

KANSAS-LOWER REPUBLICAN BASIN TOTAL MAXIMUM DAILY LOAD

Waterbody: Upper Soldier Creek Watershed Water Quality Impairment: Sediment Impact on Aquatic Life

1. INTRODUCTION AND PROBLEM IDENTIFICATION

Subbasin: Middle Kansas

Counties: Shawnee, Jackson, and Nemaha

HUC 8: 10270102

HUC 11: 080 (Soldier, Crow, James, and Dutch Creeks)

HUC 14: 010, parts of 020, 030., and 040

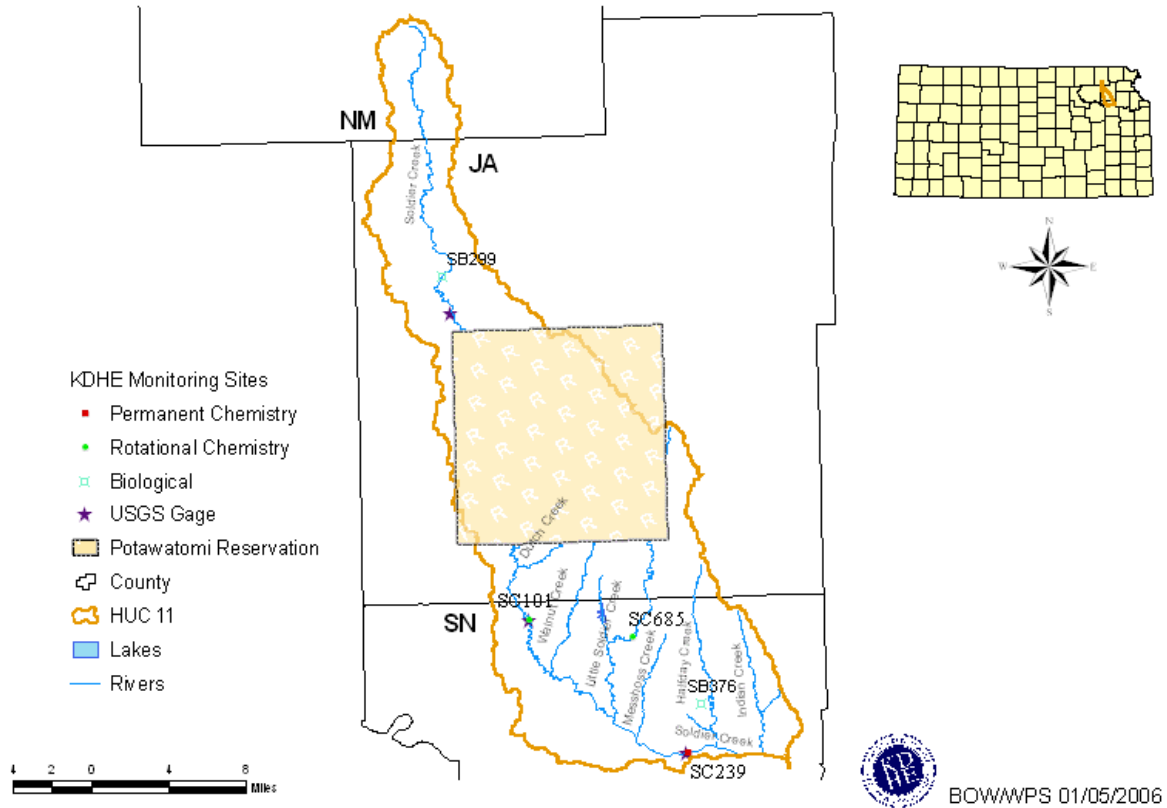
Drainage Area: 157 miles² at Delia, 49.3 miles² at Circleville (Figure 1)

Special Considerations: The Prairie Band Potawatomi Reservation lies within this watershed. The reservation covers 121 miles², most of which is within the watershed of Solder Creek. Tribal lands lie outside the jurisdiction and oversight of the Kansas Department of Health and Environment.

Main Stem Segments: 9, starting at confluence of Little Soldier Creek, extending to the southern boundary of the Prairie Band Potawatomi Reservation; 9009, starting at the northern boundary of the Prairie Band Potawatomi Reservation, with headwaters in Nemaha County near Corning

Tributary Segments: WQLS: Walnut Creek (91) from the confluence with Soldier Creek upstream to the boundary of the Prairie Band Potawatomi Reservation
WQLS: Dutch Creek (92) from the confluence with Soldier Creek upstream to the boundary of the Prairie Band Potawatomi Reservation
WQLS: James Creek (87) from the confluence with Soldier Creek upstream to the boundary of the Prairie Band Potawatomi Reservation

Soldier Creek TMDL Stream Network



(Figure 1)

Designated Uses: Expected Aquatic Life Support.

1998 303d Listing: Table 2–Stream Segments Identified by Biological Monitoring

Impaired Use: Expected Aquatic Life Support on Segment 9, Expected Aquatic Life Support on Segment 9009

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)).

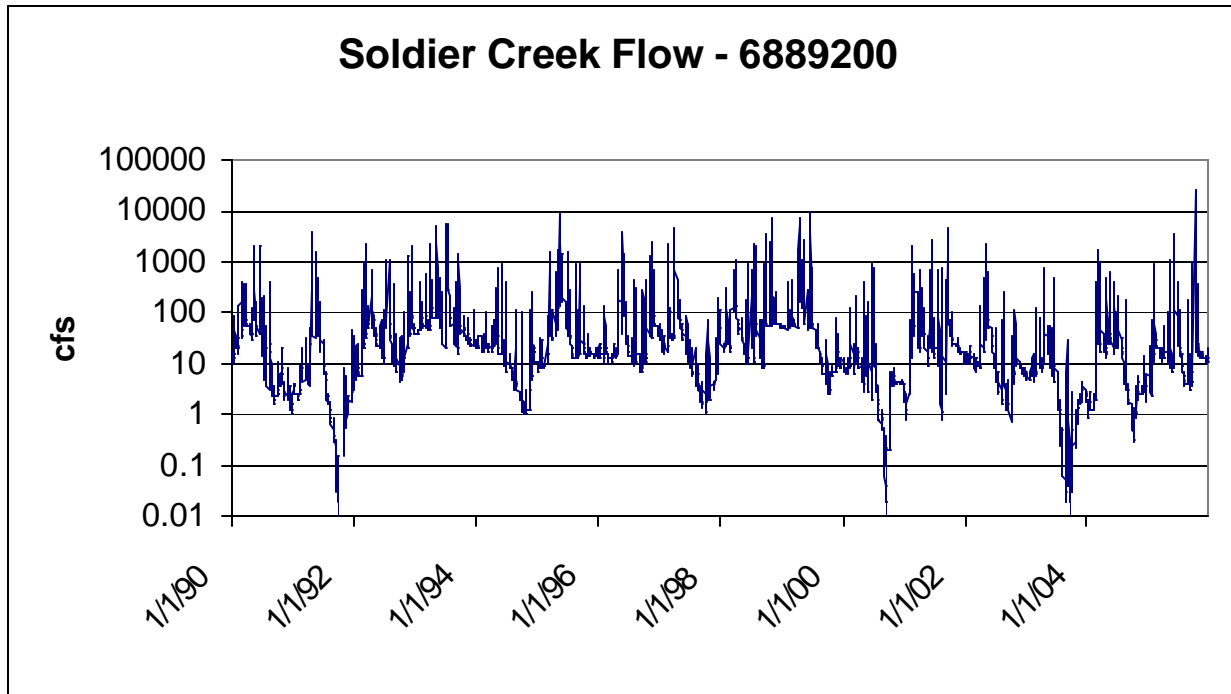
2. CURRENT WATER QUALITY CONDITION AND DESIRED ENDPOINT

Level of Support for Designated Use under 1998 303d: Partially Supporting Aquatic Life

Monitoring Sites: Chemistry: Station 101 near Delia; Biology: Station 299 near Circleville

Period of Record Used: TSS: 1985-2005 at SC101; 1985--2004 Biology: 1985-2004 (12 biological samples)

Flow Record: USGS Gaging Station on Soldier Creek near Delia: 06889200 (Percentile Ranking: 10/01/1970-12/24/05, Figure 2-Most recent 15 year flow record)



(Figure 2)

Table 1: Current Condition:

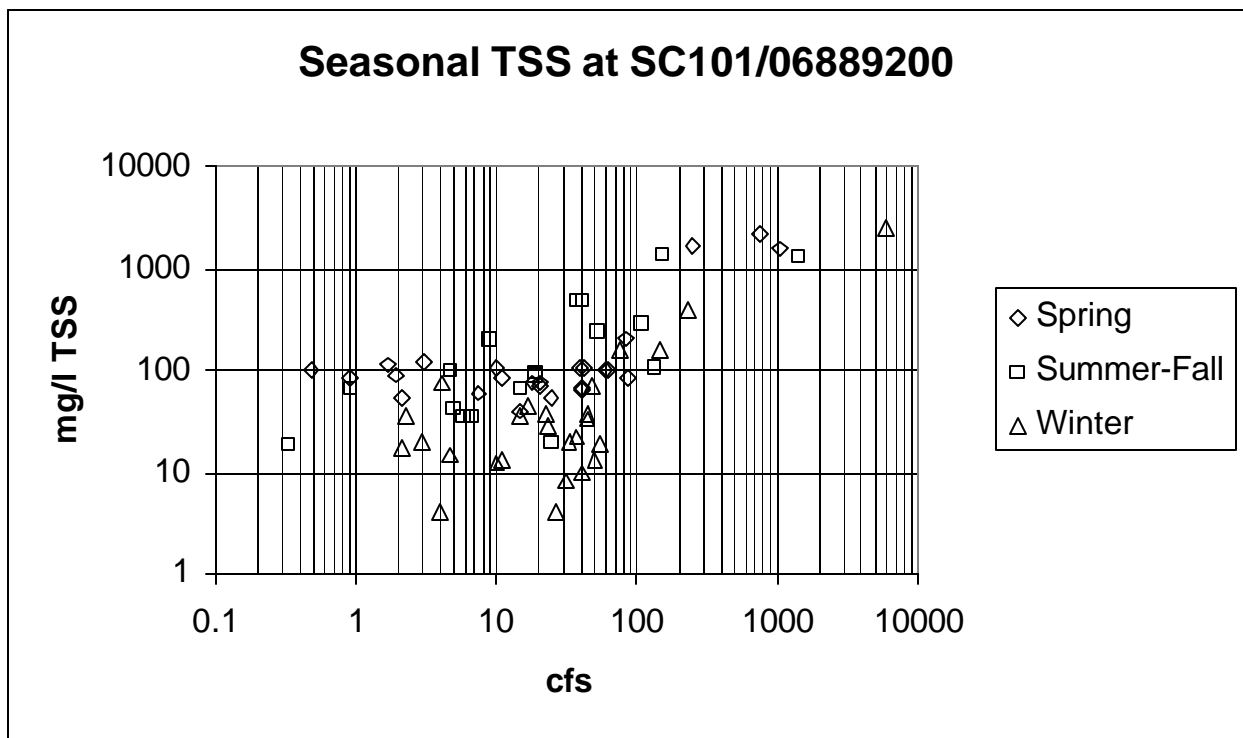
Parameter	Historical Average & Range (1985 - 2004 for biological data)
Macroinvertebrate Biotic Index (MBI)	4.83 (4.28 - 5.77)
% Ephemeroptera, Plecoptera, and Trichoptera (EPT) Taxa	26.25 (14 - 38)
% Abundance of Ephemeroptera, Plecoptera, and Trichoptera (EPT)	46 (20-65)
Total Suspended Solids	232.4 mg/L (4 - 2396 mg/L)
Flow	101 cfs (0-24900 cfs)

Percent EPT taxa and total suspended solid concentrations need to be analyzed to address the sediment/biological impact impairment. The Macroinvertebrate Biotic Index (MBI) may also be examined. The EPT index is the proportion of aquatic taxa present within a stream belonging to pollution intolerant orders; Ephemeroptera, Plecoptera and Trichoptera (mayflies, stoneflies and caddisflies). Higher percentages of total taxa comprising these three groups indicate less pollutant stress and better water quality. Typically, these macroinvertebrates utilize a coarse substrate in the stream for habitat. Elevated

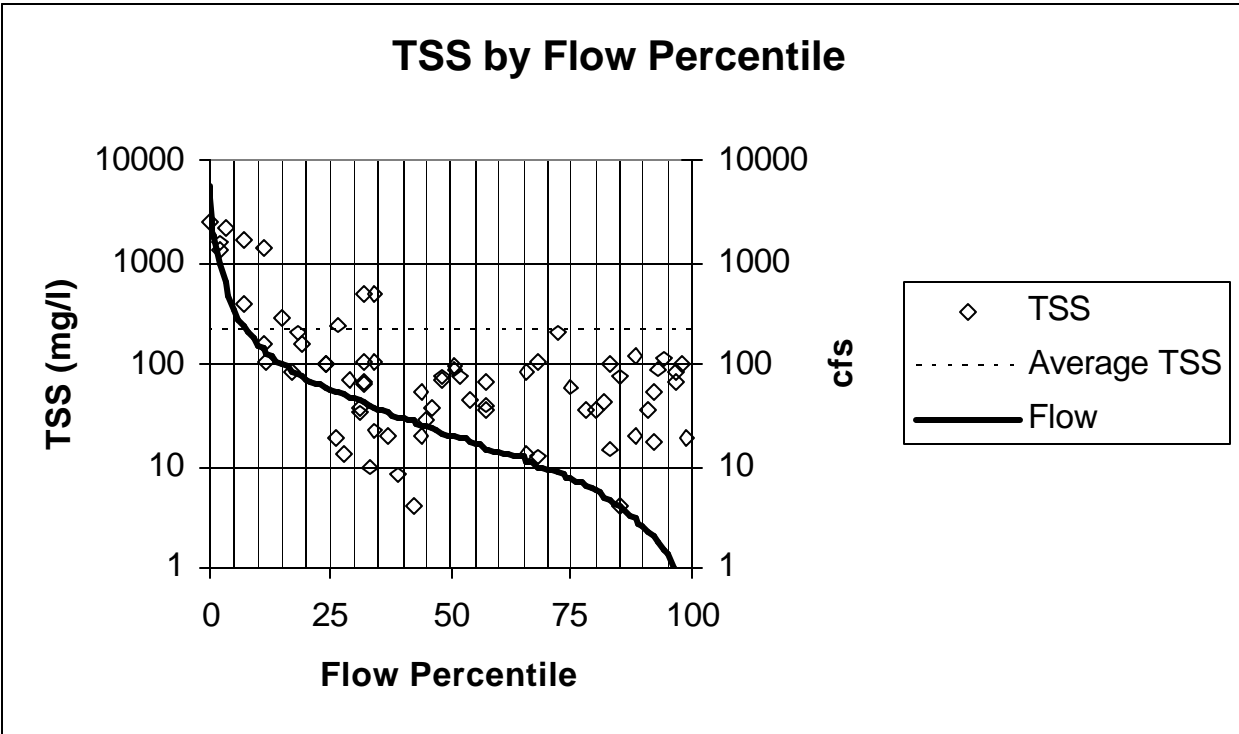
amounts of suspended solids deposit on the substrate and limits substrate utility by these clean water indicator species.

Biological monitoring metrics were used to assess compliance with KDHE standards for water quality (Table 1). MBI values less than, or equal to, 4.5 are considered fully supporting, values greater than, or equal to, 5.4 are considered non-supporting, and intervening values are designated as partially supporting. EPT abundance standards establish full support levels greater than, or equal to, 48%, non-supporting at levels below, or equal to, 30%, and partially supporting for intervening values. MBI values over the period of record averaged 4.83, partially supporting, with four samples indicating full support, seven samples indicating partial support, and one sample indicating non-supporting conditions. EPT abundances over the period of record averaged 46.17, partially supporting, with six samples indicating full support, five samples indicating partial support, and one sample indicating non-supporting conditions.

Total suspended solids (TSS) increase logarithmically with logarithmically increasing flows. KDHE monitoring records (Figure 3) indicate that TSS varies through four orders of magnitude (less than 10 mg/l to greater than 1000 mg/l) in this system. Total suspended solids ranges include fairly high levels, averaging 232 mg/l; however, median concentration is 70 mg/l. The monitoring record suggests that efforts targeting moderate to high flow events may have the greatest impact on TSS levels (Figure 4). Average TSS values during flows of less than 1000 cfs were 156 mg/l, however 19 of the 69 samples were above 100 mg/l. Average TSS values during flows of less than 154 cfs, the 10 percentile exceedance value, were 99 mg/l, however 16 of the 66 samples exceeded 100 mg/l. At moderate flow levels, 36 cfs or less, average TSS was 56 mg/l, and only 4 of the 40 samples exceeded 100 mg/l.



(Figure 3)



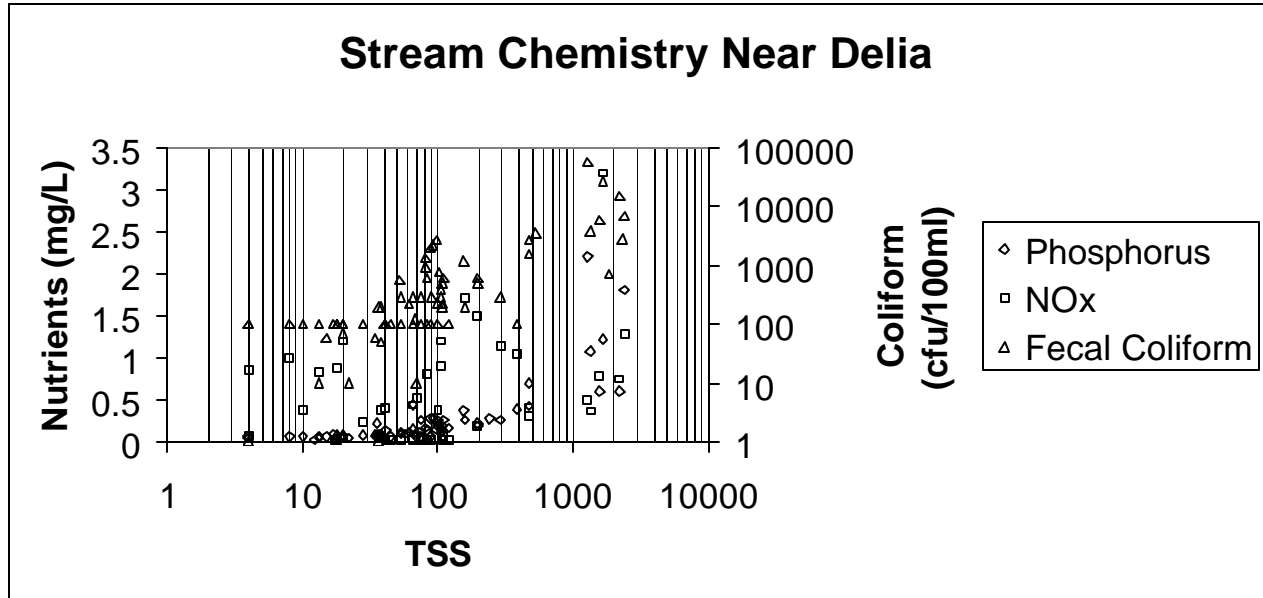
(Figure 4)

Desired Endpoint for Soldier Creek for 2006 - 2011

The use of 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 will be an average EPT count of 48% or greater over 2006-2011. Additionally, MBI values should approach 4.5 as additional evidence of improved biological condition at Circleville.

Achievement of this endpoint would be indicative of full support of the aquatic life use in the stream reach, therefore the narrative water quality standard pertaining to suspended solids would be attained.

Suspended sediment is an important factor influencing biological activity in this system. Sediment loads are correlated with nutrient loading and coliform loading. At levels below 100mg/l of total suspended solids (TSS) phosphorus, NO_x, and fecal coliform levels are low (Figure 5). Sampling occurs year round, and TSS levels greater than 100 mg/l have been measured in all seasons. There is no described seasonal variation of this TMDL. The desired endpoint is average TSS levels below 100 mg/l over 2006-2011 at Delia for flows less than 1000 cfs.



(Figure 5)

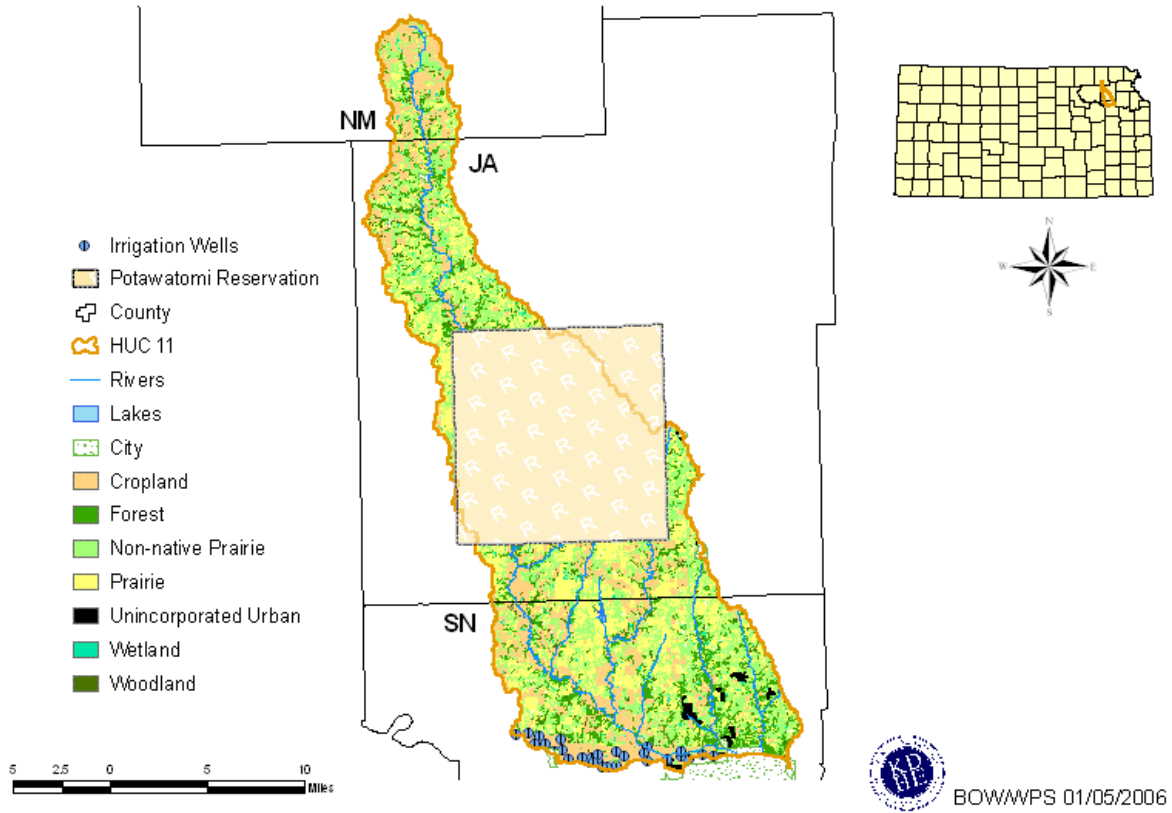
3. SOURCE INVENTORY AND ASSESSMENT

Land Use: The Kansas GAP dataset was used to analyze land use patterns in the watershed. Most of the watershed is grassland (native and non-native) (58%), cropland (22%), and woodland (15%). Reservation land use patterns are similar to those of the watershed as a whole. A hundred foot buffer was applied to the state rivershed network, and land use data were analyzed to determine near stream riparian land use. Cropland levels are similar within the hundred foot buffer (19%) as compared to the watershed as a whole (22%); however prairie is substantially replaced with woodland. Major land use results are summarized in Table 2 and presented in Figure 6.

Table 2: Land Use Patterns :

	Soldier Creek Watershed	Outside Reservation Boundaries	Within Reservation Boundaries	100 Ft. Buffer of All Streams	100 Ft. Buffer of Streams Outside Reservation	100 Ft. Buffer of Streams inside Reservation
Woodland	15.84%	15.87%	15.80%	42.05%	41.23%	44.21%
Prairie (Native)	29.65%	26.62%	36.40%	18.08%	16.24%	22.93%
Prairie (Non-native)	29.00%	29.64%	27.60%	17.83%	19.20%	14.22%
Cropland	22.77%	24.71%	18.45%	19.15%	19.89%	17.20%

Soldier Creek TMDL Land Use



(Figure 6)

NPDES: There is one NPDES facility discharger to Upper Soldier Creek, the City of Soldier. The 3-cell lagoon system has a design flow of 0.019 MGD. The current permit (M-KS70-0001; KS0081035) is in effect from November 1, 2005 to October 31, 2010 and has a TSS limit of 80 mg/l average over a month with a weekly average of 120 mg/l. Since 2004, Soldier discharged an average TSS of 33 mg/l and never exceeded its permit limits.

Contributing Runoff: The watershed has an average soil permeability of 0.6 inches/hour according to NRCS STATSGO database. Runoff would be produced under storms ranging in duration from one to six hours, having a recurrence interval of five, ten or twenty five years. Runoff is chiefly generated as infiltration excess with rainfall intensities greater than soil permeabilities. Generally, 86 percent of the watershed would generate runoff under dryer conditions. Moderate or wet conditions (larger storms) would see runoff contributed from 90 and 98 percent of the watershed respectively.

Background Levels: Background levels of total suspended solids come from two sources, channel erosion and overland runoff of sheet and rill erosion. Sediment concentrations increase with increasing flows because of increased runoff and increased erosive force within the channel. Stable channels

naturally maintain their morphology as a result of ongoing erosion and depositional processes.

Changes to channel morphology, as have been documented by USGS Water-Resources Investigations Report 02-4047, Historical Channel Change Along Soldier Creek, Northeast Kansas, by channelization activities result in increased bank erosion and higher solids loads from in-stream sources. Major channelization and resulting degradation of the streambed are reported as confined currently to the areas south of Rocky Ford on the Prairie Band Potawatomi Reservation, though this limit on downcutting is not expected to be permanent. Other smaller efforts upstream, including road construction activities have been recorded as causing smaller downcutting effects upstream of the reservation.

Intact riparian corridors reduce suspended solids loads by strengthening channel banks, which reduces their susceptibility to erosion, and by intercepting solids loads from overland flow. No background levels were calculated for this TMDL because suitable, unimpacted stream segments were not available for analysis.

Historical data collected at USGS chemistry monitoring sites above and below the reservation were analyzed to determine if TSS levels were affected by runoff from the reservation. TSS data were normalized to account for total land area above the sampling station and compared. TSS levels at the two sites were indistinguishable once normalized for land area. We therefore decline to assign specific load components to the portion of the watershed within the boundaries of the reservation.

4. ALLOCATION OF POLLUTION REDUCTION RESPONSIBILITY

There is an indirect, yet un-quantified relation between solids loading and biological integrity. Decreased solids loads should result in aquatic communities with larger proportions of their populations derived from pollution intolerant orders, indicative of improved water quality.

The nature of biological data, which integrates the impacts of the entire watershed on the aquatic community, defies allocation of specific loads between point and non-point sources. The relative presence of point and non-point activities has to be used to assess the relative contributions and responsibilities for sediment load reduction in the watershed. Therefore, allocations are made for this TMDL in a general sense to direct appropriate action following in the belief that qualitative reduction in sediment loads will yield improved MBI and EPT values. More detailed allocations will be made in 2010 based on additional source assessment and establishment of quantitative relations between stream sediment and aquatic biology for this stream.

Point Sources: There is one NPDES discharger, the City of Soldier (KS0081035, M-KS70-0001- expires 10/31/2010) on the stream. Soldier uses a three-cell lagoon system and its permit limits the amount of suspended solids it may discharge to a monthly average of 80 mg/l. Adherence to this limit will not cause impairment to stream or its biology. Based on the assessment of sources, point sources do not contribute to water quality impairment relative to sediment impacts on stream biology. At this point, the Wasteload Allocation will be a maintenance of TSS loadings from point sources such that average monthly TSS concentrations are maintained below 80 mg/l, leading to in-stream concentrations below 100 mg/l at flows below 1 cfs. Soldier's WLA is 12.7 lbs/day.

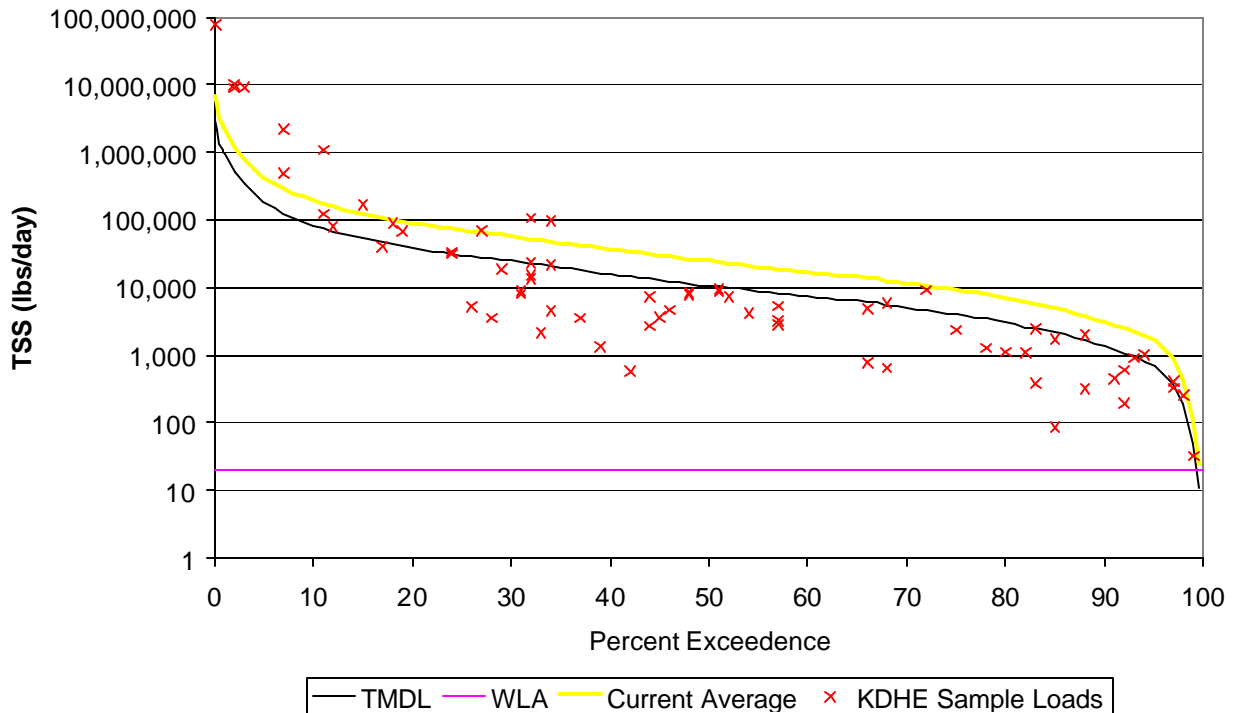
The Prairie Band Pottawatomie Tribe operate an activated sludge wastewater treatment plant that discharges 0.03 MGD to James Creek that enters Soldier Creek above Delia. The permit (KS0096202- expires 10/2/2010) has a monthly discharge limit of 30 mg/l, thus its WLA would be 7.5 lbs/day. However, Kansas does not have jurisdiction to implement this WLA.

Non-Point Sources: Overland runoff carries sediment from the land surface within the watershed into the streams. The sporadic nature of the EPT values indicates that sediment impairment waxes and wanes over time, hinting that loadings are variable. As such, non-point sources are implicated as a primary source of these loadings. Additional assessment is necessary to quantify the specific sources of the solids loading. At this point, the Load Allocation will be a reduction of sediment loadings such that average total suspended solids concentrations are below 100 mg/L (Figure 7) in stream a majority of the time. This is, effectively, a 35% reduction in TSS from current averages at flows less than 1000 cfs, the 2 percent exceedence flow. Figure 7 presents the TSS Load capacity that will likely improve the diversity of aquatic life in Upper Soldier Creek. Specific load allocations at certain flows are displayed in Table 3.

Because solid loadings are strongly linked with discharge, management changes that reduce solid loading at high flows will be particularly important for addressing the identified impairment. Solids carried into the stream during high flow events from overland flow and bank erosion deposit on the stream bottom as peak flows decline and the solids load-carrying capacity of the stream is reduced. During moderate to low flows solids transport capacity is reduced, resulting in less mobility for introduced solids, and colmation of in-stream surfaces remains relative to the predevelopment channel conditions. Management strategies that reduce peak discharge by increasing infiltration in the watershed will result in reduced overland flow erosion, reduced bank erosion, and over time should decrease solids loading to the streams. Protection and restoration of the riparian corridor and floodplain are recommended as important management strategies for reducing peak flows and reducing erosion related loading in Soldier Creek.

Flow Exceedence	Flow	WLA	LA	LC
90%	2 cfs	20.2 #/day	1,060 #/day	1,080 #/day
75%	9 cfs	20.2 #/day	4,840 #/day	4,860 #/day
50%	30 cfs	20.2 #/day	16,180 #/day	16,200 #/day
25%	80 cfs	20.2 #/day	43,180 #/day	43,200 #/day
10%	200 cfs	20.2 #/day	107,980 #/day	108,000 #/day

TSS TMDL for Upper Soldier Creek at Delia



(Figure 7 – The total maximum daily load curve for Soldier Creek TSS, delineating the allowable conditions expected to adequately protect aquatic life based on the flow record from 10/1/1970 through 12/24/2005.)

Defined Margin of Safety: The margin of safety will be explicitly established by use of multiple biological indices. Therefore in addition to the endpoint of greater than 48% abundance of EPT organisms, an average MBI below 4.5 should be seen and the percentage of EPT taxa should average greater than 25%. Since the impairment was originally cited based on the condition of the biological community, use of the three indices confirms that the macroinvertebrate indicators are consistent with good water quality and full support of the aquatic life use of Upper Soldier Creek.

State Water Plan Implementation Priority: Because this TMDL will begin to address the relationship between aquatic community response and sediment loading over the next five years and because it presents the opportunity for the State to begin to work with the Potawatomi Tribe on watershed management for water quality, this TMDL will be a High Priority for implementation.

Unified Watershed Assessment Priority Ranking: This watershed lies within the Middle Kansas Subbasin (HUC 8: 10270102) with a priority ranking of 4 (Highest Priority for restoration work).

Priority HUC 11s and Stream Segments: The Soldier Creek (130) subwatershed in Jackson County should be the priority focus of initial implementation since it is the drainage for Segment 9009 which is assessed for biological integrity and the drainage lies wholly within State jurisdiction. Expansion of implementation efforts downstream will ensue as cooperative efforts between the State and the Potawatomi Tribe develop.

5. IMPLEMENTATION

Desired Implementation Activities

1. Implement and maintain conservation farming, including conservation tillage, contour strips and no till farming.
2. Install grass buffer strips along streams.
3. Reduce activities within riparian areas
4. Minimize road and bridge construction impacts on streams
5. Monitor wastewater discharges for excessive Total Suspended Solid loadings
6. Begin to develop a Soldier Creek watershed management plan with the Potawatomi Tribe to improve water quality throughout the drainage.

Implementation Programs Guidance

NPDES - KDHE

- a. Ensure proper monitoring, permitting, and operations of the Soldier wastewater systems to limit TSS discharge.

Non-Point Source Pollution Technical Assistance - KDHE

- a. Support Section 319 demonstration projects for reduction of siltation runoff from agricultural or road construction activities
- b. Provide technical assistance on practices geared to establishment of vegetative buffer strips.
- c. Provide technical assistance on road construction activities in vicinity of streams.
- d. Establish a long-term Watershed Restoration and Protection Plan with the Pottawatomie Tribe and Jackson and Shawnee County Conservation Districts for the Soldier Creek Watershed to comprehensively reduce the loading and delivery of pesticides, sediment and nutrients to the stream system throughout its watershed.

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

- a. Apply conservation farming practices, including terraces and waterways
- b. Provide sediment control practices to minimize erosion and sediment transport

Riparian Protection Program - SCC

- a. Establish or reestablish natural riparian systems, including vegetative filter strips and streambank vegetation.
- b. Develop riparian restoration projects

Buffer Initiative Program - SCC

- a. Install grass buffer strips near streams.
- b. Leverage Conservation Security Program to hold riparian land out of production.

Extension Outreach and Technical Assistance - Kansas State University

- a. Educate agricultural producers on sediment and pasture management
- b. Provide technical assistance on buffer strip design and minimizing cropland runoff

Timeframe for Implementation: Initial emphasis over 2007-2010 will be on implementation of pollution reduction practices associated with reducing solids loading within this subwatershed. Implementation of riparian corridor protection and restoration will have initial priority, due to the relatively long periods of time needed to establish large woody vegetation that will stabilize the streambanks and intercept overland runoff. Management strategies farther from the stream edge should be implemented with available resources secondarily to those in the riparian zone. Ongoing evaluation of biological and solids data should be used to target future implementation activities based on pollutant source assessment so that the greatest load reductions can be achieved with available resources.

Targeted Participants: Primary participants for implementation will likely be agricultural producers operating within the drainage of the priority subwatershed. Initial work over 2007-2010 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. Degree of residue compliance on Highly Erodible Lands
3. Acreage of poor rangeland or overstocked pasture
4. Livestock use of riparian areas
5. Unvegetated or graded roadside ditches
6. Construction projects without erosion control techniques

Some inventory of local needs should be conducted in 2007 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 2010: The year 2010 marks the next visit into the Kansas-Lower Republican Basin to establish and revise TMDLs for the watershed. At that point in time, adequate source assessment should be complete which allows an allocation of resources to responsible activities contributing to the sediment impairment. Additionally, biological data from Soldier Creek over 2006-2010 should not indicate trends of reduced support of the aquatic community. Quantitative relationships between suspended sediment and biological measures should be established by 2010. Efforts to develop and implement watershed management to improve water quality throughout the Soldier Creek drainage, in concert with the Pottawatomie Tribe, should be underway by 2010. This TMDL may be revised during the Third Round of KLR TMDLs in 2010, in order to incorporate expanded implementation efforts to improve water quality on the lower reaches of Soldier Creek, including those within the Potawatomi Tribal Lands.

Delivery Agents: The primary delivery agents for program participation will be the Jackson County 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.

Reasonable Assurances:

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

1. K.S.A. 65-171d empowers the Secretary of KDHE to prevent water pollution and to protect the beneficial uses of the waters of the state through established water quality standards.
2. 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.
3. 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.
4. 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.

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

6. The *Kansas Water Plan* and the Kansas-Lower Republican 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 is a **High Priority** consideration. Priority should be given to activities which reduce loadings of suspended solids to the stream prior to 2011.

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

KDHE will collect seasonal biological samples from Soldier Creek for three years over 2007 - 2011 and an additional two years over 2012-2015 to evaluate achievement of the desired endpoint. . Periodic monitoring of sediment content of wastewater discharged from treatment systems will be expected under reissued NPDES and state permits.

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 2007-2008 in order to support appropriate implementation projects

7. FEEDBACK

Public Notice: Public notification of the second round of TMDLs in the Kansas-Lower Republican Basin was made in the Kansas Register in January 5, 2006. An active Internet Web site was established at <http://www.kdheks.gov/tmdl/> to convey information to the public on the general establishment of TMDLs and specific TMDLs for the Kansas-Lower Republican Basin.

Public Hearing: Public Hearings on the second round of TMDLs for the Kansas-Lower Republican Basin were held in Olathe on January 19, and in Topeka on January 30, 2006.

Basin Advisory Committee: The Kansas-Lower Republican Basin Advisory Committee met to discuss the second round of TMDLs in the basin on April 7, 2005 in Lawrence, July 26, 2005 in Concordia, October 20, 2005 in Lawrence and January 24, 2006 in Topeka.

Milestone Evaluation: In 2010, evaluation will be made as to the progress in implementing Best Management Practices in Jackson County. Subsequent decisions will be made regarding the implementation approach and follow up of additional implementation in the watershed. This TMDL may be revised to incorporate expanded assessment, planning and implementation for the lower portion of the Soldier Creek Watershed.

Consideration for 303(d) Delisting: The stream will be evaluated for delisting under Section 303(d), based on the biological monitoring data collected between 2010 and 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 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, the next anticipated revision will come in 2007 which will emphasize revision of the Water Quality Management Plan. At that time, incorporation of this TMDL will be made into both documents. Recommendations of this TMDL will be considered in Kansas Water Plan implementation decisions under the State Water Planning Process for Fiscal Years 2007-2015

Revised February 22, 2007.

Bibliography

Juracek, K. E., 2002. Historical Channel Change Along Soldier Creek, Northeast Kansas. Water-Resources Investigations Report 02-4047, U.S. Geological Survey. Lawrence, KS.