<u>Thirty-seven Years and Counting, A review of the 1979</u> <u>Environmental Assessment for the Oil and Gas Leasing</u> <u>Program of the Osage Indian Tribe, Osage County, Oklahoma</u>

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<u>Thirty-seven Years and Counting</u>, <u>A review of the 1979 Environmental Assessment for the</u> <u>Oil and Gas Leasing Program of the Osage Indian Tribe</u>, <u>Osage County</u>, <u>Oklahoma</u>

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The subject Environmental Assessment (EA) was transmitted by Thomas Ellison of the Bureau of Indian Affairs, Muskogee, Oklahoma to the Honorable H. Dale Cook, U.S. District Court Judge on May 30, 1979 in response to a May 4, 1977 order of that Court regarding compliance with the National Environmental Policy Act. The transmittal letter contained the following statement:

"The review process indicated that significant environmental impacts would not result from the proposed action. Consequently, the decision has been made to issue this notice of intent not to prepare and Environmental Impact Statement."

A copy of the 1979 EA including the BIA's transmittal letter to the court is available at: <u>http://hydrationengineering.com/1979-osage-ea.pdf</u>

This paper will review the 1979 EA, the EA's forecasts to the year 2000, and oil and gas impacts through 2015. A forecast of future oil and gas activities in Osage County is being prepared by Hydration Engineering on behalf of the Osage Producers Association will be published at a later date. Substantial portions of the 1979 EA have been selected by the authors and are reproduced here.

This paper follows the organization of the 1979 EA with references to the sections and page numbers.

In the following, direct quotes form the 1979 EA are in plane type, comments of Hydration Engineering, PLLC are in italics.

I. DESCRIPTION OF THE OSAGE COUNTY, OKLAHOMA OIL AND GAS LEASING PROGRAM

A. LOCATION AND SUMMARY OF PROGRAM

Page 3: "About 34,000 wells have been completed in Osage County since oil and gas development began."

Through the end of 1978, 32,245 wells had been completed. (HIS, US Production Data, <u>https://www.ihs.com/products/us-oil-gas-production-data.html</u> accessed 5/3/2016)

B. PROGRAM BACKGROUND

1. Establishment of Osage Ownership and Authority

Page 6: "On October 21, 1978, Congress again amended the original Act of 1906, but instead of granting another extension of 25 years or less, the latest amendment extended Federal trust supervision over the Osage mineral estate in perpetuity (that is, for an indefinite period, and annuity payable forever). The US Department of Interior is forever vested with complete supervision and management of the Osage mineral estate."

Because the 1979 EA resulted in the conclusion, "that significant environmental impacts would not result from the proposed action", an Environmental Impact Statement (EIS) was not required. The decision of the

BIA in 2014 to go directly to an EIS in preparing a replacement for the 1979 EA introduces the requirement to consider alternatives. The Council on Environmental Quality (CEQ) regulations require that a range of alternatives be considered including "no action" (40 CFR 1508.25(a)(1)). NEPA and the CEQ contemplated alternatives such as, to build an airport, or, not to build an airport. In that case the "no action" alternative would be not to build. Operation of the Osage mineral estate does not provide such a convenient "no action" alternative.

2. History of Oil and Gas Field Development and Production

Page 7: "Beginning in 1974 and continuing to the present, another increase in production is evident because of increased exploration and improved recovery methods, encouraged by high oil prices. The historical trend and oil production from Osage County is shown in Figure 2. Projected production also is shown for three possible scenarios to the year 2000."



The 1979 EA oil production forecast ("most probable projection") is contrasted with actual production here:

Actual production forecast from Oklahoma Corporation Commission annual reports (to 2006) and the BIA (2006-2015).

The increase in production was slight and short lived, nevertheless, the production forecast for the year 2000 was, accidently, on the money. The 1979 EA forecasted significantly greater <u>total production</u> than actually occurred.



The forecasted total production for the time period, 1978 to 2000, 227 million barrels, was not reached until 2014.

Page 9: "During the early period of production there was little control of surface field management. Spillage of oil and surface discharge of brine were common."

The long term consequences of legacy spills are discussed below.

Page 10: "Each drilling operation may occupy as much as one and one-half acres. This includes actual working space, temporary pits for storage of drilling fluids, and auxiliary equipment."

Still an accurate statement. After completion of drilling, surface requirements are approximately ½ acre per well, an estimate used in the 1979 EA and still valid. Long term affected area is discussed below.

Page 10: "Acid treatment or mechanical fracturing of the rock around wells also can be used to restore or maintain production by increasing the permeability so that oil can flow more easily into the well."

Mechanical fracturing was common in 1979, commercial fracking began in Oklahoma and Texas (Halliburton) in 1949. (<u>http://www.halliburton.com/public/pe/contents/Data_Sheets/web/H/H06640.pdf</u> accessed 5/21/2016)

C. PROGRAM OPERATIONS

1. Program Operation Responsibility and Procedures

"The Superintendent of the Osage Agency has the delegated responsibility to manage oil and gas operations on the Osage Reservation. This responsibility includes, but is not limited to:

- (1) approval of all oil and/or gas mining leases;
- (2) approval of drilling, workover, and plugging operations;
- (3) maintaining accurate records of all production and income received;
- (4) appraising damages and collection of compensation for damages on restricted Indian lands;

(5) reviewing all incoming well records to ensure that they comply with Agency standards;

(6) monitoring overall lease operations to ensure that lessees do not cause pollution (surface or subsurface); and

(7) ensuring that leases carry out lease operations in a prudent manner."

The Superintendent's responsibility (then and now) regarding the approval of leases includes:

25 CFR 226.2(c) "Each oil and/or gas lease and activities and installations associated therewith subject to these regulations shall be assessed and evaluated for its environmental impact prior to its approval by the Superintendent."

This acknowledgement of NEPA appeared in the 25CFR 226 regulations in 1974 after the enactment of the National Environmental Policy Act of 1969 (NEPA) and before the Court's 1977 order. However, we have no evidence that the Superintendent documented "assessments and evaluations".

3. Leasing Procedures

Page 14: "As of October 1978, there were 4,549 active oil, gas or combination leases in Osage County. Approximately 600 leases were sold in 1977 and this trend is expected to continue for the next several years. Table 1 gives an indication of the increase in number of leases which has occurred since 1970."

Date (ending)	Number of oil/gas or combination leases	Acreage
June 1970	2,418	509,729
June 1971	2,318	484,686
June 1972	2,361	454,385
June 1973	2,559	503,083
June 1974	3,108	632,253
June 1975	3,793	1,096,444
Sept. 1976	4,307	1,141,114
Sept. 1977	4,612	1,185,657
Sept. 1977 [sic]	4,549	1,170,493

The leased acreage is grossly overstated in Table 1. We are at a loss to explain the error, however, oil and gas leased surface may have been counted twice. The BIA says there are 4,200 leases today. (Robin Phillips, Superintendent, Osage Agency, letter to Chairman Waller, Osage Minerals Council, May 15, 2016) A typical lease is 160 acres. Acres leased in 1977 was about 740,000.

4. Drilling Activity

Page 21: "The total well count for all types of actively operating wells in Osage County in October 1978 was as follows:

Туре	Number
Oil	9,702
Gas	489
Oil/Gas Combination	52
Water Input	2,553
Salt Water Disposal	1,148
Water Supply	141
Hazardous Material Disposal	1
Total	14,160

Fiscal Year <u>(ending)</u>	Number of Oil and <u>Gas Wells Completed</u>	<u>Number of Dry</u> <u>Holes</u>
June 30, 1970	165	68
June 30, 1971	125	56
June 30, 1972	157	47
June 30, 1973	102	41
June 30, 1974	229	82
June 30, 1975	311	227
September 30, 1976	409	137
September 30, 1977	417	137
September 30, 1978	449	55

Page 24: "During the last several years, approximately 650 drilling permits have been issued annually by the Osage Agency. Of those, an average of about 75 percent of all wells drilled are completed as oil wells, about 5 percent are completed as gas wells, and about 20 percent are completed as dry holes and are plugged and abandoned."





5. Production

Page 25: "Since oil production began in Osage County in 1897 through September 1978, a total of 1,095,851,806 barrels of oil and billions of cubic feet of gas have been produced. Current rates of production are approximately 11.0 million barrels of oil and 8.6 billion cubic feet of gas annually."

"... gas activity is expected to increase more rapidly than oil production, probably by 20 percent per year for the next several years. As of October 1978, a total of 489 gas wells were producing in Osage County."

Although this prediction did not materially affect the conclusions it was very optimistic.



"As of October 1978, the county-wide production from 9,600 wells was averaging slightly less than 3.5 barrels per day."

In 2015 the production from 14,000 wells averaged less than 1 barrel per day.

Page 26: "The amount of formation water produced at most wells is around 40 barrels of water to each barrel of oil, and the total amount produced in 1977 has been estimated to be about 410,000,000 barrels. The surface disposal of deleterious formation water in watercourses such as streams or freshwater ponds is prohibited."

Forty barrels of produced water per barrel of oil may still be in the ballpark, the Osage Nation Underground Injection Control Program office has this information from annual reports required by 40 CFR Subpart GGG – Osage mineral Reserve – Class II Wells.

"Reworking of old wells to increase production can include acid treating, redrilling, hydro-fracturing, or otherwise improving well productivity."

As noted above, mechanical fracturing was common in 1979, commercial fracking began in Oklahoma and Texas (Halliburton) in 1949.

(<u>http://www.halliburton.com/public/pe/contents/Data_Sheets/web/H/H06640.pdf</u>, accessed 5/21/2016). This is significant because recent litigation claimed that fracturing was a recent development, not reflected in the 1979 EA.

6. Well Abandonment and Plugging Procedures

Page 28: "Both dry holes and old wells which are no longer economically productive must be plugged."

Proper stewardship of the resource requires plugging of wells. Unplugged wells, whether recently abandoned or historic, invite contamination of ground and surface water, gas leaks, problems with future CO_2 floods,

etc. In the past the Minerals Council and the BIA have agreed to leave wells unplugged in the expectation that an unplugged would facilitate reentry. On occasion this may be true but generally this is a risky policy.

Page 31: "Approximately 175 wells have recently been plugged and abandoned each year in Osage County."

7. Transportation and Transmission

Page 31: "Approximately 150 miles of unpaved gravel roads are constructed annually to carry out new oil and gas field operations." (At 20ft. width, 363 acres per year)

Page 32: "Oil trucking firms also use the roads to deliver oil from tank batteries to gathering points or refineries. These companies presently truck about 6 percent of all oil produced in Osage County, and normally carry 160 to 200 barrels of oil per load."

Today, virtually all oil purchased in the Osage is moved by truck either out of the county or to a pipeline facility within the county.

"The countywide estimate (Osage Agency, 1978) for all major oil, gas or saltwater lines used to deliver products to their proper location for sale or disposal is about 8,000 miles of pipelines. Approximately 150 to 200 miles of new pipelines are being installed annually (1978 rate) due to new oil and gas operations. This level of activity is not expected to change in the foreseeable future."

In 1979, 370 wells were completed. This estimate of 0.4 to ½ mile per new well is on the high side and conservative from the perspective of addressing environmental impact. A typical ¼ section lease without significant terrain issues needs about ½ mile of lease roads for four wells, 1/8 mile per well.

8. Safety and Environmental Controls

This section contains a discussion of the various federal regulations which existed when the 1979 EA was prepared.

Page 33: "To bring the Osage Agency, the Bureau of Indian Affairs, and the Department of the Interior into conformity with the purposes, intent and procedures set forth in the National Environmental Policy Act (NEPA, 1969), Section 516 was added to the Department Manual (dealing with environmental quality) on September 17, 1970 (revised September 27, 1971). In addition, the Bureau of Indian Affairs' environmental guidelines (Interim Guidelines, Environmental Quality Handbook, 30 BIAM, Supplement 1) were promulgated in August 1973. Environmental regulations specific to Osage Agency operations for oil and gas mining were revised effective July 22, 1974 (amended 1976 and 1978), and include environmental considerations."

Page 34: "....it is obvious that management of the Osage Mineral Estate has been conscientiously working to maintain an unpolluted environment in Osage County for many decades."

Although self-serving, a sincere and accurate statement.

II. DESCRIPTION OF EXISTING AND PROJECTED ENVIRONMENTAL CONDITIONS IN OSAGE COUNTY, OKLAHOMA

A. REGIONAL LAND USE

Page 38: *Table 3. Present and projected land use (in acres) in Osage County, Oklahoma is reproduced here:* Table 3. Present and projected land use (in acres) for Osage County, Oklahoma

Land Use Category	Present Acreage ^a	Percent Cover	Project Year 2000 Acreage ^b	Percent Cover
Wooded Land	220,000 ^c	14.90	205,000	13.89
Rangeland	926,617	62.76	912,744	61.82
Pasture Land	184,820	12.52	222,400	15.06
Cropland & Orchards	82,000	5.55	60,000	4.07
Wetland	3,855	0.26	3,700	0.25
Urban & Built up ^d	16,130	1.09	18,820	1.27
Paved highways & Country Roads	13,318	0.90	14,773	1.00
Strip-mines & Gravel Pits	670	0.05	200	0.05
Oil Waste Land	2,000	0.14	2,5 44 ^e	0.24
Confined Feedlot	160	0.01	200	0.01
Operations				
Water	26,910	1.82	34,500	2.34
Total	1,476,480	100.00	1,476,480	100

^a Based on US Soil Conservation Service (1994), but modified for more correct estimates of surface water, urban areas, roads, oil waste land and other categories for 1978 status.

^b Based partially on projected trends as outlined by the Osage County Conservation District (1973), INCOG 208 Area wide Water Quality Management Plan (1978), State Department of Transportation (personal communication), and estimates of water coverage assuming all proposed Corps of Engineers reservoirs are completed.

^c Commercial forest = 70,000 acres (1972), according to Osage County Conservation District ^d Includes city street mileage.

^e Assumes historical average (1970-1978) of 164 spills per year with average area of 0.158 acres degraded per spill, and no natural revegetation of reclamation of resulting oil waste land.

Other than "oil waste land", Table 3 does not contain area for oil and gas (a major error). On page 112 16,273 acres are estimated for 1978 and 23,455 acres are forecast by 2000 (page 112).

Present and projected oil and gas land use (in acres) for Osage County, Oklahoma

		<u>1978</u>	<u>2000 forecast</u>	<u>2016</u>
Oil waste land		2,000(1)	2,544(5)	1,628(8)
Wells, tank batteries, etc.		7,000(2)	10,254(6)	9,878(9)
Lease Roads		7,273(3)	10,657(6)	10,273(10)
	Totals	16,273(4)	23,455(7)	21,779

(1) Provided by Soil Conservation Service, probably a good horseback estimate

(2) 14,000 active wells at 0.5 acres per well

(3) 0.52 acres per well for lease roads (0.2 miles per well at 20 ft. width)

(4) Page 111

(5) 2,000 plus 544 acres for 164 spills per year

(6) 6,508 net additional wells (back calculated), the missing page, 112, may contain this information (7) Page 111

(8) From a 2015 Hydration Engineering township by township count of oil waste land, see http://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx, it appears that the legacy brine scars are gradually diminishing.

(9) 0.5 acres per well, 16,500 producing wells*, 3,255 disposal wells* *Robin Phillips, Superintendent, Osage Agency BIA, letter to Evert Waller, Chairman Osage Minerals Council May 11, 2016

(10) 0.52 acres per well for lease roads, 19,755 total wells

In spite of the errors in Table 3 the forecast of surface affected by oil and gas activities was reasonable and conservative. <u>2016 oil and gas land use is 7% less than the 1979 EA forecast for 2000.</u>

The 2000 forecast for urban and built up area was 18,200 acres. In June 2011 INCOG reported (2030 Osage County Compressive Plan) that the annexation fence line of Osage cities and towns was 164,880 acres (Sand Springs (30%), Tulsa (5%), Skiatook (59%), Pawhuska (0.4%), and Sperry (5%)), 11.2 percent of the county, and <u>nine times the 1979 EA forecast</u> for urban and built up areas.

Wind energy was not anticipated in the 1979 EA. 17,900 acres are required for the Trade Wind Energy, Osage and Mustang Run Wind projects. (Trade Wind Energy, <u>http://tradewindenergy.com/project_category/wind/</u> accessed 5/22/2016). If a third wind energy project is

developed in Osage county the total wind energy area will exceed oil and gas.

B. PHYSICAL CHARACTERISTICS

5. Air Quality

Page 48: "Overall, air quality in Osage County is quite good. The Osage County Conservation District (1973) noted that smoke from a few industrial areas and occasional grass fires were the most significant air pollutants. Several studies performed by the US Army Corps of Engineers ((1972-1975) concluded that stagnant meteorological conditions which lead to air pollution episodes are unlikely to occur in Osage County."

Industrial "smoke" had been significantly reduced with the replacement of the horizontal retort zinc smelter in Bartlesville in 1976. Industrial smoke sources probably included the Tulsa refineries and a steel mill in Sand Springs, the steel mill is gone, and the refineries have much improved emission controls. Grass fires, prescribed burns and otherwise, probably remain the source of "most significant air pollutants".

6. <u>Noise</u>

Page 50: "In areas of active drilling or pumping, noise was at much higher level than in the urban or rural settings. In one instance, a noise level (exceeded 10 percent of the time) of 92 dBA was measured at the boundary of a well drilling site. In close proximity (within 50 feet of large gas-powered pumps, pulse noise was at high levels, in some instances over 100 dBA. At present, the general industry standards of OSHA (Section 1910.95) indicate that the noise level, on an 8-hour time-weighted average, should be no greater than 90 dBA and on a 2-hour average should be no greater than 100 dBA. Several pumping stations and work areas which were investigated during field reconnaissance in Osage County for this study displayed signs which warned that protective devices for the ears were required if a person had to work in the area for more than 4 hours."

See comment on noise regulation below under "Regulatory Jurisdiction".

7. Surface Water Resources

a. Sources and Use

Page 55: Table 5 which contains obvious errors is reproduced here with an explanation to follow.

Table 5. Reported surface and groundwater use in Osage County, Oklahoma for 1975 and 1976 (all values in acrefeet).

	19	75	1976		
Use Category	From Surface Water	From Ground- Water	From Surface Water	From Ground Water	
Crop Irrigation	636	489	606	680	
Municipal	7,500	58	20,555	59	
Industrial	506	0	475	0	
Recreation and Wildlife	0	0	228	0	
Secondary Oil Recovery	76	2,388°	75	2,714ª	
Other Municipal and Industrial	0	0	0	0	
New Well Development ^b	182	-	204	-	
Sub – Total	8,900	2,935	22,143	3,453	
Annual-Totals	11,8	835	25,596		

^aGroundwater use for secondary oil recovery includes a minor amount of alluvial and Vamoosa aquifer fresh water; however, the vast majority of the reported use consists of saline water from below the zone of portable water and reinjected to pressurize the fields.

^bCalculated values; assumes 1.5 barrels of water per foot of new drilled, average depth of 2,200 feet; with 432 wells completed in 1975 and 483 wells completed in 1976. Although some ground water is used, almost all use of water for new well development came from surface streams and small impoundments (personal communication, Mr. Dave Baldwin, Superintendent, Osage County, January, 1979). Other data from Oklahoma Water Resources Board. Source: Reported Water Use, 1975 and 1976 – Oklahoma Water Resources Board.

No explanation was provided for the 287% increase in municipal water use from 1975 to 1976. Therefore, we consider this an error. (And, 500 acre feet per year is equivalent to 188 gallons per day for the entire population of the county, twice typical per capita water use.)

Including produced saline water, 2,388 and 2,714 acre feet, in this tabulation of fresh water use is inappropriate and not relevant. In any event, according to the 1979 EA, fresh water use for new well development is not more than 2% of total freshwater use. Usual practice is to purchase fresh pond or lake water for drilling and mud making from a local surface owner.

b. Surface Water Quality

Page 54: "Water quality in Osage County, as in most areas of northeastern Oklahoma which are not heavily urbanized, is moderately good. However, relatively high chloride concentrate ions exist in some surface waters, including Keystone Reservoir, because of natural or man-induced brine inflows."

This is as close as the 1979 EA gets to recognizing that significant chlorides in surface waters may be from natural sources. The Osage name for Salt Creek is Ne ske le Ka ha, the name predates European contact. High quality water was otherwise observed by the Osage, Ne Log ny, Good Water, was a camp near Nelogony. (Louis F. Burns, A History of the Osage People, The University of Alabama Press, 2004.), (Larry O'Dell, "Salt and Salt Works," Encyclopedia of Oklahoma History and Culture, www.okhistory.org - accessed December 17, 2015.) Salt springs, oil seeps, and gas vents were useful indicators in early petroleum exploration. (Kenny A. Franks, "Petroleum Industry," Encyclopedia of Oklahoma History and Culture, www.okhistory.org - accessed December 17, 2015.) (Carl Coke Rister, Oil! Titan of the Southwest, University of Oklahoma Press, 1949). As early oil development reduced pressure on shallow reservoirs the springs diminished and surface water quality probably improved.

Arkansas River salinity is well understood and the Salt Fork of the Arkansas being one source.

"... three problem areas (surface water quality) were described (by INCOG) within Osage County. In the Salt Creek sub-basin, it was noted that fecal coliform bacteria counts often exceeded State limits of 200/100 ml; this situation was ascribed partially to inadequate disinfection of municipal wastewater discharges in the watershed."

The offending Salt Creek municipal wastewater discharges, Burbank and Shidler, are listed in Table 8. (Fairfax was omitted in Table 8 in error.) Municipal waste water discharges into Salt Creek are now in compliance but a coliform problem persists due to cattle.

"In the Bird Creek sub-basin, it was noted that pH values less than 6.5 occurred at the mouth of Hominy Creek (just outside Osage County), attributed to runoff from adjacent oil fields. Also in the Bird Creek sub-basin, excessive chloride concentrations with a mean of 335 mg/l were measured below Pawhuska; this also was ascribed to oil well fields in the area. In addition to describing existing problems areas, the INCOG 208 Plan described in detail potential water quality problem areas. These areas were delineated during the study by comparing INCOG's monitored data with a set of future water quality goals established by INCOG. These detailed descriptions will not be repeated herein, but they generally deal with the subject of describing probable future impacts and mitigation measures for nutrients, heavy metals and bacteria within eight major sub-basins; oil field drainage problems were not mentioned specifically."

The management of surface water quality has changed with the legal and regulatory evolution of the Clean Water Act. To understand the current status of water quality in Osage County it is useful to understand:

"A TMDL (Total Maximum Daily Load) is a pollution budget and includes a calculation of the maximum amount of a pollutant that can occur in a waterbody and allocates the necessary reductions to one or more pollutant sources. A TMDL serves as a planning tool and potential starting point for restoration or protection activities with the ultimate goal of attaining or maintaining water quality standards. Under section 303(d) of the Clean Water Act, states, territories and authorized tribes (included in the term State here) are required to submit lists of impaired waters. These are waters that are too polluted or otherwise degraded to meet water quality standards. The law requires that the states establish priority rankings for waters on the lists and develop Total Maximum Daily Loads (TMDL) for these waters." (EPA, <u>https://www.epa.gov/tmdl accessed 5/23/2016</u>)

The Osage Nation is not an "authorized tribe" in this context and the Oklahoma Department of Environmental Quality (ODEQ) creates the TMDL budget and submits the lists of impaired waters to the EPA.

TMDLs have been completed for ten Osage streams all corresponding to the beneficial use, Primary Body Contact Recreation (swimming). The source of the contamination was determined to be cattle.

Seven streams and five lakes have been identified as impaired for at least one additional beneficial use but have yet to have TMDL studies completed.

Birch Lake, Bluestem Lake, Hominy Lake, and Hulah Lake are impaired for the beneficial use Warm Water Aquatic Habitat (fishing). The water quality is compromised by turbidity.

Beneficial use for agricultural irrigation is impaired by the sulfates in Pawhuska City Lake water. (The source is likely to be gypsum interbedded with limestone at the adjacent quarry.)

Beneficial use of Fairfax Lake for public water supply is compromised by Chlorophyll-a.

Stream segments with TMDL studies pending are Delaware Creek, Bird Creek, upper Hominy Creek, lower Hominy Creek, Mission Creek, Buck Creek, Sand Creek, Gray Horse Creek, Doga Creek, and Salt Creek.

When ODEQ lists a water body they identify possible sources of contamination as a tool to direct further investigation. They select possible sources from a list of 41. ODEQ explains: "When DEQ lists waterbodies on the 303(d) list, all possible sources are added for each impairment. As we have no way to determine the actual sources at the time of listing, anything in the watershed that could possibly contribute to the impairment is included. This does not mean that the listed sources are the cause, just that there is some possibility that they could contribute to the impairment." (ODEQ email to Fred Storer, 5/23/2016) The full 2014 303(d) list is available at: http://www.deg.state.ok.us/WQDNew/305b 303d/2014/2014 appendix c 303d-final.pdf.

Sources of interest in Osage County and the corresponding code number used in the 303(d) list include:

- 46 Grazing in Riparian or Shoreline Zones
- 49 Highway/Road/Bridge Runoff (Non-construction Related)
- 59 Impacts from Land Application of Wastes
- 85 Municipal Point Source Discharges
- 92 On-site Treatment Systems (Septic Systems and Similar Decentralized Systems)
- 97 Other Spill Related Impacts
- 102 Petroleum/natural Gas Activities (Legacy)
- 108 Rangeland Grazing
- 111 Residential Districts
- 133 Wastes from Pets
- 136 Wildlife Other than Waterfowl
- 140 Source Unknown
- 155 Natural Sources
- 156 Agriculture

(From Appendix 2014 OK Integrated Report, Appendix C - 303(d) List of Impaired Waters, Page 82)

Delaware Creek, lower Hominy Creek, and Sand Creek are possibly impaired by Petroleum/Natural Gas Activities (Legacy) in addition to 8 to 9 other listed possible sources.

It should be understood that the Clean Water Act's fishable-swimmable goals are not a reflection of pre European contact Osage water quality. Natural oil and saltwater seeps are historic and creeks would not have met coliform standards if a buffalo herd was in residence.

8. <u>Groundwater</u>

a. Formations and Yield

Page 59: "Groundwater production in Osage County can be described as scant to moderate with water being of poor to fair quality. Supplies are not adequate for large scale industrial, municipal or agricultural use, and such users must depend mostly on surface supplies."

b. Groundwater quality

"The following table shows the minimum and maximum concentrations for sulfate, chloride, nitrate and total hardness for 23 samples of the Vamoosa formation (Oklahoma Geological Survey, Enid quadrangle Report, in press):

	Minimum	Maximum	
	concentration	concentration	
Parameter	(in mg/l)	(in mg/l)	
Sulfate	7.0	250	
Chloride	5.0	360	
Nitrate	0.0	83	
Hardness	15.0	560"	

The EA describes in general terms the alluvial deposits of the Arkansas River and the Vamoosa formation, but does not comment on any connection between oil and gas activities and the quality of the ground water in Osage County.

Subsequent studies by the US Geological Survey (Abbott, M.M., 1997, Water Quality of the Quaternary and Ada-Vamoosa Aquifers on the Osage Reservation, Osage County, Oklahoma,

<u>http://pubs.usgs.gov/wri/wri994231/pdf/wri99-4231.pdf</u>, accessed 5/20/2016) implicate oil and gas operations as the source of reduced water quality in the Vamoosa. "Several constituents in samples from the Ada-Vamoosa aquifer wells within a quarter mile of an oil well were significantly greater than from Ada-Vamoosa aquifer wells not near oil wells. Where no oil wells have been drilled through freshwater aquifers, the water quality of the Ada-Vamoosa aquifer is similar to the water quality of the Quaternary aquifer." A later study (Abbott, M.M., and DeHay, Kelli, 2008, Aquifer tests and characterization of transmissivity, Ada-Vamoosa Aquifer on the Osage Reservation, Osage County, Oklahoma, 2006: U.S. Geological Survey Scientific Investigations Report 2008-5118, <u>http://pubs.usgs.gov/sir/2008/5118/</u>, accessed 5/20/2016) notes that over pumping can compromise water quality. "Over pumping of existing wells or significant additional well development in this area of the aquifer could pull the naturally occurring saline water, which is expected to be down dip to the west up into the fresh water stored in the aquifer."

Most rural homes are now served by one of several municipal or rural water districts (INCOG map, <u>http://www.incog.org/Transportation/OsageCo/Maps/facilities_water(11x17)19.pdf)</u> Accessed 5/21/2016)



C. SOCIO-ECONOMIC AND CULTURAL CHARACTERISTICS

1. Demography

Page 66: "Recent population estimates by the Indian Nations Council of Governments (INCOG), suggest a county population in 1978 of 35,644 with about 7,700 households.

Projections for the future call for strong growth in the county by the year 2000, the Economic Development Planning Group, Series I projections, prepared in 1978, suggest a 24.6 percent increase in population between 1976 and the year 2000 (Table 10). The Tulsa Metropolitan and Transportation Study (TMATS) Level II update predicts a much greater increase almost 100 percent. In the report <u>Arkansas Riverbed Project (Bruce B. Parish and Associates, 1977)</u> and increase in Osage County population is predicted to be about 7,000 persons or an increase of 22 percent. While specific projections differ in magnitude, there appear to be consensus that the area will experience significant growth over the next 20 years, primarily due to proximity of Tulsa's outward expanding metropolitan growth, increased industrial promotion, increase in new reservoir-related tourism, and development of a new prison at Hominy."

Page 69:

"Table 10. Population, employment, and personal income, recent and projected, for Osage County, Oklahoma

		Year		
Category	1976	1980	1990	2000
Population ^a	32.6	34.3	35.4	40.3
Employment (total) ^b	5.5	5.5	5.2	6.1
Mining	0.7	0.7	0.6	0.7
Construction	0.1	0.2	0.2	0.2
Manufacturing	0.7	0.6	0.7	0.9
Transportation, communications				
and public utilities	0.1	0.1	0.1	0.1
Wholesale trade	0.2	0.2	0.2	0.3
Retail trade	0.7	0.6	0.6	0.7
Finance, insurance and				
real estate	0.1	0.1	0.1	0.3
Services	0.6	0.6	0.6	0.8
Government	0.8	0.8	0.9	0.8
Agriculture	1.0	0.7	0.4	0.3
Other	0.5	0.9	0.8	1.0
Personal income	\$5,111°	\$7,766	\$16,079	\$28,470
Per-capita	(\$3,165)	(\$3,600)	(\$4,718)	(\$5,726)

^a all data in 1000's

^b all employment data in 1000's

^c 1975 data

Data in () are expressed in 1967 dollars

Source: Economic Development Planning Group, Tulsa Metropolitan Area Planning Commission; <u>Population,</u> <u>Employment and Personal Income Projections</u>; January, 1978.

Osage Co. Population (Thousands)	1976	1980	1990	2000	2010	2015
1979 EA Forecast	32.6	34.3	35.4	40.3		
Actual		39.3	41.6	44.4	47.5	49.3(INCOG)

Oil and gas employment was contained in the "Mining" category in Table 10.

Osage County employment coded as Mining (NAICS Code 21) was 546 on June 30, 2014, and 435 on October 31, 2015 (the last date available). (<u>http://www.bls.gov/cew/apps/data_views/data_views.htm#tab=Tables</u>, accessed 5/26/2016)

3. Business, Industry and Agriculture

Page 70: "Although Osage County is primarily rural in character, its economy is based on mining (oil and gas extraction), agricultural production, and apparel and textiles manufacturing and support services. In 1975, the market value of oil and gas produced in the county was in excess of \$100 million. The importance of the petroleum industry to the local economy is shown in Table 11. The 1975 oil and gas related payrolls, (excluding refining), amounted to over \$42,000,000, or 23 percent of total payrolls from all business sources in that year."

"Refining" would be in reference to natural gas/gas liquids plant operations.

"The market value of all agricultural products sold in 1974 was \$23,514,000."

"In addition to agriculture and the oil and gas industries dispersed through the county, apparel and textiles manufacturing industries located in Pawhuska, Fairfax, and Hominy are important employers."

Apparel and textiles manufacturing has since ended.

Table 11 is reproduced here in spite of gross errors.

Page 71: "Table 11. 1975 oil and gas-related business activity for Osage County, Oklahoma.

Business Activity	Number of Employees	Annual payroll (x \$1000)	Number of establishments
Mining	1723	24,673	121
Oil and gas extraction	1583	23,068	112
Crude petroleum and natural gas	878	13,751	61
Oil and gas field services	500-999	N/A	47
Drilling of oil and gas wells	340	5,083	16
Oil and gas field services	298	3,273	24
Refining	500-999	D	D

D – Figure withheld to avoid disclosure

Source: County Business Patterns, 1976: US Census, CPB#76-38"

We acknowledge the obvious errors in the data presented in the EA Table 11. The total oil and gas employees in Table 11, 5,822 to 6,820, exceed the total employment for the county reported elsewhere.

Page 75:

5. Employment

"Osage County had a total employment of 5,500 workers with an additional 820 unemployed workers in 1976."

7. Municipal Facilities and Services

Page 76:

"Residents in rural areas rely on wells for supply and on septic tanks for disposal."

This is no longer an accurate statement. Most rural residences are connected to rural water districts. However, on site waste disposal is common.

8. Transportation and Transmission

Page 77:

".... about 3,000 miles of mostly gravel roads are maintained by oil companies and lessees for daily operations. According to the Osage Agency records, approximately 150 miles of unpaved roads are being added yearly to carry out new oil and gas activities."

Page 78:

".... the Osage Agency estimates that there are about 8,000 miles of delivery pipelines in Osage County. They also estimate that about 200 miles of new pipelines are being installed annually at the present state of exploration and development."

We believe that 8,000 miles included flowlines from wells to tank batteries.

11. Historical and Cultural Resources

Page 82:

"Fighting on the side of the Confederacy during the Civil War, the Osages lost their land in Kansas to white settlers."

This is an example of errors and over simplifications in this section of the 1979 EA.

D. ECOLOGICAL CHARACTERISTICS

3. Aquatic Biology

a. Introduction

Page 94: "Osage County has approximately 1.82 percent of its area covered with water, including both streams and impoundments."

2.7 percent of Osage County is covered by water based on a 2015 Hydration Engineering township-bytownship count, see <u>http://websoilsurvey.sc.eqov.usda.gov/App/WebSoilSurvey.aspx</u>.

b. Fisheries

Page 97: "Osage County is probably among the best in the State for fishing."

E. Environmental Degradation

Page 107: "Some environmental degradation in Osage County directly related to the oil and gas leasing program has occurred due to oil and/or brine spills and the resulting contamination of soil, streams and groundwater. Although previous sections of this chapter have documented the land use and water quality conditions affected by historical oil and gas activity, the rate of degradation currently extant is a function of the amount of annual petroleum production and the successful enforcement of environmental controls."

"The Clean Water Act of October 1972, Public Law 92-500 Section 311 (as Amended, 1977), requires that all spills involving petroleum or hazardous materials which could potentially flow into the waters of the US be reported to the EPA under the Oil Spill Pollution Prevention Regulations (40 CFR, parts 110 and 112). These data are available for the State of Oklahoma at the EPA Region VI office in Dallas, Texas for the period from January, 1972 through November, 1978. A search of these data files provided the Statewide and Osage County information on number and size of oil spills listed in Table 22. A single crude oil spill of 6,578 barrels, which occurred in 1976 due to a break in an interstate pipeline, was omitted from consideration because it has no direct bearing on oil and gas production activities, nor is it related in any way to Osage Agency authority."

	Number of Sp Accidents	oills and		Volume of Cro Spilled (Barre	ıde Oil Is)	
Year	Oklahoma	Osage	Osage %	Oklahoma	Osage	Osage %
<i>1972</i>	93	8	5.82	15,250	845	5.54
1973	151	15	5.75	23,093	830	3.59
1974	151	14	5.69	18,538	200	1.08
1975	146	9	6.29	10,785	1,590	14.74
1976	112	6	6.70	25,741	189	0.73
1977	152	12	7.13	8,282	303	3.66
1978	124	8	7.68	7,271	281	3.86

Table 22, Page 108, is reproduced in part here:

Source: Records of the US Environmental Protection Agency, Region VI, Dallas, Texas.

Page 109: "Although 106,980 barrels of crude were spilled during the seven years considered, only 4,238 barrels (or 3.9 percent) were spilled in Osage County. The average size of individual spills in Osage County was 58 barrels, just half of the state wide average of 117 barrels. Obviously, oil production in

Osage County causes much less environmental degradation per barrel of production than production elsewhere in Oklahoma. This excellent record is attributable to the strict pollution control program of the Osage Agency, and possibly to the fact that average annual well production during the past five years was 2,200 barrels for Oklahoma and only 1,288 in Osage County.

EPA does not publish oil spill data as used in the 1979 EA. However, reports of spills are now made to the National Response Center (<u>http://www.nrc.uscq.mil/</u>). Osage spills expressed as a percentage of Oklahoma reported spills followed the trend reported in the 1979 EA until 2012 when reported Osage spill reports increased dramatically.





The sudden increase in reported spills in 2013 is the result of the Osage Agency making telephone spill reports to the National Response Center (NRC). The Osage Agency is reporting all spills, oil and/or produced water, regardless of the quantity or proximity to the "waters of the United States". From 2013 the reporting practices of the Osage Agency are clearly different from the State of Oklahoma and the balance of the US. For the most recent comparable year, 2012, Osage County spills were 5 percent of the state total. In 2015 the NRC received 32,405 reports, 588 or 2 percent of the total from Oklahoma about half of those from Osage County.

III. ENVIRONMENTAL IMPACTS

A. ENERGY PRODUCTION

Page 110: "No estimate of total Osage petroleum reserves (proven and probable) is available, although 300 to 400 million barrels is a reasonable consensus among local professionals. Based on considerations of national demands, known reserves, daily production rates, recent exploration success and improved recovery techniques, a most probable projection of total oil production from Osage County for 1979 until the year 2000 is 210.5 million barrels (see Figure 2)."

Figure 2 is a graph illustrating the forecast production year by year to 2000, it does not provide the total production. Nevertheless, our estimate ("most probable" 1979 EA forecast) based on the area under the forecast curve is in agreement, 211.7 verses 210.5 million barrels for the period January 1, 1979 through December 31, 1999. Actual total production did not reach 210.5 million barrels until 2014.

Page 111: ".... current annual (gas) production rates are estimated at 8.6 billion cubic feet. As of September 30, 1978, a total of 489 gas wells existed in Osage County, and a large number of oil wells also produce additional gas. Osage Tribal official's estimate that gas well drilling is increasing now by about 20 percent per year, and that annual gas production by the year 2000 will be at least 9.125 billion cubic feet per year. They also estimate total county recoverable reserves to be 400 to 600 billion cubic feet of gas."

B. REGIONAL LAND USE

Page 111: "Since 1900, when oil production began in (what would become) the county, a relatively minor impact on land use has occurred due to the exploration, drilling, production and abandonment of wells. Even though about 34,000 wells have been drilled in the county through 1978, only about 14,000 wells of various types are still active. The sites of the 20,000 inactive wells have essentially been returned to pre-activity conditions; that is, the wells are plugged, and the ground surface has been recontoured. Within a short period the areas are revegetated by characteristic cover for the area. For the 14,000 active wells, because an average of ½ acre is required for the pump, storage tanks, parking, etc. about 7,000 acres (0.47 percent) of Osage County land are impacted due to energy production. Similarly, assuming small access roads for operational activities have a width of 20 feet, then the 3,000 miles of unpaved oil and gas company roads in the county impact another 7,273 acres (0.49 percent). Finally, some 2,000 acres (0.14 percent) of temporarily altered waste land caused by oil and brine spills exist throughout the county. Thus, land currently affected by the (Page 112 is missing from the available copy)."

Page 113: "Additional waste land will be created throughout the county as accidental oil and brine spills occur during the next 21 years. As detailed in Section F (Page 150), an average of 164 spills per year (assuming the number of spills per year in the period 1970-78 remains constant), will produce an additional 544 acres of waste land by the year 2000. Added to the land use impacts of well sites and road construction, the total portion of Osage County affected by the oil and gas leasing program from 1979 to the year 2000 will be 7,182 acres (0.49 percent of the county). Accounting for existing and new wells, well abandonment, new access roads and road taken out of use, and an approximately constant spill rate (each spill causing 0.158 acres of wasteland), then total Osage County acreage committed to the oil and gas leasing program by the year 2000 will be 23,455 acres (or 1.59 percent of the land) which contrasts to the current 16,273 acres (1.10 percent of the land)."

As noted above (II.A. REGIONAL LAND USE) waste land has decreased from 2000 acres in 1978, to 1,628 acres in 2015. (From a 2015 Hydration Engineering township-by-township count of oil waste land from the Soil Conservation Service's <u>Web Soil Survey</u>, see http://websoilsurvey.sc.eqov.usda.gov/App/WebSoilSurvey.aspx)

- C. PHYSICAL IMPACTS
- 1. Physiography and Geology

Page 114: "..... no geologic disturbances in the county have been linked with the extraction of oil and gas or the injection of brine. No surface collapse, landside, or earthquake has ever been associated with program activities."

From 7/26/1981 through 5/21/2016 there have been 15 recorded low magnitude earthquakes in Osage County (9 "microearthquakes" and 7 capable of being felt slightly by some people but causing no damage to buildings). Nine earthquakes have occurred since 2/4/2014.

(http://www.ou.edu/content/ogs/research/earthquakes/catalogs.html accessed 5/21/2016)



The nine minor earthquakes, all in far western Osage County (west of -96.9 longitude) detected since February 4, 2014, are all believed to be induced seismicity resulting from large scale dewatering/reinjection facilities operating under EPA UIC Class II permits. These operations are not typical of Osage produced water reinjection as practiced for decades.

2. <u>Soils</u>

Page 114: "Soils may be impacted by contamination from oil or brine spills and erosion that is facilitated by clearing for well field service roads or well sites. Contaminated soil is classified as waste land by the Soil Conservation in Service since its agricultural productivity is essentially depleted and natural recovery is extremely slow process (often 20 or more years). About 2,000 acres of wasteland now exist, and another 544 acres are projected to result from spills between 1979 and the year 2000."

As noted above, soil maps are now available on the Soil Conservation Service's <u>Web Soil Survey</u>. The most recent count of waste land in Osage County is 1,628 acres.

Page 116: "Based upon the distribution of new development by slope category and the erosion rate assumptions given above, erosion from well, roads, and spills will produce 1.4 million tons of sediment in the year 2000."

".... the total county erosion will produce about 48.8 million tons of sediment in the year 2000. Thus, the oil and gas leasing program, which involves less than 2 percent of the county acreage, will produce 2.9 percent of the erosion expected in the year 2000."

3. Air Quality

Page 118: "The impact of oil and gas production, storage, and transmission activities on the air quality in Osage County is relatively minor, but will continue to be a long-term adverse impact. The primary pollutant which results from oil and gas operations is ozone. Ozone is formed as a photochemical oxidant when sunlight reacts with airborne hydrocarbons escaping from leaks, evaporating from open storage tanks, or released as exhaust emissions. Although a large number of wells and associated storage tanks, and daily transfer operations exist in Osage County, the climatological characteristics of the region preclude the likelihood of stagnant episodes. It is probable, however, that the ozone formed from the hydrocarbon emissions in Osage County can, under certain meteorological conditions, contribute to and aggravate the current ozone problem in Tulsa County and the metropolitan area. However, the impact of these emissions is estimated to be negligible in comparison to that resulting from highway vehicle and industrial emissions in and around Tulsa."

This is an accurate statement. However, it should also be understood that "ozone alerts" in Tulsa occur from May through September. There have been 142 ozone alerts in Tulsa since 1999, none in the winter (<u>http://www.ozonealert.com/faq.htm#standard</u> accessed 5/22/2016). Prevailing winds, spring through autumn, are from the south and southeast. Osage county hydrocarbon emissions are in Kansas when Tulsa ozone alerts occur.

"With regard to local conditions in well fields in Osage County, minor air pollution results from gas engines associated with pumping operations and drilling machinery. Additionally, fugitive dust is a seasonal nuisance during

various field activities involving clearing of well sites, drilling or other activities. The local air pollution and fugitive dust are not considered significant impacts of environmental degradation."

Significant, although interment threats to oil and gas facilities, wildfires and prescribed burning contribute to reduced air quality. An estimate of emissions from Osage County wildfires and prescribed burning is not available. Emission factors for particulates, carbon monoxide, and hydrocarbons, have been published for prescribed burning by the EPA but cannot be used with confidence. "The measurement of particulate matter emission factors and concentrations in the vicinity of the agricultural burning (sampling) is not a simple task." (National Resource Conservation Service, USDA,

http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/air/?&cid=nrcs143_008984 accessed 5/22/2016.

4. Noise Levels

Page 119: "Because wells are sufficiently dispersed (noise dissipates to background levels at a distance of around 1,000 feet), no significant regional impact will result from future exploration, drilling and production. However, noise levels at some sites do exceed 100 dBA.

"... there have been no complaints or investigations regarding noise problems in the county (personal communications, Mr. James P. Johnson, Area Director, OSHA, Tulsa, Oklahoma November 1978).

See comment on noise regulation below under "Regulatory Jurisdiction".

5. Surface Waters

Page 120: "With regard to surface water quality, according to INCOG 208 planning studies and sampling, one major stream in Osage County receives pollutants (primarily high chloride concentrations) which exceed State Standards and which INCOG has attributed to oil field operations. That stream is Bird Creek at two locations: one area near the mouth of Hominy Creek (just outside Osage County), and another area immediately downstream of Pawhuska. The impacts noted were that pH exceeded the State Standard and that excessive chloride (above that of the Federal drinking water Standard) was present, respectively. Both of the immediate watershed areas were water quality sampling was done contained a relatively large number of producing and abandoned wells and dry holes."

Page 121: "Further studies may even be able to show that the chronic high chloride concentration in Bird Creek at Pawhuska is only related to natural brine seeps from county oil activities that took place decades in the past."

Page 122: "The Osage County Conservation District (1973) reported that the "number one water pollutant" in Osage County was sediment derived from a number of small isolated areas throughout the county. Their report listed four sources for which better soil conservation controls were recommended: these were: (1) agricultural and non-agricultural land, (2) unsurfaced roads and roadside erosion, (3) gully erosion, mostly on private lands, and (4) oil waste land. The report encouraged proper disposal of salt water."

The Oklahoma Conservation Commission's Water Quality Division tracks non-point source impairment and maintains a useful interactive stream health map (<u>https://www.ok.gov/conservation/Agency_Divisions/Water_Quality_Division/</u>). The Osage County Conservation District is a subunit of the Conservation Commission.

"Although a large number of both old and new wells are found in the county, and most of the unitized lease areas are under waterflood, surface water contamination due to oil and gas activities (as documented by INCOG, the Oklahoma State Department of Health, and the Osage County Conservation District), has been quite minimal. Total long-term adverse impacts to surface waters in general appear to be slight to moderate even though occasional brine pollution in very localized areas may be termed serve, but of short duration. In instances of severity there have been occasional fishkills or deaths of livestock reportedly due to a brine spill."

When ask about fish kills in Osage County the Department of Wildlife Conservation did not have any fish kill reports and deferred to ODEQ. ODEQ wrote: "... we only have three reported kills (in Osage County) since Jan. 1, 1995". (ODEQ email to Fred Storer, 9/22/2015). The ODEQ did express concern about the volume and frequency of spills as reported to the NRC (2015) and stated that there could be fish kills that they do not hear about. Apparently, ODEQ was unaware of the dramatic increase in BIA NRC reported spills beginning in 2012.

Reports to the NRC do, on occasion, include a comment regarding fish kills, but they are not common. In 2015, 59 NRC reports contained comments regarding fish kills out of a total of 32,405 spill reports.

6. Groundwater

Page 123: "Inspection of well logs and discussions with personnel familiar with the Osage oil and gas industry have indicated that old producing wells which may not have been cased to below the bottom of the freshwater zone, old wells with a faulty casing now being used for injection of brine, and oil wells which were improperly plugged represent the possible sources of potable groundwater contamination. The previous comparison reveals that alluvial aquifer is not jeopardized by these conditions and only about one-third of the Vamoosa in Osage County (191,150 acres) has a significant probability of such contamination."

A well that should be plugged should not be ignored. If the responsible party cannot be identified, bond funds should be applied to plugging, if the bond has been released the well is the BIA's responsibility. An additional alternative is help from the Oklahoma Energy Resources Board OERB has cleaned up 876 oil and gas sites in Osage County at a cost of \$4,351,064 (<u>http://www.oerb.com</u> accessed 5/29/2016)

Page 124: "... it is unlikely that the oil and gas leasing program has resulted in any adverse impact to the potable groundwater resources of the county since the promulgation of NEPA. Furthermore, as old wells are abandoned and plugged while new wells are drilled and cased, both under current stringent permit procedures, the annual rate of contamination will decrease each year between now and the year 2000."

Repeated from above: Subsequent studies by the US Geological Survey (Abbott, M.M., 1997, Water Quality of the Quaternary and Ada-Vamoosa Aquifers on the Osage Reservation, Osage County, Oklahoma, http://pubs.usgs.gov/wri/wri994231/pdf/wri99-4231.pdf, accessed 5/20/2016) implicate oil and gas operations as the source of reduced water quality in the Vamoosa. "Several constituents in samples from the Ada-Vamoosa aquifer wells within a quarter mile of an oil well were significantly greater than from Ada-Vamoosa aquifer wells not near oil wells. Where no oil wells have been drilled through freshwater aquifers, the water quality of the Ada-Vamoosa aquifer is similar to the water quality of the Quaternary aquifer." A later study (Abbott, M.M., and DeHay, Kelli, 2008, Aquifer tests and characterization of transmissivity, Ada-Vamoosa Aquifer on the Osage Reservation, Osage County, Oklahoma, 2006: U.S. Geological Survey Scientific Investigations Report 2008-5118, http://pubs.usgs.gov/sir/2008/5118/, accessed 5/20/2016) notes that over pumping can compromise water quality. "Over pumping of existing wells or significant additional well development in this area of the aquifer could pull the naturally occurring saline water, which is expected to be down dip to the west up into the fresh water stored in the aquifer."

D. SOCIO-ECONOMIC AND CULTURAL IMPACTS

1. Demographic Factors

Page 124: "Based on the relatively stable oil production projections through the year 2000 (see Figure 2), the oil and gas leasing program will have a minimal effect on the demographic and economic characteristics of Osage County during this period. Overall population in Osage County is projected to increase by 7,900 persons by the year 2000 or 24 percent since 1976.

The population increased by 11,800 or 36 percent by 2000.

Page 128: ".... the oil and gas industry is not anticipated to be a major element in the general socio-economic future of Osage County."

The total wages paid (all entities, public and private) in Osage County in 2014 was \$241 million. The "Mining" wages paid, \$28 million, or 11 percent. The "Mining" employment was 8 percent of total employed, wages per employee being 46 percent greater than average. <u>http://www.bls.gov/cew/apps/data_views/data_views.htm#tab=Tables</u> accessed 5/26/2016)

Market value of Osage County agriculture products sold \$121 million (2102) (<u>https://www.agcensus.usda.gov/Publications/2012/Full_Report/Volume_1,_Chapter_2_County_Level/Okla_homa/st40_2_001_001.pdf</u> accessed 5/26/2016); market value of oil and gas sold in 2015 in excess of \$200 million (a low crude price year).

3. Personal Income

Page 128: "The royalty income from oil and gas leasing in Osage County provides personal income to members of the Osage Tribe. Royalty money is distributed to heirs or others who have been willed portions of the original 2,229 allotments. Although most incomes goes to individual Indians outside the county, a significant amount (perhaps 25 percent) is paid to tribal members living in Osage County."

5. Transportation

a. Highways and Roads

Page 129: "... 3,000 miles of dirt and gravel access roads maintained by oil and gas lessees and operators account for an additional 7,273 acres." (About 0.2 miles per well)

" ... 150 miles of new dirt and gravel access roads will be built each year for oil field operations. ... additional access roads (assuming 150 miles built and 66 miles abandoned) will require 4,275 more acres of land. Thus, this net conversion of land use for new access roads will be the most significant impact of the oil and gas program on transportation to the year 2000. In the year 2000, a total of 11,548 acres (0.8 percent) of Osage County will be devoted to dirt and gravel access roads."

b. Pipelines

Page 130: "Pipelines are the major mode of movement of gas, oil and their products. Approximately 8,000 miles of pipelines presently exist in Osage County. The recent rate of pipeline installment has been an average of 175 miles annually, and this rate is not expected to change. Therefore an additional 3,675 miles of pipeline will have been added to the county by the year 2000. ... The great, majority of pipelines which would be added are smaller pipelines placed on the surface by lessees. .. It is up to surface landowners and lessees to work out details of pipeline installation."

Page 131: "Most older surface pipelines are metal and are relatively unaffected by range fires. During the present decade, some operators use plastic surface gathering lines. If a grass or bush fire occurs at the site of a plastic line, the line may melt or rupture and cause additional problems. Usually, and agreement is reached between the surface landowner and the lessee before plastic pipe is used. If additional damage is caused by a surface plastic pipe during a fire, a claim may be placed against the operator by the surface landowner if the operator is shown to have caused the fire initially. When a fire is caused by natural means (such as lightning), there would be no justification for additional damage claims if the surface owner had originally agreed to allow the installation of plastic pipe on his property. Currently, most wells tank Batteries and other installations for oil and gas production are protected by lightning rods to prevent fires or explosions."

It is now common practice to bury plastic flow lines unless prevented by rock. Lightning rods are no longer installed having proved to be difficult to properly install and marginally effective.

6. Visual and Aesthetic Resources

Page 132: "The oil and gas leasing program has had, and will continue to have, a noticeable effect on the natural scenic resources of Osage County. The presence of 14,000 well sites and their pumps and storage tanks (increasing to over 18,000 by the year 2000) intrudes on the character of otherwise expansive rolling prairies. Noise from exploration, drilling or pumping can be an occasional aesthetic nuisance. This impact is reversible, however, and as individual wells or entire leases are abandoned, the areas are returned to their original aesthetic condition. "

The familiar esthetic of pumps and tank batteries is quickly being surpassed by wind farms, cell phone towers, power lines, and "another decorative evidence of mankind's triumph over chaos" (Peter Matthiessen, <u>Wildlife in America</u> (1959)).

E. ECOLOGICAL IMPACTS

1. Vegetation Cover

Page 135: "Approximately 7,770 acres of native rangeland will be used for oil and gas related activities by the year 2000. This accounts for only 0.8 percent of the present area of native rangeland in Osage county. ... Approximately 3,213 acres will be reclaimed to native rangeland by the year 2000 from abandoned wells and access roads."

"Approximately 1,850 acres of wooded land will be removed by the year 2000 by activities directly related to the oil and gas industry. The remaining projected loss of 13,150 aces of wooded land by the year 2000 will be caused by urbanization, defoliation of existing wooded areas by 2,4,5-T herbicide, and other activities beyond the realm of influence of the oil and gas industry. The impact of the oil and gas leasing program on wooded land in Osage County will be slight since less than one percent of the available wooded land will be removed from production due to oil and gas related activities... By the year 2000, approximately 722 acres of wooded land will be allowed to revegetate due to the abandonment of some wells and access roads."

Page 137:

to the year 2000. Acreage Acreage Total Disturbed Acreage Disturbed Acres Disturbed by New by Oil or Disturbed (1979-Land Use by New Access Brine 2000) Category Wells Roads Spills Annual Total Annual Total Annual Total 7,770 Rangeland 126 2,646 228 4,788 16 336 Wooded 30 630 54 4 1,848 1,134 84 Land Pasture 25 525 45 945 3 63 1,533 Land Cropland 11 231 20 420 1.4 29 680

7,287

347

"Table 24. Acres disturbed by oil and gas related activities in four major land use categories, present and projected to the year 2000.

Acreage disturbed at the end of 1978:

192

Totals

active well sites = 7,000 acres access roads = 7,273 acres oil waste land = 2,000 acres Total 16,273 acres

4,032

Acreage reclaimed from abandoned wells (1979-2000) = 1,838

512

11,881

24.4

Acreage reclaimed from abandoned access roads (1979-2000) = 3,360 acres (Assume no acreage reclaimed from oil waste land)

Total acres disturbed in the year 2000 = existing disturbed acreage + new disturbed acreage- reclaimed acreage, or: 16,273+11,831 - 5,198 = 22,906 acres (1.55 percent of Osage County)

^aAccounts for about 96 percent of land use areas and areas of oil and gas activities.

Source: ECI calculations."

2. Aquatic Biology

Page 139: "In Osage County, fishkills occasionally have occasionally have been reported in several past years. However, within the past 3 years there have been no salt-related fishkills in Osage County according to the local State Fisheries Biologist (personal communication, Mr. Don Hicks, Fisheries Biologist, December 21, 1978). On the other hand, both the local fisheries biologist and game biologist have indicated that they are aware of at least two stream locations in Osage County which still experience chronic saltwater inflows from oil operations. One of these areas is near Kaw Reservoir (community of Lyman) and the other is on Turkey Creek, a tributary of Hulah Reservoir."

"A survey of seventy-five streams in Osage County, which was conducted by the Oklahoma Department of Wildlife Conservation in 1977, showed that 23 of the streams surveyed had experienced fish kills (Table 25). Few dates and no other information was provided for fishkills, and the actual occurrences were mostly recorded from interviews with local residents who at one time or another recalled seeing dead fish in their streams. The stream survey data did not reveal the types of fish or the numbers killed, nor the extent of each stream affected by the kill. Only one stream, Rock Creek – a tributary of hominy Creek – was noted in the survey as having experienced numerous fishkills."

Table 25 (page 140) shows dates (year occurred) for two fish kills, other kills are "remembered" but not dated.

Repeated from above: When ask about fish kills in Osage County the Department of Wildlife Conservation did not have any fish kill reports and deferred to ODEQ. ODEQ wrote: "... we only have three reported kills (in Osage County) since Jan. 1, 1995".

Page 142: "... a moderate number of fishkills and aquatic habitat contamination will occur in the foreseeable future."

3. Game and Non-game Animals

Page 143: "As previous calculations have revealed, wooded land, cropland, native rangeland, and pasture land will be altered by oil and gas related activities by the year 2000. This accounts for only a small portion of the total acreage in Osage County which will change land use categories in that period. Attempts to improve productivity, inundation by reservoirs and increased urbanization will have a much greater impact on wildlife habitat availability than activities relative to oil and gas production."

"In most cases unless soil erosion becomes a serious problem, areas which have been negatively impacted by oil and gas production activities such as well sites, access road right-of-way, and oil waste land are able to recover and become viable native rangeland within a few years after abandonment."

4. Threatened or Endangered Species

Page 143: "With regard to the four species of Osage County wildlife listed by the US Department of Interior as endangered, the oil and gas leasing program has had and should not have any impact."

The 1979 EA did not attempt to anticipate the addition of species to the endangered list. The BIA's responsibilities are defined by the Endangered Species Act (ESA) and the pursuant regulations.

From the ESA: SEC. 7. (a) FEDERAL AGENCY ACTIONS AND CONSULTATIONS. — (2) Each Federal agency shall, in consultation with and with the assistance of the Secretary, insure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered species or threatened species ... "

Recognition of the full requirements of the ESA in the 1979 EA might have helped the BIA avoid its still unfilled obligations for completing Section 7 consultations for the listed as endangered American Burying Beetle.

F. ACCIDENTS, DISASTERS AND SPILLS

3. Oil and Brine Spills

Page 150: "Historically, oil spills in Osage County have caused less environmental degradation per unit of production than spills throughout the rest of Oklahoma. Although the data in Table 22 (page 108) include only oil spills reaching surface water as required by Federal law, they are indicative of the relative effectiveness of the environmental controls enforced by the Osage Agency."

"To obtain a more complete description and quantification of the annual impact of both oil and brine spills in Osage County, a review of spill reports in lease files was conducted. There are approximately 5,000 files at the Osage Agency in Pawhuska representing all currently active wells. A random sampling of these files, designed to provide a statistically valid estimate of spill frequency within the county, was undertaken. A technical discussion of sampling techniques and the statistical analysis are included in Appendix A."

Appendix A is not included in the available copy of the 1979 EA.

"Briefly summarized, Appendix A reveals that within the 90 percent confidence interval the annual number of oil and brine spills within Osage is between 127 and 201. At the 95 percent confidence level, the number is between 120 and 208. For purposes of impact assessment, the figure 164 is utilized as the mean number of accidents per year. Due to sample size available, it is unadvisable to attempt to statistically project the number of accidents attributable independently to either oil spills or brine spills. However, of the 38 spills reported in the sampled files 66 percent were brine spills, 26 percent were oil spills and 8 percent involved spills of both substances. The sample size also is insufficient to develop a statistically valid estimator of the area killed per spill, but the arithmetic mean (6,880 square feet) serves as the best estimate for purposes of this report."

Page 151: "Based on the above findings, it is estimated that the yearly rate of vegetation destruction is the average number of accidents (164) multiplied by the average area destroyed per spill (6,880 square feet). This accounts for about 25.9 acres of oil waste land created each year for a cumulative total of 544 acres by the year 2000. Based on projected land use (Table 3), 84 acres of wooded land, 336 acres of rangeland, 63 acres of pastureland and 29 acres of cropland will be impacted by spills by the year 2000. This is less than 0.04 percent of the county."

"It is reasonable to expect that without additional spills some oil waste land is able to recover to normal vegetation within 20 years. Most of the spills, about three-fourths each year in Osage County, involve brine. As brine soaks into the soil it becomes chemically bound and is rather slow to leach out. This salt causes a severe osmotic imbalance between plant roots and associated soil particles and usually results in the death of the plant due to the lack of available water. Brine spills cause more severe impacts in low-growth communities such as rangeland, pasture land and cropland, and are less severe in areas of large trees and shrubs which have deeper roots. In addition to decreasing availability of water to plants, brine solutions are directly toxic to plants."

Page 152: "Approximately one-third of the spills in Osage County involve oil and other petroleum products. Oil also is toxic to most plants, and tends to coat the roots, stems, and leaves, thereby preventing the absorption of water and air into the plants. In most cases, oil spills do not penetrate deeply into the soil as does brine; therefore, they produce less impact on plants with deep root systems (such as forest species)."

"In many cases involving oil or brine spills, the spilled substance accumulates in either a pond or stream. This situation presents a serious problem if domestic livestock or wildlife come there to drink. A few reports appear in the Osage Agency files in which accounts are given of death, miscarriage or severe weight loss in domestic animals after drinking from such a water source. Among the other types of impacts involving surface contamination from spills are salt encrustations along streams, oil floating on water surfaces, and increased aquatic plant growth (eutrophication) resulting from input of increased mineral nutrients. These types of impacts may be locally severe, although they occur only at a rare to occasional frequency."

At this point (page 153) there is a missing page in the 1979 EA. The page numbered 153 is identical to the page numbered 154. The table of contents indicates page 153 should begin the section, IV. <u>CONSULTATION</u> <u>AND COORDINATION</u>, A. INTRODUCTION AND OBJECTIVES. Page 154 begins with the continuation of a list of questions for other Federal agencies.

IV. CONSULTATION AND COORDINATION

B. SUMMARY OF FINDINGS

1. Regulatory Jurisdiction

Page 158: " ... the Oklahoma Corporation Commission, which regulates oil and gas production on private, State and local government lands in Oklahoma, does not exercise regulatory jurisdiction within Osage County."

Note: The language chosen, "does not exercise regulatory jurisdiction", avoids the question of having regulatory jurisdiction.

Page 160: "The US Environmental Protection Agency (EPA) has jurisdiction nationwide over air and water pollution under authority of the Clean Air Act (as amended several times from 1967-1977), the Federal Water Pollution Control Act Amendments (commonly referred to as the Clean Water Act –1977), the Oil Spill Pollution Prevention Act (1973), and the Safe Drinking Water Act (1974, amended 1977). It also administers the Noise Control Act (1972, amended 1976). The EPA's jurisdiction extends to Osage County, and it has cooperated in the past with the Osage Agency in ensuring that public potable water supplies were protected from contamination due to oil and gas exploration or production. Inspectors from the Region VI EPA Office in Dallas occasionally check well sites for violations of the Oil Spill Pollution Prevention Act. Any violations are subsequently reported to the Osage Agency for remedial action, although responsibility for spill prevention rests with the lessee rather than with the Agency."

The Noise Control Act is not relevant to the Osage environment. The EPA has this to say: "In the past, EPA coordinated all federal noise control activities through its Office of Noise Abatement and Control. EPA phased out the office's funding in 1982 as part of a shift in federal noise control policy to transfer the primary responsibility of regulating noise to state and local governments. However, the Noise Control Act of 1972 and the Quiet Communities Act of 1978 were never rescinded by Congress and remain in effect today, although essentially unfunded." <u>https://www.epa.gov/aboutepa/epa-history-noise-and-noisecontrol-act</u> Accessed 5/20/2016

Page 162: "Agencies of the State of Oklahoma also have jurisdictional authority in Osage County. However, the authority over oil and gas operations which the Oklahoma Corporation Commission has throughout the State does not extend to Osage County."

In this case the description of OCC authority is less ambiguous. Nevertheless, it is not reflected in state law nor has it been tested in the courts.

"A total of eight State agencies are in some manner involved with the regulating surface or groundwater resources in Oklahoma and, hence, in Osage County. Among these agencies are the Water Resources Board, the Department of Pollution Control, the Oklahoma Conservation Commission, the Health Department, the Department of Wildlife Conservation, and the Department of Agriculture. It appears that some overlap in responsibilities exists, but each agency is vested with carrying out certain supervisory and enforcement procedures. During the coordination phase of this study, it became evident that problems discovered by these State agencies were virtually all related to the actions of an individual landowner or industry. In no instance was it mentioned that any problem was universal in Osage County or resulted for the operations of the Osage Agency oil and gas leasing procedures. There appears to be such a lack of past legal precedent regarding the ongoing operations of the Osage Agency that many of the State seem uncertain as to whether or not they have any jurisdictional authority in Osage County over oil and lease operations or problems encountered.

To some degree this ambiguity was addressed with the creation of the Oklahoma Department of Environmental Quality in 1993. The Department of Pollution Control was eliminated and some responsibilities of the Department of Health, Oklahoma Corporation Commission, and Water Resources Board were transferred to ODEQ. A sample of regulatory responsibilities of Oklahoma agencies:

Oklahoma Conservation Commission – identification of waters impaired by nonpoint source pollution and projects to improve water quality (<u>https://www.ok.gov/conservation/Agency_Divisions/Water_Quality_Division/index.html</u>)

Oklahoma Water Resources Board – organization and control of Special Purpose districts; conservancy districts or master conservancy districts, regional water distribution districts; rural water, sewer, gas, solid waste management districts, and irrigation districts

(<u>http://www.owrb.ok.gov/util/rules/pdf_rul/current/Ch10.pdf</u>) - appropriative rights to use stream water (<u>http://www.owrb.ok.gov/util/rules/pdf_rul/current/Ch20.pdf</u>) - reservoir requirements and safety (<u>http://www.owrb.ok.gov/util/rules/pdf_rul/current/Ch25.pdf</u>) - authority to use fresh groundwater (<u>http://www.owrb.ok.gov/util/rules/pdf_rul/current/Ch30.pdf</u>) - drilling and installation of ground water wells (<u>http://www.owrb.ok.gov/util/rules/pdf_rul/current/Ch35.pdf</u>) - writing and protection of Oklahoma's water quality standards (<u>http://www.owrb.ok.gov/util/rules/pdf_rul/current/Ch46.pdf</u>)

Oklahoma Department of Environmental Quality – regulation of emissions of air pollutants including authority delegated by the US EPA pursuant to the Clean Air Act (<u>http://www.deq.state.ok.us/aqdnew/ComplianceEnforcement/index.htm</u>). - UIC Class I wells, authority delegated by the US EPA (<u>http://www.deq.state.ok.us/rules/652.pdf</u>) - implementation of water quality standards (established by OWRB), responsibilities delegated by the US EPA pursuant to the Clean Water Act including Section 303(d) i.e. TMDL and the National Pollutant Discharge Elimination System i.e. point source discharges (<u>http://www.deq.state.ok.us/rules/690.pdf</u>)

2. Groundwater Protection

Page 163: "During the consultation and coordination process, several Federal and State agencies clearly acknowledged and interest in, or jurisdictional responsibility over, the groundwater resources in Osage County. The US Geological Survey in conjunction with the Oklahoma Geological Survey, has performed studies of the aquifers in Oklahoma. In particular, those agencies have studied the Vamoosa aquifer which extends in a north-south direction across central Osage County. One objective of their study is to determine the possibility of (and probable sources of) contamination of the portable zone of the aquifer. The Vamoosa aquifer study is currently under thorough revision regarding its findings. The Vamoosa study and similar studies are a concern of the US Environmental Protection Agency (Region VI Office, Dallas, Texas), which regulates water quality of wells used as public drinking water supplies."

The Groundwater Division of the Oklahoma Water Resources Board is the permitting Agency in Oklahoma for nondomestic water wells. All persons wishing to drill a water well for industrial, irrigation, or other non-domestic use in Osage County are required to first get approval from the Water Resources Board. A total of 36 entities have approved permit applications on file with the WRB in Oklahoma City; however, it is suspected that many water wells have been drilled without proper approval (personal communication, Mr. J. A. Wood, Groundwater Division, WRB, October 20, 1978). The WRB keeps records of annual tests of quality and depth-to-fresh water for wells in each county. Osage County contains only one such well which has been monitored since about 1970. In looking through WRB files on reports of brine contamination of wells in Osage County, no evidence was found of a reported contamination."

Page 164: "Throughout the consultation process, the topic of potential groundwater contamination was brought up by many groups or individuals as one of concern. Along with surface water brine contamination, this topic ranked high among all concerns. The only agencies which are in the active process of studying groundwater contamination problems as related to oil and gas drilling operations (specifically in Osage County) are the EPA and the USGS.

This section of the 1979 EA, "CONSULTATION AND COORDINATION", fails to acknowledge the essential role the US EPA has in regulation of UIC Class II wells (The Safe Drinking Water Act was passed in 1974.)

3. Surface Water and Soil Protection

Page 164: "The subject of brine contamination of surface waters and soils in Osage County was mentioned as a major concern, especially by agencies such as the EPA, SCS, WRB, FWS and other specifically involved with saltwater effects on streams, ponds, reservoirs and other natural or man-made surface watercourses. Among the specific concerns mentioned by various agencies were the deterioration of water quality for public consumption, possible deleterious effects on fish and wildlife, destruction of crops or natural vegetation by brine, and effects on livestock. With perhaps one or two exceptions, little mention was make of the secondary effects of subsequent erosion or adverse aesthetic effects due to loss of vegetation cover."

"Although the topic of brine contamination was mentioned repeatedly, little was said about actual or potential oil spills due to pipeline rupture, inadequate care in drilling or production, or leakage due to other causes. Apparently, the only groups other than the Osage Agency which maintain any kind of permanent records on oil spills in Oklahoma re the USGS and EPA. Formal USGS report (Form NTL-3) have been kept since 1974. Because USGS jurisdiction does not extend to Osage County, the records show no spills there although surrounding counties have experienced occasional spills. Table 22 (Chapter II, Section E) of this report summarizes oil spills in Oklahoma, including Osage County, reported to the EPA, Staff of the US Fish and Wildlife Service expressed concern about ruptured waste pool walls, thereby permitting discharge of contaminates to the surface water; however, no record of such incident was provided for this study."

Page 165: "One of the concerns apparent from the consultation phase of this study is that reports of pollution events or accidents are not systematically made to agencies with related responsibilities. There appeared to be a desire for, but lack of, communication between various agencies about such conditions. Most agencies indicated that they would find out incidentally about spills or accidents."

4. Other Considerations

Page 165: "Two local organizations have a definite interest in, although no real authority over, the oil and gas leasing program. These groups are the Osage County Cattle Owners' Association, which maintains an Oil and Gas Committee; and members of the Osage County Conservation District, who occasionally report instances of pollution to either the Osage Agency or to local Soil Conservation Service office in Pawhuska. It should be noted here that these groups are surface owners with no mineral interest."

"Among the other topics of concern by individual agencies or groups were maintenance of access roads, protection of fish and wildlife, mitigation of cultural resources, and protection of crops and livestock. Except for discussions

related to compensation to the Osage Tribe or lessees for oil and gas properties to be acquired for highway rightsof-way or Army Corps of Engineers property, no agency or organization specifically expressed concern with any of the social or economic effects within the county. Effects on agricultural productivity with regard to cattle grazing and crop growth were mentioned by several of the individuals contacted."

Page 165 is the last page of the 1979 EA. Appendices referenced in the text are not included in the available copy.

Authors Conclusions

- The conclusion expressed in Thomas Ellison's transmittal letter of May 30, 1979, "... significant environmental impacts would not result from the proposed action" has proven to be valid for the forecast period, 1979 to 2000, and remains so today.
- The forecast of the environmental consequences of the operation of the Osage Oil and Gas Leasing Program is accurate and conservative after 37 years with the exception of minor induced seismic activity in far western Osage County.
- The 1979 EA did not anticipate changes not directly relevant to oil and gas, urbanization of the county, population growth, wind energy, etc.
- A new Environmental Assessment following the format of 1979 EA could be prepared for a forecast period to 2035 which is likely to support the conclusion that no significant environmental impacts would result from the proposed action.