MISSOURI RIVER BASIN TOTAL MAXIMUM DAILY LOAD

Waterbody/Assessment Unit: South Fork Big Nemaha River
Water Quality Impairment: Biology

1. INTRODUCATION AND PROBLEM IDENTIFICATION

Subbasin: South Fork Big Nemaha

Counties: Nemaha (KS), Marshall (KS), Pawnee (NE), and Johnson (NE)

HUC 8: 10240007

Ecoregion: Western Corn Belt Plains, Loess and Glacial Drift Hills (47i)

Drainage Area: Approximately 517.0 sq. miles (KS: 314.6 sq. miles)

Main Stem Segments: WQLS: **3**, 15 and 16, starting 0.4 mile downstream from the confluence with Turkey Creek in North-central Nemaha County and traveling upstream to headwaters in South-central Nemaha County (**Figure 1**).

Tributary Segments:

- Turkey Cr (4 &5)
  - Burger Cr (24)
  - Wolf Cr (12 & 13)
  - Manley Cr (14)
  - Wildcat Cr (22)
- Deer Cr (18)
  - Wolf Pen Cr (25)
- Harris Cr (166)
- Wildcat Cr (23)
- Fisher Cr (28)
- Tennessee Cr (29)
- Illinois Cr (30)

Designated Uses: Primary Contact Recreation "C" on main stem segment 15 and Secondary Contact Recreation on the remaining main stem segments (3 and 16) and tributaries. Other designated uses for main stem segments include Expected Aquatic Life Support and Domestic Water Supply, Food Procurement, Ground Water Recharge, Industrial Water Supply, Irrigation and Livestock watering.

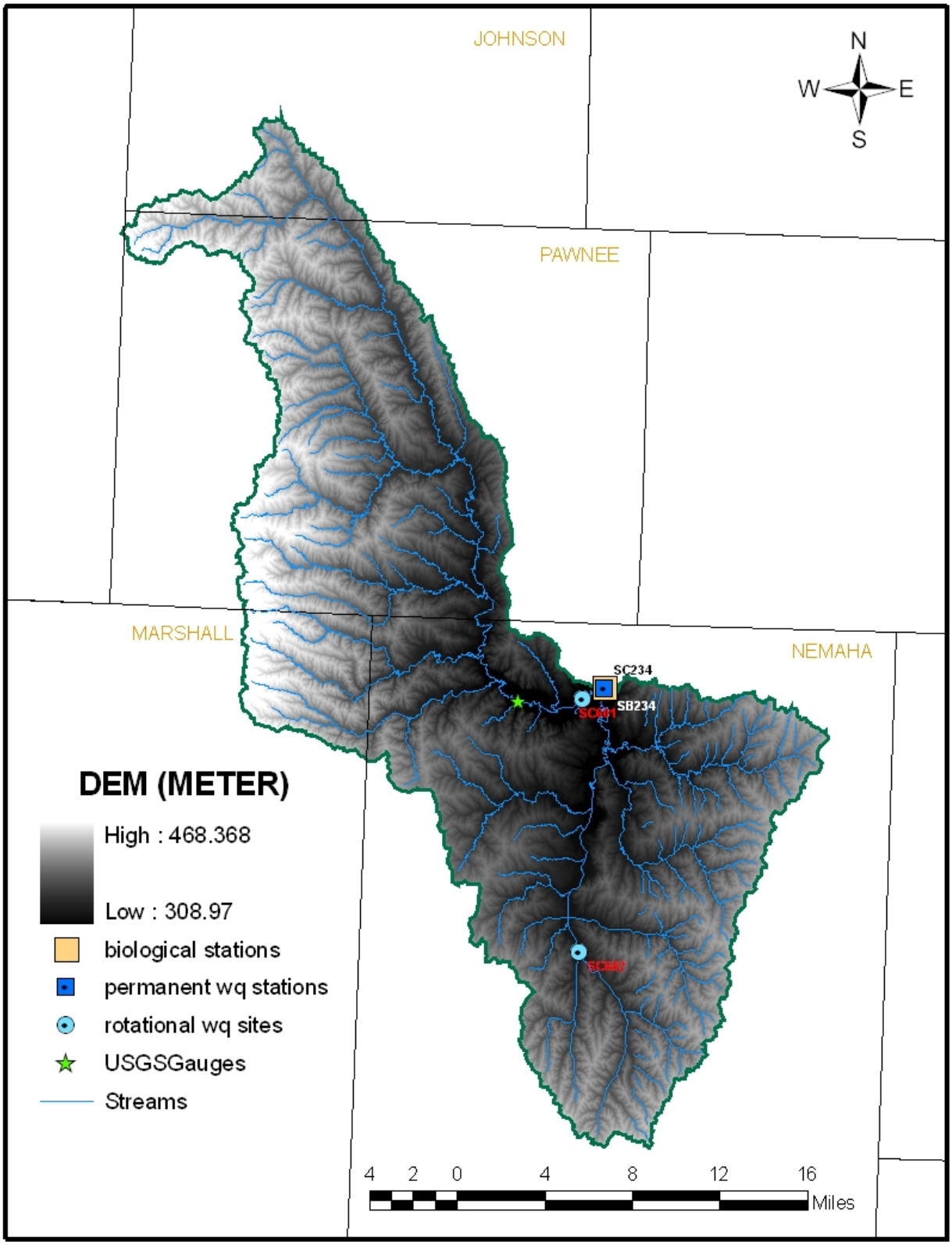

Figure 1. DEM, biological and water quality monitoring stations, and USGS gaging station in South Fork Big Nemaha Watershed

2002, 2004, 303(d) Listing: Missouri River Basins – South Fork Big Nemaha River, Main Stem Segments (3, 15, and 16-part)

Impaired Use: Expected Aquatic Life Support on Main Stem Segments

Water Quality Standard: Suspended solids – Narrative: Suspended solids added to surface waters by artificial sources shall not interfere with the behavior, reproduction, physical habitat or other factor related to the survival and propagation of aquatic or semi-aquatic or terrestrial wildlife. (KAR 28-16-28e(c)(2)(B)).

2. CURRENT WATER QUALITY CONDITION AND DESIRED ENDPOINT

Level of Support for Designated Use under 2004 303(d): Not Supporting Aquatic Life

Monitoring Site: Biological Monitoring Station (SB234) and Permanent Ambient Stream Water Quality Monitoring Station (SC234) with two upstream Rotational Water Quality Stations (SC601 and SC682). SC601 is located on Main Stem Segment (4) of Turkey Creek near Bern whereas SC682 is located on Main Stem Segment (16) of South Fork Big Nemaha River near Seneca.

Period of Record Used: Biology (SB234): 1983 – 2005 (9 biological samples); Water Quality (SC234): monthly from 1985 to 1989 and bimonthly during the period between 1990 and 2005. Rotational Water Quality: 1991 – 2005 for SC601 and 1994 – 2005 for SC682.

Flow Record: Turkey Creek near the city of Bern (USGS Gaging Station 06814000; 1950 – 2005) was used to estimate flow for Biological Station SB234 at South Fork Big Nemaha River Basin based on the proportional drainage area (Perry et al., 2004).

Long Term Flow Conditions: South Fork Big Nemaha River: Estimated Median Flow = 37 cfs, 7Q10 = 0.06 cfs, 10% Exceedance Flow = 363 cfs, 95% Exceedance Flow = 0.9 cfs.

Current Conditions: Biological criteria for stream health in Kansas are based on multi-metric indices: (1) Macroinvertebrate Biotic Index (MBI) developed to assess the impact of oxygen demanding nutrients and organic enrichment on macroinvertebrate populations; (2) Kansas Biotic Index (KBI) developed specifically for Kansas insects (10 orders) to address potential impairment associated with nutrient oxygen demand; (3) EPT index is the portion of aquatic taxa present within a stream belonging to three pollution intolerant orders [Ephemeroptera (mayflies), Plecoptera (stoneflies), Trichoptera (caddisflies)] – the presence of greater numbers of these species is considered indicative of higher water quality because these macroinvertebrates use coarse substrates as habitats; and (4) %EPT Abundance is the percentage of all individuals collected belonging to these three orders. **Table 1** shows average index values from 1983 to 2004 and their associated criteria.

Table 1. Multi-Metric indices for Biological Monitoring Station SB234 in 1983 – 2005.

Biological Index	Average	Fully Supporting	Partially Supporting	Non-Supporting
MBI	4.91	$\leq$ 4.5	4.51 – 5.39	$\geq$ 5.4
KBI	2.84	$\leq$ 2.6	2.61 – 2.99	$\geq$ 3.0
EPT	12	$\geq$ 13	8 – 12	$\leq$ 8
%EPT	49.7	$\geq$ 48	31 – 47	$\leq$ 30

For this stream segment, average MBI, KBI, and EPT values indicate that aquatic life support is partially impaired, while average %EPT show that aquatic life is fully supported. To holistically address aquatic support, these biological indices were integrated according to 305(b) methodology, with the exception of %EPT index. The exclusion of %EPT index in this biological assessment was because its individual values were highly correlated with EPT values (**Table 2**) and the metric itself does not measure diversity of community structure.

Table 2. Correlation of the multi-metric indices for Biological Monitoring Station SB234.

Biological Index	MBI	KBI	EPT	%EPT
MBI	1			
KBI	0.958	1		
EPT	-0.588	-0.656	1	
%EPT	-0.648	-0.699	0.836	1

Note: A correlation is a number between 0 and $\pm$1 that describe the degree of relationship between two variables. A large number value indicates a close relationship. A minus sign indicates a negative relationship between the variables.

Average nutrient (NH3-N, NO3-N, organic N, and total P) and biological oxygen demand (BOD) concentrations were generally higher at Water Quality Stations 234 and 601 (**Table 3**). Likewise, total suspended solids (TSS) concentrations were also elevated at those monitoring sites. As compared to a relatively less impacted, full support biological site (SB529), organic nutrients, BOD, and in particular TSS are considered the main cause for biological impairment for Station SB234. Average MBI, KBI, EPT, and EPT% values for Station SB529 were 4.31, 2.74, 13, and 54.1%, respectively. As indicated earlier that the EPT groups like to utilize coarse substrates as habitats in the stream. Excess amount of TSS load that deposits on the substrates at Station SB234 imposes a great physical threat to their living conditions.

Table 3. Comparison of average nutrient and sediment concentrations for Water quality Monitoring Stations SC682, SC601, SC234, and SC529.

Station Name	Station ID	BOD	NH_3-N mg/L	NO_3-N mg/L	Organic N mg/L	Total P mg/L	TSS mg/L
S.F. Big Nemaha near Seneca	SC682	2.34	0.14	1.36	0.40	0.23	73
Turkey Cr near Bern	SC601	3.52	0.05	0.76	0.82	0.42	357
S.F. Big Nemaha near Bern	SC234	3.59	0.08	1.29	0.84	0.43	296
Chikaskia R. near Corbin	SC529	2.35	0.05	1.18	1.07	0.23	172

Table 4 shows average nutrient and TSS concentrations for the composite index groups (> 1.5 and $\leq$ 1.5) at the streamflow values less than 100 cfs (flow exceedance $\geq$ 30%), which they are representative of the typical stream conditions in South Fork Big Nemaha River.

Table 4. Comparison of average nutrient and sediment concentrations for Water quality Monitoring Stations SC682, SC601 and SC234 (Full support: 1999 and 2001; Partial/Non-support: the remainder of the water quality records).

Station ID	Composite Index	Biological Status	BOD	NH_3-N mg/L	NO_3-N mg/L	Organic N mg/L	Total P mg/L	TSS mg/L
SC682	> 1.5	Partial/Non-Support	2.33	0.08	0.96	0.42	0.17	21
	≤ 1.5	Full Support	1.54	0.07	1.67	-	0.13	27
SC601	> 1.5	Partial/Non-Support	3.50	0.06	0.59	0.61	0.23	94
	≤ 1.5	Full Support	1.51	0.05	0.97	0.69	0.19	31
SC234	> 1.5	Partial/Non-Support	3.25	0.07	0.89	0.73	0.25	61
	≤ 1.5	Full Support	1.44	0.04	1.48	0.53	0.21	39

Note: To derive composite index values, the number of 1, 2, and 3 were assigned to full support, partial support, and non-support, respectively, and then these numeric values were averaged based on MBI, KBI, and EPT.

Figures 2 and **3** shows the composite biological index developed from MBI, KBI and EPT indices for the periods of 1993–1994 and 1999–2005, respectively. The relationship of the composite index to the flow exceedance is shown in **Figure 4**. In general, the composite index values corresponded well with the percent of flow exceedance. As flow decreased, the index values increased accordingly, indicating that biological communities were under stress when streamflow decreased.

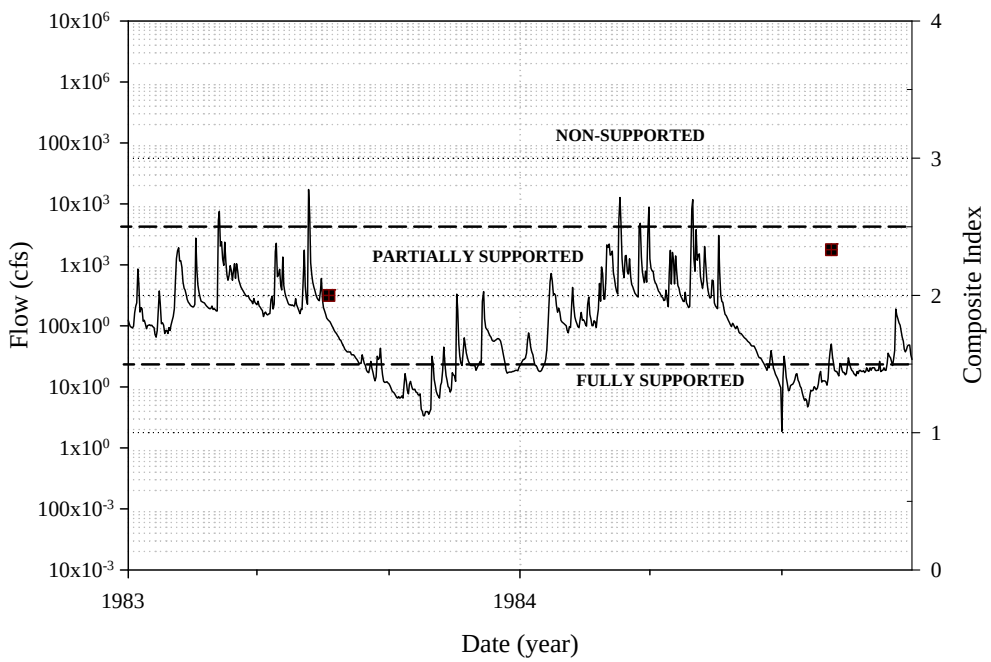

Figure 2. Composite index (≤ 1.5 fully supported, 1.51-2.49 partially supported, and ≥ 2.5 non-supported) for Biological Monitoring Station SB234 during 1983 – 1984.

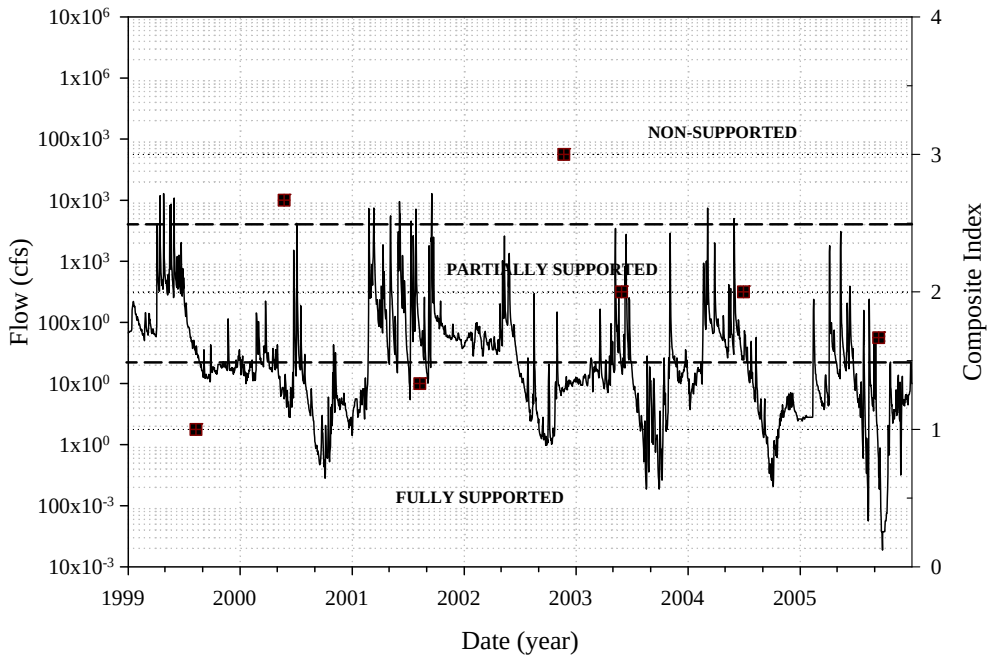

Figure 3. Composite index (≤ 1.5 fully supported, 1.51-2.49 partially supported, and ≥ 2.5 non-supported) for Biological Monitoring Station SB234 during 1999 – 2005.

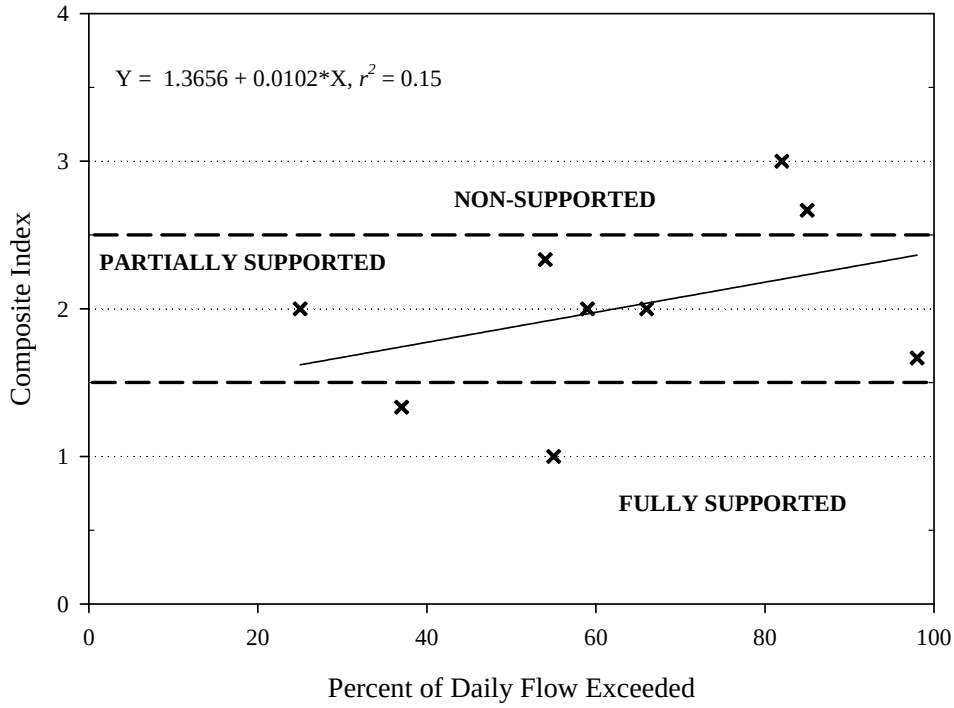

Figure 4. Plot of composite index in relation to percent of daily flow exceeded at Biological Monitoring Station SB234 during 1983 – 2004.

Desired Biological Endpoint for South Fork Big Nemaha River at Station 234:

The use of multiple biological indices allows assessment of the cumulative impacts of dynamic water quality on aquatic communities present within the stream. As such, these index values serve as a baseline of biological health of the stream. Sampling occurs during open water season (April to November) within the aquatic stage of the life cycle of the macroinvertebrates. As such there is no described seasonal variation of the desired endpoint of this TMDL. The desired endpoint is to achieve an average composite value of 1.49 or less, based on KBI, MBI, and EPT, over 2008 – 2012.

Achievement of this endpoint would be indicative of full support of the aquatic life use in the stream reach. The paired watershed assessment approach is adopted and thus SB529 serves as a biological benchmark to determine the desirable biological endpoint for SB234. The narrative water quality standards of suspended solids derived from SB529 may therefore be placed on South Fork Big Nemaha Watershed. While this narrative water quality standard pertaining to suspended solids is utilized by this TMDL, there is no direct linkage between composite index values and suspended solids levels. A number of factors, including flows, adequate habitat and stream modifications, may contribute to the occasional excursion in index values above 1.5. As a result, the link between composite index values and suspended solids levels on South Fork Big Nemaha River remains qualitative at this stage of the TMDL.

3. SOURCE INVENTORY AND ASSESSMENT

NPDES: There are six NPDES permitted municipal wastewater plants within the watershed, and two of them are located in the Nemaha County, KS (**Table 4**, and **Figure 5**). Projections of future water use and resulting wastewater appear to be within design flows for each of the current system's treatment capacity. For example, population projections for Oneida to the year 2020 indicate slight declines. Projections for Seneca to the year 2020 indicate slight growth.

Table 4. Municipal wastewater treatment plants (WWTP) and city population (U.S. Census, 2000) in the South Fork Big Nemaha Watershed and monthly mean effluent TSS concentrations (Maximum) during 2001 – 2005 († indicates monthly average WWTP discharge values. For Oneida WWTP, no discharge has been reported from the Oneida since 2001.)

WWTP Facility	NPDES #	Population	Stream Reach	Segment	Design Flow	TSS (mg/L)	Type
Oneida, KS	KS0093467	70	Harris Creek	166	0.01 mgd	80 (permitted)	Lagoon
Seneca, KS	KS0047538	2,122	S.F. Big Nemaha	16	0.50 mgd	49 (136)	Lagoon
Pawnee, NE	-	1,033	Turkey Creek	-	0.134 mgd†	13 (30)	Mech.
Burchard, NE	-	103	Turkey Creek	-	0.004 mgd†	40 (44)	Lagoon
Steinauer, NE	-	74	Turkey Creek	-	0.003 mgd†	53 (133)	Lagoon
Lewiston, NE	-	86	Turkey Creek	-	0.002 mgd†	70 (400)	Lagoon

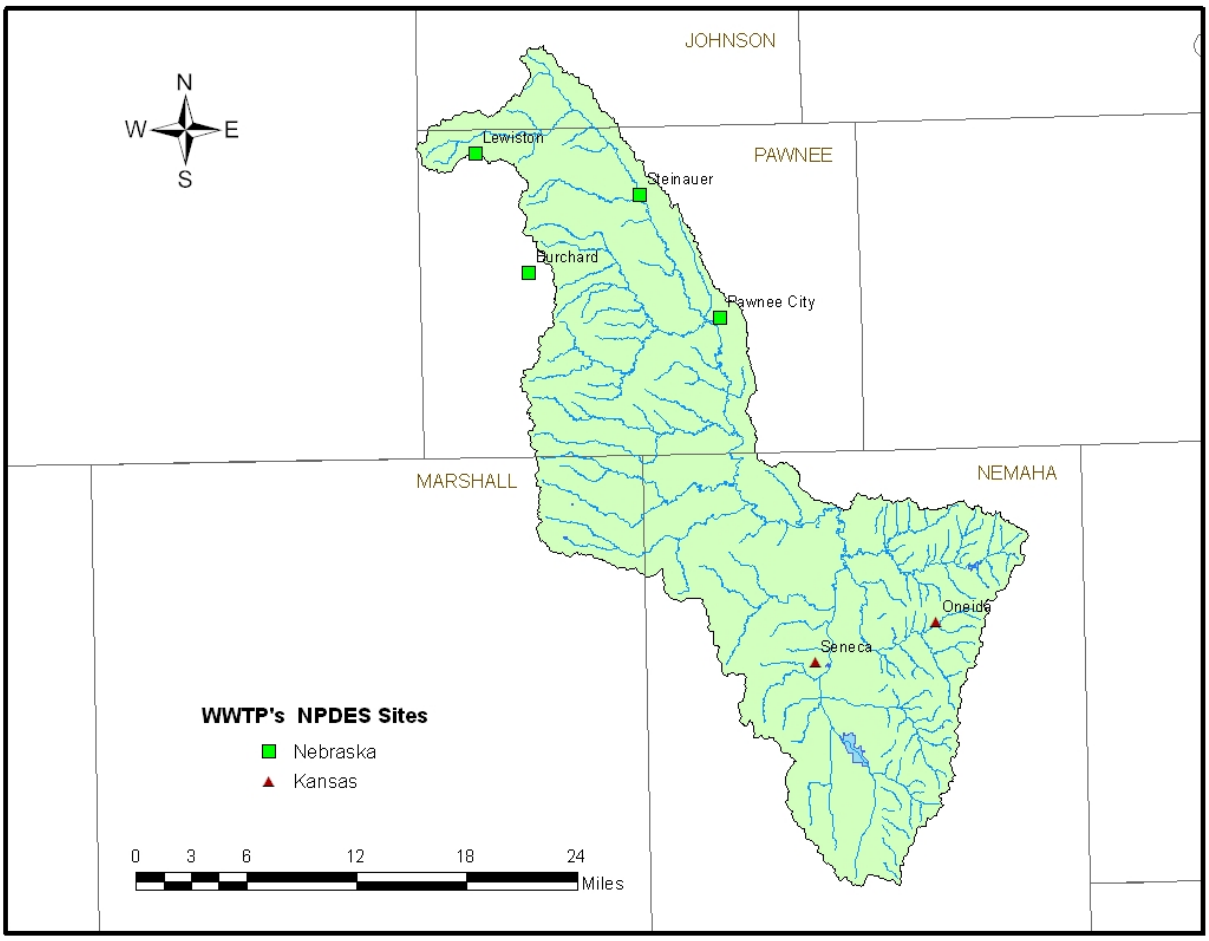

Figure 5. WWTP facilities in the South Fork Big Nemaha Watershed.

Livestock Waste Management Systems: In total, there are 97 confined animal feeding operation sites (**Figure 6**). Sixty-eight of which are either certified (13) or permitted (55) in Kansas. These facilities (20 dairy, 23 swine, 1 chicken, 24 mixed/beef, dairy, or sheep) are primarily located in the central portion of the Nemaha County. One of these facilities, a swine operation (9650 head), is of sufficient size to warrant NPDES permitting (KS0090191). A new NPDES permit was issued by KDHE on September 28, 2006 with conditions ensuring adequate retention of livestock wastewater and management of livestock manure to prevent runoff of pollution to Harris Creek through a unnamed tributary. All of these permitted livestock facilities have waste management systems designed to minimize runoff entering their operation or detain runoff emanating from their facilities. In addition, they are designed to retain a 25-year, 24-hr rainfall/runoff event as well as an anticipated two weeks of normal wastewater from their operations. Typically, this rainfall event coincides with streamflow that exceeds less than 1-5% of time. Events of this type, higher flows that are infrequent and of short duration, might likely contribute certain total suspended solids/sediment to South Fork Big Nemaha River. Therefore, maintaining the water level of a waste lagoon at a sufficient level (e.g., 2-6 ft) below the lagoon berm is required to ensure retention of the runoff from such intense, local storm events to prevent nutrient and sediment loads to the river.

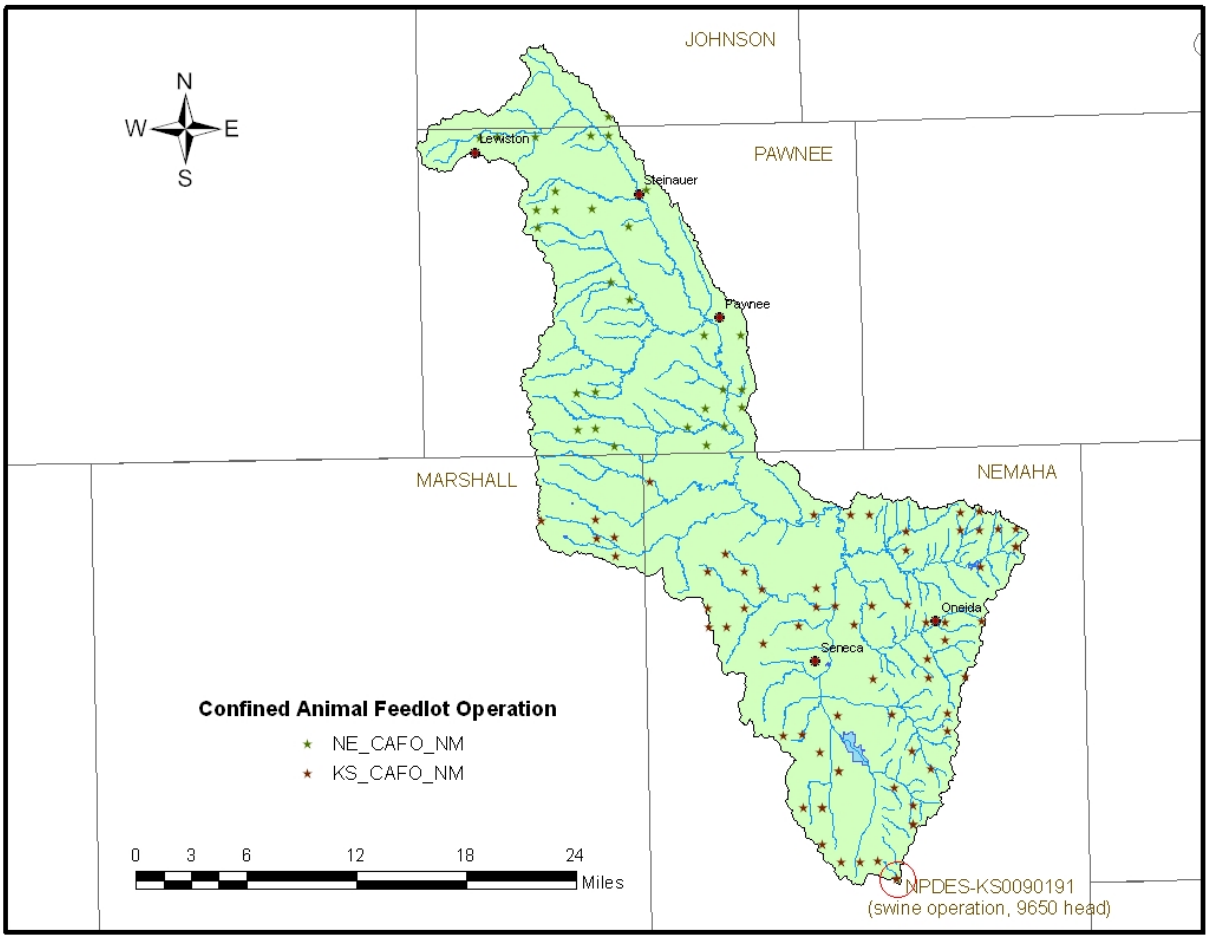

Figure 6. Livestock Waste Management Facilities in the South Fork Big Nemaha Watershed.

Land Use: Based on National Land Cover Data (NLCD), the predominant land use is cultivated cropland, which accounts for about 49% of the total land area in the watershed (**Figure 7**). Urban area, such as residential, commercial and industrial uses, comprises only less than 1% of the watershed. Approximately 3% of the land is occupied by forest. Grassland and pasture occupy 23% and 24% of the watershed, respectively. There are about 13,044 acres of riparian area (30 m buffer along the stream system) in the watershed, most of which is categorized as cropland (38%), while grassland, pasture and forest account for about 17%, 27% and 17%, respectively. According to the National Agricultural Statistics Service, numbers of cattle estimated in the pasture, based on the watershed area in each county, are summarized in **Figure 8**. In total, there are 53,383 head of cattle in 2005, 73% of which are located in Nemaha County, KS. Nineteen percent of these cattle (9,183 head) are in Pawnee County, NE.

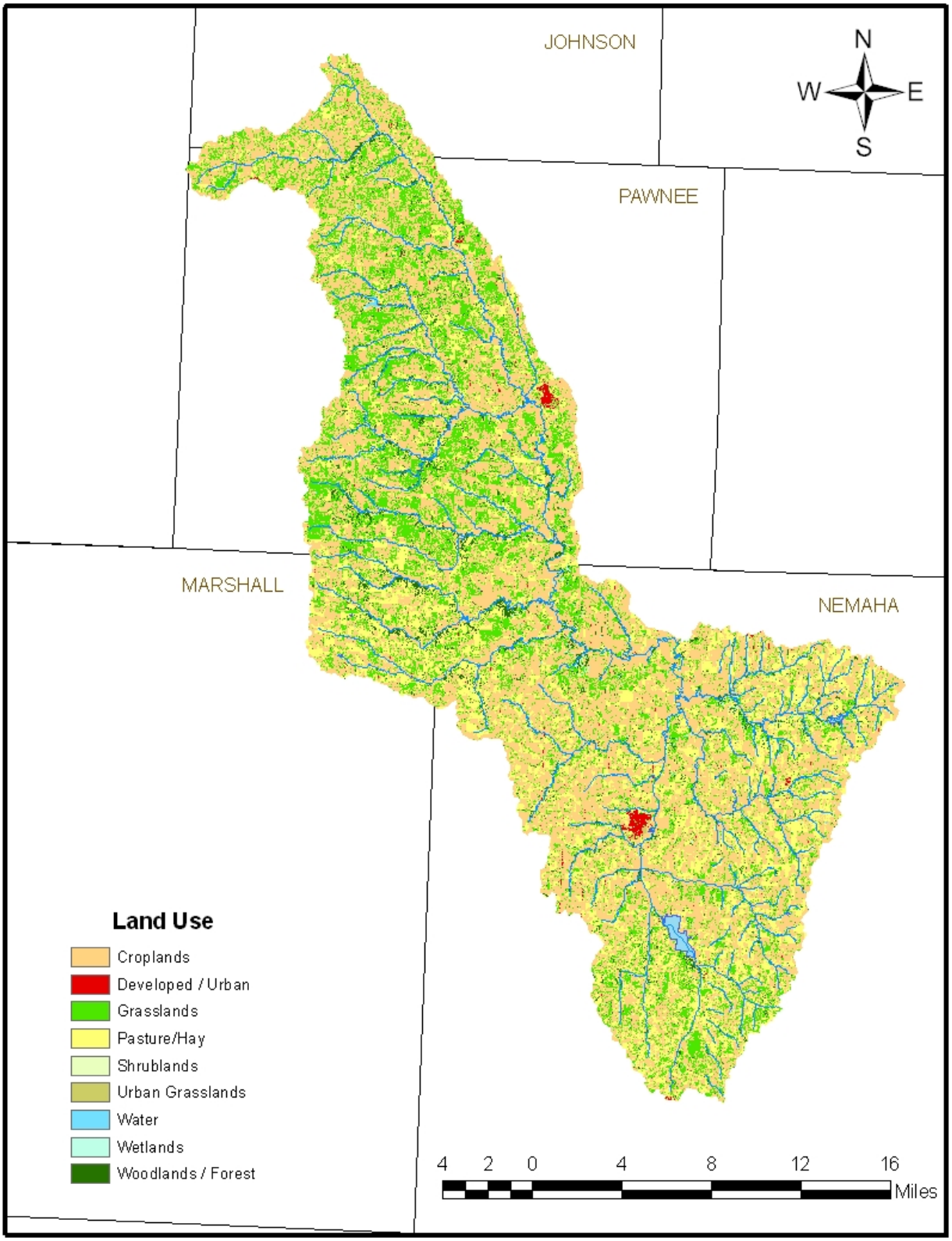

Figure 7. Land use and land cover types in the South Fork Big Nemaha Watershed.

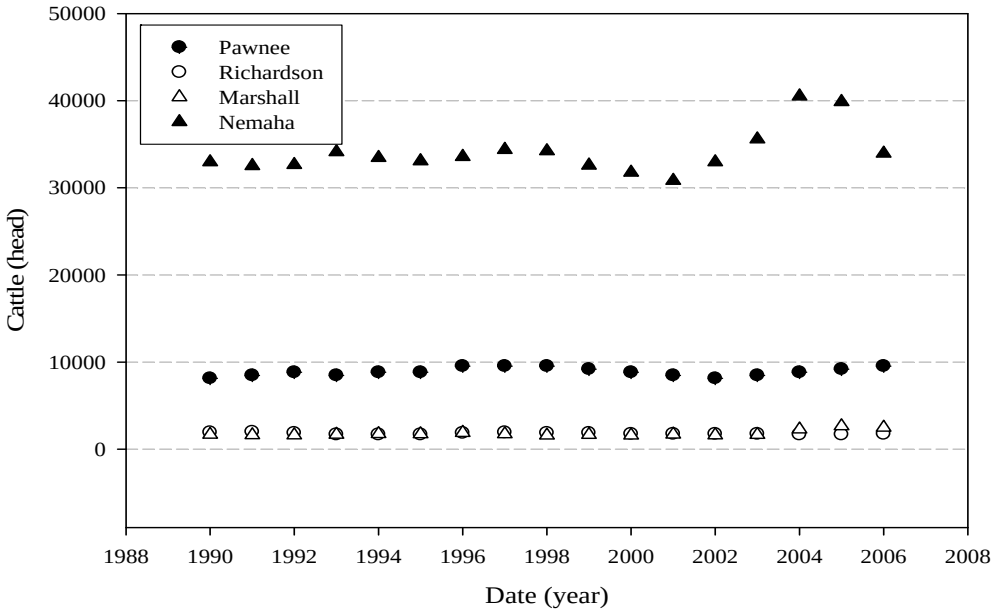

Figure 8. Distribution of cattle in the pasture of South Fork Big Nemaha Watershed.

On-Site Waste Systems: According to the 1990 census data from the U.S Census Bureau, there were 1,096 septic tank systems in the entire watershed, 758 of which were in Nemaha while 229, 47 and 62 septic systems were located in Pawnee (NE), Richardson (NE), and Marshall (KS), respectively. The comparison of rural county communities (farm and non-farm) between the 1990 and 2000 data clearly indicated that the people who relied on septic systems in the farm areas diminished from 1990 to 2000 (**Table 5**). Though failing on-site systems can contribute sediment and nutrients, the effects of these sediment and nutrient loads on the macroinvertebrates in the stream are likely associated with the low flows. In addition, many houses are currently connected to a public sewage system, sediment and nutrient contributions from these on-site waste systems during the high flows may be minimal in the South Fork Big Nemaha River watershed.

Table 5. Summary of rural community comparisons between 1990 and 2000 for Marshall, Nemaha, Johnson, and Pawnee counties in the watershed (the decennial data was from the U.S. Census Bureau).

Type	% watershed in County	Rural Community	1990	2000
Marshall, KS	3.69	Farm	2,398	1,840
		Non-farm	5,948	6,068
Nemaha, KS	54.76	Farm	2,717	2,070
		Non-farm	7,729	8,647
Johnson, NE	6.24	Farm	1,161	705
		Non-farm	3,512	3,783
Pawnee, NE	35.32	Farm	905	701
		Non-farm	2,412	2,386

Contributing Runoff: The areas of the watershed in Kansas have an average soil permeability of 0.4 inches/hour according to NRCS STATSGO data base. These areas produce runoff even under relative low (1.71"/hr) potential runoff conditions. Under very low (1.14"/hr) potential conditions, this potential contributing area is reduced to about 88%. Runoff is chiefly generated as infiltration excess with rainfall intensities greater than soil permeabilities. As the watersheds' soil profiles become saturated, excess overland flow is produced. Generally, storms producing less than 0.57"/hr of rain will still generate runoff from 82% of the areas. **Figure 9** shows flow percentiles for both Turkey Creek (SC601) and S.F. Big Nemaha River (SC234).

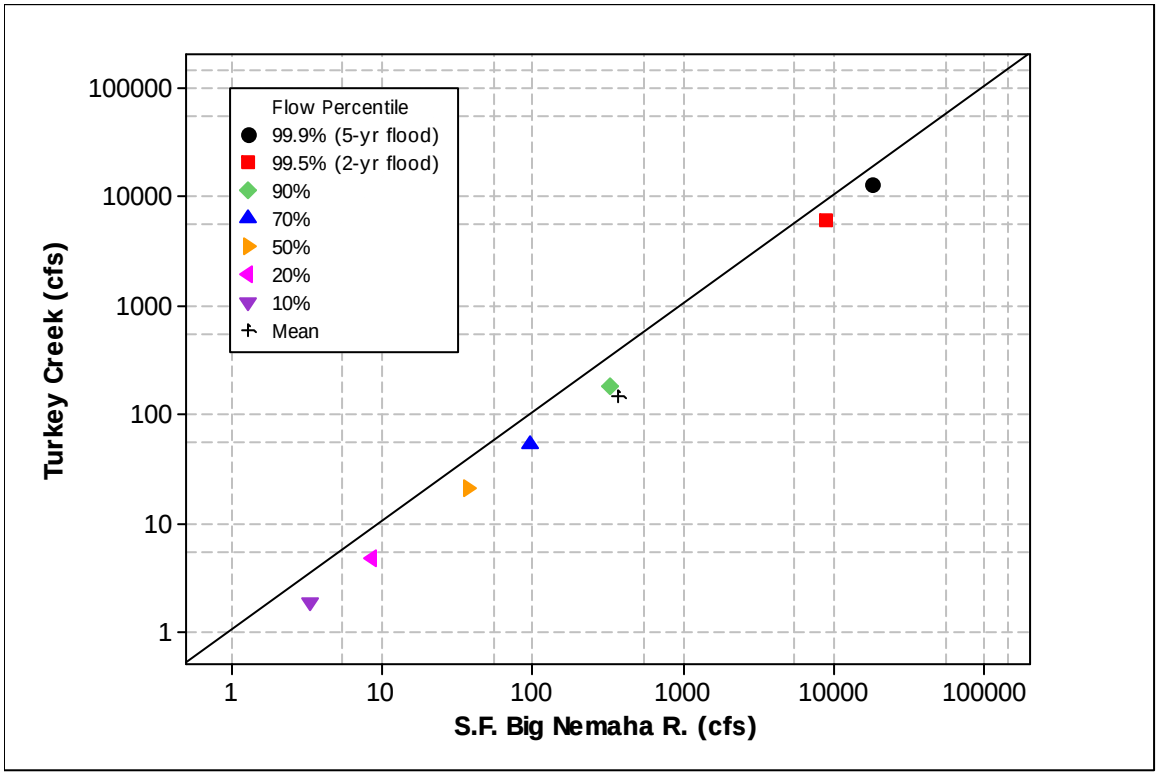

Figure 9. Flow percentiles for Site SC601 at Turkey Creek and Site SC234 at S.F. Big Nemaha River.

Background Levels: The forest occupies 15% of the 30-m riparian area but 27% of the entire riparian area is the pasture where cattle might have access to stream channels and contribute small sediment and/or nutrient loads. Most of the background levels of total suspended solids and associated organics come from natural sheet and rill erosions from overland runoff. Stream bank and bed erosions may be another important source during high flow events. In addition to sediment, droughts can have significant stress effects on macroinvertebrate communities and according to the USGS, the average streamflow measured in northeast Kansas during 2001 – 2006 is the lowest 5-year average flow in the history.

4. ALLOCATION OF POLLUTION REDUCTION RESPONSIBILITY

There is an indirect, yet un-quantified relationship between sediment loading and biological integrity. Decreased sediment loads, indicative of improved water quality, should result in better aquatic communities. The ability of biological data to integrate the various physical and

chemical impacts of the entire watershed on the aquatic community defies allocation of specific suspended solid loads between point and nonpoint sources. Because biological integrity is a function of multiple factors, the initial pollution load reduction responsibility will be to decrease the average condition of sediment over the range of flows encountered on the South Fork Big Nemaha River.

Figure 10 shows TSS concentrations and streamflow measured at SC234 and SC529 in the South Fork Big Nemaha and Chikaskia Rivers, respectively. For the ultimate stage of the TMDL, the desired TSS concentrations at SC234 should be set towards the TSS levels observed across the seasons at Chikaskia River near Corbin (SC529) to improve stream habitat conditions for macroinvertebrate communities. For the interim, TSS levels should be at concentrations associated with full-support composite biological index values.

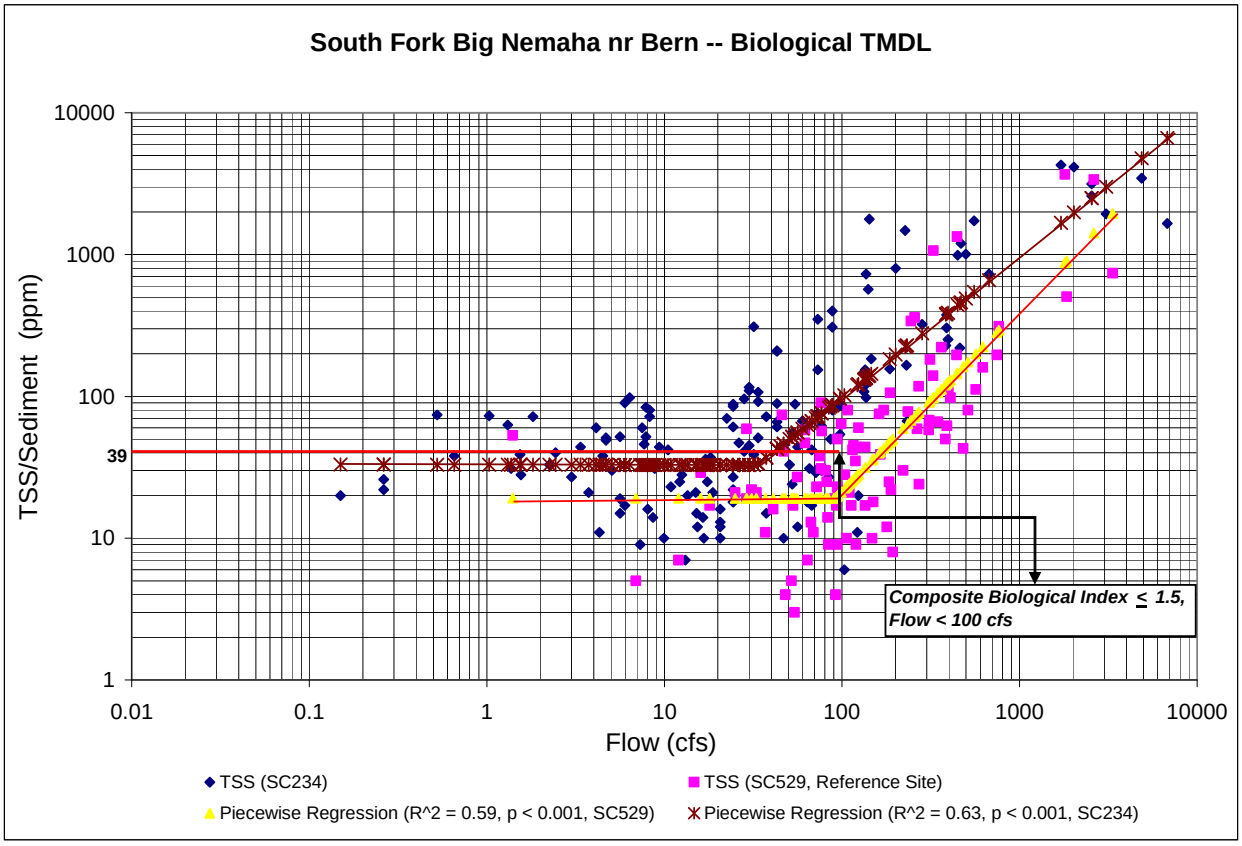

Figure 10. TSS concentrations and streamflow values measured at SC234 and SC529 [Reference Site (Chikaskia River)].

Point Sources: There are six NPDES dischargers in the watershed (2 in Kansas and 4 in Nebraska, see **Table 4**), all with permit limits for TSS. The exact loads contributed by these facilities are unknown and will need to be determined in the future through monitoring of effluent and ambient receiving streamflow. Assuming the total effluent volume (1 cfs) arrives at the monitoring site, this total flow would be 95% of the time in the South Fork Big Nemaha River. However, the point source influence on water quality may extend to higher flows as well. Therefore, the allocation for point sources is demarcated by the area under each respective load

duration curve bounded from 95% to 100% (**Figure 11**). At this stage of the TMDL, the assumed condition is maintenance of current conditions at those low flows, presuming an offset of lower loading at higher flows. The Wasteload Allocation represents the load in the stream which the point sources contribute. In most cases, this is a function of permit limits; in the case of TSS, the monthly permit limits for the two Kansas WWTPs are both set at 80 mg/L. Any excessive TSS coming from the Nebraska's NPDES facilities can be monitored at Site 601 on Turkey Creek. Wasteload allocation for Kansas WWTPs and CAFOs are listed in **Appendix A**.

Should future wasteloads increase in the watershed and discharge into the impaired segment, the wasteload allocation will be revised by increasing the critical flow volume and if necessary, adjusting the current load allocation to tradeoff loads with these new point source dischargers.

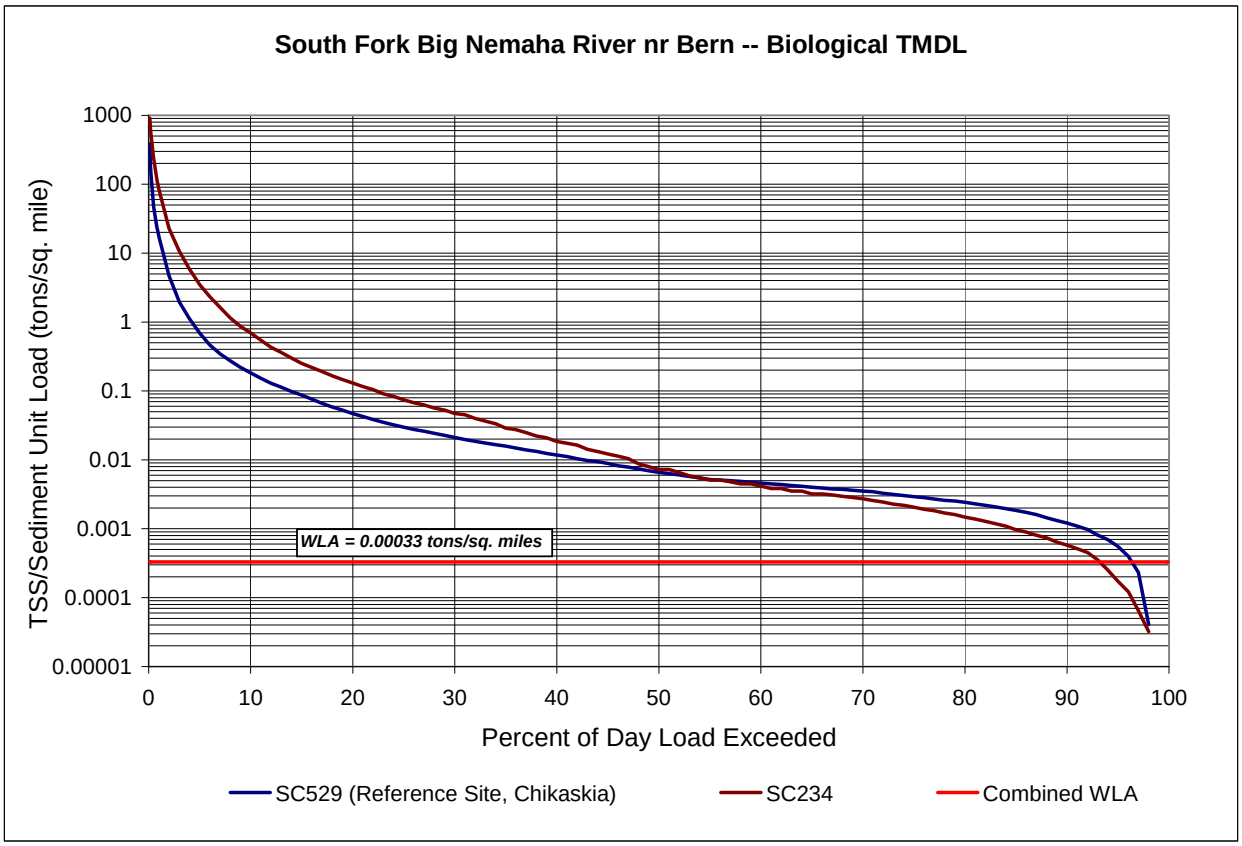

Figure 11. TSS (or sediment) unit loads for SC234 and SC529.

Non-Point Sources: Given the runoff characteristics of the watershed, overland runoff can easily carry sediment from the watershed into the stream reaches. The composition of the watershed indicates a mixture of rural and urban non-point sources which may contribute to the downstream impairment. These sources tend to become dominant under higher flow conditions. Therefore, the area under the load duration curves bounded from 0 – 95% (in particular, 0 – 55%, **Figure 11**) constitutes the Load Allocation for this TMDL. As indicated in **Figure 11**, a 71% (flow weighted average for the flow exceedance between 0 – 55%) reduction of sediment is required to establish the desired stream condition for the biological communities in the South Fork Big Nemaha River. Estimated Daily Load Allocations are listed in **Table 6** for South Fork

Big Nemaha River at Site SC234. **Table 7** shows estimated Daily Load Allocations for Turkey Creek at Site SC601. Based on data analysis (**Table 4**), TSS primarily come from the lower parts of the watershed, and therefore no Daily Load Allocations is assigned to Site SC682 (**Table 8)**. **Figure 12** shows the TSS (sediment) TMDL, based on the Reference Site SC529, with seasonal sediment loads measured at Site SC234 during 1985 – 2005.

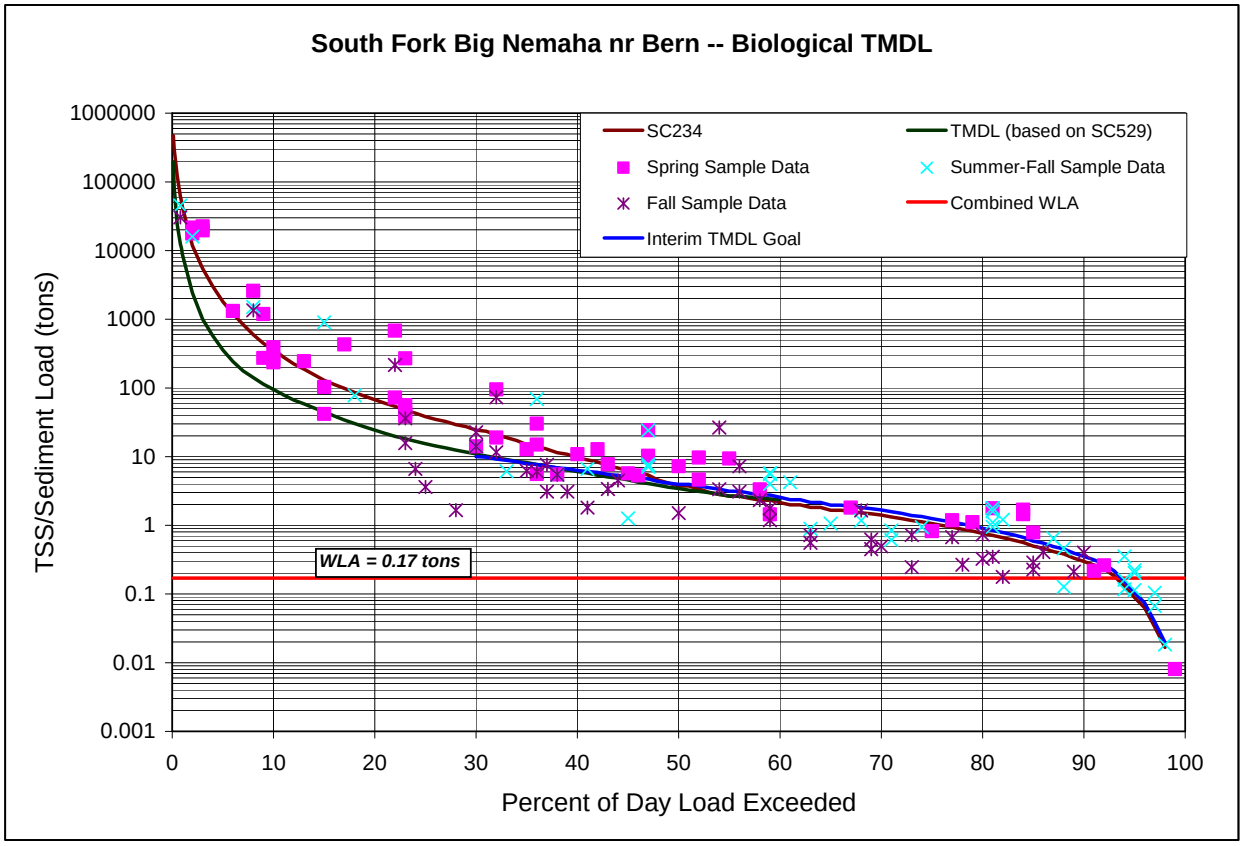

Figure 12. Biological TMDL for South Fork Big Nemaha River near Bern, with seasonal loading measured at SC234 during 1985 – 2005 (Spring = Apr – Jul, Summer – Fall = Aug – Oct; Winter = Nov – Mar).

Table 6. Daily TSS Load Allocations and their associated load reduction calculated for South Fork Big Nemaha River at Site SC234, based on the reference site data (SC529, Chikaskia R.).

Percent Flow Exceedance	Estimated Flow (cfs)	Ultimate Load Allocation (tons/day)	Ultimate TSS Reduction (tons/day)
90	3.4	0.3	0.0
80	8.6	0.8	0.0
70	15.9	1.4	0.0
60	24.4	2.2	0.0
50	37.5	3.7	0.3
40	59.9	9.6	3.5
30	95.5	24.3	13.3
20	159.2	67.4	43.1
10	369.0	361.1	266.1

Table 7. Daily TSS Load Allocations and their associated load reduction calculated for Turkey Creek at Site 601, based on the reference site data (SC529, Chikaskia R.).

Percent Flow Exceedance	Estimated Flow (cfs)	Ultimate Load Allocation (tons/day)	Ultimate TSS Reduction (tons/day)
90	2.0	0.0	0.0
80	5.1	0.0	0.0
70	9.3	0.0	0.0
60	14.3	1.4	0.2
50	22.0	2.0	3.2
40	35.1	3.6	12.4
30	56.0	6.4	37.9
20	93.3	14.2	116.3
10	216.3	55.7	678.9

Table 8. Daily TSS Load Allocations and their associated load reduction calculated for upper South Fork Big Nemaha River near Seneca at Site SC682, based on the reference site data (SC529, Chikaskia R.).

Percent Flow Exceedance	Estimated Flow (cfs)	Ultimate Load Allocation (tons/day)	Ultimate TSS Reduction (tons/day)
90	0.6	0.00	0.0
80	1.6	0.00	0.0
70	2.9	0.02	0.0
60	4.4	0.04	0.0
50	6.8	0.08	0.0
40	10.9	0.16	0.0
30	17.3	0.34	0.0
20	28.8	0.81	0.0
10	66.9	3.77	0.0

Defined Margin of Safety: The calculation and use of multiple biological metrics provides a margin of safety that aquatic life support has been fully attained, and the designated use has been restored. A consistently compliant suite of scores for KBI, MBI, and EPT indices will be regarded as the requisite criteria for this TMDL. Fully supporting scores for these metrics will stand as evidence that plant nutrients entering the river from artificial sources have been controlled and are preventing the accelerated succession or replacement of aquatic biota and the production of undesirable quantities or types of aquatic life.

State Water Plan Implementation Priority: Because the South Fork Big Nemaha River is a major tributary to the Missouri River and since there will be a concurrent effort to reduce high atrazine concentrations from Turkey Creek, which may have adverse effects on aquatic organisms in the stream, this TMDL will be a High Priority for implementation.

United Watershed Assessment Priority Ranking: This watershed lies within the South Fork Big Nemaha Subbasin (HUC 8: 10240007) with a priority of 9 (Highest Priority for restoration work).

5. IMPLEMENTATION

Desired Implementation Activities

1. Implement and maintain conservation farming, including conservation tilling, contouring strips and no till farming to reduce suspended solids loads from tributaries to South Fork Big Nemaha River.
2. Improve riparian conditions along stream systems by installing grass and/or forest buffer strips to trap suspended solids, and reducing livestock activities within riparian areas to reduce stream bank erosion.
3. Install pasture management practice, including proper stock density, to reduce soil erosion and storm runoff.
4. Minimize road and bridge construction impacts on streams.
5. Monitor wastewater discharges for excessive suspended solids loadings.
6. Incorporate this TDML into the Missouri River Basin WRAPS projects.

Implementation Programs Guidance

NPDES - Municipal Program – KDHE

a. Monitor effluent from wastewater treatment plants to determine their suspended solids and nutrient contributions.
b. Ensure proper monitoring, permitting, and operations of municipal wastewater systems to reduce suspended solids and nutrient discharges.

Watershed Management Program – KDHE

a. Develop Watershed Restoration and Protection Strategy project for Missouri River Basin to target South Fork Big Nemaha River's sediment issue.
b. Provide technical assistance on management practices geared to livestock operations which minimize their impact to stream channels.
c. Provide technical assistance on pesticide management to minimize agrochemical impact aquatic organisms, and vegetative buffer development in the vicinity of the stream.
d. Coordinate watershed management efforts with Nebraska Department of Environment Quality to control sediment load from Turkey Creek.

Environmental Field Services – KDHE

a. Work with Department of Wildlife and Parks and Biological Survey to evaluate stream habitat and other environmental factors affecting aquatic communities throughout South Fork Big Nemaha River.

Livestock Waste Management Program – KDHE

a. Ensure waste lagoons for animal feeding operations have adequate capacity to minimize spills during wet seasons.

Water Resource Cost Share & Non-Point Source Pollution Control Programs - SCC

a. Apply conservation farming practice, including terraces and waterways, sediment control basins, and constructed wetlands within the watershed.
b. Provide sediment control practices to minimize erosion and sediment and nutrient transport from cropland and grassland in the watershed.

Riparian Protection Program - SCC

a. Establish or restore natural riparian systems, including vegetative filter strips and streambank vegetation along South Fork Big Nemaha River and its tributaries.
b. Develop riparian restoration projects along targeted stream segments, especially those areas with baseflow.
c. Promote wetland construction to reduce runoff and assimilate sediment loadings.
d. Coordinate riparian management within the watershed.

Buffer Initiative Program - SCC

a. Install vegetative buffer strips along South Fork Big Nemaha River and its tributaries.
b. Leverage Conservation Reserve Enhancement Program to hold riparian land out of production

Time frame for Implementation: Sediment reduction practices should be installed within the priority subwatersheds of South Fork Big Nemaha River during the years 2008 – 2015.

Targeted Participants: Primary participants for implementation will likely be agricultural producers operating within the drainage of priority subwatersheds. Initial work over 2008 – 2012 should include an inventory of activities in those areas with greatest potential to impact the stream, including, within a mile of the stream:

1. Total rowcrop acreage and gully locations
2. Conservation compliance on highly erodible areas
3. Acreage of poor rangeland or overstocked pasture
4. Livestock use of riparian areas and condition of riparian areas
5. Unvegetated or graded roadside ditches
6. Construction projects without erosion control techniques
7. Uncontrolled entry points for urban runoff
8. Impervious area generating increased runoff

Some inventory of local needs should be conducted in 2008 – 2009 to identify such activities. Such an inventory would be done by local program managers with appropriate assistance by commodity representatives and state program staff in order to direct state assistance programs to the principal activities influencing the quality of the streams in the watershed during the implementation period of this TMDL.

Milestone for 2012: The year 2012 marks next visit into the Missouri Basin for TMDL development and revision. At that point in time, adequate source assessment should be completed which allows an allocation of resources to responsible activities contributing to the sediment impairment. Additionally, biological data from the South Fork Big Nemaha River over 2008 –2012 should not indicate trends of reduced support of the aquatic community.

Quantitative relationships between suspended sediment and biological measures should be established by 2012 and sampled data from South Fork Big Nemaha River should indicate evidence of reduced sediment levels relative to the conditions seen over 1985 – 2005.

Delivery Agents: The primary delivery agents for program participation will be conservation district for programs of the State Conservation Commission, and the Natural Resources Conservation Service. Producer outreach and awareness will be delivered by Kansas State Extension and agricultural interest groups such as Kansas Farm Bureau and Kansas Livestock Association and grain crop associations. On-site waste system inspections will be performed by Local Environmental Protection Program personnel for Nemaha, Marshall Counties (and Pawnee and Johnson Counties in NE).

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 to -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 non-point 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*.

9. The *Kansas Water Plan* and the Missouri River Basin Plan provide the 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 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 watersheds 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 a High Priority consideration.

Effectiveness: Sediment control has been proven effective through conservation tillage, contour farming and use of grass waterways and buffer strips. The key to success will be widespread utilization of conservation farming within the watersheds cited in this TMDL.

6. MONITORING

As quantified sediment-biology relations become established, KDHE will continue to collect seasonal biological samples from South Fork Big Nemaha River for three years over 2008 – 2012 to evaluate achievement of the desired endpoint. Should the impairment status be verified, the desired endpoint under this TMDL will be refined and more intensive sampling will be conducted over the period 2013 – 2017 to assess progress in this TMDL's implementation. Periodic monitoring of sediment or solid content of wastewater discharged from treatment systems will be expected under reissued NPDES and state permits. Further biological sampling sites may be established to address conditions throughout the reach segments and direct subwatershed priorities.

Additional source assessment needs to be conducted and local program management needs to identify its targeted participants of state assistance programs for implementing this TMDL. This information should be collected in 2007 – 2011 in order to support appropriate implementation projects.

7. FEEDBACK

Public Meetings: Public meetings to discuss this TMDL in the Missouri Basin have been held since 2001. An active Internet Web site was established at www.kdheks.gov/tmdl/ to convey information to the public on the general establishment of TMDLs in the Missouri Basin and this specific TMDL.

Public Hearing: A Public Hearing on this Missouri Basin TMDL was held in Hiawatha on May 30, 2007.

Basin Advisory Committee: The Missouri Basin Advisory Committee met to discuss this TMDL on June 26, 2006 in Atchison, December 1, 2006 and January 26, 2007 in Highland, March 16, 2007 in Atchison and May 14, 2007 in Hiawatha.

Milestone Evaluation: In 2012, evaluation will be made as to implementation of management practices to minimize the non-point source runoff contributing to this impairment. 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 2012.

Consideration for 303(d) Delisting: The stream will be evaluated for delisting under Section 303(d), based on the monitoring data in 2008 – 2015. Therefore, the decision for delisting will come about in the preparation of the 2016 303(d) list. Should modifications be made to the applicable water quality criteria during the intervening implementation period, consideration for delisting, desired endpoints of this TMDL and implementation activities may 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 (CPP), the next anticipated revision will come in 2007 which will emphasize revision of the Water Quality Management Plan (WQMP). At that time, incorporation of this TMDL will be made into both of the CPP and WQMP documents. Recommendations of this TMDL will be considered in *Kansas Water Plan* implementation decisions under the State Water Planning Process during Fiscal Years 2008 – 2015.

Revised, October 23, 2007

Bibliography

Perry, C.A., D.M. Wolock and J.C Artman, 2004. Estimate of flow duration, mean flow, and peak-discharge frequency values for Kansas Stream locations. USGS Scientific Investigations Report 04–5033; 651 p.

Appendix A. Wasteload allocations for WWTPs and active CAFO facilities.

Facility	Permit #	Wasteload Allocation (tons/day)
WWTP		
Oneida	M-MO15-OO01	0.003
Seneca	M-MO19-OO01	0.167
CAFO		
Swine, Beef (Total Animal Head: 100, Marshall CO)	A-MOMS-BA01	0
Swine (200, Marshall)	A-BBMS-SA08	0
Swine (240, Marshall)	A-BBMS-SA10	0
Swine, Beef (390, Marshall)	A-MOMS-BA04	0
Swine (1720, Marshall)	A-BBMS-S048	0
Swine (9650, Nemaha CO)	A-MONM-H002	0
Dairy (80, Nemaha)	A-MONM-MA19	0
Chickens Dry (10000, Nemaha)	A-MONM-FA01	0
Beef (240, Nemaha)	A-KSNM-BA02	0
Dairy (60, Nemaha)	A-MONM-MA01	0
Dairy (30, Nemaha)	A-MONM-MA03	0
Dairy (140, Nemaha)	A-BBNM-BA02	0
Dairy (25, Nemaha)	A-KSNM-MA06	0
Dairy (50, Nemaha)	A-MONM-MA05	0
Dairy (75, Nemaha)	A-MONM-MA08	0
Swine, Beef (690, Nemaha)	A-MONM-S051	0
TruckwashP-2 (0, Nemaha)	A-MONM-T001	0
Swine, Beef (2782, Nemaha)	A-MONM-S062	0
Swine (1200, Nemaha)	A-MONM-S057	0
Swine, Beef (3000, Nemaha)	A-MONM-S007	0
Swine, Dairy, Sheep (720, Nemaha)	A-MONM-S012	0
Swine (600, Nemaha)	A-KSNM-S005	0
Dairy (300, Nemaha)	A-MONM-M004	0
Swine (3049, Nemaha)	A-MONM-S023	0
Dairy (120, Nemaha)	A-MONM-M017	0
Swine (2560, Nemaha)	A-MONM-S001	0
Dairy (266, Nemaha)	A-MONM-M019	0
Dairy (50, Nemaha)	A-MONM-M002	0
Dairy (545, Nemaha)	A-MONM-M009	0
Dairy (250, Nemaha)	A-MONM-M001	0
Swine, Beef (1274Nemaha)	A-MONM-S008	0
Dairy (350, Nemaha)	A-MONM-M012	0
Swine, Beef (689, Nemaha)	A-MONM-S065	0
Swine, Beef, Kennel (310, Nemaha)	A-MONM-S034	0
Swine, Beef (1868, Nemaha)	A-MONM-S024	0
Swine (900, Nemaha)	A-MONM-S042	0
Dairy (102, Nemaha)	A-MONM-M018	0
Dairy, Sheep (310, Nemaha)	A-MONM-M025	0
Swine, Beef (1780, Nemaha)	A-MONM-S063	0
Swine (395, Nemaha)	A-KSNM-S006	0
Swine (450, Nemaha)	A-MONM-S046	0
Swine (566, Nemaha)	A-MONM-S044	0
Dairy (650, Nemaha)	A-MONM-M014	0
Dairy, Beef (635, Nemaha)	A-MONM-M015	0
Swine, Beef, Dairy (1910, Nemaha)	A-MONM-M023	0
Swine, Beef (1350, Nemaha)	A-MONM-S060	0
Swine, Beef (400, Nemaha)	A-MONM-S043	0
Dairy (230, Nemaha)	A-MONM-M020	0

Swine, Beef (1650, Nemaha)	A-MONM-S064	0
Swine (340, Nemaha)	A-MONM-S061	0
Swine (1920, Nemaha)	A-MONM-S052	0
Dairy (160, Nemaha)	A-MONM-M011	0
Dairy (200, Nemaha)	A-MONM-M013	0
Swine, Beef (2744, Nemaha)	A-MONM-S053	0
Swine (1495, Nemaha)	A-MONM-S040	0
Swine (400, Nemaha)	A-MONM-S037	0
Swine (672, Nemaha)	A-MONM-S056	0
Swine (3285, Nemaha)	A-MONM-S025	0
Swine (3920, Nemaha)	A-MONM-S048	0
Swine (450, Nemaha)	A-MONM-S026	0
Swine (1622, Nemaha)	A-MONM-S035	0
Swine (1000, Nemaha)	A-MONM-S045	0
Swine, Beef (2710, Nemaha)	A-MONM-S013	0
Swine, Beef (1455, Nemaha)	A-MONM-S002	0
Swine, Beef (620, Nemaha)	A-MONM-S017	0
Dairy, Swine (1100, Nemaha)	A-MONM-M022	0
Swine (2000, Nemaha)	A-MONM-S039	0
Dairy (127, Nemaha)	A-MONM-M021	0