

# NEOSHO RIVER BASIN TOTAL MAXIMUM DAILY LOAD

**Water Body: South Fork Cottonwood River Watershed**  
**Water Quality Impairment: Biology**

## 1. INTRODUCTION AND PROBLEM IDENTIFICATION

<b>Subbasin:</b>	Lower Cottonwood
<b>Counties:</b>	Chase, Butler, and Greenwood
<b>HUC 8:</b>	11070203
<b>HUC 11 (HUC 14):</b>	<b>030</b> (010, 020, 030, 040, 050) (Figure 1)
<b>Ecoregion:</b>	Flint Hills (28)
<b>Drainage Area:</b>	235 square miles
<b>Main Stem Segment:</b>	WQLS: South Fork Cottonwood River (9, 10); starting at the confluence of the Cottonwood River, traveling upstream, and ending in the northeast corner of Butler County.
<b>Tributaries:</b>	Sharpes Cr (38) Rock Cr (37) Kirk Cr (48) Crocker Cr (46) Corn Cr (47) Little Cedar Cr (45) Mercer Cr (716) Little Cedar Cr (11) Cannonball Cr (745)
<b>Designated Uses:</b>	Special Aquatic Life Support, Primary and Secondary Contact Recreation, Domestic Water Supply, Food Procurement, Groundwater Recharge, Industrial Water Supply, Irrigation, Livestock Watering
<b>2002 303(d) Listing:</b>	Neosho River Basin Streams
<b>Impaired Use:</b>	Special Aquatic Life Support on Main Stem Segments.

**Water Quality Standard:** General--Narrative: Surface water shall be free, at all times, from the harmful effects of substances that originate from artificial sources of pollution and that produce any public hazard, nuisance condition or impairment of a designated use. (KAR 28-16-28e(b)(1)).

**2. CURRENT WATER QUALITY CONDITION AND DESIRED ENDPOINT**

**Stream Chemistry Monitoring Site:** Station 582 near Bazaar (South Fork Cottonwood River)

Period of Record Used: 1990 - 2003

**Biological Monitoring Site:** Station 357 on the South Fork Cottonwood River

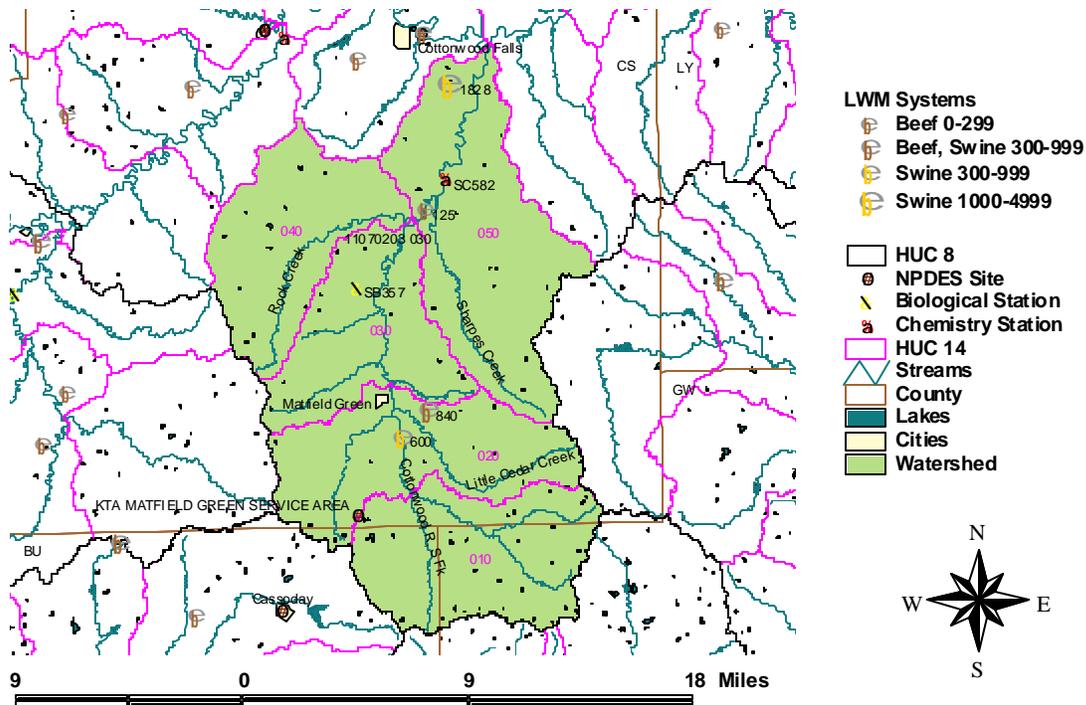
Period of Record Used: 1985 - 2001

Level of Support for Designated Use: Partial Support for all indices and % mussel loss

**Flow Record:** Matched to flow duration for Cedar Creek near Cedar Point (07180500)

**Figure 1**

# South Fork Cottonwood River TMDL Reference Map



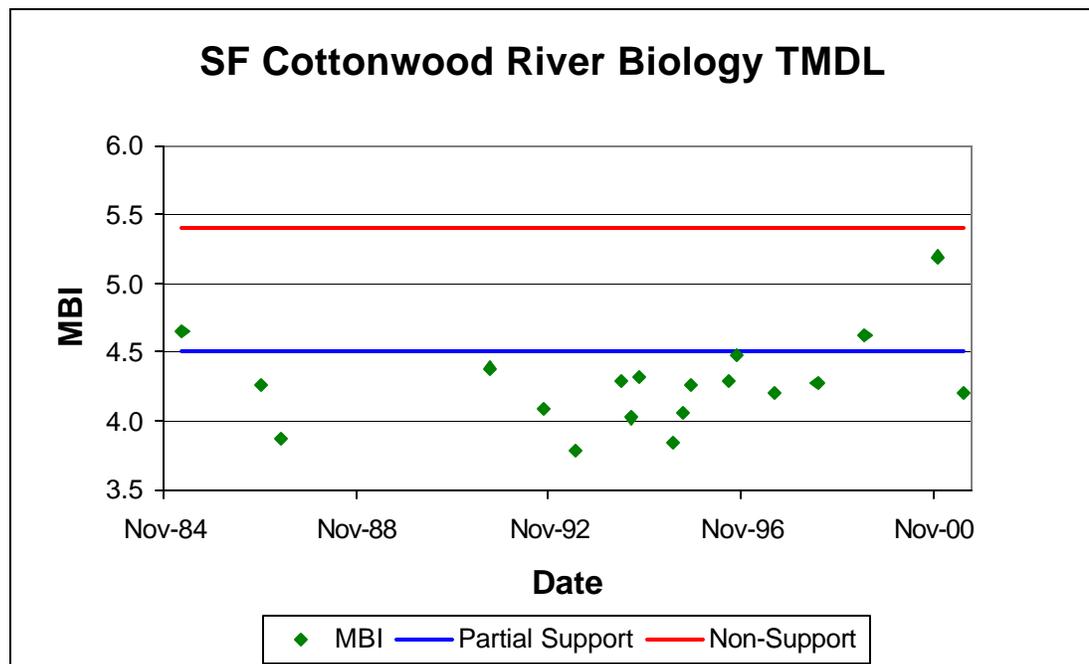
**Current Conditions:**

Three main parameters (MBI, KBI, and %EPT) were analyzed to address the biology impairment. The Macroinvertebrate Biotic Index rates the nutrient and oxygen demanding pollution tolerance of large taxonomic groups (order and family). Higher values indicate greater pollution tolerances. Along with the number of individuals within a rated group, a single index value is computed which characterizes the overall tolerance of the community. The higher the index values the more tolerant the community is of organic pollution exerting oxygen demands in the stream setting. Index values greater than 5.4 are indicative of non-support of the aquatic life use; values between 4.51 and 5.39 are indicative of partial support and values at or below 4.5 indicate full support of the aquatic life use. The Kansas Biotic Index (KBI) is similar to the MBI in that it indicates the impact of nutrient and oxygen demanding pollutants.

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.

The biological community has been historically borderline impaired at this site. Over the period of record, the average MBI value was 4.27, ranging from 3.79 to 5.19. The MBI value indicated partial support (MBI between 4.51 and 5.39) in 1985, 1999, and 2000 (Figure 2). Sixteen percent of the surveys resulted in MBI values over 4.5; the rest were less than 4.5, indicative of full support of aquatic life. Average MBI under partial support conditions was 4.91; average MBI under full support conditions was 4.18. See the table below for the average stream chemistry concentrations during this time period.

**Figure 2**



### Average Concentrations When the MBI Indicates Full and Partial Support

Level of Support	Sample Size	MBI	KBI	% EPT Count	NH <sub>4</sub> (mg/L)	NO <sub>3</sub> (mg/L)	TP (mg/L)	TSS (mg/L)	BOD (mg/L)	FCB (counts/100 mL)	Flow (cfs)
Full Support	14	4.18	2.58	59	0.038	0.33	0.071	44.5	2.49	234	91.9
Partial Support	2	4.91	2.80	36	0.024	0.42	0.110	72.0	2.05	4402	45.8

A stream is deemed partial supporting when the KBI values range between 2.61 and 3.0. For the South Fork Cottonwood River, the KBI values fall between this range 58% of the time (Figure 3). The percent EPT count indicates full support when greater than 48% of the aquatic community consists of pollution intolerant species. The community dropped below this level 26% of the time over the period of record (Figure 4).

**Figure 3**

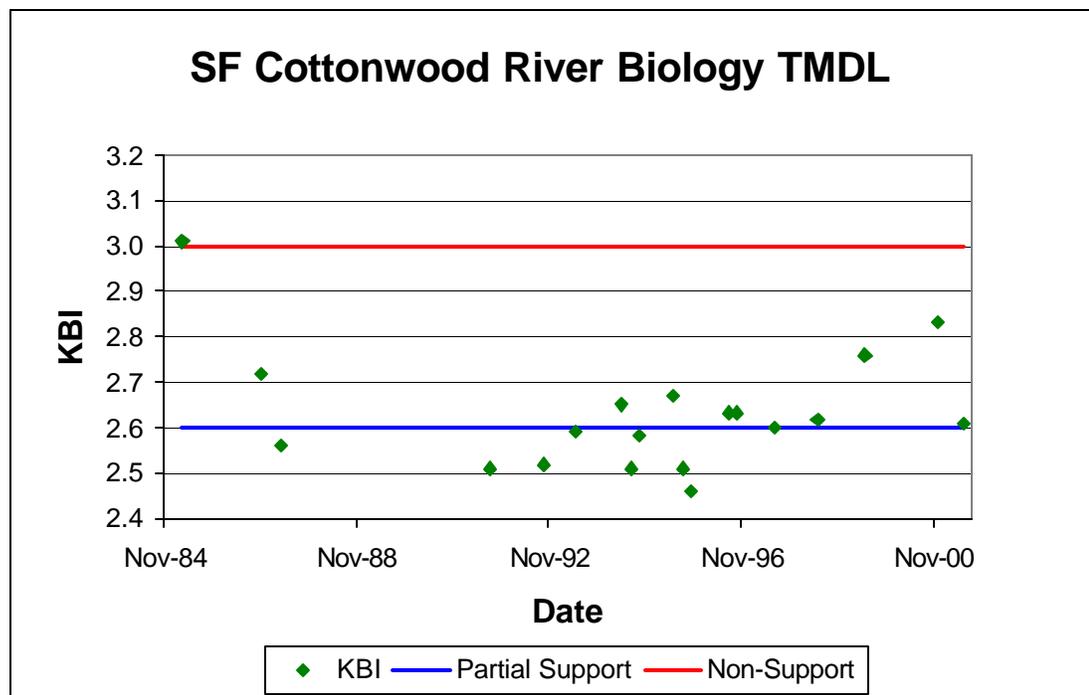
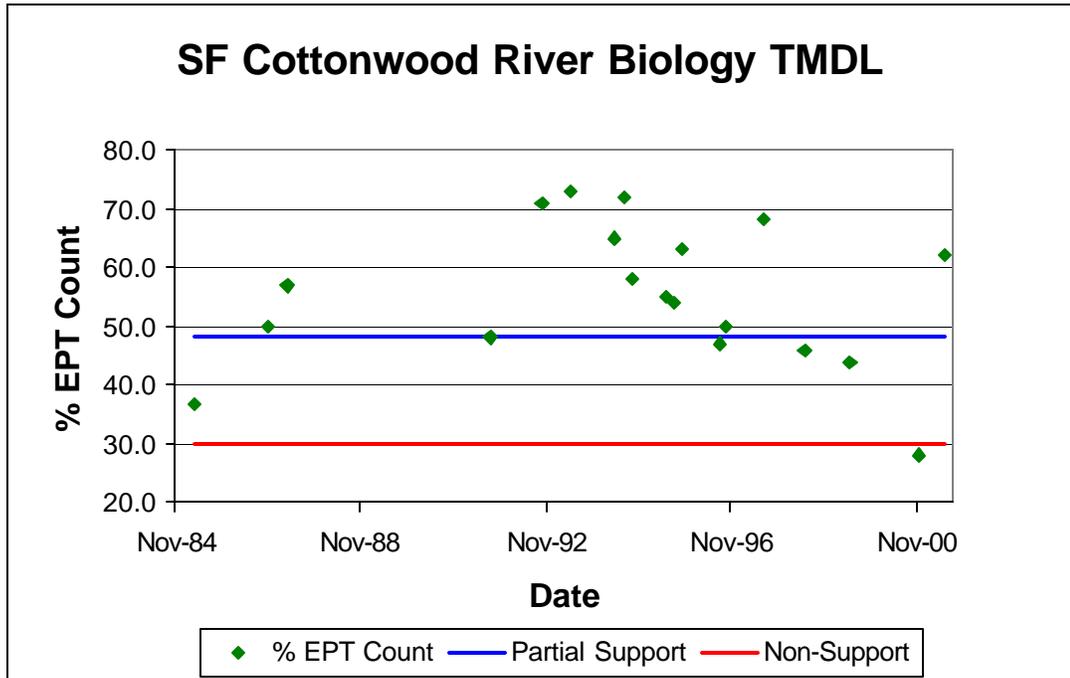


Figure 4

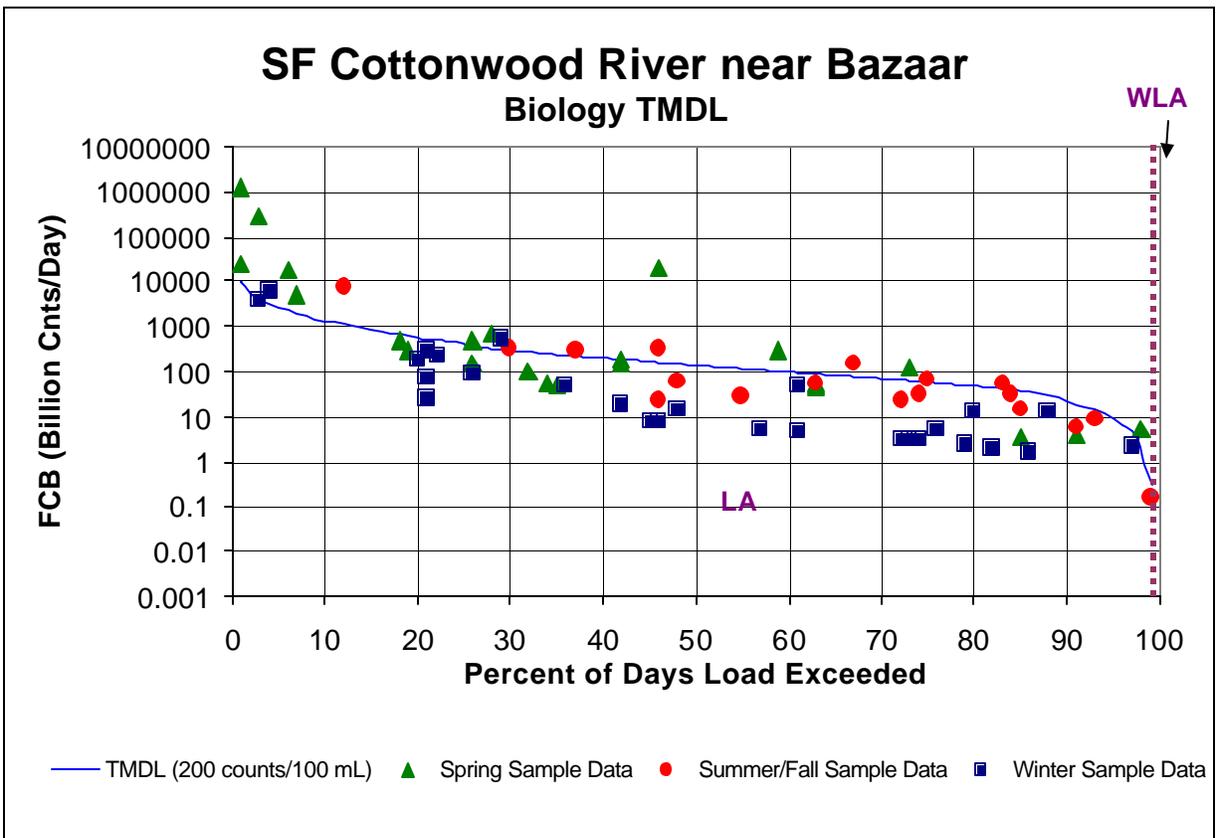


Three sets of analysis were completed to determine if there is a direct link between elevated levels of probable contaminants and the biological metrics indicating partial or full support. The main sources of pollution in the watershed are animal waste, effluent from a waste treatment plant, and fertilizer applications. Therefore, the following parameters that are related to nutrient loading were assessed: ammonia, nitrate, total phosphorus, biochemical oxygen demand, fecal coliform bacteria, and total suspended solids. Each parameter was split into two groups based on if the biological metrics indicated full support or partial support. A statistically significant correlation ( $P=0.010$ ) was seen for fecal coliform bacteria concentrations and the MBI values. The percent EPT count correlation to fecal coliform bacteria levels was not as strong ( $P=0.104$ ). The correlation between the KBI and fecal coliform bacteria concentrations was the weakest. Overall, more samples need to be taken to confirm these relationships.

Fecal Coliform Bacteria Concentrations Under Full and Partial Support

Metric	FCB (counts/ 100 mL) under Full Support	FCB (counts/ 100 mL) under Partial Support
MBI	234	4402
%EPT Count	200	2403
KBI	234	1425

Figure 5



The majority of the fecal coliform bacteria are entering the stream during high flow events during the spring (Figure 5). This is due to run-off from nonpoint sources such as confined animal feeding operations, animal grazing, and animal waste applications to cropland. The design flow from the waste treatment plant is 0.0245 cfs; the flow duration curve shows that no exceedences are seen at that low flow condition from 99 to 100% of days load exceeded. No significant trends in the fecal coliform bacteria levels are seen over time.

From 1992 to 2002, the mussel population declined by 23% which indicates partial support. Freshwater mussels are intolerant of high ammonia levels, and ammonia is a potential contaminant given the sources in the watershed. Nonetheless, significant relationships could not be assessed because the detection limit changed several times during the period of record. The last date that ammonia was detected was March 14, 2001.

Biological index values were compared for the biological monitoring stations located in the Lower Cottonwood Subbasin. Overall, the metrics at these sampling sites tend to be similar. Over the period of record, no statistically significant differences are seen between station 357 on the South Fork Cottonwood River and station 274 on the Cottonwood River.

### Comparison of Biological Index Values (1996 - 2002) in the Lower Cottonwood Subbasin

Station	MBI	KBI	%EPT Count	% Mussel Loss
SB357 SF Cottonwood River	4.58	2.71	45	23
SB274 Cottonwood River	4.33	2.49	61	25
SB718 Fox Creek	4.58	2.70	47	57
SB719 Palmer Creek	4.64	2.76	41	N/A

### Desired Endpoints of Water Quality at Site 357 over 2007 - 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 seasons (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 endpoint would be no more than one sampling with a MBI values greater than 4.5 over 2007-2011.

Achievement of this endpoint would be indicative of full support of the aquatic life use in the stream reach. While there is linkage between MBI values and fecal coliform bacteria levels, there have been no violations of chronic water quality criteria. In order to verify the fecal coliform bacteria impairment, at least five consecutive samples would need to be collected during separate 24-hour periods within a 30-day period. This TMDL will be phased, concentrating on lowering the levels of animal waste entering the stream.

### Current Condition (1990 - 2001 data) and Reductions for South Fork Cottonwood River

Parameter	Current Condition	TMDL	Percent Reduction
Fecal Coliform Bacteria (counts/100 mL)	4,402	200	95 %
Macroinvertebrate Biotic Index	4.91	< 4.5	8 %
EPT Count (%)	36	> 48	33 % Increase
Mussel Loss (%)	23	10	57 % Increase

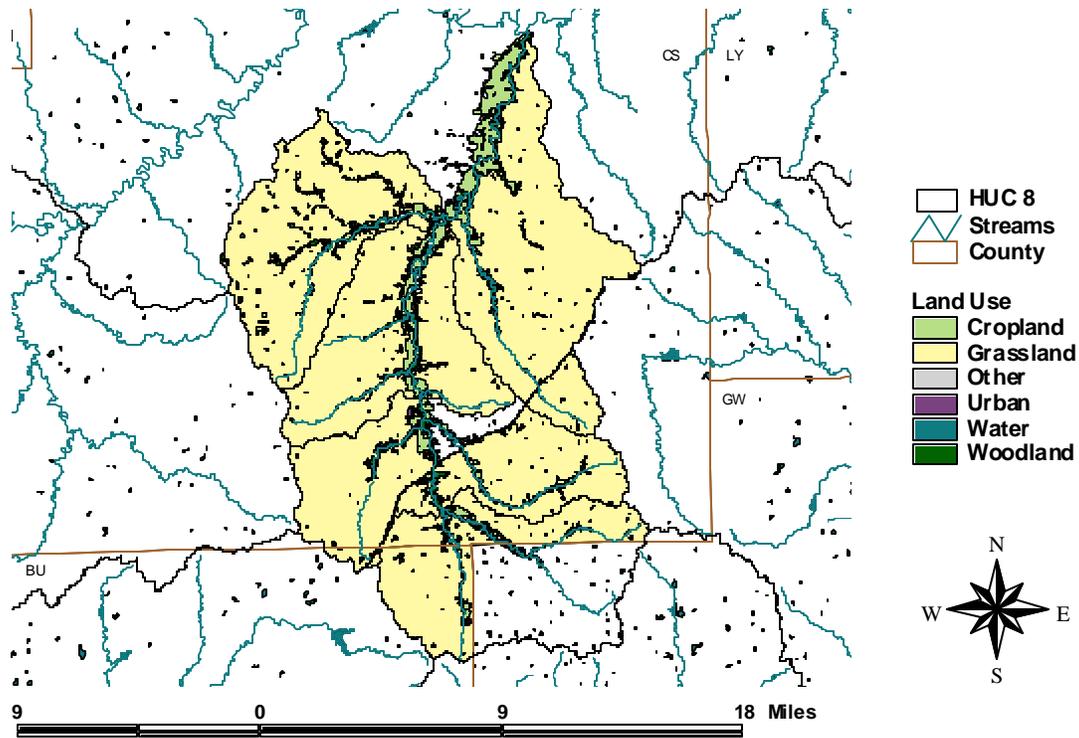
## 3. SOURCE INVENTORY AND ASSESSMENT

**NPDES:** One permitted waste treatment facility is located within the watershed (Figure 1). The Kansas Turnpike Authority, Matfield Green Service Area (Kansas Permit Number C-NE46-0001) has a three-cell lagoon system. The permitted design flow is 0.0158 MGD (0.0245 cfs). The permit requires monitoring for fecal coliform bacteria. From March 2003 to February 2004, the lagoon discharged only during five of the twelve months. Fecal Coliform Bacteria was rarely detected. Nonetheless, the

Matfield Green Service Area will be held to 200 counts/100 mL of fecal coliform bacteria at the current design flow, which is equal to 0.12 billion counts per day. The facility has a schedule of compliance to construct a new lagoon facility by April 1, 2005.

**Land Use:** Most of the watershed is grassland (91% of the area), cropland (5%), and woodland (3%) (Figure 6). The grazing density is high in winter and medium in summer.

## South Fork Cottonwood River Land Use



**Figure 6**

**Livestock Waste Management Systems:** Four operations are registered, certified, or permitted within the watershed (Figure 1). There are one beef, two swine, and one combined beef/swine operations in the watershed. Two of these facilities are NPDES permitted, non-discharging facilities with 2,668 animal units. 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 to retain the 25 year, 24 hour rainfall/runoff event, as well as an anticipated two weeks of normal wastewater from their operations. Such a rainfall event typically coincides with stream flows

which are exceeded 1-5 percent of the time. Therefore, events of this type, infrequent and of short duration, are not likely to add to chronic impairment of the designated uses of the waters in this watershed. Requirements for maintaining the water level of the waste lagoons a certain distance below the lagoon berms ensure retention of the runoff from the intense, local storms events. In Chase County, where many of the facilities are relatively close to the river, such an event would generate 6.2 inches of rain, yielding 5.0 to 5.8 inches of runoff in a day. Permit compliance data was examined, and no evidence of spills was detected. Potential animal units for all facilities in the watershed total 3,393. The actual number of animal units on site is variable, but typically less than potential numbers.

**Livestock Waste Management Systems in the Watershed**

<b>Kansas Permit Number</b>	<b>Livestock Waste Management System</b>	<b>Wasteload Allocation - FCB</b>
A-NECS-H001	Sigel	0 billion counts/day
A-NECS-C001	Talkington	0 billion counts/day

**On-site Waste Systems :** Forty-six percent of households in Chase County have septic systems. The population density is low for the watershed area (1.4 people/mi<sup>2</sup>). The town of Matfield Green anticipates a 20% population decline.

**Background Levels:** Wildlife contributes to the fecal coliform bacteria load.

**4. ALLOCATION OF POLLUTION REDUCTION RESPONSIBILITY**

There is a direct relation between levels of fecal coliform bacteria loading and biological integrity. Decreased loads should result in improved aquatic communities, and biological metrics indicative of improved water quality. The goal of this TMDL is to maintain the MBI scores below 4.5 and keep fecal coliform bacteria levels below the water quality standard of 200 counts/100 mL. The decrease of fecal coliform bacteria levels will apply over the range of flows encountered on the South Fork Cottonwood River, indicated by the TMDL curves on page 6.

**Point Sources:** The Wasteload Allocation for the one discharging point source is outlined on page 8. The translation of the existing load into the ambient loads seen at the monitoring site is unknown and will need to be determined in the future through monitoring of effluent and ambient receiving streamflow. Assuming the total design effluent volume arrives at the monitoring site, that flow (0.0245 cfs) would likely influence conditions under the 7Q10. Given that the partial support indications from the MBI tended to occur under flow conditions which were exceeded 99% of the time or more, the allocation for point sources is demarcated by the area under each load duration curve for FCB, bounded from 99% to 100%. At this stage of the TMDL, the assumed condition is maintenance of current average conditions during periods of full support at those low flows, presuming some of the offset of lower nonpoint source loading at higher flows.

As previously noted in the source assessment, non-discharging lagoons of agricultural livestock waste management systems do not discharge with sufficient frequency or duration to cause an impairment in the South Fork Cottonwood River watershed. As such those facilities will have a Wasteload Allocation of zero. Typically, if these facilities discharge in the event of an intense rainfall occurrence, the corresponding streamflow from the watershed as a whole will be in the vicinity of the 1-5 percent exceedance and would transport any pollutant load swiftly out of the river system.

**Nonpoint Sources:** Given the runoff characteristics of the watershed, overland runoff can easily carry fecal coliform bacteria from the watershed into the stream reaches. The composition of the watershed indicates that rural nonpoint 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 1-99% constitutes the Load Allocation for this TMDL.

**Defined Margin of Safety:** Additional biological measures are necessary to assure indications of good aquatic community health. Therefore, the defined Margin of Safety for this TMDL will be a proportion of EPT individuals making up at least 48% of the sample population, including ammonia intolerant species, when MBI values are 4.5 or lower. This will ensure that the majority of aquatic macroinvertebrate population is composed of pollution intolerant taxa. This measure may also correlate with the availability of adequate habitat in the stream to support such a community.

**State Water Plan Implementation Priority:** Because monitoring to determine the fecal coliform bacteria impairment will require more time, this TMDL will be a Medium Priority for implementation.

**Unified Watershed Assessment Priority Ranking:** This watershed lies within the Lower Cottonwood River Subbasin (HUC 8: 11070203) with a priority ranking of 43 (Medium Priority for restoration work).

**Priority HUC 11s and Stream Segments:** The entire watershed is within HUC 11s (030).

## 5. IMPLEMENTATION

### Desired Implementation Activities

1. Renew state and federal permits and inspect permitted facilities for permit compliance.
2. Install proper manure and livestock waste storage.
3. Install grass buffer strips along tributaries.
4. Install pasture management practices, including proper stock density on grasslands.
5. Remove winter feeding sites in proximity to streams.
6. Reduce livestock use of riparian areas.
7. Insure proper on-site waste system operations in proximity to main streams.
8. Improve aquatic habitat quality.
9. Reintroduce Unionid Mussel Species.

## **Implementation Programs Guidance**

### **NPDES and State Permits - KDHE**

- a. Commercial permits for facilities in the watershed will be renewed after 2003 with continuation of bacteria monitoring and permit limits preventing excursions in bacteria criteria.
- b. Livestock permitted facilities will be inspected for integrity of applied pollution prevention technologies.
- c. Registered livestock facilities with less than 300 animal units will apply pollution prevention technologies.
- d. Manure management plans will be implemented to prevent bacteria loadings to the stream.

### **Non-Point Source Pollution Technical Assistance - KDHE**

- a. Support Section 319 demonstration projects for pollution reduction from livestock operations in watershed.
- b. Provide technical assistance on practices geared to small livestock operations which minimize impact to stream resources.
- c. Guide federal programs such as the Environmental Quality Improvement Program, which are dedicated to priority subbasins through the Unified Watershed Assessment, to priority watersheds and stream segments within those drainage areas identified by this TMDL.
- d. Assist local efforts to monitor water quality from managed grasslands, pre- and post-spring prescribed burn, to further target practices to contributing areas.
- e. Create a Watershed Restoration and Protection Strategy for HUC 11070203.

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

- a. Develop improved grazing management plans.
- b. Install livestock waste management systems for manure storage.
- c. Implement manure management plans.
- d. Install replacement on-site waste systems.
- e. Coordinate with USDA/NRCS Environmental Quality Improvement Program in providing educational, technical and financial assistance to agricultural producers.

### **Riparian Protection Program - SCC**

- a. Design winter feeding areas away from streams.
- b. Develop riparian restoration projects.

### **Buffer Initiative Program - SCC**

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

**Extension Outreach and Technical Assistance - Kansas State University**

- a. Educate livestock producers on riparian and waste management techniques.
- b. Provide technical assistance on livestock waste management design.
- c. Continue Section 319 demonstration projects on livestock management.

**Agricultural Outreach - KDA**

- a. Provide information on livestock management to commodity advocacy groups.
- b. Support Kansas State outreach efforts.

**Local Environmental Protection Program - KDHE**

- a. Inspect and repair on-site waste systems within 500 feet of main stem and tributary streams.

**Species Recovery - KDWP**

- a. Evaluate habitat quality.
- b. Improve habitat and reintroduce species as necessary.

**Time Frame for Implementation:** Evaluation of local water quality improvements in the watershed should occur prior to 2007.

**Targeted Participants:** Primary participants for implementation will be small livestock producers operating without need of permits within the priority watershed. Implemented activities should be targeted at those areas with greatest potential to impact the stream. Nominally, this would be activities located within one mile of the streams including:

1. Facilities with inadequate water quality controls.
2. Unpermitted permanent feeding/holding areas.
3. Sites where drainage runs through or adjacent to livestock areas.
4. Sites where livestock have full access to contributing tributaries and the stream is primary water supply.
5. Grazed acreage, overstocked acreage and acreage with poor range condition.
6. Poor riparian sites.
7. Near stream feeding sites.
8. Failing on-site waste systems in proximity to listed segments and feeder tributaries.

Some inventory of local needs should be conducted before 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 2007:** The year 2007 marks the midpoint of the ten-year implementation window for the watershed. At that point in time, adequate Best Management Practices should be implemented which

allows for protection of the watershed.

**Delivery Agents:** The primary delivery agents for program participation will be the conservation districts 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 or Kansas Livestock Association, the Kansas Pork Producers Council and the Kansas Dairy Association. On-site waste system inspections will be performed by Local Environmental Protection Program personnel for Chase 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.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.
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 Neosho 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 **Medium Priority** consideration. Priority should be given to activities which reduce loadings of animal waste material to the stream after 2007.

**Effectiveness:** Nonpoint source controls for livestock waste have been shown to be effective in reducing pollution in locales such as the Herrington Lake watershed. The key to effectiveness is participation within a finite subwatershed to direct resources to the activities influencing water quality. The milestones established under this TMDL are intended to gauge the level of participation in those programs implementing this TMDL.

## 6. MONITORING

At first, KDHE will continue to collect seasonal biological samples from the South Fork Cottonwood River for at least three years over 2002 - 2007 and an additional three years over 2007-2011 to evaluate if fecal coliform bacteria levels are below the water quality standard and if desired biological endpoints are being achieved.

Monitoring of bacteria levels in effluent will be a condition of NPDES and state permits for facilities. This monitoring will continually assess the functionality of the systems in reducing bacteria levels in the effluent released to the streams.

## 7. FEEDBACK

**Public Meetings:** Public meetings to discuss TMDLs in the Neosho Basin were held January 9, 2002 in Burlington and March 4, 2002 in Council Grove. 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 Neosho Basin.

**Public Hearing:** Public Hearings on the TMDLs of the Neosho Basin were held in Burlington and Parsons on June 3, 2002.

**Basin Advisory Committee:** The Neosho Basin Advisory Committee met to discuss the TMDLs in the basin on October 2, 2001, January 9, March 4, and June 3, 2002.

**Discussion with Interest Groups:** Meetings to discuss TMDLs with interest groups include:  
Kansas Farm Bureau: February 26 in Parsons and February 27 in Council Grove

**Milestone Evaluation:** In 2007, evaluation will be made as to the amount of water quality improvement activity which has occurred within the watershed and current condition of the South Fork Cottonwood River. Subsequent decisions will be made regarding the implementation approach and follow up of additional implementation in the watershed.

**Consideration for 303(d) Delisting:** The stream will be evaluated for delisting under Section 303(d), based on the monitoring data over the period 2007-2011. Therefore, the decision for delisting will come

about in the preparation of the 2012 303(d) list. Should modifications be made to the applicable water quality criteria during the ten-year 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 2003 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 2003-2007.

### **Bibliography**

Augsburger T, Keller AE, Black MC, Cope WG, and Dwyer FJ. 2003. Water Quality Guidance for Protection of Freshwater Mussels (Unionidae) from Ammonia Exposure. *Environmental Toxicology and Chemistry*, Vol. 22, No. 11, pp. 2569-2575.

7/8/04