



Produced Water Volumes and Management Practices for 2017

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Acknowledgements

- Special thanks to GWREF and GWPC for supporting this work
- This type of report would not be possible without the efforts of many state officials who provided the data
- Also had support from some EPA HQ and regional staff and from DOI's BOEM
- For the second time (in 2012 and again in 2017) Thom Kerr provided advice and support in obtaining and understanding data from the Colorado Oil and Gas Conservation Commission

Produced Water Information Needs

- How much produced water is generated in the United States in a single year?
 - Look at all states and federal lands/waters
 - Look at all water that comes to the surface along with oil and gas
- How is that large volume of produced water managed?
 - Injection
 - Discharge
 - Evaporation
 - Recycle/reuse

Past Studies

- Argonne National Laboratory compiled this information for the 2007 calendar year (funded by DOE)
 - Clark and Veil (2009)
- Veil Environmental compiled this information for the 2012 calendar year (funded by GWPC)
 - Veil (2015)
- Veil Environmental compiled this information again for the 2017 calendar year (funded by GWREF)
- This gives three comparable sets of data spaced five years apart

Approach

- Contact oil and gas agencies in 32 states to obtain data
 - Provide a standard questionnaire containing two tables
 - Oil, gas, water volumes
 - How water is managed
- Contact federal agencies with oil and gas data responsibility
- Where necessary, contact state environmental protection agencies
- Use a variety of methods to fill in the gaps where state submittals were not fully complete
- Develop state summaries that include the state data and discussion of how data were derived
 - Provide state summaries to each state with an opportunity to review and comment

Requests for Data for 2017 Year

- Produced water, oil, and gas volume data

Type of Hydrocarbon	# Wells Producing Primarily That Type of Hydrocarbon	Total Volume of Produced Water Brought to Surface (bbl/year)	Volume of Hydrocarbon Produced (bbl/year or Mmcf/year)
Crude oil from conventional formations			
Natural gas from conventional formations			
Crude oil from unconventional formations			
Natural gas from unconventional formations			
Other			
Total			

Requests for Data for 2017 Year

- Produced water management data

Management Practice	Total Volume of Produced Water Managed by That Practice (bbl/year)	Percentage of Produced Water Managed by That Practice
Injection for enhanced recovery		
Injection for disposal		
Surface discharge		
Evaporation		
Offsite commercial disposal		
Reuse within the oil and gas industry		
Reuse in ways other than in the oil and gas industry		
Total		

Time Line

- Questionnaires sent to states in May 2019
- Most data for Federal lands came from agency websites
 - Some follow up needed for offshore discharges from four EPA regions
- Made many follow up emails and calls throughout the summer to fill in data gaps
- Made presentation on preliminary findings at September 2019 GWPC Annual Forum
- Sent State Summaries to each state in October 2019 to allow opportunity for review and comment
- Submitted draft report to GWPC in November
- Updated report based on comments and submitted final report to GWPC in February 2020
- Report released in February 2020

Results

Produced Water Volume in 2017

- Total produced water volume from approximately 1 million U.S. oil and gas wells in 2017 is
24.4 billion bbl
 - Equivalent to ***1 trillion gallons/year***
- Average of ***69 million bbl/day*** or
2.8 billion gallons/day

Top Ten States in 2017 Oil Production

Ranking 2017	Ranking 2012	State	2017 Volume (bbl)	% of Total Oil
1	1	Texas	1,271,143,548	37
2	2	Federal Offshore	619,697,287	18
3	3	North Dakota	390,730,886	11
4	5	Alaska	180,546,058	5
5	7	New Mexico	172,587,378	5
6	4	California	172,293,268	5
7	6	Oklahoma	159,207,164	5
8	9	Colorado	132,846,403	4
9	10	Wyoming	75,717,834	2
10	8	Louisiana	52,282,199	2

Top Ten States in 2017 Gas Production

Ranking 2017	Ranking 2012	State	2017 Volume (Mmcf)	% of Total Gas
1	1	Texas	8,124,096	23
2	4	Pennsylvania	5,464,661	16
3	3	Louisiana	3,306,864	9
4	6	Alaska	3,268,520	9
5	7	Oklahoma	2,350,071	7
6	2	Colorado	2,174,415	6
7	5	Wyoming	1,808,429	5
8	21	Ohio	1,770,454	5
9	11	West Virginia	1,611,100	5
10	9	New Mexico	1,296,990	4

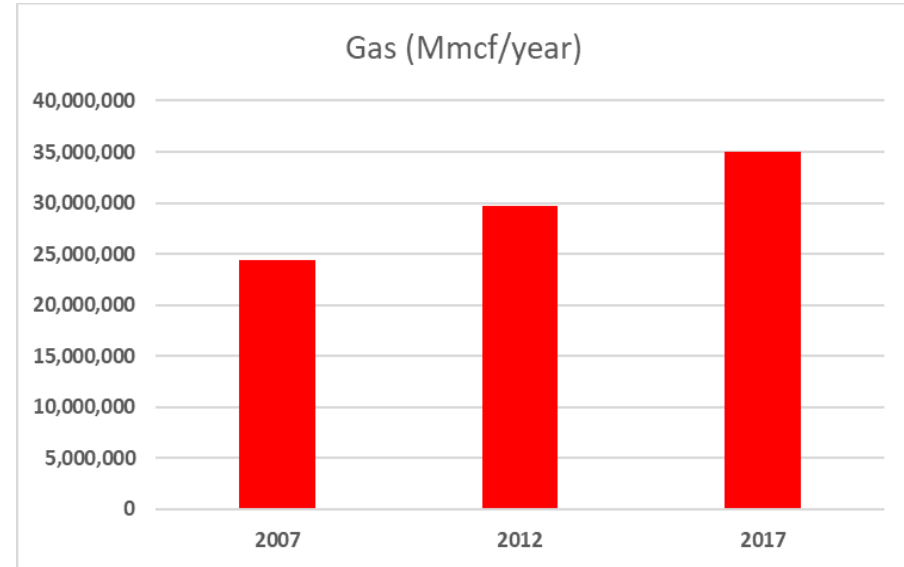
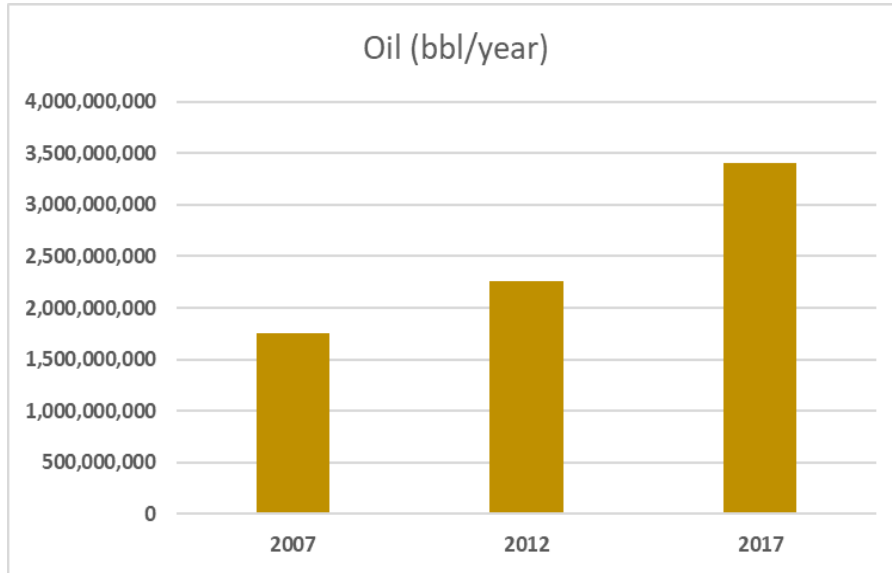
Top Ten States in 2017 Water Production

Ranking 2017	Ranking 2012	State	2017 Volume (bbl)	% of Total Water
1	1	Texas	9,895,084,619	41
2	2	California	3,134,503,023	13
3	3	Oklahoma	2,844,485,617	12
4	4	Wyoming	1,705,309,511	7
5	5	Kansas	1,205,091,949	5
6	6	Louisiana	998,519,062	4
7	7	New Mexico	879,740,841	4
8	8	Alaska	828,067,983	3
9	9	Federal offshore	575,926,287	2
10	11	North Dakota	505,828,554	2

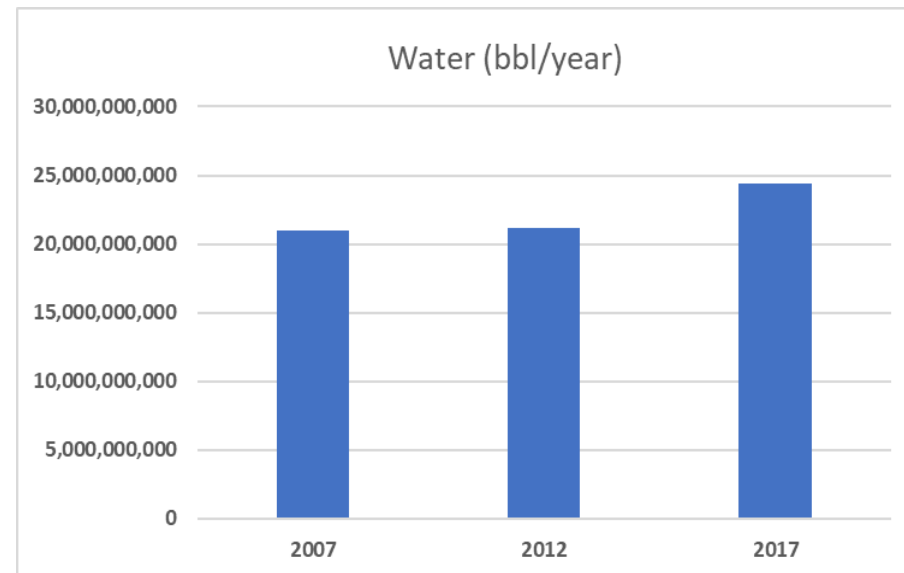
Changes in Fluid Production - 2012 to 2017

- U.S. oil production increased by **50.4%** to 3.4 billion bbl
- U.S. gas production increased by **17.7%** to 35 million Mmcf
- U.S. water production increased by **15.2%** to 24.4 billion bbl

Ten Year Changes in Fluid Production



- Oil production increased by **94.6%**
- Gas production increased by **43.6%**
- Water production increased by **16.2%**



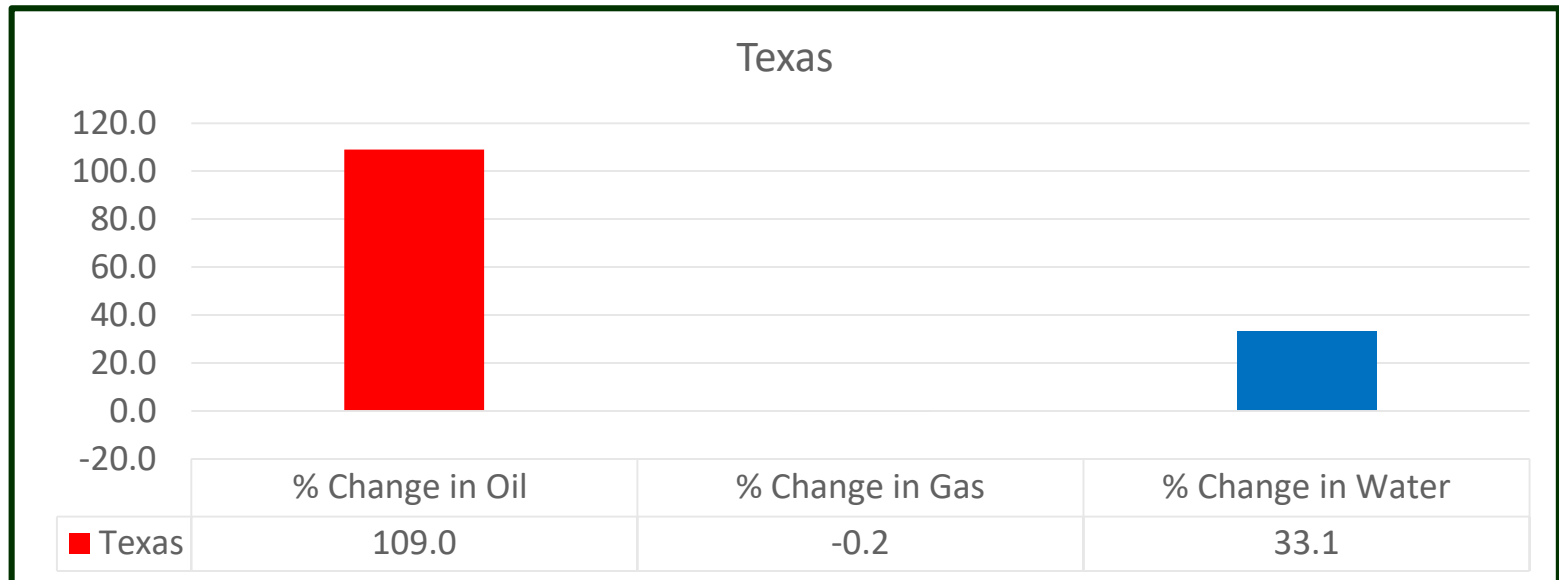
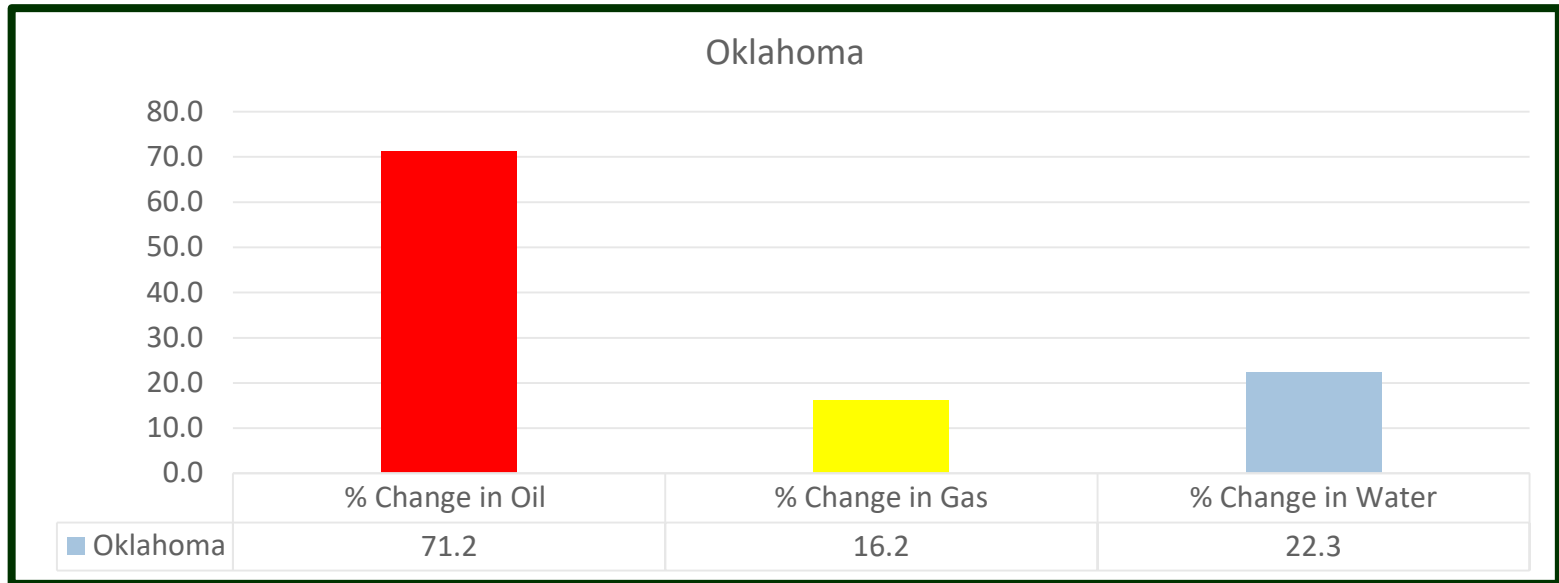
Master Spreadsheet Shows Trends within a State (2012-2017) - Volume

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
		Oil 2017 (bbl/year)	Gas 2017 (Mmcf)	Water 2017 (bbl/year)	Water from Oil 2017 (bbl/year)	Water from Gas 2017 (bbl/year)	WOR 2017	WGR 2017		Oil 2012 (bbl/year)	Gas 2012 (Mmcf)	Water 2012 (bbl/year)	Water from Oil 2012 (bbl/year)	Water from Gas 2012 (bbl/year)	WOR 2012	WGR 2012		Oil 2007	Gas 2007	Water 2007
1	State																			
2	Alabama	6,827,900	150,857	63,870,227	29,335,000	34,535,000	4.3	229		11,310,000	216,000	106,619,000	37,858,000	68,761,000				5,028,000	285,000	119,004,000
3	Alaska	180,546,058	3,268,520	828,067,983	no data	no data	n/a	n/a		192,368,000	3,182,000	769,153,000	768,133,000	1,019,000				263,595,000	3,498,000	801,336,000
4	Arizona	12,829	342	38,786	36,186	2,600	2.8	7.6		51,900	116	81,000	66,700	14,200				43,000	1,000	68,000
5	Arkansas	5,288,375	692,469	315,958,569	305,273,682	10,684,887	57.7	15.4		6,568,000	1,137,000	184,867,000	174,614,000	10,253,000				6,103,000	272,000	166,011,000
6	California	172,293,268	189,444	3,134,503,023	no data	no data	n/a	n/a		197,749,000	174,000	3,074,585,000	3,071,362,000	3,222,000				244,000,000	312,000	2,552,194,000
7	Colorado	132,846,403	2,174,415	310,650,278	no data	no data	n/a	n/a		49,361,000	1,709,000	358,389,000	no data	no data				2,375,000	1,288,000	383,846,000
8	Florida	1,923,238	23,132	58,673,032	no data	no data	n/a	n/a		2,171,000	19,000	62,641,000	no data	no data				2,078,000	2,000	50,296,000
9	Idaho	0	3,789	91,566	no data	no data	n/a	n/a		0	0	0	no data	no data				0	0	0
10	Illinois	8,314,000	2,131	282,599,989	no data	no data	n/a	n/a		8,908,000	2,100	99,142,000	99,142,423	no data				3,202,000	No data	136,872,000
11	Indiana	1,780,016	5,914	50,797,713	no data	no data	n/a	n/a		2,350,000	8,800	57,566,000	48,931,000	8,635,000				1,727,000	4,000	40,200,000
12	Kansas	35,822,288	241,845	1,205,091,949	no data	no data	n/a	n/a		43,743,000	299,000	1,061,019,000	971,009,000	90,010,000				36,612,000	371,000	1,244,329,000
13	Kentucky	2,477,000	88,715	13,913,894	no data	no data	n/a	n/a		3,198,000	106,000	19,689,000	no data	no data				3,572,000	95,000	24,607,000
14	Louisiana	52,282,199	3,306,864	998,519,062	no data	no data	n/a	n/a		82,781,000	3,347,000	927,635,000	no data	no data				52,495,000	1,382,000	1,149,643,000
15	Michigan	5,800,000	97,500	80,500,000	18,500,000	62,000,000	3.2	775		7,400,000	130,000	117,000,000	25,000,000	92,000,000				5,180,000	168,000	114,580,000
16	Mississippi	17,037,830	52,275	171,145,175	167,565,806	3,579,369	9.8	68		24,146,000	437,000	231,236,000	228,069,000	3,167,000				20,027,000	97,000	330,730,000
17	Missouri	116,808	0	2,763,613	2,763,613	0	23.7	n/a		175,000	12,000	2,103,000	2,103,000	no data				80,000	No data	1,613,000
18	Montana	20,707,078	27,529	141,733,134	139,816,906	1,916,226	6.8	70		26,495,000	67,000	182,833,000	179,085,000	3,748,000				34,749,000	95,000	182,266,000
19	Nebraska	2,092,816	456	50,069,495	47,566,021	2,503,474	23	5490		2,514,000	1,200	58,641,000	57,873,000	769,000				2,335,000	1,000	49,312,000
20	Nevada	284,954	3	6,510,029	6,510,029	0	23	n/a		368,000	4	5,865,000	5,865,000	no data				408,000	0	6,785,000
21	New Mexico	172,587,378	1,296,990	879,740,841	no data	no data	n/a	n/a		85,340,000	1,252,000	775,930,000	674,902,000	101,028,000				59,138,000	1,526,000	665,685,000
22	New York	214,821	11,800	189,746	113,292	76,464	0.5	6.5		360,000	27,000	510,000	208,000	301,000				378,000	55,000	649,000
23	North Dakota	390,730,886	688,605	505,828,554	505,820,717	7,837	1.3	n/a		243,272,000	259,000	291,147,000	284,426,000	6,721,000				44,543,000	71,000	134,991,000
24	Ohio	19,802,406	1,770,454	24,142,988	5,073,914	19,069,074	0.25	10.8		5,063,000	86,000	5,542,000	4,860,000	682,000				5,422,000	86,000	6,940,000
25	Oklahoma	159,207,164	2,350,071	2,844,485,617	no data	no data	n/a	n/a		92,988,000	2,023,000	2,325,153,000	no data	no data				60,760,000	1,643,000	2,195,180,000
26	Pennsylvania	6,454,010	5,464,661	55,321,026	no data	no data	n/a	n/a		4,300,000	2,260,000	34,089,000	no data	no data				1,537,000	172,000	3,912,000
27	South Dakota	1,304,321	260	6,924,285	6,923,943	342	5.3	n/a		1,754,000	15,000	5,296,000	5,296,000	no data				1,665,000	12,000	4,186,000
28	Tennessee	275,316	3,038	44,163	no data	no data	n/a	n/a		372,000	6,000	1,480,000	no data	no data				350,000	1,000	2,263,000
29	Texas	1,271,143,548	8,124,096	9,895,084,619	no data	no data	n/a	n/a		608,213,000	8,137,000	7,435,659,000	no data	no data				342,087,000	6,878,000	7,376,913,000
30	Utah	34,438,271	315,143	155,047,940	125,739,740	29,308,200	3.7	93		30,195,000	491,000	166,945,000	no data	no data				19,520,000	385,000	148,579,000
31	Virginia	795	115,492	2,156,931	0	2,156,931	n/a	18.7		9,700	146,000	3,232,000	54,400	3,177,000				19,000	112,000	1,562,000
32	West Virginia	7,570,204	1,611,100	26,650,935	0	0	n/a	n/a		2,561,000	539,000	13,772,000	no data	no data				679,000	225,000	8,337,000
33	Wyoming	75,717,834	1,808,429	1,705,309,511	1,432,993,542	272,315,969	18.9	151		45,382,000	2,079,000	2,178,065,000	1,646,601,000	531,464,372				54,052,000	2,253,000	2,355,671,000
34	State Total	2,785,900,014	33,886,339	23,816,424,673						1,781,466,600	28,167,220	20,555,884,000	8,285,458,523	924,971,572				1,273,759,000	21,290,000	20,258,560,000
35	Federal Offshore	619,697,287	1,114,880	575,926,287	no data	no data	n/a	n/a		482,774,000	1,563,000	624,762,000	no data	no data				467,180,000	2,787,000	587,353,000
36	Tribal Lands	no data	no data	no data	no data	no data	no data	no data		no data	no data	no data	no data	no data				9,513,000	297,000	149,261,000
37	Federal Total	619,697,287	1,114,880	575,926,287	no data	no data	n/a	n/a		482,774,000	1,563,000	624,762,000	no data	no data				476,693,000	3,084,000	736,614,000
38	U.S. Total	3,405,597,301	35,001,219	24,392,350,960						2,264,240,600	29,730,220	21,180,646,000	no data	no data				1,750,452,000	24,374,000	20,995,174,000
39																				

Master Spreadsheet Shows Trends within a State (2012-2017) - Management Practices

	A	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	
			Injection EOR 2017 (bbl/yr)	Injection for disposal 2017 (bbl/yr)	Surface discharge 2017 (bbl/yr)	Evaporation 2017 (bbl/yr)	Offsite Commercial Disposal 2017 (bbl/yr)	Beneficial Reuse in Oil Field 2017	Beneficial Reuse outside oil field 2017	Total Prod Water Managed 2017		Injection EOR 2012 (bbl/yr)	Injection for disposal 2012 (bbl/yr)	Surface discharge 2012 (bbl/yr)	Evaporation 2012 (bbl/yr)	Offsite Commercial Disposal 2012 (bbl/yr)	Beneficial Reuse 2012 (bbl/yr)	Total Prod Water Managed 2012	Total Water injected for EOR 2012	Total Water Managed 2012		
1	State																					
2	Alabama		861,000	29,980,000	32,858,000	0	171,000	0	0	63,870,000		2,000,000	38,451,000	66,102,000	0	66,000	0	106,619,000	2,000,000	106,619,000		
3	Alaska		772,433,217	84,966,098	37,222	0	0	0	0	857,436,537		652,028,000	84,662,000	32,463,000	0	0	0	769,153,000	1,045,383,000	1,162,508,000		
4	Arizona		0	47,208	0	0	0	0	0	47,208		0	98,000	0	0	0	0	98,000	0	98,000		
5	Arkansas		44,270,037	266,347,907	0	0	5,340,625	0	0	315,958,569		41,385,000	141,269,000	0	0	213,000	2,000,000	184,867,000	41,385,000	184,867,000		
6	California		1,841,612,368	694,302,395	13,809,445	28,752,996	56,144,945	159,535,576	311,107,975	3,105,265,700		1,412,090,000	623,012,000	60,298,000	649,184,000	283,750,000	46,251,000	3,074,585,000	1,489,785,000	3,152,280,000		
7	Colorado		108,207,977	157,040,690	18,217,065	20,084,676	0	29,728,976	0	333,279,384		123,855,000	123,890,000	40,315,000	35,002,000	22,392,000	47,648,000	393,102,000	123,855,000	393,102,000		
8	Florida		48,636,117	10,249,420	0	0	0	0	0	58,885,537		47,676,000	14,965,000	0	0	0	0	62,641,000	47,676,000	62,641,000		
9	Idaho		0	0	0	91,566	0	0	0	91,566		0	0	0	0	0	0	0	0	0		
10	Illinois		193,261,188	89,338,801	0	0	0	0	0	282,599,989		105,268,000	0	0	0	0	0	105,268,000	105,268,000	105,268,000		
11	Indiana		36,296,729	14,450,187	50,797	0	0	0	0	50,797,713		43,131,000	14,377,000	58,000	0	0	0	57,566,000	43,131,000	57,566,000		
12	Kansas		298,991,227	906,098,487	0	0	2,235	0	0	1,205,091,949		276,299,000	784,721,000	0	0	0	??	1,061,020,000	276,299,000	1,061,020,000		
13	Kentucky		12,789,124	1,124,770	0	0	0	0	0	13,913,894		18,597,000	1,092,000	no data	no data	no data	no data	19,689,000	18,597,000	19,689,000		
14	Louisiana		70,739,593	877,374,282	0	0	50,405,187	0	0	998,519,062		31,336,000	857,417,000	0	0	38,881,000	0	927,634,000	31,336,000	927,634,000		
15	Michigan		14,500,000	64,500,000	0	0	1,500,000	0	0	80,500,000		17,000,000	100,000,000	0	0	??	??	117,000,000	17,000,000	117,000,000		
16	Mississippi		41,391,526	156,763,266	0	0	0	0	0	198,154,792		127,180,000	104,056,000	0	0	0	0	231,236,000	127,180,000	231,236,000		
17	Missouri		2,586,948	176,665	0	0	0	0	0	2,763,613		1,748,000	354,000	0	0	0	0	2,102,000	1,748,000	2,102,000		
18	Montana		73,571,587	58,893,204	6,576,855	2,691,488	0	0	0	141,733,134		106,797,000	56,536,000	19,500,000	??	??	??	182,833,000	130,013,000	206,049,000		
19	Nebraska		23,515,265	24,694,793	319,812	1,009,932	409,674	0	120,019	50,069,495		34,368,000	18,760,000	0	5,476,000	0	0	58,604,000	34,368,000	58,604,000		
20	Nevada		0	6,528,730	0	0	0	0	0	6,528,730		0	4,743,000	0	0	0	0	4,743,000	0	4,743,000		
21	New Mexico		351,201,250	443,893,992	0	0	0	79,176,676	0	874,271,918		381,160,000	381,160,000	0	0	0	0	762,320,000	381,160,000	762,320,000		
22	New York		2,238	17,510	19,088	523	87,151	33,323	29,913	189,746		27,000	1,000	uncertain	0	uncertain	uncertain	28,000	27,000	28,000		
23	North Dakota		40,833,265	266,459,626	0	0	198,535,663	0	0	505,828,554		52,484,000	161,978,000	0	0	76,685,000	0	291,147,000	128,087,000	366,750,000		
24	Ohio		554,565	37,886,014	0	0	0	3,837,053	85,384	42,363,016		605,000	14,157,000	0	0	0	756,000	15,518,000	605,000	15,518,000		
25	Oklahoma		1,276,853,948	1,185,687,061	0	0	381,944,608	0	0	2,844,485,617		1,098,312,000	1,087,080,000	0	0	139,760,000	0	2,325,152,000	1,098,312,000	2,325,152,000		
26	Pennsylvania		0	566,870	893,870	0	0	0	50,767,765	198,556		52,427,061	0	4,220,000	780,000	0	0	29,082,000	34,082,000	0	34,082,000	
27	South Dakota		4,179,533	2,743,752	0	1,000	0	0	0	6,924,285		3,025,000	2,271,000	0	0	0	0	5,296,000	5,981,000	8,252,000		
28	Tennessee		27,887	1,170	0	15,106	0	0	0	44,163		0	0	0	1,480,000	0	0	1,480,000	0	1,480,000		
29	Texas		4,557,819,641	3,586,674,633	34,279,995	0	1,716,310,350	0	0	9,895,084,619		3,717,830,000	2,922,805,000	371,178,000	0	795,025,000	??	7,806,838,000	3,717,830,000	7,806,838,000		
30	Utah		61,800,708	76,439,156	7,103,047	9,705,029	0	0	0	155,047,940		71,535,000	85,534,000	11,589,000	0	12,968,000	??	181,626,000	71,535,000	181,626,000		
31	Virginia		0	2,156,931	0	0	0	0	0	2,156,931		0	3,232,000	0	0	0	0	3,232,000	0	3,232,000		
32	West Virginia		3,660,000	15,000,000	195,650	0	7,795,285	0	0	26,650,935		3,660,000	3,876,000	2,846,000	0	3,391,000	??	13,773,000	3,660,000	13,773,000		
33	Wyoming		802,309,212	243,010,765	648,126,190	40,000,000	2,450,183	0	0	1,735,896,350		855,756,000	312,944,000	??	??	??	??	1,168,700,000	855,756,000	1,168,700,000		
34	State Total		#####	9,303,414,383	762,487,036	102,352,316	2,413,301,621	330,874,654	311,541,847	23,906,878,007		9,225,152,000	7,947,661,000	605,129,000	691,142,000	#####	125,737,000	19,967,952,000	9,797,977,000	20,540,777,000		
35	Federal Offshore		0	0	575,926,287	0	0	0	0	575,926,287		62,703,000	62,703,000	515,916,000	0	0	0	641,322,000	62,703,000	641,322,000		
36	Tribal Lands		no data	no data	no data	no data	no data	no data	no data	no data		no data	no data	no data	no data	no data	no data	no data	no data	no data		
37	Federal Total		0	0	575,926,287	0	0	0	0	575,926,287		62,703,000	62,703,000	515,916,000	0	0	0	641,322,000	62,703,000	641,322,000		
38	U.S. Total		#####	9,303,414,383	1,338,413,323	102,352,316	2,413,301,621	330,874,654	311,541,847	24,482,804,294		9,287,855,000	8,010,364,000	1,121,045,000	691,142,000	#####	125,737,000	20,609,274,000	9,860,680,000	21,182,099,000		
39			43.6	38.0	5.5	0.4	9.9	1.4	1.3													

Master Spreadsheet Allows Visualization of Trends within a State (2012-2017)



Why Do Oil and Gas Increase at a Faster Rate than Water?

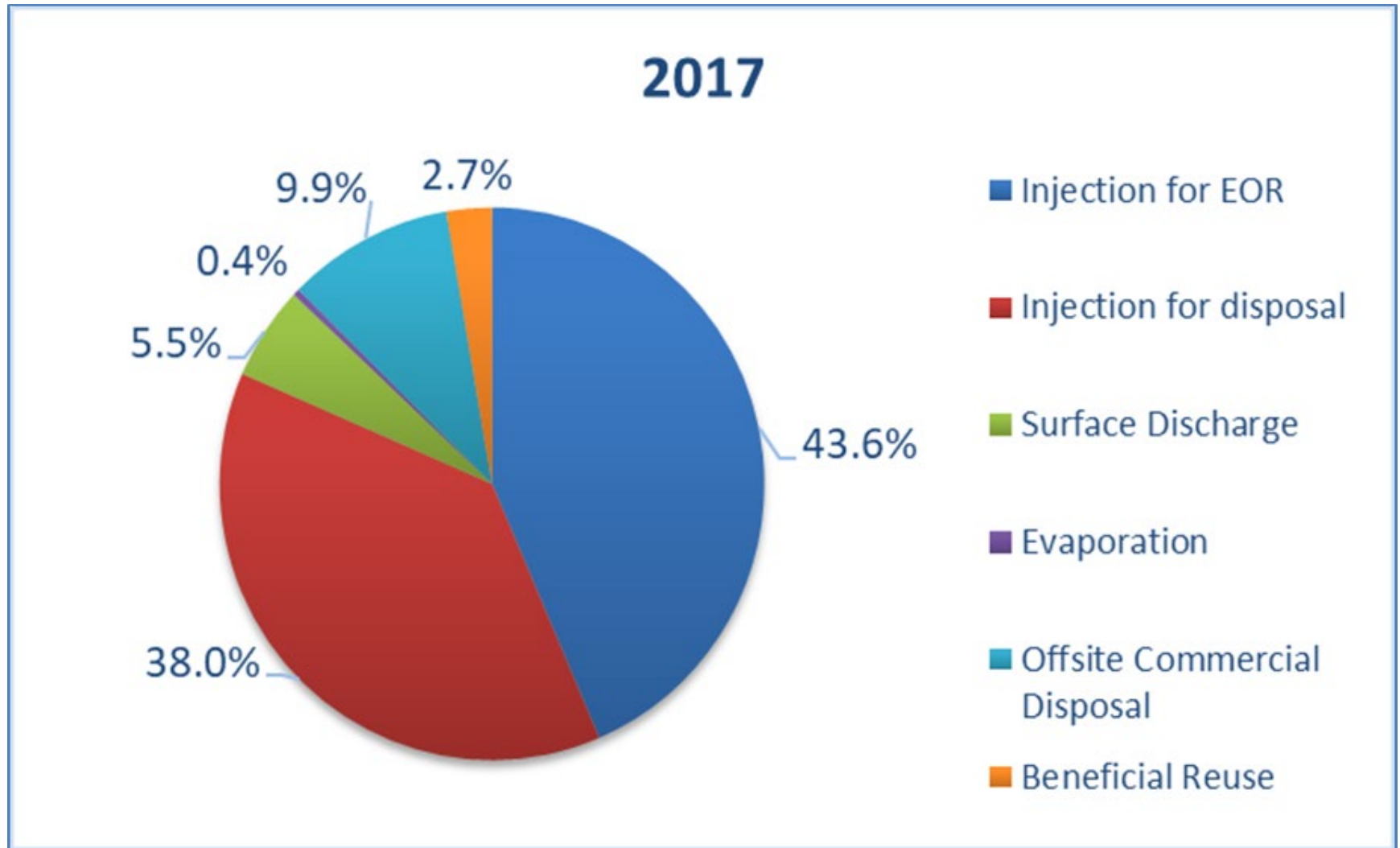
Here is my hypothesis:

- Conventional production generates a small initial volume of water that gradually increases over time. The total lifetime water production from each well can be high
- Unconventional production from shales and coal seams generates a relatively large amount of produced water initially but the volume drops off, leading to a low lifetime water production from each well
- Between 2007 and 2012, many new unconventional wells were placed into service and many old conventional wells (with high water cuts) were taken out of service
 - The same trend continued from 2012 to 2017
- The new wells generated more hydrocarbon for each unit of water than the older wells they replaced

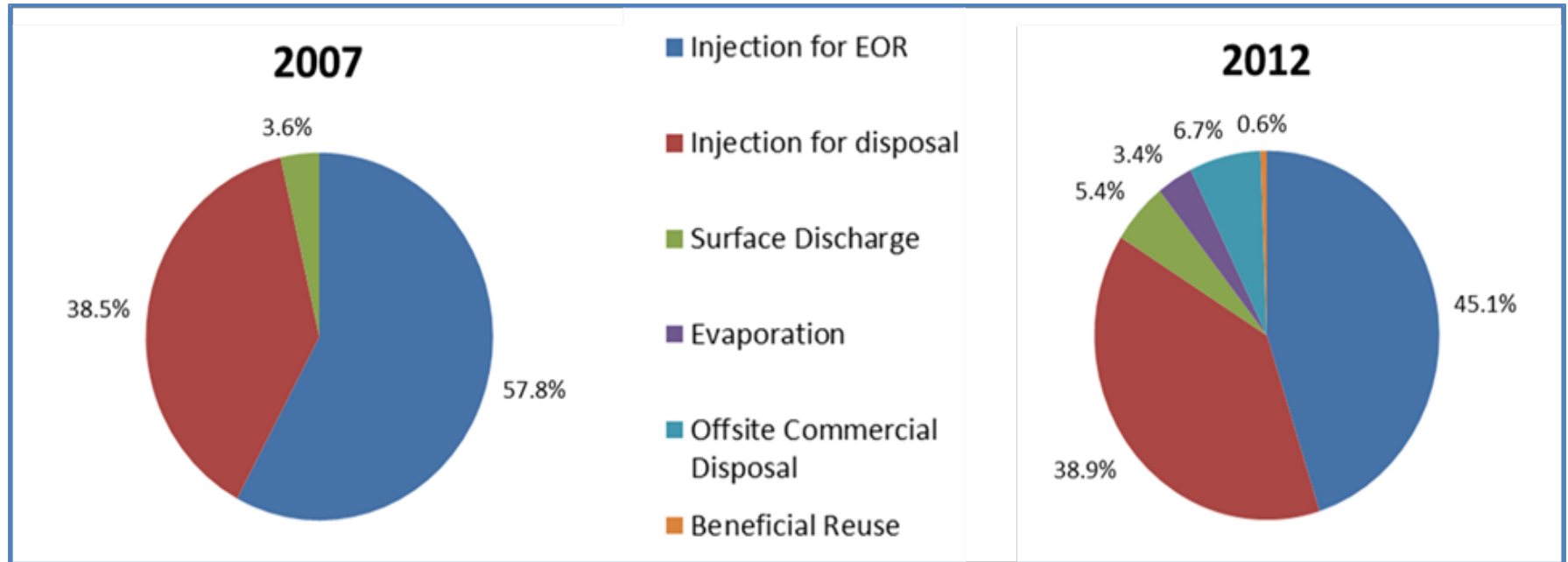
Ratio of Water to Oil and Gas Production

- Few states provided separate water from oil production and water from gas production
- I calculated water/oil ratio (WOR) and water/gas ratio (WGR), but do not believe they are representative for the whole country since most of the states with large numbers of older conventional wells with high water cuts are not included in the data set
- As a substitute, I converted gas volume to BOE (barrels of oil equivalent) and added oil volume to BOE volume to get a national water/BOE ratio of about **2.5** for 2017.
 - for the sake of comparison, the water-to-BOE ratio for 2012 was **2.76**. For 2007, the same ratio was **3.40**.
 - supports the overall trend that less water is being generated per unit of hydrocarbon in 2017 compared to earlier years

Water Management 2017



Water Management 2007 and 2012



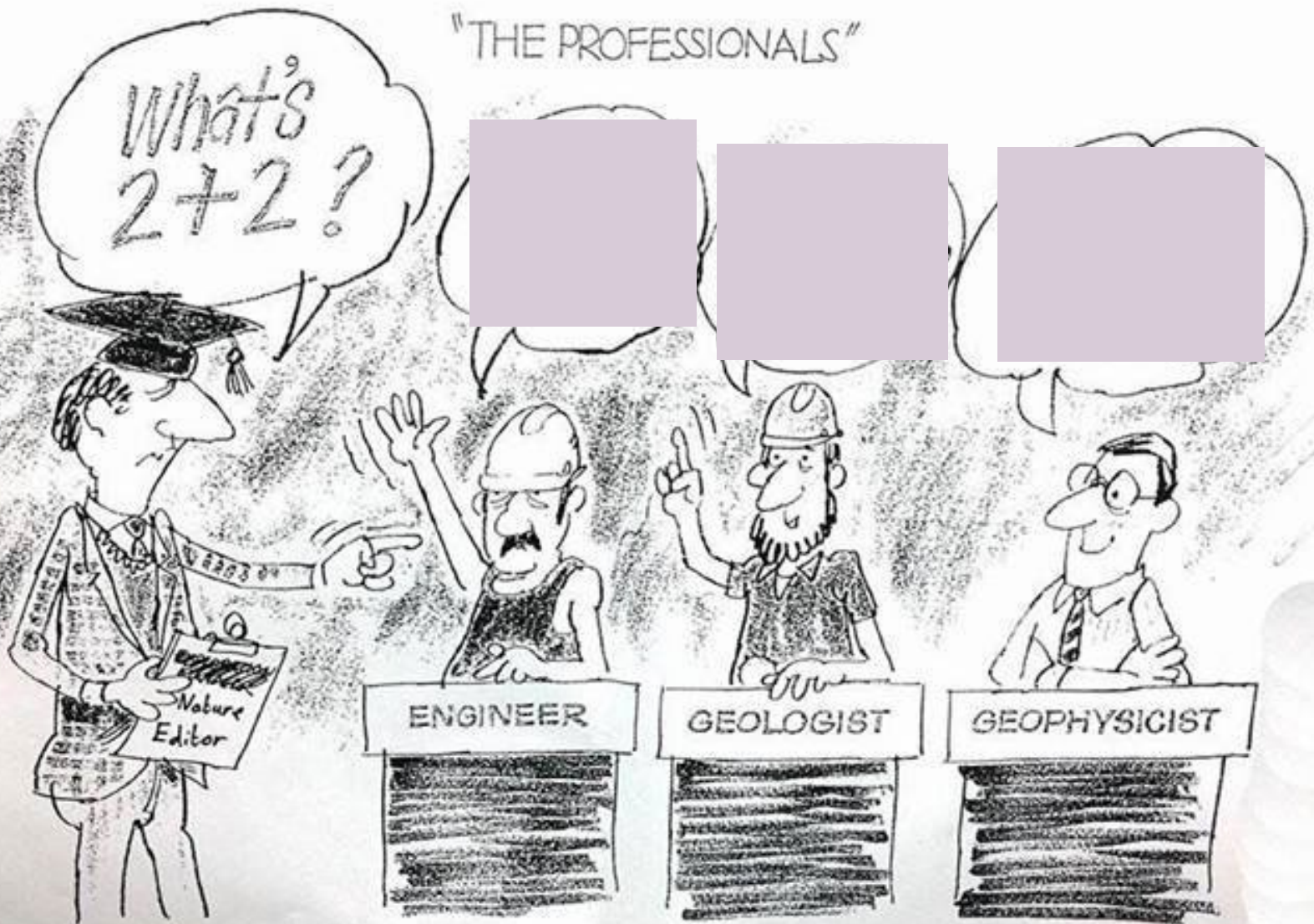
% of Produced Water Managed by Injection

Year	% Injected into Disposal Wells	% Injected for EOR	% Injected by Offsite Commercial Disposal Companies	Total % Injected
2017	43.6	38.0	9.9	91.5
2012	38.9	45.1	6.7	90.7
2007	38.5	57.8	no data	96.3

Data Availability

- State agencies collect different types of oil and gas and water data to meet their own needs and to comply with their state laws. In this study, more than 30 states were requested to provide data. There was some variation in the types of data that were available.
- Other than injection volumes, most states do not keep track of how produced water is managed
- Few states maintain data on beneficial reuse within the oil and gas industry or otherwise
- Where data were not available through the state agency questionnaires, additional efforts were made to estimate water volumes and management practices.

"THE PROFESSIONALS"

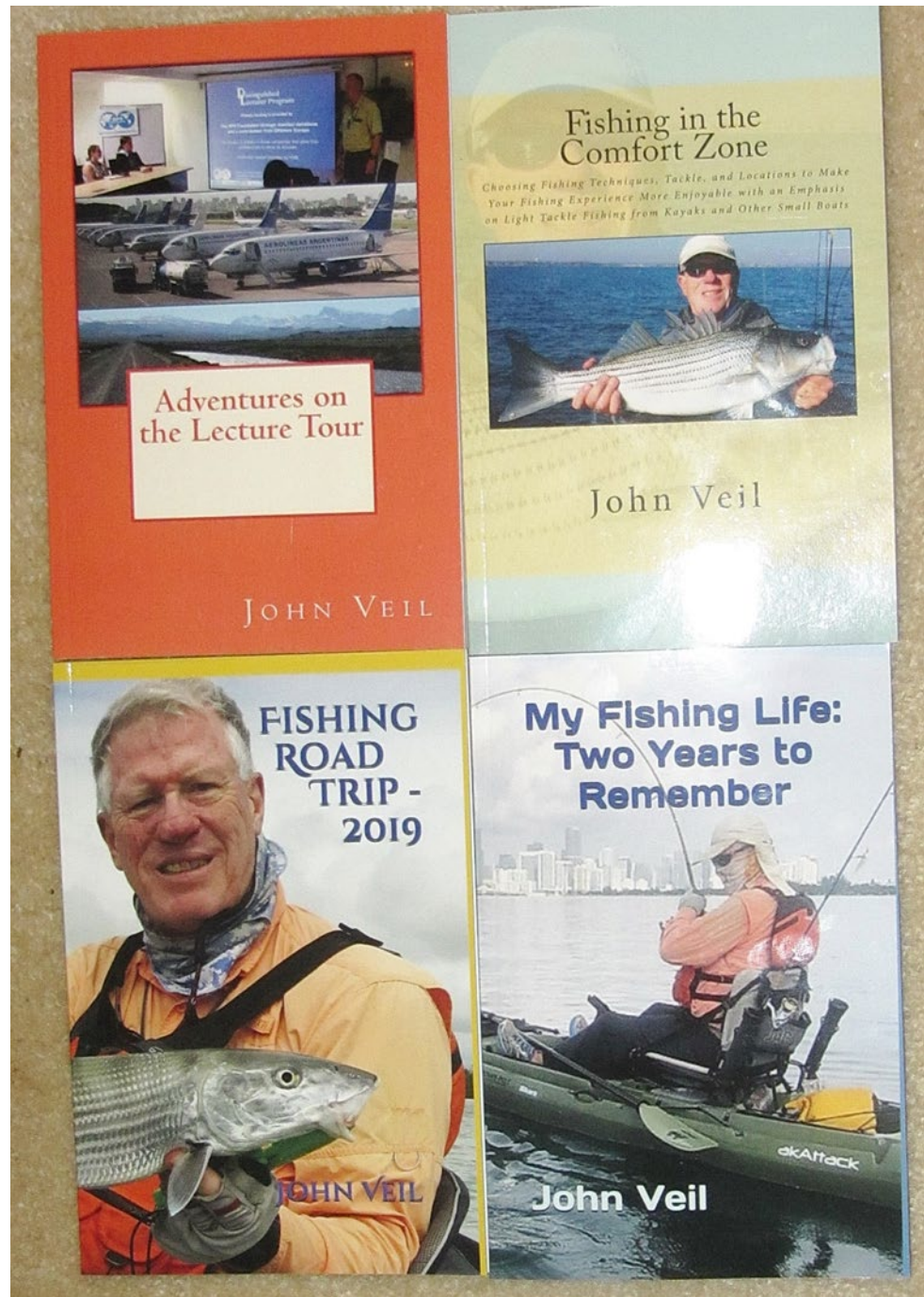


Final Thoughts

- This report provides a third set of data, spaced five years apart, of produced water volumes and management in the United States
- A comprehensive master spreadsheet (a separate Excel file) contains state-by-state data for 2007, 2012, and 2019
 - These will serve as excellent resources for researchers, policy makers, and others
- Shift from conventional to unconventional oil and gas production has led to less produced water per unit of hydrocarbon
- This type of national data collection effort is very difficult and time-consuming
 - Good luck to the person who does this the next time

Retirement

- I have participated in GWPC since 1989
 - This is likely to be my final meeting
- In my retirement, I will focus my writing on fun books rather than on technical reports
- There is a lot of fishing in my future



How Is Fishing Like the Oil and Gas Business?

- In both cases you are using strategy and technology to find and capture a natural resource
- You get better at finding oil and gas and managing the oil and gas process the more you do it – the same for fishing
- Just when you think you really understand oil and gas, something changes and you have a problem
 - Fishing is just like that. You can have 5 good catching days in a row followed by 2 lousy days.
- Success in both cases can be enjoyable and rewarding
- In both cases, water plays a large role
- My favorite lures are made of soft plastic and my fishing kayaks are made from polypropylene – most likely derived from petroleum

