UPPER ARKANSAS BASIN TOTAL MAXIMUM DAILY LOAD

Waterbody: **Arkansas River near Garden City**
Water Quality Impairment: Sulfate

1. INTRODUCTION AND PROBLEM IDENTIFICATION

Subbasin: Middle Arkansas-Lake McKinney **Counties:** Hamilton, Kearney and Finney

HUC 8: 11030001 **HUC 11s:** Not Applicable

Drainage Area: 1661 miles^2 between Garden City and Coolidge

Main Stem Segments: 1, 3, 5, 7 & 9 from stateline to small stream E of Garden City **(Figure 1)**

Tributary Segments: Frontier Ditch (16)

Designated Uses: All uses including Special Aquatic Life Support and Primary Contact Recreation

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

Impaired Uses: Domestic Water Supply, Livestock Watering and Groundwater Recharge

Water Quality Standards: Domestic Water Supply: 250 mg/l at any point of domestic water supply diversion (K.A.R.28-16-28e(c) (3) (A); Livestock Watering: 1000 mg/l (Table 1a of K.A.R. 28-16-28e(d));

In stream segments where background concentrations of naturally occurring substances, including chlorides, sulfates and selenium, exceed the water quality criteria listed in Table 1a of KAR 28-16-28e(d), at ambient flow, the existing water quality shall be maintained, and the newly established numeric criteria shall be the background concentration, as defined in KAR 28-16-28b(f). (KAR 28-16-28e(b)(9)).

In surface waters designated for the groundwater recharge use, water quality shall be such that, at a minimum, degradation of ground water quality does not occur. Degradation shall include any statistically significant increase in the concentration of any chemical contaminant in ground water resulting from surface water infiltration or injection. (K.A.R. 28-16-28e(c) (5)).

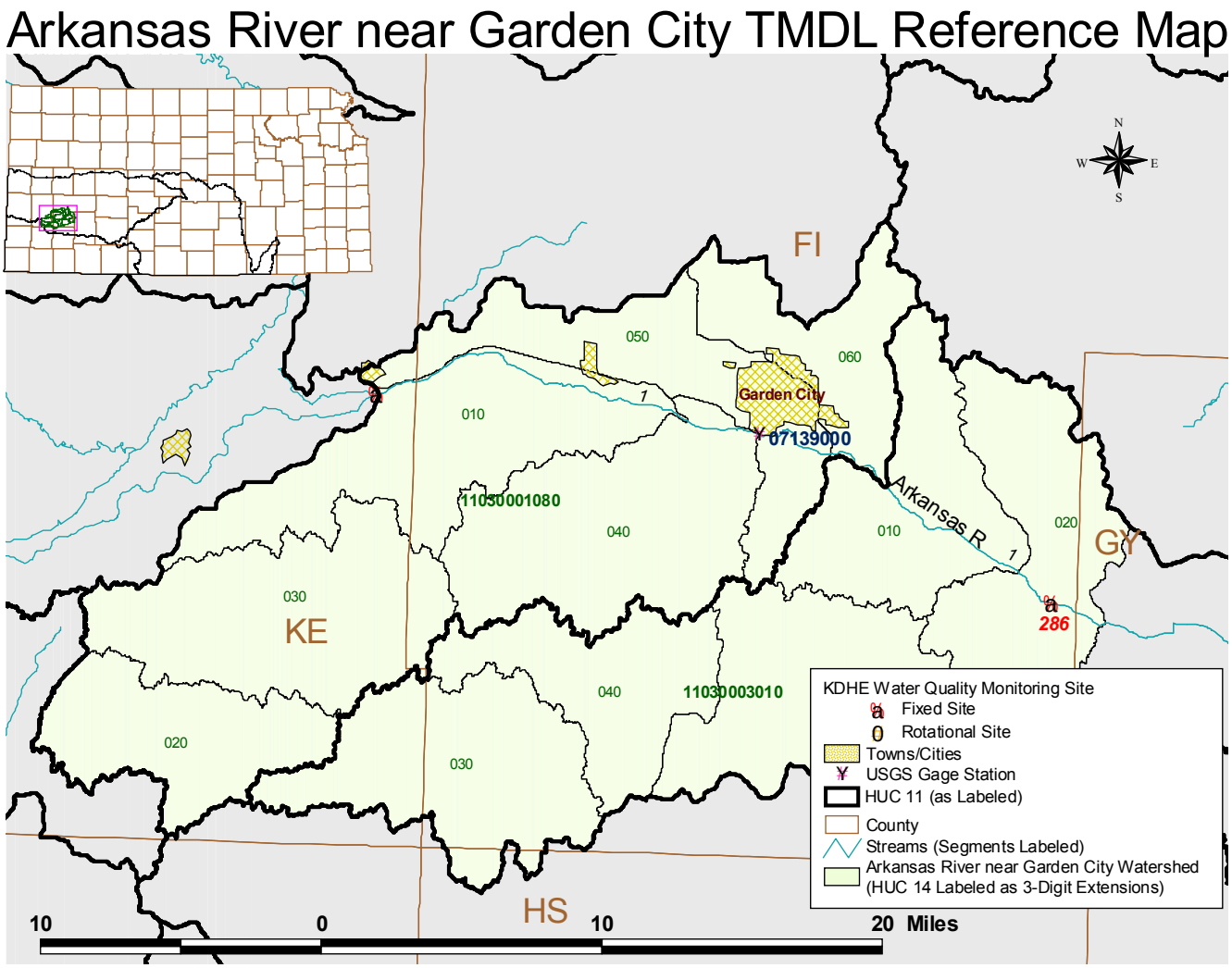

Figure 1

2. CURRENT WATER QUALITY CONDITION AND DESIRED ENDPOINT

Level of Support for Designated Use under 1998 303d: Not Supporting Domestic Water Supply or Livestock Watering

Monitoring Sites: Station 223 near Coolidge, 598 near Deerfield, 286 near Pierceville

Period of Record Used: 1987--1999

Flow Record: (USGS Stations on Arkansas River near Coolidge (07137500), near Syracuse (07138000) and at Garden City (07139000), Recorded daily data 1987 - 1999)

Flow Conditions: Average Flows from 1987 - 1999: Coolidge, 316 cfs; Syracuse, 321 cfs; Garden City, 163 cfs. Median Flows over 1987 - 1999: Coolidge, 191 cfs; Syracuse, 196 cfs; Garden City, 35 cfs. 7Q10 assumed to be 1 cfs.

Current Conditions: Sulfate concentrations have been elevated along the Arkansas River, averaging 1875 mg/l near Garden City over 1987-1999. This high level has long been the norm, sulfate concentrations have averaged 1990 mg/l among samples taken at Coolidge over 1963-1999. Analysis of concentration over time shows a single dip below 1000 mg/l, but typical levels remain around 2000 mg/l. Concentrations generally reach an upper bound as the saturation limit for gypsum in the vicinity of 2500 mg/l is approached (Figure 2). Seasonally, average river sulfate concentrations at Pierceville for March-July, August-October and November-February over 1987-1999 are 1709,1801 and 2111 mg/l, respectively.

Below Garden City, concentrations across flow ranges during 1987-1999 average 1860 mg/l at flow below 10 cfs, 2002 mg/l at flows between 10 and 250 cfs, 1702 mg/l between 250-1000 cfs and 972 mg/l at flows over 1000 cfs (Figure 3). At the stateline near Coolidge from 1963-1999, sulfate concentrations average over 2000 mg/l consistently at flows between 0-200 cfs while average concentrations below 1300 mg/l are seen from 300-1000 cfs, marked by significant concentration decreases between 200-300 cfs and over 1000 cfs (Figure 4).

There are significant changes in hydrology and the resulting water quality of the river between Coolidge and Garden City. While there is little change in flow between Coolidge and Syracuse, the river typically loses flow between Kendall and Garden City, in part because of diversions from the ditch systems in Kearney and Finney counties. However, most of the annual loss in flow in this reach of the river exceeds the total sum of irrigation diversions. There has been a historic natural loss of flow to the surrounding aquifer which may be aggrevated by the regional drawdown of the High Plains Aquifer. Over the long term, flows over 200 cfs at the stateline are necessary for any substantial flows over 50 cfs to be present at Garden City (Figure 5).

This hydrologic relationship is reflected in sulfate concentrations seen along the river. At the Deerfield station, average sulfate concentrations were 1986 mg/l over 1990-1999, very similar to the Coolidge average. In comparing samples taken at the same time, Coolidge averaged 1969 mg/l and Deerfield averaged 1959 mg/l, therefore the river is basically unchanged in Hamilton and Kearny counties. A slight decrease in concentration is noted between Deerfield and Pierceville, with concurrent samples averaging 1838 mg/l at Deerfield and 1818 mg/l at Pierceville. At low flows, the wastewater from Garden City may be the predominant source of flow seen at Pierceville and since the city's sulfate discharge averages under 400 mg/l, this may lead to a decrease in concentration compared to upstream sites.

Since the gage at Garden City was re-started in 1987, coinciding with collection of samples at Pierceville, the conditions seen during the period 1987-1999 will establish the benchmark for this

TMDL. The period between 1987 and 1999 encompasses extremes in hydrologic condition ranging from the drought periods of 1988-1991, as well as floods from 1993 and 1995. Persistent resumption of flow on the Arkansas River started around June, 1996. Given the dynamic nature of flows seen at Garden City, the more recent record is presumed to reflect the anticipated flow conditions under the effective period of this TMDL. The period is likely to be wetter than past years. For example, flows of 200 cfs at Coolidge were exceeded 48% of the time over 1987 - 1999 and 33% of the time over 1963-1999. Flows of 500 cfs were infrequent, exceeded 10-15% of the time. As seen in Figure 6, flows at Syracuse are nearly identical to those seen at Coolidge. Over 1987-1999, no flow was seen at Garden City about 40% of the time. Flows measured at the Coolidge gage at the same time of sampling over 1963 - 1999 shows a significant dip in flow over the 1970's, followed by recovery over the 1980's and 1990's. This flow pattern coincided with the larger sulfate concentrations seen on average at Coolidge (Figure 7).

Since the sulfate concentration is near-constant over the flow regime seen at Coolidge a majority of the time, the loads of sulfate calculated from sampled data will mirror the flow pattern. The 1970's while having the largest average concentrations among samples, also had the lowest average loads. The average load seen in 1963-1969 was 788 tons per day. By 1990-1999, the average was 1533 tons per day. Given that more flows around 200 cfs have crossed the stateline recently, the constant concentrations within those flows have driven up the mass of sulfate entering Kansas.

Some dilution is seen on a plot of concurrent sulfate concentrations at Coolidge and Pierceville (Figure 8). Considerably more dilution is seen at sulfate levels above 1700 mg/l. A regression line plots below the 1:1 line essentially beyond the 1500 mg/l level. Overall, concentrations near Garden City are 94% of those at the stateline. Of interest, however, are the six outliers seen at Coolidge concentrations of 1100-1300 mg/l. The elevated sulfate conditions seen at Pierceville relative to concentrations crossing the stateline correspond to dates of no or low flow at the Garden City gage in 1988 and 1990. Prior to these incidents, persistent flow went past the gage from 1986 to mid-April of 1988. Sporadic flow then occurred in May and June of 1988 as well as June of 1990. July and August of 1988 saw no flow during those months. The heightened sulfate at Pierceville during April to June of 1988 and June 1990 may reflect discharge from bank storage of high sulfate water below Garden City after recent flow events. The incidence of high sulfate during July and August of 1988 may be local groundwater seepage in the vicinity of Pierceville, or wastewater from Garden City which made it to Pierceville in a more concentrated condition after evaporative loss. There are no ditches present between Garden City and Pierceville and the power plant in Garden City, while having effluent high in sulfate, was not operating during this time period. Analysis of the remaining concurrent data, indicate sulfate levels at Pierceville remain near or below the concentrations seen upstream

Finally, initial analysis of ground water quality by Kansas Geological Survey indicates evidence of increased total dissolved solid concentrations and sulfate in the ground water profile over the last 3-4 decades. Current data hint that recent flows with lower sulfate concentrations may result in improved water quality in the upper layers of the alluvium. Levels of higher sulfate and dissolved solids may migrate downward through the alluvial material into the underlying High

Plains Aquifer over time. The indication is as long as the river loses water to the alluvial deposits and remains high in sulfate, some degradation in ground water quality should be expected to occur, notwithstanding current water quality standards pertaining to ground water recharge.

Desired Endpoint Condition of Water Quality at Station 286 over 2005 -2010

While the ultimate goal of a TMDL is attainment of the applicable criteria associated with the water quality standards and designated uses of the segment in question; 250 mg/l in this case, the historic data taken over the range of flows indicates that such a goal is unattainable. Similarly, the standard for livestock watering (1000 mg/l) cannot be reliably met, given elevated background conditions seen in the river. There are two conditions which indicate the inability of any corrective actions to bring about achievement of the 250 mg/l criterion. The first occurs at high flows above 250 cfs and represents the typical sulfate condition while the watershed is in a diluted state. Sulfate levels average 1570 mg/l over 1987-1999 at flows over 250 cfs, ranging from 767-2392 mg/l. This condition probably represents the contemporary background level which might be reached with the cessation of irrigation activity in the basin. Such conditions are infrequent, occurring less than 15% of the time. They do, however, indicate the unlikelihood that the 250 mg/l criterion can be achieved.

The second background level occurs below 200 cfs, representing the long term impact of water use and reuse within the Arkansas River valley. As seen before, there is little change in concentration with flow within the 10-250 cfs range, averaging 2000 mg/l. Cessation of irrigation would not notably reduce sulfate levels until sufficient time had passed to purge accumulated salts within the valley ground water and soil profiles. Even then, natural geologic contributions from Cretaceous shales along the river would maintain sulfate levels above 250 mg/l. While this background levels are chiefly natural, they have been aggravated from consumptive use and irrigation return flows within the Arkansas River valley from John Martin Reservoir to Garden City. Since there are no direct flow diversions for domestic water supply along the river, attempting to improve the surrounding ground water through reduced loading represents the chief concern of this TMDL. As such some interim endpoint must be developed under this TMDL to reflect this improvement in the relatively short term.

Overall, in this phase of the TMDL an interim endpoint will be to reduce the long term average sulfate concentration below the current average of 1875 mg/l seen at Pierceville. Attaining this reduction should begin to stabilize the quality of the surrounding ground water, albeit at a level elevated beyond typical standards.

Seasonal variation in the endpoint is accounted by examining the data on a seasonal basis relative to a long term average of 1875 mg/l. This TMDL may be expressed as a load duration curve corresponding with an constant average of 1875 mg/l (Figure 9). The long range goal is to see future samples plot below the designated curve, particularly in Spring and Summer.

As noted previously, there is some decrease in sulfate between the stateline and Garden City.

This reduction can be seen seasonally, ranging from 5-7%. Lowest concentrations are associated with runoff conditions in the Spring. As groundwater influences become more significant, sulfate concentrations increase. The highest concentrations occur in Winter with its lack of runoff and dominant ground water input to the river. Opportunities to see reduced sulfate levels probably are during the Spring and Summer in situations where runoff is available.

Season	1987-1999 Garden City Sulfate in mg/l	1987-1999 Stateline Sulfate in mg/l	Pct Reduction of Sulfate downstream
Spring	1717 mg/l	1802 mg/l	5 %
Summer-Fall	1800 mg/l	1943 mg/l	7 %
Winter	2115 mg/l	2226 mg/l	5 %

These endpoints might be realized through flows of better quality coming down river over time. Emphasis will be placed on improving quality at the higher flows since this results in lower overall loads entering the stream-aquifer system. It is unlikely that concentrations will improve at flows below 200 cfs. Due consideration of delivery requirements and administration of the Arkansas River Compact between Kansas and Colorado has to be incorporated in this TMDL and will affect the attainment of these modest endpoints. Additionally, evaluation of the existing criterion has to be made under the guise of the current Surface Water Quality Standards, with possible incorporation of background levels and review of designated uses in subsequent phases of this TMDL..

3. SOURCE INVENTORY AND ASSESSMENT

NPDES: There are two NPDES permitted wastewater dischargers located along stream reach 1 of the Arkansas River in the vicinity of Garden City.

DISCHARGER	STREAM REACH	SEGMENT	DESIGN FLOW	EXPIRATION DATE
Garden City MWWTP	Arkansas River	1	4 -6 MGD	2001
Sunflower Elec	Arkansas River	1	0.477 MGD	2002

Population projections indicate substantial growth for Garden City (22.5%) to the year 2020. According to projections of future water use and resulting wastewater, Garden City MWWTP looks to have sufficient treatment capacity available. The plant is looking to upgrade to treat up to 6 MGD in the future. Sampling of the effluent over 1998-1999 reveals a monthly average of 335 mg/l of sulfate in the wastewater. Under dry flow conditions, the effluent from the city may constitute the streamflow of the Arkansas River sampled at Pierceville. The electric power plant, located in west Garden City, uses cooling towers and consequently has concentrations of sulfate which exceed 2000 mg/l routinely. Average concentration of sulfate in its wastewater reaching the river is 2460 mg/l. Loss of water through evaporation while the wastewater flows down river between Garden City and Pierceville can elevate sulfate levels found in downstream samples.

Irrigation Return Flow: As noted in the analysis of the current situation, large concentrations of sulfate enter the state at Coolidge. Looking at coincident 1990-1993 data, average concentrations of sulfate below John Martin Dam were 1034 mg/l. Concentrations rose to 1908 mg/l at Lamar, 21 miles downstream. Averages at Coolidge for the same period were 2170 mg/l. This increase in concentration occurs as a result of the pattern of water use and reuse interacting with the natural sulfate sources present in the geology and soils of Eastern Colorado. Water leaving John Martin enters the irrigation ditch system which is prevalent on the Colorado plains. Flows at John Martin for the 1990-1993 drought time period averaged 316 cfs. This dropped to 14 cfs at Lamar, then rose to 640 cfs at Coolidge. Evaluating wet conditions by including flows from 1994 and 1995, maintains the pattern: 367 cfs at John Martin; 146 at Lamar, 885 cfs at Coolidge. It would appear that the Arkansas River conveys ground water seepage from mounded water tables under irrigated lands and tailwater leaving one ditch system to be diverted by another downstream. Most flow is directed through the ditch systems with flow delivery at the stateline constituting tailwater and return flows. Hence, the elevated sulfate levels over naturally high concentrations are chiefly a consequence of the water use pattern in eastern Colorado.

Within Kansas, there are currently six active ditches upstream of Garden City that use Arkansas River water: Frontier, Amazon, Great Eastern, Southside, Farmers and Garden City canals (Figure 10). Two ditches, the Ft. Aubrey and Alamo ditches, are no longer active. The Frontier Ditch diverts water in Colorado and returns a portion of unused water to the river above Syracuse. The Amazon and Great Eastern Ditch divert water from the same headgate east of Kendall and convey water to the Lake McKinney area. Water for the Great Eastern Ditch moves through Lake McKinney to irrigate eastern Kearny County. The Amazon Ditch continues northeastward to the northeast portion of the county. Occasionally, these canals will return 5-10 cfs to the river for one to two days in order to clear the canals of debris at the upstream end. The Southside Ditch diverts water a few miles downstream from the Amazon/Great Eastern headgate and is commonly used as an alternative conveyance system for the Farmers and Garden City ditch service areas to avoid significant transit losses in the river between Kendall and Deerfield. Such water returns to the river just west of Deerfield and is diverted at the Farmers/Garden City headgate downstream of Deerfield to irrigate areas near Holcomb. Indications from the Division of Water Resources indicates that little tailwater returns from these ditches. An average of 59,516 af/yr have been diverted from surface water in Hamilton, Kearney and Finney counties since 1990, given a 120 day irrigation period, this would equate to about 250 cfs.

Ground water irrigation starts in earnest south of Lakin in Kearny County and becomes the prevalent practice in Finney County. This marks the area where the river overlies the High Plains Aquifer. Flows at Garden City reflect this usage as extended periods of low or no flow are recorded at the gage on the river south of town. Very little return flow comes from lands irrigated by wells, with tailwater control requirements part of water rights overseen by the Division of Water Resources and Groundwater Management District No. 3. Given that certain reaches of the river have historically had large transit losses through infiltration to the surrounding ground water, additional influence on the stream from the high density of water use within the alluvial corridor and surrounding High Plains Aquifer ensures that the river will be a losing stream from Syracuse eastward. Surrounding groundwater has typically had sulfate levels

under 500 mg/l. The lack of fresh water inflow from the surrounding aquifer has left the alluvial aquifer subject to elevated sulfate levels as river water has been induced downward into the unconsolidated deposits.

Background Levels: Sulfate has certainly been elevated within the river for decades and it is likely that natural levels contributed from the interaction of the Arkansas River with gypsum deposits in the Pierre Shale in eastern Colorado would elevate sulfate concentrations above the water quality criteria for domestic water supply or livestock. However, the pattern of irrigation return flows has increased the sulfate concentrations through evapotranspiration and extended inundation of gypsum soils to aggrevate the current impairments.

4. ALLOCATION OF POLLUTION REDUCTION RESPONSIBILITY

The nature of sulfate loading along the Arkansas River has been rooted in decades of natural contributions aggravated by patterns of irrigation water use and reuse. Therefore, short term reduction in sulfate loads crossing the stateline will be negligible. Flows of improved water quality over the long term may gradually bring about a lowering in ambient concentrations of sulfate seen throughout these stream reaches. As such, widespread application of this TMDL and its desired endpoints is premature. Therefore, establishment of background levels is appropriate and allocations relative to point and non-point sources are to be made in light of those elevated levels and current contributions..

Point Sources: Unless point sources act to concentrate salts through reuse and evaporation, they will tend to discharge water that is similar in sulfate content to that within their water supplies. Garden City's wastewater is an order of magnitude lower in sulfate than the river condition. However, evaporative action through cooling towers at power plants can create effluent with high sulfate levels. The Wasteload Allocation recognizes that the 7Q10 for the Arkansas River at Garden City results in a flow at Pierceville that is effectively zero. Therefore, any flow seen at the monitoring site at Pierceville will be either be a fraction of the design flows from the Garden City area or water passing through Garden City at higher flows. Based on the relationship between Coolidge flow and flow at Garden City, it would seem that the chief contribution to low flows is potentially the Garden City wastewater.

As Garden City effluent dominates downstream flow more and more, water quality in the river near Pierceville should improve relative to background levels, because of the lower sulfate levels in the municipal wastewater. Assuming 70% of the wastewater is lost through evaporation, resulting sulfate concentrations will rise to the 1800-2000 mg/l at Pierceville. Assuming Garden City upgrades to a design flow of 6 MGD and the power plant holds its design flow constant at 0.477 MGD, the Wasteload Allocation of 13.6 Tons per day, should reduce sulfate concentrations below the current average of 1875 mg/l at flows at or below 10 cfs (Figure 9). Given the city will discharge up to 6 MGD and that its sulfate levels are below 400 mg/l 85% of the time, Garden City should be allocated 10 T/D of sulfate.

The power plant has a small amount of effluent which is high (avg = 2460 mg/l) in sulfate. If the

plant effluent is held to a level below the current ambient average of 1875 mg/l, the resulting allocation to the plant should be 3.6 T/D at 0.477 MGD and 1800 mg/l. Figure 11 indicates the resulting concentrations of sulfate at Garden City and Pierceville under varying rates of Garden City discharge. Unless the power plant discharges at its design flow, sulfate levels should be below current averages if Garden City discharges at least 3 MGD, thereby achieving the endpoint of this TMDL. Reduction of power plant discharges would also improve downstream water quality conditions. The quality of the effluent established by this Wasteload Allocation is improved over the quality of the underlying ground water and should mark a gradual improvement.

Non-Point Sources: The primary cause of elevated sulfate throughout these stream reaches is the natural contribution from the geology and soils of the drainage area in the valley aggravated by the historic pattern of irrigation return flow along the river, a non-point source. A majority of the return flow emanates from the water use pattern in Colorado since little tailwater occurs within Kansas. The Load Allocation will be to reduce the average sulfate content of flows over 200 cfs over the next ten years. This allocation will be documented through the plotting of future sampled loads below the TMDL curve, indicative of a 1875 mg/l average.

Activities to reduce sulfate in this flow range would benefit from more direct delivery of some flow between John Martin and the stateline and a sequence of higher quality water at high flows over the long term to reduce sulfate loads entering the stream system. These practices must adhere to the protocols and procedures of the Arkansas River Compact between Kansas and Colorado and any subsequent rulings relative to litigation involving the Compact.

Defined Margin of Safety: The margin of safety will be defined where direct allocations may influence water quality at flows below 10 cfs which is subject to the influence of point source discharges. The margin of safety for this TMDL and its Wasteload Allocation will be implicit based on the conservative assumptions used in determining the wasteload allocation. These assumptions include the use of coincidental design flows, the dominance of Garden City wastewater which tends to have sulfate levels lower than the presumed 400 mg/l level and the severe (70%) loss of water through evaporation for flow between Garden City and Pierceville.

State Water Plan Implementation Priority: This TMDL will be a Medium Priority for implementation because of the need to establish background levels given high ambient concentrations, time is needed to establish any new operating procedures for the delivery of water under the Arkansas River Compact by Colorado to Kansas; review of alternative delivery operations will need to be explored between the two states during Compact discussions; and the two states will need to collaborate on a comprehensive plan for reduction of irrigation return flow constituents, particularly selenium, which is also elevated at the stateline.

Unified Watershed Assessment Priority Ranking: This watershed lies within the Middle Arkansas-Lake McKinney Subbasin (HUC 8: 11030001) with a priority ranking of 31 (Medium Priority for restoration work).

Priority HUC 11s and Stream Segments: Because the sulfate impairment is confined to the mainstem of the Arkansas River, priority will be given to Segment 9 as the entry point of high sulfate within water coming from Colorado and Segment 1 where potential return flows and point source discharges influence water quality (Figure 1).

5. IMPLEMENTATION

Desired Implementation Activities

Short term

1. Renew necessary state and federal permits and monitor permitted facilities for permit compliance with appropriate effluent limits
2. Establish appropriate background concentrations reflecting dominant natural processes and confirm designated uses along the river.
3. Develop and implement source water protection plans for communities along river.
4. Reduce tailwater entering river from irrigated lands in Kansas.
5. Evaluate the fate of water between Garden City and Pierceville at low flow conditions.

Long term

6. Provide alternate operations and delivery of water from Colorado to Kansas that improves water quality, but does not increase consumption or depletions in violation of the Arkansas River Compact.
7. Use the occasional high flows to move sulfate accumulations through stream system
8. Develop long term plan for irrigation return flow management to reduce sulfate and selenium loadings
9. Increase conservation of water in the valley, within the context of the Kansas Water Appropriation Act and reduce phreatophyte loss of water along channel.

Implementation Programs Guidance

NPDES and State Permits - KDHE

a. Municipal and industrial permits for facilities along river will be renewed in 2002 with appropriate sulfate effluent limits reflecting background concentrations.
b. Examine opportunities to eliminate discharges with extreme sulfate concentrations entering the river.

Non-Point Source Pollution Technical Assistance - KDHE

a. Develop source water protection plans for wellfields of Coolidge, Syracuse, Lakin, Deerfield, Holcomb and Garden City

Water Quality Standards and Assessment - KDHE

a. Confirm designated uses of domestic water supply and livestock watering on

stream reaches
b. Establish background levels of sulfate for Coolidge and Pierceville monitoring sites
c. Monitor real-time conductivity of Arkansas River at Coolidge for further characterization of sulfate levels and seasonal flow conditions
d. Collect and analyze data on elevated selenium levels for 2002 Section 303d list

Water Quality Planning - KDHE

a. Collaborate with Colorado on comprehensive irrigation return flow management plan for reduction in sulfate and selenium loadings
.

Governor's Water Quality Initiative - Governor's Office

a. Invite Colorado Governor to begin collaborative bi-state effort to improve water quality on Arkansas River.

Arkansas River Compact - Division of Water Resources

a. Evaluate new delivery mechanisms and procedures as allowed by the Compact and actions of the Compact Administration.
b. Examine opportunities to deliver Compact water from John Martin Reservoir directly down the river to the stateline without diversion by upstream ditches
c. Insure that spills from John Martin Reservoir are available to provide flushing flows downstream.
d. Assist KDHE in collaborative efforts with Colorado on opportunities to reduce phreatophytic water use, increase water conservation and improve the quality of irrigation return flows consistent with the Arkansas River Compact.

Water Appropriations - Division of Water Resources

a. Reduce remaining tailwater entering river within Kansas.
b. Promote water conservation techniques in surface and ground water irrigation

Subbasin Water Management - Division of Water Resources

a. Evaluate the interaction of the Arkansas River and the surrounding aquifer between Garden City and Pierceville at low flows.
b. Evaluate flow conditions between the furthest downstream ditch headgate and the Garden City gaging station.

Water Planning - Kansas Water Office

a. Complete research with Kansas Geological Survey on water quality issues of Upper Arkansas River
b. Initiate study with Corps of Engineers on reestablishing stream channel along Arkansas River and potential benefits in reduced water consumption and ground water infiltration of a re-defined channel.

c. Direct any funds available within the Water Conservation Projects Fund to water management and conservation activities along the Arkansas River.

Timeframe for Implementation: Water quality planning, monitoring and assessment, wastewater permitting, tailwater management and source water protection planning should occur over 2000 - 2005. Integration of water quality management, potentially involving irrigation return flows and administration and operations of the Arkansas River Compact should commence in 2005. Development of a TMDL for the selenium impairment will begin in 2004.

Targeted Participants: Primary participants for implementation will be the state agencies in the two states with responsibilities for water right administration and water quality management. The irrigation ditches in both states will be involved in any return flow management plans. Municipalities along the river with wellfields will be involved in the development of source water protection plans.

Milestone for 2005: The year 2005 marks the mid-point of the ten year implementation window for the stream segments. At that point in time, water quality should be considered for incorporation within the operating protocols of the Arkansas River Compact Administration or other interstate mechanisms. Additionally, sampled data from Station 286 should indicate evidence of reduced sulfate levels at low flow conditions relative to the conditions seen over 1987-1999.

Delivery Agents: The primary delivery agents for program participation will be the Division of Water Resources and the Kansas Department of Health and Environment.

Reasonable Assurances:

Authorities: The following authorities may be used to direct activities along the river 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. The Federal Safe Drinking Water Act empowers KDHE to develop Source Water Protection Assessments and Plans.

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-1803 creates the Water Conservation Projects Fund to be administered by the Kansas Water Office for water conservation and water use efficiency projects in the Upper Arkansas River Basin impacted by the Arkansas River Compact.

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.

8. K.S.A. 82a-520 contains the Arkansas River Compact between Colorado and Kansas, including the provisions for administering the delivery of water between the states..

9. K.S.A. 82a-701, et seq. authorizes the Chief Engineer and the Division of Water Resources to administer water appropriations in the state, including prevention of waste and planning and practicing water conservation.

Funding: The Water Conservation Projects Fund receives a portion of the funds recovered through the litigation over the Arkansas River Compact. The Fund is to be used for projects involving efficiency improvements to canals, water use efficiency devices, tailwater systems of irrigation system efficiency upgrades, monitoring equipment, artificial recharge or water right purchase and maintenance of the Arkansas River channel.

Other protection or planning activities are incorporated within the Upper Arkansas Basin Plan of 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 a portion of the $16-18 million available annually from the State Water Plan Fund to water quality and water conservation projects and programs. While most of this Medium Priority TMDL involves implementation activities after 2005 which can be supported through other funds, some monitoring and Source Water Protection Planning activities should be considered for funding in the 2002-2005 time period.

Effectiveness: Irrigation return flow controls are difficult to implement, although tailwater management has been practiced in Kansas for decades. The interaction of the requirements of the Arkansas River Compact complicates the ability of the state to implement this TMDL. As such, the priority for this TMDL will remain Medium, as the state explores collaborative opportunities to reduce the impairment of excessive loading from irrigated lands in Colorado. Furthermore, the more pressing issue of selenium impairment with parallel causes will arise with the development of the 2002 Section 303d list and anticipated subsequent TMDL.

Should bi-state cooperation lag below expectations over the next five years to hinder progress in improving water quality conditions from those seen over 1987-1999, the federal government may impose more stringent conditions on the states in order to meet the desired endpoints expressed in this TMDL.

6. MONITORING

KDHE should collect bimonthly samples at Stations 223 and 286 over 2000-2010 in order to assess progress in implementing this TMDL over each of the three defined seasons during the initial implementation period. During the evaluation period (2005-2010), more targeted sampling may need to be conducted under flow conditions below 10 cfs and between 200-400 cfs in order to determine the achievement of the desired endpoints of this TMDL. Use of the real time flow data available at the Coolidge and Garden City stream gaging stations can direct sampling efforts. Additionally, support of a real time conductivity probe at the Coolidge gage will allow additional analysis of the inter-relationship between sulfate levels and flows arriving from Colorado.

Monitoring of sulfate levels in effluent will be a condition of NPDES and state permits for facilities discharging to the Arkansas River.

Water use, tailwater returns and streamflow gains and losses will be monitored by the Division of Water Resources.

7. FEEDBACK

Public Meetings: Public meetings to discuss TMDLs in the Upper Arkansas Basin were held March 8, 2000 and April 24, 2000 in Garden City. 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 will be 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 and 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 consideration of

water quality that may be achievable within the framework of the Arkansas River Compact Administration or through other cooperative actions of the States of Colorado and Kansas. Subsequent decisions will be made regarding the implementation approach.

Consideration for 303d Delisting: The river will be evaluated for delisting under Section 303d, 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 Source Water Protection and monitoring under this TMDL will be considered in *Kansas Water Plan* implementation decisions under the State Water Planning Process for Fiscal Years 2001-2005. Implementation of water supply management and conservation activities will likely occur after 2005.

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