MISSOURI RIVER BASIN TOTAL MAXIMUM DAILY LOAD

Water Body: **Blue River**
Water Quality Impairment: Nutrients and Oxygen Demand Impact on Aquatic Life

1. INTRODUCTION AND PROBLEM IDENTIFICATION

Subbasin: Lower Missouri - Crooked **Counties:** Johnson and Miami

HUC 8: 10300101 **HUC 11** (HUC 14s)**: 010** (010 & 020)

Drainage Area: 64.8 square miles

Main Stem Segment: WQLS: 33; starting at the state line and traveling upstream to headwaters near Olathe.

Designated Uses: Expected Aquatic Life Support; Primary & Secondary Contact Recreation; Domestic Water Supply; Food Procurement; Ground Water Recharge; Industrial Water Supply Use; Irrigation Use; Livestock Watering Use for Main Stem Segment.

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

Impaired Use: Expected Aquatic Life Support on Main Stem Segment.

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)(B)).

2. CURRENT WATER QUALITY CONDITION AND DESIRED ENDPOINT

Level of Support for Designated Use under 1998 303(d): Partially Supporting

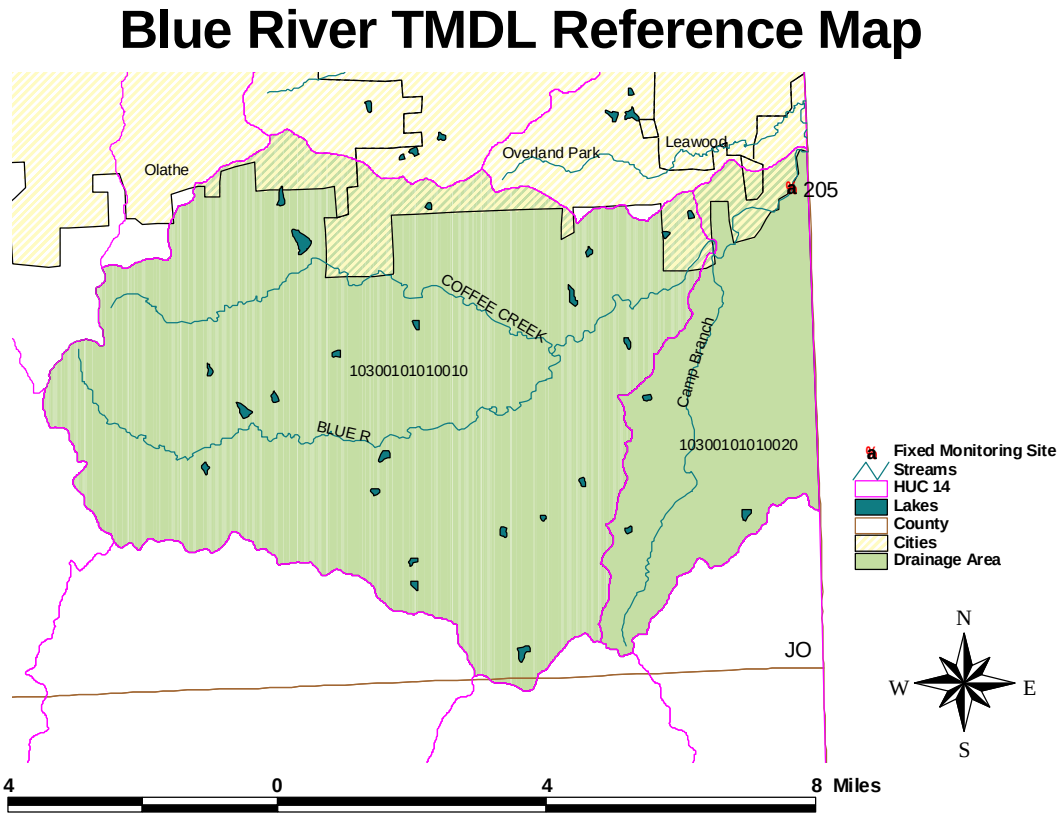
Monitoring Sites: Chemistry and Biological Station 205 near Stanley (Figure 1)

Period of Record Used: 1982-2000 for Biological Data; 1985-2000 for Stream Chemistry

Flow Record: Blue River near Stanley (USGS Gaging Site 06893080) 1974-2000

Long Term Flow Conditions: Median Flow = 5.5 cfs**,** 7Q10 = 1 cfs

Figure 1



Current Conditions:

Parameter	Historical Average & Range
Macroinvertebrate Biotic Index (MBI)	4.83 (4.33 -5.61)
% Ephemeroptera, Plecoptera, and Trichoptera (EPT) Taxa (Count)	28 % (13 -56 %)
Biochemical Oxygen Demand (BOD)	3.02 mg/L (0.01 - 24.3 mg/L)
Phosphorus	132 ug/L (10 - 910 ug/L)
Ammonia	66 ug/L (10 - 750 ug/L)
Nitrate	708 ug/L (10 - 3,140 ug/L)
Total Suspended Solids	35 mg/l (1 - 562 mg/l)

Three main parameters (MBI, %EPT, and BOD) were analyzed to address the nutrient/ oxygen demand 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 value 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 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.

On this stream segment, the average MBI value indicates that aquatic life support is partially impaired (MBI between 4.51 and 5.39). Seventy-nine percent of the surveys resulted in MBI values over 4.5, and the rest of the samples were under 4.5. Average MBI under partial support conditions was 4.89; average MBI under full support conditions was 4.42. When aquatic life is partially impaired, the percentage of EPT taxa ranges from 13 - 37% (27% average). Under full support conditions, the percentage averages 37%. The historical average of BOD (3.0 mg/L) is within normal background levels (3 - 4 mg/L).

Phosphorus, ammonia, and nitrate were graphed against the flow. (All graphs are located in Appendix B). The nutrient concentrations increased slightly with increased flow, which may indicate that phosphorus, ammonia, and nitrate are transported into the stream segments during high runoff events. The average concentration of nutrients (132 ug/L phosphorus, 66 ug/L ammonia, and 707 ug/L nitrate) in the Blue River watershed is similar to concentrations seen at surrounding biological monitoring sites.

Desired Endpoint for Blue River for 2005 - 2009

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 endpoint would be average MBI value of 4.5 or less over 2005-2009.

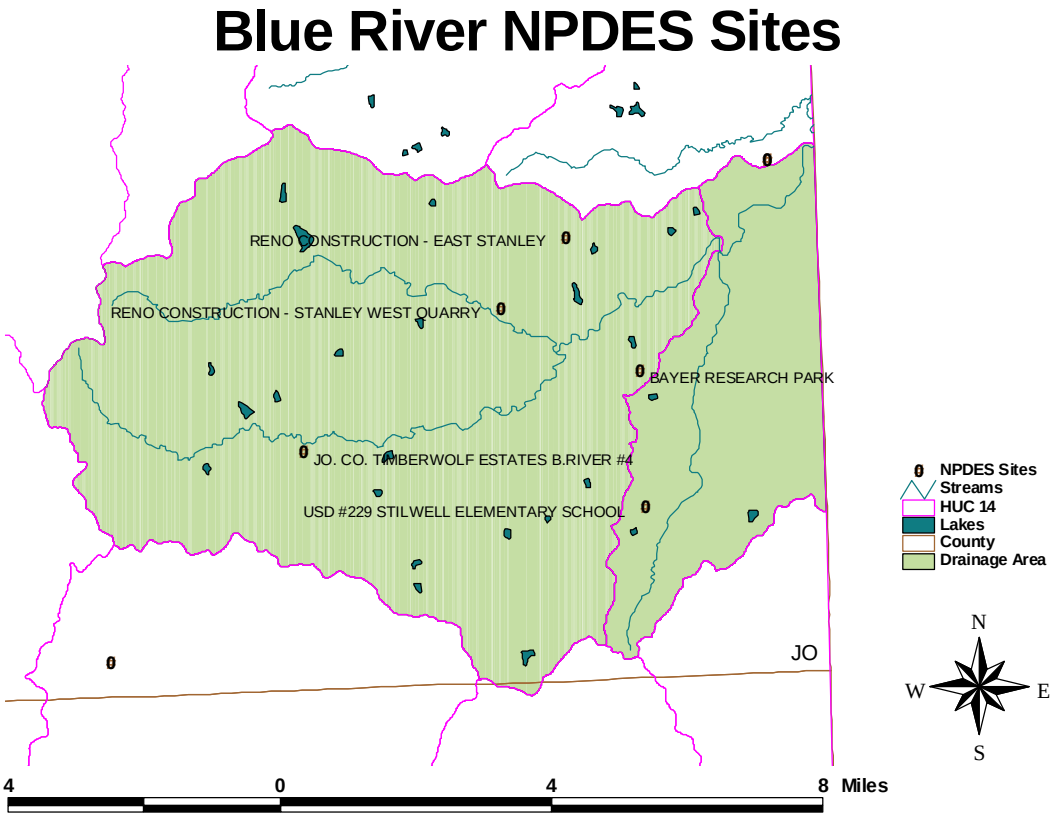
Achievement of this endpoint would be indicative of full support of the aquatic life use in the stream reach. While the narrative water quality standards pertaining to nutrients and total suspended solids are utilized by this TMDL, there is no direct linkage between MBI values and nutrient and total suspended solids levels. A number of factors may contribute to the occasional excursion in index values above 4.5. These include flows, adequate habitat and stream modifications. The link between MBI values and nutrient and total suspended solids levels on Blue River remains qualitative at this phase of the TMDL.

3. SOURCE INVENTORY AND ASSESSMENT

NPDES: There are three NPDES permitted wastewater dischargers located within the watershed that may contribute to the impairment (Figure 2).

FACILITY	STREAM REACH	TYPE	DESIGN FLOW	EXPIRATION DATE
USD#229 STILLWELL ELEMENTARY SCHOOL WTF	CAMP BRANCH	ACTIVATED SLUDGE	0.002 MGD	*2003*
JO CO TIMBERWOLF ESTATES BLUE RIVER #4	UNNAMED TRIBUTARY	2-CELL LAGOON	0.019 MGD	*2003*
BAYER RESEARCH PARK	UNNAMED TRIBUTARY	WASTE TREATMENT PLANT	0.08 MGD	*2003*

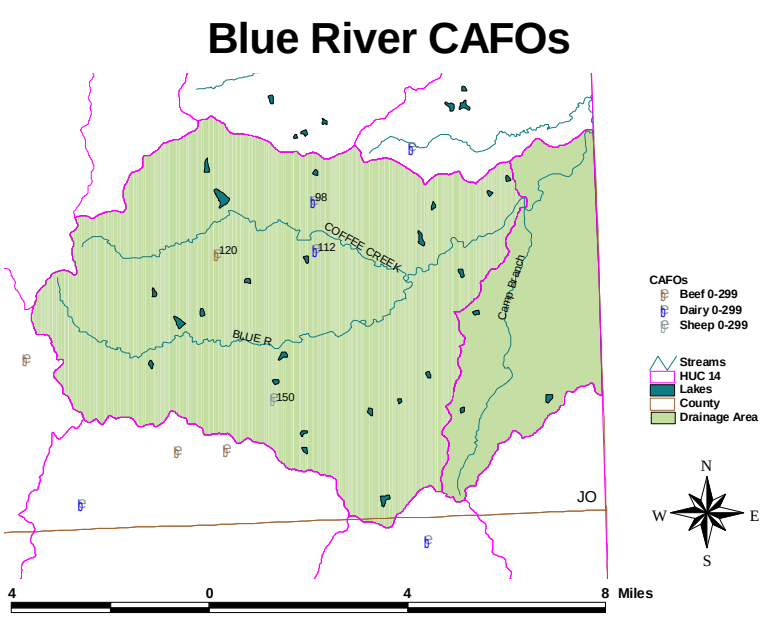
Figure 2



Population projections indicate significant growth for Leawood (52.5%), Olathe (46.1%), and Overland Park (46.1%) to the year 2020. The population density is high. Given the lack of relationship between nutrient levels and MBI values, implications for these point sources to the impairment are not clear.

Livestock Waste Management Systems: Four operations are permitted within the watershed, accounting for a potential of up to 480 animal units (Figure 3). A majority of those operations are dairy (2). There are cattle (1) and sheep (1) operations in the Blue River watershed as well. 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. Many of the facilities may be located adjacent to the stream segments with a higher susceptibility to runoff.

Figure 3

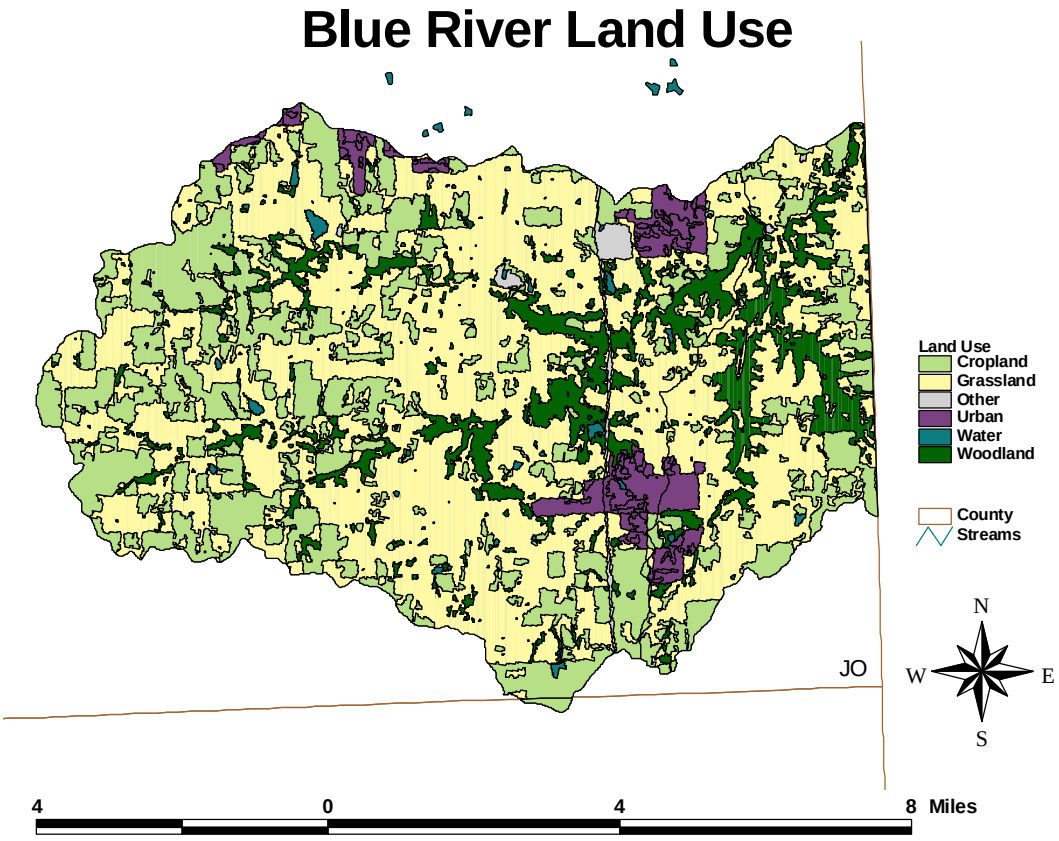


Land Use: Most of the watershed is grassland (54.2%) (Figure 4). Grazing density of livestock is moderate (40.3 animal units per square mile) throughout the watershed. Nine percent is urban, and 27.8% is cropland. In 1999, 16,794 tons of fertilizer were bought in Johnson County. Fourteen percent of Johnson county lies within the watershed. Assuming an even distribution, about 2,292 tons of fertilizer were bought and used in the watershed in 1999.

Contributing Runoff: The watershed's average soil permeability is 0.6 inches/hour according to NRCS STATSGO data base. About 100% of the watershed produces runoff even under relative low (1.5''/hr) potential runoff conditions. Under very low (<1"/hr) potential conditions, this potential contributing area is slightly reduced (98%). Runoff is chiefly generated as infiltration excess with rainfall intensities greater than soil permeabilities. As the watersheds' soil profiles become saturated, excess overland flow is produced. Generally, storms producing

less than 0.5"/hr of rain will generate runoff from only 1% of this watershed, chiefly along the stream channels.

Figure 4



Background Levels: Woodland makes up 11.8% of the watershed and is located adjacent to the rivers. Leaf litter falls into the streams and decomposes increasing the oxygen demand. Small amounts of phosphorus are contributed from the watershed soils. Nitrogen loads may be contributed from the atmosphere.

4. ALLOCATION OF POLLUTION REDUCTION RESPONSIBILITY

There is a direct, yet unquantified relation between nutrient loading and impaired biological integrity. Decreased loads should result in aquatic communities which are indicative of improved water quality. The TMDL goals and gross allocations for the Blue River are outlined in the table below. Due to the lack of linkage between nutrient loading and biological integrity, approximately a 15% reduction was used to test the response of the aquatic community to the reduced nutrient load.

The ability of biological data to integrate the various physical and chemical impacts of the entire watershed on the aquatic community defies allocation of specific nutrient loads between point and nonpoint sources. Additionally, no specific relationship between the observed ambient nutrient levels and the biological impairment indicated by the MBI value could be established. Because biological integrity is a function of multiple factors, the initial pollution load reduction responsibility will be to decrease the average condition of nutrients and sediment over the range of flows encountered on the Blue River. Future monitoring will be designed to uncover the actual reasons for the impairment, and this TMDL will be adjusted to reflect the new information.

For this phase of the TMDL, an average condition is considered across the seasons, to establish goals of the endpoint and desired reductions. Therefore, average ambient levels are multiplied by the average flow estimated for the Blue River. This is represented graphically by the integrated area under each load duration curve established by this TMDL. The area is segregated into allocated areas assigned to point sources (WLA) and nonpoint sources (LA). Future growth in wasteloads should be offset by reductions in the loads contributed by nonpoint sources. This offset along with appropriate limitations should eliminate the impairment. This TMDL represents the "Best Professional Judgment" as to the expected relationship between these sources and the expected MBI score.

Point Sources: There are three municipal facilities releasing effluent into the watershed. The existing loads contributed by these facilities are unknown and will need to be determined in the future through monitoring of effluent and ambient receiving streamflow. Assuming the total design effluent volume arrives at the monitoring site, that flow (0.156 cfs) would likely influence flow conditions up to those which are exceeded 70% of the time on the Blue River. Therefore, the allocation for point sources is demarcated by the area under each respective load duration curve bounded from 70% to 100%. At this stage of the TMDL, the assumed condition is maintenance of current conditions at those low flows, presuming an offset of lower nonpoint loading at higher flows. The Wasteload Allocation represents the load in the stream which the point sources contribute. In most cases, this is a function of permit limits and plant performance; in the case of nutrients and BOD, there are some assimilation and degradation of the constituents in transit while flowing downstream. Further refinement of this allocation will come with information on effluent concentrations and developed nutrient criteria for streams, resulting in specific permit limits in the second stage of this TMDL.

Nonpoint Sources: Given the runoff characteristics of the watershed, overland runoff can easily carry sediment, phosphorus, and nitrogen from the watershed into the stream reaches. The composition of the watershed indicates a mixture of rural and urban 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 1-70% constitutes the Load Allocation for this TMDL. Because of the predominant loads under runoff conditions, this Load Allocation intends to reduce loadings such that ambient levels for phosphorus are below 110 ppb in stream, nitrate below 0.6 ppm, ammonia below 0.056 ppm,

BOD below 2.5 ppm and sediment concentrations average below 30 ppm in the stream.

First Stage TMDL Goals and Gross Allocations for the Blue River*

	MBI	Total Phosphorus	Potential Available Nitrogen	BOD	TSS
CURRENT	4.83	3.9 #/D	23.0 #/D	89.7 #/D	1,040.0 #/D
REDUCTION	0.33	0.6 #/D	3.3 #/D	15.7 #/D	150.0 #/D
TMDL	4.50~	3.3 #/D	19.7 #/D	74.0 #/D	890.0 #/D
WLA		0.8 #/D	1.0 #/D	25.3 #/D	25.3 #/D
L.A.		2.5 #/D	18.7 #/D	48.7 #/D	864.7 #/D

~A concurrent requirement will be that the EPT individuals shall make up at least 37% of the sample population.
* Calculations are in Appendix A.

Defined Margin of Safety: Given the variable nature of the MBI values seen on this stream, 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 37% of the sample population 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 the Blue River is in a mixed rural-urban setting, subject to increased pressure of development, this TMDL will be a Medium Priority for implementation. While additional monitoring, source assessment and definition of the relationship between aquatic community response and nutrient loading are studied in anticipation of numeric nutrient criteria to be developed over the next five years, the emphasis of this TMDL will be the nonpoint contributions of sediment and nutrients in the watershed.

Unified Watershed Assessment Priority Ranking: This watershed lies within the Lower Missouri-Crooked Subbasin (HUC 8: 10300101) with a priority ranking of 32 (Medium Priority for restoration work).

Priority HUC 11s and Stream Segments: The entire Blue River watershed (segment 33) lies within HUC 11 (010)

5. IMPLEMENTATION

Desired Implementation Activities

1. Implement necessary soil sampling to recommend appropriate fertilizer applications on cropland.
2. Maintain necessary conservation tillage and contour farming to minimize cropland erosion.
3. Install necessary grass buffer strips along streams.
4. Reduce activities within riparian areas.
5. Install proper manure storage.
6. Implement necessary nutrient management plans to manage manure application to land.
7. Monitor wastewater discharges for excessive nutrient loadings.

Implementation Programs Guidance

NPDES - KDHE

a. Monitor effluent from wastewater systems to determine their nutrient contributions and ambient concentrations of receiving streams.

b. Ensure proper monitoring, permitting, and operations of municipal wastewater systems to limit nutrient and BOD discharges after numeric criteria are established.

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.

d. Assist evaluation of stormwater quality from urbanized areas of watershed.

Technical Services - KDHE

a. Incorporate numeric nutrient criteria into water quality standards after final EPA nutrient criteria guidance is issued.

Environmental Field Services - KDHE

a. Work with Department of Wildlife and Parks to assess stream habitat and other factors impacting the aquatic community throughout the Blue River.

Local Environmental Protection Program - KDHE

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

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

a. Apply conservation farming practices, including terraces and waterways, sediment control basins, and constructed wetlands.

b. Provide sediment control practices to minimize erosion and sediment and nutrient transport

Riparian Protection Program - SCC

a. Establish or reestablish natural riparian systems, including vegetative filter strips and streambank vegetation.
b. Develop riparian restoration projects
c. Promote wetland construction to assimilate nutrient loadings

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 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

Time Frame for Implementation: The first stage directs pollutant reduction practices should be installed within the priority subwatersheds during the years 2006-2006, with minor follow up implementation, including other subwatersheds over 2006-2009. To some degree, reduction practices associated with reducing bacteria impairment will have an impact on reducing nutrient loads to the stream. Monitoring of wastewater and receiving stream quality should commence with the renewal of permits.

The second stage involves incorporating refined allocations and load reductions including permit limits which should be in place after final EPA guidance has established numeric criteria and those criteria have been incorporated into Kansas water quality standards.

Targeted Participants: Primary participants for initial implementation will likely be agricultural producers operating within the drainage of the priority subwatershed. Initial work over 2002-2006 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
7. Uncontrolled entry points for urban runoff

Some inventory of local needs should be conducted in 2002 - 2006 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.

Municipal point sources will initiate monitoring and subsequently treat effluent to reduce nutrient loading once EPA guidance and numeric criteria are in place. Some assessment of stormwater quality coming from urbanized areas of the watershed will be needed to direct any appropriate stormwater management practices.

Milestone for 2006: The year 2006 marks the midpoint of the ten-year implementation window 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 nutrient impairment. Additionally, biological data from the Blue River over 2002-2006 should not indicate trends of reduced support of the aquatic community. Numeric nutrient criteria should be established by 2005 and sampled data from Blue River should indicate evidence of reduced nutrient levels relative to the conditions seen over 1982-2000.

Delivery Agents: The primary delivery agents for program participation will be KDHE permitting programs working with the point source dischargers, the State Conservation Commission, and the Natural Resources Conservation Service. Producer outreach and awareness will be delivered by Kansas State Extension and agricultural interest groups such as Kansas Farm Bureau and Kansas Livestock Association and grain crop associations. On-site waste system inspections will be performed by Local Environmental Protection Program personnel for Johnson 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 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 Missouri 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 bacteria and nutrients to the stream prior to 2006.

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.

Technology exists for nitrogen and phosphorus removal and can be placed in wastewater systems with proper planning and design.

Should voluntary participation significantly lag below expectations over the implementation period or monitoring indicates lack of progress in improving water quality conditions from those seen over 1985-2000, the state may employ more stringent regulations on nonpoint sources in the watershed through establishment of a Critical Water Quality Management Area in order to meet the desired endpoints expressed in this TMDL.

6. MONITORING

As numeric nutrient criteria become established, KDHE will continue to collect seasonal biological samples from Blue River for at least three years over 2001 - 2005 and an additional three years over 2005-2009 to evaluate achievement of the desired endpoint. Monitoring of

nutrient content of wastewater discharged from treatment systems will be expected under new and reissued NPDES and state permits, including ambient monitoring above and below the facilities.

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 2001-2005 in order to support appropriate implementation projects and corrective actions.

7. FEEDBACK

Public Meeting: A public meeting to discuss TMDLs in the Missouri Basin was held February 28, 2001 in Atchison. 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 Missouri Basin.

Public Hearing: A Public Hearing on the TMDLs of the Missouri Basin was held in Hiawatha on May 29, 2001.

Basin Advisory Committee: The Missouri Basin Advisory Committee met to discuss the TMDLs in the basin on October 3, 2000, February 28 and May 29, 2001.

Milestone Evaluation: In 2006, evaluation will be made as to the degree of implementation which has occurred within the watershed and current condition of the Blue River. Subsequent decisions will be made regarding the implementation approach and follow up of additional implementation in the watershed. The second stage of this TMDL is anticipated to begin after 2005 with the adoption of numeric criteria in water quality standards.

Consideration for 303(d) Delisting: The river will be evaluated for delisting under Section 303(d), based on the monitoring data over the period 2005-2009. Therefore, the decision for delisting will come about in the preparation of the 2010 303d 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 2002 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 2002-2006.

APPENDIX A

CALCULATIONS OF CURRENT AND DESIRED LOADS

Estimated Existing Loads calculated by median flow and average concentration:

Total Phosphorus: 5.5 cfs * 0.132 mg/l * 5.4 = 3.9 #/D
Nitrate: 5.5 cfs*0.708 mg/l*5.4 = 21.0 #/D
Ammonia: 5.5 cfs*0.066 mg/l*5.4 = 2.0 #/D
BOD: 5.5 cfs*3.02 mg/l*5.4 = 89.7 #/D
TSS: 5.5 cfs*35.0 mg/l*5.4 = 1,040.0 #/D

Desired Loads recalculated using lower ambient concentrations:

Total Phosphorus: 5.5 cfs * 0.11 mg/l * 5.4 = 3.3 #/D
Nitrate: 5.5 cfs*0.60 mg/l*5.4 = 18.0 #/D
Ammonia: 5.5 cfs*0.056 mg/l*5.4 = 1.7 #/D
BOD: 5.5 cfs*2.5 mg/l*5.4 = 74.0 #/D
TSS: 5.5 cfs*30.0 mg/l*5.4 = 890.0 #/D

Wasteload Allocations calculated by design flow and desired or permitted concentrations

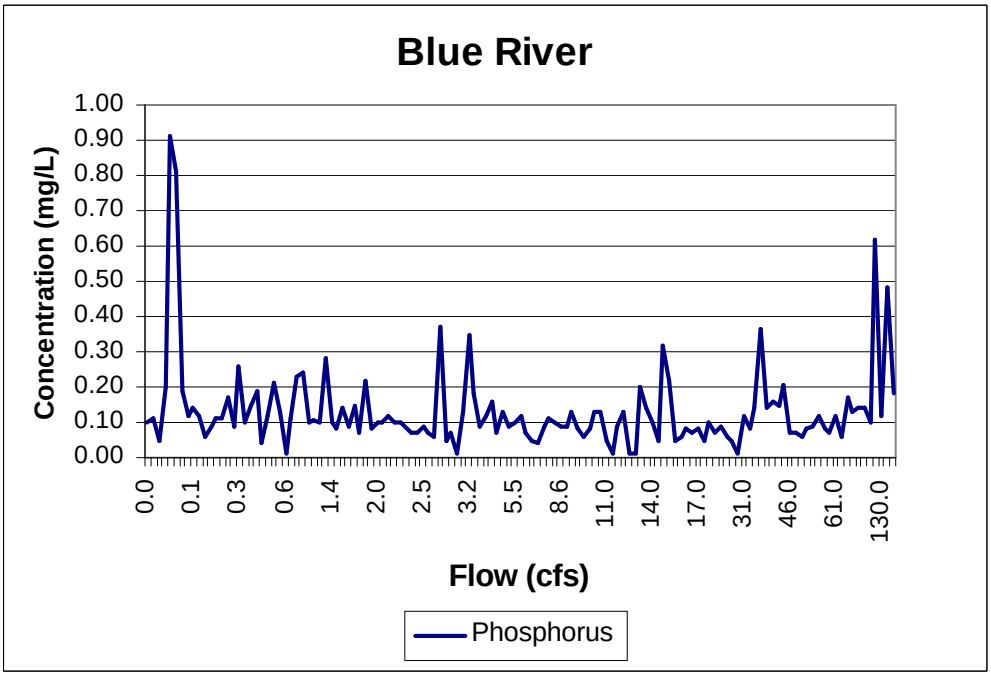
Sum of upstream dischargers = 0.101 MGD (0.156 cfs)

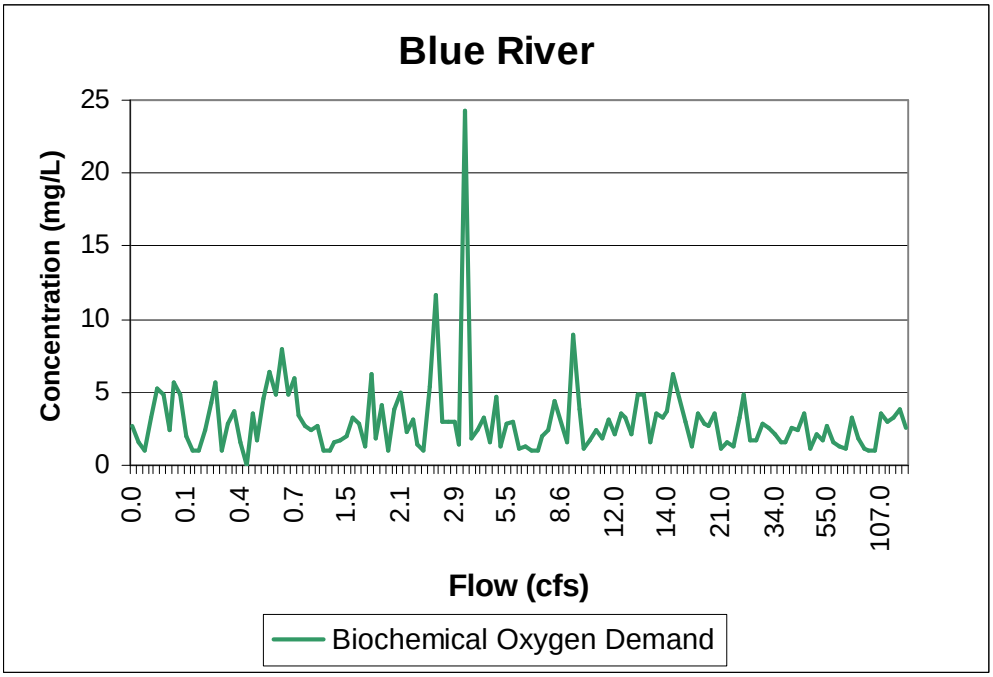
Total Phosphorus: 0.156 cfs * 1.00 mg/l * 5.4 = 0.8 #/D
Nitrate: 0.156 cfs*1.0 mg/l*5.4 = 0.8 #/D
Ammonia: 0.156 cfs*0.2 mg/l*5.4 = 0.2 #/D
BOD: 0.156 cfs*30.0 mg/l*5.4 = 25.3 #/D
TSS: 0.156 cfs*30.0 mg/l*5.4 = 25.3 #/D

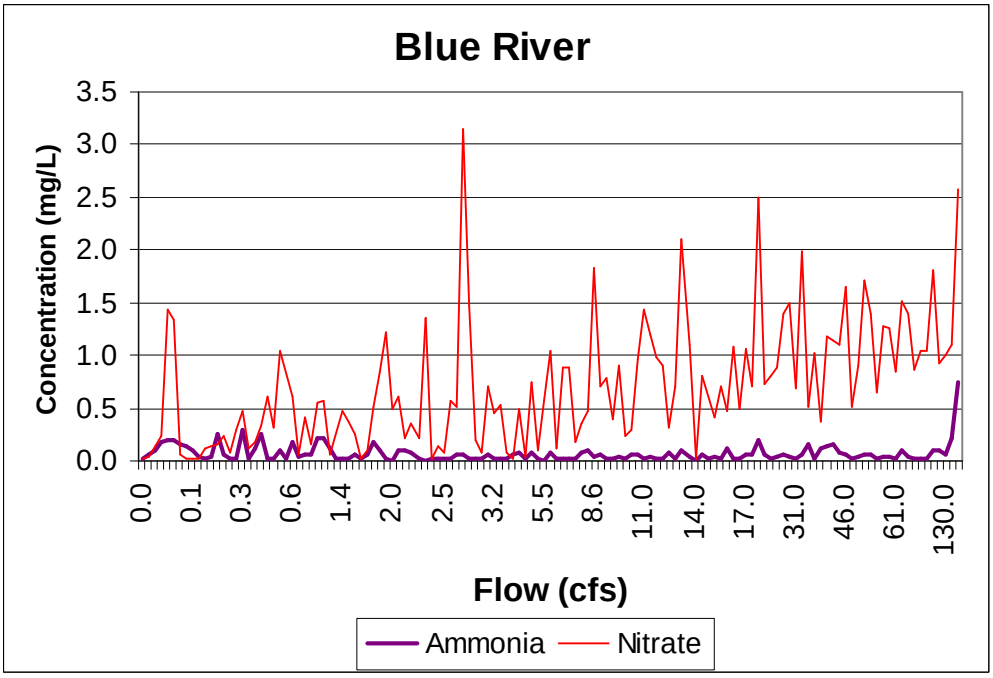
Load Allocations found by subtracting Wasteload Allocation from Desired Load:

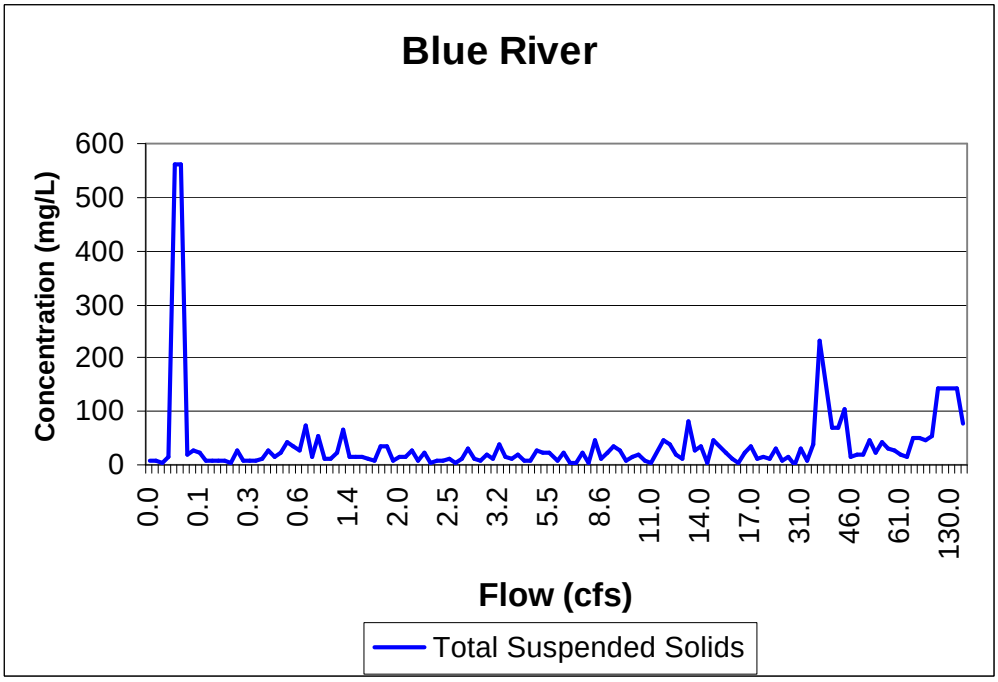
Total Phosphorus: 2.5 #/D
Nitrate: 17.2 #/D
Ammonia: 1.5 #/D
BOD: 48.7 #/D
TSS: 864.7 #/D

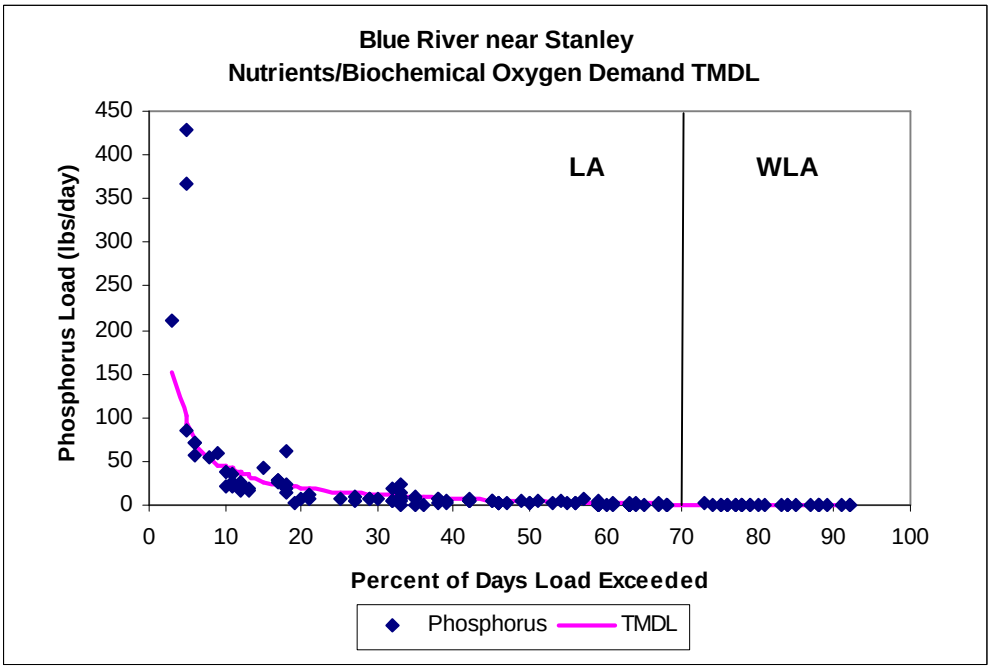
APPENDIX B

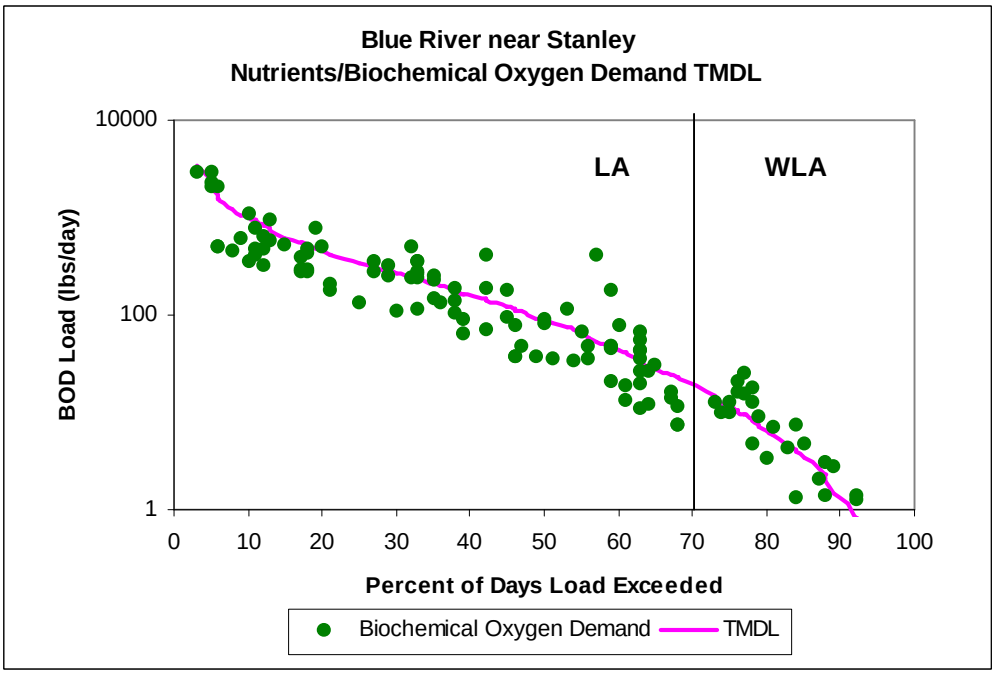

Blue River
Concentration (mg/L)
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0.0
0.1
0.3
0.6
1.4
2.0
2.5
3.2
5.5
8.6
11.0
14.0
17.0
31.0
46.0
61.0
130.0
Flow (cfs)
Phosphorus

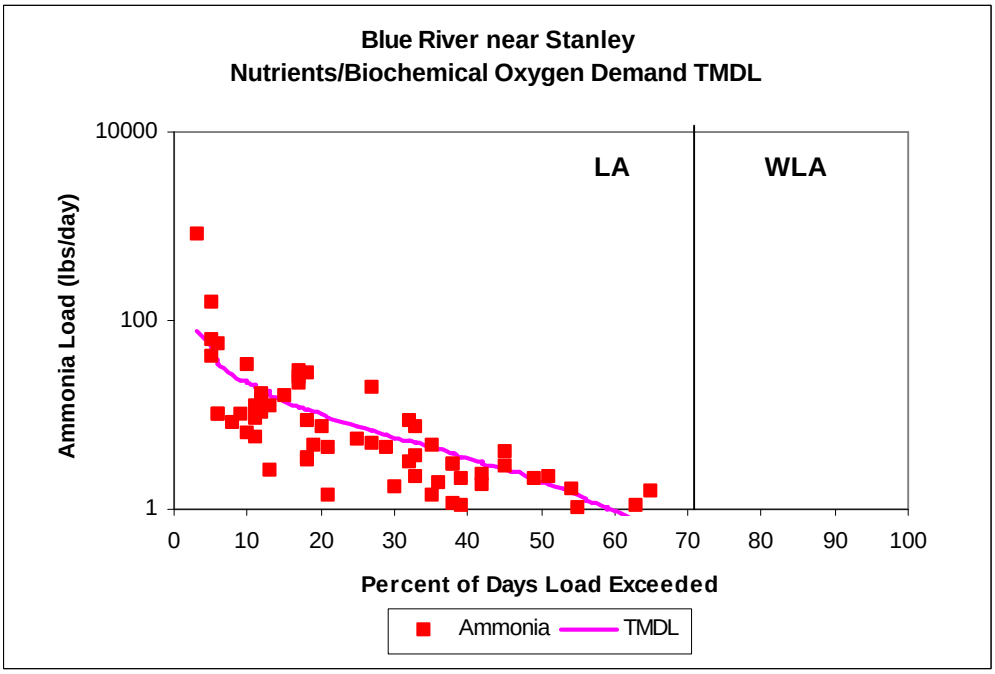

Blue River
Concentration (mg/L)
25
20
15
10
5
0
0.0
0.1
0.4
0.7
1.5
2.1
2.9
5.5
8.6
12.0
14.0
21.0
34.0
55.0
107.0
Flow (cfs)
Biochemical Oxygen Demand

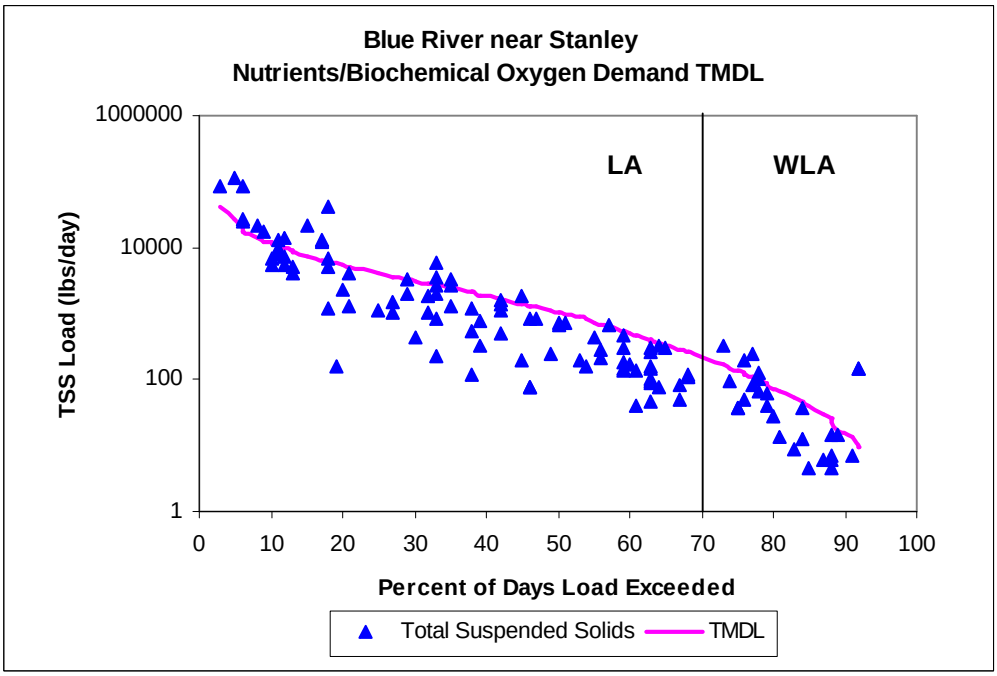

Blue River
Concentration (mg/L)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.0
0.1
0.3
0.6
1.4
2.0
2.5
3.2
5.5
8.6
11.0
14.0
17.0
31.0
46.0
61.0
130.0
Flow (cfs)
Ammonia
Nitrate

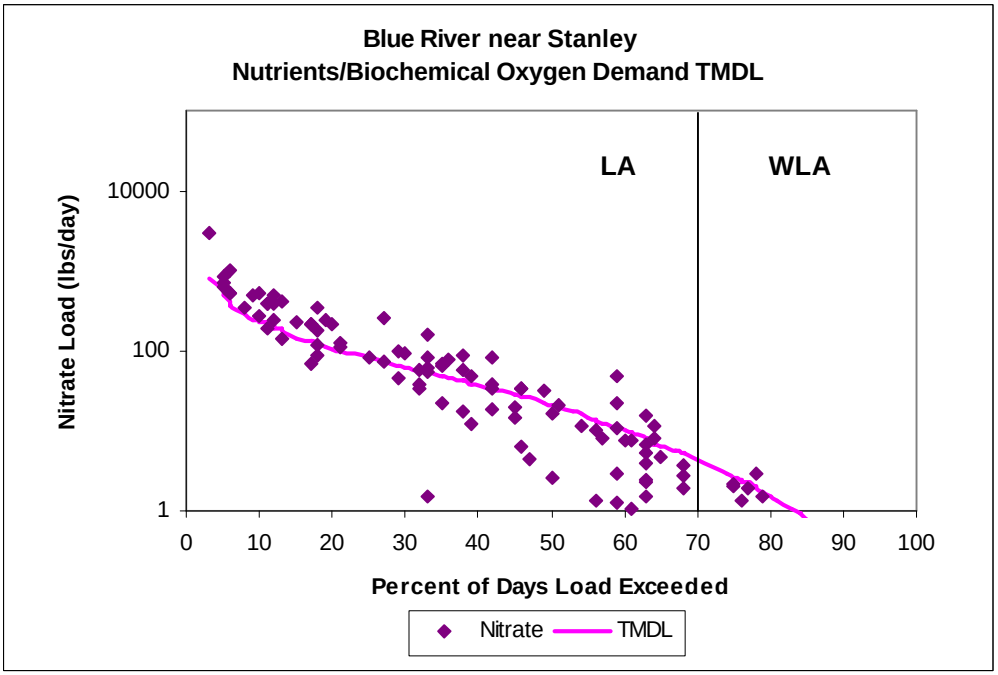

Blue River
Concentration (mg/L)
600
500
400
300
200
100
0
0.0
0.1
0.3
0.6
1.4
2.0
2.5
3.2
5.5
8.6
11.0
14.0
17.0
31.0
46.0
61.0
130.0
Flow (cfs)
Total Suspended Solids

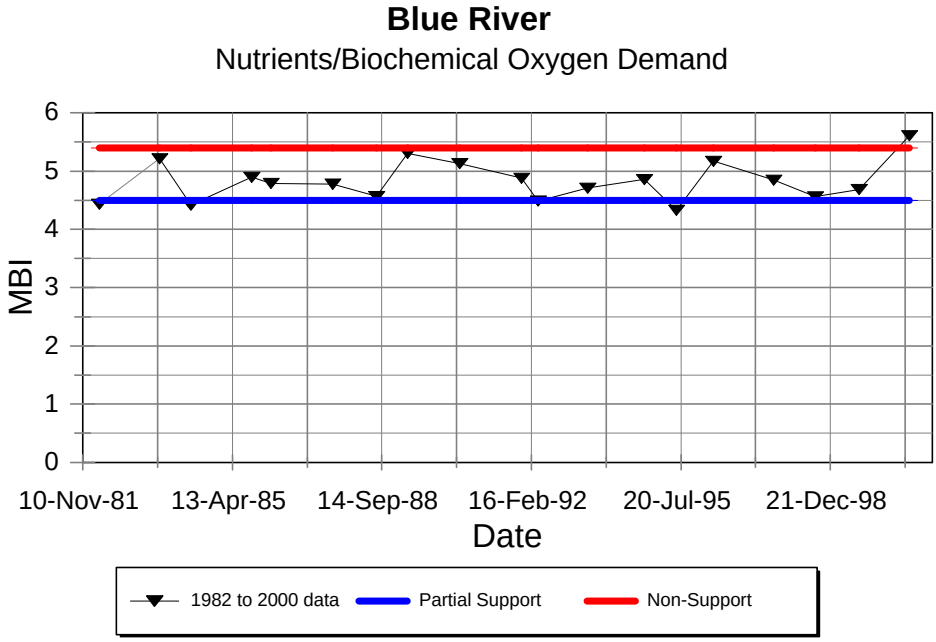

Blue River near Stanley
Nutrients/Biochemical Oxygen Demand TMDL
Phosphorus Load (lbs/day)
450
400
350
300
250
200
150
100
50
0
LA
WLA
0
10
20
30
40
50
60
70
80
90
100
Percent of Days Load Exceeded
Phosphorus
TMDL

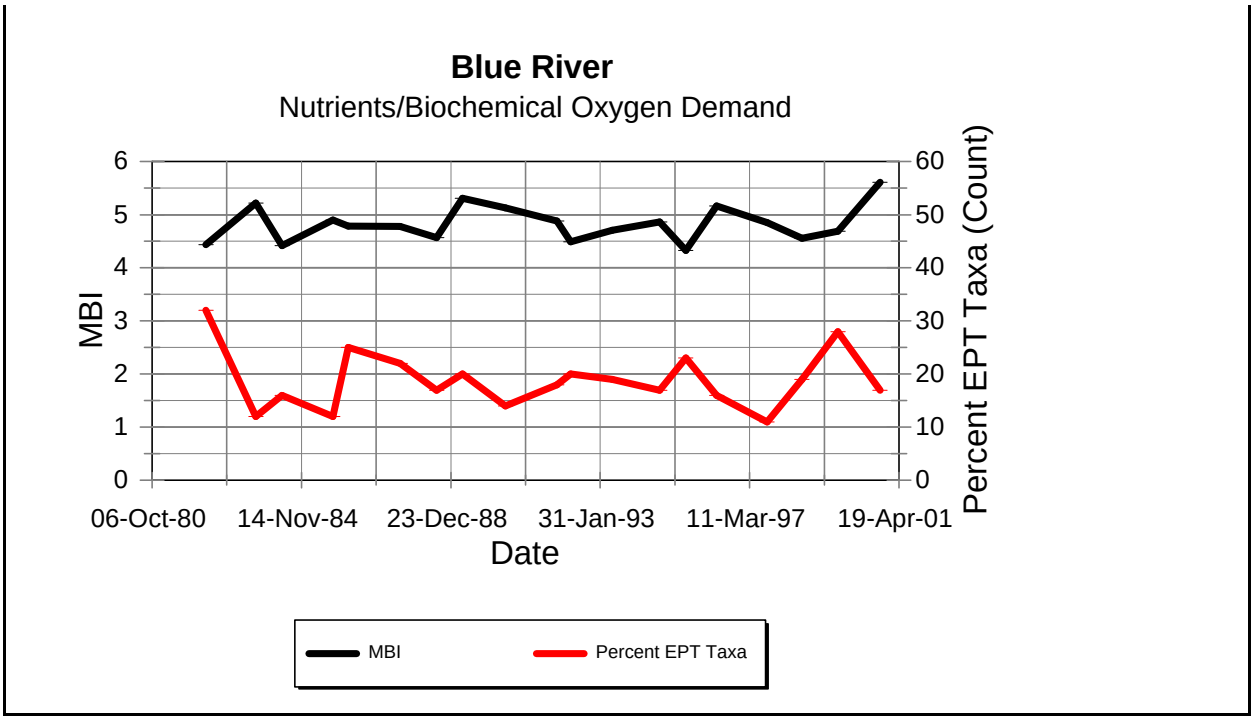

Blue River near Stanley
Nutrients/Biochemical Oxygen Demand TMDL
BOD Load (lbs/day)
10000
100
1
LA
WLA
0
10
20
30
40
50
60
70
80
90
100
Percent of Days Load Exceeded
Biochemical Oxygen Demand
TMDL


Blue River near Stanley
Nutrients/Biochemical Oxygen Demand TMDL
Ammonia Load (lbs/day)
10000
100
1
LA
WLA
0
10
20
30
40
50
60
70
80
90
100
Percent of Days Load Exceeded
Ammonia
TMDL


Blue River near Stanley
Nutrients/Biochemical Oxygen Demand TMDL
TSS Load (lbs/day)
1000000
10000
100
1
LA
WLA
0
10
20
30
40
50
60
70
80
90
100
Percent of Days Load Exceeded
Total Suspended Solids
TMDL


Blue River near Stanley
Nutrients/Biochemical Oxygen Demand TMDL
LA
WLA
Nitrate Load (lbs/day)
10000
100
1
0
10
20
30
40
50
60
70
80
90
100
Percent of Days Load Exceeded
Nitrate
TMDL


Blue River
Nutrients/Biochemical Oxygen Demand
MBI
6
5
4
3
2
1
0
10-Nov-81
13-Apr-85
14-Sep-88
16-Feb-92
20-Jul-95
21-Dec-98
Date
1982 to 2000 data
Partial Support
Non-Support


Blue River
Nutrients/Biochemical Oxygen Demand
MBI
Percent EPT Taxa (Count)
0
1
2
3
4
5
6
0
10
20
30
40
50
60
06-Oct-80
14-Nov-84
23-Dec-88
31-Jan-93
11-Mar-97
19-Apr-01
Date
MBI
Percent EPT Taxa