WATER

Water Quality

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PLANNING PERMITTING DESIGN SCIENCES

WATER QUALITY
U.S. 287 BYPASS AT LAMAR

Project Number: C 2871-026

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WATER QUALITY

The proposed construction of the US 287 bypass at Lamar, Colorado has the potential to impact surface waters that cross through the bypass corridor including the Arkansas River, Willow Creek, and various irrigation canals and ditches. The location of the primary surface waters with respect to the proposed bypass is shown in Figure 1. Starting at the north end of the bypass, the surface water features include the Markham Arroyo Canal, Hyde Canal, Arkansas River, Willow Creek, Lamar Canal, and Fort Bent Canal. Several smaller ditches, canal laterals, and seepage areas are also present in the northern portion of the proposed bypass but are not shown on the figure.

WATER QUALITY CLASSIFICATION

The segment of the Lower Arkansas River Basin and its tributaries from the outlet of John Martin Reservoir to the Colorado/Kansas border is characterized by high salinity and has been classified by the State of Colorado as Class 2 Warm Water Aquatic Life, Class 2 Recreation, Domestic Water Supply, and Agriculture. These classifications are summarized below (CDPHE 2002).

> Class 2 Warm Water Aquatic Life – These surface waters are not capable of supporting a wide variety of warm water biota, including sensitive species, due to physical habitat, water flows or levels, or uncorrectable water quality conditions that result in substantial impairment of the abundance and diversity of species.
>
> Class 2 Recreation – These surface waters are not suitable or intended to become suitable for recreational uses involving primary contact with the water. They are suitable for recreational uses such as wading, fishing, and other streamside activities.
>
> Domestic Water Supply – These surface waters are suitable for potable water supplies after receiving standard treatment.
>
> Agriculture – These surface waters are suitable for irrigation of crops and are not hazardous as drinking water for livestock.

STREAMFLOW AND WATER ANALYSES

The streamflow and water quality data collected at the United States Geological Survey (USGS) station located at the Highway 50 and 287 bridge over the Arkansas River in Lamar provide baseline characteristics for the river immediately upstream of the proposed bypass (USGS 2002). This information is presented in Appendix A and summarized in Table 1 and Figures 2, 3 and 4.

Mean monthly streamflow data from the USGS station is shown graphically on Figure 2. The graph shows that there is a low flow period of less than 100 cubic feet per second (cfs) from October through March and a high flow period of greater than 100 cfs from

FIGURE 1
LAMAR AREA CANALS

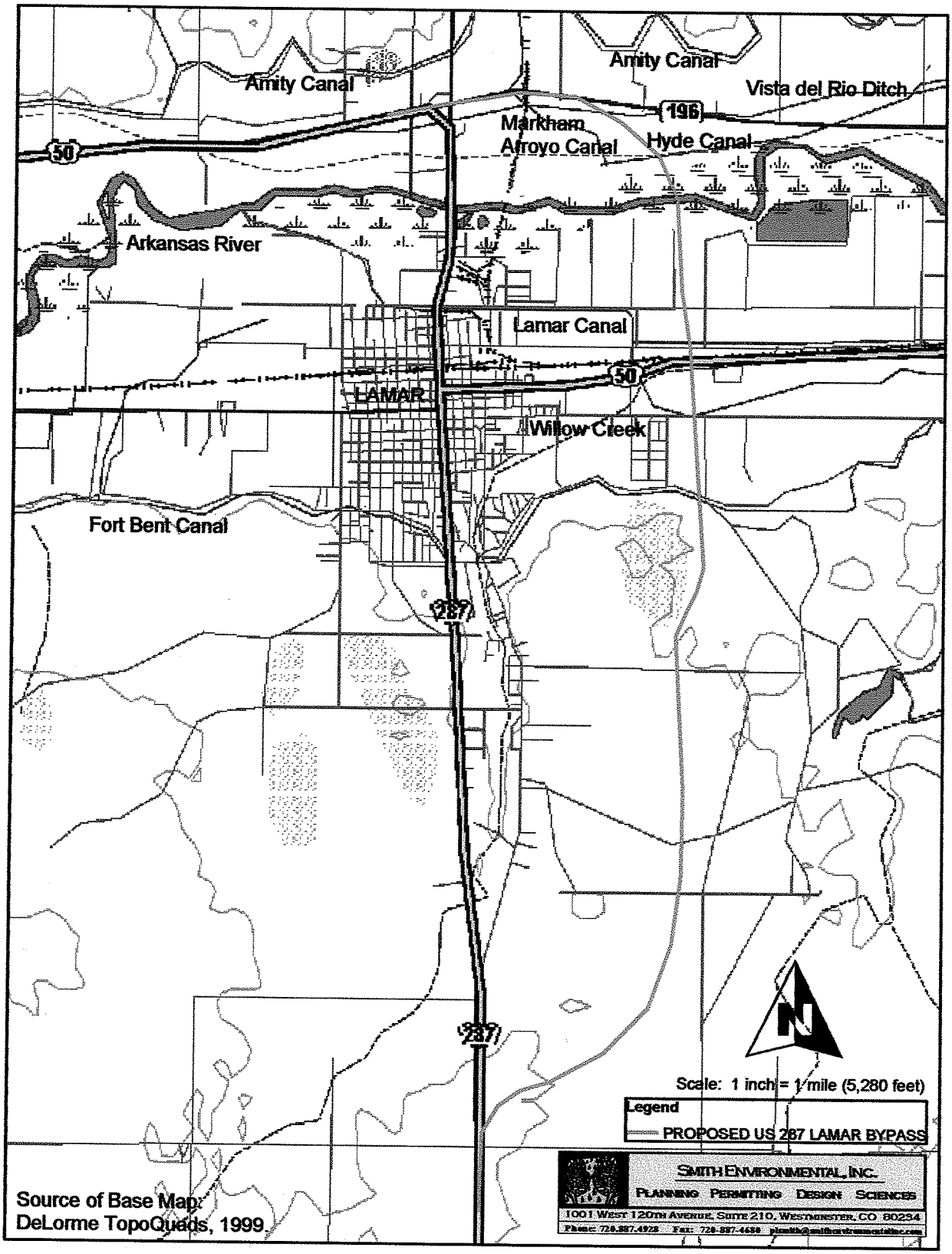

Table 1
Arkansas River Sample Analytical Results at Lamar, Colorado Gaging Station, August 18, 1988

Constituent	Units	Concentration	Numeric Standard (a)
Temperature	degrees C	23.5	
Discharge Rate	cubic feet per second	512	
Specific Conductivity	microsiemens/cm	2,240	
Dissolved Solids	mg/L	1,870	
Lab pH	standard units	8.2	6.5 - 9.0 (b)
Acid Neutralizing Capacity	mg/L as CaCO3	154	
NO2 + NO3 (as N)	mg/L	0.21	10.5 (c)
Calcium	mg/L	190	
Magnesium	mg/L	100	
Sodium	mg/L	230	
Potassium	mg/L	6.3	
Chloride	mg/L	64	250
Sulfate	mg/L	1,100	2,400
Arsenic	ug/L	1	50
Boron	ug/L	310	750
Cadmium	ug/L	<1	5.6 - 20.3 (d)
Chromium	ug/L	2	61 (e)
Copper	ug/L	2	26 - 116 (d)
Lead	ug/L	<5	9.5 - 51.1 (d)
Molybdenum	ug/L	7	
Vanadium	ug/L	<1	
Zinc	ug/L	<10	341 - 1,495 (d)
Selenium	ug/L	5	19
Uranium	ug/L	23	5,968 - 40,748

Notes:
(a) Numeric standards are from the Colorado Department of Public Health and Environment Water Quality Control Commission Regulation No. 32 Classifications and Numeric Standards Arkansas River Basin amended December 10, 2001 for the Lower Arkansas River Basin from John Martin Reservoir to the Colorado/Kansas border.
(b) acceptable pH range
(c) sum of NO_2 (0.5) and NO_3 (10.0)
(d) chronic standard based on water hardness of 350 to 2,000 mg/L as CaCO3
(e) sum of CrIII (50) and CrVI (11)

Source: Sample analytical results are from the United States Geological Service gaging station (No. 07133000) located on the Arkansas River at Lamar, Colorado. The results were obtained from the survey's web site at http://waterdata.usgs.gov/co/nwis/inventory.

Figure 2

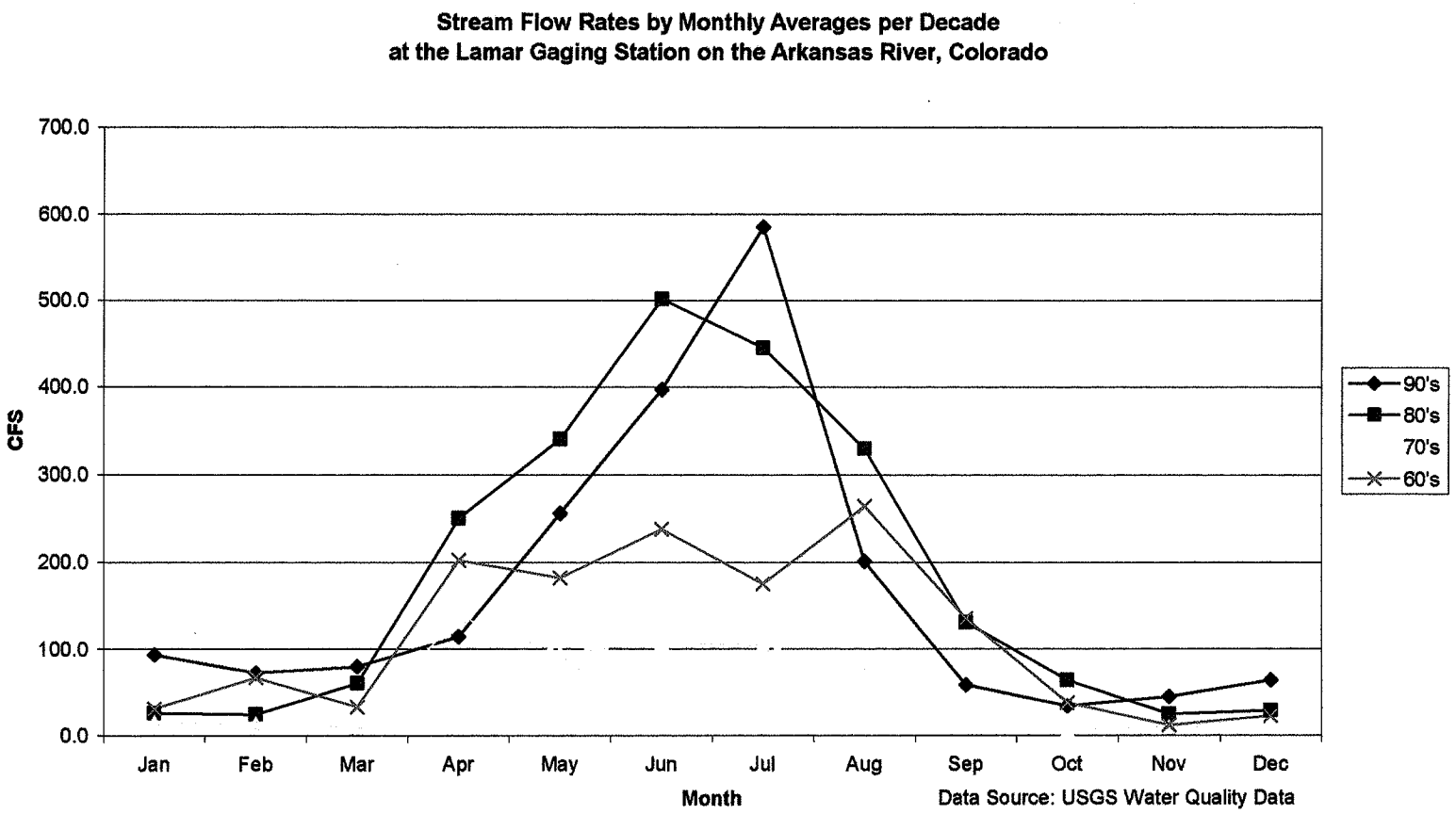
Stream Flow Rates by Monthly Averages per Decade
at the Lamar Gaging Station on the Arkansas River, Colorado
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
CFS
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month
90's
80's
70's
60's
Data Source: USGS Water Quality Data

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Figure 3

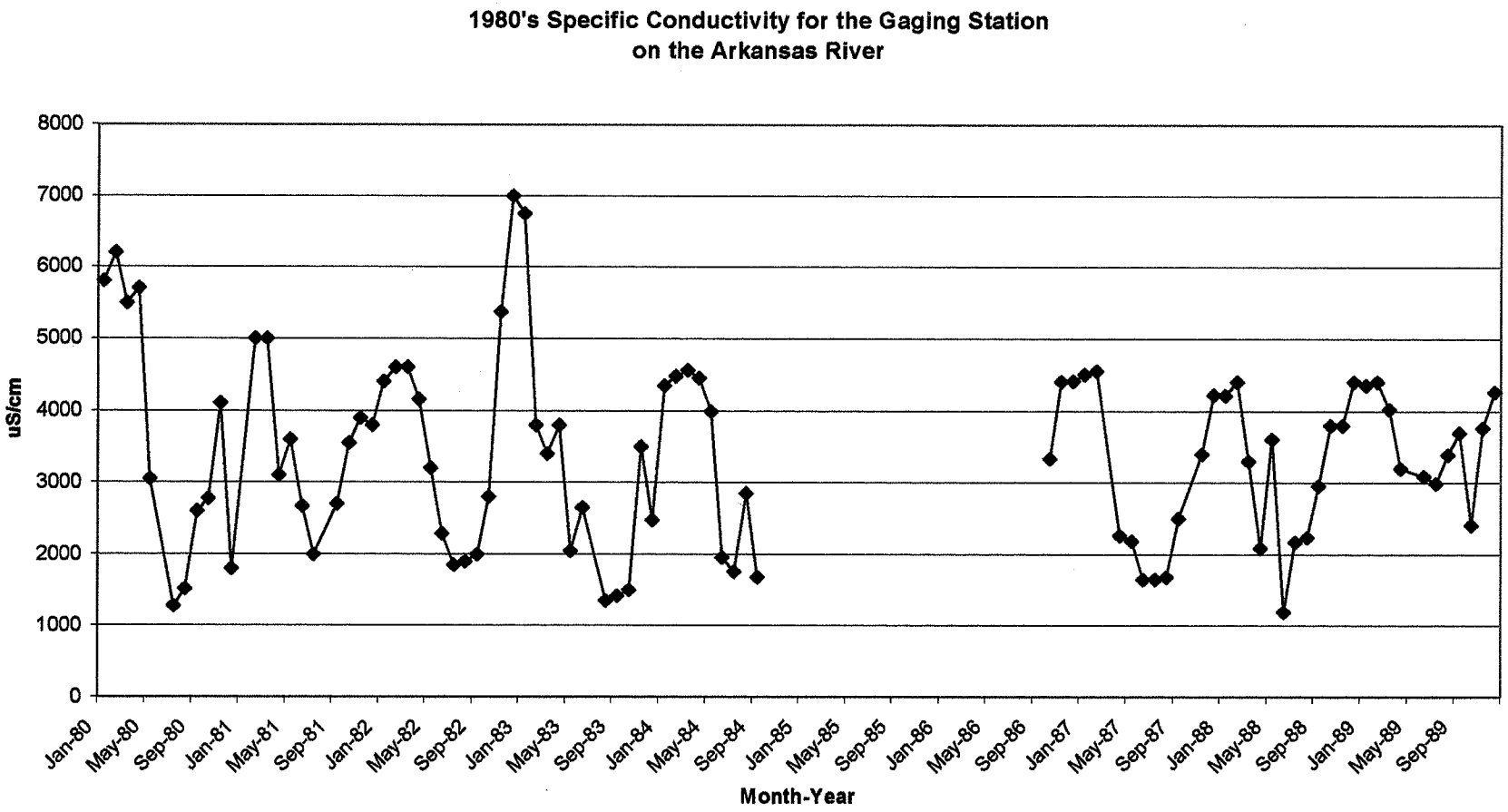
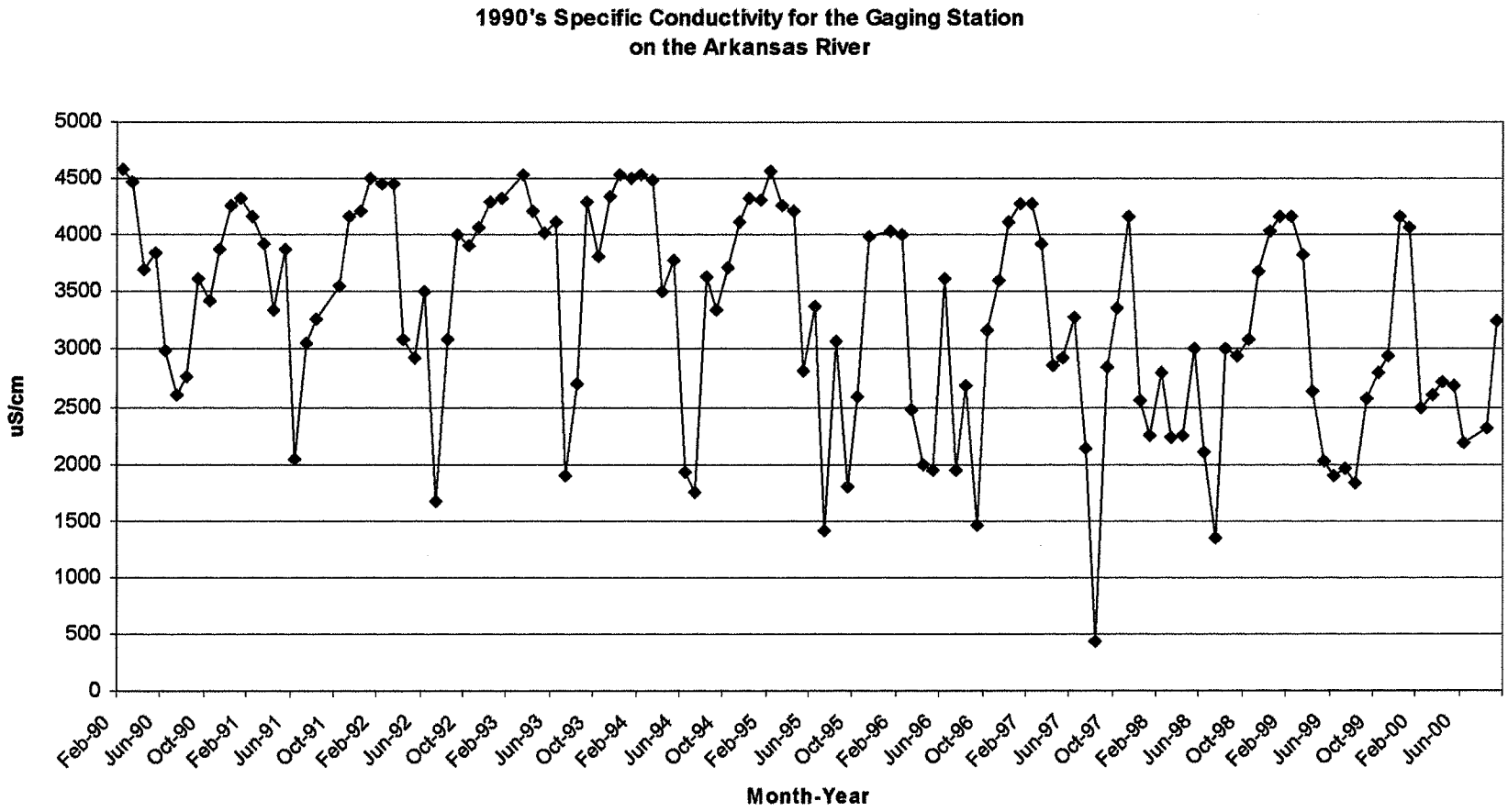


Figure 4


1990's Specific Conductivity for the Gaging Station
on the Arkansas River
uS/cm
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
Feb-90
Jun-90
Oct-90
Feb-91
Jun-91
Oct-91
Feb-92
Jun-92
Oct-92
Feb-93
Jun-93
Oct-93
Feb-94
Jun-94
Oct-94
Feb-95
Jun-95
Oct-95
Feb-96
Jun-96
Oct-96
Feb-97
Jun-97
Oct-97
Feb-98
Jun-98
Oct-98
Feb-99
Jun-99
Oct-99
Feb-00
Jun-00
Month-Year

April through September. The high flow period coincides with the high seasonal demand for irrigation of farm lands. Flows in the lower Arkansas River are controlled by releases from the upstream John Martin and Pueblo Reservoirs. The higher flow rates observed during the 1980s and 1990s compared to the 1960s and 1970s are due to the construction of the Pueblo Reservoir in the mid-1970s and changes in the operating procedures at the John Martin Reservoir starting in 1980 (Lewis 1998).

Streamflow plays an important role in controlling the water quality of the lower Arkansas River. The level of dissolved solids in the river typically increases as the flow rate decreases. This inverse relationship is shown graphically in Figures 3 and 4 where mean specific conductance from the USGS station is plotted on a monthly basis for the 1980s and 1990s, respectively. Specific conductance is a field parameter that is directly related to the level of dissolved solids present in water. The graph shows that mean specific conductance typically ranged between 1,500 and 2,500 microsiemens per centimeter at 25 degrees Celsius (μS/cm) from June through August and between 2,500 and 4,500 μS/cm from September through May. The U.S. Salinity Laboratory rates irrigation water with a specific conductance greater than 2,250 μS/cm as a very high salinity hazard (Richards 1954). Use of special agricultural management practices and the growing of salinity tolerant crops may be required to effectively utilize these waters.

Table 1 presents the analytical results from a water sample collected at the USGS station on August 18, 1988. This is the most comprehensive sampling event conducted by the USGS at this gauging station. The table also presents the protective numeric standards that have been developed for this segment of the Arkansas River by the Colorado Water Quality Control Commission. The analytical results do not indicate any exceedance of the numeric standards; however, constituent concentrations would generally be expected to be higher during the low flow period of the year. Constituents with relatively low numeric standards that tend to accumulate in irrigated waters such as selenium, boron, and nitrate represent the greatest concern during low streamflow periods.

U.S. Geological Survey gauging data is also available for Willow Creek in the Lamar area from May 1974 to September 1977 (USGS 2002). The data, presented in Appendix B, indicates that peak flows occur during May through August. The highest recorded monthly mean streamflow was 12.9 cubic feet per second in May 1997. A specific conductance of 320 μS/cm was recorded in June 1975 and May 1976, indicating that the Willow Creek water is not as saline as the Arkansas River. The river flows year round; however, winter flows are typically substantially lower.

The canals and ditches receive their water from the Arkansas River, nearby creeks, surface seeps, irrigation return flow and surface water runoff. Water quality varies in the canals and ditches depending on the water source and time of year. Higher flow rates are maintained during the growing season. The Lamar Canal is reported to carry water continuously throughout the year, whereas the Hyde Canal and Fort Bent Canal are typically dry during parts of the winter (Newhold 2002).

POTENTIAL SURFACE WATER IMPACTS

Potential impacts to the surface water quality in the vicinity of the bypass corridor may be classified into short and long-term impacts. The expected short-term impact consists primarily of increased soil erosion to the water bodies caused by adjacent excavation and construction activities. Long-term impacts include potential contamination from increased vehicular traffic and road maintenance activities.

Short-Term Impact and Mitigation Measures

Increased soil erosion is expected to occur during the construction of bridges, culverts, embankments, road base, and road surface over and adjacent to the Arkansas River, Willow Creek, irrigation canals, and intermittent surface drainage areas. Soil erosion has the potential to contribute dissolved and suspended solids to the surface water which will increase turbidity, total P, and dissolved NO_3; slightly increase the sodium adsorption ratio and salinity, and probably raise the pH slightly. With the implementation of erosion control measures, the impact from erosion on water quality is expected to be low because the surface water is generally highly saline and the surface water flow volume is high compared to the potential runoff flow volume (i.e., the amount of additional solids contributed by erosion is expected to be small compared to the amount of dissolved and suspended solids already present in the surface water).

The extent of soil erosion can be mitigated through the use of standard soil erosion control practices including water diversion structures (e.g., channels, berm), sedimentation ponds, silt fence and straw bales, erosion control blankets, and the timely seeding and mulching of disturbed areas. Riprap and other embankment stabilization measures also may be required where water flow has the potential to cause bank cutting.

It is recommended that proposed construction activities be closely coordinated with the local water control authority to minimize disruption of water flow for irrigation and other purposes. This may include the use of temporary water diversion measures and/or the scheduling of some construction activities during low water use periods. Access to the ditches and canals would also need to be incorporated into the highway design if the bypass corridor intersects the existing access roads.

Dewatering of the shallow ground water table below and adjacent to the Arkansas River may be required at some locations to allow construction of bridge supports. The ground water is expected to be of similar or better quality than the river water. Downstream discharge of the extracted water may cause scouring and erosion along the riverbed and/or banks. These impacts can be reduced or eliminated by placing the discharge point in areas where the erosion potential is low and by installing erosion control measures at the discharge point.

Long-Term Impact and Mitigation Measures

Long-term water quality impacts associated with the proposed bypass include the introduction of contamination into surface water from vehicular traffic and road-maintenance activities. The potential also exists for a spill of solid or liquid material from a container truck near a surface water body, resulting in localized contamination.

Liquid exhaust emissions and oil/gas leakage from vehicles cause the gradual buildup of low concentrations of petroleum hydrocarbons in the soil surrounding roadways. Runoff from these areas into adjacent surface water bodies may contain low concentrations of petroleum hydrocarbons, however if the hydrocarbons reside in the topsoil for a month or so from March 15th through October 31st, biodegradation of these hydrocarbons will occur and eliminate most to all them. Biodegradation is less likely to occur during the winter; hence the possibility of hydrocarbons entering water bodies is slightly higher during the winter months. This potential source of contamination is relatively minor as the hydrocarbon concentration in roadway runoff is typically below the minimum detection level for standard laboratory analyses.

The application of sand, magnesium chloride, and other materials to the highway during the winter months has the potential to degrade the water quality of the adjacent surface waters over time. These impacts would not be extensive because the water crossings are relatively short in length and, as previously discussed, the surface water already contains elevated levels of dissolved solids. The installation of permanent erosion control measures in the vicinity of each surface water crossing can mitigate the effect of potential impacts by capturing and diverting contaminated runoff away from the surface water.

An accident involving a tanker or material transport truck has the potential to release deleterious materials into surface water at a water crossing. The effect of an accident of this type would vary depending on the quantity and type of material spilled, the response time, and the containment actions taken by emergency personnel. The potential for an accidental release near surface water can be reduced by making the water crossings as safe as practical (e.g., adequate width and shoulders, unobstructed views, minimal turns and intersections).

REQUIRED PERMITS

The following permits must be submitted and approved before construction activities can be performed in or adjacent to the Arkansas River and Willow Creek.

SB40 Wildlife Certification – A state agency (such as CDOT) is required to obtain this wildlife certification from the Colorado Division of Wildlife when the agency plans construction in any stream or its bank or tributaries.

Section 401 Water Quality Certification – A 401 permit is required in conjunction with an Individual 404 Permit (dredge and fill permit) for any transportation construction project where work occurs below ordinary high-water line or adjacent to wetlands. The 401 Certification is obtained from the Water Quality Control Division of the Colorado Department of Public Health and Environment (CDPHE).

Section 402 Permit – A 402 discharge permit is required for construction dewatering operations associated with activities such as utility excavation, bridge pier installation, foundation or trench digging, or other subsurface activities. The permit application is submitted to, and obtained from the Water Quality Control Division of CDPHE.

Section 404 Permit – A 404 permit is required when dredging or filling occurs below the ordinary high water line in any body of water considered a Water of the United States (i.e., navigable waters and adjacent wetlands), as defined in Section 404 of the Clean Water Act. Because of the magnitude of wetland impacts that may occur on this project, an Individual Permit from the U.S. Army Corps of Engineers office in Pueblo will probably be required.

Stormwater Permit – A permit to discharge stormwater is required for all construction sites exceeding one acre. Application for coverage under the Stormwater Construction General Permit is made to the Water Quality Control Division of CDPHE.

SUMMARY

Surface water in the bypass corridor is characterized by high salinity and is generally of better quality during the high flow periods of late spring and summer. Water quality impacts associated with the proposed bypass include short-term impacts resulting from excavation and construction activities and long-term impacts resulting from vehicle traffic and maintenance activities. Potential water quality impacts may be mitigated by installing temporary and permanent erosion control measures at each water crossing. Mitigation measures may also be incorporated into the state and federal permits needed to perform construction activities in or adjacent to the Arkansas River and its tributaries.

REFERENCES

Arkansas River Basin. Colorado Department of Public Health and Environment, CDPHE. 2002. Regulation No. 32: Classifications and Numeric Standards for Water Quality Control Commission 5CCR 1002-1003.

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