No Swimming, Osage County, Oklahoma

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September 5, 2015 - www.HydrationEngineering.com

The Clean Water Act of 1972 set out the ambitious Fishable – Swimmable goal:

> *"… provide for the protection and propagation of fish, shellfish, and wildlife and provides for recreation in and on the water.."*

The Fishable-Swimmable goal implies that once upon a time all streams and lakes were Fishable and Swimmable (anthropologists assure Indian villages were moved as necessary). Having triumphed over chaos, we are now attempting to restore nature to some semblance of its former glory. While most people have their own idea of what is fishable and swimmable - uniform and numerical standards are useful to manage the task before us.

To represent Swimmable water the Oklahoma Water Resources Board (OWRB) uses the term Primary Body Contact Recreation (PBCR), for the fishable water, Warm Water Aquatic Culture (WWAC). These "beneficial uses" along with Public and Private Water Supply (PPWS) and Agriculture are used in reference to Osage waters. Other OWRB beneficial uses are Secondary Body Contact Recreation (boating) and Navigation. Swimming and fishing are usually the first to be compromised.

Measuring Impairment:

Primary Body Contact Recreation is tested by measuring total coliforms, fecal coliforms, *Escherichia coli*, fecal streptococci, and/or enterococci.

Warm Water Aquatic Culture is tested by measuring turbidity, dissolved oxygen, and macroinvertebrate biological diversity.

Suitability for agricultural use is usually related to chlorides, sulfates, total dissolved solids, etc.

Suitability for water supply can be any number of things but the lakes and streams of interest in Osage County are usually suitable raw material for PPWS.

Dealing with Impairment:

Section 303(d) of the Clean Water Act requires states to develop lists of impaired waters. Many streams in Osage County are listed as impaired usually for swimming and fishing. There is one stream segment and one lake that are listed as impaired for agricultural use, we will discuss these later.

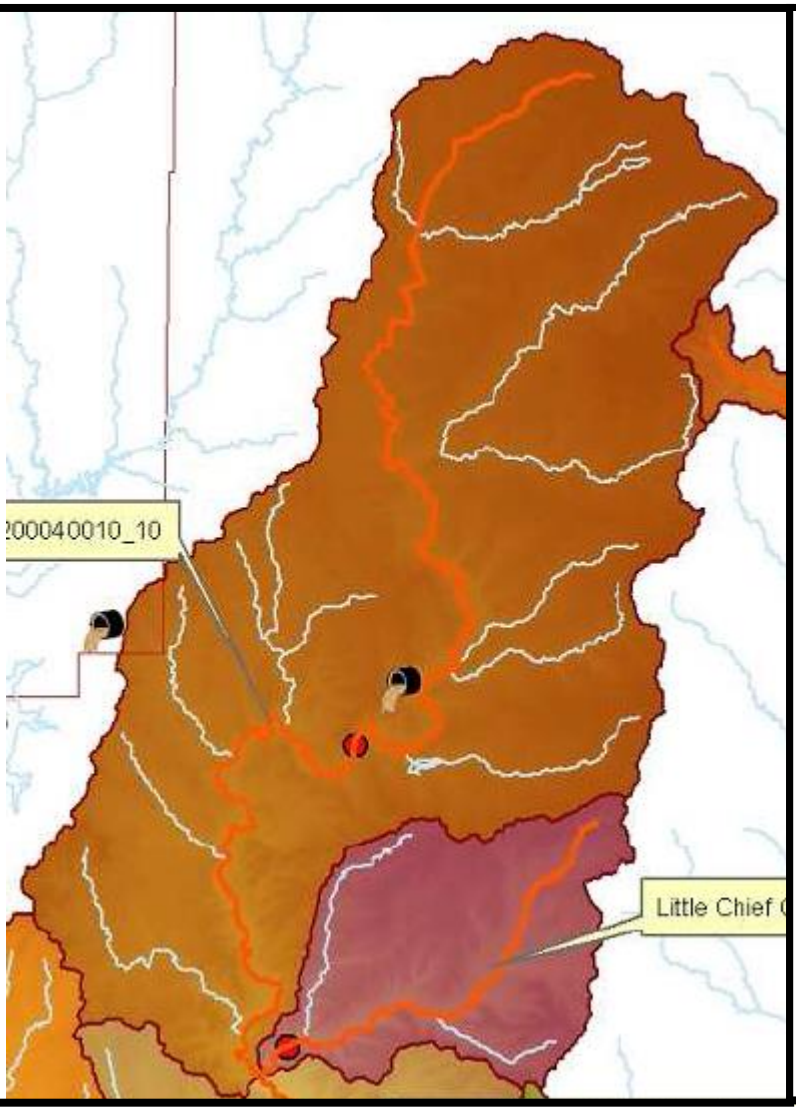
When a water body is listed it is queued up for a TMDL (Total Maximum Daily Load) study. A simple TMDL example is a town discharging treated waste water in to a stream. The stream is deficient in some respect and does not support fish. The TMDL is performed to determine what improvement is required in the sewage treatment facilities for the stream to support fish.

The Oklahoma Department of Environmental Quality (ODEQ) performs the TMDLs on a priority basis. Naturally, there is a backlog, a typical situation of legislative over commitment and under funding. Swimming usually gets priority because of public health gets priority.

Posted – No Swimming:

To date TMDL studies have been performed for fecal bacteria in fifteen Osage County Streams all are impaired and not suitable for swimming. The completed TMDLs confirmed and quantified the problem, there were no surprises.

Salt Creek (upper) OK621200040010_10 an Example



Salt Creek (upper) watershed

Water Body IDOK621200040010-10

130,796 acres

15,485 Cattle (USDA est. 2002)

1,598,597 billion (1.6 X 10^{15}) fecal coliform production per day (99.9% of total) from cattle

Per animal fecal coliform production from American Society of Agricultural Engineers (1999)

Data collected 1999 – 2007

Only point source discharge: City of Shidler plus 8 sanitary sewer overflows from 1998-2008

Map and data from: Bacteria Total Maximum Daily Loads for Streams in Salt Creek Area, Oklahoma, Oklahoma Department of Environmental Quality, August 31, 2009

Fecal Bacteria TMDLs for Osage Streams

Stream	Stream ID	Stream Miles	Watershed Area (acres)
Beaver Creek	OK621210000050_10	22	56,712
Bird Creek (1)	OK121300020010_10	36	84,122
Bird Creek (2)	OK121300030010_00	25	66,839
Bird Creek, North (3)	OK121300030320_00	20	25,961
Candy Creek	OK121300020080_00	17	29,408
Clear Creek	OK121300030200_00	20	36,054
Doga Creek	OK621200020020_00	10	23,354
Gray Horse Creek	OK621200010400_00	16	31,658
Hominy Creek (4)	OK121300040010_00	13	22,293
Hominy Creek (5)	OK121300040280_00	34	125,200
Little Chief Creek	OK621200040070_00	13	24,179
Mission Creek	OK121400020190_00	18	26,827
Salt Creek (6)	OK621200040010_00	17	32,060
Salt Creek (7)	OK621200040010_10	44	130,796
Sand Creek	OK121400040010_00	60	154,800
	Total	364	870,263

(1) Below Birch Creek, (2) Above Birch Creek to Bluestem Lake, (3) Not a tributary to Bluestem Lake, (4) Below Skiatook Lake and into Tulsa County, (5) Above Skiatook Lake, (6) Below Little Chief Creek, (7) Above Little Chief Creek

The watershed area represented by the completed fecal TMDLs is 59 percent of the surface of Osage County.

The sources of fecal bacteria reaching the stream include people, dysfunctional septic tanks, sanitary sewer over flows, malfunctioning municipal sewage treatment, pets, wildlife, livestock, application of wastes to fields, etc. The TMDL's determined that the overwhelming source of fecal contamination for these streams is "commercially raised farm animals". **99.9 percent of the fecal matter comes from livestock. 99.9 percent is the AVERAGE of the fifteen TMDLs.**

In Osage County fecal production from "commercially raised farm animals" is over 99 percent cattle. In this paper the terms, commercially raised farm animals, cattle, livestock, and cows are used interchangeably. The USDA animal counts were made in 2002 and do not include BLM wild horse holding facilities. (Fecal coliform production from horses (per animal) is significantly less than cattle.) Buffalo are not included in the TMDL reports.

The amount of improvement required is beyond the scope of this paper, but is discussed in each TMDL. Best Management Practices for reducing fecal contribution from cattle are well known and technical assistance is available from the Oklahoma Conservation Commission, a district office is located in Pawhuska.

Impaired Fishing:

"When the sun is bright,
and the moon is right,
the fish will bite, maybe" *Izaak Walton (1593-1640)*

Izaak would be amazed but, Warm Water Aquatic Communities are impaired. That does not mean that you won't catch fish, you may, if the moon is right, just not so many and not the variety you hoped for.

Most Osage streams and lakes are WWAC impaired, usually due to turbidity. TMDLs have been completed for only three.

Turbidity TMDLs for Osage Streams

Stream	Stream ID	Stream Miles	Watershed Area (acres)
Doga Creek	OK621200020020_00	10	23,354
Gray Horse Creek	OK621200010400_00	16	31,658
Salt Creek (lower)	OK621200040010_00	17	32,060
	Total	43	87,072

These TMDLs failed to separate non-point sources from background. The reports contain this statement:

> *"The relatively homogeneous land use/land cover categories within the Study Area are associated with agricultural and range management activities. This suggests that various nonpoint sources of TSS include sediments originating from grazing in riparian corridors of streams and creeks, highway/road/bridge runoff (non-construction related), non-irrigated crop production, rangeland grazing and other sources of sediment loading."*

Impairments waiting on TMDLs:

Waters which have been determined to be impaired, but do not have TMDLs (for the listed impairment) include:

Impaired Waters without TMDLs

Water	ID	Impairments	Potential Source Codes
Beaver Creek	OK621210000050_10	WWAC	46, 59, 87, 92, 108, 111, 133, 136, 140
Bigheart Creek	OK120420010140_00	PBCR	46, 92, 108, 111, 133, 136, 140
		WWAC	46, 49, 59, 87, 92, 102, 108, 111, 136, 140
Birch Lake	OK121300030040_00	WWAC	140
Bluestem Lake	OK121300030300_00	WWAC	140

Water	ID	Impairments	Potential Source Codes
Buck Creek	OK121400030170_00	PBCR	46, 92, 108, 111, 133, 136, 140
		WWAC	46, 49, 59, 87, 92, 102, 108, 111, 136, 140
Delaware Creek	OK121300010150_01	PBCR	46, 59, 92, 108, 111, 133, 136, 140
		WWAC	46, 59, 87, 92, 108, 111, 133, 136, 140
Fairfax Lake	OK621200040040_00	PPWS	140
Hominy Creek (Below Skiatook Lake)	OK121300040010_00	WWAC	46, 59, 87, 92, 108, 111, 133, 136, 140
Hominy Creek (Above Skiatook Lake)	OK121300040280_00	Agriculture	49, 97, 102, 140
Hominy Lake	OK121300040350_00	WWAC	140
Hulah Lake	OK121400030020_00	WWAC	140
Pawhuska Lake	OK121300030230_00	Agriculture	140
Sand Creek	OK121400040010_00	WWAC	46, 49, 87, 102, 108, 140

Potential source codes are a shopping list that guide the development of the TMDLs and may not be significant at the end of the day. (Septic tanks are always initially listed as a source of fecal bacteria but they can't compete with cows in the creek.) Twelve potential source codes used for 13 streams and lakes above were selected by ODEQ from a list of 41.

Source Codes Used

Potential Source	Code
Riparian & Shoreline Grazing	46
Road Runoff	49
Land Application of Wastes	59
Non-irrigated Crops	87
Septic Tanks, etc.	92
Spills (1)	97
Petroleum (Legacy) (2)	102
Range Grazing	108
Residential Areas	111
Pet Wastes	133
Wildlife (non-waterfowl)	136
Unknown Source (3)	140

(1) Although not so specified by ODEQ we have treated spills as entirely related to oil & gas operations

(2) The source code uses the term "Legacy" to describe old oil production scars.

(3) Unknown Source is a catch all term which may mean unknown or just all of the above

Grouping the sources can be useful.

		Source Groups	
Group	**Source Codes**	**Times Used**	**Percent**
"Civilization"	49, 92, 111, 133	31	35
Agriculture	46, 59, 87, 108	30	34
Unknown	140	16	19
Deer, etc.	136	8	10
Petroleum	97, 102	4	5

Discussion of the lakes and creeks with impairments not addressed by TMDL studies:

Beaver Creek (far northwest Osage County), in addition to the fecal bacteria TMDL, **Beaver Creek** is impaired for WWAC and is dominated by agricultural sources.

Bigheart Creek, previously known as Black Boy Creek, flows to the Arkansas through Sand Springs. Fishing and Swimming are not recommended. Petroleum (Legacy) is listed as a potential source along with eleven others.

Birch Lake is impaired and OWRB says cause is unknown. It is likely that the turbidity impairs the WWAC. Man made the lake and the lake made the problem.

Bluestem Lake, now impaired for WWAC, was built by the Works Progress Administration about 1937. It impounds Middle Bird Creek and South Bird Creek **not** North Bird Creek, OK121300010010_00, the subject of the Fecal Bacteria TMDL discussed above. Bluestem provides more than half of Pawhuska's municipal water.

Buck Creek is a tributary to Sand Creek and crosses US 60 about 5 miles west of Bartlesville. Swimming is impaired, a TMDL would have the same conclusions as the one performed for Sand Creek.

Delaware Creek crosses the county line between Sperry and Tulsa. It has the usual variety of problems and is impacted by urban sprawl.

ODEQ reports that **Fairfax Lake**'s suitability as a public water supply is compromised by algae. There are various problems with algae, the most common, taste and odor.

Hominy Creek (below Skiatook Lake) is similar to Delaware Creek but urbanization is not as advanced.

Hominy Creek (above Skiatook Lake), **Sand Creek**, and **Bigheart Creek**, have impairments caused by chlorides and attributed to Petroleum (Legacy) sources. While time is curing these problems they should be inventoried and mitigated where possible. The Oklahoma Energy Resources Board can be of assistance. OERB has restored 836 sites in Osage County.

Hominy Creek (above Skiatook Lake) shows "Other Related Spills" as source code. The Bureau of Indian Affairs requires that spills from oil and gas operations be reported to its spill hotline. Osage oil field spills are largely salt water which contribute chlorides impacting agricultural beneficial uses. Oil operators are required to have Spill Prevention, Control, and Countermeasure Plans which have been effective in minimizing spills. In spite of the issues with **Hominy Creek**, **Skiatook Lake** is considered to have high quality water and is designated by "OWRB as a Sensitive Water Supply" with a full complement of unimpaired beneficial uses.

Hulah Lake is muddy, some say its problem is Kansas. Authorized in 1936 and completed in 1951 it predated Environmental Impact Statements but, it is safe to say the Corps of Engineers did not make any guaranties regarding the clarity of the water.

Pawhuska Lake by all appearances has the highest quality water in Osage County. However, ODEQ says the lake water is impaired for agricultural use because of sulfates (SO_4^{-2}). (The only agricultural use for Pawhuska Lake water is town gardens.) The source of the sulfates is almost certainly the quarry immediately north of the lake. Limestone is interbedded with gypsum, calcium sulfate ($CaSO_4 \cdot 2H_2O$), and gypsum is soluble in water.

The headwaters of **Sand Creek** are about 3 miles northeast of Foraker and flow to the Caney River at Bartlesville. In addition to the fecal coliform TMDL Sand Creek is impaired for WWAC. Its fishable issues are almost entirely related to cattle.

Conclusions:

Cattle dominate the stream water quality problems in Osage County. Any significant improvements in Osage County water quality, let alone achieving the goals of the Clean Water Act, require changes in ranching practices. Fortunately best management practices (BMPs) have been identified to reduce bacteria runoff from grazing lands and direct deposit into streams.

Oil and gas impacts are related to legacy oil field scars. Many have been cleaned up and some of the remainder are amenable to cleanup. Spills should be avoided and if not avoided cleaned up.

Hulah and **Birch Lakes** will remain muddy. **Skiatook Lake** should be protected and not allowed to decline.

For the sake of brevity we have ignored the border waters, **Kaw Lake**, the **Arkansas River**, and **Keystone Lake.** And, ODEQ still has streams to evaluate.

It is possible to make No Swimming the exception rather than the rule AND, improve the fishing.

Nothing in this paper should be interrupted as a criticism of the Oklahoma Water Resources Board or the Oklahoma Department of Environmental Quality. They do an excellent job with limited resources.

Sources:

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