UPPER ARKANSAS RIVER BASIN TOTAL MAXIMUM DAILY LOAD

Waterbody: **Upper Arkansas River near Pierceville**
Water Quality Impairment: pH

1. INTRODUCTION AND PROBLEM IDENTIFICATION

Subbasin: Middle Arkansas–Lake McKinney and Arkansas-Dodge City

Counties: Finney, Kearny, Gray, Grant, Haskell and Ford

HUC 8: 11030001 and 11030003

11030001 **HUC 11** (HUC 14s)**:** **080** (010, 020, 030, 040, 050, 060)

11030003 **HUC 11** (HUC 14s)**:** **010** (010, 020, 030,040,050, 060, 070, 080)
020 (010, 020, 030,040,050, 060, 070, 080, 090)
030 (010, 020, 030, 040, 050)

Drainage Area: 1,310 mi^2

Main Stem Segment: 1 (Middle Arkansas - Lake McKinney) and 1 (Arkansas - Dodge City); beginning in Dodge City and traveling upstream to headwaters in eastern Kearny County (**Figure 1**).

Designated Uses: Primary Contact Recreation; Domestic Water Supply; Food Procurement; Ground Water Recharge; Industrial Water Supply Use; Irrigation Use; Livestock Watering Use for Main Stem Segment(s)

Special Aquatic Life Support for Segment 1 (Middle Arkansas–Lake McKinney)

Expected Aquatic Life Support for Segment 1 (Arkansas-Dodge City)

1998 303(d) Listing: Table 1 - Predominant Non-point Source and Point Source Impacts

Impaired Use: Chronic Aquatic Life

Water Quality Standard: pH not less than 6.5 and not greater than 8.5 (KAR 28-16-28e(c)(2)(C)

2. CURRENT WATER QUALITY CONDITION AND DESIRED ENDPOINT

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

Monitoring Sites: Station 286 at Pierceville (**Figure 1**)

Period of Record Used: 1986 to 1999 (Station 286)

Flow Record: Arkansas River at Garden City (USGS Station 07139000); 1986 to 1999

Long Term Flow Conditions: 10% Duration High Flow Exceedence = 370 cfs, 7Q10 = 1 cfs

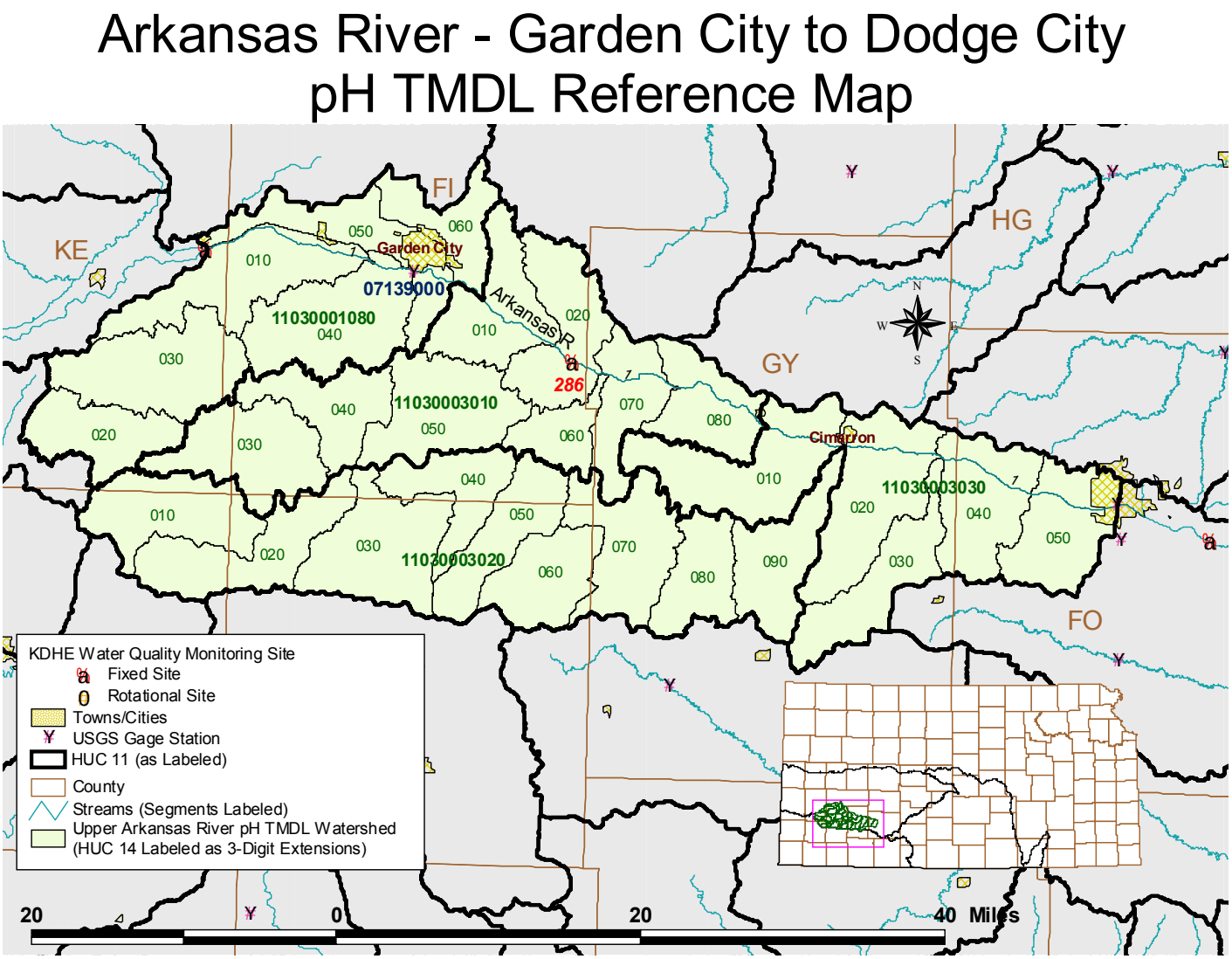

Figure 1

Current Conditions: Samples for each of the three defined seasons, Spring (Mar-Jul), Summer-Fall (Aug-Oct) and Winter (Nov-Feb), are plotted for the Pierceville (286) Monitoring Station on the Arkansas River. Excursions were noted in all seasons at Site 286. Excursions usually occurred under the lower flow conditions in each season, usually less than 10 cfs at the Garden City Gaging Station (07139000) for the Spring and less than 200 cfs in the Summer-Fall and Winter seasons (see plot below for samples taken at flows greater than 1 cfs). Generally, trends for those samples exceeding 8.5 pH show some combination of higher water temperatures, higher phosphorus concentrations, higher dissolved oxygen concentrations and lower turbidity. No excursions have been recorded at the monitoring site immediately upstream from Site 286 (Site 598). Only one excursion from the standard has been recorded since 1990 at Site 286. The lack of excursions in recent years can likely be attributed to much higher flows in the river. These factors are indicative of a point source loading the river with excessive nutrients under lower flow conditions.

Additionally, flow duration data were examined from Garden City Gaging Station for each of the three defined seasons: Spring (Mar-Jul), Summer-Fall (Aug-Oct) and Winter (Nov-Feb). High flows and runoff equate to lower flow durations, baseflow and point source influences generally occur in the 75-99% range. pH/flow exceedence curves were established for the criterion by plotting pH samples on flow exceedence for the flow on the sample date. The water quality standard(s) on the pH/flow exceedence curves represent the TMDL, since the standard is dimensionless and no load can be calculated. Historic excursions from WQS are seen as plotted points outside the acceptable pH range. Water quality standards are met for those points plotting within the acceptable range.

As previously noted, excursions were seen in all three seasons. Sixteen percent of Spring samples and 27% of Summer-Fall samples were over the pH criterion. Twenty nine percent of Winter samples were over the criterion. Overall 23% of the samples were over the criteria. This would represent a baseline condition of partial support of the impaired designated use.

NUMBER OF SAMPLES OUTSIDE OF pH STANDARD (6.5 - 8.5) BY FLOW AND SEASON

Station	Season	0 to 10%	10 to 25%	25 to 50%	50 to 75%	75 to 90%	90 to 100%	Cum Freq
Ark R. nr Pierceville (286)	Spring	0	0	0	3	0	0	3/19 = 16%
	Summer	0	2	0	1	0	0	3/11 = 27%
	Winter	0	0	4	1	0	0	5/17 = 29%

Desired Endpoints of Water Quality (Implied Load Capacity) at Site 286 over 2005 - 2009:

The ultimate endpoint for this TMDL will be to Achieve the Kansas Water Quality Standards fully supporting Aquatic Life. The current standard of a pH on not less than 6.5 and not greater than 8.5 was used to establish a pH/flow exceedence TMDL curve.

These endpoints will be reached as a result of expected, though unspecified, reductions in loading from the various sources in the watershed resulting from implementation of corrective actions and Best Management Practices, as directed by this TMDL. Achievement of the endpoints indicate loads are within the loading capacity of the stream, water quality standards are attained and full support of the designated uses of the stream has been restored.

3. SOURCE INVENTORY AND ASSESSMENT

NPDES: There are two NPDES permitted municipal wastewater dischargers within the watershed. Of these two, only Garden City is upstream of the sampling site.

MUNICIPALITY	STREAM REACH	SEGMENT	DESIGN FLOW	TYPE
Garden City	Arkansas River	1 (Middle Ark - Lake McKinney)	4.0 mgd	Mech.
Cimarron	Arkansas River	1 (Arkansas - Dodge City)	0.3 mgd	Lagoon

Population projections for Garden City to the year 2020 indicate strong growth (38% increase from 1990). Projections of future water use and resulting wastewater appear to exceed design flows for the current system's treatment capacity. The excursions from the water quality standards appear to occur under all flow conditions. Of significance to point sources are the excursions under low flow in all seasons, especially during winter, indicating that point sources may have an impact under lower flows in the watershed. Garden City has recently upgraded its treatment system. These improvements should substantially reduce nutrient loading to the river from the previous system.

Livestock Waste Management Systems: Sixty seven operations are registered, certified or permitted within the watershed. With the exception of two dairy, two swine and 3 truck wash operations, all facilities are beef. Seventeen facilities (all beef) are located within a mile of the main stem. Potential animal units for facilities within one mile of the main stem total 115,389. Potential animal units for all facilities in the watershed total 610,668. The actual number of animal units on site is variable, but typically less than potential numbers.

Land Use: Most of the watershed is cropland (77% of the area), grassland (21.5% of the area) or urban land use (1%). Both the off-season and growing season grazing density of livestock upstream of monitoring site 286 are fairly low when compared to the rest of the Upper and Lower Arkansas River Basin, especially for those HUC14s located adjacent to Arkansas River. Based on 1997 water use reports, approximately 68% of the cropland in the watershed is irrigated. Irrigation is fairly evenly distributed across the watershed.

On-Site Waste Systems: For areas south of the river and in the middle of the watershed the population density is very low, 1 - 13 persons/mi^2 while areas in the upper and lower portions of the watershed adjacent to the river have average to high densities (up to about 400 persons/mi^2)

especially for areas associated with towns/cities. Rural population projections for Ford County through 2020 show moderate increases; projections for Kearny County show a small increase, in the population. Projections for all other primary counties in the watershed show declines in the rural population. While failing on-site waste systems can contribute nutrient loadings, their impact on the Arkansas River is somewhat limited in areas of low population densities, given magnitude of other sources in the watershed. Higher population densities in rural areas located near the river should be assessed.

Background Levels: Some nutrient loading may be associated with environmental background levels, but it is likely that the contribution to the river is below the levels necessary to violate the water quality standards.

4. ALLOCATION OF POLLUTANT REDUCTION RESPONSIBILITY

It is presumed that biological activity during periods of warm temperatures and low flows with low turbidity trigger pH rises through photosynthesis. Therefore, it is assumed that reductions in phosphorus loads should limit biological activity and reduce pH exceedences under certain critical flow conditions. Therefore, the allocation of wasteloads and loads will be made in terms of phosphorus reductions. Yet, because pH is a presently undefined manifestation of multiple factors, the initial pollution load reduction responsibility will be to decrease the average condition of phosphorus over the range of flows encountered on the Arkansas River. These reductions have been based on the relationship between pH and phosphorus for the samples taken at Water Quality Monitoring site 286. Allocations relate to the phosphorus levels seen in the creek for two groups of samples. The first group is when pH was greater than the standard and the second is when pH was within the standard. From this, a 25% reduction in phosphorus concentration is needed to achieve an average phosphorus level of 0.21 mg/L or less. Additional monitoring over time will be needed to further ascertain the relationship between the phosphorus/nutrient reductions of point and non-point sources, flow durations, and pH levels along the river.

For this phase of the TMDL, an average condition is considered across the seasons, to establish goals of the endpoint and desired reductions. Therefore, target average ambient levels are multiplied by the average flow estimated for the Arkansas River near Pierceville. 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 physical factors, nutrients and pH.

Point Sources: Based upon the magnitude of design flows of the Garden City waste treatment plant and frequency of excursions at the lower seasonal flow ranges, point sources are seen as a significant cause of the water quality violations. Recent upgrades to the Garden City wastewater

treatment plant should substantially reduce nutrient loading to the river from the previous system. At this stage of the TMDL, the assumed condition is reduction of historic levels at those low flows. 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.

The Wasteload Allocations under this TMDL apply at the downstream monitoring site and reflect the average ambient conditions seen below the point sources under low flow conditions. Actual loadings by the point sources at their outfalls are much greater, but again because of the assimilation and degradation of the nutrients imposed by the biological processes of the stream, resulting downstream loads decrease substantially.

The Wasteload Allocation, as directed by the phosphorus graph, is defined at the flow condition of either one and a half times the design flow or the 7Q10, whichever is greater, thereby exerting influence on the water quality of the stream. For the Arkansas River at this location, that flow condition would be flows of 0-10 cfs. Such flows have been exceeded 49-99% of the time during the Spring, 41-99% of the time over the Summer and Fall and 69-99% time in the Winter season. Future NPDES and state permits will be conditioned such that discharges from permitted facility will not cause violations of the applicable criteria at these low flows.

Non-Point Sources: Based on the assessment of sources, the distribution of excursions from water quality standards and the relationship of those excursions to runoff conditions, non-point sources are also seen as a significant cause of water quality violations. Background levels are not viewed as a significant cause of the problem. The Load Allocation, as directed by the phosphorus graph, assigns responsibility for reducing average phosphorus conditions over seasonal flow conditions exceeding 10 cfs by 25% in the future.

Implementation of non-point source nutrient reduction practices should be taken within one mile of the river or any directly contributing tributary in areas of the watershed upstream of monitoring site 286 (HUC11 11030001080 and part of 11030003010). Implementation of non-point source nutrient reduction practices should be taken in urban areas within HUC11 11030001080. Within HUC11 11030001080 and the upper part of 11030003010 (HUC14s 010, 020, 030,040 and 050) Best Management Practices will be directed toward areas within one mile of the main stem. Additionally, within HUC11 11030001080 Best Management Practices will be directed toward those urban activities such that there will be minimal violation of the applicable pH criteria (via nutrient load management) at these flows. On-Site waste system integrity should be addressed in this HUC11 with its higher population density, starting with HUC14s 010, 040, 050, 060.

Defined Margin of Safety: The margin of safety provides some hedge against the uncertainty of loading and the pH endpoint. Therefore, the margin of safety will be implicit based on assumptions that reduced phosphorus levels in point source effluent during coincidental low flow conditions and design wastewater flows will maintain pH levels below 8.5.

State Water Plan Implementation Priority: Because the pH issue in the watershed centers on nutrient management, this TMDL will be a Medium Priority for implementation

Unified Watershed Assessment Priority Ranking: The upstream reach of this watershed lies within the Middle Arkansas–Lake McKinney (11030001) with a priority ranking of 31 (Moderate Priority for restoration work) and the primary portion of the watershed lies within the Arkansas - Dodge City (11030003) with a priority ranking of 8 (Highest Priority for restoration work).

Priority HUC 11s: HUC11s 11030001080 and the upper part of 11030003010 are of importance in this TMDL.

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.
8. Establish appropriate nutrient criteria for streams in water quality standards.

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 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. Establish relationship of nutrient levels, streamflow and pH for Arkansas 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 further assessment of source contributions and establishing the relationship between nutrient levels and resulting pH levels should occur between 2001-2005. Ongoing bacteria Best Management Practices will be implemented along the stream during this time. 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 2001-2005 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

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 2005: The year 2005 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. Numeric nutrient criteria should be established by 2005 and sampled data from the Arkansas River should indicate evidence of reduced nutrient levels relative to the conditions seen over 1985-1999.

Delivery Agents: The primary delivery agents for program participation will be KDHE permitting programs working with the point source dischargers, particularly Garden City. The Finney and Gray County conservation districts deliver programs of the State Conservation Commission, andthe 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 Finney 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 Upper 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 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. While this watershed and its TMDL are a Medium Priority consideration from the nutrient perspective, priority should be given to activities which coincidentally reduce loadings of nutrients and bacteria to the river prior to 2005.

Effectiveness: Nutrient control has been proven effective through appropriate waste management plans, 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 collect bimonthly samples at Station 286 including pH samples. Based on that sampling, the status of 303(d) listing will be evaluated in 2005. Should impaired status remain, the desired endpoints under this TMDL will be refined, implementation pursued and more intensive sampling will need to be conducted under specified seasonal flow conditions over the period 2005-2009.

7. FEEDBACK

Public Meetings: Public meetings to discuss TMDLs in the Upper Arkansas Basin were held March 8 and April 24 in Garden City and April 25 in Great Bend. 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 Upper Arkansas Basin.

Public Hearing: A Public Hearing on the TMDLs of the Upper Arkansas Basin was held in Garden City on May 31, 2000.

Basin Advisory Committee: The Upper Arkansas Basin Advisory Committee met to discuss the TMDLs in the basin on October 6, 1999; January 11 and 24, 2000; March 8, 2000;

Discussion with Interest Groups: Meetings to discuss TMDLs with interest groups include:

Associated Ditches of Kansas: October 6, 1999; January 28, 2000; March 8, 2000; and April 24, 2000.
Agriculture: February 28, 2000
Environmental: March 9, 2000

Milestone Evaluation: In 2005, evaluation will be made as to the degree of impairment which has occurred within the watershed and current condition of the listed stream segments. Subsequent decisions will be made regarding implementation approach and follow up on additional implementation in subwatersheds.

Consideration for 303(d) Delisting: The watershed 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 303(d) list. Should modifications be made to applicable criterion during the ten year implementation period, consideration for delisting, desired endpoints of this TMDL and implementation activities may be adjusted accordingly.

At this phase of the TMDL, assessment for delisting will evaluate if the percent of samples over the applicable pH criterion is less than 10% for samples taken over the monitoring period of 2001-2005. This assessment defines full support of the designated use under water quality standards as measured and determined by current Kansas Water Quality Assessment protocols. These assessment protocols are similar to those used to cite the stream segments in this watershed as impaired on the Kansas 1998 Section 303d list. As protocols and assessments for impairment change for future 303(d) lists, the monitoring data collected under this TMDL will use these new assessments and protocols for delisting consideration.

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 after Fiscal Year 2005.

Approved September 11, 2000