue, OK	33.99704	-96.241099	11140102	476	6/1/1936	5/31/2008
7332900	Coal Creek near Lehigh, OK	34.45176	-96.232496	11140103	8	10/1/1977	9/30/1981
7332950	Muddy Boggy Creek at Atoka, OK	34.38981	-96.12027	11140103	445	10/1/1978	9/30/1981
7333000	North Boggy Creek near Stringtown, OK	34.51898	-96.060827	11140103	136	10/1/1955	5/31/1959
7333500	Chickasaw Creek near Stringtown, OK	34.46148	-96.026935	11140103	33	10/1/1955	9/30/1968
7333800	McGee Creek near Stringtown, OK	34.4426	-95.869707	11140103	87	4/1/1956	9/30/1968
7333910	McGee Creek near Farris, OK	34.3151	-95.87526	11140103	176	10/1/1977	5/31/1982
7334000	Muddy Boggy Creek near Farris, OK	34.27149	-95.912205	11140103	1,087	10/1/1937	5/31/2008
7335000	Clear Boggy Creek near Caney, OK	34.25259	-96.205545	11140104	720	10/1/1942	5/31/2008
7335300	Muddy Boggy Creek near Unger, OK	34.02677	-95.750248	11140103	2,273	9/1/1982	5/31/2008
7335500	Red River at Arthur City, TX	33.8751	-95.501902	11140101	44,531	10/1/1905	5/31/2008
7335700	Kiamichi River near Big Cedar, OK	34.63844	-94.612724	11140105	40	10/1/1965	5/31/2008
7335790	Kiamichi River near Clayton, OK	34.57482	-95.340803	11140105	708	12/1/1980	5/31/2008
7336000	Tenmile Creek near Miller, OK	34.29871	-95.744698	11140105	68	10/1/1955	9/30/1970
7336200	Kiamichi River near Antlers, OK	34.24871	-95.605248	11140105	1,138	10/1/1972	5/31/2008
7336500	Kiamichi River near Belzoni, OK	34.20066	-95.484409	11140105	1,423	10/1/1925	9/30/1972
7336820	Red River near De Kalb, TX	33.684	-94.694377	11140106	47,348	10/1/1968	5/31/2008
7337500	Little River near Wright City, OK	34.06955	-95.046616	11140107	645	10/1/1929	9/30/1989
7337900	Glover River near Glover, OK	34.09761	-94.902167	11140107	315	10/1/1961	5/31/2008
7338000	Little River near Idabel, OK	33.93566	-94.826329	11140107	1,173	10/1/1929	9/30/1946
7338500	Little River blw Lukfata Creek, nr Idabel, OK	33.94122	-94.758548	11140107	1,226	10/1/1946	5/31/2008
7338750	Mountain Fork at Smithville, OK	34.46233	-94.63522	11140108	320	10/1/1991	5/31/2008
7339000	Mountain Fork near Eagletown, OK	34.04178	-94.619936	11140108	787	4/1/1924	5/31/2008
71912213	Spavinaw Creek near Colcord, OK	36.32258	-94.685224	11070209	163	10/1/2001	5/31/2008
73274406	Little Washita River ab SCS Pond No 26 nr Cyril,OK	34.91479	-98.250884	11130302	3	3/1/1995	5/31/2008
73274408	Little Washita River Tributary near Cyril, OK	34.9259	-98.233661	11130302	1	3/1/1995	9/30/2004
73274458	Little Washita River Tributary near Cement, OK	34.86257	-98.141158	11130302	6	6/1/1995	9/30/2004
7146500	ARKANSAS R AT ARKANSAS CITY, KS	37.05642	-97.058094	11030013	36,106	10/1/1902	5/31/2008
7172000	CANEY R NR ELGIN, KS	37.00394	-96.316664	11070106	445	10/1/1939	2/15/2009

Table 4-2 USGS Streamflow Gages Used to Determine Surface Water Supply in the Oklahoma Comprehensive Water Plan Update

USGS Station Number	Gage Name	Start Date of Discharge Measurement	End Date of Discharge Measurement[1]	Dates of Missing Data within the Period of Record (Oct 1 1949 - Sep 30 2007)
07146500	Arkansas R at Arkansas City, KS	10/1/1948	12/31/1963	
07151000	Salt Fork Arkansas River at Tonkawa, OK	10/1/1977	5/31/2008	10/1/1949~9/30/1978
07152000	Chikaskia River near Blackwell, OK	10/1/1959	5/31/2008	
07152500	Arkansas River at Ralston, OK	5/1/1905	9/30/1976	10/1/1949~3/31/1965,10/1/1967~7/31/1968, 10/1/1976~9/30/2007
07155590	CIMARRON R NR ELKHART, KS	10/1/1937	5/31/2008	
07157950	Cimarron River near Buffalo, OK	6/1/1960	12/31/1963	1/1/1964~9/30/2007
07158000	Cimarron River near Waynoka, OK	10/1/1937	10/3/1993	10/1/1993~9/30/2007
07160000	Cimarron River near Guthrie, OK	10/1/1942	5/31/2008	
07161000	Cimarron River at Perkins, OK	6/28/1983	5/31/2008	10/1/1949~6/30/1984
07164500	Arkansas River at Tulsa, OK	4/1/1903	6/30/2003	10/1/1949~9/30/1951, 10/1/1971~9/30/1972, 7/1/2003~9/30/2007
07165570	Arkansas River near Haskell, OK	4/1/1905	5/31/2008	
07171000	Verdigris River near Lenapah, OK	7/1/1905	5/31/2008	
07175500	Caney River near Ramona, OK	10/1/1937	9/30/1993	10/1/1993~9/30/2007
07177500	Bird Creek near Sperry, OK	10/1/1949	5/31/2008	
07178600	Verdigris River near Inola, OK	10/1/1989	5/31/2008	10/1/1939~9/30/1989, 1/1/1991~4/30/1992
07190500	Neosho River near Langley, OK	10/1/1927	10/3/2007	
07193500	Neosho River blw Ft Gibson Lake nr Ft Gibson, OK	10/1/1938	5/31/2008	
07198000	Illinois River near Gore, OK	10/1/1937	5/31/2008	
07228000	Canadian Rv nr Canadian, TX	10/1/1952	5/31/2008	10/1/1949~9/30/1952, 10/1/1968~9/30/1969, 10/1/1972~9/30/1973, 10/1/1987~9/30/1988
07228500	Canadian River at Bridgeport, OK	10/1/1902	5/31/2008	
07229200	Canadian River at Purcell, OK	10/1/1937	5/31/2008	10/1/1993~6/30/2000, 7/1/2003~9/30/2007
07229300	Walnut Creek at Purcell, OK	10/1/1946	5/31/2008	

Table 4-2 USGS Streamflow Gages Used to Determine Surface Water Supply in the Oklahoma Comprehensive Water Plan Update

USGS Station Number	Gage Name	Start Date of Discharge Measurement	End Date of Discharge Measurement[1]	Dates of Missing Data within the Period of Record (Oct 1 1949 - Sep 30 2007)
07230500	Little River near Tecumseh, OK	1/1/1905	5/31/2008	
07231000	Little River near Sasakwa, OK	5/1/1997	9/30/2007	10/1/1949~4/30/1997
07231500	Canadian River at Calvin, OK	10/1/1937	5/31/2008	
07234000	Beaver River at Beaver, OK	10/1/1943	5/31/2008	
07237000	Wolf Creek near Fort Supply, OK	4/1/1938	5/31/2008	10/1/2000~3/31/2001
07237500	North Canadian River at Woodward, OK	3/25/1924	5/31/2008	
07239000	North Canadian River at Canton, OK	10/1/1937	5/31/2008	
07241000	North Canadian River blw Lk Overholser nr OKC, OK	10/1/1944	5/31/2008	10/1/1964~9/30/1969
07242000	North Canadian River near Wetumka, OK	10/1/1939	5/31/2008	
07243500	Deep Fork near Beggs, OK	10/1/1939	5/31/2008	
07245000	Canadian River near Whitefield, OK	10/1/1944	9/30/1970	10/1/1970~9/30/2007
07249413	Poteau River near Panama, OK	10/1/1938	5/31/2008	
07249985	Lee Creek near Short, OK	10/1/1945	5/31/2008	
07250550	AR River at James W. Trimble L&D nr Van Buren, AR	10/1/1938	5/31/2008	
07299710	Sandy Creek near Eldorado, OK	6/1/1972	5/31/2008	10/1/1949~5/31/1972
07300500	Salt Fork Red River at Mangum, OK	10/1/1939	9/30/1991	12/29/1990~12/30/1990, 1/17/1991~2/28/1991, 10/1/1991~9/30/2007
07301110	Salt Fork Red River near Elmer, OK	10/1/1937	5/31/2008	10/1/1976~2/9/1983
07301500	North Fork Red River near Carter, OK	10/1/1937	5/31/2008	
07303000	North Fork Red River blw Altus Dam nr Lugert,	5/1/1960	5/31/2008	10/1/1949~4/30/1960, 10/1/1994~9/30/2001
07303500	Elm Fork of North Fork Red River nr Mangum, OK	10/1/1965	5/31/2008	10/1/1949~9/30/1965
07305000	North Fork Red River near Headrick, OK	10/1/1925	5/31/2008	
07305500	West Otter Creek at Snyder Lk nr Mt Park, OK	10/1/1950	5/31/2008	10/1/1949~9/30/1950
07307028	North Fork Red River near Tipton, OK	4/1/1971	5/31/2008	10/1/1949~3/31/1971
07311000	East Cache Creek near Walters, OK	4/1/1936	5/31/2008	
07311500	Deep Red Creek near Randlett, OK	10/1/1902	5/31/2008	

Table 4-2 USGS Streamflow Gages Used to Determine Surface Water Supply in the Oklahoma Comprehensive Water Plan Update

USGS Station Number	Gage Name	Start Date of Discharge Measurement	End Date of Discharge Measurement[1]	Dates of Missing Data within the Period of Record (Oct 1 1949 - Sep 30 2007)
07313500	Beaver Creek near Waurika, OK	10/1/1953	9/30/1993	10/1/1949~9/31/1953, 10/1/1993~9/30/2007
07313600	Cow Creek at Waurika, OK	3/1/1966	9/30/1970	10/1/1949~2/29/1966, 10/1/1970~9/30/2007
07315700	Mud Creek near Courtney, OK	10/1/1960	5/31/2008	10/1/1949~9/30/1960
07315900	Walnut Bayou near Burneyville, OK	10/1/1960	9/30/1971	10/1/1949~9/30/1960, 1/1/1964~9/30/1968, 10/1/1971~9/20/2007
07324200	Washita River near Hammon, OK	10/1/1969	5/31/2008	10/1/1987~9/30/1989
07325500	Washita River at Carnegie, OK	10/1/1937	9/30/2006	10/1/2006~9/30/2007
07326000	Cobb Creek near Fort Cobb, OK	10/1/1939	5/31/2008	
07326500	Washita River at Anadarko, OK	1/1/1903	5/31/2008	10/1/1937~9/30/1963
07328100	Washita River at Alex, OK	10/1/1964	5/31/2008	10/1/1986~8/31/1988
07328500	Washita River near Pauls Valley, OK	10/1/1937	5/31/2008	
07331000	Washita River near Dickson, OK	10/1/1928	5/31/2008	
07332500	Blue River near Blue, OK	6/1/1936	5/31/2008	
07334000	Muddy Boggy Creek near Farris, OK	10/1/1937	5/31/2008	
07336500	Kiamichi River near Belzoni, OK	10/1/1925	9/30/1972	10/1/1972~9/30/2007
07338500	Little River blw Lukfata Creek, nr Idabel, OK	10/1/1946	5/31/2008	
07339000	Mountain Fork near Eagletown, OK	4/1/1924	5/31/2008	
07335000	Clear Boggy Creek near Caney, OK	10/1/1942	5/31/2008	

Notes:

[1] Discharge measurements downloaded on 6/2/2008

Table 4-3 Average Annual and Median Surface Water Supplies for 1950 through 2007

Basin Number	Basin ID	Basin Name	Average Annual Flow Volume (AF/YR)	Assumed Upstream Interstate Compact Obligation Average Annual Flow Volume (AF/YR)[1]	Average Annual Median Flow Volume (AF/YR)[2]	Assumed Upstream Interstate Compact Obligation Average Annual Median Flow Volume (AF/YR)[1]
1	10100	Red River Mainstem (To Kiamichi River)	405,229	0	297,760	0
2	10201	Little River (McCurtain County) - 1	2,675,794	182,701	2,021,663	141,428
3	10202	Little River (McCurtain County) - 2	1,263,534	0	928,436	0
4	10203	Little River (McCurtain County) - 3	981,565	182,701	759,827	141,428
5	10301	Kiamichi River - 1	1,603,944	0	728,440	0
6	10302	Kiamichi River - 2	1,265,228	0	574,611	0
7	10411	Muddy Boggy River - 1	1,321,853	0	559,960	0
8	10412	Muddy Boggy River - 2	626,431	0	238,498	0
9	10420	Clear Boggy Creek	516,435	0	238,724	0
10	10500	Red River Mainstem (To Blue River)	104,521	0	44,626	0
11	10601	Blue River - 1	328,444	0	140,233	0
12	10602	Blue River - 2	228,433	0	97,532	0
13	10700	Red River Mainstem (To Washita)	156,606	0	66,865	0
14	10810	Lower Washita	1,284,803	8,897	866,579	6,724
15	10821	Middle Washita - 1	653,582	8,897	474,816	6,724
16	10822	Middle Washita - 2	488,909	8,897	363,705	6,724
17	10831	Upper Washita - 1	330,134	8,897	238,999	6,724
18	10832	Upper Washita - 2	25,747	0	14,608	0
19	10833	Upper Washita - 3	274,117	8,897	181,755	6,724
20	10840	Washita Headwaters	133,552	8,897	88,553	6,724
21	10900	Red River Mainstem (To Walnut Bayou)	2,093,630	8,897	1,211,917	6,724
22	11000	Walnut Bayou	42,739	0	6,287	0
23	11100	Mud Creek	143,580	0	27,520	0
24	11201	Beaver Creek - 1	196,753	0	85,067	0
25	11202	Beaver Creek - 2	108,561	0	58,713	0
26	11203	Beaver Creek - 3	56,905	0	17,005	0
27	11311	Cache Creek - 1	403,659	0	127,135	0
28	11312	Cache Creek - 2	156,175	0	73,110	0
29	11321	Deep Red Creek And West Cache Creek - 1	223,578	0	42,835	0
30	11322	Deep Red Creek And West Cache Creek - 2	122,520	0	23,473	0
31	11400	Red River Mainstem (To North Fork of Red)	106,402	0	20,385	0
32	11511	Lower North Fork Red River - 1	309,444	59,417	154,008	28,664
33	11512	Lower North Fork Red River - 2	302,132	59,417	150,369	28,664
34	11513	Lower North Fork Red River - 3	238,641	59,417	117,874	28,664
35	11514	Lower North Fork Red River - 4	11,235	0	3,827	0
36	11521	Upper North Fork Red River - 1	46,753	40,439	25,807	22,238

Table 4-3 Average Annual and Median Surface Water Supplies for 1950 through 2007

Basin Number	Basin ID	Basin Name	Average Annual Flow Volume (AF/YR)	Assumed Upstream Interstate Compact Obligation Average Annual Flow Volume (AF/YR)[1]	Average Annual Median Flow Volume (AF/YR)[2]	Assumed Upstream Interstate Compact Obligation Average Annual Median Flow Volume (AF/YR)[1]
37	11522	Upper North Fork Red River - 2	90,523	40,439	49,780	22,238
38	11601	Salt Fork Red River - 1	134,983	31,350	63,507	13,117
39	11602	Salt Fork Red River - 2	59,282	31,350	24,804	13,117
40	11701	Prairie Dog Town Fork Red River - 1	14,306	2,283	2,506	400
41	11702	Prairie Dog Town Fork Red River - 2	16,063	2,283	2,814	400
42	11801	Elm Fork Red River - 1	79,410	18,978	26,890	6,426
43	11802	Elm Fork Red River - 2	69,558	18,978	23,554	6,426
44	20101	Poteau River - 1	1,547,447	270,125	1,169,120	204,084
45	20102	Poteau River - 2	1,469,975	270,125	1,110,589	204,084
46	20201	Lower Arkansas River - 1	25,203,447	6,493,079	23,544,672	5,137,529
47	20202	Lower Arkansas River - 2	22,221,733	6,086,804	19,277,031	4,861,230
48	20300	Canadian River (To North Canadian River)	4,171,441	113,670	3,516,680	57,448
49	20400	Middle Arkansas River	6,657,875	1,650,463	5,589,996	1,230,359
50	20510	Lower North Canadian River	587,556	39,769	399,286	20,292
51	20520	Middle North Canadian River	153,059	39,769	108,603	20,292
52	20531	Upper North Canadian River - 1	122,860	39,769	101,859	20,292
53	20532	Upper North Canadian River - 2	98,678	39,769	71,334	20,292
54	20533	Upper North Canadian River - 3	32,670	12,796	24,815	9,720
55	20540	North Canadian Headwaters	38,161	24,773	13,836	8,982
56	20611	Lower Canadian River - 1	1,187,391	73,901	634,036	37,156
57	20612	Lower Canadian River - 2	56,232	0	21,543	0
58	20620	Middle Canadian River	501,819	73,901	268,011	37,156
59	20630	Upper Canadian River	246,135	73,901	122,395	37,156
60	20700	Deep Fork River	646,932	0	417,530	0
61	20801	Little River - 1	248,786	0	124,067	0
62	20802	Little River - 2	137,020	0	75,079	0
63	20910	Lower Cimarron River	1,182,148	40,271	5,213,911	25,942
64	20920	Middle Cimarron River	849,921	40,271	466,264	25,942
65	20930	Upper Cimarron River	88,823	40,271	56,203	25,942
66	20940	Cimarron Headwaters	10,080	4,300	1,897	809
67	21011	Lower Salt Fork Arkansas River - 1	1,229,767	446,899	662,654	230,154
69	21012	Lower Salt Fork Arkansas River - 2	494,602	242,316	196,972	96,501
70	21013	Lower Salt Fork Arkansas River - 3	458,565	242,316	182,620	96,501
68	21020	Upper Salt Fork Arkansas River	677,928	204,583	442,889	133,654
71	21100	Arkansas River - Cimarron Rivers to Keystone Lake	6,008,461	1,650,463	5,197,352	1,230,359

Table 4-3 Average Annual and Median Surface Water Supplies for 1950 through 2007

Basin Number	Basin ID	Basin Name	Average Annual Flow Volume (AF/YR)	Assumed Upstream Interstate Compact Obligation Average Annual Flow Volume (AF/YR)[1]	Average Annual Median Flow Volume (AF/YR)[2]	Assumed Upstream Interstate Compact Obligation Average Annual Median Flow Volume (AF/YR)[1]
72	21200	Arkansas River Mainstem (To Kansas State Line)	4,204,148	1,610,192	3,271,342	1,204,416
73	21301	Bird Creek - 1	495,970	0	239,005	0
74	21302	Bird Creek - 2	418,122	0	201,491	0
75	21401	Caney River - 1	973,931	259,468	740,026	197,153
76	21402	Caney River - 2	901,120	259,468	684,701	197,153
77	21511	Verdigris River (To Oologah Dam) - 1	3,728,325	1,289,484	3,214,480	938,666
78	21512	Verdigris River (To Oologah Dam) - 2	3,550,383	1,289,484	3,061,062	938,666
79	21520	Verdigris River (To Kansas State Line)	2,126,812	1,030,015	1,531,103	741,513
80	21601	Grand (Neosho) River - 1	6,422,329	2,727,226	5,851,490	2,364,500
81	21602	Grand (Neosho) River - 2	5,325,040	2,685,800	4,613,177	2,326,757
82	21700	Illinois River	1,096,430	305,962	968,479	270,257

Notes:

[1] Values are not removed from the average annual or annual median flow. This flow represents the estimated portion of the surface water supply that is

[2] Average Annual Median Flow Volume is cacluated from the median daily historical streamflow record.

Table 4-4 Unused Existing Reservoir Yield in 2010

Name	Authority	Primary Basin ID	Water Supply Storage (AF)	Water Supply Yield (AFY)	Existing Permits (AFY)[1]	Available Yield in 2010 for New Permits (AFY)	Portion of Yield to be Used in 2010 (%)[2]
Pine Creek	U.S. Army Corps of Engineers	3	49,400	94,080	33,605	60,475	36%
Broken Bow	U.S. Army Corps of Engineers	4	152,500	196,000	10,780	185,220	3%
Hugo	U.S. Army Corps of Engineers	5	47,600	64,960	55,192	9,768	61%
Sardis	U.S. Army Corps of Engineers	6	297,200	156,800	7,030	149,770	1%
Atoka	City of Oklahoma City	8	123,500	92,067	93,952	0	98%
McGee Creek	Bureau of Reclamation	8	109,800	71,800	64,608	7,192	71%
Fuqua	City of Duncan	14	21,100	3,427	1,245	2,182	36%
Arbuckle	Bureau of Reclamation	14	62,600	24,000	24,000	0	80%
Fort Cobb	Bureau of Reclamation	18	78,350	18,000	18,000	0	75%
Foss	Bureau of Reclamation	20	177,390	18,000	17,634	366	50%
Texoma	U.S. Army Corps of Engineers	21	150,000	168,000	2,419	165,582	1%
Waurika	U.S. Army Corps of Engineers	25	167,600	45,590	44,806	784	37%
Ellsworth	City of Lawton	28	68,700	23,500	23,500	0	50%
Lawtonka	City of Lawton	28	64,000	23,500	23,500	0	84%
Tom Steed	Bureau of Reclamation	35	88,160	16,000	16,100	0	73%
Wister	U.S. Army Corps of Engineers	45	46,557	46,250	31,530	14,720	65%
Eufaula	U.S. Army Corps of Engineers	48	56,000	56,000	61,906	0	65%
Arcadia	U.S. Army Corps of Engineers	60	23,090	12,320	12,500	0	56%
Thunderbird	Bureau of Reclamation	62	105,900	21,700	21,600	100	94%
Keystone	U.S. Army Corps of Engineers	71	20,000	22,400	13,968	8,432	61%
McMurtry	City of Stillwater	71	13,500	3,002	2,649	353	62%
Kaw	U.S. Army Corps of Engineers	72	171,200	187,040	174,403	12,637	61%

Table 4-4 Unused Existing Reservoir Yield in 2010

Name	Authority	Primary Basin ID	Water Supply Storage (AF)	Water Supply Yield (AFY)	Existing Permits (AFY)[1]	Available Yield in 2010 for New Permits (AFY)	Portion of Yield to be Used in 2010 (%)[2]
Birch	U.S. Army Corps of Engineers	74	7,600	3,360	2,800	560	42%
Skiatook	U.S. Army Corps of Engineers	74	62,900	15,680	15,680	0	67%
Copan	U.S. Army Corps of Engineers	76	7,500	3,360	3,340	20	33%
Hulah	U.S. Army Corps of Engineers	76	19,800	13,888	13,886	2	70%
Oologah	U.S. Army Corps of Engineers	79	342,600	172,480	173,646	0	44%
Tenkiller Ferry	U.S. Army Corps of Engineers	82	25,400	29,792	40,212	0	92%

Notes:

[1] Exisiting Permits includes fully used permits and those with a schedule of use.

[2] The portion of the yield that is unpermitted or is being used to less than the permitted amount due to a schedule of use.

Table 4-5 Streamflow Data Confidence Levels for OCWP Basins

Basin Number	Basin ID	Basin Name	SW Flow Confidence
1	10100	Red River Mainstem (To Kiamichi River)	High
2	10201	Little River (McCurtain County) - 1	High
3	10202	Little River (McCurtain County) - 2	Low
4	10203	Little River (McCurtain County) - 3	Low
5	10301	Kiamichi River - 1	High
6	10302	Kiamichi River - 2	Medium
7	10411	Muddy Boggy River - 1	Medium
8	10412	Muddy Boggy River - 2	Low
9	10420	Clear Boggy Creek	Medium
10	10500	Red River Mainstem (To Blue River)	High
11	10601	Blue River - 1	Medium
12	10602	Blue River - 2	Low
13	10700	Red River Mainstem (To Washita)	High
14	10810	Lower Washita	Low
15	10821	Middle Washita - 1	Low
16	10822	Middle Washita - 2	Low
17	10831	Upper Washita - 1	High
18	10832	Upper Washita - 2	Low
19	10833	Upper Washita - 3	Low
20	10840	Washita Headwaters	High
21	10900	Red River Mainstem (To Walnut Bayou)	High
22	11000	Walnut Bayou	High
23	11100	Mud Creek	High
24	11201	Beaver Creek - 1	High
25	11202	Beaver Creek - 2	Medium
26	11203	Beaver Creek - 3	High
27	11311	Cache Creek - 1	High
28	11312	Cache Creek - 2	High
29	11321	Deep Red Creek And West Cache Creek - 1	High
30	11322	Deep Red Creek And West Cache Creek - 2	Low
31	11400	Red River Mainstem (To North Fork of Red)	High
32	11511	Lower North Fork Red River - 1	High
33	11512	Lower North Fork Red River - 2	Medium
34	11513	Lower North Fork Red River - 3	Low
35	11514	Lower North Fork Red River - 4	High
36	11521	Upper North Fork Red River - 1	High
37	11522	Upper North Fork Red River - 2	Medium
38	11601	Salt Fork Red River - 1	Medium
39	11602	Salt Fork Red River - 2	Low
40	11701	Prairie Dog Town Fork Red River - 1	High
41	11702	Prairie Dog Town Fork Red River - 2	High
42	11801	Elm Fork Red River - 1	High
43	11802	Elm Fork Red River - 2	High
44	20101	Poteau River - 1	High

Table 4-5 Streamflow Data Confidence Levels for OCWP Basins

Basin Number	Basin ID	Basin Name	SW Flow Confidence
45	20102	Poteau River - 2	High
46	20201	Lower Arkansas River - 1	Medium
47	20202	Lower Arkansas River - 2	High
48	20300	Canadian River (To North Canadian River)	Low
49	20400	Middle Arkansas River	Medium
50	20510	Lower North Canadian River	Low
51	20520	Middle North Canadian River	Low
52	20531	Upper North Canadian River - 1	Medium
53	20532	Upper North Canadian River - 2	Low
54	20533	Upper North Canadian River - 3	Medium
55	20540	North Canadian Headwaters	Low
56	20611	Lower Canadian River - 1	Low
57	20612	Lower Canadian River - 2	Medium
58	20620	Middle Canadian River	Medium
59	20630	Upper Canadian River	High
60	20700	Deep Fork River	Low
61	20801	Little River - 1	Low
62	20802	Little River - 2	Medium
63	20910	Lower Cimarron River	Medium
64	20920	Middle Cimarron River	Low
65	20930	Upper Cimarron River	High
66	20940	Cimarron Headwaters	Medium
67	21011	Lower Salt Fork Arkansas River - 1	Medium
69	21012	Lower Salt Fork Arkansas River - 2	Medium
70	21013	Lower Salt Fork Arkansas River - 3	Low
68	21020	Upper Salt Fork Arkansas River	Low
71	21100	Arkansas River - Cimarron Rivers to Keystone Lake	Medium
72	21200	Arkansas River Mainstem (To Kansas State Line)	Low
73	21301	Bird Creek - 1	Medium
74	21302	Bird Creek - 2	Low
75	21401	Caney River - 1	Medium
76	21402	Caney River - 2	Low
77	21511	Verdigris River (To Oologah Dam) - 1	Medium
78	21512	Verdigris River (To Oologah Dam) - 2	Medium
79	21520	Verdigris River (To Kansas State Line)	High
80	21601	Grand (Neosho) River - 1	Medium
81	21602	Grand (Neosho) River - 2	Low
82	21700	Illinois River	Low

Table 4-6 Streamflow Data Confidence Levels for Upstream Out of State Flows

Basin Number	Basin ID	Basin Name	Upstream State	SW Flow Confidence
4	10203	Little River (McCurtain County) - 3	Arkansas	Medium
20	10840	Washita Headwaters	Texas	Medium
37	11522	Upper North Fork Red River - 2	Texas	Medium
39	11602	Salt Fork Red River - 2	Texas	Medium
41	11702	Prairie Dog Town Fork Red River - 2	Texas	High
43	11802	Elm Fork Red River - 2	Texas	High
45	20102	Poteau River - 2	Arkansas	High
46	20201	Lower Arkansas River - 1	Arkansas	Medium
53	20532	Upper North Canadian River - 2	Texas	High
54	20533	Upper North Canadian River - 3	Texas	Medium
55	20540	North Canadian Headwaters	New Mexico	Medium
55	20540	North Canadian Headwaters	Texas	Medium
59	20630	Upper Canadian River	Texas	High
65	20930	Upper Cimarron River	Kansas	High
66	20940	Cimarron Headwaters	Colorado	Medium
66	20940	Cimarron Headwaters	New Mexico	Medium
68	21020	Upper Salt Fork of the Arkansas River	Kansas	Medium
70	21013	Lower Salt Fork of the Arkansas River - 3	Kansas	Medium
72	21200	Arkansas River Mainstem (To Kansas State Line)	Kansas	High
76	21402	Caney River - 2	Kansas	Medium
79	21520	Verdigris River (To Kansas State Line)	Kansas	Medium
80	21601	Grand (Nesho) River - 1	Arkansas	High
81	21602	Grand (Nesho) River - 2	Arkansas	High
81	21602	Grand (Nesho) River - 2	Kansas	Medium
81	21602	Grand (Nesho) River - 2	Missouri	Medium
82	21700	Illinois River	Arkansas	Medium

Table 4-7: Aquifer Data Initial Confidence Levels for Major Aquifers in Oklahoma[1]

Aquifer	Aquifer Type	Aquifer Configuration Confidence Level[2]	Aquifer Storage Confidence Level[2]	Recharge Confidence Level[2]
Ogallala	Bedrock	High	High	Medium
Rush Springs	Bedrock	High	High	High
Central Oklahoma (Garber-Wellington)	Bedrock	Medium	Medium	High
Antlers	Bedrock	Medium	Medium	Medium
Roubidoux	Bedrock	Low	Medium	Medium
Vamoosa-Ada	Bedrock	High	Medium	High
Arbuckle-Simpson	Bedrock	Medium	Low	High
North Canadian River	Alluvium and Terrace	Medium	High	High
Canadian River	Alluvium and Terrace	Low	Medium	Low
Washita River	Alluvium and Terrace	Medium	Medium	Medium
North Fork of the Red River	Alluvium and Terrace	Low	Medium	Low
Cimarron River	Alluvium and Terrace	High	High	High
Red River	Alluvium and Terrace	Low	Medium	Low
Elk City	Bedrock	Medium	High	Medium
Salt Fork of the Arkansas	Alluvium and Terrace	Low	Medium	Low
Arkansas River	Alluvium and Terrace	Low	Medium	Low
Blaine	Bedrock	Medium	Medium	Low
Tillman Terrace	Alluvium and Terrace	High	High	Medium
Arbuckle-Timbered Hills	Bedrock	Medium	Low	Low
Gerty Sand	Alluvium and Terrace	Low	Medium	Low
Enid Isolated Terrace	Alluvium and Terrace	Medium	Medium	Medium

Notes:

[1] Major aquifers defined from the Oklahoma Water Atlas (OWRB 2007).

[2] Confidence level is relative to estimates in other aquifers for that parameter, prior to undertaking additional mapping and analyses.

Table 4-8 Major Bedrock Groundwater Aquifer Recharge

Basin #	Aquifer	Aquifer Type	Low Recharge Estimate (in/yr)	High Recharge Estimate (in/yr)	Chosen Recharge Estimate (in/yr)	Recharge Calculation Method
1	Antlers	Bedrock	0.3	1.7	1	Computer model results
2	Arbuckle-Simpson	Bedrock	4.7	4.7	4.7	Baseflow measurements
3	Arbuckle-Timbered Hills	Bedrock	0.3	0.6	0.45	Percentage of precipitation
4	Blaine	Bedrock	1.5	1.5	1.5	Percentage of precipitation
5	Garber-Wellington	Bedrock	1.1	1.61	1.355	Baseflow measurements
6	Elk City	Bedrock	2	4	3	Computer model results
7	Ogallala	Bedrock	0.1	2.2	1.15	Computer model results
8	Roubidoux	Bedrock	2.5	12	2.5	Computer model results & percentage of precipitation
9	Rush Springs	Bedrock	0.2	3.5	1.85	Baseflow measurements
10	Vamoosa-Ada	Bedrock	0.5	1.52	1.01	Baseflow measurements

Notes:

[1] Major aquifers defined from the Oklahoma Water Atlas (OWRB 2007).

[2] Confidence level is relative to estimates in other aquifers for that parameter, prior to undertaking additional mapping and analyses.

Table 4-9 County Groundwater Storage and Recharge for Aquifers with Available Data

County	Aquifer	Class[1]	Type	Surface Area (Acres)	Recharge (in/yr)	Recharge Volume (AFY)	Aquifer Storage Volume (AF)
Atoka	Antlers	Major	Bedrock	253,600	8.5	35,900	2,557,000
Bryan	Antlers	Major	Bedrock	607,100	1.8	15,200	11,322,000
Carter	Antlers	Major	Bedrock	51,400	6.8	7,300	405,000
Choctaw	Antlers	Major	Bedrock	511,200	4.9	29,800	11,520,000
Johnston	Antlers	Major	Bedrock	141,800	5.1	20,100	1,099,000
Love	Antlers	Major	Bedrock	273,400	3	22,800	2,547,000
Marshall	Antlers	Major	Bedrock	271,400	0.6	13,600	6,146,000
McCurtain	Antlers	Major	Bedrock	518,700	2.8	30,300	16,754,000
Pushmataha	Antlers	Major	Bedrock	95,000	6.8	13,500	1,240,000
Carter	Arbuckle-Simpson	Major	Bedrock	19,700	9.4	7,700	507,000
Johnston	Arbuckle-Simpson	Major	Bedrock	142,100	18.8	55,700	3,923,000
Murray	Arbuckle-Simpson	Major	Bedrock	102,700	14.1	40,200	2,979,000
Pontotoc	Arbuckle-Simpson	Major	Bedrock	73,100	14.1	28,600	2,062,000
Caddo	Arbuckle-Timbered Hills	Major	Bedrock	29,300	1.2	1,500	119,000
Comanche	Arbuckle-Timbered Hills	Major	Bedrock	185,600	1.2	4,600	740,000
Kiowa	Arbuckle-Timbered Hills	Major	Bedrock	25,400	1.2	1,300	102,000
Haskell	Arkansas River	Major	Alluvium and Terrace	17,100	5	6,500	14,000
Kay	Arkansas River	Major	Alluvium and Terrace	2,700	10	1,100	6,000
Leflore	Arkansas River	Major	Alluvium and Terrace	35,600	10	14,800	65,000
Muskogee	Arkansas River	Major	Alluvium and Terrace	70,500	20	29,400	105,000
Osage	Arkansas River	Major	Alluvium and Terrace	85,000	20	35,400	155,000
Pawnee	Arkansas River	Major	Alluvium and Terrace	31,900	10	13,300	34,000
Sequoyah	Arkansas River	Major	Alluvium and Terrace	69,700	20	29,000	108,000
Tulsa	Arkansas River	Major	Alluvium and Terrace	74,800	10	31,200	193,000
Wagoner	Arkansas River	Major	Alluvium and Terrace	150,100	15	62,600	265,000
Greer	Blaine	Major	Bedrock	45,700	3	5,700	139,000
Harmon	Blaine	Major	Bedrock	238,600	6	29,800	720,000
Jackson	Blaine	Major	Bedrock	180,900	4.5	22,600	543,000
Blaine	Canadian River	Major	Alluvium and Terrace	76,100	4	12,700	230,000
Canadian	Canadian River	Major	Alluvium and Terrace	91,600	6	15,300	446,000
Cleveland	Canadian River	Major	Alluvium and Terrace	121,200	6	20,200	518,000
Custer	Canadian River	Major	Alluvium and Terrace	22,600	4	3,800	68,000
Dewey	Canadian River	Major	Alluvium and Terrace	282,600	8	47,100	987,000
Ellis	Canadian River	Major	Alluvium and Terrace	36,500	2	6,100	81,000
Grady	Canadian River	Major	Alluvium and Terrace	44,300	4	7,400	231,000
Haskell	Canadian River	Major	Alluvium and Terrace	23,000	4	3,800	12,000
Hughes	Canadian River	Major	Alluvium and Terrace	105,800	6	17,600	334,000

Table 4-9 County Groundwater Storage and Recharge for Aquifers with Available Data

County	Aquifer	Class[1]	Type	Surface Area (Acres)	Recharge (in/yr)	Recharge Volume (AFY)	Aquifer Storage Volume (AF)
McClain	Canadian River	Major	Alluvium and Terrace	159,900	10	26,700	729,000
Mcintosh	Canadian River	Major	Alluvium and Terrace	59,200	2	9,900	177,000
Muskogee	Canadian River	Major	Alluvium and Terrace	60,200	4	10,000	46,000
Pittsburg	Canadian River	Major	Alluvium and Terrace	38,900	2	6,500	61,000
Pontotoc	Canadian River	Major	Alluvium and Terrace	53,300	4	8,900	231,000
Pottawatomie	Canadian River	Major	Alluvium and Terrace	36,900	2	6,100	193,000
RogerMills	Canadian River	Major	Alluvium and Terrace	110,700	4	18,400	321,000
Seminole	Canadian River	Major	Alluvium and Terrace	42,100	4	7,000	164,000
Alfalfa	Cimarron River	Major	Alluvium and Terrace	71,800	4.6	13,800	276,000
Garfield	Cimarron River	Major	Alluvium and Terrace	18,000	2.3	3,500	83,000
Kingfisher	Cimarron River	Major	Alluvium and Terrace	198,500	4.6	38,000	1,011,000
Logan	Cimarron River	Major	Alluvium and Terrace	37,000	4.6	7,100	174,000
Major	Cimarron River	Major	Alluvium and Terrace	194,400	4.6	37,300	930,000
Woods	Cimarron River	Major	Alluvium and Terrace	312,800	6.9	60,000	1,384,000
Beckham	Elk City	Major	Bedrock	70,000	8.4	16,300	809,000
Custer	Elk City	Major	Bedrock	7,600	2.8	1,800	27,000
RogerMills	Elk City	Major	Bedrock	12,300	5.6	2,900	42,000
Washita	Elk City	Major	Bedrock	103,300	8.4	24,100	1,365,000
Garfield	Enid Isolated Terrace	Major	Alluvium and Terrace	51,800	11.5	9,900	260,000
Cleveland	Garber-Wellington	Major	Bedrock	351,100	4.4	32,200	14,258,000
Lincoln	Garber-Wellington	Major	Bedrock	336,000	6.4	44,800	8,482,000
Logan	Garber-Wellington	Major	Bedrock	273,600	4.8	36,500	6,996,000
Oklahoma	Garber-Wellington	Major	Bedrock	458,400	6.6	42,000	18,388,000
Pottawatomie	Garber-Wellington	Major	Bedrock	413,000	9.6	55,100	10,475,000
Garvin	Gerty Sand	Major	Alluvium and Terrace	18,300	2	1,500	81,000
McClain	Gerty Sand	Major	Alluvium and Terrace	9,400	2	800	35,000
Pontotoc	Gerty Sand	Major	Alluvium and Terrace	42,700	1	3,600	108,000
Blaine	North Canadian River	Major	Alluvium and Terrace	141,600	3	11,800	978,000
Canadian	North Canadian River	Major	Alluvium and Terrace	113,800	3	9,500	549,000
Cleveland	North Canadian River	Major	Alluvium and Terrace	10,200	5.1	1,400	31,000
Dewey	North Canadian River	Major	Alluvium and Terrace	21,600	1	1,800	191,000
Harper	North Canadian River	Major	Alluvium and Terrace	180,900	2	15,100	1,547,000
Hughes	North Canadian River	Major	Alluvium and Terrace	60,700	10	25,300	225,000
Lincoln	North Canadian River	Major	Alluvium and Terrace	7,600	5	1,600	33,000
Major	North Canadian River	Major	Alluvium and Terrace	89,900	2	7,500	773,000
Mcintosh	North Canadian River	Major	Alluvium and Terrace	53,400	7	31,100	199,000
Okfuskee	North Canadian River	Major	Alluvium and Terrace	75,600	10	31,500	329,000

Table 4-9 County Groundwater Storage and Recharge for Aquifers with Available Data

County	Aquifer	Class[1]	Type	Surface Area (Acres)	Recharge (in/yr)	Recharge Volume (AFY)	Aquifer Storage Volume (AF)
Oklahoma	North Canadian River	Major	Alluvium and Terrace	120,400	8.5	17,100	717,000
Pottawatomie	North Canadian River	Major	Alluvium and Terrace	86,000	5	17,900	516,000
Seminole	North Canadian River	Major	Alluvium and Terrace	60,800	7	17,700	176,000
Woodward	North Canadian River	Major	Alluvium and Terrace	232,300	5	19,400	2,024,000
Beckham	North Fork of the Red River	Major	Alluvium and Terrace	198,600	9.2	38,100	1,786,000
Greer	North Fork of the Red River	Major	Alluvium and Terrace	75,300	11.5	14,400	680,000
Jackson	North Fork of the Red River	Major	Alluvium and Terrace	50,400	6.9	9,700	454,000
Kiowa	North Fork of the Red River	Major	Alluvium and Terrace	102,200	11.5	19,600	841,000
Beaver	Ogallala	Major	Bedrock	1,069,200	0.3	8,900	24,047,000
Cimarron	Ogallala	Major	Bedrock	907,900	0.4	15,100	10,367,000
Ellis	Ogallala	Major	Bedrock	634,100	1.2	15,900	10,078,000
Harper	Ogallala	Major	Bedrock	31,700	1	1,300	125,000
RogerMills	Ogallala	Major	Bedrock	259,100	2.7	19,400	2,461,000
Texas	Ogallala	Major	Bedrock	1,267,900	0.3	10,600	40,390,000
Woodward	Ogallala	Major	Bedrock	207,100	1.2	5,200	3,121,000
Bryan	Red River	Major	Alluvium and Terrace	176,500	25	73,500	686,000
Choctaw	Red River	Major	Alluvium and Terrace	113,200	20	47,200	357,000
Cotton	Red River	Major	Alluvium and Terrace	23,600	2.5	4,900	53,000
Jefferson	Red River	Major	Alluvium and Terrace	144,500	10	30,100	324,000
Love	Red River	Major	Alluvium and Terrace	175,000	7.5	36,500	826,000
McCurtain	Red River	Major	Alluvium and Terrace	189,300	10	78,900	198,000
Tillman	Red River	Major	Alluvium and Terrace	62,200	5	13,000	148,000
Adair	Roubidoux	Major	Bedrock	368,300	5	76,700	6,216,000
Cherokee	Roubidoux	Major	Bedrock	498,000	10	103,800	7,352,000
Craig	Roubidoux	Major	Bedrock	437,600	7.5	91,200	4,739,000
Delaware	Roubidoux	Major	Bedrock	508,000	7.5	105,800	8,111,000
Mayes	Roubidoux	Major	Bedrock	275,000	5	57,300	4,226,000
Muskogee	Roubidoux	Major	Bedrock	78,300	5	16,300	1,025,000
Ottawa	Roubidoux	Major	Bedrock	307,100	5	64,000	5,077,000
Sequoyah	Roubidoux	Major	Bedrock	452,600	10	94,300	6,017,000
Wagoner	Roubidoux	Major	Bedrock	17,500	2.5	3,600	268,000
Blaine	Rush Springs	Major	Bedrock	27,400	1.8	4,100	351,000
Caddo	Rush Springs	Major	Bedrock	577,700	12.6	86,700	21,808,000

Table 4-9 County Groundwater Storage and Recharge for Aquifers with Available Data

County	Aquifer	Class[1]	Type	Surface Area (Acres)	Recharge (in/yr)	Recharge Volume (AFY)	Aquifer Storage Volume (AF)
Canadian	Rush Springs	Major	Bedrock	29,400	3.6	4,400	182,000
Comanche	Rush Springs	Major	Bedrock	34,400	5.4	5,200	830,000
Custer	Rush Springs	Major	Bedrock	383,400	5.4	57,500	28,735,000
Dewey	Rush Springs	Major	Bedrock	123,100	3.6	18,500	6,108,000
Grady	Rush Springs	Major	Bedrock	126,500	9	19,000	1,913,000
Stephens	Rush Springs	Major	Bedrock	19,400	3.6	2,900	69,000
Washita	Rush Springs	Major	Bedrock	228,400	3.6	34,300	19,842,000
Alfalfa	Salt Fork of the Arkansas River	Major	Alluvium and Terrace	271,000	2.3	51,900	1,198,000
Grant	Salt Fork of the Arkansas River	Major	Alluvium and Terrace	178,800	2.3	34,300	759,000
Kay	Salt Fork of the Arkansas	Major	Alluvium and Terrace	58,600	9.2	11,200	148,000
Woods	Salt Fork of the Arkansas River	Major	Alluvium and Terrace	33,400	2.3	6,400	86,000
Tillman	Tillman Terrace	Major	Alluvium and Terrace	182,600	17.4	44,100	1,283,000
Creek	Vamoosa-Ada	Major	Bedrock	261,300	4.2	30,500	2,318,000
Lincoln	Vamoosa-Ada	Major	Bedrock	142,300	2.1	8,300	1,302,000
Okfuskee	Vamoosa-Ada	Major	Bedrock	88,800	2.8	10,400	800,000
Osage	Vamoosa-Ada	Major	Bedrock	608,800	4.4	55,800	1,824,000
Pawnee	Vamoosa-Ada	Major	Bedrock	134,000	1.1	12,300	811,000
Payne	Vamoosa-Ada	Major	Bedrock	87,200	0.7	5,100	1,324,000
Pottawatomie	Vamoosa-Ada	Major	Bedrock	69,200	3	2,900	437,000
Seminole	Vamoosa-Ada	Major	Bedrock	258,100	3.5	15,100	6,115,000
Caddo	Washita River	Major	Alluvium and Terrace	92,700	8.1	20,900	439,000
Custer	Washita River	Major	Alluvium and Terrace	136,100	9.6	36,300	1,254,000
Garvin	Washita River	Major	Alluvium and Terrace	114,500	8.8	42,000	895,000
Grady	Washita River	Major	Alluvium and Terrace	134,400	5.4	30,200	464,000
Kiowa	Washita River	Major	Alluvium and Terrace	16,000	2.7	3,600	67,000
McClain	Washita River	Major	Alluvium and Terrace	22,900	4.4	8,400	209,000
Murray	Washita River	Major	Alluvium and Terrace	29,400	4.4	10,800	221,000
RogerMills	Washita River	Major	Alluvium and Terrace	85,300	3.2	22,800	969,000
Washita	Washita River	Major	Alluvium and Terrace	65,500	2.7	14,700	402,000

Notes:

1 Aquifer class is defined by OWRB based on the well pumping withdrawal rates observed in the aquifer, where major aquifers have greater withdrawal

2 Recoverable Storage Volume is equal to 80% of the initial storage volume of the aquifer

Table 4-10 Groundwater Storage and Recharge for Oklahoma Aquifers

Aquifer	Class[1]	Type	Aquifer Area (acres)	Recharge Rate (in/yr)	Recharge Rate (AFY)	Aquifer Storage Volume (AFY)
Antlers	Major	Bedrock	2,723,662	0.8	188,500	53,589,800
Arbuckle-Simpson	Major	Bedrock	337,629	4.7	132,200	9,471,100
Arbuckle-Timbered Hills	Major	Bedrock	240,333	0.4	7,400	961,300
Blaine	Major	Bedrock	465,152	1.5	58,100	1,402,400
Elk City	Major	Bedrock	193,136	2.8	45,100	2,243,600
Roubidoux	Major	Bedrock	2,942,358	2.5	613,000	43,030,800
Rush Springs	Major	Bedrock	1,549,593	1.8	232,600	79,838,100
Vamoosa-Ada	Major	Bedrock	1,649,642	1.0	140,400	14,931,600
Garber-Wellington	Major	Bedrock	1,832,124	1.4	210,600	58,599,400
Arkansas River	Major	Alluvium and Terrace	536,052	0.0	0	945,800
Canadian River	Major	Alluvium and Terrace	1,364,937	0.0	0	4,830,400
Cimarron River	Major	Alluvium and Terrace	832,540	0.0	0	3,858,700
Enid Isolated Terrace	Major	Alluvium and Terrace	51,803	0.0	0	259,800
North Fork of the Red River	Major	Alluvium and Terrace	426,461	0.0	0	3,761,900
Red River	Major	Alluvium and Terrace	884,283	0.0	0	2,591,300
Salt Fork of the Arkansas River	Major	Alluvium and Terrace	541,795	0.0	0	2,191,200
Tillman Terrace	Major	Alluvium and Terrace	182,575	0.0	0	1,283,400
Cherokee Group	Minor	Bedrock	798,394	3.0	199,599	1,153,800
Broken Bow	Minor	Bedrock	148,634	1.2	14,863	313,600
East-Central Oklahoma	Minor	Bedrock	964,180	2.8	224,975	12,026,800
El Reno	Minor	Bedrock	3,613,885	0.8	225,868	14,986,500
Boone	Minor	Bedrock	8,093	0.5	364	222,800
Hennessey - Garber	Minor	Bedrock	1,251,522	2.7	281,593	4,351,600
Kiamichi	Minor	Bedrock	3,157,446	1.1	289,433	6,798,900
Holly Creek	Minor	Bedrock	18,450	0.0	1	132,600
Northeastern Oklahoma Pennsylvanian	Minor	Bedrock	214,861	2.1	37,601	706,100
Pennsylvanian	Minor	Bedrock	1,607,986	1.1	147,399	39,083,700
Pine Mountain	Minor	Bedrock	18,970	1.2	1,897	26,100
Post Oak	Minor	Bedrock	56,097	3.6	16,829	1,149,000
Potato Hills	Minor	Bedrock	20,664	1.2	1,980	39,000
Southwestern Oklahoma	Minor	Bedrock	961,541	2.2	180,289	2,899,500
North-Central Oklahoma	Minor	Bedrock	1,849,395	1.0	154,116	11,400,000
Western Oklahoma	Minor	Bedrock	892,730	1.5	111,591	3,935,200
Cache Creek Alluvium and Terrace	Minor	Alluvium and Terrace	183,050	0.0	0	597,000
Verdigris River Groundwater Basin	Minor	Alluvium and Terrace	67,934	0.0	0	0

Table 4-10 Groundwater Storage and Recharge for Oklahoma Aquifers

Aquifer	Class[1]	Type	Aquifer Area (acres)	Recharge Rate (in/yr)	Recharge Rate (AFY)	Aquifer Storage Volume (AFY)
Southern Neosho River Alluvium and Terrace	Minor	Alluvium and Terrace	25,457	0.0	0	40,500
Middle Neosho River Alluvium and Terrace	Minor	Alluvium and Terrace	15,580	0.0	0	24,000
Northern Neosho River Alluvium and Terrace	Minor	Alluvium and Terrace	38,001	0.0	0	57,000
Chikaskia River Alluvium and Terrace	Minor	Alluvium and Terrace	21,090	0.0	0	69,800
Ashland Isolated Terrace	Minor	Alluvium and Terrace	15,443	0.0	0	64,500
Beaver Creek Alluvium and Terrace	Minor	Alluvium and Terrace	36,062	0.0	0	120,600
Little River Alluvium and Terrace	Minor	Alluvium and Terrace	92,151	0.0	0	196,800
Haworth Isolated Terrace	Minor	Alluvium and Terrace	5,588	0.0	0	0
Fairview Isolated Terrace	Minor	Alluvium and Terrace	28,442	0.0	0	62,000
Isabella Isolated Terrace	Minor	Alluvium and Terrace	5,884	0.0	0	21,000
Loyal Isolated Terrace	Minor	Alluvium and Terrace	15,362	0.0	0	50,000
Ogallala	Major	Bedrock	4,376,988	0.2	76,400	90,590,200
North Canadian River	Major	Alluvium and Terrace	1,254,796	0.0	0	8,286,800
Washita River	Major	Alluvium and Terrace	696,750	0.0	0	4,920,600
Ogallala	Major	Bedrock	4,376,988	0.2	76,400	90,590,200
Gerty Sand	Major	Alluvium and Terrace	70,416	0.0	0	223,500

Notes:

1 Aquifer class is defined by OWRB based on the well pumping withdrawal rates observed in the aquifer, where major aquifers have greater withdrawal rates than minor aquifers.

Table 4-11 Groundwater Storage and Recharge by Basin

Basin Number	Basin ID	Basin Name	Bedrock Recharge (AF/YR)	Bedrock Storage (AF)	Alluvial and Terrace Storage (AF)
1	10100	Red River Mainstem (To Kiamichi River)	15,216	6,570,550	156,551
2	10201	Little River (McCurtain County) - 1	8,237	3,648,642	3,516
3	10202	Little River (McCurtain County) - 2	9,429	3,802,387	0
4	10203	Little River (McCurtain County) - 3	37	16,544	0
5	10301	Kiamichi River - 1	13,500	3,508,423	65,761
6	10302	Kiamichi River - 2	8,908	713,092	0
7	10411	Muddy Boggy River - 1	17,475	3,371,070	42,721
8	10412	Muddy Boggy River - 2	3,787	215,642	8,646
9	10420	Clear Boggy Creek	40,492	3,612,510	0
10	10500	Red River Mainstem (To Blue River)	6,730	2,367,642	198,432
11	10601	Blue River - 1	3,515	2,097,473	35,913
12	10602	Blue River - 2	51,588	4,105,012	923
13	10700	Red River Mainstem (To Washita)	5,193	3,098,889	451,957
14	10810	Lower Washita	42,008	2,452,693	612,847
15	10821	Middle Washita - 1	964	77,753	583,414
16	10822	Middle Washita - 2	42,940	7,442,556	447,875
17	10831	Upper Washita - 1	17,950	3,613,818	203,019
18	10832	Upper Washita - 2	29,537	8,378,644	0
19	10833	Upper Washita - 3	68,186	24,784,224	1,240,065
20	10840	Washita Headwaters	21,421	1,555,333	994,196
21	10900	Red River Mainstem (To Walnut Bayou)	93,583	10,682,040	579,070
22	11000	Walnut Bayou	8,162	622,554	170,996
23	11100	Mud Creek	617	50,647	136,695
24	11201	Beaver Creek - 1	0	0	29,156
25	11202	Beaver Creek - 2	7,133	656,172	0
26	11203	Beaver Creek - 3	0	0	0
27	11311	Cache Creek - 1	0	0	0
28	11312	Cache Creek - 2	7,978	1,124,859	0
29	11321	Deep Red Creek And West Cache Creek - 1	1,341	171,096	0
30	11322	Deep Red Creek And West Cache Creek - 2	0	0	22,280

Table 4-11 Groundwater Storage and Recharge by Basin

Basin Number	Basin ID	Basin Name	Bedrock Recharge (AF/YR)	Bedrock Storage (AF)	Alluvial and Terrace Storage (AF)
31	11400	Red River Mainstem (To North Fork of Red)	0	0	658,081
32	11511	Lower North Fork Red River - 1	0	0	297,606
33	11512	Lower North Fork Red River - 2	0	0	544,210
34	11513	Lower North Fork Red River - 3	20,672	897,053	556,517
35	11514	Lower North Fork Red River - 4	0	0	57,417
36	11521	Upper North Fork Red River - 1	0	0	540,314
37	11522	Upper North Fork Red River - 2	10,588	590,500	1,312,602
38	11601	Salt Fork Red River - 1	20,439	394,832	59,878
39	11602	Salt Fork Red River - 2	3,006	58,215	0
40	11701	Prairie Dog Town Fork Red River - 1	15,466	297,333	139
41	11702	Prairie Dog Town Fork Red River - 2	19,233	371,524	0
42	11801	Elm Fork Red River - 1	0	0	108,588
43	11802	Elm Fork Red River - 2	0	0	79,927
44	20101	Poteau River - 1	37	1,905	10,325
45	20102	Poteau River - 2	0	0	0
46	20201	Lower Arkansas River - 1	105,591	5,719,541	129,727
47	20202	Lower Arkansas River - 2	34,821	1,854,915	115,434
48	20300	Canadian River (To North Canadian River)	4,130	1,315,693	737,963
49	20400	Middle Arkansas River	3,475	211,440	274,957
50	20510	Lower North Canadian River	49,246	11,494,624	1,233,234
51	20520	Middle North Canadian River	517	181,135	1,049,209
52	20531	Upper North Canadian River - 1	3,113	1,504,679	1,431,708
53	20532	Upper North Canadian River - 2	8,231	11,257,483	1,335,469
54	20533	Upper North Canadian River - 3	9,727	4,907,047	147,859
55	20540	North Canadian Headwaters	24,596	42,539,963	0
56	20611	Lower Canadian River - 1	16,545	4,124,521	1,037,329
57	20612	Lower Canadian River - 2	0	0	166,531
58	20620	Middle Canadian River	15,051	3,451,938	983,016
59	20630	Upper Canadian River	66,215	20,877,876	1,262,639
60	20700	Deep Fork River	91,849	14,595,102	21,525

Table 4-11 Groundwater Storage and Recharge by Basin

Basin Number	Basin ID	Basin Name	Bedrock Recharge (AF/YR)	Bedrock Storage (AF)	Alluvial and Terrace Storage (AF)
61	20801	Little River - 1	14,355	2,622,255	16,206
62	20802	Little River - 2	36,948	9,821,915	88,081
63	20910	Lower Cimarron River	15,229	2,320,393	224,400
64	20920	Middle Cimarron River	25,305	5,369,806	3,157,923
65	20930	Upper Cimarron River	2,328	5,340,577	832,618
66	20940	Cimarron Headwaters	3,052	1,946,373	0
67	21011	Lower Salt Fork Arkansas River - 1	0	0	87,569
69	21012	Lower Salt Fork Arkansas River - 2	0	0	3,806
70	21013	Lower Salt Fork Arkansas River - 3	0	0	0
68	21020	Upper Salt Fork Arkansas River	0	0	1,691,405
71	21100	Arkansas River - Cimarron Rivers to Keystone Lake	38,603	2,840,511	68,747
72	21200	Arkansas River Mainstem (To Kansas State Line)	2,227	58,238	98,099
73	21301	Bird Creek - 1	0	0	0
74	21302	Bird Creek - 2	25,282	661,165	0
75	21401	Caney River - 1	0	0	0
76	21402	Caney River - 2	19,480	509,427	0
77	21511	Verdigris River (To Oologah Dam) - 1	0	0	106,446
78	21512	Verdigris River (To Oologah Dam) - 2	0	0	0
79	21520	Verdigris River (To Kansas State Line)	15,694	652,660	0
80	21601	Grand (Neosho) River - 1	217,874	11,735,196	5,755
81	21602	Grand (Neosho) River - 2	119,467	7,265,566	0
82	21700	Illinois River	119,507	7,194,816	5,408

Table 4-12 Return Flow Percentages by Basin and Demand Sector

Basin Number	Basin ID	Basin Name	Average Annual Return Flow Volume (AFY)[1]						
			Municipal & Industrial	Self Supplied Residential	Oil & Gas	Self Supplied Industrial	Thermoelectric Power	Livestock	Crop Irrigation
1	10100	Red River Mainstem (To Kiamichi River)	51%	0%	0%	0%	38%	0%	10%
2	10201	Little River (McCurtain County) - 1	57%	0%	0%	0%	38%	0%	10%
3	10202	Little River (McCurtain County) - 2	63%	0%	0%	0%	38%	0%	10%
4	10203	Little River (McCurtain County) - 3	95%	0%	0%	0%	38%	0%	10%
5	10301	Kiamichi River - 1	95%	0%	0%	0%	38%	0%	10%
6	10302	Kiamichi River - 2	95%	0%	0%	0%	38%	0%	10%
7	10411	Muddy Boggy River - 1	95%	0%	0%	0%	38%	0%	10%
8	10412	Muddy Boggy River - 2	81%	0%	0%	0%	38%	0%	10%
9	10420	Clear Boggy Creek	56%	0%	0%	0%	38%	0%	10%
10	10500	Red River Mainstem (To Blue River)	63%	0%	0%	0%	38%	0%	10%
11	10601	Blue River - 1	48%	0%	0%	0%	38%	0%	10%
12	10602	Blue River - 2	48%	0%	0%	0%	38%	0%	10%
13	10700	Red River Mainstem (To Washita)	95%	0%	0%	0%	38%	0%	10%
14	10810	Lower Washita	41%	0%	0%	0%	38%	0%	10%
15	10821	Middle Washita - 1	95%	0%	0%	0%	38%	0%	10%
16	10822	Middle Washita - 2	59%	0%	0%	0%	38%	0%	10%
17	10831	Upper Washita - 1	95%	0%	0%	0%	38%	0%	10%
18	10832	Upper Washita - 2	0%	0%	0%	0%	38%	0%	10%
19	10833	Upper Washita - 3	46%	0%	0%	0%	38%	0%	10%
20	10840	Washita Headwaters	48%	0%	0%	0%	38%	0%	10%
21	10900	Red River Mainstem (To Walnut Bayou)	52%	0%	0%	0%	38%	0%	10%
22	11000	Walnut Bayou	84%	0%	0%	0%	38%	0%	10%
23	11100	Mud Creek	41%	0%	0%	0%	38%	0%	10%
24	11201	Beaver Creek - 1	16%	0%	0%	0%	38%	0%	10%
25	11202	Beaver Creek - 2	5%	0%	0%	0%	38%	0%	10%
26	11203	Beaver Creek - 3	84%	0%	0%	0%	38%	0%	10%
27	11311	Cache Creek - 1	0%	0%	0%	0%	38%	0%	10%
28	11312	Cache Creek - 2	33%	0%	0%	0%	38%	0%	10%
29	11321	Deep Red Creek And West Cache Creek - 1	35%	0%	0%	0%	38%	0%	10%
30	11322	Deep Red Creek And West Cache Creek - 2	27%	0%	0%	0%	38%	0%	10%
31	11400	Red River Mainstem (To North Fork of Red)	52%	0%	0%	0%	38%	0%	10%
32	11511	Lower North Fork Red River - 1	0%	0%	0%	0%	38%	0%	10%
33	11512	Lower North Fork Red River - 2	43%	0%	0%	0%	38%	0%	10%
34	11513	Lower North Fork Red River - 3	19%	0%	0%	0%	38%	0%	10%
35	11514	Lower North Fork Red River - 4	0%	0%	0%	0%	38%	0%	10%
36	11521	Upper North Fork Red River - 1	71%	0%	0%	0%	38%	0%	10%
37	11522	Upper North Fork Red River - 2	26%	0%	0%	0%	38%	0%	10%
38	11601	Salt Fork Red River - 1	48%	0%	0%	0%	38%	0%	10%
39	11602	Salt Fork Red River - 2	0%	0%	0%	0%	38%	0%	10%
40	11701	Prairie Dog Town Fork Red River - 1	0%	0%	0%	0%	38%	0%	10%
41	11702	Prairie Dog Town Fork Red River - 2	63%	0%	0%	0%	38%	0%	10%
42	11801	Elm Fork Red River - 1	95%	0%	0%	0%	38%	0%	10%
43	11802	Elm Fork Red River - 2	0%	0%	0%	0%	38%	0%	10%
44	20101	Poteau River - 1	95%	0%	0%	0%	38%	0%	10%
45	20102	Poteau River - 2	93%	0%	0%	0%	38%	0%	10%
46	20201	Lower Arkansas River - 1	84%	0%	0%	0%	38%	0%	10%
47	20202	Lower Arkansas River - 2	63%	0%	0%	0%	38%	0%	10%
48	20300	Canadian River (To North Canadian River)	64%	0%	0%	0%	38%	0%	10%
49	20400	Middle Arkansas River	42%	0%	0%	0%	38%	0%	10%

Table 4-12 Return Flow Percentages by Basin and Demand Sector

Basin Number	Basin ID	Basin Name	Average Annual Return Flow Volume (AFY)[1]						
			Municipal & Industrial	Self Supplied Residential	Oil & Gas	Self Supplied Industrial	Thermoelectric Power	Livestock	Crop Irrigation
50	20510	Lower North Canadian River	35%	0%	0%	0%	38%	0%	10%
51	20520	Middle North Canadian River	22%	0%	0%	0%	38%	0%	10%
52	20531	Upper North Canadian River - 1	5%	0%	0%	0%	38%	0%	10%
53	20532	Upper North Canadian River - 2	15%	0%	0%	0%	38%	0%	10%
54	20533	Upper North Canadian River - 3	0%	0%	0%	0%	38%	0%	10%
55	20540	North Canadian Headwaters	3%	0%	0%	0%	38%	0%	10%
56	20611	Lower Canadian River - 1	23%	0%	0%	0%	38%	0%	10%
57	20612	Lower Canadian River - 2	15%	0%	0%	0%	38%	0%	10%
58	20620	Middle Canadian River	31%	0%	0%	0%	38%	0%	10%
59	20630	Upper Canadian River	17%	0%	0%	0%	38%	0%	10%
60	20700	Deep Fork River	15%	0%	0%	0%	38%	0%	10%
61	20801	Little River - 1	79%	0%	0%	0%	38%	0%	10%
62	20802	Little River - 2	5%	0%	0%	0%	38%	0%	10%
63	20910	Lower Cimarron River	59%	0%	0%	0%	38%	0%	10%
64	20920	Middle Cimarron River	29%	0%	0%	0%	38%	0%	10%
65	20930	Upper Cimarron River	22%	0%	0%	0%	38%	0%	10%
66	20940	Cimarron Headwaters	0%	0%	0%	0%	38%	0%	10%
67	21011	Lower Salt Fork Arkansas River - 1	25%	0%	0%	0%	38%	0%	10%
69	21012	Lower Salt Fork Arkansas River - 2	24%	0%	0%	0%	38%	0%	10%
70	21013	Lower Salt Fork Arkansas River - 3	0%	0%	0%	0%	38%	0%	10%
68	21020	Upper Salt Fork Arkansas River	22%	0%	0%	0%	38%	0%	10%
71	21100	Arkansas River - Cimarron Rivers to Keystone Lake	55%	0%	0%	0%	38%	0%	10%
72	21200	Arkansas River Mainstem (To Kansas State Line)	50%	0%	0%	0%	38%	0%	10%
73	21301	Bird Creek - 1	39%	0%	0%	0%	38%	0%	10%
74	21302	Bird Creek - 2	32%	0%	0%	0%	38%	0%	10%
75	21401	Caney River - 1	14%	0%	0%	0%	38%	0%	10%
76	21402	Caney River - 2	21%	0%	0%	0%	38%	0%	10%
77	21511	Verdigris River (To Oologah Dam) - 1	74%	0%	0%	0%	38%	0%	10%
78	21512	Verdigris River (To Oologah Dam) - 2	60%	0%	0%	0%	38%	0%	10%
79	21520	Verdigris River (To Kansas State Line)	89%	0%	0%	0%	38%	0%	10%
80	21601	Grand (Neosho) River - 1	76%	0%	0%	0%	38%	0%	10%
81	21602	Grand (Neosho) River - 2	89%	0%	0%	0%	38%	0%	10%
82	21700	Illinois River	59%	0%	0%	0%	38%	0%	10%

Table 4-13 Out-of-Basin Demands by Basin for the Municipal and Industrial Demand Sector

Basin Number	Basin ID	Basin Name	Out-of-Basin Demands					
			2010	2020	2030	2040	2050	2060
1	10100	Red River Mainstem (To Kiamichi River)	0	0	0	0	0	0
2	10201	Little River (McCurtain County) - 1	0	0	0	0	0	0
3	10202	Little River (McCurtain County) - 2	0	0	0	0	0	0
4	10203	Little River (McCurtain County) - 3	0	0	0	0	0	0
5	10301	Kiamichi River - 1	0	0	0	0	0	0
6	10302	Kiamichi River - 2	0	0	0	0	0	0
7	10411	Muddy Boggy River - 1	0	0	0	0	0	0
8	10412	Muddy Boggy River - 2	430	1,969	2,114	2,114	2,114	2,114
9	10420	Clear Boggy Creek	0	0	0	0	0	0
10	10500	Red River Mainstem (To Blue River)	0	0	0	0	0	0
11	10601	Blue River - 1	0	0	0	0	0	0
12	10602	Blue River - 2	0	0	0	0	0	0
13	10700	Red River Mainstem (To Washita)	0	0	0	0	0	0
14	10810	Lower Washita	0	0	0	0	0	0
15	10821	Middle Washita - 1	19	79	142	204	270	336
16	10822	Middle Washita - 2	330	501	660	803	946	1,094
17	10831	Upper Washita - 1	46	210	393	597	825	1,079
18	10832	Upper Washita - 2	0	0	0	0	0	0
19	10833	Upper Washita - 3	0	0	0	0	0	0
20	10840	Washita Headwaters	0	0	0	0	0	0
21	10900	Red River Mainstem (To Walnut Bayou)	0	0	0	0	0	0
22	11000	Walnut Bayou	0	0	0	0	0	0
23	11100	Mud Creek	0	0	0	0	0	0
24	11201	Beaver Creek - 1	0	0	0	0	0	0
25	11202	Beaver Creek - 2	25	80	101	127	164	210
26	11203	Beaver Creek - 3	37	117	147	185	238	306
27	11311	Cache Creek - 1	0	0	0	0	0	0
28	11312	Cache Creek - 2	0	0	0	0	0	0
29	11321	Deep Red Creek And West Cache Creek - 1	0	0	0	0	0	0
30	11322	Deep Red Creek And West Cache Creek - 2	0	0	0	0	0	0
31	11400	Red River Mainstem (To North Fork of Red)	0	0	0	0	0	0

Table 4-13 Out-of-Basin Demands by Basin for the Municipal and Industrial Demand Sector

Basin Number	Basin ID	Basin Name	Out-of-Basin Demands					
			2010	2020	2030	2040	2050	2060
32	11511	Lower North Fork Red River - 1	0	0	0	0	0	0
33	11512	Lower North Fork Red River - 2	50	173	274	356	423	477
34	11513	Lower North Fork Red River - 3	85	319	590	861	1,131	1,429
35	11514	Lower North Fork Red River - 4	0	0	0	0	0	0
36	11521	Upper North Fork Red River - 1	0	0	0	0	0	0
37	11522	Upper North Fork Red River - 2	0	0	0	0	0	0
38	11601	Salt Fork Red River - 1	43	147	233	302	360	406
39	11602	Salt Fork Red River - 2	0	0	0	0	0	0
40	11701	Prairie Dog Town Fork Red River - 1	0	0	0	0	0	0
41	11702	Prairie Dog Town Fork Red River - 2	0	0	0	0	0	0
42	11801	Elm Fork Red River - 1	0	0	0	0	0	0
43	11802	Elm Fork Red River - 2	0	0	0	0	0	0
44	20101	Poteau River - 1	0	0	0	0	0	0
45	20102	Poteau River - 2	0	1	2	2	3	4
46	20201	Lower Arkansas River - 1	99	385	677	967	1,264	1,566
47	20202	Lower Arkansas River - 2	127	426	650	849	1,049	1,251
48	20300	Canadian River (To North Canadian River)	0	0	0	0	0	0
49	20400	Middle Arkansas River	1,300	4,283	6,609	8,328	9,709	11,088
50	20510	Lower North Canadian River	1,415	4,279	6,036	6,403	6,498	6,592
51	20520	Middle North Canadian River	256	780	1,075	1,075	1,075	1,075
52	20531	Upper North Canadian River - 1	0	0	0	0	0	0
53	20532	Upper North Canadian River - 2	0	0	0	0	0	0
54	20533	Upper North Canadian River - 3	0	0	0	0	0	0
55	20540	North Canadian Headwaters	0	0	0	0	0	0
56	20611	Lower Canadian River - 1	0	0	0	0	0	0
57	20612	Lower Canadian River - 2	26	107	192	278	366	457
58	20620	Middle Canadian River	713	2,239	3,279	3,768	4,124	4,473
59	20630	Upper Canadian River	0	0	0	0	0	0
60	20700	Deep Fork River	504	1,537	2,118	2,118	2,118	2,118
61	20801	Little River - 1	0	0	0	0	0	0
62	20802	Little River - 2	637	1,940	2,674	2,674	2,674	2,674

Table 4-13 Out-of-Basin Demands by Basin for the Municipal and Industrial Demand Sector

Basin Number	Basin ID	Basin Name	Out-of-Basin Demands					
			2010	2020	2030	2040	2050	2060
63	20910	Lower Cimarron River	0	0	0	0	0	0
64	20920	Middle Cimarron River	565	1,755	2,528	2,764	2,995	3,236
65	20930	Upper Cimarron River	0	0	0	0	0	0
66	20940	Cimarron Headwaters	0	0	0	0	0	0
67	21011	Lower Salt Fork Arkansas River - 1	0	0	0	0	0	0
69	21012	Lower Salt Fork Arkansas River - 2	0	0	0	0	0	0
70	21013	Lower Salt Fork Arkansas River - 3	0	0	0	0	0	0
68	21020	Upper Salt Fork Arkansas River	0	0	0	0	0	0
71	21100	Arkansas River - Cimarron Rivers to Keystone Lake	358	1,065	1,795	2,505	3,010	3,493
72	21200	Arkansas River Mainstem (To Kansas State Line)	0	0	0	0	0	0
73	21301	Bird Creek - 1	1,016	3,283	5,033	6,276	7,229	8,161
74	21302	Bird Creek - 2	0	0	0	0	0	0
75	21401	Caney River - 1	0	0	0	0	0	0
76	21402	Caney River - 2	0	0	0	0	0	0
77	21511	Verdigris River (To Oologah Dam) - 1	39	125	192	239	275	311
78	21512	Verdigris River (To Oologah Dam) - 2	11	36	56	71	83	95
79	21520	Verdigris River (To Kansas State Line)	0	0	0	0	0	0
80	21601	Grand (Neosho) River - 1	0	0	0	0	0	0
81	21602	Grand (Neosho) River - 2	0	0	0	0	0	0
82	21700	Illinois River	0	0	0	0	0	0

Table 4-14 Out-of-Basin Supplies by Basin for the Municipal and Industrial Sector

Basin Number	Basin ID	Basin Name	Out-of-Basin Supplies					
			2010	2020	2030	2040	2050	2060
1	10100	Red River Mainstem (To Kiamichi River)	0	0	0	0	0	0
2	10201	Little River (McCurtain County) - 1	0	0	0	0	0	0
3	10202	Little River (McCurtain County) - 2	0	0	0	0	0	0
4	10203	Little River (McCurtain County) - 3	0	0	0	0	0	0
5	10301	Kiamichi River - 1	0	0	0	0	0	0
6	10302	Kiamichi River - 2	0	0	0	0	0	0
7	10411	Muddy Boggy River - 1	0	0	0	0	0	0
8	10412	Muddy Boggy River - 2	3,232	9,850	13,575	13,575	13,575	13,575
9	10420	Clear Boggy Creek	0	0	0	0	0	0
10	10500	Red River Mainstem (To Blue River)	0	0	0	0	0	0
11	10601	Blue River - 1	0	0	0	0	0	0
12	10602	Blue River - 2	0	0	0	0	0	0
13	10700	Red River Mainstem (To Washita)	0	0	0	0	0	0
14	10810	Lower Washita	62	198	249	313	402	517
15	10821	Middle Washita - 1	0	0	0	0	0	0
16	10822	Middle Washita - 2	0	0	0	0	0	0
17	10831	Upper Washita - 1	0	0	0	0	0	0
18	10832	Upper Washita - 2	376	711	1,053	1,400	1,771	2,173
19	10833	Upper Washita - 3	0	0	0	0	0	0
20	10840	Washita Headwaters	0	0	0	0	0	0
21	10900	Red River Mainstem (To Walnut Bayou)	0	0	0	0	0	0
22	11000	Walnut Bayou	0	0	0	0	0	0
23	11100	Mud Creek	0	0	0	0	0	0
24	11201	Beaver Creek - 1	0	0	0	0	0	0
25	11202	Beaver Creek - 2	0	0	0	0	0	0
26	11203	Beaver Creek - 3	0	0	0	0	0	0
27	11311	Cache Creek - 1	0	0	0	0	0	0
28	11312	Cache Creek - 2	0	0	0	0	0	0
29	11321	Deep Red Creek And West Cache Creek - 1	0	0	0	0	0	0
30	11322	Deep Red Creek And West Cache Creek - 2	0	0	0	0	0	0
31	11400	Red River Mainstem (To North Fork of Red)	0	0	0	0	0	0

Table 4-14 Out-of-Basin Supplies by Basin for the Municipal and Industrial Sector

Basin Number	Basin ID	Basin Name	Out-of-Basin Supplies					
			2010	2020	2030	2040	2050	2060
32	11511	Lower North Fork Red River - 1	0	0	0	0	0	0
33	11512	Lower North Fork Red River - 2	0	0	0	0	0	0
34	11513	Lower North Fork Red River - 3	0	0	0	0	0	0
35	11514	Lower North Fork Red River - 4	93	320	508	658	783	883
36	11521	Upper North Fork Red River - 1	0	0	0	0	0	0
37	11522	Upper North Fork Red River - 2	85	319	590	861	1,131	1,429
38	11601	Salt Fork Red River - 1	0	0	0	0	0	0
39	11602	Salt Fork Red River - 2	0	0	0	0	0	0
40	11701	Prairie Dog Town Fork Red River - 1	0	0	0	0	0	0
41	11702	Prairie Dog Town Fork Red River - 2	0	0	0	0	0	0
42	11801	Elm Fork Red River - 1	0	0	0	0	0	0
43	11802	Elm Fork Red River - 2	0	0	0	0	0	0
44	20101	Poteau River - 1	0	0	0	0	0	0
45	20102	Poteau River - 2	0	0	0	0	0	0
46	20201	Lower Arkansas River - 1	0	0	0	0	0	0
47	20202	Lower Arkansas River - 2	0	0	0	0	0	0
48	20300	Canadian River (To North Canadian River)	456	2,064	2,294	2,384	2,476	2,576
49	20400	Middle Arkansas River	0	0	0	0	0	0
50	20510	Lower North Canadian River	0	0	0	0	0	0
51	20520	Middle North Canadian River	0	0	0	0	0	0
52	20531	Upper North Canadian River - 1	0	0	0	0	0	0
53	20532	Upper North Canadian River - 2	0	0	0	0	0	0
54	20533	Upper North Canadian River - 3	0	0	0	0	0	0
55	20540	North Canadian Headwaters	0	0	0	0	0	0
56	20611	Lower Canadian River - 1	52	213	383	553	730	910
57	20612	Lower Canadian River - 2	0	0	0	0	0	0
58	20620	Middle Canadian River	0	0	0	0	0	0
59	20630	Upper Canadian River	0	0	0	0	0	0
60	20700	Deep Fork River	109	362	609	845	1,076	1,317
61	20801	Little River - 1	0	0	0	0	0	0
62	20802	Little River - 2	742	2,290	3,477	4,311	4,739	5,159

Table 4-14 Out-of-Basin Supplies by Basin for the Municipal and Industrial Sector

Basin Number	Basin ID	Basin Name	Out-of-Basin Supplies					
			2010	2020	2030	2040	2050	2060
63	20910	Lower Cimarron River	0	0	0	0	0	0
64	20920	Middle Cimarron River	0	0	0	0	0	0
65	20930	Upper Cimarron River	0	0	0	0	0	0
66	20940	Cimarron Headwaters	0	0	0	0	0	0
67	21011	Lower Salt Fork Arkansas River - 1	0	0	0	0	0	0
69	21012	Lower Salt Fork Arkansas River - 2	0	0	0	0	0	0
70	21013	Lower Salt Fork Arkansas River - 3	0	0	0	0	0	0
68	21020	Upper Salt Fork Arkansas River	0	0	0	0	0	0
71	21100	Arkansas River - Cimarron Rivers to Keystone Lake	0	0	0	0	0	0
72	21200	Arkansas River Mainstem (To Kansas State Line)	339	1,002	1,698	2,382	2,865	3,325
73	21301	Bird Creek - 1	0	0	0	0	0	0
74	21302	Bird Creek - 2	187	650	1,016	1,323	1,602	1,898
75	21401	Caney River - 1	0	0	0	0	0	0
76	21402	Caney River - 2	0	0	0	0	0	0
77	21511	Verdigris River (To Oologah Dam) - 1	340	1,138	1,770	2,243	2,629	3,013
78	21512	Verdigris River (To Oologah Dam) - 2	822	2,656	4,072	5,076	5,846	6,599
79	21520	Verdigris River (To Kansas State Line)	0	0	0	0	0	0
80	21601	Grand (Neosho) River - 1	1,152	3,734	5,709	7,140	8,275	9,389
81	21602	Grand (Neosho) River - 2	0	0	0	0	0	0
82	21700	Illinois River	83	329	569	803	1,043	1,283

Section 5
Physical Water Supply Availability Results

The primary objectives of the physical supply availability analysis are to characterize statewide physical water supply availability through the 2060 planning horizon, compare these supply projections with demand projections, and quantify anticipated gaps in physical supply. This section describes the basis of the analyses, the results of the analyses, and known limitations of the methods and results.

5.1 Basis of Physical Water Supply Availability Analysis

The Oklahoma H_2O physical water supply availability tool provides the ability to analyze any of a number of scenarios and potential future conditions. The following conditions were used to assess the baseline physical supply availability:

- The return flows from a given basin are delivered to the next downstream basin or can be used in the basin of origin.
- The change in upstream demand affects the supply availability downstream. For example, return flows generated in a basin will continue to flow downstream until the supply is depleted.
- Supplies in BGW aquifers are not hydrologically connected to SW.
- Existing out-of-basin supplies were used to satisfy the receiving basin's incremental demand (2010 to 2060) up to the permitted transfer capacity.
- Future demand is supplied by water from the basin that generates the demand (i.e., the analysis characterized the gap that would be expected to occur if all new demand was satisfied with local sources and existing out-of-basin supplies).
- All effects of well pumping remain in the basin where a well is located.

The maximum SW gap for the period of record is defined as the maximum of the sum of the monthly gaps for a given year for all basins. For the 2020 planning horizon, the change in demand (2020 demand minus 2010 demand) is subtracted from the available supply (historical hydrology) to estimate the gap. Similarly, for the 2060 planning horizon, the change in demand (2060 demand minus 2010 demand) is subtracted from the available supply (historical hydrology) to estimate the gap. AGW and BGW values are referred to as storage depletions rather than gaps, because each aquifer has a certain amount of available storage that may be used before there is no remaining supply. A BGW storage depletion is assumed to occur if the demand exceeds the aquifer recharge rate, and an AGW storage depletion is assumed to occur if the AGW demand exceeds the available streamflow after the SW demand has been subtracted.

None of the analyses presented herein are intended to indicate the legal or economic availability of water under Oklahoma's existing water administrative system. Rather, these analyses focus on the physical availability of SW and GW supplies. Analyses of the amounts of water that could be permitted for use, by basin, are documented separately.

5.2 Physical Water Supply Availability Results

As one example of the effects of variable hydrology, the maximum SW gap was characterized based on two historical hydrologic scenarios. One of Oklahoma's worst single-year droughts on record occurred in 2006, whereas 2007 represented a high-precipitation year in most parts of the state. These two years were used to demonstrate examples of the water availability and shortages that might occur under dry- and wet-year conditions.

However, recognizing that conditions vary substantially from one area to another in any given year, the entire period of record for streamflows from water years 1950 through 2007 was used to examine the anticipated probability of SW gaps.

AGW aquifers have a hydrologic connection with the overlying streams and rivers. This connection means that AGW storage depletions can reduce SW flows. The interaction of AGW storage depletions and SW flows is complex and changes over time depending on the location and rate of AGW storage depletions and on the SW flows themselves. Even so, AGW demand from well pumping eventually is supplied by the flow in streams or from recharged water that would have discharged to streams. This analysis incorporates the AGW-SW connection by attributing all AGW demand to streamflow.

BGW aquifers in Oklahoma, for the most part, do not have a hydrologic connection to overlying SW. BGW aquifers are replenished slowly by recharge from surface infiltration and from adjacent aquifers. This analysis evaluates BGW storage depletions using projected BGW demand in comparison to the estimates of annual incremental recharge to major BGW aquifers. Depletions to BGW aquifers are tabulated in comparison to estimates of the volume of water in storage in these aquifers.

The potential for gaps and storage depletions was analyzed for future demand projections, by basin, in 10-year increments from 2010 through 2060. Both the magnitude and the probability of supply gaps and storage depletions are important considerations in water supply planning. For instance, many communities or water users would take steps to mitigate shortages if they were anticipated to be high in both magnitude and probability. However, investments in infrastructure to mitigate a low-probability, high-magnitude shortage may not be economically feasible, depending on local conditions and priorities. Conversely, a high-probability, low-magnitude shortage (e.g., less than 500 AFY) might be addressed by demand management measures. Potential solutions for addressing anticipated supply needs will be addressed on a basin level in the Regional Reports.

The resulting SW gaps are presented graphically for the 2010 and 2060 demand in Figure 5-1 through Figure 5-6. Those figures depict the minimum, median, and maximum

SW gaps that would be anticipated under the past 10 years of hydrology for the 2010 and 2060 incremental demand in each basin. The last 10 years of hydrology (streamflow gage) data are used for this illustration to best reflect recent and current development in the basin, including existing SW diversions, reservoirs, and other water demand and management aspects. However, the entire 58-year period of hydrologic record was used to illustrate the potential probability of SW gaps in each basin, as depicted in **Figure 5-7** and **Figure 5-8** for the 2010 and 2060 baseline demand conditions, respectively.

Similarly, **Figure 5-9** through **Figure 5-14** illustrate the minimum, median, and maximum AGW storage depletions that would be anticipated for the 2010 and 2060 demand when compared to the last 10 years of hydrology, and **Figure 5-15** and **Figure 5-16** illustrate the anticipated probability of AGW storage depletions for the 2010 and 2060 demand. **Figure 5-17** and **Figure 5-18** illustrate the BGW storage depletions for the 2010 and 2060 incremental demand scenarios based on the incremental recharge rate, respectively.

The projections of maximum SW gaps and GW storage depletions, based on historical hydrology from water years 1950 through 2010 and the 2010 through 2060 incremental demand are summarized in **Tables 5-1, 5-2, and 5-3**. The cells in these tables are color-coded to correspond with the relative magnitude of the SW gaps or GW storage depletions for each basin and each future planning horizon.

An estimate of the SW flow at each of the 82 OCWP SW gages in 2060 is presented in terms of the annual average flow and the minimum annual flow in **Figure 5-19** and **Figure 5-20**, respectively. These projections are based on flow data for the 58-year period of record at each OCWP stream gage location and the projected SW use in each basin in 2060. The minimum streamflow shown for each basin is an estimate of the minimum flow for that basin under any of the 58 years of historical hydrologic data, and as such, the minimum flows shown in the figure would likely not occur for all 82 basins in any single future calendar year. SW gaps are calculated based on a monthly comparison of SW demand to gaged flow. Therefore, gaps may occur in any basin, including those for which minimum annual flows are projected to be greater than zero.

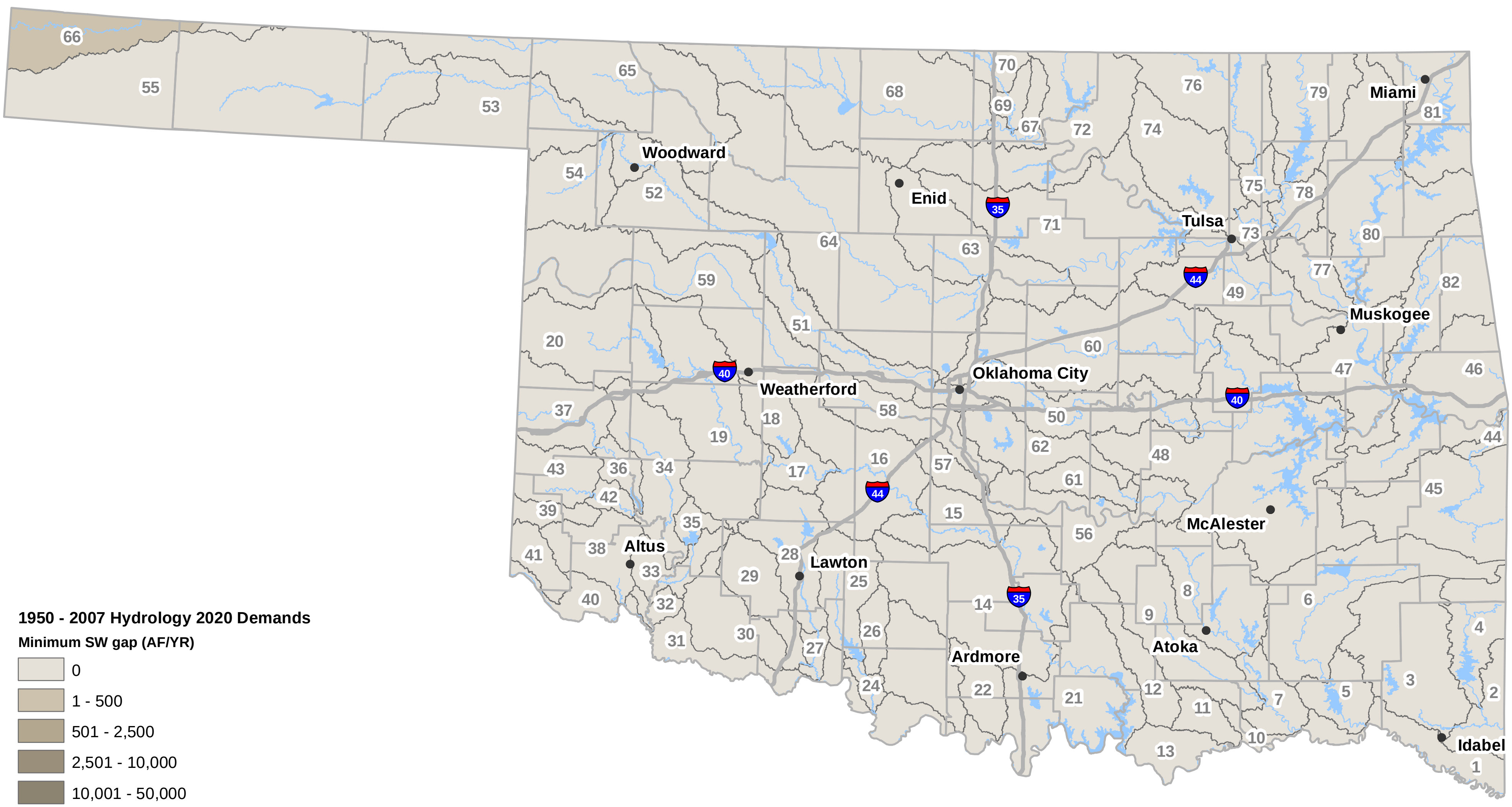
The Regional Reports will further characterize the gaps and storage depletions and evaluate potential water supply options. Potential water supply options may include demand reduction, increased reliance on SW, and increased reliance on GW, new reservoir storage, or out-of-basin supplies.

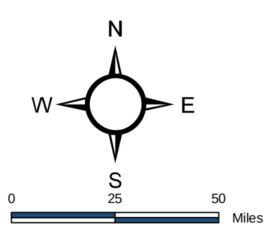
5.3 Limitations and Uncertainties in the Water Availability Analyses

There are several known limitations and uncertainties associated with the current model methodology and input data. The effects of these limitations will be investigated with alternate assumptions and supply scenarios as the technical studies move from the statewide screening level down to the basin level, as described in Section 6 of this report. The key known limitations include the following:

- Localized SW gaps or GW storage depletions may not be evident at the basin level, such that the magnitude and/or probability of localized shortages might be greater than those shown via this analysis for each OCWP basin.
- Future proportions of SW and GW used to satisfy future demand for a given basin and water use sector may differ from current proportions.
- The Red River is not considered a water supply source due to high salinity and other challenges.
- Grand River Dam Authority (GRDA) contracts are implicitly included in the input dataset using SW diversion amounts identified in the OWRB Water Rights database (OWRB 2008b).
- The statistical method used to estimate flows where actual data are missing is not constrained to a minimum flow value; therefore, periods of zero flow may be created when actual flows may have occurred.
- Drawing down the water in a reservoir may influence the timing or quantity of gaps, especially when the majority of consumptive use occurs upstream of the stream gage.
- Upstream states were assumed to use 60 percent of all available flow into Oklahoma based on OWRB's permitting protocol, which is adapted from interstate compact obligations between Oklahoma and its neighboring states.
- Downstream interstate compact obligations were assumed to not constrain availability, and are analyzed separately as part of the legal availability analysis.

Figure 5-1 - Minimum Annual Surface Water Supply Availability Gap for 1950 through 2007 Historical Hydrology and 2020 Demands





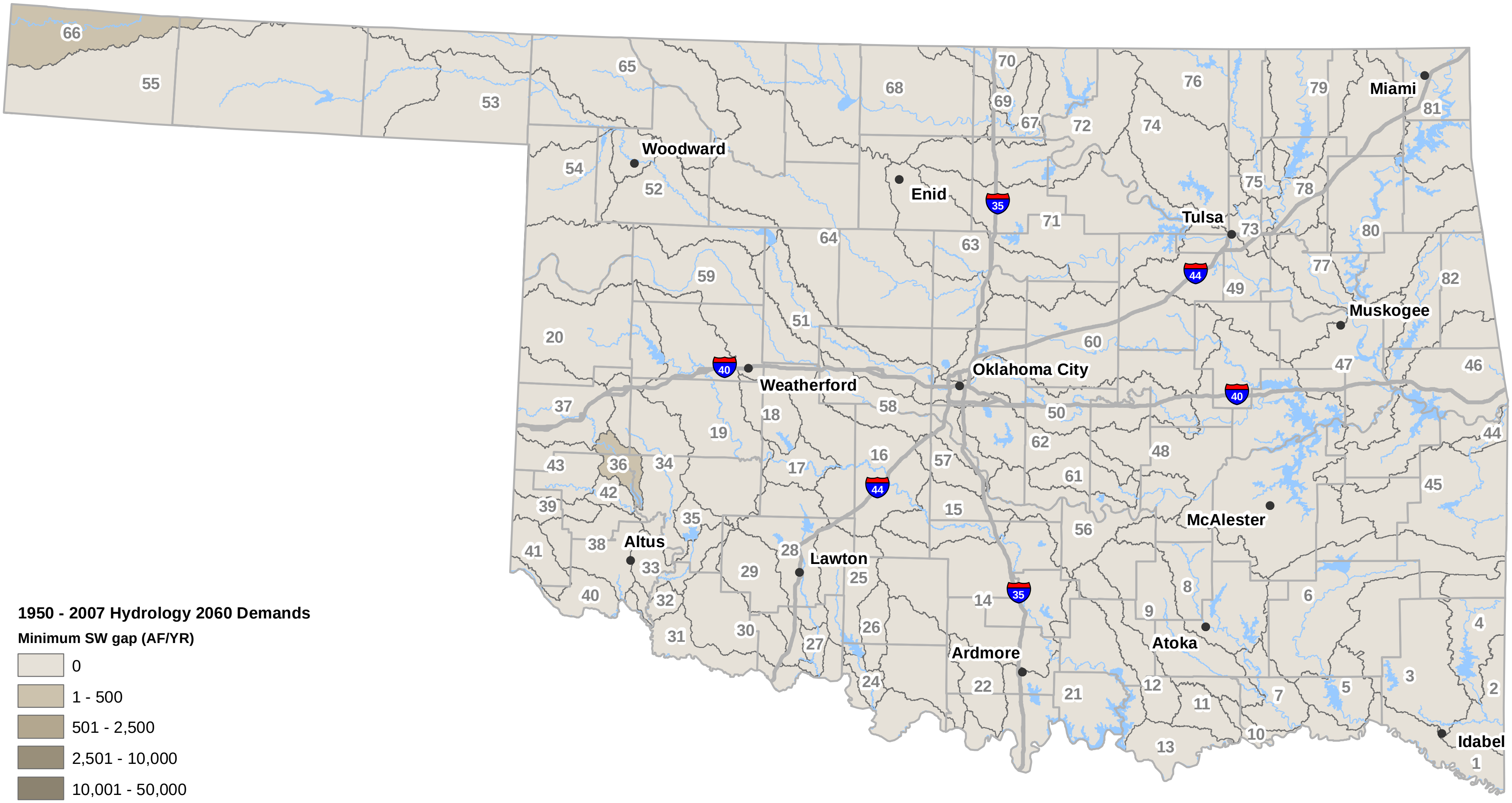
State of Oklahoma OWRB Water Resources Board the water agency

US Army Corps of Engineers

CDM

Oklahoma Comprehensive Water Plan OCWP

Figure 5-2 - Minimum Annual Surface Water Supply Availability Gap for 1950 through 2007 Historical Hydrology and 2060 Demands



1950 - 2007 Hydrology 2060 Demands

Minimum SW gap (AF/YR)

- 0
- 1 - 500
- 501 - 2,500
- 2,501 - 10,000
- 10,001 - 50,000

N

W E

S

0 25 50

Miles

State of Oklahoma OWRB WATER RESOURCES BOARD the water agency

US Army Corps of Engineers

CDM

Oklahoma Comprehensive Water Plan OCWP

Figure 5-3 - Median Annual Surface Water Supply Availability Gaps for 1950 - 2007 Historical Hydrology and 2020 Demands

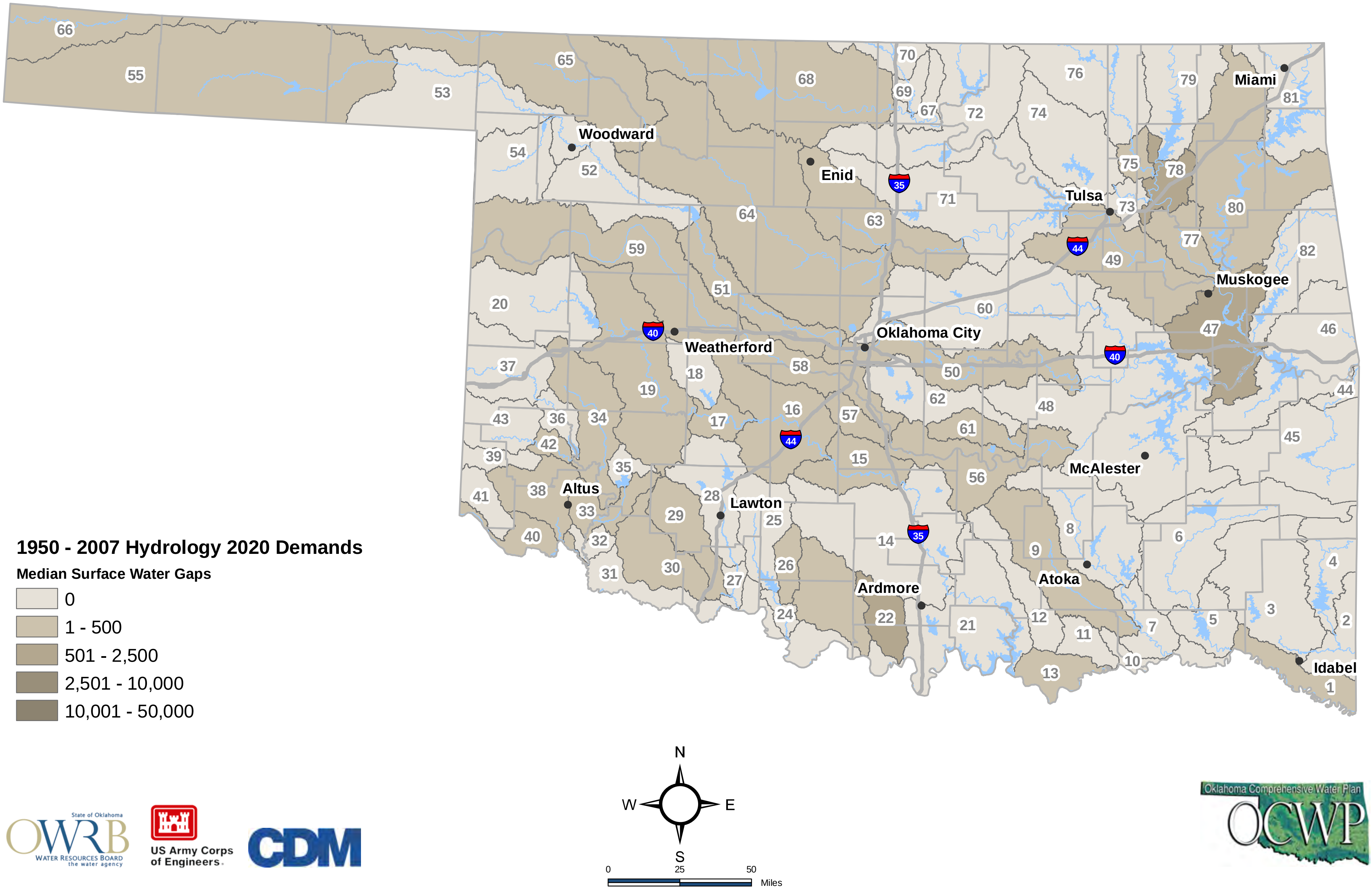


Figure 5-4 - Median Annual Surface Water Supply Availability Gaps for 1950 - 2007 Historical Hydrology and 2060 Demands

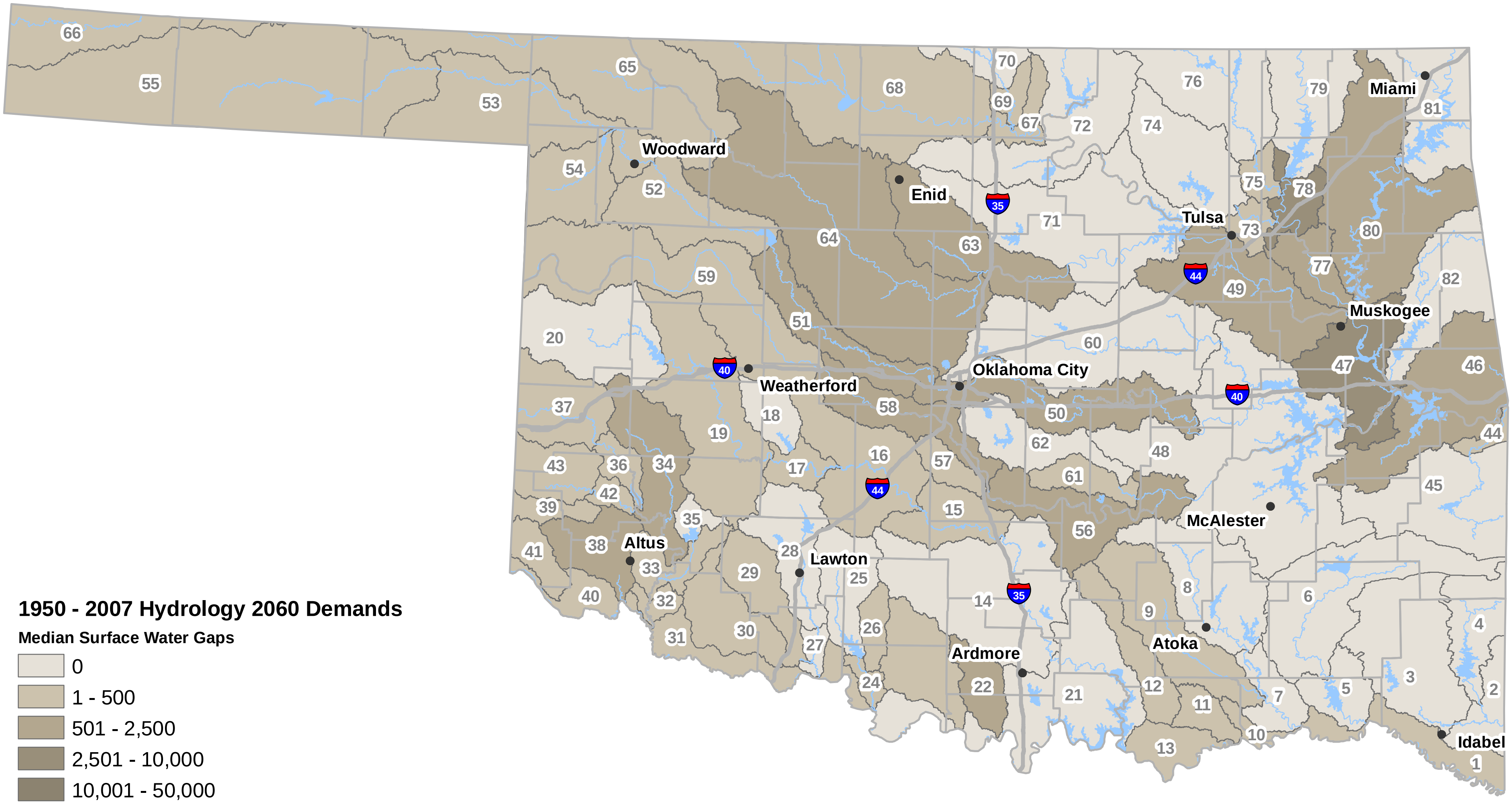
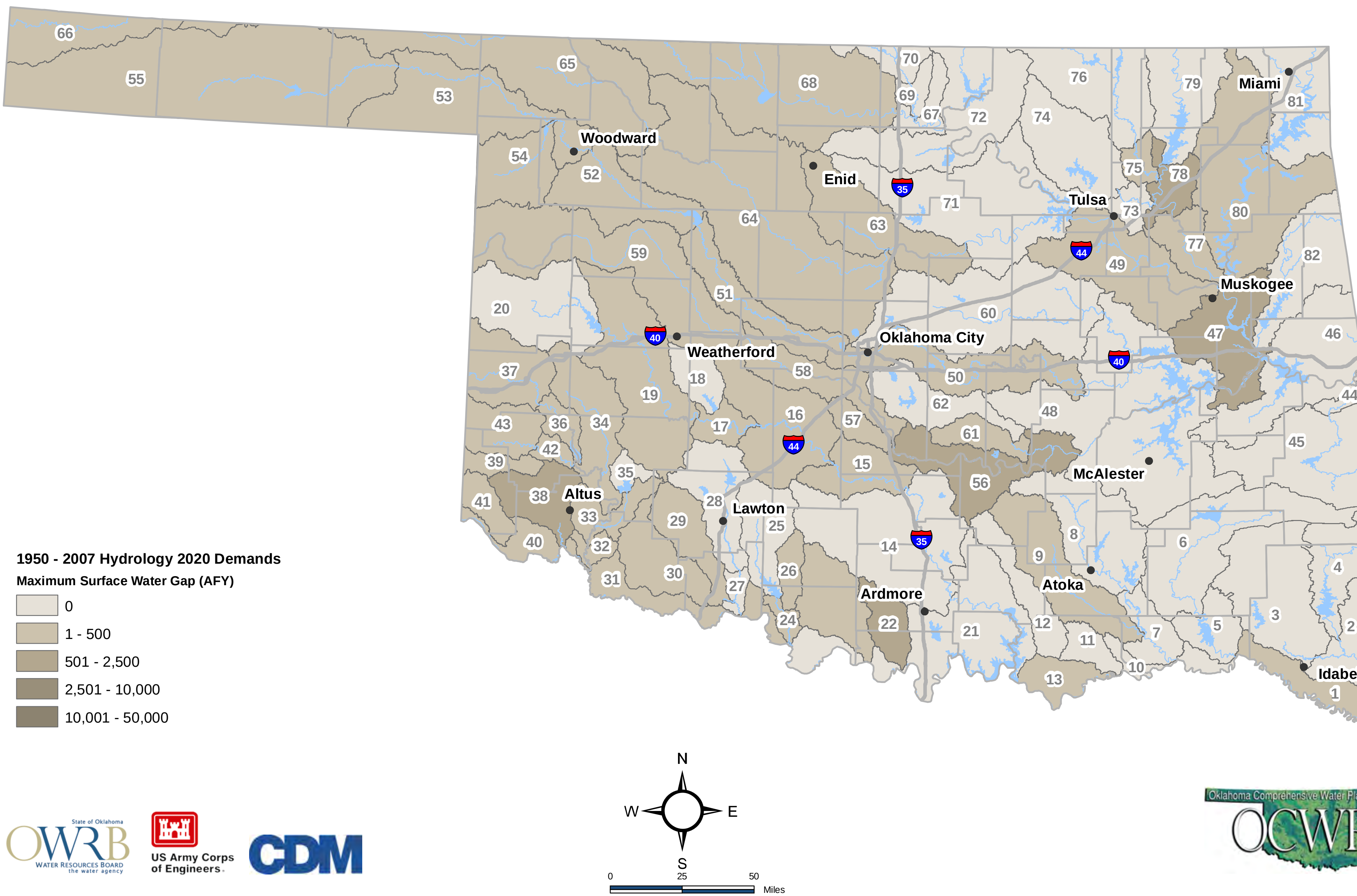


Figure 5-5 - Maximum Annual Surface Water Gap for 1950 through 2007 Historical Hydrology and 2020 Demands



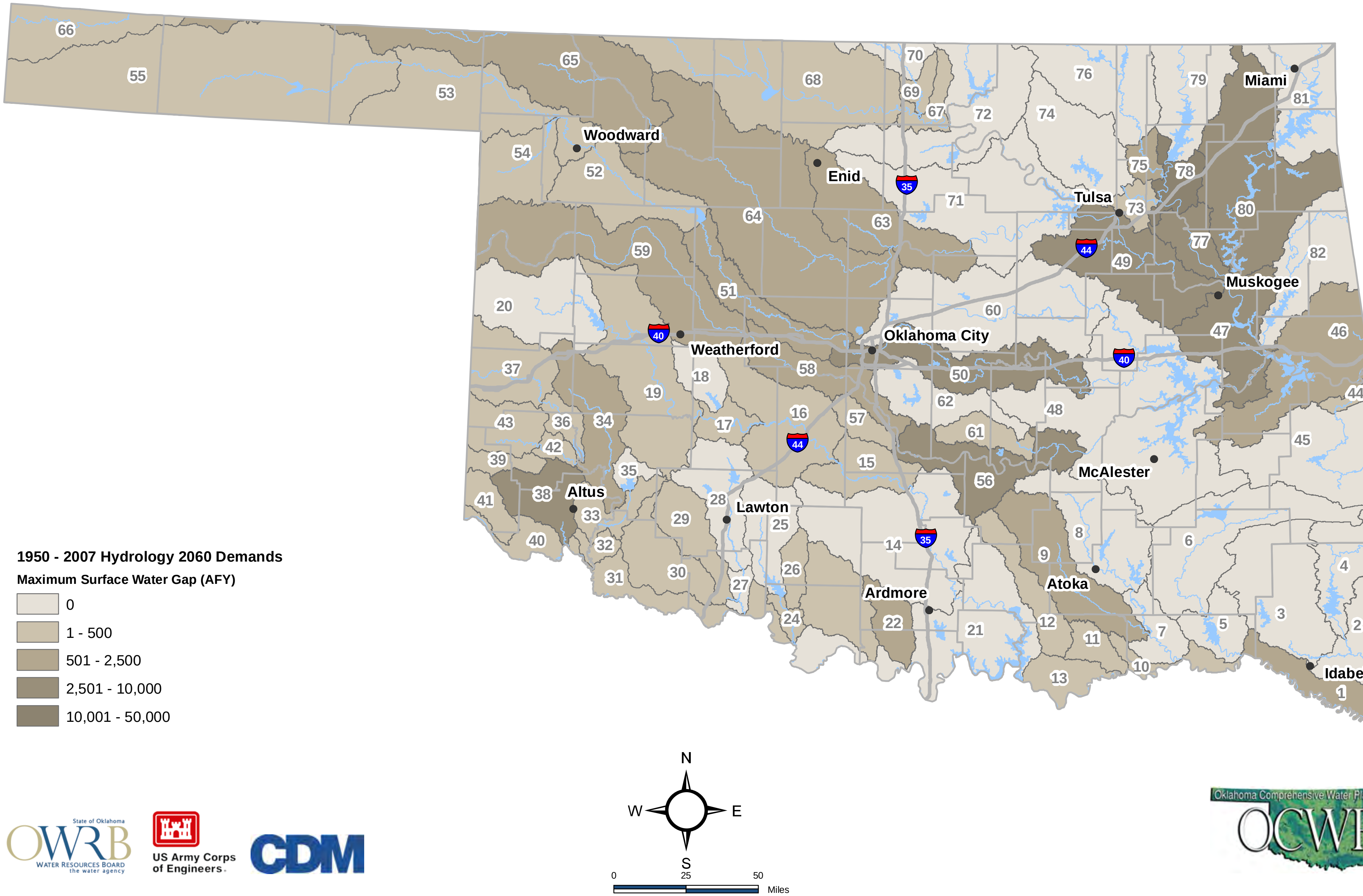
US Army Corps of Engineers

CDM

Oklahoma Comprehensive Water Plan

OCWP

Figure 5-6 - Maximum Annual Surface Water Gap for 1950 through 2007 Historical Hydrology and 2060 Demands



State of Oklahoma OWRB WATER RESOURCES BOARD the water agency

US Army Corps of Engineers

CDM

Oklahoma Comprehensive Water Plan OCWP

Figure 5-8 - Frequency of Annual Surface Water Supply Gaps for 2060 Demands

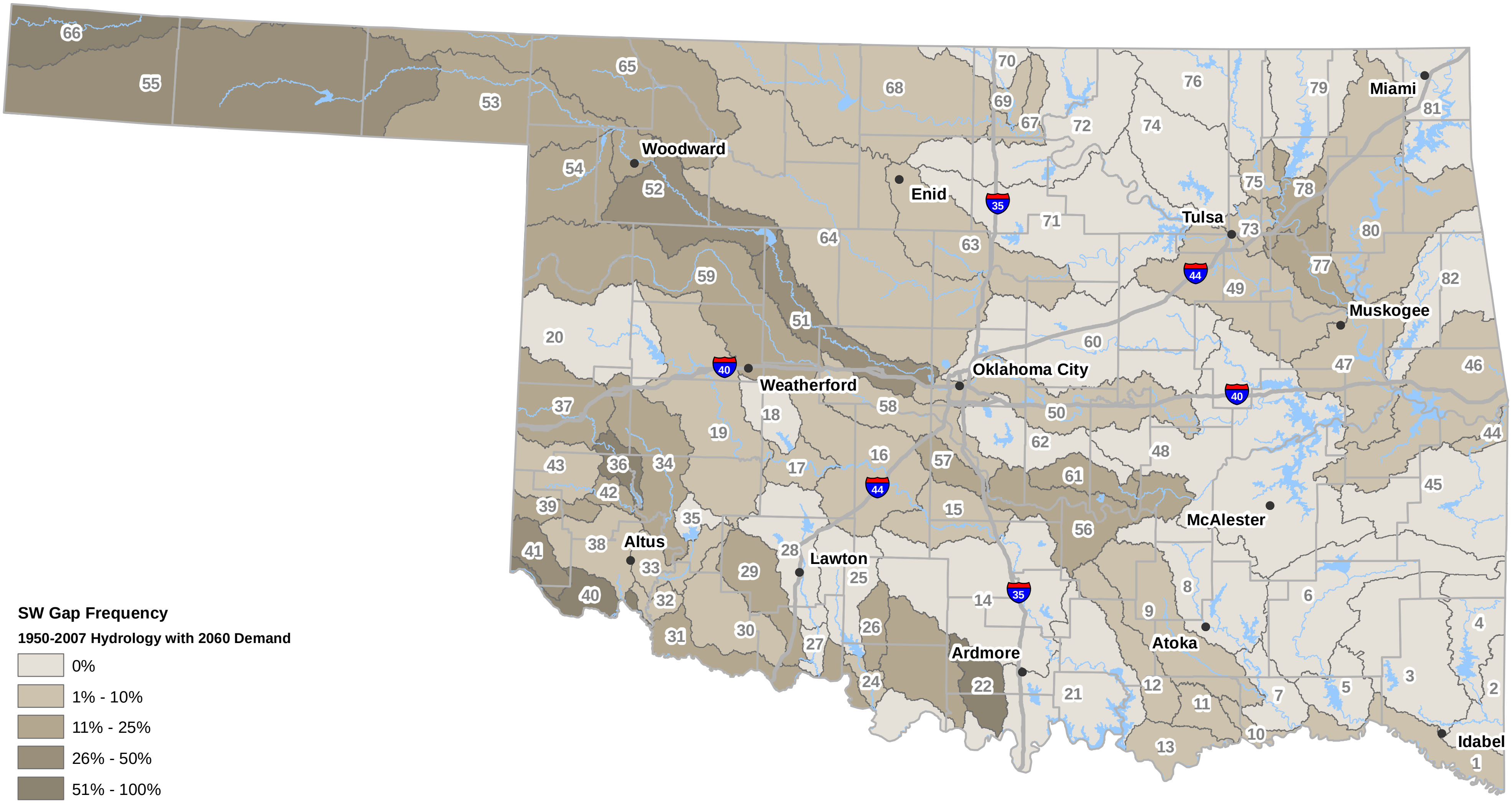


Figure 5-7 - Frequency of Annual Surface Water Supply Gaps for 2020 Demands

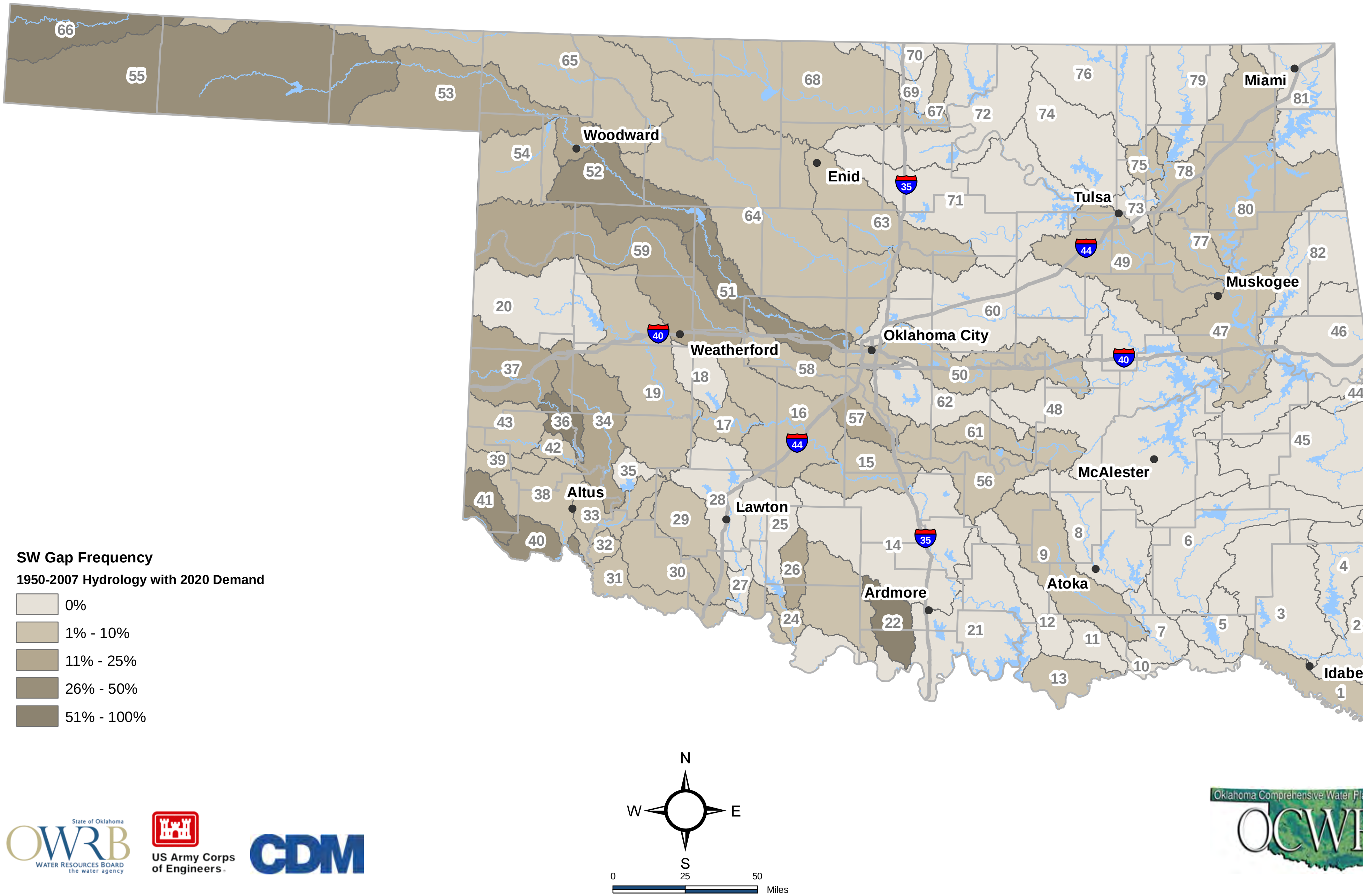
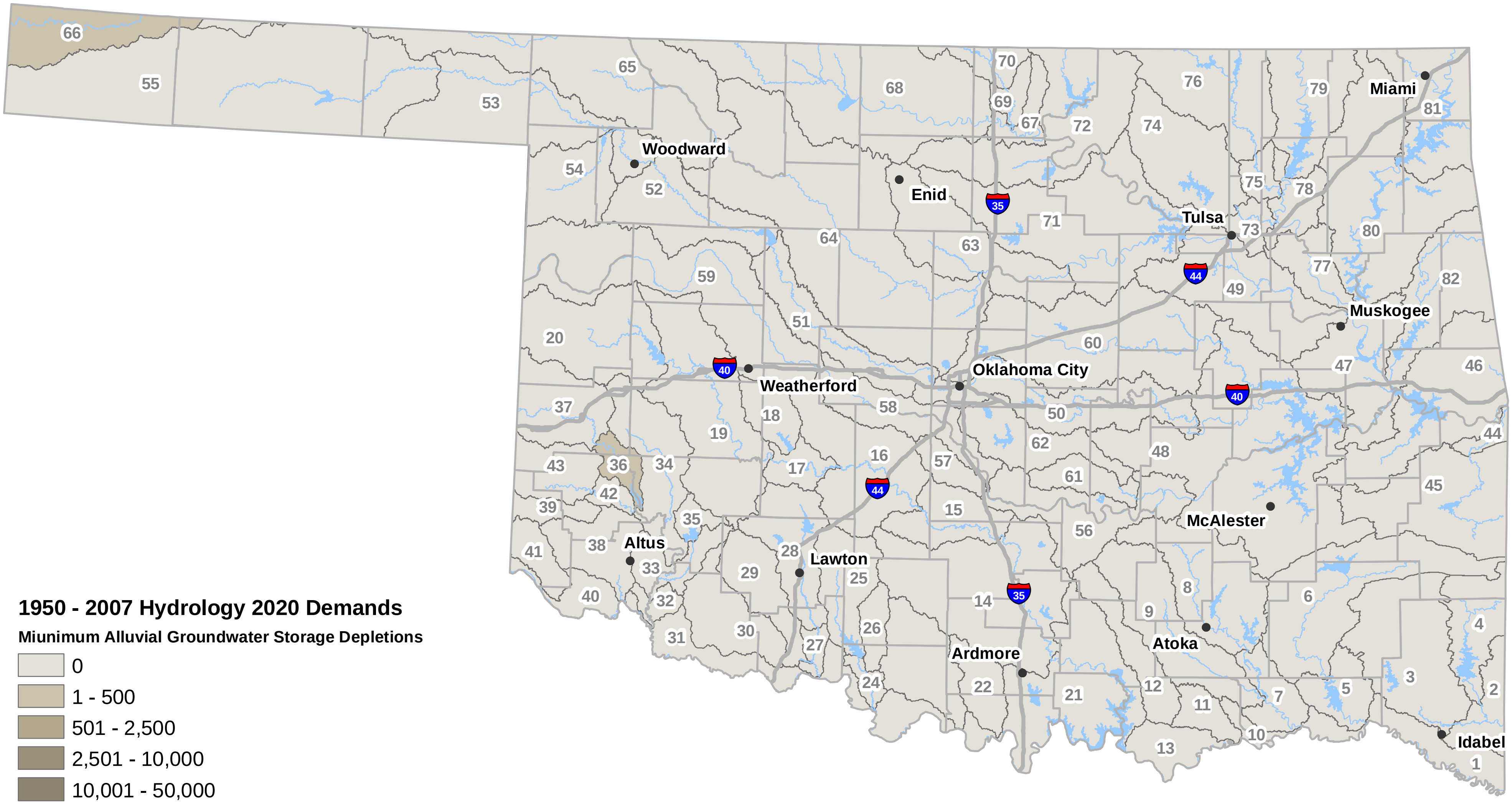


Figure 5-9 - Minimum Annual Alluvial Groundwater Storage Depletions for 1998 through 2007 Historical Hydrology and 2020 Demands



N
W E
S
0 25 50 Miles

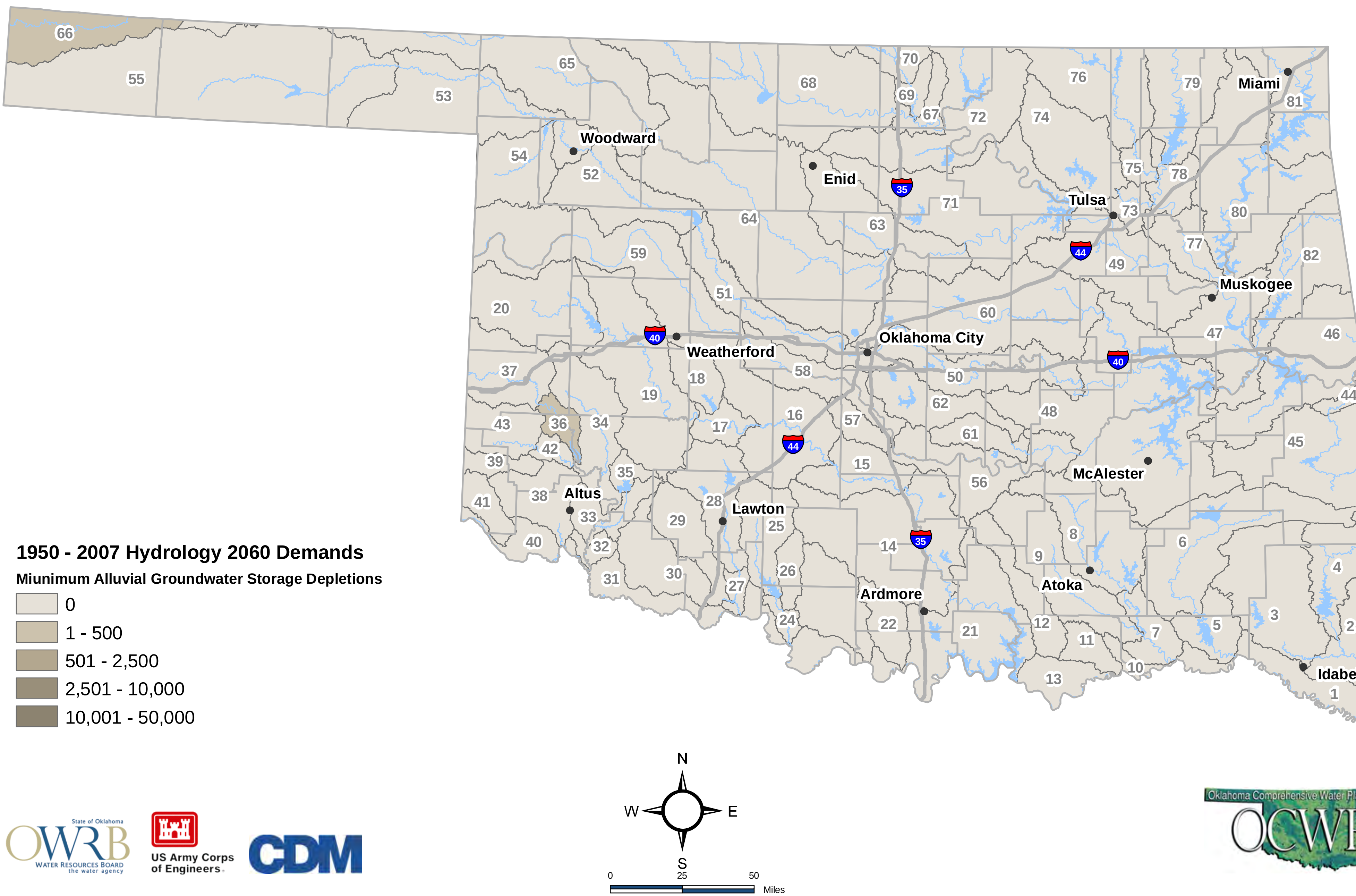
State of Oklahoma OWRB WATER RESOURCES BOARD the water agency

US Army Corps of Engineers

CDM

Oklahoma Comprehensive Water Plan OCWP

Figure 5-10 - Minimum Annual Alluvial Groundwater Storage Depletions for 1998 through 2007 Historical Hydrology and 2060 Demands



State of Oklahoma OWRB WATER RESOURCES BOARD the water agency

US Army Corps of Engineers

CDM

Oklahoma Comprehensive Water Plan OCWP

Figure 5-11 - Median Annual Alluvial Groundwater Storage Depletions for 1950 through 2007 Historical Hydrology and 2020 Demands

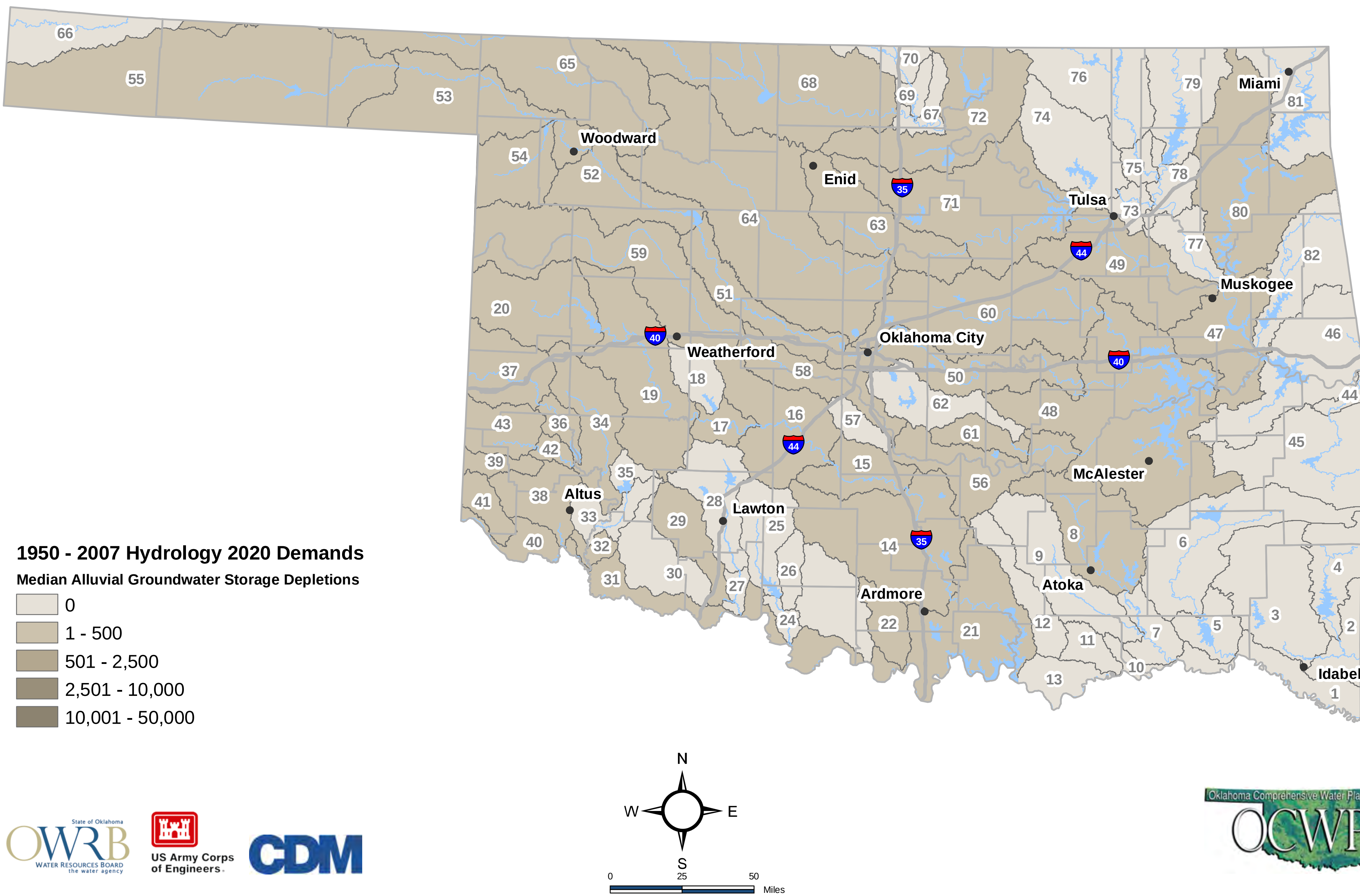
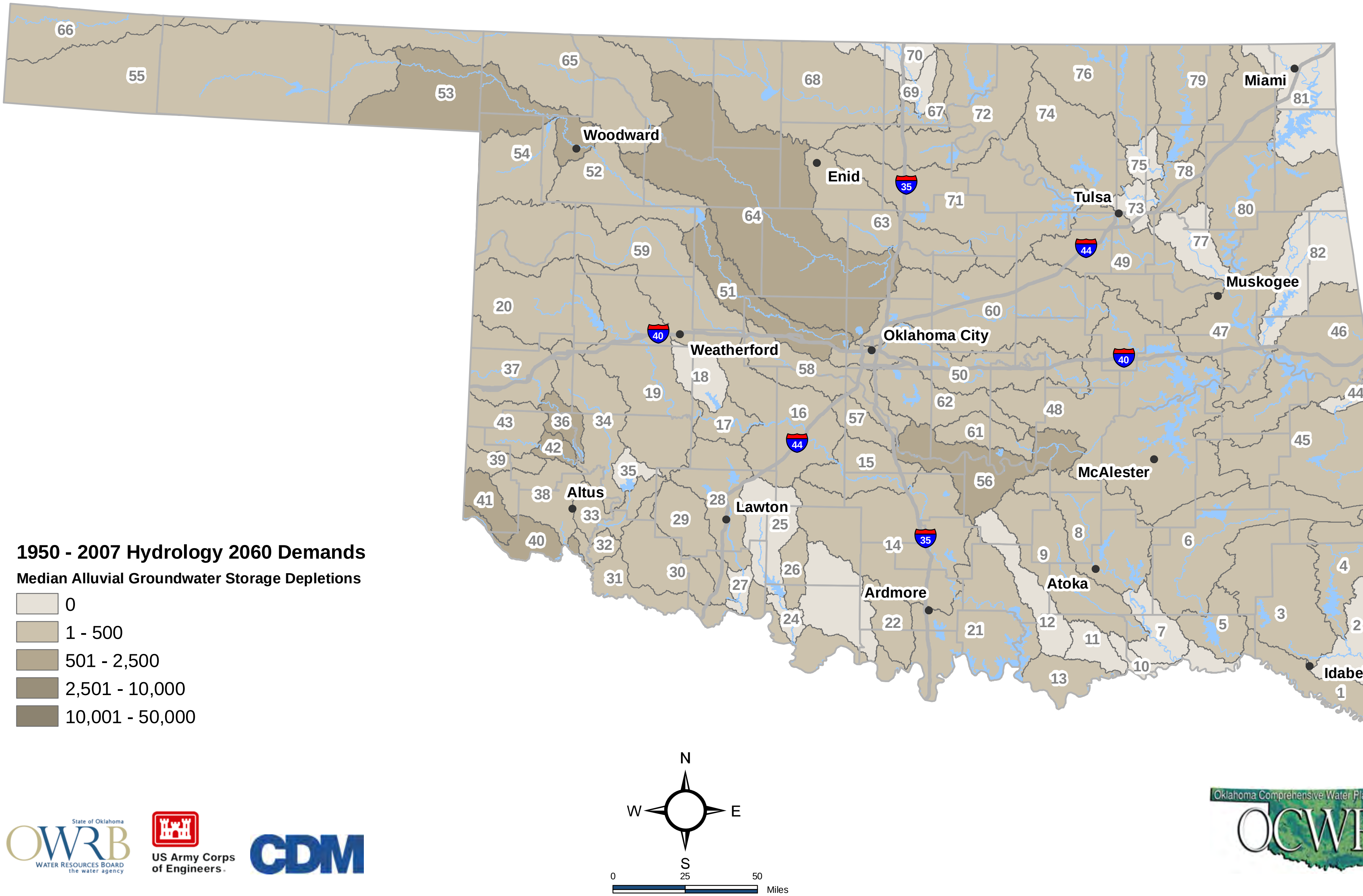


Figure 5-12 - Median Annual Alluvial Groundwater Storage Depletions for 1950 through 2007 Historical Hydrology and 2060 Demands



OWRB State of Oklahoma Water Resources Board the water agency

US Army Corps of Engineers

CDM

Oklahoma Comprehensive Water Plan OCWP

Figure 5-13 - Maximum Annual Alluvial Groundwater Storage Depletions for 1950 through 2007 Historical Hydrology and 2020 Demands

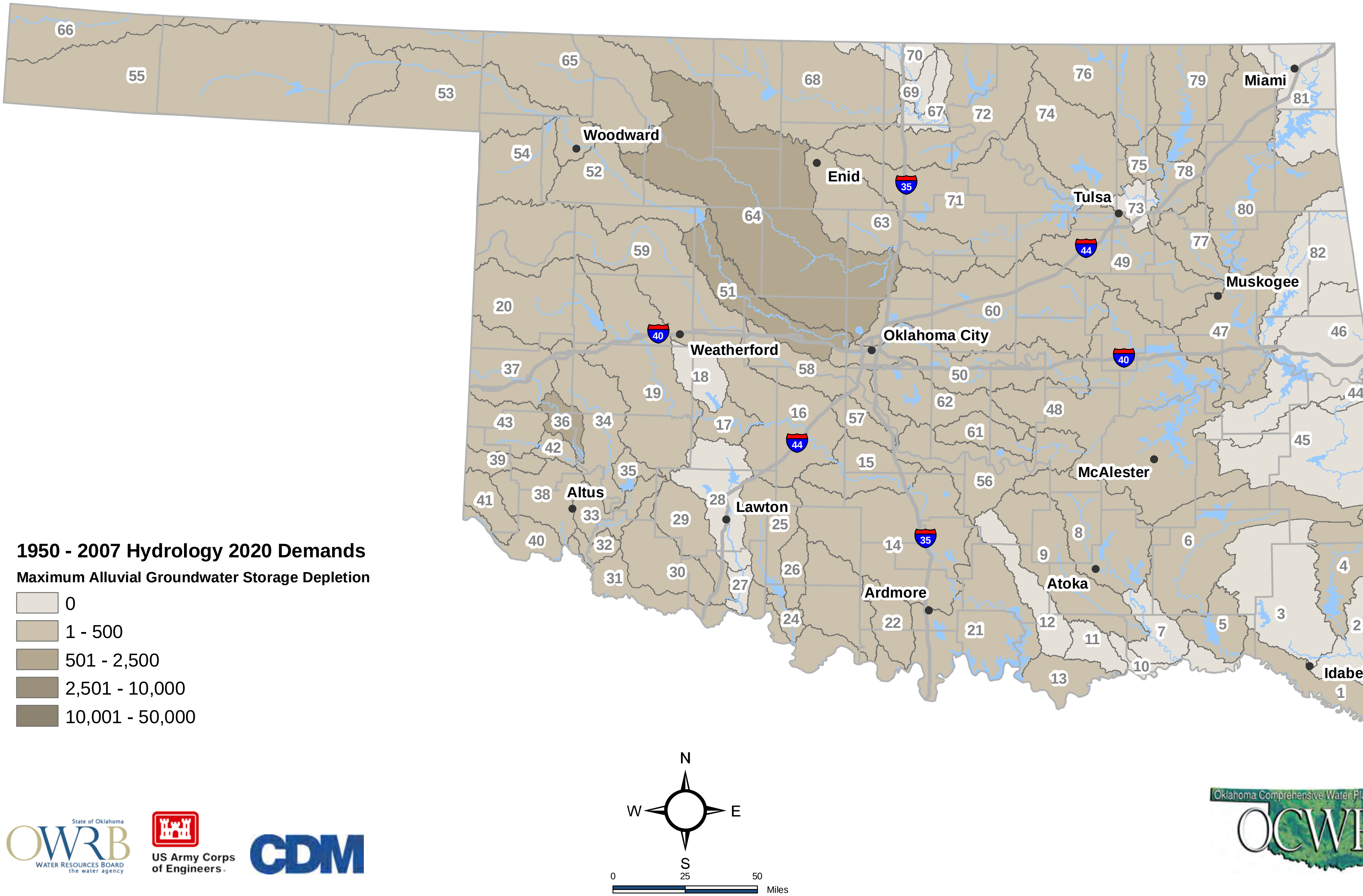


Figure 5-14 - Maximum Annual Alluvial Groundwater Storage Depletions for 1950 through 2007 Historical Hydrology and 2060 Demands

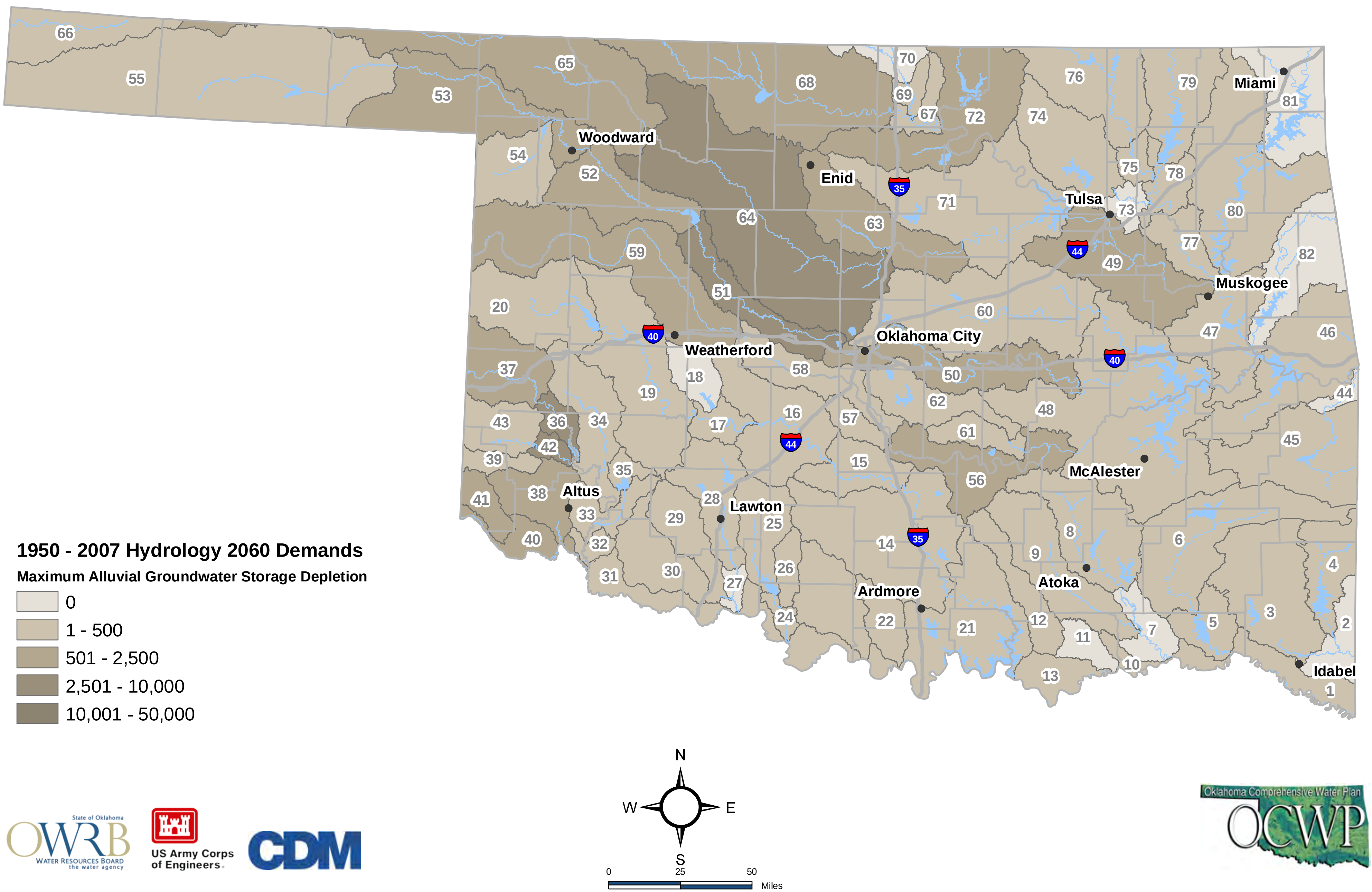


Figure 5-15 - Probability of Annual Alluvial Groundwater Storage Depletions for 2020 Demands

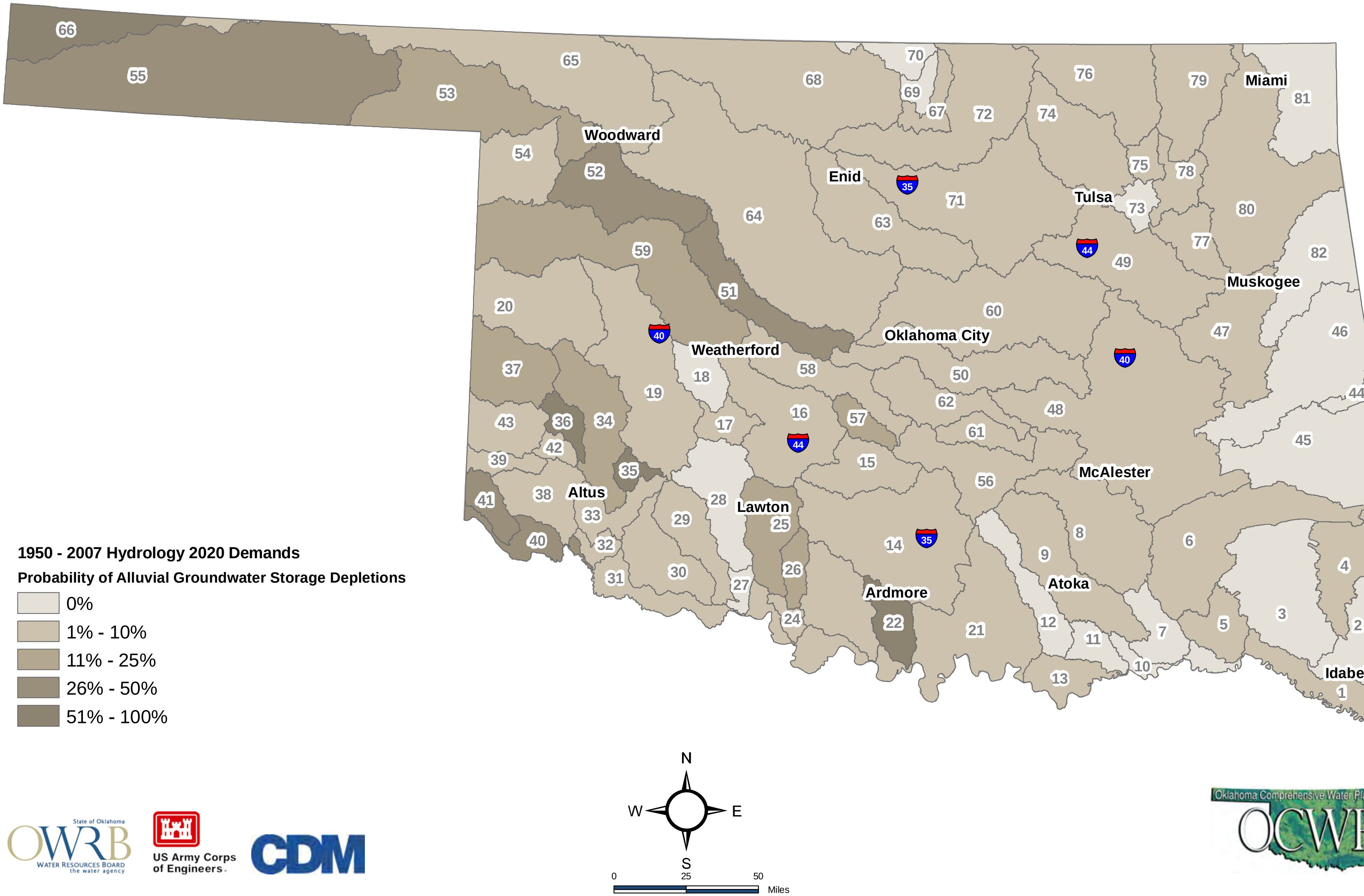
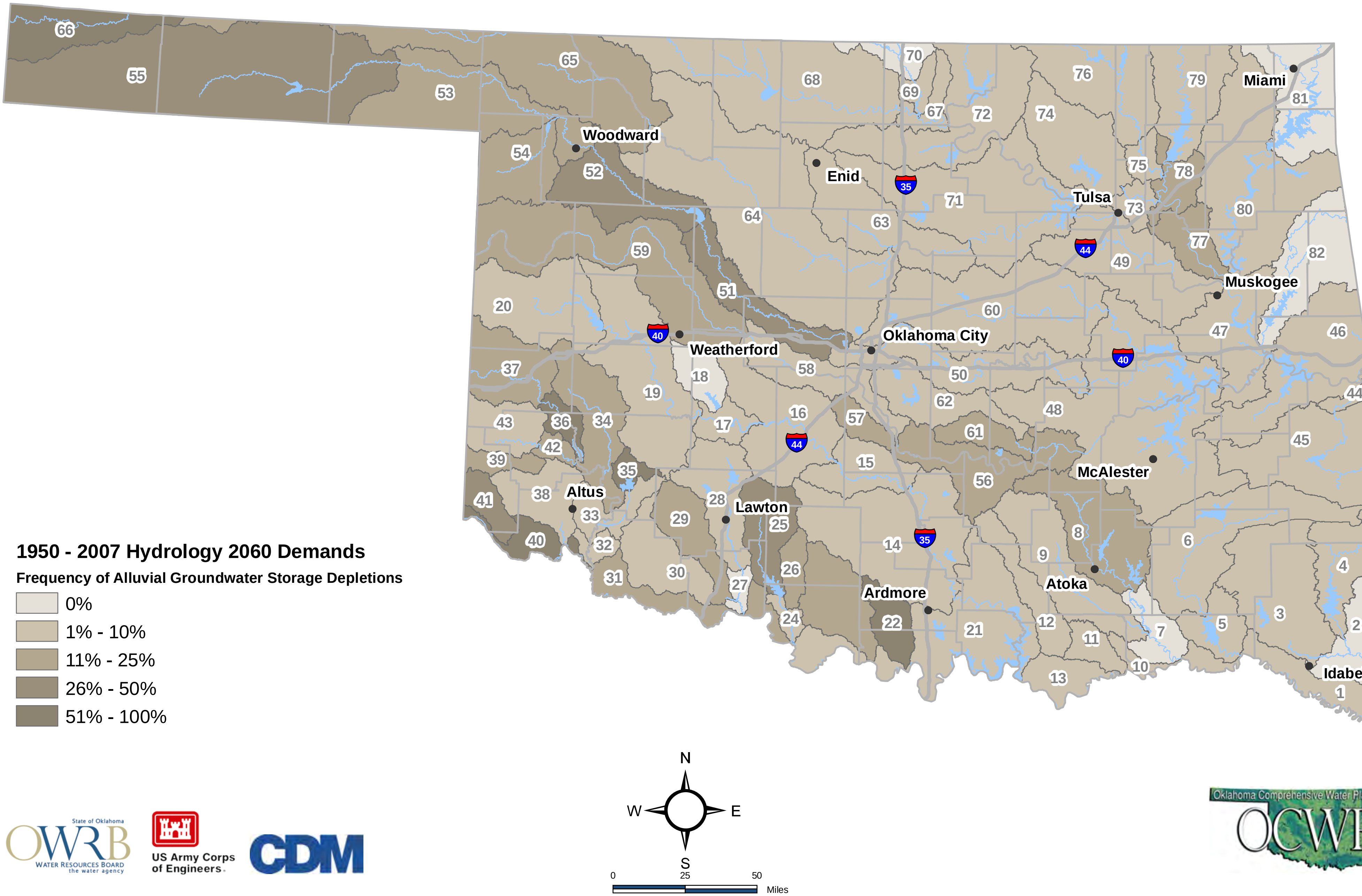


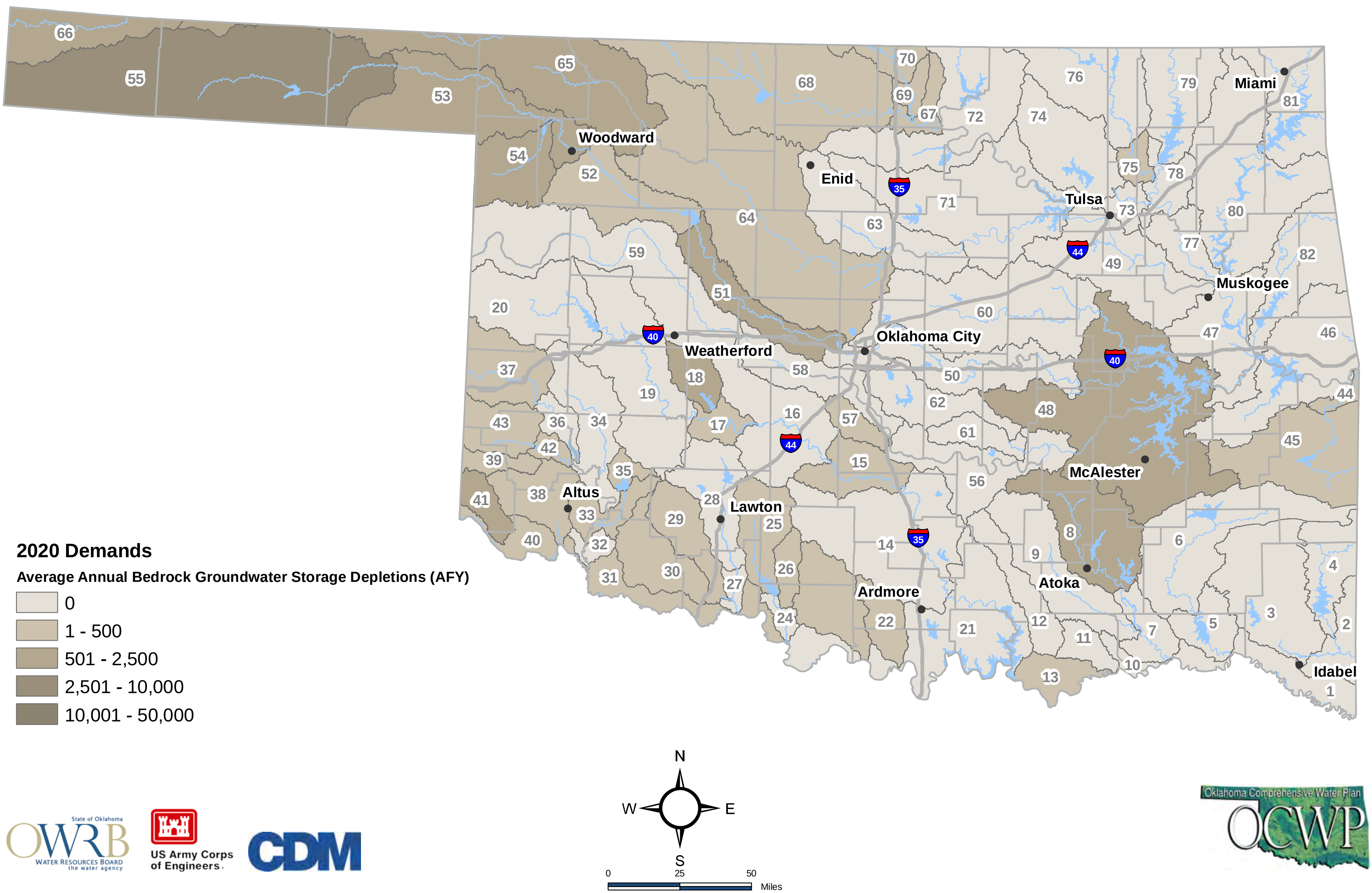
Figure 5-16 - Frequency of Annual Alluvial Groundwater Storage Depletions for 2060 Demands



US Army Corps of Engineers

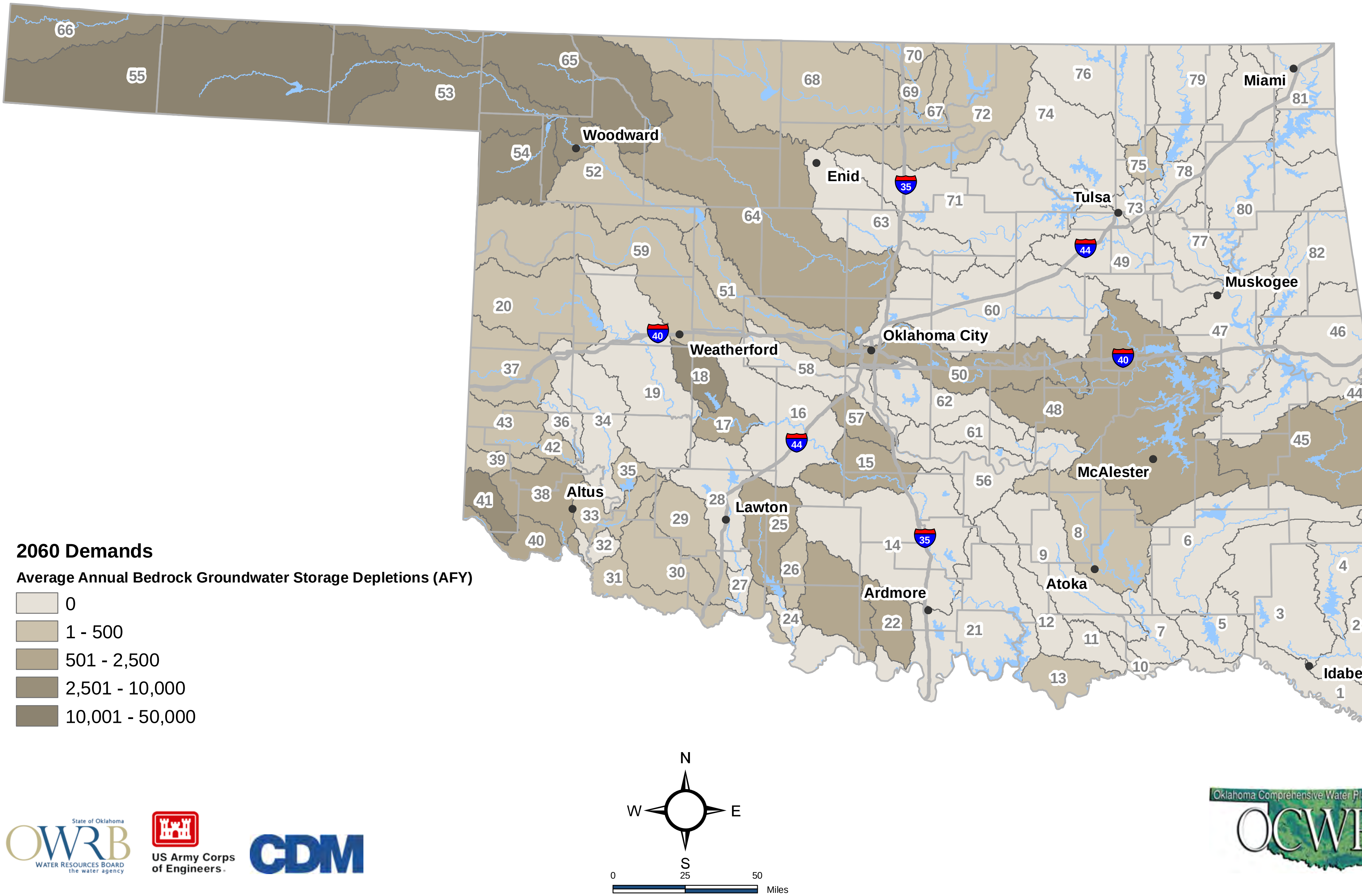
Oklahoma Comprehensive Water Plan

Figure 5-17 - Bedrock Groundwater Storage Depletions in Excess of Annual Average Recharge for 2020 Demands



OWRB WATER RESOURCES BOARD the water agency · US Army Corps of Engineers · CDM

Figure 5-18 - Bedrock Groundwater Storage Depletions in Excess of Annual Average Recharge for 2060 Demands



State of Oklahoma OWRB WATER RESOURCES BOARD the water agency

US Army Corps of Engineers

CDM

Oklahoma Comprehensive Water Plan OCWP

5-19 - Estimated Average Annual Streamflow in 2060

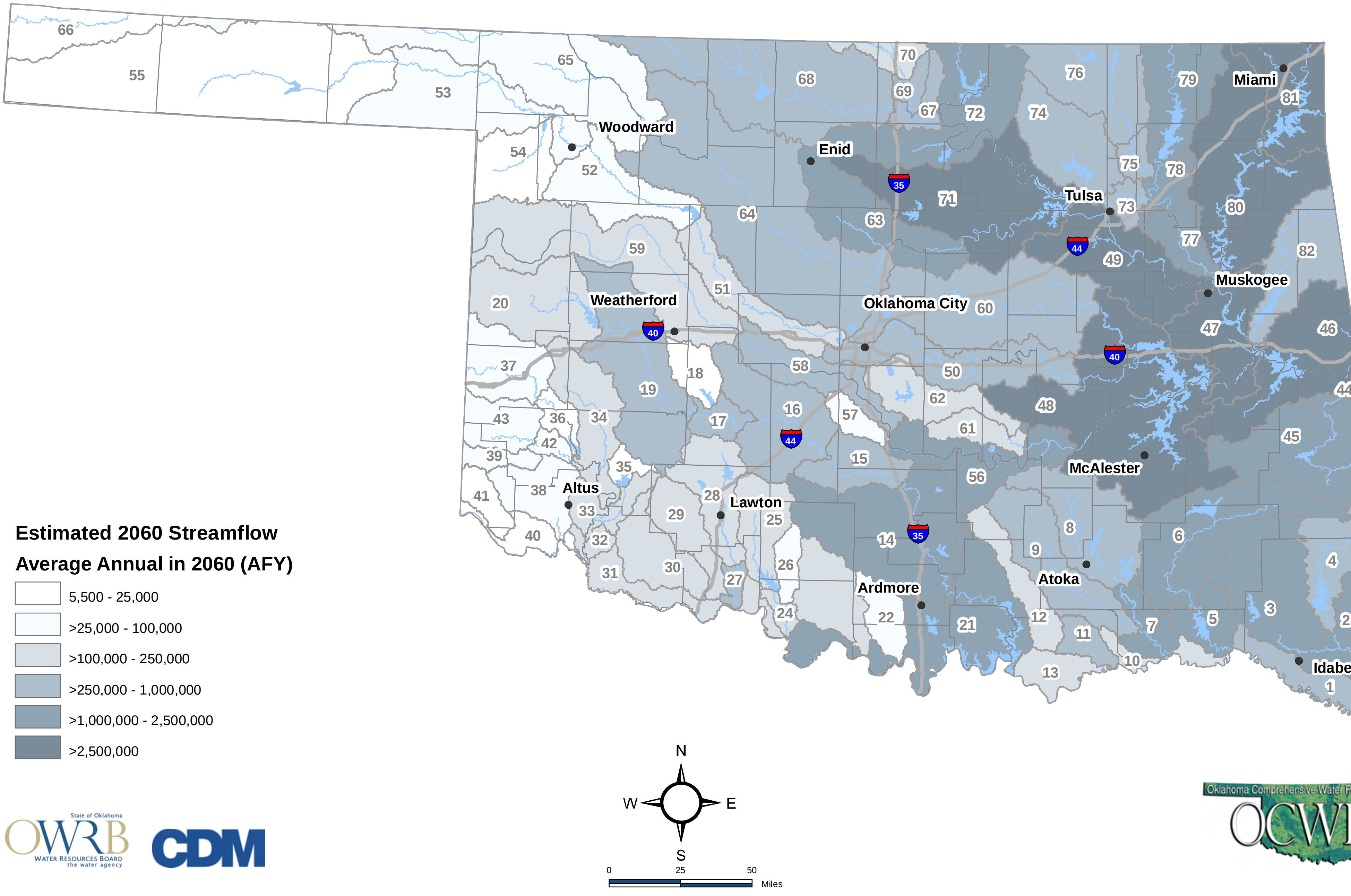
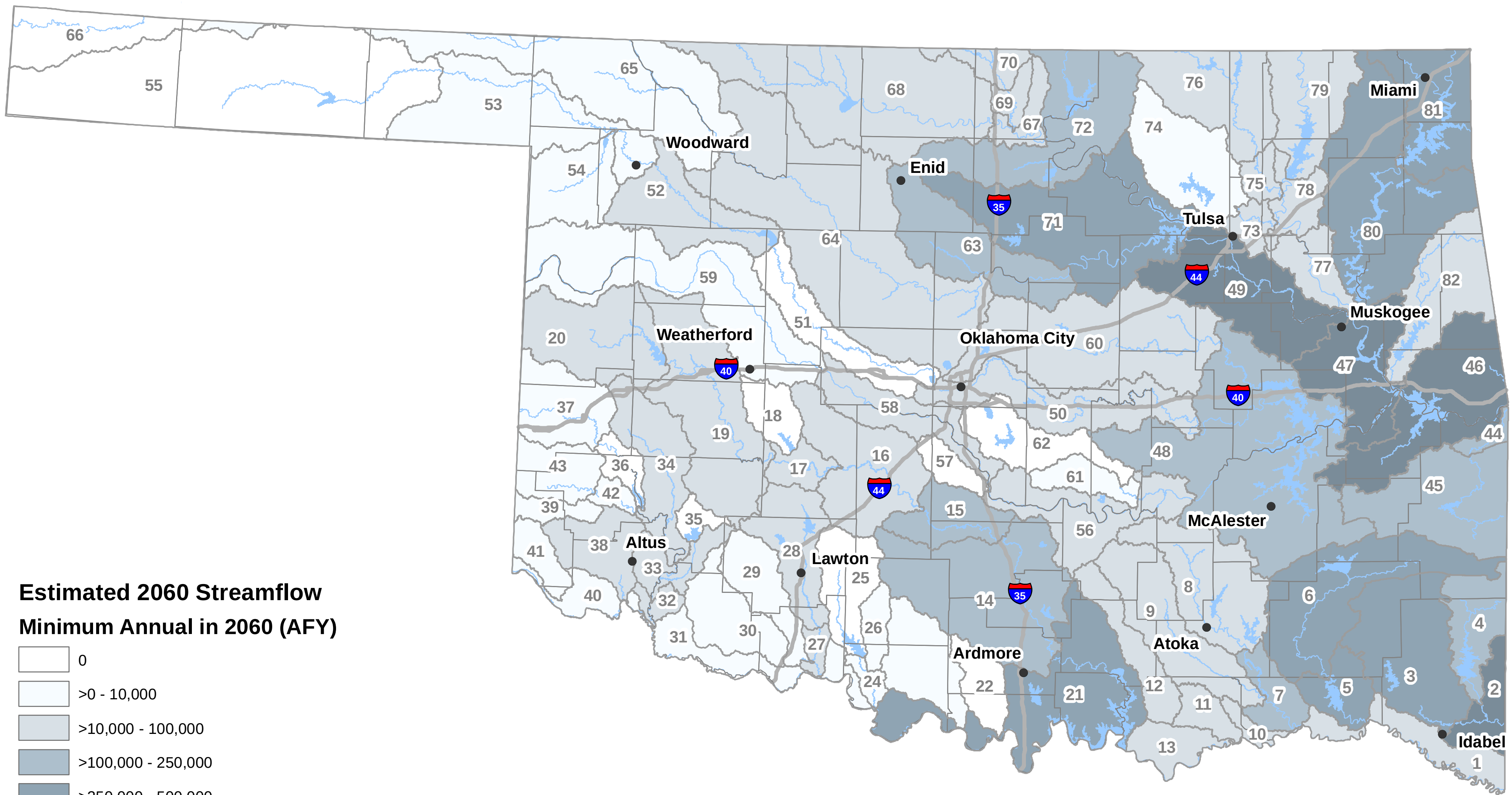


Figure 5-20 - Estimated Minimum Annual Streamflow in 2060



Estimated 2060 Streamflow

Minimum Annual in 2060 (AFY)

- 0
- >0 - 10,000
- >10,000 - 100,000
- >100,000 - 250,000
- >250,000 - 500,000
- >500,000

N
W E
S

0 25 50 Miles

State of Oklahoma OWRB Water Resources Board the water agency

CDM

Oklahoma Comprehensive Water Plan OCWP

Table 5-1 - Maximum Annual Surface Water Supply Availability Gaps for the Demand Projections for 1950 through 2007 Historical Hydrology (AFY)

Table Shading Legend (Text displays gap range in AFY)	0	0.1 - 500	501 - 2,500	2,501 - 10,000	10,001 - 20,000

Basin Number	Basin ID	Basin Name	2020	2030	2040	2050	2060
1	10100	Red River Mainstem (To Kiamichi River)	80	210	330	490	770
2	10201	Little River (McCurtain County) - 1	0	0	0	0	0
3	10202	Little River (McCurtain County) - 2	0	0	0	0	0
4	10203	Little River (McCurtain County) - 3	0	0	0	0	0
5	10301	Kiamichi River - 1	0	0	0	0	0
6	10302	Kiamichi River - 2	0	0	0	0	0
7	10411	Muddy Boggy River - 1	0	0	0	0	0
8	10412	Muddy Boggy River - 2	0	0	0	0	0
9	10420	Clear Boggy Creek	400	620	880	1,090	1,400
10	10500	Red River Mainstem (To Blue River)	0	0	20	40	60
11	10601	Blue River - 1	0	0	20	30	50
12	10602	Blue River - 2	0	50	110	160	230
13	10700	Red River Mainstem (To Washita)	10	80	140	210	350
14	10810	Lower Washita	0	0	0	0	0
15	10821	Middle Washita - 1	50	110	240	320	510
16	10822	Middle Washita - 2	60	150	240	320	430
17	10831	Upper Washita - 1	30	60	90	130	450
18	10832	Upper Washita - 2	0	0	0	0	0
19	10833	Upper Washita - 3	30	60	120	190	290
20	10840	Washita Headwaters	0	0	0	0	0
21	10900	Red River Mainstem (To Walnut Bayou)	0	0	0	0	0
22	11000	Walnut Bayou	1,300	840	640	710	820
23	11100	Mud Creek	90	100	130	150	170
24	11201	Beaver Creek - 1	0	10	20	20	30
25	11202	Beaver Creek - 2	0	0	0	0	0
26	11203	Beaver Creek - 3	20	40	60	70	100
27	11311	Cache Creek - 1	0	0	0	0	0
28	11312	Cache Creek - 2	0	0	0	0	0
29	11321	Deep Red Creek And West Cache Creek - 1	90	150	240	280	340
30	11322	Deep Red Creek And West Cache Creek - 2	20	50	100	140	160
31	11400	Red River Mainstem (To North Fork of Red)	0	20	30	40	100
32	11511	Lower North Fork Red River - 1	0	0	0	10	10
33	11512	Lower North Fork Red River - 2	10	40	50	220	310
34	11513	Lower North Fork Red River - 3	190	580	1,140	1,750	2,510
35	11514	Lower North Fork Red River - 4	0	0	0	0	0

Table 5-1 - Maximum Annual Surface Water Supply Availability Gaps for the Demand Projections for 1950 through 2007 Historical Hydrology (AFY)

Table Shading Legend (Text displays gap range in AFY)	0	0.1 - 500	501 - 2,500	2,501 - 10,000	10,001 - 20,000

Basin Number	Basin ID	Basin Name	2020	2030	2040	2050	2060
36	11521	Upper North Fork Red River - 1	0	0	0	10	20
37	11522	Upper North Fork Red River - 2	0	60	90	170	250
38	11601	Salt Fork Red River - 1	550	1,490	2,530	3,330	4,590
39	11602	Salt Fork Red River - 2	0	0	0	0	20
40	11701	Prairie Dog Town Fork Red River - 1	30	50	120	180	260
41	11702	Prairie Dog Town Fork Red River - 2	0	0	0	10	20
42	11801	Elm Fork Red River - 1	40	120	170	200	270
43	11802	Elm Fork Red River - 2	0	10	10	20	20
44	20101	Poteau River - 1	0	0	0	0	10
45	20102	Poteau River - 2	0	0	0	0	0
46	20201	Lower Arkansas River - 1	0	0	330	470	640
47	20202	Lower Arkansas River - 2	950	2,010	3,220	4,590	6,120
48	20300	Canadian River (To North Canadian River)	0	0	0	0	0
49	20400	Middle Arkansas River	400	1,150	2,350	3,950	5,900
50	20510	Lower North Canadian River	180	670	1,460	2,270	3,490
51	20520	Middle North Canadian River	420	550	840	1,190	1,590
52	20531	Upper North Canadian River - 1	0	0	0	30	70
53	20532	Upper North Canadian River - 2	0	20	50	130	170
54	20533	Upper North Canadian River - 3	0	20	80	80	160
55	20540	North Canadian Headwaters	30	90	180	200	320
56	20611	Lower Canadian River - 1	1,290	2,620	4,350	6,260	8,770
57	20612	Lower Canadian River - 2	50	180	250	360	450
58	20620	Middle Canadian River	320	500	1,000	1,720	2,700
59	20630	Upper Canadian River	110	280	470	660	920
60	20700	Deep Fork River	0	0	0	0	0
61	20801	Little River - 1	20	100	130	190	250
62	20802	Little River - 2	0	0	0	0	0
63	20910	Lower Cimarron River	540	1,110	1,720	2,340	3,070
64	20920	Middle Cimarron River	410	960	1,650	2,330	3,130
65	20930	Upper Cimarron River	100	210	380	590	860
66	20940	Cimarron Headwaters	60	160	240	290	400
67	21011	Lower Salt Fork Arkansas River - 1	0	20	50	90	120
69	21012	Lower Salt Fork Arkansas River - 2	0	0	0	20	30
70	21013	Lower Salt Fork Arkansas River - 3	0	0	0	0	0
68	21020	Upper Salt Fork Arkansas River	20	80	150	250	410
71	21100	Arkansas River - Cimarron Rivers to Keystone Lake	0	0	0	0	0
72	21200	Arkansas River Mainstem (To Kansas State Line)	0	0	0	0	0

Table 5-1 - Maximum Annual Surface Water Supply Availability Gaps for the Demand Projections for 1950 through 2007 Historical Hydrology (AFY)

Table Shading Legend (Text displays gap range in AFY)	0	0.1 - 500	501 - 2,500	2,501 - 10,000	10,001 - 20,000

Basin Number	Basin ID	Basin Name	2020	2030	2040	2050	2060
73	21301	Bird Creek - 1	0	0	0	10	60
74	21302	Bird Creek - 2	0	0	0	0	0
75	21401	Caney River - 1	130	360	580	770	1,130
76	21402	Caney River - 2	0	0	0	0	0
77	21511	Verdigris River (To Oologah Dam) - 1	550	1,260	2,180	3,360	4,440
78	21512	Verdigris River (To Oologah Dam) - 2	1,620	3,840	6,150	8,580	11,900
79	21520	Verdigris River (To Kansas State Line)	0	0	0	0	0
80	21601	Grand (Neosho) River - 1	870	1,800	2,790	3,840	4,930
81	21602	Grand (Neosho) River - 2	0	0	0	0	0
82	21700	Illinois River	0	0	0	0	0

Table 5-2 - Maximum Annual Alluvial Ground Water Supply Availability Depletion for the Demand Projections for 1950 through 2007 Historical Hydrology (AFY)

Table Shading Legend (Text displays gap range in AFY)	0	0.1 - 500	501 - 2,500	2,501 - 10,000	10,001 - 20,000

Basin Number	Basin ID	Basin Name	2020	2030	2040	2050	2060
1	10100	Red River Mainstem (To Kiamichi River)	0	10	20	20	40
2	10201	Little River (McCurtain County) - 1	0	0	0	0	0
3	10202	Little River (McCurtain County) - 2	0	0	0	0	10
4	10203	Little River (McCurtain County) - 3	0	10	10	10	20
5	10301	Kiamichi River - 1	0	0	0	0	20
6	10302	Kiamichi River - 2	0	10	30	30	40
7	10411	Muddy Boggy River - 1	0	0	0	0	0
8	10412	Muddy Boggy River - 2	50	70	120	180	270
9	10420	Clear Boggy Creek	20	30	40	60	60
10	10500	Red River Mainstem (To Blue River)	0	0	0	0	0
11	10601	Blue River - 1	0	0	0	0	0
12	10602	Blue River - 2	0	0	0	0	0
13	10700	Red River Mainstem (To Washita)	0	30	40	60	100
14	10810	Lower Washita	50	140	250	340	440
15	10821	Middle Washita - 1	30	60	130	180	270
16	10822	Middle Washita - 2	10	20	30	40	50
17	10831	Upper Washita - 1	10	30	40	60	180
18	10832	Upper Washita - 2	0	0	0	0	0
19	10833	Upper Washita - 3	10	20	90	130	190
20	10840	Washita Headwaters	20	40	90	160	240
21	10900	Red River Mainstem (To Walnut Bayou)	60	160	220	280	380
22	11000	Walnut Bayou	80	80	80	90	120
23	11100	Mud Creek	0	0	0	0	0
24	11201	Beaver Creek - 1	0	0	0	0	0
25	11202	Beaver Creek - 2	0	0	0	0	0
26	11203	Beaver Creek - 3	0	0	0	0	10
27	11311	Cache Creek - 1	0	0	0	0	0
28	11312	Cache Creek - 2	0	0	0	0	10
29	11321	Deep Red Creek And West Cache Creek - 1	30	60	100	160	210
30	11322	Deep Red Creek And West Cache Creek - 2	0	20	30	40	50
31	11400	Red River Mainstem (To North Fork of Red)	60	200	280	330	490
32	11511	Lower North Fork Red River - 1	10	20	40	100	150
33	11512	Lower North Fork Red River - 2	0	10	10	100	150
34	11513	Lower North Fork Red River - 3	50	130	270	370	460

Table 5-2 - Maximum Annual Alluvial Ground Water Supply Availability Depletion for the Demand Projections for 1950 through 2007 Historical Hydrology (AFY)

Table Shading Legend (Text displays gap range in AFY)	0	0.1 - 500	501 - 2,500	2,501 - 10,000	10,001 - 20,000

Basin Number	Basin ID	Basin Name	2020	2030	2040	2050	2060
35	11514	Lower North Fork Red River - 4	0	0	0	0	0
36	11521	Upper North Fork Red River - 1	500	1,010	1,510	1,930	2,550
37	11522	Upper North Fork Red River - 2	120	300	460	640	840
38	11601	Salt Fork Red River - 1	120	310	540	720	980
39	11602	Salt Fork Red River - 2	50	80	130	170	220
40	11701	Prairie Dog Town Fork Red River - 1	130	310	440	610	790
41	11702	Prairie Dog Town Fork Red River - 2	160	330	530	650	900
42	11801	Elm Fork Red River - 1	390	970	1,500	1,930	2,680
43	11802	Elm Fork Red River - 2	40	70	120	180	300
44	20101	Poteau River - 1	0	0	0	0	0
45	20102	Poteau River - 2	0	0	0	20	30
46	20201	Lower Arkansas River - 1	0	0	50	70	80
47	20202	Lower Arkansas River - 2	40	80	120	160	210
48	20300	Canadian River (To North Canadian River)	170	210	280	340	420
49	20400	Middle Arkansas River	90	260	410	570	740
50	20510	Lower North Canadian River	30	110	240	360	540
51	20520	Middle North Canadian River	670	960	1,490	2,090	2,810
52	20531	Upper North Canadian River - 1	130	320	500	680	880
53	20532	Upper North Canadian River - 2	360	730	1,150	1,530	2,080
54	20533	Upper North Canadian River - 3	60	140	250	300	390
55	20540	North Canadian Headwaters	60	130	240	290	370
56	20611	Lower Canadian River - 1	420	860	1,360	1,930	2,610
57	20612	Lower Canadian River - 2	0	40	60	130	150
58	20620	Middle Canadian River	90	160	270	420	600
59	20630	Upper Canadian River	280	490	710	990	1,340
60	20700	Deep Fork River	40	120	210	310	430
61	20801	Little River - 1	40	120	160	190	220
62	20802	Little River - 2	0	20	50	70	100
63	20910	Lower Cimarron River	310	590	900	1,180	1,480
64	20920	Middle Cimarron River	880	1,850	2,970	3,980	5,190
65	20930	Upper Cimarron River	150	330	540	750	1,040
66	20940	Cimarron Headwaters	0	0	0	20	20
67	21011	Lower Salt Fork Arkansas River - 1	0	20	50	80	90
69	21012	Lower Salt Fork Arkansas River - 2	0	0	0	0	0
70	21013	Lower Salt Fork Arkansas River - 3	0	0	0	0	0
68	21020	Upper Salt Fork Arkansas River	70	220	430	660	1,010

Table 5-2 - Maximum Annual Alluvial Ground Water Supply Availability Depletion for the Demand Projections for 1950 through 2007 Historical Hydrology (AFY)

Table Shading Legend (Text displays gap range in AFY)	0	0.1 - 500	501 - 2,500	2,501 - 10,000	10,001 - 20,000

Basin Number	Basin ID	Basin Name	2020	2030	2040	2050	2060
71	21100	Arkansas River - Cimarron Rivers to Keystone Lake	40	70	110	150	200
72	21200	Arkansas River Mainstem (To Kansas State Line)	140	280	410	560	790
73	21301	Bird Creek - 1	0	0	0	0	0
74	21302	Bird Creek - 2	0	70	70	90	130
75	21401	Caney River - 1	0	0	0	0	0
76	21402	Caney River - 2	0	0	0	20	30
77	21511	Verdigris River (To Oologah Dam) - 1	0	0	0	0	0
78	21512	Verdigris River (To Oologah Dam) - 2	0	0	20	60	70
79	21520	Verdigris River (To Kansas State Line)	0	10	20	30	50
80	21601	Grand (Neosho) River - 1	70	70	140	210	250
81	21602	Grand (Neosho) River - 2	0	0	0	0	0
82	21700	Illinois River	0	0	0	0	0

Table 5-3 - Average Annual Bedrock Groundwater Depletions for the Demand Projections (AFY)

Table Shading Legend (Text displays gap range in AFY)	0	0.1 - 500	501 - 2,500	2,501 - 10,000	10,001 - 20,000

Basin Number	Basin ID	Basin Name	2020	2030	2040	2050	2060
1	10100	Red River Mainstem (To Kiamichi River)	0	0	0	0	0
2	10201	Little River (McCurtain County) - 1	0	0	0	0	0
3	10202	Little River (McCurtain County) - 2	0	0	0	0	0
4	10203	Little River (McCurtain County) - 3	0	0	0	0	0
5	10301	Kiamichi River - 1	0	0	0	0	0
6	10302	Kiamichi River - 2	0	0	0	0	0
7	10411	Muddy Boggy River - 1	0	0	0	0	0
8	10412	Muddy Boggy River - 2	1,910	600	240	260	360
9	10420	Clear Boggy Creek	0	0	0	0	0
10	10500	Red River Mainstem (To Blue River)	0	0	0	0	0
11	10601	Blue River - 1	0	0	0	0	0
12	10602	Blue River - 2	0	0	0	0	0
13	10700	Red River Mainstem (To Washita)	40	90	140	200	260
14	10810	Lower Washita	0	0	0	0	0
15	10821	Middle Washita - 1	90	190	290	390	560
16	10822	Middle Washita - 2	0	0	0	0	0
17	10831	Upper Washita - 1	360	720	1,090	1,370	1,810
18	10832	Upper Washita - 2	970	1,950	2,920	3,670	4,990
19	10833	Upper Washita - 3	0	0	0	0	0
20	10840	Washita Headwaters	0	10	40	90	150
21	10900	Red River Mainstem (To Walnut Bayou)	0	0	0	0	0
22	11000	Walnut Bayou	260	410	590	720	940
23	11100	Mud Creek	300	370	440	540	620
24	11201	Beaver Creek - 1	0	0	0	0	0
25	11202	Beaver Creek - 2	160	300	470	620	840
26	11203	Beaver Creek - 3	60	110	170	220	300
27	11311	Cache Creek - 1	0	0	0	0	0
28	11312	Cache Creek - 2	0	0	0	0	0
29	11321	Deep Red Creek And West Cache Creek - 1	40	70	100	150	180
30	11322	Deep Red Creek And West Cache Creek - 2	0	0	0	0	0
31	11400	Red River Mainstem (To North Fork of Red)	0	0	0	0	0
32	11511	Lower North Fork Red River - 1	0	0	0	0	0
33	11512	Lower North Fork Red River - 2	0	0	0	0	0
34	11513	Lower North Fork Red River - 3	0	0	0	0	0
35	11514	Lower North Fork Red River - 4	0	0	0	0	0

Table 5-3 - Average Annual Bedrock Groundwater Depletions for the Demand Projections (AFY)

Table Shading Legend (Text displays gap range in AFY)	0	0.1 - 500	501 - 2,500	2,501 - 10,000	10,001 - 20,000

Basin Number	Basin ID	Basin Name	2020	2030	2040	2050	2060
36	11521	Upper North Fork Red River - 1	0	0	0	0	0
37	11522	Upper North Fork Red River - 2	40	80	120	160	200
38	11601	Salt Fork Red River - 1	460	920	1,380	1,740	2,310
39	11602	Salt Fork Red River - 2	100	200	300	370	500
40	11701	Prairie Dog Town Fork Red River - 1	170	360	530	670	870
41	11702	Prairie Dog Town Fork Red River - 2	510	1,030	1,550	1,950	2,570
42	11801	Elm Fork Red River - 1	80	160	270	340	450
43	11802	Elm Fork Red River - 2	60	110	170	220	300
44	20101	Poteau River - 1	0	0	0	0	60
45	20102	Poteau River - 2	120	240	420	520	680
46	20201	Lower Arkansas River - 1	0	0	0	0	0
47	20202	Lower Arkansas River - 2	0	0	0	0	0
48	20300	Canadian River (To North Canadian River)	700	440	510	520	530
49	20400	Middle Arkansas River	0	0	0	0	0
50	20510	Lower North Canadian River	0	0	160	450	800
51	20520	Middle North Canadian River	600	290	160	80	100
52	20531	Upper North Canadian River - 1	40	60	100	140	170
53	20532	Upper North Canadian River - 2	1,190	2,420	3,870	5,260	7,070
54	20533	Upper North Canadian River - 3	1,710	3,460	5,250	6,760	9,110
55	20540	North Canadian Headwaters	7,510	17,010	26,940	35,590	47,100
56	20611	Lower Canadian River - 1	0	0	0	0	0
57	20612	Lower Canadian River - 2	140	320	470	640	820
58	20620	Middle Canadian River	0	0	0	0	0
59	20630	Upper Canadian River	0	0	0	20	290
60	20700	Deep Fork River	0	0	0	0	0
61	20801	Little River - 1	0	0	0	0	0
62	20802	Little River - 2	0	0	0	0	0
63	20910	Lower Cimarron River	0	0	0	0	0
64	20920	Middle Cimarron River	170	310	450	580	720
65	20930	Upper Cimarron River	620	1,270	1,910	2,440	3,260
66	20940	Cimarron Headwaters	1,050	2,090	3,130	3,950	5,250
67	21011	Lower Salt Fork Arkansas River - 1	0	0	0	0	0
69	21012	Lower Salt Fork Arkansas River - 2	0	0	0	0	0
70	21013	Lower Salt Fork Arkansas River - 3	0	0	0	0	0
68	21020	Upper Salt Fork Arkansas River	20	60	170	200	240
71	21100	Arkansas River - Cimarron Rivers to Keystone Lake	0	0	0	0	0

Table 5-3 - Average Annual Bedrock Groundwater Depletions for the Demand Projections (AFY)

Table Shading Legend (Text displays gap range in AFY)	0	0.1 - 500	501 - 2,500	2,501 - 10,000	10,001 - 20,000

Basin Number	Basin ID	Basin Name	2020	2030	2040	2050	2060
72	21200	Arkansas River Mainstem (To Kansas State Line)	0	0	0	0	10
73	21301	Bird Creek - 1	0	0	0	0	0
74	21302	Bird Creek - 2	0	0	0	0	0
75	21401	Caney River - 1	0	0	0	0	0
76	21402	Caney River - 2	0	0	0	0	0
77	21511	Verdigris River (To Oologah Dam) - 1	0	0	0	0	0
78	21512	Verdigris River (To Oologah Dam) - 2	0	0	0	0	0
79	21520	Verdigris River (To Kansas State Line)	0	0	0	0	0
80	21601	Grand (Neosho) River - 1	0	0	0	0	0
81	21602	Grand (Neosho) River - 2	0	0	0	0	0
82	21700	Illinois River	0	0	0	0	0

Section 6
Effects of Water Conservation and Climate Change

6.1 Climate Change Implications on Supply and Demand

In recent years, significant national and international scientific efforts have been undertaken to understand and characterize the potential implications of climate change on water resources. A wide range of models and assumptions are being used by the scientific community to estimate future temperatures, precipitation quantities and patterns, and other factors affecting water supply and demand. The Oklahoma Climatological Survey (OCS; http://climate.ok.gov) has conducted a review of the current assessments of climate change research and concludes the following to be true:

- The earth's climate has warmed during the last 100 years;
- The earth's climate will very likely continue to warm for the foreseeable future;
- Much of the global average temperature increases over the last 50 years can be attributed to human activities, particularly increasing greenhouse gases in the atmosphere; and
- Oklahoma will be impacted.

In particular, climate change is projected to continue to alter the water cycle across the U.S., including the total amount of annual precipitation, timing of the precipitation, precipitation intensity and probability, and location of precipitation. Nationwide, most locations already have experienced increases in both precipitation and streamflow and decreases in drought during the second half of the 20th Century.

The U.S. Global Climate Research Program (USGCRP) projects that more frequent heavy rainfall events and droughts will affect much of the Great Plains as climate changes. The USGCRP notes, "Projections of increasing temperatures, faster evaporation rates, and more sustained droughts brought on by climate change will only add more stress to overtaxed water sources."

A variable precipitation history and an uncertain future under climate change combine to challenge even the most forward-thinking and resourceful managers of resources and infrastructure. While there remains significant uncertainty in the potential range of climate change impacts, particularly with regard to changes in precipitation, a sensitivity analysis of the possible effects of climate change was undertaken as part of the OCWP technical studies. By assessing sensitivity of potential impacts on both water supply and water demand from projected changes in climate, the OCWP is providing some insights into the degree to which the balance of water supply and water use might change should those projections hold true.

6.1.1 Potential Effects on Oklahoma Temperature, Precipitation, and Water Supply

According to a recent report by USBR, review of current downscaled climate projections over Oklahoma suggests that the southern Great Plains are likely to be warmer in the future, although the rate of warming varies. Projections of precipitation differ from model to model and range between drier and wetter than historical conditions (U.S. Bureau of Reclamation (USBR) Technical Memorandum 86-68210-2010-01).

In order to assess the potential implication of SW availability under climate change conditions, five climate change scenarios were developed based on ensembles of climate projection models. The scenarios were developed from a set of readily-available downscaled projections obtained from the bias-corrected and spatially downscaled World Climate Research Programme (WCRP) Phase 3 Coupled Model Intercomparison Project (CMIP3) Climate Projections archive (WCRP CMIP3, 2009) described by Maurer et al (2007). At the time of this study, the archive contained 112 projections of monthly temperature and precipitation, with each projection consisting of an overlap period of 1950 through 1999 and a projection period of 2000 through 2099.

The WCRP archive contains statistically downscaled and bias-corrected data developed jointly by USBR, Santa Clara College, and the Lawrence Livermore National Laboratory. WCRP-CMIP3 archive has been developed using peer reviewed methods (Maurer et al., 2002) and is currently being used by USBR and many other entities for climate change impact analyses.

The five scenarios were developed for two different projection horizons: 2030 and 2060. Four of the scenarios link to representative ensembles of projections along a range of potential temperature and precipitation conditions. Q1 is a hot and dry scenario; Q4 is a warm wet scenario; and Q2 and Q3 are intermediate scenarios. The fifth scenario, "C," is the central tendency of Q1-Q4.

The OCWP methodology for developing climate projections closely followed that applied by USBR as part of their "ensemble hybrid-delta" method (USBR Technical Memorandum 86-68210-2010-01). Projections were developed based on differences in regional mean annual temperature and precipitation compared to the historical baseline (Figure 6-1). Q1 represents the ensemble projection developed from the set of individual projections with predicted mean annual temperature changes greater than the median projected change (upper half) and predicted mean annual precipitation changes less than the median projected change (lower half) (i.e., hot and dry). Similarly, Q2 is developed from the lower half of both the temperature and precipitation change; Q3 from the upper half of both temperature and precipitation change (hot and wet); and Q4 from the lower half of temperature change and upper half of precipitation change (warm and wet). The C scenario represents the pool of projections from the interquartile range of change projections: 25th to 75th percentile of both temperature and precipitation change.

For each of the five scenarios, and each month, climate adjustment factor distributions were calculated based on differences between the ensemble pools of data and the historical baseline data set. These adjustment factors were then applied to the historical timeseries data set to incorporate climate change impacts associated with the given planning horizon, while maintaining historical patterns of month to month variability. To bracket the range of potential climate projections and in light of the uncertainties in climate change projections, the Q1 (Hot/Dry) and Q4 (Warm/Wet) scenarios were selected for estimating potential future conditions in Oklahoma.

The impact on temperature and precipitation under the Q1 and Q4 scenarios was used to estimate the potential implications on both SW supply and water demand across Oklahoma. The potential change in 2060 maximum temperature in August from the historical average is depicted in Figure 6-2 for the Q1 and Q4 scenarios. Similarly, Figure 6-3 shows the potential change in annual precipitation from the historical average for these scenarios.

A hydrology model was used to quantify the sensitivity of runoff to changed climate conditions. This sensitivity was expressed as a set of changes in runoff that were estimated by comparing simulated runoff based on the historical weather record with simulated runoff based on an adjusted weather record that reflects projected changes in climate. This approach compensates for some of the unavoidable bias inherent in any hydrology model.

This work employed a physical process-based hydrology model, the Variable Infiltration Capacity (VIC) macro-scale hydrology model. The VIC model is a distributed (gridded) macro-scale (regional-scale) physical hydrology model with several applications to climate change studies and successful application to numerous basins around the world.

The VIC model operates on each grid cell independently. The scale of the grid cells may be varied depending on the application, but in this work the model was constructed on a 1/8° spatial resolution, which is roughly a square 8 miles (12 kilometers) on a side. In this work the VIC model was run on a daily time step. Runoff was aggregated by stream basin and to a monthly time step.

The estimated sensitivity of runoff to projected climate change was quantified by making two runs of the hydrology model, one that used the historical weather record (the baseline case) and a second that used a projected weather record (the projected case; as is described below, these two records are the same length and each month in the projected record corresponds to the same month in the historical record). For each month in the historical record the sensitivity of runoff to climate change is expressed as the ratio between the runoff simulated using the projected record and the runoff simulated using the historical record.

The projected effects in 2060 on SW flows, expressed as a change relative to the 1950-2007 historical average, are depicted in Figure 6-4 for the Hot/Dry (Q1) scenario, indicating a possible upper end of impacts to Oklahoma's SW supplies. Additional information and projections for other scenarios and the 2030 timeframe are provided along with detailed explanations of the methods and results of the climate change impacts in the OCWP Climate Impacts to Streamflow Report.

6.1.2 Potential Effects on Water Demand

Recognizing that changes in our climate would affect both Oklahoma's water supplies and demand, OCWP technical analyses also considered the potential for climate change to affect certain demand sectors' forecasted water use. Specifically, the M&I and Crop Irrigation demand sectors were analyzed for how they could change under the Hot/Dry (Q1) and Warm/Wet (Q4) climate change scenarios. These two demand sectors were analyzed because they both include outdoor irrigation that has the potential to be significantly affected by climate change. The state's other five demand sectors may be affected to some degree by climate change, but those impacts would be expected to be much less significant than the M&I and Crop Irrigation demand sectors. Moreover, these two demand sectors together comprise over two-thirds of Oklahoma's water demand, such that the demand sectors that would be most significantly affected by climate change are also the major drivers of water use in Oklahoma.

6.1.2.1 M&I Demand

Statistical results of the OCWP Climate Demand Model were used to model the impacts of climate change on M&I water demand. The Climate Demand Model was developed using regression analysis and assessed the relationship between weather and monthly water demand for five communities in geographically diverse areas of Oklahoma. Details of the Climate Demand Model are documented in the OCWP Weather Production Model Revised Final Technical Memorandum. The relationships between M&I demand and historical weather are expressed as elasticities, or the percent change in monthly water demand given a unit change in monthly weather.

Variation in both monthly average daily maximum temperature and monthly total precipitation were found to have statistically significant relationships with water production. The elasticities for maximum temperature and precipitation were used to adjust monthly water demand estimates for the potential shifts in maximum temperature and precipitation.

Table 6-1 provides the statewide M&I demand forecast summary for the Hot/Dry (Q1) and Warm/Wet (Q4) climate scenarios as well as the difference from the baseline forecast. As expected, the 2060 Hot/Dry scenario produces the largest increase in M&I demand. The projected 73,256 AFY increase in 2060 demand under the Hot/Dry scenario is significant, equivalent to the projected increase in demand under the baseline (no climate change) scenario of about 20 years of M&I demand growth across Oklahoma. The change in M&I demand from baseline under climate change scenarios statewide are displayed in Figure 6-5. The county-level demand projections were subsequently allocated to the 82 OCWP basins for an evaluation of potential shortages under climate change conditions.

6.1.2.2 Crop Irrigation Demand

Modeling climate change impacts on agriculture demand required adaptation and use of the model developed for the OCWP baseline forecast. Climate change is assumed to impact only the Crop Irrigation demand and no change is assessed for the Livestock demand sector. The model considers a county's number of acres to be irrigated in the future, relative crop mix, monthly irrigation requirements for each crop, and losses due to irrigation system inefficiencies. The baseline forecast used monthly irrigation requirements for crops at 11 stations throughout Oklahoma, as reported in the Natural Resource Conservation Service (NRCS) Irrigation Guide Report, Oklahoma Supplement (NRCS 2006).

For the climate change scenario forecast, it was assumed that the number of irrigated acres, relative mix of crops, and irrigation efficiencies would remain constant from the baseline forecast. Irrigation crop requirements by station were assumed to change given climate change scenarios. Changes to the baseline demand forecast for Crop Irrigation demand across all of Oklahoma's counties were calculated using NRCS methods and the climate inputs described in Section 6.1.1. Those changes were then applied to the baseline demand to determine the projected demand for Crop Irrigation under climate change conditions.

Table 6-2 provides a statewide summary of Crop Irrigation demand under baseline, Hot/Dry, and Warm/Wet conditions. The projected 143,567 AFY increase in 2060 demand under the Hot/Dry scenario is significant, equivalent to the projected increase in demand under the baseline (no climate change) scenario of about 50 years of Crop Irrigation demand growth across Oklahoma. The change in Crop Irrigation demand from baseline under climate change scenarios statewide are displayed in Figure 6-6. The county-level demand projections were subsequently allocated to the 82 OCWP basins, using the same methods employed for allocating baseline county demand values to baseline basin-level demand forecasts.

6.1.3 Climate Change Implications for Water Supply Shortages

Ultimately, the effects of climate change on Oklahoma's SW supplies and water demand could affect the shortages users will face in the future. To characterize those possible implications, projections of monthly SW flow for each of the 82 OCWP basins under climate change were input into the Oklahoma H_2O tool, along with projections of demand under climate change conditions. Other than the climate change-driven adjustments to SW supply (streamflow data), Crop Irrigation demand, and M&I demand, no other modifications were made relative to the baseline scenario for projecting future water shortages under climate change. Specifically, the changes in the SW gaps in each basin were examined for 2030 and 2060 conditions under the Hot/Dry and Warm/Wet scenarios. The potential change in SW gaps and GW storage depletions under these climate change supply and demand conditions, relative to the baseline scenario, are presented in Table 6-3 and Table 6-4.

Impacts on SW gaps are expected to be most significant under the Hot/Dry scenario, and are anticipated to increase in their severity over time. Figure 6-7 and Figure 6-8 depict the potential change in SW gaps under Hot/Dry climate change supply and demand conditions, relative to the baseline scenario. Figure 6-7 shows the change in the magnitude of SW gaps under the 2060 Hot/Dry scenario. Figure 6-8 depicts the change in probability of SW gaps under the same conditions, where the increase is expressed as an incremental increase in percentage points. For example, if a basin's probability of gaps increased from 40 percent (baseline) to 50 percent (climate change), the figure would indicate an increase of 10 percentage points. In light of the potential impacts on supplies and demand, Oklahoma water planners at the federal, state, and local level should continue to monitor climate change science and adapt their planning as more data become available.

6.2 Conservation

Water conservation is being recognized as an important tool in managing water resources. In addition to providing decreased cost to water providers and reductions in customer water bills, the water saved through conservation programs has been shown to help reduce or avoid the demand for water restrictions during periods of drought. Conservation can be implemented on both the demand and supply/distribution side of water management. Reductions in water demand diminish the amount of water required by end users while supply side leak detection reduces water loss in a system. Both approaches can reduce the volume of water utilities produce or irrigators need, helping decrease operation and maintenance expenses. Due to the potential to reduce demand and subsequent gaps and storage depletions, conservation will be included as a water supply option in the Regional Reports.

6.2.1 Expanded Conservation Scenarios

Demand Conservation scenarios that are applied to the previously developed baseline forecast for the M&I and SSR and Crop Irrigation sector of the OCWP. Demand scenarios with conservation were developed based on patterns of current conservation and factors affecting future conservation activities occurring throughout the state. These factors include cost-effectiveness of potential programs, ease of implementation, and acceptance by both the citizens of Oklahoma and water provider decisionmakers. The evaluation included the impact of statewide expansion of a number of basic conservation activities to all Oklahoma water providers as well as implementation of a statewide water efficient indoor plumbing code ordinance that improves upon the current U.S. standards. Agricultural conservation activities evaluated included dryland production, increased irrigation efficiencies, and crop shifting.

The conservation scenarios were developed on the county-level through a combination of the activities, which are presented in Table 6-5. Additional information on the conservation scenarios can be found in the Demand Report (CDM 2011). The county-level demand projections were subsequently allocated to the 82 OCWP basins, using the same methods employed for allocating baseline county demand values to baseline basin-level demand forecasts. Scenario I Conservation measures are projected to decrease 2060 demand by 240,000 AFY, which is equivalent to about 15 percent of the total demand from the affected demand sectors. Scenario II Conservation measures are projected to decrease 2060 demand by 440,000 AFY, which is equivalent to a 25 percent reduction in the total demand of the affected demand sectors.

6.2.2 Expanded Conservation Scenarios Effects on Water Supply Shortages

The conservation scenarios could reduce the demand on Oklahoma's water supplies and decrease the shortages users will face in the future. To characterize those possible implications, projections of demand under conservation scenarios I and II for each of the 82 OCWP basins were input into the Oklahoma H_2O tool. Other than the reductions in demand in the Crop Irrigation, M&I, and SSR demand sectors, no other modifications were made relative to the baseline scenario for projecting future water shortages. The potential change in SW gaps and GW storage depletions under these reduced demand conditions, relative to the baseline scenario, are presented in Table 6-6 and Table 6-7.

Impacts from moderately expanded conservation (Scenario I) on SW gaps and GW storage depletions are expected to be most significant for basins with substantial M&I demand or for Crop Irrigation demand in the southwestern portion of the state. Substantially expanded conservation (Scenario II) could potentially greatly reduce or eliminate gaps and storage depletions throughout the state. Expanded conservation activities, under the Demand Management water supply option, was evaluated for each basin relative to other potential water supply options and will be included in the Data and Analysis section of the Regional Reports. Please refer to the reports for additional information and discussion for the effects of conservation on water supply shortages.

Figure 6-1 - Ensemble Climate Change Scenarios

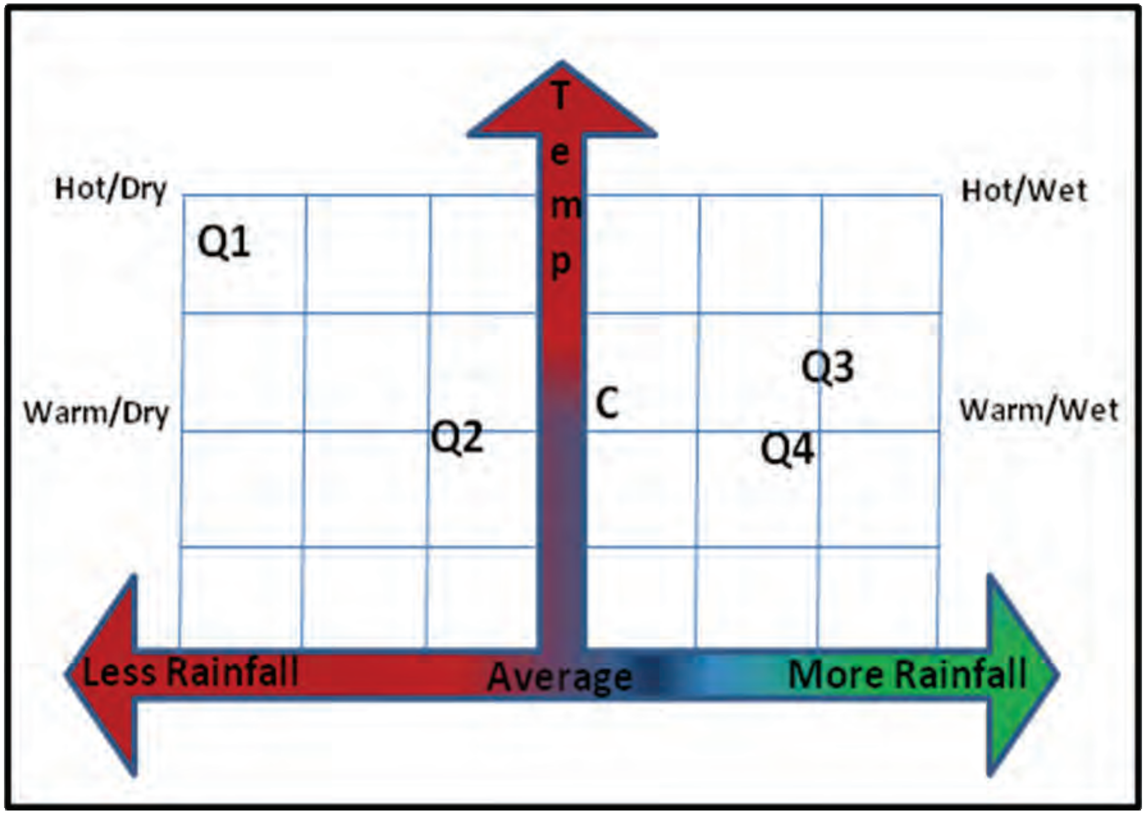


Figure 6-2 - Potential Change in 2060 Maximum Temperature in August from Historical Average

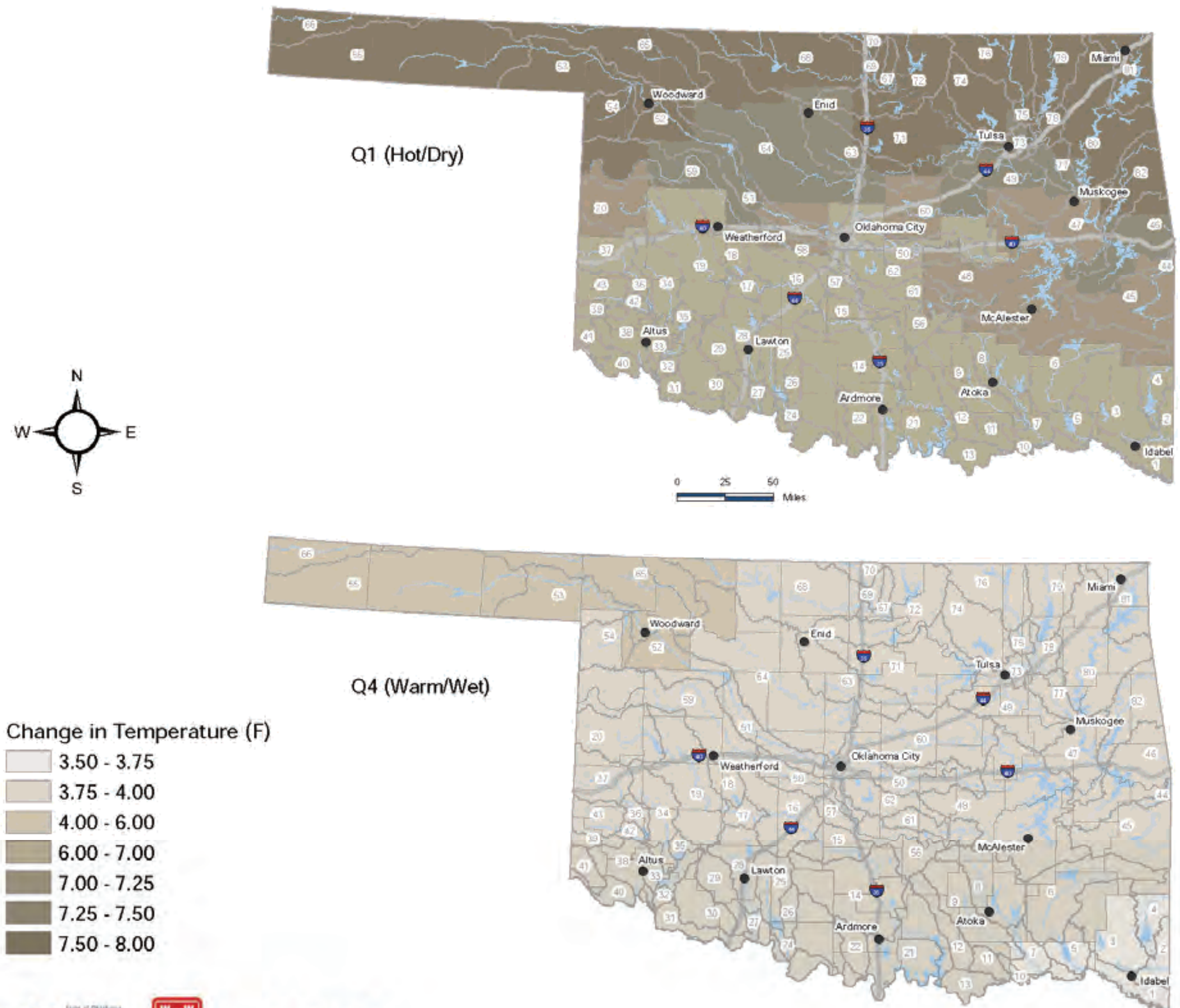


Figure 6-3 - Potential Change in 2060 Annual Precipitation from Historical Average

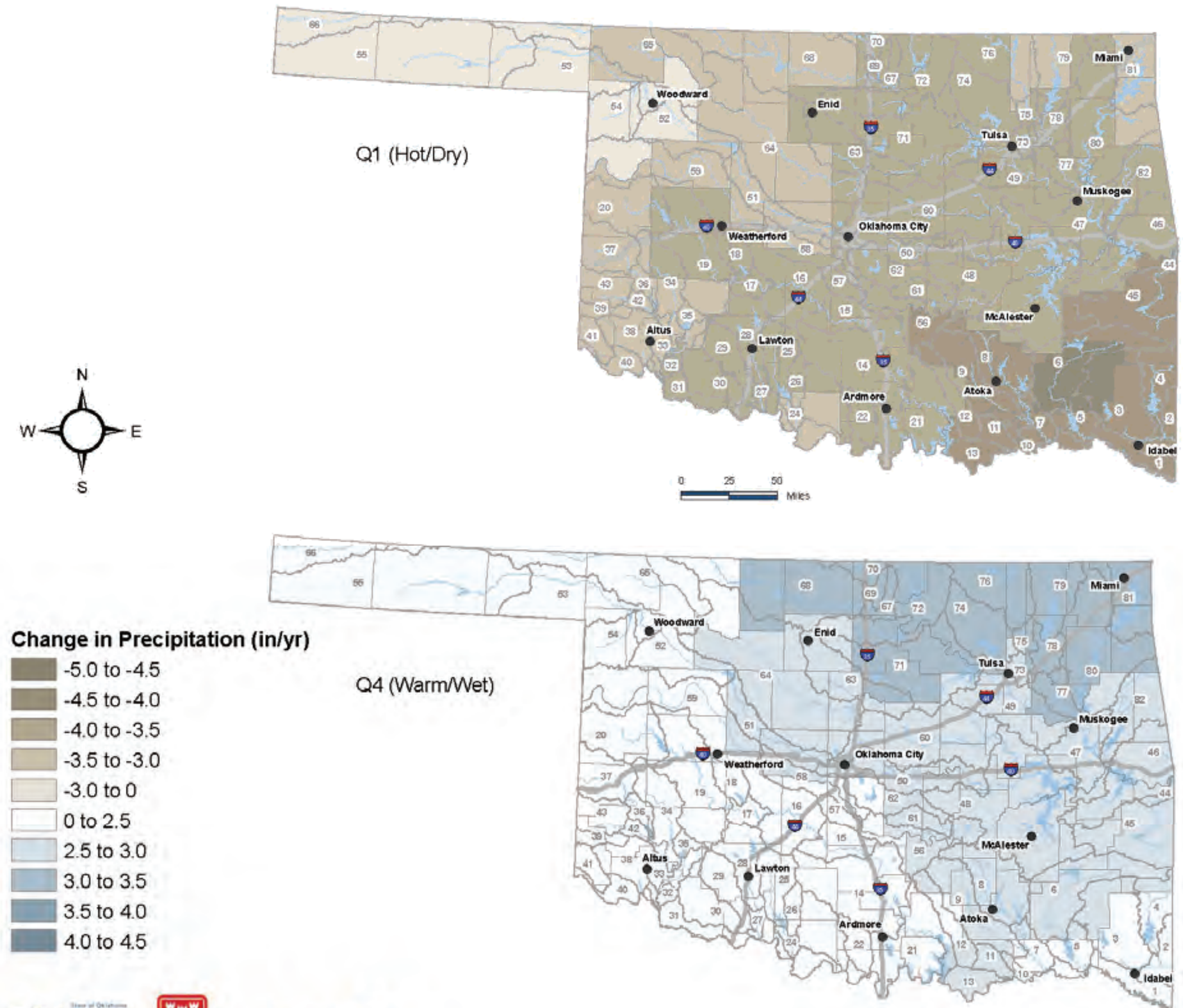


Figure 6-4 - Potential Change in Surface Water Gaged Flow with Climate Change, 2060 Hot/Dry Scenario

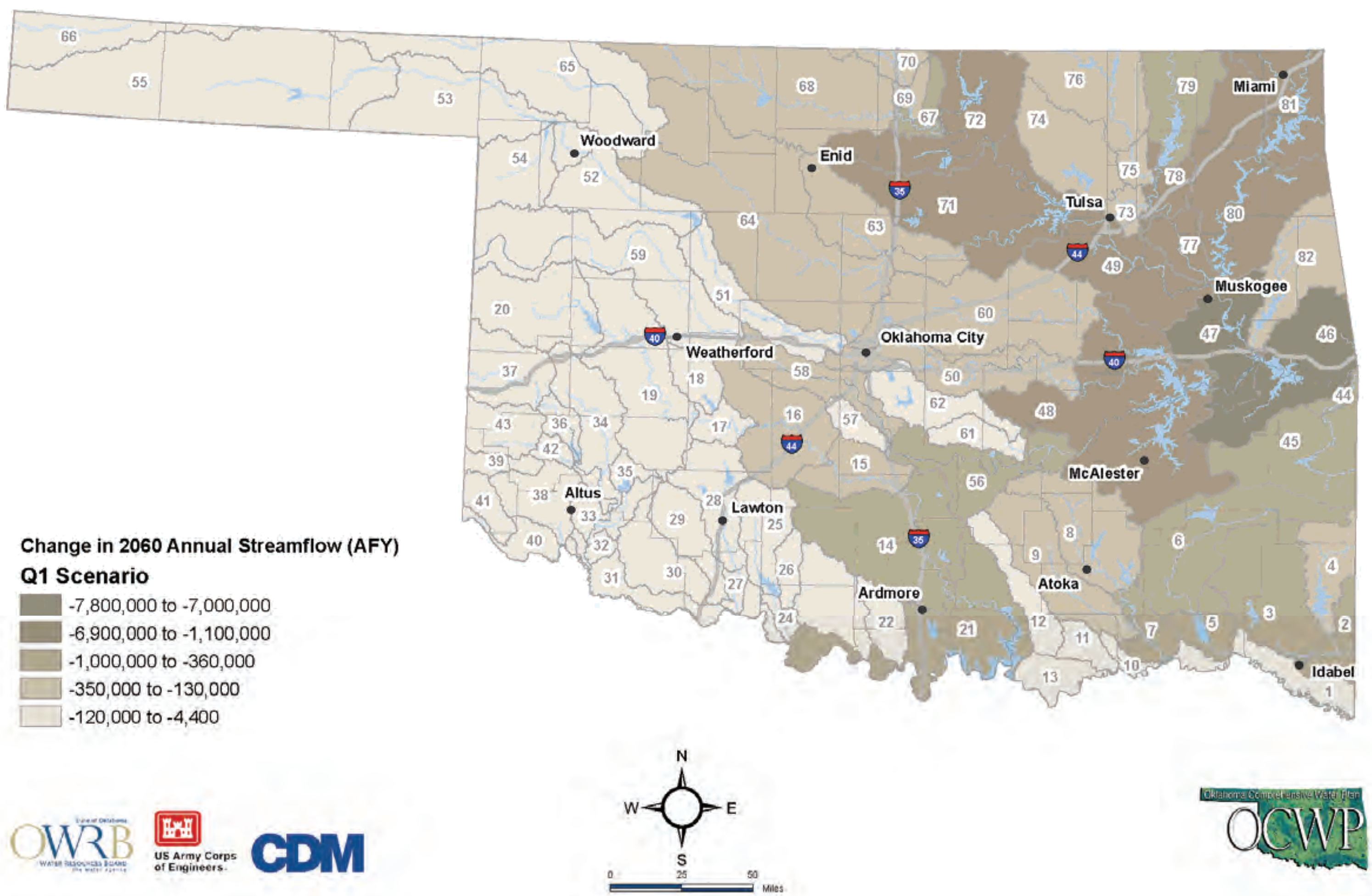


Figure 6-5 - Potential Change in M&I Demand with Climate Change, 2060 Hot/Dry and Warm/Wet Scenarios

Figure 6-6 - Potential Change in Crop Irrigation Demand with Climate Change, 2060
Hot/Dry and Warm/Wet Scenarios

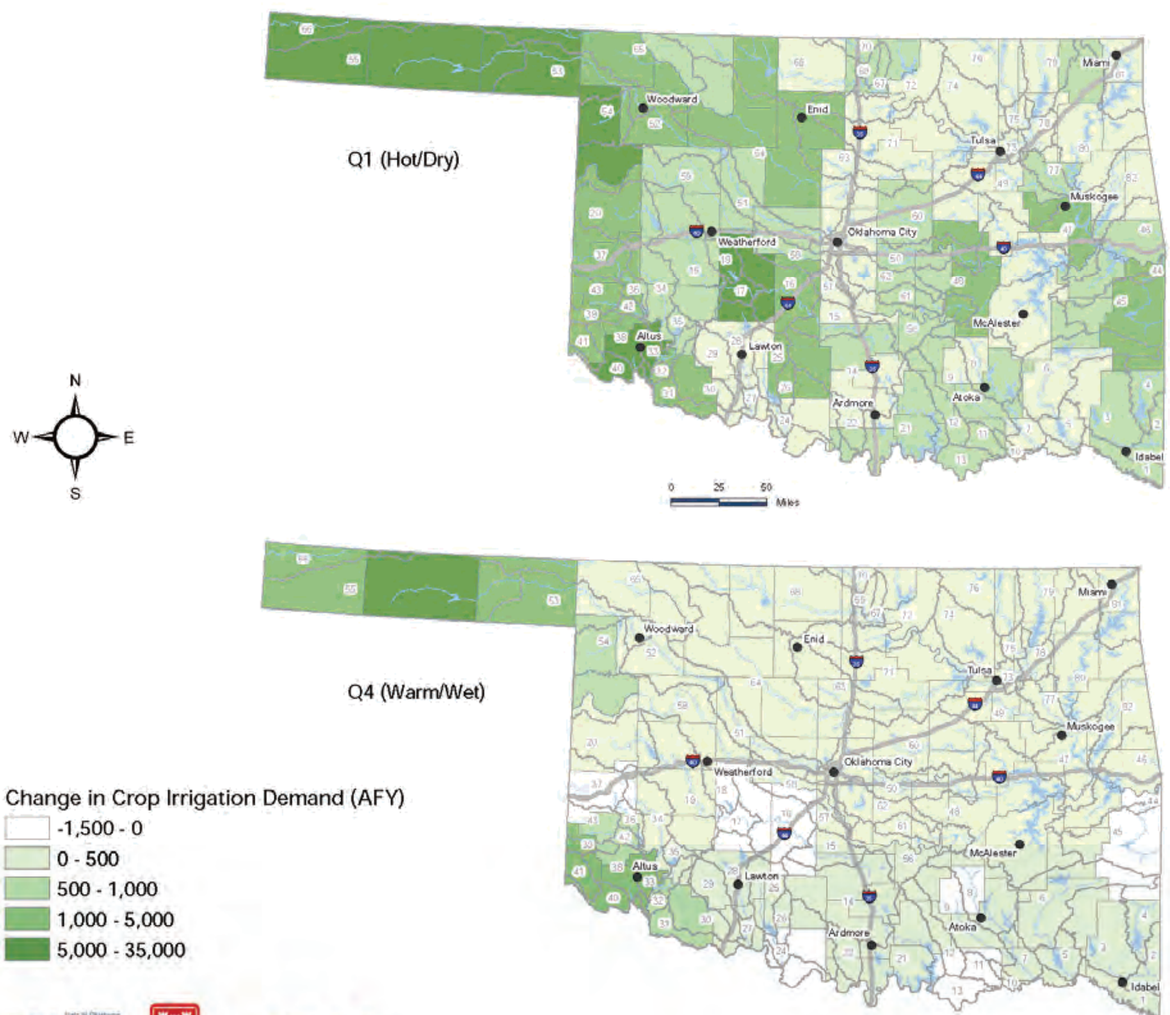
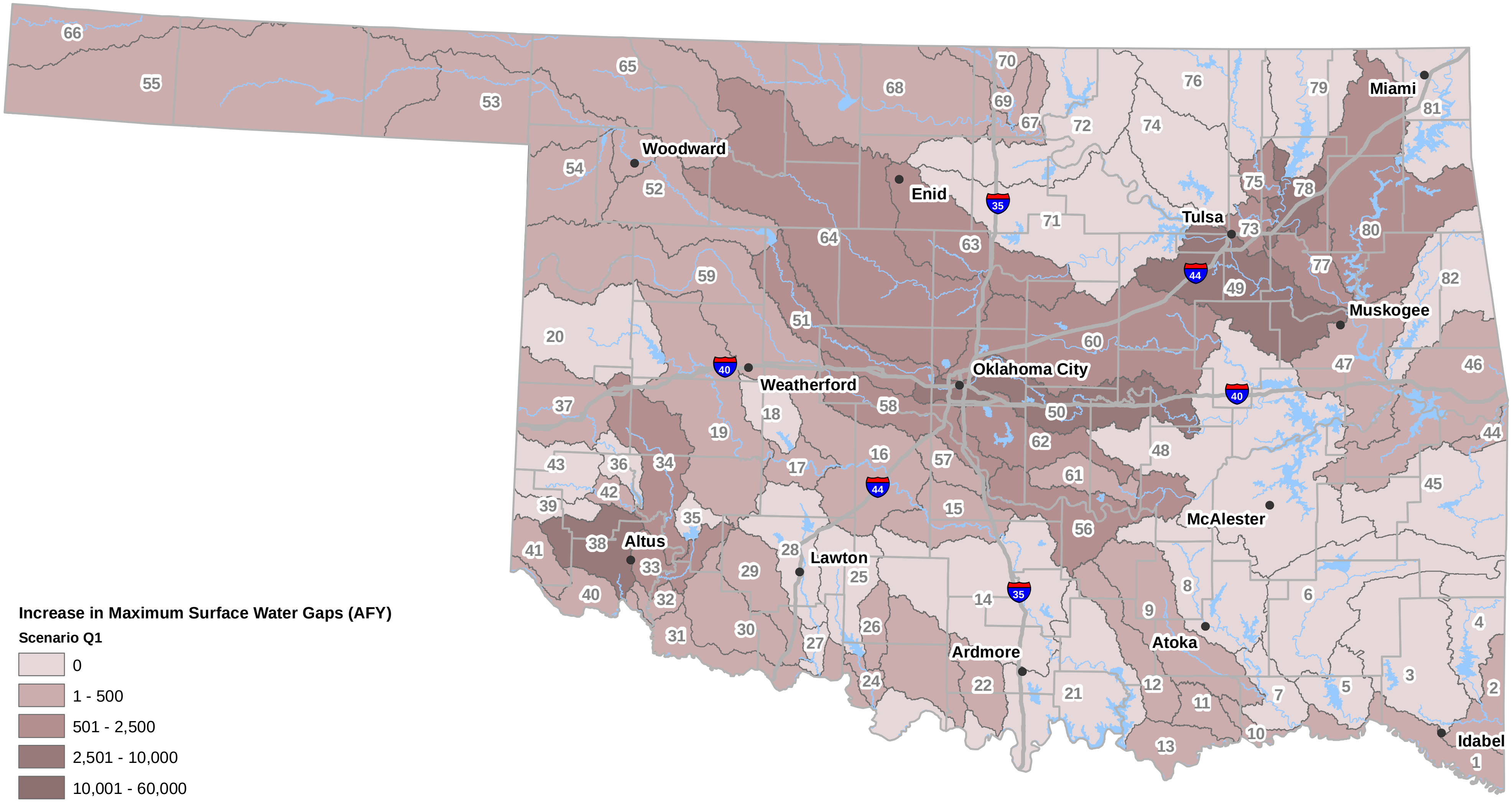


Figure 6-7 - Potential Change in Magnitude of Surface Water Gaps, 2060 Hot/Dry Scenario



N
W E
S
0 25 50
Miles

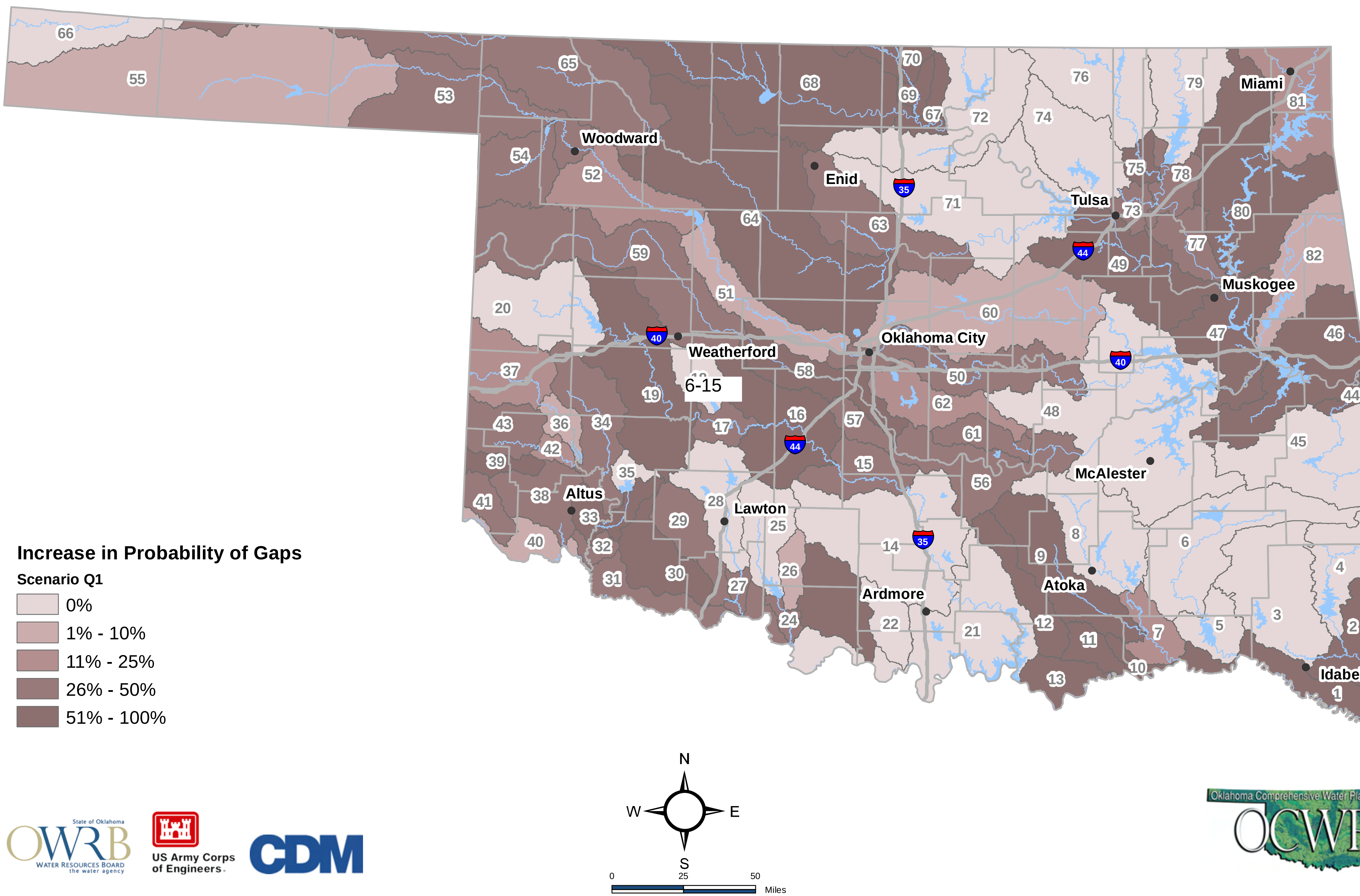
State of Oklahoma OWRB Water Resources Board the water agency

US Army Corps of Engineers

CDM

Oklahoma Comprehensive Water Plan OCWP

Figure 6-8 - Potential Change in Probability of Surface Water Gaps, 2060 Hot/Dry Scenario



US Army Corps of Engineers

CDM

Oklahoma Comprehensive Water Plan OCWP

Table 6-1. Statewide Municipal and Industrial Demand Forecast Under Climate Change

Year	Baseline (AFY or %)	Hot/Dry (AFY or %)	Warm/Wet (AFY or %)
2030	682,391	718,747	699,119
2060	772,773	846,029	805,398
Change from Baseline			
2030	N/A	36,356	16,727
2060	N/A	73,256	32,625
Percent Increase from Baseline			
2030	N/A	5.3%	2.5%
2060	N/A	9.5%	4.2%

Table 6-2. Statewide Crop Irrigation Demand Forecast Under Climate Change

Year	Baseline (AFY or %)	Hot/Dry (AFY or %)	Warm/Wet (AFY or %)
2030	806,112	892,221	823,622
2060	897,464	1,041,032	926,557
Change from Baseline			
2030	N/A	86,109	17,511
2060	N/A	143,567	29,093
Percent Increase from Baseline			
2030	N/A	10.7%	2.2%
2060	N/A	16.0%	3.2%

Table 6-3 - Potential Change in Annual Surface Water Gaps with Climate Change, 2030 and 2060 Hot/Dry and Warm/Wet (AFY)

			Hot/Dry (Q1)		Wet/Warm (Q4)	
Basin Number	Basin ID	Basin Name	Change in the Size of 2030 Gaps (AFY)	Change in the Size of 2060 Gaps (AFY)	Change in the Size of 2030 Gaps (AFY)	Change in the Size of 2060 Gaps (AFY)
1	10100	Red River Mainstem (To Kiamichi River)	490	340	-20	-30
2	10201	Little River (McCurtain County) - 1	80	10	10	40
3	10202	Little River (McCurtain County) - 2	0	0	0	0
4	10203	Little River (McCurtain County) - 3	0	0	0	0
5	10301	Kiamichi River - 1	0	0	0	0
6	10302	Kiamichi River - 2	0	0	0	0
7	10411	Muddy Boggy River - 1	60	0	10	10
8	10412	Muddy Boggy River - 2	0	0	0	0
9	10420	Clear Boggy Creek	430	440	-100	-10
10	10500	Red River Mainstem (To Blue River)	120	20	0	-30
11	10601	Blue River - 1	70	40	0	-30
12	10602	Blue River - 2	190	80	-10	10
13	10700	Red River Mainstem (To Washita)	380	320	10	-60
14	10810	Lower Washita	0	0	0	0
15	10821	Middle Washita - 1	310	170	-20	-110
16	10822	Middle Washita - 2	550	240	-60	20
17	10831	Upper Washita - 1	290	120	-40	-270
18	10832	Upper Washita - 2	0	0	0	0
19	10833	Upper Washita - 3	290	150	0	0
20	10840	Washita Headwaters	0	0	0	0
21	10900	Red River Mainstem (To Walnut Bayou)	0	0	0	0
22	11000	Walnut Bayou	130	250	-40	30
23	11100	Mud Creek	80	60	-10	-20
24	11201	Beaver Creek - 1	30	30	10	-20
25	11202	Beaver Creek - 2	0	0	0	0
26	11203	Beaver Creek - 3	70	150	20	20
27	11311	Cache Creek - 1	70	0	0	0
28	11312	Cache Creek - 2	0	0	0	0

Table 6-3 - Potential Change in Annual Surface Water Gaps with Climate Change, 2030 and 2060 Hot/Dry and Warm/Wet (AFY)

Basin Number	Basin ID	Basin Name	Hot/Dry (Q1)		Wet/Warm (Q4)	
			Change in the Size of 2030 Gaps (AFY)	Change in the Size of 2060 Gaps (AFY)	Change in the Size of 2030 Gaps (AFY)	Change in the Size of 2060 Gaps (AFY)
29	11321	Deep Red Creek And West Cache Creek - 1	170	150	-50	-50
30	11322	Deep Red Creek And West Cache Creek - 2	160	230	10	40
31	11400	Red River Mainstem (To North Fork of Red)	50	90	10	-10
32	11511	Lower North Fork Red River - 1	60	80	0	20
33	11512	Lower North Fork Red River - 2	800	590	20	-270
34	11513	Lower North Fork Red River - 3	450	700	-70	-10
35	11514	Lower North Fork Red River - 4	0	0	0	0
36	11521	Upper North Fork Red River - 1	0	0	0	0
37	11522	Upper North Fork Red River - 2	50	40	-10	0
38	11601	Salt Fork Red River - 1	4,060	6,400	810	1,480
39	11602	Salt Fork Red River - 2	0	0	0	0
40	11701	Prairie Dog Town Fork Red River - 1	110	180	30	30
41	11702	Prairie Dog Town Fork Red River - 2	20	30	0	10
42	11801	Elm Fork Red River - 1	70	100	0	0
43	11802	Elm Fork Red River - 2	10	0	0	10
44	20101	Poteau River - 1	1,190	280	0	150
45	20102	Poteau River - 2	0	0	0	0
46	20201	Lower Arkansas River - 1	1,850	60	0	-640
47	20202	Lower Arkansas River - 2	9,970	250	40	-1,610
48	20300	Canadian River (To North Canadian River)	0	0	0	0
49	20400	Middle Arkansas River	6,590	3,430	510	210
50	20510	Lower North Canadian River	1,800	3,350	510	760
51	20520	Middle North Canadian River	480	760	150	270
52	20531	Upper North Canadian River - 1	40	60	0	30
53	20532	Upper North Canadian River - 2	50	60	20	-40
54	20533	Upper North Canadian River - 3	30	20	-10	-120
55	20540	North Canadian Headwaters	110	220	-30	-200
56	20611	Lower Canadian River - 1	2,050	810	-380	-1,020

Table 6-3 - Potential Change in Annual Surface Water Gaps with Climate Change, 2030 and 2060 Hot/Dry and Warm/Wet (AFY)

Basin Number	Basin ID	Basin Name	Hot/Dry (Q1)		Wet/Warm (Q4)	
			Change in the Size of 2030 Gaps (AFY)	Change in the Size of 2060 Gaps (AFY)	Change in the Size of 2030 Gaps (AFY)	Change in the Size of 2060 Gaps (AFY)
57	20612	Lower Canadian River - 2	80	190	-70	-40
58	20620	Middle Canadian River	2,000	1,200	-50	-1,430
59	20630	Upper Canadian River	40	80	-110	-110
60	20700	Deep Fork River	0	850	0	0
61	20801	Little River - 1	20	30	-20	-30
62	20802	Little River - 2	0	1,140	0	0
63	20910	Lower Cimarron River	650	990	-370	-1,130
64	20920	Middle Cimarron River	1,330	1,830	110	90
65	20930	Upper Cimarron River	550	440	-50	-310
66	20940	Cimarron Headwaters	120	250	30	70
67	21011	Lower Salt Fork Arkansas River - 1	250	90	-10	-120
69	21012	Lower Salt Fork Arkansas River - 2	150	90	0	-30
70	21013	Lower Salt Fork Arkansas River - 3	60	40	0	0
68	21020	Upper Salt Fork Arkansas River	580	250	-80	-390
71	21100	Arkansas River - Cimarron Rivers to Keystone Lake	0	0	0	0
72	21200	Arkansas River Mainstem (To Kansas State Line)	0	0	0	0
73	21301	Bird Creek - 1	550	1,090	90	290
74	21302	Bird Creek - 2	0	0	0	0
75	21401	Caney River - 1	1,700	1,760	-220	-220
76	21402	Caney River - 2	0	0	0	0
77	21511	Verdigris River (To Oologah Dam) - 1	2,350	1,130	-310	-1,530
78	21512	Verdigris River (To Oologah Dam) - 2	4,390	3,620	-1,880	-5,070
79	21520	Verdigris River (To Kansas State Line)	0	0	0	0
80	21601	Grand (Neosho) River - 1	1,110	510	-920	-2,550
81	21602	Grand (Neosho) River - 2	0	0	0	0
82	21700	Illinois River	0	0	0	0

Table 6-4 - Potential Change in the Probability of Annual Surface Water Gaps with Climate Change, 2030 and 2060 Hot/Dry and Warm/Wet (AFY)

Basin Number	Basin ID	Basin Name	Hot/Dry (Q1)		Wet/Warm (Q4)	
			Change in the Probability of 2030 Gaps (AFY)	Change in the Probability of 2060 Gaps (AFY)	Change in the Probability of 2030 Gaps (AFY)	Change in the Probability of 2060 Gaps (AFY)
1	10100	Red River Mainstem (To Kiamichi River)	62%	71%	14%	5%
2	10201	Little River (McCurtain County) - 1	41%	60%	5%	7%
3	10202	Little River (McCurtain County) - 2	0%	0%	0%	0%
4	10203	Little River (McCurtain County) - 3	0%	0%	0%	0%
5	10301	Kiamichi River - 1	0%	0%	0%	0%
6	10302	Kiamichi River - 2	0%	0%	0%	0%
7	10411	Muddy Boggy River - 1	26%	24%	3%	2%
8	10412	Muddy Boggy River - 2	0%	0%	0%	0%
9	10420	Clear Boggy Creek	57%	67%	-3%	3%
10	10500	Red River Mainstem (To Blue River)	21%	62%	0%	0%
11	10601	Blue River - 1	10%	59%	0%	-2%
12	10602	Blue River - 2	43%	57%	0%	-2%
13	10700	Red River Mainstem (To Washita)	48%	60%	2%	-3%
14	10810	Lower Washita	0%	0%	0%	0%
15	10821	Middle Washita - 1	45%	47%	-2%	-3%
16	10822	Middle Washita - 2	36%	52%	0%	0%
17	10831	Upper Washita - 1	34%	47%	0%	-2%
18	10832	Upper Washita - 2	0%	0%	0%	0%
19	10833	Upper Washita - 3	41%	52%	0%	-3%
20	10840	Washita Headwaters	0%	0%	0%	0%
21	10900	Red River Mainstem (To Walnut Bayou)	0%	0%	0%	0%
22	11000	Walnut Bayou	0%	0%	0%	-2%
23	11100	Mud Creek	55%	57%	-7%	-9%
24	11201	Beaver Creek - 1	43%	40%	-9%	-40%
25	11202	Beaver Creek - 2	0%	0%	0%	0%
26	11203	Beaver Creek - 3	16%	7%	-17%	-33%
27	11311	Cache Creek - 1	26%	50%	0%	0%
28	11312	Cache Creek - 2	0%	0%	0%	0%

Table 6-4 - Potential Change in the Probability of Annual Surface Water Gaps with Climate Change, 2030 and 2060 Hot/Dry and Warm/Wet (AFY)

Basin Number	Basin ID	Basin Name	Hot/Dry (Q1)		Wet/Warm (Q4)	
			Change in the Probability of 2030 Gaps (AFY)	Change in the Probability of 2060 Gaps (AFY)	Change in the Probability of 2030 Gaps (AFY)	Change in the Probability of 2060 Gaps (AFY)
29	11321	Deep Red Creek And West Cache Creek - 1	60%	48%	-3%	-10%
30	11322	Deep Red Creek And West Cache Creek - 2	71%	59%	5%	3%
31	11400	Red River Mainstem (To North Fork of Red)	66%	45%	12%	-9%
32	11511	Lower North Fork Red River - 1	41%	50%	0%	3%
33	11512	Lower North Fork Red River - 2	74%	79%	-2%	-10%
34	11513	Lower North Fork Red River - 3	34%	33%	-14%	-9%
35	11514	Lower North Fork Red River - 4	0%	0%	0%	0%
36	11521	Upper North Fork Red River - 1	0%	2%	0%	-2%
37	11522	Upper North Fork Red River - 2	72%	24%	-12%	-22%
38	11601	Salt Fork Red River - 1	52%	28%	10%	5%
39	11602	Salt Fork Red River - 2	0%	59%	0%	-17%
40	11701	Prairie Dog Town Fork Red River - 1	7%	3%	2%	2%
41	11702	Prairie Dog Town Fork Red River - 2	72%	36%	0%	7%
42	11801	Elm Fork Red River - 1	28%	21%	-3%	-2%
43	11802	Elm Fork Red River - 2	53%	48%	0%	-16%
44	20101	Poteau River - 1	53%	67%	0%	2%
45	20102	Poteau River - 2	0%	0%	0%	0%
46	20201	Lower Arkansas River - 1	60%	79%	0%	-2%
47	20202	Lower Arkansas River - 2	53%	76%	-3%	-2%
48	20300	Canadian River (To North Canadian River)	0%	0%	0%	0%
49	20400	Middle Arkansas River	45%	74%	-12%	-14%
50	20510	Lower North Canadian River	28%	41%	-2%	-3%
51	20520	Middle North Canadian River	7%	9%	-5%	-3%
52	20531	Upper North Canadian River - 1	81%	17%	0%	3%
53	20532	Upper North Canadian River - 2	52%	45%	7%	-9%
54	20533	Upper North Canadian River - 3	86%	29%	-9%	-52%
55	20540	North Canadian Headwaters	21%	5%	-40%	-34%
56	20611	Lower Canadian River - 1	45%	34%	-10%	-7%

Table 6-4 - Potential Change in the Probability of Annual Surface Water Gaps with Climate Change, 2030 and 2060 Hot/Dry and Warm/Wet (AFY)

Basin Number	Basin ID	Basin Name	Hot/Dry (Q1)		Wet/Warm (Q4)	
			Change in the Probability of 2030 Gaps (AFY)	Change in the Probability of 2060 Gaps (AFY)	Change in the Probability of 2030 Gaps (AFY)	Change in the Probability of 2060 Gaps (AFY)
57	20612	Lower Canadian River - 2	41%	38%	-2%	-10%
58	20620	Middle Canadian River	69%	76%	-2%	-7%
59	20630	Upper Canadian River	45%	43%	-10%	-9%
60	20700	Deep Fork River	0%	2%	0%	0%
61	20801	Little River - 1	45%	45%	-5%	2%
62	20802	Little River - 2	0%	19%	0%	0%
63	20910	Lower Cimarron River	33%	48%	-9%	-7%
64	20920	Middle Cimarron River	48%	60%	0%	0%
65	20930	Upper Cimarron River	34%	29%	-17%	-28%
66	20940	Cimarron Headwaters	2%	0%	2%	0%
67	21011	Lower Salt Fork Arkansas River - 1	67%	91%	-2%	-7%
69	21012	Lower Salt Fork Arkansas River - 2	93%	95%	0%	-3%
70	21013	Lower Salt Fork Arkansas River - 3	74%	98%	0%	0%
68	21020	Upper Salt Fork Arkansas River	67%	83%	-5%	-7%
71	21100	Arkansas River - Cimarron Rivers to Keystone Lake	0%	0%	0%	0%
72	21200	Arkansas River Mainstem (To Kansas State Line)	0%	0%	0%	0%
73	21301	Bird Creek - 1	50%	40%	3%	3%
74	21302	Bird Creek - 2	0%	0%	0%	0%
75	21401	Caney River - 1	90%	88%	-2%	0%
76	21402	Caney River - 2	0%	0%	0%	0%
77	21511	Verdigris River (To Oologah Dam) - 1	47%	31%	-24%	-24%
78	21512	Verdigris River (To Oologah Dam) - 2	50%	31%	-19%	-24%
79	21520	Verdigris River (To Kansas State Line)	0%	0%	0%	0%
80	21601	Grand (Neosho) River - 1	53%	67%	-7%	-10%
81	21602	Grand (Neosho) River - 2	0%	16%	0%	0%
82	21700	Illinois River	0%	9%	0%	0%

Table 6-5. Summary of OCWP Conservation Scenarios

Demand Sector	Conservation Scenario	Description
Municipal & Industrial	Scenario I Moderately Expanded Conservation	• Passive conservation achieved by 2060 for public-supplied residential (PSR) and 2030 for public-supplied nonresidential (PSNR). Passive conservation is defined as conservation that can be achieved through government plumbing codes as part of the Energy Policy Act. • 90% of water providers in each county will meter their customers, unless current metered percentage is greater than 90%. • Non-revenue water (NRW) will be reduced to 12%, where applicable • Conservation pricing will be implemented by 20% of purveyors in rural counties, 40% in mostly urban counties, and 60% in counties with high metropolitan populations. • Water conservation educational programs will be implemented by all providers, which include billing inserts and conservation tip websites to reduce demand by 3%.
	Scenario II Substantially Expanded Conservation	• Passive conservation (as described in Scenario I) • All purveyors will meter their customers. • NRW will be reduced to 10% where applicable. • Conservation pricing will be implemented by 60% of purveyors in rural counties, 80% in mostly urban counties, and 100% in counties with high metro populations. • Water conservation education programs will be implemented to reduce demand by 5% including school education programs and media campaigns in addition to billing inserts and a conservation tip website. • High efficiency plumbing code ordinance will be implemented. This ordinance requires use of high efficiency fixtures with lower maximum flow rates than those required under the Energy Policy Act.
Agricultural Irrigation	Scenario I Moderately Expanded Conservation	• The field application efficiency of surface irrigation systems for Harmon, Jackson, Tillman, and Kiowa counties will increase to 80 percent beginning in 2015 (All of Basins 40 and 41, portions of Basins 34, 36, 38, and 42) . • In Harmon, Jackson, Tillman, and Kiowa counties, 10% of the land irrigated by surface irrigation will shift to micro-irrigation beginning in 2015. (All of Basins 40 and 41, portions of Basins 34, 36, 38, and 42) • All sprinkler systems will have a field application efficiency of 90% beginning in 2015, representing implementation of LEPA nozzles on existing sprinkler systems. • Water saved through conservation activities is not applied to a water scheme elsewhere, such as expanding the number of irrigated acres, thus achieving true conservation.
	Scenario II Substantially Expanded Conservation	• All assumptions from Scenario I are applicable. • All acres of water intensive crops (corn for grain and forage crops, including alfalfa and pasture grass), shift to less water intensive crops (grain for sorghum) beginning in 2015. While is it highly unlikely that all water intensive crop production will stop, this assumption allows for analysis of full implementation of the "what-if" scenario.

Table 6-6 - Potential Decreases in Physical Water Supply Shortages with Moderately Expanded Conservation Activities (AFY)

Basin Number	Basin ID	Basin Name	Change in the Size of 2060 SW Gaps (AFY)	Change in the Size of 2060 AGW Storage Depletions (AFY)	Change in the Size of 2060 BGW Storage Depletions (AFY)	Change in the Probability of 2060 SWGaps (AFY)	Change in the Probability of 2060 AGW Storage Depleitons (AFY)
1	10100	Red River Mainstem (To Kiamichi River)	-190	0	0	0%	0%
2	10201	Little River (McCurtain County) - 1	0	0	0	0%	0%
3	10202	Little River (McCurtain County) - 2	0	-10	0	0%	0%
4	10203	Little River (McCurtain County) - 3	0	-10	0	0%	0%
5	10301	Kiamichi River - 1	0	-20	0	0%	0%
6	10302	Kiamichi River - 2	0	-10	0	0%	0%
7	10411	Muddy Boggy River - 1	0	0	0	0%	0%
8	10412	Muddy Boggy River - 2	0	-40	-60	0%	0%
9	10420	Clear Boggy Creek	-380	-30	0	0%	0%
10	10500	Red River Mainstem (To Blue River)	-50	0	0	-2%	0%
11	10601	Blue River - 1	-50	0	0	-3%	0%
12	10602	Blue River - 2	-90	0	0	-2%	0%
13	10700	Red River Mainstem (To Washita)	-280	-80	-160	-3%	-5%
14	10810	Lower Washita	0	-160	0	0%	-2%
15	10821	Middle Washita - 1	-180	-110	-190	-5%	-3%
16	10822	Middle Washita - 2	-180	-20	0	0%	0%
17	10831	Upper Washita - 1	-60	-10	-330	0%	0%
18	10832	Upper Washita - 2	0	0	-1,050	0%	0%
19	10833	Upper Washita - 3	-160	-110	0	-2%	-2%
20	10840	Washita Headwaters	0	-20	-150	0%	0%
21	10900	Red River Mainstem (To Walnut Bayou)	0	-110	0	0%	0%
22	11000	Walnut Bayou	-360	-30	-170	0%	0%
23	11100	Mud Creek	-90	0	-380	-2%	0%
24	11201	Beaver Creek - 1	-30	0	0	0%	0%
25	11202	Beaver Creek - 2	0	0	-190	0%	0%

Table 6-6 - Potential Decreases in Physical Water Supply Shortages with Moderately Expanded Conservation Activities (AFY)

Basin Number	Basin ID	Basin Name	Change in the Size of 2060 SW Gaps (AFY)	Change in the Size of 2060 AGW Storage Depletions (AFY)	Change in the Size of 2060 BGW Storage Depletions (AFY)	Change in the Probability of 2060 SWGaps (AFY)	Change in the Probability of 2060 AGW Storage Depleitons (AFY)
26	11203	Beaver Creek - 3	-90	-10	-50	-7%	0%
27	11311	Cache Creek - 1	0	0	0	0%	0%
28	11312	Cache Creek - 2	0	-10	0	0%	0%
29	11321	Deep Red Creek And West Cache Creek - 1	-280	-150	-90	-3%	-3%
30	11322	Deep Red Creek And West Cache Creek - 2	-160	-50	0	-31%	-26%
31	11400	Red River Mainstem (To North Fork of Red)	-100	-390	0	-41%	-21%
32	11511	Lower North Fork Red River - 1	-10	-150	0	-5%	-10%
33	11512	Lower North Fork Red River - 2	-310	-150	0	-5%	-5%
34	11513	Lower North Fork Red River - 3	-890	-270	0	-5%	-7%
35	11514	Lower North Fork Red River - 4	0	0	0	0%	0%
36	11521	Upper North Fork Red River - 1	0	-380	0	0%	0%
37	11522	Upper North Fork Red River - 2	30	-480	-200	-17%	-10%
38	11601	Salt Fork Red River - 1	-4,590	-980	-2,310	-53%	-52%
39	11602	Salt Fork Red River - 2	-20	-50	-90	0%	0%
40	11701	Prairie Dog Town Fork Red River - 1	-190	-700	-870	-14%	-14%
41	11702	Prairie Dog Town Fork Red River - 2	-20	-900	-2,570	-62%	-88%
42	11801	Elm Fork Red River - 1	-40	-280	-40	0%	0%
43	11802	Elm Fork Red River - 2	0	-60	-30	-5%	0%
44	20101	Poteau River - 1	-10	0	0	0%	0%
45	20102	Poteau River - 2	0	0	-80	0%	0%
46	20201	Lower Arkansas River - 1	-340	10	0	0%	0%
47	20202	Lower Arkansas River - 2	-240	-20	0	0%	0%

Table 6-6 - Potential Decreases in Physical Water Supply Shortages with Moderately Expanded Conservation Activities (AFY)

Basin Number	Basin ID	Basin Name	Change in the Size of 2060 SW Gaps (AFY)	Change in the Size of 2060 AGW Storage Depletions (AFY)	Change in the Size of 2060 BGW Storage Depletions (AFY)	Change in the Probability of 2060 SWGaps (AFY)	Change in the Probability of 2060 AGW Storage Depleitons (AFY)
48	20300	Canadian River (To North Canadian River)	0	-160	-160	0%	0%
49	20400	Middle Arkansas River	-4,900	-510	0	0%	0%
50	20510	Lower North Canadian River	-3,100	-470	-800	0%	0%
51	20520	Middle North Canadian River	-1,250	-2,040	-80	0%	0%
52	20531	Upper North Canadian River - 1	-20	-400	-150	-5%	-2%
53	20532	Upper North Canadian River - 2	-40	-510	-1,710	0%	-5%
54	20533	Upper North Canadian River - 3	-10	-50	-1,390	-5%	-3%
55	20540	North Canadian Headwaters	-140	-110	-15,510	-3%	-3%
56	20611	Lower Canadian River - 1	-1,150	-490	0	-2%	-2%
57	20612	Lower Canadian River - 2	-310	-120	-380	0%	-3%
58	20620	Middle Canadian River	-1,950	-410	0	0%	0%
59	20630	Upper Canadian River	-140	-90	-280	-2%	0%
60	20700	Deep Fork River	0	-250	0	0%	0%
61	20801	Little River - 1	-20	-10	0	0%	0%
62	20802	Little River - 2	0	-100	0	0%	0%
63	20910	Lower Cimarron River	-1,490	-730	0	0%	0%
64	20920	Middle Cimarron River	-2,210	-3,440	-470	-2%	-2%
65	20930	Upper Cimarron River	-230	-330	-1,670	-3%	-3%
66	20940	Cimarron Headwaters	-70	0	-1,090	0%	-5%
67	21011	Lower Salt Fork Arkansas River - 1	-120	-90	0	0%	0%
69	21012	Lower Salt Fork Arkansas River - 2	-30	0	0	0%	0%
70	21013	Lower Salt Fork Arkansas River - 3	0	0	0	0%	0%
68	21020	Upper Salt Fork Arkansas River	-130	-380	-40	0%	-2%
71	21100	Arkansas River - Cimarron Rivers to Keystone Lake	0	-180	0	0%	0%

Table 6-6 - Potential Decreases in Physical Water Supply Shortages with Moderately Expanded Conservation Activities (AFY)

Basin Number	Basin ID	Basin Name	Change in the Size of 2060 SW Gaps (AFY)	Change in the Size of 2060 AGW Storage Depletions (AFY)	Change in the Size of 2060 BGW Storage Depletions (AFY)	Change in the Probability of 2060 SWGaps (AFY)	Change in the Probability of 2060 AGW Storage Depleitons (AFY)
72	21200	Arkansas River Mainstem (To Kansas State Line)	0	-170	-10	0%	0%
73	21301	Bird Creek - 1	-60	0	0	0%	0%
74	21302	Bird Creek - 2	0	-90	0	0%	0%
75	21401	Caney River - 1	-860	0	0	0%	0%
76	21402	Caney River - 2	0	-30	0	0%	-2%
77	21511	Verdigris River (To Oologah Dam) - 1	-1,490	0	0	-2%	0%
78	21512	Verdigris River (To Oologah Dam) - 2	-1,840	-20	0	0%	-2%
79	21520	Verdigris River (To Kansas State Line)	0	-30	0	0%	0%
80	21601	Grand (Neosho) River - 1	-1,640	-780	0	0%	0%
81	21602	Grand (Neosho) River - 2	0	0	0	0%	0%
82	21700	Illinois River	0	0	0	0%	0%

Table 6-7 - Potential Decreases in Physical Water Supply Shortages with Substantially Expanded Conservation

Basin Number	Basin ID	Basin Name	Change in the Size of 2060 SW Gaps (AFY)	Change in the Size of 2060 AGW Storage Depletions (AFY)	Change in the Size of 2060 BGW Storage Depletions (AFY)	Change in the Probability of 2060 SWGaps (AFY)	Change in the Probability of 2060 AGW Storage Depleitons (AFY)
1	10100	Red River Mainstem (To Kiamichi River)	-500	-30	0	-12%	-2%
2	10201	Little River (McCurtain County) - 1	0	0	0	0%	0%
3	10202	Little River (McCurtain County) - 2	0	-10	0	0%	-2%
4	10203	Little River (McCurtain County) - 3	0	-10	0	0%	-2%
5	10301	Kiamichi River - 1	0	-20	0	0%	-7%
6	10302	Kiamichi River - 2	0	-20	0	0%	-3%
7	10411	Muddy Boggy River - 1	0	0	0	0%	0%
8	10412	Muddy Boggy River - 2	0	-90	-210	0%	-7%
9	10420	Clear Boggy Creek	-910	-30	0	-3%	-9%
10	10500	Red River Mainstem (To Blue River)	-60	0	0	-3%	0%
11	10601	Blue River - 1	-50	0	0	-3%	0%
12	10602	Blue River - 2	-170	0	0	-3%	0%
13	10700	Red River Mainstem (To Washita)	-350	-100	-240	-7%	-7%
14	10810	Lower Washita	0	-330	0	0%	-14%
15	10821	Middle Washita - 1	-280	-160	-320	-9%	-9%
16	10822	Middle Washita - 2	-350	-40	0	-2%	-2%
17	10831	Upper Washita - 1	-280	-100	-890	-2%	-2%
18	10832	Upper Washita - 2	0	0	-2,600	0%	0%
19	10833	Upper Washita - 3	-220	-170	0	-5%	-5%
20	10840	Washita Headwaters	0	-170	-150	0%	-2%
21	10900	Red River Mainstem (To Walnut Bayou)	0	-190	0	0%	-2%
22	11000	Walnut Bayou	-590	-80	-420	-3%	-7%
23	11100	Mud Creek	-130	0	-570	-17%	0%
24	11201	Beaver Creek - 1	-30	0	0	-45%	0%
25	11202	Beaver Creek - 2	0	0	-580	0%	0%
26	11203	Beaver Creek - 3	-100	-10	-160	-79%	-69%
27	11311	Cache Creek - 1	0	0	0	0%	0%

Table 6-7 - Potential Decreases in Physical Water Supply Shortages with Substantially Expanded Conservation

Basin Number	Basin ID	Basin Name	Change in the Size of 2060 SW Gaps (AFY)	Change in the Size of 2060 AGW Storage Depletions (AFY)	Change in the Size of 2060 BGW Storage Depletions (AFY)	Change in the Probability of 2060 SWGaps (AFY)	Change in the Probability of 2060 AGW Storage Depleitons (AFY)
28	11312	Cache Creek - 2	0	-10	0	0%	-3%
29	11321	Deep Red Creek And West Cache Creek - 1	-340	-210	-160	-52%	-47%
30	11322	Deep Red Creek And West Cache Creek - 2	-160	-50	0	-41%	-31%
31	11400	Red River Mainstem (To North Fork of Red)	-100	-480	0	-55%	-57%
32	11511	Lower North Fork Red River - 1	-10	-150	0	-5%	-10%
33	11512	Lower North Fork Red River - 2	-310	-150	0	-12%	-7%
34	11513	Lower North Fork Red River - 3	-1,210	-330	0	-12%	-12%
35	11514	Lower North Fork Red River - 4	0	0	0	0%	0%
36	11521	Upper North Fork Red River - 1	-20	-1,190	0	-97%	0%
37	11522	Upper North Fork Red River - 2	30	-540	-200	-21%	-21%
38	11601	Salt Fork Red River - 1	-4,590	-980	-2,310	-53%	-53%
39	11602	Salt Fork Red River - 2	-20	-100	-220	-34%	-5%
40	11701	Prairie Dog Town Fork Red River - 1	-190	-710	-870	-14%	-14%
41	11702	Prairie Dog Town Fork Red River - 2	-20	-900	-2,570	-64%	-95%
42	11801	Elm Fork Red River - 1	-100	-1,000	-150	-7%	-2%
43	11802	Elm Fork Red River - 2	-10	-170	-110	-38%	-7%
44	20101	Poteau River - 1	-10	0	0	-2%	0%
45	20102	Poteau River - 2	0	-10	-350	0%	-5%
46	20201	Lower Arkansas River - 1	-340	0	0	0%	0%
47	20202	Lower Arkansas River - 2	-470	-40	0	0%	0%
48	20300	Canadian River (To North Canadian River)	0	-300	-330	0%	-10%
49	20400	Middle Arkansas River	-5,890	-740	0	-16%	-17%
50	20510	Lower North Canadian River	-3,490	-540	-800	-22%	-22%
51	20520	Middle North Canadian River	-1,540	-2,700	-100	-36%	-36%
52	20531	Upper North Canadian River - 1	-30	-620	-170	-7%	-22%

Table 6-7 - Potential Decreases in Physical Water Supply Shortages with Substantially Expanded Conservation

Basin Number	Basin ID	Basin Name	Change in the Size of 2060 SW Gaps (AFY)	Change in the Size of 2060 AGW Storage Depletions (AFY)	Change in the Size of 2060 BGW Storage Depletions (AFY)	Change in the Probability of 2060 SWGaps (AFY)	Change in the Probability of 2060 AGW Storage Depleitons (AFY)
53	20532	Upper North Canadian River - 2	-110	-1,710	-6,350	-38%	-41%
54	20533	Upper North Canadian River - 3	-60	-330	-9,040	-57%	-52%
55	20540	North Canadian Headwaters	-260	-310	-41,040	-26%	-26%
56	20611	Lower Canadian River - 1	-2,380	-940	0	-12%	-12%
57	20612	Lower Canadian River - 2	-450	-150	-550	-55%	-53%
58	20620	Middle Canadian River	-2,670	-600	0	-17%	-19%
59	20630	Upper Canadian River	-220	-400	-280	-3%	-3%
60	20700	Deep Fork River	0	-390	0	0%	-22%
61	20801	Little River - 1	-110	-120	0	-14%	-14%
62	20802	Little River - 2	0	-100	0	0%	-52%
63	20910	Lower Cimarron River	-2,370	-1,200	0	-3%	-3%
64	20920	Middle Cimarron River	-3,130	-5,190	-720	-17%	-17%
65	20930	Upper Cimarron River	-600	-880	-3,120	-21%	-21%
66	20940	Cimarron Headwaters	-360	-20	-4,660	-14%	-66%
67	21011	Lower Salt Fork Arkansas River - 1	-120	-90	0	-7%	-7%
69	21012	Lower Salt Fork Arkansas River - 2	-30	0	0	-3%	0%
70	21013	Lower Salt Fork Arkansas River - 3	0	0	0	0%	0%
68	21020	Upper Salt Fork Arkansas River	-300	-840	-120	-3%	-3%
71	21100	Arkansas River - Cimarron Rivers to Keystone Lake	0	-200	0	0%	-21%
72	21200	Arkansas River Mainstem (To Kansas State Line)	0	-230	-10	0%	0%
73	21301	Bird Creek - 1	-60	0	0	-7%	0%
74	21302	Bird Creek - 2	0	-130	0	0%	-22%
75	21401	Caney River - 1	-1,130	0	0	-10%	0%
76	21402	Caney River - 2	0	-30	0	0%	-3%
77	21511	Verdigris River (To Oologah Dam) - 1	-2,470	0	0	-9%	0%
78	21512	Verdigris River (To Oologah Dam) - 2	-2,910	-20	0	-7%	-26%
79	21520	Verdigris River (To Kansas State Line)	0	-40	0	0%	-3%

Table 6-7 - Potential Decreases in Physical Water Supply Shortages with Substantially Expanded Conservation

Basin Number	Basin ID	Basin Name	Change in the Size of 2060 SW Gaps (AFY)	Change in the Size of 2060 AGW Storage Depletions (AFY)	Change in the Size of 2060 BGW Storage Depletions (AFY)	Change in the Probability of 2060 SWGaps (AFY)	Change in the Probability of 2060 AGW Storage Depleitons (AFY)
80	21601	Grand (Neosho) River - 1	-2,610	-820	0	-3%	-3%
81	21602	Grand (Neosho) River - 2	0	0	0	0%	0%
82	21700	Illinois River	0	0	0	0%	0%

Section 7
Related Technical Studies

Related and ongoing technical studies compliment the physical water supply availability analysis described in this report. These include potential constraints, challenges, and opportunities associated with:

- Permitting and interstate compacts, sometimes referred to as the permitting availability of water
- Infrastructure needed to divert or produce, store, deliver, and/or treat water supplies
- Water quality factors, characterized as potential future constraints on the use of specific supplies for the various water demand sectors

Basins with permitting or water quality constraints will be overlaid with the physical supply (wet water) gaps presented in this report to assess overall water supply challenges, and to guide options for supplying each basin's needs. Infrastructure needs will be generally characterized based on the results of the 2008 Water Provider Survey (CDM 2009b) and the short-term and long-term supply and infrastructure needs of water providers that will be presented in the Regional Reports. Basin-specific water supply options to meet future water supply needs will be presented for each of the OCWP water supply analysis basins as part of the Regional Reports.

Section 8
References

CDM (Camp Dresser & McKee Inc.) 2009a. *Demand Forecast Report.* Prepared for OWRB. October.

CDM. 2009b. *Draft Provider Survey R*eport. Prepared for OWRB. October.

Hirsch, R. M. 1982. A Comparison of Four Streamflow Record Extension Techniques, *Water Resour. Res*., 18(4), 1081–1088.

ODC (Oklahoma Department of Commerce). 2009. 2008 Oklahoma County Population Estimates 2000-2008, http://www.okcommerce.gov/index.php?option=com_docman&Itemid=639&subcat=44

ODEQ (Oklahoma Department of Environmental Quality). 2008. Safe drinking water information system database for Oklahoma as of 07/08/2008.

OTC (Oklahoma Tax Commission). 2008. Oklahoma Tax Commission Municipal Boundaries GIS Shapefile.

OWRB (Oklahoma Water Resources Board). 1995. 1995 Update of the Oklahoma Comprehensive Water Plan, http://www.owrb.ok.gov/supply/ocwp/pdf_ocwp/1995_OCWP.pdf

OWRB (2005), Boundaries of Rural Water Systems in Oklahoma, htp://www.owrb.ok.gov/maps/data/owrbdata.php#RWS.

OWRB (2007), Oklahoma Water Atlas, http://www.owrb.ok.gov/news/publications/wa/wa.php.

OWRB (2008a). OWRB 90-Day Provisional Temporary Permit Database with all geographic and legal information as of 7/15/2009.

OWRB (2008b). OWRB Water Rights Database with all geographic and legal information as of 7/15/2009.

OWRB (2009), OWRB Stream System Boundary GIS shapefile.

USEPA (United States Environmental Protection Agency. 2008. Topography based on the national elevation dataset (NED).

USGS (United States Geological Survey. 2008. Hydrologic Drought of Water Year 2006 Compared with Four Major Drought Periods of the 20th Century in Oklahoma, Scientific Investigation Report 2008-5199.

USGS. 2008. Subwatershed (12-digit), 6th level, hydrologic unit boundaries for the State of Oklahoma.