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OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

PUBLIC NOTICE[1]

July 21, 2014

Availability of Draft Mineral TMDLs for the Beaver River Study Area

Proposed Modification to Incorporate Beaver River Area Mineral TMDLs into Oklahoma's Water Quality Management Plan

Request for Public Comments

Public Comment Period Ends on September 4, 2014

Beaver River (OK720500020290_00) just north of the City of Beaver.

(Photo courtesy of the National Weather Service)

The Oklahoma Department of Environmental Quality (DEQ) is seeking comments on a draft Total Maximum Daily Load (TMDL) report entitled "**Mineral TMDL Report for the Beaver River Study Area**". The impairments addressed in this study are minerals. Appendix F of Oklahoma Water Quality Standards (OWQS) [Title 785, Chapter 45] uses the word "minerals" to primarily refer to chloride, sulfates, and total dissolved solids (TDS). TDS is a measure of the amount of material dissolved in water and was found to be the cause of impairments for 1,541 miles of streams in Oklahoma. In addition, chloride impairs 1678 miles of streams, and sulfates impair 1,955 miles of streams (DEQ 2012). High salinity (salts such as chloride and sulfates) may interfere with the growth of aquatic vegetation which can affect the aquatic ecosystem, make water taste bad, and harm plumbing. Salts also increase the risk of high blood pressure in some people. Sulfates in surface water is a concern because, in excess, it can react with dissolved metals in the water to form other more toxic chemicals and make the water more acidic.

The Beaver River Mineral TMDL report describes the reductions needed in the amounts of chloride, sulfates, and total dissolved solids to improve water quality in the Beaver River Study Area. DEQ is also proposing to incorporate these TMDLs into Oklahoma's Water Quality Management Plan (208 Plan). The "**208 Factsheet Regarding Mineral TMDLs in the Beaver River Basin**" is attached. The full Beaver River mineral TMDL report can be found on-line at: http://www.deq.state.ok.us/WQDnew/tmdl/index.html.

[1] As a convenience, this DEQ public notice includes links to third-party sites. DEQ's inclusion of a linked site does NOT constitute an endorsement, recommendation, or favoring of the contents. Please be aware that we do not control or guarantee the accuracy, relevance, timeliness, or completeness of this outside information. Further, the inclusion of third-party sites is not intended to reflect their importance, nor is it intended to endorse any views expressed by the author or organization of the reference. The purpose of providing these links is to ensure that the recipient or reader of this notice has additional useful information and references to assess this TMDL report.

BACKGROUND

The Federal Clean Water Act requires states to develop Water Quality Standards (WQS)[2] which provide goals and pollution control targets for improving water quality where the standards are not met. The waterbodies where standards are not met are considered to be "impaired." Impaired waterbodies are listed on what is known as the 303(d) list, which refers to Section 303(d) of the Clean Water Act. The plan to improve water quality for impaired waterbodies is accomplished by establishing limits known as Total Maximum Daily Loads (TMDLs) for each pollutant not meeting the standards. TMDLs set levels for pollutants that allow waterbodies to achieve their WQS for beneficial uses. Beneficial uses include water for drinking, recreation, aesthetics, agriculture, fishing, and swimming. The beneficial uses are all described in in the Oklahoma Water Quality Standards (OWQS) [Title 785, Chapter 45]. All waterbodies and their designated beneficial uses can be found in Appendix A of the OWQS. The assessment on whether the waterbodies are meeting their designated beneficial uses along with the current 303(d) list of impaired waterbodies is in a document entitled the "Integrated Report". The criteria to determine if a stream is listed on the 303(d) list can be found in Implementation of Oklahoma's Water Quality Standards (Title 785, Chapter 46). States are required to develop Integrated Reports every two years.

TMDLs

A TMDL is a plan of action to reduce pollutant loads so that impaired waterbodies will be able to meet their beneficial uses. TMDLs calculate the maximum amount of a pollutant allowed to enter a waterbody so that the waterbody will be able to meet water quality standards for that particular pollutant. The TMDL report uses scientific data collection, analysis, and water quality modeling to determine the sources and amounts of the pollutants entering the waterbodies. Then the TMDL allocates loads to point sources (these are known as waste load allocation or WLA) and nonpoint sources (NPS) which are given a load allocation or LA.

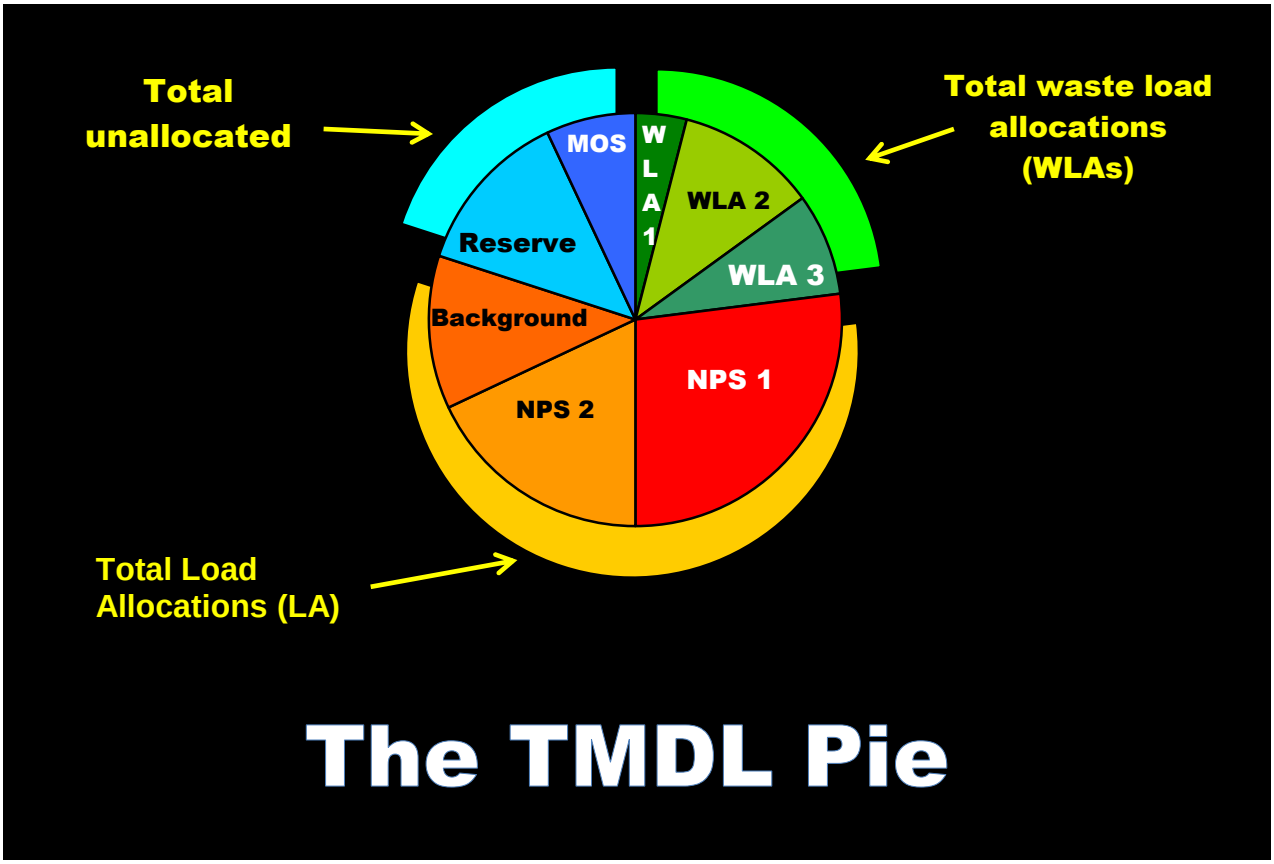
The National Pollutant Discharge Elimination System (NPDES) program regulates point source discharges. The NPDES Program in Oklahoma, in accordance with an agreement between DEQ and EPA, is implemented via the Oklahoma Pollutant Discharge Elimination System (OPDES) Act. OPDES Standards can be found in Title 252, Chapter 606 (http://www.deq.state.ok.us/rules/606.pdf). A point source is described as a "discernable, confined, and discrete conveyance from which pollutants are or may be discharged to surface waters." These are usually, but not always, discharges from a pipe. TMDLs must provide WLAs for all NPDES regulated point sources. Nonpoint sources (NPS) are ones, like agricultural runoff, that cannot be identified as entering a waterbody at a single location.

DEQ file photo of a point source discharge

An important part of TMDL analysis is the identification of all sources of pollutants (both point and nonpoint) in the watershed. Once identified, all contributing sources of the pollutants are allocated a portion of the allowable load. This usually requires a reduction in the amount of pollution the source is discharging in order to help the waterbody no longer be impaired. Natural background sources, seasonal variations, and a margin of safety (usually at least 10%) are all taken into account in the allocations. The TMDL equation is as follows:

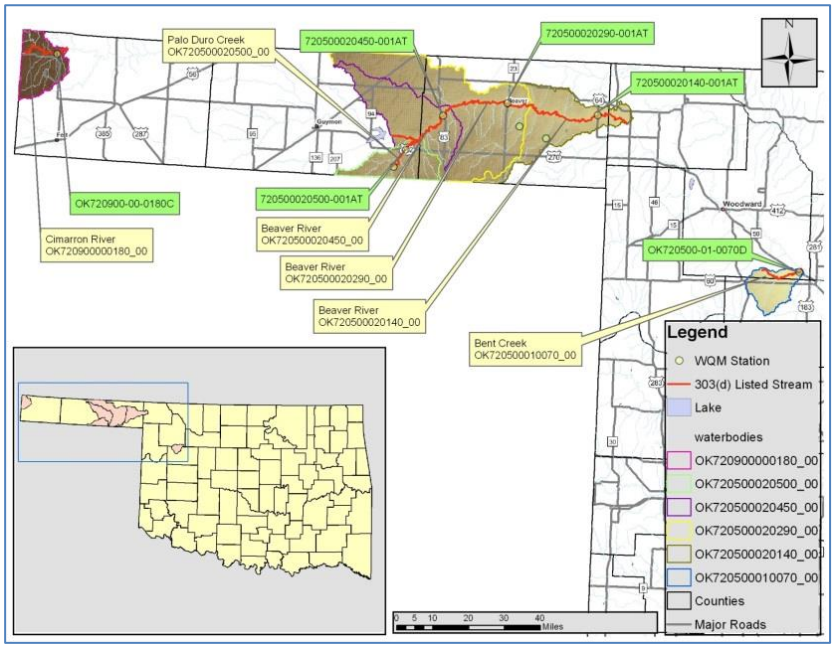
TMDL = WLA (waste load allocations from point sources) **+ LA** (from nonpoint sources) **+ MOS** (Margin of safety)

[2] A PowerPoint presentation on "Implementation of Water Quality Standards" can be found at the Oklahoma Water Resources Board's (OWRB) website. It can be found at: www.owrb.ok.gov/supply/ocwp/pdf_ocwp/WaterPlanUpdate/watersciencesseminar/SmolenWQImplementation.pdf



WATERSHED

The Beaver River Study Area is in northwestern Oklahoma in the Cimarron Headwaters (USGS HUC 11040001), Upper Cimarron (USGS HUC 11040002) Middle Beaver (HUC 11100102), Palo Duro (HUC 11100104), Lower Beaver (HUC 11100201), and Middle North Canadian (HUC 11100301) watersheds. The Study Area covers portions of Beaver, Cimarron, Dewey, Harper, Texas, and Woodward counties. These areas have high levels of TDS. According to the Oklahoma Corporation Commission, all of these are high saline[3] counties. The salts found in western Oklahoma are left over from the ancient seas that used to cover this part of the State when they evaporated. The underlying geological areas are the Dalhart Basin, Anadarko Shelf and the Anadarko Basin geological province.



[3] "Saline" water is a general term for water that contains a significant concentration of dissolved salts – mainly sodium chloride (NaCl) – aka "salt". The High Saline counties can be found in the "Oil and Gas Data Mining" database at the Oklahoma Corporation Commission website. After clicking on this link, then click on "GIS Data Mining". Once that page opens, click on "Environmental" to expand the layer that shows the High Saline counties as well as soil farming sites (these are actually land application sites – not commercial soil farms). Check the "Visible" box to see them.

BENEFICIAL USES

The designated beneficial uses for the waterbodies in the Beaver River Study Area are:

- Aesthetics (AES)
- Agriculture (AG)
- Fish & Wildlife Propagation-Warm Water Aquatic Community Subcategory (WWAC)
- Fish Consumption (FISH)
- Primary Body Contact Recreation (PBCR)
- Public & Private Water Supply (PPWS)
- High Quality Water (HQW)

The assessment of all Oklahoma waterbodies for their beneficial uses can be found in Appendix B (Comprehensive Waterbody Assessment) of Oklahoma's Integrated Report. **Table 1** is a summary from Oklahoma's 2012 Integrated Report on whether or not the waterbodies in the Study Area met their designated beneficial uses:

Table 1: Assessment of Beneficial Uses for Waterbodies in the Beaver River Study Area

Waterbody Name	WBID	HUC	AES	AG	WWAC	FISH	PBCR	PPWS	HQW
Bent Creek	OK720500010070_00	11100301	F	N	F	X	N	I	
Beaver River	OK720500020140_00	11100201	F	N	N	N	N		
Beaver River	OK720500020290_00	11100201 & 11100102	F	N	N	N	N		
Beaver River	OK720500020450_00	11100102	F	N	N	F	N		
Palo Duro Creek	OK720500020500_00	11100102 & 11100104	I	N	N	I	N	I	
Cimarron River	OK720900000180_00	11040001 & 11040002	I	N	N	X	N	I	√

F – Fully supporting that designated use; **N – Not supporting that use**; **I – Insufficient information**; **X – Not assessed**

IMPAIRMENTS

According to Oklahoma's 2012 Integrated Report, none of the waterbodies in the Study Area met their designated beneficial use for Agriculture.[4] That is because all of the waterbodies were impaired for minerals. The Agriculture beneficial use refers to the suitability of a waterbody for activities such as irrigation or livestock watering. If a waterbody is impaired by a pollutant so that it is unable to meet its designated beneficial use, then the impairment is listed on the 303(d) list in the Integrated Report. Impaired waterbodies in this Study Area are shown in the half of **Table 2** with the blue-shaded header. An "**x**" indicates that the impaired waterbody is on the 303(d) list for chloride, sulfates, or TDS.

TMDL STUDY

The TMDL study evaluated six waterbodies in the Beaver River Study Area that DEQ designated as impaired in the 2012 Integrated Report 303(d) list for nonsupport of the agricultural beneficial use. Water quality monitoring was conducted to see whether or not the waterbodies are actually impaired. In Oklahoma, water quality monitoring is conducted by several different agencies including the Oklahoma Conservation Commission (OCC), the Oklahoma Water Resources Board (OWRB), and the U.S. Geological Survey (USGS). Between 1999 – 2012, 347 mineral samples were collected for the waterbodies

[4] The specifics of the Agriculture beneficial use are outlined in 785:45-5-13 of the Oklahoma Water Quality Standards.

in the Study Area. For this study, the water quality data generated by all of these samples was analyzed to find out if the waterbodies in the Study Area were impaired for chloride, sulfates, or TDS thus necessitating a TMDL. The water quality data examined to make these determinations can be found in Appendix A of the "**2014 Beaver River Study Area Mineral TMDL Report**".

The results of the data analyses are also summarized in **Table 2**. An "**x**" in the half of the table with the yellow header indicates that sampling data showed the waterbody to be impaired for chloride, sulfates, or TDS. TMDLs were developed for these waterbodies. The "**x**" in red represents a waterbody that was found to be impaired when the water quality data was analyzed but that the waterbody had not been on the 2012 303(d) list as being impaired. That was the case with Palo Duro Creek (OK720500020500_00) which was found to be impaired for chloride when it was sampled. As a result, a TMDL for chloride for Palo Duro Creek was developed.

Table 2: Assessed Impairments and Actual Impairments in the Study Area

Waterbody Name	Waterbody Identification	Waterbody impairments from the 2012 303(d) List			TMDLs needed after sampling results analyzed		
		Chloride	Sulfates	TDS	Chloride	Sulfates	TDS
Bent Creek	OK720500010070_00		X			X	
Beaver River	OK720500020140_00	X			X		
Beaver River	OK720500020290_00	X	X	X	X	X	X
Beaver River	OK720500020450_00	X	X	X	X	X	X
Palo Duro Creek	OK720500020500_00		X	X	X	X	X
Cimarron River	OK720900000180_00		X			Delisted	

POINT SOURCE DISCHARGES IN THE BEAVER RIVER STUDY AREA

Point source discharges are single, identifiable, and localized, like discharges from a pipe. TMDLs must provide WLAs for all NPDES regulated point sources.

- **OPDES-regulated municipal and industrial wastewater treatment facilities (WWTF):** There aren't any municipal or industrial OPDES-permitted facilities in the Study Area. However, there are three municipal and one industrial facilities which are located in Texas in the Palo Duro Creek watershed.

- **OPDES-regulated stormwater discharges:** DEQ regulates stormwater discharges from Municipal Separate Storm Sewer Systems (MS4s), industrial sites, and construction sites. But DEQ's stormwater program does not include discharges from Indian Country lands, discharges related to oil & gas extraction, or discharges associated with agricultural purposes. The National Stormwater Quality Database (NSQD) summarizes concentrations for a number of pollutants of concern in stormwater runoff from around the country. Based on data summarized in the NSQD, median chloride concentrations for runoff from urban land uses were all below 10 mg/L. In the NSQD median effluent TDS concentrations in stormwater from urban land uses ranged from 61 to 119 mg/L. For details about DEQ's Stormwater Program, go to http://www.deq.state.ok.us/WQDnew/stormwater/

  - **OPDES regulated stormwater discharges through Municipal Separate Storm Sewer Systems (MS4s):** Polluted stormwater runoff is commonly transported through MS4s, from which it is often discharged untreated into local waterbodies. Cities and towns in urbanized areas must use Best Management Practices (BMPs) to prevent harmful pollutants from being washed or dumped into local streams and lakes. MS4s outline these BMPs in their stormwater management program. They must also obtain an MS4 Permit from DEQ (OKR04). The Beaver River Study Area does not have any MS4s.

DEQ file photo of storm drain marker

- **Industrial Sites:** Stormwater run-off from industrial sites is regulated because stormwater from industrial facilities may come into contact with many different types of pollutants including process wastewater, equipment wash run-off, leaks from storage tanks, oil & gas from vehicles, pesticides & fertilizers, and sediment. DEQ's Multi-Sector General Permit (MSGP) authorizes the discharge of stormwater from industrial facilities. The determination of whether or not an industrial facility must obtain stormwater discharge permit coverage is based both on the facility's Standard Industrial Classification (SIC) code and whether or not the facility has the potential to contaminate stormwater. To find out which industries are covered, refer to Table 1-2 beginning on Page 3 of the MSGP (OKR05). To get an industrial stormwater permit, a Notice of Intent (NOI) must be filed with DEQ and the applicable application and annual permit fees must be paid. Also, a stormwater pollution prevention plan (SWP3) **must** be developed and implemented according to the requirements of this permit. But since facilities with MSGPs are not required to monitor for minerals, they are not considered as a point source for minerals.

  - **Rock, Sand, and Gravel Quarries:** Stormwater from rock, sand and gravel quarries in Oklahoma fall under the MSGP. But wastewater generated at quarries is regulated under DEQ General Permit OKG950000. General Permit OKG950000 does not allow discharge of wastewater into Outstanding Resource Waters, High Quality Waters, Sensitive Public & Private Water Supplies, and Appendix B Waters [OAC 785:45-5-25(c)(2)]. The General Permit isn't applicable in this TMDL report because there aren't any rock/sand/gravel quarries located in the Study Area.

- **Construction Sites:** A Construction General Permit (OKR10) is required for any stormwater discharges associated with construction activities that result in land disturbance of equal to or greater than one (1) acre, or less than one (1) acre if they are part of a larger common plan of development or sale that totals at least one (1) acre. The permit also authorizes any stormwater discharges from support activities (e.g. concrete or asphalt batch plants, equipment staging yards, material storage areas, excavated material disposal areas, and borrow areas) that are directly related to a construction site that is required to have permit coverage, and is not a commercial operation serving unrelated different sites.

  An authorization to discharge from DEQ must be received prior to beginning any construction activities with stormwater discharges. In order to receive this authorization, a Notice of Intent (NOI) must be filed with DEQ and the applicable application and annual permit fees must be paid. Also, a stormwater pollution prevention plan (SWP3) must be developed and implemented according to the requirements of the OKR10 permit. Construction sites are not considered to be a point source for minerals.

- **NPDES regulated Animal Feeding Operations (AFOs):** The Agricultural Environmental Management Services (AEMS) is a program within the Oklahoma Department of Agriculture, Food and Forestry (ODAFF). Through regulations established by the Oklahoma Concentrated Animal Feeding Operation (CAFO) Act, Swine Feeding Operation (SFO) Act, and the Poultry Feeding Operation (PFO) Registration Act, AEMS helps develop, coordinate, and oversee environmental policies and programs aimed at protecting the Oklahoma environment from pollutants associated with agricultural animals and their waste. ODAFF is the NPDES-permitting authority for CAFOs and SFOs in Oklahoma under what ODAFF calls the Agriculture Pollutant Discharge Elimination System (AgPDES). PFOs are smaller animal feeding operations so they are not required to get NPDES permits. They are only required to register with ODAFF and follow PFO rules. In the Beaver River Study Area, there weren't any PFOs.

  A CAFO is an animal feeding operation that confines and feeds 1,000 or more animal units for 45 days or more in a 12-month period. The CAFO Rules are designed to protect water quality through the use of Best Management Practices (BMPs). BMPs include dikes, berms, terraces, ditches or other similar structures used to isolate animal waste from outside surface drainage. Except for a 25-year, 24–hour rainfall event, CAFOs are considered "no discharge" facilities. If not managed properly, CAFOs have

the potential to cause serious impacts on water quality.[5] Potential problems for CAFOs include possible animal waste discharges to State waterbodies and failure to properly operate wastewater lagoons. This is a concern because CAFOs can contribute chlorides which are found in animal waste. According to ODAFF, there are four CAFOs with 90,500 cattle in the Beaver River watershed. The CAFOs are highlighted in Table 3-3 in the TMDL report and shown in Figure 3-1. Site specific data was not available for upstream CAFOs in the watershed from Colorado, Kansas, New Mexico, or Texas.

Photo courtesy of Michigan State University.

An SFO is a lot or facility where swine kept for at least ninety (90) consecutive days or more in any twelve-month period. A "concentrated swine feeding operation" has a certain number of swine[6] and either discharges its pollutants into nearby waterbodies through a ditch, flushing system or other constructed device, or the pollutants flow directly into waterbodies that flow through or come into direct contact with swine at the facility. SFOs are required to follow Oklahoma SFO Rules and develop a Swine Waste Management Plan to prevent swine waste from being discharged into surface or groundwater. This Plan includes the use of BMPs to prevent runoff & erosion.[7] The Swine Waste Management Plan may include, but is not limited to, a Comprehensive Nutrient Management Plan per NRCS guidance or Nutrient Management Plan per EPA guidance. In the Beaver River Study Area, there are 29 SFOs with 122,423 swine. The SFOs are shown in Figure 3-1 of the TMDL report. Details about the SFOs are the entries that are not highlighted in Table 3-3.

NONPOINT SOURCE DISCHARGES IN THE BEAVER RIVER STUDY AREA

Almost all the minerals found in the waterbodies in the Beaver River Basin come from nonpoint sources. Nonpoint sources include those sources that cannot be identified as entering the waterbody at a specific location. Nonpoint sources of pollutants are typically separated into urban and rural categories. Surface storm runoff[8] is an important source of loading in urban areas with roads and other paved, impervious surface areas. Because most of the Study Area is rural, runoff from urban areas is not considered to be a significant source of minerals. Nonpoint sources of minerals can include:

- **Local geological formations & groundwater:** Local geological formations can have a direct effect on in-stream water quality. Because the Study Area in northwestern Oklahoma was once a shallow sea during the Permian age (about 245 - 290 million years ago), there are beds of salts such as gypsum and anhydrite that were leftover as the sea water evaporated. Gypsum from the drainage of geological formations can lead to high sulfate concentrations. Chloride and TDS is present in surface water runoff being dissolved from rocks or from natural salt deposits. Other sources of sulfate and chlorides include bedrock outcroppings and underlying alluvial sediments consisting of shale, siltstones, and sandstones.

Naturally-occurring salts near the Cimarron River.

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5 The United States Department of Agriculture's (USDA) Natural Resources Conservation Service (NRCS) has a program where operators of Animal Feeding Operations/Confined Animal Feeding Operations (AFO/CAFO) can apply for financial assistance for the storage, treatment, and utilization of animal waste. This is a statewide process to address the water quality impacts of these facilities to the rivers and streams of the State. For more information, go to www.nrcs.usda.gov/wps/portal/nrcs/detail/ok/programs/financial/?cid=nrcs142p2_000482.

6 A concentrated swine feeding operation has at least 750 swine that each weighs over 25 kilograms (about 55 pounds), 3,000 weaned swine weighing under 25 kilograms, or 300 swine animal units. A swine animal unit is a unit of measurement for any swine feeding operation calculated by adding the following numbers: The number of swine weighing over twenty-five (25) kilograms, multiplied by four-tenths (0.4), plus the number of weaned swine weighing under twenty-five (25) kilograms multiplied by one-tenth (0.1)

7 Swine Animal Waste Management Plan Requirements [Title 35 (ODAFF), Chapter 17 (Water Quality), Subchapter 3 (Swine Feeding Operations)] can be found in 35:17-3-14.

8 For information on how to reduce runoff after rainstorms, request the free DVD from EPA entitled "Reduce Runoff: Slow it Down, Spread it Out, Soak it in!" (EPA Publication #84211001) by calling them at 800-490-9198 or by ordering it from their webpage (http://www.epa.gov/nscep/). The DVD includes the video, "After the Storm", which was co-produced by EPA and The Weather Channel. The "After the Storm" brochure (PDF) can be downloaded at http://water.epa.gov/action/weatherchannel/index.cfm.

All groundwater contains minerals dissolved from rocks and soils through which aquifers have come in contact. The quality of dissolved minerals in groundwater primarily depends on the type of rock or soil through which the water has passed, the length of contact time, and pressure/temperature conditions. Many aquifers in western Oklahoma have high concentrations of naturally occurring chloride and sulfates from groundwater. As a result, groundwater quality can contribute minerals to receiving streams on the surface – even under low flow conditions. Historic and recent groundwater data and studies suggest groundwater may be a source of mineral contamination of surface waters. But the samples collected from water wells near the Study Area showed that groundwater concentrations of chloride, TDS, and sulfate were lower than the surface water concentrations.

- **Agricultural irrigation:** Irrigation of cropland from groundwater or surface water can result in the buildup of salts on the landscape over time. Overwatering or stormwater runoff can result in these salts draining into a nearby waterbody. But agricultural irrigation is not considered to be a major source for dissolved minerals in the Study Area.

- **Oil and Gas Well Operations**[9]

  In Oklahoma, the Oklahoma Corporation Commission regulates all oil & gas activities, including environmental rules.[10] These rules include items such as soil farming, land application, produced water, abandoned oil & gas wells, evaporation pits, injection wells, and disposal of drilling wastes. The Corporation Commission's environmental rules are found in their regulations.[11]

  - **Soil farming sites** (aka Land Farming): Soil farming[12] is the application of oil and gas drilling wastes to the land to allow the soil's naturally-occurring microbial population to metabolize, transform, and break down the waste. But salts (which contain chloride) cannot biodegrade and may accumulate in excessive amounts in soils. If that happens, chloride could be carried by storm runoff to nearby streams. But, there are no commercial soil farming sites in the Study Area.

  - **Land Application**[13] (aka land treatment, land spreading) uses the same natural soil processes as soil farming, but land application is a *one-time* application to a parcel of land. The land application boundary has to be at least 100 feet from any perennial stream, freshwater pond, lake, or wetland. The boundary also has to be at least 50 feet from any intermittent stream.[14] There have been 274 permits for applying drilling waste on fields in the Study Area. But whether the soil farming is commercial or a one-time land application, minerals can concentrate and transport to nearby receiving waters during rainfall runoff.

Drilling Mud Application to Fields
Courtesy of OSU Extension

9 For any complaints concerning oil and gas drilling, production, and/or abandoned oil and gas wells, go to: http://www.occeweb.com/Complaints/OGcomplaints2.html.

10 Oklahoma Statutes (O.S.): 27A O.S. § 1-3-101 section E

11 Oklahoma Administrative Code (OAC) Title 165 (Corporation Commission), Chapter 10 (Oil and Gas Conservation), Subchapter 9 (Commercial Disposal Facilities).

12 OK Corp Commission Rules: Title 165:10-9-2

13 OK Corp Commission Rules: Title 165:10-7-26

14 OK Corp Commission Rules: Title 165:10-7-26(c)(6) – The location of these streams must be determined by using a USGS topographic map. This map can be found at the DEQ ArcGIS Viewer website under "USGS Quads": http://gis.deq.ok.gov/flexviewer/

- **Produced water:** Produced water is water trapped underground that is brought to the surface along with oil or gas. It comprises 98% of all waste generated by U.S. oil & gas operations since 8 – 10 barrels of water are brought to the surface for each barrel of oil.[15] This water is about five times more salty than the ocean.

USGS Photo: Sampling produced water from an oil well in northern Louisiana.

  Produced water is a possible source of minerals. Levels of **chloride** in produced water in oil wells in this Study Area ranged from 1120 mg/L in the Cimarron River (OK720900000180_00) watershed to 169,215 mg/L in the Beaver River (OK720500020290_00) watershed. Levels of **sulfate** in produced water ranged from 0 mg/L in the Beaver River (OK720500020450_00) watershed to 6,532 mg/L in the Palo Duro Creek (OK720500020500_00) watershed. Levels of **TDS** in produced water ranged from 2,152 mg/L in the Cimarron River (OK720900000180_00) watershed to 276,064 mg/L in the Beaver River (OK720500020140_00) watershed. Details are in Appendix D of the TMDL report.

  According to OK Corp Comm rules, disposal of produced water includes the following options: reclaim and/or recycle, underground injection, or discharge (in accordance with 165:10-7-17). The most common commercial disposal method for produced water is injection wells. Reclaiming/Recycling of produced water is not common for agricultural re-use mainly because of the salt/TDS content. But produced water can be used for things such as hydraulic fracturing for natural gas wells (fracking), cooling water for power plants, dust control in mines, and water for wildfire control.[16]

- **Pits:**[17] Pits are commonly dug next to drilling rigs and are used for the disposal of drilling muds and other fluids in natural gas or oil fields. Evaporation pits containing produced water/brine can be dangerous to migratory birds and other wildlife who mistake the pits for natural bodies of water. The sticky oil can entrap birds in the pits, and they die from exposure and exhaustion. Covering the pits/ponds with netting helps to avoid this problem. Also, other wildlife can fall into the pits when they approach the pit to drink. Unlined pits have been shown to decrease the quality of nearby groundwater. However, there are no commercial pits in the Study Area.

- **Underground injection (Class II) wells:** The most common method used to dispose of produced water[18] in Oklahoma is underground injection wells. The Corporation Commission's regulations are designed to decrease contamination from the well site to surrounding areas. There are 152 of these underground injection wells in the Study Area.

- **Abandoned or improperly capped oil and gas wells:** In the United States, there are at least 2.5 million abandoned oil and gas wells which are not permanently capped. Many underground formations are permeated with brine that is up to five times saltier than sea water and can contain radioactivity, heavy metals and/or other toxins. Without extensive and costly plugging, brine can flow up the well shaft and seep into fresh water aquifers or reach the surface. In the mid-1960s oil-producing states enacted regulations to protect fresh water supplies by requiring that hundreds of feet of cement be poured in the wells at different levels in the process of closing them properly. Chloride, brine, and TDS pollutant loadings from uncapped wells can also build up on the ground surface and be transported by rainfall runoff to receiving streams, as well as being carried down into groundwater which later seeps into streams. Every abandoned well has the potential for contributing pollutants from aquifers to surface waters. The Oklahoma Energy Resources Board (OERB) restores about 12,000 orphaned and abandoned well sites a year across Oklahoma at no cost to the landowner.[19]

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15 "*Water Use in Oklahoma and Available Options for Recycling Produced Water*": http://oipa.com/page_images/1323881144.pdf

16 U.S. Department of Energy, National Energy Technology Laboratory, Produced Water Fact Sheet – Industrial Use.

17 OK Corp Commission Rules: Title 165:10-7-16 (non-commercial), Title 165:10-9-1 (use of commercial pits)

18 Argonne National Laboratory (2009). *Produced Water Volumes and Management Practices in the United States*, Page 41.

19 If you know of an abandoned well site, you can register the land for restoration at: http://www.oerb.com/Default.aspx?tabid=137.

- **Road salts** used for deicing streets during the winter: In 2010, Oklahoma used 122,000 metric tons of rock salt – most of which was used for roadway deicing. Studies have shown that, in urbanized areas, about 95% of the chloride that goes into a watershed comes from deicing streets and parking lots in the winter. Surface runoff, vehicle spraying, and wind can blow the salts and affect local waterbodies. Given the few paved roads in this rural Study Area that are salted during winter storms, road salts are not considered to be a significant source of chloride.

- **Production spills:** A total of 16,906 fluid releases in Oklahoma were reported to the Corporation Commission from 1993 – 2003. Saltwater made up about 76% of the total volume of all spills. The quantified releases of saltwater had a median volume of 40 barrels.

The best way to minimize runoff from these sites is by using Best Management Practices (BMPs) which include drilling practices that minimize generation of drilling wastes and bioremediation.

Summary of Possible Sources of Impairment:

Despite limited data, the following general deductions can be made regarding sources of minerals that can affect surface water quality in the impaired watersheds of the Study Area:

- Permitted facilities (WWTF, CAFOs) in the impaired watersheds contribute insignificant pollutant loading of chlorides, sulfates and TDS.

- Given the limited amount of developed land within the impaired watersheds of the Study Area, urban runoff contributes insignificant pollutant loading of chlorides, sulfates and TDS.

- During high flow conditions, in-stream concentrations of minerals are lower because stormwater runoff provides dilution.

- Background concentrations of sulfate originate from drainage of geological formations and their high gypsum content.

- Groundwater flow can contribute minerals to receiving streams even under low flow conditions.

- The persistent availability of minerals may be attributed to historical oil and gas field development, underground injection well activities, and natural geology, despite various remediation efforts within the Study Area.

- Land application activities can result in the buildup of mineral concentrations on the land surface which could be transported to receiving waters under some rainfall runoff conditions.

- Given the limited number of paved roadways salted during winter storms within the impaired watersheds of the Study Area, roadway salts contribute insignificant pollutant loading of chlorides, sulfates and TDS.

- The majority of mineral loadings in the Study Area originate from a variety of nonpoint sources, both background and anthropogenic sources.

TMDL Calculations:

The purpose of a TMDL is to identify sources of pollutants in a watershed and calculate the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards. The Beaver River Study Area contains waterbodies that are in violation of Oklahoma Water Quality Standards with respect to chloride, sulfate, or TDS. The TMDL calculates the reduction in each of these minerals that would be needed in order for these streams to be in compliance with Oklahoma's WQS. This was done using load duration curves. The calculations include present and future sources as well as a margin of safety. For more information on how the TMDLs were developed, read Sections 4 & 5 and Appendix B of the *Mineral TMDL Report for the Beaver River Study Area*.

Recommendations:

After re-evaluating the mineral data following Oklahoma's assessment protocol, 11 TMDLs (Table 3) were developed for the 5 impaired streams in the Beaver River Study Area. These can be found in Tables 5-2 – Table 5-12 of the *Mineral TMDL Report for the Beaver River Study Area*. Table 3 indicates the amount that each pollutant will need to be reduced [Percent Reduction Goal (PRG)] in order for that waterbody to meet water quality standards and thus its Agriculture designated beneficial use:

Table 3: TMDL Percent Reduction Goal Needed for Waterbody to Meet Water Quality Standards for Minerals

Waterbody Name	Waterbody ID	These impairments must be reduced by the following amounts in bold in order to meet water quality standards.					
		Chloride – Single Sample	**Chloride – Average**	**Sulfate – Single Sample**	**Sulfate - Average**	**TDS – Single Sample**	**TDS – Average**
Bent Creek	OK720500010070_00			38.5%	**40.3%**		
Beaver River	OK720500020140_00	**43.4%**	34.9%				
Beaver River	OK720500020290_00	**66.0%**	59.6%	**39.4%**	29.0%	**54.4%**	50.9%
Beaver River	OK720500020450_00	**77.9%**	77.9%	**40.2%**	20.1%	58.9%	**64.5%**
Palo Duro Creek	OK720500020500_00	**59.4%**	50.2%	**68.9%**	60.7%	**63.6%**	55.1%

Providing comments

- DEQ invites your comments. The comment period will be open for 45 days. The TMDL report is a draft document and is subject to change based on comments received during the public participation process.
- You may also request a public meeting in writing. If there is a significant degree of interest, DEQ will schedule a public meeting.
- All official comments for the record must be submitted either in writing or by e-mail before the end of the comment period. DEQ will prepare a responsiveness summary addressing all comments received. After evaluating comments received and making any necessary changes, the TMDL report will be submitted to EPA for final approval. The final results of the TMDL will be incorporated into Oklahoma's Water Quality Management Plan.

Please submit your comments in writing to:

Dr. Karen Miles
Water Quality Division
Oklahoma Department of Environmental Quality
P.O. Box 1677
Oklahoma City, OK 73101-1677
(405) 702-8192
E-mail: Water.Comments@deq.ok.gov

Comments must be received by 4:30 pm on Thursday, September 4, 2014

Obtaining copies: You may view the full Beaver River Mineral TMDL Report by going to the DEQ website at: www.deq.state.ok.us/WQDnew/tmdl/index.html or by picking up copies at the DEQ main office, Water Quality Division, 707 North Robinson, Oklahoma City from 8:30 am – 4:30 pm. A document copying fee may apply.

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

You are receiving this notice because you are either on DEQ's list to receive all public notices, or you requested notices about your watershed. In addition to proposed TMDL reports, DEQ's Watershed Planning & Stormwater Permitting Section sends out public notices about proposed wasteload allocations (208s), proposed changes to the CPP or Integrated Report, 404 projects, 401 Certification requests, and stormwater permits.

If you would like to receive any or all of these public notices via e-mail, please send your e-mail address to Water.Comments@deq.ok.gov. Also, please let us know if you want to receive notices for the entire State or just for your watershed.

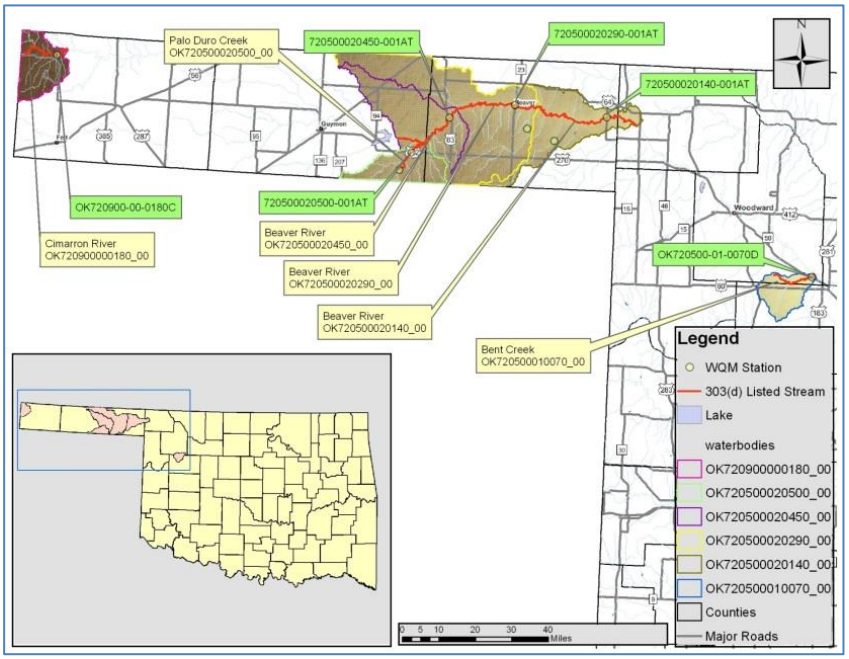
By receiving PDF public notices via e-mail, you will help save money and the environment by reducing the amount of paper we use to mail them. In addition to helping the environment, you will be able to click on helpful FYI hyperlinks.

Note to newspapers: This notice is for your information only. **Do not publish in the legal section or as a legal notice.**

Beaver River (OK720500020290_00) just north of the City of Beaver.

(Photo courtesy of the National Weather Service)

208 FACTSHEET FOR MINERAL TMDLs in the BEAVER RIVER STUDY AREA



Watershed:

The Beaver River TMDL Study Area is located in the northwestern portion of Oklahoma in the Cimarron Headwaters (USGS HUC 11040001), Upper Cimarron (USGS HUC 11040002), Middle Beaver (HUC 11100102), Palo Duro (HUC 11100104), Lower Beaver (HUC 11100201), and Middle North Canadian (HUC 11100301) watersheds. The Study Area covers portions of Beaver, Cimarron, Dewey, Harper, Texas, and Woodward counties.

Beneficial Uses in the Beaver River Study Area:

According to the Oklahoma Water Quality Standards, the designated beneficial uses for the waterbodies in the Beaver River Study Area are Aesthetics (AES), Agriculture (AG), Fish & Wildlife Propagation-Warm Water Aquatic Community Subcategory (WWAC), Fish Consumption (FISH), Primary Body Contact Recreation (PBCR), Public & Private Water Supply (PPWS), and High Quality Water (HQW). **Table 1** is the assessment from Oklahoma's 2012 Integrated Report on whether or not these waterbodies met their beneficial uses.

Table 4: Assessment of Beneficial Uses for Waterbodies in the Beaver River Study Area

Waterbody Name	WBID	HUC	AES	AG	WWAC	FISH	PBCR	PPWS	HQW
Bent Creek	OK720500010070_00	11100301	F	N	F	X	N	I	
Beaver River	OK720500020140_00	11100201	F	N	N	N	N		
Beaver River	OK720500020290_00	11100201 & 11100102	F	N	N	N	N		
Beaver River	OK720500020450_00	11100102	F	N	N	F	N		
Palo Duro Creek	OK720500020500_00	11100102 & 11100104	I	N	N	I	N	I	
Cimarron River	OK720900000180_00	11040001 & 11040002	I	N	N	X	N	I	√

F – Fully supporting that designated use; N – Not supporting that use; I – Insufficient information; X – Not assessed

Impaired Waterbodies in the Beaver River Study Area:

The designated beneficial use addressed in the Beaver River TMDL Study Area was Agriculture. Waterbodies that were indicated as impaired for chloride, sulfates, or total dissolved solids (TDS) on Oklahoma's 2012 303(d) list, are designated with an "**x**" in the half of **Table 2** with a dark blue header. Between 1999 – 2012, 347 mineral samples were collected for the waterbodies in the Study Area. These samples were examined to verify if these waterbodies were still impaired. The results of the data analyses are also summarized in **Table 2**. An "**x**" in the half of the table with the yellow header indicates that sampling data showed the waterbody to still be impaired for chloride, sulfates, or TDS. TMDLs were developed for these waterbodies. The "**x**" in red represents a waterbody that was found to be impaired when the water quality data was analyzed but that the waterbody had not been on the 2012 303(d) list as being impaired. That was the case with Palo Duro Creek (OK720500020500_00) which was found to be impaired for chloride when it was sampled. As a result, a TMDL for chloride for Palo Duro Creek was developed.

Table 2: Assessed Impairments and Actual Impairments in the Study Area

Waterbody Name	Waterbody Identification	Waterbody impairments from the 2012 303(d) List			TMDLs needed after sampling results analyzed		
		Chloride	Sulfates	TDS	Chloride	Sulfates	TDS
Bent Creek	OK720500010070_00		X			X	
Beaver River	OK720500020140_00	X			X		
Beaver River	OK720500020290_00	X	X	X	X	X	X
Beaver River	OK720500020450_00	X	X	X	X	X	X
Palo Duro Creek	OK720500020500_00		X	X	X	X	X
Cimarron River	OK720900000180_00		X			Delisted	

Possible Sources of Impairments:

Point sources - The point sources examined in the Beaver River Study Area were:

- **OPDES-regulated municipal and industrial wastewater treatment facilities (WWTF)** – There aren't any municipal or industrial OPDES-permitted facilities in the Study Area though there are three municipal and one industrial facilities which are located upstream in Texas in the Palo Duro Creek watershed. But permitted facilities in the impaired watersheds contribute insignificant pollutant loading of chlorides, sulfates and TDS.

- **OPDES regulated stormwater discharges** - Given the limited amount of developed land within the impaired watersheds of the Study Area, urban runoff contributes insignificant pollutant loading of chlorides, sulfates and TDS. During high flow conditions, in-stream concentrations of minerals are lower because stormwater runoff provides dilution.

  - Municipal Separate Storm Sewer Systems (MS4s) - There aren't any in the Study Area.

  - Industrial Sites – Since facilities with a Multi-Sector General Permit (MSGP) aren't required to monitor for minerals, they are not considered as a point source for minerals.

    - Rock, Sand, and Gravel Quarries – Wastewater generated at quarries is regulated under DEQ General Permit OKG950000. But there aren't any quarries in the Study Area.

  - Construction Sites - Construction sites are not considered to be a point source for minerals in the Study Area.

- **NPDES-regulated Animal Feeding Operations (AFOs)** –The Oklahoma Department of Agriculture, Food and Forestry (ODAFF) has been approved by EPA to issue NPDES permits in Oklahoma under what ODAFF calls the Agriculture Pollutant Discharge Elimination System (AgPDES). A CAFO is an animal feeding operation that confines and feeds 1,000 or more animal units for 45 days or more in a 12-month period. The CAFO Rules are designed to protect water quality through the use of Best Management Practices (BMPs). There are four CAFOs with 90,500 cattle in the Beaver River watershed. There are also 29 Swine Feeding Operations (SFOs) with 122,423 swine in the Study Area. SFOs must follow SFO rules and develop a Swine Waste Management Plan to prevent swine waste from being discharged into surface or groundwater. In the Beaver River Study Area, there weren't any Poultry Feeding Operations.

Nonpoint sources - The nonpoint sources examined in the Beaver River Study Area were:

- Local geological formations - Background concentrations of sulfate originate from drainage of geological formations and their high gypsum content.
- Groundwater - Groundwater flow can contribute minerals to receiving streams even under low flow conditions.
- Agricultural irrigation - Agricultural irrigation is not considered to be a major source for dissolved minerals in the Study Area.
- Oil and Gas Well Operations - In Oklahoma, the Oklahoma Corporation Commission regulates all oil & gas activities, including environmental rules.[20]
  - Soil farming sites - There aren't any soil farming sites in the Study Area.
  - Land Application - Land application activities can result in the buildup of mineral concentrations on the land surface which could be transported to receiving waters under some rainfall runoff conditions. There have been 274 permits for applying drilling waste on fields in the Study Area.
  - Produced water - In the Study Area, the highest level of **chloride** (169,215 mg/L) and **TDS** (274,383 mg/L) in underground injected wells with produced water was in the Beaver River (OK720500020290_00) watershed. The highest level of **sulfate** in produced water was 6,532 mg/L in an underground injected well in the Palo Duro Creek (OK720500020500_00) watershed.
  - Pits - There aren't any commercial pits in the Study Area.
  - Underground injection (Class II) wells - There are 152 underground injection wells in the Study Area.
  - Abandoned or improperly capped oil and gas wells
- Road salts – Given the limited number of paved roadways salted during winter storms within the impaired watersheds of the Study Area, roadway salts contribute insignificant pollutant loading of chlorides, sulfates and TDS.
- Production spills: A total of 16,906 fluid releases in Oklahoma were reported to the Corporation Commission from 1993 – 2003. Saltwater made up about 76% of the total volume of all spills. The quantified releases of saltwater had a median volume of 40 barrels.

For details about each of these sources and their impact on the impairment of waterbodies in the Study Area, consult the full Beaver River Mineral TMDL report at the following DEQ webpage: http://www.deq.state.ok.us/WQDnew/tmdl/index.html.

[20] Oklahoma Statutes (O.S.): 27A O.S. § 1-3-101 section E

TMDLs:

The TMDLs were calculated using load duration curves. Afterwards, 11 TMDLs (Table 3) were developed for the 5 impaired streams in the Beaver River Study Area. Table 3 shows the amount that each pollutant will need to be reduced [Percent Reduction Goal (PRG)] in order for that waterbody to meet water quality standards and its designated beneficial use for agriculture:

Table 3: Percent Reduction Goal Needed for Waterbody to Meet Water Quality Standards

Waterbody Name	Waterbody ID	These impairments must be reduced by the following amounts in bold in order to meet water quality standards.					
		Chloride – Single Sample	**Chloride – Average**	**Sulfate – Single Sample**	**Sulfate - Average**	**TDS – Single Sample**	**TDS – Average**
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EPA Approval Date: Pending
Record Last Updated: 7/18/2014