MARAIS DES CYGNES BASIN TOTAL MAXIMUM DAILY LOAD

Waterbody / Assessment Unit (AU): Salt Creek Watershed
Water Quality Impairment: Dissolved Oxygen

1. INTRODUCTION AND PROBLEM IDENTIFICATION

Subbasin: Upper Marais des Cygnes **Counties**: Lyon, Osage

HUC8: 10290101 **HUC10** (12): 1029010103(05, 06)

Ecoregion: Central Irregular Plains, Osage Cuestas (40b)

Drainage Area: Approximately 110 Square Miles

Water Quality Limited Segments:

Main Stem	***Tributaries***
Salt Creek (29)	Mute Creek (92)
	Jersey Creek (76)

Designated Uses: Salt Creek (29) is designated for expected aquatic life; Primary Contact Recreation Class C; Drinking Water Supply; Food Procurement; Groundwater Recharge; Industrial Use; Irrigation Watering Use; and Livestock Watering Use.

Mute Cr (92) is designated for expected aquatic life; secondary contact recreation class b; irrigation watering use; and livestock watering use.

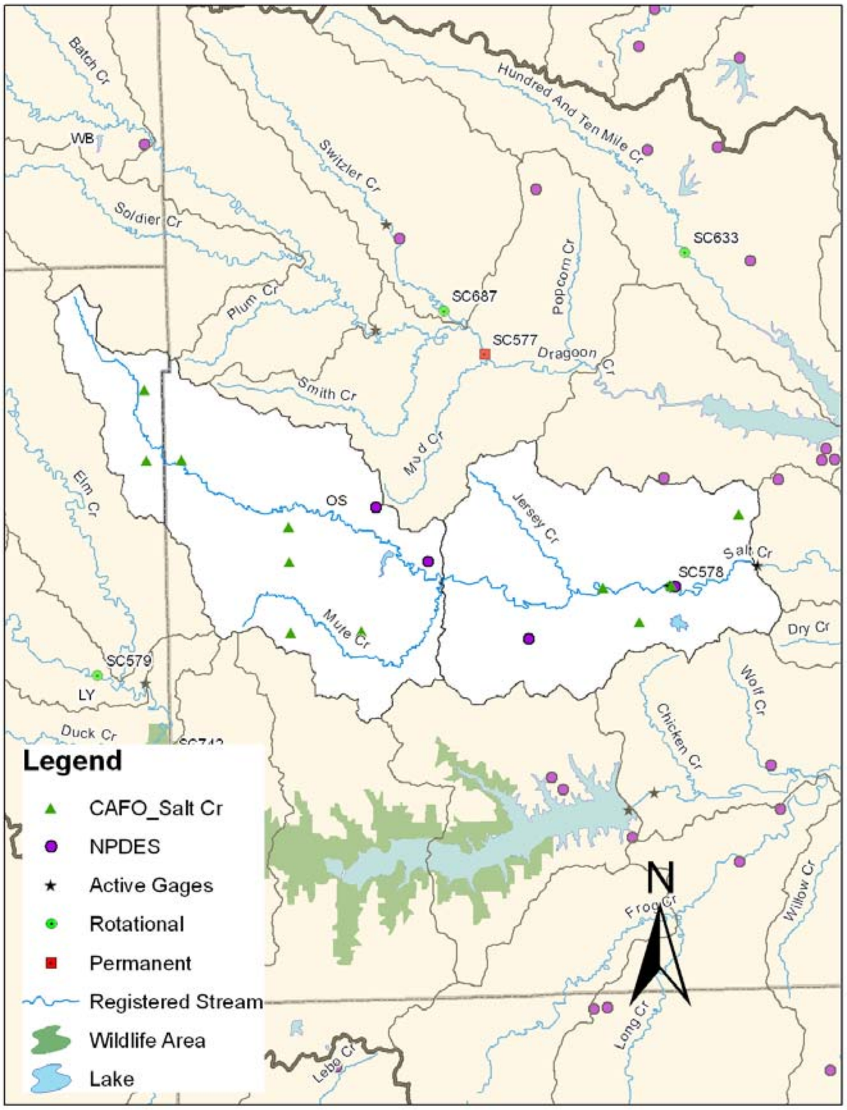
Jersey Cr (76) is designated for expected aquatic life; secondary contact recreation class b; and food procurement.

303(d) Listings: Kansas stream segments monitored by Station SC578, Salt Creek, cited as impaired by Dissolved Oxygen in the 2002, 2004, 2008, 2010, and 2012 303(d) lists.

Impaired Use: Expected Aquatic Life Support

Water Quality Criteria: The concentration of Dissolved Oxygen (DO) shall not be lowered by the influence of artificial sources of pollution. Dissolved Oxygen (DO): 5 mg/L (K.A.R. 28-16-28e(d), Table 1g).

Figure 1. Salt Creek watershed basemap.



2. CURRENT WATER QUALITY CONDITION AND DESIRED ENDPOINT

Level of Support for Designated Uses under 2012-303(d): Not supporting Aquatic Life.

Stream Monitoring Site and Period of Record: Active KDHE rotational ambient stream chemistry sampling station SC578 located on Salt Creek near Lyndon. Sampled during the years of 1990, 1994, 1998, 1999, 2000, 2002, 2006, and 2010.

Flow Record: USGS gage 06911490 on Salt Creek at Lyndon (1999-2012) and USGS Gage 06911500 on Salt Creek near Lyndon (1988-1999) were utilized to establish flow conditions in the watershed. The USGS gage 06911490 is located at the same location of the KDHE sampling station. For samples collected prior to the use of this gage (prior to October of 1999) the flow values for each sampling date are based on USGS gage 06911500, which is just downstream of the sampling point a few stream miles.

Table 1. Long term flow conditions as calculated from USGS flow data from USGS Gages 06911490 and 06911500.

Stream	Avg. Flow (cfs)	Percent of Flow Exceedance			
		75%	50%	25%	10%
Salt Creek at Lyndon USGS Gage 06911490 (1999-2012)	58	1.2	5.8	22.0	77.0
Salt Creek near Lyndon USGS Gage 06911500 (1988-1999)	75.3	0.72	4.5	27.0	104.7
Salt Creek Combined Flow from USGS gages 06911490 and 06911500 (1988-2012)	66.1	0.9	5.3	24.0	92.0

Precipitation: The average annual rainfall in the watershed is approximately 39.5 inches/year.

Current Condition: Since loading capacity varies as a function of the flow present in the stream, this TMDL represents a continuum of desired concentrations over all flow conditions, rather than fixed at a single value. Sampling data from station SC578 is categorized into three defined seasons: Spring (April-June), Summer-Fall (July-October) and Winter (November-March).

Dissolved Oxygen (DO) concentrations on Salt Creek are observed in Figure 2. All of the impairments associated with the DO deficiency are observed during the low flow condition, with one violation occurring in late Spring and the rest of the violations occurring in the Summer-Fall season as seen in Table 2. The majority of the impairments have occurred during the hot month of August. The overall annual averages were not below 5 mg/L during any of the sampling years as seen in Table 3. A monthly summary of the frequency of impairment is detailed in Table 4 and Figures 3 and 4. The monthly average DO concentrations are below 5 mg/L during the months of August and September. The annual seasonal averages, as seen in Figure 5, are below 5 mg/L during the summer-fall seasons during 2000, 2002, and 2006.

The years of 1999 and 2000 were sampled more than any other sampling year. Samples were collected monthly during these two years, which indicates this station was programmatically selected for more intensive sampling for these two years. According to the regular schedule for rotational sampling stations, SC578 is a rotational station that is sampled on a quarterly bases every fourth year. The regularly scheduled rotational sampling years include 1990, 1994, 1998, 2002, 2006, and 2010.

Table 2. Seasonal DO sampling summary relatives to flow condition at SC578.

Season	High Q (0-24%)	Normal Q (25-49%)	Low Q (50-99%)	Cum Frequency
Spring	0/9	0/5	1/3	1/17 = 6%
Summer-Fall	0/1	0/1	6/14	6/17 = 37.5%
Winter	0/6	0/6	0/6	0/18 = 0%
All Data	0/16	0/12	7/23	7/51 = 13.7%

Table 3. Yearly DO sampling summary relative to season at SC578.

Sampling Year	Spring Average (mg/L)	Summer-Fall Average (mg/L)	Winter Average (mg/L)	Yearly Average (mg/L)	Violations/ Num.of Samples (Frequency)
1990	8.25	5.3	-	6.78	1 / 4 = 25%
1994	7.9	5.2	6.3	6.5	0 / 5 = 0%
1998	6.2	7.1	12.25	8.52	1/6 = 16.7%
1999	8.47	5.2	10.62	8.28	1/12 = 8.3%
2000	7.67	4.7	10.88	8.43	1/9 = 11.1%
2002	8.15	3.7	9.55	7.82	1/5 = 20%
2006	7.5	3.8	10.4	7.23	2/6 = 33.3%
2010	6.34	5.11	10.12	7.92	0/4 = 0%
Average	7.56	5.01	10.02	7.68	7/51 = 13.7%

Figure 2. DO sampling results at SC578.

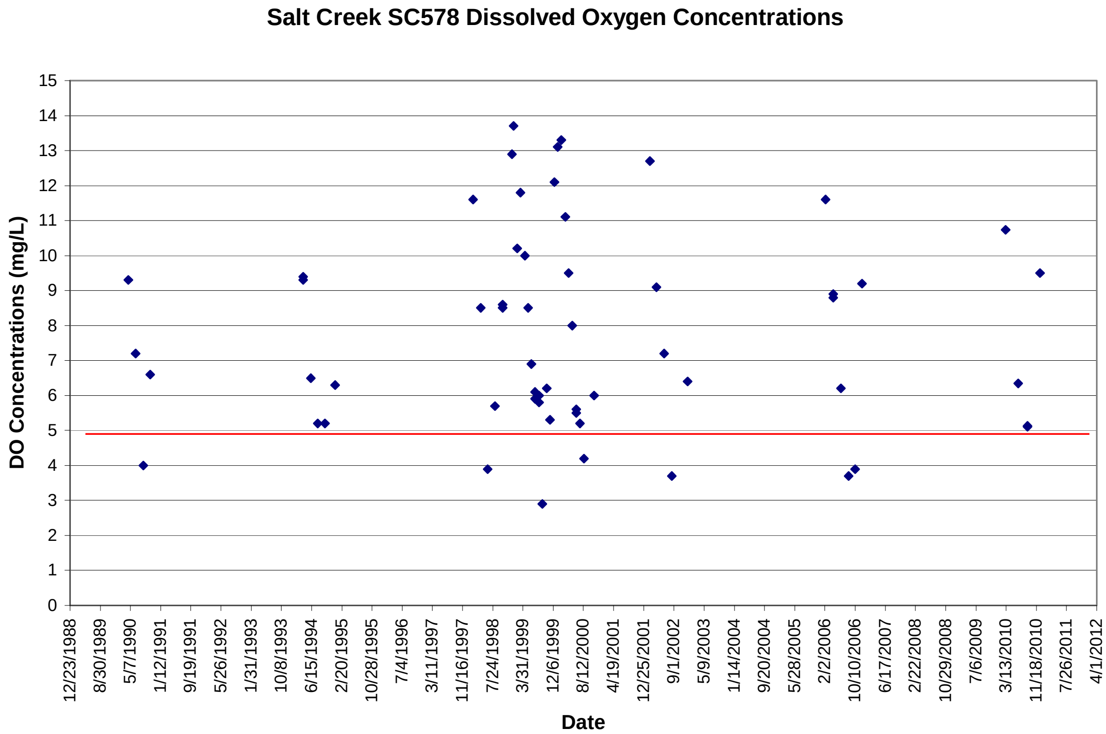


Table 4. Monthly DO sampling summary at SC578.

Month	DO Average (mg/L)	Number of Samples	Number of Violations	Impairment Frequency (%)
January	13.4	2	0	0%
February	11.88	5	0	0%
March	11.21	3	0	0%
April	9.21	7	0	0%
May	8.25	2	0	0%
June	6.22	8	1	12.5%
July	5.55	2	0	0%
August	4.61	7	4	57.14%
September	4.01	2	1	50%
October	6.08	5	1	20%
November	5.65	2	0	0%
December	9.4	6	0	0%
All Months	7.96	51	7	13.73%

Figure 3. Monthly DO Concentration averages.

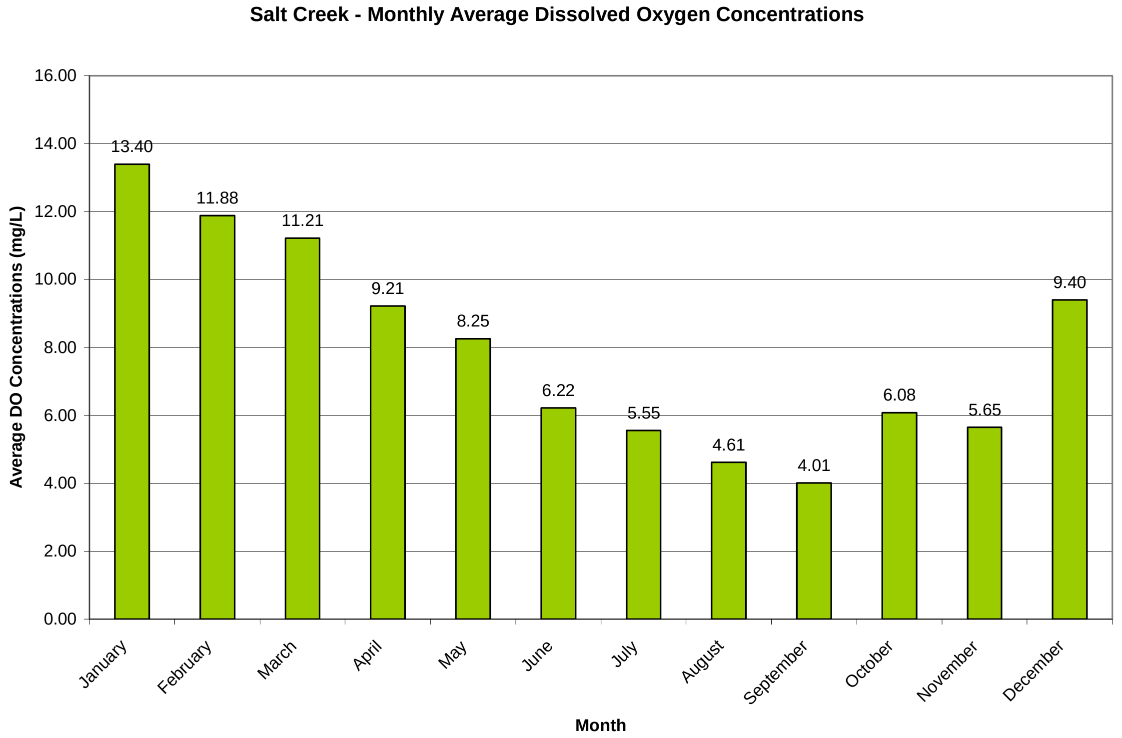


Figure 4. Monthly DO samples at SC578.

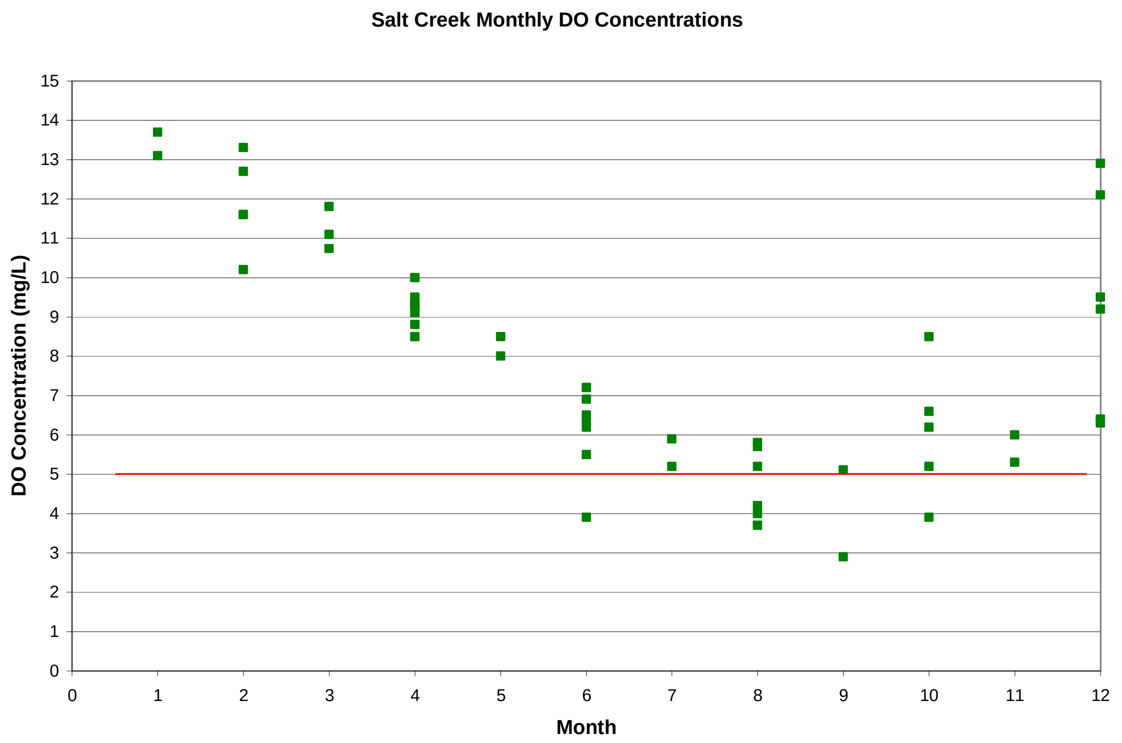


Figure 5. Seasonal DO annual averages at SC578.

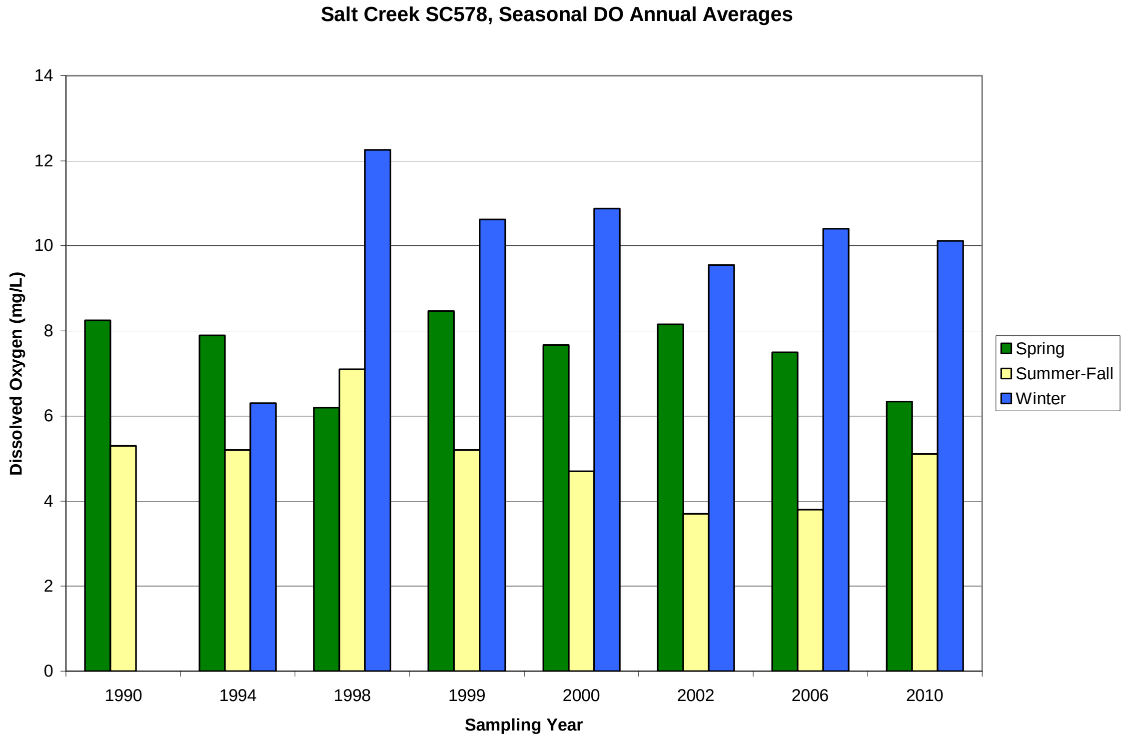
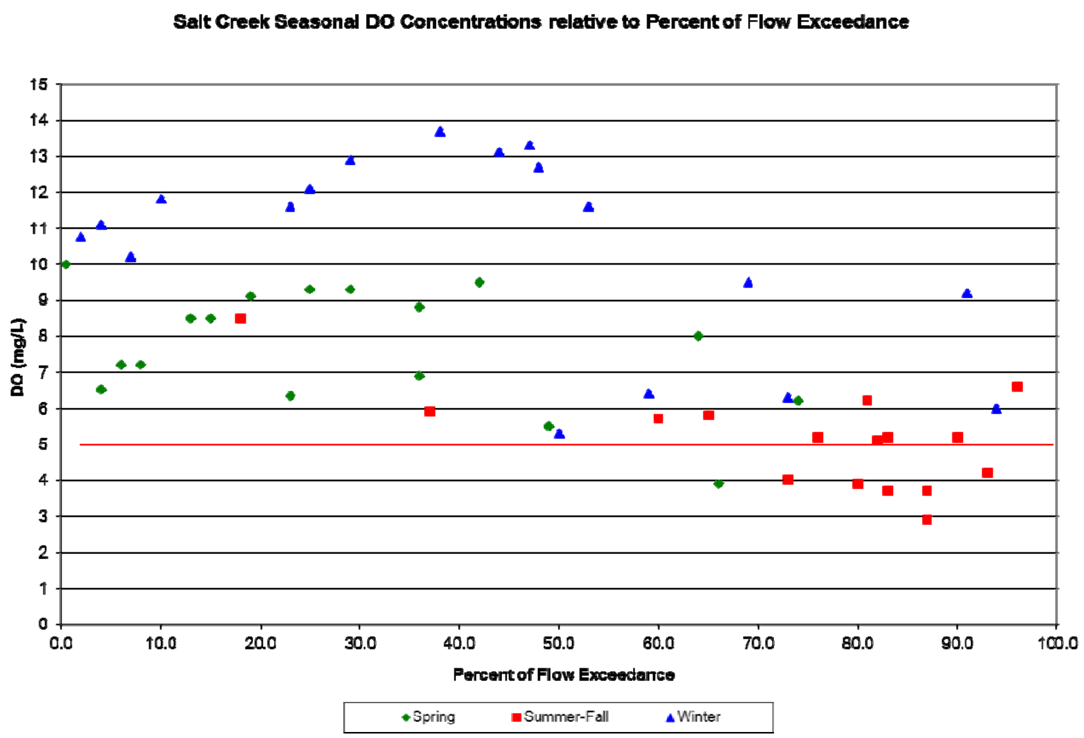


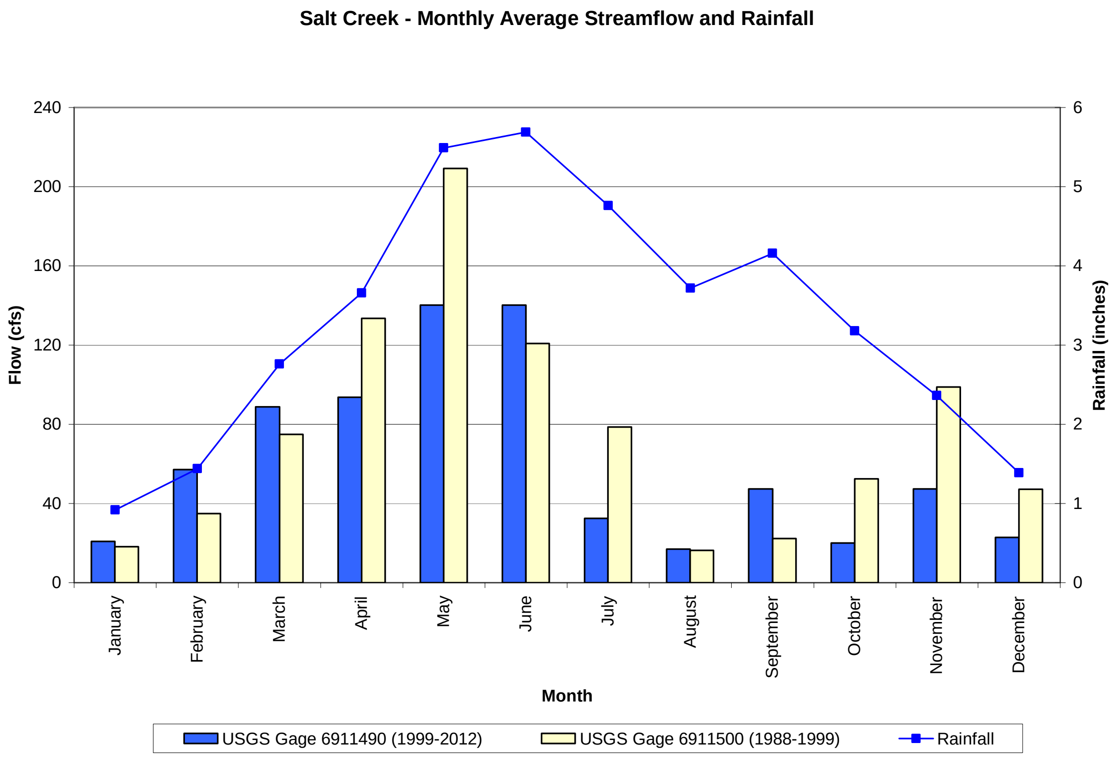
Figure 6. Seasonal DO concentrations at SC578 relative to the percent of flow exceedance.



Stream temperatures also influence DO concentrations in Salt Creek, where higher temperatures along with the low flow condition are common with DO violations. Seasonal average DO concentrations indicate that concentrations are the lowest in the Summer-Fall season as seen in Table 3 and Figure 6.

Streamflows with the least amount of flow occur during the Summer-Fall season and correspond well with the months with the lower average monthly DO concentrations. Monthly rainfall averages tend to have a similar pattern as the average streamflow within the watershed as seen in Figure 7.

Figure 7. Monthly average streamflow and rainfall at SC578.



There are lower DO concentrations in the summer-fall season when stream temperatures are elevated as illustrated in Figure 8. There is a negative relationship between DO concentrations and stream temperatures and a positive relationship between DO and pH in Salt Creek as illustrated in Figures 9. The pH values are generally higher with elevated DO concentrations and decrease with lower DO concentrations. There are no discernible relationships between DO concentrations and total phosphorus or total suspended solids.

Figure 8. DO and stream temperature relationship at SC578.

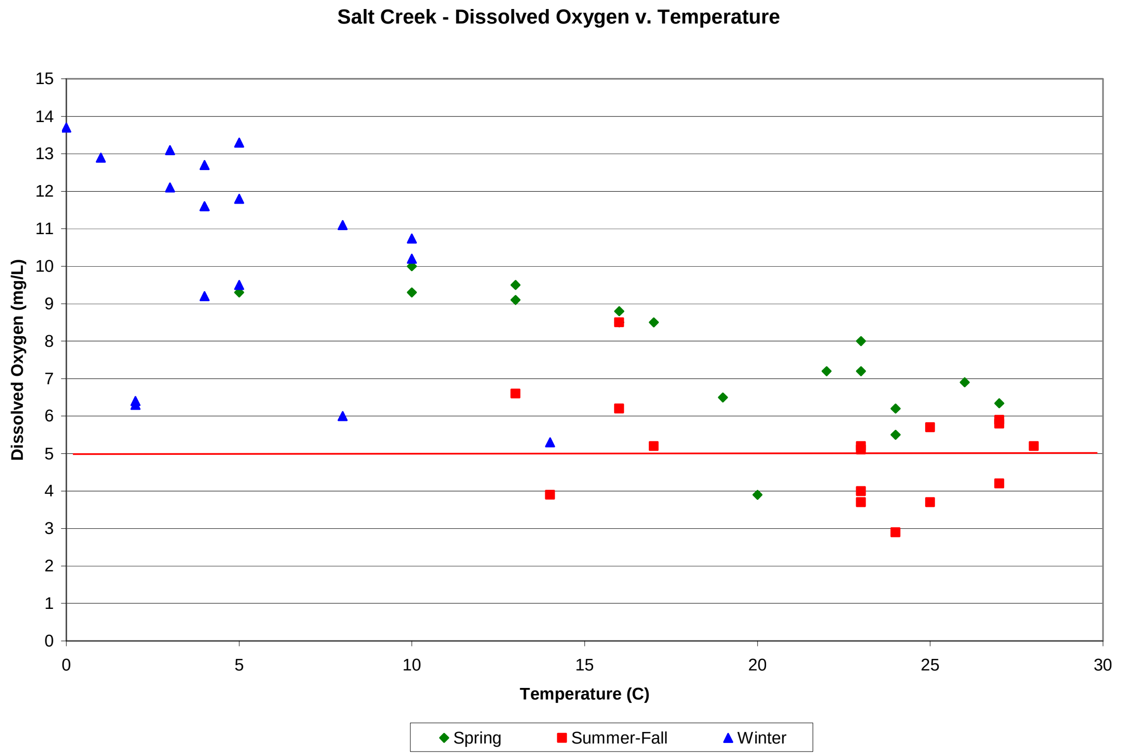
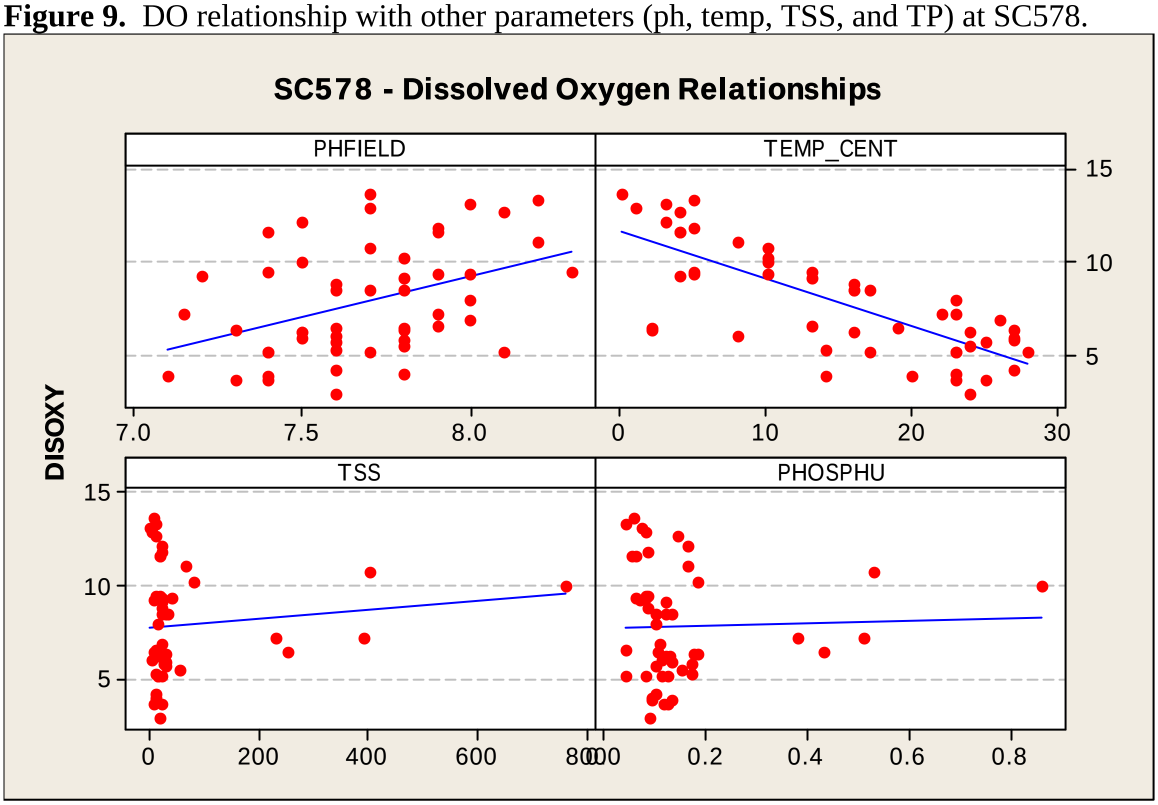


Figure 9. DO relationship with other parameters (ph, temp, TSS, and TP) at SC578.



Desired Endpoints of Water Quality (Implied Load Capacity) in Salt Creek:

The ultimate endpoint for this TMDL will be to achieve the Kansas Water Quality Standards fully supporting aquatic life support, indicated by dissolved oxygen concentrations of 5 mg/L or more. Seasonal variation is accounted for by this TMDL, since the TMDL endpoint is sensitive to the low flow and temperature conditions usually occurring in the Summer-Fall season and higher DO levels occur during the periods of higher sustained flow. Low flow periods aggravate situations of deficient dissolved oxygen within this watershed. Achievement of the endpoint indicates any loads of oxygen-demanding substance are within the loading capacity of the stream, water quality standards are attained and full support of the designated uses of the stream has been restored.

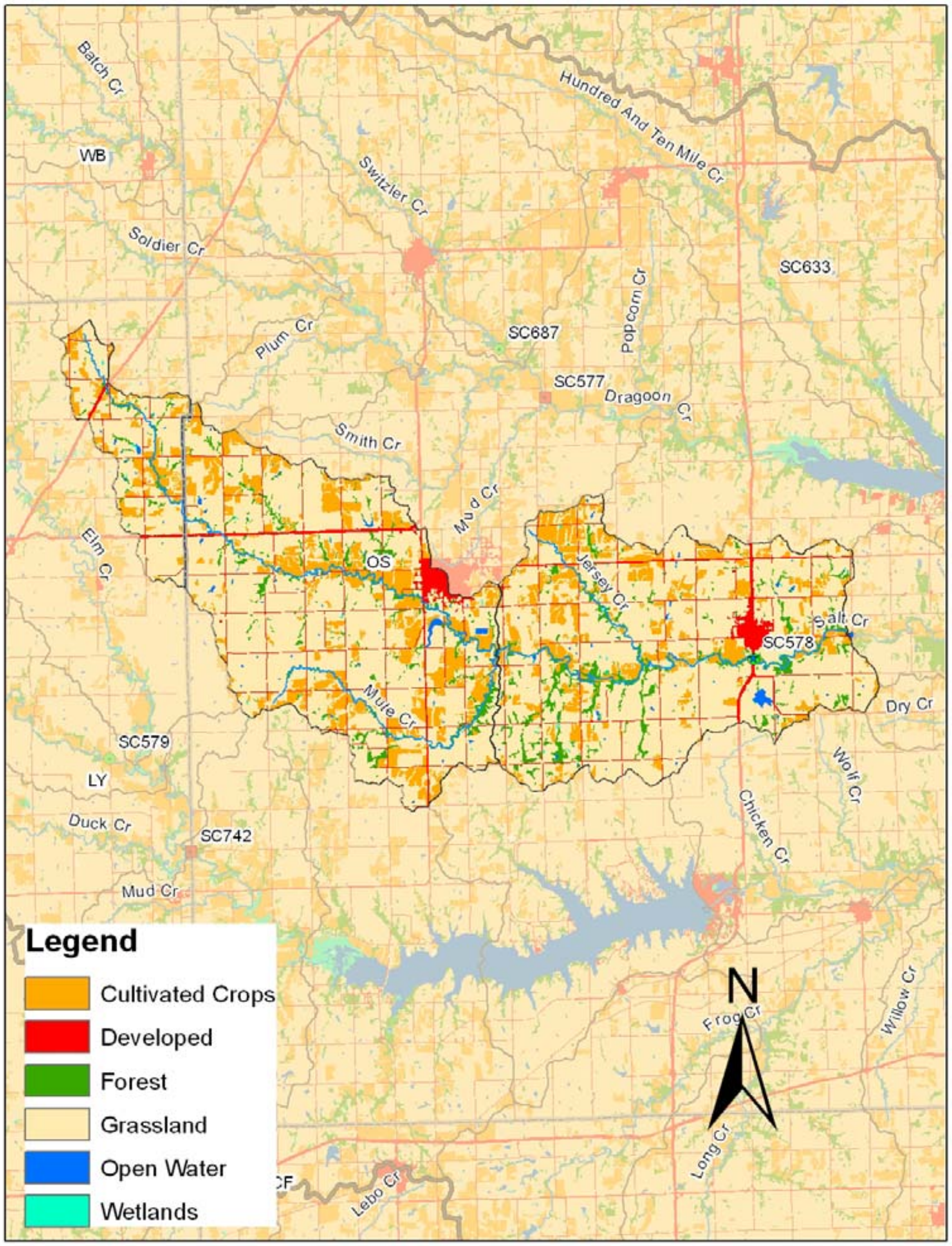
3. SOURCE INVENTORY AND ASSESSMENT

Land Use: The land cover in the Salt Creek watershed is dominantly grassland and cropland. Table 5 further details the percentages of all landuse acres in the watershed. As seen in Figure 10, cropland is the predominant land cover lying along the main segments of Salt Creek.

Table 5. Landuse acreage in the Salt Creek Watershed.

Landuse	Acres	Percent of Watershed
Grassland/Pasture	48309	68.90
Cultivated Crops	13138	18.74
Forest	4126	5.88
Developed	3944	5.63
Open Water	433	0.62
Wetlands	164	0.23

Figure 10. Landuse map for Salt Creek watershed.



Point Sources: There are four NPDES facilities located within the Salt Creek watershed as seen in Table 6. The Builders Choice Concrete plant has a general concrete plant permit to discharge overflow from their wash water basin. There has not been any reported discharge from this facility since 2004. The Hamm Quarry facility is a limestone quarry operation that is permitted to discharge stormwater runoff and treated wash water from a settling pond. There has not been any reported discharge from this facility. The City of Osage City wastewater treatment facility utilizes a three-cell lagoon system. One of the permit limits is for Biochemical Oxygen Demand (BOD) (45 mg/L weekly average and 30 mg/L monthly average), which requires quarterly sampling. The average BOD concentration in the City of Osage City's effluent is 21.6 mg/L (see Appendix C for BOD discharge data). The City of Lyndon wastewater treatment facility is a mechanical plant with a design flow of 0.15 MGD that discharges to Salt Creek below the KDHE monitoring station. This facility monitors DO concentrations in the effluent along with BOD (limit of 45 mg/L weekly average and 30 mg/L monthly average). The average DO concentration in the Lyndon effluent is 8.0 mg/L and the average BOD concentration is 13.8 mg/L (see Appendix D for DO and BOD discharge data). The City of Lyndon does not contribute to the Dissolved Oxygen impairment at SC578 since the discharge is downstream from the monitoring station.

Table 6. NPDES facilities in the Salt Creek watershed.

Permit	Facility Name	Type	NPDES Number	Design Flow (MGD)
I-MC21-PO02	HAMM - LIEBER/PLAGE #74	Seasonal Discharge	KS0080853	0
I-MC29-PR01	Builders Choice Concrete	Concrete Batch	KSG110139	0
M-MC21-OO01	LYNDON, CITY OF	Trickling Filter, UV, Activated Sludge	KS0024821	0.15
M-MC29-OO01	OSAGE CITY, CITY OF	3-Cell Lagoon	KS0022675	0.295

Contributing Runoff: The watershed of Salt Creek has a mean soil permeability value of 0.41 inches/hour, ranging from 0.01 to 1.29 inches/hour according to the NRCS STATSGO database. According to a USGS open-file report (Juracek, 2000), the threshold soil-permeability values that represents very high, high, moderate, low, very low, and extremely low rainfall intensity, were set at 3.43, 2.86, 2.29, 1.71, 1.14, and 0.57"/hour, respectively. The lower rainfall intensities generally occur more frequently than the higher rainfall intensities. The higher soil-permeability thresholds imply a more intense storm during which areas with higher soil permeability potentially may contribute runoff. Runoff is chiefly generated as infiltration excess with rainfall intensities greater than the soil permeability. As soil profiles become saturated, excess overland flow is produced. For the Salt Creek watershed, runoff will be produced by a rainfall event producing 1.14 inches/hour rain in approximately 61% of the watershed, and a rainfall event producing 1.29 inches/hour of rain will produce runoff over the entire watershed based on the soil permeability values in the watershed.

Livestock Waste Management Systems: There are eleven certified or permitted confined animal feeding operations (CAFOs) within the Salt Creek watershed (see Appendix A). These facilities are designed to retain a 25-year, 24-hour rainfall/runoff event as well as an anticipated two weeks of normal wastewater from their operations. Typically, this rainfall event coincides with streamflow that occurs less than 1-5% of the time. Though the total potential number of animals is approximately 4,070 head in the watershed, the actual number of animals at the feedlot operations is typically less than the allowable permitted number.

According to the Kansas Agricultural Statistics, as of January 1, 2011 the estimated number of all cattle and cows for Lyon and Osage counties are 65,000 and 34,000 respectively.

On-site Waste Systems: Households outside of the City of Lyndon and Osage City are presumably utilizing on-site septic systems. The Spreadsheet Tool for Estimating Pollutant Load (STEPL) was utilized to identify the number of septic systems within the HUC12s within the watershed. According to STEPL, there are approximately 389 septic systems within the Salt Creek watershed with an anticipated failure rate of 0.93%. On-site septic systems are likely an insignificant source contributing to the dissolved oxygen impairment within the Salt Creek watershed.

Background: The natural hydrologic characteristics of the watershed influence DO concentrations during periods of low flow that are prevalent during the warmer summer months. Leaf litter and wastes derived from natural wildlife may add to the nutrient load.

Relationship with Other Parameters: Based on the assessment it is apparent that dissolved oxygen deficiencies are driven by low flow conditions and higher stream temperatures. Violations that occur during these conditions are likely natural occurrences based on the hydrodynamics of the stream system since the stream is likely lacking sustained flows during these periods. During these conditions the aquatic life use is ultimately impaired by the lack of flow, which may be accompanied by the pooling of water within the streambed.

Figures 11 and 12 display comparisons of data sets based on compliant and non-compliant DO samples. The compliant data set consists of 44 samples compared to the seven noncompliant DO samples at SC578. There are some distinct observations between the datasets. The pH values for the compliant DO samples are higher than the non-compliant samples. Temperatures are higher and the percent of flow exceedance values are much lower for samples that violated the DO standard as seen in Figure 12. Figure 13 breaks out a comparison between low flow (50-99% flow exceedance) and high flow (0-49% flow exceedance) samples relative to the sampling period as detailed by the critical and non-critical sampling periods. Where the critical sampling period encompasses samples collected during the months when DO violations occurred, which includes the period from June through October. The non-critical period includes the months of January, February, March, April, May, November and December where no DO violations have been observed.

Figure 11. pH comparisons between all compliant samples, high temperature compliant samples and noncompliant DO samples at SC578. High temperature compliant samples are limited to the temperature range ($\geq$14 degrees C) as the noncompliant samples.

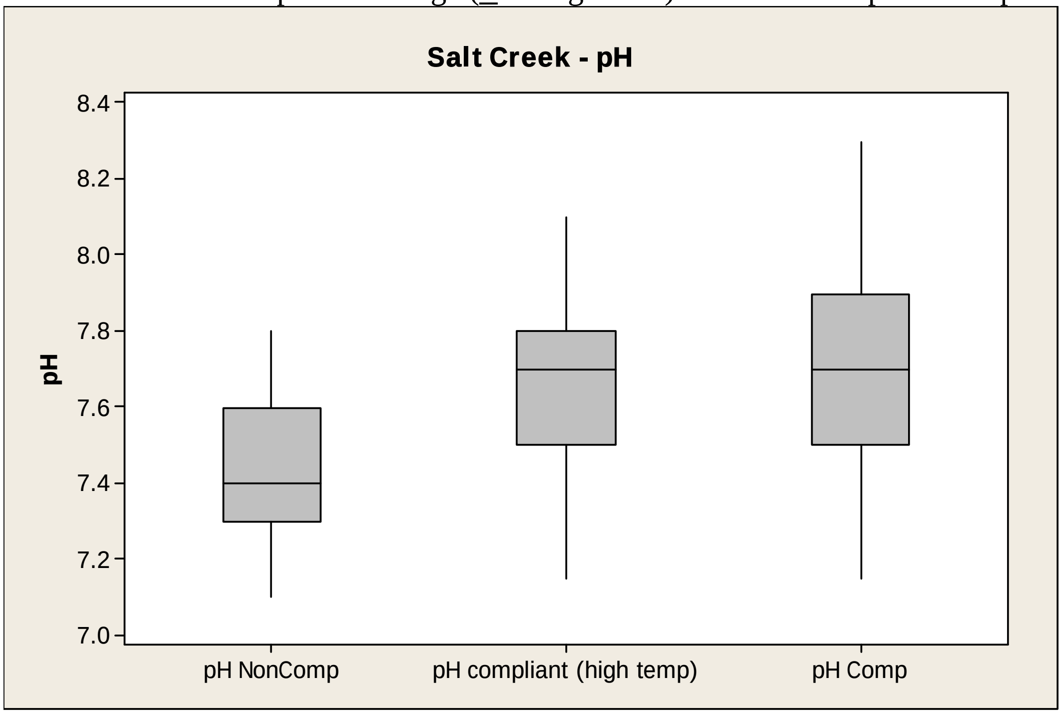


Figure 12. Percent of Flow Exceedance comparisons between compliant and noncompliant DO samples at SC578.

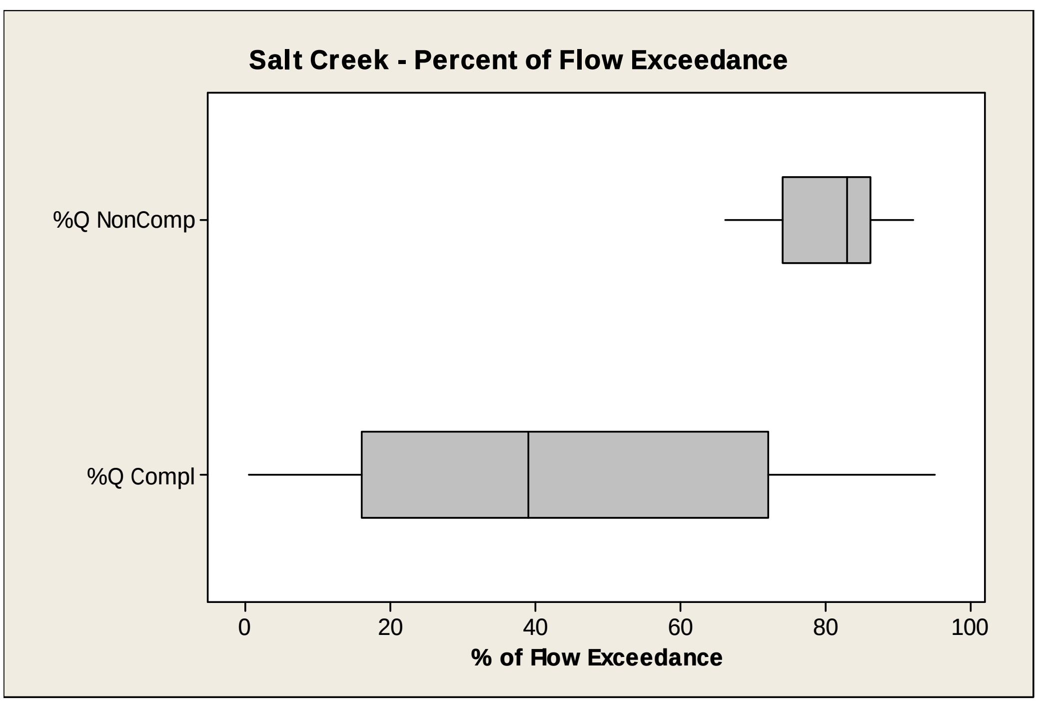
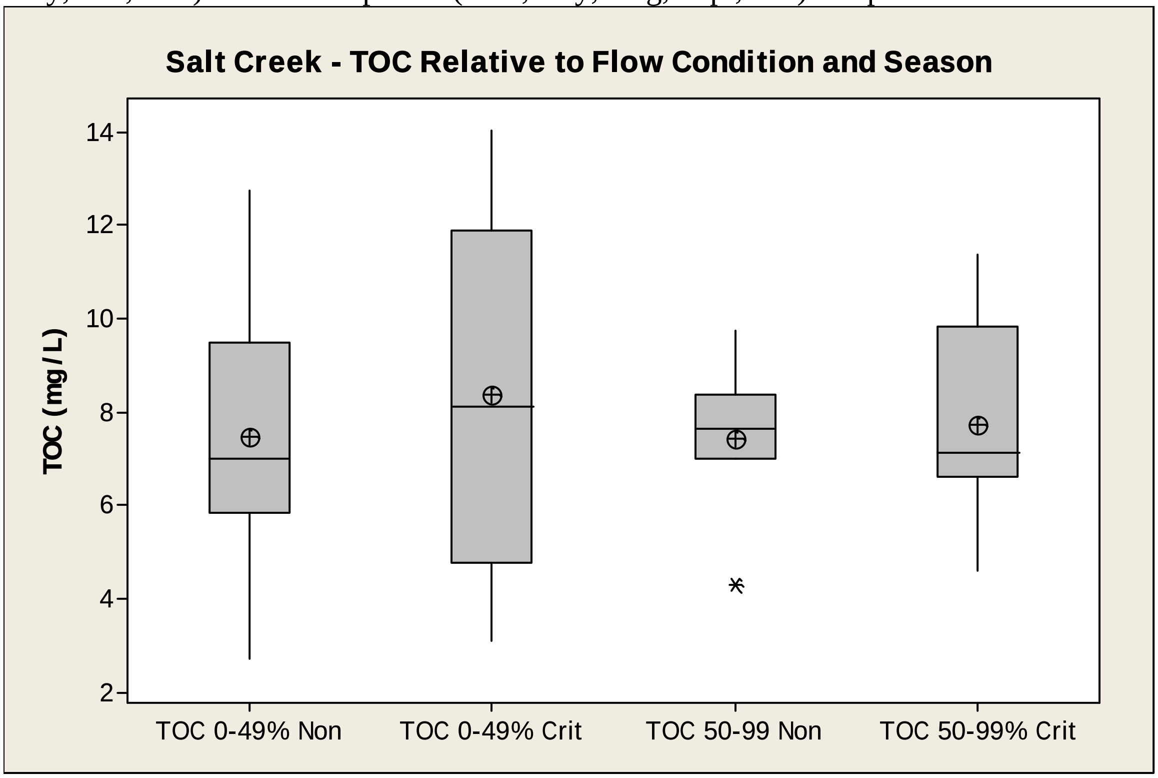


Figure 13. TOC concentration comparisons between samples relative to flow conditions based on percent of flow exceedance and non-critical period (Jan, Feb, Mar, April, May,Nov, Dec) and critical period (June, July, Aug, Sept, Oct) samples at SC578**.**



4. ALLOCATION OF POLLUTION REDUCTION RESPONSIBILITY

The TMDL is a concentration based TMDL, where all stream segments within the watershed must maintain a Dissolved Oxygen Concentration of 5 mg/L or more at all times that the stream has sustained flow. There is some degree of uncertainty on establishing allocations under this TMDL. Total Organic Carbon (TOC) will be allocated under this TMDL as the pollutant to meet the DO TMDL, though ultimately success of this TMDL will be measured through in stream DO compliance. Additionally the DO impairment is related to the low flow condition and may be attributed to hydrological conditions.

KDHE discontinued sampling for Biochemical Oxygen Demand (BOD) in 2001 and began utilizing Total Organic Carbon (TOC) analyses in late 2000 in lieu of BOD. KDHE conducted analyses in 2000 to determine if TOC concentrations could be utilized as a surrogate for BOD and whether a statistical translation could be made for this expression. KDHE utilized 675-paired sets of data in the analyses and concluded that there are relationships in the stream data. “The data suggest that, for effluent and point source related waters, the BOD/TOC ratio is almost one-to-one. Ambient waters have much lower ratios, suggesting that a portion of the TOC is in more refractory substances (i.e., cell walls, lignin, cellulose, etc.)” (Carney, 2000). The analysis of the paired ambient stream data was utilized for this report. The regression analyses for this group is summarized as follows:

R square = 0.34
P Value = <0.0001
For a TOC value of 10mg/L, the most likely BOD concentration = 4.31 mg/L
Lower 95% BOD = 3.34 mg/L
Upper 95% BOD = 5.29 mg/L

BOD/TOC Ratio:
Arithmetic Mean = 0.44
Geometric Mean = 0.35
Median = 0.37

Generally, higher BOD and TOC concentrations indicate that more oxygen will be consumed by an ecosystem, which may result in an oxygen deficient stream system as the population increases among microorganism communities. The average TOC concentration for Salt Creek is 7.6 mg/L under all flow conditions. The average BOD concentration for the samples collected prior to 2003 is 2.75 mg/L. The critical period when DO violations occurred is from June through October. The average TOC concentration during the 50 to 99% flow exceedance range is 7.71 mg/L for the critical period. The monthly periods from January through May, along with November and December consists of the months where no DO violations have occurred and is considered the non-critical period. During these months the average TOC concentration during the low flow range (50-99% exceedance) is 7.42 mg/L. The average BOD/TOC Ratio at SC578 is 0.36 and the median ratio is 0.39.

TOC will be allocated for all flow conditions based on the data set of low flow (50-99% flow exceedance) samples at SC578 during the non-critical months consisting of January, February, March, April, May, November and December, with an average TOC concentration of 7.42 mg/L. These allocations are conservatively set for all flow conditions since there are no DO violations at the higher flow condition from the 0-49 % flow exceedance range.

Point Sources: Since the DO violations are associated with critically low flow events from June-October it is conceivable that point sources are not contributing to the DO impairment. Wasteload Allocations (WLA) will be assigned to the two wastewater treatment facilities based on 30 mg/L BOD monthly averages and the design flow for these facilities. The WLA is 111.5 lbs/day of BOD as detailed in Table 7. Based on the discharge monitoring reports, the City of Lyndon and Osage City have BOD averages in their effluent well below the established limits and it is therefore anticipated that these facilities will be well under the assigned WLA throughout the year. The equivalent TOC WLA for these two facilities is 301.4 lbs/day. This translates to an in-stream TOC WLA of 27.57 lbs/day, based on the design flows for the facility and the TOC concentration (7.42 mg/L) target at SC578. The WLA associated with the City of Lyndon enters Salt

Creek below KDHE sampling station SC578. As detailed in Appendix B, the WLA is zero for the other two permitted facilities within the watershed.

Table 7. Wasteload Allocations in the Salt Creek watershed.

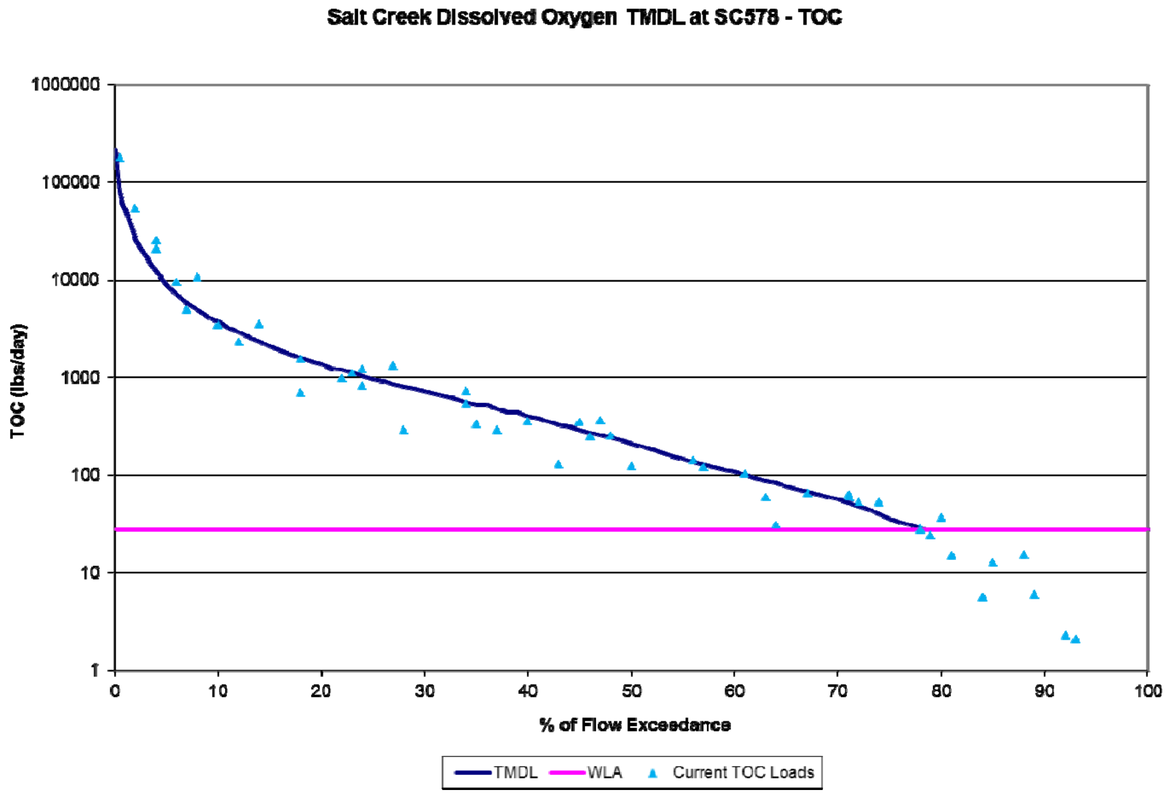
Facility	WLA – BOD (lbs/day)	WLA – TOC (lbs/day)
City of Lyndon	37.6	101.6
Osage City	73.9	199.8
Total WLA	111.5	301.4

Nonpoint Sources: All load allocations will be assigned to station SC578 on Salt Creek segment 29. The TMDL and load allocations are based on a load duration curve approach as seen in Figure 14 and Table 8. The Load Allocations under average flow conditions are 2620.92 lbs/day of TOC at station SC578.

Table 8. TOC loads and TMDL at specified flow conditions.

Station SC578 % of Flow Exceedance	Flow (cfs)	WLA (lbs/day)	LA (lbs/day)	TMDL (lbs/day)
Average Flow	66.1	27.57	2620.92	2648.49
50%	5.3	27.57	184.79	212.36
25%	24	27.57	934.06	961.63
10%	92	27.57	3658.69	3686.26
5%	221.8	27.57	8859.51	8887.08

Figure 14. Dissolved Oxygen TMDL on Salt Creek at SC578.



Defined Margin of Safety: The margin of safety provides some hedge against the uncertainty of daily loading that contributes to the impairment of dissolved oxygen deficiencies. This TMDL uses an implicit margin of safety, relying on conservative assumptions made with wastewater facilities assuming they discharge permitted BOD concentrations at design flow. Additionally, the allocations are conservatively set for all flow conditions when the impairment occurs only during the low flow condition during the critical months from June through October along with higher stream temperatures.

State Water Plan Implementation Priority: Because low dissolved oxygen levels in Salt Creek are often related to natural seasonal conditions resulting in higher temperatures during times of lower flow, this TMDL will be a Low priority for implementation.

Unified Watershed Assessment Priority Ranking: The Salt Creek watershed lies within the Upper Marais des Cygnes Subbasin (HUC8: 10290101) with a priority ranking of 5 (High Priority restoration work).

Priority Stream segments: Because of the lack of certainty regarding potential sources and naturally occurring background concentrations in the watershed, no priority subwatershed or stream segment will be identified.

5. IMPLEMENTATION

Desired Implementation Activities

1. Install grass buffer strips where needed along streams.
2. Maintain adequate streamflow by ensuring streamflow is not artificially reduced or impeded, particularly during low flow durations.
3. Ensure that labeled application rates of chemical fertilizers are being followed and implement runoff control measures.
4. Implement nutrient management plans to manage manure land applications and runoff potential.
5. Ensure appropriate treatment of wastewater through compliance of NPDES limits.

Implementation Programs Guidance

Nonpoint Source Pollution Technical Assistance-KDHE

a. Support Section 319 demonstration projects for reduction from streambank erosion, sediment runoff, and livestock operations.
b. Provide technical assistance on practices geared to the establishment of vegetative buffer strips.

NPDES and State Permits – KDHE

a. Livestock permitted facilities will be inspected for integrity of applied pollution prevention technologies.
b. Registered livestock facilities with less than 300 animal units will apply pollution prevention technologies.
c. Manure management plans will be implemented.
d. Municipal wastewater is below BOD limits.

Riparian Protection Program – KDA Divison of Conservation

a. Establish or re-establish natural riparian systems, including vegetative filter strips along small tributaries.

Buffer Initiative Program – KDA Division of Conservation

a. Install buffer strips near streams.
b. Work in conjunction with Federal Conservation Reserve Enhancement Program and Conservation Security Program to hold marginal riparian land out of production.

Timeframe for Implementation: Continued monitoring over the years from 2013 to 2022.

Milestone for 2017: In accordance with the TMDL development schedule for the State of Kansas, the year 2017 marks the next cycle of 303(d) activities in the Marais des Cygnes Basin to review data from the Salt Creek watershed to assess continued incidence of dissolved oxygen deficiencies.

Delivery Agents: The primary delivery agents for program participation will be the Kansas Department of Health and Environment.

Reasonable Assurances:
Authorities: The following authorities may be used to direct activities in the watershed to reduce pollution.

1. K.S.A. 65-171d empowers the Secretary of KDHE to prevent water pollution and to protect the beneficial uses of the waters of the state through required treatment of sewage and established water quality standards and to require permits by persons having a potential to discharge pollutants into the waters of the state.

2. K.S.A. 65-164 and 165 empowers the Secretary of KDHE to regulate the discharge of sewage into the waters of the state.

3. K.S.A. 2002 Supp. 82a-2001 identifies the classes of recreation use and defines impairment for streams.

4. K.A.R. 28-16-69 through -71 implements water quality protection by KDHE through the establishment and administration of critical water quality management areas on a watershed basis.

5. K.S.A. 2-1915 empowers the State Conservation Commission to develop programs to assist the protection, conservation and management of soil and water resources in the state, including riparian areas.

6. K.S.A. 75-5657 empowers the State Conservation Commission to provide financial assistance for local project work plans developed to control nonpoint source pollution.

7. K.S.A 82a-901, et seq. empowers the Kansas Water Office to develop a state water plan directing the protection and maintenance of surface water quality for the waters of the state.

8. K.S.A. 82a-951 creates the State Water Plan Fund to finance the implementation of the *Kansas Water Plan*, including selected Watershed Restoration and Protection Strategies.

9. The *Kansas Water Plan* and the Marais des Cygnes Basin Plan provide guidance to state agencies to coordinate programs intent on protecting water

quality and to target those programs to geographic areas of the state for high priority in implementation.

Funding: The State Water Plan Fund annually generates $16-18 million and is the primary funding mechanism for implementing water quality protection and pollutant reduction activities in the state through the Kansas Water Plan. The state water planning process, overseen by the Kansas Water Office, coordinates and directs programs and funding toward watersheds and water resources of highest priority. Typically, the state allocates at least 50% of the fund programs supporting water quality protection through the WRAPS program. This watershed and its TMDL are a Low Priority consideration.

Effectiveness: Buffer strips are publicized as a means to filter sediment before it reaches a stream and riparian restoration projects have been acclaimed as a significant means of stream bank stabilization. The key to effectiveness is participation within a targeted area to direct resources to the activities influencing water quality. Secondary wastewater treatment is very effective at reducing BOD in effluent.

6. MONITORING

KDHE will continue to collect samples through 2022 at the rotational station SC578 on Salt Creek on a quarterly basis every fourth year. Point source facilities will continue to monitor BOD in their wastewater.

7. FEEDBACK

Public Notice: An active internet website was established at http://www.kdheks.gov/tmdl/index.htm to convey information to the public on the general establishment of TMDLs and specific TMDLs for the Marais des Cygnes Basin. This TMDL was initially posted on website on May 3, 2013 for public review.

Public Hearing: A Public Hearing on the Marais des Cygnes River Basin TMDLs was held on May 23, 2013 in Ottawa to receive comments. Public comments for this TMDL were held open from May 4 through June 7, 2013. KDHE did not receive any comments regarding this TMDL.

Basin Advisory Committee: The Marais des Cygnes River Basin Advisory Committee met to discuss these TMDLs on September 14, 2012 in Fort Scott.

Milestone Evaluation: In 2017, evaluation will be made as to the degree of impairment continuing to occur within the watershed. Subsequent decisions will be made regarding the implementation approach, priority of allotting resources for implementation and the need for additional or follow up implementation in this watershed at the next TMDL cycle for this basin in 2017 with consultation from local stakeholders and the BAC.

Consideration for 303(d) Delisting: Salt Creek will be evaluated for delisting under section 303(d), based on the monitoring data over 2013-2022. Therefore, the decision for delisting will come about in the preparation of the 2024-303(d) list. Should modifications be made to the applicable water quality criteria during the implementation period consideration for delisting, desired endpoints of this TMDL and implementation activities might be adjusted accordingly.

Incorporation into Continuing Planning Process, Water Quality, Management Plan and the Kansas Water Planning Process: Under the current version of the Continuing Planning Process, the next anticipated revision would come in 2014, which will emphasize implementation of WRAPS activities. At that time, incorporation of this TMDL will be made into the WRAPS. Recommendation of this TMDL will be considered in the Kansas Water Plan implementation decisions under the State Water Planning Process for Fiscal Years 2013-2022.

November 7, 2013

Bibliography

Carney, E.C., May 4, 2000. Kansas Department of Health and Environment Memorandum regarding: Comparison of historic BOD and TOC data in Kansas.

Juracek, K.E., 2000. Soils- Potential Runoff. U.S. Geological Survey Open-File Report 00-253. Information available on the internet at www.KansasGIS.org . Accessed on October 3, 2012.

Perry, C.A., D.M. Wolock and J.C.Artman, 2004. Estimates of Flow Duration, Mean Flow, and Peak-Discharge Frequency Values for Kansas Stream Location, USGS Scientific Investigations Report 2004-5033.

Appendix A. Permitted and Registered CAFO Facilities in Salt Creek Watershed.

Permit	Facility County	Animal Totals	Permit Animal	WLA
A-MCLY-SA01	Lyon	275	Swine	0
A-MCOS-BA20	Osage	750	Beef	0
A-MCLY-M002	Lyon	60	Dairy	0
A-MCOS-BA11	Osage	450	Beef	0
A-MCOS-BA12	Osage	330	Beef	0
A-MCOS-BA07	Osage	145	Beef	0
A-KSOS-BA05	Osage	800	Beef	0
A-MCOS-BA08	Osage	180	Beef	0
A-MCOS-BA15	Osage	80	Beef	0
A-MCOS-B007	Osage	800	Beef	0
A-MCOS-BA22	Osage	200	Beef	0

Appendix B. WLA for NPDES facilities in the Salt Creek watershed.

Permit	Facility Name	Permit Expires	NPDES Number	BOD WLA (lbs/day)	TOC WLA (lbs/day)
I-MC21-PO02	HAMM - LIEBER/PLAGE #74	6/30/2014	KS0080853	0	0
I-MC29-PR01	Builders Choice Concrete	9/30/2017	KSG110139	0	0
M-MC21-OO01	LYNDON, CITY OF	9/30/2014	KS0024821	37.6	101.6
M-MC29-OO01	OSAGE CITY, CITY OF	6/30/2014	KS0022675	73.9	199.8

Appendix C. City of Osage City discharge monitoring data.
City of Osage City effluent BOD concentrations.

Date	BOD (mg/L)
3/26/2001	21
6/20/2001	27
12/14/2001	28
6/20/2002	22
7/24/2002	20
12/30/2002	26
2/17/2003	23
4/7/2003	27
8/29/2003	20
11/24/2003	22.9
1/6/2004	29
6/9/2004	20
7/1/2004	28
12/13/2004	15
1/3/2005	26
6/22/2005	24
7/26/2005	15
10/4/2005	19
1/10/2006	20
6/6/2006	18
8/8/2006	27
12/20/2006	27.2
1/2/2007	25.6
4/9/2007	21.6
7/9/2007	15
11/13/2007	21
1/28/2008	18
4/7/2008	21
8/20/2008	19
10/13/2008	26
1/27/2009	18
5/19/2009	25
9/23/2009	24
10/2/2009	19
2/2/2010	15
4/13/2010	11
8/16/2010	16
10/11/2010	25
1/31/2011	16
4/11/2011	16
8/29/2011	13
10/3/2011	29
1/16/2012	12
4/17/2012	29
9/5/2012	33

Appendix D. City of Lyndon discharge monitoring data.

City of Lyndon effluent Dissolved Oxygen concentrations.

Date	Dissolved Oxygen (mg/L)
10/20/2004	6.61
11/17/2004	5.07
12/8/2004	7.36
1/24/2005	4.12
2/23/2005	6.5
3/30/2005	5.56
4/20/2005	6.1
5/11/2005	6.06
6/17/2005	8.06
7/27/2005	6.49
8/15/2005	6.82
9/9/2005	5.53
10/25/2005	7.88
11/29/2005	7.21
12/23/2005	4.73
1/23/2006	8.94
2/23/2006	8.84
3/28/2006	8.76
4/7/2006	8.17
4/13/2006	7.78
4/20/2006	8.03
4/26/2006	8.07
5/3/2006	8.24
5/12/2006	7.74
5/19/2006	7.12
5/25/2006	7.1
6/5/2006	7.2
6/14/2006	6.05
6/19/2006	7.49
6/29/2006	7.1
7/7/2006	5.37
7/13/2006	6.75
7/20/2006	5.66
7/26/2006	5.98
8/3/2006	6.15
8/11/2006	6.02
8/18/2006	6.46
8/24/2006	6.11
8/30/2006	6.35
9/9/2006	6.53
9/13/2006	6.53
9/18/2006	6.77

9/28/2006	6.81
10/5/2006	6.88
10/12/2006	7.03
10/21/2006	8.24
10/27/2006	8.52
10/31/2006	7.67
11/8/2006	6.92
11/13/2006	8.17
11/21/2006	8.07
11/28/2006	7.88
12/6/2006	8.57
12/14/2006	7.2
12/19/2006	7.76
12/27/2006	8.53
1/4/2007	8.36
1/11/2007	7.48
1/18/2007	9.99
1/26/2007	10.03
2/1/2007	9.65
2/6/2007	9.98
2/12/2007	10.2
2/19/2007	9.22
2/26/2007	9.79
3/8/2007	8.32
3/13/2007	7.1
3/22/2007	8.14
3/26/2007	8.02
4/5/2007	7.85
4/10/2007	8.5
4/19/2007	8.14
4/26/2007	7.92
5/4/2007	7.88
5/11/2007	7.71
5/15/2007	7.84
5/24/2007	7.3
5/30/2007	7.52
6/7/2007	6.85
6/10/2007	6.9
6/23/2007	6.21
6/29/2007	7.78
7/3/2007	7.68
7/10/2007	7.15
7/21/2007	6.65
7/26/2007	6.52
8/4/2007	6.71
8/9/2007	6.35
8/14/2007	6.47
8/24/2007	6.88

9/6/2007	6.16
9/11/2007	5.8
9/21/2007	6.4
9/30/2007	7.64
10/4/2007	6.73
10/11/2007	7.22
10/16/2007	7.33
10/25/2007	8.18
11/1/2007	7.41
11/9/2007	7.6
11/14/2007	7.36
11/23/2007	8.73
11/29/2007	8.11
12/6/2007	7.54
12/13/2007	8.41
12/20/2007	7.95
12/29/2007	8.45
1/2/2008	8.36
1/12/2008	8.58
1/16/2008	8.89
1/26/2008	8.69
1/28/2008	8.38
2/8/2008	9.21
2/14/2008	8.22
2/23/2008	9.01
2/26/2008	9.51
3/6/2008	9.35
3/11/2008	9.88
3/19/2008	8.52
3/26/2008	8.32
4/2/2008	8.61
4/10/2008	8.44
4/15/2008	8.15
4/24/2008	8.22
5/1/2008	7.68
5/10/2008	7.81
5/13/2008	7.16
5/20/2008	7.46
5/29/2008	7.25
6/12/2008	7.07
6/17/2008	7.41
6/26/2008	6.5
6/30/2008	6.65
7/11/2008	6.47
7/16/2008	6.75
7/24/2008	6.26
7/30/2008	7.88
8/9/2008	6.45

8/14/2008	7.36
8/20/2008	8.18
8/30/2008	7.41
9/4/2008	8.05
9/11/2008	8.05
9/18/2008	7.47
9/25/2008	8
9/29/2008	8.01
10/8/2008	8.51
10/16/2008	8.73
10/23/2008	8.93
10/28/2008	9.55
11/4/2008	6.7
11/12/2008	8.71
11/20/2008	8.21
11/24/2008	8.51
12/4/2008	8.64
12/11/2008	8.88
12/18/2008	8.38
12/26/2008	8.37
12/29/2008	8.64
1/8/2009	8.88
1/17/2009	10.02
1/23/2009	9.23
1/29/2009	10.31
2/5/2009	9.6
2/10/2009	9.47
2/20/2009	9.66
2/25/2009	9.71
3/5/2009	8.67
3/20/2009	9.63
4/9/2009	9.5
4/24/2009	9.23
5/7/2009	9.63
5/16/2009	10.4
5/22/2009	9.46
5/27/2009	9.32
6/5/2009	8.2
6/11/2009	8.6
6/19/2009	8.15
6/25/2009	8.33
7/2/2009	7.72
7/10/2009	7.46
7/16/2009	7.83
7/25/2009	7.68
7/30/2009	7.57
8/5/2009	7.3
8/13/2009	6.85

8/20/2009	7.46
8/28/2009	7.25
9/1/2009	7.44
9/10/2009	9.61
9/17/2009	7.84
9/24/2009	8.69
10/3/2009	8.8
10/7/2009	7.68
10/14/2009	9.38
10/23/2009	9.6
10/26/2009	9.23
11/3/2009	8.8
11/12/2009	8.68
11/19/2009	9.52
11/24/2009	9.64
12/7/2009	9.54
12/22/2009	8.58
1/14/2010	10.22
1/21/2010	11.02
2/3/2010	10.22
2/23/2010	9.95
3/8/2010	9.25
3/23/2010	9.56
4/8/2010	9.22
4/20/2010	8.6
5/17/2010	8.89
5/24/2010	8.11
6/3/2010	8.01
6/30/2010	8.21
7/20/2010	6.48
7/28/2010	8.23
8/10/2010	7.69
8/23/2010	6.49
9/9/2010	7.85
9/30/2010	9.04
10/7/2010	7.75
10/28/2010	10.15
11/3/2010	8.92
11/18/2010	9.85
12/2/2010	9.1
12/20/2010	9.24
1/4/2011	9.69
1/17/2011	9.26
2/15/2011	9.95
2/22/2011	10.5
3/7/2011	10.34
4/14/2011	8.3
5/16/2011	8.56

6/7/2011	7.91
7/6/2011	8.21
8/23/2011	5.62
9/28/2011	7.65
10/27/2011	8.87
11/7/2011	8.36
12/1/2011	10.25
1/5/2012	8.8
2/22/2012	8.85
3/19/2012	9.2
4/12/2012	9.62
5/14/2012	7.41
6/19/2012	8.13
7/17/2012	6.71
8/7/2012	6.13
9/20/2012	7.27

City of Lyndon BOD effluent concentrations.

Date	BOD (mg/l)
6/1/2004	19.4
7/19/2004	8.4
8/23/2004	19.8
9/22/2004	18.6
10/20/2004	12.4
11/17/2004	20.8
12/8/2004	9
1/24/2005	28.2
2/23/2005	20.5
3/30/2005	25.7
4/20/2005	18.2
5/11/2005	26
6/17/2005	16.8
7/27/2005	13.7
8/15/2005	16
9/9/2005	26.2
10/25/2005	18
11/29/2005	15.1
12/23/2005	41.9
1/23/2006	13.6
2/23/2006	16.6
3/28/2006	33.6
4/13/2006	24.2
5/25/2006	28.6
6/14/2006	20.2
7/20/2006	18.3
8/24/2006	19.1

9/13/2006	20.2
10/12/2006	23
11/8/2006	25.4
12/6/2006	29.4
12/19/2006	12.6
1/4/2007	28.1
1/18/2007	25
2/6/2007	32.6
2/19/2007	20.2
3/8/2007	29.2
3/22/2007	8.7
4/5/2007	22.4
4/19/2007	9.8
5/15/2007	11.2
5/24/2007	4.2
6/7/2007	5.4
6/23/2007	5.5
7/10/2007	7.5
7/21/2007	5
8/9/2007	20.6
8/24/2007	15.5
9/6/2007	15.1
9/21/2007	10.5
10/11/2007	11
10/25/2007	12.4
11/9/2007	10.6
11/29/2007	11.6
12/6/2007	17.8
12/20/2007	8.8
1/12/2008	13.5
1/28/2008	18.2
2/14/2008	10
2/26/2008	10.8
3/11/2008	11.7
3/26/2008	9.8
4/2/2008	16.4
4/15/2008	14.1
5/1/2008	10.8
5/13/2008	14.2
6/12/2008	5.6
6/26/2008	11.4
7/16/2008	6.6
7/24/2008	12.5
8/14/2008	10.2
8/20/2008	12.2
9/4/2008	2.1
9/18/2008	6.5
10/8/2008	3.3

10/28/2008	10.8
11/4/2008	16.1
11/20/2008	4.3
12/4/2008	7.5
12/18/2008	8.2
1/8/2009	15.7
1/29/2009	10.5
2/10/2009	14.6
2/25/2009	6.4
3/5/2009	9.4
3/20/2009	8.6
4/9/2009	3.6
4/24/2009	<2
5/7/2009	3
5/22/2009	3.4
6/11/2009	4.4
6/25/2009	3.3
7/2/2009	10
7/16/2009	9
8/5/2009	9.6
8/20/2009	11
9/1/2009	13.5
9/17/2009	11.7
10/14/2009	10.5
10/26/2009	6.2
11/3/2009	6.8
11/19/2009	10.4
12/7/2009	4.9
12/22/2009	10.6
1/14/2010	15.2
1/21/2010	10.9
2/3/2010	15
2/23/2010	11.1
3/8/2010	13.3
3/23/2010	25.8
4/8/2010	13.7
4/20/2010	10.6
5/17/2010	30.2
5/24/2010	5.6
6/3/2010	8.5
6/30/2010	3.4
7/20/2010	9.5
7/28/2010	5
8/10/2010	23.6
8/23/2010	13.2
9/9/2010	15
9/30/2010	5.6
10/7/2010	14.2

10/28/2010	10
11/3/2010	16.4
11/18/2010	8.8
12/2/2010	36.8
12/20/2010	12.5
1/4/2011	7
1/17/2011	7.6
2/15/2011	20.6
2/22/2011	14.8
3/7/2011	5.2
4/14/2011	10.2
5/16/2011	15
6/7/2011	12.9
7/6/2011	15.2
8/23/2011	5.2
9/28/2011	17.5
10/27/2011	16.2
11/7/2011	10.5
12/1/2011	10.7
1/5/2012	12.9
2/22/2012	10.8
3/19/2012	10.4
4/12/2012	21.4
5/14/2012	9.5
6/19/2012	15
7/17/2012	10.5
8/7/2012	11.4
9/20/2012	15