ARKANSAS RIVER BASIN TOTAL MAXIMUM DAILY LOAD

Waterbody/Assessment Unit: Arkansas River below Hutchinson
Water Quality Impairment: Biology
(2013 Corrective Revisions to August 3, 2007 Biology TMDL)

1. INTRODUCTION AND PROBLEM IDENTIFICATION

Subbasin: Gar-Peace Creek, Cow Creek

HUC 8: 11030010 and 11030011

HUC 10 (HUC 12s**):** 02-(01, 02) and 03-(08)

Ecoregion: Central Great Plains, site in Wellington-McPherson Lowland (27d); watershed in Great Bend Sand Prairie (27c)

Drainage Area: At USGS Gage 07143330: Total Drainage Area- 38,910 sq miles, Contributing Drainage Area- 31,724 sq miles
Targeted by this TMDL: 107 sq miles

Main Stem Segment: Arkansas River upstream from Haven to the junction with Salt Creek (segment 3 and the part of segment 1 upstream from Haven)

Included Tributaries: Original Channel of Cow Creek (1755)

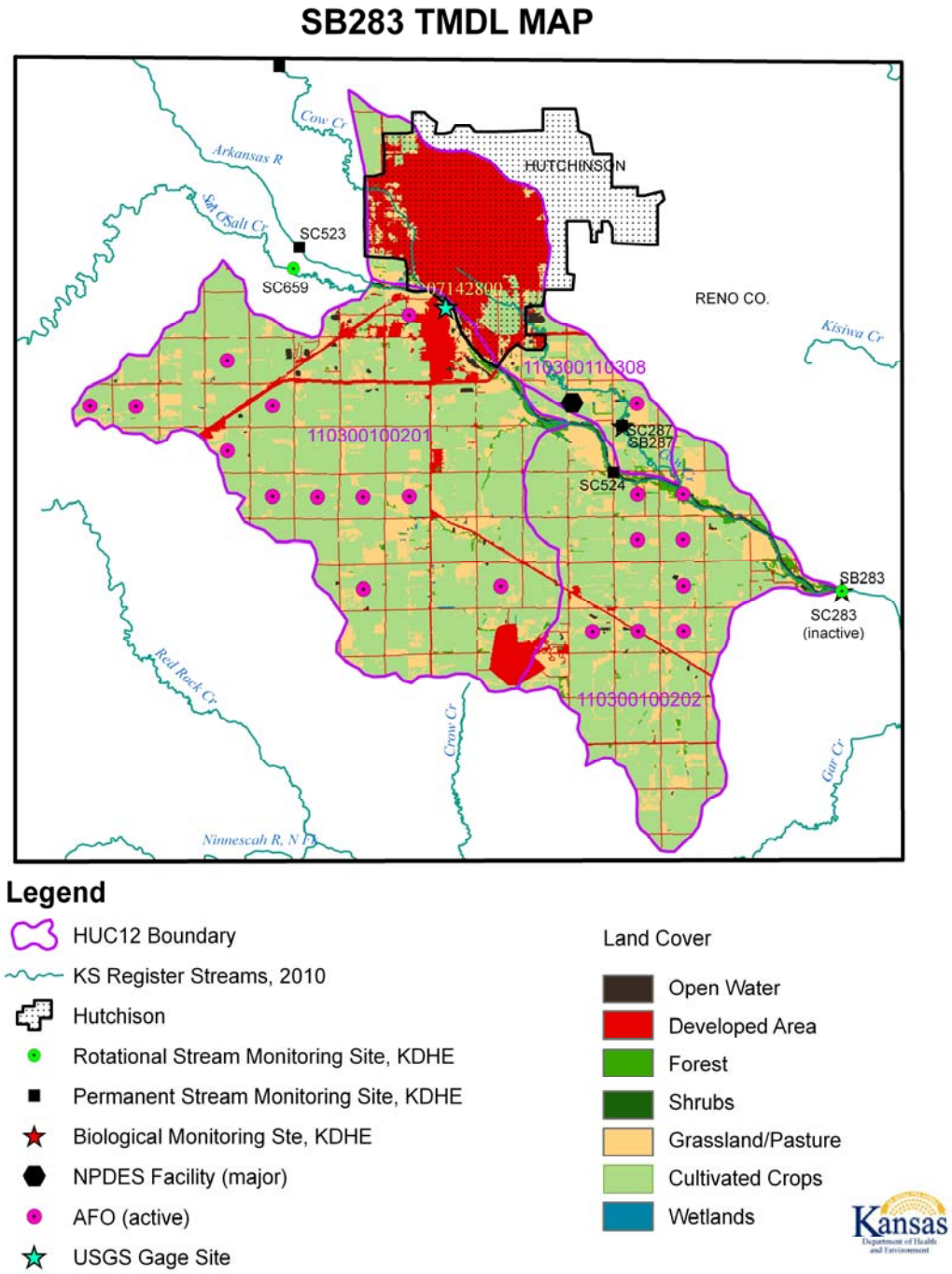
Upstream Contributing Waters Influencing, but notTargeted by this TMDL:

Cow Creek (11030011, Segment 1)
Salt Creek (11030010, Segment 7)
Arkansas River (11030010, Segment 4)

Designated Uses: **Arkansas River Segment 1:** Special Aquatic Life Support, Primary Contact Recreation (B), , Drinking Water Supply, Food Procurement, Groundwater Recharge, Irrigation Water, Industrial Water, Livestock Water. **Segment 3 and Cow Creek Segment 1755:** same, but Expected Aquatic Life Support instead

Impaired Use: Aquatic Life Support on segments 1 and 3 of the main stem

Water Quality Standard: Nutrients – Narrative: The introduction of plant nutrients into streams, lakes or wetlands from artificial sources shall be controlled to prevent the accelerated succession or replacement of aquatic biota or the production of undesirable quantities or kinds of aquatic life. (KAR 28-16-28e(c)(2)(A)).



(Figure 1- Map of the Arkansas River basin near Hutchinson. The mainstem of the Arkansas river is the impaired water.**)**

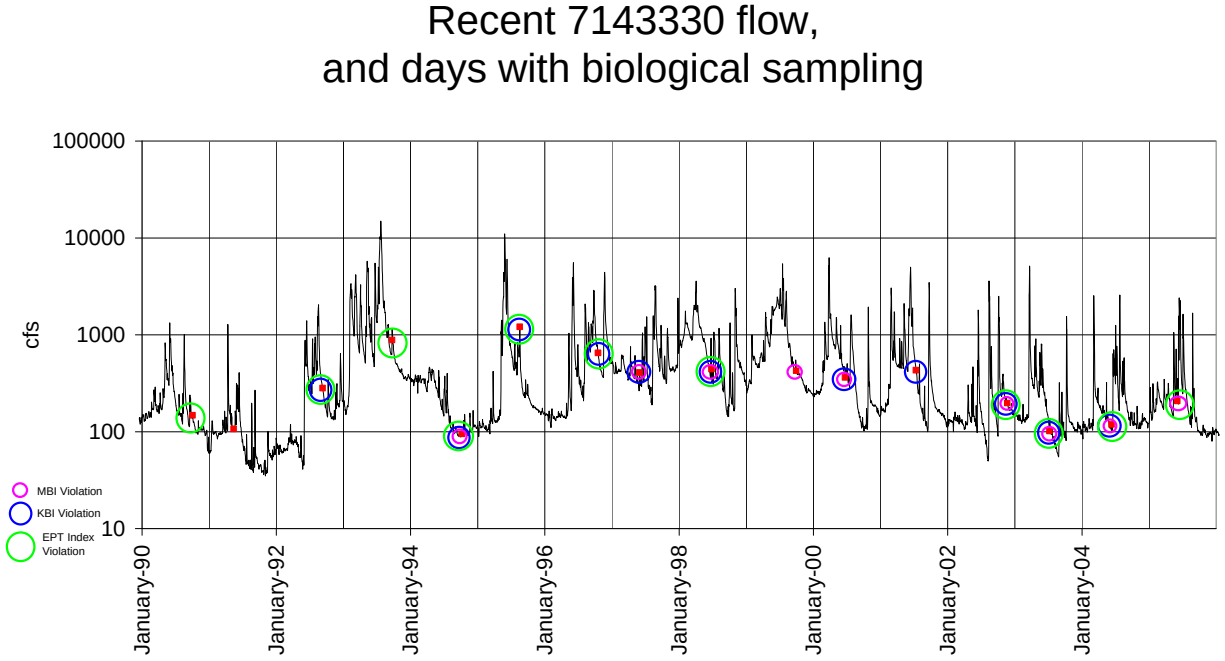
2. CURRENT WATER QUALITY CONDITION AND DESIRED ENDPOINT

Level of Support for designated use under 2004 303(d): Partially Supporting

Monitoring Sites: Chemistry: Station 524 Arkansas River below Hutchinson, Station 287 Cow Creek below Hutchinson; Biology: Station 283 near Hutchinson Upstream Contributions monitored by Station 522 on Cow Creek, Station 523 on the main stem of the Arkansas upstream from Hutchinson, Station 659 on Salt Creek**.**

Period of Record Used: Chemistry: Total Nitrogen 2000-2012 at SC524 and SC287, all other chemistry 1990-2005; Biology: 1982-2011 (29 biological samples)

Flow Record: USGS Gaging Station on the Arkansas River near Hutchinson-07143330 (Percentile Ranking: 10/01/1970, Figure 2- Most recent 15 year flow record)



(Figure 2- Original 1990 - 2005 flow record, with sampling dates and biological metric violations.**)**

Current Conditions:

Four biological metrics were examined to determine the level of biological impairment at SB283; MBI, KBI-NO, EPT Index and EPT % (see Appendix A for a detailed explanation of the metrics), **Table 1**. Each of the four parameters had some years with less than fully supporting designations, though EPT % had the least, six of 29, with the most recent occurrances happening

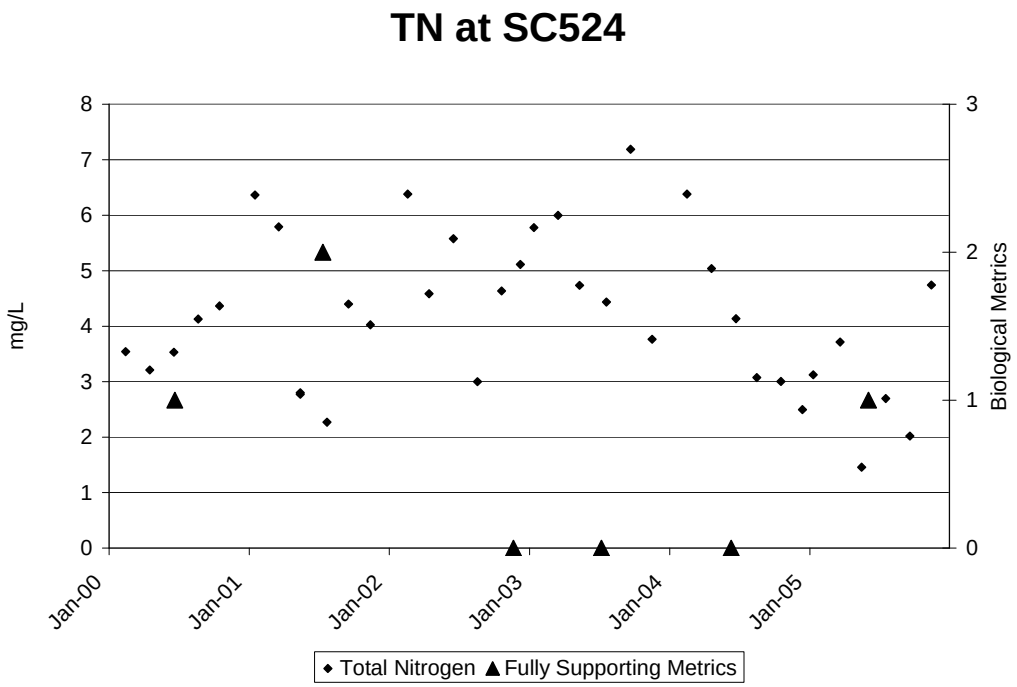
in the drought year of 2006 and again in 2009. Consistent exceedences of the MBI indicator began happening in 1997, and have continued through the most recent sampling year with the exception of 2001 and 2010. KBI violations and EPT Index exceedences have occurred consistently throughout the period of record. These measure different aspects of community structure as indicated by the lack of relationships or consistency among themselves year-to-year. Since the original TMDL in 2006, the metrics have all shown tendencies of deteriorating biological integrity in the river, although the average differences in metrics before and after 2006 are not statistically significant ($p > 0.10$).

Sampling Date	MBI	KBI-NO	EPT INDEX	EPT%ABUNDANCE
7/27/1982	4.48	2.69	13	51
10/5/1983	5.05	2.91	9	22
5/24/1984	4.96	2.92	13	41
8/29/1985	4.66	2.8	13	52
10/22/1986	4.25	2.6	12	45
5/21/1987	4.19	2.57	13	60
7/28/1988	4.38	2.66	16	54
10/5/1989	4.4	2.59	10	49
10/3/1990	4.4	2.63	11	50
5/15/1991	4.17	2.57	13	53
9/10/1992	4.02	2.62	10	56
9/22/1993	4.03	2.43	12	74
10/7/1994	4.9	2.57	10	25
8/18/1995	4.39	2.63	12	73
10/17/1996	4	2.65	9	81
5/30/1997	4.55	2.8	15	79
6/26/1998	4.93	2.88	11	54
9/30/1999	4.52	2.55	17	63
6/21/2000	4.93	2.77	15	61
7/12/2001	4.17	2.78	14	71
11/21/2002	4.84	3.06	10	60
7/8/2003	4.92	2.82	10	59
6/10/2004	5.01	2.78	11	63
6/3/2005	4.92	2.48	12	52
6/21/2006	4.98	2.99	9	17
8/28/2007	4.55	2.76	18	71
8/11/2009	4.87	2.92	11	45
4/13/2010	4.44	2.83	12	56
6/7/2011	4.70	2.50	15	58
Average	4.60	2.72	11.90	54
Supporting	13	9	12	23
Partially Supporting	16	19	17	3
Non-Supporting	0	1	0	3

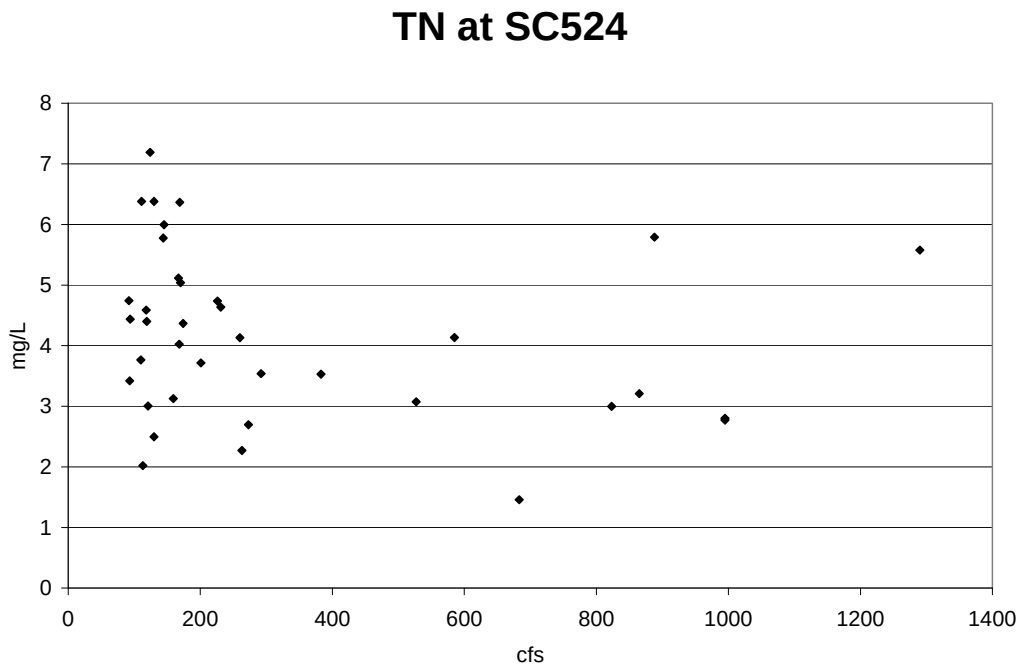
(Table 1: Biological Monitoring Metrics at SB283 over the period of record.**)**

Nutrient concentrations were plotted against flow for SC524 and against date for SC524 and SC287. The period of record for total nitrogen is shorter, and plots of dissolved inorganic nitrogen and soluble reactive (ortho) phosphorus were rejected following Dodds (2003): "Another potential problem with using inorganic nutrient pools to represent trophic state and nutrient availability ratios arises because concentration values are in units of mass per unit volume, and cannot be used with certainty to estimate supply (i.e., turnover rate of the nutrient pool, expressed either in mass per unit volume per unit time or simply as per unit time) to organisms without information on uptake and remineralization."

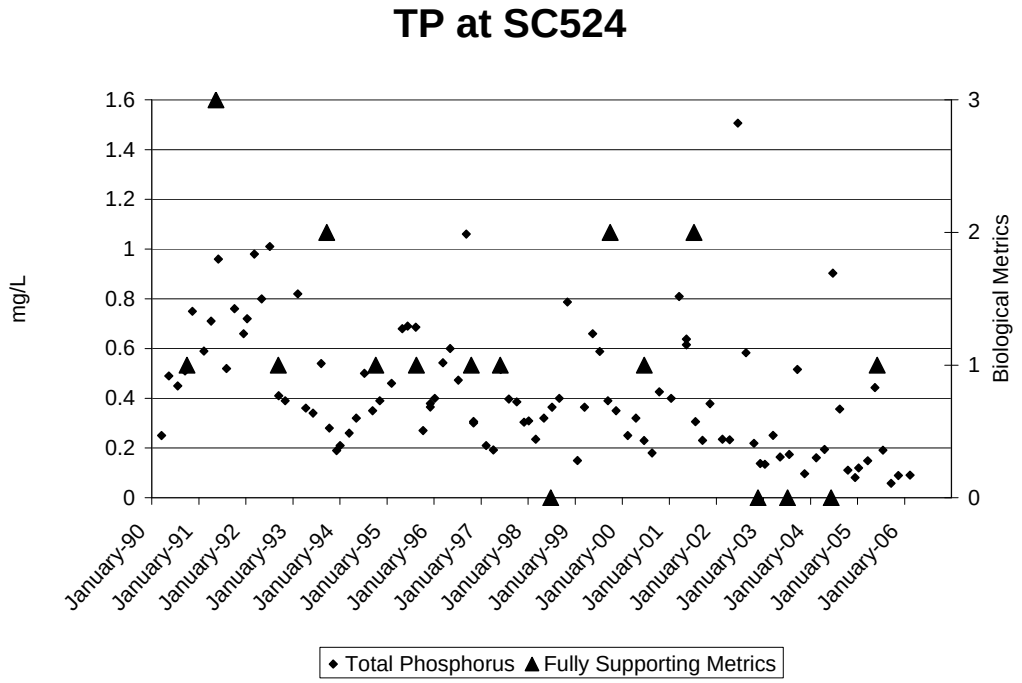
Elevated concentrations of some nutrients are known to be associated with some point sources, however, agricultural runoff can contain highly elevated concentrations of inorganic nutrients, making it difficult to accurately predict the source of a pollutant in streams draining large land areas. Further difficulty arises because nutrients introduced by point sources will change forms as biological uptake and processing occur.



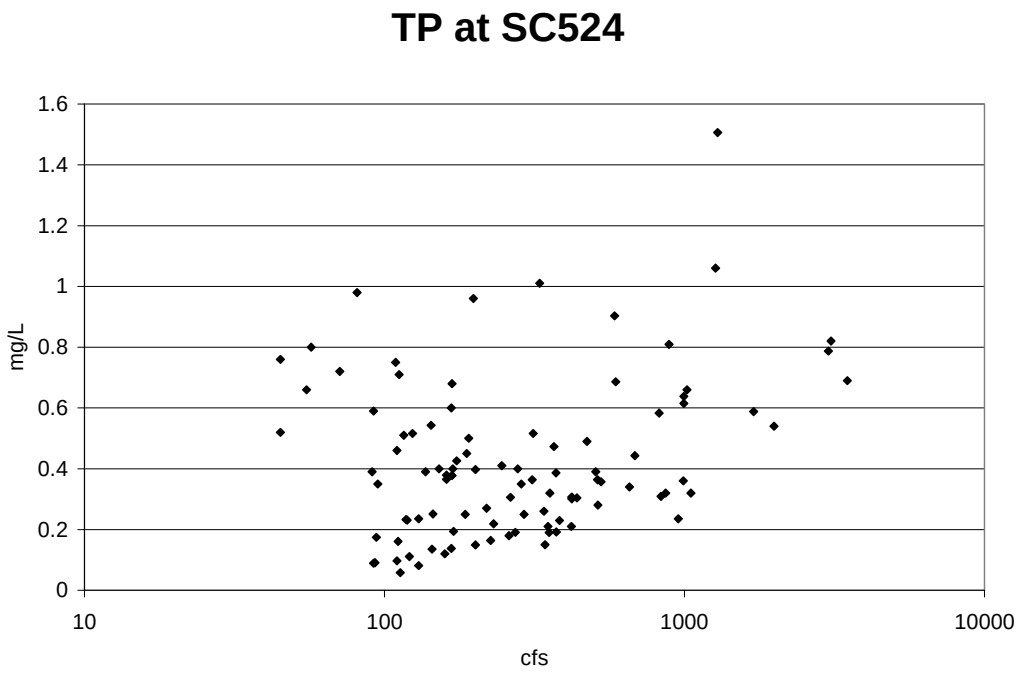
(Figure 1- Total Nitrogen calculated from Total Kjeldahl Nitrogen and oxidized nitrogen at SC524 downstream from Hutchinson by date. MBI, KBI-NO, and EPT Index are summed for fully supporting designation on the secondary axis.**)**



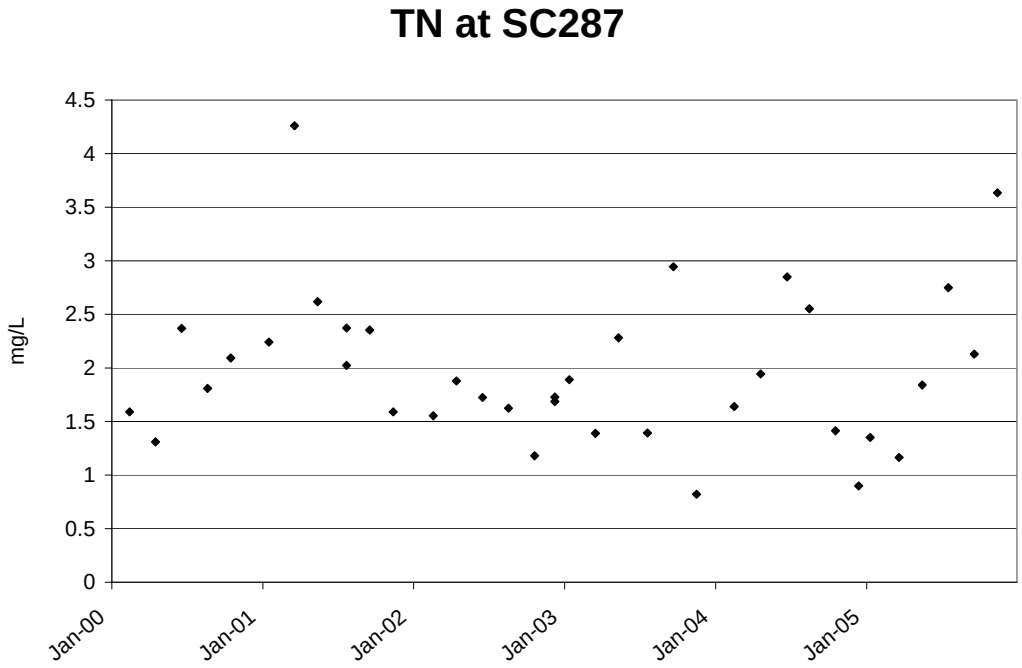
(Figure 2- Total Nitrogen calculated from Total Kjeldahl Nitrogen and oxidized nitrogen at SC524 downstream from Hutchinson by flow at USGS gage 07143330.**)**



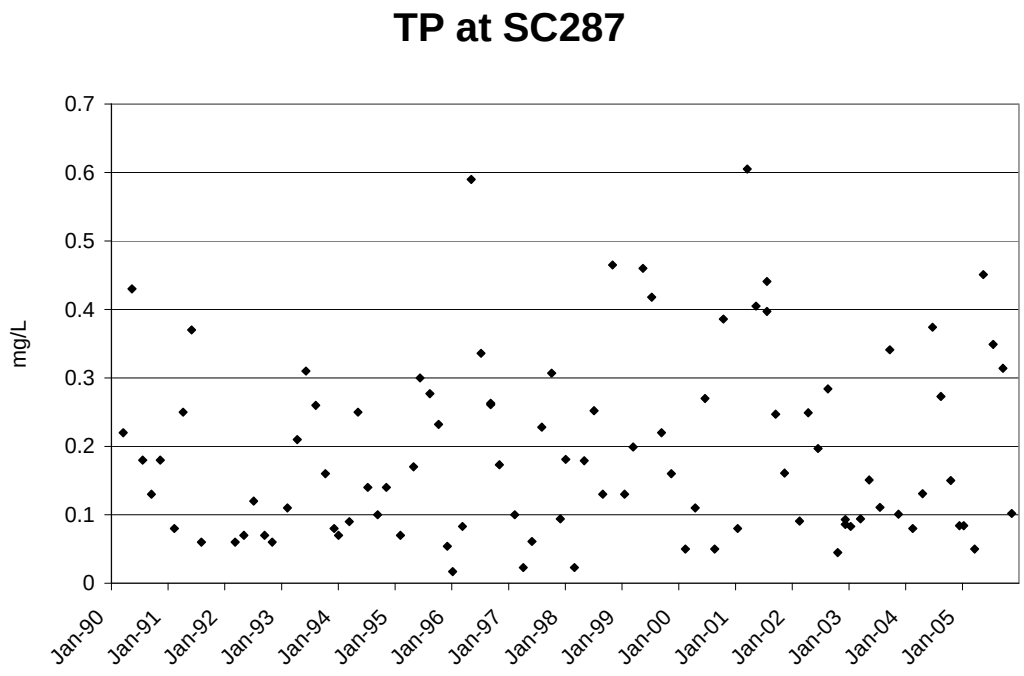
(Figure 3- Total Phosphorus at SC524 downstream from Hutchinson by date. MBI, KBI-NO, and EPT Index are summed for fully supporting designation on the secondary axis.**)**



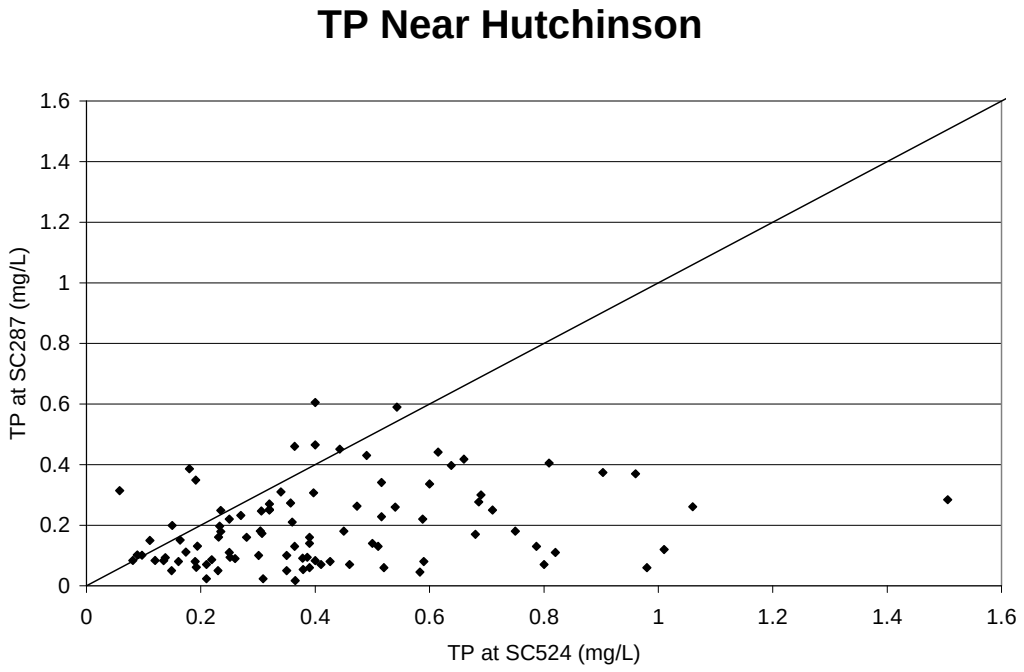
(Figure 4- Total Phosphorus at SC524 downstream from Hutchinson by flow at USGS gage 07143330.**)**



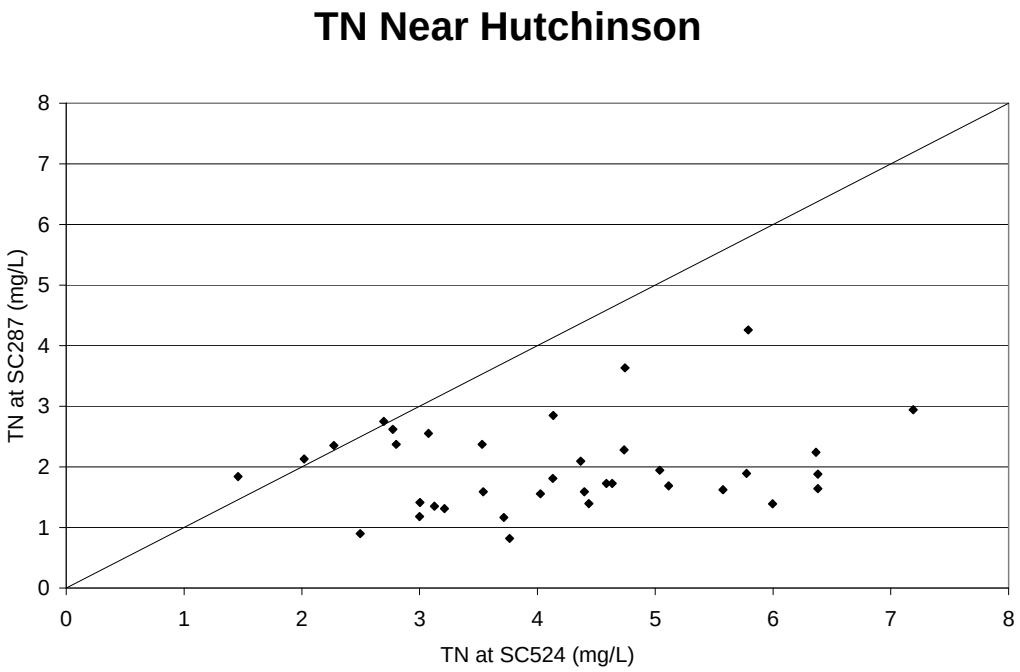
(Figure 5- Total Nitrogen calculated from Total Kjeldahl Nitrogen and oxidized nitrogen at SC287 downstream from Hutchinson by date.**)**



(Figure 6- Total Phosphorus at SC287 downstream from Hutchinson by date.**)**



(Figure 7- Contributions of Total Phosphorus from the original channel of Cow Creek, measured at SC287, are generally lower than the concentrations in the main stem of the Arkansas River, as measured at SC524. 1-to-1 line shown for comparison purposes.**)**



(Figure 8- Contributions of Total Nitrogen from the original channel of Cow Creek, measured at SC287, are generally lower than the concentrations in the main stem of the Arkansas River, as measured at SC524. 1-to-1 line shown for comparison purposes.**)**

Desired Endpoint for Arkansas River near Hutchinson in 2016:

The desired endpoint for this system will be a macroinvertebrate community reflecting full support values in all four biological metrics. Achievement of this endpoint will be indicative of full support of the aquatic life use designation for this stream reach, as well as all other designated uses, including primary contact recreation and domestic water supply, necessary to meet Kansas Water Quality Standards. To achieve this endpoint, and meet the narrative criteria for the prevention of nutrient enrichment, a set of nutrient (nitrogen and phosphorus) concentration goals should be established to guide load reductions and allow this stream to fully support aquatic life. Because of the influence of upstream sources, and the relative uncertainty over the exact level of nutrient enrichment that can occur while still fully supporting aquatic life, this TMDL will be staged and adjusted for flow conditions.

Periphyton and algae growth is greatest in aquatic environments under conditions of high light availability, elevated nutrient concentrations, and stable, low flows. During high flow events bedload moves, particularly in sandbottom streams like the Arkansas River, and dislodges benthic algae and periphyton, preventing the accumulation of large mats. Nutrient loads at moderately elevated flows are also of less concern, because they tend to move quickly downstream at rates that exceed the uptake capacity of benthic primary producers. For this reason, Stage One nutrient concentration goals of 0.29 mg/l for TP and 2.9 mg/l for TN at flows above median flow will be used. For lower flows, however, an alternate goal is needed.

In order to account for seasonal availability of nutrients at low flow, median and lower quartile (25%) values of spring and summer TN and TP from Streams with Ecoregion V – Subregion 27 were selected and averaged. Only values associated with seasons of predominantly low flow (monthly flows below the long-term monthly average flow) were selected. The resulting average values serve as the Stage-Two goals of this TMDL and are 1.16 mg/L for TN and 225 µg/L for TP. These values lie under the suggested levels for TN and over the suggested levels for TP recommended by Dodds, et al (1988) for streams at the mesotrophic-eutrophic threshold (1.5mg/L TN; 75 µg/L TP). Load duration curves were established using the nutrient goals of both Stages

Current TN and TP samples were translated into instantaneous loads and plotted against the percent flow duration for the flow occurring on that date of sampling. A regression of these instantaneous loads and the percent flow duration was derived using a cubic equation as the best fit line. The current condition load curve represents the existing condition of nutrient enrichment along the Arkansas River below Hutchinson. Achievement of the TMDL will mean future loads will approach the range of TN and TP values typical of Subregion 27 streams. Reductions of nutrient concentrations beyond these levels should prevent the production of undesirable quantities or kinds of aquatic life, including algae and periphyton, with a concurrent restructuring of the macroinvertebrate community to one that is composed primarily of high water quality species and meets KDHE indicators for full support designations.

This reach of the Arkansas River is also cited by the 2012 Section 303(d) list of impaired waters as impaired by excessive total phosphorus since the median concentration at SC524 exceeds 0.201 mg/l TP. Current plans for TMDL development schedules the development of the TMDL for this impairment in 2016. At that time, the phosphorus portion of this Biology TMDL will be replaced by the new total phosphorus TMDL with updated staged and phased endpoints and resulting allocations. At that time, this Biology TMDL will be revised to address any total nitrogen loadings in excess of balanced levels. In the meantime, the current initial endpoints reflect expected nutrient reductions from operational changes at upstream point sources as directed by their 2013 NPDES permits. Responses to stream biologic communities to these reductions indicated by concentrations approaching the initial endpoints will be noted over 2014-2016 and used to reset the stream nutrient endpoints with the 2016 TMDL revision.

3. SOURCE INVENTORY AND ASSESSMENT

Upstream Contributions: Nutrient concentrations flowing into the main stem of the Arkansas River from upstream typically exceed the goals established in this TMDL. Upstream contributions are summarized in Tables 2 and 3. Summary statistics were calculated for samples collected from 2000 forward, the period for which Total Kjeldahl Nitrogen has been collected allowing a calculation of total nitrogen. Total phosphorus from upstream sources were calculated based on the entire monitoring period, 1990-2005.

TN (mg/l)	Average	Median	Maximum	Minimum
SC523	3.41	3.37	5.18	0.80
SC522	2.59	2.44	6.80	0.56
SC523 Mar.- Oct. Low Flow	3.38	3.37	4.29	2.45
SC522 Mar.- Oct. Low Flow	2.50	2.52	3.13	1.63

(Table 2- Contributions of Total Nitrogen, as calculated from Total Kjeldahl Nitrogen plus oxidized inorganic nitrogen, at upstream monitoring stations.**)**

TP (mg/l)	Average	Median	Maximum	Minimum
SC523	0.25	0.17	2.34	0.02
SC522	0.43	0.35	0.062	2.20
SC523 Mar.- Oct. Low Flow	0.12	0.09	0.35	0.02
SC522 Mar.- Oct. Low Flow	0.43	0.40	1.30	0.16

(Table 3- Contributions of Total Phosphorus at upstream monitoring stations.**)**

Land Use: The 2006 Kansas LULC dataset was used to analyze land use patterns in the watershed. Most of the three HUC 12 sub-watersheds in the immediate vicinity of Hutchinson are dominated by cropland (62%), urban (17%) and grassland (17%), with limited other uses as summarized in **Table 4**. The proportion of urban and developed land within the drainage to the Arkansas River between the Nickerson and Hutchinson gages dwindles to 3.25%, accounting for the rural dominance of the Salt and Cow Creek drainages. For stormwater purposes, the 3.25% value will be used to estimate MS4 wasteload allocations.

Land Use Type in Hutchinson's 3 HUC12s along Arkansas River	Percent
Cropland	62.4%
Woodland and Forest	2.2%
Grassland and Pasture	16.9%
Urban	17.2%

(Table 4- Land Use in the TMDL area.**)**

NPDES: The city of Hutchinson operates a permitted wastewater treatment system with a design flow of 8.3 million gallons per day (MGD). The city of South Hutchinson operates a 2.0 MGD facility on the south side of the river. Recent (2012-2013) operations average a daily discharge of 4.70 MGD and 0.65MGD respectively. Past upgrades at Hutchinson resulted in substantially lower effluent nitrate and phosphorus concentrations prior to 2006, seen in Figure 9. However, nutrient content in the effluent has increased markedly since 2011. For the 2012 – 2013 period, total nitrogen concentrations averaged 21.11 mg/L, nitrate concentrations averaged 6.22 mg/L and total phosphorus concentrations averaged 2.40 mg/L.

The South Hutchinson wastewater facility has relatively high nutrient concentrations, (Figure 10), since 2012: TN-12.7 mg/L, NO_3-11.2 mg/L, TP-5.2 mg/L.

Nutrient loads from Hutchinson, as shown in Figure 11, also show a swing upward in recent years. The Hutchinson wasteload allocation, based on design flow and expected concentrations of 1.5 mg/l and 8 mg/l, respectively for phosphorus and nitrogen, were largely met prior to 2011. Some exceedances have been seen since that time. Nutrient loads from South Hutchinson are an

order of magnitude lower than those of Hutchinson (Figure 12). Phosphorus loads have been fairly constant, but above the intended wasteload allocation. Nitrogen loads have risen lately but remain below South Hutchinson's wasteload allocation. Two other dischargers in the area, Fun Valley and Reno County Sewer District #202 potentially discharge 0.008 and 0.02 MGD, respectively. Both facilities employ lagoons to treat their wastewater. Typical expected values of TN and TP in wastewater emanating from lagoons are 7 mg/l and 2 mg/l, respectively. These facilities are not likely to contribute significantly to the nutrient loads seen at SC524 or Haven gage. Other NPDES permitted facilities exist within the area covered by this TMDL, but do not discharge by design. All NPDES facilities covered by this TMDL are listed in Appendix C.

Stormwater emanating from Hutchinson's jurisdiction is also permitted under NDPES and thus needs a wasteload allocation for any MS4 discharges and loadings. According to Table 4, 13% of the area within this TMDL is urban. This percentage will be the basis for calculating the MS4 WLA.

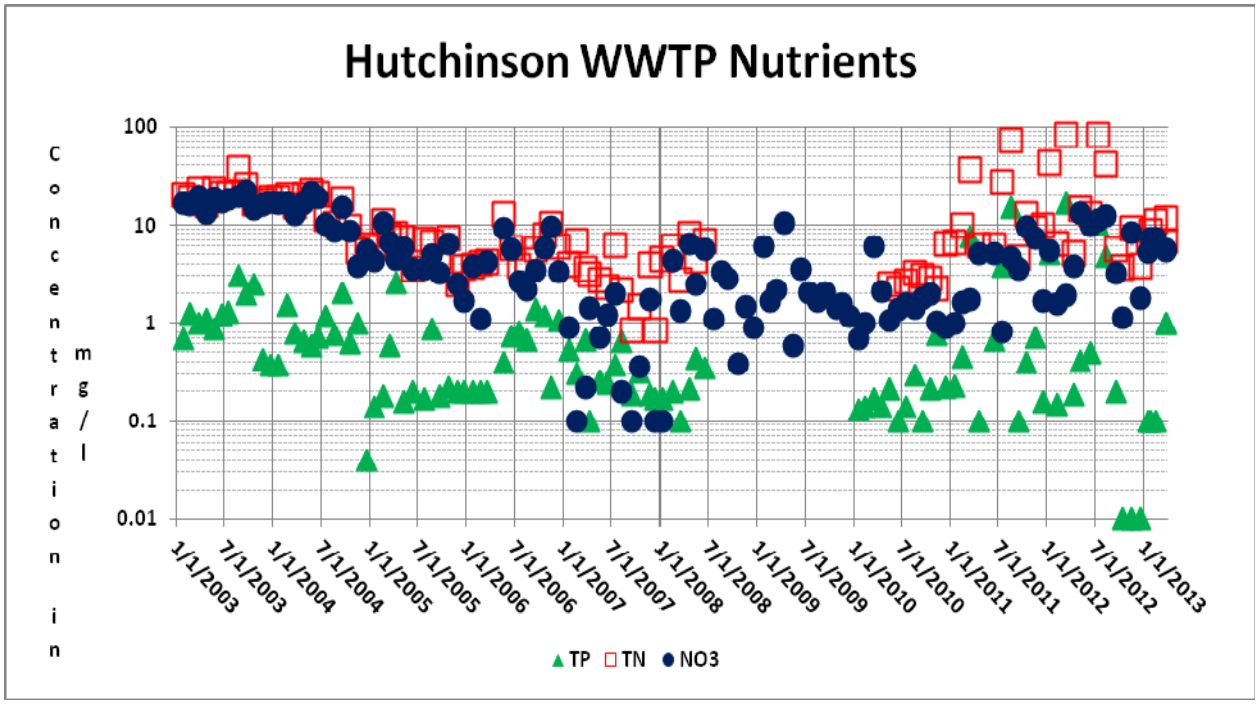


Figure 9- Nutrient levels in wastewater from Hutchinson.

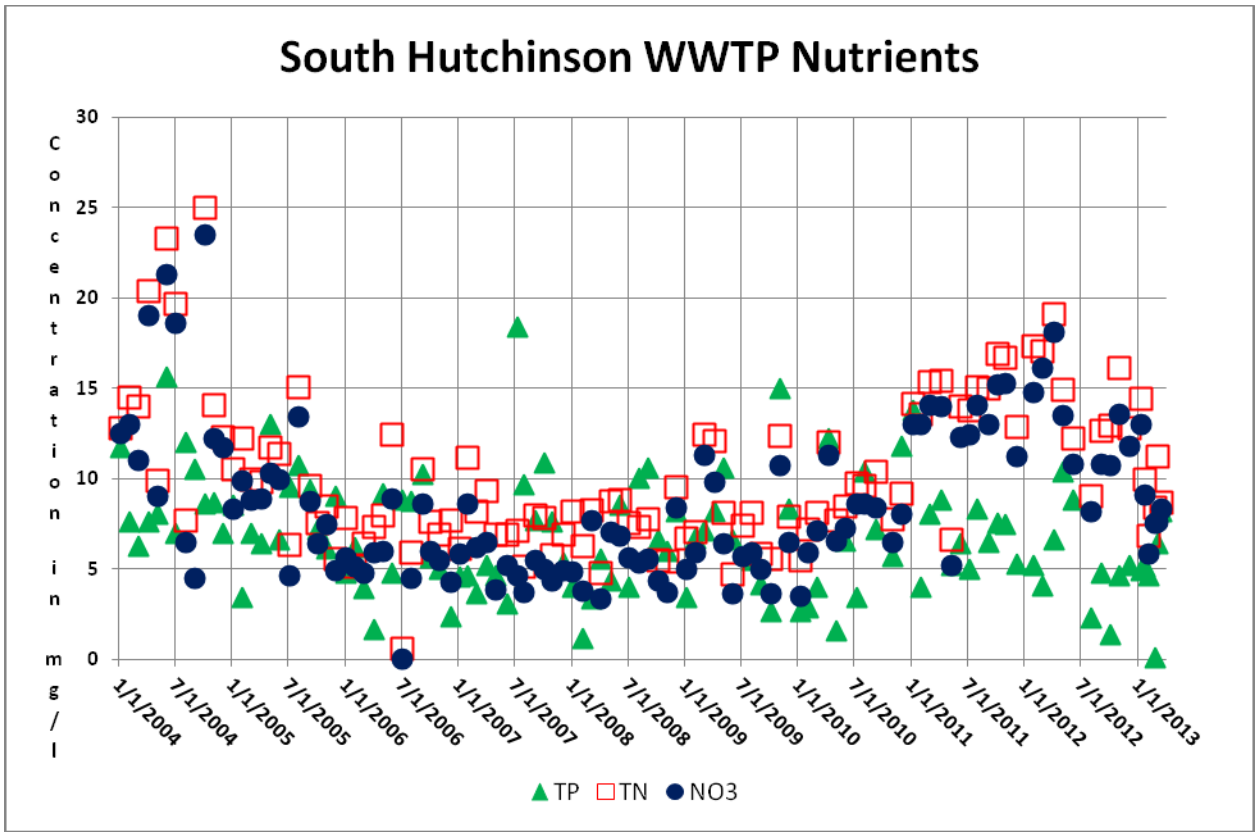


Figure 10. Nutrient levels in wastewater of South Hutchinson

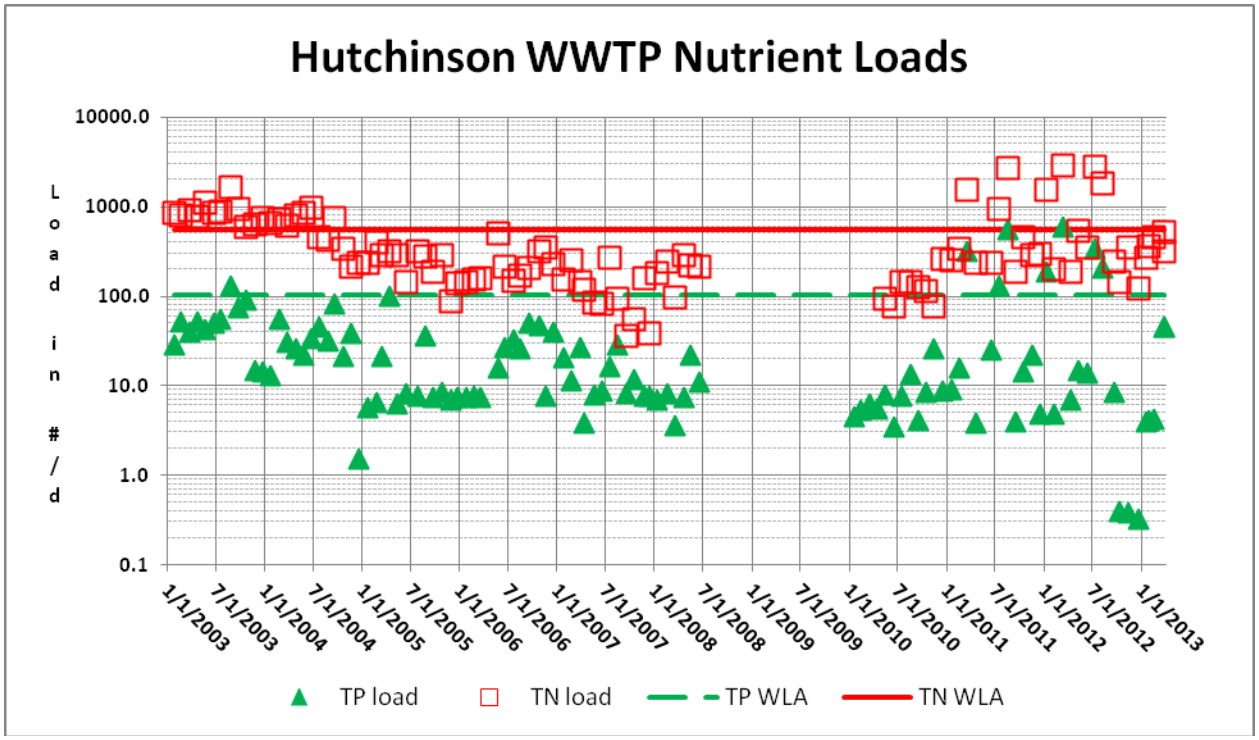


Figure 11. Nutrient loads in Hutchinson wastewater.

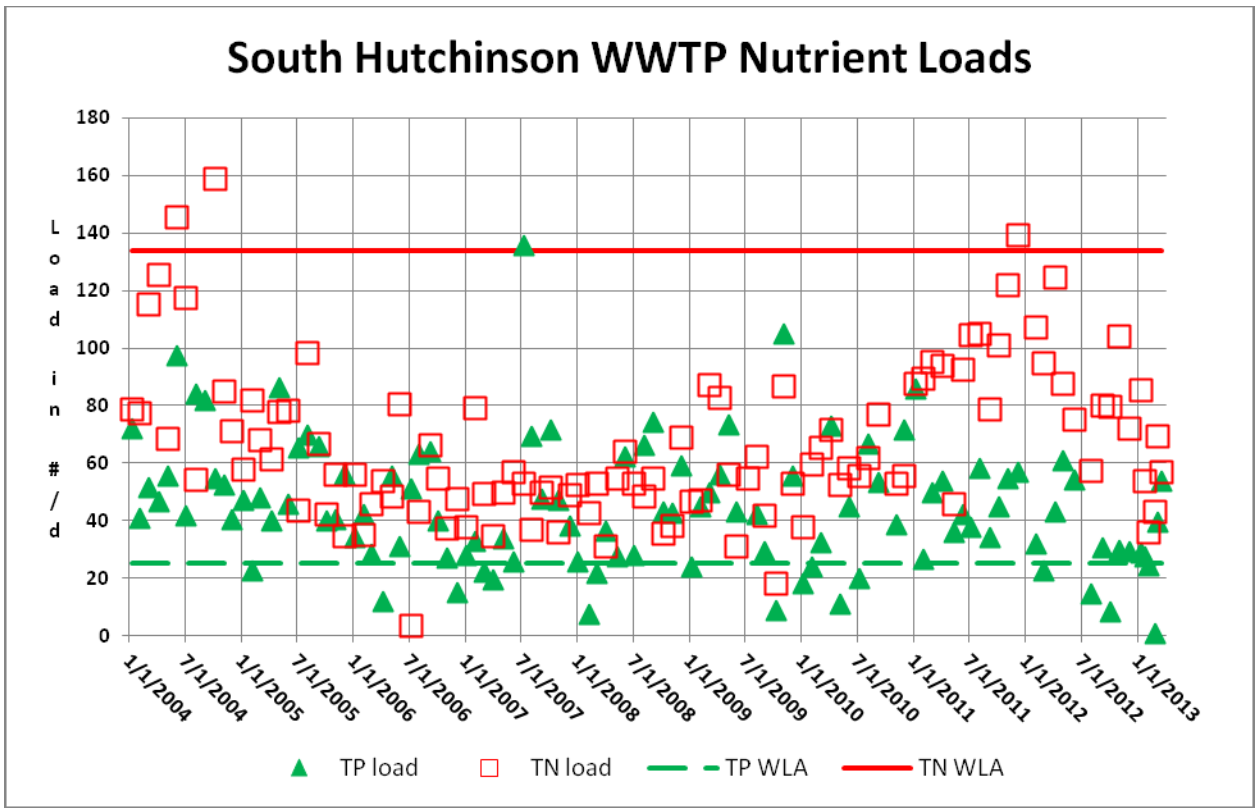


Figure 12. Nutrient loads in South Hutchinson wastewater.

CAFO: There are 26 known confined animal feeding operations in the drainage. The dominant type is a small (less than 300 animals) dairy, with limited beef, a single small swine and a single small horse operation. A summary of the operations by size and animal type is included in Table 5, details in Appendix B, locations are marked in Figure 1.

All permitted livestock facilities have waste management systems designed to minimize runoff entering their operations or detaining runoff emanating from their areas. Such systems are designed for the 25 year, 24 hour rainfall/runoff event, which would be indicative of flow durations well under 10 percent of the time. The actual number of animal units on site is variable, but typically less than permitted numbers.

Type	Size	Number Present*
Dairy	0-299	20
Beef	0-299	3
Beef	300-999	2
Horses	0-299	1
Swine	300-999	1
* one facility has a joint permit, 26 total permits		

(Table 5- Summary of all confined animal feeding operations within the TMDL area.**)**

Background Levels: EPA publication 822-B-01-014 Ambient Water Quality Criteria Recommendations: Information Supporting the Development of State and Tribal Nutrient Criteria Rivers and Streams in Nutrient Ecoregion V provides tables of estimated background nutrient concentrations within the Central Great Plains. Total nitrogen background concentrations range from 0.71-0.84 mg/L; total phosphorus background concentrations are 0.09 mg/L.

4. ALLOCATION OF POLLUTION REDUCTION RESPONSIBILITY

This TMDL is downstream from over 30,000 square miles of drainage, and as such is strongly dependent on upstream nutrient reductions for full compliance. A combination approach of USGS gages and USGS estimates of flow (Perry, et al., 2004) was used to calculate the approximate average flow contribution of upstream tributary segments. Results are summarized in Table 6.

Source of Flow	Percentage Contribution at 07143330
Arkansas River at Junction with Salt Creek	60%
Cow Creek	10%
Salt Creek	2.5%
Hutchinson WWTP	5%
Immediate area along Arkansas River	22.5%

(Table 6- Relative proportions of the flow as seen above SC524 by source.**)**

The linkage between indices of biotic integrity and nutrient loading was originally developed based on observed biochemical oxygen demand stressors and known toxicity of ammonia to aquatic life. However, given the level of wastewater treatment above SB283 those concerns are not likely the contributing elements for the moderate stress observed in the macroinvertebrate community structure. Instead, it is believed that the partially supporting designations at SB283 arise from a complicated linkage with overall elevated nutrient levels and involves in-stream benthic colonization by periphyton and other aquatic primary producers. Load reductions are displayed through load duration curves based on the desired level of TP and TN during the first stage **(Figure 13 and 14).**

Point Sources: The city of Hutchinson has significantly reduced their nutrient loading with plant upgrades and other wastewater treatment at their wastewater plant. Following guidance within the Kansas Surface Water Nutrient Reduction Plan, their goals shall be total nitrogen not to exceed 8 mg/L and total phosphorus not to exceed 1.5 mg/L; resulting in a wasteload allocation of 555 lbs per day TN and 104 lbs per day TP at a design flow of 8.3 MGD. Past operations at the Hutchinson facility have produced effluent complying with these limits, and the city is encouraged to resume meeting its wasteload allocation.

Current concentrations at the South Hutchinson facility are greater than its initial goals of 8 mg/l TN and 1.5 mg/l TP, (or alternative goals of 10 mg/l TN and 1.0 mg/l TP), but its consistently low volume of wastewater allows it to generally stay within its TN wasteload allocation of 134 pounds per day. Phosphorus wasteloads are consistently greater than its assigned wasteload allocation of 25 pounds per day. Reductions will be needed to meet any load limits for South Hutchinson, especially as it increases its discharge volume toward its design flow of 2 MGD.

Hutchinson's NPDES permit should be issued in 2013 and be up for renewal in 2018. South Hutchinson's NPDES permit has been issued and will be renewed by the end of 2017. After 2018, these nutrient concentration goals will become limits that treatment technology should achieve without problem.

The Reno County Sewer District #202 facility at Yoder's and Fun Valley's wasteload allocations seen in Appendix C are based on their respective 0.02 and 0.008 MGD design flows and an assumed 2 & 7 mg/l technology limits for phosphorus and nitrogen from lagoons. They represent a minuscule impact in nutrient loading to the Arkansas River. The combined wasteload allocation from these two discharging facilities along with Hutchinson and South Hutchinson totals 130 pounds per day for TP and 690 pounds per day for TN.

A wasteload allocation is also needed for Hutchinson's MS4 stormwater permit. That allocation is derived as a proportion of the runoff-influenced load allocation that represents the percentage of the surrounding land area addressed in this TMDL that is within the Hutchinson jurisdictional limits. Based on concurrent flow measurements on the Arkansas River at Hutchinson and Nickerson since 1997, it was found that 60% of the flow seen at the Hutchinson (Haven) gage passed by the Nickerson gage. Therefore, the balance of 40% of the Haven flow is generated within the land use proportions found in the 13 HUC12s that potentially contribute flow between Nickerson and Hutchinson which includes the Cow Creek Watershed in its entirety. Hutchinson comprises 3.25% of that intervening land below Nickerson that flows to the Arkansas River. Therefore, the wasteload allocation for Hutchinson MS4 stormwater will be 3.25% of the intervening 40% of load allocation occurring at flows greater than median flow. Stormwater is assumed to be an insignificant contributor at flows less than average flow.

The resulting Wasteload Allocations represent a correction and improvement in the values provided in the 2006 TMDL. Those WLA values were computed using actual average flows from the point sources. The revised wasteloads reflect correct use of the design flows from the Hutchinson, South Hutchinson and Reno County Sewer District facilities. Additionally, Wasteload Allocations are provided for the mistakenly omitted facilities at Fun Valley and the urban stormwater covered by Hutchinson's MS4 NPDES permit (KSR044009).

Nonpoint Sources: The continuation of elevated nutrient loads at SC524 after the upgrades at the Hutchinson WWTP confirms that regional, nonpoint sources contribute to the observed concentrations of nitrogen and phosphorus in the Arkansas River. Because the exact reduction in nutrients required to return SB283 to a fully supporting designation can only be estimated, this TMDL will be staged and flow adjusted. Nonpoint sources of nitrogen and phosphorus will be reduced during flow events greater than median flow so the average TN will be less than 2.9 mg/L and TP will be less than 0.29 mg/L. High flow events will need landscape level best management practices to interact with any dilution effect of greater quantities of water.

Non-point sources contributing loads at flows less than median will need a slight reduction of TP loading (Figure 13), but a potentially large amount of reduction for TN (Figure 14). Low flow loading within the area covered by this TMDL is likely affected by groundwater, which may have accumulated nutrients that require longer mitigation periods to reduce than surface runoff. The ultimate endpoint for low flows will be lower than for high flows, reflecting the relative

importance of low flow periods for benthic primary production, however the time period for these reductions is necessarily longer. Regressions deriving the current load curves are provided by **Appendix D**.

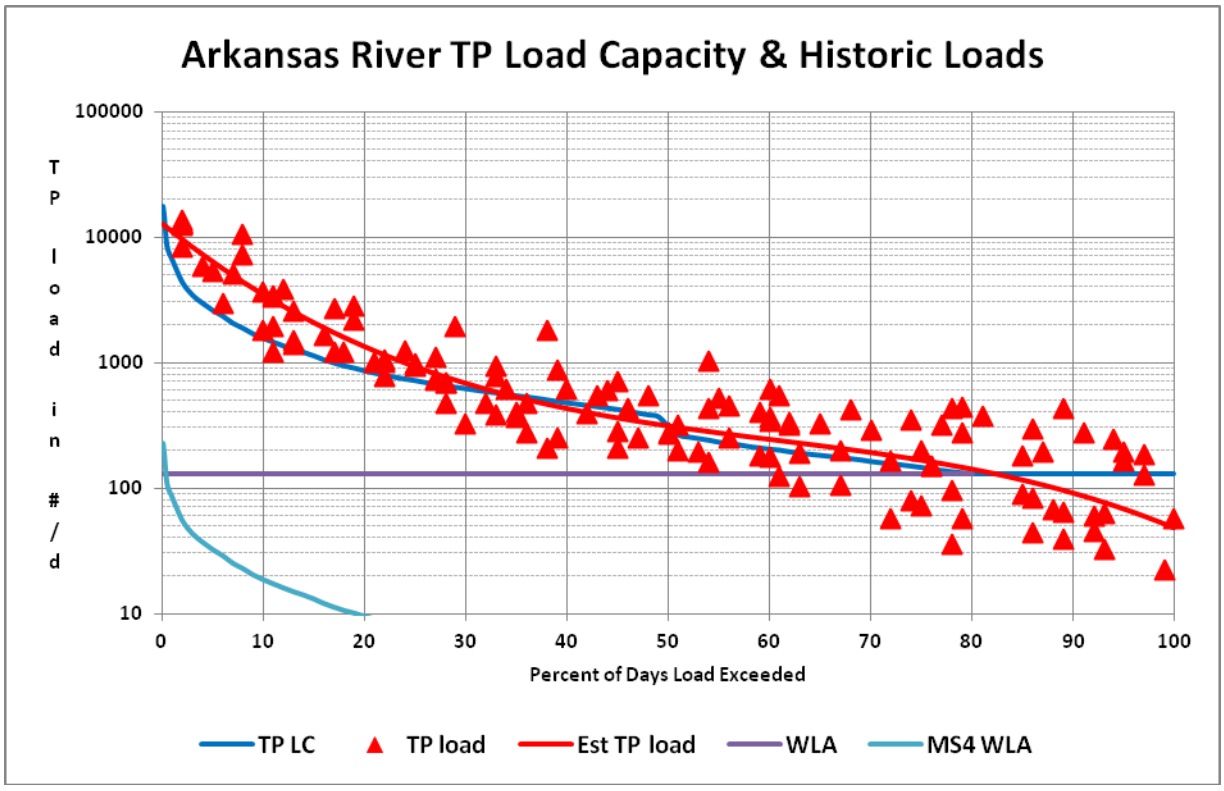


Figure 13. TP Load Capacity and Allocations for Arkansas River below Hutchinson

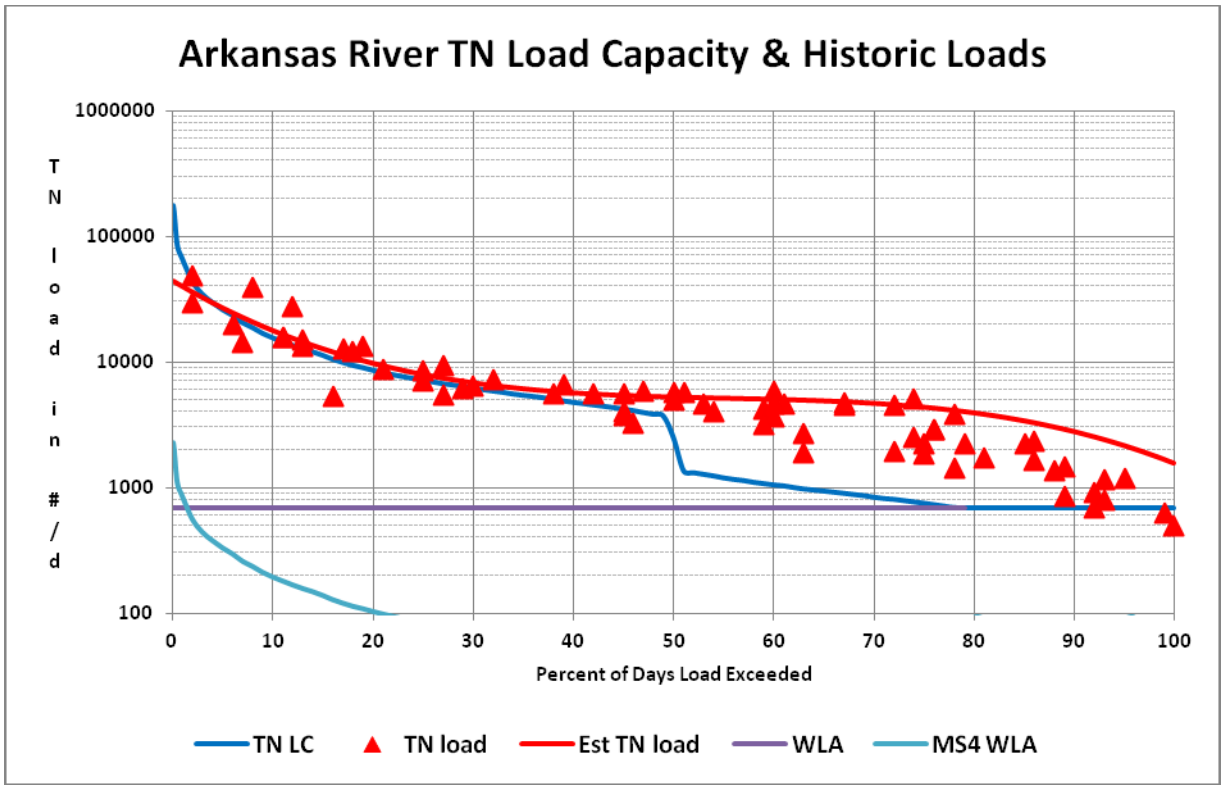


Figure 14. TN Load Capacity and Allocations for Arkansas River below Hutchinson

Total P Loads	Load Capacity	Wasteload Alloc	MS4 – WLA	Load Allocation
90% Flows	130 #/d	130 #/d	0 #/d	0 #/d
75% Flows	145.8 #/d	130 #/d	0.2 #/d	15.6 #/d
50% Flows	310 #/d	130 #/d	2 #/d	178 #/d
25% Flows	719 #/d	130 #/d	8 #/d	581 #/d
10% Flows	1559 #/d	130 #/d	19 #/d	1411 #/d

Table 7. Load Capacities and Allocations of Total P on Arkansas River near Hutchinson

Total N Loads	Load Capacity	Wasteload Alloc	MS4 – WLA	Load Allocation
90% Flows	690 #/d	690 #/d	0 #/d	0 #/d
75% Flows	752 #/d	690 #/d	1 #/d	61 #/d
50% Flows	2500 #/d	690 #/d	24 #/d	1786 #/d
25% Flows	7188 #/d	690 #/d	84 #/d	6413 #/d
10% Flows	15596 #/d	690 #/d	194 #/d	14712 #/d

Table 8. Load Capacities and Allocations of Total N on Arkansas River near Hutchinson

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-NO, MBI and EPT Index 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 iterative assessment will be needed to determine the relationship between aquatic community response and nutrient loading, while Hutchinson works to resume the historic substantially reduced nutrient concentration in their outfall, this TMDL will be a **Medium Priority** for implementation. During this stage, the emphasis of this TMDL will be on monitoring the macroinvertebrate community at SB283 and reducing upstream nutrient concentrations entering these segments at low flow.

Unified Watershed Assessment Priority Ranking: This watershed lies within the Arkansas Gar-Peace (11030010) subbasin with a priority of 19, high priority for restoration work.

Priority HUC 11s and Stream Segments: Because in-stream denitrification rates decline logarithmically with increasing flow, priority for additional nutrient reduction efforts will be on the lands adjacent to the main stem river and the tributary segment included in this TMDL. Emphasis shall be on implementing best management practices for nutrient reduction in both agricultural and urban areas.

5. IMPLEMENTATION

Desired Implementation Activities

1. Monitor wastewater discharges to assess reduction in long-term nutrient loadings through wastewater treatment processes.
2. Repair or replace or remove faulty septic systems in the area
3. Improve riparian conditions along the Arkansas River and its tributaries.
4. Implement necessary soil sampling to recommend appropriate fertilizer applications on cropland
5. Maintain necessary conservation tillage and contour farming to minimize cropland erosion.
6. Install necessary grass buffer strips along low-order streams.
7. Install proper manure storage
8. Implement necessary nutrient management plans to manage manure application to land
9. Abate any urban stormwater contributions of nutrients to the Arkansas River through best management practices
10. Implement urban watershed outreach programs to reduce nutrient loading from Hutchinson stormwater.

Implementation Programs Guidance

NPDES - Municipal Program Sections- KDHE

a. Issue renewed NPDES permits with monitoring of nutrients and goals/limits of 1.5 mg/l TP and 8.0 mg/l TN for discharged effluent.
b. Evaluate influence of nutrient levels in Hutchinson wastewater on downstream nutrient levels monitored at Station 524.
c. Encourage current and future operations at the Hutchinson Wastewater Treatment Plant, to match historic plant performance.
d. Implement an average annual limit of 8.0 mg/l for total nitrogen and 1.5 mg/l for total phosphorus for the South Hutchinson Wastewater Treatment Plant, through improved plant operations.
e. Review and approve necessary plans and specifications for treatment plant operations in order to achieve nutrient reduction.

Local Environmental Protection Program - KDHE

a. Support county inspections of on-site wastewater systems to minimize nutrient loadings

Watershed Management Program - KDHE

a. Support demonstration projects and outreach efforts dealing with erosion and sediment control, nutrient management, stormwater management and practices, pollution prevention, public outreach and studies of water quality impacts of new development.
b. Support onsite waste treatment inspections, upgrades and repairs through the Reno County Local Environmental Protection Program.
c. Provide technical assistance on nutrient management and vegetative buffer development in vicinity of streams.
d. Support aspects of the Hutchinson Stormwater Programs, outside the requirements of the Phase II NPDES permit, that promote stream buffers, installation of new and retrofitted stormwater management practices, including Low Impact Development and Best Management Practices, and runoff treatment practices, to mitigate the impacts of impervious area in the watershed.

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Water Resource Cost Share & Nonpoint Source Pollution Control Programs – KDA – DOC

a. Apply conservation farming practices, including terraces and waterways, sediment control basins, and constructed wetlands in cropland of unincorporated areas of Reno County lying within the watershed.
b. Provide sediment control practices to minimize erosion and sediment and nutrient transport from cropland and grassland in the watershed.
c. Repair faulty septic systems located adjacent to the Arkansas River and its main tributaries.

Riparian Protection Program - KDA – DOC

a. Establish or reestablish natural riparian systems, including vegetative filter strips and streambank vegetation along the Arkansas River and its tributaries.
b. Develop riparian restoration projects.
c. Promote wetland construction to assimilate nutrient loadings.
d. Coordinate riparian management within Hutchinson and in unincorporated Reno County.

Buffer Initiative Program - KDA – DOC

a. Install vegetative buffer strips along the Arkansas River and its tributaries.

Extension Outreach and Technical Assistance - Kansas State University

a. Educate agricultural producers on sediment, nutrient and pasture management
b. Provide technical assistance on buffer strip design and minimizing cropland runoff
c. Encourage annual soil testing to determine capacity of field to hold phosphorus

Nonpoint Source Pollution Technical Assistance – KDHE

a. Support Section 319 demonstration projects for reduction of sediment runoff from agricultural activities as well as nutrient management.
b. Provide technical assistance on practices geared to establishment of vegetative buffer strips.
c. Provide technical assistance on nutrient management in vicinity of streams.

Time Frame for Implementation: Any ongoing projects involving pollutant reduction practices should be installed within the area described in this TMDL by the year 2015. Urban stormwater mitigation programs should commence with the issuance of the Hutchinson Phase II NPDES stormwater permit in 2013.

The second stage will commence in 2016 when this TMDL will be reviewed and revised in conjunction with development of the stream total phosphorus TMDL for the Arkansas River in the vicinity of Hutchinson and will involve incorporating refined endpoints, allocations and load reductions including permit limits in iterative fashion.

Targeted Participants: Primary participants for implementation will be the city of Hutchinson, residents of the city of Hutchinson and agricultural producers operating within the drainage of the subwatersheds. Initial work in 2007-2014 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
2. Cultivation alongside stream
3. Fields with manure applications
4. On-site wastewater discharges to stream
5. Condition of riparian areas
6. Presence of livestock along stream

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.

Municipal sources will continue monitoring and treating effluent to maintain nutrient loading at, or below, levels described in this TMDL.

Milestone for 2016: The year 2011 marks the transition to the stream phosphorus TMDL At that point in time, adequate source assessment should be complete which allows an allocation of resources to responsible activities contributing to the nutrient impairment. Additionally, biological data from Arkansas River over 2006-2015 should not indicate trends of reduced support of the aquatic community. Stream chemisty data from Arkansas River should indicate evidence of reduced nutrient levels relative to the conditions seen over 1990-2005.

Delivery Agents: The primary delivery agents for program participation will be KDHE Municipal Program Section, the Reno County Conservation District for programs of the State Department of Agriculture - Conservation Division, 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 Reno County.

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. 2-1915 empowers the State Conservation Commission (dba Kansas Department of Agriculture – Division of Conservation) to develop programs to assist the protection, conservation and management of soil and water resources in the state, including riparian areas.

4. 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.

5. 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.

6. K.S.A. 82a-951 creates the State Water Plan Fund to finance the implementation of the *Kansas Water Plan.*

7. The *Kansas Water Plan* and the Lower Arkansas 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 Revolving Loan Fund is operated through the Municipal Program at KDHE and provides low interest loans for wastewater treatment improvement. Since its inception, $750 million in loans have been made to municipal dischargers in the state. The Non-Point Source Pollution Control Fund of the State Conservation Commission distributes $2.8 million annually to the 105 Conservation Districts to implement non-point source abatement practices, including repair and replacement of faulty septic systems and riparian area improvements.

Effectiveness: Nutrient 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 and waste management within the watersheds cited in this TMDL.

6. MONITORING

KDHE will continue to monitor stream chemistry and biology over 2014 - 2016, including total nutrient concentrations quarterly at SC524, SC523, SC 287 and SC522, and quarterly once every four years at SC659. Stream biology macroinvertebrates will continue to be collected at SB283 in attempted annual visits. Wastewater discharges in the area covered under this TMDL will continue to be required to monitor total nutrient concentrations. Prior to 2016 KDHE will evaluate all new biological samples collected and determine if the river is fully supporting aquatic life, as indicated by the suite of metrics identified in the Defined Margin of Safety.

7. FEEDBACK

Public Meetings: An active Internet Web site was established at http://www.kdhe.state.ks.us/tmdl/ to convey information to the public on the general establishment of TMDLs and specific TMDLs for the Lower Arkansas Basin.

Public Hearing: A Public Hearing on the TMDLs of the Lower Arkansas Basin was held on September 4, 2013 in Newton. The public record was held open until September 27, 2013. No comments were received on this TMDL.

Basin Advisory Committee: The Lower Arkansas Advisory Committee met to discuss the TMDLs in the basin on May 31, 2012 in Hutchinson, September 12, 2012 in Halstead, April 3, 2013 in Hutchinson and July 19, 2013 in Hutchinson.

Milestone Evaluation: In 2016, an evaluation will be made as to the degree of achievement of the four biological metrics for the Arkansas River and lower Cow Creek and relationships with ambient nutrient levels in the streams. The phosphorus portion of this TMDL will transition into a new TMDL for stream phosphorus for this reach of the Arkansas River in 2016.

Consideration for 303(d) Delisting: The stream will be evaluated for delisting under Section 303(d), based on the monitoring data over the period 2006-2015. Therefore, the decision for delisting will come about in the preparation of the 2016 303(d) list. With the transition to the stream phosphorus TMDL in 2016, any modifications to the applicable water quality criteria or endpoint during the subsequent ten-year 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 will come in 2014 which will emphasize implementation of TMDLs. At that time, incorporation of this TMDL will be made into the document. Recommendations of this TMDL will be considered in Kansas Water Plan implementation decisions under the State Water Planning Process for Fiscal Years 2014-2015.

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Appendix A-KDHE Biological Monitoring Metrics

MBI- Macroinvertebrate Biotic Index: Developed to assess the impact of oxygen demanding nutrients and organic enrichment on macroinvertebrate populations. Has a wider range of possible scores than the KBI, but the research basis for the larger number of values is lacking. Has more generalization into higher taxanomic units than the KBI. Includes many insect genera and species and other common macroinvertebrates, such as leaches, worms, snails, bivalves, flatworms, and crayfish; some of the insect species scored in the KBI are not scored in the MBI.
Scoring Range: 1 (intolerant)-11 (tolerant)
Fully Supporting- ≤ 4.5
Partially Supporting- 4.51-5.39
Non-Supporting- ≥ 5.4

KBI- Kansas Biotic Index: Reported here as the Nutrient Oxygen Demand component. Developed specifically for Kansas insects belonging to the 10 orders of insects known to occur in Kansas, this metric has six potential categories of impairment- Nutrient Oxygen Demand, Agricultural Pesticides, Heavy Metals, Salinity, Suspended Sediments and Solids, and Persistent Organic Compounds. Species were assigned tolerance values and the composite score for the site is the abundance weighted average tolerance score for the population collected.
Scoring Range: 0 (intolerant)-5 (tolerant)
Fully Supporting- ≤ 2.6
Partially Supporting- 2.61-2.99
Non-Supporting- ≥ 3.0

EPT- Ephemeroptera (mayflies), Plecoptera (stoneflies), Trichoptera (caddisflies): The simple sum of the number of species collected belonging to these three orders. EPT are widely recognized as relatively intolerant to pollution, and generally the presence of greater numbers (both diversity and abundance) of these species is considered indicative of higher water quality.
Fully Supporting- ≥ 13
Partially Supporting- 8-12
Non-Supporting- ≤ 8

EPT % Abundance: The percentage of all individuals collected belonging to these three orders. Large populations of a few species may swing this metric to fully supporting when the EPT index registers a partial or non-supporting condition. This metric does not measure diversity in community structure.
Fully Supporting- $\geq 48\%$
Partially Supporting- 31-47%
Non-Supporting- $\leq 30\%$

Appendix B:

Permit #	Total Head		KS Authorized Head	Federal Authorized Head	Animal Type	Size	TN & TP WLA (lbs/day)
A-ARRN-BA15		500	250	500	Beef	0-299	0
A-ARRN-BA10		525	263	525	Beef	0-299	0
A-ARRN-BA04		150	75	150	Beef	0-299	0
A-ARRN-BA08		700	700	700	Beef	300-999	0
A-ARRN-BA12		800	800	800	Beef	300-999	0
A-ARRN-MA10		30	42	42	Dairy	0-299	0
A-ARRN-MA14		21	25	27	Dairy	0-299	0
A-ARRN-MA07		50	70	70	Dairy	0-299	0
A-ARRN-M025		200	280	280	Dairy	0-299	0
A-ARRN-M015		100	140	140	Dairy	0-299	0
A-ARRN-M047		40	56	56	Dairy	0-299	0
A-ARRN-M026		35	49	49	Dairy	0-299	0
A-ARRN-M022		35	49	0	Dairy	0-299	0

Permit #	Total Head		KS Authorized Head	Federal Authorized Head	Animal Type	Size	TN & TP WLA (lbs/day)	
A-ARRN-M048		40	56	56	Dairy	0-299		0
A-ARRN-M049		60	71	76	Dairy	0-299		0
A-ARRN-M040		80	112	112	Dairy	0-299		0
A-ARRN-M012		35	49	49	Dairy	0-299		0
A-ARRN-M046		110	142	142	Dairy	0-299		0
A-ARRN-M043		30	42	42	Dairy	0-299		0
A-ARRN-M038		50	70	70	Dairy	0-299		0
A-ARRN-M010		60	84	84	Dairy	0-299		0
A-ARRN-M041		40	56	56	Dairy	0-299		0
A-ARRN-M003		140	196	196	Dairy	0-299		0
A-ARRN-M044		35	49	49	Dairy	0-299		0
247		48	51	61	Dairy,Horses	0-299,0-299		0
A-ARRN-S017		2499	1000	1000	Swine	Swine300-999		0

Appendix C:

KS Permit #	NPDES Permit #	Facility Name	TN WLA (lbs/day)	TP WLA (lbs/day)	Category
I-AR49-PO08	KS0119733	CARGILL SALT	0	0	Salt
I-AR49-CO10	KS0089320	KRAUSE PLOW CORPORATION, INC.	0	0	Cooling
I-AR49-NP04	KSJ000521	MAST CUSTOM PROCESSING PLANT	0	0	Non-discharging
I-AR82-NP01	KSJ000516	NATIONAL BY-PRODUCTS-S. HUTCHINSON	0	0	Non-discharging
C-AR49-NO04	KSJ000601	PHEASANT ACRES COUNTRY LIVING	0	0	Non-discharging
M-AR49-NO07	KSJ000455	RENO CO. S.D. #201	0	0	Non-discharging
I-AR98-PO01	KS0091715	RENO CO. S.D. #202	1.17	0.33	Wastewater
M-AR49-OO01	KS0080586	FUN VALLEY WASTEWATER LAGOONS	0.47	0.13	Wastewater
I-AR49-CO19	KS0091065	TRINITY UNITED METHODIST CHURCH	0	0	Cooling
C-AR82-NO02	KSJ000192	WHISPERING PINES TRAILER COURT	0	0	Non-discharging
I-AR82-PO01	KS0000345	MORTON SALT	0	0	Salt
I-AR82-PO15	KS0098591	FI KANSAS REMIDIATION TRUST	0	0	Groundwater remediation
I-AR49-PO02	KS0001112	IMC SALT, INC.	0	0	Groundwater remediation
I-AR49-PO22	KS0095257	INEEDA LAUNDRY AND DRY CLEANER	0	0	Groundwater remediation
I-AR82-PR01	KSG110043	MID AMERICA REDI-MIX, INC	0	0	Concrete
I-AR49-CO20	KS0091251	SHIELD IND INC.	0	0	Cooling
I-AR49-CO21	KS0095575	TRINITY JUNIOR-SENIOR CATHOLIC SCHOOL	0	0	Cooling
M-AR82-OO02	KS0095711	CITY OF SOUTH HUTCHINSON	134	25	Muni wastewater
M-AR49-IO01	KS0036188	CITY OF HUTCHINSON	555	104	Muni wastewater

Appendix D: Regressions of Current Loads on Flow Percentiles

Regression Analysis: log tp ld versus Pct, Pct2, Pct 3

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The regression equation is
log tp ld = 4.11 - 0.0653 Pct + 0.000910 Pct2 - 0.000005 Pct 3


Predictor         Coef     SE Coef      T      P
Constant       4.10620     0.08739  46.99  0.000
Pct          -0.065298    0.007743  -8.43  0.000
Pct2          0.0009096   0.0001825   4.98  0.000
Pct 3      -0.00000489  0.00000121  -4.04  0.000


S = 0.259369   R-Sq = 82.8%   R-Sq(adj) = 82.4%


Analysis of Variance

Source           DF      SS      MS       F      P
Regression        3  41.588  13.863  206.07  0.000
Residual Error  128   8.611   0.067
Total           131  50.199


Source  DF  Seq SS
Pct      1  38.037
Pct2     1   2.455
Pct 3    1   1.096
```

Regression Analysis: log tn ld versus Pct, Pct2, Pct 3

```
The regression equation is
log tn ld = 4.65 - 0.0476 Pct + 0.000830 Pct2 - 0.000005 Pct 3


70 cases used, 62 cases contain missing values


Predictor         Coef     SE Coef      T      P
Constant       4.65438     0.06989  66.60  0.000
Pct          -0.047622    0.006013  -7.92  0.000
Pct2          0.0008303   0.0001356   6.12  0.000
Pct 3      -0.00000549  0.00000087  -6.30  0.000


S = 0.130277   R-Sq = 91.3%   R-Sq(adj) = 90.9%
```

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	3	11.7236	3.9079	230.25	0.000
Residual Error	66	1.1202	0.0170		
Total	69	12.8437			

Source	DF	Seq SS
Pct	1	11.0433
Pct2	1	0.0064
Pct 3	1	0.6738