SOLOMON BASIN TOTAL MAXIMUM DAILY LOAD

Waterbody/Assessment Unit: Deer Creek
Water Quality Impairment: Sulfate and Selenium
(Modifies Portion of 2003 Waconda Lake Selenium TMDL)

1. INTRODUCTION AND PROBLEM IDENTIFICATION

Subbasin: Lower N. Fk. Solomon **County:** Phillips and Norton

HUC 8: 10260012

HUC 10 (HUC 12)**:** **010** (01, 02, 03, 04, 05, 06 and 07)

Drainage Area: 303.7 square miles

Main Stem Segment: WQLS: 23, 25, 27, 29 and 31 (Deer Creek) starting at confluence with N. Fk. Solomon River just below Kirwin Reservoir in southeast Phillips County and traveling upstream to headwaters in east-central Norton County (**Figure 1**).

Tributaries:
Plum Cr (24)
Spring Cr (28)
Plotner Cr (30)
Boughton Cr (34)
Starvation Cr (38)

Designated Uses: Expected Aquatic Life Support; Secondary Contact Recreation and Food Procurement Use for Main Stem Segments.

Impaired Use: Domestic Water Supply and Aquatic Life Support

Water Quality Standard: Sulfate: 250 mg/L at any point of domestic water supply diversion (K.A.R.28-16-28e(c) (3) (A)

Selenium: 5 ug/L as chronic criterion; 20 ug/L as acute criterion; 50 ug/L as domestic water supply criterion

In stream segments where background concentrations of naturally occurring substances, including chlorides and sulfates, exceed the domestic water supply criteria listed in table 1a in subsection (d), at ambient flow, due to intrusion of mineralized groundwater, the existing water quality shall be maintained, and the newly established numeric criteria for domestic water supply shall be the background concentration, as defined in K.A.R. 28-16-28b(e). Background concentrations shall be established using the methods outlined in the ‘‘Kansas implementation procedures: surface water quality standards,’’ as defined in K.A.R. 28-16-28b(ee), available upon request from the department. (K.A.R. 28-16-28e(c) (3)(B))

2. CURRENT WATER QUALITY CONDITION AND DESIRED ENDPOINT

Level of Support for Designated Use under 2008 303(d): Existing TMDL for Not Supporting Domestic Water Supply and Aquatic Life

Monitoring Sites: Station 721 near Kirwin

Period of Record Used: 1999 –2008 for Station 721

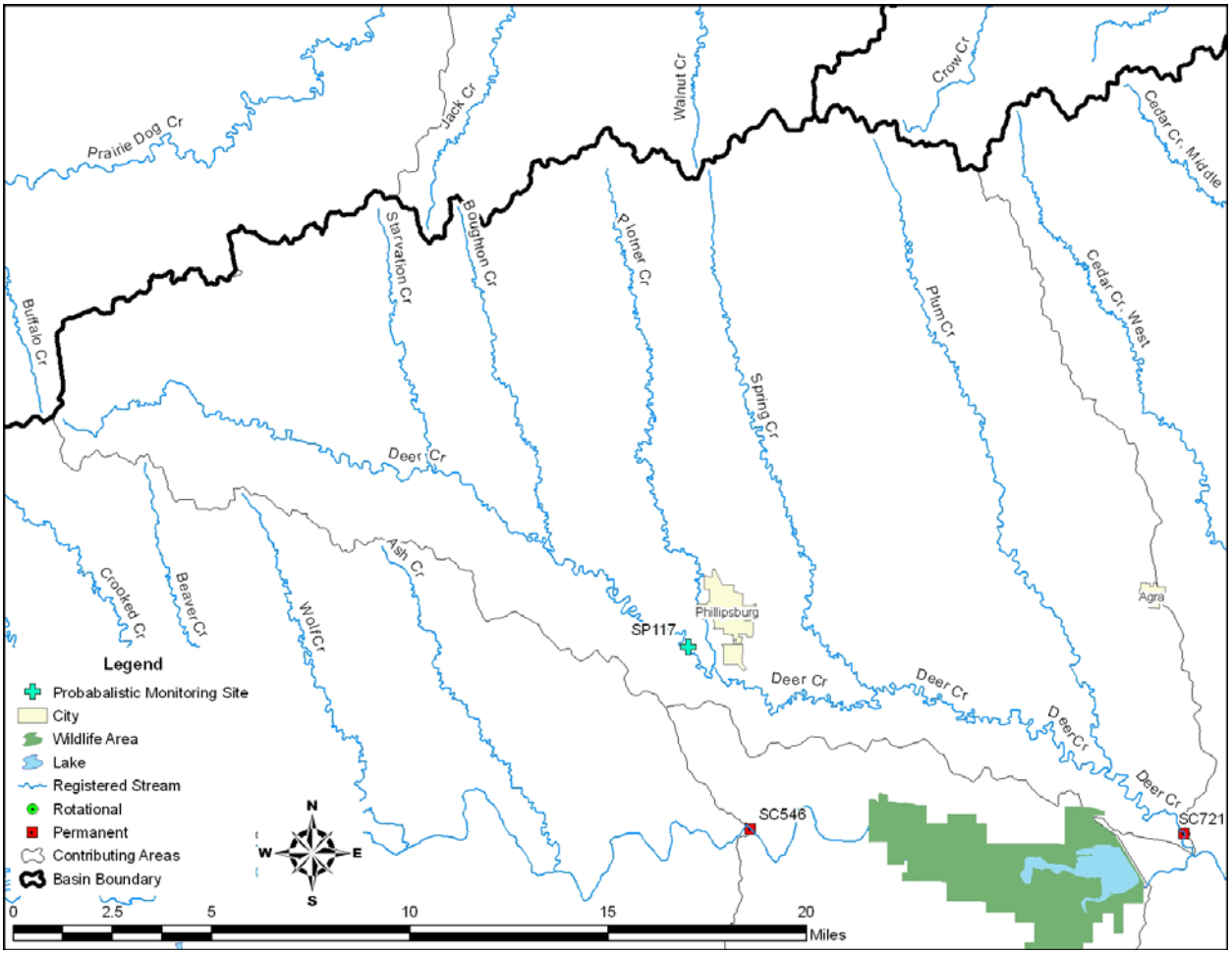

Figure 1 Deer Creek Watershed

Hydrology

The upper portion of Deer Creek (above the confluence with Plotner Creek) does not flow under dry conditions. The lower portion of the watershed might contribute some low flow, but the dominant factor is the wastewater discharges from the four NPDES facilities down Plotner Creek and the drainage ditch to the east. Those four facilities (Phillipburg, TAMKO, Mineral Right and the refinery terminal) make up about 1 cfs of flow so under low flow, the stream is heavily effluent dependent. As flows increase, more incoming flow is generated from the western drainage, mixing with the Plotner Creek discharges, and then joining flow coming from the eastern tributaries. The USGS maintained a gaging station on Deer Creek near Phillipsburg over 1966 – 1981; the flows recorded indicated the hydrologic response from the upper portions of the watershed. Estimation using the gaging station on the North Fork Solomon at Glade hints that hydrologic conditions have been drier since 1999 (**Figure 2**). Flows along the lower portion of the watershed begin in earnest with the upper quartile (75%) flows; the upper watershed contributes flows during median flow conditions (**Table 1**).

Water Use

Phillipsburg essentially supplies users in the central part of Phillips County, including Mineral Right and TAMKO. Phillipsburg gets its water from a large number of wells in the alluvium of the NF Solomon south of the city. DWR reports from 2006 and 2007 indicate total diversions of 0.765 and 1.029 MGD, respectively, yet wastewater discharges average about 0.33 MGD. 2006 residential use was 0.295 MGD and fell after the drought broke in 2007 to 0.258 MGD (**Figure 3**). Sales to industries doubled from 0.28 MGD to 0.536 MGD between 2006 and 2007. This probably reflects the start up of Prairie Horizon Energy's ethanol plant in town.

The composition of Phillipsburg's well water contained an average sulfate of 230 ppm and 23 ppb of selenium. The towns of Glade and Speed also draw from the NF alluvium and see high selenium or sulfate in their water supply. So the wastewater discharge into Deer Creek essentially reflects a transfer of deep NF Solomon alluvial water into the Deer Creek surface drainage. Since Phillipsburg supplies the other users in the vicinity, the source water for the industrial users is infused with water of moderately high sulfate and elevated selenium before any processing occurs.

There is little irrigation (surface or ground water) along Deer Creek, but most of it occurs on the lower reaches north and east of Kirwin. It is likely that some irrigators located below Phillipsburg are diverting the wastewater in Deer Creek.

Ambient Sulfate and Selenium Patterns

Sulfate varies from 100-400 ppm among samples taken on Deer Creek (**Figure 4**). Concentrations below 250 ppm have been seen consistently since 2005. Spikes above 250 might be influenced by high flows moving surface deposits of gypsum into the stream system. Selenium concentrations vary on either side of 9 ppb, the original recommended background

concentration from the 2003 Waconda Lake Selenium TMDL (**Figure 5**). High concentrations were noted at the end of 2008.

Overall averages of sulfates are elevated at lower flows and at higher flows, relative to normal flow conditions (**Figure 6**). The "U" shaped relation might be explained by influence of wastewater at low flows and runoff loading from upland sources during wet periods. The normal conditions might dilute wastewater sufficiently and not see much flow contribution from upland areas, thus, lower sulfate levels are seen. Sulfate concentrations are not correlated to seasonality, as marked by water temperatures above and below 10 degrees C.

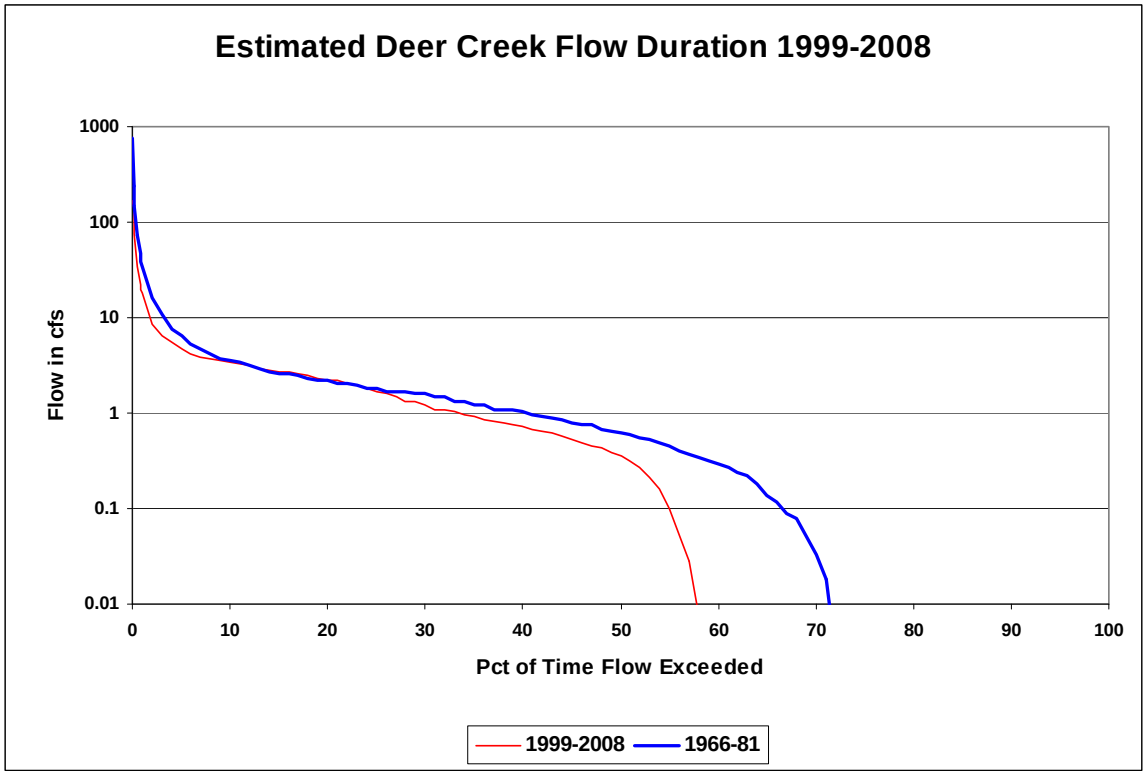

Figure 2. Historic and Estimated Flow Duration on Deer Creek

Stream Name	HUC 12	Dr. Area	Dry 80-100% 90% Q	Low 60-80% 75% Q	Normal 40-60% 50% Q	High 20-40% 25% Q	Wet 0-20% 10% Q	Mean Q
Deer Creek (31)	01	6.6	0	0	0.01	0.01	0.02	0.02
Deer Creek (31)	01	34	0	0	0.14	0.2	0.4	1.65
Starvation Crk (38)	*02*	*21.8*	*0*	*0*	*0.06*	*0.08*	*0.16*	*0.83*
Deer Creek (31)	02	62.9	0	0	0.69	1.5	2.7	4.04
Broughton Crk (34)	*02*	*23.9*	*0*	*0*	*0*	*0*	*0*	*1.09*
Deer Creek (31)	02/03	105	0	0	1.46	3.44	7.07	7.48
Plotner Creek (30)	*03*	*35.6*	*0*	*0*	*0*	*0*	*0.28*	*2.11*
Deer Creek (29)	03/04	152	0	0.11	2.26	5.47	11.8	11.2
Spring Crk (28)	*04*	*37.9*	*0*	*0*	*0*	*0*	*0.76*	*2.46*
Deer Creek (27)	04	197	0	0.47	3.08	7.54	16.7	14.8
Big Creek (26)	*05*	*40.4*	*0*	*0*	*0*	*0.09*	*1.18*	*2.78*
Deer Creek (25)	05	244	0	0.86	3.99	9.82	22	18.7
Plum Creek (24)	*06*	*51.6*	*0*	*0*	*0.13*	*0.63*	*2.4*	*3.79*
Deer Creek (23)	07	305	0	1.35	5.16	12.7	29	23.6

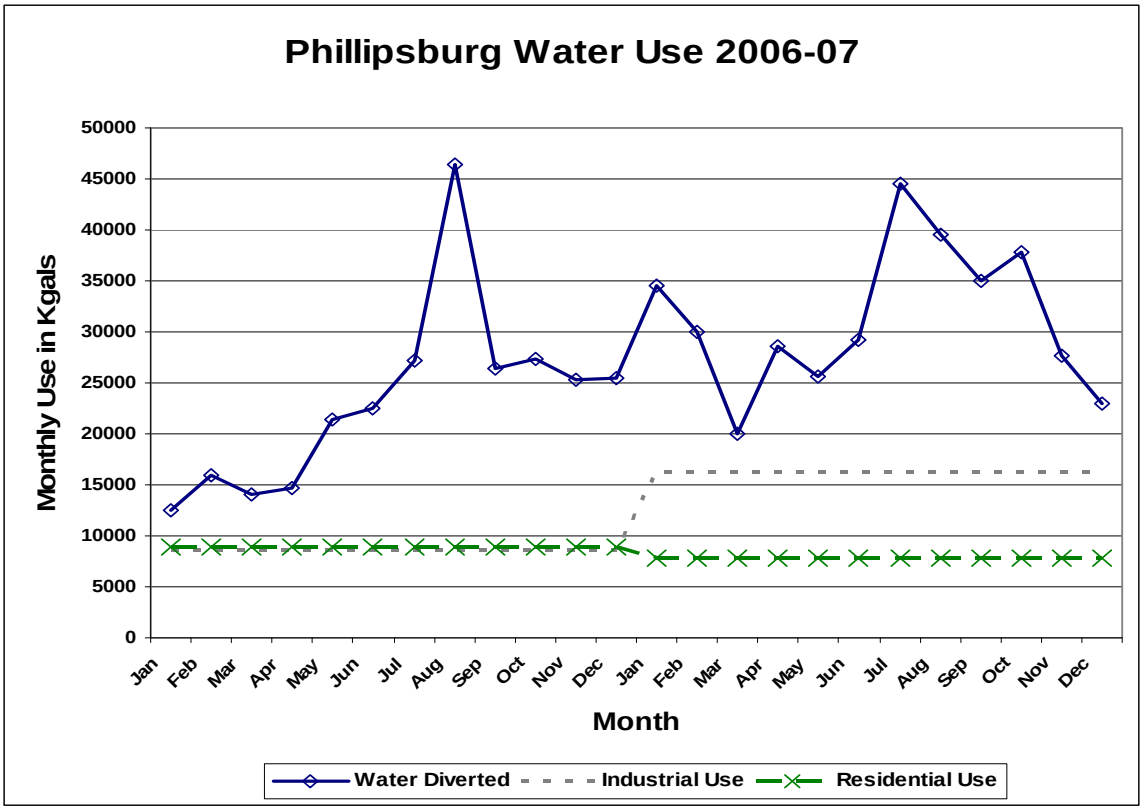

Figure 3. Water Use at Phillipsburg, 2006-2007

Table 1. Estimated flows in the Deer Creek Watershed

Conversely, selenium concentrations are not distinguishable among flow conditions, but are markedly elevated under colder conditions (**Figure 7**). This might reflect constant sourcing by wastewater and ground water seepage into Deer Creek.

Phillipsburg's NPDES permit required monitoring of sulfate and selenium above and below the confluence of Deer and Plotner Creeks (**Figure 8**). That information indicated that there were periods of no flows above the confluence and increased sulfate below the confluence indicating loading from the Plotner dischargers. Selenium was less definitive as far as any increases due to the point sources; elevated selenium was seen on occasion in the reach above Plotner Creek (**Figure 9**).

BEFS' Probabilistic Stream Monitoring Program also sampled Deer Creek above Plotner Creek four times in 2007, concurrently with routine sampling at the regular monitoring site on the lower portion of Deer Creek (**Figure 10**). Those results indicate increases in the downstream direction for both sulfate and selenium, suggesting some influence from sources lying in between the two sampling locations.

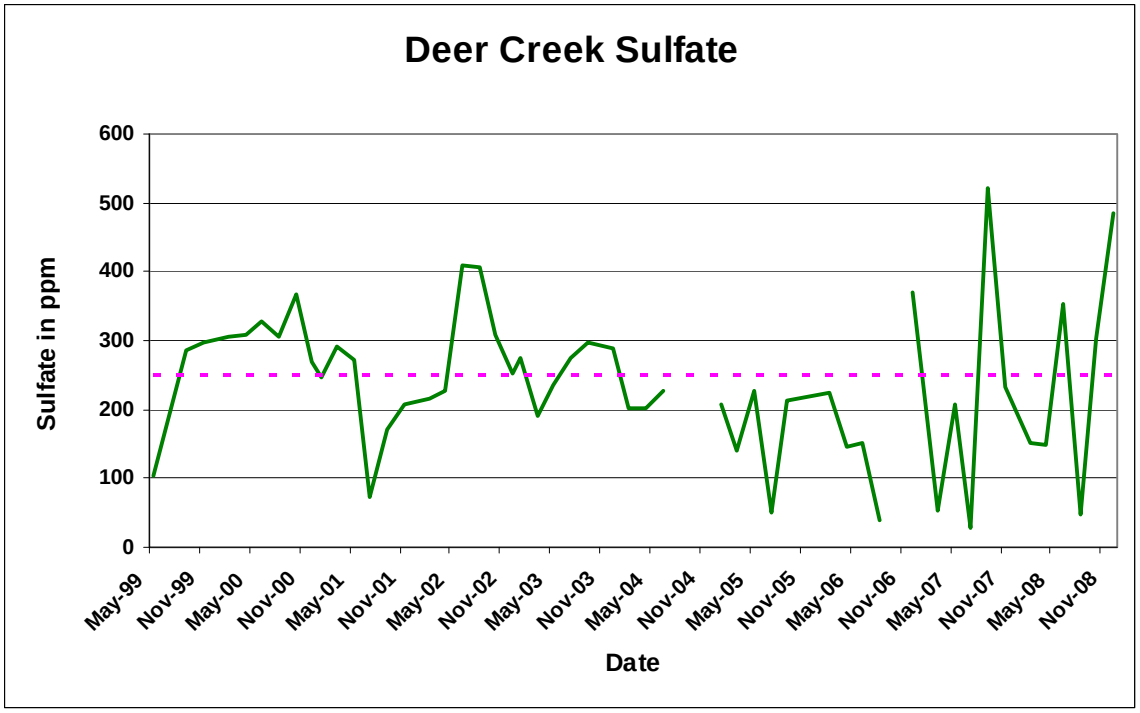

Figure 4. Ambient Sulfate Concentrations on Deer Creek

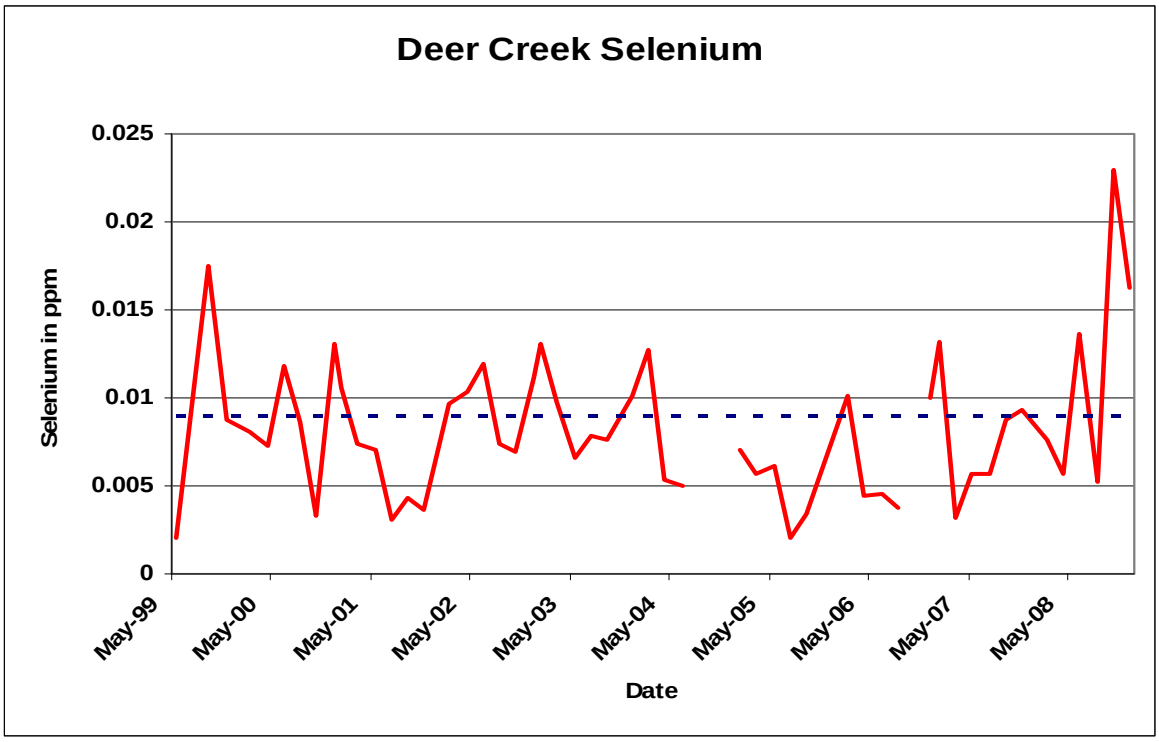

Figure 5. Ambient Selenium Concentrations on Deer Creek

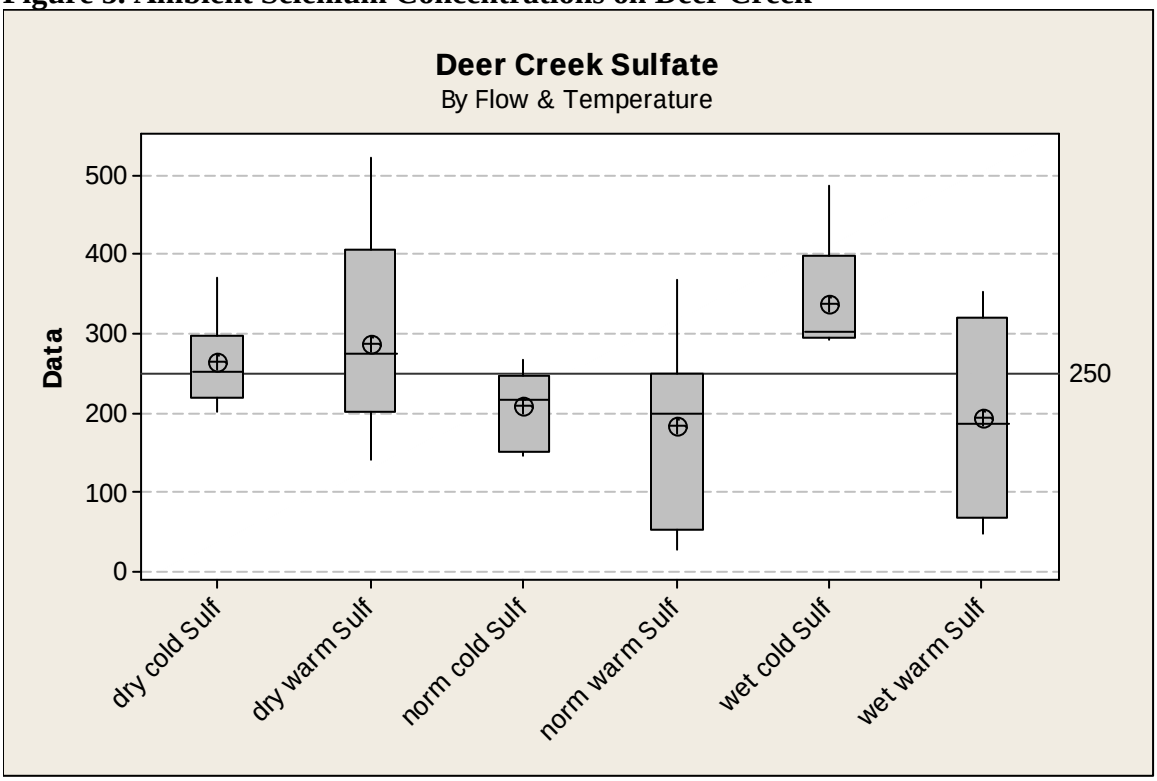

Figure 6. Sulfate Concentrations at Varying Flows and Temperatures

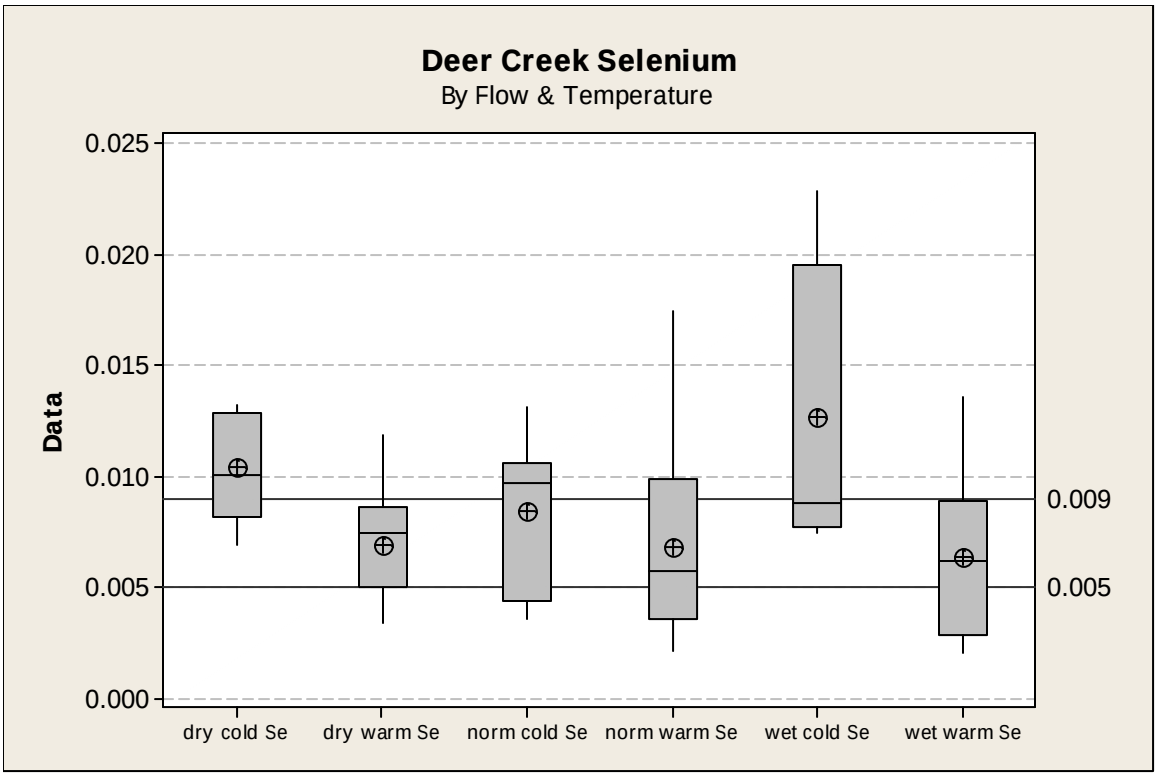

Figure 7. Selenium Concentrations at Varying Flows and Temperatures

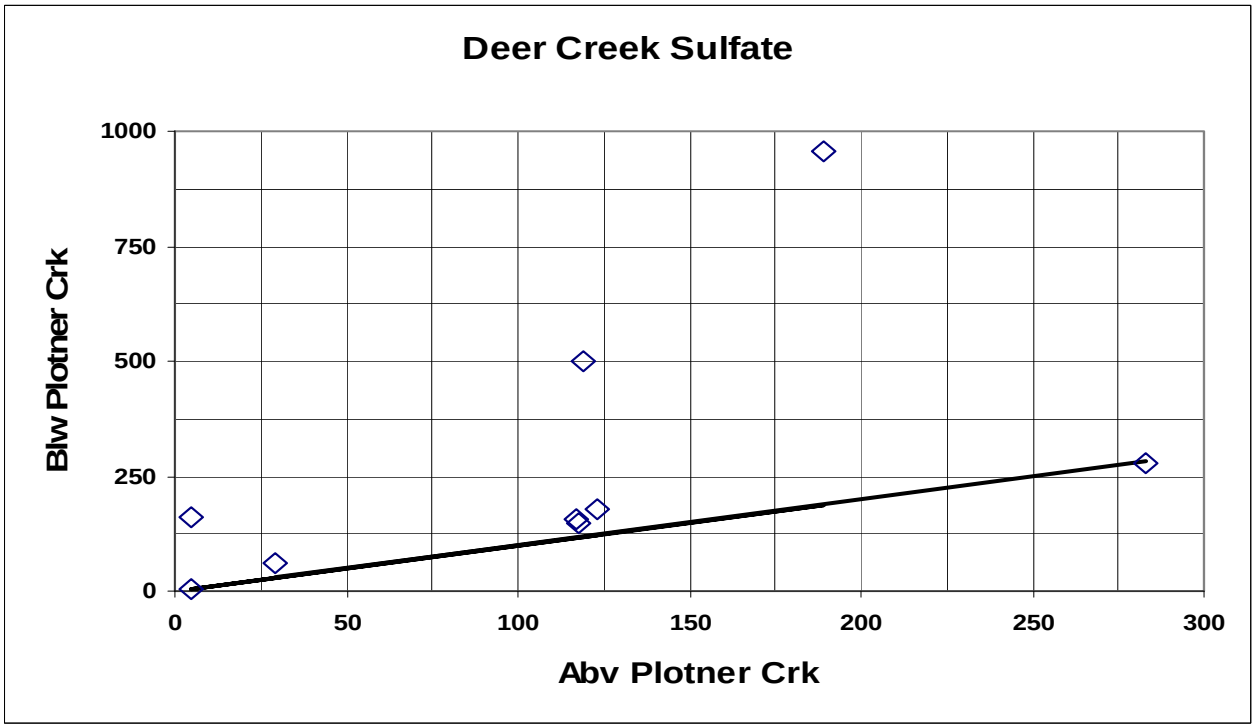

Figure 8. Sulfate Above and Below Phillipsburg Outfall

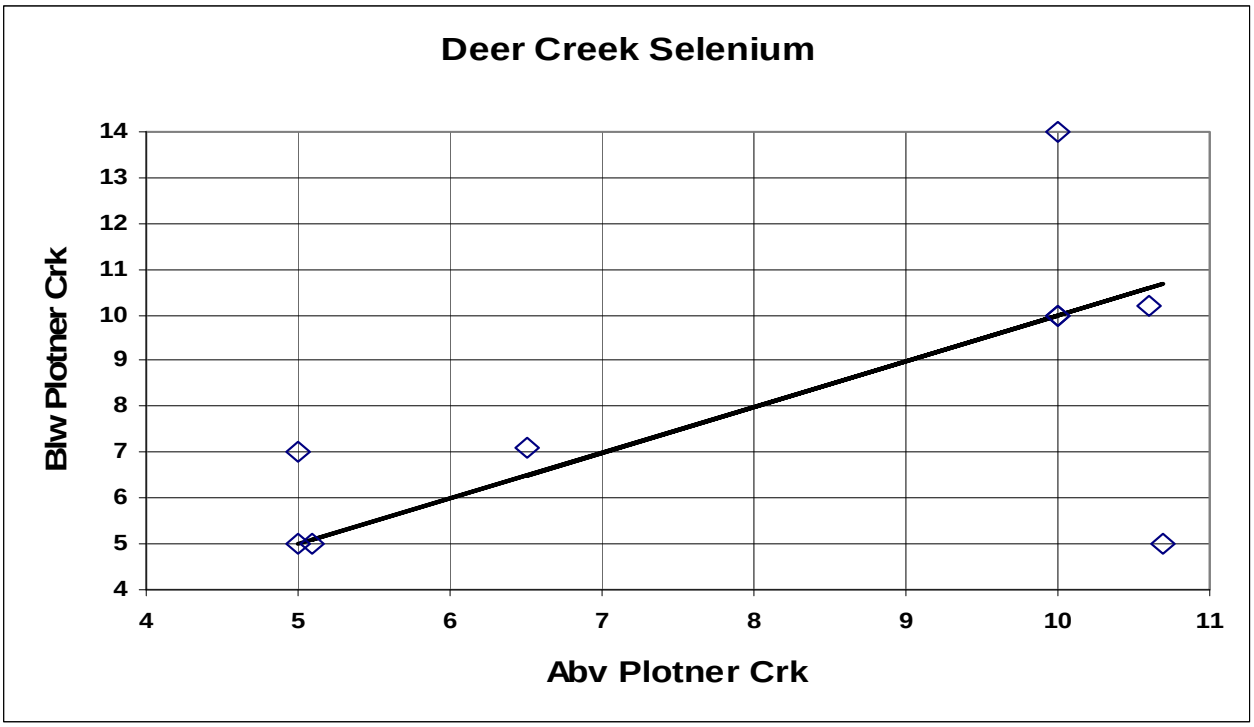

Figure 9. Selenium Above and Below Phillipsburg Outfall

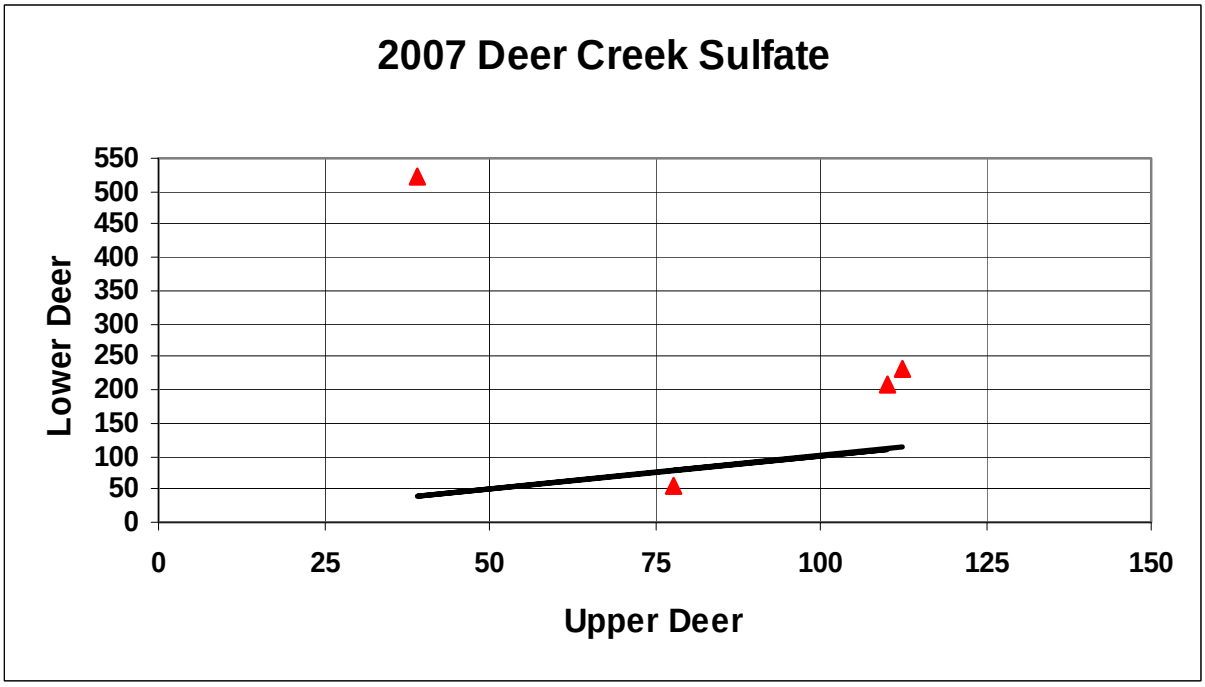

Figure 10. 2007 Sulfate at Upper and Lower Deer Creek Watershed Locations

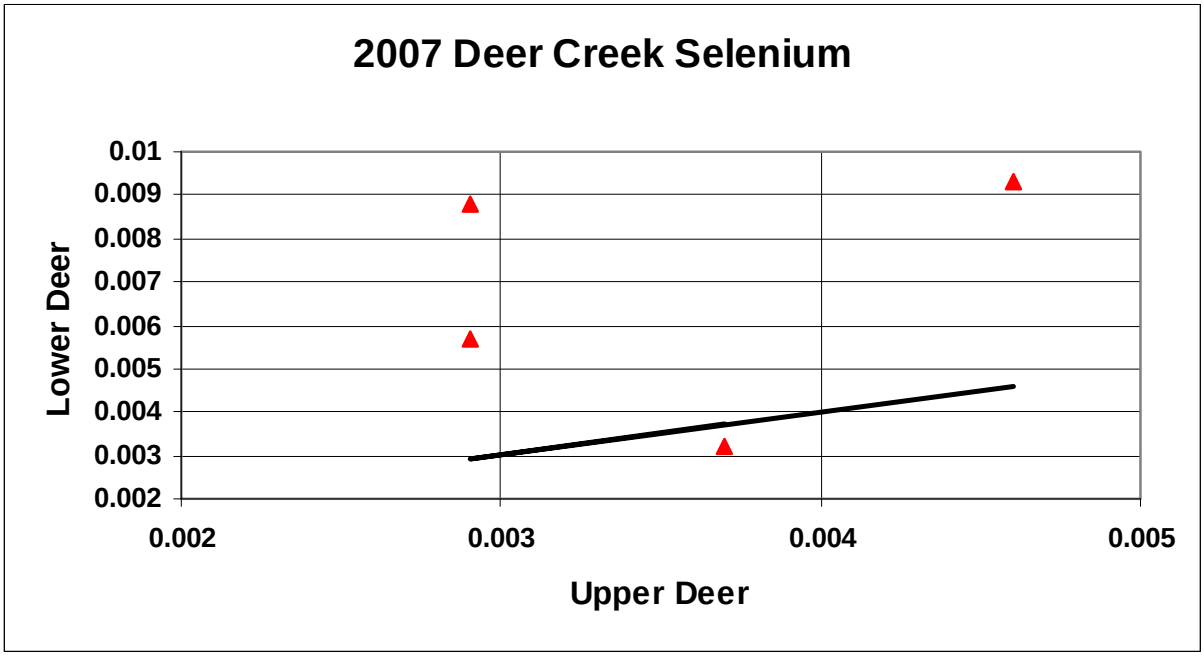

Figure 11. 2007 Selenium at Upper and Lower Deer Creek Watershed Locations

Desired Endpoints of Water Quality (Implied Load Capacity) at Site 721 over 2011 – 2020

The ultimate endpoint for this TMDL will be to achieve Kansas Water Quality Standards which fully support Domestic Water Supply and Aquatic Life. The criterion for sulfate will remain 250 mg/l and that for selenium will be the suggested background concentration of 9 ug/l established in the 2003 TMDL. The objective of the TMDL will be to reduce resulting downstream sulfate and selenium concentrations in the face of increased design flows at the discharging facilities. The endpoints recognize that there is some natural background contributions of sulfate and selenium into the Deer Creek watershed, therefore some elevated concentrations might be expected, particularly at higher flows. However, the purpose of this TMDL will be to reduce loads to Deer Creek, such that reduced concentrations might be seen in the future.

This endpoint will be reached as a result of managing wastewater through source management, alternative water supplies and wastewater volume reduction. Achievement of the endpoint indicates loads 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

NPDES: There are four discharging facilities into the Deer Creek system, all congregated in the vicinity of Plotner Creek (**Table 2**). Municipal permitted wastewater dischargers within the

watershed are shown in **Figure 12**. Of these, only Phillipsburg discharges, the cities of Agra and Prairie View have non-discharging lagoons that will not contribute to the sulfate or selenium load to Deer Creek.

Phillipsburg effluent averaged 430 ppm of sulfate over 2006-2008, which is a marked increase in concentration from the levels seen in the source water (~230 ppm) (**Figure 13**). Wastewater averaged about 10 ppb of selenium over 2006-2008 (**Figure 14**). Concentrations from mid-2007 to 2008 tended to be lower than those of 2006-mid 2007. This might reflect improved flow conditions on the NF Solomon replenishing its alluvium with somewhat fresher water than the ambient ground water that was pumped during the drought. The wastewater selenium concentration is about half of what has been measured in the source water, so perhaps some of the selenium is locked up in the solid phase somewhere in the water supply treatment/distribution or wastewater treatment process, particularly when the effluent encountered low oxygen conditions, lowering the solubility of selenium.

One source of the elevated levels seen in the effluent might be reject water from Prairie Horizon's ethanol operation loading into the wastewater system. In the first three months of 2009, the facility used 0.26-0.30 MGD, returning 0.04-0.09 MGD to the wastewater treatment plant. That reject water averaged 750-930 ppm of sulfate and 18.6-26.8 ppb of selenium. These loadings made up 20-60% of the sulfate load and 20-50% of the selenium load seen in the baseline loads from Phillipsburg. Though more seasonal, Mineral Right may also place some summer loads into the Phillipsburg system.

TAMKO typically adds about 50 ppm of sulfate during its process and use of water supplied by Phillipsburg. There is no real difference in the selenium content seen in the water entering and exiting TAMKO. TAMKO's wastewater averages about 300-350 ppm sulfate and 12 ppb selenium, but tends to be small in volume (**Figure 15**). Note the selenium content of the water supplied by Phillipsburg is also only 12 ppb, so some loss of selenium occurs between the alluvial wells and the distribution system. The ethanol plant also receives relatively low selenium water from Phillipsburg.

Mineral Right only operates during the warm weather season and discharges sporadically. Samples taken in 2005-2006 ranged in sulfate from 241-398 ppm, not terribly different than water supplied by Phillipsburg. However, the sulfate ranges over 2007-2008, jumped to 16-4070 ppm, with 5 of the 7 samples taken during that period over 1000 ppm, indicating some addition by processing (**Table 4**).

The old refinery/terminal is now chiefly a ground water remediation project. The wastewater from that operation, while high in chlorides, is low in sulfate, and may reflect the ambient condition of local ground water in the Phillipsburg area. There is no need to assign wasteload allocations for sulfate or selenium leading to NPDES permit limits for this "clean" point source.

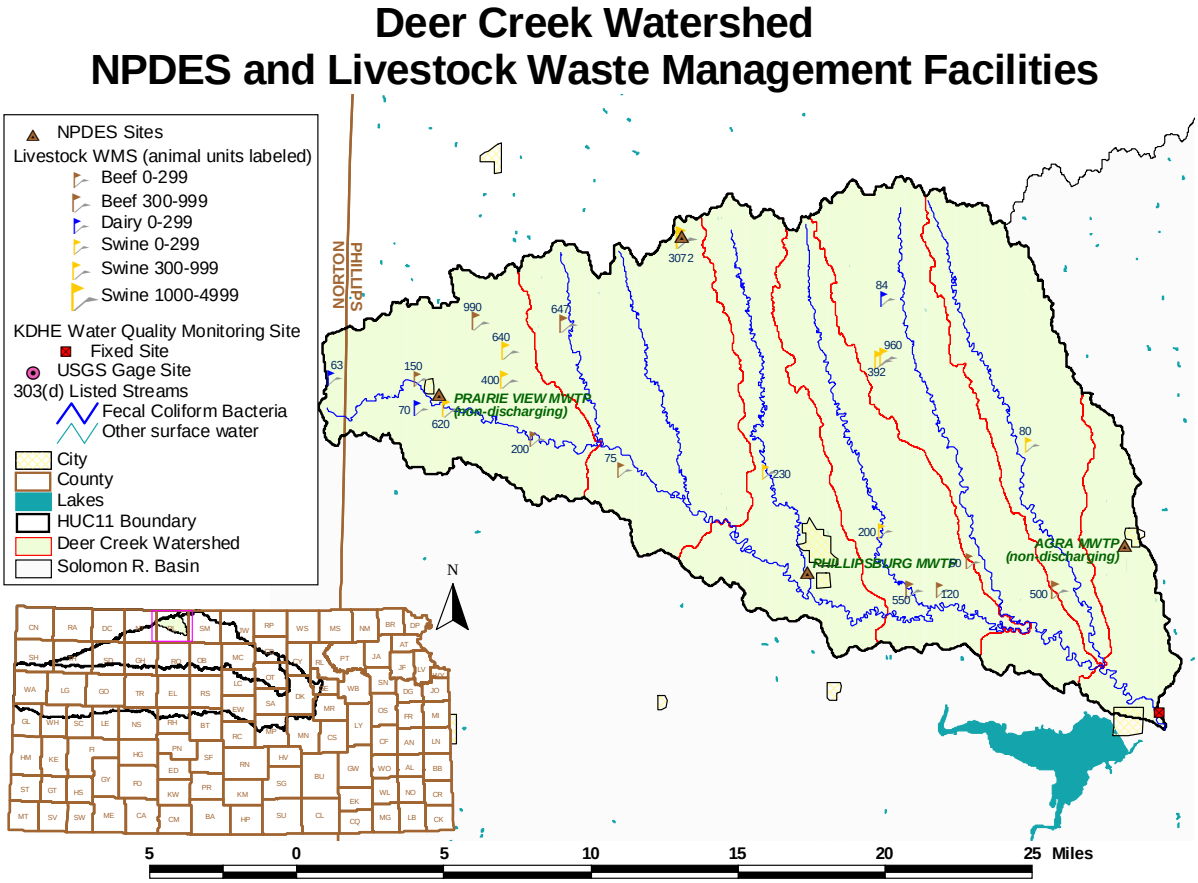

Figure 12. Municipal Dischargers in Deer Creek Watershed

Table 2 NDPES Dischargers to Deer Creek

Discharging Facility	NPDES Permit#	State Permit#	Expiration Date	Design Flow	Type
Phillipsburg WWTP	KS0097331	M-S031-OO02	9/30/14	0.50 MDG	Activated

					Sludge
TAMKO	KS0001392	I-SO31-PO01	9/30/14	0.087 MGD	Settling Basins
Mineral Right	KS0088277	I-SO31-PO04	11/30/09	0.461 MGD	Settling Basin
Coffeyville Resources	KS0089036	I-SO31-PO05	1/31/14	0.1152 MGD	4-Cell Lagoon

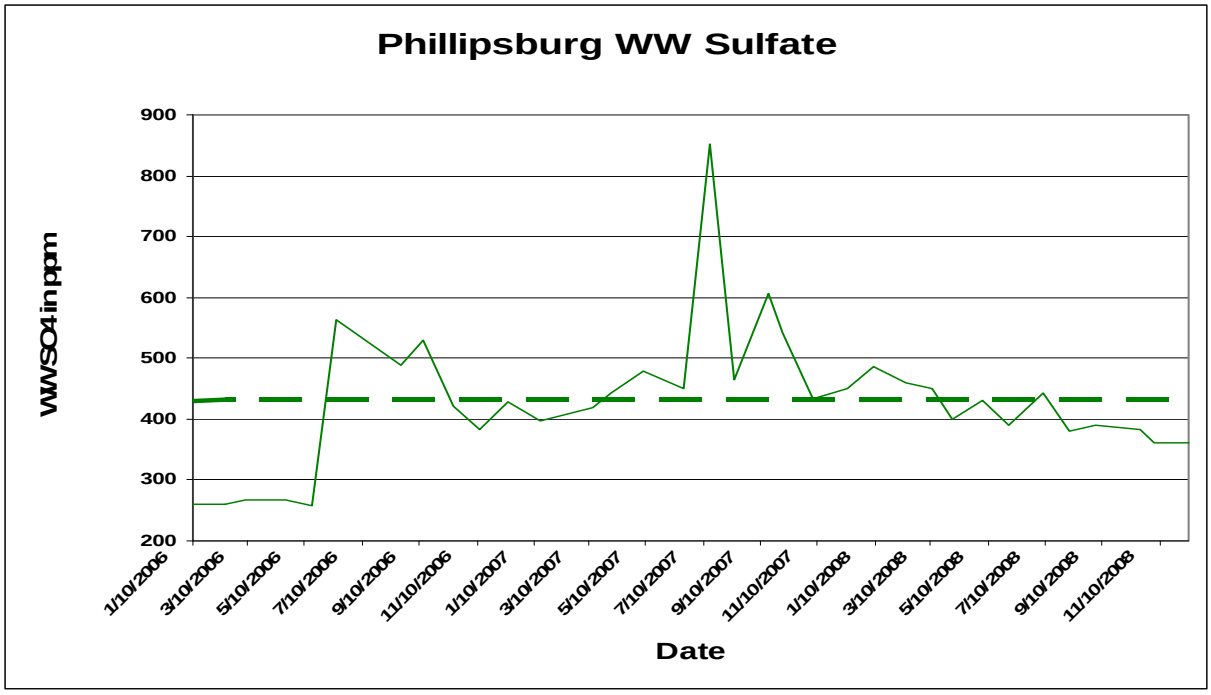

Figure 13. Phillipsburg Wastewater Sulfate Content

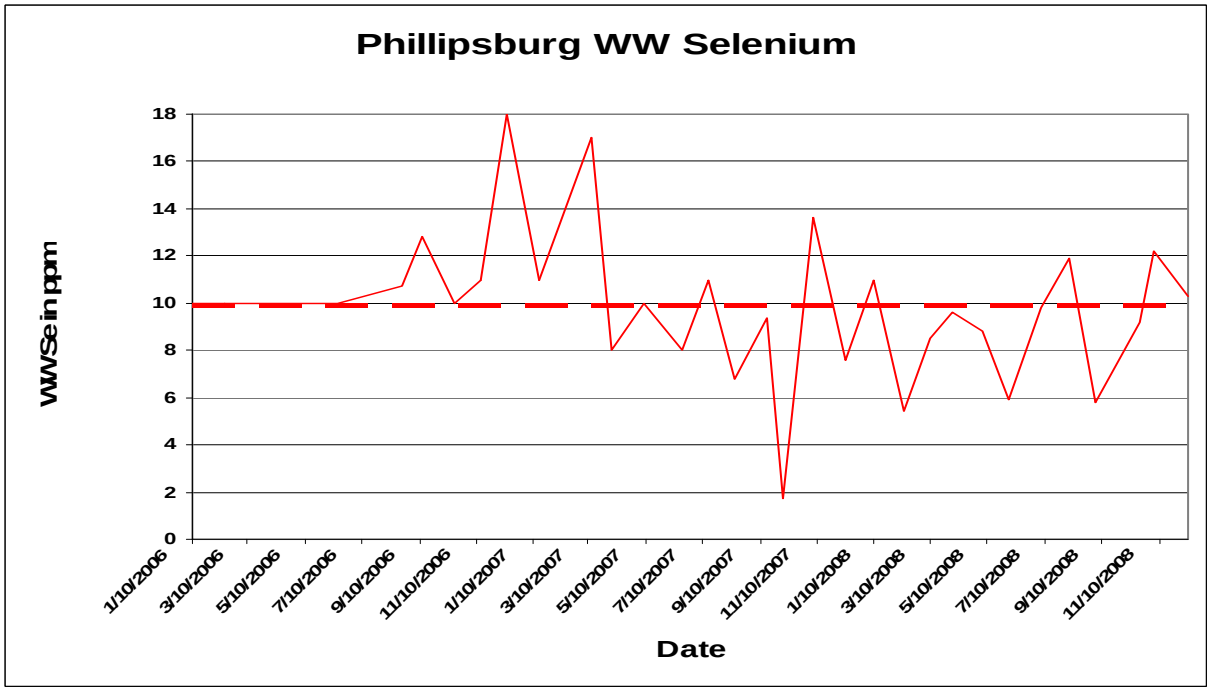

Figure 14. Phillipsburg Wastewater Selenium Content

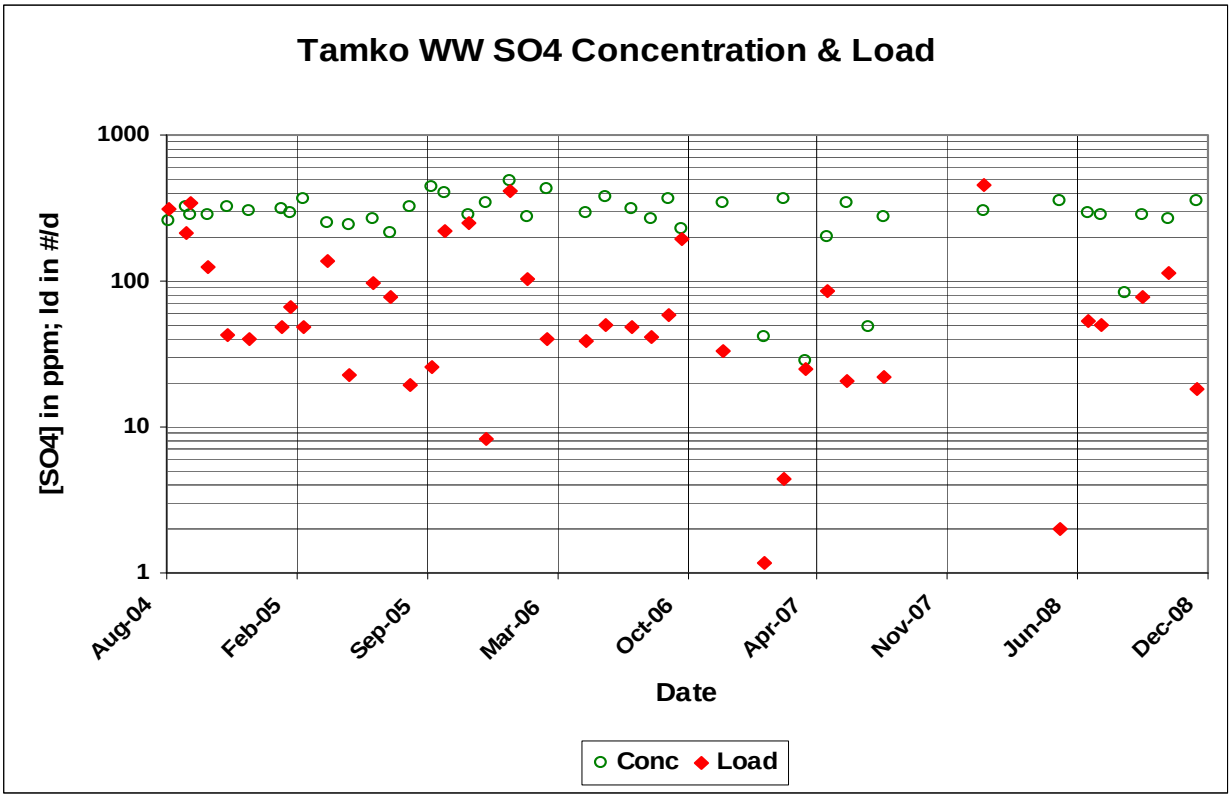

Figure 15. TAMKO Wastewater Sulfate

Table 3. Mineral Right Sulfate Discharges

date	so4	ww flow	so4 load
20050601	284	0.03	71.18676
20050701	324	0.06	162.4261
20050815	398	0.08	266.0313
20050922	290	0.02	48.46047
20060628	273	0.02	45.61968
20060727	370	0.14	432.8021
20060809	338	0.14	395.3706
20060925	241	0.03	60.40848
20070730	2520	0.11	2316.076
20070823	4070	0.18	6121.058
20070918	1230	0.08	822.1569
20071018	16.2	0.2	27.07102
20080522	1100	0.93	8547.424
20080814	1150	0.51	4900.356
20081006	229	0.65	1243.679
average	855.5467	0.212	1697.342

Geology/Soils
The underlying geology is dominated by Niobrara Chalk, particularly the Smoky Hill Member, which contains gypsum and selenate and contributes sulfate and selenium to the surface and ground waters in and around Deer Creek (**Figure 16**). Certain soils in the uplands, such as Wakeen silt loam, are chalky and likely have gypsum deposits which can be transported to the streams under higher flows and contribute sulfate or selenium loads.

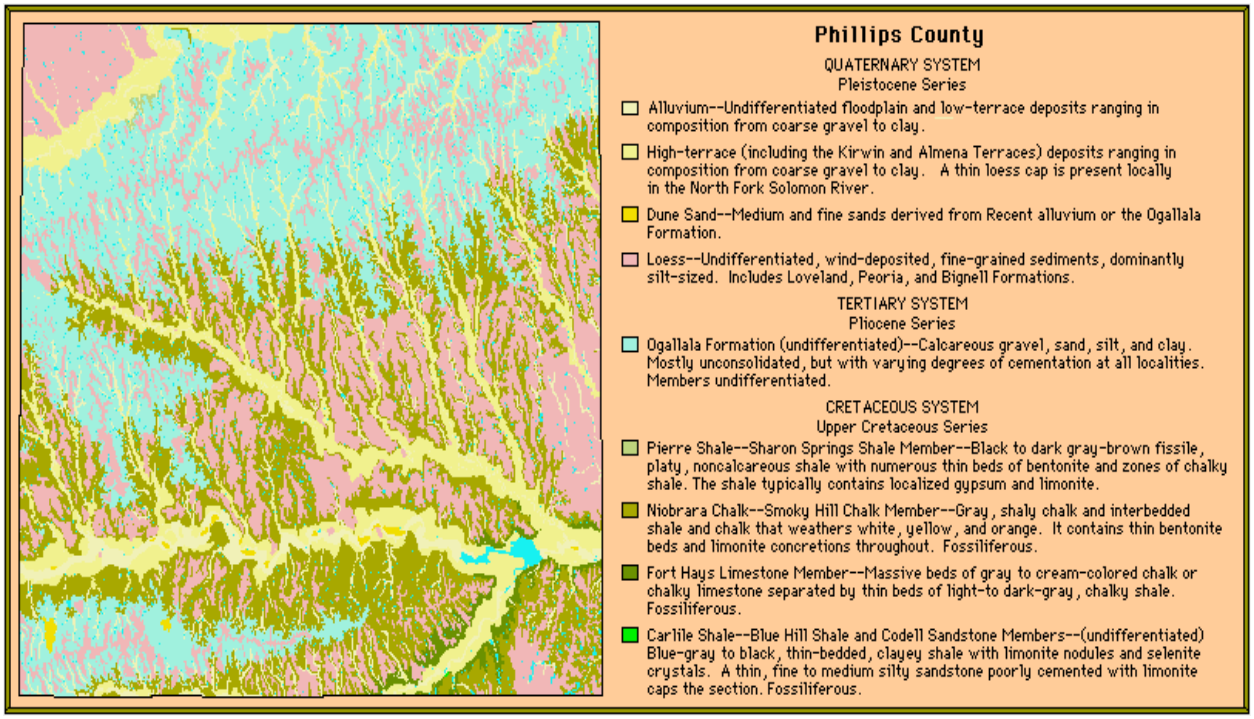

Figure 16. Geologic Map of Phillips County, including Deer Creek Watershed.

4. ALLOCATION OF POLLUTION REDUCTION RESPONSIBILITY

This TMDL will manage reductions in sulfate and selenium through wastewater management with wasteload allocations and conditions. The wasteload allocations essentially provide flexibility in operations and require no immediate changes in process or operations from those currently employed. The wasteload allocations do guard against increased impacts by larger volumes of wastewater from the three facilities on Deer Creek.

For selenium, no wasteload allocations are assigned because it appears that those concentrations are driven by the selenium content of Phillipsburg's water supply. In fact, the processing of water and wastewater do lower the selenium content of the raw water supply. Therefore, the expectation of the revised TMDL will be to continue monitoring of the effluent as well as their respective water supplies.

Point Sources: Sulfate wasteload allocations were determined by simple mass balance calculations involving estimated conditions on Deer Creek, above and below the Plotner Creek – Phillipsburg area and typical concentrations seen from the point sources. The objective was to reduce resulting downstream sulfate and selenium concentrations in the face of increased design flows at the facilities. (Appendix A displays various scenarios of flow condition, ambient

background concentrations and point source contributions). The desired Wasteload Allocations for the three primary dischargers is displayed in **Table 4**.

Table 4. Deer Creek Sulfate Wasteload Allocations

Facility	Current WW flow	Avg SO4	Current Load	Design flow	WW SO4 Goal	WLA
Phillipsburg	0.33 MGD	430 ppm	1186 #/d	0.5 MGD	300 ppm	1253 #/d
TAMKO	0.03 MGD	350 ppm	88 #/d	0.1 MGD	350 ppm	300 #/d
Mineral Right	0.20 MGD	315 ppm	526 #/d	0.25 MGD	315 ppm	658 #/d

The remaining permitted wastewater facilities will have a Wasteload Allocation of zero since they are not expected to discharge to Deer Creek.

Non-Point Sources: Based on the assessment of sources, geologic contributions comprise the non-point source loadings to Deer Creek, without anthropogenic impacts. Therefore, the Load Allocations for sulfate into Deer Creek will be the ambient concentrations seen above the confluence of Plotner Creek and in the intervening flows between Phillipsburg and Kirwin. These Load Allocations vary with flow and and ambient concentration. For the three assumed flow conditions, the Load Allocations are 527 #/d at low flow, 10236 #/d at normal flow and 46683#/d at high flow.

Defined Margin of Safety: The Margin of Safety for this TMDL will be implied, relying on conservative assumptions in the establishment of the wasteload allocations for the three discharging facilities that potentially influence sulfate (and selenium) concentrations on thelower reaches of Deer Creek. Those assumptions include simultaneous discharge at design flow rates and discharge for extended periods of time at higher than anticipated concentrations in the associated wastewater. Since much of the contributions stem from the underlying geology or by imported source water, management of the volume of wastewater discharged to Deer Creek will be effective in deriving more favorable conditions in the creek.

State Water Plan Implementation Priority: Because the potential solution to the elevated sulfate and selenium seen in Deer Creek lies with wastewater management, without necessary treatment intervention, this TMDL will be designated a High Priority for implementation.

Unified Watershed Assessment Priority Ranking: This watershed lies within the Lower North Fork Solomon Basin (HUC 8: 10260012) with a priority ranking of 34 (Medium Priority for restoration work).

Priority Stream Segments: Priority focus of implementation will concentrate on managing wastewater by the facilities in and around Phillipsburg.

5. IMPLEMENTATION

The key to the sulfate wasteload allocations are for the three facilities to work within their assigned loads, not to have sulfate limits placed in their permits. For TAMKO, the facility has historically remained within the 300 pound WLA, except during times of rain, when washoff increases the volume of their wastewater. In all but one of those situations, the concentration of the wastewater was below 300 ppm sulfate.

For Mineral Right, the issue is to evaluate their process to see how and why the sulfate concentrations have increased in the past two years and to work to restore sulfate levels down to levels consistent with their water supply. This would also benefit Phillipsburg by lowering the load of any contribution from Mineral Right into their wastewater system. Because Mineral Right discharges so infrequently (20, 4 and 34 days in 2006, 2007 & 2008, respectively), Mineral Right can also manage the release of their wastewater so as to not create shock loads to Deer Creek.

For Phillipsburg, management comes in two forms. First, work with industrial contributors to their wastewater system, particularly Prairie Horizon, to lower those loadings into the system. Second, locate a new source of water. DWR indicates the city is investigating developing a well field north of the city in the High Plains Aquifer. If this does occur, it will effectively lower the sulfate and selenium content of the water supply which will translate into lower effluent levels from the city as well as its industrial customers. This will certainly improve the selenium loading to Deer Creek which is currently impacted by the selenium content of NF Solomon alluvial ground water.

Therefore, on their respective NPDES permits, the wasteloads should be noted as the limit. If the future limits in the table are included, they have to be viewed in context of the wasteload provided when the facility discharges at the higher design flows. Higher concentrations are permissible if the volume of wastewater is lower than design.

Finally, monitoring requirements should remain for both sulfate and selenium. Wastewater should be monitored and the sulfate/selenium content of the water supply should be reported. For Phillipsburg, this is the aggregate content from the NF well field. For Mineral Right and TAMKO, it is the content of the water received by Phillipsburg.

Also, for Phillipsburg and Mineral Right, sampling on Deer Creek above and below Plotner Creek should continue to gather more information on the relative impact of the discharges on Deer Creek. For Phillipsburg, they should sample 3-4 times a year and note conditions on upper Deer Creek (no flow, dry weather baseflow or runoff). For Mineral Right they should sample 1-2 times during their operational season at the time they are making a release from their facility.

Suggested conditions for Phillipsburg ,TAMKO and Mineral Right NPDES permits to account for Sulfate and Selenium TMDLs for Deer Creek.

1. Phillipsburg
    a. Monitor daily flow in MGD from outfall

b. Selenium: Monitor quarterly
c. Sulfate: Monitor monthly and set a final wasteload limit of 1253 pounds per day.
d. Monitor Deer Creek locations upstream and downstream of Plotner Creek for sulfate and selenium quarterly and note flow conditions at time of sampling.
e. Monitor sulfate and selenium content of raw water supply from NF Solomon well field.
f. Evaluate feasibility of reducing sulfate wasteloads from industrial users discharging into wastewater system.
g. Evaluate impact of using alternate water supply withdrawn from High Plains Aquifer north of city on sulfate and selenium concentrations in water supply and wastewater.

2. TAMKO
   a. Monitor weekly flow in gpd from Outfalls #001 & #003
   b. Selenium: Monitor quarterly at Outfall #004
   c. Sulfate: Monitor monthly at Outfall #004 and set a final wasteload limit of 300 pounds per day
   d. Monitor sulfate and selenium content of water supply received from Phillipsburg (#005) on schedule consistent with outfall #004 monitoring.

3. Mineral Right
   a. Monitor daily flow in MGD from outfall
   b. Selenium: Monitor quarterly
   c. Sulfate: Monitor monthly and set a final wasteload limit of 658 pounds per day.
   d. Monitor daily flow in MGD and monthly sulfate of process wash water directed to city sanitary sewer system.
   e. Monitor sulfate and selenium content of water supply received from Phillipsburg on schedule consistent with outfall monitoring.
   f. Monitor Deer Creek locations upstream and downstream of Plotner Creek for sulfate and selenium twice during wastewater discharges between May and October and note flow conditions in creek at time of sampling.
   g. Evaluate cause of increased sulfate in wastewater during 2007-2008 over concentrations seen in wastewater during 2005-2006.

Timeframe for Implementation: Wastewater management practices should be initiated during the current (2009-2014) permit period; conditions will be assessed at time of permit renewal in 2014 to determine if additional actions are necessary.

Targeted Participants: Primary participants for implementation will be water supply and wastewater operators at the three discharging facilities.

Milestone for 2014: In accordance with the TMDL development schedule for the State of Kansas, the year 2014 marks the next cycle of 303(d) activities in the Solomon Basin. At that point in time, sulfate and selenium at Site 721 on Deer Creek should show indications of declining concentrations relative to those seen prior to 2010.

Delivery Agents: The primary deliver agents for program participation will be KDHE, the City of Phillipsburg and industrial users in and around Phillipsburg.

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

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

2. 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.

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 071 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 Solomon River Basin Plan provide the guidance to state agencies to coordinate programs intent on protecting water quality and to target those programs to geographic area of the state for high priority in implementation.

Funding: The State Water Plan annually generates $16-18 million and is the primary funding mechanism for implementing water quality protection and pollution 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 watershed and water resources of highest priority. Typically, the state allocates at least 50% of the fund to programs supporting water quality protection. This watershed and its TMDL are located within a **High**

Priority WRAPS area and should receive support for pollution abatement practices that lower the loading of sulfate and selenium into the North Fork Solomon River and Waconda Lake.

Effectiveness: Management of wastewater discharges and source water supply integrity will be effective in lowering sulfate and selenium content of wastewater discharged to Deer Creek.

6. MONITORING

KDHE will continue to collect quarterly to bimonthly samples in every year at Station SC721. Based on the sampling data, the priority status of the 303(d) listing will be evaluated in 2014. If the impairment status of Deer Creek changes, the desired endpoints under this TMDL may be refined to reflect necessary reductions in sulfate and selenium. Additional data will be collected through the permitted facilities pursuant to the conditions of their NPDES permit. The stream will be evaluated for possible delisting in 2020.

7. FEEDBACK

Public Notice: An active Internet Web site was established at www.kdheks.gov/tmdl/ to convey information to the public on the general establishment of TMDLs and specific TMDLs for the Solomon Basin.

Public Hearing: A Public Hearing on this TMDL was held on February 10, 2010 in Phillipsburg to receive comments on this TMDL.

Basin Advisory Committee: The Solomon River Basin Advisory Committee met to discuss the TMDLs in the basin on July 7, 2009 in Stockton and September 30, 2009 in Stockton and again on March 2, 2010 in Beloit.

Watershed Restoration and Protection Strategy Group: This TMDL has been reviewed in February, 2010 by the Waconda Lake WRAPS group.

Milestone Evaluation: In 2014, evaluation will be made as the degree of implementation which has occurred 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 2014 with consultation from local stakeholders and WRAPS teams.

Consideration for 303(d) Delisting: Deer Creek will be evaluated for delisting under section 303(d), based on the monitoring data over 2010-2019. Therefore, the decision for delisting will come about in the preparation of the 2020-303(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 2010, which will emphasize implementation of WRAPS activities. At that time, incorporation of this TMDL will be made

into the WRAPS. Recommendations of this TMDL will be considered in the Kansas Water Plan implementation decisions under the State Water Planning Process for Fiscal Years 2010-2019.

Developed February 9, 2010

Appendix A. Wasteload Scenarios for Sulfate Reduction on Deer Creek

Scenario	upstream q	upstrm sulf	refinery q	refinery sulf	Min Rt q	Min Rt Sulf	Pburg q	Pburg Sulf	Tamko q	Tamko Sulf	Interv q	Interv sulf	721 q	721 sulf
Low Flow	**0**	**0**	**0.139254**	**150**	**0.309454**	**315**	**0.510599**	**430**	**0.046418**	**350**	**0.5**	**195.0952**	**1.505725**	**300.00**
Baseline			**0.09**		**0.2**		**0.33**		**0.03**					
			WLA =	**112.79592**		**526.38094**		**1185.61**		**87.730156**	**LA ds=**	**526.76**	**LC =**	**2439.27**
		WW flow	**1.005725**										**1.5**	
Low Flow	0	0	0.154727	150	0.386817	315	0.773635	430	0.154727	350	0.5	195	1.969906	319.49
Design q			**0.1**		**0.25**		**0.5**		**0.1**					
			WLA =	125.32879		657.97617		1796.379		292.43385	LA ds=	526.5	LC =	3398.62
		WW flow	1.469906											0.00
Low Flow	0	0	0.154727	150	0.386817	315	0.773635	**300**	0.154727	350	0.5	195	1.969906	268.44
Design q			0.1		0.25		0.5		0.1					
Lower Pburg			WLA =	125.32879		657.97617		1253.288		292.43385	LA ds=	526.5	LC =	2855.53
		WW flow	1.469906											0.00
Low Flow	0	0	0.154727	150	0.386817	**855**	0.773635	430	0.154727	350	0.5	195	1.969906	425.53
Design q			0.1		0.25		0.5		0.1					
High Min Rt			WLA =	125.32879		1785.9353		1796.379		292.43385	LA ds=	526.5	LC =	4526.58
		WW flow	1.469906											0.00
Low Flow	0	0	0.154727	150	0.386817	**1400**	0.773635	430	0.154727	350	0.5	195	1.969906	532.55
Design q			0.1		0.25		0.5		0.1					
V High Min Rt			WLA =	125.32879		2924.3385		1796.379		292.43385	LA ds=	526.5	LC =	5664.98
		WW flow	1.469906											0.00
Low Flow	0	0	0.154727	150	**0**	315	0.773635	430	0.154727	350	0.5	195	1.583088	320.59
Design q			0.1		**0**		0.5		0.1					
No Min Rt			WLA =	125.32879		0		1796.379		292.43385	LA ds=	526.5	LC =	2740.64
		WW flow	1.083088											0.00
Low Flow	0	0	0.154727	150	0.386817	315	0.773635	430	**0**	350	0.5	195	1.815179	316.89
Design q			0.1		0.25		0.5		**0**					

No TAMKO			WLA =	125.32879		657.97617		1796.379		0	LA ds=	526.5	LC =	3106.18
		WW flow	1.315179											0.00
Low Flow	0	0	0.154727	150	0.386817	315	0.773635	300	0.154727	350	0.5	195	1.969906	268.44
TMDL			0.1		0.25		0.5		0.1					
			WLA =	125.32879		657.97617		1253.288		292.43385	LA ds=	526.5	LC =	2855.53
		WW flow	1.469906											0.00
Normal	2.5	250	0.139254	150	0.309454	315	0.510599	430	0.046418	350	5.5	231	9.005725	249.80
Flow			0.09		0.2		0.33		0.03					
Current			WLA =	112.79592		526.38094		1185.61		87.730156	LA ds=	10235.7	LC =	12148.22
WLA		WW flow	1.005725										9	
Normal	2.5	250	0.154727	150	0.386817	315	0.773635	300	0.154727	350	5.5	231	9.469906	245.70
Flow			0.1		0.25		0.5		0.1					
TMDL			WLA =	125.32879		657.97617		1253.288		292.43385	LA ds=	10235.7	LC =	12564.73
		WW flow	1.469906										9	
High	7	185	0.139254	150	0.309454	315	0.510599	430	0.046418	350	21	350	29.00572	310.25
Flow			0.09		0.2		0.33		0.03					
Current			WLA =	112.79592		526.38094		1185.61		87.730156	LA ds=	46683	LC =	48595.52
WLA		WW flow	1.005725										29	
High	7	185	0.154727	150	0.386817	315	0.773635	300	0.154727	350	21	350	29.46991	307.99
Flow			0.1		0.25		0.5		0.1					
TMDL			WLA =	125.32879		657.97617		1253.288		292.43385	LA ds=	46683	LC =	49012.03
		WW flow	1.469906										29	
High	7	185	0.154727	150	0.386817	855	0.773635	430	0.154727	350	21	350	29.46991	318.49
Flow			0.1		0.25		0.5		0.1					
High Min Rt			WLA =	125.32879		1785.9353		1796.379		292.43385	LA ds=	46683	LC =	50683.08
		WW flow	1.469906										29	
High	7	185	0.154727	150	0	855	0.773635	430	0.154727	350	21	350	29.08309	311.35
Flow			0.1		0		0.5		0.1					
No Min Rt			WLA =	125.32879		0		1796.379		292.43385	LA ds=	46683	LC =	48897.14

		WW flow	1.083088										29	
High	7	185	0.154727	150	0.386817	315	0.773635	430	0	350	21	350	29.31518	311.19
Flow			0.1		0.25		0.5		0					
High Min Rt			WLA =	125.32879		657.97617		1796.379		0	LA ds=	46683	LC =	49262.68
		WW flow	1.315179										29	
Low Flow	0	0	0.154727	150	0.386817	1400	0.773635	430	0	350	0.5	195	1.815179	548.11
Design q			0.1		0.25		0.5		0					
V High Min Rt			WLA =	125.32879		2924.3385		1796.379		0	LA ds=	526.5	LC =	5372.55
No Tamko		WW flow	1.315179											0.00
Normal	2.5	250	0.154727	150	0.386817	1400	0.773635	375	0.154727	350	5.5	231	9.469906	296.15
Flow			0.1		0.25		0.5		0.1					
V High Min Rt			WLA =	125.32879		2924.3385		1566.61		292.43385	LA ds=	10235.7	LC =	15144.41
		WW flow	1.469906										9	
Low Flow	0	0	0.23209	150	0.23209	315	0.773635	300	0.046418	350	0.5	195	1.784233	254.32
Best Scenario			0.15		0.15		0.5		0.03					
			WLA =	187.99319		394.7857		1253.288		87.730156	LA ds=	526.5	LC =	2450.30
		WW flow	1.284233											0.00
					0.143896	855								
					0.093									
						664.36794								